Appendix D - CaseRite Software Instructions

Federal Motor Carrier Safety Administration (FMCSA)
U.S. Department of Transportation

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Appendix D - CaseRite Software Instructions

There are four screens in the CaseRite software. As you click on each tab across the top of the screen, a new worksheet (screen) comes up. You must complete the required fields in each screen prior to the completion of your enforcement action. Once you make the decision to initiate an enforcement action, CaseRite transfers the investigation information you entered into CAPRI, and penalty assessment information you entered into UFA together, which pre-populates many fields within CaseRite.

What are the six basic elements of the enforcement report?

The six basic elements of the enforcement report, generated by CaseRite, are as follows:

1. The Case Report,
2. Continuation Page (located in the General Tab),
3. Numbered Exhibit Abstracts (located in the Violations Tab),
4. Lettered Exhibit Abstracts (located in the General Tab),
5. Notice of Claim (which includes the Statement of Charges and Service List),
6. The Investigation Summary

We will be explaining each of them as you go through the numerous sections of CaseRite. There are four screens that will require your data entry while in CaseRite: **Subject, Violations, General and Management.**

Screen 1 (Subject)

From the File menu option, select New, and then select CAPRI/UFA. Select the subject name you will be initiating an enforcement action against. This will start the process of automatically transferring the subject information from CAPRI and UFA, with all of its accompanying information, into CaseRite. Ensure that the information on the Subject screen is correct; enter the case number in the CASE NUMBER box if it has not been pulled in from CAPRI and UFA. Enter any other missing required data.

What if I initiate an enforcement action on a motor carrier when an investigation was not done?

From the File menu option, you would select New, and then Create (e.g., a crash investigation, etc.) You will be required to enter all of the required data on all of the CaseRite screens.

What if I initiate an enforcement action after discovering serious safety and/or out-of-service (OOS) violations while conducting a roadside inspection?

From the File menu option, you would select New, and then ASPEN. Select the subject name, report number or US DOT number you will be initiating the enforcement action against. The subject information and violation information will automatically transfer, in the same method used, as if you had transferred the data from CAPRI/UFA.

You are now ready to move to Screen 2.

Screen 2 (Violations)

Under Screen 2, you will be entering data to complete your Numbered Exhibit Abstracts. The Numbered Exhibit Abstract presents a description of the violation and those essential elements which set the basis of the violation. The essential elements are:

- Transportation (origin and destination)
- Commercial Motor Vehicle
- On a public highway
- In commerce subject to our jurisdiction
- Failing to comply with some provision of the regulations

Numbered exhibit abstracts are prepared for each violation documented within the enforcement report.

There are two data fields under the Violations Screen, **Violations and Charges.** We will explain both for you:

Violations: These are the violations you discovered and cited within the CAPRI software, and subsequently identified in the UFA software, as a violation that you are going to initiate an enforcement action against. Using your mouse, right-click over the Primary Violation Cite. Your options are: New Violation, Edit Violation, Delete Violation or Select Abatement.

When would I select the New Violation option?

You would select the New Violation option when you select to assess a penalty for a violation that you did not include in the initial UFA assessment software. You will be required to enter the Primary Violation Code, the Number Discovered, the Number Documented, and the Fine Amount for this violation. You would select UFA Fine Used, only if you re-entered the UFA software, and added the New Violation to the UFA Assessment Software. We will explain the Section 222 option next.

What does the Section 222 option mean?

Section 222 refers to Section 222 of the Motor Carrier Safety Improvement Act of 1999 (MCSIA). Section 222 requires FMCSA to assess the maximum civil penalty for each violation of the law (i.e. Federal Motor Carriers Safety Regulations and Commercial Driver's License Regulations) by any person who is found to have committed a pattern of violations of a critical or acute regulation, issued to carry out

such a law or to have previously committed the same or related violation of critical or acute regulations issued to carry out such a law. **This option must be checked if you are preparing a Section 222 case.**

A motor carrier will be assessed the maximum penalty if it is found to have committed a pattern of violations. A pattern of violations is defined as critical or acute violations within the same part and has been previously assessed penalties (i.e. two closed enforcement actions) within the past 6 years, they could potentially be penalized the maximum civil penalty allowed by law for violations in the same FMCSR Parts. It is also known as the Three Strikes Penalty Rule.

Example: A motor carrier has had three enforcement actions issued to them: **First** Closed Enforcement Action issued four years ago, for critical violations of Parts 391 and 395-Strike one in Parts 391 and 395; **Second** Closed Enforcement Action issued two years ago for an acute violations of Part 382 and Part 383 and for critical violations of Part 395 (strike one for Parts 382 and 383. Strike two for Part 395). You are conducting an investigation **today**, and you discover still critical violations within Part 395. This will be their third strike for being assessed penalties for critical violations in Part 395. You will now be required to amend the initial UFA assessed amount to the maximum penalty amount for your Part 395 violation.

When would I select the Edit Violation option?

You would select the Edit Violation option when you have made a change to the Number Checked, Number Discovered, Violation Category or if it's a Section 222 penalty.

When would I select Delete Violation option?

You would select the Delete Violation option when either you or your reviewing division personnel recommend you do not pursue enforcement for a specific violation.

When would I choose Select Abatement option?

You will always be required to select the abatement clause for each violation you are pursuing enforcement action against. Generally, it will default to the standard abatement clause for that violation. On a rare occasion, you may be required to prepare a custom abatement clause. Ensure you consult with your reviewing division personnel or SCET.

Charges: These are the charges for each violation you have chosen to pursue an enforcement action against. You may have one charge for each violation, or you may have multiple charges. Using your mouse, right-click within the Charges blank box. Your options are Add Charge, Edit Charge, Copy Charge or Delete Charge.There will be numerous occasions when the general charge template information will be all of the information you need. However, there will be numerous other occasions when you will need to provide additional charge information, after the charge template information, to help further explain your violation charge.

When would I select the Add Charge option?

You will always be required to select the Add Charge option. When you select Add Charge, you will be entering the violation charge data. You will be required to enter the Violation Date and the Violator's Name. Next select the Charge Template. It will be defaulted to the Standard Charge Introduction Template for your violation charge. Ensure this is the primary violation charge you are initiating enforcement against, and then select Build Template. This will allow you to enter specific required charge details in a fill-in-the-blank format. As you can see, the violation date, carrier name and driver name are

already entered, as you completed that data entry earlier. Simply fill in the required text information. You can see in the lower screen the text information you are entering to complete the violation charge. After you are done, select OK to complete that charge.

What would I enter in the Supporting Documents field?

You will enter the names and dates of the documents, and specific information regarding the documents you have gathered, to prove your violation charge. You will need to list each of them separately. You may also choose to further outline how the supporting document you have listed supports your violation charge. You may also reference a specific Lettered Exhibit Abstract in this field, as it may further support your violation charge.

When would I select the Edit Charge option?

You would select the Edit Charge option after you have already made your initial charge information entry. You may choose to edit the violation date, violators name or other charge information.

When would I select Copy Charge option?

You would select the Copy Charge option when you are entering an additional separate charge for the same violation. Such as, you have one driver who violated the 10-hour rule on three separate dates. You simply, select copy charge and change the violation date and then change the charge information to reflect the specific violation information. You may also use the Copy Charge option when you have two different drivers who have committed the same violation.

When would I select Delete Charge option?

You would select the Delete Charge option when either you or your reviewing division personnel recommend you do not pursue enforcement for a specific violation.

Screen 3 (General)

Under Screen 3, you will be entering data to complete your Lettered Exhibit Abstracts and your Continuation Page. There are two data fields under the General Screen: **Lettered Exhibit** and Background Information. We will explain both for you:

Lettered Exhibit

You will prepare Lettered Exhibit Abstracts to show (or establish) a motor carrier's knowledge and willfulness of the committed violations. You may list a motor carrier official's written statement, acknowledging the committed violations, or how the motor carrier's paperwork is processed. You may prepare a Lettered Exhibit Abstract to support one or multiple violation charges. When you prepare a Lettered Exhibit Abstract to support one or multiple violations, ensure that you reference the Lettered Exhibit Abstract within the Supporting Documents field in the Numbered Exhibit Abstracts. There is no limit to the documents you may list on a Lettered Exhibit Abstract.

Your options are Add, Delete or to enter data in the Exhibit Text field. Using your mouse, click on Add, and move your curser to the highlighted box with the asterisk to the left. Enter the Alpha character (e.g., A, B, C, D, etc.) for each Lettered Exhibit Abstract. You may choose to enter motor carrier statements on

one Lettered Exhibit Abstract, and other motor carrier procedural documents on another Lettered Exhibit Abstract. You would select the Delete function to remove a prepared Lettered Exhibit Abstract.

Exhibit Text

You will enter the names and dates of specific documents, and specific information regarding the documents you have gathered, which support your violation charge. You will need to list each of them separately. You may also choose to further outline how the documents you have listed further support your violation charge. You may also reference a specific Numbered Exhibit Abstract in this field, as it may have been referenced within your violation charge.

Background Information (AKA Continuation Page)

Information for completion of the Continuation Page is entered in the background information. The Continuation Page contains information that is used to furnish a description of the subject in the enforcement report and to report the areas of violation discovered during the investigation. This document provides background information that is helpful to supervisors and counsel in determining extent of violations and culpability of subject. This narrative must contain factual information and be clear and precise to persons who may or may not have knowledge of transportation industry practices. The Continuation Sheet contains six headings as follows:

1. **Description -** Enter additional information that is not shown in Part A of the investigation. Additional names, such as of corporate officials and their titles, should be provided here. If sufficient information appears on Part A for the subject, the only entry under this heading is "See Parts A and C of the investigation."

   In the event an enforcement report is being prepared for an additional subject (e.g., Driver, Employee: Dispatcher, Consultant, etc.) or the enforcement report did not result from an investigation, the following information is required in the description of the subject:

   - Full legal name and mailing address.
   - Driver's license information, issuing State, and license number.
   - Social Security Number.
   - Physical description, date of birth, height, weight, color of hair, color of eyes, and other information, as appropriate.
   - Individual's Cellular Phone Number
   - Occupation and description of duties, as appropriate.
   - Information on gross income for past year (include any evidence of financial insolvency, if known or any claimed by the subject of the report).

   NOTE: If you are preparing an enforcement action not initiated from an investigation, refer to *Uniform Fine Assessment (UFA)* under Initiating an Enforcement Action

2. **Contact Reason -** Provide the reason for contacting the subject. This investigation was initiated because:
   - The subject is listed on the Investigate 1 prioritization list. The carrier has two BASICs requiring investigation. They are: Vehicle at 99.3% and a prior Serious Violation in Driver Fitness at 88%.

- Written complaint alleging violations of Part 391 (driver qualifications), Part 395 (excessive hours), and Part 396 (maintenance of equipment) was received against subject, etc.
- Falsified Medical Examiner's Certificate was discovered for subject during another investigation of a different subject.
- Special Circumstances: Fatal Crash, Multiple Injury Crash, Roadside Inspection, Conditional Carrier Review, Safety Audit, etc.

NO ENFORCEMENT REPORT IS LIMITED TO THE ABOVE EXAMPLES.

3. **Enforcement Reason** - Enter factual information explaining the reason enforcement action is being taken, e.g., pattern of violations, failing to maintain safety management controls, serious risk to the public, or fatal accident.

   An example of this type entry might include, but is not limited to, the following: Enforcement Reason - This report is being submitted because:

   - This investigation revealed the carrier is operating in noncompliance of the FMCSR. The carrier did not have a complete driver qualification (DQ) file for any of the 26 drivers employed. Two of the 26 drivers had no DQ file maintained by the carrier. Sixteen drivers records of duty status (RODS) were checked; all 16 failed to make records when required, or they operated in violation of the 10, 15, and 60-hour/70-hour limits, or falsified their records to conceal hours violations.
   - The carrier has taken no action to correct those areas of noncompliance discovered during a previous investigation.
   - Driver admitted, in a written statement, to having falsified the medical examiner's certificate himself.
   - A Fatal Crash, Multiple Injury Crash, or Crash resulting in an HM spill due to motor carrier's failure to maintain their vehicles, or properly manage their drivers' hours of service.
4. **Knowledge and Willfulness** - Enter prior enforcement activity and other efforts that have been taken to encourage compliance. Reference should be made to the lettered Exhibit Abstracts that pertain to the information. An example of this type of entry might include, but is not limited to, the following:
   - Violations discovered and documented in this report were also cited on the previous investigation dated 00/00/00 (see Exhibit B).
   - Following the previous review, carrier President John S. Smith submitted a letter to FMCSA on 00/00/00 stating the company's operation had been brought into compliance and detailed his personal involvement in the process (see Exhibit C).
   - Violations of this type and documented in this present report also appeared on state inspection reports which are included as lettered Exhibit D.
5. **Defenses** - Enter the defenses or excuses provided by the various employees interviewed during the investigation. An example of this type of entry might include, but is not limited to, the following:
   - Mr. John S. Smith, carrier President, stated their safety compliance problems have been related to the turnover of personnel in the operations division.
   - Mr. John S. Cooper, Operations Manager, stated there was not enough time to qualify the new drivers and control their hours, due to pressure from their customers.
   - Ms. Jane B. Smoot, Dispatcher/Log Clerk, stated that she had been advising drivers verbally not to drive more than 10 hours without 8 hours off duty.

- Mr. Jake V. Brown, road driver, advised he was never asked by the company to stay under any certain hours before resting.

6. **Additional Information-** Identify the various documents collected during the investigation and identify the person(s) that provided them. Identify any witness not previously described in the report. As necessary, identify the persons preparing the documents, the person who can explain the purpose and distribution of the documents, or other facts not readily apparent from the face of the documents. If not clear from other parts of the enforcement report, explain the facts, which the witnesses can testify to. An example of this type of entry might include, but is not limited to, the following:
   - All carrier documents obtained in this investigation were obtained from John S. Cooper, Operations Manager and Jane B. Smoot, Dispatcher/Log Clerk. Both of them personally obtained the records from the carrier's files and identified the RODS, trip sheets, receipts, and the company's procedures for dispatching freight and controlling the driver's activities.
   - Mr. John S. Smith, carrier President reported the gross revenue of $750,000 for calendar year 0000.

Additional Information section can also be used for information about the subject that is not deemed appropriate for any of the above sections. The investigator shall use this section to more fully explain the investigative process, so that agency supervisors, counsel, and decision makers can have a more clear understanding of the facts of the case. Included herein is an explanation as to why the investigator may have deviated from the required sampling requirement of this manual.

Once you have completed filling out the information required on the Subject Screen, entered all of the Charge information on the Violation Screen, and entered all of the information in the General Screen, you will be required to enter data in the Management Screen to complete your Enforcement Case Report.

Screen 4 (Management)

Under Screen 4, you will be entering data to complete the Managing Reviewer Information, how the Enforcement Action originated, and critical tracking dates. There are three data fields within the Management Screen: **Management Review, Origin of Enforcement, and Tracking Dates.** We will explain each of them for you:

Management Review

You and your division reviewing personnel (or Service Center Enforcement Team) will be entering the following information:

1. The Name of the Reviewer,
2. The Title of the Reviewer, and
3. The Date the Review of the Enforcement Case Report was completed.

Origin of Enforcement

From the drop down selection box, you will need to select the Origin for your enforcement action from the following selection choices:

- CR,
- HMPIP (a Hazardous Materials Package Inspection),
- Roadside Inspection,

- Terminal Review,
- CTFR, and
- Special Investigation.

Tracking Dates

You will need to manually enter the following tracking dates:

- Investigation Assigned,
- Investigation Completed,
- Date NOC (Notice of Claim) Served, and
- Date of CR/Inspection.

The tracking dates are important, as there are specific timeframes a motor carrier has to respond to a Notice of Claim. If the Notice of Claim is signed at the Service Center, they will enter the Date the NOC was served.

Additional data fields within Screen 4 (Management) are Reviewer Comments, Investigator Notes, and Part C Comments.

Reviewer Comments

This field is where the reviewing official would enter any comments regarding the accuracy and timeliness of the enforcement report. Additional comments regarding the enforcement report may also be entered here regarding the proposed civil penalty.

Investigator Notes

These are notes of additional information the investigator wishes to include with the enforcement report that are not presented elsewhere in the enforcement report.

Part C Comments

This field contains the comments the investigator entered in CAPRI Part C. The Part C comments are included for both the investigator's and reviewer's reference.

Now that you have completed the data entry process for your Enforcement Case Report (e.g., The Numbered Exhibit Abstracts, Lettered Exhibit Abstracts, the Continuation Page), you are ready to print the Enforcement Case Report.

With Screen 1 (Subject) open, select File from the menu bar, and then select Print. Your Print Selections are as follows:

- Notice of Claim
- Statement of Charges
- NOC Service List
- Lettered Exhibits
- Numbered Exhibits
- Case Report
- Continuation Page
- Reviewer Notes
- Investigator Notes
- CR Summary
- UFA Report

The Notice of Claim, Statement of Charges and NOC Service List are the standard documents which are mailed to the claimant. These documents may be included in your enforcement case report submitted to the reviewing official, or the reviewing official will print them after completing the review process.

We have explained the Lettered Exhibits, the Numbered Exhibits, the Continuation Page, Reviewer Notes, and Investigator Notes. The UFA Report is the same report that was imported when you initiated the CaseRite process.

What is the Case Report?

The Case Report is also referred to as the Cover Page. The Case Report outlines the following information for the Enforcement Case Report:

a. The Case Number,
b. The U.S. DOT number (if applicable),
c. The Subject Name and Mailing Address,
d. The Violations,
e. The Violation Description,
f. The Number Discovered,
g. The Number Documented,
h. The Tracking Dates you entered on the Management Page,
i. The Reviewing Official Name and Title, and Date of Review, and
j. The Signature of the Investigator and their SI Code (e.g., US####)

The Case Report document is generally submitted as a cover to the enforcement case report, followed by the Continuation Page and the Lettered and Numbered Exhibits. Your reviewing official or division policy determines the order in which you submit your enforcement case report documents.

What is the CR Summary?

This is a summary of the completed investigation. It provides basic information about the subject. One of the most important elements of the summary is the Part C Comments section. This is the section that contains essential information, provided by the investigator, that will be used by supervisors and counsel in consideration of sanctions.

What information must I ensure was listed in Part C Comments of **CAPRI for inclusion in the CR Summary?**

The following information must be shown in the Part C Comments of the investigation:

- Statements made by officials relative to corrective actions or safety system breakdowns discovered during the investigation
- The subject's attitude toward compliance
- The subject's level of understanding of applicable regulations
- The degree of assistance and cooperation given by officials to the investigator during the investigation
- The educational materials provided to the subject
- Anything that is atypical about the subjects operation
- The extent and nature of any divisions or business locations of the subject
- The financial condition of the subject
- The names and titles of any relevant company official or employee who were interviewed, but were not listed on Part A of the CR

- The reason for not initiating enforcement action in response to any discovered acute violation or pattern of critical violations
- The number of commercial motor vehicles which have a GVWR between 10,001 pounds and 26,000 pounds, and the number of commercial motor vehicles which have a GVWR greater than 26,000 pounds
- The names and locations of any relevant documents
- Any other information that explains and/or complements the cited violations in Part B, would increase the accuracy of the evaluation process, and aid the follow-up investigator

How do I export the enforcement report from CaseRite?

From Screen 1 (Subject), select Close Case. From the CaseRite-Enforcement Case Preparation Software main screen, select Utilities from the menu bar. Select Import/Export. You will see three screen tabs: Export, Import, and View Transfer File. From the Export Screen, select the enforcement report to be exported. Next, click on the menu bar, Export Options. You will have three options: Export to Email, Export to Disk, and Export to EMIS.

What happens when I select Export to Email?

When you select Export to Email, CaseRite will create an email attachment file in the form of a zip file. Then, CaseRite will automatically load the current email software, import the enforcement report attachment file to the email, and then allow you to select the name of the recipient of the email. Once you send the email with the enforcement report attachment, the recipient (usually the reviewing official), will be able to import the email attachment into their CaseRite program for further processing.

What happens when I select Export to Disk?

When you select Export to Disk, CaseRite will transfer an electronic export of the enforcement report to a floppy diskette. You will then be able to either provide the floppy diskette with the electronic export of the enforcement report to the reviewing official, or you will be able to send the electronic export file as an attachment to an email in the same fashion, as previously described, for import and processing by the reviewing official.

What happens when I select Export to EMIS?

When you select Export to EMIS, CaseRite will transfer an electronic export of the enforcement report to EMIS. EMIS is a FMCSA Information System, which allows entry of enforcement information by Service Center Enforcement Team (SCET) personnel relating to critical information regarding tracking dates, issuance of settlement agreements, issuance of out-of-service (OOS) orders and critical enforcement-related actions. In the majority of the cases, the reviewing official will export the reviewed enforcement report to EMIS.

Appendix F - Hazardous Materials Resource Library

These documents are provided as a resource for investigators. Many of these documents are copyrighted by the association that authored them, so they are not to be released to the public.

- **HM Enforcement Guide**
- **General Hazardous Materials Investigation Checklist**
  - Suggested Items to Include in an HM Investigation Request
- **HMSP Procedures**
  - FMCSA Notice: Domestic Transportation of Anhydrous Ammonia
- **HM Shipper Part C Template**
- **HM Motor Carrier Part C Template**
- **Severe Level I and II Violation List**
- **HM Packages PowerPoint**

Cargo Tanks

- CTMV Section Cites

CTMV Motor Carrier

- Cargo Tank Motor Carrier Investigation Checklist
- Common Cargo Tank Issues
- MC338 CTMVs
- NFPA Standard 58, 2001 (only applicable to Section 173.315(k))
- TTMA RP 61-98; 81-97; and 107 (1998)
- Road Clearance Guide
- Rear End Protection Device Guide
- Venting Capacity Guide
- MC300 – MC312 specifications
- MC330 specification
- MC331 specification pre 2004
- MC338 specification pre 2004
- Manhole Certifications
- Pads Guidance

CT Test/Inspection Facilities

- CTFR Investigation Checklist
- Cargo Tank Retest-Reinspection Letter
- CTFR Part C Template

- Person Responsible for Compliance Interview
- RI Interview
- Violations that Require CT Retesting
- WFMPE Procedures
- CGA C-6, 1993
- CGA TB-2, 1980
- EPA Method 27 Procedure
- Surface Area Calculation Spreadsheet
- Recertification Flowcharts
- PRD Pressures Chart for Bench Testing
- Method 27 Apendix A

Repair (R Stamp) Facilities

- NBIC Checklist
- NBIC QCS Checklist
- NBIC QCS Guide
- Repair R Stamp Checklist
- NBIC, 1992

Manufacturer (U Stamp) Facilities

- 1996 FMCSA Structural Evaluation Guide
- AI Responsibilities
- ASME QCS Guide
- How to Complete the ASME U-1A Form
- Manufacturers Checklist
- Manufacturers Duties
- 2015 edition of the ASME Code
    - Section V
    - Section VIII, Division 1
    - Section IX

Packages

- Package Section Cites

Cylinders

- Cylinder Checklist
- PHMSA Cylinder Brochure

General Packaging

- UN Performance Package Codes Brochure
- Package Cites Spreadsheet

Other Bulk Packages

- IBC Checklist
- Portable Tank Checklist
- DOT 51 tanks
- DOT 56 and 57 tanks

Specific Hazardous Materials

- Special Provisions and Segregation Reminders

Explosives

- Explosives Checklist
- APA 87-1, 2001
- IME Standard No. 22, 2007
- IME Standard No. 23, 2011

Radioactive Materials

- Radioactive Materials Checklist

Hazardous Substances and Wastes

- Hazardous Substances and Wastes Checklist

Materials of Trade

- MOTs Brochure

HM Communication

- HM Shipping Paper Checklist
- Non-Bulk Marking Checklist
- Bulk Marking Checklist
- Labeling Checklist
- Placarding Checklist

Training

- HM Training Checklist
- Guide to Developing a HM Training Program

Security Plans

- Security Talking Points
- SCR Q and A Guidance
- Security Plan Checklist
- Suspicious Activity Report

GUIDELINES FOR STRUCTURAL EVALUATION OF CARGO TANKS

by

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CHAPTER 1. INTRODUCTION

This document has been prepared for use as a guideline for engineers performing reviews of structural designs of cargo tanks. These reviews are usually performed as part of the Compliance Reviews performed by Safety Investigators.

The Secretary of Transportation, under 49 CFR Part 1-48, has granted the authority to perform Compliance Reviews to the Federal Highway Administration (FHWA) and more specifically, the Office of Motor Carriers (OMC). It is OMC's responsibility to regulate interstate commerce on our nation's highways as it pertains to truck and bus transportation. Since cargo tanks fall under this responsibility, it is necessary for OMC to ensure the operation and construction of these tanks are in compliance with the Code of Federal Regulations (CFR). The Office of Motor Carrier's authority within the cargo tank realm has been extended beyond strictly transportation, to encompass not only the design and construction, but the continuing qualification and maintenance of cargo tanks as well. The portions of the federal regulations pertaining to these areas may be found in 49 CFR Parts 178 & 180. One of the tools the Office of Motor Carriers utilizes to evaluate regulatory compliance is the Compliance Review, performed by Safety Investigators (SI's). The evaluation of cargo tank manufacturing facilities will, under many circumstances, be performed by SI's with the assistance of an engineer. Under these conditions, the engineer will be responsible for performing the structural evaluation portion (49 CFR Part 178) of the Compliance Review. The SI will be responsible for evaluating the facility's compliance with Part 180, which was established for the continuing qualification and maintenance once the tanks have been constructed and placed in service.

These guidelines emphasize structural evaluation of DOT 400 series cargo tanks. Most of the cargo tanks on the roads today are MC 300 series cargo tanks, however, as of September 1, 1995, the 300 series tanks are no longer authorized for construction.

THE DOT 406, 407, and 412 specification cargo tanks will replace the MC 306, 307, and 312 tanks. The manufacture of DOT 400 series tanks was

authorized beginning on December 31, 1990, and some manufacturers have already elected to produce the 400's. It is important to know that those companies choosing this option are required to design and construct in accordance with the specification in effect at the time of manufacture.

Specifications for MC 306 tanks (49 CFR 178.,340 and 178.341) became effective on December 1, 1967. The MC 306 is characteristically used for gasoline, fuel oil, alcohol, and other liquid flammables. Typically, the 306 is constructed of aluminum, is designed for atmospheric pressure, and has an elliptical cross section. Specification DOT 406 cargo tanks (49 CFR 178.320, 178.345, and 178.346) have replaced the 306's, effective September 1, 1995.

Specifications for MC 307 tanks (49 CFR 178.340 and 178.342) became effective on December 1, 1967. The MC 307 is characteristically used for solvents, plasticizers, casinghead gas, etc. Typically, the 307 is constructed of stainless steel, is designed for a pressure of at least 25 psig, and has a circular cross section. Specification DOT 407 cargo tanks (49 CFR 178.320, 178.345, and 178.347) have replaced the 307's, effective September 1, 1995.

Specifications for MC 312 tanks (40 CFR 178.340 and 178.343) became effective on December 1, 1967. The MC 312 is characteristically used for corrosive materials. Typically, the 312 is constructed of stainless or carbon steel, is designed for a pressure of 35 psig, and has a circular cross section. Specification DOT 412 cargo tanks (49 CFR 178.320, 178.345, and 178.348) have replaced the 312's, effective September 1, 1995.

Some tanks are manufactured to meet multiple specifications, such as a DOT 407/412. This is generally done in order for the user to have the ability to haul a wider range of materials.

Other specification cargo tanks exist that will not be addressed in this document. Specification MC 331 (49 CFR 178.337) and MC 338 (49 CFR 178.338) cargo tanks are high pressure vessels which demand the use of the ASME Code for their design and construction. These tanks are typically used for atmospheric gases or cryogenics. The 331's are designed for pressures anywhere from 100 to 500 psig, whereas the 338's are designed for pressures between 25.3 and 500 psig.

The structural evaluation portion of the Compliance Review must consider the requirements for:

1. Structural integrity of the tank
2. Bottom damage protection
3. Overturn damage protection
4. Rear-end damage protection

Portions of Part 178 in Title 49 of the Code of Federal Regulations must be followed for each of the four items above, and various analysis methods must be employed, some of which are included in this document. Generally, the loads imposed on cargo tanks and their components are dynamic in nature. It is the intent of the regulations to simplify and idealize these loads into equivalent steady-state conditions, and to utilize these idealizations in static analyses for the purposes of computing stresses (allowable loads).

Details of analysis procedures for many items that must be included in a structural evaluation are contained in this document; however, this manual does not address every specific detail that may be encountered. A few additional important references are the PRESSURE VESSEL HANDBOOK, and the ASME BOILER AND PRESSURE VESSEL CODE, Section VIII, Division 1, and Section II, Part D. These publications, along with other applicable reference materials, are listed in References.

It is important to note that in most cases, DOT 400 series specification cargo tanks are to be designed and constructed in accordance with the ASME Code, with some exceptions. Ensure that you have access to the Code in effect at the time of construction, and that you are versed in the exceptions indicated in each specification.

The layout of this manual was arranged in this manner purposefully. In most cases, it indicated the natural progression of steps to be completed when performing a structural evaluation of a cargo tank during a Compliance Review. It should be noted that many facilities manufacture to more than one specification, and in many cases, more than one design within each specification. It will be the responsibility of the engineer to evaluate the manufacturer's design methods and techniques on a case by case basis. Common sense would dictate that a company building 406's, all of the same

design, would necessitate one analysis for that design. If a company is more versatile and builds custom 406's, 407's, and 412's of varying designs, the logical approach would be to determine the design types producing the worse case loading scenarios, and evaluate those designs.

Geometric shapes of some cargo tanks are shown in figure 1.

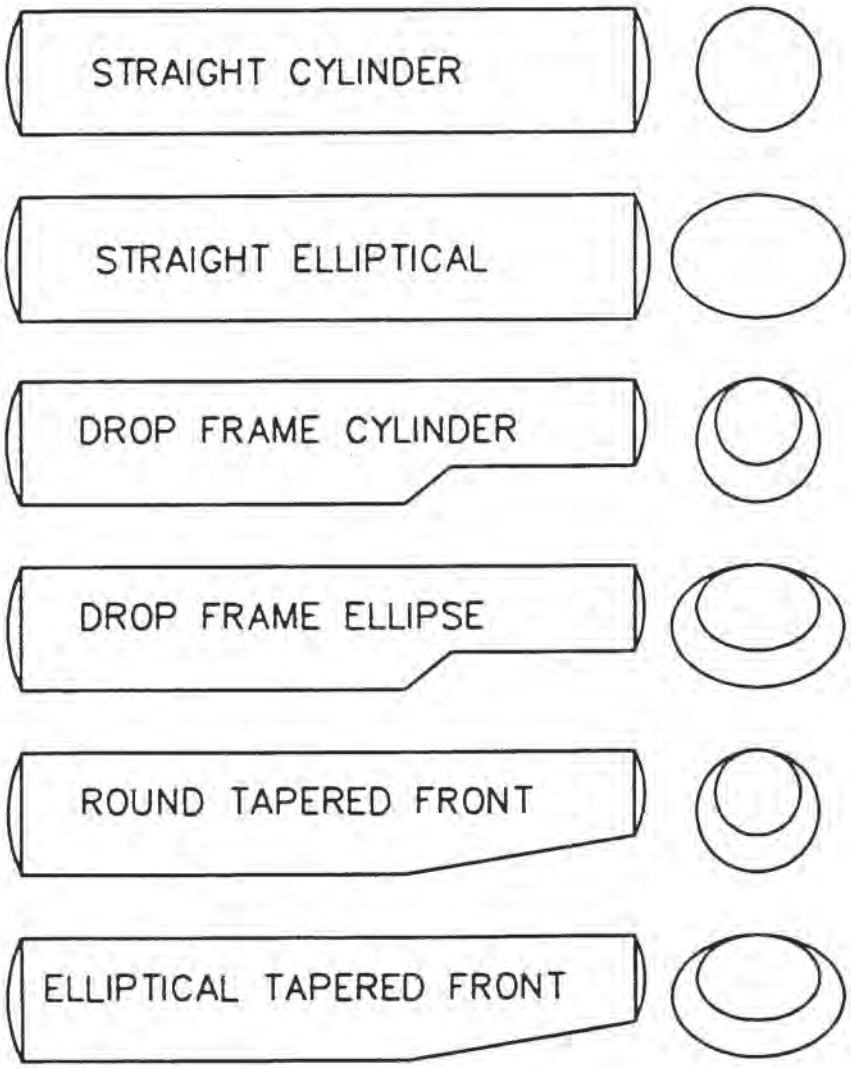

Figure 1. Common shapes of cargo tanks.

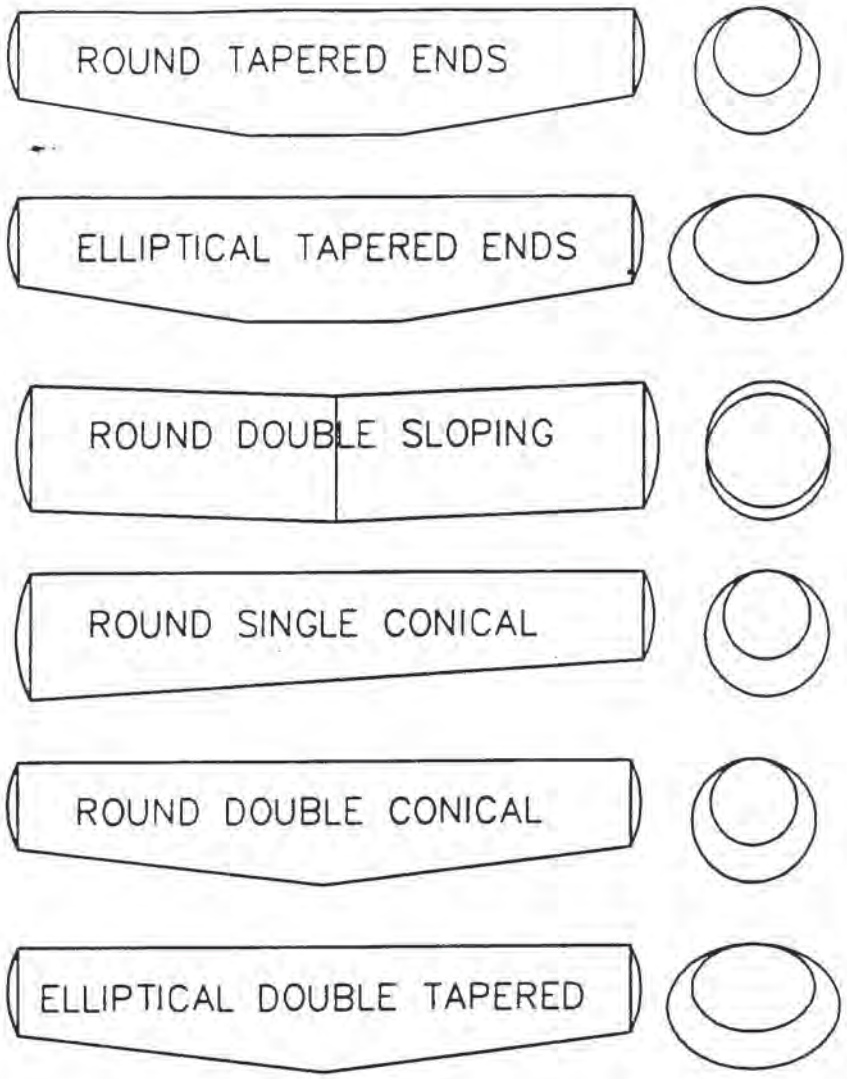

Figure 1. (Continued) Common shapes of cargo tanks.

Geometric shapes of various types of heads and baffles are shown in figure 2 through 6. Torispherical and ellipsoidal heads are frequently used on low-pressure tanks and hemispherical heads are frequently used on tanks designed for higher pressures.

Heads are formed from flat sheets of material. The forming process causes a reduction in thickness of the material which must be taken in account in design and construction of cargo tanks.

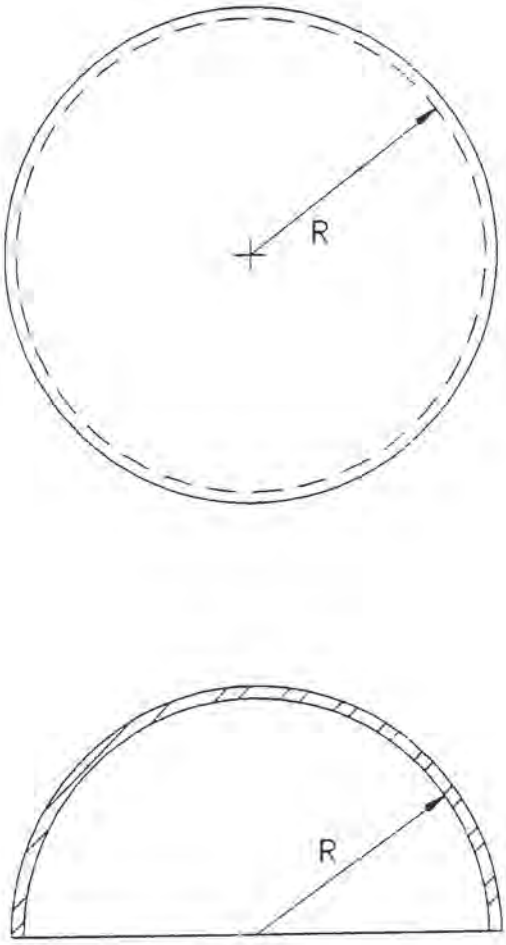

Figure 2. Typical hemispherical head used on cargo tanks designed for higher pressure.

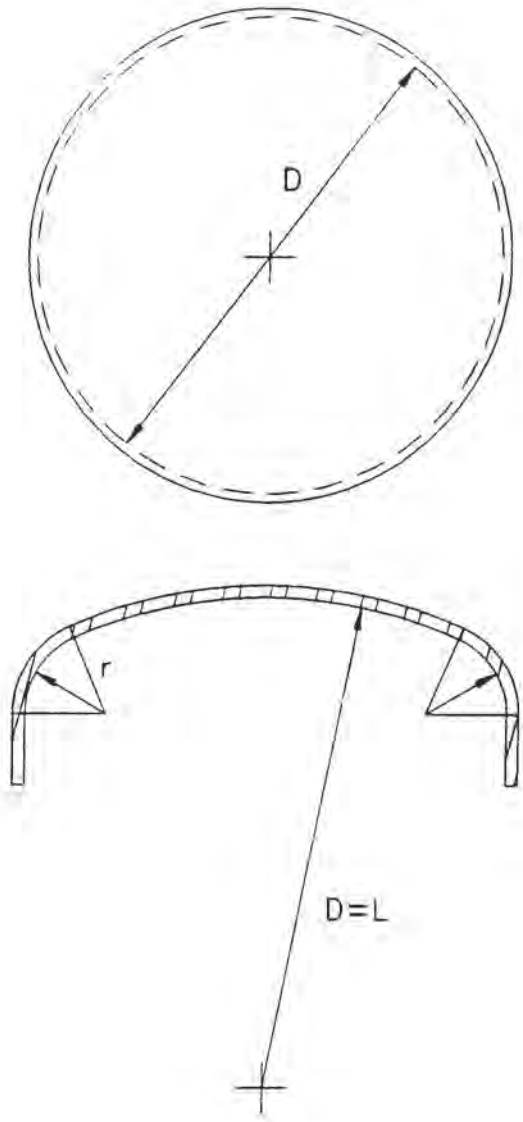

Figure 3. Typical ASME flanged and dished (torispherical) head used on cargo tanks.

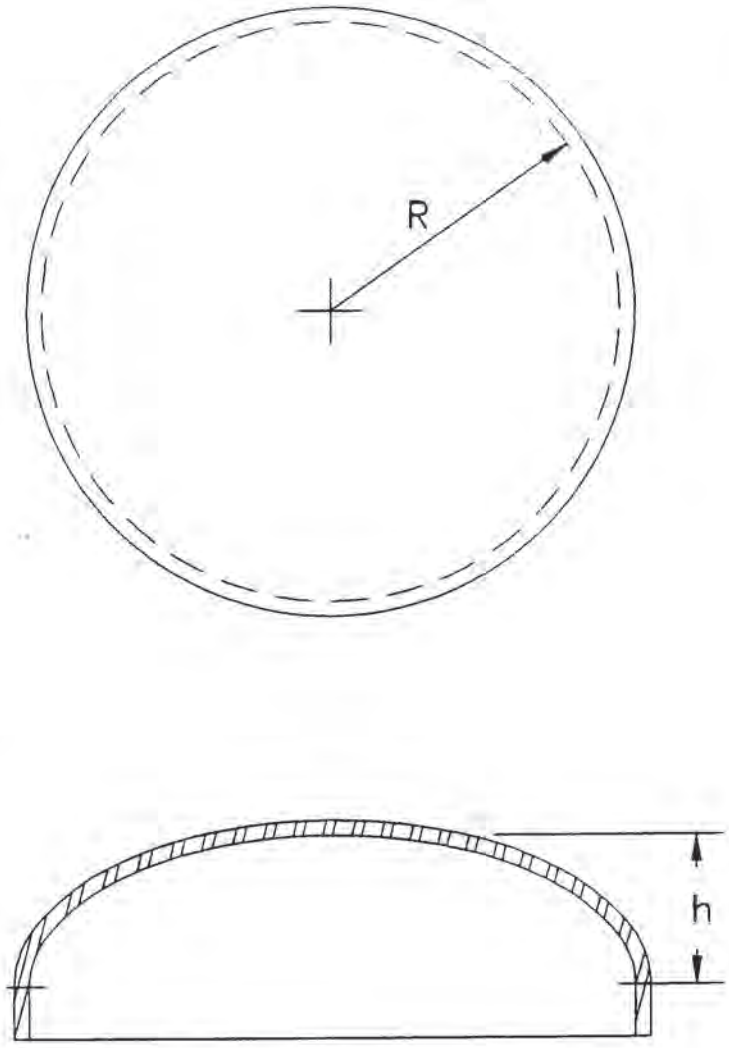

Figure 4. Typical ellipsoidal head used on cylindrical cargo tanks. Ellipsoidal heads may also be used on tanks having elliptical cross section.

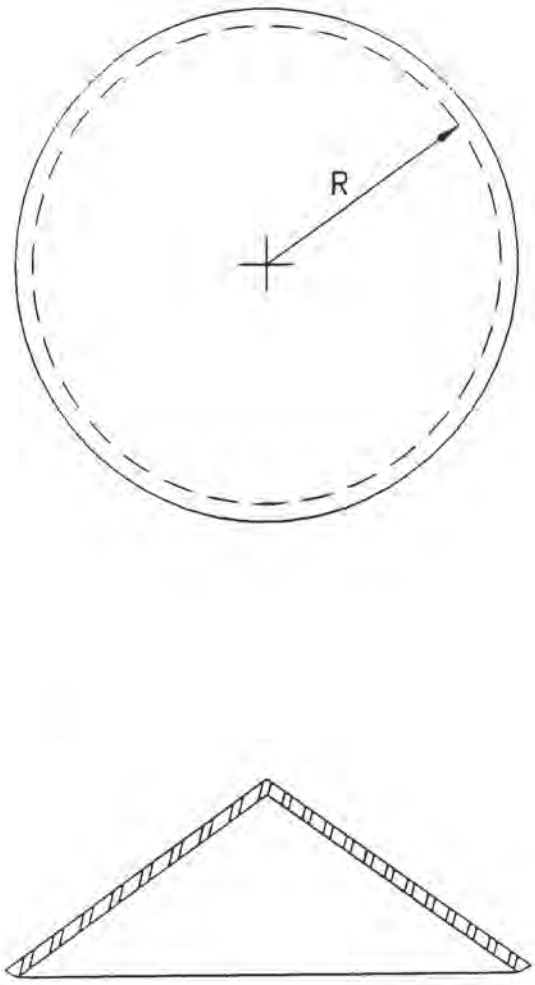

Figure 5. Conical head used on some cargo tanks.

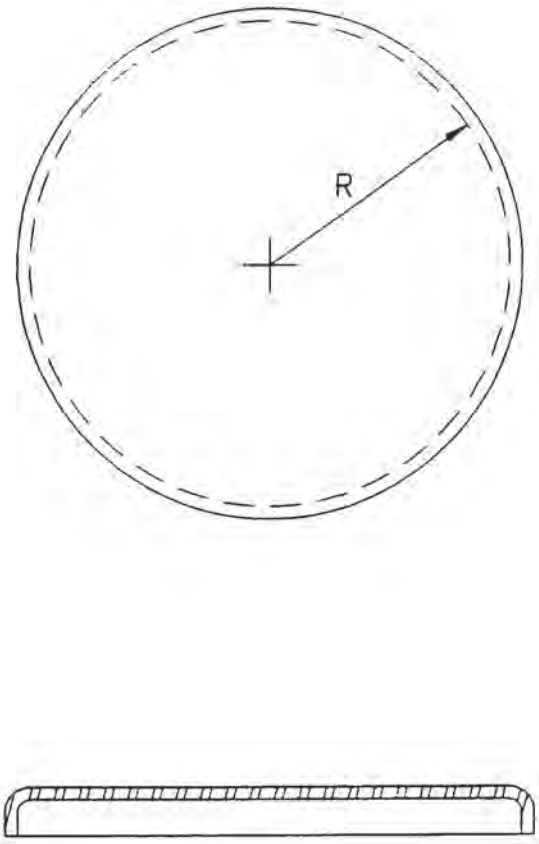

Figure 6. Typical flanged flat head.

§178.345 General design and construction requirements applicable to Specification DOT 406 (§178.346), DOT 407 (§178.347), and DOT 412 (§178.348) cargo tank motor vehicles.

§178.345-1 General requirements.

(a) Specification DOT 406, DOT 407 and DOT 412 cargo tank motor vehicles must conform to the requirements of this section in addition to the requirements of the applicable specification contained in §§178.346, 178.347 or 178.348.

(b) All specification requirements are minimum requirements.

(c) *Definitions.* The following terms apply to §§178.345, 178.346, 178.347 and 178.348.

Appurtenance means any cargo tank accessory attachment that has no lading retention or containment function and provides no structural support to the cargo tank.

Baffle means a non-liquid-tight transverse partition device that deflects, checks or regulates fluid motion in a tank.

Bulkhead means a liquid-tight transverse closure at the ends of or between cargo tanks.

Charging line means a hose, tube, pipe, or similar device used to pressurize a tank with material other than the lading.

Companion flange means one of two mating flanges where the flange faces are in contact or separated only by a thin leak sealing gasket and are secured to one another by bolts or clamps.

Connecting structure means the structure joining two cargo tanks.

Constructed and certified in conformance with the ASME Code means the cargo tank is constructed and stamped in accordance with the ASME Code, and is inspected and certified by an Authorized Inspector.

Constructed in accordance with the ASME Code means the cargo tank is constructed in accordance with the ASME Code with the authorized exceptions (see §§178.346, 178.347, and 178.348) and is inspected and certified by a Registered Inspector.

External self-closing stop-valve means a self-closing stop-valve designed so that the self-stored energy source is located outside the tank and the welded

flange.

Extreme dynamic loading means the maximum single-acting loading a cargo tank may experience during its expected life, excluding accident loadings.

Flange means the structural ring for guiding or attachment of a pipe or fitting with another flange (companion flange), pipe, fitting or other attachment.

Inspection pressure means the pressure used to determine leak tightness of the tank when testing with pneumatic pressure.

Internal self-closing stop-valve means a self-closing stop-valve designed so that the self-stored energy source is located inside the tank or tank sump, or within the welded flange, and the valve seat is located within the tank or within one inch of the external face of the welded flange or sump of the tank.

Lading means the hazardous material contained in a cargo tank.

Loading/unloading connection means the fitting in the loading/unloading line farthest from the loading/unloading outlet to which the loading/unloading hose or device is attached.

Loading/unloading outlet means the tank outlet used for normal loading/unloading operations.

Loading/unloading stop-valve means the stop valve farthest from the tank loading/unloading outlet to which the loading/unloading connection is attached.

Maximum allowable working pressure or *MAWP* See §178.345-1(k).

Multi-specification cargo tank motor vehicle means a cargo tank motor vehicle equipped with two or more cargo tanks fabricated to more than one cargo tank specification.

Normal Operating Loading means the loading a cargo tank may be expected to experience routinely in operation.

Nozzle means the subassembly consisting of a pipe or tubular section with or without a welded or forged flange on one end.

Outlet means any opening in the shell or head of a tank, (including the means for attaching a closure), except that the following are not outlets: A threaded opening securely closed during transportation with a threaded plug or a threaded cap, a flanged opening securely closed during transportation with a bolted or welded blank flange, a manhole, or gauging devices, thermometer wells, and safety relief devices.

Outlet stop-valve means the stop-valve at the tank loading/unloading outlet.

Pipe coupling means a fitting with internal threads on both ends.

Rear bumper means the structure designed to prevent a vehicle or object from under-riding the rear of a motor vehicle. See §393.86 of this title.

Rear-end tank protection device means the structure designed to protect a cargo tank and any lading retention piping or devices in case of a rear end collision.

Sacrificial Device means an element, such as a shear section designed to fail under load in order to prevent damage to any lading retention part or device. The device must break under strain at no more than 70 percent of the strength of the weakest piping element between the tank and the sacrificial device. Operation of the sacrificial device must leave the remaining piping and its attachment to the tank intact and capable of retaining lading.

Self-closing stop valve means a stop-valve held in the closed position by means of self-stored energy, which opens only by application of an external force and which closes when the external force is removed.

Shear section means a sacrificial device fabricated in such a manner as to abruptly reduce the wall thickness of the adjacent piping or valve material by at least 30 percent.

Shell means the circumferential portion of a tank defined by the basic design radius or radii excluding the closing heads.

Stop-valve means a valve that stops the flow of lading.

Sump means a protrusion from the bottom of a tank shell designed to facilitate complete loading and unloading of lading.

Tank means a container, consisting of a shell and heads, that forms a pressure tight vessel having openings designed to accept pressure tight fittings or closures, but excludes any appurtenances, reinforcements, fittings, or closures.

Test pressure means the pressure to which a tank is subjected to determine pressure integrity.

Toughness of material means the capability of a material to absorb the energy represented by the area under the stress strain curve (indicating the energy absorbed per unit volume of the material) up to the point of rupture.

Vacuum tank means a tank that is loaded by reducing the pressure in the tank to below atmospheric pressure.

Variable specification cargo tank means a cargo tank that is constructed in accordance with one specification, but which may be altered to meet another specification by changing relief device, closures, lading discharge devices, and other lading retention devices.

Void means the space between tank heads or bulkheads and a connecting structure.

Welded flange means a flange attached to the tank by a weld joining the tank shell to the cylindrical outer surface of the flange, or by a fillet weld

joining the tank shell to a flange shaped to fit the shell contour.

(d) A manufacturer of a cargo tank must hold a current ASME certificate of authorization and must be registered with the Department in accordance with part 107, subpart F of this chapter.

(e) All construction must be certified by an Authorized Inspector or by a Registered Inspector as applicable to the cargo tank.

(f) Each cargo tank must be designed and constructed in conformance with the requirements of the applicable cargo tank specification. Each DOT 412 cargo tank with a maximum allowable working pressure greater than 15 psig, and each DOT 407 cargo tank with a maximum allowable working pressure greater than 35 psig must be "constructed and certified in conformance with the ASME Code" except as limited or modified by the applicable cargo tank specification. Other cargo tanks must be "constructed in accordance with the ASME Code", except as limited or modified by the applicable cargo tank specification.

(g) Requirements relating to parts and accessories on motor vehicles, which are contained in part 393 of the Federal Motor Carrier Safety Regulations of this title, are incorporated into these specifications.

(h) Any additional requirements prescribed in part 173 of this subchapter that pertain to the transportation of a specific lading are incorporated into these specifications.

(i) *Cargo tank motor vehicle composed of multiple cargo tanks.*

(1) A cargo tank motor vehicle composed of more than one cargo tank may be constructed with the cargo tanks made to the same specification or to different specifications. Each cargo tank must conform in all respects with the specification for which it is certified.

(2) The strength of the connecting structure joining multiple cargo tanks in a cargo tank motor vehicle must meet the structural design requirements in §178.345-3. Any void within the connecting structure must be vented to the atmosphere and have a drain located on the bottom centerline. Each drain must be accessible and must be kept open at all times. The drain in any void within the connecting structure of a carbon steel, self-supporting cargo tank may be either a single drain of at least 1.0 inch diameter, or two or more drains of at least 0.5 inch diameter, 6.0 inches apart, one of which is located on the bottom centerline.

(j) *Variable specification cargo tank.* A cargo tank that may be physically altered to conform to another cargo tank specification must have the required physical alterations to convert from one specification to another clearly

indicated on the variable specification plate.

(k) *Maximum Allowable Working Pressure (MAWP).* The MAWP for each cargo tank must be greater than or equal to the largest of the following (The MAWP derived is the pressure to be used as prescribed in the ASME Code in the design of the tank):

(1) The pressure prescribed for the lading in part 173;

(2) Vapor pressure of the most volatile lading, at 115°F (expressed in psig), plus the maximum static pressure exerted by the lading at the maximum lading density, plus any pressure exerted by a gas padding (including air in the ullage space or dome), if used; or

(3) The maximum pressure in the tank during loading or unloading.

§178.345-2 Material and material thickness.

(a) All material for shell, heads, bulkheads, and baffles must conform to section II, parts A and B, of the ASME Code except as follows:

(1) The following steels are also authorized for cargo tanks "constructed in accordance with the ASME Code".

ASTM A 569
ASTM A 570
ASTM A 572
ASTM A 607
ASTM A 656
ASTM A 715

(2) Aluminum alloys suitable for fusion welding and conforming with the 0, H32 or H34 tempers of one of the following ASTM specifications may be used for cargo tanks "constructed in accordance with the ASME Code":

ASTM B-209 Alloy 5052
ASTM B-209 Alloy 5086
ASTM B-209 Alloy 5154
ASTM B-209 Alloy 5254
ASTM B-209 Alloy 5454
ASTM B-209 Alloy 5652

All heads, bulkheads and baffles must be of 0 temper (annealed) or stronger tempers. All shell materials shall be of H32 or H34 tempers except that the lower ultimate strength tempers may be used if the minimum shell thicknesses in the tables are increased in inverse proportion to the lesser ultimate strength.

(b) *Minimum thickness.* The minimum thickness for the shell and

heads must be such that the maximum stress levels specified in §178.345-3 of this subpart are not exceeded. In no case may the shell or head thickness be less than that specified in the applicable specification.

(c) *Corrosion or abrasion protection.* When required by 49 CFR part 173 for a particular lading, a cargo tank or a part thereof, subject to thinning by corrosion or mechanical abrasion due to the lading, must be protected by providing the tank or part of the tank with a suitable increase in thickness of material, a lining or some other suitable method of protection.

(1) *Corrosion allowance.* Material added for corrosion allowance need not be of uniform thickness if different rates of attack can reasonably be expected for various areas of the tank.

(2) *Lining.* Lining material must consist of a nonporous, homogeneous material not less elastic than the parent metal and substantially immune to attack by the lading. The lining material must be bonded or attached by other appropriate means to the tank wall and must be imperforate when applied. Any joint or seam in the lining must be made by fusing the materials together, or by other satisfactory means.

§178.345-3 Structural integrity.

(a) *General requirements and acceptance criteria.*

(1) The maximum calculated design stress at any point in the tank wall may not exceed the maximum allowable stress value prescribed in section VIII of the ASME Code, or 25 percent of the tensile strength of the material used at design conditions.

(2) The relevant physical properties of the materials used in each cargo tank may be established either by a certified test report from the material manufacturer or by testing in conformance with a recognized national standard. In either case, the ultimate tensile strength of the material used in the design may not exceed 120 percent of the minimum ultimate tensile strength specified in either the ASME Code or the ASTM standard to which the material is manufactured.

(3) The maximum design stress at any point in the cargo tank must be calculated separately for the loading conditions described in paragraphs (b) and (c) of this section. Alternate test or analytical methods, or a combination thereof, may be used in place of the procedures described in paragraphs (b) and (c) of this section, if the methods are accurate and verifiable.

(4) Corrosion allowance material may not be included to satisfy any of

the design calculation requirements of this section.

(b) ASME Code design and construction. The static design and construction of each cargo tank must be in accordance with Section VIII, Division 1 of the ASME Code. The tank design must include calculation of stresses generated by the MAWP, the weight of lading, the weight of structures supported by the tank wall and the effect of temperature gradients resulting from lading and ambient temperatures extremes. When dissimilar materials are used, their thermal coefficients must be used in the calculation of thermal stresses.

(1) Stress concentrations in tension, bending and torsion which occur at pads, cradles, or other supports must be considered in accordance with appendix G of section VIII, Division 1 of the ASME Code.

(2) Longitudinal compressive buckling stress for ASME certified vessels must be calculated using paragraph UG-23(b), Section VIII, Division 1 of the ASME Code. For cargo tanks not required to be certified in accordance with the ASME Code, compressive buckling stress may be calculated using alternative analysis methods which are accurate and certifiable. When alternative methods are used calculations must include both the static loads described in this paragraph and the dynamic loads described in paragraph (c) of this section.

(c) Shell design. Shell stresses resulting from static or dynamic loadings, or combinations thereof, are not uniform throughout the cargo tank motor vehicle. The vertical, longitudinal and lateral normal operating loadings can occur simultaneously and must be combined. The vertical, longitudinal and lateral extreme dynamic loadings occur separately and need not be combined.

(1) Normal operating loadings. The following procedure addresses stress in the tank shell resulting from normal operating loadings. The effective stress (the maximum principal stress at any point) must be determined by the following formula:

$$S=0.5(S_y+S_x) \pm (0.25(S_y-S_x)^2+S_s^2)^{0.5}$$

Where:

(i) S=effective stress at any given point under the combination of static and normal operating loadings that can occur at the same time, in psi.

(ii) S_y=circumferential stress generated by the MAWP and external pressure, when applicable, plus static head, in psi.

(iii) S_x= the following net longitudinal stress generated by the following static and normal operating loading conditions, in psi:

(A) The longitudinal stresses resulting from the MAWP and external pressure, when applicable, plus static head, in combination with the bending

stress generated by the static weight of the fully loaded cargo tank, all structural elements, equipment and appurtenances supported by the cargo tank wall;

(B) The tensile or compressive stress resulting from normal operating longitudinal acceleration or deceleration. In each case, the forces applied must be 0.35 times the vertical reaction at the suspension assembly, applied at the road surface, and as transmitted to the cargo tank wall through the suspension assembly of a trailer during deceleration; or the horizontal pivot of the truck tractor or converter dolly fifth wheel, or the drawbar hinge on the fixed dolly during acceleration; or anchoring and support members of a truck during acceleration and deceleration, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank, all structural elements, equipment and appurtenances supported by the cargo tank wall. The following loadings must be included:

(1) The axial load generated by a decelerative force,

(2) The bending moment generated by a decelerative force,

(3) The axial load generated by an accelerative force, and

(4) The bending moment generated by an accelerative force; and

(C) The tensile or compressive stress generated by the bending moment resulting from normal operating vertical accelerative force equal to 0.35 times the vertical reaction at the suspension assembly of a trailer; or the horizontal pivot of the upper coupler (fifth wheel) or turntable; or anchoring and support members of a truck, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank, all structural elements, equipment and appurtenances supported by the cargo tank wall.

(iv) S_s=The following shear stresses generated by the following static and normal operating loading conditions, in psi:

(A) The static shear stress resulting from the vertical reaction at the suspension assembly of the trailer, and the horizontal pivot of the upper coupler (fifth wheel) or turntable; or anchoring and support members of a truck, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank, all structural elements, equipment and appurtenances supported by the cargo tank wall;

(B) The vertical shear stress generated by a normal operating accelerative force equal to 0.35 times the vertical reaction at the suspension assembly of a trailer; or the horizontal pivot of the upper coupler (fifth wheel) or turntable; or anchoring and support members of a truck, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank, all structural elements, equipment and appurtenances supported by the

cargo tank wall;

(C) The lateral shear stress generated by a normal operating lateral accelerative force equal to 0.2 times the vertical reaction at each suspension assembly of a trailer, applied at the road surface, and as transmitted to the cargo tank wall through the suspension assembly of a trailer, and the horizontal pivot of the upper coupler (fifth wheel) or turntable; or anchoring and support members of a truck, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank, all structural elements, equipment and appurtenances supported by the cargo tank wall; and

(D) The torsional shear stress generated by the same lateral forces as described in paragraph (c)(1)(iv)(C) of this section.

(2) Extreme dynamic loadings. The following procedure addresses stress in the tank shell resulting from extreme dynamic loadings. The effective stress (the maximum principal stress at any point) must be determined by the following formula:

$$S=0.5(S_y+S_x)\pm[0.25(S_y-S_x)^2+S_S^2]^{0.5}$$

Where:

(i) S=effective stress at any given point under a combination of static and extreme dynamic loadings that can occur at the same time, in psi.

(ii) S_y=circumferential stress generated by MAWP and external pressure, when applicable, plus static head, in psi.

(iii) S_x=the following net longitudinal stress generated by the following static and extreme dynamic loading conditions, in psi.

(A) The longitudinal stresses resulting from the MAWP and external pressure, when applicable, plus static head, in combination with the bending stress generated by the static weight of the fully loaded cargo tank, all structural elements, equipment and appurtenances supported by the tank wall;

(B) The tensile or compressive stress resulting from extreme longitudinal acceleration or deceleration. In each case the forces applied must be 0.7 times the vertical reaction at the suspension assembly, applied at the road surface, and as transmitted to the cargo tank wall through the suspension assembly of a trailer during deceleration; or the horizontal pivot of the truck tractor or converter dolly fifth wheel, or the drawbar hinge on the fixed dolly during acceleration; or anchoring and support members of a truck during acceleration and deceleration, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank, all structural elements, equipment and appurtenances supported by the cargo tank wall. The following loadings must be included:

(1) The axial load generated by a decelerative force,

(2) The bending moment generated by a decelerative force,

(3) The axial load generated by an accelerative force, and

(4) The bending moment generated by an accelerative force; and

(C) The tensile or compressive stress generated by the bending moment resulting from an extreme vertical accelerative force equal to 0.7 times the vertical reaction at the suspension assembly of a trailer, and the horizontal pivot of the upper coupler (fifth wheel) or turntable; or the anchoring and support members of a truck, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank, all structural elements, equipment and appurtenances supported by the cargo tank wall.

(iv) S_s=The following shear stresses generated by static and extreme dynamic loading conditions, in psi:

(A) The static shear stress resulting from the vertical reaction at the suspension assembly of a trailer, and the horizontal pivot of the upper coupler (fifth wheel) or turntable; or anchoring and support members of a truck, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank, all structural elements, equipment and appurtenances supported by the cargo tank wall;

(B) The vertical shear stress generated by an extreme vertical accelerative force equal to 0.7 times the vertical reaction at the suspension assembly of a trailer, and the horizontal pivot of the upper coupler (fifth wheel) or turntable; or anchoring and support members of a truck, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank, all structural elements, equipment and appurtenances supported by the cargo tank wall;

(C) The lateral shear stress generated by an extreme lateral accelerative force equal to 0.4 times the vertical reaction at the suspension assembly of a trailer, applied at the road surface, and as transmitted to the cargo tank wall through the suspension assembly of a trailer, and the horizontal pivot of the upper coupler (fifth wheel) or turntable; or anchoring and support members of a truck, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank, all structural elements, equipment and appurtenances supported by the cargo tank wall; and

(D) The torsional shear stress generated by the same lateral forces as described in paragraph (c)(2)(iv)(C) of this section.

(d) In no case may the minimum thickness of the cargo tank shell and heads be less than that prescribed in §178.346-2, 178.347-2 or §178.348-2 as

applicable.

(e) For a cargo tank mounted on a frame or built with integral structural supports, the calculation of effective stresses for the loading conditions in paragraph (c) of this section may include the structural contribution of the frame or the integral structural supports.

(f) The design, construction, and installation of an appurtenance to the cargo tank must conform to the following requirements.

(1) Structural members, the suspension subframe, accident protection and external rings must be used as sites for attachment of appurtenances and other accessories to the cargo tank, when practicable.

(2) A lightweight attachment to the cargo tank wall, such as a conduit clip, brakeline clip, skirting structure, lamp mounting bracket or placard holder, must be of a construction having lesser strength than the cargo tank wall materials and may not be more than 72 percent of the thickness of the material to which it is attached.

(3) Except as prescribed in paragraphs (f)(1) and (f)(2) of this section, the welding of any appurtenance to the cargo tank wall must be made by attachment of a mounting pad, so that there will be no adverse effect upon the lading retention integrity of the cargo tank if any force less than that prescribed in §178.345-8(b)(1) of the subchapter is applied from any direction. The thickness of the mounting pad may not be less than that of the shell or head to which it is attached, and not more than 1.5 times the shell or head thickness. However, a pad with a minimum thickness of 0.187 inch may be used when the shell or head thickness is over 0.187 inch. If weep holes or tell-tale holes are used, the pad must be drilled or punched at its lowest point before it is welded. Each pad must--

(i) Extend at least 2 inches in each direction from any point of attachment of an appurtenance;

(ii) Have rounded corners, or otherwise be shaped in a manner to minimize stress concentrations on the shell or head; and

(iii) Be attached by a continuous weld around the pad except for a small gap at the lowest point for draining.

§178.345-4 Joints

(a) All joints between tank shell, heads, baffles, baffle attaching rings, and bulkheads must be welded in conformance with the ASME Code welding

procedures.

(b) Where practical all welds must be easily accessible for inspection.

§178.345-5 Manhole assemblies.

(a) Each cargo tank with capacity greater than 400 gallons must be accessible through a manhole at least 15 inches in diameter.

(b) Each manhole, fill opening and washout assembly must be structurally capable of withstanding, without leakage or permanent deformation that would affect its structural integrity, a static internal fluid pressure of at least 36 psig, or cargo tank test pressure, whichever is greater. The manhole assembly manufacturer shall verify compliance with this requirement by hydrostatically testing at least one percent (or one manhole closure, whichever is greater) of all manhole closures of each type produced each 3 months, as follows:

(1) The manhole, fill opening, or washout assembly must be tested with the venting devices blocked. Any leakage or deformation that would affect the product retention capability of the assembly shall constitute a failure.

(2) If the manhole, fill opening, or washout assembly tested fails, then five more covers from the same lot must be tested. If one of these five covers fails, then all covers in the lot from which the tested covers were selected are to be 100% tested or rejected for service.

(c) Each manhole, filler and washout cover must be fitted with a safety device that prevents the cover from opening fully when internal pressure is present.

(d) Each manhole and fill cover must be secured with fastenings that will prevent opening of the covers as a result of vibration under normal transportation conditions or shock impact due to a rollover accident on the roadway or shoulder where the fill cover is not struck by a substantial obstacle.

(e) Each manhole cover must be permanently marked by stamping or other means with:

(1) Manufacturer's name;

(2) Test pressure ____psig;

(3) A statement certifying that the manhole cover meets the requirements in §178.345-5.

(f) All fittings and devices mounted on a manhole cover, coming in contact with the lading, must withstand the same static internal fluid pressure and contain the same permanent compliance markings as that required for the

manhole cover. The fitting or device manufacturer shall verify compliance using the same test procedure and frequency of testing as specified in §178.345-5(b).

§178.345-6 Supports and anchoring.

(a) A cargo tank with a frame not integral to the tank must have the tank secured by restraining devices to eliminate any motion between the tank and frame that may abrade the tank shell due to the stopping, starting, or turning of the vehicle. The design calculations of the support elements must include the stresses indicated in §178.345-3(b) and as generated by the loads described in §178.345-3(c). Such restraining devices must be readily accessible for inspection and maintenance, except that insulation and jacketing are permitted to cover the restraining devices.

(b) A cargo tank designed and constructed so that it constitutes, in whole or in part, the structural member used in lieu of a frame must be supported in such a manner that the resulting stress levels in the tank do not exceed those specified in §178.345-3(a). The design calculations of the support elements must include the stresses indicated in §178.345-3(b) and as generated by the loads described in §178.345(c).

§178.345-7 Circumferential reinforcements.

(a) A tank with a shell thickness of less than 3/8 inch must be circumferentially reinforced with bulkheads, baffles, ring stiffeners, or any combination thereof, in addition to the tank heads.

(1) Circumferential reinforcement must be located so that the thickness and tensile strength of the shell material in combination with the frame and reinforcement produces structural integrity at least equal to that prescribed in §178.345-3 and in such a manner that the maximum unreinforced portion of the shell does not exceed 60 inches. For cargo tanks designed to be loaded by vacuum, spacing of circumferential reinforcement may exceed 60 inches provided the maximum unreinforced portion of the shell conforms with the requirements of Section VIII, Division 1 of the ASME Code.

(2) Where circumferential joints are made between conical shell sections, or between conical and cylindrical shell sections, and the angle between adjacent sections is less than 160 degrees, circumferential reinforcement

must be located within one inch of the shell joint, unless otherwise reinforced with structural members capable of maintaining shell stress levels authorized in §178.345-3. When the joint is formed by the large ends of adjacent conical shell sections or by the large end of a conical shell and a cylindrical shell section, this angle is measured inside the shell; when the joint is formed by the small end of a conical shell section and a cylindrical shell section, it is measured outside the shell.

(b) Except for doubler plates and knuckle pads, no reinforcement may cover any circumferential joint.

(c) When a baffle or baffle attachment ring is used as a circumferential reinforcement member, it must produce structural integrity at least equal to that prescribed in §178.345-3 and must be circumferentially welded to the tank shell. The welded portion may not be less than 50 percent of the total circumference of the tank and the length of any unwelded space on the joint may not exceed 40 times the shell thickness unless reinforced external to the tank.

(d) When a ring stiffener is used as a circumferential reinforcement member, whether internal or external, reinforcement must be continuous around the circumference of the cargo tank shell and must be in accordance with the following:

(1) The section modulus about the neutral axis of the ring section parallel to the shell must be at least equal to that derived from the applicable formula:

I/C=0.00027WL, for MS, HSLA and SS; or
I/C=0.000467WL, for aluminum allows;
Where:
I/C= Section modulus in inches^3
W = Tank width, or diameter in inches
L = Spacing of ring stiffener in inches; i.e., the maximum longitudinal distance from the midpoint of the unsupported shell on one side of the ring stiffener to the midpoint of the unsupported shell on the opposite side of the ring stiffener.

(2) If a ring stiffener is welded to the tank shell, a portion of the shell may be considered as part of the ring section for purposes of computing the ring section modulus. This portion of the shell may be used provided at least 50 percent of the total circumference of the tank is welded and the length of any unwelded space on the joint does not exceed 40 times the shell thickness. The

maximum portion of the shell to be used in these calculations is as follows:

Number of circumferential ring stiffener-to-shell welds	W	Shell Section
1	---	20t
2	Less than 20t	20t+W
2	20t or more	40t

where:
t=Shell thickness, inches;
W=Length of unwelded joint between parallel circumferential ring stiffener-to-shell welds.

(3) When used to meet the vacuum requirements of this section, ring stiffeners must be as prescribed in the ASME Code.

(4) If configuration of internal or external ring stiffener encloses an air space, this air space must be arranged for venting and be equipped with drainage facilities which must be kept operative at all times.

(5) Hat shaped or open channel ring stiffeners which prevent visual inspection of the tank shell are prohibited on cargo tank motor vehicles constructed of carbon steel.

§178.345-8 Accident damage protection.

(a) *General.* Each cargo tank motor vehicle must be designed and constructed in accordance with the requirements of this section and the applicable individual specification to minimize the potential for the loss of lading due to an accident.

(1) Any dome, sump, or washout cover plate projecting from the cargo tank wall that retains lading in any tank orientation, must be as strong and tough as the cargo tank wall and have a thickness at least equal to that specified by the appropriate cargo tank specification. Any such projection located in the lower 1/3 of the tank circumference (or cross section perimeter for non-circular tanks) that extends more than half its diameter at the point of attachment to the

tank or more than 4 inches from the cargo tank wall, or located in the upper 2/3 of the tank circumference (or cross section perimeter for non-circular tanks) that extends more than 1/4 its diameter or more than 2 inches from the point of attachment to the tank must have accident damage protection that are:

(i) As specified in this section;

(ii) 125 percent as strong as the otherwise required accident damage protection device; or

(iii) Attached to the cargo tank in accordance with the requirements of paragraph (a)(3) of this section.

(2) Outlets, valves, closures, piping, or any devices that if damaged in an accident could result in a loss of lading from the cargo tank must be protected by accident damage protection devices as specified in this section.

(3) Accident damage protection devices attached to the wall of a cargo tank must be able to withstand or deflect away from the cargo tank the loads specified in this section. They must be designed, constructed, and installed so as to maximize the distribution of loads to the tank wall and minimize the possibility of adversely affecting the lading retention integrity of the cargo tank. Accident induced stresses resulting from the appropriate accident damage protection device requirements in combination with the stresses from the tank operating at the MAWP may not result in a tank wall stress greater than the ultimate strength of the material of construction using a safety factor of 1.3. Deformation of the protection device is acceptable provided the devices being protected are not damaged when loads specified in this section are applied.

(4) Any piping that extends beyond an accident damage protection device must be equipped with a stop-valve and a sacrificial device such as a shear section. The sacrificial device must be located in the piping system outboard of the stop-valve and within the accident damage protection device to prevent any accidental loss of lading. The device must break at no more than 70 percent of the load that would be required to cause the failure of the protected lading retention device, part or tank wall. The failure of the sacrificial device must leave the protected lading retention device and its attachment to the tank wall intact and capable of retaining product.

(5) *Minimum road clearance.* The minimum allowable road clearance of any cargo tank motor vehicle component or protection device located between any two adjacent axles on a vehicle or vehicle combination must be at least one-half inch for each foot separating such axles, and in no case less than 12 inches.

(b) *Bottom damage protection.* Each outlet, projection or piping located in the lower 1/3 of the tank circumference (or cross section perimeter for

non-circular tanks) that could be damaged in an accident thereby resulting in the loss of lading must be protected by a bottom damage protection device, except as provided by paragraph (a)(1) of this section and §173.33(e) of this subchapter. Outlets, projections and piping may be grouped or clustered together and protected by a single protection device.

(1) Any bottom damage protection device must be able to withstand a force of 155,000 pounds (based on the ultimate strength of the material) from the front, side, or rear, uniformly distributed over each surface of the device, over an area not to exceed 6 square feet, and a width not to exceed 6 feet. Suspension components and structural mounting members may be used to provide all, or part, of the protection. The device must extend no less than 6 inches beyond any component that may contain lading in transit.

(2) A lading discharge opening equipped with an internal self-closing stop-valve need not conform to paragraph (b)(1) of this section provided it is protected so as to reasonably assure against the accidental loss of lading. This protection must be provided by a sacrificial device located outboard of each internal self-closing stop-valve and within 4 inches of the major radius of the tank shell or within 4 inches of a sump, but in no case more than 8 inches from the major radius of the tank shell. The device must break at no more than 70 percent of the load that would be required to cause the failure of the protected lading retention device, part, or tank wall. The failure of the sacrificial device must leave the protected lading retention device or part and its attachment to the tank wall intact and capable of retaining product.

(c) *Rollover Damage Protection.* Each closure for openings, including but not limited to manhole, filling or inspection openings, and each valve, fitting, pressure relief device, vapor recovery stop valve or other lading retaining fitting located in the upper 2/3 of a cargo tank circumference (or cross section perimeter for non-circular tanks) must be protected by being located within or between adjacent rollover damage protection devices, or by being 125 percent of the strength that would be provided by the otherwise required damage protection device.

(1) A rollover damage protection device on a cargo tank motor vehicle must be designed and installed to withstand loads equal to twice the weight of the loaded cargo tank motor vehicle applied as follows: normal to the tank shell (perpendicular to the tank surface) and tangential (perpendicular to the normal load) from any direction. The stresses shall not exceed the ultimate strength of the material of construction. These design loads may be considered to be uniformly distributed and independently applied. If more than one rollover

protection device is used, each device must be capable of carrying its proportionate share of the required loads and in each case at least one-fourth the total tangential load. The design must be proven capable of carrying the required loads by calculations, tests, or a combination of tests and calculations.

(2) A rollover damage protection device that would otherwise allow the accumulation of liquid on the top of the tank, must be provided with a drain that directs the liquid to a safe point of discharge away from any structural component of the cargo tank motor vehicle.

(d) *Rear-end protection.* Each cargo tank motor vehicle must be provided with a rear-end protection device to protect the tank and piping in the event of a rear-end collision and reduce the likelihood of damage which could result in the loss of lading. The rear-end tank protection device must conform to the following requirements. (Nothing in this paragraph shall be construed to relieve a manufacturer of responsibility for complying with the requirements of §393.86 of this title):

(1) The rear-end tank protection device must be designed so that it can deflect at least 6 inches horizontally forward with no contact between any part of the cargo tank motor vehicle which contains lading during transit and with any part of the rear-end protection device, or with a vertical plane passing through the outboard surface of the protection device.

(2) The dimensions of the rear-end tank protection device shall conform to the following:

(i) The bottom surface of the rear-end protection device must be at least 4 inches below the lower surface of any part at the rear of the cargo tank motor vehicle which contains lading during transit and not more than 60 inches from the ground when the vehicle is empty.

(ii) The maximum width of a notch, indentation, or separation between sections of a rear-end tank protection device may not exceed 24 inches. A notched, indented, or separated rear-end protection device may be used only when the piping at the rear of the tank is equipped with a sacrificial device outboard of a shut-off valve.

(iii) The widest part of the motor vehicle at the rear may not extend more than 18 inches beyond the outermost ends of the device or (if separated) devices on either side of the vehicle.

(3) The structure of the rear-end protection device and its attachment to the vehicle must be designed to satisfy the conditions specified in paragraph (d)(1) of this section when subjected to an impact of the cargo tank motor vehicle at rated payload, at a deceleration of 2 "g". Such impact must be

considered as being uniformly applied in the horizontal plane at an angle of 10 degrees or less to the longitudinal axis of the vehicle.

(e) *Longitudinal deceleration protection.* In order to account for stresses due to longitudinal impact in an accident, the tank shell and heads must be able to withstand the load resulting from the design pressure in combination with the dynamic pressure resulting from a longitudinal deceleration of 2 "g". For the loading condition, the allowable stress value used may not exceed the ultimate strength of the material of construction using a safety factor of 1.3. Performance testing, analytical methods, or a combination thereof, may be used to prove this capability provided the methods are accurate and verifiable. For cargo tanks with internal baffles, the decelerative force may be reduced by 0.25 "g" for each baffle assembly, but in no case may the total reduction in decelerative force exceed 1.0 "g".

§178.346 Specification DOT 406; cargo tank motor vehicle.

§178.346-1 General requirements.

(a) Each Specification DOT 406 cargo tank motor vehicle must meet the general design and construction requirements in §178.345, in addition to the specific requirements contained in this section.

(b) *Maximum Allowable Working Pressure:* The MAWP of each cargo tank must be no lower than 2.65 psig and no higher than 4 psig.

(c) Vacuum loaded cargo tanks must not be constructed to this specification.

(d) Each cargo tank must be "constructed in accordance with the ASME Code" except as modified herein:

(1) The record-keeping requirements contained in the ASME Code Section VIII, Division I do not apply. Parts UG 90 thru 94 of Section VIII, Division I do not apply. Inspection and certifi-cation must be made by an inspector registered in accordance with subpart F of part 107.

(2) Loadings must be as prescribed in §178.346-3.

(3) The knuckle radius of flanged heads must be at least three times the material thickness, and in no case less than 0.5 inch. Stuffed (inserted) heads may be attached to the shell by a fillet weld. The knuckle radius and dish radius versus diameter limitations of UG-32 do not apply. Shell sections of cargo tanks designed with a non-circular cross section need not be given a preliminary curvature, as prescribed in UG-79(b).

(4) Marking, certification, data reports, and nameplates must be prescribed in §§178.345-14, 178.346-14, 178.345-15, and 178.346-15.

(5) Manhole closure assemblies must conform to §§178.345-5 and 178.346-5.

(6) Pressure relief devices must be as prescribed in §§178.345-10 and 178.346-10.

(7) The hydrostatic or pneumatic test must be as prescribed in §§178.345-13 and 178-346-13.

(8) The following paragraphs in parts UG and UW of the ASME Code, Section VIII, Division I do not apply: UG-11, UG-12, UG-22(g), UG-32(e), UG-34, UG-35, UG-44, UG-76, UG-77, UG-80, UG-81, UG-96, UG-97, UW-13(b)(2), UW-13.1(f) and the dimensional requirements found in Figure UW-13.1.

(9) Single full fillet lap joints without plug welds may be used for arc

or gas welded longitudinal seams without radiographic examination under the following conditions:

(i) For a truck-mounted cargo tank, no more than two such joints may be used on the top half of the tank and no more than two joints may be used on the bottom half. They may not be located farther from the top and bottom centerline than 16 percent of the shell's circumference.

(ii) For self-supporting cargo tank, no more than two such joints may be used on the top of the tank. They may not be located farther from the top centerline than 12.5 percent of the shell's circumference.

(iii) Compliance test. Two test specimens of the material to be used in the manufacture of a cargo tank must be tested to failure in tension. The test specimens must be of the same thicknesses and joint configuration as the cargo tank, and joined by the same welding procedures. The test specimen may represent all the tanks that are made of the same materials and welding procedures, have the same joint configuration, and are made in the same facility within 6 months after the tests are completed. Before welding, the fit-up of the joints must represent production conditions the would result in the least joint strength. Evidence of joint fit-up and test results must be retained at the manufacturers' facility.

(iv) Weld joint efficiency. The lower value of stress at failure attained in the two tensile test specimens shall be used to compute the efficiency of the joint. Determine the failure ratio by dividing the stress at failure by the mechanical properties of the adjacent metal; this value, when multiplied by 0.75, is the design weld joint efficiency.

(10) The requirements of paragraph UW-9(d), of Section VIII, Division 1, ASME Code do not apply.

§178.346-2 Material and thickness of material.

The type and thickness of material for DOT 406 cargo tank motor vehicles must conform to §178.345-2 of this part, but may in no case be less than that indicated in Tables I and II below.

Table I. Minimum Thickness of Heads (or Bulkheads and Baffles When Used as Tank Reinforcement) Using Mild Steel (MS), High Strength Low Alloy Steel (HSLA), Austenitic Stainless Steel (SS) or Aluminum (AL)--Expressed in Decimals of an Inch After Forming.

Material	Volume capacity in gallons per inch of length								
	14 or less			Over 14 to 23			Over 23		
	MS	HSLA SS	AL	MS	HSLA SS	AL	MS	HSLA SS	AL
Thickness	.10	.100	.16	.115	.115	.173	.129	.129	.187

Table II. Minimum Thickness of Shell Using Mild Steel (MS), High Strength Low Alloy Steel (HSLA), Austenitic Stainless Steel (SS) or Aluminum (AL)--Expressed in Decimals of an Inch After Forming[1]

Cargo tank motor vehicle rated capacity (gallons)	MS	SS/HSLA	AL
More than 0 to at least 4,500	0.100	0.100	0.151
More than 4,500 to at least 8,000	0.115	0.100	0.160
More than 8,000 to at least 14,000	0.129	0.129	0.173
More than 14,000	0.143	0.143	0.187

[1]Maximum distance between bulkheads, baffles, or ring stiffeners shall not exceed 60 inches.

§178.346-3 Structural Integrity.

The structural integrity of each cargo tank motor vehicle must conform to §178.345-3.

§178.346-4 Joints.

All joints in the fabrication of each cargo tank must conform to §178.345-4.

§178.346-5 Manhole assemblies.

Each manhole assembly must conform to §178.345-5.

§178.346-6 Supports and anchoring.

Supports and anchoring on each cargo tank motor vehicle must conform to §178.345-6.

§178.346-7 Circumferential reinforcement.

The circumferential reinforcement on each cargo tank must conform to §178.345-7.

§178.346-8 Accident damage protection.

Each cargo tank motor vehicle must be protected from accident damage in accordance with §178.345-8.

§178.347 Specification DOT 407; cargo tank motor vehicle.

§178.347-1 General requirements.

(a) Each specification DOT 407 cargo tank motor vehicle must conform to the general design and construction requirements in §178.345 in addition to the specific requirements contained in this section.

(b) Each tank must be of a circular cross-section and have an MAWP of at least 25 psig.

(c) Any cargo tank built to this specification with a MAWP greater than 35 psig and each tank designed to be loaded by vacuum must be "constructed and certified in accordance with the ASME Code". The external design pressure for a cargo tank loaded by vacuum must be at least 15 psi.

(d) Each cargo tank built to this specification with MAWP of 35 psig or less must be "constructed in accordance with the ASME Code" except as modified herein:

(1) The record-keeping requirements contained in the ASME Code, Section VIII, Division I, do not apply. The inspection requirements of parts UG-90 thru 94 do not apply. Inspection and certification must be made by an inspector registered in accordance with subpart F of part 107.

(2) Loadings must be as prescribed in §178.345-3.

(3) The knuckle radius of flanged heads must be at least three times the material thickness, and in no case less than 0.5 inch. Stuffed (inserted) heads may be attached to the shell by a fillet weld. The knuckle radius and dish radius versus diameter limitations of U-32 do not apply for cargo tank motor vehicles with a MAWP of 35 psig or less.

(4) Marking, certification, data reports and nameplates must be as prescribed in §§178.345-14, 178.347-14, 178.345-15, and 178.347-15.

(5) Manhole closure assemblies must conform to §§178.345-5 and 178.347-5.

(6) Pressure relief devices must be as prescribed in §§178.345-10 and 178.347-10.

(7) The hydrostatic or pneumatic test must be as prescribed in §§178.345-13 and 178.347-13.

(8) The following paragraphs in parts UG and UW of the ASME Code, Section VIII, Division I do not apply: UG-11, UG-12, UG-22(g), UG-32(e), UG-34, UG-35, UG-44, UG-76, UG-77, UG-80, UG-81, UG-96, UG-97, UW-13(b)(2), UW-13.1(f), and the dimensional requirements found in Figure UW-

13.1.

§178.347-2 Material and thickness of material.

(a) The type and thickness of material for DOT 407 specification cargo tanks must conform to §178.345-2 and this section. In no case may the thickness be less than that indicated in Tables I and II below.

Table I. Minimum Thickness of Heads (or Bulkheads and Baffles When Used as Tank Reinforcement) Using Mild Steel (MS), High Strength Low Alloy Steel (HSLA), Austenitic Stainless Steel (SS) or Aluminum (AL)--Expressed in decimals of an Inch After Forming

Volume capacity in gallons per inch.	10 or Less	Over 10 to 14	Over 14 to 18	Over 18 to 22	Over 22 to 26	Over 26 to 30	Over 30
Thickness (MS)	0.100	0.100	0.115	0.129	0.129	0.143	0.156
Thickness (HSLA)	0.100	0.100	0.115	0.129	0.129	0.143	0.156
Thickness (SS)	0.100	0.100	0.115	0.129	0.129	0.143	0.156
Thickness (AL)	0.160	0.160	0.173	0.187	0.194	0.216	0.237

Table II. Minimum Thickness of Shell Using Mild Steel (MS), High Strength Low Alloy Steel (HSLA), Austenitic Stainless Steel (SS) or Aluminum (AL)--Expressed in Decimals of an Inch After Forming

Volume capacity in gallons per inch.	10 or Less	Over 10 to 14	Over 14 to 18	Over 18 to 22	Over 22 to 26	Over 26 to 30	Over 30
Thickness (MS)	0.100	0.100	0.115	0.129	0.129	0.143	0.156
Thickness (HSLA)	0.100	0.100	0.115	0.129	0.129	0.143	0.156
Thickness (SS)	0.100	0.100	0.115	0.129	0.129	0.143	0.156
Thickness (AL)	0.151	0.151	0.160	0.173	0.194	0.216	0.237

§178.347-3 Structural integrity.

The structural integrity of each cargo tank motor vehicle must conform to

§178.345-3.

§178.347-4 Joints.

All joints in the fabrication of each cargo tank must conform to §178.345-4.

§178.347-5 Manhole assemblies.

Each manhole assembly must conform to §178.345-5, except that each manhole assembly must be capable of withstanding internal fluid pressures of 40 psig or test pressure of the tank, whichever is greater.

§178.347-6 Supports and anchoring.

Supports and anchoring on each cargo tank motor vehicle must be in conformance with §178.345-6.

§178.347-7 Circumferential reinforcement.

The circumferential reinforcement on each cargo tank must conform to §178.345-7.

§178.347-8 Accident damage protection.

Each cargo tank motor vehicle must be protected from accident damage in accordance with §178.345-8.

178.348 Specification DOT 412; cargo tank motor vehicle.

§178.348-1 General requirements.

(a) Each specification DOT 412 cargo tank motor vehicle must conform to the general design and construction requirements in §178.345 in addition to the specific requirements of this section.

(b) The MAWP of each cargo tank must be at least 5 psig.

(c) The MAWP for each cargo tank designed to be loaded by vacuum must be at least 25 psig internal and 15 psig external.

(d) Each cargo tank having a MAWP greater than 15 psig must be of circular cross-section.

(e) Each cargo tank having a--

(1) MAWP greater than 15 psig must be "constructed and certified in conformance with the ASME Code"; or

(2) MAWP of 15 psig or less must be "constructed in accordance with the ASME Code", except as modified herein:

(i) The recordkeeping requirements contained in the ASME Code, Section VIII, Division I, do not apply. Parts UG-90 thru 94 of Section VIII, Division I do not apply. Inspection and certification must be made by an inspector registered in accordance with subpart F of part 107.

(ii) Loadings must be as prescribed in §178.348-3.

(iii) The knuckle radius of flanged heads must be at least three times the material thickness, and in no case less than 0.5 inch. Stuffed (inserted) heads may be attached to the shell by a fillet weld. The knuckle radius and dish radius versus diameter limitations of UG-32 do not apply for cargo tank motor vehicles with a MAWP of 15 psig or less. Shell sections of cargo tanks designed with a non-circular cross section need not be given a preliminary curvature, as prescribed in UG-79(b).

(iv) Marking, certification, data reports, and nameplates must be as prescribed in §§178.345-14, 178.348-14, 178.345-15, and 178.348-15.

(v) Manhole closure assemblies must conform to §§178.345-5 and 178.348-5.

(vi) Pressure relief devices must be as prescribed in §§178.345-10 and 178.348-10.

(vii) The hydrostatic or pneumatic test must be as prescribed in §§178.345-13.

(viii) The following paragraphs in parts UG and UW of the ASME Code,

Section VIII, Division I do not apply: UG-11, UG-12, UG-22(g), UG-32(e), UG-34, UG-35, UG-44, UG-76, UG-77, UG-80, UG-81, UG-96, UG-97, UW-13(b)(2), UW-13.1(f), and the dimensional requirements found in Figure UW-13.1.

§178.348-2 Material and thickness of material.

(a) The type and thickness of material for DOT 412 cargo tanks must conform to §178.345-2 of this part, but in no case may the thickness be less than that indicated in Tables I and II.

Table I.--Minimum Thickness of Heads (or Bulkheads and Baffles When Used as Tank Reinforcement) Using Mild Steel (MS), High Strength Low Alloy Steel (HSLA), Austenitic Stainless Steel (SS) or Aluminum (AL)--Expressed in Decimals of an Inch After Forming.

Volume capacity (gallons per inch)	10 or Less				Over 10 to 14				Over 14 to 18			18 and over		
Lading density at 60°F in pounds per gallon	10 lbs and less	Over 10 to 13 lbs	Over 13 to 16 lbs	Over 16 lbs	10 lbs and less	Over 10 to 13 lbs	Over 13 to 16 lbs	Over 16 lbs	10 lbs and less	Over 10 to 13 lbs	Over 13 to 16 lbs	10 lbs and less	Over 10 to 13 lbs	Over 13 to 16 lbs
Thickness (inch), steel	.100	.129	.157	.187	.129	.157	.187	.250	.157	.250	.250	.157	.250	.312
Thickness (inch), aluminum	.144	.187	.227	.270	.187	.227	.270	.360	.227	.360	.360	.227	.360	.450

Table II.--Minimum Thickness of Shell Using Mild Steel (MS), High Strength Low Alloy Steel (HSLA), Austenitic Stainless Steel (SS) or Aluminum (AL)--Expressed in Decimals of an Inch After Forming.

Volume capacity (gallons per inch)	10 or Less				Over 10 to 14				Over 14 to 18			18 and over		
Lading density at 60°F in pounds per gallon	10 lbs and less	Over 10 to 13 lbs	Over 13 to 16 lbs	Over 16 lbs	10 lbs and less	Over 10 to 13 lbs	Over 13 to 16 lbs	Over 16 lbs	10 lbs and less	Over 10 to 13 lbs	Over 13 to 16 lbs	10 lbs and less	Over 10 to 13 lbs	Over 13 to 16 lbs
Thickness (steel) Distances between heads(and bulkheads baffles and ring stiffeners when used as tank reinforcement):														
36 in. or less----------	.100	.129	.157	.187	.100	.129	.157	.187	.100	.129	.157	.129	.157	.187
Over 36 in. to 54 inches--	.100	.129	.157	.187	.100	.129	.157	.187	.129	.157	.187	.157	.250	.250
Over 54 in. to 60 inches--	.100	.129	.157	.187	.129	.157	.187	.250	.157	.250	.250	.187	.250	.312
Thickness (aluminum) Distances between heads (and bulkheads baffles and ring stiffeners when used as tank reinforcement):														
36 in. or less----------	.144	.187	.227	.270	.144	.187	.227	.270	.144	.187	.227	.187	.227	.270
Over 36 in. to 54 inches-	.144	.187	.227	.270	.144	.187	.227	.270	.187	.227	.270	.157	.360	.360
Over 54 in. to 60 inches-	.144	.187	.227	.270	.187	.227	.270	.360	.227	.360	.360	.270	.360	.450

§178.348-3 Structural Integrity.

The structural integrity of each cargo tank motor vehicle must conform to §178.345-3.

§178.348-4 Joints.

All joints in the fabrication of each cargo tank must conform to §178.345-4.

§178.348-5 Manhole assemblies.

Each manhole assembly must conform to §178.345-5.

§178.348-6 Supports and anchoring.

Supports and anchoring on each cargo tank motor vehicle must be in conformance with §178.345-6.

§178.348-7 Circumferential reinforcement.

The circumferential reinforcement on each cargo tank must conform to §178.345-7.

§178.348-8 Accident Damage Protection.

Each cargo tank motor vehicle must be protected from accident damage in accordance with §178.345-8.

§393.86 Rear end protection.

Every motor vehicle, except truck tractor, pole trailers, and vehicles engaged in driveaway-towaway operations, the date of manufacture of which is subsequent to December 31, 1952, which is so constructed that the body or the chassis assembly if without a body has a clearance at the rear end of more than 30 inches from the ground when empty, shall be provided with bumpers or devices serving similar purposes which shall be so constructed and located that:

(a) The clearance between the effective bottom of the bumpers or devices and the ground shall not exceed 30 inches with the vehicle empty;

(b) the maximum distance between the closest points between bumpers, or devices, if more than one is used, shall not exceed 24 inches;

(c) the maximum transverse distance from the widest part of the motor vehicle at the rear to the bumper or device shall not exceed 18 inches;

(d) the bumpers or devices shall be located not more than 24 inches forward of the extreme rear of the vehicle; and

(e) the bumpers or devices shall be substantially constructed and firmly attached.

Motor vehicles constructed and maintained so that the body, chassis, or other parts of the vehicle afford the rear end protection contemplated shall be deemed to be in compliance with this section.

CHAPTER 3. INFORMATION COLLECTION

Information to be requested from a manufacturer should include the following:

1. Production drawings of the tank including all relevant dimensions, date of manufacture and regulation(s) to which tank is designed.
2. Material specifications for the tank material.
3. Design calculations to verify that the tank design meets applicable requirements.
4. Tank capacity in gallons.
5. Maximum product density.
6. Maximum design weight of lading.
7. Gross vehicle weight rating (GVWR).
8. Weight of undercarriage for tank trailer.
9. Weight of tank and appurtenances.
10. Height from ground to center of tank.
11. Production drawings of overturn protection devices, including all relevant dimensions and methods of attachment to the tank.
12. Material specifications for all materials used to manufacture overturn protection devices and attach them to the tank.
13. Design calculations or test results to verify that the overturn protection devices satisfy the criteria quoted above, if they are available. Such documentation is required for Series 400 tanks but is optional for Series 300 tanks.
14. Production drawings of the rear-end protection device, including all relevant dimensions and methods of attachment to the cargo tank motor vehicle.
15. Material specifications for all materials used to manufacture the rear-end protection device and attach it to the vehicle.
16. Design calculations or test results to verify that the rear-end protection device satisfies the requirements if they are available. Documentation is not required for rear-end protection devices.
17. Specifications for and size of bolts connecting rear-end protection structure to trailer.
18. Production drawings of bottom damage protection devices, including all relevant dimensions and methods of attachment to the tank.
19. Material specifications for all materials used to manufacture bottom damage protection devices and attach them to the tank.

20. Design calculations or test results to verify that the bottom damage protection devices satisfy the criteria quoted above, if they are available. Such documentation is required for Series 400 tanks but is optional for Series 300 tanks.
21. Information from name plate.

This information should be examined carefully in the presence of the manufacturer's Design Certifying Engineer, so that initial questions and clarifications can be resolved immediately.

CHAPTER 4. METHODS OF ANALYSIS

Methods of analysis for computation of stresses in or allowable loads for cargo tanks are presented in this chapter. Many types of loads are imposed on cargo tanks. Some loads are static while others are dynamic and quite complex. Loadings described in the DOT regulations are intended to be used in static analysis procedures. Methods of analysis for the following types of loads are presented:

- Internal/external pressure
- Gravity of tank, appurtenances and lading
- Vertical acceleration
- Longitudinal acceleration
- Longitudinal deceleration
- Lateral acceleration
- Temperature gradients

Allowable stresses for materials commonly used in cargo tanks, including compressive and shear critical buckling stresses, are also addressed in this chapter.

DOT regulations require that static design of all DOT 406/407/412 cargo tanks be in accordance with the ASME Code. Static design involves all loads imposed on the cargo tank while it is at rest but does not include dynamic road loads. Any DOT 407 tank with a Maximum Allowable Working Pressure (MAWP) greater than 35 psig or designed to be loaded by vacuum must be constructed and certified in accordance with the ASME Code. Any DOT 412 tank with a MAWP greater than 15 psig must be constructed and certified in conformance with ASME Code.

Both ASME and non-ASME analysis/design methods are addressed in this chapter.

Stresses due to internal/external pressure:

Circular cross sections:

For circumferential stress in cylindrical vessels (vessels having circular cross sections), when the thickness does not exceed one-half of the inside radius,

or P does not exceed 0.385Se, the following formula from ASME Code part UG-27 may be used to compute the required wall thickness:

$$t = PR/(Se-0.6P)$$

where:

- t = required thickness of wall of vessel, in.
- P = internal pressure in vessel, psi
- R = inside radius of vessel, in.
- S = maximum allowable tensile stress in wall of vessel, psi
- e = joint efficiency of welded longitudinal joint if one is present. It is the ratio of the tensile strength of a joint to the tensile strength of the adjacent vessel wall.

This formula can be arranged to compute the allowable internal pressure based on circumferential stress as follows:

$$P = Set/(R+0.6t)$$

where:

- P = allowable internal pressure in vessel, psi
- S = maximum allowable tensile stress in wall of vessel, psi
- e = joint efficiency of welded longitudinal joint
- R = inside radius of vessel, in.
- t = actual thickness of wall of vessel, in.

The formula can be arranged to solve for the actual circumferential tensile stress in the wall of the vessel as follows:

$$S = (PR/t) + 0.6P$$

where:

- S = actual tensile stress in wall of vessel, psi
- P = internal pressure in vessel, psi
- R = inside radius of vessel, in.
- t = actual thickness of wall of vessel, in.

The joint efficiency, e, is omitted from the formula above because it should be associated with strength rather than with computed stress. The value of stress computed from the above equation can be combined with stresses computed for other loads to compute the principal tensile stress in a vessel wall.

For longitudinal stress in cylindrical vessels when the thickness does not exceed one-half of the inside radius, or P does not exceed 1.25Se the following formulas may be used:

The required thickness of wall based on longitudinal stress can be computed using the following; however, thickness based on internal pressure would be controlled by the circumferential stress:

$$t = PR/(2Se+0.4P)$$

where:

- t = required thickness of wall of vessel
- P = internal pressure in vessel, psi
- R = inside radius of vessel, in.
- S = maximum allowable tensile stress in wall of vessel, psi
- e = joint efficiency of welded circumferential joint if one is present. It is the ratio of the tensile strength of a joint to the tensile strength of the adjacent vessel wall.

This formula can be rearranged to compute the allowable internal pressure based on longitudinal stress as follows; however, allowable pressure would be controlled by the circumferential stress:

$$P = 2Set/(R-0.4t)$$

where:

- P = allowable internal pressure in vessel, psi
- S = maximum allowable tensile stress in wall of vessel, psi
- e = joint efficiency of welded longitudinal joint
- R = inside radius of vessel, in.
- t = actual thickness of wall of vessel, in.

This formula can be arranged to compute the actual longitudinal tensile stress in the wall of the vessel as follows:

$$S = (PR/2t) - 0.2P$$

where:

- t = thickness of wall of vessel, in.
- P = internal pressure in vessel, psi
- R = inside radius of vessel, in.

S = computed circumferential tensile stress in wall of vessel, psi.

Again, the joint efficiency, e, is omitted because it should be associated with strength rather than computed stress.

The formulas presented above are from the ASME Code but can be used for non-ASME designs. The engineer may also choose to use simplier formulas for thin wall pressure vessels for non-ASME designs.

For circumferential stress in a cylindrical vessel:

$$S = PR/t$$

where:

S = computed tensile stress in wall of vessel, psi
P = internal pressure in vessel, psi
R = inside radius of vessel, in.
t = thickness of wall of vessel, in.

For longitudinal stress in a cylindrical vessel:

$$S = PR/2t$$

where:

S = computed tensile stress in wall of vessel, psi
P = internal pressure in vessel, psi
R = inside radius of vessel, in.
t = thickness of wall of vessel, in.

Non-circular cross sections:

The formulas presented above for cylindrical vessels under internal pressure are not appropriate for vessels having non-circular cross sections. Bending stresses are not induced in the walls of cylindrical vessels, but are induced in vessels of non-circular cross section. Under internal pressure, non-circular cross sections tend to deform into circular cross sections and thereby induce bending stresses in the walls.

DOT Specification 178.346-1 (406 tanks) requires a MAWP of no lower than 2.65 psig and no higher than 4 psig. Many DOT 406 tanks have elliptical or approximately elliptical cross sections. Elliptical sections are frequently approximated with circular arcs having two or more different radii as shown in figure 7.

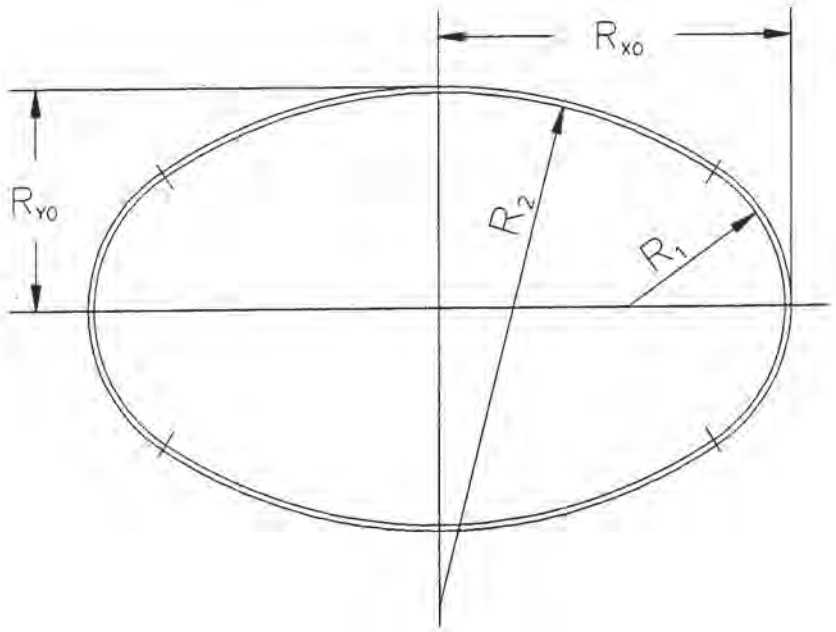

Figure 7. Approximately elliptical cross-section constructed of circular arcs.

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Heads: (pressure on concave side)

For ellipsoidal heads on circular tanks where the ratio of major to minor axis is 2:1, the following formulas may be used:

$$t = PD/(2Se-0.2P)$$

or $P = 2Set/(D+0.2t)$

or $S = (PD/2t) + 0.1P$

General formulas for other ellipsoidal heads on circular tanks are:

$$t = PDK/(2Se-0.2P)$$

or $P = 2Set/(KD+0.2t)$

or $S = (KPD/2t) + 0.1P$

where:

$K = (1/6)[2+(D/2h)^2]$

D = Inside diameter of head at its juncture with shell, inches.

h = inside depth of ellipsoidal head (from point of tangency of flange to inside surface at center), inches.

Example 3. Internal pressure - Ellipsoidal head - Pressure on concave side.

An ellipsoidal head with an inside diameter, D, of 60 inches and a thickness, t, of 0.200 inches is made of SA36 steel. The head is subjected to an internal pressure on its concave side of 25 psi. Magnitude of tensile stress in the head is to be computed.

The tensile stress in the head is:

$S = (PD/2t) + 0.1P$
$S = [(25)(60)/2(.200)] + 0.1(25)$
$S = 3{,}753$ psi

For ASME torispherical heads in which the knuckle radius is 6% of the inside crown radius (i.e. L/r=16.67) and the inside crown radius equals the inside diameter of the skirt the following formulas may be used:

$$t = 0.885PL/(Se-0.1P)$$

or $P = Set/(0.885L+0.1t)$

or $S = (.885PL/t) + 0.1P$

General formulas for other torispherical heads are:

$$t = PLM/(2Se-0.2P)$$

or $P = 2Set/(LM+0.2t)$

or $S = (PLM/2t) + 0.1P$

where:

$M = (1/4)[3+(L/r)^{1/2}]$

L = Inside radius of spherical portion of torispherical head (inside crown radius), inches.

r = Knuckle inside radius, inches.

Example 4. Internal pressure - Torispherical head - Pressure on concave side.

A torispherical head with an inside diameter, D, an inside crown radius, L, of 68 inches and a thickness, t, of 0.219 inches is made of SA36 steel. The head is subjected to an internal pressure of 45 psi on its concave side. (See figure 3, page 7.) Magnitude of tensile stress in the head is to be computed.

The tensile stress in the head is:

$S = (.885PL/t) + 0.1P$
$S = (0.885(45)(68)/.219) + 0.1(45)$
$S = 12{,}370$ psi

For hemispherical heads whose wall thickness does not exceed 0.356 R or P does not exceed 0.665Se, the following formulas may be used:

$$t = PR/(2Se-0.2P)$$

or $P = 2Set/(R+0.2t)$

or $S = (PR/2t) + 0.1P$

Example 5. Internal pressure - Hemispherical head - Pressure on concave side.

A hemispherical head has a radius, L, of 30 in. and a thickness, t, of 0.200 inches is made of SA36 steel. The head is subjected to an internal pressure, P, of 45 psi. (See figure 2, page 6.) The magnitude of the tensile stress is to be computed.

The tensile stress in the head is:

$$S = PR/2t + 0.1P$$
$$S = 45(30)/2(.200) + 0.1(45)$$
$$S = 3{,}380 \text{ psi}$$

For ASME Code designs, procedures given in UG-28 of the Code, which make use of charts provided therein, may be used to determine the required wall thickness of a tank shell for a given external pressure or the allowable external pressure for a given wall thickness. Procedures presented in appendix L of the ASME Code show the computation of an allowable compressive buckling stress for evaluating stresses due to external pressure combined with other loads.

Example 6. External pressure on shell (ASME design).

A DOT 407 tank is made of SA240/316L stainless steel. The outside radius of the tank, R_o, is 28.625 inches. The top portion of the shell, which is subjected to an axial compressive stress, is 0.165 inches thick and the tank is 500 inches long with stiffeners spaced at 50 inches. The tank operates at a temperature range of zero to 100°F. The critical compressive buckling strength in the top portion of the shell in the longitudinal direction is to be computed using the ASME Code.

Begin by checking to determine if the thickness satisfies the requirements in UG-28(c)(1) which is for cylinders with $D_o/t \geq 10$. Note that this procedure addresses stresses from only external pressure and does not include stresses from other structural loadings. This procedure also assumes that adequate stiffener rings are provided. Adequacy of stiffener rings is addressed later in this chapter.

Step 1 - $L/D_o = 50/57.25 = 0.873$
$D_o/t = 57.25/.165 = 347.0$

Note: L represents the length between circumferential reinforcing devices (stiffeners).

Step 2 - Go to figure G in subpart 3 of Section II, Part D, pages 674 and 675 of the 1992 Code.

Step 3 - Using the values of L/D_o or D_o/t from Step 1, the chart gives a value for Factor A of about 2.5×10^{-4}.

Step 4 - Find material chart in subpart 3 of Section II, Part D. The proper chart can be found in the "External Pressure Chart No." column of the material specification.
For SA240/316L the material specification is on pages 66 and 67 of Table 1A in Section II, Part D, and the material chart for this material, HA-4, can be found on page 681 of subpart 3.

Step 5 - Using Factor A of 2.5×10^{-4} and a design temperature of "up to 100°F" in Chart HA-4, Factor B can be determined to be about 3,500.

Step 6 - The maximum allowable external working pressure is determined from the formula in UG-28 to be:
$P_a = 4B/[3(D_o/t)] = 4(3,500)/[3(347)] = 13.4$ psi

Step 7 - Since Factor B was obtainable in Step 5 from the material chart, Step 7 is not applicable.

Step 8 - If P_a is greater than or equal to the external pressure on the tank the design is adequate.

Once the thickness of the tank is determined to be adequate using UG-28, UG-23(b) should be used to determine the maximum allowable compressive stress.

Step 1 - Calculate Factor A from the formula:
$A = 0.125/(R_o/t)$
For this example:
$A = 0.125/(28.625/.165)$
$A = 7.21 \times 10^{-4}$

Step 2 - Go to material chart in subpart 3 of Section II, Part D. For SA240/316L the material chart is HA-4 on page 681 of Section II, Part D.

Step 3 - Using Factor A as 7.2 X 10^{-4} and a design temperature of "up to 100°F", Factor B, which is the allowable compressive stress can be determined to be 8,800 psi.

Step 4 - Not necessary since Factor B was determined in Step 3.

Step 5 - Since the allowable compressive stress found from Factor B (8,800 psi) is less than the allowable tensile stress, (17,500 psi from Table 1A of Section II, Part D) the allowable longitudinal compressive stress for this tank shell is 8,800 psi.

Example 7. External pressure on heads (convex side) (ASME design). See UG-33 of the ASME Code, Section VIII, Division 1.

Given: DOT 407 tank, D_o=60", t=0.165", MAWP=35 psi. Material is SA240/316L SS. Tank is vacuum loaded and must withstand external pressure of one atmosphere (14.7 psi). Example analyses for various types of heads are illustrated below.

Hemispherical heads:

Step 1 - UG-33(c) refers the designer to UG-28(d)

Step 2 - Compute the Factor A

$A = 0.125/(R_o/t) = 0.125/(30/0.165) = 6.88 \times 10^{-4}$

Step 3 - Go to the material chart in subpart 3 of Section II, Part D. Determine the value of B.

Assuming the tank is designed to handle a product temperature of up to 300°F, Factor B would be approximately 6,600.

Step 4 - Calculate the maximum allowable external pressure:

$P_a = B/(R_o/t) = 6,600/(30/0.165) = 36.3$ psi

36.3 psi > 14.7 psi OK

Ellipsoidal heads:

$R_o=0.9D_o = 0.9(60) = 54"$

Step 1 - Compute the Factor A.

$A = 0.125/(R_o/t) = 0.125/(54/0.165) = 3.82 \times 10^{-4}$

Step 2 - Go to the material chart in subpart 3 of Section II, Part D. Determine the value of B.
Assuming the tank is designed to handle a product temperature of up to 300°F, Factor B would be approximately 4,800.

Step 3 - Calculate the maximum allowable external pressure:
$P_a = B/(R_o/t) = 4{,}800/(54/0.165) = 14.67$ psi
14.7 psi = atmospheric pressure (full vacuum). This head design is borderline.

Torispherical heads:

$R_o = 72''$

Step 1 - Compute the Factor A.
$A = 0.125/(R_o/t) = 0.125(72/0.165) = 2.86X10^{-4}$

Step 2 - Go to the material chart in subpart 3 of Section II, Part D. Determine the value of B.
Assuming the tank is designed to handle a product temperature of up to 300°F, Factor B would be approximately 3,800.

Step 3 - Calculate the maximum allowable external pressure:
$P_a = B/(R_o/t) = 3{,}800(72/0.165) = 8.71$ psi.

The maximum allowable pressure calculated, 8.71 psi, is less than design pressure (14.7 psi) so this design would be inadequate.

Pressure due to static head:

Consider a 1-ft. tall column of water acting on 1 square foot of surface.

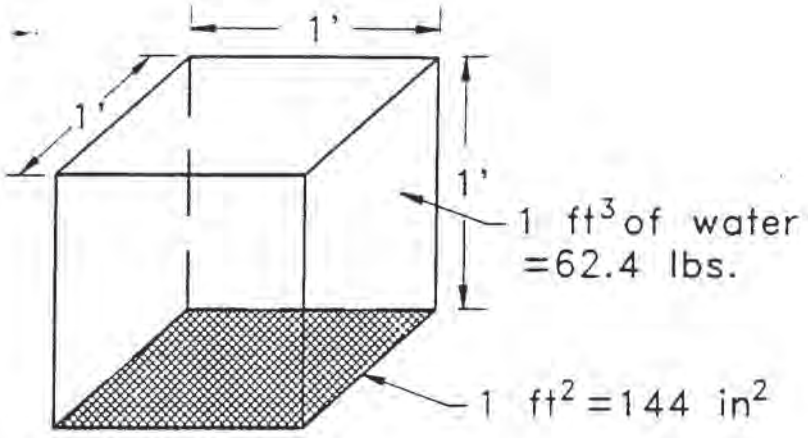


Figure 9. Illustration of parameters for static head.

The pressure on the bottom surface is:

62.4 lbs./144 in.^{2} = 0.433 psi

Water exerts 0.433 psi per foot of head or the inverse of 0.433 is 1/0.433 = 2.31. In other words, 2.31 feet of head of water is equivalent to 1 psi (2.31 ft/psi.). This is a hydrostatic pressure, i.e., it is the same value in all directions.

A similar factor for another liquid can be obtained by dividing 2.31 by the relative specific gravity of the other liquid. The relative specific gravity of water is 1.00. Relative specific gravity for another liquid can be obtained by dividing its density in lbs/gal. by 8.33. The density of water is 8.33 lbs/gal.

231 cu.in. = 1 gal
7.5 gal. = 1 cu. ft.

The steady-static pressure due to constant acceleration of a column of liquid (oriented in any direction) is equal to the static head pressure multiplied by the acceleration in g's.

Stresses due to static head pressure:

Stresses due to static head pressure can be computed in the same manner and with the same equation used for stresses from MAWP. Static head is usually known in units of inches or feet of height of the liquid. If the liquid is water with a relative specific gravity of 1.00 or 8.33 lbs/gal, the static head pressure can be computed by multiplying the feet of head by 0.433. The relative specific gravity of another liquid can be obtained by dividing the density in lbs/gal by 8.33. The static head pressure for that liquid can be obtained by multiplying the feet of head by 0.433 and by the relative specific gravity. During design and analysis, the specific gravity of the heaviest product (liquid) should be used.

Example 8. Computation of stress due to static head.

A cylindrical cargo tank with a vertical height, h, of 56.9 inches is used for transporting gasoline which has a specific gravity, γ, of 0.7. The tank has a thickness, t, of .165 inches. To determine the static head pressure at the bottom of the tank:

$$P = (h/12)(0.433)(\gamma)$$
$$P = (56.9/12)(0.433)(0.7) = 1.44 \text{ psi}$$

Circumferential stress due to this pressure can be computed by:

$$S_{y2} = (PR/t) + 0.6P$$
$$S_{y2} = 1.44(28.5)/.165 + 0.6(1.44)$$
$$S_{y2} = 250 \text{ psi at bottom of tank}$$

Stresses due to static head can also be accounted for by adding the static head pressure to the MAWP for calculations of stress (figure 9). Static head pressure is zero at the top of the tank during static and normal operating loading conditions. The following formulas can be used:

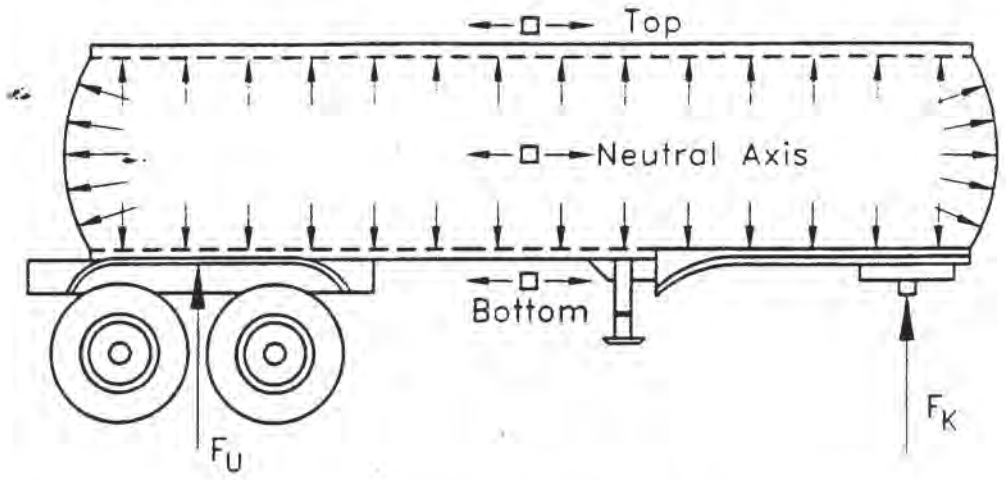


Figure 10. Illustration for computation of stresses due to combined internal pressure and static head.

At top of tank:

$$S_x = (P_m)R/2t$$
$$s_y = (P_m)R/t$$

At neutral axis (near midheight):

$$S_x = [P_m+P_h/2]R/2t$$
$$S_y = [P_m+P_h/2]R/t$$

At bottom of tank:

$$S_x = [P_m+P_h]R/2t$$
$$S_y = [P_m+P_h]R/t$$

where P_m = MAWP or zero or vacuum pressure, psi.

P_h = pressure due to static head of product, psi.

Flexural Shear in Thin-Walled Vessels:

A simplified formula for maximum flexural shear stress in a thin-wall flexural member of circular cross section can be derived from the flexural shear stress formula from basic strength of materials:

$$S_s = VA\bar{y}/Ib$$

For a solid semi-circle, the area is $\pi R^2/2$ and the centroid is located at $4R/3\pi$ from the flat side where R is the radius. Then $A\bar{y}$ is $2R^3/3$. Then $A\bar{y}$ for a thin-wall semi-circle would be $2(R_o^3-R_i^3)/3$. The moment of inertia, I, is $\pi(R_o^4-R_i^4)/4$. b in the equation for S_s is 2t which is $2(R_o-R_i)$. When these parameters are substituted into the equation for S_s, the result is:

$$S_s = [V(2)(R_o^3-R_i^3)/3] / [\pi(R_o^4-R_i^4)(2)(R_o-R_i)/4]$$

$$S_s = [V(R_o^3-R_i^3)] / [3\pi(R_o^2-R_i^2)(R_o^2+R_i^2)(R_o-R_i)/4]$$

$$S_s = [V(R_o^3-R_i^3)] / [3\pi(R_o^2-R_i^2)(R_o^3-R_iR_o^2+R_i^2R_o-R_i^3)/4]$$

$(R_o-R_i)^3$ → zero

and $S_s = V/0.5A$

where:

S_s = maximum shear stress in wall of tank, psi. This maximum occurs in the wall at the neutral axis of the cross section.
V = shear force on the cross section, lbs.
A = area of the cross sections, in^2.

If R_o/t is greater than 5, the error is less than 1%.

Stresses due to static gravity weight:

For structural analysis of a trailer type cargo tank, the tank can be idealized as a simply supported beam with overhangs on each end. On single or tandem axle trailers, the reaction on the rear undercarriage can be idealized as a concentrated force, especially for computation of maximum bending moment. Three concentrated forces or a distributed force could be used if the engineer chooses to do so. If the trailer has more than two axles, the reaction should be idealized in a manner consistent with the nature of the suspension system and subframe. The manner in which the reaction is idealized would influence the magnitude of shear force adjacent to the reaction. At the kingpin, idealization of the reaction as a concentrated force is appropriate. Idealization of a typical trailer cargo tank is shown in figure 11.

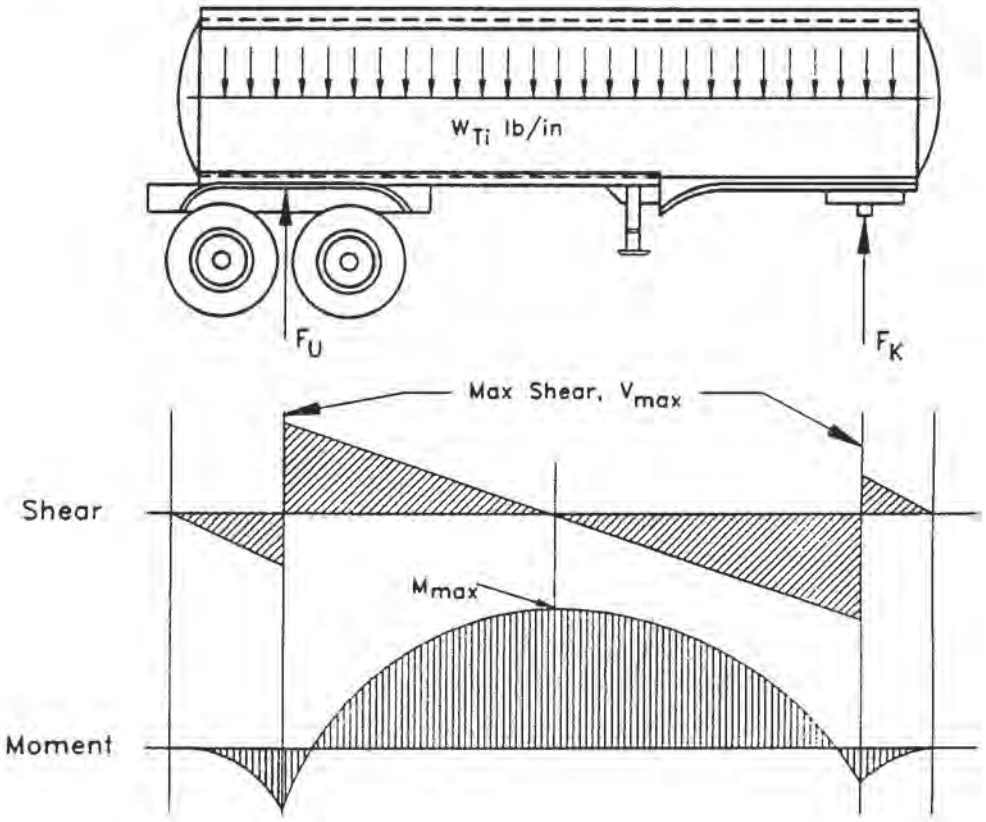


Figure 11. Diagrams for static weight of tank and lading.

Maximum shear stress, S_s, occurs in the side walls of the tank at the neutral axis at the cross section of maximum shear force and can be computed using the following equation:

$$S_{sf} = V_{max}/0.5A$$

where:

S_{sl} = maximum flexural shear stress, psi
V_{max} = maximum shear force, lbs.
A = cross sectional area of tank, in^2

Maximum longitudinal normal stress occurs at point of maximum moment and can be computed using the flexure formula:

$$S_{x3} = M_{max}/Z_e$$

where:

S_{x3} = maximum flexural stress, psi
M_{max} = maximum bending moment, in-lbs.
Z_e = elastic section modulus, in^3

The stresses computed above are due to static weight of the tank and lading. When a vehicle is in motion, it is subjected to dynamic loadings.

The loading diagram shown assumes a uniformly distributed load from the static weight of the tank and lading. Small (less than 1,000 lbs.) appurtenances, attachments and fittings on the tank can be included in the weight of the tank and assumed to be uniformly distributed. However, larger masses attached to the tank should be treated as concentrated loads and the appropriate shear and moment diagrams should be constructed.

Example 9. Computation of shear and bending stresses in elliptical tank.

The static gravity bending stresses in an DOT 406 tank trailer are to be computed. The tank has an elliptical cross section with continuous overturn rails along the top and continuous frame rails along the bottom. Details of the cross section are shown in figure 12.

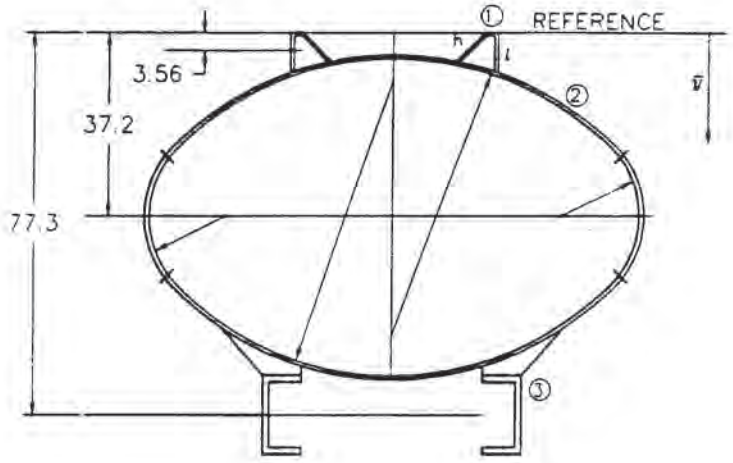


Figure 12. Cross section of elliptical DOT 406 tank.

Material = 5454 H32 (Aluminum)
S_u = 36,000 psi
S_a = .25(36,000) = 9,000 psi
Thickness = 0.173 inches
Capacity = 7,200 gallons
MAWP = 3 psi
W_s = 8,000 lbs. (shell)
W_u = 6,000 lbs. (undercarriage)
W_L = 46,000 lbs. (lading)
$W_T = W_L + W_s$ (filled tank)
W_T = 46,000 + 8,000
W_T = 54,000 lbs.
W_{Ti} = 54,000/500 = 108 lb/in.

Cross section properties of DOT 406 tank.

(1) Overturn Rail (See figure 45)
5454 H32
8"=h, 9.5"=ℓ
0.173"=t

(2) DOT 406 Elliptical Tank
5454 H32
92" X 64"
0.173"=t

(3) Frame Rails
12" by 2.96" by 7.41 lb/ft. American Standard Aluminum Channel

Areas of Segments (not including support attachments)

Overturn Rails
$A_1 = [(8+9.5)](0.173)$
$A_1 = 3.0$/rail
$A_1 = 6.0$ in^2 (for 2 rails)

Tank Shell
$A_2 = \pi(R_{yo}R_{xo}-R_{yi}R_{xi})$
$A_2 = \pi[(32)(46)-(31.827)(45.827)]$
$A_2 = 42.3$ in^2

Frame Rails
$A_3 = 6.30$/rail
$A_3 = 12.6$ in^2 (for 2 rails)

Centroid of Section

Segment	A_i	$\bar{y}_i$	$A_i\bar{y}_i$
Overturn Rails	6.0	3.56	21.4
Tank Shell	42.3	37.20	1,574
Frame Rails	12.6	77.63	978
	60.9		2,573

$\bar{x}$ = centerline of section (symmetrical)
$\bar{y} = \Sigma A_i \bar{y}_i / \Sigma A_i$ = 2,573/60.9 = 42.3 inches from reference axis

Moment of Inertia

$I_1 = bh^3/12$
$I_1 = (0.173)(8)^3/12+(0.173)(9.5)^3/12$
$I_1 = 19.7 \text{ in}^4$
$I_2 = \pi(R_{yo}^3 R_{xo} - R_{yi}^3 R_{xi})/4$
$I_2 = \pi[(32^3)(46)-(31.827^3)(45.827)]/4$
$I_2 = 23{,}477 \text{ in}^4$
$I_3 = 131.8 \text{ in}^4$ per rail
$I_3 = 263.6 \text{ in}^4$

$I_{TOT} = \Sigma I_o + \Sigma Ad^2$
$I_{TOT} = (I_1+Ad_1^2)+(I_2+Ad_2^2)+(I_3+Ad_3^2)$
$I_{TOT} = [(19.7)+(6.0)(42.3-3.56)^2]+[(23{,}477)+(42.3)(42.3-37.2)^2]$
$+[(263.6)+(12.6)(42.3-77.63)^2]$
$I_{TOT} = 9{,}024 + 24{,}577 + 15{,}991$
$I_{TOT} = 49{,}592 \text{ in}^4$

Section modulus at top surface of overturn rail:

$Z_e = 49{,}592/42.3$
$Z_e = 1{,}172 \text{ in}^3$

Section modulus at top surface of tank wall:

$Z_e = 49{,}592/(42.3-37.2+32)$
$Z_e = 49{,}592/37.1$
$Z_e = 1{,}337 \text{ in}^3$

Section modulus at bottom surface of bottom frame rails:

$Z_e = 49{,}592/(77.3+6-42.3)$
$Z_e = 49{,}592/41$
$Z_e = 1{,}210 \text{ in}^3$

Section modulus at bottom surface of tank wall:

$Z_e = 49{,}592/(37.2+32-42.3)$
$Z_e = 49{,}592/26.9$
$Z_e = 1{,}844 \text{ in}^3$

Weights, dimensions, reactions, shear diagram and bending moment diagram for the tank idealized as a simply supported beam are presented in figure 13.

The maximum bending moment occurs at 214 in. forward of the center of the rear suspension and is 2,361,000 in.-lbs. The highest longitudinal tensile stress in the tank wall occurs at the bottom surface of the tank wall and is:

$$S_{x3} = M_{max}/Z_e$$
$$S_{x3} = 2{,}361{,}000/1{,}800$$
$$S_{x3} = 1{,}312 \text{ psi (tension)}$$

The maximum compressive stress in the tank wall at the top surface is:

$$S_{x3} = M_{max}/Z_e$$
$$S_{x3} = 2{,}361{,}000/1{,}330$$
$$S_{x3} = -1{,}809 \text{ psi (compression)}$$

The maximum tensile stress at the bottom surface of the longitudinal frame rails is:

$$S_{x3} = M_{max}/Z_e$$
$$S_{x3} = 2{,}361{,}000/1{,}185$$
$$S_{x3} = 2{,}069 \text{ psi (tension)}$$

The maximum compressive stress at the top surface of the continuous overturn protection rails is:

$$S_{x3} = M_{max}/Z_e$$
$$S_{x3} = 2{,}361{,}000/1{,}166$$
$$S_{x3} = -2{,}025 \text{ psi (compression)}$$

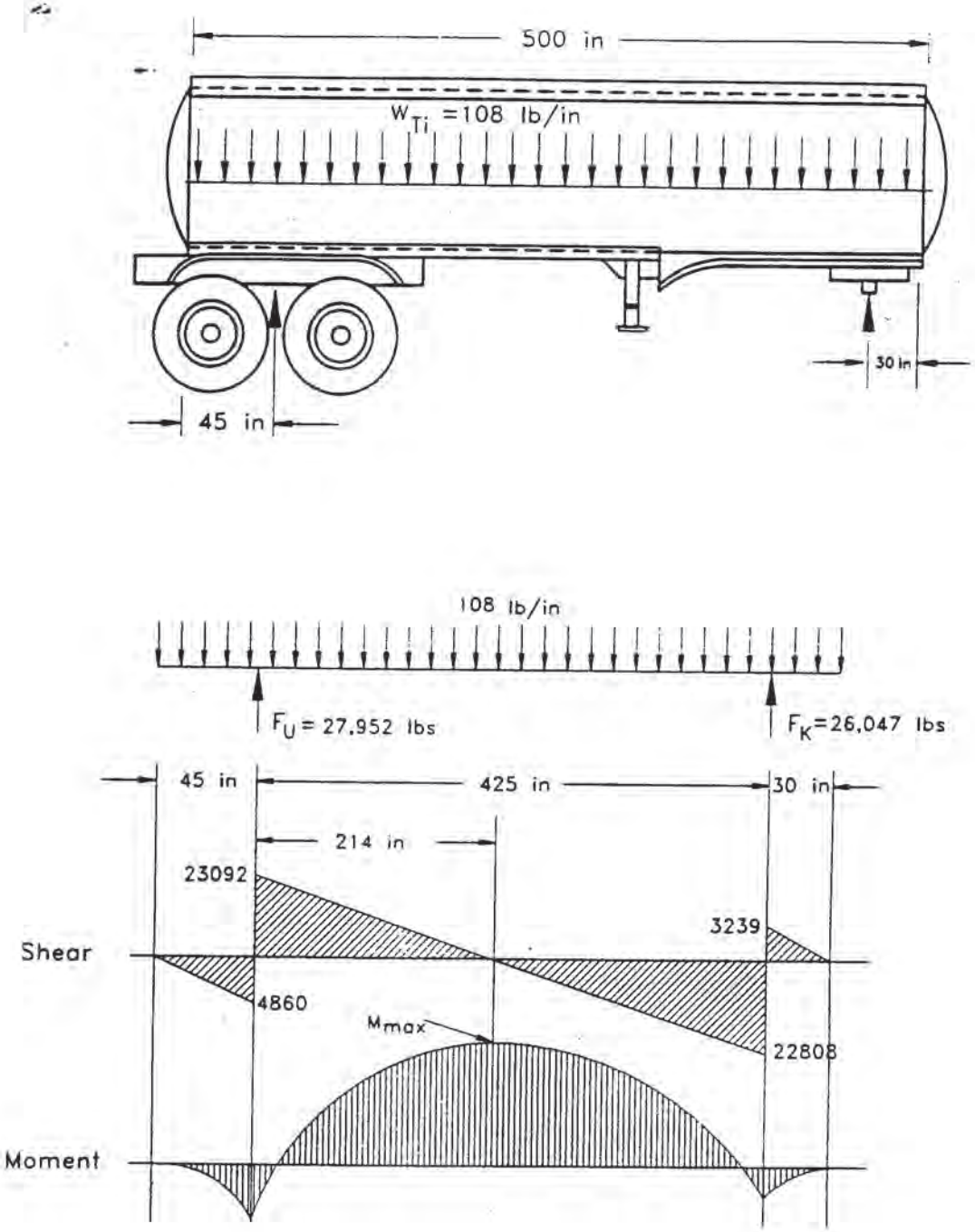


Figure 13. Shear and bending moment diagrams for example 9.

Example 10. Shear and bending stresses due to static weight.

A cylindrical tank has an inside radius, R_i, of 28.46 inches and an outside radius, R_o, of 28.625 inches. The tank is subject to a uniformly distributed weight, W_{Ti}, of 100 lbs/in. The reactions are located at the kingpin and rear tandems as shown.

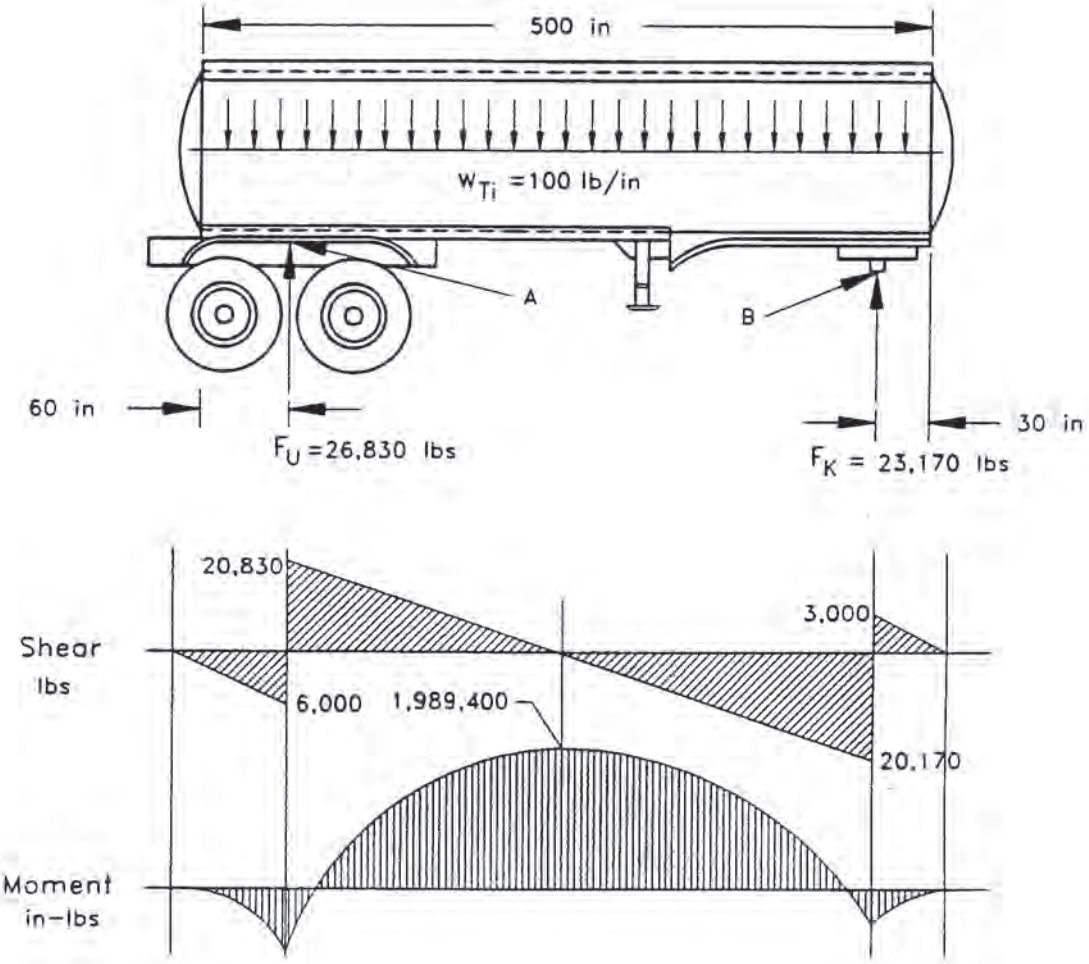


Figure 14. Shear and bending moment diagrams for example 10.

The maximum bending stress due to static weight will be at the point of maximum moment. (Unless there is a welded joint near the point of maximum moment with a weld efficiency of less than 1.0.) To find the point of maximum moment one must first compute the reactions.

$\sum M_A = 100(500)[(500/2)-60] - F_k(410) = 0$
$F_k = 23{,}170$ lbs.
$F_u = 50{,}000 - 23{,}170$
$F_u = 26{,}830$ lbs.

The maximum moment is at the point where the shear, V = 0. The distance, L_{max}, from the rear of the tank to the location of maximum moment may be computed as follows:

$L_{max} = F_u/W_{Ti} = 26{,}830/100 = 268.3$ inches from the rear of the tank or 208.3 inches from the reaction, F_u
$M_{max} = F_u(208.3) - W_{Ti}(268.3)^2/2$
$M_{max} = 26{,}830(208.3) - 100(268.3)^2/2$
$M_{max} = 1{,}989{,}400$ in-lbs.

The bending stress due to static weight is then computed by:

$$S_{x3} = M_{max}/Z_e$$

where:

Z_e = elastic section modulus = I/c
$I = \pi(R_o^4-R_i^4)/4 = \pi(28.625^4-28.46^4)/4 = 12{,}053$ in^4
c = 28.6 inches
$Z_e = 12{,}053/28.6 = 421.1$ in^3

so:

$S_{x3} = 1{,}989{,}400$ in-lbs/421.1 in^3 = 4,724 psi

The shear forces can be computed or taken from the shear diagram. The maximum flexural shear stress will occur at the cross section subjected to the highest shear force. It will occur in the side walls at the neutral axis which is at or near mid-depth and can be closely approximated, as stated earlier, by:

$S_{sl} = V_{max}/(0.5A)$

$A = \pi(28.625^2-28.460^2)$

$A = 29.6 \text{ in}^2$

$S_{sl} = 20{,}830 \text{ lbs.}/(0.5)(29.6)$

$S_{sl} = 1{,}407 \text{ psi}$

Stresses due to weight of lading and structures (appurtenances) supported by tank wall can be considered along with bending stresses due to static weight. Lightweight appurtenances can be considered to be uniformly distributed along the length of the tank and included with the uniformly distributed self weight of the tank. Heavier appurtenances should be considered to be concentrated loads at their attachments.

Local stresses in the tank wall that result from attachments of heavier appurtenances, rollover protection devices, and other supports, should be evaluated in accordance with procedures in appendix G of the ASME Code and the Welding Research Council Bulletin 107 to the extent that they are applicable. A difficulty exists in applying procedures in (WRC) Bulletin 107 in that the procedures do not account for doubler plates (or pads) that are commonly used in mounting attachments to cargo tank walls.

Stresses due to vertical acceleration:

Shear and bending moment diagrams for vertical accelerative force can be constructed in the same manner as those for gravity weight as shown in figure 15. Weight of the tank, appurtenances and lading, as well as the reactions for gravity weight, are multiplied by a factor, F_2. The value of F_2 is the specified vertical acceleration in g's. It is 0.35 for normal operating loadings and 0.70 for extreme dynamic loadings.

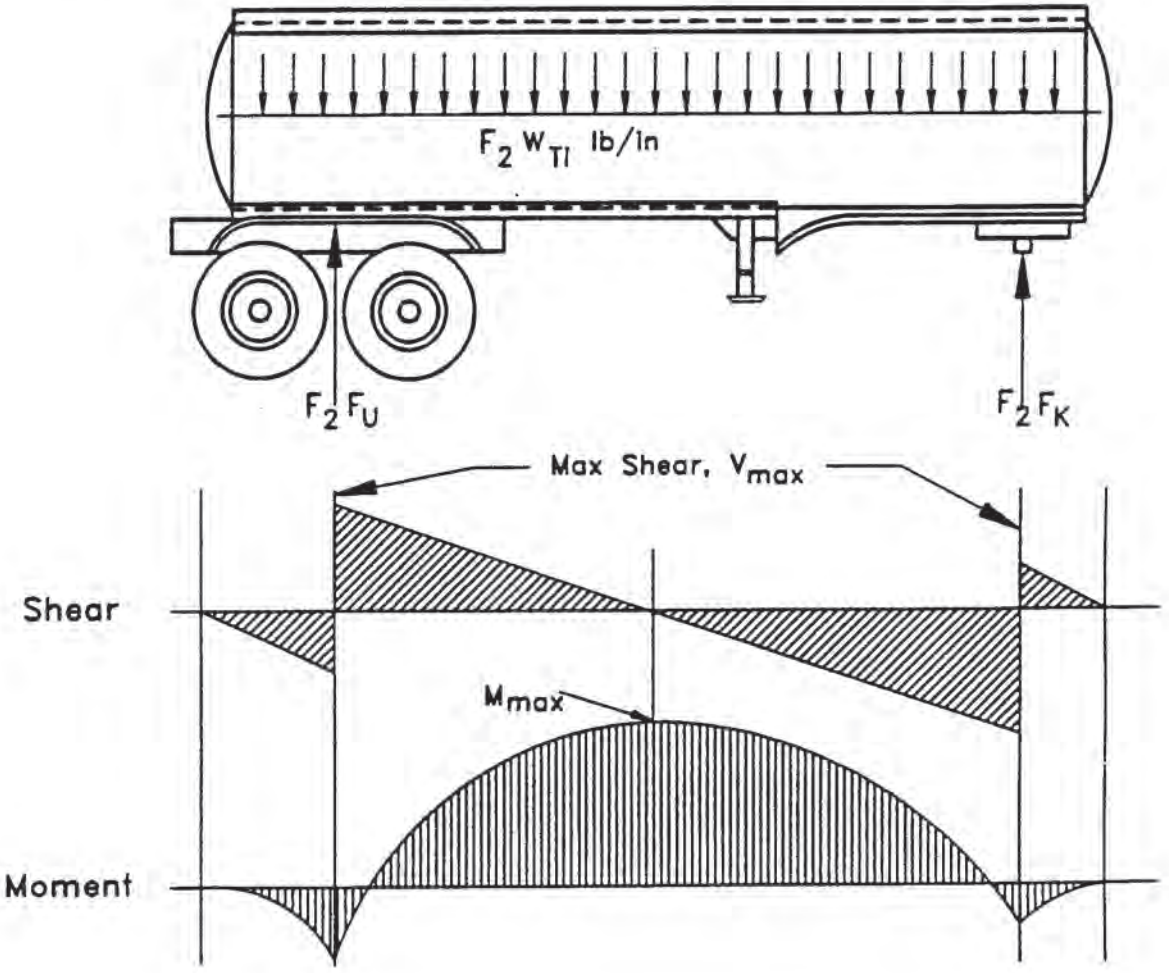


Figure 15. Idealization of cargo tank for vertical accelerative force.

Example 11. Computation of shear stress generated by normal operating vertical accelerative force.

This calculation is identical to the preceeding one in example 10 with a factor of 0.35 applied to account for normal operating loads.

$S_{s2} = V_{max}/0.5A$
$S_{s2} = 0.35(20,830)/(0.5)(29.6)$
$S_{s2} = 493$ psi

It is noted that $S_{s2} = F_2 S_{s1}$.

Example 12. Computation of bending stresses due to normal operating vertical accelerative force.

The vertical accelerative force due to normal operating loads would act as shown in figure 16.

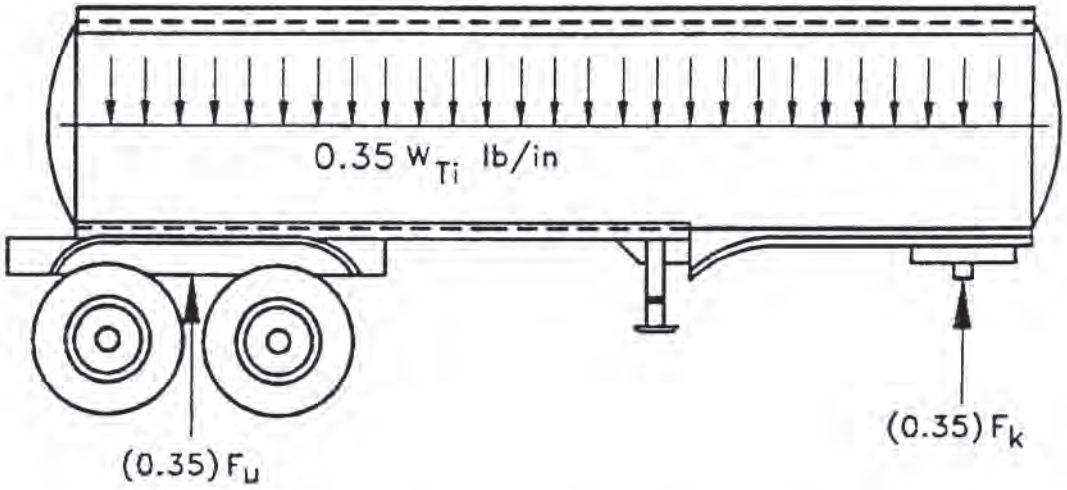


Figure 16. Idealization of cargo tank for normal operating vertical accelerative force.

$S_{x4} = M_{max}/Z_e$

where:

$M_{max} = (0.35)(1,989,400)$ in-lbs.
$Z_e = 421.1$ in^3

S_{x4} = [0.35(1,989,400/421.1) = 1,653 psi

It is noted that $S_{x4} = F_2 S_{x3}$.

Stresses due to longitudinal deceleration:

Axial Stresses

The axial load generated by a decelerative force can be considered as shown in figure 17. For normal operating longitudinal deceleration, the factor, F_1, is 0.35 and for extreme dynamic longitudinal deceleration, it is 0.70. The tensile stress can be computed using:

$$S_{x5} = F_x/A$$
$$S_{x5} = F_1(F_u+W_u)/A$$

where:

(F_u+W_u) = total weight of rear of trailer, lbs.
A = cross section area of tank, in^2.

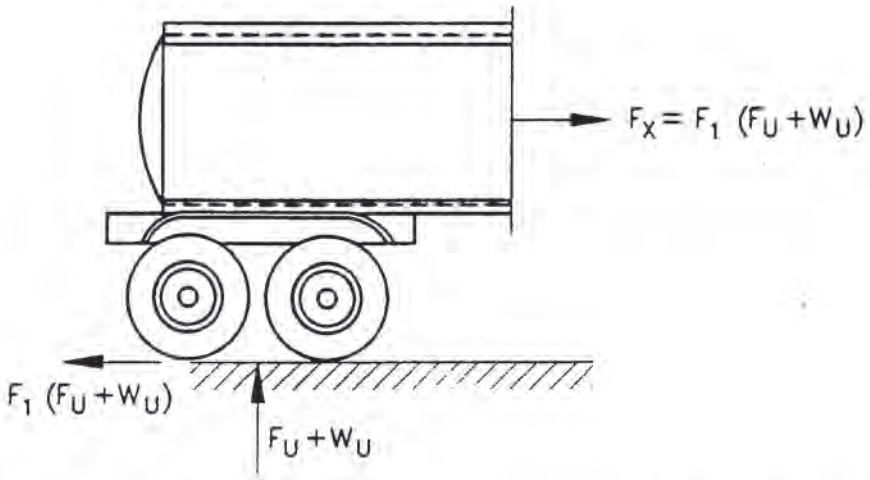


Figure 17. Idealization of cargo tank for computation of axial tensile stress due to longitudinal decelerative force from application of trailer brakes.

Example 13. Computation of axial tensile stress due to a decelerative force (trailer brakes).

Continuing from example 10, and given the following values, the axial tensile stress (only trailer brakes applied) can be computed as shown:

Weight of the undercarriage at the rear tandem (W_u) = 6,000 lbs.
Normal operating load factor (F_l) = 0.35
Reaction at rear tandem (F_u) = 26,830 lbs.
Area of tank cross section (A) = 29.6 in^2

$$S_{x5} = F_x/A = [F_l(F_u+W_u)]/A = [0.35(26,830+6,000)]/29.6$$
$$S_{x5} = 388 \text{ psi}$$

Note that it may be necessary in some cases to compute the compressive stress in the tank due to deceleration (tractor brakes applied only); however, the worst case loading scenarios will generally yield higher stresses in tension due to the above computation. If there is a circumferential weld located in close proximity to the rear tandem, it may be necessary to evaluate the stresses at a material strength lessened by a joint efficiency value (if less than unity).

Bending Stresses

The bending moment generated by a longitudinal decelerative force can be considered as shown in figure 18. For normal operating deceleration, the factor, F_l, is 0.35 and for extreme dynamic deceleration it is 0.70. The tensile stress in the bottom of the tank and the compressive stress in the top of the tank can be computed using:

$$S_{x6} = M/Z_e = 0.35(F_u+W_u)H_v/Z_e$$

where:

(F_u+W_u) = total weight of rear of trailer, lbs.
H_v = height from road to centerline of tank cross section, inches.
Z_e = elastic section modulus of tank cross section.

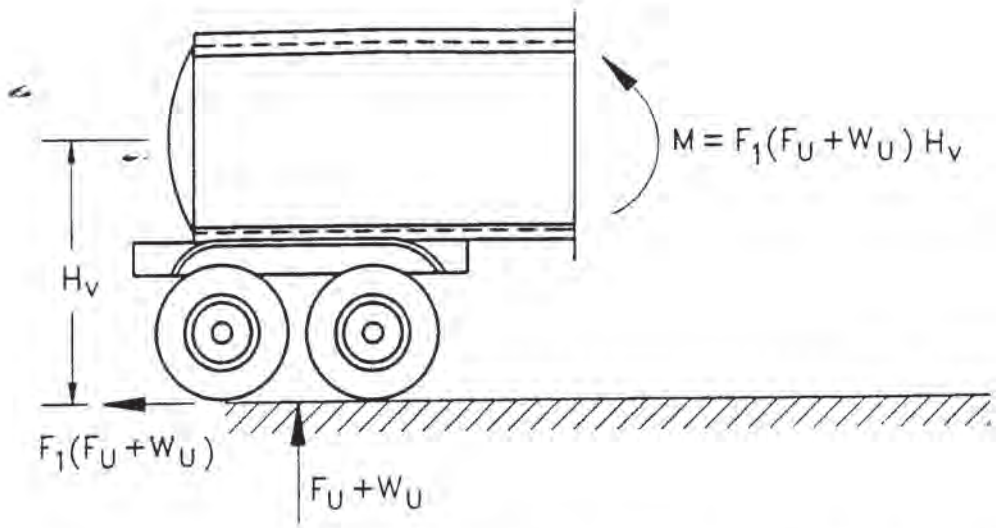


Figure 18. Idealization of cargo tank for computation of flexural tensile and compressive stresses due to longitudinal decelerative force from application of trailer brakes.

Example 14. Stresses due to bending moment generated by a decelerative force (trailer brakes).

Continuing from example 10, and given the following values, the bending moment due to trailer brake application only is computed as shown.

Distance from the application of the force (at the road surface) to the center of the tank (H_v) = 85 inches

Elastic section modulus (Z_e) = 421.1 in^3
Normal operating load factor (F_1) = 0.35

$S_{x6} = M/Z_e = [F_1(F_u+W_u)(H_v)]/Z_e$
$S_{x6} = [0.35(26,830 + 6,000)(85)]/421.1$
$S_{x6} = 2,319$ psi

Stresses due to longitudinal acceleration:

Axial Stresses

The axial load generated by an accelerative force can be considered as shown in Figure 19. For normal operating longitudinal acceleration, the factor F_1, is 0.35 and for extreme dynamic longitudinal acceleration, is 0.70. The tensile stress can be computed by using:

$$S_{x7} = 0.35\ F_k/A$$

where:

F_k = reaction force at kingpin, lbs.

A = cross sectional area of tank, in^2

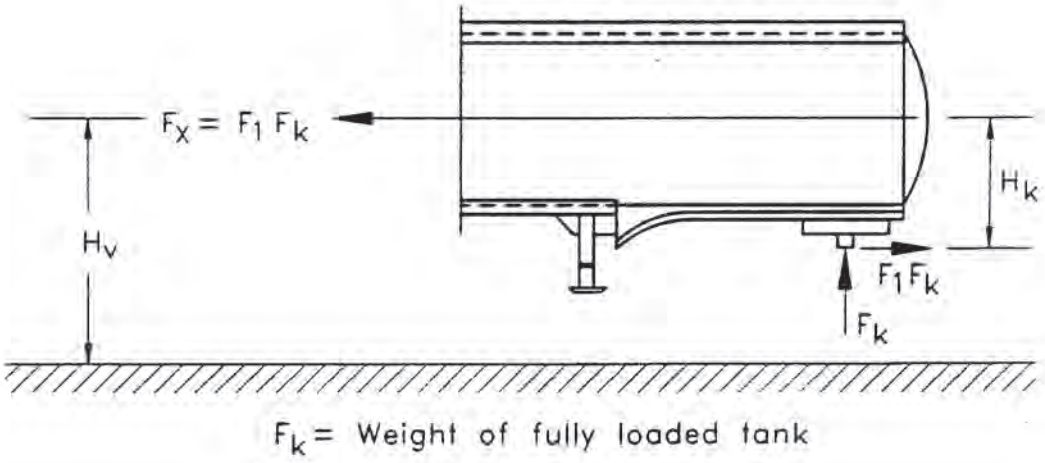


Figure 19. Idealization of cargo tank for computation of axial tensile stress due to accelerative force.

Example 15. Stresses due to axial force generated by an accelerative force.

A cylindrical tank is subject to an accelerative force of 0.35 times the reaction force at the kingpin during normal operating loads. The area, A, of the tank is 29.6 inches and the reaction force, F_k is 23,170 lbs. Axial stress due to the load is computed by:

$$S_{x7} = 0.35(F_k)/A = 0.35(23,170)/29.6$$
$$S_{x7} = 274 \text{ psi (tension)}$$

Bending Stresses

The bending moment generated by an accelerative force can be considered as shown in Figure 20. For normal operating acceleration, the factor, F_1, would be 0.35 and for extreme dynamic loading, it would be 0.70. The tensile stress in the bottom of the tank and the compressive stress in the top of the tank can be computed using:

$$S_{x8} = M\backslash Z_e = 0.35\ F_k H_k / Z_e$$

where:

F_k = reaction force at kingpin, lbs.
H_k = distance from transverse hinge point of fifth wheel to centroid of transverse cross section of tank, in.
Z_e = elastic section modulus of tank, in^3.

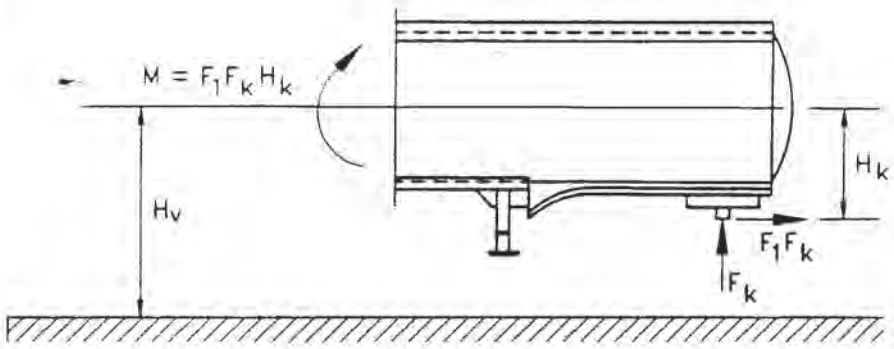


Figure 20. Idealization of cargo tank for computation of flexural tensile and compressive stresses due to accelerative force.

Example 16. Stresses due to bending moment generated by accelerative force.

Continuing from Example 15, and given the following values, the bending moment at the kingpin location due to acceleration can be computed as shown.

The height from the fifth wheel hinge point to the center of the tank (H_k) = 31.6 inches.
Elastic section modulus (Z_e) = 421.1 in^3
Normal operating load factor (F_l) = 0.35
F_k = reaction of kingpin = 23,170 lbs.

$S_{x8} = M/Z_e = [(F_l)(F_k)(H_k)]/Z_e$
$S_{x8} = [0.35(23,170)(31.6)]/421.1$
$S_{x8} = 609$ psi

Stresses due to lateral acceleration:

Shear Stress

Flexural shear stresses and torsional shear stresses generated by a lateral accelerative force can be addressed as illustrated in figures 19 and 20. Weight of the tank, appurtenances and lading are multiplied for a factor, F_3, which is the lateral accelerative force in g's. It's magnitude is 0.2 for normal operating loadings and 0.4 for extreme dynamic loadings.

For flexural shear stresses, lateral supports are assumed at the vertical center of the tank and lateral shear forces are determined as illustrated in figure 21.

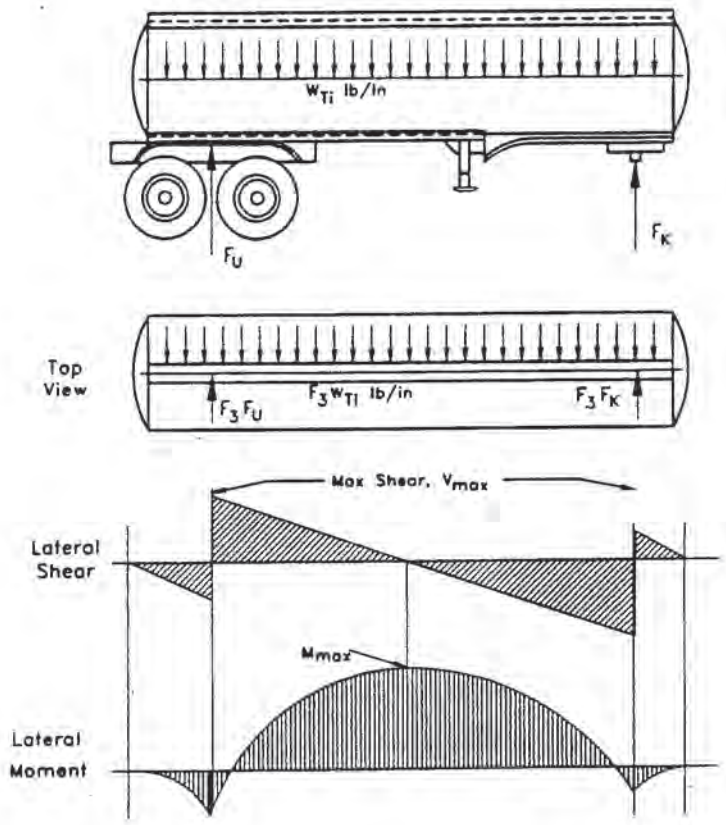


Figure 21. Shear force diagram for a lateral accelerative force.

Example 17. Computation of shear and bending stress due to a lateral accelerative force.

A cylindrical cargo tank has a reaction force at the undercarriage, F_u, of 26,830 lbs. The tank has an inside radius, R_i, of 28.46 inches and an outside radius, R_o, of 28.625 inches. The lateral accelerative force for normal operating loadings is 0.2 times each of the reaction forces. The lateral shear force diagram would be the same as the diagram from example 9 with all values multiplied by 0.2. The maximum shear stress in the wall of the tank would occur at the top and bottom of the tank on a section immediately forward of the reaction force at the undercarriage and is computed as follows:

$$S_{s3} = V_{max}/(0.5A)$$
$$A = \pi(R_o^2-R_i^2)$$
$$A = \pi(28.625^2-28.46^2)$$
$$A = 29.6 \text{ in}^2$$
$$S_{s3} = 0.2(20,830)/(29.6/2)$$
$$S_{s3} = 281 \text{ psi}$$

The maximum bending moment in the lateral direction from figure 21 is 397,880 in-lbs. For this example, the section modulus for bending in the lateral direction is assumed to be 421.1; however, it is noted that the value might differ from that for bending in the vertical direction. The bending stresses are:

$$S_{x9} = M/Z_e$$
$$S_{x9} = 397,880/421.1$$
$$S_{x9} = \pm 945 \text{ psi}$$

The loading condition for torsional shear can be visualized by considering the tank (trailer) to be fixed against rotation at the front end and subjected to an overturning torque at the rear axles as shown in figure 22.

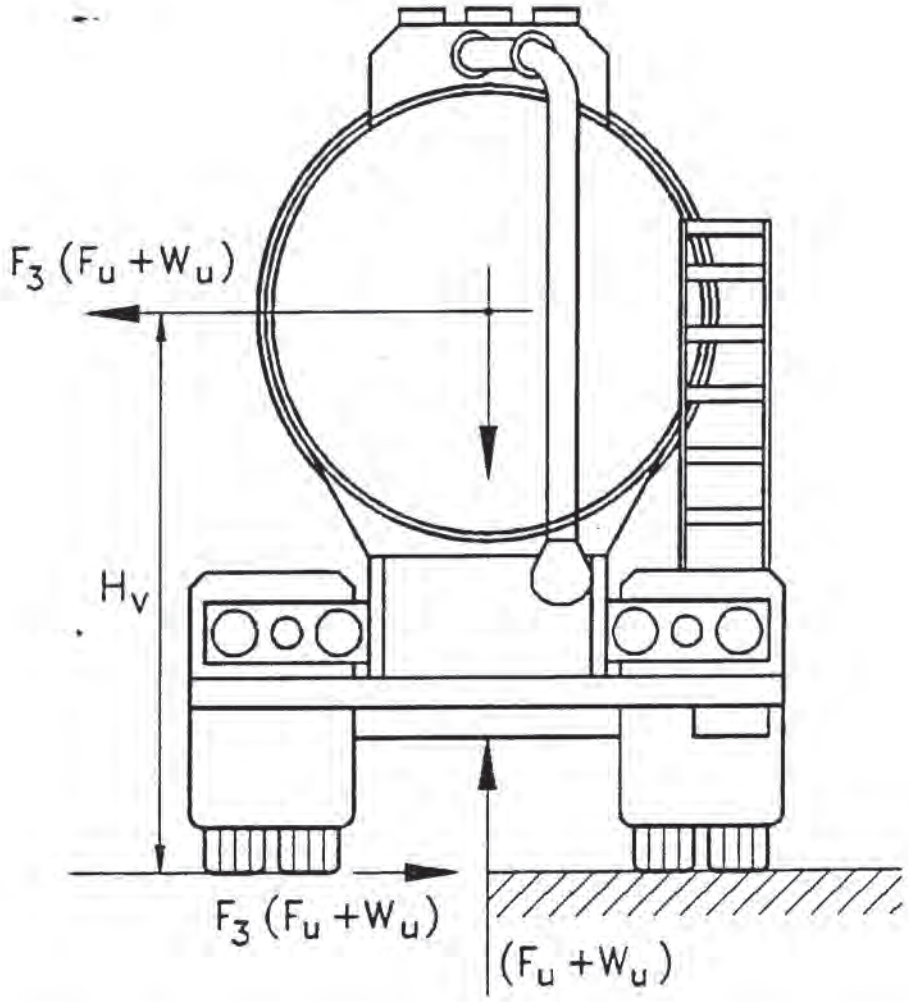


Figure 22. Illustration of the lateral accelerative force that produces torsional loading in a tank trailer.

The overturning torque for normal operating loading is:

$$T = F_3(F_u+W_u)H_v$$
$$T = 0.2\ (F_u+W_u)H_v$$

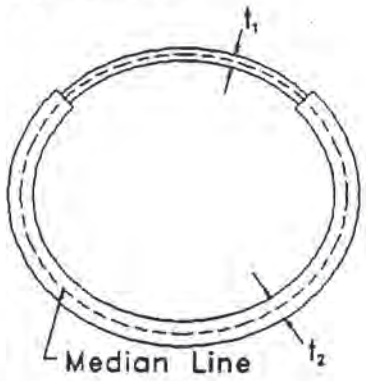
For tanks having circular cross sections of uniform wall thickness, the torsional shear stress may be computed using:

$$S_{s4} = TR_o/J$$

where:

S_{s4} = torsional shear stress in tank wall, psi.
R_o = outside radius of tank, in.
$J = 2\pi R_{avg}^3 t$

For thin-walled tanks having non-circular cross sections or circular cross sections of non-uniform wall thickness the torsional shear stresses may also be computed using the following procedure.



$$S_{s4} = T/2tA_m$$

where:

T = applied torque
t = wall thickness at point where stress is being computed
A_m = area enclosed by median line of tank wall

Figure 23. Definition of torsional shear stress formula for tanks having non-circular cross sections or circular cross sections of non-uniform wall thickness. Cross section may be any closed shape.

Example 18. Computation of torsional shear stress in cylindrical tanks.

A cylindrical tank has a reaction force at the undercarriage, F_u, of 26,830 lbs. and weight of the undercarriage, W_u, is 6,000 lbs. The dimensions of the tank are:

R_i = 28.46 inches
R_o = 28.625 inches
t = 0.165 inches
H_v = 85 inches

The overturning torque for normal operating loads is:

$T = 0.2(W_u+F_u)H_v$
$T = 0.2(6,000+26,830)85$
$T = 558,110$ in-lbs.

Torsional shear stress is computed by:

$S_{s4} = TR_o/J$
$R_o = 28.625$
$R_{avg} = (28.625+28.46)/2$
$R_{avg} = 28.54$
$J = 2\pi R^3_{avg}t$
$J = 2\pi(28.54)^3(.165)$
$J = 24,100$ in^4
$S_{s4} = 558,110(28.625)/24,100$
$S_{s4} = 663$ psi

Example 19. Computation of torsional shear stress in tanks with non-circular cross sections or circular cross sections with non-uniform wall thickness.

The applied overturning torque is computed as outlined for cylindrical tanks. To determine the stress in a vessel at a point where the thickness is 0.165 inches, and the area enclosed by the median line of the tank wall, A_m, is 2,559 in^2.

$S_{s4} = T/2tA_m$

$T = 558{,}110$ in-lbs. (from previous example)

$A = \pi R^2_{avg}$

$A = \pi(28.54)^2$

$S_{s4} = 558{,}110/[2(.165)(2{,}559)]$

$S_{s4} = 661$ psi

The area enclosed by the median line of the tank wall, A_m, can be approximated by using the formula for the area of a ellipse.

$A = \pi R_{xo} R_{yo}$

or by using the manufacturers figure for gallons per inch and multiply by 231 in^3/gal

$A_m =$ ___(gal/in)(231 in^3/gal) = _____ in^2

Stresses due to temperature gradients:

§178.345-3(b) requires that stresses due to the effect of temperature gradients resulting from lading and ambient temperature extremes be included in design.

Formulas for computing stresses due to a temperature gradient through the wall of a thin-walled cylinder for the case when the temperature gradient results from steady heat flow are given in Timoshenko's Theory of Elasticity[6]. If the temperature on the inside is T_i and the temperature on the outside is zero, the temperature at any distance, r, from the center is:

$$T = T_i \frac{\log(b/r)}{\log(b/a)}$$

where:

b is the outside radius of the cylinder
a is the inside radius of the cylinder

Note that ΔT, the difference in the temperature on the inside and outside, may be used for T_i if the temperature on the outside is not zero.

If temperature on the inside is higher than that on the outside, a compressive stress will exist (in the plane of the wall) on the inside surface of the wall and a tensile stress will exist (in the plane of the wall) on the outside surface. These stresses will exist in both the circumferential and longitudinal direction. They will be equal in magnitude in the two directions on the inside surface and on the outside surface. On the inside surface:

$$S_x = S_y = -\alpha E T_i/(2)(1-\nu)$$

On the outside surface:

$$S_x = S_y = \alpha E T_i /(2)(1-\nu)$$

where:

α is thermal coefficient for the wall material
E is modulus of elasticity for the wall material

T_i is difference in temperature on inside surface and outside surface, deg F.

ν is Poisson's ratio for the wall material

This analysis procedure is not applicable at locations near heads or bulkheads.

Allowable stresses:

Allowable tensile stress for non-ASME tanks.

The regulations in §178.345-3, state that the maximum calculated stress in the tank wall may not exceed allowable values given in Section VIII of the ASME Code or 25% of the tensile strength of the material. The regulations continue to state that the strength of materials may be established by reports from the manufacturer or by testing to a national standard, but the value may not exceed 120 percent of that given by the ASME Code or ASTM Standard. Section VIII refers to Section II, Part D, where extensive tables are given.

Allowable tensile stress for ASME tanks.

The ASME Code Section VIII and Section II, Part D are used to determine allowable tensile stress for materials at various temperatures. Extensive tables are included in Section II, Part D.

Allowable compressive stress for non-ASME tanks.

For non-ASME Code designs, the allowable compressive stress of a cargo tank wall may be computed using either the Alcoa formula or the Roark and Young formula: (reference case #13 and #15, Table 35, 5th ed.)

Alcoa formula with no factor of safety.

$$S_{bA} = (\pi/4)^2(E)/\{(R_j/t_s)[1+(R_j/t_s)^{1/2}/35]^2\}$$

Roark and Young formula with no factor of safety.

$$S_{bY} = 0.6Et/R_i$$

However, Roark and Young state that, for case #15, tests indicate an actual buckling strength of from 40 to 60 percent of the theoretical value, or:

$$S_{bY} = 0.3Et/R_i$$

This latter formula compares more closely with the Alcoa formula and should be used for computing compressive buckling stress for non-ASME tanks.

A factor of safety of 1.5, applied to either of the above formulas should be used for computing the allowable compressive strength of cargo tanks. The allowable compressive stress would be:

$$S_b = S_{bA}/1.5$$

or $$S_b = S_{bY}/1.5$$

For ASME certified tank designs, the ASME Code must be followed.

Example 20. Compressive buckling strength of cargo tank shell (non-ASME).

A DOT 407 tank is made of SB209 A95454-H32 aluminum (S_u = 36,000 psi, S_{yield} = 26,000 psi). The outside diameter of the shell is 63.5 inches. The top portion of the shell, which is subjected to an axial compressive stress, is 0.165 inches thick.

The critical compressive buckling of the top portion of the shell is to be computed. The inside radius of the shell is 63.5/2 - .165 = 31.585 inches. The modulus of elasticity is $12.5X10^6$ psi.

For the Alcoa formula with no factor of safety, the critical buckling strength would be:

$$S_{bA} = (\pi/4)^2(E)/\{(R_i/t_s)[1+(R_i/t_s)^{1/2}/35]^2\}$$

$$S_{bA} = (\pi/4)^2(12.5X10^6)/\{(191.4)[1+(191.4)^{1/2}/35]^2\}$$
$$S_{bA} = 20{,}693 \text{ psi}$$

The allowable compressive buckling strength would be:

$$S_b = S_{bA}/1.5$$
$$S_b = 20{,}693/1.5$$
$$S_b = 13{,}795 \text{ psi}$$

For the Roark and Young formula with no factor of safety, the critical buckling strength would be:

$$S_{bY} = 0.3Et/R_i$$
$$S_{bY} = 0.3(12.5X10^6)(.165)/31.585$$
$$S_{bY} = 19{,}590 \text{ psi}$$

The allowable compressive buckling strength would be:

$$S_b = S_{bY}/1.5$$
$$S_b = 19{,}590/1.5$$
$$S_b = 13{,}060 \text{ psi}$$

Allowable compressive stress for ASME tanks.

Tables and charts in the ASME Code are used to determine the allowable compressive stress in a cargo tank wall. The procedure is illustrated in example 6 on page 57. The allowable compressive stress is the value of B from Step 5, page 58, $B = S_b = 3{,}500$ psi.

Stiffener Rings:

Stiffener rings, baffles and/or bulkheads are used to provide lateral support for walls of cargo tanks. This is done to generally maintain the shape of the tank and to provide lateral stability to the portion of the tank wall subject to compressive stresses. Ability of a stiffener ring to perform its intended function is dependent upon its strength and stiffness. Section 178.345-7 of DOT regulations places requirements on the spacing and elastic section modulus of

stiffener rings. A portion of the tank wall may be considered to function compositely with a ring as shown in figure 24. The ASME Code has a similar requirement for moment of inertia of a ring. A portion of the tank wall may be used if the engineer chooses to do so as illustrated in figure 26.

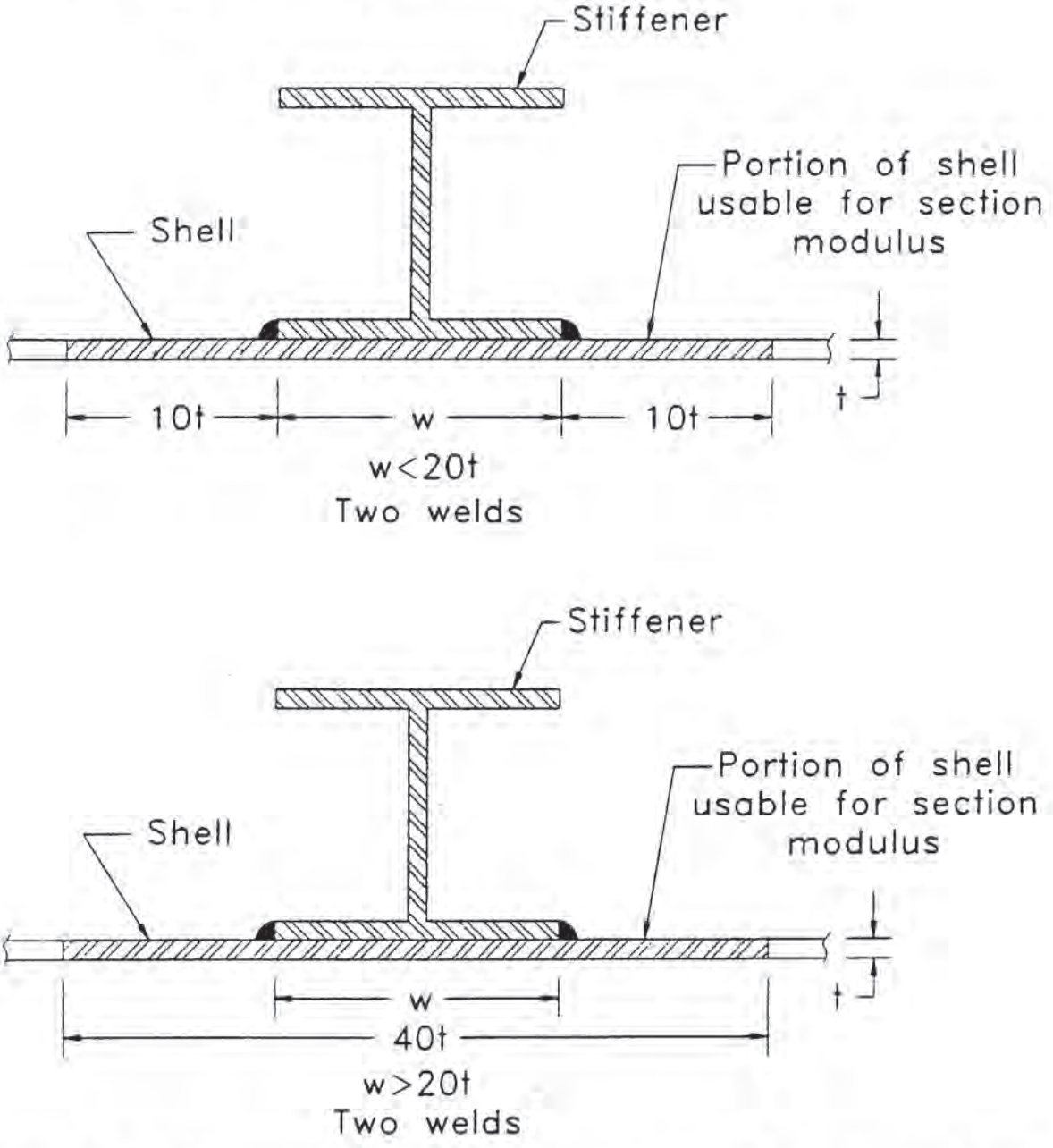


Figure 24. Definition of cross section for computation of section modulus of ring stiffener for DOT (non-ASME) tanks.

Example 21. Computation of section modulus for ring stiffener by DOT regulations (non-ASME).

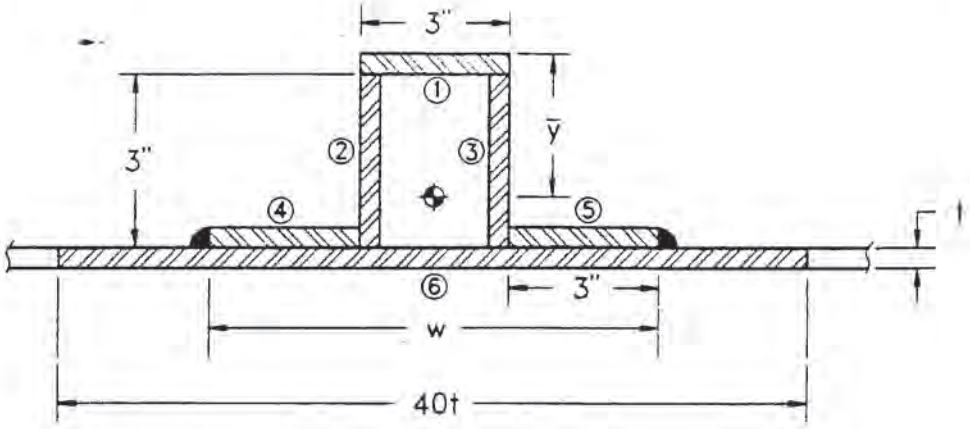


Figure 25. Cross section of ring stiffener and tank wall. If w is greater than 20t, the maximum length of wall usable is 40t.

w>20t, so length of shell usable is 40t.

t = 0.25 inches
w = 9 inches

Determine centroid of section.

Section #	A_i	$\bar{y}_i$	$A_i\bar{y}_i$
1	0.75	0.125	0.09375
2	0.75	1.75	1.3125
3	0.75	1.75	1.3125
4	0.75	3.125	2.34375
5	0.75	3.125	2.34375
6	2.5	3.375	8.4375
	6.25 in^2		15.84375

$\bar{x}_i$ = centerline of section (symmetrical)
$\bar{y}_i = \Sigma A_i\bar{y}_i/\Sigma A_i = 15.84375/6.25 = 2.54$ inches

Determine section modulus

$I_{TOT} = I_0 + Ad^2$

Section 1	$I = bh^3/12 = (3)(0.25)^3/12 = 0.00391$
	$Ad^2 = (0.75)(2.54-0.125)^2 = 4.3561$ in^4
Section 2 & 3	$I = bh^3/12 = (0.25)(3)^3/12 = 0.5625$
	$Ad^2 = (0.75)(2.54-1.75)^2 = 0.4622$ in^4
Section 4 & 5	$I = bh^3/12 = (3)(0.25)^3/12 = 0.00391$
	$Ad^2 = (0.75)(2.54-3.125)^2 = 0.2611$ in^4
Section 6	$I = bh^3/12 = (10)(0.25)^3/12 = 0.0130$
	$Ad^2 = (2.5)(2.54-3.375)^2 = 1.7640$ in^4
Section 1	$= I+Ad^2 = (0.00391+4.3561) = 4.3600$ in^4
Section 2 & 3	$= I+Ad^2 = (0.5625+0.4622) = 1.0247$ in^4
Section 4 & 5	$= I+Ad^2 = (0.00391+0.2611) = 0.2650$ in^4
Section 6	$= I+Ad^2 = (0.0130+1.7640) = 1.7770$ in^4
	$I_{TOT} = 4.3600+2(1.0247)+2(0.2650)+1.7770$
	$I_{TOT} = 8.7164$ in^4
	$c = 2.65$ inches

Section modulus $Z_e = I/c = 8.7164/2.65 = 3.289$ in^3

The required section modulus per §178.345-7 for structural steel is:

$I/c = 0.00027w\ell$

$w = 57.25$ inches

$\ell = 60$ inches (max allowed)

$= 0.00027(57.25)(60) = 0.927$ in^3 < 3.289 in^3 OK

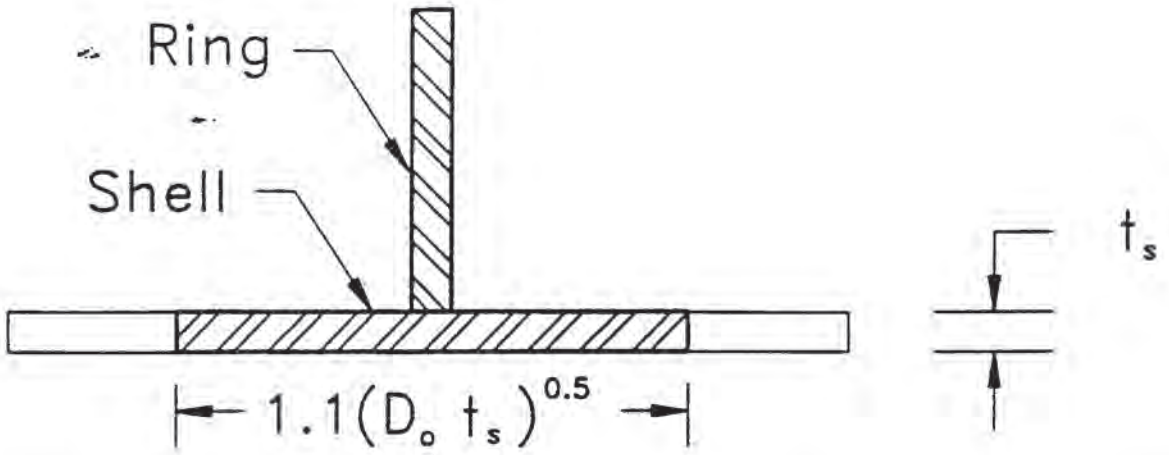


Figure 26. Definition of cross section for computation of moment of inertia of ring stiffener for ASME tanks.

Example 22. Determine adequacy of a circumferential stiffening ring for ASME tanks. (ASME Code UG-29)

Minimum Required Thickness t = 0.20"
Stiffening Rings are 3/8" by 3" strap
Tank Diameter = 60"
Length between straps = 72" (equally spaced so L_s = 72")
Thickness of tank shell = t_s = 0.25"
Cross sectional area of ring A_s = 0.375 X 3 = 1.125 in^2
External Pressure = P = 14.7 psi (Vacuum tank)
Material - SA240/316L stainless steel
Design Temperature 300°F

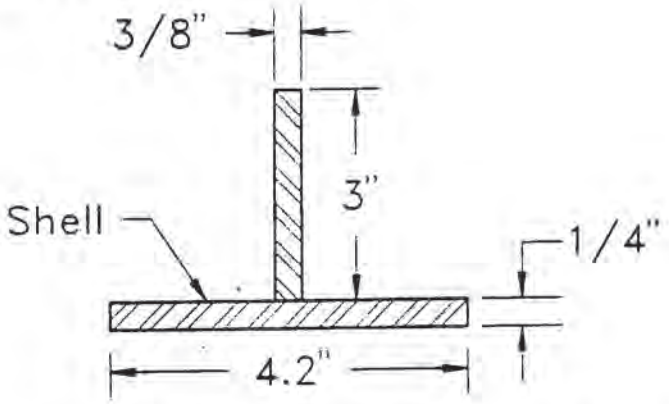


Figure 27. Cross section of ring stiffener and portion of tank for computation of moment of inertia.

The length of the shell allowed to be used is $1.10(D_o t_s)^{0.5}$ = 4.2"

The adequacy shall be determined by UG-29 as follows:

Step 1 Using A_s, t, D_o, P, and L_s calculate
$B = 0.75(PD_o)/[t+(A_s/L_s)]$
$B = .75(14.7)(60)/(.20+1.125/72)$
B = 3068

Step 2 Go to the applicable material chart in Subpart 3 of Section II, Part D. For SA240/316 stainless steel the material chart is found in FIG HA-4 on page 681 of Section II, Part D.

Steps 3&4 Use this chart to determine the value of A. For B=3068 and a

design temperature of 300° F. The value of A can be determined to be 2.4×10^{-4}

Step 5 Does not apply since A can be determined by Step 4.

Step 6a For considering only the stiffening ring, the required moment of inertia is:

$I_s = [D_o^2 L_s(t+A_s/L_s)A]/14$

$I_s = [60^2(72)(.20+1.125/72)2.4 \times 10^{-4}]/14$

$I_s = 0.96$

Step 7a Moment of inertia for only the stiffening ring is:

$I = bh^3/12 = .375(3)^3/12 = 0.84 < 0.96$

Note: It is up to the designer whether to use the stiffener alone as calculated in steps 6a and 7a, or use the stiffener and the allowable shell contribution (as given in the definition of I′ in UG-29) which is calculated in steps 6b and 7b below:

Step 6b For considering the stiffening ring and the allowable shell contribution, the required moment of inertia is:

$I'_s = [D_o^2 L_s(t+A_s/L_s)A]/10.9$

$I'_s = [60^2(72)(.2+1.125/72)2.4 \times 10^{-4}]/10.9$

$I'_s = 1.23$

Step 7b Moment of inertia for the stiffening ring and the shell contribution is:

Section #	Area	$\bar{y}_i$	$A\bar{y}_i$
1	1.125	1.75	1.97
2	1.05	0.125	0.13
	$\sum A=2.175$		$\sum A\bar{y}=2.1$

$\bar{y} = \sum A\bar{y}/\sum A = 2.1/2.175 = 0.97$

$I_1 = bh^3/12+Ad^2 = .375(3)^3/12+1.125(1.75-.97)^2 = 1.528$

$I_2 = bh^3/12+Ad^2 = 4.2(.25)^3/12+1.05(.97-.125)^2 = .755$

$I' = I_1+I_2 = 1.528+.755 = 2.283 > I's$

Step 8 If either $I > I_s$ or $I' > I's$, the design is adequate.

In this case, $I' > I's$ so the stiffener design is adequate.

Design of tanks by ASME Code.

Design requirements of the ASME Code that are applicable to ASME certified cargo tanks are included in Section VIII-Division 1 and are as follows:

UG-16	GENERAL
UG-20	DESIGN TEMPERATURE
UG-21	DESIGN PRESSURE
UG-22	LOADINGS
UG-23	MAXIMUM ALLOWABLE STRESS VALUES
UG-25	CORROSION
UG-27	THICKNESS OF SHELLS UNDER INTERNAL PRESSURE
UG-28	THICKNESS OF SHELLS AND TUBES UNDER EXTERNAL PRESSURE
UG-29	STIFFENING RINGS FOR CYLINDRICAL SHELLS UNDER EXTERNAL PRESSURE
UG-30	ATTACHMENT OF STIFFENING RINGS
UG-32	FORMED HEADS, AND SECTIONS, PRESSURE ON CONCAVE SIDE
UG-33	FORMED HEADS, PRESSURE ON CONVEX SIDE
UG-36	OPENINGS IN PRESSURE VESSELS
UG-37	REINFORCEMENT REQUIRED FOR OPENINGS IN SHELLS AND FORMED HEADS
UW-12	JOINT EFFICIENCIES

Appendix 1 of Section VIII

Appendix 13 of Section VIII

Appendix G of Section VIII

Appendix L of Section VIII

The engineer is referred to Section VIII-Division 1 and Section II-Materials Part D-Properties for guidance on analysis procedures and design values.

CHAPTER 5. LOADING REQUIREMENTS

General requirements for DOT 406, 407, 412 cargo tank motor vehicles are given in Section 178.345.

Specific requirements for DOT 406 (§178.346).

The MAWP must be no lower than 2.65 psig and no higher than 4 psig.

Vacuum loaded cargo tanks must not be constructed to this specification.

DOT 406 tanks must be "constructed in accordance with the ASME Code" with exceptions.

Minimum thicknesses of materials are set forth in §178.346-2

Specific requirements for DOT 407 (§178.347).

The tank must be of circular cross-section and have an MAWP of at least 25 psig. Any tank with an MAWP greater than 35 psig and any tank designed to be loaded by vacuum must be "constructed and certified in accordance with the ASME Code". External pressure for a tank loaded by vacuum must be at least 15 psi.

Tanks with MAWP of 35 psig or less must be "constructed in accordance with ASME Code" with exceptions.

Minimum thicknesses of materials are prescribed in §178.347-2.

Specific requirements for DOT 412 (§178.348).

MAWP must be at least 5 psig. If loaded by vacuum, MAWP must be at least 25 psig internal and 15 psig external. If MAWP is greater than 15 psig, tank must be circular cross-section. If MAWP is greater than 15 psig, tank must be "constructed and certified in conformance with ASME Code". If

MAWP is 15 psig or less, tank must be "constructed in accordance with ASME Code" with exceptions.

Minimum thicknesses of tank materials are prescribed in §178.348-2.

For all three designs, the principal normal stresses should be computed for the appropriate combinations of loads using the stress transformation equation. All potential points of maximum stress should be considered.

Structural evaluation procedures.

The following paragraphs provide suggested guidance (and a checklist) for organizing a structural evaluation.

1. Identify geometry of tank and materials used.
2. Identify whether ASME or non-ASME design.
3. Check minimum thickness of tank heads and shell using minimum thickness tables in DOT regulations.
4. Check spacing of circumferential reinforcement.
   - A. Check section modulus of ring stiffeners if they are used for circumferential reinforcement.
   - B. Check adequacy of baffles and bulkheads if they are used for circumferential reinforcement.
5. Check structural integrity of tank.
   - A. Check structural integrity of tank walls using loading combinations in the following section.
   - B. Check adequacy of heads using procedures in parts UG-32 and UG-33 of the ASME Code.
6. Check adequacy of rollover protection.
7. Check adequacy of bottom damage protection.
8. Check adequacy of rear-end protection.

Loading Combinations.

The loading combination that should be considered for static design is:

COMB. SA - Combined stresses due to:
- pressure/vacuum
  S_{x1}, S_{y1}
- static head
  S_{x2}, S_{y2}
- static gravity loads
  S_{x3}, S_{s1}

The loading combinations that should be considered for normal operating loadings include the following:

COMB. NA - Combined stresses due to:
- pressure/vacuum (if appropriate)
  S_{x1}, S_{y1}
- static head
  S_{x2}, S_{y2}
- static gravity loads
  S_{x3}, S_{s1}
- vertical acceleration
  S_{x4}, S_{s2}
- longitudinal deceleration created by trailer braking
  S_{x5}, S_{x6}
- lateral acceleration
  S_{x9}, S_{s3}, S_{s4}

COMB. NB - Combined stresses due to:
- pressure/vacuum (if appropriate)
  S_{x1}, S_{y1}
- static head
  S_{x2}, S_{y2}
- static gravity loads
  S_{x3}, S_{s1}
- vertical acceleration
  S_{x4}, S_{s2}

- longitudinal acceleration
  S_{x7}, S_{x8}
- lateral acceleration
  S_{x9}, S_{s3}, S_{s4}

COMB. NC - Combined stresses due to:

- pressure/vacuum (if appropriate)
  S_{x1}, S_{y1}
- Static head
  S_{x2}, S_{y2}
- static gravity loads
  S_{x3}, S_{s1}
- vertical acceleration
  S_{x4}, S_{s2}
- longitudinal deceleration created by tractor braking
  S_{x10}, S_{x11}
- lateral acceleration
  S_{x9}, S_{s3}, S_{s4}

The loading combinations that should be considered for extreme dynamic loadings include:

COMB. EA - Combined stresses due to:

- pressure/vacuum (if appropriate)
  S_{x1}, S_{y1}
- static head
  S_{x2}, S_{y2}
- static gravity loads
  S_{x3}, S_{s1}
- longitudinal deceleration created by trailer braking
  S_{x5}, S_{x6}

COMB. EB - Combined stresses due to:

- pressure/vacuum (if appropriate)
  S_{x1}, S_{y1}
- static gravity loads
  S_{x3}, S_{s1}
- static head

S_{x2}, S_{y2}
- longitudinal acceleration
  S_{x7}, S_{x8}

COMB. EC - Combined stresses due to:
- pressure/vacuum (if appropriate)
  S_{x1}, S_{y1}
- static gravity loads
  S_{x3}, S_{s1}
- static head
  S_{x2}, S_{y2}
- longitudinal deceleration created by tractor braking
  S_{x10}, S_{x11}

COMB. ED - Combined stresses due to:
- pressure/vacuum (if appropriate)
  S_{x1}, S_{y1}
- static gravity loads
  S_{x3}, S_{s1}
- static head
  S_{x2}, S_{y2}
- vertical acceleration
  S_{x4}, S_{s2}

COMB. EE - Combined stresses due to:
- pressure/vacuum (if appropriate)
  S_{x1}, S_{y1}
- static head
  S_{x2}, S_{y2}
- static gravity loads
  S_{x3}, S_{s1}
- lateral acceleration
  S_{x9}, S_{s3}, S_{s4}

The effective stress (maximum/minimum principal stress) at any point must be determined for appropriate combinations of static and normal operating loadings, and combinations of static and extreme dynamic loadings using the following stress transformation equation in Section 178.345-3.

$$S = 0.5(S_x+S_y) \pm [0.25(S_x-S_y)^2+S_s^2]^{0.5}$$

Example 23. Structural integrity analysis of DOT 412 cargo tank.

Weight of Tank Shell = W_s = 5,400 lbs.
Weight of Tractor = W_{Tr} = 17,500 lbs.
Max. Weight of Lading = W_L = 60,000 lbs.
Max. Weight of Tank Plus Lading = W_T = 65,400 lbs.
Lading is Muriatic Acid With Specific Gravity γ = 1.2
Weight of Undercarriage = W_u = 8,000 lbs.
Thickness of Tank Wall = t = 0.219 inches
MAWP = P_m = 45 psi
Material = SA 240/316L
H_k = 35 inches
H_v = 85 inches
Outside diameter of tank = 60 inches

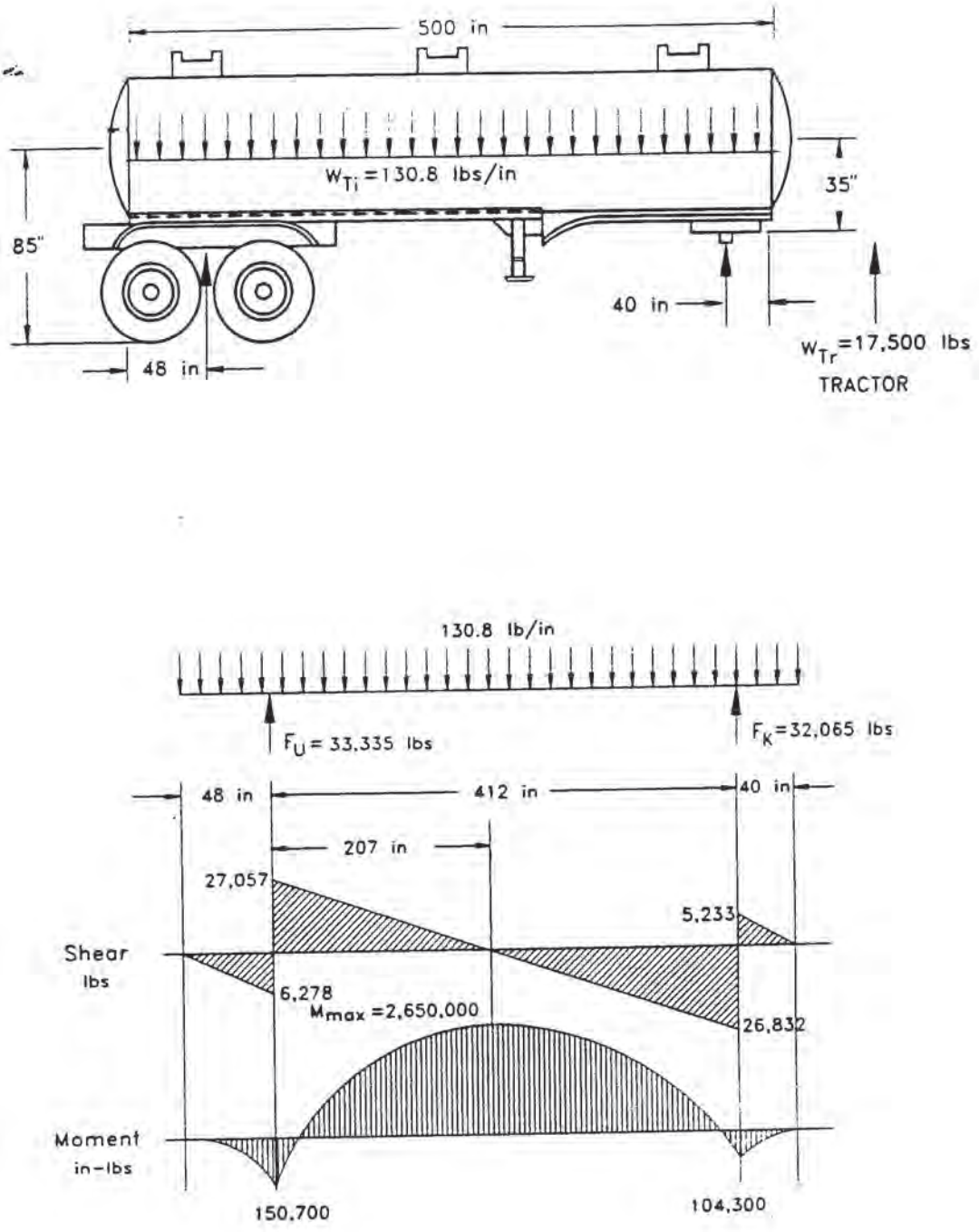


Figure 28. Load, shear and moment diagrams for example 23.

(1) Determine Reactions

- Weight uniformly distributed
- No major appurtances (>1,000 lbs.)
- Weight per inch, $W_{Ti} = W_T/L = 65,400/500 = 130.8$ lbs/in.

$\Sigma M_{FU} = 65,400\ (500/2-48) - F_k(500-40-48) = 0$

$F_k = 32,065$ lbs.

$F_u = 33,335$ lbs.

(2) Locate Point of Maximum Moment.

- at point where shear (V)=0

L_{max} at 33,335/130.8 = 255 inches from rear of tank
or 27,057/130.8 = 207 inches from rear support.

(3) If no weld is at or near the center of the tank or the joint efficiency is 1.0, stresses should be analyzed at the sections of maximum moment and maximum shear at the top, bottom and side centerline of the tank.

(4) Stresses Due to Internal Pressure

Circumferential Stress

$S_{y1} = PR_i/t + 0.6P = [45(29.78)/.219]+.6(45)$

$S_{y1} = 6,146$ psi

$S_{y1} = 6,146$ psi at top, bottom and side centerline

Longitudinal Stress

$S_{x1} = PR_i/2t - .2P = [45(29.78)/2(.219)]-.2(45)$

$S_{x1} = 3,051$ psi

$S_{x1} = 3,051$ psi and acts at top, bottom and side centerline of tank.

(5) Stress Due to Static Head

- At bottom of tank

$P = (D_i/12)(.433)\gamma = (59.56/12)(.433)(1.2) = 2.58$ psi

$S_{y2} = PR_i/t + .6P = [2.58(29.78)/.219]+.6(2.58) = 352$ psi

$S_{x2} = PR_i/2t - .2P = [2.58(29.78)/2(.219)]-.2(2.58) = 175$ psi

	S_{y2}	S_{x2}
At Bottom	352 psi	175 psi
At Side Centerline	352/2 = 176 psi	175/2 = 87 psi
At Top	0 psi	0 psi

(6) Static Shear Stress Due to Static Weight.

$S_{s1} = V_{max}/(0.5A)$

$A = \pi(R_o^2-R_i^2) = 41.3$ in^2

$S_{s1} = 27,057/[0.5(41.3]$

$S_{s1} = 1,310$ psi

$S_{s1} = 0$ at top and bottom

$S_{s1} = 1,310$ psi at side centerline

(7) Bending Stress Due to Static Weight

Maximum Moment

$M_{max} = 2,650,000$ in-lbs.

Section Properties

$I = (\pi/4)(R_o^4-R_i^4) = (\pi/4)(30^4-29.78^4)$

$I = 18,457$ in^4

$c = 30$ inches

$Z_e = I/c = 18,457/30 = 615.2$ in^3

$S_{x3} = M_{max}/Z_e = 2,650,000/615.2$

$S_{x3} = 4,308$ psi

$S_{x3} = 4,308$ psi on bottom

$S_{x3} = 0$ at side centerline

$S_{x3} = -4,308$ psi on top

(8) Axial Stress Due to Normal Longitudinal Acceleration.

Factor, $F_l = 0.35$
$S_{x7} = .35F_k/A = .35(32,065/41.3)$
$S_{x7} = 272$ psi at top, bottom and side centerline

(9) Bending Stress due to Normal Longitudinal Acceleration.

Factor, $F_l = 0.35$
$S_{x8} = M/Z_e = 0.35F_kH_k/Z_e$
$S_{x8} = 0.35(32,065)35/615.2$
$S_{x8} = 638$ psi
$S_{x8} = 638$ at bottom
$S_{x8} = 0$ at side centerline
$S_{x8} = -638$ at top

(10) Axial Stress Due to Normal Longitudinal Deceleration. Trailer braking only

Factor, $F_l = 0.35$
$S_{x5} = F/A = .35(F_u+W_u)/A$
$S_{x5} = .35(33,335+8,000)/41.3$
$S_{x5} = 350$ psi at top, bottom and side centerline

(11) Bending Stress Due to Normal Longitudinal Deceleration. Trailer braking only

Factor, $F_l = .35$
$S_{x6} = M/Z_e = [0.35(F_u+W_u)(H_v)]/Z_e$
$S_{x6} = [0.35(33,335+8,000)(85)]/615.2$
$S_{x6} = 1,999$ psi
$S_{x6} = 1,999$ psi at bottom
$S_{x6} = 0$ at side centerline
$S_{x6} = -1,999$ psi at top

(12) Axial Stress Due to Normal Longitudinal Deceleration. Tractor braking only.

Factor, $F_1 = 0.35$

$S_{x10} = F/A = 0.35(F_k+W_{Tr})/A$

$S_{x10} = 0.35(32,065+17,500)/41.3$

S_{x10} = -420 psi at top, bottom and side centerline

(13) Bending Stress Due to Normal Longitudinal Deceleration. Tractor braking only.

Factor, $F_1 = 0.35$

$S_{x11} = M_{max}/Z_e$

where: $M_{max} = 0.35(F_k+W_{Tr})H_k$

$M_{max} = 0.35(32,065+17,500)(35)$

M_{max} = 607,000 in-lbs.

$S_{x11} = 607,000/615.2$

S_{x11} = 987 psi

S_{x11} = -987 psi at bottom

S_{x11} = 0 psi at side centerline

S_{x11} = 987 psi at top

(14) Bending Stresses Due to Normal Vertical Acceleration.

Factor, $F_2 = 0.35$

$S_{x4} = M_{max}/Z_e$

where: $M_{max} = (0.35)(2,650,000)$

$S_{x4} = 0.35(2,650,000)/615.2$

S_{x4} = 1,508 psi

S_{x4} = 1,508 psi at bottom

S_{x4} = 0 at side centerline

S_{x4} = -1,508 psi at top

(15) Bending Stresses Due to Normal Lateral Acceleration.

Factor, $F_3 = 0.2$

$S_{x9} = M_{max}/Z_e$

where: $M_{max} = (0.2)(2,650,000)$

$S_{x9} = (0.2)(2{,}650{,}000)/615.2$

$S_{x9} =$

$S_{x9} = \pm 862$ psi (tension on one side and compression on other side)

For some tanks, the value of Z_e for lateral bending might differ from that for vertical bending.

(16) Shear Stress Due to Normal Vertical Acceleration.

Factor, $F_2 = 0.35$

$S_{s2} = V_{max}/(0.5A)$

$S_{s2} = 0.35(27{,}057)/[0.5(41.3)]$

$S_{s2} = 459$ psi

$S_{s2} = 0$ at top and bottom

$S_{s2} = 459$ psi at side centerline

(17) Shear Stress Due to Normal Lateral Acceleration.

Factor, $F_3 = 0.2$

$S_{s3} = V_{max}/(0.5A)$

$S_{s3} = 0.2(27{,}057)/[0.5(41.3)]$

$S_{s3} = 262$ psi

$S_{s3} = 262$ psi at top and bottom

$S_{s3} = 0$ at side centerline

(18) Torsional Shear Stress Due to Normal Lateral Accelerative Force.

Factor, $F_3 = 0.2$

$T = 0.2(W_u+F_u)H_v$

$T = 0.2(8{,}000+33{,}335)(85)$

$T = 702{,}695$ in-lbs.

$J = 2\pi R_{avg}{}^3 t$

where: $R_{avg} = (30+29.78)/2 = 29.89$ inches

$J = 2\pi(29.89)^3(.219)$

$J = 36{,}745$ in^4

$S_{s4} = TR_o/J$

S_{s4} = 702,695(30)/36,745
S_{s4} = 574 psi
S_{s4} = 574 psi at top, bottom and side centerline

Extreme Dynamic Loads

(19) Axial Stress Due to Extreme Longitudinal Acceleration.

Factor, F_l = 0.70
$S_{x7} = 0.7F_k/A$
S_{x7} = 0.7(32,065)/41.3
S_{s7} = 543 psi at top, bottom and side centerline

(20) Bending Stresses Due to Extreme Longitudinal Acceleration.

Factor, F_l = 0.70
$S_{x8} = M/Z_e = 0.7F_kH_k/Z_e$
S_{x8} = 0.7(32,065)(35)/615.2
S_{x8} = 1,277 psi
S_{x8} = 1,277 psi at bottom
S_{x8} = 0 at side centerline
S_{x8} = -1,277 psi at top

(21) Axial Stress Due to Extreme Longitudinal Deceleration. Trailer braking only

Factor, F_l = 0.7
$S_{x5} = F/A = 0.7(F_u+W_u)/41.3$
S_{x5} = 0.7(33,335+8,000)/41.3
S_{x5} = 701 psi at top, bottom and side centerline

(22) Bending Stress Due to Extreme Longitudinal Deceleration. Trailer braking only

Factor, F_l = 0.7
$S_{x6} = M/Z_e = [0.7(F_u+W_u)(H_v)]/Z_e$

S_{x6} = 0.7(33,335+8,000)(85)/615.2
S_{x6} = 3,998 psi
S_{x6} = 3,998 psi at bottom
S_{x6} = 0 at side centerline
S_{x6} = -3,998 psi at top

(23) Axial Stress Due to Extreme Longitudinal Deceleration. Tractor braking only.

Factor, F_1 = 0.7
S_{x10} = F/A = 0.7(32,065+17,500)/41.3
S_{x10} = -840 psi (compression) at top, bottom and side centerline

(24) Bending Stress Due to Extreme Longitudinal Deceleration. Tractor braking only.

Factor, F_1 = 0.7
$S_{x11} = M_{max}/Z_e$
where: $M_{max} = 0.7(F_k+W_{Tr})H_k$
M_{max} = 0.7(32,065+17,500)(35)
M_{max} = 1,214,000 in-lbs.
S_{x11} = 1,214,000/615.2
S_{x11} = 1,973 psi
S_{x11} = -1,973 at bottom
S_{x11} = 0 psi at side centerline
S_{x11} = 1,973 psi at top

(25) Bending Stresses Due to Extreme Vertical Acceleration.

Factor, F_2 = 0.7
$S_{x4} = M_{max}/Z_e$
where: M_{max} = (0.7)(2,650,000) in-lbs.
S_{x4} = (0.7)(2,650,000)/615.2
S_{x4} = 3,015 psi
S_{x4} = 3,015 psi at bottom
S_{x4} = 0 at side centerline
S_{x4} = -3,015 psi at top

(26) Shear Stress Due to Extreme Vertical Acceleration.

Factor, $F_2 = 0.7$
$S_{s2} = V_{max}/0.5A = 0.7(27,057)/0.5(41.3)$
$S_{s2} = 917$ psi
$S_{s2} = 0$ at top and bottom
$S_{s2} = 917$ psi at side centerline

(27) Shear Stress Due to Extreme Lateral Acceleration.

Factor, $F_3 = 0.4$
$S_{s3} = 0.4(V_{max})/.5A$
$S_{s3} = 0.4(27,057)/.5(41.3)$
$S_{s3} = 524$ psi
$S_{s3} = 524$ psi at top and bottom
$S_{s3} = 0$ psi at side centerline

(28) Torsional Shear Stress Due to Extreme Lateral Acceleration.

Factor, $F_3 = 0.4$
$T = 0.4(W_u+F_u)H_v$
$T = 0.4(33,335+8,000)(85)$
$T = 1,405,390$ in-lbs.
$J = 36,745$ in^4 from Part 17
$S_{s4} = TR_o/J$
$S_{s4} = 1,405,390(30)/36,745$
$S_{s4} = 1,147$ psi
$S_{s4} = 1,147$ psi at top, bottom and side centerline

(29) Bending Stress Due to Extreme Lateral Acceleration.

Factor, $F_3 = 0.4$
$S_{x9} = M_{max}/Z_e$ (about vertical axis)
where: $M_{max} = 0.4(2,650,000)$
$M_{max} = 1,060,000$ in-lbs.
$Z_e = 615.2$ in^3 (assumed same as for vertical bending)
$S_{x9} = 1,060,000/615.2$
$S_{x9} = \pm 1,723$ psi at side centerlines

Table 2. Summary of Stresses Due to Static Loads

Load Description	Stress Designation	Normal Stress (psi)			Shear Stress (psi)		
		Bottom	Centerline	Top	Bottom	Centerline	Top
Internal Pressure	S_{y1} S_{x1}	6,146 3,051	6,146 3,051	6,146 3,051	— —	— —	— —
Static Head	S_{X2} S_{y2}	175 352	87 176	0 0	— —	— —	— —
Static Weight	S_{X3} S_{S1}	4,308 —	0 —	-4,308 —	— 0	— 1,310	— —

Table 3. Summary of Stresses Due to Normal Operating Loads.

Load Description	Stress Designation	Normal Stress (psi)			Shear Stress (psi)		
		Bottom	Centerline	Top	Bottom	Centerline	Top
Longitudinal Acceleration	S_{X7} S_{X8}	272 638	272 0	272 -638	— —	— —	— —
Longitudinal Deceleration (Trailer Braking Only)	S_{X5} S_{X6}	350 1,999	350 0	350 -1,999	— —	— —	— —
Longitudinal Deceleration (Tractor Braking Only)	S_{X10} S_{S11}	-420 -987	-420 0	-420 987	— —	— —	— —
Vertical Acceleration	S_{X4} S_{S2}	1,508 —	0 —	-1,508 —	— 0	— 459	— 0
Lateral Acceleration	S_{X9} S_{S3} S_{S4}	0 — —	±862 — —	0 — —	— 262 574	— 0 574	— 262 574

Table 4. Summary of Stresses Due to Extreme Dynamic Loads.

Load Description	Stress Designation	Normal Stress (psi)			Shear Stress (psi)		
		Bottom	Centerline	Top	Bottom	Centerline	Top
Longitudinal Acceleration	S_{X7} S_{X8}	543 1,277	543 0	543 -1,277	--- ---	--- ---	--- ---
Longitudinal Deceleration (Trailer Braking Only)	S_{X5} S_{X6}	701 3,998	701 0	701 -3,998	--- ---	--- ---	--- ---
Longitudinal Deceleration (Tractor Braking Only)	S_{X10} S_{S11}	-840 -1,973	-840 0	-840 1,973	--- ---	--- ---	--- ---
Vertical Acceleration	S_{X4} S_{S2}	3,015 ---	0 ---	-3,015 ---	--- 0	--- 917	--- 0
Lateral Acceleration	S_{X9} S_{S3} S_{S4}	0 --- ---	±1,723 --- ---	0 --- ---	--- 524 1,147	--- 0 1,147	--- 524 1,147

Principal stresses for the appropriate and required combinations of loads can be computed using the stress transformation equation as illustrated on the following pages.

Static Design (Must comply with ASME Code)

COMB. SA:

At bottom of tank at maximum moment with internal pressure:

$S_x = S_{x1} + S_{x2} + S_{x3}$
$S_x = 3,051 + 175 + 4,308$
$S_x = 7,534$ psi
$S_y = S_{y1} + S_{y2}$
$S_y = 6,146 + 352$
$S_y = 6,498$ psi
$S_s = 0$ psi
$S = 7,534$ psi (tension)

At top of tank at maximum moment with internal pressure:

$S_x = S_{x1} + S_{x3}$
$S_x = 3,051 - 4,308$
$S_x = -1,257$ psi
$S_y = 6,146$ psi
$S_s = 0$ psi
$S = 6,147$ psi (tension)
$S = -1,257$ psi (compression)

At top of tank at maximum moment without internal pressure:

$S_x = S_{x3}$
$S_x = -4,308$ psi
$S_y = 0$ psi
$S_s = 0$ psi
$S = -4,308$ psi (compression)

Normal Operating Loadings

COMB. NA: (Usual loads with trailer braking)

At bottom of tank at maximum moment:

$S_x = S_{x1} + S_{x2} + S_{x3} + S_{x4} + S_{x5} + S_{x6}$

$S_x = 3,051 + 175 + 4,308 + 1,508 + 350 + 1,999$

$S_x = 11,391$ psi

$S_y = S_{y1} + S_{y2}$

$S_y = 6,146 + 352$

$S_y = 6,498$ psi

$S_s = S_{s4}$

$S_s = 574$ psi

$S = 0.5(S_x+s_y) \pm (0.25(S_x-S_y)^2+S_s^2)^{0.5}$

$S = 0.5(11,391+6,498) \pm (0.25(11,391-6,498)^2+574^2)^{0.5}$

$S = 8,945 \pm 2,513$

$S = 11,458$ psi (tension)

At top of tank at maximum moment without internal pressure:

$S_x = S_{x2} + S_{x3} + S_{x4} + S_{x5} + S_{x6}$

$S_x = 0 -4,308 -1,508 + 350 -1,999$

$S_x = -7,465$ psi

$S_y = 0$ psi

$S_s = S_{s4}$

$S_s = 574$ psi

$S = 0.5(S_x+S_y) \pm (0.25(S_x-S_y)^2+S_s^2)^{0.5}$

$S = 0.5(-7,465) \pm (0.25(-7,465)^2+574^2)^{0.5}$

$S = -3,733 \pm 3,776$

$S = -7,509$ psi (compression)

COMB. NB: (Usual loads with tractor accelerating)

At bottom of tank at maximum moment:

$S_x = S_{x1} + S_{x2} + S_{x3} + S_{x4} + S_{x7} + S_{x8}$

$S_x = 3,051 + 175 + 4,308 + 1,508 + 272 + 638$

$S_x = 9,952$ psi

$S_y = S_{y1} + S_{y2}$

$S_y = 6,146 + 352$

$S_y = 6,498$ psi

$S_s = S_{s4}$

$S_s = 574$ psi

$S = 0.5(S_x+S_y) \pm (0.25(S_x-S_y)^2+S_s^2)^{0.5}$

$S = 0.5(9,952+6,498) \pm (0.25(9,952-6,498)^2+574^2)^{0.5}$

$S = 8,225 \pm 1,820$

$S = 10,045$ psi (tension)

At top of tank at maximum moment with internal pressure:

$S_x = S_{x1} + S_{x3} + S_{x4} + S_{x7} + S_{x8}$

$S_x = 3,051 - 4,308 - 1,508 + 272 - 638$

$S_x = -3,131$ psi

$S_y = S_{y1}$

$S_y = 6,146$

$S_s = S_{s4}$

$S_s = 574$

$S = 0.5(S_x+S_y) \pm (0.25(S_x-S_y)^2+S_s^2)^{0.5}$

$S = 0.5(-3,131+6,146) \pm (0.25(-3,131-6,146)^2+574^2)^{0.5}$

$S = 1,508 \pm 4,674$

$S = -3,166$ psi (compression)

$S = 6,182$ psi (tension)

At top of tank at maximum moment without internal pressure:

$S_x = S_{x3} + S_{x4} + S_{x7} + S_{x8}$

$S_x = -4,308 - 1,508 + 272 - 638$

$S_x = -6,182$ psi

$S_y = 0$ psi

$S_s = S_{s4}$

$S_s = 574$ psi

$S = 0.5(S_x+S_y) \pm (0.25(S_x-S_y)^2+S_s^2)^{0.5}$

$S = 0.5(-6,182) \pm (0.25(-6,182)^2+574^2)^{0.5}$

$S = -3,091 \pm 3,144$

$S = -6,235$ psi (compression)

COMB. NC: (Usual loads with tractor braking)

At bottom of tank at maximum moment with internal pressure:

$S_x = S_{x1} + S_{x2} + S_{x3} + S_{x4} + S_{x10} + S_{x11}$
$S_x = 3,051 + 175 + 1,508 + 4,308 -420 -987$
$S_x = 7,635$ psi
$S_y = S_{y1} + S_{y2}$
$S_y = 6,146 + 352$
$S_y = 6,498$ psi
$S_s = S_{s4}$
$S_s = 574$

$S = 0.5(S_x+S_y) \pm (0.25(S_x-S_y)^2+S_s^2)^{0.5}$
$S = 0.5(7,635+6,498) \pm (0.25(7,635-6,498)^2+574^2)^{0.5}$
$S = 7,067 \pm 808$
$S = 7,875$ psi (tension)

At bottom of tank at maximum moment without internal pressure:

$S_x = S_{x2} + S_{x3} + S_{x4} + S_{x10} + S_{x11}$
$S_x = 175 + 4,308 + 1,508 -420 -987$
$S_x = 4,584$ psi
$S_y = S_{y2}$
$S_y = 352$ psi
$S_s = S_{s4}$
$S_s = 574$

$S = 0.5(S_x+S_y) \pm (0.25(S_x-S_y)^2+S_s^2)^{0.5}$
$S = 0.5(4,584+352) \pm (0.25(4,584-352)^2+574^2)^{0.5}$
$S = 2,468 \pm 2,192$
$S = 4,660$ psi (tension)

At top of tank at maximum moment with internal pressure:

$S_x = S_{x1} + S_{x3} + S_{x4} + S_{x10} + S_{x11}$
$S_x = 3,051 -4,308 -1,508 -420 +987$
$S_x = -2,198$ psi
$S_y = S_{y1}$
$S_y = 6,146$ psi
$S_s = S_4$
$S_s = 574$

$S = 0.5(S_x+S_y) \pm (0.25(S_x-S_y)^2+S_s^2)^{0.5}$

$$S = 0.5(-2,198+6,146) \pm (0.25(-2,198-6,146)^2+574^2)^{0.5}$$
$$S = 1,974 \pm 4,211$$
$$S = 6,185 \text{ psi (tension)}$$
$$S = 2,237 \text{ psi (compression)}$$

At top of tank at maximum moment without internal pressure:

$$S_x = S_{x3} + S_{x4} + S_{x10} + S_{x11}$$
$$S_x = -4,308 -1,508 -420 + 987$$
$$S_x = -5,249 \text{ psi}$$
$$S_y = 0 \text{ psi}$$
$$S_s = S_{s4}$$
$$S_s = 574$$
$$S = 0.5(S_x+S_y) \pm (0.25(S_x-S_y)^2+S_s^2)^{0.5}$$
$$S = 0.5(-5,249+0) \pm (0.25(-5,249-0)^2+574^2)^{0.5}$$
$$S = -2,625 \pm 2,686$$
$$S = -5,311 \text{ psi (compression)}$$

Extreme Dynamic Loadings

COMB. EA: (Static loads with trailer braking)

At bottom of tank at maximum moment:

$$S_x = S_{x1} + S_{x2} + S_{x3} + S_{x5} + S_{x6}$$
$$S_x = 3,051 + 175 + 4,308 + 701 + 3,998$$
$$S_x = 12,233 \text{ psi}$$
$$S_y = S_{y1} + S_{y2} = 6,146 + 352$$
$$S_y = 6,498 \text{ psi}$$
$$S_s = 0 \text{ psi}$$
$$S = 12,233 \text{ psi (tension)}$$

At top of tank at maximum moment with internal pressure:

$$S_x = S_{x1} + S_{x2} + S_{x3} + S_{x5} + S_{x6}$$
$$S_x = 3,051 + 175 -4,308 + 701 + 3,998$$
$$S_x = 3,617 \text{ psi}$$
$$S_y = S_{y1}$$
$$S_y = 6,146 \text{ psi}$$

S_s = 0 psi

S = 3,617 psi (tension)

and S = 6,146 psi (tension)

At top of tank at maximum moment without internal pressure:

$S_x = S_{x3} + S_{x5} + S_{x6}$

S_x = -4,308 + 701 -3,998

S_x = -7,605 psi

S_y = 0 psi

S_s = 0 psi

S = -7,605 psi (compression)

COMB. EB: (Static loads with tractor accelerating)

At bottom of tank at maximum moment:

$S_x = S_{x1} + S_{x2} + S_{x3} + S_{x7} + S_{x8}$

S_x = 3,051 + 175+ 4,308 + 543 + 1,277

S_x = 9,354 psi

$S_y = S_{y1} + S_{y2}$ = 6,146 + 352

S_y = 6,498 psi

S_s = 0 psi

S = 9,354 psi (tension)

At top of tank at maximum moment with internal pressure:

$S_x = S_{x1} + S_{x3} + S_{x7} + S_{x8}$

S_x = 3,051 -4,308 + 543 -1,277

S_x = -1,991 psi

$S_y = S_{y1}$

S_y = 6,146 psi

S_s = 0 psi

S = 6,146 psi (tension)

or S = -1,991 psi (compression)

At top of tank at maximum moment without internal pressure:

$S_x = S_{x3} + S_{x7} + S_{x8}$

S_x = -4,308 + 543 -1,277

S_x = -5,042 psi

S_y = 0 psi

S_s = 0 psi

S = 0 psi (tension)

or S = -5,042 psi (compression)

COMB. EC: (Static loads with tractor braking)

At bottom of tank at maximum moment with internal pressure:

$S_x = S_{x1} + S_{x2} + S_{x3} + S_{x10} + S_{x11}$

S_x = 3,051 + 175+ 4,308 -840 -1,973

S_x = 4,721 psi

$S_y = S_{y1} + S_{y2}$ = 6,146 + 352

S_y = 6,498 psi

S_s = 0 psi

S = 6,498 psi (tension)

At bottom of tank at maximum moment without internal pressure:

$S_x = S_{x2} + S_{x3} + S_{x10} + S_{x11}$

S_x = 175 + 4,308 -840 -1,973

S_x = 1,670 psi

$S_y = S_{y2}$ = 352 psi

S_s = 0 psi

S = 1,670 psi (tension)

At top of tank at maximum moment with internal pressure:

$S_x = S_{x1} + S_{x3} + S_{x10} + S_{x11}$

S_x = 3,051 -4,308 -840 + 1,973

S_x = -124 psi

$S_y = S_{y1}$

S_y = 6,146 psi

S_s = 0 psi

S= 6,146 psi (tension)

At top of tank at maximum moment without internal pressure:

$S_x = S_{x3} + S_{x10} + S_{x11}$

S_x = -4,308 -840 +1,973

S_x = -3,175 psi

S_y = 0 psi

S_s = 0 psi

$S = -3{,}175$ psi (compression)

COMB. ED: (Static loads with vertical acceleration)

At bottom of tank at maximum moment with internal presssure:

$S_x = S_{x1} + S_{x2} + S_{x3} + S_{x4}$
$S_x = 3{,}051 + 175 + 4{,}308 + 3{,}015$
$S_x = 10{,}549$ psi
$S_y = S_{y1} + S_{y2} = 6{,}146 + 352$
$S_y = 6{,}498$ psi
$S_s = 0$ psi
$S = 10{,}549$ psi (tension)

At top of tank at maximum moment without internal pressure:

$S_x = S_{x3} + S_{x4}$
$S_x = -4{,}308 - 3{,}015$
$S_x = -7{,}323$ psi
$S_y = 0$ psi
$S_s = 0$ psi
$S = -7{,}323$ psi (compression)

COMB. EE: (Static loads with lateral acceleration)

At bottom of tank at maximum moment with internal pressure:

$S_x = S_{x1} + S_{x2} + S_{x3}$
$S_x = 3{,}051 + 175 + 4{,}308$
$S_x = 7{,}534$ psi
$S_y = S_{y1} + S_{y2} = 6{,}146 + 352$
$S_y = 6{,}498$ psi
$S_s = S_{s4}$
$S_s = 1{,}147$ psi
$S = 0.5(S_x+S_y) \pm (0.25(S_x-S_y)^2+S_s^2)^{0.5}$
$S = 0.5(7{,}534+6{,}498) \pm (0.25(7{,}534-6{,}498)^2+1{,}147^2)^{0.5}$
$S = 7{,}016 \pm 1{,}259$
$S = 8{,}275$ psi (tension)

At top of tank at maximum moment with internal pressure:

$S_x = S_{x1} + S_{x3}$

$S_x = 3,051 - 4,308$

$S_x = -1,257$ psi

$S_y = S_{y1}$

$S_y = 6,146$ psi

$S_s = S_{s4}$

$S_s = 1,147$

$S = 0.5(S_x+S_y) \pm (0.25(S_x-S_y)^2+S_s^2)^{0.5}$

$S = 0.5(-1,257+6,146) \pm (0.25(-1,257-6,146)^2+1,147^2)^{0.5}$

$S = 2,445 \pm 3,875$

$S = 6,320$ psi (tension)

or $S = -1,431$ psi (compression)

At tension side of tank at maximum moment with internal pressure:

$S_x = S_{x1} + S_{x2} + S_{x9}$

$S_x = 3,051 + 87 + 1,723$

$S_x = 4,861$ psi

$S_y = S_{y1} + S_{y2} = 6,146 + 176$

$S_y = 6,322$ psi

$S_s = S_{s4}$

$S_s = 1,147$ psi

$S = 0.5(S_x+S_y) \pm (0.25(S_x-S_y)^2+S_s^2)^{0.5}$

$S = 0.5(4,861+6,322) \pm (0.25(4,861-6,322)^2+1,147^2)^{0.5}$

$S = 5,591 \pm 1,360$

$S = 6,951$ psi (tension)

At compression side of tank at maximum lateral moment with internal pressure:

$S_x = S_{x1} + S_{x2} + S_{x9}$

$S_x = 3,051 + 87 - 1,723$

$S_x = 1,415$ psi

$S_y = S_{y1} + S_{y2} = 6,146 + 176$

$S_y = 6,322$ psi

$S_s = S_{s4}$

$S_s = 1,147$ psi

$S = 0.5(S_x+S_y) \pm (0.25(S_x-S_y)^2+S_s^2)^{0.5}$

$S = 0.5(1,415+6,322) \pm (0.25(1,415-6,322)^2+1,147^2)^{0.5}$

$S = 3,869 \pm 2,708$

$S = 6,577$ psi (tension)

At compression side of tank at maximum lateral moment without internal pressure:

$S_x = S_{x2} + S_{x9}$
$S_x = 87 - 1{,}723$
$S_x = -1{,}636$ psi
$S_y = S_{y2} = 176$ psi
$S_s = S_{s4}$
$S_s = 1{,}147$ psi

$S = 0.5(S_x+S_y) \pm (0.25(S_x-S_y)^2+S_s^2)^{0.5}$
$S = 0.5(-1{,}636+176) \pm (0.25(-1{,}636-176)^2+1{,}147^2)^{0.5}$
$S = -730 \pm 1{,}462$
$S = -2{,}192$ psi (compression)

At bottom of tank adjacent to F_u with internal pressure:

$S_x = S_{x1} + S_{x2}$
$S_x = 3{,}051 + 175$
$S_x = 3{,}226$ psi
$S_y = S_{y1} + S_{y2} = 6{,}146 + 352$
$S_y = 6{,}498$ psi
$S_s = S_{s3} + S_{s4}$
$S_s = 524 + 1{,}147$
$S_s = 1{,}671$ psi

$S = 0.5(S_x+S_y) \pm (0.25(S_x-S_y)^2+S_s^2)^{0.5}$
$S = 0.5(3{,}226+6{,}498) \pm (0.25(3{,}226-6{,}498)^2+1{,}671^2)^{0.5}$
$S = 4{,}862 \pm 2{,}339$
$S = 7{,}201$ psi (tension)

At top of tank adjacent to F_u with internal pressure:

$S_x = S_{x1}$
$S_x = 3{,}051$ psi
$S_y = S_{y1}$
$S_y = 6{,}146$ psi
$S_s = S_{s3} + S_{s4}$
$S_s = 524 - 1{,}147$
$S_s = -623$ psi

$S = 0.5(S_x+S_y) \pm (0.25(S_x-S_y)^2+S_s^2)^{0.5}$
$S = 0.5(3{,}051+6{,}146) \pm (0.25(3{,}051-6{,}146)^2+623^2)^{0.5}$
$S = 4{,}599 \pm 1{,}668$

$S = 6{,}267$ psi (tension)

At side of tank adjacent to F_u with internal pressure:

$S_x = S_{x1} + S_{x2}$

$S_x = 3{,}051 + 87$

$S_x = 3{,}138$ psi

$S_y = S_{y1} + S_{y2} = 6{,}146 + 176$

$S_y = 6{,}322$ psi

$S_s = S_{s1} + S_{s4}$

$S_s = 1{,}310 + 1{,}147$

$S_s = 2{,}457$ psi

$S = 0.5(S_x+S_y) \pm (0.25(S_x-S_y)^2+S_s^2)^{0.5}$

$S = 0.5(3{,}138+6{,}322) \pm (0.25(3{,}138-6{,}322)^2+2{,}457^2)^{0.5}$

$S = 4{,}730 \pm 2{,}928$

$S = 7{,}658$ psi (tension)

CHAPTER 6. BOTTOM DAMAGE PROTECTION

Specifications for bottom damage protection are contained in §178.345-8(b). If bottom damage protection devices are used they must be able to withstand or deflect away from the cargo tank a force of 155,000 pounds (based on the ultimate strength of the material) from the front, side, or rear. Additional details are provided in the DOT Regulations.

The analysis procedure(s) to be employed to evaluate bottom damage protection devices is dependent upon the structure of the device. The device should be idealized appropriately and appropriate structural analysis procedures should be employed.

If an outlet, projection or piping is located in the lower 1/3 of the tank at the rear of the tank and it is protected by the rear-end protection device, the rear-end protection device must meet bottom damage protection requirements in addition to rear-end protection requirements.

CHAPTER 7. ROLLOVER DAMAGE PROTECTION

Criteria for DOT 406, DOT 407, DOT 412 cargo tank motor vehicles are included in §178.345-8(c). This section requires that the guards

> "...must be designed and installed to withstand loads equal to twice the weight of the loaded cargo tank motor vehicle applied as follows: normal to the tank shell (perpendicular to the tank surface); and tangential (perpendicular to the normal load) from any direction. The stresses shall not exceed the ultimate strength of the material of construction. These design loads may be considered to be uniformly distributed and independently applied. If more than one rollover protection device is used, each device must be capable of carrying its proportionate share of the required loads and in each case at least one-fourth the total tangential load. The design must be proven capable of carrying the required loads by calculations, tests or a combination of tests and calculations."

Analysis Procedures

One common type of rollover damage protection device is an inverted "U" shaped member made of tubular elements as shown in figure 29. The devices are frequently installed at a stiffened cross section of the tank. In some designs, gusset plates are used between the tank wall and the rollover device to increase capacity to carry horizontal longitudinal load. Some designs have used a third leg to increase capacity.

The two-legged inverted "U" devices behave as a frame when subjected to vertical load or horizontal transverse load. Such frames can be analyzed using moment distribution procedures, frame analysis equations from Roarke and Young, approximate methods for frames, or finite element methods. For horizontal longitudinal load, these two-legged devices can be idealized as cantilever beams.

A difficulty, common to all of the suggested methods of analysis, is idealization of the strength and stiffness of the tank at its juncture with the rollover device.

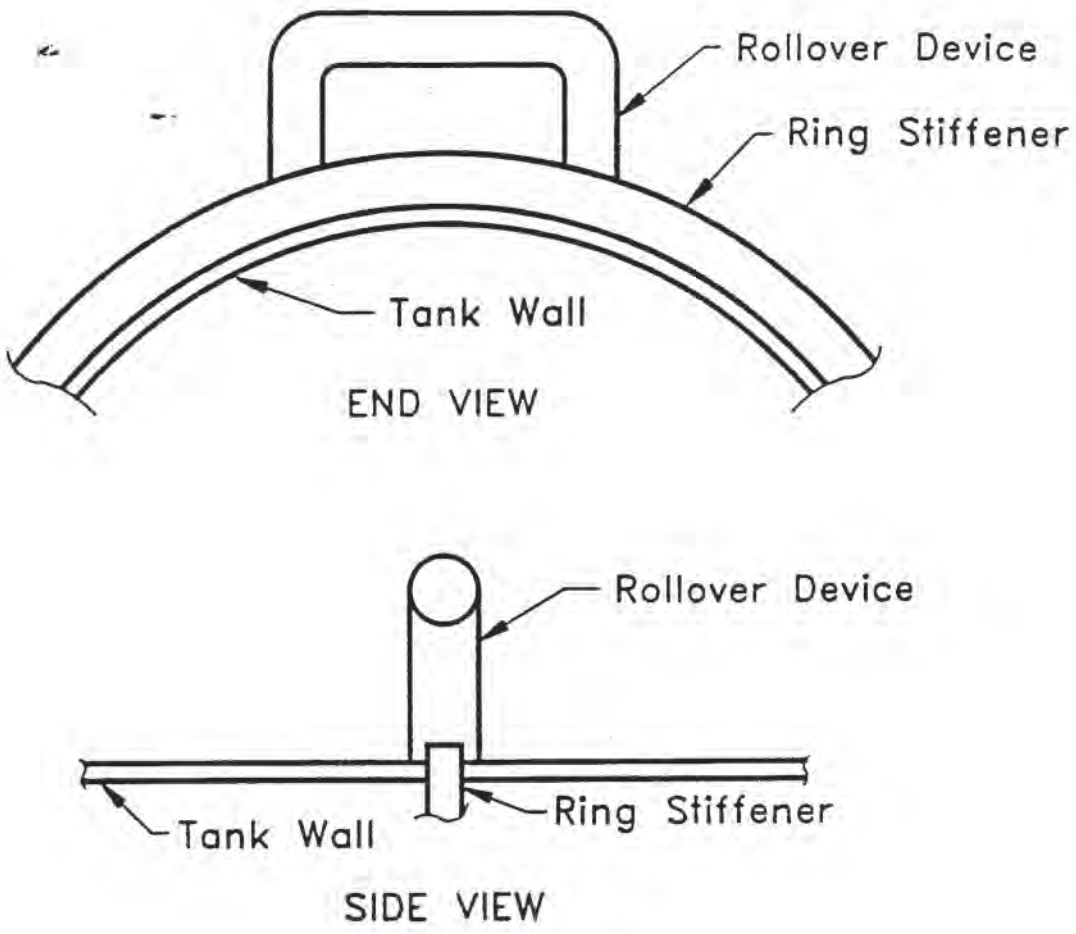


Figure 29. Inverted "U" rollover protection device.

Example 24. Analysis of inverted "U" using moment distribution.

The two-legged inverted "U" device shown in figure 30 is one of three devices used on a DOT 400 Series cargo tank motor vehicle whose total weight is 49,700 lbs. The device is made of 3-inch standard pipe with an ultimate strength of 65.2 ksi. Properties of the pipe cross section are given in figure 30. Each device must withstand a load of 2W/n which is 2(49,700)/3 = 33.13k.

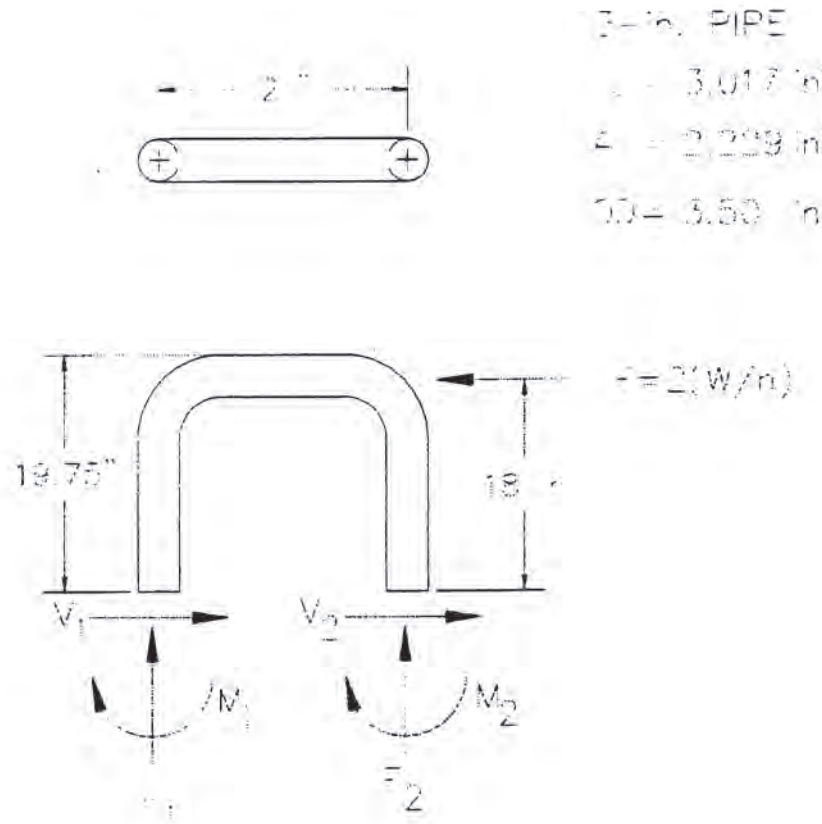


Figure 30. Two-legged, inverted "U" rollover device for DOT 400 Series cargo tank.

For the first analysis, it is assumed that the tank wall provides rigid support for the overturn device at the points of attachment. This is a reasonable assumption but is not accurate because the tank walls are flexible.

A moment distribution analysis table for "side sway" with assumed fixed-end moments of +100 in-k is presented in figure 32. The results show final joint moments of +77.9 in-k at joints A and D and 56.4 in-k at joints B and C. Further analysis to impose static equilibrium for the horizontal force of 33.13 kips is required.

For member AB:

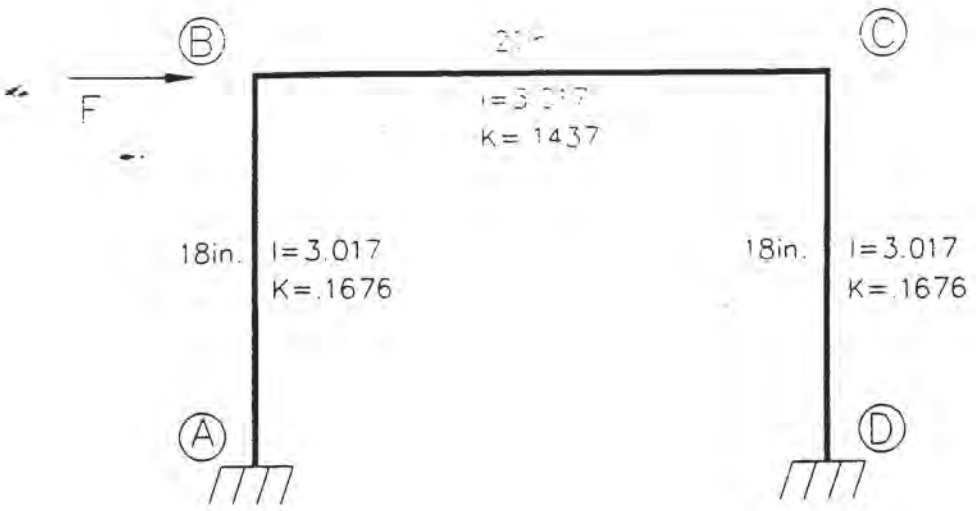
$\sum M_B=0$; $-H_A(18)+77.9+56.4 = 0$

$H_A = (77.9+56.4)/18$

$H_A = 7.46k$

also

$H_D = 7.46k$



Joint	A	B		C		D
Member	AB	BA	BC	CB	CD	DC
K	.1676	.1676	.1437	.1437	.1676	.1676
Dist. F.	0	.538	.462	.462	.538	0
F.E.M.	+100	+100	0	0	+100	+100
1st Dist	0	-53.8	-46.2	-46.2	-53.8	0
CO	-26.9	0	-23.1	-23.1	0	-26.9
2nd Dist	0	+12.4	+10.7	+10.7	+12.4	0
CO	+6.2	0	+5.3	+5.3	0	+6.2
3rd Dist	0	-2.8	-2.5	-2.5	-2.8	0
CO	-1.4	0	-1.2	-1.2	0	-1.4
4th Dist	0	+.6	+.6	+.6	+.6	0
Σ	+77.9	+56.4	-56.4	-56.4	+56.4	+77.9

Figure 31. Moment distribution analysis of rollover device with horizontal transverse load and bottom ends of vertical members fixed.

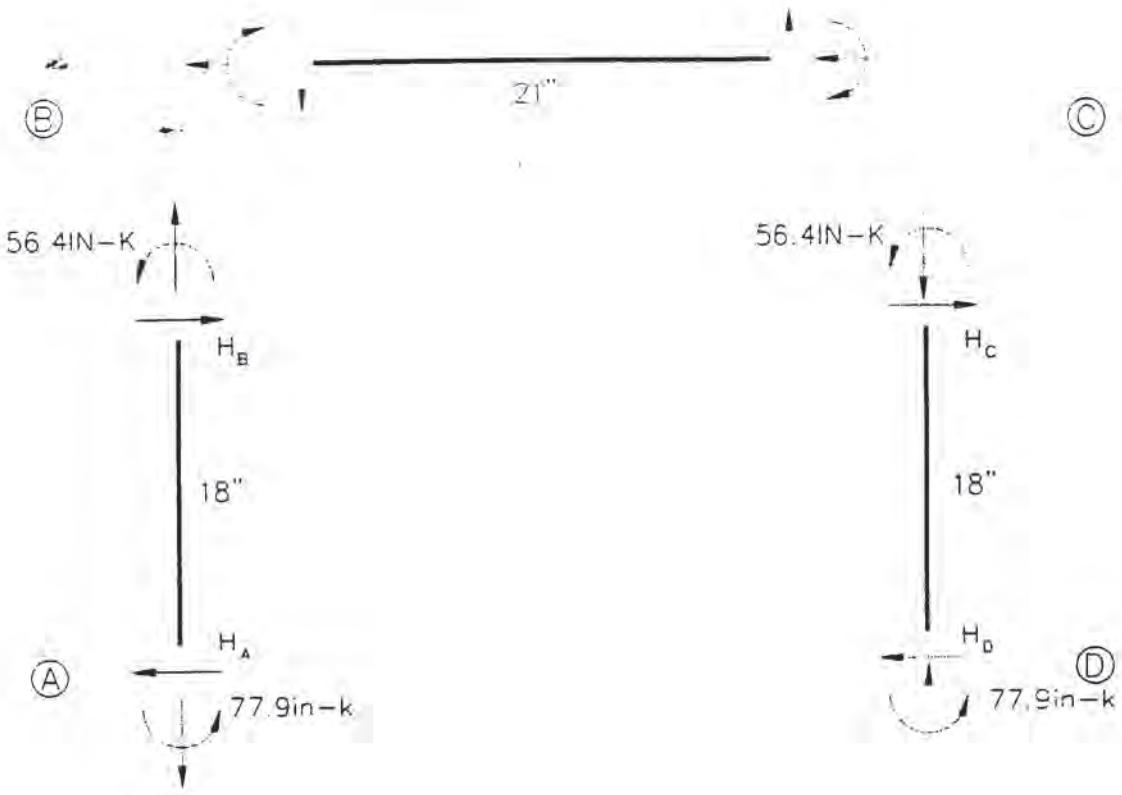


Figure 32. Preliminary results of moment distribution analysis with assumed fixed end moments.

For entire structure:

$\sum F_x=0$; F-7.46-7.46=0

F = 14.92k

The adjustment factor that must be applied to the results in figure 31 is:

33.13/14.92 = 2.22

All moments (and forces) for the solution presented in figure 31 must be multiplied by 2.22 for an actual load of 33.13 kips. The final adjusted moments at joints A and D are each 173 in-k as shown in figure 33.

Further, static analysis results in axial forces of 11.9 kips and shear forces of 16.56 kips in each of the vertical members.

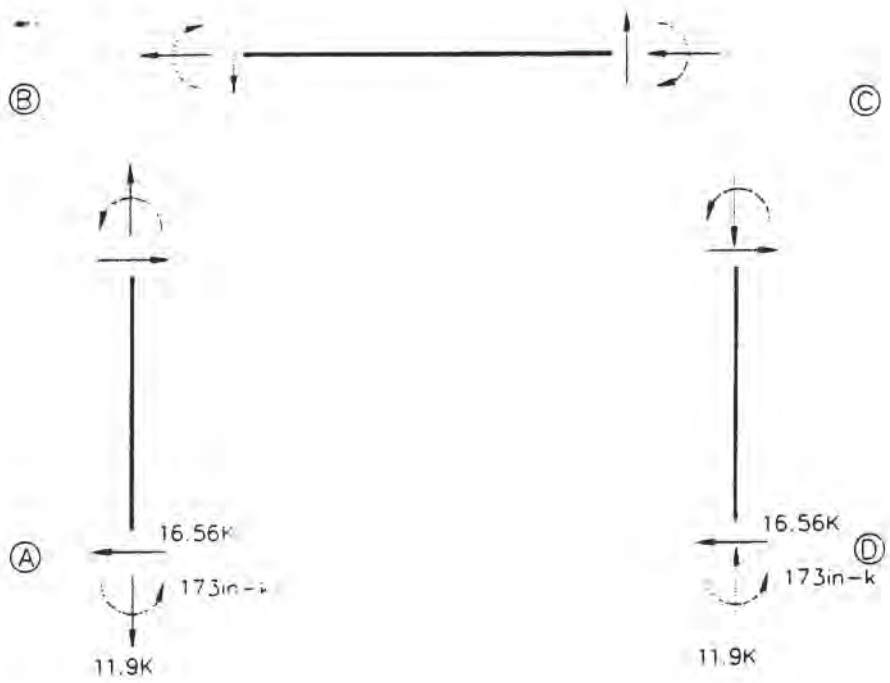


Figure 33. Final results of moment distribution analysis of structure in figure 31.

The maximum axial stress in member A-B, near joint A, is:

$$\text{Max } S = P_A/A + M/Z_e$$
$$\text{Max } S = 11.9/2.229 + 173(1.75)/3.017$$
$$\text{Max } S = 5.3 + 100.3$$
$$\text{Max } S = 105 \text{ ksi} > 65.2 \text{ ksi} \quad \text{(No good)}$$

The axial stress in the horizontal member near joints B and C would be:

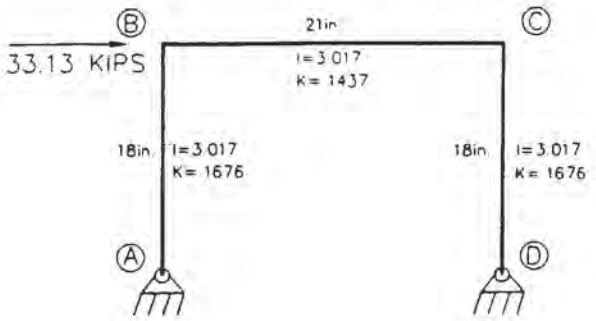
$$S = F/A + M/Z_e$$
$$M = 56.4(2.22)$$
$$M = 125.2$$
$$S = 16.56/2.229 + 125.2(1.75)/3.017$$
$$S = 7.4 + 72.6$$
$$S = 80.0 \text{ ksi}$$

The axial stress in the vertical members near joints B and C would be:

$$S = F/A + M/Z_e$$
$$S = 11.9/2.229 + 125.2(1.75)/3.017$$
$$S = 5.3 + 72.6$$
$$S = 77.9 \text{ ksi} > 65.2 \text{ ksi} \quad \text{(No good)}$$

An analysis of the two leg-device for horizontal transverse load using the Moment Distribution Method and the assumption that the tank shell provides no stiffness in bending in the legs of the device is presented in figure 34. The final adjusted moments are shown in figure 35. The computed maximum tensile (or compressive) stresses in the vertical legs of the device occur near joints B and C and is 186 ksi.

If the effective stiffness of the tank wall were known and could be included in the analysis, the results would be expected to be somewhere between the two Moment Distribution solutions presented herein.



Joint	A	B		C		D
Member	AB	BA	BC	CB	CD	DC
K	.1676	.1676	.1437	.1437	.1676	.1676
Dist. F	1	.538	.462	.462	.538	1
FEM	+100	+100	0	0	+100	+100
1st Dist	-100	-53.8	-46.2	-46.2	-53.8	-100
CO	-26.9	-50	-23.1	-23.1	-50	-26.9
2nd Dist	+26.9	+39.3	+33.8	+33.8	+36.3	+26.9
CO	+19.6	+13.4	+16.9	+16.9	+13.4	+19.6
3rd Dist	-19.6	-16.3	-14.0	-14.0	-16.3	-19.6
CO	-8.1	-9.8	-7.0	-7.0	-9.8	-8.1
4th Dist	+8.1	-9.0	+7.8	+7.8	+9.0	+8.1
CO	4.5	4.0	3.9	3.9	4.0	4.5
5th Dist	-4.5	-4.2	-3.6	-3.6	-4.2	-4.5
CO	-2.1	-2.2	-1.8	-1.8	-2.2	-2.1
6th Dist	+2.1	+2.1	+1.8	+1.8	+2.1	+2.1
Σ	0	31.5	-31.5	-31.5	31.5	0

Figure 34. Moment distribution analysis of rollover device with horizontal transverse load and bottom ends of vertical members hinged.

It is noted that for each of the two solutions by Moment Distribution presented on the previous pages, the sum of moments for the two ends of a vertical member of the device is 298 in-k. For the first solution (with the ends of the legs fixed) the moments are 173 in-k at the bottom and 125 in-k at the top. These total 298 in-k. For the second solution (with the ends of the legs pinned) the moments are zero at the bottom and 298 in-k at the top.

For a more accurate solution wherein partial fixity of the tank wall would be accurately included, the moments would also total 298 in-k. The degree of fixity that would result in the lowest maximum stresses in the legs of the device would be one that caused the moments to be equal at each end of the legs. (i.e. 298 ÷ 2 = 149 in-k) In this case, the stresses in each end of the legs would be:

$$S = F/A + M/Z_e$$
$$S = F/A + 149(1.75)/3.017$$
$$S = F/A + 86 \text{ ksi}$$

F/A would be somewhere between 5.3 and 12.7 ksi which would make the maximum stress over 90 ksi.

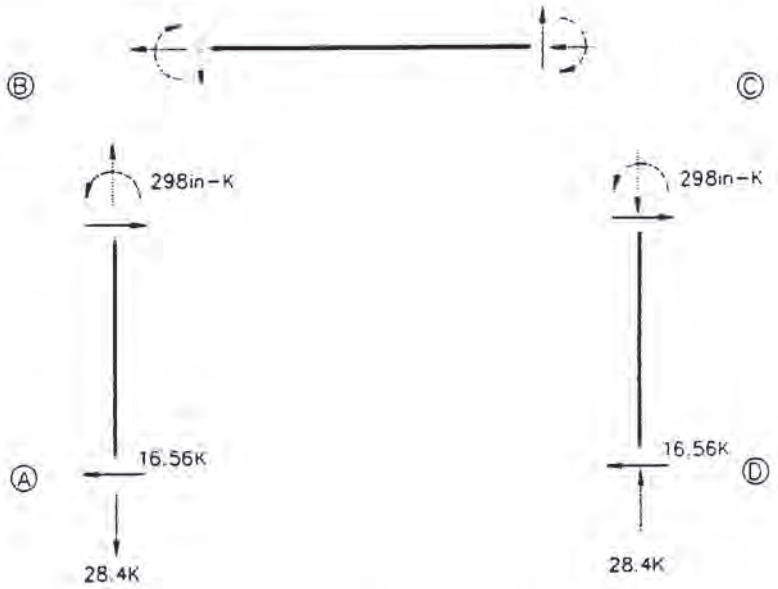


Figure 35. Results of moment distribution analysis of structure in figure 34.

Roark and Young Analysis

Equations for structural analysis of single bent frames are given in Roark and Young for various combinations of member sizes, member lengths and support conditions. For a frame subjected to a concentrated side load and with fixed supports as shown in figure 36, the following six general equations for coefficients are given:

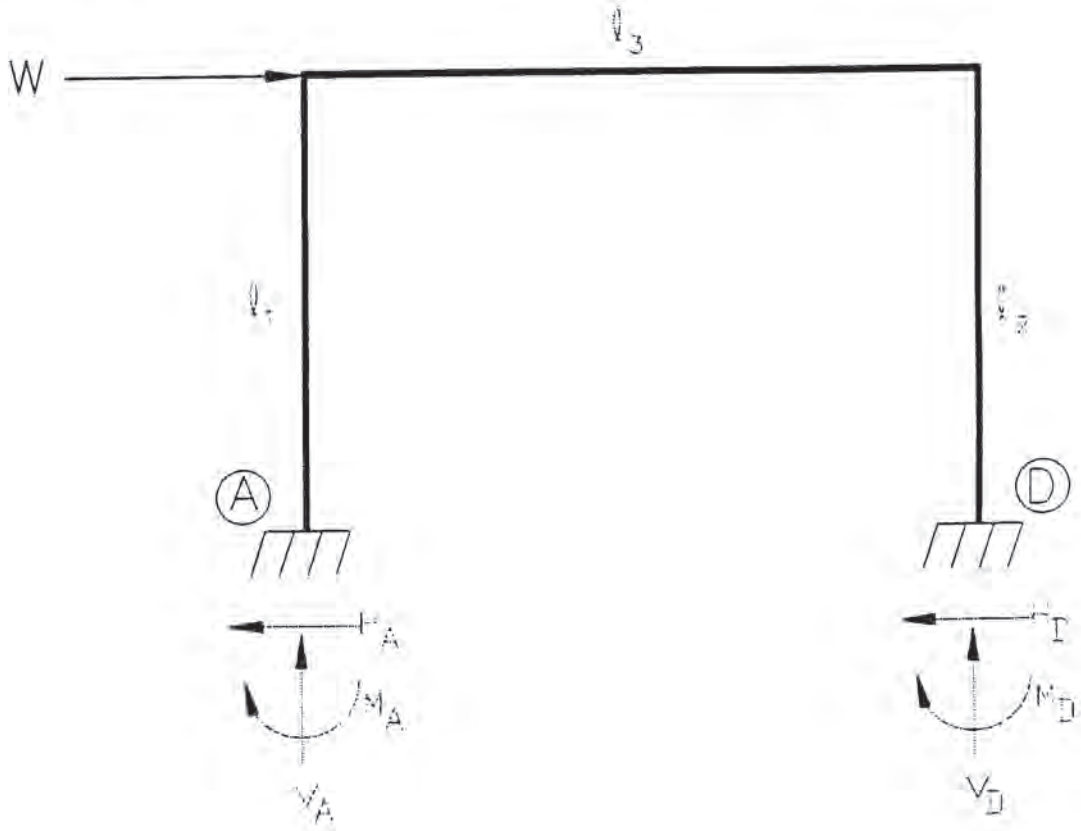


Figure 36. Idealization of rollover protection device for analysis using formulas from Roark and Young.

$$C_{HH} = \ell_1^3/3E_1I_1 + [\ell_1^3-(\ell_1-\ell_2)^3]3E_2I_2 + \ell_1^2\ell_3/E_3I_3$$

$$C_{HV} = C_{VH} = \ell_2\ell_3(2\ell_1-\ell_2)/2E_2I_2 + \ell_1\ell_3^2/2E_3I_3$$

$$C_{HM} = C_{MH} = \ell_1^2/2E_1I_1 + \ell_2(2\ell_1-\ell_2)/2E_2I_2 + \ell_1\ell_3/E_3I_3$$

$$C_{VV} = \ell_2\ell_3^2/E_2I_2 + \ell_3^3/3E_3I_3$$

$$C_{VM} = C_{MV} = \ell_2\ell_3/E_2I_2 + \ell_3^2/2E_3I_3$$

$$C_{MM} = \ell_1/E_1I_1 + \ell_2/E_2I_2 + \ell_3/E_3I_3$$

For the frame shown in figure 36, the equations reduce to:

$$C_{HH} = 2\ell_1^3/3EI + \ell_1^2\ell_3/EI$$

$$C_{HV} = \ell_1^2\ell_3/2EI + \ell_1\ell_3^2/2EI$$

$$C_{HM} = \ell_1^2/EI + \ell_1\ell_3/EI$$

$$C_{VV} = \ell_2\ell_3^2/EI + \ell_3^3/3EI$$

$$C_{VM} = \ell_2\ell_3/EI + \ell_3^2/2EI$$

$$C_{MM} = \ell_1/EI + \ell_2/EI + \ell_3/EI$$

Factors for loads are computed using the three following equations:

$$LF_H = W(C_{HH} - \ell_1C_{HM} + \ell_1^3/6E_1I_1)$$

$$LF_V = W(C_{VH} - \ell_1C_{VM})$$

$$LF_M = W(C_{MH} - \ell_1C_{MM} + \ell_1^2/2E_1I_1)$$

Coefficients and factors for loads can then be used in the following equations to solve for reactions at the left support. Reactions at the right support can then be evaluated using equations of static equilibrium.

$$C_{HH}H_A + C_{HV}V_A + C_{HM}M_A = LF_H$$

$$C_{VH}H_A + C_{VV}V_A + C_{VM}M_A = LF_V$$

$$C_{MH}H_A + C_{MV}V_A + C_{MM}M_A = LF_M$$

Example 25. Structural analysis of frame using equations from Roark and Young.

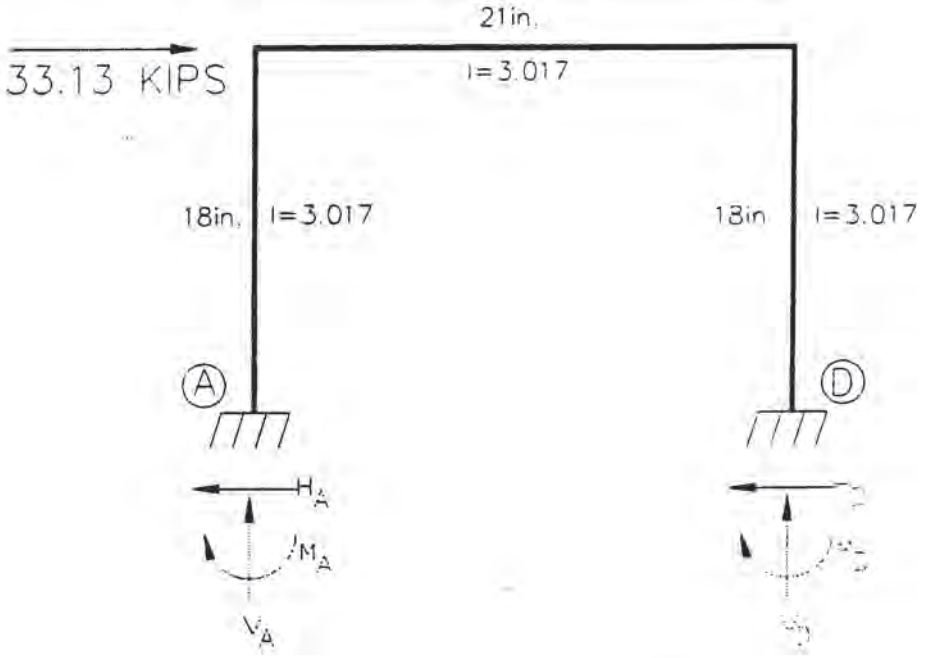


Figure 37. Idealization of frame for analysis using formulas from Roark and Young.

Use $E = 29x10^6$ psi
Then $EI = 29x10^6(3.017)$
$EI = 87.5x10^6$

$C_{HH} = 2\ell_1^3/3EI + \ell_1^2\ell_3/EI$

$C_{HH} = 2(18)^3/(3)(87.5x10^6) + (18)^2(21)/(87.5x10^6)$

$C_{HH} = 122.2x10^{-6}$

$C_{HV} = \ell_1^2\ell_3/2EI + \ell_1\ell_3^2/2EI$

$C_{HV} = (18)^2(21)/2EI + 18(21)^2/2EI$

$C_{HV} = 84.24x10^{-6}$

$C_{HM} = \ell_1^2/EI + \ell_1\ell_3/EI$

$C_{HM} = (18)^2/(87.5x10^6) + 18(21)/(87.5x10^6)$

$C_{HM} = 8.023x10^{-6}$

$C_{VV} = \ell_2\ell_3^2/EI + \ell_3^3/3EI$

$C_{VV} = (18)(21)^2/87.5x10^6 + (21)^3/3(87.5x10^6)$

$C_{VV} = 126.0x10^{-6}$

$C_{VM} = \ell_2\ell_3/EI + \ell_3^2/2EI$

$C_{VM} = (18)(21)/87.5x10^6 + (21)^2/2(87.5x10^6)$

$C_{VM} = 6.84x10^{-6}$

$C_{MM} = \ell_1/EI + \ell_2/EI + \ell_3/EI$

$C_{MM} = 18/87.5x10^6 + 18/87.5x10^6 + 21/87.5x10^6$

$C_{MM} = 0.651x10^{-6}$

$LF_H = W(C_{HH} - \ell_1C_{HM} + \ell_1^3/6EI$

$$LF_H = W[(122.2x10^{-6}) - 18(8.023x10^{-6}) + (18)^3/(6)(87.5x10^6)]$$

$$LF_H = W(-11.09x10^{-6})$$

$$LF_V = W(C_{VH} - \ell_1 C_{VM})$$

$$LF_V = W[84.24x10^{-6} - 18(6.84x10^{-6})]$$

$$LF_V = W(-38.88x10^{-6})$$

$$LF_M = W(C_{MH} - \ell_1 C_{MM} + \ell_1^2/2EI)$$

$$LF_M = W(8.023x10^{-6}) - 18(.651x10^{-6}) + (18)^2/(2)(87.5x10^6)$$

$$LF_M = W(-1.847x10^{-6})$$

$$C_{HH}H_A + C_{HV}V_A + C_{HM}M_A = LF_H$$

$$122.2x10^{-6}H_A + 84.24x10^{-6}V_A + 8.023x10^{-6}M_A = -11.09x10^{-6}W$$

$$C_{HV}H_A + C_{VV}V_A + C_{VM}M_A = LF_V$$

$$84.24x10^{-6}H_A + 126.0x10^{-6}V_A + 6.84x10^{-6}M_A = -38.88x10^{-6}W$$

$$C_{MH}H_A + C_{MV}V_A + C_{MM}M_A = LF_M$$

$$8.023x10^{-6}H_A + 6.84x10^{-6}V_A + .651x10^{-6}M_A = -1.847x10^{-6}W$$

These equations are solved simultaneously to result in:

$H_A = +16.6k$
$V_A = -11.9k$
$M_A = -173$ in-k

The combined stress adjacent to joint A due to axial force and bending moment is:

$$Max\ S = V_A/A + M_A/Z_e$$
$$Max\ S = 11.9/2.229 + 173/1.724$$

Max S = 5,34+100.34
Max S = 105 ksi

Approximate Methods.

Approximate methods of structural analysis can be used to analyze two-legged inverted "U" rollover protection devices. One such method is the portal method. In the portal method, it is assumed that points of inflection (zero moment) occur at mid-height of the vertical members. The horizontal shear will be the same value in each of the two vertical members and the bending moment at the base of each of the two vertical members will be the same.

The assumptions stated above make the structure statically determinate and an analysis can be completed using statics.

Example 26. Analysis of inverted "U" using portal (approximate) method.

$V_1 = V_2$
$F_1 = F_2$
$M_1 = M_2$
$F_1 = (9/21)F$
$V_1 = F/2$
$M_1 = 9V_1 = 9(F/2)$
$\max S = F_1/A + M_1/Z_e$

For the values given in figure 32, the solution would be:

$V_1 = F/2 = 33.13/2 = 16.57k$
$F_1 = (9/21)F = (9/21)(33.13) = 14.2k$
$M_1 = 9(V_1) = 9(16.57) = 149$ in-k
$\max S = F_1/A + M_1/Z_e$
$\max S = 14.2/2.229 + 149/1.724$
$\max S = 6.4 + 86.4$
$\max S = 92.8$ ksi

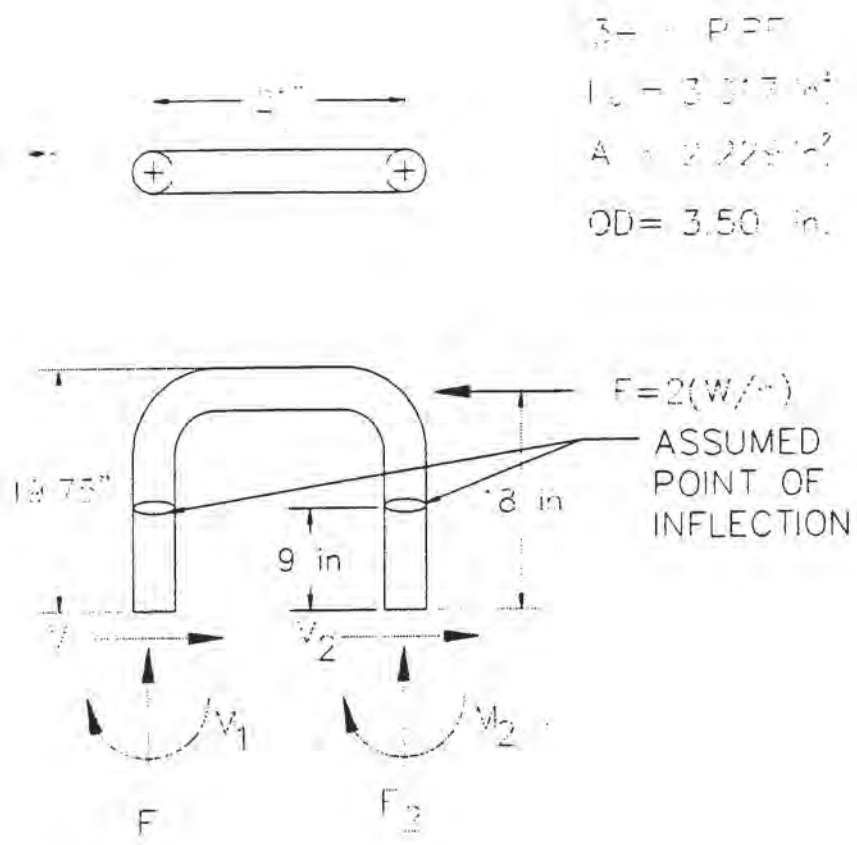


Figure 38. Idealization of rollover protection device for approximate analysis.

Example 27. Analysis of inverted "U" using finite elements.

Stresses in the rollover devices were further evaluated using a finite element analysis procedure. For these analyses, the ends of the legs of the devices were assumed fixed against rotation at the points of attachment to the tank wall.

For the two-leg device subjected to a horizontal transverse load of 33.13 kips the maximum stress is:

$$\max S = F/A + M/Z_e$$
$$\max S = 11.37/2.229 + 181.5/1.724$$
$$\max S = 5.1 + 105$$
$$\max S = 110 \text{ ksi}$$

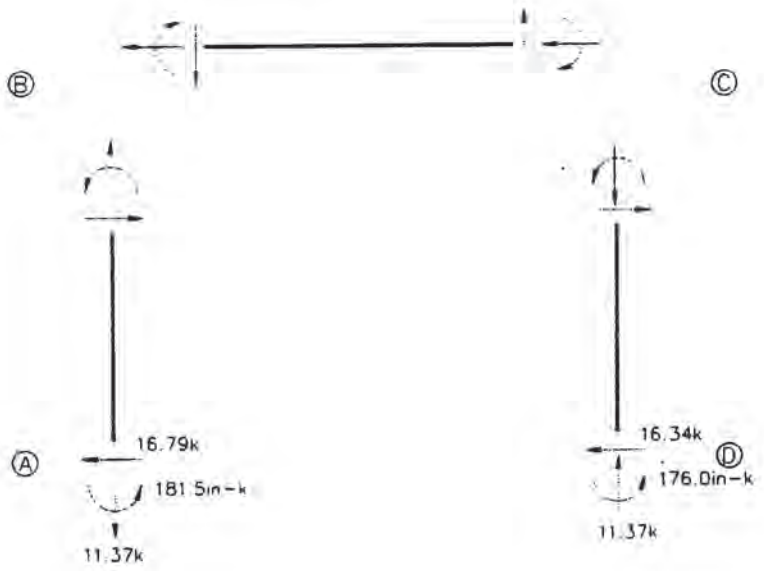
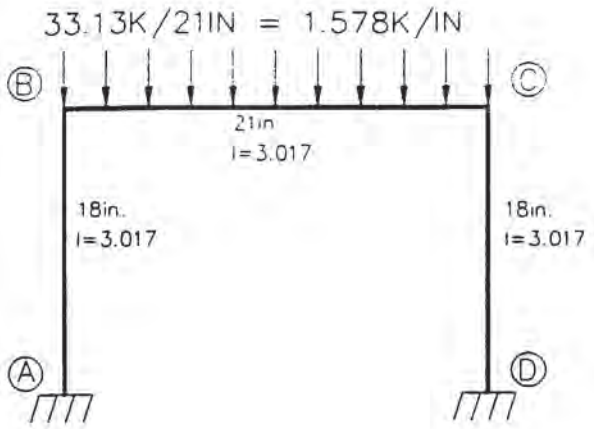


Figure 39. Results of finite element analysis of device subjected to horizontal transverse load of 33.13 kips.

Table 5. Comparison of results of various analysis procedures for inverted "U" rollover protection device subjected to horizontal transverse load.

Method of Analysis	Maximum Normal Stress, ksi	Location of Maximum Normal Stress
Moment Distribution w/ends fixed	105	Bottom end of vertical members
Moment Distribution w/ends hinged	186	Top end of vertical members
Roark and Young w/ends fixed	105	Bottom end of vertical members
Portal Method	92.8	Both ends at vertical members
Finite Element Method w/ends fixed	110	Bottom end of vertical members

A moment distribution analysis can be performed for vertical load on the device. Idealization of the structure and load, and the moment distribution table are shown in figure 40. Further static analysis gives the results shown in figure 41.



Joint	A	B		C		D
Member	AB	BA	BC	CB	CD	DC
K	.1676	.1676	.1437	.1437	.1676	.1676
Dist. F	0	.538	.462	.462	.538	0
FEM	0	0	+58	-58	0	0
1st Dist	0	-31.2	-26.8	+26.8	+31.2	0
CO	-15.6	0	+13.4	-13.4	0	+15.6
2nd Dist	0	-7.2	-6.2	+6.2	+7.2	0
CO	-3.6	0	+3.1	-3.1	0	+3.6
3rd Dist	0	-1.7	-1.4	+1.4	+1.7	0
CO	-.9	0	+.7	-.7	0	+.9
4th Dist	0	-.4	-.3	+.3	+.4	0
Σ	-20.1	-40.5	+40.5	-40.5	+40.5	+20.1

Figure 40. Moment distribution analysis of rollover device with vertical load and bottom ends of vertical members fixed.

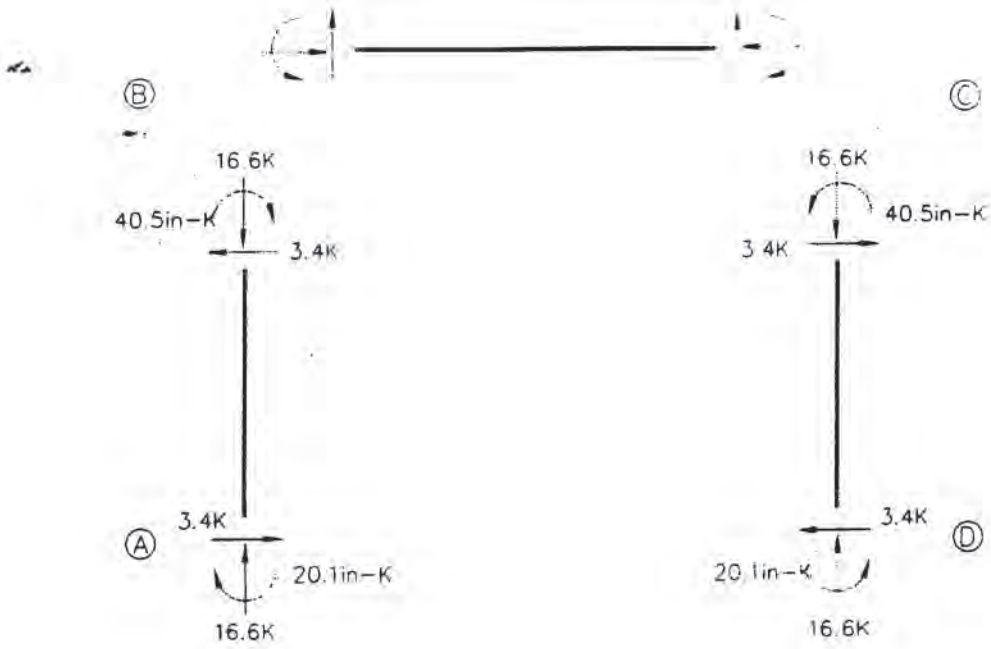


Figure 41. Results of moment distribution analysis for vertical load.

The maximum normal stresses in members A-B and C-D occur near joints B and C and are:

$$\max S = F/A + M/Z_e$$
$$\max S = 16.6/2.229 + 40.5/1.724$$
$$\max S = 7.5 + 23.5$$
$$\max S = 31.0 \text{ ksi}$$

It is noted that an approximate analysis such as S = P/A would result in:

$$S = 33.13/(2)(2.229)$$
$$S = 7.4 \text{ ksi}$$

which is much less than 31.0 ksi computed using moment distribution.

A finite element analysis of the rollover device shown in figure 40 and subjected to vertical load was performed and the results are presented in figure

42. The maximum normal stress in vertical member A-B occurs near joint B and is:

$$\max S = F/A + M/Z_e$$
$$\max S = 16.565/2.229 + 38.086/1.724$$
$$\max S = 7.43 + 22.09$$
$$\max S = 29.5 \text{ ksi}$$

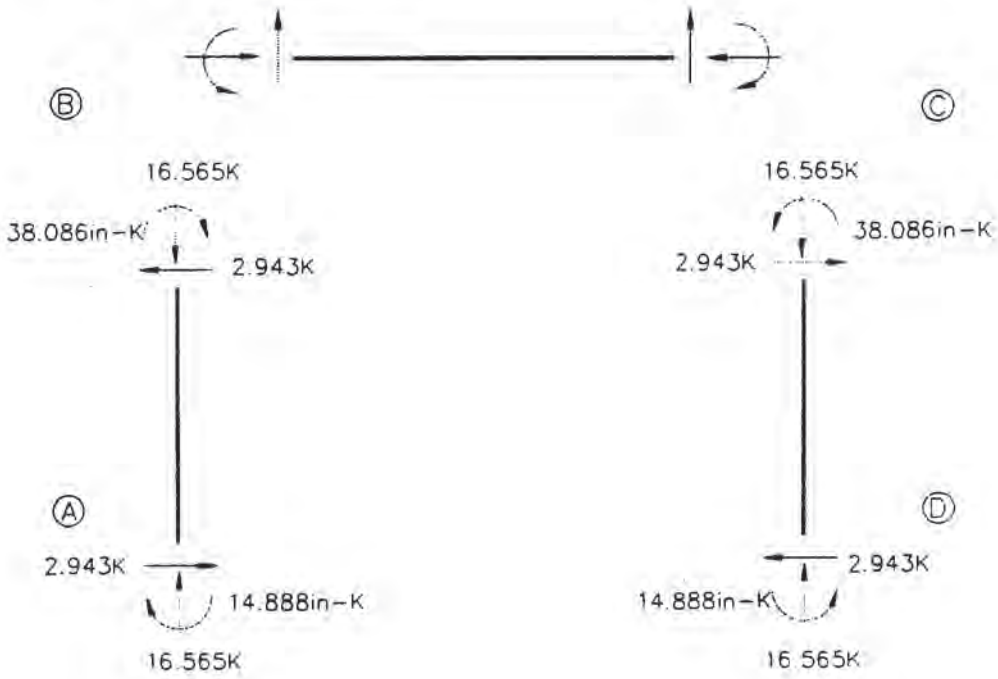


Figure 42. Results of finite element analysis for structure in figure 40.

Rectangular box-like structures fabricated from flat plates and resembling "tombstones" have been used for rollover protection devices. One such design used on a DOT 400 series trailer is shown in figure 43.

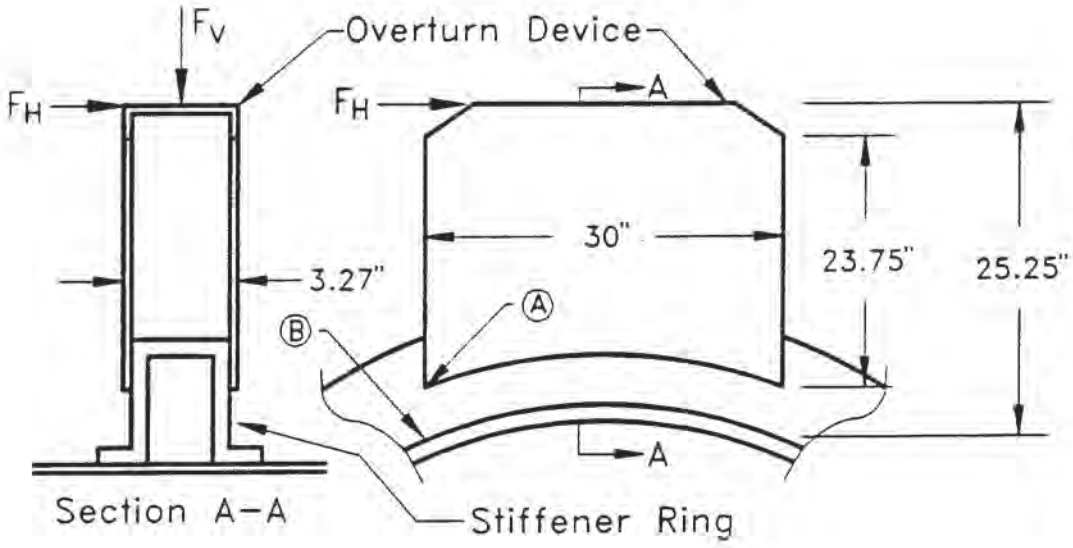


Figure 43. Box-like or "tombstone" rollover protection device.

The box is made from 10 gage (0.135 in.) Type 304 stainless steel. The device is welded to a stiffener ring made from 12 gage (0.105 in.) stainless steel. Two of these devices are used on a trailer having a total weight of 61,500 lbs. The vertical load that must be supported by the two devices is twice the total weight of the loaded tank (i.e., 2(61,500) = 123,000 lbs.). Each device must support half of this load or 61,500 lbs. The direct compressive stress in the device due to vertical load would be:

$$S = F/A = 61,500/8.91 = 6,900 \text{ psi}$$

The devices are required to support a horizontal longitudinal load and a horizontal transverse load of twice the total weight. Each device would be

required to support 61,500 lbs. For horizontal load, the device will behave as a cantilever beam. The elastic section modulus for bending in the longitudinal direction is 12.55 $in.^3$ and the bending stress is:

$$S = M/Z_e$$
$$S = 61,500(23.75)/12.55$$
$$S = 116,400 \text{ psi.}$$

The elastic section modulus for bending in the transverse direction is 52.5 in^3 and the bending stress is:

$$S = M/Z_e$$
$$S = 61,500(23.75)/52.5$$
$$S = 27,820 \text{ psi}$$

The average shear stress in the walls of the box when subjected to horizontal transverse load would be:

$$S_s = V/A$$
$$S_s = 61,500/(2)(30)(.135)$$
$$S_s = 7,593 \text{ psi}$$

The average shear stress in the walls of the box when subjected to horizontal longitudinal load would be:

$$S_s = V/A$$
$$S_s = 61,500/(2)(3.27)(.135)$$
$$S_s = 69,657 \text{ psi}$$

Buckling of Plates in Compression - (Roark and Young)

Elastic buckling of the thin plates used in "tombstone" devices should be checked. The compression "flange" for horizontal longitudinal bending can be checked using formulas from Table 35 in Roark and Young. Case 1 in that table is for a rectangular plate loaded with uniform compression on two opposite edges.

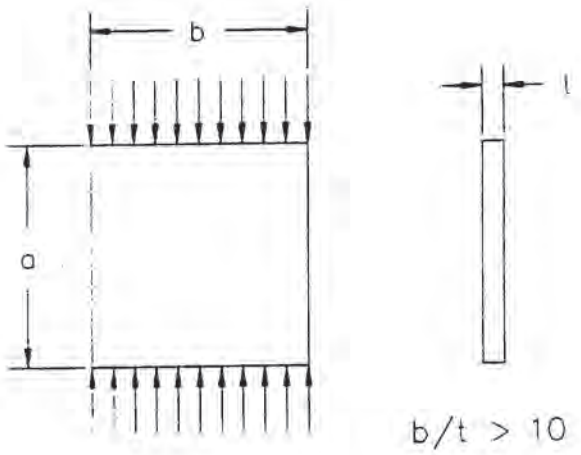


Figure 44. Rectangular plate under equal uniform compression on two opposite edges b with b/t>10.

Case 1a is for all edges of the plate simply supported and the formula for critical buckling stress is:

$$S_{cr} = [KE/(1-\nu^2)](t/b)^2$$

where K depends on the ratio of a/b and b is the length of each loaded edge.

a/b =	0.2	0.3	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.7	3	∞
K =	22.2	10.9	6.92	4.23	3.45	3.29	3.40	3.68	3.45	3.32	3.29	3.32	3.40	3.32	3.29	3.29

For the example at hand a/b would be 24.75/30 = 0.825, which would give a value of K = 3.43.

The critical bulking stress would be:

$$S_{cr} = [KE/1-\nu^2)](t/b)^2$$
$$S_{cr} = [(3.43)(28x10^6)/(1-.3^2)](.135/30)^2$$
$$S_{cr} = 2{,}137 \text{ psi}$$

For all edges of the plate clamped, the formula for critical buckling stress is the same as given above and values of K are:

a/b =	1	2	3	∞
K =	7.7	6.7	6.4	5.73

If a value of K = 7.7 is used for the device being considered the critical buckling stress would be:

$$S_{cr} = [KE/1-\nu^2)](t/b)^2$$
$$S_{cr} = [7.7(28x10^6)/(1-.3^2)](.135/30)^2$$
$$S_{cr} = 4{,}798 \text{ psi}$$

It is noted that both of the values computed above are extremely small in comparison with both the yield strength of the material and the computed stress due to load.

Buckling of Plates in Shear - (Roark and Young)

Case 4 in Table 35 of Roark and Young is for a rectangular plate under uniform shear on all edges.

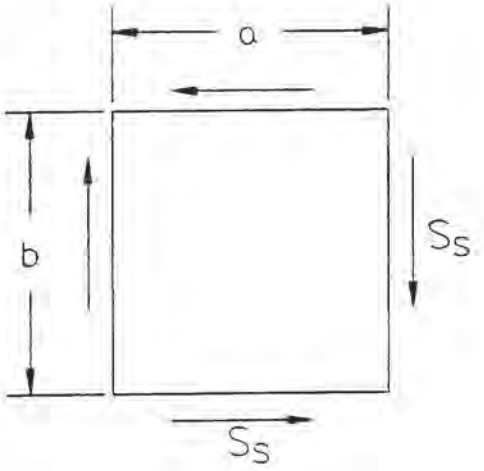


Figure 45. Rectangular plate under uniform shear on all edges.

For all edges of the plate simply supported, the critical shear stress is:

$$S_{scr} = [KE/(1-\nu^2)](t/b)^2$$

where K depends on the ratio a/b and b is the length of the shorter sides.

a/b =	1.0	1.2	1.4	1.5	1.6	1.8	2.0	2.5	3.0	∞
K =	7.75	6.58	6.00	5.84	5.76	5.59	5.43	5.18	5.02	4.40

For an a/b ratio of 30/24.75=1.21, K would be 6.55. The critical shear stress would be:

$$S_{scr} = [KE/(1-\nu^2)](t/b)^2$$
$$S_{scr} = [6.55(28x10^6)/(1-.3^2)](.135/24.75)^2$$
$$S_{scr} = 5{,}996 \text{ psi}$$

For all edges of the plate clamped, the formula for critical shear stress is the same as above but the following values of K are given:

a/b =	1	2	∞
K =	12.7	9.5	7.38

For an a/b ratio of 1.21, K would be 12.0 and the critical shear stress would be:

$$S_{scr} = [KE/(1-\nu^2)](t/b)^2$$
$$S_{scr} = [12.0(28x10^6)/(1-.3^2)](.135/24.75)^2$$
$$S_{scr} = 10{,}985 \text{ psi}$$

Buckling of Plates in Shear-(Salmon and Johnson).

Salmon and Johnson give the following formula for critical buckling shear stress for a thin rectangular plate simply supported on all edges and subjected to shear:

$$S_{scr} = [K\pi^2 E]/[12(1-\nu^2)(b/t)^2]$$

where:

$K = 5.34+4.0(b/a)^2$

E = modulus of elasticity, psi

ν = poisson's ratio

t = thickness of plate, in.

b = short dimension of plate, in.

a = long dimension of plate, in.

From the previous computations, the ratio of b/a would be 0.825 and the value of K would be:

$K = 5.34+4.0(b/a)^2$

$K = 5.34+4.0(.825)^2$

$K = 8.06$

The critical buckling shear stress would be:

$S_{scr} = [K\pi^2 E]/[12(1-\nu^2)(b/t)^2]$

$S_{scr} = [8.06\pi^2(28x10^6)]/[12(1-.3^2)(24.75/.135)^2$

S_{scr} = 6,068 psi

This compares to 5,996 psi from the Roark and Young formula.

Buckling of Plates in Shear-(Guide for Stability Design).

The Structural Stability Research Council, in their Guide to Stability Design-Criteria for Metal Structures, give the following formula for critical buckling shear stress for a thin rectangular plate subjected to shear with all edges fixed:

$$S_{scr} = [K\pi^2 E]/[12(1-\nu^2)(b/t)^2]$$

where:

$$K = 8.98 + 5.6(b/a)^2$$

and all other variables as defined by Salmon and Johnson in the previous section.

From the previous computation, the ratio of b/a would be 0.825 and the value of K would be:

$$K = 8.98 + 5.6(.825)^2$$
$$K = 12.79$$

The critical buckling shear stress would be:

$$S_{scr} = [12.79\pi^2(28X10^6)]/12(1-0.3^2)(24.75/.135)^2$$
$$S_{scr} = 9{,}630 \text{ psi}$$

This compares to 10,985 psi from the Roark and Young formula.

Example 28. Analysis of continuous overturn rails.

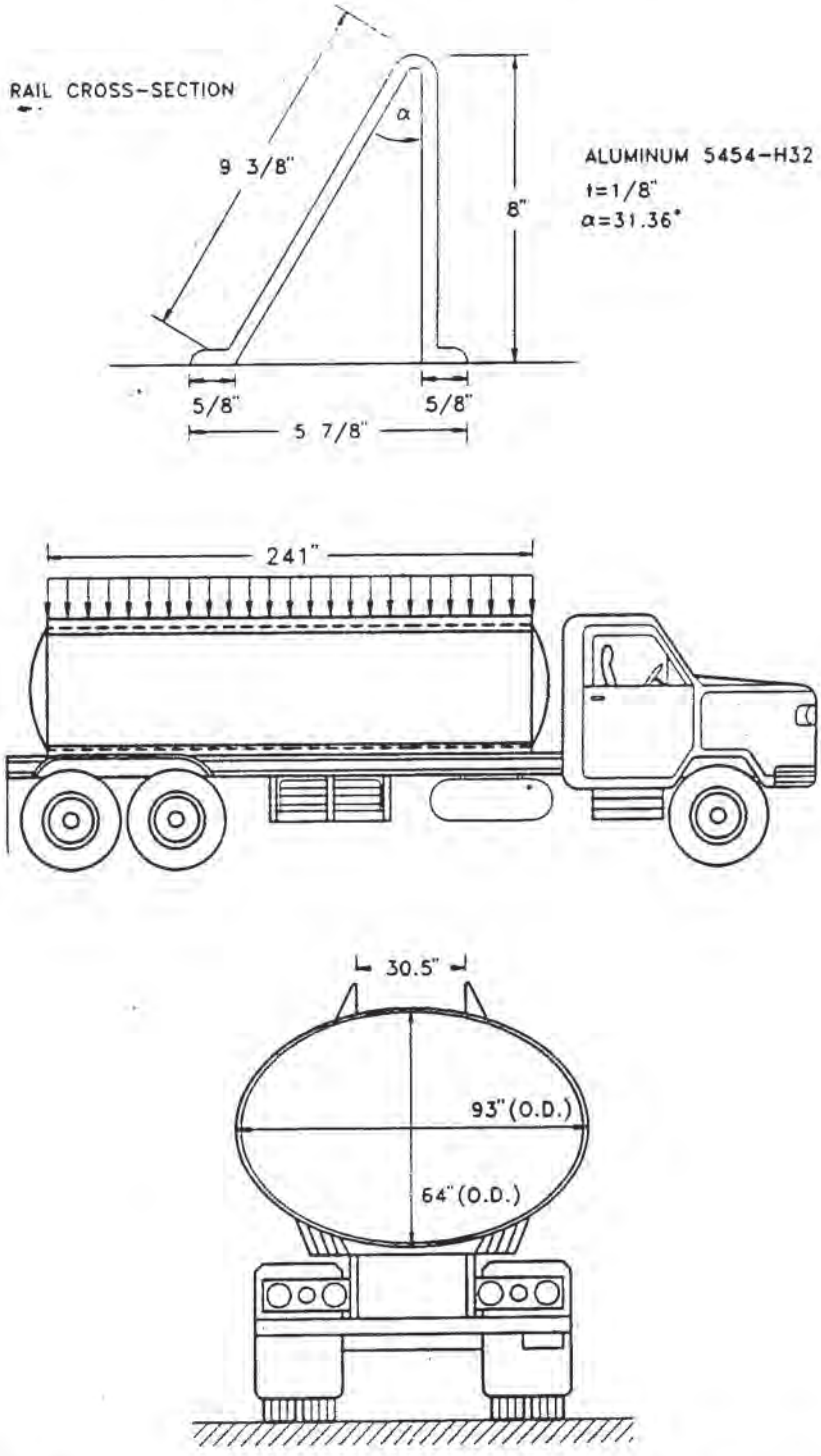


Figure 46. Continuous overturn protection rail on single unit cargo tank truck.

The continuous overturn rails shown on the vehicle in figure 46 are to be analyzed for the required loads of 2g's in the vertical, horizontal transverse and horizontal longitudinal directions.

The analysis presented serves to illustrate the manner in which overturn rails have been analyzed. IT IS NOT A RECOMMENDED METHOD. The method is based on assumed uniform support at the rail throughout its length and that assumption has not been substantiated. The authors think that concentrations of force at bulkheads and baffles make that assumption inappropriate. Work is being performed to address that question.

Gross weight of vehicle = 51,000 lbs.
Vertical load: F = 2G = 2(51,000 lbs.) = 102,000 lbs.
102,000/241 = 423.25 lbs/inch (uniformly distributed)
Horizontal load: W = 2G = (2)(51,000 lbs.) = 102,000 lbs.
102,000/241 = 423.25 lbs/inch (uniformly distributed)

A free body diagram for the rail for vertical load is shown in figure 47.

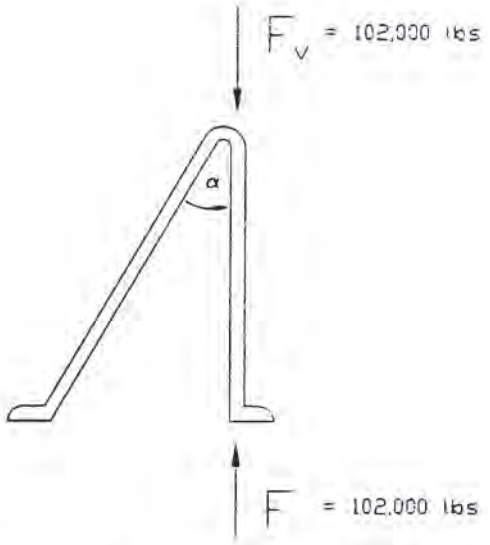


Figure 47. Free body diagram for overturn rail for vertical load.

Strength of the rail element in compression is controlled by either the yield strength or the compressible buckling strength. The compressive buckling

strength is computed using Euler's formula.

$$P_{cr} = \pi^2 EI/L^2$$

where:

$E = 10.2 \times 10^6$ psi

$I = bh^3/12 = (241)(0.125)^3/12 = 0.0392$ in^4

For the 8" leg:

$P_{cr} = \pi^2(10.2 \times 10^6)(0.0392)/8^2 = 61{,}660$ lbs.

$S_{cr} = P_{cr}/A = 61{,}600/(241)(0.125) = 2{,}047$ psi

For the 9 3/8" leg:

$P_{cr} = \pi^2(10.2 \times 10^6)(0.0392)/9.375^2 = 44{,}900$ lbs.

$S_{cr} = P_{cr}/A = 44{,}900/(241)(0.125) = 1{,}490$ psi

The actual compressive stress in the 8" leg is:

$S = F/A$

$S = 102{,}000/[241(0.125)(2)]$ (2 devices)

$S = 1{,}693$ psi < 2,047 psi OK

A free body diagram for the overturn rail subjected to horizontal transverse load is shown in figure 48.

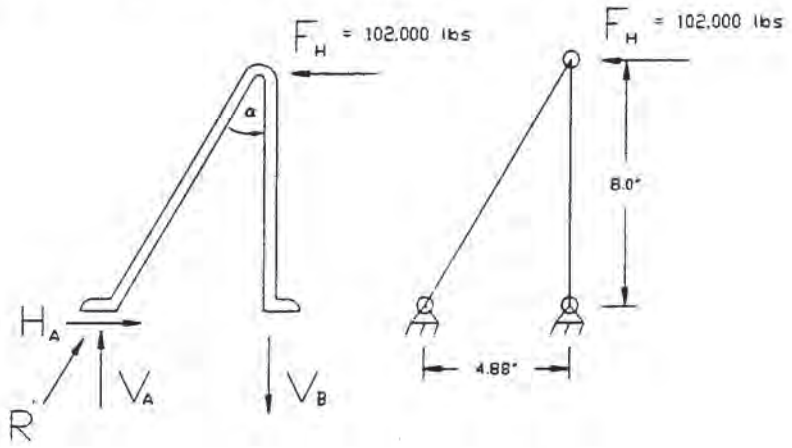


Figure 48. Free body diagram for overturn rail for horizontal transverse load.

Computation of stresses for this loading yields the following:

H_A = 102,000 lbs.
V_B = 102,000(8)/4.88
V_B = 167,213 lbs.
S_B = 167,213/(241)(.125)
S_B = 5,551 psi (tension)
V_A = 167,213 lbs.
$R = (167{,}213^2+102{,}000^2)^{0.5}$
R = 195,868 lbs.
S_A = 195,868/(241)(.125)
S_A = 6,502 psi (compression) > 1,490 psi FAILS

Note this analysis assumes that the overturn rails are fully supported by the shell along their entire length.

Analysis of Local Stresses.

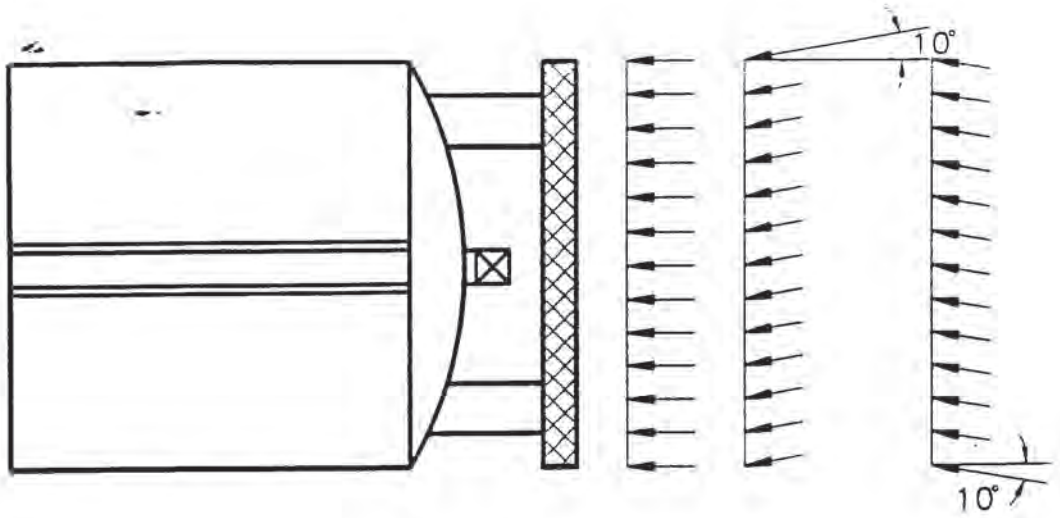
Local stresses which occur at pads, cradles, or other supports must be considered in accordance with appendix G of the ASME Code. Appendix G references several other publications for analyzing different types of local stresses. For local stresses in cylinders due to external loads it references the Welding Research Council (WRC) Bulletin No. 107.

One common loading situation which must be considered are the stresses in the tank wall due to loads on overturn protection devices.

8. REAR-END PROTECTION

Requirements for rear-end protection for 400 Series cargo tank vehicles are given in §178.345-8(d). Geometric requirements are the same as current requirements for MC 300 Series. Structural strength requirements specify a load from 2 g's deceleration but no factor of safety is required and the material strength to be used is not addressed. The load from 2 g's deceleration would be twice the total weight of the fully loaded cargo tank motor vehicle. §178.345-8(b) addresses bottom damage protection and requires that a bottom damage protection device be able to withstand a force of 155,000 lbs. regardless of the weight of the vehicle. If rear-end protection devices protect an outlet, projection or piping, it must also be designed to withstand a minimum force of 155,000 lbs. although twice the weight of the vehicle may be less than 155,000 lbs. In other words, under these conditions, rear-end protection must also meet the bottom damage protection requirement. In addition, §178.345-8(d) states that the load should be uniformly applied in the horizontal plane at an angle of 10 degrees or less to the longitudinal axis of the vehicle as shown in figure 49.

This regulation seems to imply that performance is the key requirement. It is required that the bumper/device prevent contact with lading containing components of the cargo tank motor vehicle at the specified load. The bumper/device may be sacrificial so long as it serves the required function. Yield strength of the material is an appropriate limit state because the device would have few or no repetitions of the maximum load. An ultimate strength failure mechanism type of analysis is also appropriate.



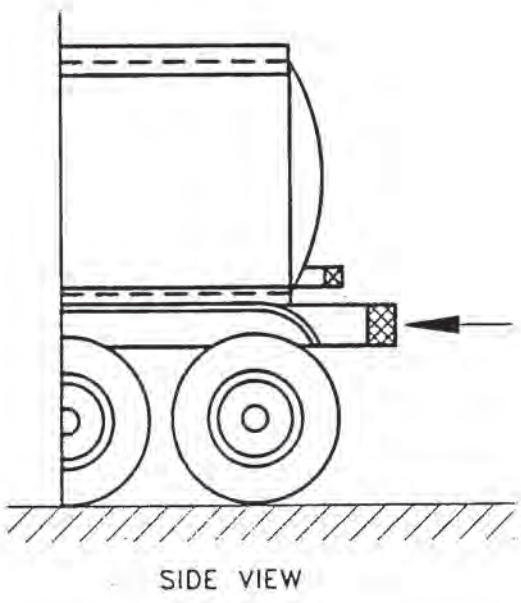


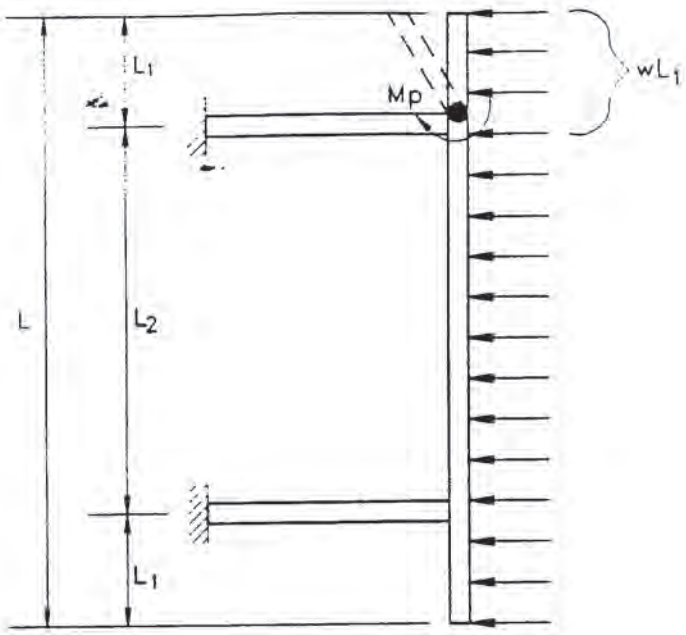
Figure 49. Loading for rear-end protection devices for DOT 400 Series cargo tank motor vehicles.

Possible ultimate strength, plastic hinge, failure mechanisms for rear-end protection devices consisting of two longitudinal and one transverse structural member are shown in figures 50 through 52.

In figure 50, the failure mechanism consists of the overhanging portion of the transverse member being deflected forward with a plastic hinge formed in the transverse member at its juncture with the longitudinal member.

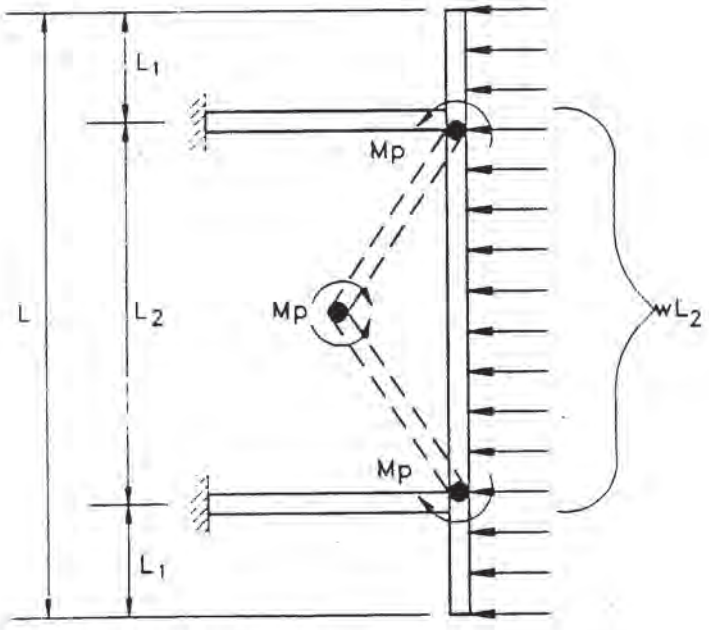
In figure 51, the failure mechanism typically forms in the transverse member between the two longitudinal members and has three plastic hinges in the transverse member. However, if the moment capacity of the longitudinal members is small, another failure mechanism might form.

The plastic hinge failure mechanism shown in figure 52 is for the side load component when the load is applied at 10 deg. to the longitudinal axis of the vehicle. The parallel component will be less critical than the case where full load is applied parallel to the longitudinal axis. For the transverse component, plastic hinges would form in the longitudinal struts at their front ends if they are suitably attached to the vehicle. Plastic hinges at the rear end of the longitudinal members would form either in the longitudinal member or the transverse member depending on which member has the smaller plastic moment value.



$wL_1 = 2M_p/L_1$
so that
$wL = (2M_p/L_1)(L/L_1)$
where
$wL > 2w_{TOTAL}$
then
$2w_{TOTAL} \leq (2M_p/L_1)(L/L_1)$

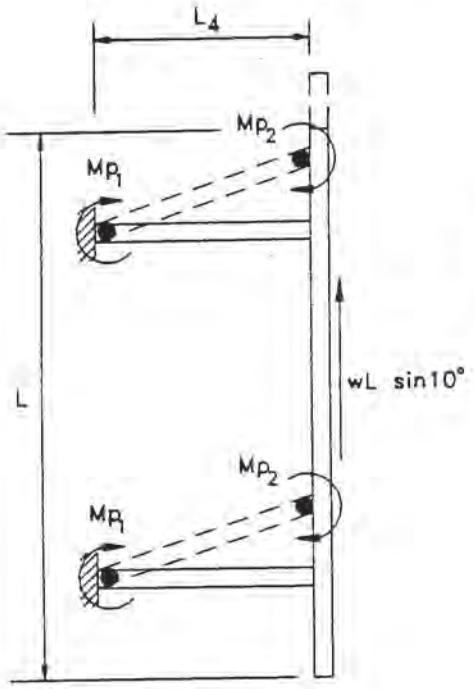
Figure 50. Plastic hinge failure mechanism for cantilevered portion of horizontal bar.



$wL_2 = 16M_p/L_2$
so that
$wL = (16M_p/L_2)(L/L_2)$
where
$wL \geq 2w_{TOTAL}$
then
$2w_{TOTAL} \leq (16M_p/L_2)(L/L_2)$

Figure 51. Plastic hinge failure mechanism for interior portion of horizontal bar.

The parallel component will be less critical than the case where full load is applied parallel to the longitudinal axis. For the transverse component, plastic hinges would form in the longitudinal struts at their front ends if they are suitably attached to the vehicle. Plastic moments at the rear end of the longitudinal members would form either in the longitudinal member or the transverse member depending on which value is lesser.



$$wL = (2M_{p1}+2M_{p2})/L_4 \sin 10°$$

where

$$wL \geq 2w_{TOTAL}$$

then

$$2w_{TOTAL} \leq (2M_{p1}+2M_{p2})/L_4 \mathrm{Sin}10°$$

Figure 52. Possible plastic hinge failure mechanism for side load. Other mechanisms may be possible depending upon relative strengths of members and connections.

Example 29. Analysis of stresses in rear-end protection device.

The rear-end protection device shown in figure 53 is used on a cargo tank trailer. Total weight of the vehicle is 80,000 lbs. Adequacy of the strength of the device is to be checked against DOT series requirements. The device must withstand a force of twice the weight of the vehicle. 2 X 80,000 = 160,000 lbs. This load acts in the horizontal plane anywhere within ±10° of the longitudinal axis of the vehicle. For the device shown:

$L = 88$ in.
$L_1 = 25$ in.
$L_2 = 38$ in.
$L_4 = 34$ in.

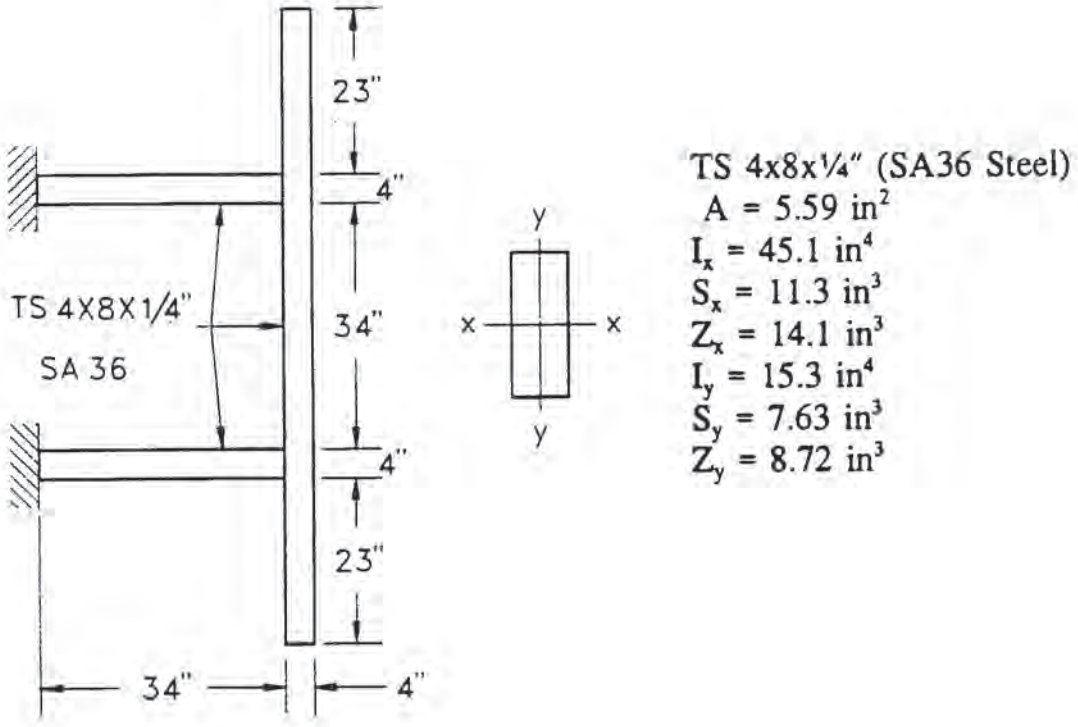


Figure 53. Rear-end protection device for cargo tank trailer.

The plastic moment capacity of the TS section about its vertical axis is:

$$M_p = F_y Z_p$$
$$M_p = 36(8.72)$$
$$M_p = 314 \text{ in-k}$$

For longitudinal loading, the failure mechanism shown in figure 47 yields a total strength of :

$$wL = (2M_p/L_1)(L/L_1)$$
$$wL = [(2)(314)/25](88/25)$$
$$wL = 88 \text{ kips} < 160 \text{ kips} \quad \underline{\text{FAIL}}$$

The failure mechanism shown in figure 48 yields a total strength of:

$$wL = (16M_p/L_2)(L/L_2)$$
$$wL = [(16)(314)/38](88/38)$$
$$wL = 306 \text{ kips} > 160 \text{ kips} \quad \underline{\text{OK}}$$

The failure mechanism shown in figure 49 yields a strength of:

$$wL = (2M_{p1}+2M_{p2})/L_4 \sin 10°$$
$$wL = [(2)(314)+2(314)]/34 \sin 10°$$
$$wL = 212 \text{ kips} > 160 \text{ kips} \quad \underline{\text{OK}}$$

The analysis shows that the overhanging end of the transverse member does not have adequate strength to resist the required load.

Many rear-end protection devices will be more complicated because diagonal braces, web plates and other structural members have been provided to increase strength of the device. Such devices can not be analyzed accurately with simple idealizations and methods of analysis. Appropriate approximate analysis or finite element analysis procedures are in order for such devices.

Some rear-end protection devices are constructed such that the longitudinal members slope downward to the rear (e.g. the horizontal bumper bar is lower than the front attach points of the longitudinal members). For such devices, a bending moment about the transverse axis will exist at the front attach points of the underride device and stresses due to that moment plus axial load should be evaluated.

Some devices on single unit trucks consist of a horizontal bumper bar

attached to the truck frame with two vertical members and with two diagonal struts extending from the horizontal bar forward and up to the truck frame. For such devices, the horizontal bar can be analyzed as a beam as illustrated in the previous example. For longitudinal load, the attaching members (verticals and diagonals) can be analyzed as trusses if member alignment is suitable. For side load, the device is a three dimensional structure and finite element analysis procedures are appropriate. However, a plastic hinge failure mechanism might also be appropriate.

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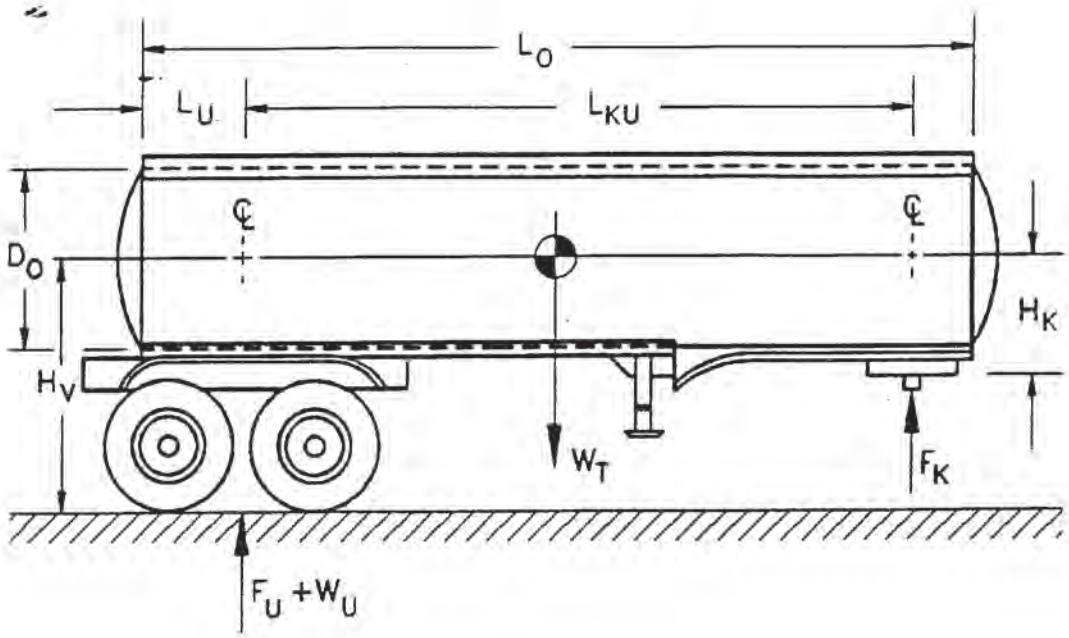
APPENDIX A. NOMENCLATURE



A = Cross sectional area of tank shell or other structural member, in^2.

A_m = Area enclosed by median line of vessel wall, in^2.

a_g = Acceleration due to gravity (32.2 ft/sec/sec).

a = Acceleration, ft/sec/sec.

b = Number of baffles in cargo tank compartment.

c = Distance from neutral axis to extreme fiber of flexural member, inches.

C_i = Inside circumference of shell, inches.

C_o = Outside circumference of shell, inches.

D = Inside diameter of head at its juncture with shell, inches.

D_i = Inside diameter of shell, inches.

D_{iy} = Inside width of non-circular pattern at minor axis, inches.

e = Joint efficiency for, or the efficiency of, appropriate joint in cylindrical or spherical shells, or the efficiency of ligaments between openings, whichever is less. For welded vessels, use the efficiency specified in UW-12 of the ASME code. The ASME Code uses E for joint efficiency.

E = Modulus of elasticity of material at design temperature, psi. The ASME Code uses E for joint efficiency.

F_1 = Factor for longitudinal decelerative/accelerative force.
= 0.35 for normal operating loadings.
= 0.70 for extreme dynamic loadings.

F_2 = Factor for vertical acceleration.
= 0.35 for normal operating loadings.
= 0.70 for extreme dynamic loadings.

F_3 = Factor for lateral acceleration.
0.20 for normal operating loadings.
0.40 for extreme dynamic loadings.

F_u = Reaction load at undercarriage, lbs.

F_k = Reaction load at kingpin, lbs.

g = Acceleration due to gravity, 32.2 ft/sec/sec.

h = Inside depth of ellipsoidal head (from point of tangency of flange to inside surface at center), inches.

H_k = Height from transverse hinge point of fifth wheel to centroid of transverse cross section of tank, inches.

H_v = Height from road to centerline of tank cross section, inches.

I = Moment of inertia, in^4.

For elliptical cross sections which are true conic sections of uniform wall thickness, the moment of inertia is given as follows:

$$I = \frac{\pi}{4} [R_{xo} R_{yo}^3 - R_{xi} R_{yi}^3]$$

Since many vessels of non-circular cross section are not true conic sections, the designer of the shell may find it necessary to utilize alternate formulas more appropriate to the section under consideration.

J = Polar moment of inertia, in^4.

L = Dish radius of major axis of non-circular pattern, inches.

L_k = Distance from cargo tank front head seam to center of kingpin, inches.

L_o = Overall length of shell from front head seam to rear head seam, inches.

L_s = Center to center spacing of ring stiffeners, inches.

L_u = Distance from cargo tank rear head seam to center of undercarriage, that is, halfway between the axles of a tandem, the second axle of a tridem, or the center of the axle of a single axle trailer, inches.

L_{ku} = Distance from centerline of kingpin to center of undercarriage, inches.

L_x = Distance from cargo tank front head seam, inches.

L_{max} = Distance from cargo tank rear head seam to cross section where maximum bending moment occurs, inches.

M = Bending moment, in-lbs.

P = Internal or external pressure, psi.

P_d = Dynamic impact pressure, psi.

P_h = Static head pressure, psi.

P_m = Maximum allowable working pressure (MAWP), psi.

MAWP = The MAWP for each cargo tank must be greater than or equal to the largest of the following: (The MAWP derived is the pressure to be used as prescribed in the ASME Code in the design of the tank).

(1) The pressure prescribed for the lading in part 173:

(2) Vapor pressure of the most volatile lading, at 115° F (expressed in psig), plus the maximum static pressure exerted by the lading at the maximum lading density, plus any pressure exerted by a gas padding (including air in the ullage space or dome, if used, or

(3) The maximum pressure in the tank during loading or unloading.

P_t = Total static pressure = $P_d + P_h$, psi.

Q = Dimensionless factor from the ASME Code.
A factor in the formulas for torispherical heads depending on the head proportion (R_h/R_k). Based on the ratio on the inside crown radius to the inside knuckle radius.

R_k = Knuckle radius, inches.

R_h = Inside radius of head (crown radius), inches.

R_i = Inside radius of shell, inches.

R_o = Outside radius of shell, inches.

R_{xi} = Half the length of the inside major axis for true conic elliptical sections, inches.

R_{xo} = Half the length of the outside major axis for true conic elliptical sections, inches.

R_{yi} = Half the length of the inside minor axis for true conic elliptical sections, inches.

R_{yo} = Half the length of the outside minor axis for true conic elliptical sections, inches.

$\bar{r}$ = Radius of curvature, inches.

S = Effective stress, at any given point under the most severe combination of static and dynamic loadings that can occur at the same time, psi.

S_a = Allowable tensile stress from DOT Regulation or ASME Code, psi.

S_b = Allowable compressive buckling stress, psi.

S_{bA} = Critical compressive buckling stress - Alcoa Formula, psi.

S_{bY} = Critical compressive buckling stress - Roark & Young Formula, psi.

S_c = Compressive stress due to static bending loads, psi.

S_d = Effective tensile stress generated by a 2 "g" deceleration of liquid cargo, psi.

S_{dx} = Longitudinal tensile stress generated by a 2 "g" deceleration of liquid cargo, psi.

S_{dy} = Circumferential tensile stress generated by a 2 "g" deceleration of liquid cargo, psi.

S_m = Maximum allowable tensile stress for a particular material per Table UHA-23, UCS-23, or UNF-23 of the ASME Code, psi.

S_{scr} = Critical shear buckling stress for rectangular plate.

S_u = Ultimate tensile strength for a particular material, psi.

S_x = Net longitudinal stress, in psi, generated by appropriate combinations of the following stresses:

$$S_{x1}, S_{x2}, S_{x3}, S_{x4}, S_{x5}, S_{x6}, S_{x7}, S_{x8}, S_{x9}, S_{x10} \text{ and } S_{x11}$$

S_{x1} = Longitudinal stresses resulting from the MAWP or the lowest pressure at which the cargo tank may operate, psi.

S_{x2} = Longitudinal tensile stress due to static head of liquid lading, psi.

S_{x3} = Tensile or compressive stress resulting from the bending moment caused by static weight of the fully loaded cargo tank, all structural elements, equipment and appurtenances supported by the cargo tank wall, psi.

S_{x4} = Tensile or compressive stress generated by the bending moment resulting from a vertical accelerative force, psi.

S_{x5} = Tensile stress generated by the axial load resulting from longitudinal decelerative force from application of trailer brakes, psi.

S_{x6} = Tensile or compressive stress generated by the bending moment resulting from a longitudinal decelerative force from application of trailer brakes, psi.

S_{x7} = Tensile stress generated by the axial load resulting from a longitudinal accelerative force, psi.

S_{x8} = Tensile or compressive stress generated by the bending moment resulting from a longitudinal accelerative force, psi.

S_{x9} = Tensile or compressive stress generated by the bending moment resulting from a lateral accelerative force, psi.

S_{x10} = Compressive stress generated by the axial load resulting from a longitudinal force from application of tractor brakes, psi.

S_{x11} = Tensile or compressive stress generated by the bending moment resulting from a longitudinal decelerative force from application of tractor brakes, psi.

S_y = Net circumferential stress, in psi, resulting from the appropriate combinations of the following stresses:

S_{y1} and S_{y2}

S_{y1} = Circumferential stress generated by internal or external pressure, when applicable, psi.

S_{y2} = Circumferential stress due to static head of liquid lading, psi.

S_s = Net shear stress, in psi, resulting from the appropriate combinations of the following stresses:

S_{s1}, S_{s2}, S_{s3} and S_{s4}

S_{s1} = Vertical (flexural) shear stress generated by gravity of fully loaded cargo tank, psi.

S_{s2} = Vertical (flexural) shear stress generated by a vertical accelerative force, psi.

S_{s3} = Lateral (flexural) shear stress generated by a lateral accelerative force, psi.

S_{s4} = Torsional shear stress generated by a lateral accelerative force, psi.

t = Actual thickness of tank wall, inches.

t_{min} = Minimum thickness for the shell and heads must be such that the maximum stress levels specified in §178.345-3 are not exceeded, inches.

t_h = Minimum thickness of head, inches.

t_s = Minimum thickness of shell (corrosion allowance is added to this value), inches.

T = Torque, inch-lbs.

V = Volume of tank, gallons.

w = Weight per unit length, lbs/inch.

W_b = Maximum density of product which can be carried in a cargo tank which may not be fully loaded, lbs/gal.

W_c = Maximum density of tank contents for a fully loaded cargo tank, lbs/gal.

W_k = Weight of kingpin/upper coupler, lbs.

W_L = Maximum total weight of product which can be carried in the vessel, lbs.

W_s = Weight of empty vessel (Total weight of empty trailer minus W_k minus W_u), lbs.

W_T = Weight of vessel and contents = W_s+W_L, lbs.

W_{Ti} = Weight of vessel and contents per unit length, lbs/inch.

W_{Tr} = Weight of tractor, lbs.

W_u = Weight of trailer undercarriage, lbs.

Z_e = Elastic section modulus = I/R_o = I/c, in^3.

Z_p = Plastic section modulus, in^3.

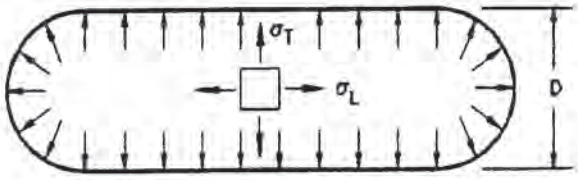
α = Coefficient of thermal expansion for material, inches/inch/deg F.

ν = Poisson's ratio

APPENDIX B. SELECTED FORMULAS
for Section Properties and Stresses

Stresses in Thin-wall Pressure Vessels:

The basic formulas for stresses in thin-wall pressure vessels (due to either internal or external pressure) come from basic strength of materials. For a cylindrical vessel:

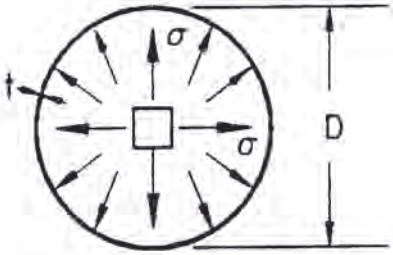


P=pressure

$$\sigma_L = \frac{PD}{2t}$$

$$\sigma_T = \frac{PD}{4t}$$

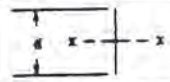
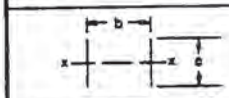
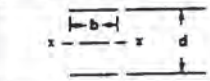
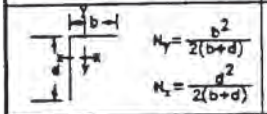
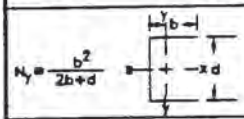
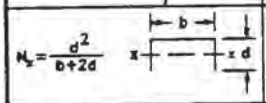
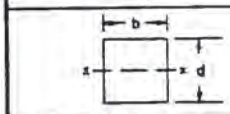
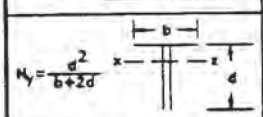
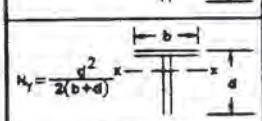
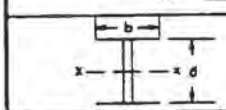
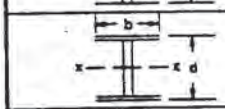
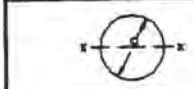
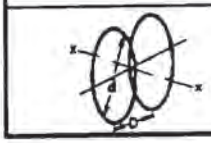
For a spherical vessel:



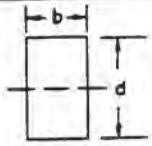
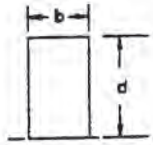
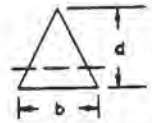
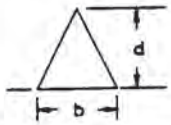
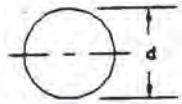
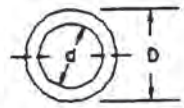
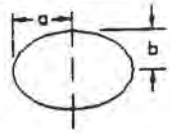
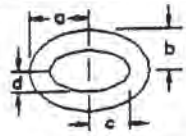
$$\sigma = \frac{PD}{4t}$$

As stated above, these formulas are also applicable to vessels subjected to external pressure (vacuum inside). However, the thin walls of a vessel may buckle elastically when loaded in compression and the strength of the vessel must be based on the compressive buckling strength of the thin walls. Bulkheads baffles or rings which have adequate stiffness/strength and are suitably attached to the vessel walls, serve to reduce the effective length of vessel wall subjected to compressive buckling and thereby increase the strength of the vessel.

Properties of Weld Treated as Line

Outline of Welded Joint b=width d=depth	Bending (about horizontal axis x-x)	Twisting
	$S_w = \frac{d^2}{6}$	$J_w = \frac{d^3}{12}$
	$S_w = \frac{d^2}{3}$	$J_w = \frac{d(3b^2+d^2)}{6}$
	$S_w = bd$	$J_w = \frac{b^3+3bd^2}{6}$
 $N_y = \frac{b^2}{2(b+d)}$ $N_x = \frac{d^2}{2(b+d)}$	$S_w = \frac{4bd+d^2}{6} = \frac{d^2(4b+d)}{6(2b+d)}$ top bottom	$J_w = \frac{(b+d)^4 - 6b^2d^2}{12(b+d)}$
$N_y = \frac{b^2}{2b+d}$ 	$S_w = bd + \frac{d^2}{6}$	$J_w = \frac{(2b+d)^3}{12} - \frac{b^2(b+d)^2}{(2b+d)}$
$N_x = \frac{d^2}{b+2d}$ 	$S_w = \frac{2bd+d^2}{3} = \frac{d^2(2b+d)}{3(b+d)}$ top bottom	$J_w = \frac{(b+2d)^3}{12} - \frac{d^2(b+d)^2}{(b+2d)}$
	$S_w = bd + \frac{d^2}{3}$	$J_w = \frac{(b+d)^3}{6}$
$N_y = \frac{d^2}{b+2d}$ 	$S_w = \frac{2bd+d^2}{3} = \frac{d^2(2b+d)}{3(b+d)}$ top bottom	$J_w = \frac{(b+2d)^3}{12} - \frac{d^2(b+d)^2}{(b+2d)}$
$N_y = \frac{d^2}{2(b+d)}$ 	$S_w = \frac{4bd+d^2}{3} = \frac{4bd^2+d^3}{6b+3d}$ top bottom	$J_w = \frac{d^3(4b+d)}{6(b+d)} + \frac{b^3}{6}$
	$S_w = bd + \frac{d^2}{3}$	$J_w = \frac{b^3+3bd^2+d^3}{6}$
	$S_w = 2bd + \frac{d^2}{3}$	$J_w = \frac{2b^3+6bd^2+d^3}{6}$
	$S_w = \frac{\pi d^2}{4}$	$J_w = \frac{\pi d^3}{4}$
	$I_w = \frac{\pi d}{2}(D^2 + \frac{d^2}{2})$ $S_w = \frac{I_w}{c}$ where $c = \frac{\sqrt{D^2+d^2}}{2}$	

Properties of Standard Sections

	Area A	Moment of Inertia I	Section Modulus S	Radius of Gyration r
	bd	$\frac{bd^3}{12}$	$\frac{bd^2}{6}$	$\frac{d}{\sqrt{12}}$
	bd	$\frac{bd^3}{3}$	$\frac{bd^2}{3}$	$\frac{d}{\sqrt{3}}$
	$\frac{bd}{2}$	$\frac{bd^3}{36}$	$\frac{bd^2}{24}$	$\frac{d}{\sqrt{18}}$
	$\frac{bd}{2}$	$\frac{bd^3}{12}$	$\frac{bd^2}{12}$	$\frac{d}{\sqrt{6}}$
	$\frac{\pi d^2}{4}$	$\frac{\pi d^4}{64}$	$\frac{\pi d^3}{32}$	$\frac{d}{4}$
	$\frac{\pi}{4}(D^2-d^2)$	$\frac{\pi}{64}(D^4-d^4)$	$\frac{\pi}{32}\frac{(D^4-d^4)}{D}$	$\frac{\sqrt{D^2+d^2}}{4}$
	πab	$\frac{\pi a^3 b}{4}$	$\frac{\pi a^2 b}{4}$	$\frac{a}{2}$
	$\pi(ab-cd)$	$\frac{\pi}{4}(a^3 b-c^3 d)$	$\frac{\pi(a^3 b-c^3 d)}{4a}$	$\frac{1}{a}\sqrt{\frac{a^3 b-c^3 d}{ab-cd}}$

APPENDIX C. STRENGTHS OF SELECTED MATERIALS AT NORMAL TEMPERATURES

STEEL

ASME DESIGN.	ASTM DESIGN.	PRODUCT FORM	F_y, ksi YIELD STR.	F_u, ksi TENSILE STR.
SA36	A36	PLATE AND ROLLED SHAPES	36	58
SA53-B		PIPE	35	60
SA105		FORGINGS	36	70
SA106-A	A106	PIPE	30	48
SA193-B7		BOLTING 4-7 IN.	75	100
SA193-B7		BOLTING 2.5-4 IN.	95	115
SA193-B7		BOLTING < 2.5 IN.	105	125
SA194-2H		------	-----	-----
SA240-304				
SA240-304L		PLATE	25	70
SA240-316				
SA240-316L		PLATE	25	70
SA285-C		PLATE	30	55
SA285-C		PLATE/SHT	30	55
SA414				
SA516				
	A569			
	A570			
	A572			
	A607			
	A656			
	A715			

ALUMINUM

SPEC. NO.	ALLOY DESIGN.	PRODUCT FORM	F_y, ksi YIELD STR.	F_u, ksi TENSILE STR.
SB209	5052-0	PLATE/SHT	9.5	25
SB209	5052-32	PLATE/SHT	23	31
SB209	5052-H34	PLATE/SHT	26	34
SB209	5086-0	PLATE/SHT	14	35
SB209	5086-H32	PLATE/SHT	28	40
SB209	5086-H34	PLATE/SHT	34	44
SB209	5154-0	PLATE/SHT	11	30
SB209	5154-H32	PLATE/SHT	26	36
SB209	5154-H34	PLATE/SHT	29	39
SB209	5254-0	PLATE/SHT	11	30
SB209	5254-H32	PLATE/SHT	26	36
SB209	5254-H34	PLATE/SHT	29	39
SB209	5454-0	PLATE/SHT	12	31
SB209	5454-H32	PLATE/SHT	26	36
SB209	5454-H34	PLATE/SHT	29	39
SB209	5652-0	PLATE/SHT	9.5	25
SB209	5652-H32	PLATE/SHT	23	31
SB209	5652-H34	PLATE/SHT	26	34

APPENDIX D. DIMENSIONS OF PIPE

Nominal Pipe Size	Outside Diameter	NOMINAL WALL THICKNESS											
		Sched. 20	Sched. 30	Std. Weight	Sched. 40	Sched. 60	Extra Strong	Sched. 80	Sched. 100	Sched. 120	Sched. 140	Sched. 160	XX Strong
1/8	0.405	---	---	0.068	0.068	---	0.095	0.095	---	---	---	---	---
1/4	0.540	---	---	0.088	0.088	---	0.119	0.119	---	---	---	---	---
3/8	0.675	---	---	0.091	0.091	---	0.126	0.126	---	---	---	---	---
1/2	0.840	---	---	0.109	0.109	---	0.147	0.147	---	---	---	0.187	0.294
3/4	1.050	---	---	0.113	0.113	---	0.154	0.154	---	---	---	0.218	0.308
1	1.315	---	---	0.133	0.133	---	0.179	0.179	---	---	---	0.250	0.358
1-1/4	1.660	---	---	0.140	0.140	---	0.191	0.191	---	---	---	0.250	0.382
1-1/2	1.900	---	---	0.145	0.145	---	0.200	0.200	---	---	---	0.281	0.400
2	2.375	---	---	0.154	0.154	---	0.218	0.218	---	---	---	0.343	0.436
2-1/2	2.875	---	---	0.203	0.203	---	0.276	0.276	---	---	---	0.375	0.552
3	3.500	---	---	0.216	0.216	---	0.300	0.300	---	---	---	0.438	0.600
3-1/2	4.000	---	---	0.226	0.226	---	0.318	0.318	---	---	---	---	0.636
4	4.500	---	---	0.237	0.237	---	0.337	0.337	---	0.438	---	0.531	0.674
5	5.563	---	---	0.258	0.258	---	0.375	0.375	---	0.500	---	0.625	0.750
6	6.625	---	---	0.280	0.280	---	0.432	0.432	---	0.562	---	0.718	0.864
8	8.625	0.250	0.277	0.322	0.322	0.406	0.500	0.500	0.593	0.718	0.812	0.906	0.875
10	10.750	0.250	0.307	0.365	0.365	0.500	0.500	0.593	0.718	0.843	1.000	1.125	---
12	12.750	0.250	0.330	0.375	0.406	0.562	0.500	0.687	0.843	1.000	1.125	1.312	---

APPENDIX E. MOTOR CARRIER REGULATIONS FOR MC 306/307/312 CARGO TANKS.

NOTE: Construction of MC 306, 307 and 312 cargo tanks was allowed until 31 August 1995 to specifications in effect on 30 December 1990.

§178.340 General design and construction requirements applicable to specifications MC 306 (§178.341), MC 307 (§178.342), and MC 312 (§178.343) cargo tanks.

§178.340-1 Specification requirements for MC 306, MC 307 and MC 312 cargo tanks.

(a) Specification MC 306, MC 307 and MC 312 cargo tanks constructed on or after December 1, 1967 for the bulk transportation of hazardous commodities must meet the requirements contained in this section in addition to the requirements of each applicable specification as contained in §178.341 (MC 306), §178.342 (MC 307) and (MC 312).

(b) All of these specification requirements are minimum requirements.

§178.340-2 General requirements.

(a) Every cargo tank and vessel shall be designed and constructed in accordance with the best known and available practices in addition to the other applicable cargo tank specification requirements.

(b) Those requirements relating to parts and accessories applicable to all motor vehicles engaged in interstate commerce as contained in Part 393 of the Motor Carrier Safety Regulations are an integral part of this specification.

(c) Where applicable the additional requirements prescribed in Part 173 to accommodate specific commodities are considered an integral part of these specifications.

(d) Multi-purpose cargo tank.

(1) A single cargo tank may be divided into compartments of different specification construction. Each such compartment shall conform to specification requirements concerned.

(2) A single cargo tank may be physically altered to comply with another cargo tank specification in these regulations; or altered to accommodate a commodity not requiring a DOT specification tank.

§178.340-3 Material

(a) All sheet and plate material for shell, heads, bulkheads and baffles for cargo tanks which are not required to be constructed in accordance with the American Society of Mechanical Engineers' Boiler and Pressure Vessel Code shall meet the following minimum applicable requirements:

(1) ALUMINUM ALLOYS (AL). Only aluminum alloy material suitable for fusion welding and in compliance with one of the following ASTM specifications shall be used:

ASTM B-209 Alloy 5052
ASTM B-209 Alloy 5086
ASTM B-209 Alloy 5154
ASTM B-209 Alloy 5254
ASTM B-209 Alloy 5454
ASTM B-209 Alloy 5652

All heads, bulkheads, baffles, and ring stiffeners may use 0 temper (annealed) or stronger tempers. All shell shall be made of materials with properties equivalent to H 32 or H 34 tempers, except that lower ultimate strength tempers may be used if the minimum shell thicknesses in Table II in §§178.341-2, 178.342-2, or 178.343-2 are increased in inverse proportion to the lesser ultimate strength.

(2) STEEL.

	Mild steel (MS)	High strength low alloy steel (HSLA)	Austenitic stainless steel (SS)
Yield point-p.s.i.----------	25,000	45,000	25,000
Ultimate strength-p.s.i.-----	45,000	60,000	70,000
Elongation, 2-inch samples-%	20	25	30

§178.340-4 Structural integrity.

(a) Maximum stress values. The maximum calculated stress value must not exceed 20 percent of the minimum ultimate strength of the material as authorized in 340-3, except when ASME Code pressure vessel design requirements apply.

(b) Loadings. Cargo tanks shall be provided with additional structural elements as necessary to prevent resulting stresses in excess of those permitted in paragraph (a) of this subsection. Consideration shall be given to forces imposed by each of the following loads individually, and where applicable a vector summation of any combination thereof:

(1) Dynamic loading under all product load configurations.
(2) Internal pressure.
(3) Superimposed loads such as operating equipment, insulation, linings, hose tubes, cabinets and piping.
(4) Reactions of supporting lugs and saddles or other supports.
(5) Effect of temperature gradients resulting from product and ambient temperature extremes. Thermal coefficients of dissimilar materials where used should be accommodated.

§178.340-5 Joints.

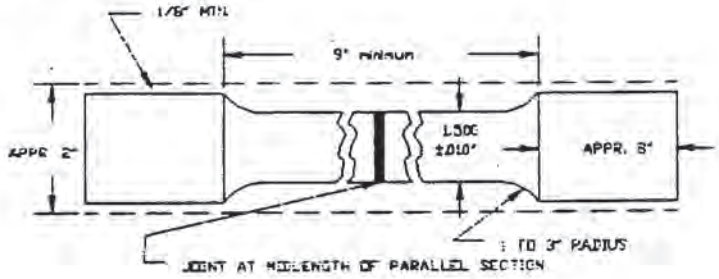
(a) Method of joining. All joints between tank shells, heads, baffles (or baffle attaching rings), and bulkheads shall be welded in accordance with the requirements contained in this section.

(b) Strength of joints (Aluminum Alloy (AL)). All welded aluminum alloy joints shall be made in accordance with recognized good practice, and the efficiency of a joint shall be not less than 85 percent of the properties of the adjacent material. Aluminum alloys shall be joined by an inert gas arc welding process using aluminum-magnesium type of filler metals which are consistent with the material suppliers recommendations.

(c) Strength of joints (Mild Steel(MS), High Strength Low Alloy (HSLA), Austenitic Stainless Steel (SS)). Joints shall be welded in accordance with recognized good practice and the efficiency of any joint shall be not less than 85 percent of the mechanical properties of the adjacent metal in the tank.

(1) Combinations of mild steel (MS), high strength low alloy (HSLA) and/or austenitic stainless steel (SS), may be used in the construction of a single tank, provided that each material, where used, shall comply with the minimum requirements specified in §178.340-3(a) for the material used in the construction of that section of the tank. Whenever stainless steel sheets are used in combination with steels of other types of steel, joints made by welding shall be formed by the use of stainless steel electrodes or filler rods and the stainless steel electrodes or filler rods used in the welding shall be suitable for use with the grade of stainless steel concerned, according to the recommendations of the manufacturer of the stainless steel electrodes or filler rods.

(d) Compliance test. Compliance with the requirements contained in paragraph (b) or (c) of this subsection for the welded joints indicated in paragraph (a) of this subsection shall be determined by preparing from materials representative of those to be used in tanks subject to this specification and by the same technique of fabrication, 2 test specimens conforming to figure as shown below and testing them to failure in tension. One pair of test specimens may represent all the tanks to be made of the same combination of materials by the same technique of fabrication, and in the same shop, within six months after the tests on such samples have been completed. The butt welded specimens tested shall be considered qualifying other types or combinations of types of weld using the same filler material and welding process as long as parent metals are of the same types of material.



§178.340-6 Supports and anchoring.

(a) Cargo tanks with frames not made integral with the tank as by welding, shall be provided with restraining devices to eliminate any relative motion between the tank and frame which may result from the stopping, starting or turning of the vehicle. Such restraining devices shall be readily accessible for inspection and maintenance, except that insulation and jacketing are permitted to cover the restraining devices.

(b) Any cargo tank designed and constructed so that it constitutes in whole or in part the structural member used in lieu of a frame, shall be supported in such a manner that the resulting stress levels in the cargo tank do not exceed those specified in §178.340-4(a). The design calculations of the support elements shall include loadings imposed by stopping, starting and turning in addition to those imposed as indicated in §178.340-4(b) using 20 percent of the minimum ultimate strength of the support material.

§178.340-7 Circumferential reinforcement.

(a) Tanks with shell thicknesses less than 3/8 of an inch shall in

addition to the tank heads be circumferentially reinforced with either bulkheads, baffles, or ring stiffeners. It is permissible to use any combination of the aforementioned reinforcements in a single cargo tank.

(1) Location. Such reinforcement shall be located in such a manner that the maximum unreinforced portion of the shell be as specified in Table II of the applicable specification and in no case more than 60 inches. Additionally such circumferential reinforcement shall be located within one inch of points where discontinuity in longitudinal shell sheet alignment exceeds 10 degrees unless otherwise reinforced with structural members capable of maintaining shell stress levels permitted in §178.340-4(a).

(b) Baffles. Baffles or baffle attaching rings if used as reinforcement members shall be circumferentially welded to the tank shell. The welding must not be less than 50 percent of the total circumference of the vessel and the maximum unwelded space on this joint shall not exceed 40 times the shell thickness.

(c) Double bulkheads. Tanks designed to transport different commodities which if combined during transit will cause a dangerous condition or evolution of hear or gas shall be provided with compartments separated by an air space. This air space shall be vented and be equipped with drainage facilities which shall be kept operative at all times.

(d) Ring stiffeners. Ring stiffeners when used to comply with this section shall be continuous around the circumference of the tank shell and shall have a section modulus about the neutral axis of the ring section parallel to the shell at least equal to that determined by the following formula:

I/C(Min)=0.00027WL (MS, HSLA, and SS) Steel
I/C(Min)=0.000467WL (AL) Aluminum Alloy

where:

I/C= Section modulus (inches^3).
W = Tank width or diameter (inches)
L = Ring spacing (inches):i.e., the maximum distance from the midpoint of the unsupported shell on one side of the ring stiffener to the midpoint of the unsupported shell on the opposite side of the ring stiffener.

(1) If a ring stiffener is welded to the tank shell (with each

circumferential weld not less than 50 percent of the total circumference of the vessel and the maximum unwelded space on this joint not exceeding 40 times the shell thickness) a portion of the shell may be considered as part of the ring section for purposes of computing the ring section modulus. The maximum portion of the shell to be used in these calculations is as follows:

Circumferential ring stiffener to tank shell welds	Distance between parallel circumferential ring stiffener to shell welds	Shell section credit
1	--	20t
2	Less than 20t	20t+W
2	20t or more	40t

where:

t = Shell thickness

W = Distance between parallel circumferential ring stiffener to shell welds.

(2) If configuration of internal or external ring stiffener encloses an air space, this air space shall be arranged for venting and be equipped with drainage facilities which shall be kept operative at all times.

§178.340-8 Accident damage protection.

(a) Appurtenances: The term "appurtenance" means any cargo tank accessory attachment that has no liquid product retention or other liquid containment function, and provides no structural support to the tank.

(1) The design, construction, and installation of any appurtenance to the shell or head of the cargo tank must be such as to minimize the possibility of appurtenance damage or failure adversely affecting the product retention integrity of the tank.

(2) Structural members, such as the suspension subframe, overturn protection and external rings, when practicable, should be utilized as sites for attachment of appurtenances and any other accessories to a cargo tank.

(3) Except as prescribed in subparagraph (5) of this paragraph, the welding of any appurtenance to a shell or head must be made by attachment to a

mounting pad. The thickness of a mounting pad must not be less than that of the shell or head to which it is attached. A pad must extend at least 2 inches in each direction from any point of attachment of an appurtenance. Pads must have rounded corners or otherwise be shaped in a manner to preclude stress concentration on the shell or head. The mounting pad must be attached by a continuous weld around the pad.

(4) The appurtenance must be attached to the mounting pad so there will be no adverse affect upon the product-retention integrity of the tank if any force is applied to the appurtenance, in any direction, except normal to the tank, or within 45° of normal.

(5) Shirting structures, conduit clips, brakeline clips, and similar lightweight attachments, which are of a metal thickness, construction, or material, appreciably less strong but not more than 72 percent of the thickness of the tank shell or head to which such a device is attached, may be secured directly to the tank shell or head if each device is so designed and installed that damage to it will not affect the product retention integrity of the tank. These lightweight attachments must be secured to the tank shell by continuous weld or in such manner as to preclude formation of pockets, which may become sites for incipient corrosion.

(b) Rear bumpers. Every cargo tank shall be provided with a rear bumper to protect the tank and piping in the event of a rear end collision and minimize the possibility of any part of the colliding vehicle striking the tank. The bumper shall be located at least 6 inches to the rear of any vehicle component which is used for loading or unloading purposes or may at any time contain lading while in transit. Dimensionally, the bumper shall conform to 49 CFR 393.86. Structurally, the bumper shall be designed to successfully absorb (no damage which will cause leakage of product) the impact of the vehicle with rated payload, with a deceleration of 2 "g" using a factor of safety of two based on the ultimate strength of the bumper material. For purposes of these regulations such impact shall be considered uniformly distributed and applied horizontally (parallel to the ground) from any direction at an angle not exceeding 30° to the longitudinal axis of the vehicle.

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(c) Overturn protection. All closures for filling, manhole or inspection openings shall be protected from damage which will result in leakage of lading in the event of overturning of the vehicle by being enclosed within the body of

the tank or dome attached to the tank or by guards.

(1) When guards are required, they shall be designed and installed to withstand a vertical load of twice the weight of the loaded tank and a horizontal load in any direction equivalent to one-half the weight of the loaded tank. These design loads may be considered independently. Ultimate strength of the material shall be used as a calculation base. If more than one guard is used each shall carry its proportionate share of the load. If protection other than guards are considered the same design load criteria is applicable.

(2) Except for pressure actuated vents no overturn protection is required for non-operating nozzles or fittings less than five inches in diameter (which do not contain product while in transit) that project a distance less than the inside diameter of the fitting. This projected distance may be measured either from the shell or the top of an adjacent ring stiffener provided such stiffener is within 30 inches of the center of the nozzle or fitting.

(3) If the overturn protection is so constructed as to permit accumulation of liquid on the top of the tank, it shall be provided with drainage facilities directed to a safe point of discharge.

(d) Piping.

(1) Product discharge piping shall be provided with protection in such a manner as to reasonably assure against the accidental escape of contents. Such protection may be provided by:

(i) A shear section located outboard of each emergency valve sear and within 4 inches of the vessel which will break under stain and leave the emergency valve sear and its attachment to the vessel and the valve head intact and capable of retaining product. The shear section shall be machined in such a manner as to abruptly reduce the wall thickness of the adjacent piping (or valve) material by at least 20 percent; or

(ii) By suitable guards capable of successfully absorbing a concentrated horizontal force of at least 8000 pounds applied from any horizontal direction, without damage to the discharge piping which will adversely affect the product retention integrity of the discharge valve.

(2) Minimum road clearance. The minimum allowable road clearance of any cargo tank component or protection device located between any two adjacent axles on a vehicle or vehicle combination shall be at least 1/2 inch for each foot separating such axles and in no case less than 12 inches.

(3) Strength of piping, fittings, hose and hose couplings. Hose, piping and fittings for tanks to be unloaded by pressure shall be designed for a bursting pressure of at least 100 psig and not less than four times the pressure to which,

in any instance, it may be subjected in service by the action of any vehicle mounted pump or other device (not including safety relief valves), the action of which may be to subject certain portions of the tank piping and hose to pressures greater than the design pressure of the tank. Any coupling used on hose to make connections shall be designed for a working pressure not less than 20 percent in excess of the design pressure of the hose and shall be so designed that there will be no leakage when connected.

(4) Provision for expansion and vibration. Suitable provisions shall be made in every case to allow for and prevent damage due to expansion, contraction, jarring and vibration of all pipe. Slip joints shall not be used for this purpose.

(5) Heater coils. Heater coils, when installed, shall be so constructed that the breaking-off of their external connections will not cause leakage of contents of tank.

(6) Gauging, loading, and air-inlet devices. Gauging, loading and air-inlet devices, including their valves, shall be provided with adequate means for their secure closure, and means shall also be provided for the closing of pipe connections of valves.

On May 2, 1989, §178.340-8(b) was revised to read as follows:

§178.340-8 Accident damage protection.

(b) *Rear-end Protection.* Each cargo tank shall be provided with a rear accident damage protection device to protect the tank and piping in the event of a rear-end collision and reduce the likelihood of damage which could result in the loss of lading. The rear-end protection device must be in the form of a rear bumper or rear-end tank protection device meeting the following:

(1) *Rear bumper.* (i) The bumper shall be located at least 6 inches to the rear of any vehicle component used for loading or unloading or that may contain lading while the vehicle is in transit.

(ii) The dimensions of the bumper shall conform to §393.86 of this title.

(iii) The structure of the bumper shall be designed to withstand, without leakage of lading, the impact of the vehicle with rated payload, at a deceleration of 2 "g" using the safety factor of two based on the ultimate strength of the bumper material. Such impact shall be considered uniformly distributed and applied horizontally (parallel to the ground) from any direction at any angle not exceeding 30 degrees to the longitudinal axis of the vehicle.

(2) *Rear-end tank protection device.* (Noting in this paragraph shall be construed to relieve a manufacturer of responsibility for complying with the requirements of §393.86 of this title.)

(i) The inboard surface of the rear-end tank protection device shall be located at least 6 inches to the rear of any vehicle component used for loading or unloading or that may contain lading while the vehicle in is transit, in order to prevent the device from applying force upon the cargo tank or tank components in the event of an accident.

(ii) The dimensions of the rear-end protection device shall conform to the following:

(A) The bottom surface of the rear-end protection device must be at least 4 inches below the lower surface of any valve, fitting, or piping at the rear of the tank and not more than 60 inches from the ground with the vehicle empty.

(B) The maximum width of a notch, indentation, or separation between sections of a rear-end tank protection device may not exceed 24 inches. A notched, indented, or separated rear-end protection device may be used only when the piping at the rear of the tank is equipped with a sacrificial device

outboard of a shutoff valve. (a sacrificial device is an element, such as a shear section, designed to fail under load in order to prevent damage to any lading retention part or device. The device must break under strain at no more than 70 percent of the strength of the weakest piping element between the tank and the sacrificial device. Operation of the sacrificial device must leave the remaining piping and its attachment to the tank intact and capable of retaining lading.)

(C) The widest part of the motor vehicle at the rear may not extend more than 18 inches beyond the outermost ends of the device or (if separated) devices on either side of the vehicle.

(iii) The structure of the rear-end tank protection device and its attachment to the vehicle must be designed to withstand without leakage of lading, the impact of the cargo tank motor vehicle at rated payload, at a deceleration of 2 "g" using a safety factor of two based on the ultimate strength of the materials used. Such impact shall be considered uniformly distributed and applied horizontally (parallel to the ground) from any direction at an angle not to exceed 30 degrees to the longitudinal axis of the vehicle.

§178.341 Specification MC 306; cargo tanks

§178.341-1 General requirements.

(a) Specification MC 306 cargo tanks must comply with the general design and construction requirements in §178.340 in addition to the specific requirements contained in this section.

(b) Design pressure. The design pressure of each cargo tank shall not be less than that pressure exerted by the static head of the fully loaded tank in the upright position.

§178.341-2 Thickness of shell, heads, bulkheads and baffles.

(a) Material thickness. The minimum thicknesses of tank material authorized in §178.340-3 shall be predicated on not exceeding the maximum allowable stress level (§178.340-4(a) but in no case less than those indicated in Tables I and II below.

(1) Product density. The material thicknesses contained in Tables I and II are minimums based on a maximum 7.2 pounds per gallon product weight. If the tank is designed to haul products weighing more than 7.2 pounds per gallon, the gallon per inch value used to determine the minimum thickness of heads, bulkheads, baffles or shell sheets shall be the actual section capacity required in gallons per inch multiplied by the actual product density in pounds per gallon divided by 7.2.

Table I.–Minimum Thickness of Heads, Bulkheads and Baffles. Mild Steel (MS), High Strength Low Alloy Steel (HSLA), Austenitic Stainless Steel (SS) in United States Standard Gauge–Aluminum (AL)--Expressed in Decimals of an Inch.

	Volume Capacity in Gallons Per Inch											
	10 or Less			Over 10 to 14			Over 14 to 18					
	MS	HSLA SS	AL	MS	HSLA SS	AL	MS	HSLA SS	AL	MS	HSLA SS	AL
Thickness--	14	15	.096	13	14	.109	12	13	.130	11	12	.151

Table II.--Minimum Thickness of Shell Sheets. (Mild Steel (MS), High Strength Low Alloy Steel (HSLA), Austenitic Stainless Steel (SS) in United States Standard Gauge--Aluminum Alloy (AL)--Expressed in Decimals of an Inch.

Maximum Shell Radius	Distance Between Bulkheads, Baffles or Ring Stiffener	Volume Capacity in Gallons Per Inch											
		10 or Less			Over 10 to 14			Over 14 to 18			18 and over		
		MS	HSLA SS	AL	MS	HSLA SS	AL	MS	HSLA SS	AL	MS	HSLA SS	AL
Less than 70"	36" or less-----	14	16	.087	14	16	.087	14	15	.096	13	14	.109
	Over 36" to 54"--	14	16	.087	14	15	.096	13	14	.109	12	13	.130
	54" Thru 60"-----	14	15	.096	13	14	.109	12	13	.130	11	12	.151
70" or more Less than 90"	36" or less-----	14	16	.087	14	15	.096	13	14	.109	12	13	.130
	Over 36" to 54"--	14	15	.096	13	14	.109	12	13	.130	11	12	.151
	54" Thru 60"-----	13	14	.109	12	13	.130	11	12	.151	10	11	.173
90" or more Less than 125"	36" or less-----	14	15	.096	13	14	.109	12	13	.130	11	12	.151
	Over 36" to 54"--	13	14	.109	12	13	.130	11	12	.151	10	11	.173
	54" Thru 60"-----	12	13	.130	11	12	.151	10	11	.173	9	10	.194
125" or more	36" or less-----	13	14	.109	12	13	.130	11	12	.151	10	11	.173
	Over 36" to 54"--	12	13	.130	11	12	.151	10	11	.173	9	10	.194
	54" Thru 60"-----	11	12	.151	10	11	.173	9	10	.194	8	9	.216

§178.342 Specification MC 307; cargo tanks.

§178.342-1 General requirements.

(a) Specification MC 307 cargo tanks must comply with the general design and construction requirements in §178.340, in addition to the specific design requirements contained in this section.

(b) The design pressure (maximum allowable working pressure) of each cargo tank shall be not less than 25 psig. For working pressures in excess of 50 psig, the tank must be designed in accordance with the requirements of the ASME Code.

(c) Tanks shall be of circular cross-section.

§178.342-2 Thickness of shell, heads, bulkheads, and baffles.

(a) Material thickness. The minimum thickness of tank material authorized by §178.340-3 shall be not less than those obtained by applying the following formulas nor less than those specified in Table I and II below:

Thickness of shell = $T_s = PD/2SE_s$

Thickness of heads = $T_h = 0.885PL/SE_h$ (for pressure on concave side only)

Where:

T_s = Maximum thickness of shell material, exclusive of allowance for corrosion or other loadings;

T_h = Minimum thickness of head material, after forming, exclusive of allowance for corrosion and other loadings;

P = Design pressure, pounds per square inch;

D = Inside diameter of shell, inches;

L = Inside crown radius of head, inches;

S = Maximum allowable stress value, pounds per square inch equals one-fourth of specified minimum ultimate tensile strength. (One-fourth of aluminum alloy's annealed minimum ultimate strength.);

E_s = Lowest efficiency of any longitudinal joint in shell.

(85% max.);

E_h = Lowest efficiency of any joint in head. (85% max.).

(1) The knuckle radius of the head shall not be less than three times the material thickness. The straight flange shall not be less than three times the material thickness for butt-welded heads.

(2) For heads with pressure on the convex side, the material thickness as obtained by the above formula shall be increased by 67 percent unless such heads are adequately braced to prevent excessive distortion.

(b) Corrosion allowance. Vessels or part of vessels subject to thinning by corrosion , erosion or mechanical abrasion shall have provision made to withstand the intended life and service by a suitable increase in the thickness of the material over that determined by the design formulas, or by using some other suitable method of protection. Material added for these purposed need not be of the same thickness for all parts of the vessel if different rates of attack are expected for the various parts.

Table I.--Minimum Thickness of Heads, Bulkheads and Baffles. Mild Steel (MS), High Strength Low Alloy Steel (HSLA), Austenitic Stainless Steel (SS) in United States Standard Gauge--Aluminum (AL) in Decimals of an Inch

	Volume Capacity in Gallons Per Inch																				
	10 or Less			Over 10 to 14			Over 14 to 18			18 to 22			22 to 26			26 to 30			30 and Over		
	ML	HSLA SS	AL	ML	HSLA SS	AL	ML	HSL A SS	AL	ML	HSLA SS	AL	ML	HSLA SS	AL	ML	HSLA SS	AL	ML	HSLA SS	AL
Thickness	14	15	.109	13	14	.130	12	13	.151	11	12	.173	10	11	.194	9	10	.216	8	9	.237

Table II.--Minimum Thickness of Shell Sheets. (Mild Steel (MS), High Strength Low Alloy Steel (HSLA), Austenitic Stainless Steel (SS) in United States Standard Gauge--Aluminum Alloy (AL)--Expressed in Decimals of an Inch.

Distance Between Bulkheads, Baffles or other Shell Stiffeners	Volume Capacity in Gallons Per Inch																				
	10 or Less			Over 10 to 14			14 to 18			18 to 22			22 to 26			26 to 30			30 and Over		
	MS	HSLA SS	AL	MS	HSLA SS	AL	MS	HSLA SS	AL	MS	HSLA SS	AL	ML	HSLA SS	AL	ML	HSLA SS	AL	ML	HSLA SS	AL
36" or Less----------	14	16	.109	14	16	.109	14	15	.109	13	14	.130	12	13	.151	11	12	.173	10	11	.194
Over 36" to 54"------	14	16	.109	14	15	.109	13	14	.130	12	13	.151	11	12	.173	10	11	.194	9	10	.216
54" Thru 60"---------	14	15	.109	13	14	.130	12	13	.151	11	12	.173	10	11	.194	9	10	.216	8	9	.237

§178.343 Specification MC 312; cargo tanks.

§178.343-1 General requirements.

(a) Specification MC 312 cargo tanks must comply with the general design and construction requirements in §178.340 in addition to the specific requirements contained in this section.

(b) Tank design. Cargo tanks built under this specification that are unloaded by pressure in excess of 15 psig must be designed and constructed in accordance with and fulfill all requirements of the ASME Code. No tank shall have head, bulkheads, baffles or shell thicknesses less than that specified in §178.343-2, Tables I and II, nor shall the spacing of bulkheads, baffles or shell stiffeners exceed that specified in §178.340-7.

(c) Design pressure shall be not less than pressure used for unloading.

§178.343-2 Thickness of shell, heads, bulkheads and baffles of the non-ASME Code tanks.

(a) Material thickness. The minimum thicknesses of tank material authorized in §178.340-3 shall be predicated on not exceeding the maximum allowable stress level in §178.340(a) but in no case less than those indicated in Tables I and II listed below, or the accompanying aluminum alloy formula:

(1) Aluminum alloy formula:

$$\text{Thickness of Aluminum Alloy Materials} = \text{Steel Thickness from Tables I \& II} \times (3\times10^{7}/E)^{1/3}$$

Where E = Modulus of Elasticity of the material to be used.

(b) Lining. Except as provided in paragraph (c) of this subsection, cargo tanks shall be lined and the material used for lining each cargo tank subject to this specification shall be homogenous, nonporous, imperforate when applied, not less elastic than the metal of the tank proper, and substantially immune to attach by the commodities to be transported therein. It shall be directly bonded or attached by other equally satisfactory means. Joints and seams in the lining shall be made by fusing the material together, or by other

equally satisfactory means.

(c) Conditions under which tanks need not be line. Tanks need not be lined as provided in paragraph (b) of this subsection, if:

(1) The material of the tank is thick enough to withstand 10 years normal service without being reduced at any point to less thickness than that specified in paragraph (a) of this subsection corresponding to its type; or,

(3) The chemical reaction between the material of the tank and the commodity to be transported therein is such as to allow the tank to be properly passivated or neutralized and if the tank is not frequently cleaned and not used in the transportation of other commodities.

Table I.--Minimum Thickness of Heads, Bulkheads and Baffles. Mild Steel (MS), High Strength Low Alloy Steel (HSLA), Austenitic Stainless Steel (SS) in United States Standard Gauge--unless otherwise expressed in fractions of an inch

	Volume Capacity in Gallons Per Inch											
	10 or Less			Over 10 to 14			14 to 18			18 and Over		
	Product Weight in Pounds Per Gallon @ 60° F											
	10 lbs and Less	Over 10 to 13 lbs	13 lbs to 16	10 lbs and Less	Over 10 to 13 lbs	13 lbs to 16	10 lbs and Less	Over 10 to 13 lbs	13 lbs to 16	10 lbs and Less	Over 10 to 13 lbs	13 lbs to 16
Thickness-	12	10	8	10	8	3/16	9	3/16	1/4	8	1/4	1/4

Table II.--Minimum Thickness of Shell Sheets. (Mild Steel (MS), High Strength Low Alloy Steel (HSLA), Austenitic Stainless Steel (SS) in United States Standard Gauge--unless otherwise expressed in fractions of an inch.

Maximum Shell Radius	Distance Between Bulkheads, Baffles or Ring Stiffener	Volume Capacity in Gallons Per Inch											
		10 or Less			Over 10 to 14			14 to 18			18 and over		
		Product Weight in Pounds Per Gallon @ 60° F											
		10 lbs. and Less	Over 10 to 13 lbs.	13 lbs. to 16	10 lbs. and Less	Over 10 to 13 lbs.	13 lbs. to 16	10 lbs. and Less	Over 10 to 13 lbs.	13 lbs. to 16	10 lbs. and Less	Over 10 to 13 lbs.	13 lbs. to 16
Less than 70"	36" or less------	12	10	8	12	10	8	12	10	8	10	8	3/16
	Over 36" to 54"--	12	10	8	12	10	8	10	8	3/16	9	3/16	1/4
	54" Thru 60"-----	12	10	8	10	8	3/16	9	3/16	1/4	8	1/4	1/4
70" or more Less than 90"	36" or less------	12	10	8	12	10	8	10	8	3/16	9	3/16	1/4
	Over 36" to 54"--	12	10	8	10	8	3/16	9	3/16	1/4	8	1/4	1/4
	54" Thru 60"-----	10	8	3/16	9	3/16	1/4	8	1/4	1/4	3/16	1/4	5/16
90" or more Less than 125"	36" or less------	12	10	8	10	8	3/16	9	3/16	1/4	1/4	8	1/4
	Over 36" to 54"--	10	8	3/16	9	3/16	1/4	8	1/4	1/4	3/16	1/4	5/16
	54" Thru 60"-----	9	3/16	1/4	8	1/4	1/4	3/16	1/4	5/16	3/16	1/4	5/16
125" or more	36" or less------	10	8	3/16	9	3/16	1/4	8	1/4	1/4	3/16	1/4	5/16
	Over 36" to 54"--54"	9	3/16	1/4	8	1/4	1/4	3/16	1/4	5/16	3/16	1/4	5/16
	Thru 60"-----	8	1/4	1/4	3/16	1/4	5/16	3/16	1/4	5/16	3/16	5/16	3/8

APPENDIX F. STRUCTURAL EVALUATION OF MC 306/307/312 CARGO TANKS.

MC regulations for 300 series cargo tanks do not give detailed load combinations or analysis procedures for evaluating structural integrity of cargo tanks but do give detailed loadings for overturn protection and rear-end protection. Also, some 307/312 cargo tanks must be designed in accordance with the ASME Code.

As a result of lack of detailed requirements for non-ASME, MC 300 series cargo tanks, manufacturers have developed dynamic load factors and analysis procedures through their experiences.

For an MC 306 cargo tank, structural integrity of the tank is frequently based on analysis of the tank idealized as a simple beam subjected to static gravity weights of the tank, lading and appurtenances. Bending stresses computed for this situation are then multiplied by a factor of 1.7 to account for "dynamic effects". (This would be the same as the computation of bending stresses due to extreme vertical acceleration for an MC 406 cargo tank.) This is considered to be a surrogate for vertical acceleration, lateral acceleration, braking, etc. The computed tensile stress is compared to that allowed by the regulations (20% of ultimate). Weld joint efficiencies must be at least 85% and are already accounted for in the allowable stress value. Computed compressive stress is compared to allowable values from the Alcoa or Roark and Young formulas. Minimum shell thickness must conform to values given in the regulations. Ring stiffener spacing and section modulus must also conform to the regulations. The design of many MC 306 cargo tanks has been based on this simplified approach.

The analysis/design of non-ASME, MC 307/312 cargo tanks would also be based on the approach described above.

Structural analysis procedures for MC 307/312 cargo tanks required to meet portions of the ASME Code, would be the same as those for DOT 407/412 cargo tanks except for differences in the MC and DOT Regulations.

AI Responsibilities

The Inspector shall make all inspections specifically required of him plus such other inspections as he believes are necessary to enable him to certify that all vessels which he authorizes to be stamped with the Certification Mark have been designed and constructed in accordance with the requirements of this Division. Some, but not all, of the required inspections and verifications, which are defined in the applicable rules, are summarized as follows:

	Verifying that the Manufacturer has a valid Certificate of Authorization (UG-117(a)) and is working to a Quality Control System (UG-117(e))
	Verifying that the applicable design calculations are available (U-2(b), U-2(c), 10-5, and 10-15(d)) verifying that materials used in the construction of the vessel comply with the requirements of UG-4 through UG-14 (UG-93)
	Verifying that all welding and brazing procedures have been qualified (UW-28, UW-47, and UB-42)
	Verifying that all welders, welding operators, brazers, and brazing operators have been qualified (UW-29, UW-48, and UB-43)
	Verifying that the heat treatments, including PWHT, have been performed (UG-85, UW-10, UW-40, UW-49, and UF-52)
	Verifying that material imperfections repaired by welding were acceptably repaired (UG-78, UW-52(d)(2)(-c), UF-37, and UF-47(c))
	Verifying that weld defects were acceptably repaired (UW-51(a) and UW-52(c))
	Verifying that required nondestructive examinations, impact tests, and other tests have been performed and that the results are acceptable (UG-84, UG-93, UW-50, UW-51, UW-52, and UB-44)
	Making a visual inspection of vessel to confirm that the material identification numbers have been properly transferred (UG-77 and UG-94)
	Making a visual inspection of the vessel to confirm that there are no material or dimensional defects (UG-95, UG-96, and UG-97)
	Performing internal and external inspections and witnessing the hydrostatic or pneumatic tests (UG-96, UG-97, UG-99, UG-100, and UG-101)
	Verifying that the required marking is provided (UG-115) and that any nameplate has been attached to the proper vessel
	Signing the Certificate of Inspection on the Manufacturer's Data Report when the vessel, to the best of his knowledge and belief, is in compliance with all the provisions of this Division. When the Inspector has certified by signing the Manufacturer's Data Report, this indicates acceptance by the Inspector. This acceptance does not imply assumption by the Inspector of any of the responsibilities of the Manufacturer.
	When mass production of pressure vessels makes it impracticable for the Inspector to personally perform each of his required duties, the Manufacturer, in collaboration with the Inspector, shall prepare an inspection and quality control procedure setting forth, in complete detail, the method by which the requirements of this Division will be maintained. This procedure shall be developed, accepted, and implemented in accordance with Mandatory Appendix 35.

Cargo Tank Motor Carrier Investigation Checklist

Cargo tank owners and motor carriers that lease cargo tanks for more than 30 days are required to maintain certain documents. These requirements only apply to DOT specification cargo tanks.

Motor carriers that lease cargo tanks for less than 30 days are not subject to maintaining documents per Section 180.417(a)(2).

If an owner sells a cargo tank, they must provide the purchaser or lessee with a copy of all the documents discussed here, per Section 180.417(d).

<u>Cargo Tank Test/Inspection Reports 180.417(b)(3)</u>
(See the section on MC330/331 Cargo Tanks also)

- These reports must be retained until the next test/inspection of the same type is due.
- Be sure to check for each test/inspection that is required for that specification per Section 180.407(c) and that each cargo tank motor vehicle is within the test/inspection due date.
- Review the test/inspection report to ensure that all the items required by Section 180.417(b)(1) and (2) are included (normally this is a CT facility violation, but the carrier should be familiar with what is required).
- Test/Inspection reports at carrier should be signed by a company representative.
- Check the MCMIS profile of the CT testing facility to verify their registration is valid, and that they are registered for all the functions they are performing.

MC330/331/173.315(k) Cargo Tank Motor Vehicles

- Check for the additional information required on the pressure test report per Section 180.417(c). This report must be retained for the life of the cargo tank and one year thereafter.
- MC330/331 CTs made of quenched and tempered (QT) steel (or NQT CTs that didn't receive postweld heat treatment) must have a Wet Fluorescent Magnetic Particle Exam (WFMPE) conducted just prior to the pressure test per Section 180.407(g)(3). Check for this report.
- Some CT testing facilities will out-source specialty tests, like the Wet Fluorescent Magnetic Particle Exam (WFMPE). If so, verify that the company conducting the test/inspection is registered as a CT facility with FMCSA.
- Check for the certification of the installation emergency discharge control systems required by Sections 173.315(n) and 180.405(m). This requirement applies to all poison gases and flammable gases, anhydrous ammonia, and non-flammable gases with a subsidiary hazard.
- Check for the monthly tests on the emergency discharge control systems per Section 180.416(d).
- Hoses used to comply with the emergency discharge control requirements (such as a smart hose) must be tested during the annual leakage test. Check the leakage test report to ensure this was done. See 180.416(e).
- New or repaired delivery hoses must be pressure tested prior to being placed in service per Section 180.416(f). Check for these reports.
- Does their driver training include these elements?

Manufacturer's Certificate or Certificate of Compliance

This is required by Section 180.417(a) and is a critical violation.

Each manufacturer of a specification cargo tank must provide the purchaser with a manufacturer's certificate, also called a certificate of compliance. This is essentially the CT's "birth certificate," certifying that it meets DOT specifications for the specification it was built to.

It may be in a certificate form or it may just be a printed statement. The requirements for what to include in the certificate is found in Section 178.345-15 for 400 series CTs; 178.340-10 for 306, 307, and 312; Section 78.336-18 for MC330; Section 178.337-18 for MC331 and Section 178.338-19 for MC338. Be sure to check for any specification shortages noted on the certificate.

Many CT owners have difficulty locating this document, particularly if the CT is several years old or if it was purchased in used condition. If the manufacturer is still in business, they should be able to provide a copy of the certificate.

If the manufacturer's certificate cannot be located and the CT was manufactured prior to September 1, 1995, Section 180.417(a)(3) provides a method for the owner and a Registered Inspector to produce a duplicate certificate.

If a CT is no longer capable of meeting the specification to which it was built, the specification plate must be removed, obliterated, or securely covered. The details of the conditions causing the withdrawal of certification must be documented and signed on the manufacturer's certificate and retained by the owner for 1 year (see Section 180.405(j)).

ASME Code Stamped Cargo Tanks (U-1A form)
This is required by Section 180.417(a) and is a critical violation.

Certain CTs must be stamped that they meet the ASME Code with a U Stamp marking. This may be on a separate plate or on the specification plate (see below).

In addition to the manufacturer's certificate, these CTs must have an ASME U-1A report. This report (usually one page) must be maintained in the same manner as the manufacturer's certificate. Replacement U-1A reports are available from the original manufacturer or the National Board of Boiler and Pressure Vessel Inspectors.

Repairs
The CT owner or motor carrier that leases a CTMV for more than 30 days must retain documentation of all repairs, modifications, stretching, rebarrelling, etc., completed on the CT in the same manner as the manufacturer's certificate. See 180.413(c).

To weld on the wall of a cargo tank, the person performing the repairs must be registered with FMCSA as a CT facility, and must hold a valid NBIC R Stamp. Welding on other parts of the CT, such as the appurtenance pads on the CT or the chassis or suspension, does not require an R Stamp.

Check for repair records and also visually inspect as many CTs as you can for evidence of repairs to the CT wall. Unauthorized repairs are not unusual. Verify the person who performed the repairs has a valid R Stamp in MCMIS.

For repairs on the CT wall, a pressure test must be conducted after the repairs are completed (Section 180.413(b)). For repairs on piping, a leakage test must be conducted after the piping is reinstalled on the tank (Section 180.413(c)). Check for these reports.

Modifications, stretching, rebarrelling must be certified in writing by a Design Certifying Engineer (DCE). This documentation will vary in appearance (see Section 180.413(d)).

Document Retention 180.417(a)(1) and (2)

For all documents except most test/inspection reports (see the section on MC330/331 CTs), the retention period for owners is for the life of the cargo tank and one year thereafter. If ownership of the cargo tank changes, the prior owner must retain the documents for one year. Motor carriers leasing cargo tanks for more than 30 days are required to maintain documents for the entire lease and one year thereafter.

Note for investigations

It is strongly recommended that investigators read the specification requirements in Part 178 for the specific cargo tanks the motor carrier transports prior to the review. Investigators should also read Part 180 Subpart E prior to any motor carrier CT review.

Cargo Tank Yard Walk-Around

It is strongly encouraged to physically check some cargo tank motor vehicles. Ensure that the cargo tank motor vehicle is in service and ready for transportation.

Check for:

- Dents, gouges, weld cracks, corroded/abraded areas that have not been evaluated by a Registered Inspector.
- Unrepaired leaks.
- Evidence of recent welding to the cargo tank wall. Check the paperwork to ensure the weld repair was performed by a CT facility that holds an R or U Stamp.
- Check the manual remote shutoff devices to ensure they appear operational (don't actuate them) and the marking is present.
- Ensure the test/inspection markings are present and current (180.407(b) and (c)).
- Ensure all markings and placards are present and correct.
- MC330/331/173.315(k) CTMVs: Check for compliance with the emergency discharge control device (173.315(n), 180.416, 177.840) and the emergency procedures (177.840(l)).

<Name of Owner>
<Name of Company>
<Street Address>
<City, State, Zip Code>

<Date>

RE: <CT facility name>, <CT #>

Dear <Owner>:

Your company has been identified as a customer of <CT facility name>, <CT #>. As the result of an investigation into <CT facility name> conducted by the Federal Motor Carrier Safety Administration (FMCSA) on <DATE>, serious violations of the U.S. Department of Transportation Hazardous Materials Regulations (HMR) were discovered. The investigation revealed that <CT facility name> was conducting cargo tank motor vehicle tests and inspections that did not comply with the requirements of 49 CFR Part 180. Based on the deficient tests and inspections, FMCSA has identified the following cargo tank motor vehicles as being in violation of the HMR and unsafe to operate in the transportation of hazardous materials:

Unit Number	Year/Make	Specification	Serial #

This letter notifies you that pursuant to 49 CFR §180.407(b)(5), **the above-listed cargo tank motor vehicles may not be loaded with hazardous materials or used to transport hazardous materials until the cargo tank motor vehicles have been inspected and retested in accordance with 49 CFR §180.407.** It is a violation of the HMR to use these cargo tank motor vehicles for transportation of hazardous materials before they have been properly re-inspected and retested by an FMCSA-registered cargo tank facility.

Pursuant to 49 CFR §171.1(g), a person who knowingly violates the HMR may be assessed a civil penalty of not more than $75,000 for each violation. In cases where the violation results in death, serious illness or severe injury, the maximum civil penalty is $175,000. When there is a continuing violation that involves transporting hazardous materials, or causing hazardous materials to be transported or shipped, each day of the violation constitutes a separate offense. Any person who knowingly violates 49 U.S.C. §5104(b), or who willfully or recklessly violates a provision of the Federal hazardous material transportation law, or an order or regulation issued

thereunder, shall be subject to criminal penalties under Title 18, United States Code (USC), including imprisonment for not more than 5 years, or in the case of death or bodily injury for not more than 10 years, or both (See: 49 U.S.C. 5124(a)).

You must provide documentation that the required inspections and retesting has been performed for all of the affected cargo tank motor vehicles to the attention of <Service Center HMPM or Division HMS) by email at <email address> or by fax at <fax #>, prior to operating any of the cargo tank motor vehicles listed in this letter.

The documentation must consist of:
<Add requirements depending upon tests/inspections at issue>

If you have any questions, please contact <NAME/PHONE/EMAIL>.

Sincerely,

<NAME>
<TITLE>

CTFR PART C Template:

PURPOSE: The purpose of this template is two-fold – it documents the investigation and aids in penalty assessment if applicable. This template is intended to increase the uniformity of the investigative process. Each section should be completed as applicable. The content and context of each section should be completed with details from the investigation.

HOW TO USE: Provide details of the investigation that are not obvious or evident from reading Parts A and B of the report. All remarks should be based in fact or actual statements made by facility staff. All information contained in this report must be accurate and legally defensible.
Items noted as [REQUIRED] are required to be in Part C. Those noted as [SUGGESTED] are suggested items for Part C.

REMARKS:

INVESTIGATIVE REPORT RECEIVED BY:
[REQUIRED] Name:
[REQUIRED] Title:
[REQUIRED] Carrier/Shipper Name:
[REQUIRED] Date:
[REQUIRED] Telephone Number (if different from Part A):

If carrier refuses to accept investigative report or closeout was with less than highest ranking official provide mailing details below:
[REQUIRED] Name to whom it was sent:
[REQUIRED] Mailing method (ie Fedex, UPS, etc.):
[REQUIRED] Date Sent:
[REQUIRED] Tracking /Confirmation Number:
[REQUIRED] Telephone Number (if different from Part A):

REASON FOR INVESTIGATION:
[REQUIRED] Note if there is more than one reason for initiating this review (i.e., never reviewed, Complaint, etc.)

FACILITY OPERATION DESCRIPTION: [Include information in this section describing the Facility operation, such as, mobile vs. fixed, types of tests/inspections, specific industries (propane, gasoline), repairs/manufacturing/assembly.]
[REQUIRED] Describe the financial condition of the subject, focusing on any information that impacts the facility's operation. The objective is to gather information to support making safety assessments, determining ability to pay and reincarnated facility.
Include:
Gross Revenue - if carrier refuses to provide explain how the amount was determined
List major assets such as buildings, land, airplanes, other companies, etc.
Document the officers of the company.
List all partners not listed on Part A, where applicable.
[REQUIRED] Note the names and titles of any relevant company official or employee who were interviewed, but were not listed on Part A of the Investigative Report.
[REQUIRED] Identify whether the facility is also a motor carrier.
[REQUIRED] Explain how the company began CT testing, how long they have been in the industry.
[SUGGESTED] Provide enough detail to fully understand the nature of the business and how it is structured. Include a description of the business profit model, that is how do they make money, what is acceptable profit, how do they make up for losses, etc.
[SUGGESTED] Describe the company location and the principle place of business, maintenance facilities, etc. Provide the extent and nature of any divisions or business locations of the subject.
[SUGGESTED] Describe anything that is atypical about the subject's operation.

[SUGGESTED] Include general overview of facility's operation and identify the personnel responsible for compliance.

PRE-INVESTIGATION:
[REQUIRED] Provide a listing of the specific supporting documents that were requested and when. Include whether or not the carrier was given 48 hours to produce records not located at the principal place of business.
[REQUIRED] List documents that were not provided as requested and actions taken to obtain them
[SUGGESTED] Document issues that posed barriers to the pre-investigation process, such as locating or reaching the facility, availability and accuracy of information, etc. If extremely difficult to locate facility, explain how facility was contacted.
[SUGGESTED] Provide date(s) on which investigation was conducted and reasons for delays, extensions, etc.
[SUGGESTED] Note any specific details in conversations or observations that influenced the investigation process.

INVESTIGATION:
[REQUIRED] Describe what specific supporting documents were produced, when and by whom. Include the name and title of the person providing documents.
[REQUIRED] Describe where the supporting documents are located and how are they maintained.
[REQUIRED] Explain why recently inspected/tested cargo tank motor vehicles were not inspected.
[SUGGESTED] Note statements made by officials relative to correcting the violations discovered during the investigation
[SUGGESTED] Note any other information that explains and/or complements the cited violations in Part B, and would increase the accuracy of the evaluation process, and would aid the follow-up investigator.

TESTS/INSPECTIONS:
[REQUIRED] If a mobile tester, describe how equipment is transported to the test/inspection location.
[REQUIRED] Explain whether the equipment is adequate for the tests/inspections conducted.
[REQUIRED] Describe any violations discovered on cargo tank motor vehicles that have recently been inspected/tested by this facility.
[REQUIRED] Describe any violations or improper procedures discovered during the review and how they were discovered.
[REQUIRED] Note the tests/inspections that you observed and identify who conducted the tests/inspections.
[SUGGESTED] Identify any third party test or inspection facilities that perform tests or inspections for this facility (e.g., Authorized Inspectors, Wet Florescent Magnetic Particle Exam, etc.).
[SUGGESTED] For Pressure Tests, explain how the facility conducts bench tests of pressure relief devices and how they remove the upper coupler.

RI QUALIFICATIONS/TRAINING:
[REQUIRED] Describe the HM training the company provides to the Registered Inspectors (who conducted the training, subjects covered). Explain any violations.
[REQUIRED] Verify and describe the qualifications of all Registered Inspectors (length of experience, where experience obtained, high school diploma).

REPORT FORMS:
[REQUIRED] If using a pre-printed test/inspection report, identify the company that produces the report. Note if the company produces their own report forms.
[REQUIRED] List all items not listed on the inspection report form.
[REQUIRED] Identify the number of reports examined and explain how they were selected.

REPAIRS/MANUFACTURING/ASSEMBLY:
[REQUIRED]Verify and describe the qualifications of all welders and/or DCEs.
[REQUIRED] Identify the number of repair files reviewed and note any violations.
[REQUIRED] Describe their manufacturing/assembly operations and explain any violations discovered.
[REQUIRED] Document if a USDOT Engineer was involved in the review or design analysis.

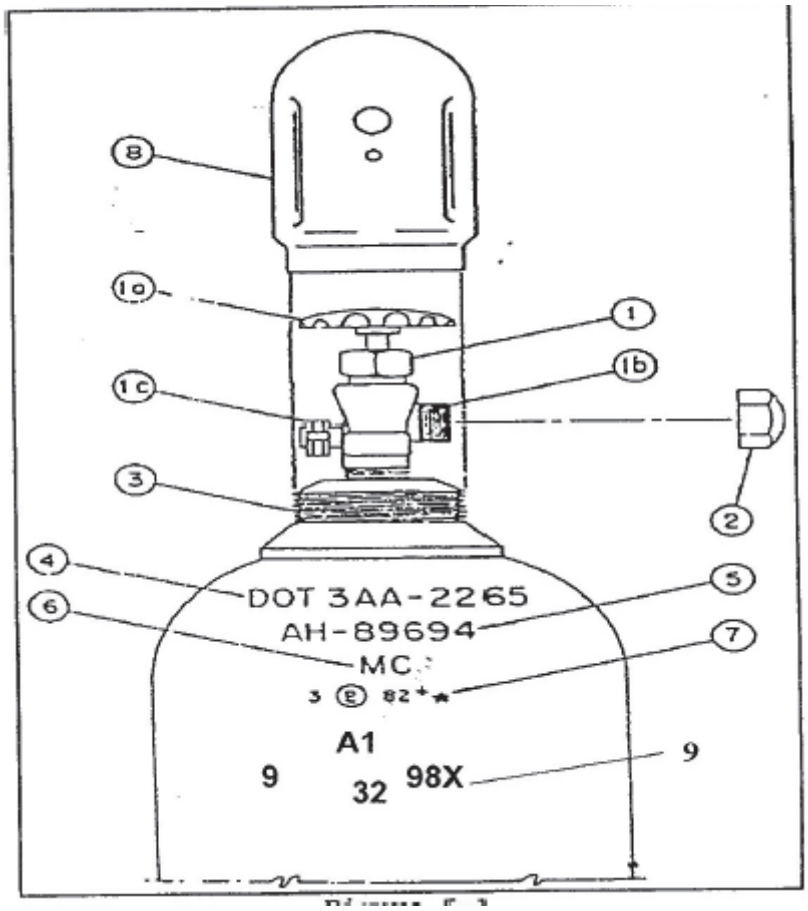
FOLLOW-ON ACTION:
[REQUIRED] Note the reason for NOT taking enforcement action for serious violations
[SUGGESTED] Provide information about the selection of the Follow-on action
[SUGGESTED] Document areas of weakness that may be future problem areas for the facility

DOCUMENTS PROVIDED TO FACILITY:
[REQUIRED] List materials provided TO the facility and any materials the facility had on hand, especially copies of the Hazardous Materials Regulations (including print date).

		Yes/No/NA
1	**GENERAL REQUIREMENTS**	
	Limited Quantities [173.306]	
	Exceptions [173.307-173.311]	
	Offering/Transporting a charged/filled cylinder that is not free of leaks, bulges, defective valves, or other safety devices, or bears evidence of physical abuse [173.301(a)(2)]	
	Offering/Transporting a charged/filled cylinder for which required markings have not been properly maintained (illegible) [173.301(b)]	
	Offering/Transporting a charged/filled cylinder without one or more pressure relief devices [173.301(f)]	
	Offering/Transporting a charged/filled cylinder with a pressure relief device for a Division 2.3 or 6.1 Hazard Zone A material [173.301(f)(6)]	
2	**SPECIFIC REQUIREMENTS FOR PIH GASES**	
	These cylinders are not authorized [173.40(a)]: o DOT 3AL specification cylinders made of aluminum alloy for Hazard Zone A; o UN composite cylinders for Hazard Zone A or B; o UN seamless cylinders for Hazard Zone A with a water capacity of more than 85 L.	
	Closures must conform to the requirements specified in 173.40(c)(1)-(4)	
	Must conform to the additional valve damage protection of 173.40(d)	
	Cannot be manifolded or connected [(173.40(e)].	
3	**MARKING AND LABELING**	
	General marking requirements for non-bulk packages [172.301]	
	Specific marking requirements for non-bulk packages [172.313, 172.324]	
	General marking requirements for bulk packages [172.302] (DOT 3T is the only DOT cylinder that is a bulk package)	
	Specific marking requirements for bulk packages [172.313, 172.322, 172.331, 172.336]	
	General labeling requirements [172.400]	
	Label modifications [172.400a]	

4	**SPECIFICATION REQUIREMENTS (PART 173 AND 178)**	
	General requirements for all Specification Cylinders [178.35]	
	Marking requirements for specification cylinders [178.35(f)] Exceptions [178.75(f)(3)] Note: See illustration at bottom of page	
	Canada (TDG Cylinders) [171.12(a)(4)]	
	UN Cylinders [178.71]	
	Cylinder testers must have PHMSA approval [178.35(b)(1)] https://portal.phmsa.dot.gov/rinlocator	
	Valve protection requirements for DOT cylinders [173.301(h)] See 173.40(d) for PIH gases	
	Valve protection requirements for UN pressure vessels [173.301b(c)]]	
	Metal attachments [173.310(k)]	
	Offering/Transporting a charged/filled cylinder, to from or within the United States, that was manufactured outside the United States which does not comply with the requirements in Part 178. [173.301(j)]	
	Manifolding See Part 177	
	Tube Trailers [173.301(i)]	
	MEGCs (UN tube trailers) [173.312 and 178.75]	
	Specific filling requirements [173.302-173.305]	
5	**PART 177 TRANSPORTATION**	
	Transporting a cylinder that has not been properly secured in the vehicle [177.840(a)(1)]	
	Transporting a packing requiring a Poison or Poison Inhalation Hazard label or placard with foodstuffs [177.841(e)(1)]	
	Transporting a package requiring a POISON, POISON GAS, OR POISON INHALATION HAZARD, label in the drivers compartment [177.841(e)(2)]	
	Transporting a toxic gas where the packagings are inner connected [177.841(c)]	
	Offering/Transporting **manifolded** (interconnected) cylinders except as authorized [173.301(g) and 177.841(c) for toxic gases]	

6	**PART 180 INSPECTIONS AND TESTS**	
	Each cylinder used for transportation of hazardous materials must be an authorized packaging [180.205(a)]	
	Charging/filling a cylinder that has not been **retested and marked** as required [180.209(a)]	
	Each cylinder requalified in accordance with this subpart must be marked as specified [180.213]	
	Requirements for requalification of UN pressure vessels [180.207]	
	No person may represent that a repair or requalification of a cylinder has been performed unless that person holds a current approval [180.205(b)]	
	Conditions requiring test and inspection of cylinders [180.205(d)]	
	Visual inspection of cylinder required each time it is pressure tested [180.205(f)]	
	Criteria for pressure testing cylinders [180.205(g)]	
	Cylinder rejection and requalification [180.205(h)]	
	Criteria for condemning cylinders [180.205(i)]	
	Reporting and record retention requirements [180.215]	
	Requalification of Multiple-Element Gas Container (MEGC, tube trailer built to UN pressure vessel specifications) [180.217]	



Important Features common to Gas cylinders

(1) valve;
(1a) valve hand wheel;
(1b) CGA outlet connection;
(1c) pressure relief device;
(2) Valve outlet cap;
(3) Collar;
(4) DOT specification and service pressure;
(5) Serial number;
(6) Manufacturer's symbol;
(7) Test date, original tester's symbol, hydrostatic testing allowance, permission to over pressurize by 10%; [178.35(f)]
(8) Cylinder cap and
(9) Requalification marking including RIN A123 [180.213(d)].

Requirements for Specification 51 Steel Portable Tanks

§178.245 Specification 51; steel portable tanks.

§178.245-1 Requirements for design and construction.

(a) Tanks must be seamless or welded steel construction, or a combination of both, and have a water capacity in excess of 454 kg (1,000 pounds). Tanks must be designed, constructed, certified and stamped in accordance with Section VIII of the ASME Code (IBR, see §171.7 of this subchapter).

(b) Tanks must be postweld heat treated and radiographed as prescribed in the ASME Code except that each tank constructed in accordance with part UHT of the ASME Code must be postweld heat treated. Where postweld heat treatment is required, the tank must be treated as a unit after completion of all the welds in and/or to the shell and heads. The method must be as prescribed in the ASME Code. Welded attachments to pads may be made after postweld heat treatment is made. A tank used for anhydrous ammonia must be postweld heat treated. The postweld heat treatment must be as prescribed in the ASME Code, but in no event at less than 1050 °F tank metal temperature. Additionally, tanks constructed in accordance with part UHT of the ASME Code must conform to the following requirements:

(1) Welding procedure and welder performance tests must be made annually in accordance with section IX of the ASME Code. In addition to the essential variables named therein, the following must be considered to be essential variables: number of passes, thickness of plate, heat input per pass, and manufacturer's identification of rod and flux. The number of passes, thickness of plate and heat input per pass may not vary more than 25 percent from the procedure qualification. Records of the qualification must be retained for at least 5 years by the tank manufacturer and made available to duly identified representatives of the Department of Transportation or the owner of the tank.

(2) Impact tests must be made on a lot basis. A lot is defined as 100 tons or less of the same heat and having a thickness variation no greater than plus or minus 25 percent. The minimum impact required for full-sized specimens shall be 20 foot-pounds (or 10 foot-pounds for half-sized specimens) at 0 °F Charpy V-Notch in both the longitudinal and transverse direction. If the lot test does not pass this requirement, individual plates may be accepted if they individually meet this impact requirement.

(c) Except as provided in paragraph (d) of this section, all openings in the tank shall be grouped in one location, either at the top of the tank or at one end of the tank.

(d) The following openings may be installed at locations other than on the top or end of the tank:

(1) The openings for liquid level gauging devices, pressure gauges, or for safety devices, may be installed separately at the other location or in the side of the shell;

(2) One plugged opening of 2-inch National Pipe Thread or less provided for maintenance purposes may be located elsewhere;

(3) An opening of 3-inch National Pipe Size or less may be provided at another location, when necessary, to facilitate installation of condensing coils; or

(4) Filling and discharge connections may be installed below the normal liquid level of the tank if the tank design conforms to the following requirements:

(i) The tank must be permanently mounted in a full framework for containerized transport. For each tank design, prototype tank, must fulfill the requirements of parts 450 through 453 of this title for compliance with the requirements of Annex II of the International Convention for Safe Containers.

(ii) Each filling and discharge connection must be equipped with an internal self-closing stop-valve capable of closing within 30 seconds of actuation. Each internal self-closing stop-valve must be protected by a shear section or sacrificial device located outboard of the valve. The shear section or sacrificial device must break at no more than 70 percent of the load that would cause failure of the internal self-closing stop-valve.

(iii) Each internal self-closing stop-valve must be provided with remote means of automatic closure, both thermal and mechanical. The thermal means of automatic closure must actuate at a temperature of not over 250 °F.

(e) Each uninsulated tank used for the transportation of compressed gas, as defined in §173.115 of this subchapter, must have an exterior surface finish that is significantly reflective, such as a light reflecting color if painted, or a bright reflective metal or other material if unpainted.

§178.245-2 Material.

(a) All material used for the construction of the tank and appurtenances shall be suitable for use with the commodity to be transported therein.

(b) A material of thickness less than $^{3}/_{16}$ inch shall not be used for the shells and heads.

§178.245-3 Design pressure.

(a) The design pressure of a tank authorized under this specification shall be not less than the vapor pressure of the commodity contained therein at 46 °C (115 °F), or as prescribed for a particular commodity by part 173 of this chapter, except that in no case shall the design pressure of any container be less than 100 psig or more than 500 psig. When corrosion factor is prescribed by these regulations, the wall thickness of the tank calculated in accordance with Section VIII of the ASME Code (IBR, see §171.7 of this subchapter) shall be increased by 20 percent or 2.54 mm (0.10 inch), whichever is less.

NOTE 1: The term design pressure as used in this specification is identical to the term "MAWP" as used in the ASME Code.

(b) [Reserved]

§178.245-4 Tank m ountings.

(a) Tanks shall be designed and fabricated with mountings to provide a secure base in transit. "Skids" or similar devices shall be deemed to comply with this requirement.

(b) All tank mountings such as skids, fastenings, brackets, cradles, lifting lugs, etc., intended to carry loadings shall be permanently secured to tanks in accordance with the requirements in Section VIII of the ASME Code (IBR, see §171.7 of this subchapter) under which the tanks were fabricated, and shall be designed to withstand static loadings in any direction equal to twice the weight of the tank and attachments when filled with the lading using a safety factor of not less than four, based on the ultimate strength of the material to be used. The specific gravity used in determining the static loadings shall be shown on the marking required by §178.245-6(a) and on the report required by §178.245-7(a).

(c) Lifting lugs and hold-down lugs may be added to either the tank or tank mountings. lfl ifting lugs and hold-down lugs are added directly to the tank, they shall be secured to doubling plates welded to the tank and located at points of support, except that lifting lugs or hold-down lugs with integral bases serving as doubling plates may be welded directly to the tank. Each lifting lug and hold-down lug shall be designed to withstand static loadings in any direction equal to twice the weight of the tank and attachments when filled with the lading using a safety factor of not less than four, based on the ultimate strength of the material to be used.

(d) All tank mountings shall be designed so as to prevent the concentration of excessive loads on the tank shell.

(e) A DOT 51 portable tank that meets the definition of "container" in §450.3(a)(2) of this title must meet the requirements of parts 450 through 453 of this title, in addition to the requirements of this subchapter.

§178.245-5 Protection of valves and accessories.

(a) All valves, fittings, accessories, safety devices, gaging devices, and the like shall be adequately protected against mechanical damage.

(b) The protective device or housing shall conform to the requirements under which the tanks are fabricated with respect to design and construction, and shall be designed to withstand static loadings in any direction equal to twice the weight of the tank and attachments when filled with the lading using a safety factor of not less than four, based on the ultimate strength of the material to be used.

(c) Requirements concerning types of valves, retesting, and qualification of portable tanks contained in §§173.32 and 173.315 of this chapter must be observed.

§178.245-6 Name plate.

(a) In addition to the markings required by Section VIII of the ASME Code (IBR, see §171.7 of this subchapter) under which tanks were constructed, they shall have permanently affixed, in close proximity to the ASME "U" stamp certification, a metal plate. This plate shall be permanently affixed by means of soldering, brazing, or welding around its complete perimeter. Neither the plate itself nor the means of attachment to the tank shall be subject to destructive attack by the contents of tank. Upon such plate shall be plainly marked by stamping, embossing, or other means of forming letters into or onto the metal plate itself the following information in characters at least $^{1}/_{8}$-inch high:

Manufacturer's name .....
Serial No. ..... Owner's serial No. .....
D.O.T. Specification No .....
Water capacity (pounds) .....
Tore weight (pounds) .....
Design pressure (psig) .....
Design specific gravity .....
Original test date .....
Tank retested at ..... (psig) on .....

(b) All tank outlets and inlets, except safety relief valves, shall be marked to designate whether they communicate with vapor or liquid when the tank is filled to the maximum permitted filling density.

§178.245-7 Report.

(a) A copy of the manufacturer's data report required by Section VIII of the ASME Code (IBR, see §171.7 of this subchapter) under which the tank is fabricated shall be furnished to the owner for each new tank.

(b) [Reserved]

SUPERSEDED REGULATIONS

The following sections are no longer part of the Hazardous Materials Regulations. For the convenience of the user the text of the superseded sections appears as follows.

Requirements for Specification 56 and 57 portable tanks

§178.251 General design and construction requirements applicable to specifications 56 (§178.252) and 57 portable tanks (§178.253).

§178.251-1 General requirements.

(a) These specifications apply to tanks of any shape (cylindrical, conical, cubical, or other).

(b) The rated gross weight of the tank must not exceed the values used during the design qualification vibration and drop tests.

(c) Each tank must be in compliance with all applicable requirements of §§173.24 and 173.32 of this chapter.

§178.251-2 Materials of construction.

(a) Except for gaskets, pressure relief devices, valve seats, liners, linings, and caps or plugs used as secondary closing devices over discharge openings, materials of construction must be metal.

(b) Hardware for handling and securing, fitting protection, outlet piping, valves, relief devices, and closures must be made of material that is electrolytically compatible with, or suitably protected from electrolytic action when joined to the product retention components of the tank.

(c) Any material used must not be susceptible to stress corrosion cracking.

(d) Material specification: All sheet, plate, and extruded material for shell, heads, bulkheads, and baffles for portable tanks must meet the following minimum requirements:

(1) Aluminum alloys. Aluminum alloys must be suitable for fusion welding and must meet the following requirements:

Minimum yield strength	24,000 p.s.i.
Minimum ultimate strength	30,000 p.s.i.
Minimum elongation of standard 2 inch gauge length	8 percent

(2) Steel. Steel must meet the following requirements:

	Mild steel	Low alloy low carbon	Stainless
Minimum yield strength, p.s.i	25,000	45,000	25,000
Minimum ultimate strength. p.s.i	45,000	60,000	70,000
Minimum elongation of standard 2 inch gage length (percent)	20	25	30

(3) Magnesium alloys. Magnesium alloy must conform to ASTM B-90-69, Grade ZE-10A.

§178.251-3 General construction requirements.

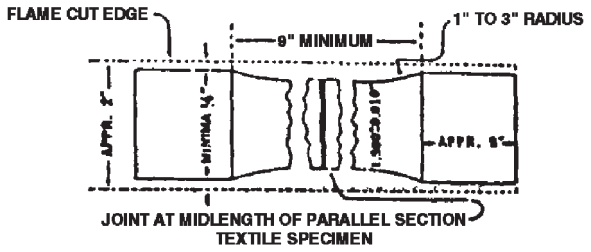
(a) Method ofj oining. All joints between tank shells, heads, baffles (or baffle attaching rings), and bulkheads must be welded in accordance with the requirements of this section.

(b) Strength ofj oints (Aluminum Alloy (AL), Magnesium Alloy (MG)). All welded joints must be made in accordance with recognized good practice. The efficiency of a joint must not be less than 85 percent of the mechanical properties of the adjacent material. Each alloy must be joined by an inert gas arc welding process using filler metals which are consistent with material suppliers recommendations.

(c) Strength ofj oints (Mild Steel (MS), High Strength Low Alloy (HSLA), Austenitic Stainless Steel (SS)). Joints must be welded in accordance with recognized good practice. The efficiency of any joint must not be less than 85 percent of the mechanical properties of the adjacent material.

(d) Compliance test. Compliance with the requirements contained in paragraph (b) or (c) of this section for the welded joints must be determined by preparing two test specimens from materials and fabrication techniques representative of those to be used in each tank. Each specimen must be tested to failure under tension. Each test specimen must be prepared and tested in accordance with ASTM Standard E8-81 for metallic materials and ASTM Standard B557-81 for aluminum and magnesium-alloy products. As a minimum, one pair of representative test specimens, consisting of the minimum and maximum thickness for each type of material used, may represent all the related tanks manufactured in the same shop within 12 months after the tests on the

samples have been successfully completed. The butt welded specimens tested may be considered as qualifying other types or combinations of types of welds using the same filler material and welding process as long as parent metals are the same.



§178.251-4 Stacking, m ounting and tie-down provisions.

(a) Load support devices. Each tank designed to be stacked in storage must be provided with load support devices. There may be no significant permanent deformation of the load support devices or the tank under either of the following stress conditions:

(1) Tanks loaded to their maximum authorized gross weight and stacked at least 18 feet high.

(2) A load on the support devices at least three times the maximum authorized gross weight of the tank.

(b) Base mounting. Each tank must be constructed with mountings to provide a secure base during transportation. The mounting may be in the form of a skid or similar structure.

(c) Tie-down system. If there are tie-down devices that are a structural part o f the tank, the tiedown system must be capable of withstanding the following static loading without significant deformation to the tank. The static loading applied must have, with respect to the center of gravity of the tank a vertical component of at least two times the maximum authorized gross weight of the tank.

(1) If the design of the tank necessitates specific front and side orientation when loaded on a transportation vehicle, the static loading applied must have two horizontal components at right angles to each other, one direction at a time as follows:

(i) A longitudinal component at least seven times the maximum authorized gross weight of the tank in the direction of travel of the vehicle, and

(ii) A component offi ve times the maximum authorized gross weight of the tank in the transverse direction, or

(2) If the design of the tank does not necessitate specific front and side orientation when loaded on a transportation vehicle, the static loading applied must have two horizontal components at right angles to each other, one direction at a time, of at least seven times the maximum authorized gross weight of the tank.

(d) If there is a structural part of the tank that could be used to tie the tank down and which is not in compliance with paragraph (c) of this section, it must be securely covered or locked during transportation to prevent its use as a tie-down.

§178.251-5 Testing.

(a) Design qualification testing. Design qualification tests prescribed in this paragraph must be made on at least one of each design and size tank, except that a set of tests, when made on a tank of one size, may serve to qualify smaller tanks made of the same kind and thickness of material, by the same fabrication technique, and with identical supports, and equivalent closures, and other appurtenances. Tests must be performed sequentially on a single tank in the order listed in this section. Additional tests must be made if there is any increase in design size of the tank, any reduction in thickness of material, or any change in material, or in fabrication technique. Test samples must be retained for 1 year.

(1) Vibration and drop tests. See applicable specification, §178.252-3(a) or §178.253-5(a).

(2) Structural integrity tests—(i) Lifting devices. If there is a system ofl ifting devices that is a structural part of the tank or is permanently attached thereto or to the support struc ture, the system mu st be capable of supporting at least three times the maximum gross weight of the tank, and each individual lifting device must be capable of supporting at least the maximum gross weight of the tank, without significant permanent deformation in either the lifting device system or in any part of the tank.

(ii) Shipment support structure. If the tank supports are a structural part of the tank, the supports must be capable of absorbing a force equal to the maximum gross weight of the tank or breaking without significant permanent deformation to the product retention component of the tank. The force must be applied to the supports at ground level from at least two horizontal directions at right angles to each other, one direction at a time.

(iii) Stacking support devices. If stacking support devices are a structural part of the tank, there must be no significant permanent deformation of any device or the tank under either of the following stress conditions:

(a) Tanks loaded to their maximum authorized gross weight and stacked at least 18 feet high.

(b) A load on the stacking support devices of at least three times the maximum authorized gross weight of the tank.

(iv) Fittings and protective devices. Each fitting (or its protective device) subject to this test requirement must be capable of withstanding a force at least two times the maximum authorized gross weight of the tank without

resultant damage to the fitting. The force must be applied to the fitting or its protective device in at least two horizontal directions at right angles to each other, one direction at a time, and in alignment with the fitting.

(b) Production quality control, testing and inspection. See applicable specification, §178.252-3(b) or §178.253-5(b).

§178.251-6 Rejected tanks.

No tank which fails to pass any of the prescribed tests may be placed in service until suitable repairs have been made and satisfactory re-test results have been obtained.

§178.251-7 Identification and marking.

(a) A metal certification plate must be permanently affixed to each tank and must be readily accessible for inspection. The plate must be marked in letters and numerals at least $^1/_8$-inch high by stamping, embossing, or other means off orming letters into or onto the metal plate itself. The marking must contain at least the following information:

Tank manufacturer .....
Specification identification: Spec. 56 or Spec. 57 .....
Design pressure (for specification 57 only) ..... p.s.i.g.
Test pressure (for specification 56 only) ..... p.s.i.g.
Serial number .....
Original test date or Leakage test date .....
Tare weight ..... lbs.
Rated gross weight [1] ..... lbs.
Volumetric capacity ..... U.S. gal. (or cu. ft.)
Materials of construction [2] .....

[1]The rated (permitted) gross weight may not exceed that weight used during the design qualification tests involving vibration and drop.

[2]E.g., AL for aluminum, MG for magnesium alloy. MS for mild steel. HSLA for high strength low alloy. SS for austenitic stainless steel, including ASTM or ASME reference.

(b) Unless the tank has been designed for stacking and meets the appropriate stacking integrity requirements of this specification, it must also be marked in letters at least 2 inches high in contrasting colors “Do Not Stack” and “Do Not Place Other Freight On Top Of This Tank”, on at least two sides of the tank. These instructions must also appear on the certification plate. Plate markings are required to meet the requirements of paragraph (a) of this section and need not be in contrasting color.

§178.252 Specification 56; metal portable tank.

§178.252-1 General requirements.

(a) Each tank must be in compliance with the general design and construction requirements in §178.251 in addition to the specific requirements of this section.

(b) Each tank may not exceed a rated gross weight of 7,700 pounds.

§178.252-2 Openings.

(a) Each fill and discharge opening must be equipped with a closure and locking device.

(b) A drum-type locking ring closure is authorized for openings not exceeding 23 inches in diameter. A drum-type locking ring closure must be at least a 12-gage bolted ring with forged lugs having at least a $^5/_8$-inch steel bolt tapped into one of the lugs. The locking ring must be equipped with a lock nut or equivalent device.

(c) For a tank that incorporates a hopper-type product discharge opening, the closure device must be constructed to retain product under the test conditions outlined in §§178.251-5 and 178.252-3(a). Closures for those openings must be designed with positive mechanical locking and sealing devices to prevent leakage during normal conditions incident to transportation.

§178.252-3 Testing.

(a) Design qualification testing. In addition to the testing prescribed in §178.251-5(a), a vibration and a drop test are also required on each design. For these tests, the tank must be filled with a fine dry powdered material having a density that results in the tank having a gross weight not less than the rated gross weight of the tank.

(1) Vibration test. This test must be performed for 1 hour using a minimum double amplitude of 1 inch at a frequency that causes the test tank to be raised from the floor of the testing table so a piece offl at steel strap may be passed between the tank and the table. The tank must be restrained so that all horizontal motion is restricted and only vertical motion is permitted.

(2) Drop test. The tank must be capable of withstanding without leakage of contents a 2-foot free drop onto a flat unyielding horizontal surface, striking the target surface in the position and attitude from which maximum damage to the tank (including closures) is expected.

(b) Production quality control, testing, and inspection—(1) Leakage test. Each tank must be tested by a minimum air or hydrostatic pressure of at least 2 pounds per square inch gage applied to the entire tank. If the air pressure is used, the entire surface of all joints under pressure must be coated with, or immersed in, a solution of soap and water, or other material suitable for the purpose of detecting leaks. If the hydrostatic pressure test is used it must be carried out by using water or other liquid having a similar viscosity, the temperature of which may not exceed 100□F. and all joints under pressure must be inspected for leaks. For either tests, the

pressure must be held for a period of time sufficiently long to assure detection ofl eaks. All closures must be in place during the test. Any tank that has detectable leakage or significant permanent deformation does not meet the requirements of this specification.

§178.253 Specification 57; metal portable tank.

§178.253-1 General requirements.

(a) Each tank must be in compliance with the general design and construction requirements in §178.251 in addition to the specific requirements of this section.

(b) Each tank must have a capacity of at least 110 gallons but not more than 660 gallons.

§178.253-2 Openings.

(a) Each fill and discharge opening must be equipped with a closure device that meets the following requirements:

(1) Any closure for a fill opening in excess of 20 square inches must be equipped with a device to prevent the closure from fully opening without first relieving internal pressure.

(2) Any product discharge valve, if used, must be provided with a leak tight device, such as a cap or plug.

(3) Each closure must be vapor tight.

(b) A drum-type locking ring closure is authorized for any opening less than 23 inches in diameter. A drum-type locking ring closure must be at least a 12-gage bolted ring with forged lugs having at least a $^{5}/_{8}$-inch steel bolt tapped into one of the lugs. The locking ring must be equipped with a lock nut or equivalent device.

§178.253-3 Protection offi ttings.

Each fitting which could be damaged sufficiently to result in leakage of tank contents must be protected by suitable guards or protective housings. The term "fitting" includes valves, closure devices, safety relief devices, and other accessories through which contents could leak from the tank. Each fitting or fitting protection device must be capable of withstanding the fitting protection test specified in §178.251-5.

§178.253-4 Vents.

(a) Each tank must be equipped with at least one pressure relief device such as a spring-loaded valve, frangible disc or fusible plug.

(b) Each pressure relief device must communicate with the vapor space of the tank when the tank is in a normal transportation attitude. Shutoffvalves must not be installed between the tank opening and any pressure relief device. Pressure relief devices must be mounted, shielded, or drained to prevent the accumulation of any material that could impair the operation or discharge capability of the device.

(c) The total emergency venting capacity (cu. ft./hr.) of each portable tank must be at least that determined from the following table.

Total surface area square feet [1 2]	Cubic feet free air per hour
20	15,800
30	23,700
40	31,600
50	39,500
60	47,400
70	55,300
80	63,300
90	71,200
100	79,100
120	94,900
140	110,700
160	126,500

[1]Interpolate for intermediate sizes.
[2]Surface area excludes area ofl egs.

(1) The pressure operated relief device must open at not less than 3 pounds per square inch gage and at not over the design test pressure of the tank. The minimum venting capacity for pressure activated vents must be 6,000 cubic feet off ree air per hour (measured at 14.7 p.s.i.a. and 60□F.) at not more than 5 pounds per square inch gage.

(2) If a frangible device is used for relieving pressure, the device must have a minimum area of 1.25 square inches and must be rated at less than the design test pressure of the tank.

(3) If a fusible device is used for relieving pressure, the device must have a minimum area of 1.25 square inches. The device must function at a temperature between 220□F. and 300□F. and at a pressure less than the design test pressure of the tank, unless this latter function is accomplished by a separate device.

(d) No relief device may be used which would release flammable vapors under normal conditions of transportation (temperature up to and including 130□F.)

§178.253-5 Testing.

(a) Design qualification testing. In addition to the testing prescribed in §178.251-5, a vibration test, a drop test, and a pressure test are also required on each design. For the vibration and drop tests, the tank must be filled with a liquid to not less than the rated gross weight.

(1) Vibration test. This test must be performed for 1 hour using a minimum double amplitude of 1 inch at a frequency that causes the test tank to be raised from the floor of the testing table so a piece offl at steel strap

may be passed between the tank and the table. The tank must be restrained so that all horizontal motion is restricted and only vertical motion is permitted.

(2) Drop test. The tank must be capable of withstanding without leakage of contents a 2-foot free drop onto a flat unyielding horizontal surface, striking the target surface in the position and attitude from which maximum damage to the tank (including piping and fittings) is expected.

(3) Pressure test. The tank must be capable of maintaining, under hydrostatic test for at least 5 minutes, at least one and one-half times the design pressure prescribed in this paragraph, without detectable leakage or significant permanent deformation. The pressure must be measured at the top of the tank. Each closure must be in place and blocked if necessary as for shipment. Each closure must be standard, except that tapping for pressurizing and gaging is permitted. Design pressure must be determined as follows:

$$P = \frac{hd}{115} + 3$$

Where:

P = Design pressure in psig;
h = Inside height of tank in inches;
d = Maximum allowable density in pounds per gallon;
115 = Number of cubic inches in 1 gallon (231) divided by a safety factor of two.

(b) Production quality control, testing and inspection—(1) Leakage test. Each tank must be leak tested by a minimum sustained air pressure of at least three pounds per square inch gage applied to the entire tank. The entire surface of all joints under pressure must be coated with or immersed in a solution of soap and water or other material suitable for the purpose of detecting leaks. The pressure must be held for a period of time sufficiently long to assure detection ofl eaks. All closures must be in place during the test, but safety relief devices may be removed and such openings plugged. Any tank that has detectable leakage or significant permanent deformation does not meet the requirements of this specification.

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Title 40: Protection of Environment
PART 63—NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS FOR SOURCE CATEGORIES
Subpart R—National Emission Standards for Gasoline Distribution Facilities (Bulk Gasoline Terminals and Pipeline Breakout Stations)

§63.425 Test methods and procedures.

(a) Each owner or operator subject to the emission standard in §63.422(b) or 40 CFR 60.112b(a)(3)(ii) shall comply with the requirements in paragraphs (a)(1) and (2) of this section.

(1) Conduct a performance test on the vapor processing and collection systems according to either paragraph (a)(1)(i) or (ii) of this section.

(i) Use the test methods and procedures in 40 CFR 60.503 of this chapter, except a reading of 500 ppm shall be used to determine the level of leaks to be repaired under 40 CFR 60.503(b), or

(ii) Use alternative test methods and procedures in accordance with the alternative test method requirements in §63.7(f).

(2) The performance test requirements of 40 CFR 60.503(c) do not apply to flares defined in §63.421 and meeting the flare requirements in §63.11(b). The owner or operator shall demonstrate that the flare and associated vapor collection system is in compliance with the requirements in §63.11(b) and 40 CFR 60.503(a), (b), and (d), respectively.

(b) For each performance test conducted under paragraph (a) of this section, the owner or operator shall determine a monitored operating parameter value for the vapor processing system using the following procedure:

(1) During the performance test, continuously record the operating parameter under §63.427(a);

(2) Determine an operating parameter value based on the parameter data monitored during the performance test, supplemented by engineering assessments and the manufacturer's recommendations; and

(3) Provide for the Administrator's approval the rationale for the selected operating parameter value, and monitoring frequency and averaging time, including data and calculations used to develop the value and a description of why the value, monitoring frequency, and averaging time demonstrate continuous compliance with the emission standard in §63.422(b) or §60.112b(a)(3)(ii) of this chapter.

(c) For performance tests performed after the initial test, the owner or operator shall document the reasons for any change in the operating parameter value since the previous performance test.

(d) The owner or operator of each gasoline storage vessel subject to the provisions of §63.423 shall comply with §60.113b of this chapter. If a closed vent system and control device are used, as specified in

§60.112b(a)(3) of this chapter, to comply with the requirements in §63.423, the owner or operator shall also comply with the requirements in paragraph (b) of this section.

(e) *Annual certification test.* The annual certification test for gasoline cargo tanks shall consist of the following test methods and procedures:

(1) Method 27, appendix A, 40 CFR part 60. Conduct the test using a time period (t) for the pressure and vacuum tests of 5 minutes. The initial pressure (P_i) for the pressure test shall be 460 mm H_2O (18 in. H_2O), gauge. The initial vacuum (V_i) for the vacuum test shall be 150 mm H_2O (6 in. H_2O), gauge. The maximum allowable pressure and vacuum changes (Δp, Δv) are as shown in the second column of Table 2 of this paragraph.

TABLE 2—ALLOWABLE CARGO TANK TEST PRESSURE OR VACUUM CHANGE

Cargo tank or compartment capacity, liters (gal)	Annual certification-allowable pressure or vacuum change (Δp, Δv) in 5 minutes, mm H_2O (in. H_2O)	Allowable pressure change (Δp) in 5 minutes at any time, mm H_2O (in. H_2O)
9,464 or more (2,500 or more)	25 (1.0)	64 (2.5)
9,463 to 5,678 (2,499 to 1,500)	38 (1.5)	76 (3.0)
5,679 to 3,785 (1,499 to 1,000)	51 (2.0)	89 (3.5)
3,782 or less (999 or less)	64 (2.5)	102 (4.0)

(2) Pressure test of the cargo tank's internal vapor valve as follows:

(i) After completing the tests under paragraph (e)(1) of this section, use the procedures in Method 27 to repressurize the tank to 460 mm H_2O (18 in. H_2O), gauge. Close the tank's internal vapor valve(s), thereby isolating the vapor return line and manifold from the tank.

(ii) Relieve the pressure in the vapor return line to atmospheric pressure, then reseal the line. After 5 minutes, record the gauge pressure in the vapor return line and manifold. The maximum allowable 5-minute pressure increase is 130 mm H_2O (5 in. H_2O).

(f) *Leak detection test.* The leak detection test shall be performed using Method 21, appendix A, 40 CFR part 60, except omit section 4.3.2 of Method 21. A vapor-tight gasoline cargo tank shall have no leaks at any time when tested according to the procedures in this paragraph.

(1) The leak definition shall be 21,000 ppm as propane. Use propane to calibrate the instrument, setting the span at the leak definition. The response time to 90 percent of the final stable reading shall be less than 8 seconds for the detector with the sampling line and probe attached.

(2) In addition to the procedures in Method 21, include the following procedures:

(i) Perform the test on each compartment during loading of that compartment or while the compartment is still under pressure.

(ii) To eliminate a positive instrument drift, the dwell time for each leak detection shall not exceed two times the instrument response time. Purge the instrument with ambient air between each leak detection. The duration of the purge shall be in excess of two instrument response times.

(iii) Attempt to block the wind from the area being monitored. Record the highest detector reading and location for each leak.

(g) *Nitrogen pressure decay field test.* For those cargo tanks with manifolded product lines, this test procedure shall be conducted on each compartment.

(1) Record the cargo tank capacity. Upon completion of the loading operation, record the total volume loaded. Seal the cargo tank vapor collection system at the vapor coupler. The sealing apparatus shall have a pressure tap. Open the internal vapor valve(s) of the cargo tank and record the initial headspace pressure. Reduce or increase, as necessary, the initial headspace pressure to 460 mm H_2O (18.0 in. H_2O), gauge by releasing pressure or by adding commercial grade nitrogen gas from a high pressure cylinder capable of maintaining a pressure of 2,000 psig.

(i) The cylinder shall be equipped with a compatible two-stage regulator with a relief valve and a flow control metering valve. The flow rate of the nitrogen shall be no less than 2 cfm. The maximum allowable time to pressurize cargo tanks with headspace volumes of 1,000 gallons or less to the appropriate pressure is 4 minutes. For cargo tanks with a headspace of greater than 1,000 gallons, use as a maximum allowable time to pressurize 4 minutes or the result from the equation below, whichever is greater.

$$T = V_h \times 0.004$$

where:

T = maximum allowable time to pressurize the cargo tank, min;

V_h = cargo tank headspace volume during testing, gal.

(2) It is recommended that after the cargo tank headspace pressure reaches approximately 460 mm H_2O (18 in. H_20), gauge, a fine adjust valve be used to adjust the headspace pressure to 460 mm H_2O (18.0 in. H_2O), gauge for the next 30 ±5 seconds.

(3) Reseal the cargo tank vapor collection system and record the headspace pressure after 1 minute. The measured headspace pressure after 1 minute shall be greater than the minimum allowable final headspace pressure (P_F) as calculated from the following equation:

$$P_F = 18\left(\frac{(18-N)}{18}\right)^{\left(\frac{V_s}{5(V_h)}\right)}$$

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where:

(P_F) = minimum allowable final headspace pressure, in. H_2O, gauge;

V_s = total cargo tank shell capacity, gal;

V_h = cargo tank headspace volume after loading, gal;

18.0 = initial pressure at start of test, in. H_2O, gauge;

N = 5-minute continuous performance standard at any time from the third column of Table 2 of §63.425(e)(i), inches H_2O.

(4) Conduct the internal vapor valve portion of this test by repressurizing the cargo tank headspace with nitrogen to 460 mm H_2O (18 in. H_2O), gauge. Close the internal vapor valve(s), wait for 30 ±5 seconds, then relieve the pressure downstream of the vapor valve in the vapor collection system to atmospheric pressure. Wait 15 seconds, then reseal the vapor collection system. Measure and record the pressure every minute for 5 minutes. Within 5 seconds of the pressure measurement at the end of 5 minutes, open the vapor valve and record the headspace pressure as the “final pressure.”

(5) If the decrease in pressure in the vapor collection system is less than at least one of the interval pressure change values in Table 3 of this paragraph, or if the final pressure is equal to or greater than 20 percent of the 1-minute final headspace pressure determined in the test in paragraph (g)(3) of this section, then the cargo tank is considered to be a vapor-tight gasoline cargo tank.

TABLE 3—PRESSURE CHANGE FOR INTERNAL VAPOR VALVE TEST

Time interval	Interval pressure change, mm H_2O (in. H_2O)
After 1 minute	28 (1.1)
After 2 minutes	56 (2.2)
After 3 minutes	84 (3.3)
After 4 minutes	112 (4.4)
After 5 minutes	140 (5.5)

(h) *Continuous performance pressure decay test.* The continuous performance pressure decay test shall be performed using Method 27, appendix A, 40 CFR Part 60. Conduct only the positive pressure test using a time period (t) of 5 minutes. The initial pressure (P_i) shall be 460 mm H_2O (18 in. H_2O), gauge. The maximum allowable 5-minute pressure change (Δp) which shall be met at any time is shown in the third column of Table 2 of §63.425(e)(1).

(i) *Railcar bubble leak test procedures.* As an alternative to paragraph (e) of this section for annual certification leakage testing of gasoline cargo tanks, the owner or operator may comply with paragraphs (i)(1) and (2) of this section for railcar gasoline cargo tanks, provided the railcar tank meets the requirement in paragraph (i)(3) of this section.

(1) Comply with the requirements of 49 CFR 173.31(d), 179.7, 180.509, and 180.511 for the testing of railcar gasoline cargo tanks.

(2) The leakage pressure test procedure required under 49 CFR 180.509(j) and used to show no indication of leakage under 49 CFR 180.511(f) shall be ASTM E 515-95 (incorporated by reference, see §63.14), BS EN 1593:1999 (incorporated by reference, see §63.14), or another bubble leak test procedure meeting the requirements in 49 CFR 179.7, 180.505, and 180.509.

(3) The alternative requirements in this paragraph (i) may not be used for any railcar gasoline cargo tank that collects gasoline vapors from a vapor balance system permitted under or required by a Federal, State, local, or tribal agency. A vapor balance system is a piping and collection system designed to collect gasoline vapors displaced from a storage vessel, barge, or other container being loaded, and routes the

displaced gasoline vapors into the railcar gasoline cargo tank from which liquid gasoline is being unloaded.

[59 FR 64318, Dec. 14, 1994; 60 FR 7627, Feb. 8, 1995; 60 FR 32913, June 26, 1995; 68 FR 70965, Dec. 19, 2003]

Explosives Checklist

The following checklist may be used for identifying additional violations of the hazardous materials regulations that apply to Explosive Hazardous Materials.

		Yes/No/NA
1	**CLASSIFICATION AND APPROVALS OF EXPLOSIVES**	
	A. Offering or transporting an explosive that has not been tested or approved [173.51(a)].	
	B. Offering or transporting a forbidden explosive [173.54]	
	C. Review copies of all approvals from PHMSA - EX numbers. http://phmsa.dot.gov/hazmat/regs/sp-a/approvals/search Fireworks may have an EX number or an FC number.	
	D. Improper transportation of samples for testing [173.56(d)]	
	E. Check import shipments of explosives for Competent Authority Approvals [173.56(g).	
	F. Improper classification of fireworks [173.56(j)].	
	G. Failure to comply with APA 87-1 for fireworks. (Contact your HMPM for a copy.)	
2	**HAZARDOUS MATERIAL SAFETY PERMIT (385.403 and 415)**	
	A. Does the carrier have a Temporary HMSP or a HMSP when transporting more than 55 pounds of 1.1 or 1.2 or 1.3 explosive materials?	
	B. Does the carrier have a Temporary HMSP or a HMSP when transporting Division 1.5 explosive materials that require the CMV to be placarded?	
	C. Ensure the carrier is complying with the communications plan/log and other requirements of Section 385.415. Note that route plans are not required to be retained.	
3	**HM WRITTEN SECURITY PLAN (172.800)**	
	A. Explosives that require the CMV to be placarded also require an assessment of possible security risks and a written hazardous material security plan. See the Security Plan checklists for additional information.	
4	**GENERAL PACKAGING REQUIREMENTS (173.60)**	
	A. Unless otherwise provided, packaging must meet PGII requirements.	
	B. Review general requirements for packaging of explosives found in 173.60(b)(1) through (b)(14).	

5	**MIXED PACKAGING REQUIREMENTS (173.61)**	
	A. Explosives packed in same outside packaging with other material [173.61(a)].	
	B. Explosives may not be packed with certain other explosives [173.61 (c) and (d)].	
	C. Explosives may be packed in one outside packaging in accordance with the following compatibility requirements [173.61(e)].	
6	**SPECIFIC PACKAGING REQUIREMENTS (173.62)**	
	A. Explosives table specifies packing instructions assigned to each explosive as specified in 172.101 HM table.	
	B. Review table for specific packing instructions [173.62(b)].	
	C. Review explosives packing table for methods of packaging [173.62 (c)].	
6a	**EXCEPTIONS FOR PACKAGING REQUIREMENTS (173.63)**	
	A. Detonating cord exception [173.63(a)].	
	B. Exception for reclassifying small arms ammunition, cartridges and cartridge power devices as a limited quantity [173.63(c)].	
	C. Detonators or blasting cap exception from packaging requirements including exception for use of IME 22 container [173.63(f)].	
7	**EXCEPTIONS FOR BLACK POWDER (173.170 and 177.838(g))**	
	A. Powder must be approved for Divisions 1.1 and 4.1 (See EX# approval document).	
	B. Total quantity in a single vehicle cannot exceed 45.4 kg (100 lbs).	
	C. Inner receptacles cannot exceed 16 oz.	
	D. No more than 25 inner receptacles in outer UN 4G boxes.	
	E. Packages marked "BLACK POWDER FOR SMALL ARMS" AND “NA 0027".	
	F. Package must bear the 4.1 (flammable solid label).	
8	**EXCEPTIONS FOR SMOKELESS POWDER (173.171 and 177.838(g))**	
	A. Powder must be approved for Divisions 1.3 or 1.4 and 4.1 (See EX# approval document).	
	B. Total quantity in a single vehicle cannot exceed 45.4 kg (100 lbs).	
	C. Inner packages cannot exceed 3.6 kg (8 lbs).	
	D. No more than 7.3 kg (16 lbs.) in one outer UN 4G PG I boxes	
	E. Packages marked "SMOKELESS POWDER FOR SMALL ARMS" AND “NA 3178".	

9	**Multipurpose Bulk Truck (173.66 and 177.35(d)**	
	A. Compliance with IME Standard 23	
	B. Federal Motor Vehicle Safety Standards	
	C. Modifications	
10	**COMMUNICATIONS REQUIREMENTS (Part 172)**	
	A. Packages must be marked with the EX number or the product code or national stock number. (Note the product code or national stock number must be specifically associated with the EX number). See Section 172.320.	
	B. EX number may be entered on shipping paper instead of marked on the box. See Section 172.320(d).	
	C. For Division 1.1, 1.2, and 1.3 must have the Division number and Compatibility Group Letter on the label. See Section 172.411(b).	
	D. Placards for explosives must contain the Division Number and when required the Compatibility Group Letter. See Section 172.504(g).	
11	**PART 177 REQUIREMENTS (177.835)**	
	A. Engine stopped during loading and unloading.	
	B. No throwing or dropping explosive packages.	
	C. No Class 1 on vehicles in combination with: more than two cargo carrying vehicles, full trailer with wheel base less than 184 inches, cargo tank, etc.	
	D. No sharp projections in the cargo bed with explosives.	
	E. Floors tight and lined.	
	F. Lading within the body of the vehicle.	
	G. Exceptions for detonators [177.835(g)].	
	H. IME-22 container constructed in accordance with IME-22 Standards [177.835(g)(3)(i)].	
	I. Segregation and separation tables [177.848].	
	J. Securement [177.834(a) and 177.835(h) and (i)].	
12	**PART 397 REQUIREMENTS**	
	A. Vehicles transporting Divisions 1.1, 1.2, and 1.3 must be attended at all times [397.5(a) and 177.835(k)].	
	B. Vehicles transporting Divisions 1.1, 1.2, and 1.3 are not parked within: 5 feet of roadway, 300 feet from bridges and occupied buildings, and private property without permission. [397.7(a)].	
	C. Drivers provided copy of Part 397 [397.19(a)(1)].	
	D. Drivers provided with Emergency instructions [397.19(a)(3)].	
	E. Written route plan [397.67(d)].	
	F. Smoking prohibition [397.13]	

To: Motor Carriers holding a Hazardous Materials Safety Permit for the transportation of Anhydrous Ammonia.

From: FMCSA Office of Enforcement, Hazardous Materials Division

Notice: Removal of Anhydrous Ammonia transported domestically as a Division 2.2 hazardous material from the type of material required to hold a Hazardous Materials Safety Permit (HMSP) (*See* 49 CFR § 385.403).

Issue:

The Federal Motor Carrier Safety Administration (FMCSA) of the United States Department of Transportation (USDOT) is issuing this notification to advise industry that the agency no longer requires a Hazardous Materials Safety Permit (HMSP) for transportation of anhydrous ammonia domestically.

Requirements:

FMCSA will no longer interpret 49 CFR § 385.403(e) as requiring an HMSP to transport anhydrous ammonia domestically (UN1005 ammonia, anhydrous 2.2 Inhalation Hazard). Anhydrous ammonia is identified in the Hazardous Materials Table (HMT) as a Division 2.2 material when transported domestically (*See* 49 CFR § 172.101). Section 173.116(a) provides that there are no hazard zones assigned to Division 2.2 hazardous materials. Because anhydrous ammonia transported domestically is not assigned a hazard zone, FMCSA no longer considers this material as "meet[ing] the criteria for 'hazard zone C,' or 'hazard zone D,' as specified in § 173.116(a)" under § 385.403(e).

Anhydrous ammonia, when transported domestically, continues to meet the definition of "material poisonous by inhalation" in 49 CFR § 171.8(3) and must be marked as an inhalation hazard in accordance with the special provisions noted in the HMT.

An HMSP is still required when transporting anhydrous ammonia classed and described as **UN1005, ammonia, anhydrous, 2.3 Poison Inhalation Hazard *or* Toxic Inhalation Hazard, Zone D**, in a packaging with a capacity greater than 13,248 L (3,500 gallons)**.**

Action Needed and How to Be Removed:

If you are a motor carrier who holds a HMSP exclusively for the transportation of anhydrous ammonia domestically, FMCSA needs your permission to remove you from the HMSP program. You cannot remove yourself online.

Please send a request for removal from the HMSP program by sending an email to fmcsa.hmsp@dot.gov. The email should include your company name and US DOT number, a point of contact, and a brief statement as to the reason for removal, including that you do not transport any other material requiring an HMSP. This will serve as your formal request and it will be placed in your permanent motor carrier file. For questions or concerns, contact the Hazardous Materials Division, at 202-385-2307 or by email at: fmcsa.hmsp@dot.gov.

Is Anhydrous Ammonia covered under the Hazardous Materials Safety Permit Program?

Due to Anhydrous Ammonia (ammonia, anhydrous) having both international and domestic entries in the Hazardous Materials Table (HMT) (*See* 49 CFR § 172.101), considerations must be made in order to determine the need for a Hazardous Materials Safety Permit (HMSP):

- For Anhydrous Ammonia in "domestic transportation" (*See* 49 CFR § 171.8) and described as **UN1005 ammonia, anhydrous 2.2 Inhalation Hazard**, an HMSP is not required.

- For Anhydrous Ammonia described as **UN1005, ammonia, anhydrous 2.3 Poison Inhalation Hazard *or* Toxic Inhalation Hazard, Zone D**, and when transported in a packaging having a capacity greater than 13,248 L (3,500 gallons), an HMSP is required. In these instances, Anhydrous Ammonia meets the definition of a Material that is Poison-By-Inhalation or Toxic-By-Inhalation as defined in 49 CFR § 171.8 and meets the criteria for a hazard zone D as specified in 49 CFR § 173.116(a).

What You Should Know:

A Guide To Developing A Hazardous Materials Training Program

U.S. Department of Transportation
Pipeline and Hazardous Materials Safety Administration

ACKNOWLEDGEMENTS

This guidance has been prepared based on a partnership agreement between the U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration (PHMSA) and the Dangerous Goods Advisory Council (DGAC) with input from the Dangerous Goods Symposium for Instructors and the hazmat community.

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PURPOSE AND SCOPE

The transportation of hazardous materials (hazmat) underpins the American economy and our way of life. We use oil and natural gas to heat and cool homes and businesses, produce electricity, and provide raw materials for plastics, f bers, paints, and other essential products. We rely on chemicals to clean our water, fuel cars, construct buildings, fertilize crops, create medicines, and manufacture clothing and many other essential commodities. However, while hazmat plays a critical role in our daily lives, the transportation of hazmat introduces some inherent risks to the public, the environment, and property that need to be appropriately managed.

This guidance document explains the training requirements in the Hazardous Materials Regulations, identif es those employees who must be trained, and provides a tool to help hazmat employers determine what type of training and training environment may be best for their employees.

Hazardous materials transportation is a process that involves people performing functions related to handling, packaging, storing, moving, loading and unloading of hazardous materials, and responding to emergency situations while such materials are in transportation. It includes employees responsible for the safe transportation hazmat. The process also incorporates functions to design, manufacture, fabricate, inspect, mark, maintain, recondition, repair, or test a package, container or packaging component used in transporting hazardous materials. With such a complex process, the United States Department of Transportation (DOT) has identif ed human error as a contributing cause for most hazmat transportation incidents.

Human error may result from a variety of factors including:

- Lack of knowledge leading to the mishandling of hazmat
- Lack of knowledge leading to undeclared shipments
- Lack of awareness that hazmat is present
- Failure to follow established safety procedures
- Lack of understanding of one’s role during an incident should one occur
- Lack of knowledge on how to respond to an incident if one occurs

Hazmat incidents caused by human error can be reduced through the implementation of an effective training program. An effective training program is a systematic method for providing training, which includes tests and quizzes. It may consist of materials such as handouts, overheads, videos, and exercises, as well as, interactive computer based training, tests and quizzes and, where there is an instructor, the instructor’s notes or course outline. The training program may be a tutored or self-study course. The training provider may be the hazmat employer or an independent training provider.

An effective training program:

- Develops a strong safety culture
- Heightens employee safety by helping employees protect themselves
- Improves a company’s effectiveness, eff ciency, and productivity
- Increases employee skills
- May prevent regulatory sanctions
- Aids in ensuring safe and secure shipments of hazardous materials
- Reduces likelihood of catastrophic event such as f re aboard aircraft
- Provides employees with understanding of why compliance and safety are necessary

HAZARDOUS MATERIALS REGULATORY REQUIREMENTS

WHAT THE HAZARDOUS MATERIALS REGULATIONS REQUIRE

The Hazardous Materials Regulations (HMR; 49 CFR Parts 100-185), issued by the Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA) under authority of the Federal hazardous materials transportation law (49 U.S.C. 5101 et seq.), establish requirements governing the commercial transportation of hazmat by highway, rail, vessel, and air.

Under the HMR, hazardous materials are categorized by analysis and experience and assigned hazard classes and packing groups based upon the risks they present during transportation. The HMR specify appropriate packaging and handling requirements for hazardous materials, and require a shipper to communicate the material's hazards through use of shipping papers, package marking and labeling, and vehicle placarding. The HMR also require shippers to provide emergency response information applicable to the specif c hazard or hazards of the material being transported.

THE HAZARDOUS MATERIALS REGULATIONS' TRAINING REQUIREMENTS

The HMR mandate training requirements for persons who prepare hazmat for shipment or who transport hazmat in commerce. The intent of the regulations is to ensure that each hazmat employee is familiar with the HMR, is able to recognize and identify hazardous materials, understands the specif c HMR requirements applicable to the functions he or she performs, and is knowledgeable about emergency response, self-protection measures, and accident prevention methods. The regulations are performance based to provide a baseline set of training requirements while acknowledging the need for f exibility due to the diversity of the hazmat workforce.

Training requirements are located in Subpart H of Part 172 of the HMR. The training requirements apply to hazmat employers and hazmat employees as def ned in §171.8.

The HMR require all hazmat employees to be trained including hazmat employers with direct supervision of hazmat transportation functions.




Hazmat employer and hazmat employee are def ned as follows:

HAZMAT EMPLOYER means a person who uses one or more employees in connection with:

- transporting hazmat in commerce;
- causing hazmat to be transported or shipped in commerce; or
- representing, marking, certifying, selling, offering, reconditioning, testing, repairing, or modifying packagings as qualif ed for use in the transportation of hazmat.

The term "hazmat employer" also includes any department, agency, or instrumentality of the United States, a State, a political subdivision of a State, or an Indian tribe engaged in offering or transporting hazmat in commerce. This term includes an owner-operator of a motor vehicle which transports hazardous materials in commerce.

HAZMAT EMPLOYEE means a person who is employed by a hazmat employer and who directly affects hazmat transportation safety including:

- an owner-operator of a motor vehicle which transports hazmat;
- a person (including a self-employed person) who:
  - loads, unloads, or handles hazmat;
  - tests, reconditions, repairs, modif es, marks, or otherwise represents packagings as qualif ed for use in the transportation of hazmat;
  - prepares hazmat for transportation;
  - is responsible for safety of transporting hazmat; or
  - operates a vehicle used to transport hazmat.

Note: See the Glossary or 49 CFR §171.8 for complete definitions.

Training must be completed within 90 days of the f rst day of employment or the f rst day of a change in job function. Until training is completed, a hazmat employee must be directly supervised by a person who has been trained. Further, each hazmat employee must be provided with recurrent training at least once every three years. Each hazmat employee must be tested upon completion of training. Training may be provided directly by the hazmat employer or by other public or private sources. Regardless of who provides the training, the hazmat employer is responsible for ensuring that appropriate testing occurs and that the training is effective, appropriate, and successful in achieving the intended objectives of providing employees with the knowledge and skills necessary to perform their job functions safely.

THE FIVE TYPES OF TRAINING REQUIRED

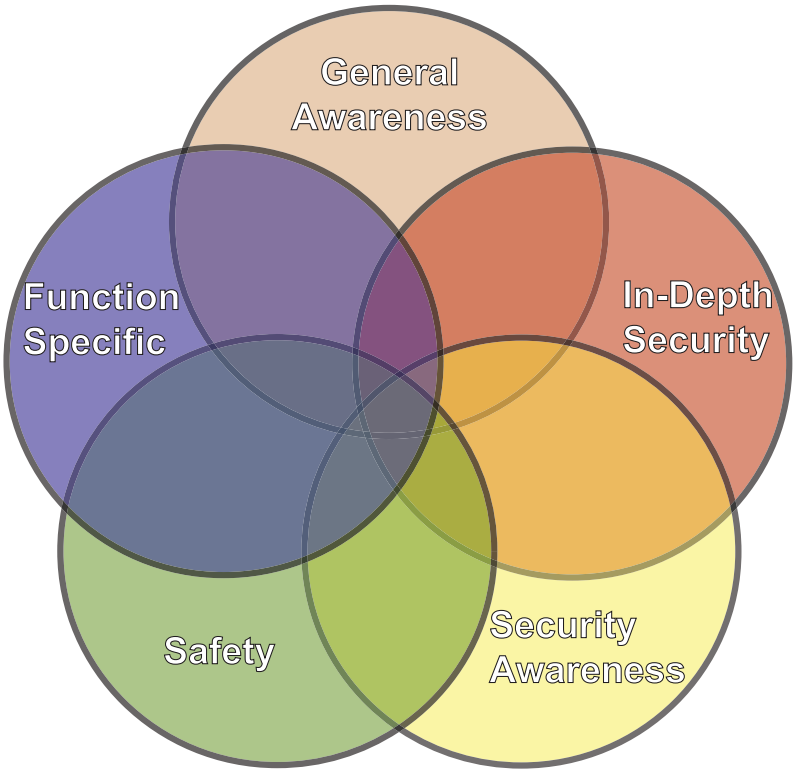
General Awareness/Familiarization Training: Training that provides familiarity with the general requirements of the HMR and enables the hazmat employee to recognize and identify hazardous materials. All hazmat employees must receive general awareness training.

Function-specific Training: Training that provides a detailed understanding of HMR requirements applicable to the function(s) performed by the hazmat employee. Each hazmat employee must be trained on the specif c functions they are required to perform.

Safety Training: Training that covers the hazards presented by hazardous materials, safe handling, emergency response information, and methods and procedures for accident avoidance. All hazmat employees must receive this training.

Security Awareness Training: Training that provides a general understanding of the security risks associated with hazardous materials transportation and the methods designed to enhance transportation security. This training should include methods on how to recognize and respond to possible security threats. All hazmat employees must receive this training.

In-depth Security Training: Training that provides a detailed understanding of a company's security plan including company security objectives, specif c security procedures, employee responsibilities, actions to take in the event of a security breach and the organizational security structure. This training must be provided to hazmat employees who handle or perform regulated functions related to the transportation of the materials covered by the security plan or who are responsible for implementing the security plan.



RECORDKEEPING REQUIREMENTS

The hazmat employer is responsible for maintaining training records for each hazmat employee. These records must be kept for the duration of the three-year training cycle while the hazmat employee is employed and for 90 days after the employee leaves employment. Training records must be made available by the employer for audit and review by regulatory authorities upon request.

Training records must include the following:

- The hazmat employee's name
- The most recent training completion date
- A description of, copy of, or reference to training materials used to meet the training requirements
- The name and address of the person providing the training
- A certif cation that the person has been trained and tested as required

Certification that the hazmat employee has been trained and tested shall be made by the hazmat employer or a designated representative. *An example training record can be found in the "Helpful Tips and Tools" section.*

OTHER DOMESTIC AND INTERNATIONAL TRAINING REQUIREMENTS

Employers should be aware that the HMR recognizes that other domestic and international agencies and organizations also have training requirements. For example, the Federal Aviation Administration prescribes training requirements for air carriers in the 14 CFR. Additionally, the International Maritime Dangerous Goods Code for vessel shipments; Transport Canada TDG Regulations; and the International Civil Aviation Organization Technical Instructions for air shipments also prescribe specif c training requirements which are important because the HMR authorizes compliance with these regulations. Therefore, depending on a company's operations, other training requirements in addition to the HMR may apply.

Relevant agencies and organizations may include:

- United States Federal Aviation Administration (FAA)
- United States Federal Motor Carrier Safety Administration (FMCSA)
- United States Federal Railroad Administration (FRA)
- United States Coast Guard (USCG)
- United States Occupational Safety and Health Administration (OSHA)
- United States Environmental Protection Agency (EPA)
- Transport Canada TDG regulations (TDG)
- International Maritime Organization (IMO)
- International Civil Aviation Organization (ICAO)

HOW TO BEGIN

DETERMINE WHO YOUR HAZMAT EMPLOYEES ARE

Safe transportation of hazardous materials depends on proper preparation of the material for shipment and safe handling of the material while it is being transported. Each hazmat employee must be aware of the hazards of such materials, their potential for causing incidents and accidents, and how they should be safely prepared and transported.

To this end, the HMR require all hazmat employees to be trained, including those with hazmat responsibilities including pre-transportation functions (See Glossary or 49 CFR §171.8) and those who supervise hazmat employees. For example, a hazmat employee may be a person (including a self-employed person or an owner-operator of a motor vehicle) who:

- Determines the hazard class of a hazardous material
- Selects a hazardous materials packaging
- Places warning signs, blocks wheels, and sets brakes on tank cars placed for loading or unloading with closures open
- Fills or loads a hazardous materials packaging
- Secures a closure on a f lled hazardous materials package or container
- Marks a package to indicate that it contains a hazardous material
- Labels a package to indicate that it contains a hazardous material
- Prepares a hazardous materials shipping paper
- Provides and maintains hazardous materials emergency response information
- Reviews a hazardous materials shipping paper to verify compliance with the HMR or international equivalents
- For persons importing a hazardous material in to the United States, provides the shipper with information as to the requirements of the HMR that apply to the shipment of the material while in the United States
- Certif es that a hazardous material is in proper condition for transportation in conformance with the requirements of the HMR
- Blocks and braces a hazardous materials package in a freight container or transport vehicle
- Segregates a hazardous materials package in a freight container or transport vehicle from incompatible cargo
- Selects, provides, or aff xes placards for a freight container or transport vehicle to indicate that it is carrying hazardous materials
- Loads or unloads hazardous materials for the purpose of transportation
- Tests, reconditions, or repairs hazmat packaging
- Operates a vehicle used to transport hazmat

DETERMINE EMPLOYEE NEEDS

As previously mentioned, HMR training requirements are performance based to provide f exibility regarding training format and delivery. Training may be provided directly by the hazmat employer or by independent training providers. Therefore, hazmat employers have a variety of training options available.

The hazmat employer is responsible for selecting training that meets company safety goals and the HMR requirements. The process may begin with conducting a needs assessment based on a thorough understanding of your company's operations and its hazmat employees' responsibilities, knowledge and capabilities.

You may want to begin with these questions:

- What hazardous materials/wastes does your company handle and which hazards do they represent? For example, do your hazmat employees handle hazardous materials such as infectious substances and lithium batteries?
- What quantities do you ship and how frequently? For example, do you ship bulk, non-bulk, ORM-D, excepted quantities, or small quantities?
- What modes of transport do you use?
- Are there materials that your employees may not be aware are hazardous materials and are subsequently being shipped undeclared. Examples include paint, perfume, batteries, aerosols, and f reworks.
- Where do you transport hazardous materials (i.e. domestic or international locations)?
- Do company accident or injury rates indicate additional training is necessary? If so, in what areas?
- What regulations does the training need to cover?
- What are the job descriptions/functions of your hazmat employees?
- Have your hazmat employees been trained previously?
- Are your hazmat employees trained in all aspects of the function(s) they are performing? For example, are your employees responsible for shipper certif cation trained in each aspect of the hazmat shipping they are certifying such as packaging or package closure requirements?
- Have any responsiblities changed?
- Has the company's operations changed?
- What languages need to be addressed?
- Are your employees aware of incident reporting requirements?
- Has anything else changed?

ASSESS TRAINING OPTIONS

After the needs assessment is complete, it is time to select a training tool. Potential selection criteria are content, method of delivery, and instructor qualif cations.

Content

Content should be easy to understand and appropriate for the audience. Suff cient time should be allocated to cover the subject matter, and techniques should be used to ensure that students comprehend and retain the material presented.

A few questions hazmat employers might ask when assessing content include:

- Is the time allotted for training suff cient for employee comprehension?
- Is the information presented clearly and accurately and in a manner that can be understood by employees of varying literacy and language skills?
- Does the training use repetition to conf rm that key points are understood?
- Does the training use exercises, questions, or other mechanisms to ensure an understanding of what has been taught?
- Is the information presented in a logical manner?
- Is comprehension tested?
- Is a test provided that allows the hazmat employee to demonstrate that they have satisfactorily completed training?
- Is there a follow-up support system? If so, what is it and does this system meet the need?

Method of Delivery

Method of delivery is another consideration.

For purposes of this guidance, training options have been broken down into four delivery methods:

- Web-based
- Computer-based
- Classroom
- Hands-on/Mentor training.

Each delivery method has advantages and disadvantages.

Instructor Qualifications

Instructor qualif cations are an important element of an effective training program. Hazmat instructors have varying degrees of subject matter expertise and teaching skills. In addition to understanding the subject matter, instructors should understand the best method of delivery for the given audiance.

ADVANTAGES AND DISADVANTAGES OF TRAINING OPTIONS

Web-based Training

Advantages	Disadvantages
Provides standardized training ensuring a consistent message	Bandwidth limitations can place constraints on certain media types
Decreases the time employees are out of the off ce	Hazmat employees must be self-directed and comfortable using the web
Allows for quick updates for rapidly changing material	Hazmat employees may be distracted or interrupted
Training is more accessible to a larger audience	It is diff cult to provide opportunities for hands-on experience
Cost effective way to refresh existing training	Some may f nd it diff cult to engage and retain
Training is more convenient for employees -- it is available anytime, anywhere	Limited interaction with an instructor
No travel costs	Diff cult to assess employee progress in real time
No cost associated with obtaining new media updates	Compatible equipment may not be available

Computer-based Training

Advantages	Disadvantages
When there is a large quantity of video or complex graphics, computer-based training can ease download times and slow operations that sometimes occur with web-based training	Requires self-direction
Offers f exibility for the end-user; hazmat employees can simply load and run the training at their convenience	Hazmat employees may be distracted or interrupted
Cost effective way to refresh existing training	It is diff cult to provide opportunities for hands-on experience
Training is more accessible to a larger audience	Minimal interaction with an instructor or subject matter expert
Hazmat employees can proceed at their own pace	Information can become outdated
No travel costs	Possible higher cost to update
	Some may f nd it diff cult to engage and retain
	Compatible equipment may not be available
	Diff cult to assess employee progress in real time

Classroom Training

Advantages	Disadvantages
Provides an instructor and a structured approach to teaching	Potential personality differences between the trainer and the hazmat employees
Allows for real time discussion and provides interaction that isn't easily duplicated even with the most advanced technology	Fellow trainees can dictate the pace of the training, leaving some students behind, and others bored with a pace that is too slow for them
Allows for constructive team building	Diff cult to guarantee outcomes
Personalized assistance from the instructor can address individual student needs	Scheduling based on trainer or facility availability, not employee needs
Leverages instructor skills and experience	Costs for travel, training, and the instructor
Easy to conf rm whether hazmat employees have taken the course	
Easy to use evaluation tools to conf rm that learning has occurred	
Opportunity to customize training to meet employer needs and requirements	

Hands-on/Mentor Training

Advantages	Disadvantages
Simulates the job	Can be high cost, high overhead
Provides hands-on experience allowing the hazmat employee to integrate theory and practice	Variables differ, so its diff cult to guarantee outcomes
Allows the hazmat employee, under supervision, to use critical thinking skills to engage in a problem solving process that incorporates professional knowledge	Timing based on mentor and/or facility availability, not necessarily employee needs
Provides a sense of urgency to develop alternatives and make decisions under the pressure of time without the possibility of serious consequences	Potential personality differences
Mentors may have more credibility with the hazmat employee since they have specif c experience relating to the subject being taught and the job site in question	A mentor must be available and capable of training
Procedural and policy gaps are identif ed	
May avoid comprehension problems related to literacy/language def ciencies	

You should assess your training needs, available time and resources, and the capabilities of your employees to identify the training content and format that best meets your training goals.

MONITOR THE EFFECTIVENESS OF TRAINING

It is important to evaluate the effectiveness of the selected training tools against expectations. Conducting an evaluation allows you to improve the future planning and implementation of training, determine if training objectives have been achieved, and proactively facilitate any necessary adjustments.

When conducting the evaluation, a few helpful questions include:

- Did the employee believe the training was effective and useful?
- What were the expectations of the training? Were these expectations met?
- After the training, is the employee prof cient in performing job duties and responsibilities?
- Does the employee appear to need further training? If so, what functions need additional focus? Is this the result of a def ciency in training?

Many techniques and tools can be used to evaluate training programs.

A few methods of evaluating training are:

- Student opinion: Using employee feedback to help determine effectiveness of the training program including identifying how to improve course content and delivery
- Supervisors' observations: Using supervisor observations to assess an employee's performance both before and after the training
- On the job improvements: Assessing whether changes occur in job performance that result in changes in accident rates, injury rates, or penalties

Regardless of the approach, if done correctly, you can use information derived from evaluations to help determine whether training is effective and how to apply future training resources.

HELPFUL TIPS AND TOOLS

The "Helpful Tips and Tools" section is provided to help you manage hazardous materials training.

DEVELOP A SAFETY CULTURE

The HMR require training for all hazmat employees. However, your training program should not stop once you have met the HMR requirements. You and your managers should work with employees to develop a supportive safety culture that encourages training as a continuous learning process.

You may want to consider implementing some or all of these measures:

- Visible promotion of a safety culture driven by top management
- Establish accountability for safety that begins with individual employees and includes all management layers
- Encourage employees to report safety issues or problems without fear of retribution or retaliation
- Encourage employees to identify new, improved ways to accomplish safety goals
- Monitor and evaluate employees as they perform their hazmat functions
- Correct potential issues as they are identif ed
- Provide opportunities for additional training
- Periodically reinforce safe practices through safety meetings
- Assess company safety performance through audits
- Consider implementing a monthly 10% hazmat inventory program in which 10% of a company's hazmat is spot checked for proper packaging and hazmat communication each month. Implementing such a practice can help detect potential errors
- Keep employees informed of assessments and results
- Review the results of incidents and inspections
- Regularly review regulatory changes and/or changes in company operations

Developing a safety culture is a continuous process, and the rewards are real. Employees take ownership of the operations for which they are responsible and share responsibility equally with management for the overall safety of the company. Enhanced safety measures help to reduce the cost of doing business by reducing accidents, decreasing workers compensation claims, and providing a more effective and targeted use of resources. Thus, companies and individuals become more competitive while protecting people, property, and the environment.

DESIGNATE A TRAINING COORDINATOR

It is your responsibility to select training options that meet the requirements of the HMR and the needs of your hazmat employees. This can be a challenging task, but it is extremely critical to ensuring that the training program you provide is effective and successful.

One way to manage hazmat training is to designate one or more employees as training coordinators.

Suggested qualif cations for training coordinators include:

- Knowledge of the HMR as they apply to company operations
- The ability to monitor and understand regulatory changes as they develop
- Knowledge of how to establish and manage a training program
- Experience in one or more of the hazmat duties being performed

Once a training coordinator(s) is in place, he or she can guide the training and development of each hazmat employee.

Suggested responsibilities include:

- Arranging for newly trained employees to be evaluated upon completion of a training program and periodically thereafter
- Determining training needs for incumbents and assessing training options
- Consulting with other industry professionals on the best quality training available
- Instituting formal training evaluation programs and providing feedback to training providers
- Communicating on the status of training with management
- Providing feedback to training providers
- Maintaining training records in accordance with the HMR

A committee of trained hazardous materials employees may be established to provide guidance and assistance to the training coordinator. Examples of potential committee responsibilities may include identifying training needs and evaluating the effectiveness of training.

A few Checklists that may assist you with managing a training program are included in the "Understanding Status of Training Efforts" section.

IMPLEMENT A PLANNING PROCESS

Implementing a planning process can help you develop a consistent approach for managing training needs. To assist, an example planning framework is provided. This framework is not intended to be exhaustive; instead, it is intended to help identify elements that could be considered.

Understand Objectives

Example:

Develop properly trained hazmat employees to meet regulatory requirements for training, develop an educated workforce, improve safety, and minimize the potential negative impacts of the hazardous materials on life, property, and the environment.

Understand Goals

Example goals:

- Reduce incidents and accidents
- Help employees protect themselves and the environment
- Improve a company's effectiveness, eff ciency, and productivity
- Develop a strong safety culture
- Prevent regulatory sanctions
- Heighten employee safety
- Increase employee skills
- Decrease property damage costs
- Help employees identify when hazardous materials are present
- Increase productivity

Implement a Training Framework

Example framework:

- Demonstrate support from all levels of leadership
- Identify point of contact(s) to manage training and coordinate internally, as appropriate
- Implement accountability
- Understand employee responsibilities, the tools they use, and company operations
- Understand status of training to date
- Conduct a needs assessment to determine what training is needed
- Prioritize training needs
- Assess the landscape of available training tools and determine which tools meet the needs of the organization and its employees
- Execute training
- Evaluate training
- Maintain accurate training records to include:
  - The hazmat employee's name
  - The most recent training completion date
  - A description of, copy of, or reference to training materials used to meet the training requirements
  - The name and address of the person providing the training; and a certif cation that the person has been trained and tested as required
- Continuously improve the training program, as necessary

IMPLEMENT A CONSISTENT PROCESS FOR RECORDKEEPING

The HMR mandate the content and retention of training records; but does not prescribe the training record format. Below is a sample record to illustrate what a record may look like.

Hazmat Employee Training Record

Employee Name:

I certify that the hazmat employee identified on this training record has been trained and tested as required by the Hazardous Materials Regulations, Subpart H.

Signed: _____ Title:_____

General Awareness / Familiarization

Description, Copy, and Location of Training	Training Provided By	Test / Score (not mandatory)	Date Trained
Hazmat DigiPack located in main office	Employer Training Officer Jane Doe	No Test	July 14, 2007
Hazardous Materials Transportation Training Modules - Copy located in main office	Employer Training Officer Jane Doe	Test attached to file: 98%	July 14, 2007

Function Specific

Description, Copy, and Location of Training	Training Provided By	Test / Score (not mandatory)	Date Trained
DOT Hazardous Materials Transportation Training Modules 3 and 4: Packaging, Marking and Labeling - Copy located in main office	Employer Training Officer Jane Doe	Test attached to file: 100%	July 14, 2007
Performance Demonstration of Packaging, Marking and Labeling - Checklist of items performed attached to this training record	Supervisor Dan	Successfully demonstrated: 100%	July 28, 2007

Safety Training

Description, Copy, and Location of Training	Training Provided By	Test / Score (not mandatory)	Date Trained
Hazardous Materials Transportation Safety - Copy of training materials available in main office	Hazmat Safety Consultative Service 123 Anywhere St. Somewhere, USA	Certificate of Completion and test attached to file: 97.5%	July 14, 2007

Security Awareness Training

Description, Copy, and Location of Training	Training Provided By	Test /Score (not mandatory)	Date Trained
Hazmat Transportation Security Awareness Training Module – USDOT/PHMSA. Copy of CD-ROM and test available in main office	Supervisor Dan	Certificate of Completion and test attached to file: 97.5%	July 14, 2007

Indepth Security Training

Description, Copy, and Location of Training	Training Provided By	Test / Score (not mandatory)	Date Trained
Company Security Plan and Training - Copy of training materials available in main office	Supervisor Dan	Verbal Test given: Passed	July 30, 2007

UNDERSTAND TRAINING CURRICULUM

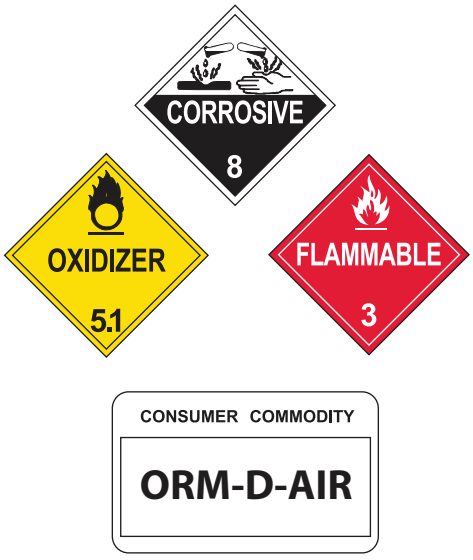
The HMR mandate f ve types of training. The HMR do not prescribe in detail what topics to address during each type of training. To assist in evaluating your company's training needs, a list of the types of training with possible curriculums is provided here. These lists are not intended to be exhaustive or all inclusive.

General Awareness/Familiarization: Provides hazmat employees with familiarity with the requirements of the Hazardous Materials Regulations and enables hazmat employees to recognize and identify hazardous materials. All hazmat employees are required to have general awareness/ familiarization training. This training typically provides a basic understanding of:

- The Identif cation of Hazardous Materials
- The Hazard Classif cation System
- How to Use the Hazardous Materials Table
- Packaging
- Markings and Labels
- Placards
- Shipping Papers
- Segregation
- Understanding of the HMR Training Requirements
- Requirements for Incident Reporting
- Security

Function Specific: Provides hazmat employees a detailed study of the requirements of the regulations applicable to the function(s) for which the person is responsible. Training needs will depend on the company operations and the hazmat employee's responsibilities. Your responsibility is to identify the specif c topics and extent to which topics are covered to meet your employees' needs.

Examples of function specific topics are included in the Function Specific Training Checklist in the "Understanding Status of Training Efforts" section.



Safety Training: Covers the hazards presented by hazardous materials, safe handling, emergency response information and methods and procedures for accident avoidance. Training that meets EPA and OSHA regulations may be acceptable in meeting the HMR. All hazmat employees are required to have safety training. Topics may include:

- Emergency Response Information
- Emergency Response Telephone Numbers
- Means of Egress
- Employee Emergency Plans and Fire Prevention Plans
- General Safety and Health Provisions
- Employee Emergency Action Plans
- Bulk Delivery and Mixing Vehicles
- Contract Employer Responsibilities
- Mechanical Integrity
- Hazardous Waste Operations and Emergency Response
- New Technology Programs
- Personal Protective Equipment
- Respiratory Protection
- Fire Protection
- Fire Brigades
- Portable Fire Extinguishers
- Fixed Extinguishing Systems
- Fire Detection Systems
- Employee Alarm Systems
- Materials Handling and Storage
- Moving the Load
- Crawler Locomotives and Truck Cranes
- Electrical Safety-Related Work Practices
- Conf ned and Enclosed Spaces
- Precautions Before Entering

Security Awareness Training: Provides hazmat employees with a general understanding of the security risks associated with hazardous materials transportation and the methods designed to enhance transportation security. All hazmat employees are required to have security awareness training. Examples of subjects that could be included are:

- Regulatory Requirements
- Potential Threats
- Potential Targets
- Prevention Tools

In-depth Security Training: Directly relates to the required company security plan. Specif c content is dependent upon the company security plan and employee responsibilities. Hazmat employees are required to receive training commensurate with their responsibilities. Training must include:

- Security Objectives
- Specif c Security Procedures
- Employee Responsibilities
- Actions to Take in the Event of a Security Breach
- Organizational Security Structure

UNDERSTANDING STATUS OF TRAINING EFFORTS (CHECKLISTS)

The hazmat employer is responsible for selecting training that meets company safety goals and the HMR requirements. Although not required by the HMR, many companies establish training policies or standard operating procedures to help with decision-making. Checklists can be used as tools to assist with understanding the status of training efforts and decision-making.

Here are examples of checklists that may be used.

DO YOU HAVE A TRAINING POLICY?

Below is an example of a checklist that can to help you to identify elements of your training policy. Rows have been left blank so you can identify criteria not listed that is included in your company training policy.

DO YOU HAVE A TRAINING POLICY?	YES	NO
Do you have a training policy?	□	□
IF YES, DOES IT INCLUDE:		
Purpose and scope	□	□
A definitions section	□	□
Identification of employees that require training	□	□
A list of employee functions and responsibilities	□	□
Identification of the type of training required	□	□
Initial training requirements	□	□
Recurrent training requirements	□	□
Function specific or company specific	□	□
Testing (pass/fail) requirements	□	□
Record keeping requirements	□	□
Certification of training requirements	□	□
Training as needed (i.e. when regulations are updated or issued)	□	□
Training every year	□	□
Training every 2 years	□	□
Training every 3 years	□	□
OTHER ITEMS AS LISTED BELOW:		
	□	□
	□	□
	□	□
	□	□
	□	□
	□	□

WHAT TYPE OF TRAINING IS PROVIDED?

Below are exmaple checklists to help you determine what additional training your employees might need. Rows have been left blank so you can identify topics not listed that are important to your company.

WHAT TYPE OF TRAINING IS PROVIDED TO YOUR EMPLOYEES?	
Classroom (In-house or external)	□
Computer-based	□
Web-based	□
Hands-on/Mentor	□
OTHER TYPES AS LISTED BELOW	
	□
	□
	□

WHAT TOPICS ARE INCLUDED IN YOUR PROGRAM?	YES	NO	N/A
General Awareness	□	□	□
Classification	□	□	□
Documentation	□	□	□
Packaging	□	□	□
Marking	□	□	□
Labeling	□	□	□
Placarding	□	□	□
Loading & Unloading (non-bulk)	□	□	□
Loading & Unloading (bulk)	□	□	□
Blocking & Bracing	□	□	□
Security Awareness	□	□	□
In-Depth Security Awareness	□	□	□
Safety	□	□	□
Segregation	□	□	□
Incident Reporting	□	□	□
Operations	□	□	□
Packaging	□	□	□
OTHER TOPICS AS LISTED BELOW			
	□	□	□
	□	□	□
	□	□	□
	□	□	□
	□	□	□

COMMERCIAL OFF-SITE VS. COMMERCIAL OR COMPANY PROVIDED IN-HOUSE

It is important to evaluate the benef ts of training programs as they relate to your company's needs. Below is an example of a checklist and criteria that may assist. Rows have been left blank so you can identify the criteria that are most important to your company.

COMMERCIALLY AVAILABLE PROGRAMS OFF-SITE	VERY IMPORTANT	IMPORTANT	NEUTRAL	NOT IMPORTANT
Knowledge/reputation of instructor	☐	☐	☐	☐
Reputation of training organization	☐	☐	☐	☐
Location of training	☐	☐	☐	☐
Length of time employee will be absent from job	☐	☐	☐	☐
	☐	☐	☐	☐
	☐	☐	☐	☐
	☐	☐	☐	☐
COMMERCIALLY AVAILABLE PROGRAMS FOR IN-HOUSE TRAINING	**VERY IMPORTANT**	**IMPORTANT**	**NEUTRAL**	**NOT IMPORTANT**
Knowledge/reputation of instructor	☐	☐	☐	☐
Reputation of training organization	☐	☐	☐	☐
No interruptions while employees are in training	☐	☐	☐	☐
Length of time required to complete program	☐	☐	☐	☐
	☐	☐	☐	☐
	☐	☐	☐	☐
	☐	☐	☐	☐
COMPANY PROVIDED IN-HOUSE INSTRUCTION	**VERY IMPORTANT**	**IMPORTANT**	**NEUTRAL**	**NOT IMPORTANT**
Availability of knowledgeable instructor	☐	☐	☐	☐
No travel costs	☐	☐	☐	☐
Length of time required to complete program	☐	☐	☐	☐
No interruptions while employees are in training	☐	☐	☐	☐
Combined instructor and computer-based training	☐	☐	☐	☐
	☐	☐	☐	☐
	☐	☐	☐	☐
	☐	☐	☐	☐

FUNCTION SPECIFIC TRAINING CHECKLIST

The following checklist is provided to assist with identifying the types of training needed to satisfy function specif c training requirements. The list provided is not intended to be exhaustive or all inclusive as there may be additional needs not covered. It is the employer's responsibility to determine which topics require in-depth coverage for their hazmat employee to enable them to perform their hazmat duties safely.

Employee Name_____

Hazard Classification:
- □ Definition of the Nine hazard Classes and ORM-D Material
- □ Class 1: Explosives
- □ Class 2: Gases
- □ Class 3: Flammable and Combustible Liquids
- □ Class 4: Flammable Solid, Spontaneously Combustible, Dangerous When Wet
- □ Class 5: Oxidizer, Organic Peroxide
- □ Class 6: Poisonous or Toxic, Infectious Substances
- □ Class 7: Radioactive
- □ Class 8: Corrosives
- □ Class 9: Miscellaneous

How to use the HMR:
- □ Hazardous Materials Table
- □ Appendix A
- □ Appendix B
- □ Special Provisions

□ Packaging Selection
- □ Packing Group Definition
  - □ Packing Group I (PGI)
  - □ Packing Group II (PGII)
  - □ Packing Group III (PGIII)
- □ Exceptions for Packing Group Assignments

□ Markings
- □ Basic and Additional Markings on Non-Bulk Packaging
- □ Markings for Bulk Packaging

□ Labels
- □ Hazard Labels and Placement
  - □ Primary Hazard Label
  - □ Subsidiary Hazard Label
- □ How Labels Convey Hazard
  - □ Color
  - □ Symbols
  - □ Text
  - □ Hazard Class Number or Division Number

□ Placards
- □ Requirements
  - □ Table 1 and Table 2
  - □ Exceptions to Placard Tables
- □ How Placards Convey Hazard
  - □ Color
  - □ Symbols
  - □ Text
  - □ Hazard Class Number or Division Number
- □ Placard Placement Requirements
- □ Use of International Placards

Check Knowledge Required Below

□ Shipping Papers
- □ Define Shipping Papers
- □ Identify Information Required and Display
  - □ Basic Description and Sequence
  - □ Additional Information
  - □ Emergency Response Telephone Number
  - □ Emergency Response Information
  - □ Certification by Shipper
- □ Identify Retention Requirements

□ Segregation
- □ Warehouse (storage)
- □ Rail
- □ Highway
- □ Vessel
- □ Air

□ Handling
- □ Loading and Unloading
- □ Filling
- □ Blocking and Bracing

□ Incident Reporting Requirements
- □ By Phone
- □ In Writing

□ Operations
- □ Air
- □ Vessel
- □ Highway
- □ Rail

□ Packaging Retesting

□ Packaging Manufacturing

Additional Topics Not Listed:

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

RESOURCES FOR MORE INFORMATION

Letters of Interpretation

The Pipeline and Hazardous Materials Safety Administration, Office of Hazardous Materials Safety (OHMS) provides written clarifications of the Hazardous Materials Regulations in the form of interpretation letters. These letters reflect the agency's current application of the HMR to the specific facts presented by the person requesting the clarification. Interpretations are one form of Guidance provided by OHMS.

Interpretations do not create legally-enforceable rights or obligations and are provided to help the public understand how to comply with the HMR.

OHMS regularly reviews interpretations for accuracy and applicability. Interpretation letters from the last ten years are published to provide the public with a greater awareness and understanding of the HMR.

To access letters of interpretation visit **www.phmsa.dot.gov/hazmat/regs/interps** and type in the word "training" in the Search Interpretation box. Information on how to request clarification of the HMR is also available at this site.

Training Materials and Publications

Training, outreach, and information dissemination are important responsibilities of PHMSA. To promote compliance with the HMR, PHMSA develops brochures, charts, publications, training CD-ROMs, videos and other safety-related information and makes them available to the public through the PHMSA website. Many of the publications spotlight safety concerns such as lithium batteries, undeclared hazmat shipments, wetlines, and alternative fuels such as ethanol.

To order training materials and publications, visit **https://hazmatonline.phmsa.dot.gov/services**

Seminars, Workshops, and Special Events

PHMSA offers free seminars, workshops, and special events throughout the year. These free training events are for anyone who offers or transports hazardous materials in commerce, provide emergency response to accidents or incidents involving hazmat, or has a desire to learn more about the HMR.

To learn more about upcoming training events, visit **www.phmsa.dot.gov/hazmat/training/seminars**

Hazmat INFO-LINE

Call our Hazmat **INFO-LINE: 1-800-467-4922** to obtain hazardous materials transportation information and copies of rulemakings. Specialists are on duty Monday through Friday from 9 a.m. to 4 p.m. Eastern time. You may call any time, 24 hours a day, seven days a week, and leave a message. We will return your call before the end of the next business day. You may also use this number to report alleged violations of the Hazardous Materials Regulations.

GLOSSARY

IN-HOUSE TRAINING Training provided to the employees of a company by a company employee or an independent training provider at the company facility.

HAZMAT EMPLOYEE Hazmat employee means:

(1) A person who is:

(i) Employed on a full-time, part time, or temporary basis by a hazmat employer and who in the course of such full time, part time or temporary employment directly affects hazardous materials transportation safety;

(ii) Self-employed (including an owner-operator of a motor vehicle, vessel, or aircraft) transporting hazardous materials in commerce who in the course of such self-employment directly affects hazardous materials transportation safety;

(iii) A railroad signalman; or

(iv) A railroad maintenance-of-way employee.

(2) This term includes an individual employed on a full time, part time, or temporary basis by a hazmat employer, or who is self-employed, who during the course of employment:

(i) Loads, unloads, or handles hazardous materials;

(ii) Designs, manufactures, fabricates, inspects, marks, maintains, reconditions, repairs, or tests a package, container or packaging component that is represented, marked, certif ed, or sold as qualif ed for use in transporting hazardous material in commerce.

(iii) Prepares hazardous materials for transportation;

(iv) Is responsible for safety of transporting hazardous materials;

(v) Operates a vehicle used to transport hazardous materials.

HAZMAT EMPLOYER

Hazmat employer means:

(1) A person who employs or uses at least one hazmat employee on a full-time, part time, or temporary basis; and who:

(i) Transports hazardous materials in commerce;

(ii) Causes hazardous materials to be transported in commerce; or

(iii) Designs, manufactures, fabricates, inspects, marks, maintains, reconditions, repairs or tests a package, container, or packaging component that is represented, marked, certif ed, or sold by that person as qualif ed for use in transporting hazardous materials in commerce;

(2) A person who is self-employed (including an owner-operator of a motor vehicle, vessel, or aircraft) transporting materials in commerce; and who:

(i) Transports hazardous materials in commerce;

(ii) Causes hazardous materials to be transported in commerce; or

(iii) Designs, manufactures, fabricates, inspects, marks, maintains, reconditions, repairs or tests a package, container, or packaging component that is represented, marked, certif ed, or sold by that person as qualif ed for use in transporting hazardous materials in commerce; or

(3) A department, agency, or instrumentality of the United States Government or an authority of a State, political subdivision of a State, or an Indian tribe; and who:

(i) Transports hazardous materials in commerce;

(ii) Causes hazardous materials to be transported in commerce; or

(iii) Designs, manufactures, fabricates, inspects, marks, maintains, reconditions, repairs or tests a package, container, or packaging component that is represented, marked, certif ed, or sold by that person as qualif ed for use in transporting hazardous materials in commerce.

INDEPENDENT TRAINING PROVIDER

A person or organization, independent of a hazmat employer, that offers hazmat training.

IN-DEPTH SECURITY TRAINING

Training related to a company's required security plan. It should cover company security objectives, specif c security procedures, employee responsibilities, actions to take in the event of a security breach and the organizational security structure.

Pre-transportation Function means a function specif ed in the HMR that is required to assure the safe safe transportation of a hazardous material in commerce, including—

(1) Determining the hazard class of a hazardous material.

(2) Selecting a hazardous materials packaging.

(3) Filling a hazardous materials packaging, including a bulk packaging.

(4) Securing a closure on a f lled or partially f lled hazardous materials package or container or on a package or container containing a residue of a hazardous material.

(5) Marking a package to indicate that it contains a hazardous material.

(6) Labeling a package to indicate that it contains a hazardous material.

(7) Preparing a shipping paper.

(8) Providing and maintaining emergency response information.

(9) Reviewing a shipping paper to verify compliance with the HMR or international equivalents.

(10) For each person importing a hazardous material in the United States, providing the shipper with timely and complete information as to the HMR requirements that will apply to the transportation of the material within the United States.

(11) Certifying that a hazardous material is in proper condition for transportation in conformance with the requirements of the HMR.

(12) Loading, blocking, and bracing a hazardous materials package in a freight container or transport vehicle.

(13) Segregating a hazardous materials package in a freight container or transport vehicle from incompatible cargo.

(14) Selecting, providing, or aff xing placards for a freight container or transport vehicle to indicate that it contains a hazardous material.

Recurrent Training Training given at intervals (usually not more than two or three years) to provide an update on regulatory changes to ensure a hazmat employee's knowledge remains at the required level to safely carry out their responsibilities.

SAFETY TRAINING	Training that covers the hazards presented by hazardous materials, safe handling, emergency response information and methods and procedures for accident avoidance.
SECURITY AWARENESS TRAINING	Training that is intended to provide a general understanding of the security risks associated with hazardous materials transportation and the methods designed to enhance transportation security. It should identify possible practical indicators of a potential security threat.
TRAINING PROGRAM	A systematic method that has been developed for providing training, which consists of associated material (such as handouts, overheads, videos, exercises, etc. as well as use of interactive computer based training), tests and quizzes and, where there is an instructor, the instructor's notes or course outline. The training program may be a tutored or self-study course.
TRAINING PROVIDER	Any person or organization that offers or provides hazmat training, including a hazmat employer.

Notes

For information about other Hazmat Publications or training questions:

Visit our website: **http://hazmat.dot.gov**

Phone: (202) 366-4900
Fax: (202) 366-7342
E-mail: training@dot.gov

Or write:

U.S. Department of Transportation
Pipeline and Hazardous Materials Safety Administration
1200 New Jersey Avenue, SE, PHH-50
Washington, DC 20590-0001

U.S. Department of Transportation
Pipeline and Hazardous Materials Safety Administration

SafeTravel
SAFETY TIPS FOR TRAVELERS
HTTP://SAFETRAVEL.DOT.GOV

HAZARDOUS SUBSTANCES AND WASTE CHECKLIST

NOTE:

- Cite motor carriers using Part 177 with the applicable secondary cite referenced below.

		Yes/No/NA
1	**GENERAL REQUIREMENTS**	
	Household waste excepted 173.12(g)	
	Limited Quantity Waste 173.12(h)	
	Transportation of Hazardous Waste must be in accordance with [171.3(a)]	
	Vehicles must be marked per 390.21 or 390.403 per [171.3(b)(1)]	
	Must comply with Hazardous Waste manifest requirements [171.3(b)(2)]	
	Must deliver the entire shipment to Designated Facility [171.3(b)(3)]	
	Carriers transporting hazardous waste must have EPA # (171.3 Note 1)	
	Definition of hazardous waste (171.8 & 40 CFR Part 262)	
	Definition of hazardous substance (171.8 & Appendix A to 172.101)	
2	**HAZARDOUS MATERIALS TABLE**	
	Proper shipping name selection and explanation of the term RQ [172.101(b)(8)]	
	The use of the word "Waste" [172.101(b)(9)]	
3	**SHIPPING PAPERS**	
	If the proper shipping name for a hazardous substance does not identify the hazardous substance a technical or chemical group name is required [172.203(c)(1)]	
	For a hazardous waste the waste code (e.g. D001) may be used in place of the technical or chemical group name [172.203(c)(1)] See also 173.12(d)	
	For a material which meets the definition of a hazardous substance the letters "RQ" must appear either before or after the basic description [172.203(c)(2)	
	Hazardous waste must be transported on an EPA Waste manifest in compliance with 40 CFR 262 [172.205(a)]	
	Hazardous Waste manifest properly prepared meets the requirements for a DOT shipping paper [172.205(h)]	
	The original copy of the manifest must be dated and signed by the generator and initial carrier at time of shipment [172.205(c)]	
	A copy of the manifest must be signed by each person receiving custody of the material [172.205(d)]	
	A copy of the manifest bearing all dates and signatures provided to each carrier [172.205(e)(1)]	
	Carrier maintains copy of manifest during transportation the same as 177.817(e) [172.205(e)(2)]	
	Retention of a copy of the manifest is required for 3 yrs. [172.205(e)(5) and 177.817(f)]	

4	**MARKING**	
	For hazardous wastes the word "Waste" is not required marking if EPA marking prescribed by 40 CFR 262.32 is applied [172.301(a)(2)]	
	Technical names required for hazardous wastes [172.301(b)] See also 173.12(d)	
	If the proper shipping name for a hazardous substance does not identify the hazardous substance a technical or chemical group name must be marked on the package [172.324(a)]	
	For materials meeting the definition of hazardous substance the letters "RQ" must be marked on the package [172.324(a) and 172.324(b)]	
	Identification number required for bulk packaging [172.302(a)]	
	Identification Number marking for bulk packaging (172.332)	
5	**LABELING**	
	General labeling requirements [172.400]	
	Label modifications [172.400a]	
6	**PLACARDING**	
	Class 9 placards not required for domestic transportation; Identification Number marking is required. [172.504(f)(9)]	
7	**ADDITIONAL PACKAGING REQUIREMENTS**	
	Open head drums authorized for semi-solids and solid hazardous waste [173.12(a)]	
	Requirements for "Lab Packs" [173.12(b) and (f)]	
	Reuse of packagings authorized for hazardous waste [173.12(c)]	
8	**TRANSPORTATION**	
	Securement 177.834(a)	
	Segregation 177.848 See exception in 173.12(e)	

DETERMINING RQ FOR SOULTIONS

The quantities in Appendix A of the HM Table are for pure products in a single package.

To calculate the RQ for a solution, you must have the percentage or the Parts Per Million (PPM) of the chemical that is listed in Appendix A. You also have to have the weight in pounds per gallon of the total solution (from shipping papers, SDS, calling shipper, etc.).

To determine if the RQ is met for a solution, refer to the table in the definition of *Hazardous Substance* in Section 171.8:

(3) When in a mixture or solution—

(i) For radionuclides, conforms to paragraph 7 of the appendix A to § 172.101.

(ii) For other than radionuclides, is in a concentration by weight which equals or exceeds the concentration corresponding to the RQ of the material, as shown in the following table:

RQ pounds (kilograms)	Concentration by weight	
	Percent	**PPM**
5000 (2270)	10	100,000
1000 (454)	2	20,000
100 (45.4)	0.2	2,000
10 (4.54)	0.02	200
1 (0.454)	0.002	20

The term does not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance in appendix A to § 172.101 of this subchapter, and the term does not include natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas).

Example

A tank containing 3000 gallons of a solution containing water and thioacetamide.

The Safety Data Sheet states that the solution contains 1% thioacetamide.

The weight in pounds per gallon of the solution is 8.32828 lbs./gal.

The RQ from Appendix A of the HMT for thioacetamide is 10 lbs.

Now you must determine the weight in pounds of the thioacetamide in the solution.

3000 gallons X 8.32828 = 24,984.84 lbs. for the entire payload.

24,984.84 x 1% = 249.8484 lbs. total of thioacetamide for the entire payload.

Since 249.8484 exceeds the 10 lb. threshold for this material, it is a Hazardous Substance.

If the PPM of a material is the only number available, multiply the PPM provided by 1,000,000 to obtain a percentage. Then follow the example above.

SHIPPING PAPERS

Shipping papers for hazardous materials are required for almost all hazardous materials, regardless of quantity, but there are exceptions.

Exceptions

- See 172.200
- Limited Quantities, HMT Column 8(a)
- Certain Special Provisions, HMT Column 7
- Some Special Permits
- Agricultural Operations, 173.5
- MOTs, 173.6
- Batteries, 173.159
- Engines and vehicles, 173.220
- Nurse Tanks, 173.315(m)

What to include

All shipping papers must have four elements, referred to as a basic shipping description (all of these elements, for each material, are listed in the table in Section §172.101):

172.202(a)(1)-(4) and (b)	**Yes/No/NA**
UN (or NA) Identification Number	
Proper Shipping Name	
Hazard Class or Division Including any applicable subsidiary hazard class or division, in parenthesis, immediately following the primary class or division	
Packing Group NOTE: Packing Groups are not required or don't exist for Class 1, Class 2, Division 5.2, Division 6.2 other than Regulated Medical Waste, Class 7, self-reactive materials and most batteries (172.202(a)(4) and 712.101(f).	

Shipping papers must also contain the following:

	Yes/No/NA
Total Quantity Transported (some exceptions), 172.202(a)(5) and (c)	
Total number and type of packages, 172.202(a)(7)	
Shipper Certification (some exceptions), 172.204 and 177.817(b)	
Emergency Telephone Number (See below), 172.602 and 172.201(e)	
Emergency Response Information (See below), 172.604	

Additional Description Requirements, 172.203

	Yes/No/NA
(a) Special Permits (DOT-SP0000)	
(b) Limited Quantities (LTD. QTY.) If not excepted	
(c) Hazardous Substances (RQ or EPA waste stream number)	
(d) Radioactive Materials	
(h)(1) Anhydrous Ammonia ("0.2 PERCENT WATER" or "NOT FOR Q AND T TANKS")	
(h)(2) Liquefied Petroleum Gas ("NONCORROSIVE," "NONCOR," OR "NOT FOR Q AND T TANKS")	
(k) Technical Names for N.O.S. Materials and other generic descriptions See also 172.202(d)	
(l) Marine Pollutants ("Marine Pollutant")	
(m) Poisonous Materials ("Poison," "Poison-Inhalation Hazard" and "Zone A/B/C/D")	
(n) Elevated Temperature Materials ("HOT")	
(o) Organic Peroxides and Self-Reactive Materials	
(p) Liquefied Petroleum Gas (LPG), Non-Odorized or Not-Odorized	
Hazardous Wastes, the word "WASTE" must precede the shipping name, 172.101(c)(9) (EPA Manifest, see Section §172.205)	

How to enter information

There is no specific *form* that must be used (except for the Hazardous Waste Manifest, 172.205), but there is a specific *format* the information must be in:

- The basic shipping description MUST be entered in the order shown in Section 172.202(a), with no additional information interspersed, per Section 172.202(b).

- When hazardous materials and non-hazardous materials are on the same shipping paper, the hazardous materials entries must be entered in one of the following manners (172.201(a)(1)):

    1. Entered first;
    2. Highlighted in a different color; or
    3. With a "X" or "RQ" (if appropriate) in a hazardous materials column.

- While in transit (see Section §177.817(e)), the hazardous materials shipping paper must be distinguished from other shipping papers by tabbing or placing it on top.

- In addition, the shipping paper must be within the driver's reach when wearing a seatbelt, ***and*** must be "readily visible" to a person entering the vehicle. Should the driver leave the vehicle, it must be on the driver's seat or must be in a holder on the driver's door. These requirements also apply to Emergency Response Information, discussed below (see Section §177.817(e)(2))

Emergency Response Information (ERI)

This requirement is found in Section 172.602, and is designed to provide first responders with initial actions that can be taken to mitigate any incident that may occur.

An Emergency Response Guidebook does qualify for this provision, however, first responders already have these and an extra copy will not provide them with any new information. The most current ERG is not required, but the information for the particular HM

Safety Data Sheets (SDS) may qualify, but not all SDS contain the required information. Shippers are permitted to create their own document provided it contains all the required information.

Section 172.602(c)(1) requires the ERI to be maintained in the same manner as the shipping papers (177.817(e), visible and within reach).

In addition to the basic shipping description, the following information is required:

- Fire/Explosion Hazards
- Immediate Precautions to Take During an Incident
- Initial Spill/Leak Handling Methods
- Preliminary First Aid Measures

Additionally, Section §172.606 requires carriers to instruct drivers to contact the carrier in the event of a hazardous materials incident; and further requires the emergency response information and the carriers telephone number to be available to responders when a trailer is left without motive power.

Emergency Response Telephone Numbers

Found in Section 172.604, an Emergency Response Telephone Number is required of anyone who "offers" a hazardous material for transportation. This generally means it is the shipper's telephone number, although they may contract with a third party to take the responsibility.

The phone number must be entered on the shipping paper in a clearly visible manner that allows it to be quickly found. If the phone number is a third party ER provider, either the name of the person/company that holds the contract or the contract number must be on the shipping paper (172.604(b)(1)).

A person knowledgeable of the material and who has "comprehensive emergency response and incident mitigation information" must monitor this number at all times that a hazardous material is in the transportation system. Callbacks, pagers, answering machines, etc., are illegal.

If you believe you have violations related to not answering soon enough, use a voicemail, or an person who is not knowledgeable, contact your HMPM for assistance.

Section 172.604(c) contains a list of HM that are excepted from the ER telephone number requirement.

Retention of Shipping Papers

The requirements for the retention of shipping papers depend upon whether you are a shipper or a motor carrier.

The time period is calculated from the date of acceptance of the shipment by the initial carrier. The shipping paper must be accessible at or through the principle place of business.

Retained shipping papers must be made available upon request, to an authorized Federal, State, or Local government agency, at reasonable times and locations.

Motor carriers that use permanent shipping papers can maintain a separate record of deliveries in conjunction with the shipping papers to comply with this provision.

Shipper: See §172.201(e)

Shippers are required to retain a copy or an electronic image for 3 years for hazardous waste and 2 years for all other hazardous materials.

Motor Carriers: See §177.817(f)

Motor carriers are required to retain a copy or an electronic image for 3 years for hazardous waste and 1 year for all other hazardous materials.

HM Training Checklist

The HM Training requirements are found in CFR Title 49, Part 172, Subpart H (Sections 172.700-704). This subpart is often referred to as HM-126F, which was the docket number assigned to it by PHMSA when the rule was developed. This requirement applies to intrastate and interstate transportation, and to both shippers and motor carriers.

Training violations are the most common HM violation cited during a review. Many companies do not realize the training regulations apply to their particular operation, or have not kept up with the refresher cycle.

When Does HM Training Apply?

The training requirements apply to most HM shipments, even if the shipment is not required to be placarded or have shipping papers. It applies to limited quantities and bulk shipments of combustible liquids. It does not apply to Materials of Trade, batteries that are in compliance with Section 173.159(e), vehicles or engines that are in compliance with Section 173.220, or other similar provisions that except a shipment from the entire HMR.

HM training is required for all "hazmat employees" (See Section 171.8) who have any job function that involves preparing a HM shipment for transportation, testing/inspecting a HM package, or actually engaged in the transportation of a HM. It includes persons loading or unloading vehicles; testing/inspecting/repairing drums, IBCs or cargo tanks; preparing shipping papers; applying markings, labels or placards; or is "responsible for safety of transporting hazardous materials." This last provision would include terminal managers, safety managers, compliance officers, etc.

What Training Is Required?

The training standard (Section 172.704(a)) requires training in the following areas: General Awareness/Familiarization; Function Specific; Safety, Security Awareness Training and in certain circumstances, In-depth Security Training. There are also training requirements specific to each mode of transportation.

General Awareness/Familiarization includes training to provide familiarity with the FHMR, and to enable the employee to recognize and identify hazardous materials consistent with the hazard communication standards (markings, labels, placards, etc.).

Function-Specific Training states that employees must receive training concerning the regulations that are specifically applicable to the functions the employee performs. The specific training provided will vary depending on the individual's involvement in the transportation system. For example, a shipping clerk would need training in the regulations applicable to shipping papers, whereas a dock employee would need loading and unloading, outage standards and package integrity, segregation and separation training, etc.

This is the most critical training component, since it covers the specific HMR provisions that apply to that job function. For example, if a motor carrier is utilizing a PHMSA Special Permit, then all employees who have a job function related to the Special Permit must be trained and tested on the Special Permit every three years. Investigators should examine the function-specific training closely and ensure all hazmat employees are adequately trained for their job function(s).

Safety Training must cover the emergency response information required in Subpart G of Part 172, measures to protect the employee from the hazards associated with materials to which they may be exposed to in the workplace, and methods and procedures for avoiding accidents. One exception to this portion of the training requirement are employees who repair, modify, recondition, or test hazardous materials packagings, and who do not perform any other function subject to the regulations, do not have to receive safety training (Section 172.704(e)(1)).

Security Awareness Training addresses training on recognizing and responding to possible security threats and an awareness of security risks associated with hazardous material transportation.

In-depth Security Training is required when the company must have a Security Plan and the hazmat employee has a duty under the Security Plan. This training must include company security objectives, specific security procedures, employee responsibilities, actions to take in the event of a security breech and the organizational security structure. There must be a test that includes questions on the company's security plan.

Also, this is the only training that an employer cannot use training documentation provided from a previous employer, since this training must be specific to the current employer's security plan.

Driver Training is required by Section 177.816. This section requires training on the FMCSRs; vehicle handling training; operations in tunnels, bridges, and railroad crossings; vehicle attendance, parking, smoking, routing, and incident reporting; segregation of cargo; loading and unloading, load securement; and specialized training for cargo tank and portable tank operations.

The CDL testing requirements may be used for compliance with this portion of the training for person with a hazardous materials or tank vehicle endorsement. In the preamble to the rulemaking allowing this, PHMSA was very clear that the employer must determine to what extent the CDL endorsement suffices for the training requirement. The CDL endorsement is not a blanket exception to driver training. For example, the CDL endorsement is not specific to the unloading/loading procedures for all cargo tanks or for all shipper or receiver facilities. It is the responsibility of the employer to ensure their HM employees are properly trained for each function they perform.

If the CDL has a renewal date of greater than 3 years, the carrier must provide this training at the appropriate intervals. For example, if a driver has a CDL that expires in 6 years, the carrier must provide the Section 177.816(b) training within 3 years after the CDL was issued. Investigators should check the last issue date of the CDL/HM endorsement.

Other Training

Other training standards (Section 172.704(b)) may be substituted for portions of the USDOT training requirements, if they meet the standards outlined in Subpart H. For example, OSHA or EPA training may cover portions of the training required by USDOT, and would not have to be repeated. If the training differs in any technical areas, like definitions, then the employee must be trained in those areas. Additionally, training completed by previous employers may also be used, if documented.

When Is HM Training Required?

Training must be done once every three years (Section 172.704(c)). Refreshers on different portions may be spread out over the course of the three years. The training for a new hazmat employee or an employee who changes hazardous materials job function(s) must be completed within 90 days after employment or after the change. A hazmat employee may perform new hazardous materials job functions before completing training if he/she does so under the supervision of a properly trained and knowledgeable hazmat employee. The training may be done within the company or through other public or private sources.

What Documentation is Required?
A record of current training (Section 172.704(d)), and of the preceding three years, must be created and retained by the employer for each hazmat employee for as long as they are employed as a hazmat employee and for 90 days thereafter. The record must include:

- The employee's name;
- The most recent training completion date;
- A description, copy, or the location of the training materials used to meet the requirements;
- The name and address of the instructor(s); and
- A certification that the hazmat employee has been trained and tested.

Important Reminders When Reviewing Training Records:

- Does the carrier retain all the required training documentation as long as the employee is employed and for 30 days after?

- Does the documentation include:

	Yes/No/NA
Certification of training **and** testing?	
Documentation of training in all five topics, if applicable: General Awareness, Safety, Function-Specific, Security Awareness, and In-Depth Security (only for employees with duties in the Security Plan)?	
Are ALL HM employees included in the training?	
Do the training documents address all applicable regulations for that function?	
Does it include Special Permit training, if applicable?	
Does the training documentation include the topics required for drivers specified in Section 177.816(a)?	
Does the training documentation include the required for cargo tank drivers specified in Section 177.816(b)?	

Case Preparation and Evidence
First, you must show that the person was an HM employee and was performing a function that is subject to the HM training requirements.

Next, you must show that the person was not trained in a specific category. How do you prove something didn't' happen?

Written statements are good for this purpose, but it must be strong statement that clearly identifies the employee(s), the function(s) they performed, and that they were not trained and/or not tested. PHMSA has stated in interpretations that there is no requirement for a written test and there is no requirement to retain test documentation. So the test may be an oral exam or a performance exam. Be very specific in your written statement that a test of any kind was not administered.

A common document provided for training documentation is a safety meeting roster. These are usually quite vague and incomplete; however, they may be used to show that training was conducted. This would be a violation of the recordkeeping requirements (172.704(d)), ***but not*** failure to train (172.704(a)).

When citing training violations, it is important to obtain copies of all the training documents the company official provides to you so you can adequately refute any defenses raised later.

While it is recommended to review training materials when they are available, it is usually difficult to establish an enforcement case for incomplete training except in incident situations. Contact your HMPM for further guidance.

Motor carriers should be cited under 177.800(c). Other entities should be cited under the 172.704 cites.

This is an example of a training record that was presented during a HM Shipper Review that complies with Section 172.704. Note that the record includes each category with the date of the training, and includes specific items such as package closure training (required for persons who close drums, IBCs, etc.) and Special Permit training.

[redacted]

Certified Record
Of
DOT HazMat Employee Training

Name of Hazmat Employee: [redacted]

The HazMat Employee's work location is: [redacted]

Type of Training Administered	Most Recent Training Date
General Awareness/Familiarization	8/11/2011
Security Awareness	10/13/2011
Safety	3/15/2012
Security In-Depth	10/13/2011
Function Specific – 30 & 55 gallon drum closure procedures	9/24/2012
Function Specific - Inspecting	9/24/2012
Function Specific - Packaging	9/24/2012
Function Specific – Shipping	9/24/2012
Function Specific – DOT Special Permit 14659	8/11/2011

Location of Training: [redacted]

Description of Training materials:
A copy of the training materials, including completed tests are in the D.O.T. Training binder. This binder is located in the office of the EHS Manager.

Name and address of person providing training:

[redacted]

Certification:

I hereby certify that the above-named hazmat employee(s) have been trained and tested, as required by Subpart H of 49 CFR Part 172.

Signature: [redacted] Date: 9-26-2012

THE
NATIONAL BOARD
OF BOILER AND PRESSURE VESSEL INSPECTORS

MANUFACTURER'S DATA REPORT REGISTRATION CHECKLIST

The following checklist is being offered to assist in ensuring that the Data Reports you are signing and submitting for registration are as complete and accurate as possible.

- Your company holds a current *Certificate of Authorization to Register National Board.*
- You have used the most current Data Report form.
- The font used for entering the technical information on the Data Report Form is an acceptable size.
    - All data reports submitted for registration must be legible. The National Board requires the use of at least a 6 point font size on the data report format and an 8 point font size on all data entered into the form by your company (Arial or comparable size in any other font style).
- Line 1 of the Data Report contains the complete name and complete physical address of the manufacturing plant as authorized by ASME and the National Board.
- Stamping information has been provided:
    - National Board Number
    - Year Built
    - Manufacturer's Serial Number
- National Board Numbers have not been duplicated and do not contain prefixes or suffixes.
- The Code Edition and Addenda Date, to which the vessel has been manufactured, have been indicated.
- The size of the item has been indicated:
    - Pressure Vessel – diameter and overall length
    - Boiler – heating surface
    - Heat Exchangers – For non-tube and shell heat exchangers, the length of the tubes or the overall length of the tube bundle must be indicated in the "Remarks" section.
- All Partial Data Reports have been properly referenced on the Primary Data Report and are being submitted with the Primary Data Report for registration. (Partial Data Reports must also be legible with an acceptable font.)
- The certification blocks have been completely filled out (including field assembly when appropriate):
    - Current ASME Certificate of Authorization number and expiration date have been indicated;
    - Manufacturer's representative has signed and dated the Data Report;
    - The inspection date has been indicated (inspection was made prior to the authorization expiration date);
    - The Authorized Inspector has signed and dated the Data Report;
    - The Authorized Inspector has provided his National Board Commission Number and Endorsement(s);
- Overview:
    - The Data Report is legible with an acceptable font size. The National Board must ensure that the Data Report submitted for registration can be reproduced.
    - All white-out/mark-over corrections and/or handwritten additions have been initialed and dated by both the manufacturer's representative and the Authorized Inspector.
    - You are submitting the original Data Report.

GUIDE FOR COMPLETING DATA REPORTS

Registration: Data reports for National Board stamped items shall be submitted to the National Board within 30 or 60 days of completion (NB Certificates issued/renewed after July 1, 2014 requires 30 days).

Preparation of Data Reports: Data reports submitted to the National Board for registration shall comply with all requirements of the applicable ASME Code section. In addition, the data reports shall also comply with all applicable National Board requirements.

Forms: Data reports must be standard ASME Code forms. (8 ½ x 11) ASME forms are available on the ASME website. Forms can also be completed and the entire registration process accomplished via the National Board's Electronic Data Transfer System (EDT).

Computer Generated Forms: The National Board follows the interpretation set forth in the ASME Code; Section VIII-1-83-17 (applies to forms for all ASME Code sections). Computer generated forms must be reviewed by the National Board prior to use for registration.

Font Size: All data reports submitted for registration must be legible. The National Board requires the use of at least a 6 point font size on the data report format and an 8 point font size on all data entered into the form by your company. (Arial or comparable size in any other font style.)

Original Data Report: The National Board requires an original data report (with original signatures) for registration.

Identification: The manufacturer's complete name and physical address (including postal code) as authorized by ASME and the National Board shall be shown on Line 1 of the data report form.

National Board Numbers: Numbers should be assigned and stamped sequentially after the hydrostatic test, beginning with #1 and continuing consecutively without skips or gaps of unused numbers. Multiple duplicate data reports (bearing more than one NB number) may be registered for items manufactured in a single day with identical information. The NB numbers shall be inclusive.

Code Case: All applicable code case numbers shall be shown on the data report.

Code Edition: The year of the code edition to which the pressure equipment was manufactured is required. (The addenda date must also be listed when applicable.)

Complete Size: Filing fees are determined by the overall size of the item being stamped. The length and diameter or heating surface is required for determining the correct filing fees. Methods for determining filing fees can be found in the National Board's registration fee schedule.

Signatures: All data reports must be signed and dated in ink by the manufacturer's representative and the authorized inspector or certified individual when appropriate. The authorized inspector must provide his/her National Board commission number and appropriate endorsements.

Method of Completing: The data report must be completely typed or completely handwritten. A typed form cannot contain handwritten additions unless they are initialed and dated by the manufacturer's representative and authorized inspector.

Correcting Data Reports:

– Original Data Report Prior to Registration: All white-outs, markovers and/or changes made on the data report are to be legibly initialed and dated by both the manufacturer's representative and authorized inspector at point(s) of correction. Do not mark "Corrected Copy" on this data report.

– Data Report Previously Registered: "Corrected Copy" and date must appear in the top right-hand corner. There are two ways to correct a report which has already been registered: 1) submit a new original, 2) submit a copy of the original with original initials and dates (by the representative and inspector) at point(s) of correction. A copy may only be submitted if the original is already on file with the National Board.

-Note 1: If the inspector that initials the changes did not originally sign the report, the new inspector shall sign, date and indicate his National Board commission number below the certification block.

- Note 2: If there has been a change in the inspection agency, use a clear legible copy of the original data report. The changes are initialed and dated by the company representative and the new AI and **"Corrected Copy"** is listed in the upper right corner of the report. In the "Remarks" section, the new agency name and the inspector's information shall be listed along with the AI's signature and date and the phrase "For Documentation Purposes Only".

Materials of Construction: Materials must be designated as **SA, SB** or **Code Case** rather than A or ASTM. For U-1A's, if the material used in the construction of the object has been impact tested, this must be indicated in the "Remarks" section. If the material was exempt from impact testing, this exemption and the specific paragraph(s) used to claim the exemption must be indicated in the "Remarks" section.

Supplementary Sheets: The appropriate ASME approved supplementary forms must be used if additional space is required to record data.

Partial Data Reports and Attachments: Partial Data Reports shall be referenced and attached for **all** sections of the code. These partial data reports shall be attached to the appropriate data report by the manufacturer of the completed item. A partial data report may reference another partial data report; however, all shall be listed on the primary report.

P-4 & H-4 Partial Data Reports: A separate NB number shall be assigned for each line completed in section 3 of the data report.

Intermediate Bulk Containers (IBCs)

Intermediate Bulk Containers (IBCs), often called "totes," are the international version of a portable tank. They have become the bulk package workhorse of the HM industry and, for the most part, have replaced DOT portable tanks.

Drivers of CMVs with IBCs are subject to the tank endorsement requirement if the total capacity of all the IBCs on the CMV exceed 1,000 gallons (by definition, IBCs are bulk packages, and must be over 119 gallon capacity). The maximum capacity of an IBC is 792 gallons.

IBCs are made of a variety of materials, but the most common are composite (plastic bladder inside a metal cage); rigid plastic; and flexible IBCs. Less common are metal; fiberboard; and wooden IBCs.

Authorization

IBCs are authorized through the HM Table, Column 7 (Special Provisions IB and IP) and Column 8c (Bulk Packages). Section 173.35 also applies:

	Yes/No/NA
Must be within test dates (173.35(a))	
Must be free from corrosion, cracks, damage and marked as required by 178.703 (173.35(b))	
Metal IBCs must be protected from thinning (173.35(c))	
No more than 98% capacity at 122°F (173.35(d))	
No HM on the outside; securely attached to transport vehicle (173.35(f))	
No PG I liquids; limitations on PG I solids (173.35(j))	
Cannot exceed gross mass on specification plate (173.35(l)	

Communication

In the international arena, there is no distinction between bulk and non-bulk. To facilitate international transportation, PHMSA has adopted the international regulations for IBCs, so an IBC can be marked and labeled as a non-bulk package, or marked and placarded as a bulk package. Note that not all of the non-bulk package markings apply to an IBC.

	Yes/No/NA
Marked and Placarded Identification Number two opposing sides (172.302(a)) when placarded on two opposing sides (172.514(c)(3))	
Marked and Labeled Identification number and shipping name on one side (172.301(a)(1)) when labeled (172.400(a)(2)). See 172.514(c)(4). Labels on two opposing sides required when more than 479 gallons (172.406(e)(6))	

IBC Specifications

The specifications for IBCs are found in Part 178 Subpart N.

Section 178.702 explains the various materials codes. Code 11 is for rigid IBCs and 13 is for flexible IBCs. Note paragraph (b), which states that composite codes will have two capital letters, such as 31HA1. The first letter is the outer receptacle material and the second letter is the inner receptacle material, and both codes are taken from the list in paragraph (a)(2).

Sometimes the Special Provisions column and the authorization sections will refer to a code of 11HZ1. These codes are from Section 178.707. The "Z" is replaced with the appropriate code from the list in Section 178.702(a)(2).

Additional marking codes are found in Section 178.703(b).

	Yes/No/NA
Must be marked with specification code (178.703(a) and 173.35(b)(2))	
Must be marked with the stacking symbol (178.703(b)(7))	
Framework of IBCs (178.704(d))	
Bottom discharge valves (178.704(e))	

IBC Tests/Inspections

When inspecting composite IBC for test dates, be sure to compare the manufacture date of the outer receptacle to that of the inner receptacle. It is a common industry practice to replace the inner receptacle (bladder), so the manufacture dates won't necessarily be the same. Use the date of the inner receptacle to verify compliance with Part 180.

	Yes/No/NA
Metal, Composite, and Rigid Plastic IBCs External visual inspection 2.5 years (180.352(b)(2)) Internal visual inspection 5 years (180.352(b)(3))	
Flexible, Fiberboard, and Wooden IBCs External visual inspection after each permitted use (180.352(c))	
Inspection markings (178.703(b) and 180.352(f))	
Repairs (180.352(d) and (e))	
Record retention (180.352(g))	

LABELING CHECKLIST

The requirements for package labeling are found in 49 CFR, Part 172, Subpart E. Unless excepted, all packages must be labeled, or if allowed, placarded. Labels are based on Column 6 of the Hazardous Materials Table (Section 172.101). A package must be labeled for all of the hazards listed in Column 6 (Section 172.400). See the list of packages that are excepted from labeling in Section 172.400a.

Requirements, Prohibitions, and Placement

The label must correspond to the hazard, and the hazardous material must be present in the package (see Sections 172.401(d) and 173.29 for empty packages). There cannot be any other marking or symbol that may be confused with the label (Section 172.401). Text is optional on labels except for the Oxygen and Class 7 labels (Section 172.405). For a 6.1, PG III material, the poison label may have “PG III” in lieu of the text.

Labels must be placed on the same surface and as near as possible to the required markings, but labels for cylinders and small packages may be affixed using a tag. Primary and subsidiary labels must be within 6” of each other. Labels must be clearly visible and unobstructed (Section 172.406).

Only one label per package is required, except for the following packages, which require a label on two opposing sides or ends, unless placarding is authorized under Part 172 Subpart F:

- Packages of 64 cubic ft. or more Non-bulk packages of radioactive materials
- DOT 106 or 110 tanks (one-ton cylinders) Portable tanks of less than 1,000 gallons
- Freight containers of 640 cubic ft. or more by volume See Section 172.406(e)

Primary and Subsidiary Labels

The primary label is the hazard class that is listed first in Column 6 of the HM Table. All other hazards listed, if any, are subsidiary labels. Section 172.402 also includes additional subsidiary label provisions for Class 7: (d), Class 1: (e), Division 2.2: (f), and Division 2.3: (g).

Mixed and Consolidated Packagings

When materials of different hazard classes are packed in the same overpack, consolidated package, or mixed packaging, the outside of the packaging must be labeled for each class of hazardous materials that it contains (Section 172.404).

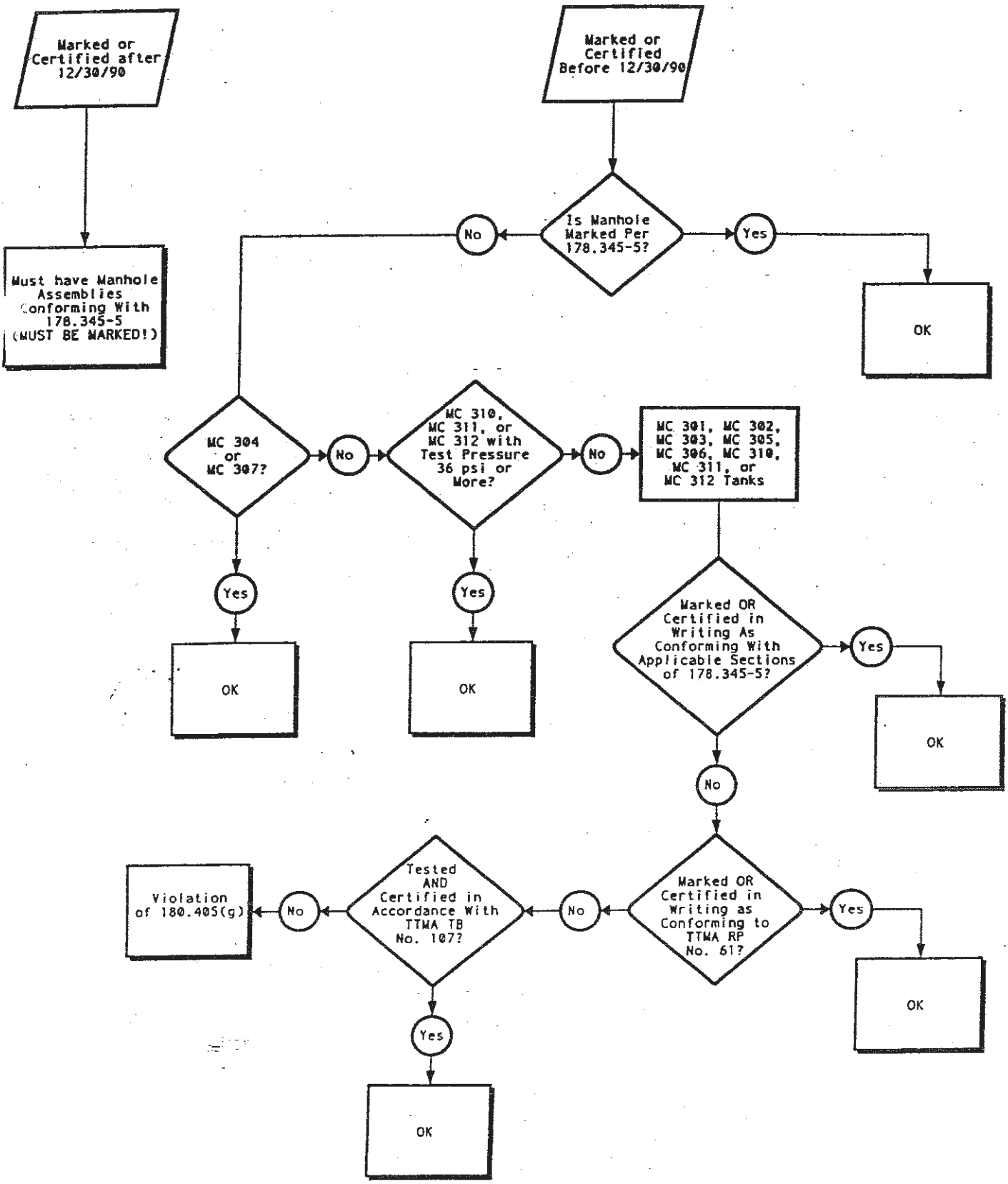
Radioactive Materials

The only authorized use for the Empty label is for packagings that previously contained radioactive materials (Section 173.428(e)). Since its only authorized use is for radioactive materials, using it on packages that contain or previously contained other hazardous materials is a violation of the communication standards (Section 173.22 requires the shipper to ensure a package is marked in accordance with the regulations).

Section 172.403 contains additional requirements for radioactive labels, including contents, activity, and transport index. Packages containing fissile materials must bear two FISSILE labels affixed to opposite sides of the package or overpack (Section 172.402(d)) and include the Criticality Safety Index (CSI) in addition to the Radioactive labels.

Cargo Tank Manhole Assembly Replacement Flow-Chart

(MC 306, 307, and 312 series and predicessors)



Betts

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FAX 814/723-7030

BETTS INDUSTRIES, INC. 1800 PENNA. AVE. W. ☐ BOX 888 ☐ WARREN, PA. 16365-0888

Since 1901

NOTICE TO BETTS-TIONA MANHOLE CUSTOMERS

The U.S. Department of Transportation Requirements for Cargo Tanks, Docket No. HM-183 states that each manhole assembly installed on MC 300, MC 301, MC 302, MC 303, MC 305 and MC 306 cargo tanks must be capable of withstanding a static internal fluid pressure of at least 36 psig without leakage or permanent deformation that would affect its structural integrity.

The owner of a cargo tank manufactured prior to December 31, 1990 must comply with the new regulation either by retrofitting the cargo tank with a manhole assembly conforming to the regulation's specifications or by obtaining a certification from the manufacturer of the manhole assembly that it conforms to Recommended Practice (RP) No. 61 of the Truck Trailer Manufacturers Association (TTMA). The retrofitting or certification must be accomplished by August 31, 1995, except that owners of five (5) or more cargo tanks subject to the regulation must retrofit or certify 20% of such tanks each year beginning in 1990 until all are in compliance.

In cases where the manufacturer of a manhole assembly cannot be identified or the manufacturer cannot certify compliance with RP No. 61, the owner may have the manhole closure tested in accordance with the procedure set forth in TTMA Technical Bulletin No. 107, and if the test is successful, the assembly may be certified as being in compliance with the new regulation.

This memorandum will serve as certification by Betts Industries, Inc. that certain Betts-Tiona manholes (identified below) do conform to TTMA RP No. 61, but only <u>as manufactured</u> and only if <u>properly installed</u> on MC 300, MC 301, MC 302, MC 303, MC 305 and MC 306 cargo tanks. This certification is sufficient to satisfy the new regulation with respect to such manholes. HOWEVER, THIS CERTIFICATION IS NOT A REPRESENTATION OF WARRANTY THAT ANY PARTICULAR BETTS-TIONA MANHOLE CURRENTLY IN USE WOULD PASS THE TEST OUTLINED IN TTMA RP NO. 61 (WHICH OBVIOUSLY DEPENDS ON USAGE AND MAINTENANCE HISTORY) OR THAT SUCH MANHOLE IS IN COMPLIANCE WITH ANY OTHER DEPARTMENT OF TRANSPORTATION REQUIREMENT.

KNAPPCO CORPORATION
4304 MATTOX ROAD
KANSAS CITY, MISSOURI 64150

Telephone (816) 741-6600
FAX (816) 741-1061

March 15, 1993

Bi-State Petroleum
Attn: Fred
655 S. Stanford
Sparks, NV 89431

Dear Fred:

This letter is in reference to manhole certification requirements set forth in HM-183, 183A sections 178.345-5, and 180.405(g)(2).

Manholes installed on cargo tanks prior to December 30, 1990:

Knappco Corporation will certify (based on test of current production models) that the following series of manholes met the requirements of 178.345-5(b) when shipped from the factory.

MA (or CB-8200), MB (or CB-8200T), ME, MF,
MG, MH, MP, and MQ

Manholes and non-relieving fill covers installed on cargo tanks as of December 30, 1990:

The following series of manholes manufactured currently are tested and certification marked on each manhole before shipping as meeting the requirements of section 178.345-5. These are the only manholes presently certified by Knappco Corporation.

DB, DP, DQ, DT, DU, DV, DW,
LM, MA, MB, ME, MF, MG, MH, MJ, MN, MP, MQ, MR, MS,
RA, RB, RP, RQ, RT, RU, RV and RW,

Manholes without marked certification cannot be installed.

Sincerely,

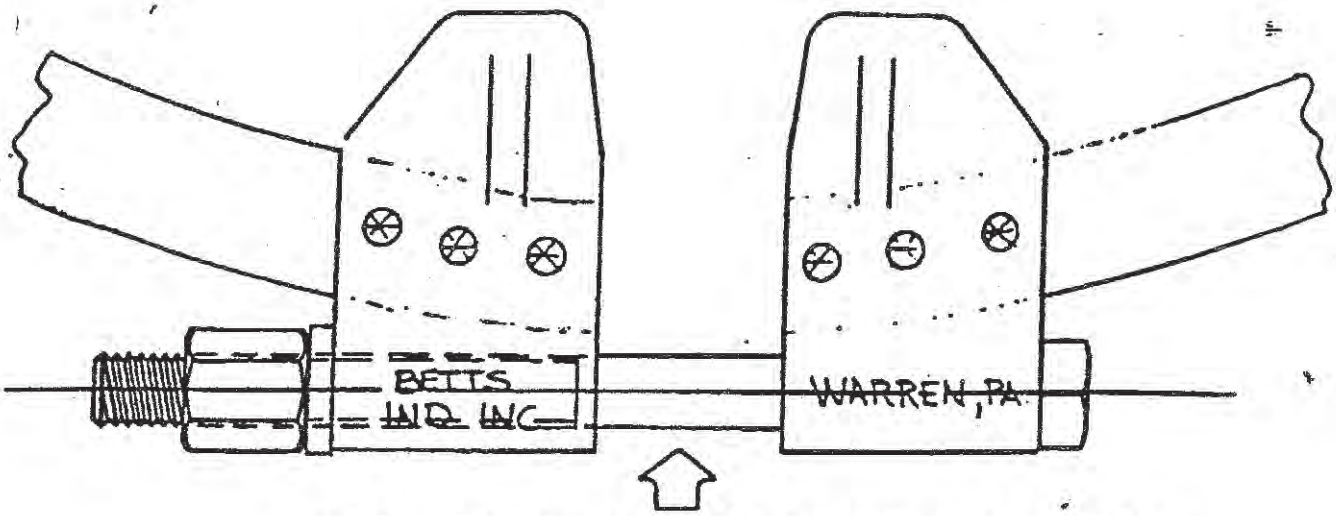
KNAPPCO CORPORATION

Hank Knaack

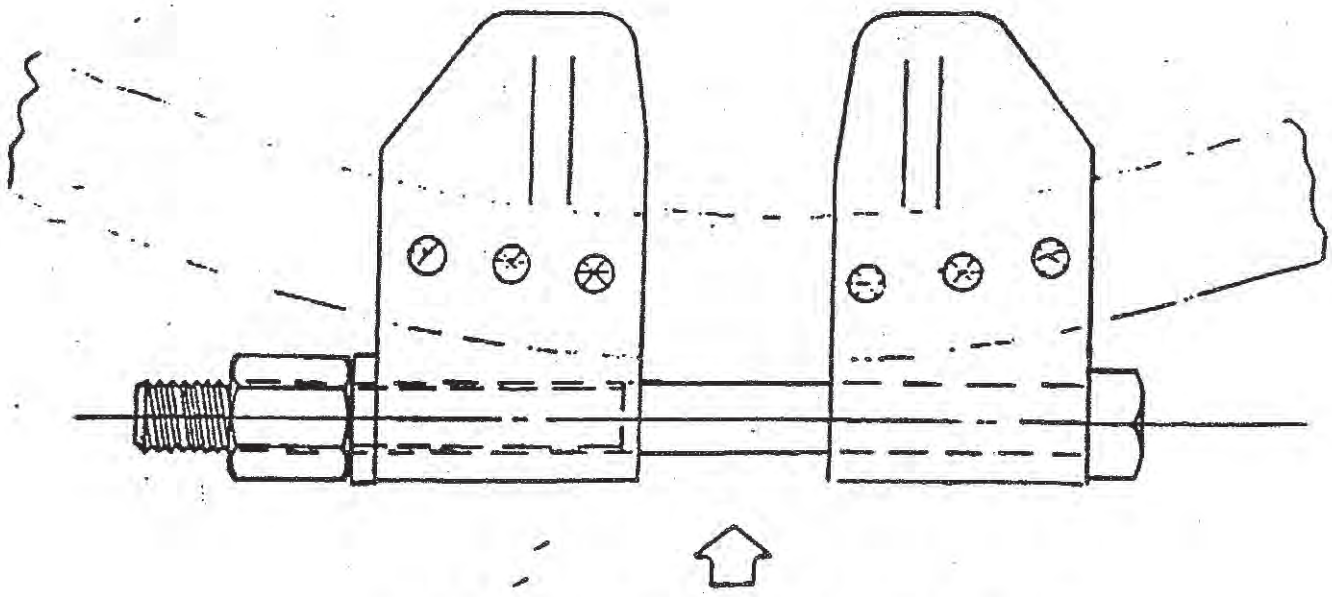
Hank Knaack
General Manager

HK/tv

ILLUSTRATIONS FOR STEP TWO



NO REPLACEMENT NEEDED



REPLACE CLAMP RING

TTMA TECHNICAL BULLETIN

Truck Trailer Manufacturers Association
1020 Princess Street
Alexandria, Virginia 22314
(703) 549-3010 FAX: 1-703-549-3014

Bulletin No. 107 **June 1, 1998**

Subject: **Procedure for Testing In-Service, Unmarked, and/or Uncertified MC 306 and Non-ASME MC 312 Type Cargo Tank Manhole Covers**
(Originally Issued June 1990, Revised June 1998)

1.0 Preface:

1.1 Recommended Practices and Technical Bulletins are furnished by the TTMA as a guide to general practices in the manufacture, use, and repair of truck trailers. However, the scope of the TTMA's Recommended Practices and Technical Bulletins is not exhaustive of all general practices in the manufacture, use, and repair of truck trailers and there may exist such general practices which do not appear in either the Recommended Practices or Technical Bulletins.

1.2 Recommended Practices and Technical Bulletins represent the state-of-the-art that existed at the time of its preparation. Users of Recommended Practices and Technical Bulletins should familiarize themselves with advancements in practices that have occurred subsequent to the Recommended Practice's or Technical Bulletin's publication date.

1.3 The TTMA has not undertaken any evaluation of all the conceivable ways in which Recommended Practices or Technical Bulletins may be used by manufacturers, users, or repairers of truck trailers nor the consequences of such uses. Everyone who uses Recommended Practices or Technical Bulletins must first satisfy himself or herself that his or her safety, the safety of others, or the safety of the truck trailer and any other equipment will not be jeopardized by their use of information contained within the Recommended Practices or Technical Bulletins.

1.4 The Recommended Practices and Technical Bulletins may contain terms or words with specialized meanings. Definitions for such terms or words may be found in TTMA RP No. 36 - Tank Trailer and Tank Container Nomenclature or TTMA RP No. 66 - Trailer Nomenclature.

1.5 Within the Recommended Practices and Technical Bulletins, "shall" is used wherever conformance with the TTMA publication requires that there be no deviation from the specific recommendation. "Should" is used wherever deviation from the specific recommendation is permissible in complying with the TTMA publication.

1.6 Conformity with TTMA publications by manufacturers, users and repairers of truck trailers is voluntary and any non-conformity with such publications is not indicative of the non-conforming practice being deficient.

1.7 Any inclusion of Recommended Practices or Technical Bulletins within any contract, document or standard is voluntary, and any such inclusion shall not imply any endorsement or approval by the TTMA due to the multitude of ways in which the Recommended Practices or Technical Bulletins may conceivably be used.

2.0 Purpose:

2.1 The purpose of this test procedure is to qualify by means of a pressure test the structural integrity of in-service manhole and fill opening covers which are not marked as conforming to TTMA RP No. 61 nor so certified by the manufacturer.

2.2 Users may determine if existing marked or unmarked covers meet RP No. 61 by contacting the manufacturer and obtaining written certification.

3.0 Scope:

3.1 This test procedure is applicable to manhole covers designed for MC 306, MC 300, MC 301, MC 302, MC 303, MC 305, and MC 312 cargo tanks.

3.2 Manhole covers not within the scope of this test can be tested per the same general procedure, but with appropriate hardware.

4.0 Qualifying Test:

4.1 In-service manhole and/or fill opening covers not marked as conforming with TTMA RP No. 61, nor so certified by the manufacturer, shall be tested using the equipment described in 5.0 and the procedure described in 6.0 of this Technical Bulletin.

4.2 Manhole and/or fill opening covers successfully meeting this test per 7.0 and prior to reinstallation on the cargo tank may be permanently marked by stamping or other means as conforming to TTMA Technical Bulletin No. 107-xx, where the last two digits indicate the year in which the latest version of the Technical Bulletin was issued. A letter following the year indicates a revision in the same year. The name of the tester and date of the test should be recorded and retained.

4.3 Any device, such as a pressure relief valve, which becomes a part of the manhole cover assembly shall be evaluated separately for compliance with the DOT requirements.

5.0 Test Equipment: (See Figure 1)

5.1 The test fixture for the 15 psig test per 4.1 consists of 16 inch diameter, 20 inch diameter, or 12 inch x 16 inch elliptical collars with a suitable material welded to the bottom. The test fixture collar shall be the same size, thickness, and material as that collar on the tank to which the manhole cover assembly is to be installed if it complies with DOT requirements.

5.2 Gauges: One (1) 0-30 psi for leakage test.

5.3 Pipe Fittings:
One (1) ½ inch NPT globe valve
One (1) ½ ball valve
One (1) ½ inch cross
Five (5) ½ inch pipe nipples

5.4 Rubber membranes of 1/8 inch thickness to fit outside diameter of manhole collar.

5.5 Steel plate with guides to block fill opening only if fill opening cover acts as a pressure relief valve. Please note that some old manhole covers have fill covers which do not provide pressure relief and those fill covers should not be blocked closed.

5.6 Vent plugs, flanges, or other devices to block holes in manhole cover.

5.7 Manhole gaskets - One (1) for each size manhole assembly to be tested.

5.8 Gaskets for the 10 inch diameter pressure relief valves.

6.0 Manhole Cover Test Procedures:

CAUTION: <u>USE WATER FOR TEST - DO NOT USE AIR</u>

6.1 Remove manhole cover assembly and clamping ring assembly to be tested from the cargo tank.

6.2 Remove any normal pressure/vacuum vents, sensors, high capacity vents or any other appurtenance that protrudes below the manhole cover.

6.3 Block the openings in the manhole cover with the devices listed in 5.6.

6.4 Fill test fixture base with water to top of collar.

6.5 Lay rubber membrane on test base.

6.6 Open 10 inch diameter pressure relief valve. Install steel plate with guides to underside of 10 inch diameter opening. Use vise grips to hold this plate in position while placing manhole cover assembly on rubber membrane.

6.7 Install a 0-30 psig gauge in test base.

6.8 Attach manhole cover assembly with its clamping ring assembly to the test fixture. While tightening clamping ring bolt, tap the ring at various points to insure equal clamping.

6.9 Slowly pressurize test fixture to 15 psig for a period of at least 5 minutes.

CAUTION: WATCH PRESSURE. DO NOT OVER-PRESSURIZE
Most water systems provide a pressure over 50 psig.

7.0 Inspection:

7.1 Any leakage will be considered a failure of this cover and others of its type and condition.

7.2 If the cover does not pass this test in its original condition, but the manhole cover assembly manufacturer has components available which will enable the cover to pass the test, covers using such components are considered satisfactory.

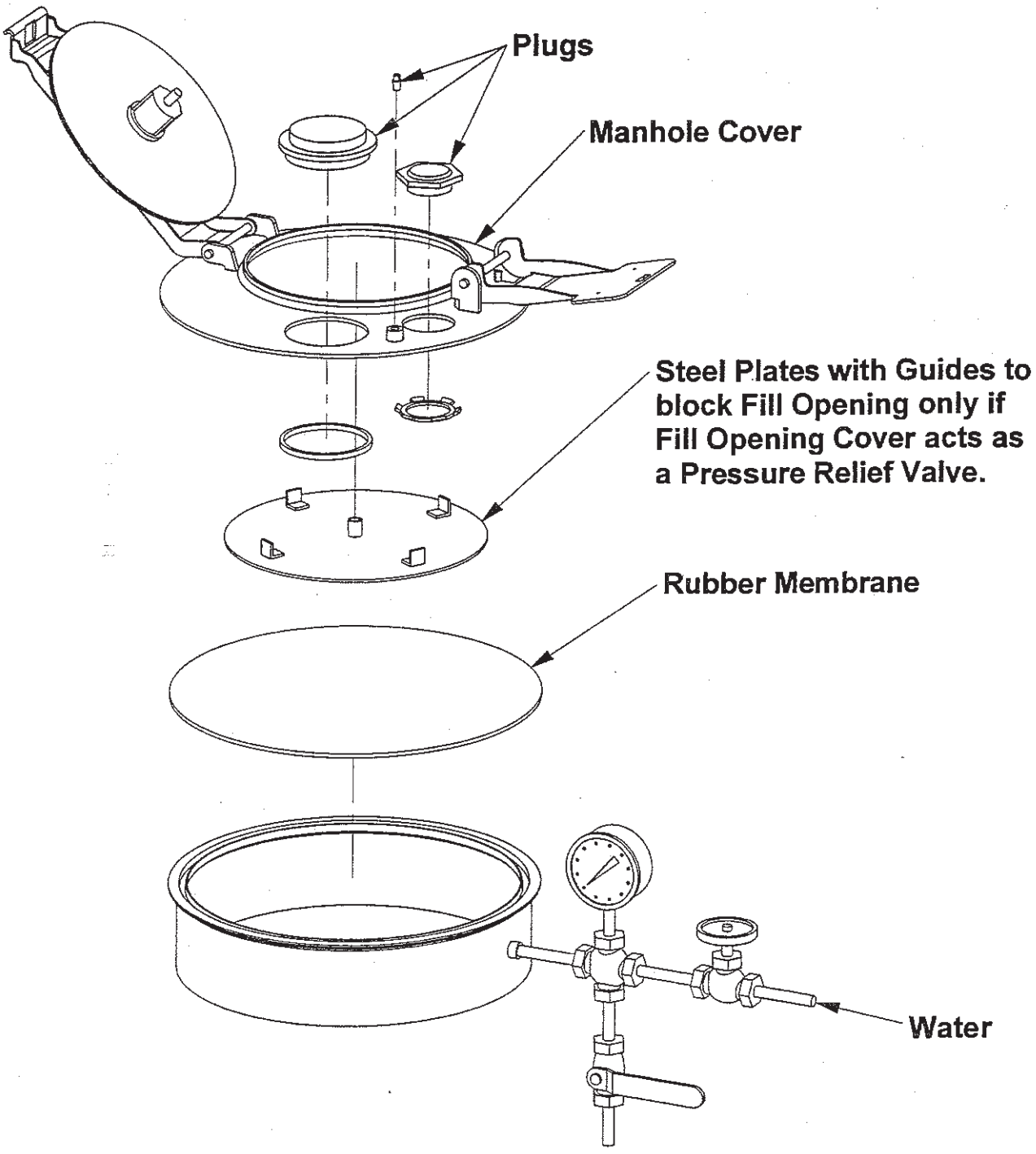
7.3 Before reinstalling the manhole cover to the cargo tank, the collar and gasket shall be inspected. If damage, distortion, corroded areas or other conditions exist that could impair its product retention capability, the collar and/or gasket shall be replaced. See TTMA Technical Bulletin No. 92 - "Maintenance of MC 306 Manhole and/or Fill Assemblies" for guidelines for the inspection and maintenance of MC 306 cargo tank manhole and/or fill assemblies.

TTMA/DWV/mm

Enclosure

FIGURE 1

MC 306 cargo tank manhole assembly test setup is shown as an example



Membrane Seal, Pressure Relief Valve Blocking Plate and Plugs for 15 PSIG Test.

TTMA Recommended Practice

RP No. 61-98
June 1, 1998

Truck Trailer Manufacturers Association
1020 Princess Street
Alexandria, Virginia 22314
(703) 549-3010
Fax: (703) 549-3014

Subject: **Performance of Manhole and/or Fill Opening Assemblies on MC 306, DOT 406, Non-ASME MC 312, and Non-ASME DOT 412 Cargo Tanks**
(Originally issued June 1982 - Revised April 1987, May 1988, and December 1989, Reissued December 1994, and Revised June 1998)

1.0 Preface:

1.1 Recommended Practices and Technical Bulletins are furnished by the TTMA as a guide to general practices in the manufacture, use, and repair of truck trailers. However, the scope of the TTMA's Recommended Practices and Technical Bulletins is not exhaustive of all general practices in the manufacture, use, and repair of truck trailers and there may exist such general practices which do not appear in either the Recommended Practices or Technical Bulletins.

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1.4 The Recommended Practices and Technical Bulletins may contain terms or words with specialized meanings. Definitions for such terms or words may be found in TTMA RP No. 36 - Tank Trailer and Tank Container Nomenclature or TTMA RP No. 66 - Trailer Nomenclature.

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1.7 Any inclusion of Recommended Practices or Technical Bulletins within any contract, document or standard is voluntary, and any such inclusion shall not imply any endorsement or approval by the TTMA due to the multitude of ways in which the Recommended Practices or Technical Bulletins may conceivably be used.

2.0 Purpose and Scope:

2.1 This Recommended Practice is intended to serve as a guide for the design, construction, and testing of manhole and fill opening covers installed on DOT specification MC 306, DOT 406, non-ASME MC 312 and non-ASME DOT 412 cargo tanks.

3.0 Definitions:

3.1 **Manhole Assembly:**

An opening usually equipped with a removable cover and large enough to admit a man into the cargo tank; may incorporate vents, fill openings, and other devices.

3.2 **Fill opening:**

An opening in top of a tank used for filling the tank. It may also be used for inspection.

4.0 Design Requirements:

4.1 The DOT requirements for closures and manholes are prescribed in 49 CFR 178.341-3 for MC 306 cargo tanks and 49 CFR 178.345-5 and 178.346-5, for DOT 406 cargo tanks.

4.2 The DOT requirements for closures and manholes are prescribed in 49 CFR 178.343-3 for MC 312 cargo tanks and in 49 CFR 178.345-5 and 178.348-5 for DOT 412 cargo tanks.

4.3 Each manhole on a MC 306 cargo tank with a compartment in excess of 2500 gallons shall be accessible through a manhole of at least 11 inches by 15 inches per 49 CFR 178.340-3. Each manhole on an MC 312 cargo tank shall be accessible through a manhole conforming to UG-46(G)(1) of the ASME Code per 49 CFR 178.343-3. UG-46(G)(1) of the ASME Code states that an elliptical or obround manhole shall be not less than 11 inches by 15 inches or 10 inches by 16 inches and a circular manhole shall be not less than 15 inches inside diameter. Each manhole on a DOT 406 and DOT 412 cargo tank with a capacity greater than 400 gallons must be accessible through a manhole at least 15 inches in diameter per 49 CFR 178.345-5(a).

4.4 The manhole opening shall be fitted with a closure capable of passing the pressure test described in 6.0.

5.0 Application:

5.1 This Recommended Practice may be used for any or all of the following purposes:

5.1.1 It may be used as a test to establish whether the design of the manhole and/or fill opening assembly complies with the pressure structural capability requirements of 49 CFR 178.345-5.

5.1.2 It may be used as a part of a quality control procedure for an established design.

5.1.3 It may be used for the experimental evaluation of designs under development.

6.0 Test Procedure

6.1 A manhole and/or fill opening assembly shall have a design qualification test pressure of 36 psig minimum with venting devices blocked. Any leakage or permanent deformation that would affect the product retention capability of the manhole and/or fill assembly shall constitute a failure.

NOTE: ***This test procedure exceeds that prescribed by MC 306 specifications.***

6.2 For quality control purposes, at least one manhole and/or fill opening cover shall be tested using the procedure outlined in 6.1 per 100 produced, but not less than one manhole and/or fill opening cover shall be tested per quarter of the year during production.

If the manhole and/or fill opening cover tested fails, then five more covers shall be tested. If one of these five covers fails, then all covers in the lot from which the tested covers were selected are to be 100% tested or rejected for service.

7.0 Marking:

7.1 Manhole and/or fill opening cover shall be permanently marked by stamping or other means with the manufacturer's name and as conforming with RP No. 61-xx where the last two digits indicates the year in which the Recommended Practice revision was issued. Any marking required by the United States Department of Transportation shall also be provided per the MC 306, DOT 406, MC 312, and DOT 412 Specifications.

TTMA/DWV/mm

TTMA Recommended Practice

RP No. 81-02
April 19, 2002

Truck Trailer Manufacturers Association
1020 Princess Street
Alexandria, Virginia 22314
(703) 549-3010
Fax: (703) 549-3014

Subject: **Performance of Spring Loaded Pressure Relief Valves on MC 306, MC 307, MC 312, DOT 406, DOT 407, and DOT 412 Tanks**
(Original Issue - June 29, 1990, Revised July 1997 and Reissued April 2002)

1.0 Preface:

1.1 Recommended Practices and Technical Bulletins are furnished by the TTMA as a guide to general practices in the manufacture, use, and repair of truck trailers. However, the scope of the TTMA's Recommended Practices and Technical Bulletins is not exhaustive of all general practices in the manufacture, use, and repair of truck trailers and there may exist such general practices which do not appear in either the Recommended Practices or Technical Bulletins.

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2.0 Purpose:

2.1 This Recommended Practice is intended as a guide for determining the reseating capability of MC 306, MC 307, MC 312, DOT 406, DOT 407, and DOT 412 cargo tank pressure relief valves in a rollover condition.

3.0 Design Requirements:

3.1 Spring loaded pressure relief valves shall be capable of meeting the performance tests described in 5.0 of this Recommended Practice.

4.0 Test Equipment:

4.1 Drop test rig and sand box (See Appendix A).

4.2 Adapter for installation of pressure relief valves.

4.3 Lifting and release equipment.

4.4 A plastic bag or other suitable receptacle to collect water ejected during the test.

5.0 Test Procedure:

5.1 Stir sand to an even consistency before each drop.

5.2 Install the pressure relief valve to be tested to the drop test rig.

5.3 Place sufficient water in the vessel to provide a liquid head of 36 inches on the pressure relief valve under test. (Measure head from the pressure relief valve centerline).

5.4 Attach plastic bag to the pressure relief valve in such a manner as to collect all water ejected during the test.

5.5 Raise test rig and drop through a distance of 24 inches.

5.6 Remove the plastic bag and measure the water ejected during the test. The amount of water ejected may not exceed the limit specified by the applicable paragraph of 49 CFR 178.345-10(b)(3).

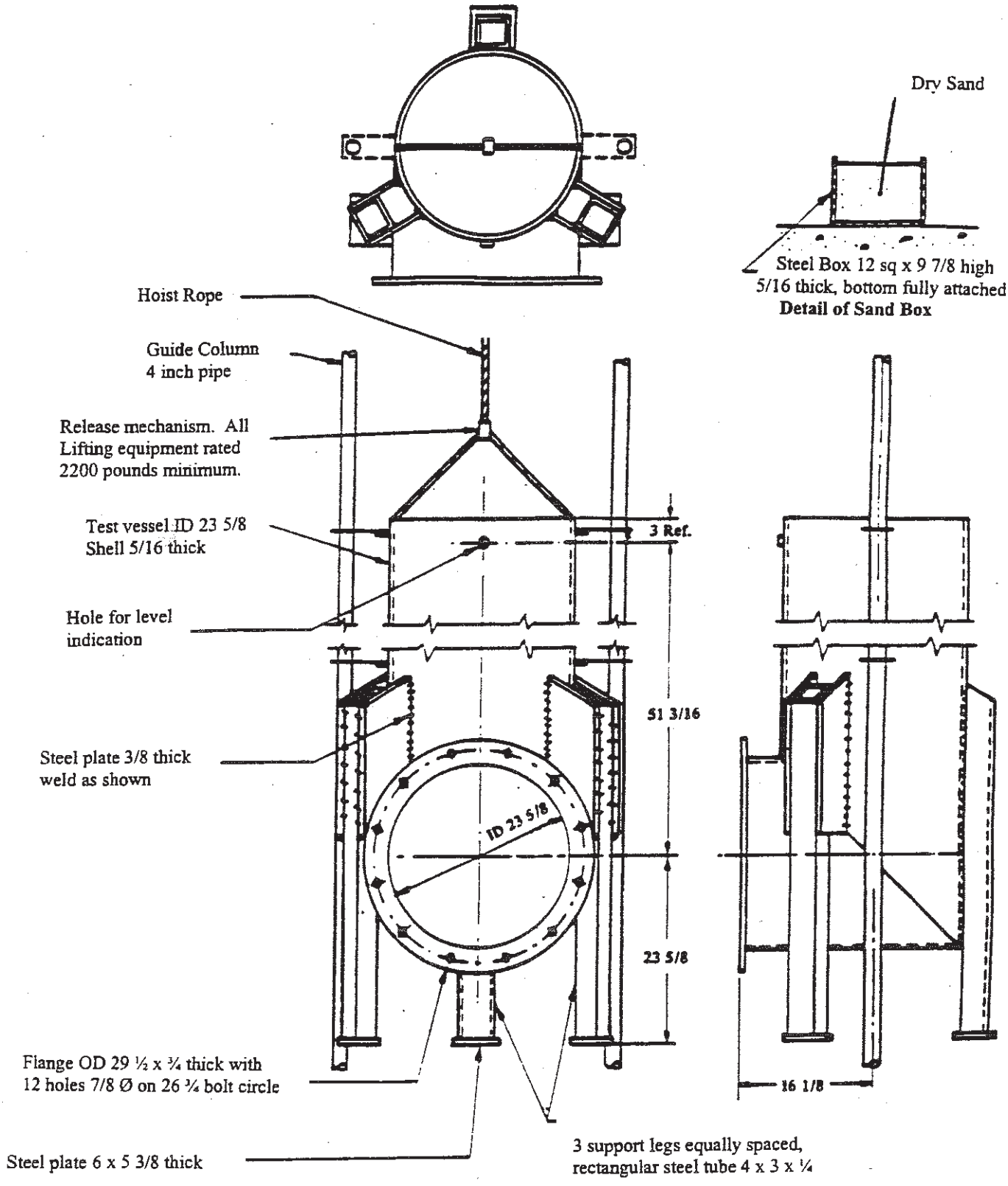
5.7 Within one minute of dropping, wipe off any water discharged and observe for any leakage. Any leakage greater than 5 cc per minute shall be considered a failure.

5.8 The pressure relief valve in the test rig shall be dropped three times and still meet the requirements of sections 5.6 and 5.7. Water ejected is not cumulative.

6.0 Marking:

6.1 The spring loaded pressure relief valve should be permanently marked with the name of the manufacturer and by stamping or other means as conforming with RP No. 81-97 where the last two digits indicate the year in which the latest version of the Recommended Practice was issued. A letter following the year indicates a revision in the same year.

The Drop Test Rig is reproduced, with changes, from Australian Standard 2809.2-1985, "Road Tank Vehicles for Dangerous Goods, Part 2 – Tankers for Flammable Liquids", courtesy of the Standards Associations of Australia. A copy of the Standard may be obtained from the American National Standards Institute, 11 West 42nd Street, New York, New York 10036 (212) 642-4900. The changes consist of deletion of the rubber pad on top of the sand box onto which the test rig is dropped and the type of sand, the level indicator hole, and rounding dimensions to fractions of an inch.



Dimensions are in inches

Betts

TEL. 814/723-1250
FAX 814/723-7030

BETTS INDUSTRIES,INC. 1800 PENNA. AVE.W. ■ BOX 888 ■ WARREN, PA. 16365-0888
Since 1901

MAINTENANCE MANUAL

FOR

PAF 406-96 & 406-98

SURGE

RELIEF VALVE

10/17/97

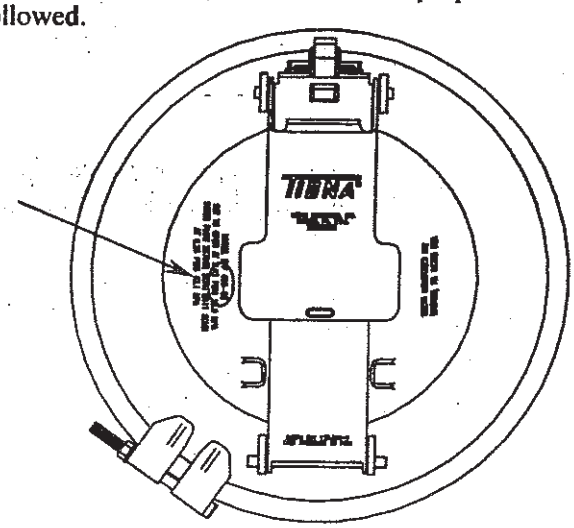
Betts Industries, Inc.
Warren, PA. 16365
(814) 723-1250

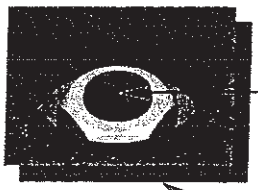
SECTION 1:
IDENTIFICATION OF ADJUSTABLE PAF SURGE RELIEF VALVE (PAF 406-96 & 98)

Betts PAF Surge Relief Valves (PAF 406-96 and PAF 406-98) meet or exceed all U.S. DOT requirements for primary pressure relief valves on DOT406 cargo tanks as contained in 49CFR178.345-10 and 49CFR178.346-3 of the Code of Federal Regulations. The Betts PAF Surge Relief Valve is able to withstand a brief pressure surge and contain lading (liquid cargo) leakage to less than one liter (per TTMA RP NO 81).

Betts PAF Surge Relief Valve (PAF 406-96 & 406-98) protects the cargo tank from rupture due to over-pressurization caused by overfilling or fire and is, therefore, crucial to the safe operation of the tank. In order to maintain your Betts PAF Surge Relief Valve in proper working condition, the following procedures must be followed.

All PAF 406-96's are cast with "MODEL PAF 406-96" And PAF 406-98's are cast with "MODEL PAF 406-98"

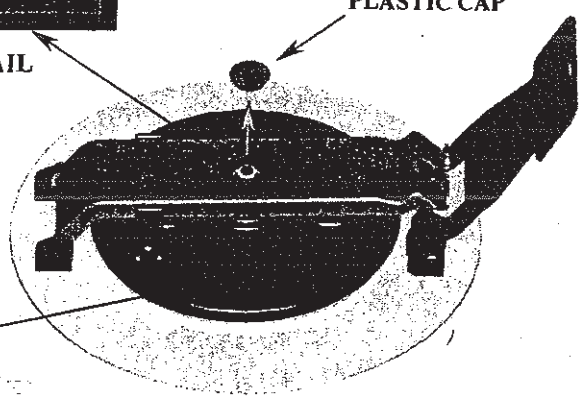




HEX

DETAIL

PLASTIC CAP



BLACK E-COATED COVER

The adjustable PAF 406-96 & 98 have an internal hex at the top of the stem under the plastic yellow cap, as well as, a Black E-coated cover.

SECTION 2:
MAINTENANCE AND TESTING
FOR PAF SURGE RELIEF VALVE 406-96 & 98

A. **U.S. DOT Requirements:** This portion of the manual refers to the DOT regulations and is intended to serve as an interface to relate the manual to the code. *This manual does not take the place of the Code of Federal Regulations.* A current copy of the Code of Federal Regulations should be reviewed and followed to insure the requirements are met for each individual case.

There are three basic tests/inspections mandated by 49CFR Part 180 for MC306 and DOT406 cargo tanks.

Test/Inspection	Interval Period	Code Paragraph
External Visual Inspection	1 year	49CFR180.407(d)
Leakage Test	1 year	49CFR180.407(h)
Pressure Retest	5 year	49CFR180.407(g)

1. **External Visual Inspection:** As part of the annual external visual inspection, 49CFR180.407(d)(3) requires that all pressure relief valves, be visually inspected for any corrosion or damage which might prevent the valve from functioning. If the cargo tank is used to haul product that is corrosive to the relief valve, the valve must be removed from the cargo tank for inspection and bench testing.

Note: Betts recommends that the external visual inspection of vents be performed monthly.

1.1. Visually inspect all external surfaces of the manhole and PAF, which includes opening the *Latch (1)* and *Strongback (5)*.
NOTE: If any corrosion or damage to the PAF or manhole is observed, it must be repaired and successfully bench tested prior to returning to service. Refer to 3.5 for PAF bench test procedure.
1.1.1. Clean and inspect the bottom side of the PAF for signs of damage, corrosion, or product gumming that could effect the operation of the Relief Valve.
1.1.2. Closely inspect the *Cylinder (10)* for any damage or dents. Also, insure *Cylinder (10)* is threaded tightly to the *Cover (9)*. See figure 1.
1.1.3. Inspect and clean the *Normal Vent (8)*.
1.1.4. Inspect the *10" Seat (25)* for damage or corrosion.
1.1.5. Inspect the *10" Fill Gasket (24)* for signs of wear or degradation.
1.1.6. Inspect the *Clamp Ring Gasket (26)* for evidence of product seepage. Replace any gaskets where seepage is detected.

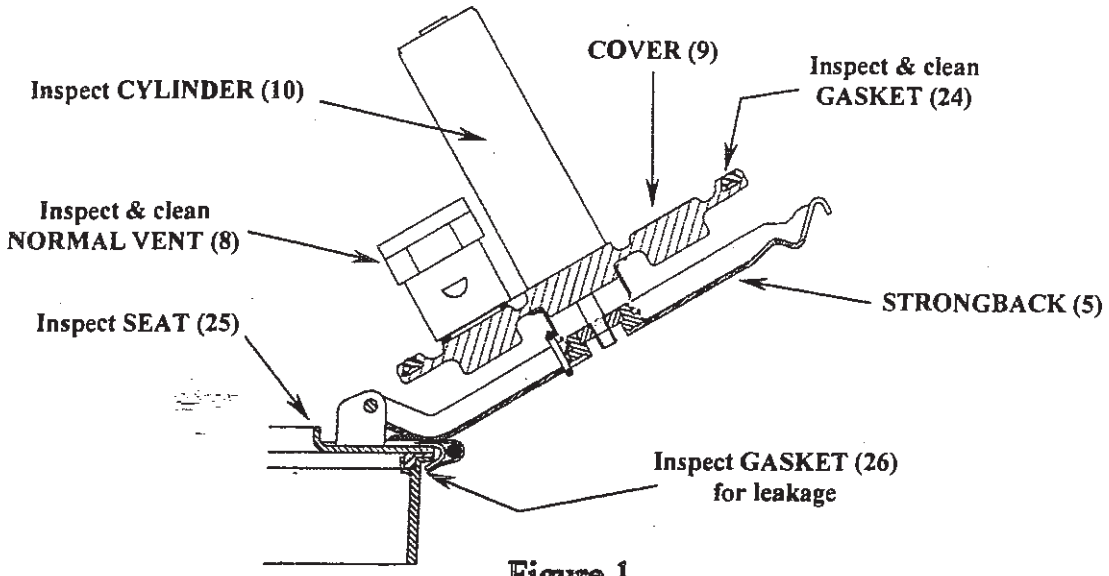


Figure 1

2. Leakage Test: 49CFR180.407(h) requires tanks to be tested annually at 80 % of the tank design pressure or MAWP, whichever is marked on the tank certification or specification plate. All tank components must remain in place during this test, except any re-closing pressure relief valve with a set pressure less than the leakage test pressure must be removed or rendered inoperative during the test. Betts Normal Vents, therefore, must be removed during the leakage test.

   2.1. Remove Normal Vent from manhole cover and plug opening with Betts Plug No. 3013.
   2.2. Apply test pressure in accordance with 49CFR180.407(h)
   2.3. Inspect all gasket joints on PAF and manhole for leaks. If PAF leaks, adjust in accordance with Set Pressure Adjustment instructions (Section 3 of this manual) and retest the unit. Replace damaged or worn gaskets as required.

3. Pressure Retest: As part of the pressure retest, 49CFR180.407(g)(ii)(A) requires that all re-closing pressure relief valves be removed from the tank for inspection and bench tested to verify that the relief valve is functioning properly. The pressure retest and the relief valve bench test must be performed at least every five years.

Note: Betts recommends that the PAF 406-96 and PAF 406-98 be bench tested annually.

3.1. **Pressure Retest Procedures:**
   3.1.1. 49CFR180.407(g)(1)(vii) requires that all closures, except for pressure relief valves, with a set pressure less than the tank test pressure must be in place during the test.
   3.1.2. Manholes must remain in place during pressure test.
   3.1.3. Open 10" PAF Relief Valve.
   3.1.4. Install Betts Retest Fixture (part no. 6556LCB) to seal the 10" opening. See figure 2.

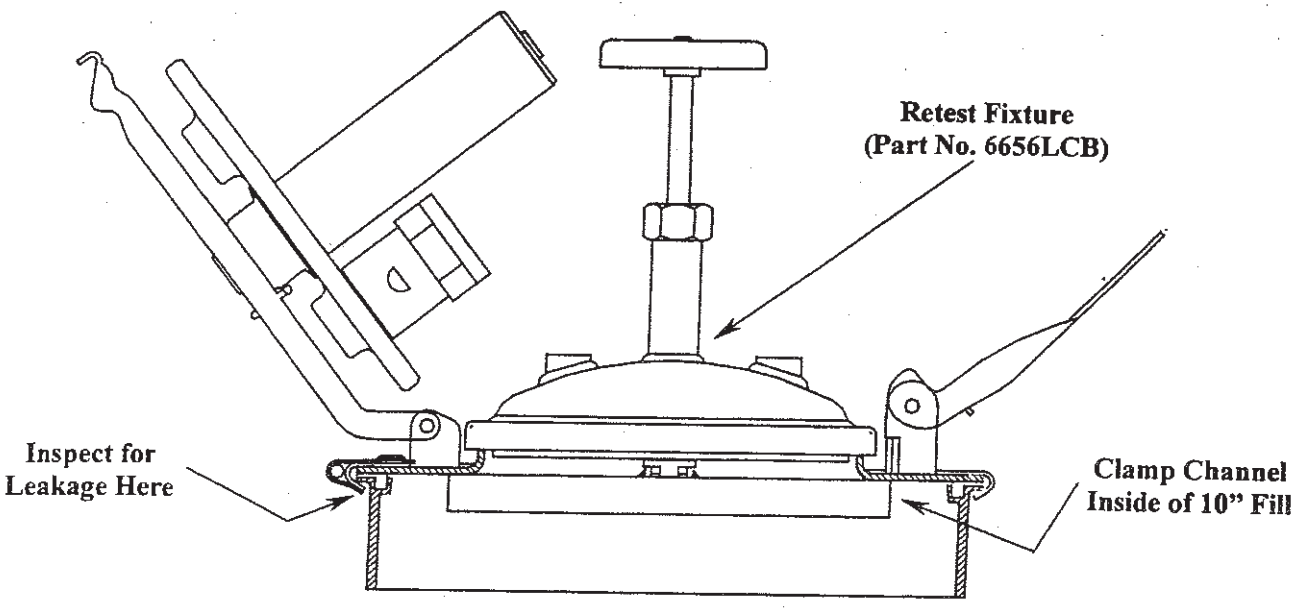


Figure 2

3.2. Betts Push and Air Operated Vapor Recovery Valves remain in place during the test.
NOTE: If vapor recovery valves from other manufactures are installed, refer to the manufacturers' instructions to see if they should be removed.

3.3. After preparing the rest of the tank, perform the pressure test in accordance with the regulations. Inspect all parts of manhole assembly for leakage. Repair or replace parts as required.

3.4. Remove all clamps or plugs from relief valve immediately after test is completed.

3.5. **Bench Test Procedure for PAF Surge 406-96 & 98**

3.5.1. Remove manhole assembly from tank by removing the clamp ring bolt and clamp ring.

3.5.2. Remove *Normal Vent (8)* and plug port with Betts Plug (No. 3013)

3.5.3. Attach manhole assembly to appropriate Betts PAF 406-96 Test Fixture (No. 6685SL.)

3.5.4. Apply a soap solution around the perimeter of the DoveTail 10" Gasket.

3.5.5. Gradually apply pressure to the tank and observe the pressure at which bubbles first appear.

3.5.6. Release the pressure from the test fixture and verify the PAF reseals.

3.5.7. Per 49CFR178.346-3(c) the set pressure must not be less than 3.63 psig and not more than 4.55 psig.

3.5.8. Replace or adjust any relief valve that fails the set pressure test requirements. Refer to instructions for Set Pressure Adjustment (Section 3 of this manual) to adjust the set pressure, and retest the unit.

4. **Normal Vent Test Procedure:** A Normal Vent Test Tank (Part No. 6687AL) must be used to test the Normal Vents. **Note:** A regulator must be used to slowly apply pressure to the tank.

4.1. Pressure Test:

4.1.1. 49CFR 178.346-3(b)(2) states that the normal vent for DOT 406 tanks must be set to open at not less than 1 psig.

4.1.2. Screw the Normal Vent into the lid of the test tank as shown in figure 3 A.

4.1.3. Slowly apply pressure to the tank and inspect the top vent opening for pressure release.

4.1.4. The set pressure on a model 6496AL Normal Vent is 1.0 to 1.5 psig.

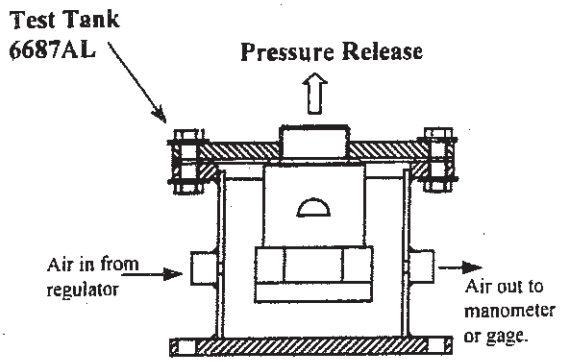
4.2. Vacuum Test: 178.346-3(c)(2) states that the normal vent for DOT 406 tanks must be set to open at no more than 6 ounces vacuum.

4.2.1. Screw the Normal Vent into the lid of the test tank as shown in figure 3 B.

4.2.2. Slowly apply pressure to the tank and inspect the top opening for pressure release. An application of a soapy solution is recommended to detect the point at which the vent opens.

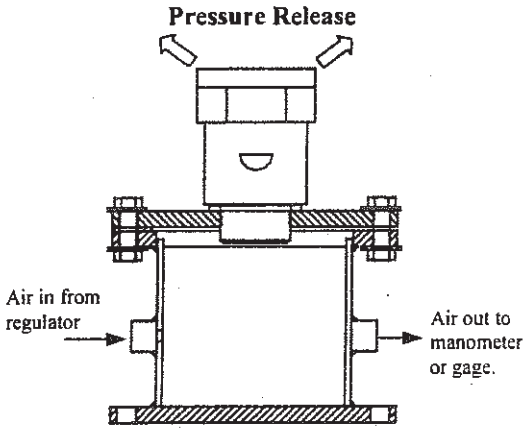
4.2.3. The vacuum set pressure on a model 6496AL Normal Vent is 0.25 to 0.375 psig.

4.3. Repair or replace any Normal Vent that does not meet the specifications.



PRESSURE TEST

Figure 3 A



VACUUM TEST

Figure 3 B

Betts Industries, Inc.
Warren, PA. 16365
(814) 723-1250

SECTION 3:
SET PRESSURE ADJUSTMENT OF PAF SURGE RELIEF VALVE

NOTE: THESE INSTRUCTIONS APPLY ONLY TO ADJUSTABLE MODEL PAF 406-96 AND PAF 406-98 W/ BLACK E-COATED COVER AND STEM WITH INTERNAL HEX AT THE TOP.

1. Relieve vapor pressure or vacuum from cargo tank.

WARNING **Failure to relieve tank pressure may result in sudden, unexpected loss of pressure. Severe personal injury or death may result.**

2. Open *Latch (1)* to expose yellow *Plastic Plug (2)* as shown in figure 4.
3. Remove yellow *Plastic Plug (2)*.
4. Place an 11/16 box end wrench over *Hex Nut (3)*.
5. Place a 7/32 allen wrench into the hex socket of the *Stem (4)*.
6. Hold the allen wrench stationary and rotate the box end wrench counterclockwise to loosen the *Hex Nut (3)* two full turns.
7. At this point, the PAF can be adjusted by rotating the *Stem (4)* with the allen wrench.
8. To increase the set pressure, turn the *Stem (4)* clockwise.

   Note: The *Stem (4)* must fully engage threads of *Hex Nut (3)*. Insure that the top of stem is flush with or slightly protruding from top of *Hex Nut (3)* when nut is tightened.

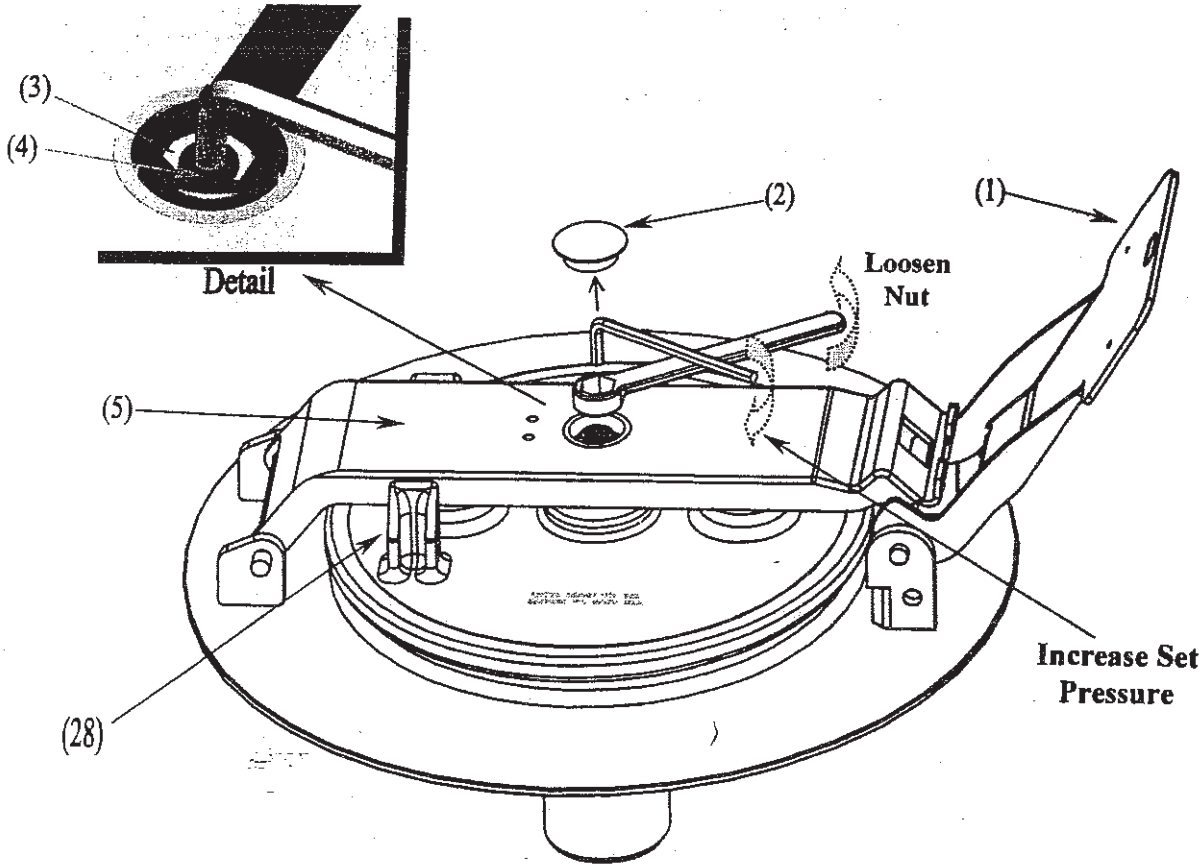


Figure 4

9. To decrease the set pressure, turn the *Stem (4)* counter-clockwise.
   Note: The amount of adjustment in the counter-clockwise direction is limited by a shoulder stop on the *Stem (4)*.
10. The adjustment feature is sensitive, so that, one turn of the stem may increase the set pressure significantly. Adjust stem ¼ turn at a time, until the desired setting is achieved.

Never adjust the relief valve so that a person must stand on the *Strongback (5)* to operate the *Latch (1)*. This could cause a person to loose their balance and fall, if there is any residual pressure in the tank when the relief valve is opened.

11. After adjusting the PAF surge relief valve, use the box wrench to tighten the *Hex Nut (3)*, while using the allen wrench to hold the stem stationary.
12. Replace the *Plastic Plug (2)*.
13. After adjustment, test the set pressure to verify that it falls within the required range. Per 49CFR178.346-3(c) the set pressure must not be less than 3.63 psig and not more than 4.55 psig. Please refer to section 2 of the manual "Maintenance and Testing for PAF Surge Relief Valve 406-96 & 98" for further information.

SECTION 4:
REMOVAL OF PAF SURGE RELIEF VALVE FROM CLOSURE ASSEMBLY

NOTE: THESE INSTRUCTIONS APPLY ONLY TO ADJUSTABLE MODEL PAF 406-96 & 98 WITH BLACK E-COATED COVER AND STEM WITH INTERNAL HEX AT THE TOP.

1. Relieve vapor pressure or vacuum from cargo tank.

WARNING **Failure to relieve tank pressure may result in sudden, unexpected loss of pressure. Severe personal injury or death may result.**

2. Open latch to expose *Yellow Plug (2)* as shown in figure 5.
3. Remove yellow Plastic Plug (2).
4. Use an 11/16 socket or box end wrench to remove *Hex Nut (3).*
5. Remove *Star Washer (6).*
6. Open fill assembly as shown in figure 6.
7. Place a 7/32 allen wrench in the hex socket of the *Stem (4).*
8. By rotating the stem clockwise, the PAF assembly can be unscrewed from the closure assembly. NOTE: During removal, care should be taken not to damage the last threads on the stem, by supporting the PAF with a hand under the cylinder.
9. Remove the *Bellow (7).*
10. At this point, further disassembly should be conducted at a workbench. Follow the procedure "Disassembly of PAF Surge Relief Valve" if disassembly of the cylinder is required.

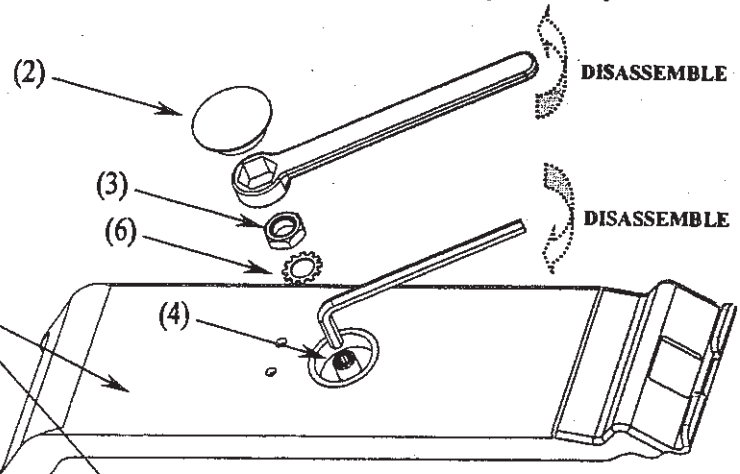


Figure 5

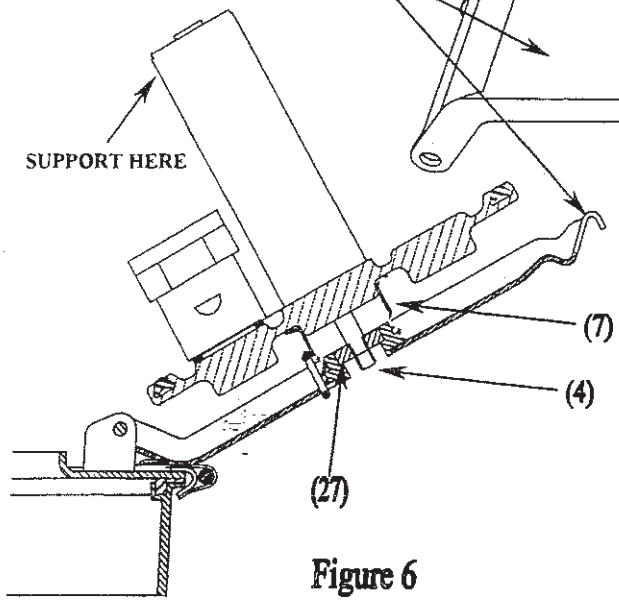


Figure 6

SECTION 5:
DISASSEMBLY OF PAF SURGE RELIEF VALVE

NOTES:

- **THESE INSTRUCTIONS APPLY ONLY TO ADJUSTABLE MODEL PAF 406-96 & PAF 406-98 WITH BLACK E-COATED COVER AND STEM WITH INTERNAL HEX AT THE TOP.**
- **UNDER NORMAL CIRCUMSTANCES, THE DISASSEMBLY OF THE SPRING CYLINDER IS NOT REQUIRED NOR RECOMMENDED, UNLESS ALL OTHER ATTEMPTS TO REPAIR THE RELIEF VALVE HAVE FAILED. IT IS RECOMMENDED THAT THE VALVE BE RETURNED TO BETTS INDUSTRIES FOR REPAIR.**
- **A PAF SURGE DISASSEMBLY TOOL (PART # 6684MS) IS REQUIRED TO DISASSEMBLE THE SPRING CYLINDER.**

1. Remove the PAF surge relief valve assembly from the closure assembly by following the steps outlined in the procedure "Removal of PAF Surge Relief Valve from Closure Assembly".
2. Remove *Normal Vent (8)* by griping with slip joint pliers and unscrewing from *Cover (9)*. See figure 7.

CAUTION **The cylinder contains a compressed spring, which could cause injury, if the cylinder is removed improperly. Review the following section carefully before attempting to remove cylinder.**

3. The *Cylinder (10)* contains *Hydraulic Oil (11)* that must be drained.
4. Use a 3/8 allen wrench to remove the *½ in. NPT Plug (12)* while holding the *Cylinder (10)* stationary by gripping with slip joint pliers within one inch from the bottom. *It is very important that the cylinder does not unscrew from the cover at this time.*
5. Remove the *1/8 in. NPT Plug (13).*
6. Drain the oil that is on the top and bottom of the *Piston (14).*

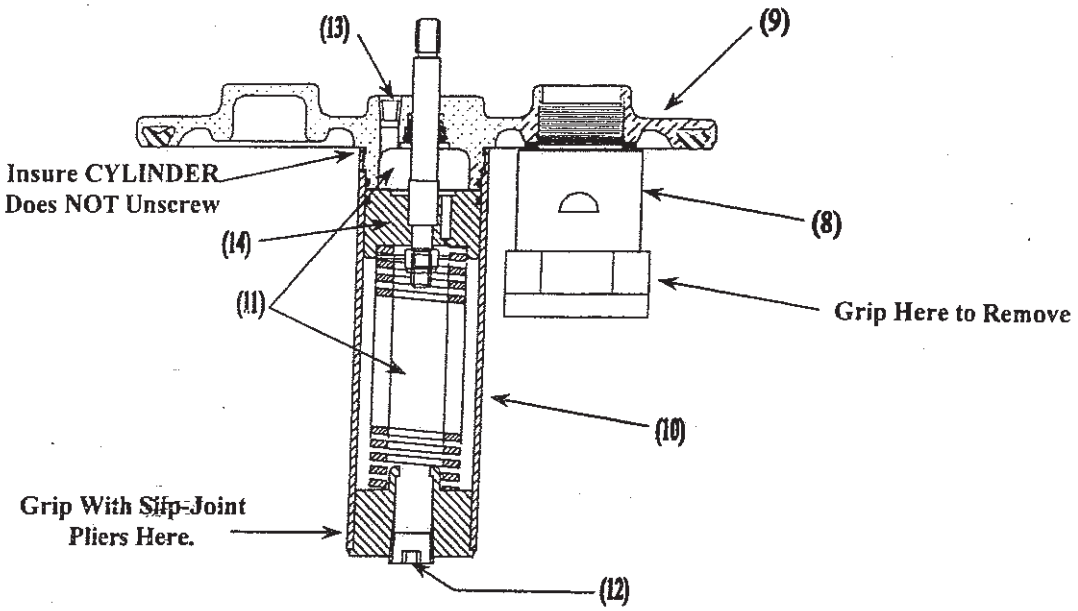


Figure 7

7. Insert the 3/8 female thread end of the *Disassembly Tool (15)* (part # 6684MS) into the ½ in. NPT opening as shown in figure 8.
8. Thread the *Disassembly Tool (15)* onto the 3/8 male thread of the *Stem (4)* that extends from the *Lock Nut (16)*. See figure 8. **The tool should engage at least four threads.**

   Note: Use a 7/32 allen wrench on the bottom of the tool and one at the top of the stem to tighten tool completely down.

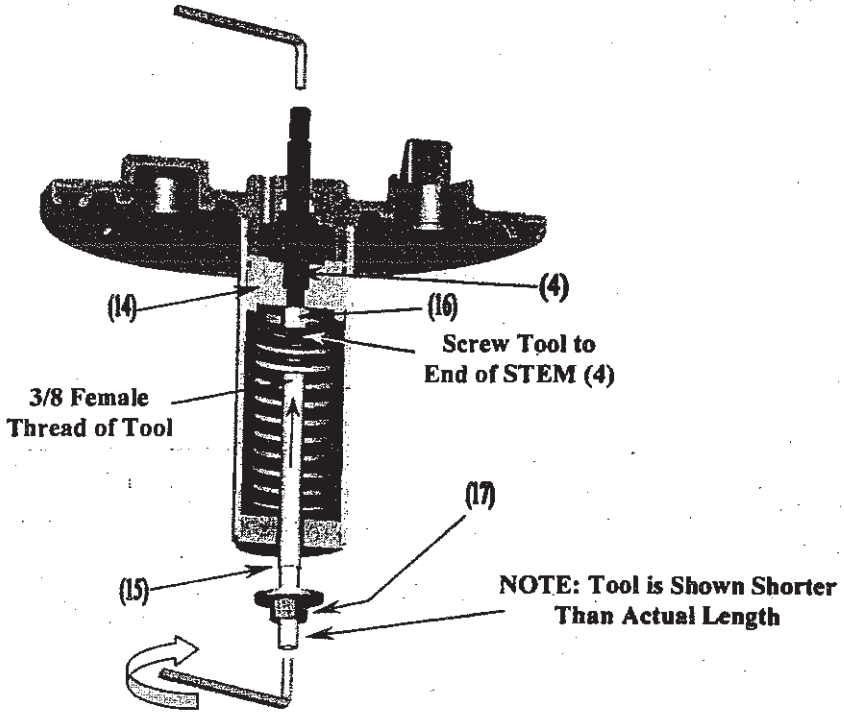


Figure 8

9. At this point, a 7/32 allen wrench must be used to hold the shaft of the tool stationary with respect to the cylinder, while an 11/16 wrench is used to turn the *Tool Nut (17)* clockwise. Once the nut has made contact with the cylinder, turn the nut two complete turns to compress the *Spring (18)*. See figure 9.

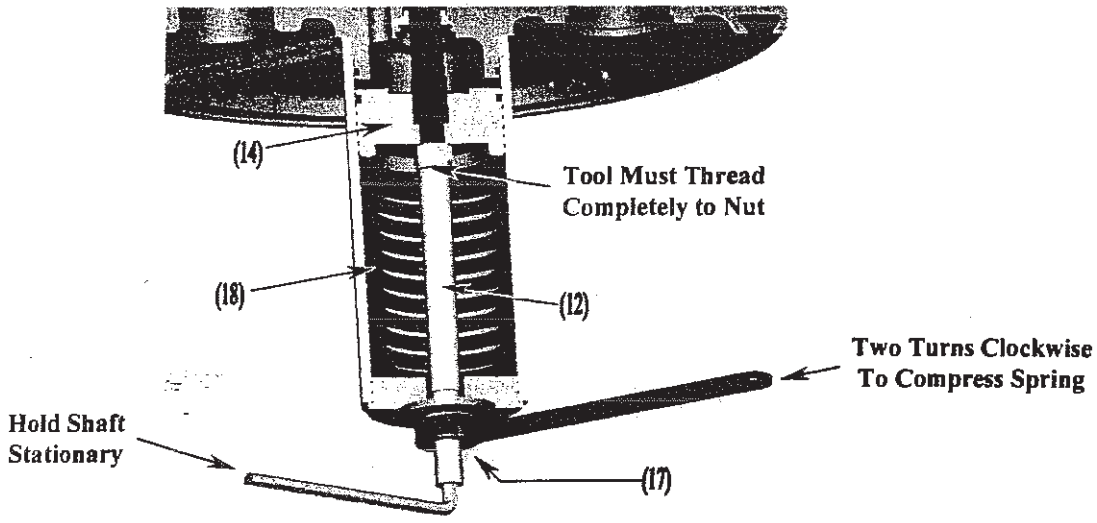


Figure 9

10. The *Cover (9)* can now be unscrewed from the *Cylinder (10).* Do **NOT** unscrew the stem from the tool. If slip joint pliers are required to grip the cylinder, only grip within one inch from the end. See figure 10.

CAUTION

After the cover is removed, the spring is still under load in the cylinder. Do NOT point the open end of the tube toward yourself or a bystander.

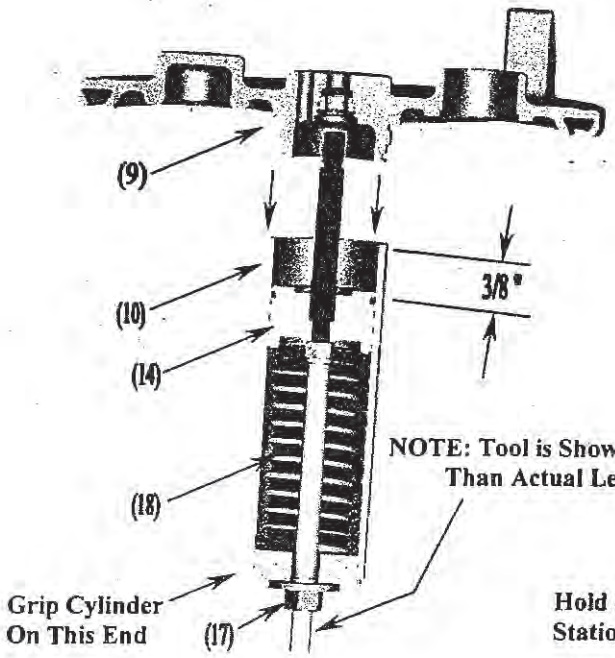


Figure 10

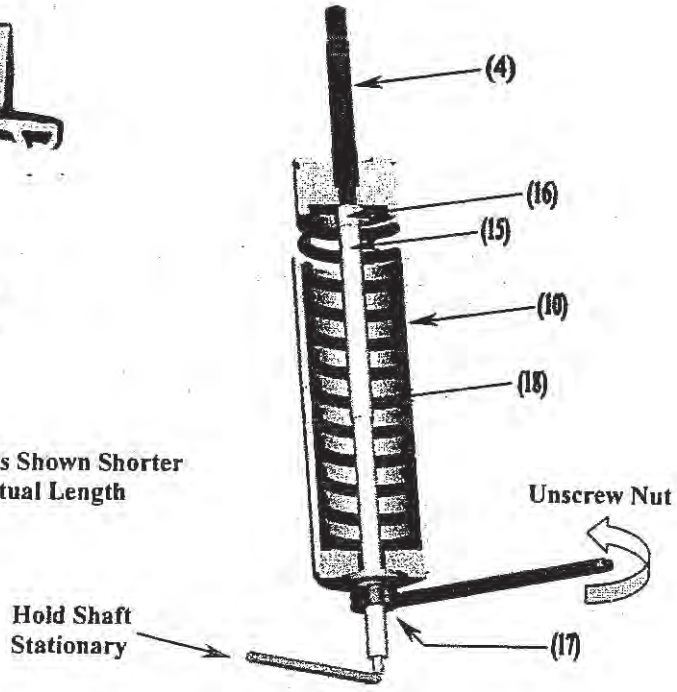


Figure 11

11. To release the spring, hold the allen wrench stationary with respect to the cylinder, and turn the *Tool Nut (17)* counter-clockwise. It is imperative that the shaft of the tool does not unscrew from the *Stem (4)* during disassembly process. Continue to back off the *Tool Nut (17)* until the piston is extended beyond the length of the spring. See figure 11.
12. At this point insure the spring tension is released, and the *Tool (15)* can be unscrewed from the *Stem (4).*

13. Disassemble the stem/piston assembly by inserting a 7/32 allen wrench into the top of the *Stem (4)* and unscrew the *LockNut (16)* using a 9/16 socket. See Figure 12. Note: The piston may appear different than shown depending on the model you may have.

14. If the *Piston O-ring (19)* requires removal, cut the o-ring with a razor blade, being careful not to damage the piston groove.

15. The *Stem O-ring (22)* and *O-ring Retainer (21)* are removed by using a snap ring tool to remove *Snap Ring (20).* See figure 13.

16. If the *Cylinder O-ring (23)* requires removal, cut the o-ring with a razor blade being careful not to damage the o-ring groove.

17. If the *10" Fill Gasket (24)* requires removal, cut a small slot in the center of the gasket and use a screwdriver to pry gasket out of dovetail groove, being careful not to damage groove. See figure 13.

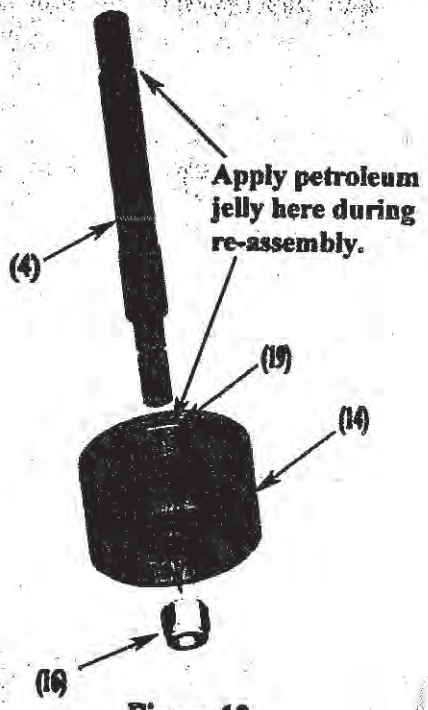


Figure 12

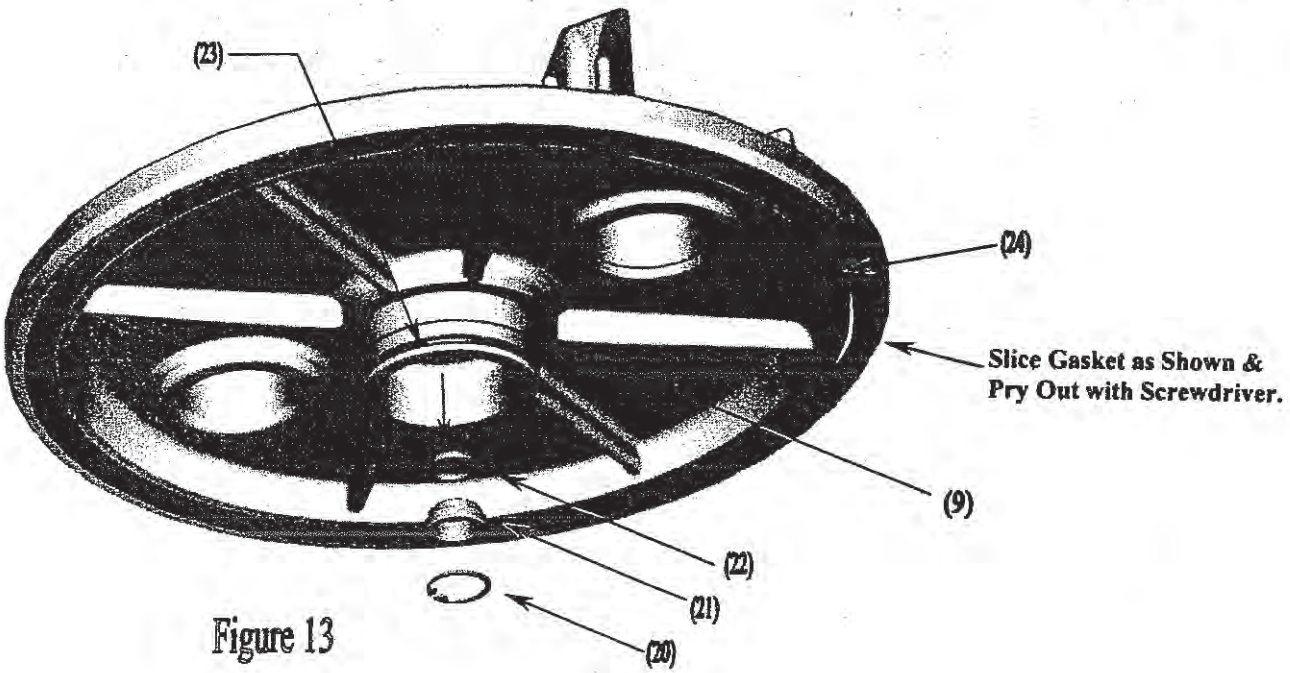


Figure 13

For maintenance or assembly instructions consult appropriate procedures.

SECTION 6:
ASSEMBLY OF PAF SURGE RELIEF VALVE

NOTE: THESE INSTRUCTIONS APPLY ONLY TO ADJUSTABLE MODEL PAF 406-96 & PAF 406-98 W/ BLACK E-COATED COVER AND STEM WITH INTERNAL HEX AT-THE TOP.

1. Preparation of O-Rings and Components:
   1.1. All parts should be cleaned and degreased to insure the removal of all product build up.
   1.2. All components should be inspected for damage or wear.
   1.3. To insure integrity of the seals, all o-rings and gaskets should be replaced using Betts' replacement parts.
   1.4. Inspect all o-ring grooves for damage (nicks, scratches, or burrs).

2. Cover sub-assembly: Refer to figure 14.
   2.1. Insert Stem *O-ring (22)* into *Cover (9)*.
   2.2. Insert *O-ring Retainer (21)* and use a snap ring tool to insert the *Snap Ring (20)* into groove.
   2.3. Place black Buna *Cylinder O-ring (23)* into o-ring groove on *Cover (9)*.
   2.4. Use Betts' *Dove Tail Gasket Tool (26)* (part # 6504AL) to place *10" Fill Gasket (24)* into *Cover (9)*. See figure 14.
      2.4.1. Lubricate the gasket and dovetail groove with a soap solution.
      2.4.2. Using fingers, pinch the back side of the gasket together and insert a small section of the gasket into the groove.
      2.4.3. Use short strokes with the *Dove Tail Gasket Tool (26)* to insert the gasket.
      2.4.4. The last portion of the gasket will need to be pushed in with fingers.

   Note: The gasket can also be installed by hand.

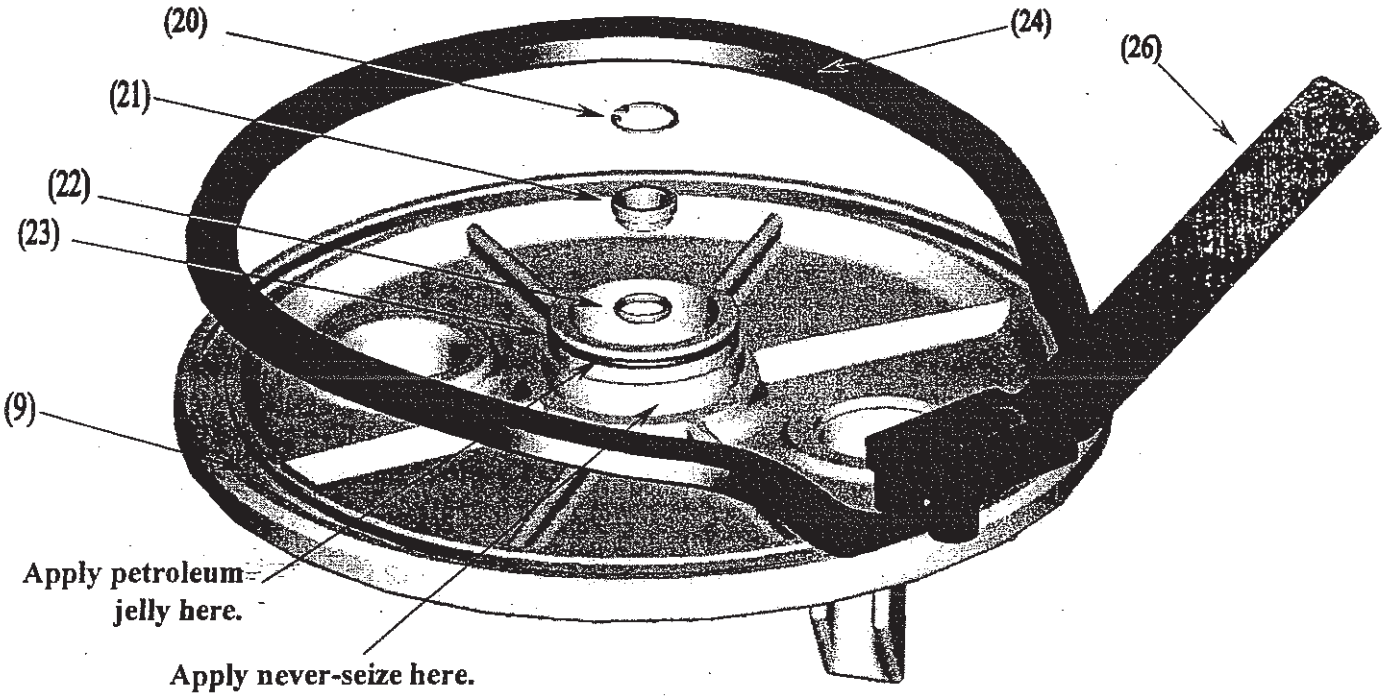


Figure 14

3. Piston/Stem sub-assembly: Refer to figure 12 of section 5.
   3.1. Inspect *Stem (4)* for signs of wear or corrosion. Replace as required.
   3.2. Insert 3/8 end of *Stem (4)* into counter sunk hole of *Piston (14)*. Note: The piston may appear different depending on which model you have.
   3.3. Insert a 7/32 allen wrench into the top of the *Stem (4)* and tighten the *Lock Nut (16)* completely down using a 9/16 socket. Note: The *Stem (4)* MUST turn freely in the *Piston (14)* after the nut is tightened.
   3.4. Pre-heat the orange Tef-Sil *Piston O-ring (19)* in warm water and immediately slide the o-ring over the *Piston (14)* and position it into groove.
   3.5. Smear a thin layer of petroleum jelly around the *Piston O-ring (19)* to facilitate ease of installing the piston into the cylinder.

4. Loading the Spring: Refer to figure 11 of section 5.
   4.1. Inspect the inside of the *Cylinder (10)* for damage (dents, scratches, or corrosion). If the cylinder is damaged it must be replaced.
   4.2. Insert the 3/8 female thread end of the *Disassembly Tool (15)* (part # 6684MS) into the ½ " NPT opening of the *Cylinder (10)*.
   4.3. Place the *Spring (18)* into the *Cylinder (10)*.
   4.4. Thread the 3/8 stub that extends from the Piston/Stem assembly into the *Disassembly Tool (15)* and tighten with two allen wrenches. **NOTE: Ensure the end of tool is tight against the Lock Nut (16) as shown in figure 11 of section 5.**
   4.5. Compress the *Spring (18)* by using a 7/32 allen wrench to hold the shaft of the tool stationary with respect to the cylinder, while an 11/16 wrench is used to turn the *Tool Nut (17)* clockwise. (See figure 11 of section 5.) Insure the threads are not damaged on the cylinder when the piston is pulled into the top of the cylinder.

⚠ CAUTION **After the spring is compressed in the cylinder, do NOT point the open end of the tube toward yourself or a bystander.**

   4.6. Continue to turn the *Tool Nut (17)* until the top of the piston is at least 7/8" below the top of the *Cylinder (10)*. See figure 10 of section 5.

5. Installing the *Cover (9)*:
   5.1. Smear a thin amount of never-seize compound on the threads of the *Cover (9)* as shown in figure 14.
   5.2. Smear petroleum jelly around Cylinder O-ring (23) as shown in figure 14 and the top of the *Stem (4)* as shown in figure 12 of section 5.
   5.3. Position the *Cover (9)* over the *Stem (4)* as shown in figure 12 of section 5.
   5.4. Slowly screw the *Cover (9)* onto the *Cylinder (10)*. Care should be taken not to damage the threads of the cylinder or cover. Beware of cross threading. Ensure that the cover is screwed completely down to the cylinder so there is **NO** gap. See figure 15.

⚠ CAUTION **The Cylinder must be threaded completely on the Cover prior to the Disassembly Tool being removed.**

   5.5. The *Spring (18)* can now be released by holding the allen wrench stationary with respect to the *Cylinder (10)* and turning the *Tool Nut (17)* counter-clockwise.
   5.6. Once the *Tool Nut (17)* has released the spring pressure, the tool can be unscrewed and removed from the *Cylinder (10)*.

6. Re-filling the hydraulic oil: Refer to figure 15.
   Note: Replace the oil in the cylinder using Kendall Hyken Glacial Blue Hydraulic Fluid, or a high quality SAE 5W-10W oil with a viscosity of 90 SUS at 100°F and a pour point of no greater than –50°F.
   6.1. Loosely insert the *1/8" NPT Plug (13)* into the opening at the top of the *Cover (9)*.
   6.2. Turn the PAF upside down and pour hydraulic fluid through the ½" NPT opening at the bottom of the *Cylinder (10)*.
   6.3. It is important that this lower chamber is completely full of oil, with **NO** air pockets.
   6.4. Place thread sealant on the *½" NPT Plug (12)* and insert it into the bottom of the *Cylinder (10)*. Tighten the plug using a 3/8 allen wrench.
   6.5. Turn the PAF right side up and remove the *1/8" NPT Plug (13)*.
   6.6. Fill the top chamber about half full of hydraulic fluid, but do **NOT** top off. An air pocket must be left in the upper chamber. At least 1/2 of an inch of fluid is recommended in the top chamber.
   6.7. Place thread sealant on the *1/8" NPT Plug (13)* and insert it in the *Cover (9)*.
7. Smear a small amount of never-seize compound on the threads of the *Normal Vent (8)* and screw it into the opening of the *Cover (9)*.

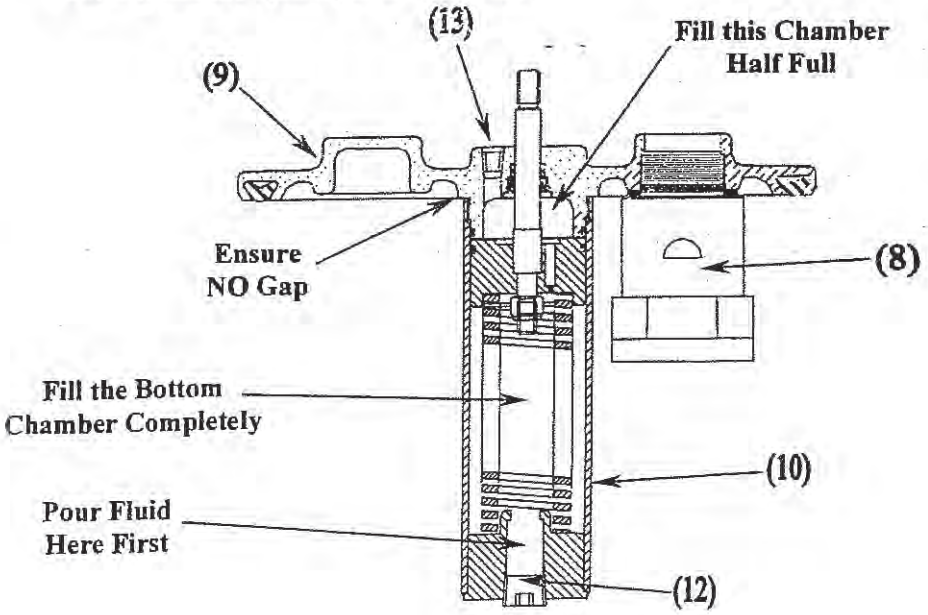


Figure 15

8. To attach the PAF Relief Valve to the closure assembly, refer to figure 6 of section 4.
   8.1. Place the *Bellow (7)* over the *Stem (4)*.
   8.2. Thread *Stem (4)* into *Wobble Support (27)* on *Strongback (5)*. NOTE: Use an 7/32 allen wrench inserted from the top of the *Wobble Support (27)* and turn counterclockwise to screw in the stem.
   8.3. Insure the first thread is not damaged as the stem is started into the wobble support.
   8.4. As the stem is threaded in, insure the *Locating Ears (28)* are aligned at the hinge side of the *Strongback (5)* and straddle the strongback as shown in figure 4 of section 3. Tighten the stem all the way in.
   8.5. Insert *Lock Washer (6)* and thread *Hex Nut (3)* onto *Stem (4)* as shown in figure 6 of section 4.
   8.6. To adjust the set pressure and tighten down the stem, refer to Section 3 of this manual.

Betts

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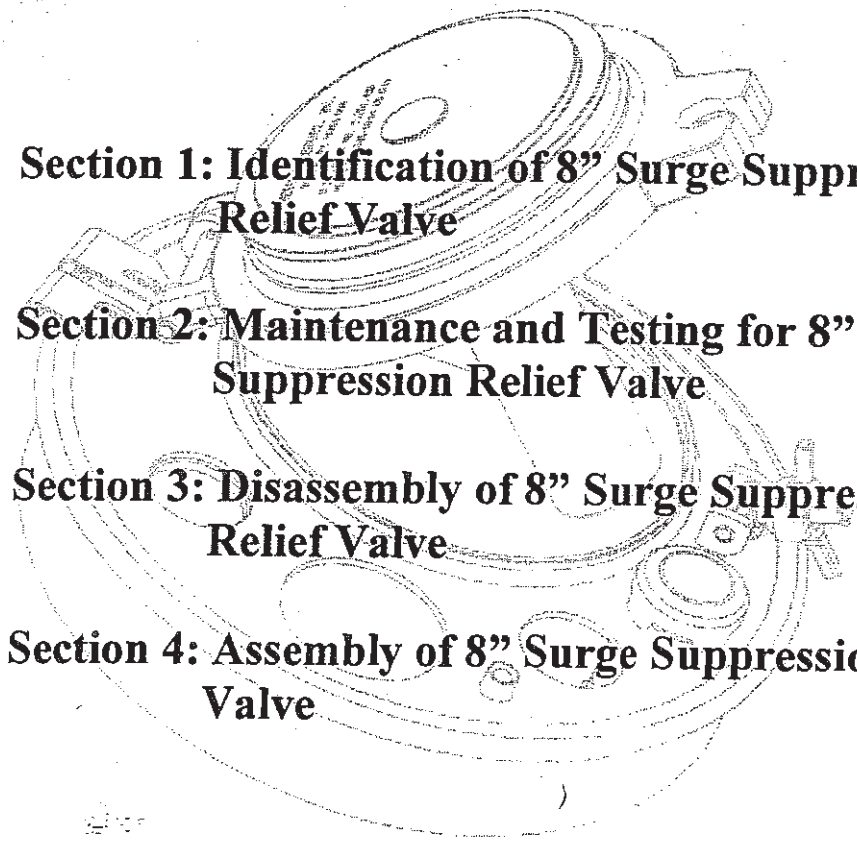
BETTS INDUSTRIES, INC. 1800 PENNA. AVE. W. BOX 888 WARREN, PA. 16365-0888

MAINTENANCE MANUAL

FOR

8" SURGE SUPPRESSION RELIEF VALVE



Section 1: Identification of 8" Surge Suppression Relief Valve

Section 2: Maintenance and Testing for 8" Surge Suppression Relief Valve

Section 3: Disassembly of 8" Surge Suppression Relief Valve

Section 4: Assembly of 8" Surge Suppression Relief Valve

8/14/98

Betts Industries, Inc.
Warren, PA. 16365
(814) 723-1250

SECTION 1:
IDENTIFICATION OF
SURGE SUPPRESSION RELIEF VALVE

Betts Surge Suppression Relief Valves (SSRV's) meet or exceed all U.S. DOT requirements for primary pressure relief valves on DOT406 cargo tanks as contained in 49CFR178.345-10 and 49CFR178.346-3 of the Code of Federal Regulations. The Betts Surge Suppression Relief Valve is able to withstand a brief pressure surge (per TTMA RP NO 81) and contain the lading to **zero leakage**. See figure 1 for identification criteria.

Betts SSRV's protects the cargo tank from rupture due to over-pressurization caused by overfilling or fire and is, therefore, crucial to the safe operation of the tank. In order to maintain your Betts SSRV's in proper working condition, the following procedures outlined in this manual must be followed.

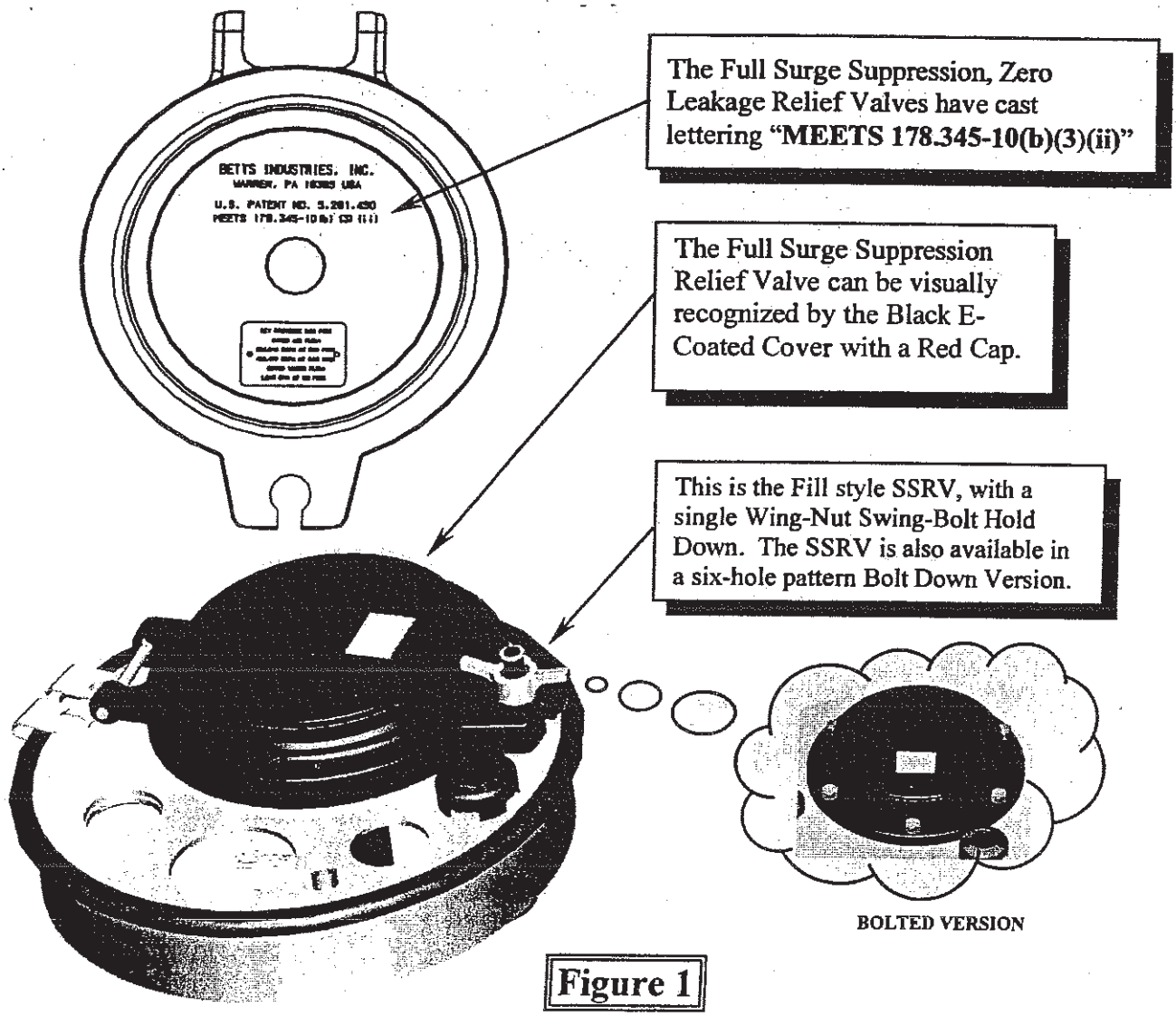


Figure 1

SECTION 2:
MAINTENANCE AND TESTING
FOR SURGE SUPPRESSION RELIEF VALVE

A. **U.S. DOT Requirements:** This manual refers to the DOT regulations. *However, it does not take the place of the Code of Federal Regulations.* A current copy of the Code of Federal Regulations should be reviewed and followed to insure the requirements are met for each case.

There are three basic tests/inspections mandated by 49CFR Part 180 for MC306 and DOT406 cargo tanks.

Test/Inspection	Interval Period	Code Paragraph
External Visual Inspection	1 year	49CFR180.407(d)
Leakage Test	1 year	49CFR180.407(h)
Pressure Retest	5 year	49CFR180.407(g)

1. **External Visual Inspection:** As part of the annual external visual inspection, 49CFR180.407(d)(3) requires that all pressure relief valves, be visually inspected for any corrosion or damage which might prevent the valve from functioning. If the cargo tank is used to haul product that is corrosive to the relief valve, the valve must be removed from the cargo tank for inspection and bench testing.

Note: Betts recommends that the external visual inspection of vents be performed monthly.

1.1. Visually inspect all external surfaces of the manhole and Surge Suppression Relief Valve (SSRV) for signs of corrosion or damage. For Fill Style SSRV this requires unscrewing swingbolt and opening SSRV. For Bolted Style SSRV this requires unbolting and removing from manhole. NOTE: Review section three steps 1 - 3 for proper procedures for SSRV removal.

1.1.1. Clean and inspect the bottom side of the SSRV for signs of damage, corrosion, or product gumming that could effect the operation of the Relief Valve. See figure 2.
1.1.2. Closely inspect the *Cylinder* for any damage or dents. Also, insure *Cylinder* is threaded tightly to the *Cover*.
1.1.3. Inspect *Normal Vent* and clean as necessary.

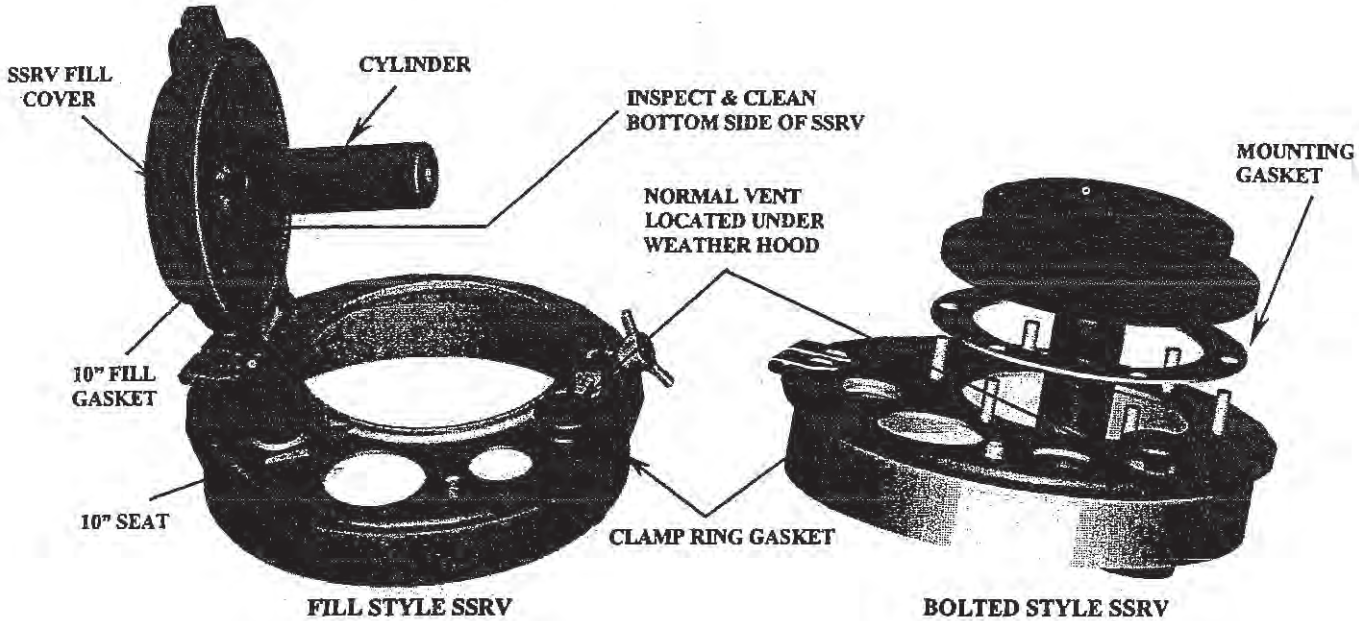


FIGURE 2-A

FIGURE 2-B

1.1.4. Inspect the *Clamp Ring Gasket* for evidence of product seepage. Replace any gaskets where seepage is detected.

1.1.5. For the Fill Style SSRV, inspect the *10" Seat* for damage or corrosion and inspect the *10" Fill Gasket* for signs of wear or degradation. Replace any gaskets where seepage is detected.

1.1.6. For the Bolted Style SSRV, inspect the *Mounting Gasket* for signs of wear or degradation. Replace any gaskets where seepage is detected.

NOTE: If any corrosion or damage to the SSRV or manhole is observed, it must be repaired and successfully bench tested prior to returning to service. Refer to 3.2 for SSRV bench test procedure.

2. **Leakage Test:** 49CFR180.407(h) requires tanks to be tested annually at 80 % of the tank design pressure or MAWP, whichever is marked on the tank certification or specification plate. All tank components must remain in place during this test, except any re-closing pressure relief valve with a set pressure less than the leakage test pressure must be removed or rendered inoperative during the test. Betts Normal Vents, therefore, must be removed during the leakage test.

   2.1. Remove *Normal Vent* from manhole cover and plug opening with Betts Plug No. 3013.
   2.2. Apply test pressure in accordance with 49CFR180.407(h)
   2.3. Inspect all gasket joints on SSRV and manhole for leaks. Replace damaged or worn gaskets as required and retest the unit.

3. **Pressure Retest:** As part of the pressure retest, 49CFR180.407(g)(ii)(A) requires that all re-closing pressure relief valves be removed from the tank for inspection and bench tested to verify that the relief valve is functioning properly. The pressure retest and the relief valve bench test must be performed at least every five years.

Note: Betts recommends that the Surge Suppression Pressure Relief Valves be bench tested annually.

3.1. **Pressure Retest Procedures:**

3.1.1. 49CFR180.407(g)(1)(vii) requires that all closures, except for pressure relief valves, with a set pressure less than the tank test pressure must be in place during the test.

3.1.2. Manholes must remain in place during pressure test.

3.1.3. Remove *Normal Vent* from manhole cover and plug opening with Betts Plug No. 3013.

3.1.4. Fill Style SSRV's must remain in place so the 10" fill gasket is subjected to test pressure.

3.1.4.1. Install Betts SSRV Pressure Test Clamp (part no. 6697) to hold SSRV closed during test. (Refer to manual included with clamp for installation instructions.)

3.1.5. Bolted Style SSRV's should be removed from the manhole and the opening blanked off with a blind flange (part no. 3939)

3.1.6. Betts Push and Air Operated Vapor Recovery Valves remain in place during the test. **NOTE: If vapor recovery valves from other manufactures are installed, refer to the manufacturers' instructions to see if they should be removed.**

3.1.7. After preparing the rest of the tank, perform the pressure test in accordance with the regulations. Inspect all parts of manhole assembly for leakage. Repair or replace parts as required.

3.1.8. Remove all clamps or plugs from relief valve immediately after test is completed.

3.2. **Bench Test Procedure for SSRV**

3.2.1. Remove manhole assembly from tank by removing the clamp ring bolt and clamp ring.

3.2.2. Remove *Normal Vent* and plug port with Betts Plug (No. 3013)

3.2.3. Attach manhole assembly to appropriate Betts PAF Test Fixture (No. 6685SL.)

3.2.4. Apply a soap solution around the perimeter of the *Cover*. See figure 3

3.2.5. Gradually apply pressure to the tank at the rate of approximately ½ psi/sec and observe the pressure at which bubbles first appear.

3.2.5.1. The *Cover* must move 3/8" before any venting occurs. See figure 3. Do not record the pressure at which the *Cover* first moves.

3.2.5.2. If the SSRV pops open forcefully, the seals in the spring cylinder and the Oil must be replaced. See section three and four for disassembly and assembly instructions.

3.2.6. Release the pressure from the test fixture and verify the SSRV reseals.
3.2.7. Per 49CFR178.346-3(c) the set pressure must not be less than 3.63 psig and not more than 4.55 psig.
3.2.8. Replace or repair any SSRV that fails the set pressure test requirements, and retest the unit.

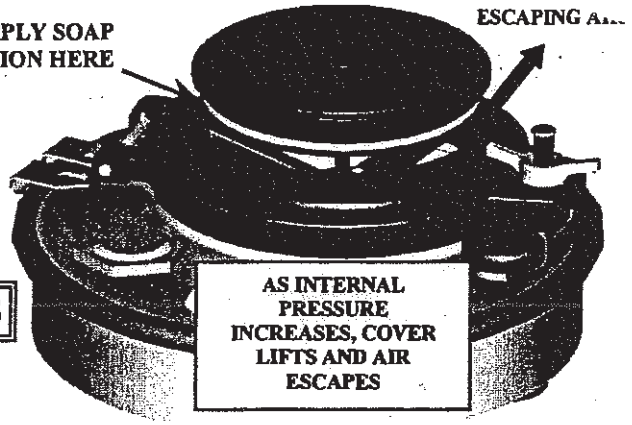
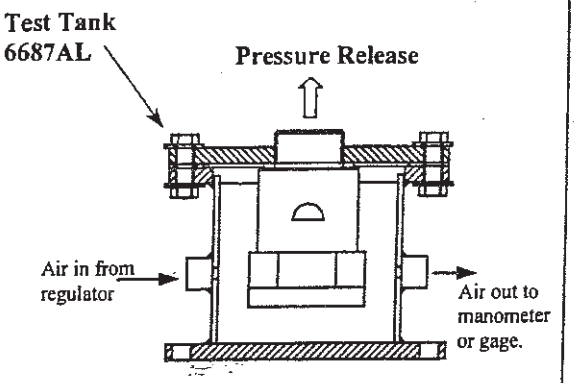


Figure 3

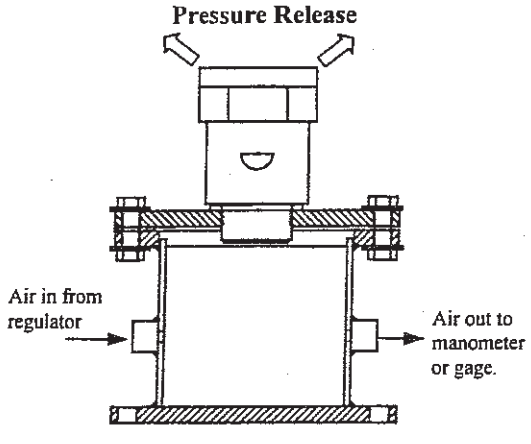
4. **Proper Installation of the Manhole Cover Utilizing the Clamp Ring**
   4.1. Insure the *Clamp Ring Gasket* is properly seated in the gasket channel of the collar.
   4.2. Center the manhole cover on the gasket and fully OPEN the *Fill Cover* as shown in figure 2-A.
   4.3. While the *SSRV Fill Cover* is open, attach the clamp ring and secure with a bolt. Tap the circumference of the clamp ring with a hammer while tightening the bolt.
   4.4. Close the *SSRV Fill Cover* and tighten swingbolt.

5. **Normal Vent Test Procedure:** A Normal Vent Test Tank (Part No. 6687AL) must be used to test the Normal Vents. **Note:** A regulator must be used to slowly apply pressure to the tank.
   5.1. Pressure Test:
      5.1.1. 49CFR 178.346-3(b)(2) states that the normal vent for DOT 406 tanks must be set to open at not less than 1 psig.
      5.1.2. Screw the Normal Vent into the lid of the test tank as shown in figure 4 A.
      5.1.3. Slowly apply pressure to the tank and inspect the top vent opening for pressure release.
      5.1.4. The set pressure on a model 6496AL Normal Vent is 1.0 to 1.5 psig.
   5.2. Vacuum Test: 178.346-3(c)(2) states that the normal vent for DOT 406 tanks must be set to open at no more than 6 ounces vacuum.
      5.2.1. Screw the Normal Vent into the lid of the test tank as shown in figure 4 B.
      5.2.2. Slowly apply pressure to the tank and inspect the top opening for pressure release. Apply a soapy solution around the vacuum disc to detect the point at which the vent opens.
      5.2.3. The vacuum set pressure on a model 6496AL Normal Vent is 0.25 to 0.375 psig.
   5.3. Repair or replace any Normal Vent that does not meet the specifications.



PRESSURE TEST

Figure 4A



VACUUM TEST

Figure 4B

SECTION 3:
DISASSEMBLY OF 8" SURGE SUPPRESSION RELIEF VALVE

NOTES:

- **UNDER NORMAL CIRCUMSTANCES, THE DISASSEMBLY OF THE SPRING CYLINDER IS NOT REQUIRED NOR RECOMMENDED, UNLESS ALL OTHER ATTEMPTS TO REPAIR THE RELIEF VALVE HAVE FAILED. IT IS RECOMMENDED THAT THE VALVE BE RETURNED TO BETTS INDUSTRIES FOR REPAIR.**
- **A SURGE SUPPRESSION DISASSEMBLY TOOL (PART # 6684MS) IS REQUIRED TO DISASSEMBLE THE SPRING CYLINDER.**

1. Relieve vapor pressure or vacuum from cargo tank.

⚠ WARNING **Failure to relieve tank pressure may result in sudden, unexpected loss of pressure. Severe personal injury or death may result.**

2. Remove the Surge Suppression Relief Valve (SSRV) from cargo tank.
   - 2.1. Removal of 10" **Fill Style** SSRV (Refer to figure 5)
     - 2.1.1. Unscrew *Wing Nut Assembly (1)* until it stops against *Stop Washer (2)*.
     - 2.1.2. The secondary safety latch requires that you must slightly lift up on *SSRV Body (3)* to rotate *Wing Nut Assembly (1)* away from body.
     - 2.1.3. Using a hammer and a 1/8" drive pin, drive out *2 Roll Pins (4)* from *Hinge Pin (5)*.
     - 2.1.4. Remove SSRV to workbench.

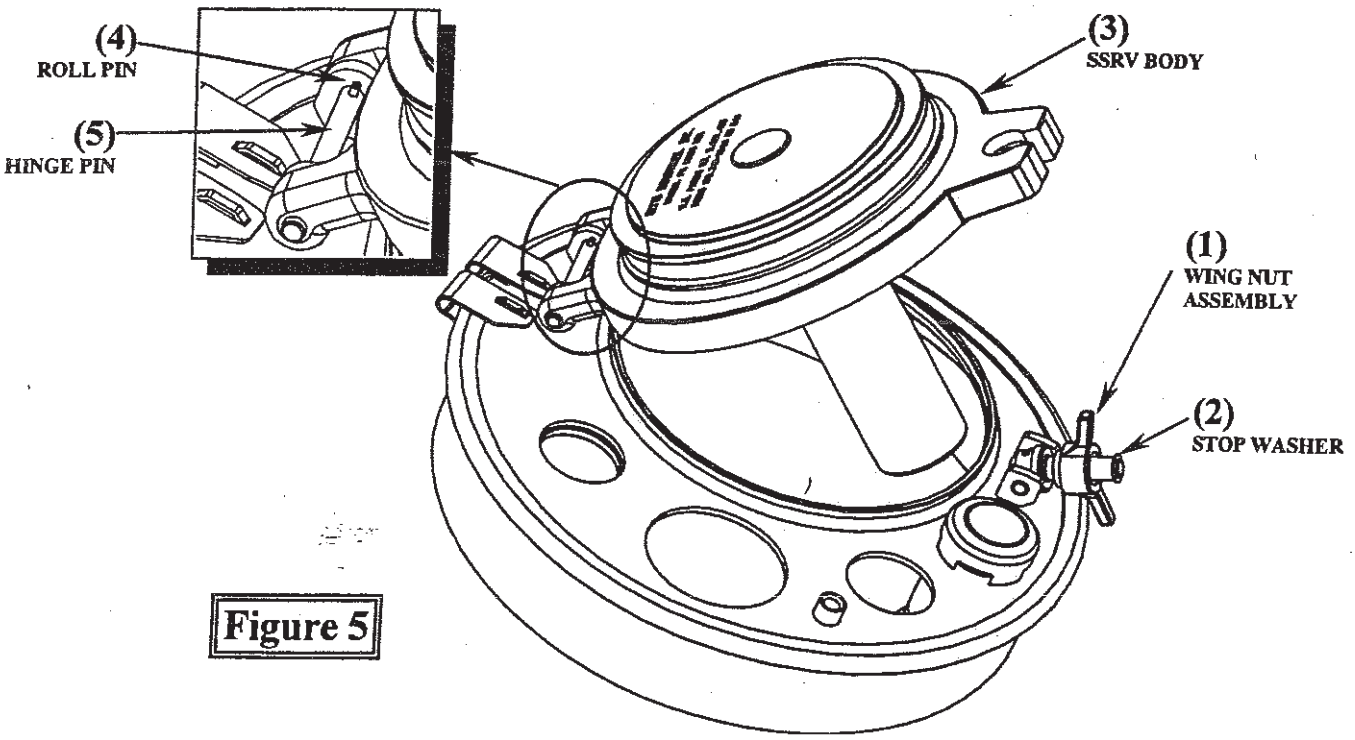


Figure 5

TTMA TECHNICAL BULLETIN

Truck Trailer Manufacturers Association
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TB No. 117 **April 19, 2002**

Title: **Orientation of PAF Manholes with Integral Hinged 10 Inch Fill Style Emergency Pressure Relief Valves**

Previous Editions: Originally Issued: May 1996, Reissued; April 2002

1.0 Preface:

1.1 No part of this document may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage or retrieval system without written permission from the Truck Trailer Manufacturers Association.

1.2 Recommended Practices and Technical Bulletins are furnished by the TTMA as a guide to general practices in the manufacture, use, and repair of truck trailers. However, the scope of the TTMA's Recommended Practices and Technical Bulletins is not exhaustive of all general practices in the manufacture, use, and repair of truck trailers and there may exist such general practices which do not appear in either the Recommended Practices or Technical Bulletins.

1.3 Recommended Practices and Technical Bulletins represent the state-of-the-art that existed at the time of its preparation. Users of Recommended Practices and Technical Bulletins should familiarize themselves with advancements in practices that have occurred subsequent to the Recommended Practice's or Technical Bulletin's publication date.

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1.5 The Recommended Practices and Technical Bulletins may contain terms or words with specialized meanings. Definitions for such terms or words may be found in TTMA RP No. 36 - Tank Trailer and Tank Container Nomenclature or TTMA RP No. 66 - Trailer Nomenclature.

1.6 Within the Recommended Practices and Technical Bulletins, "shall" is used wherever conformance with the TTMA publication requires that there be no deviation from the specific recommendation. "Should" is used wherever deviation from the specific recommendation is permissible in complying with the TTMA publication.

1.7 Conformity with TTMA publications by manufacturers, users and repairers of truck trailers is voluntary and any non-conformity with such publications is not indicative of the non-conforming practice being deficient.

1.8 Any inclusion of Recommended Practices or Technical Bulletins within any contract, document or standard is voluntary, and any such inclusion shall not imply any endorsement or approval by the TTMA due to the multitude of ways in which the Recommended Practices or Technical Bulletins may conceivably be used.

2.0 PURPOSE:

This Technical Bulletin provides guidelines for the orientation of manholes with integral hinged 10 inch fill style emergency pressure relief valves/fills on MC 306 and DOT 406 cargo tanks.

3.0 DEFINITIONS:

3.1 PRESSURE ACTUATED FILL (PAF) MANHOLES
Manholes with an integral hinged 10 inch emergency pressure relief valve which also serves as a quick open fill. The relief valve/fill may be mounted in the center of the manhole or offset to one side to make room for other accessories such as additional venting devices or overfill sensors.

3.2 NFPA 407
National Fire Protection Association, Inc. - Standard for Aircraft Fuel Servicing

4.0 BACKGROUND:

4.1 It has been standard practice for many years to orient PAF manholes on cargo tanks so that the latch on the 10 inch cover swings toward the rear of the tank and the 10 inch cover swings toward the front of the tank. The National Transportation Safety Board issued a report critical of this practice since they believe it may make the 10 inch cover more susceptible to pulling open if the tank flips over and slides forward on the overturn rails. As a result, the following recommendations have been established to address these concerns.

5.0 STANDARD & OFFSET PAF MANHOLES - NON-SELF LATCHING:

5.1 Standard and offset PAF manholes without self-latching mechanisms, shall be mounted on the tank so that the relief valve/fill opens towards the back of the tank and the latch hinges towards the front of the tank (See Figure 1 and Figure 2).

6.0 STANDARD & OFFSET PAF MANHOLES - SELF LATCHING:

6.1 In order to comply with NFPA 407, standard and offset PAF manholes with self-latching mechanisms shall be mounted on the tank so that the relief valve/fill opens towards the front of the tank (See Figure 3 & Figure 4).

Enclosures: Figures 1 through 4

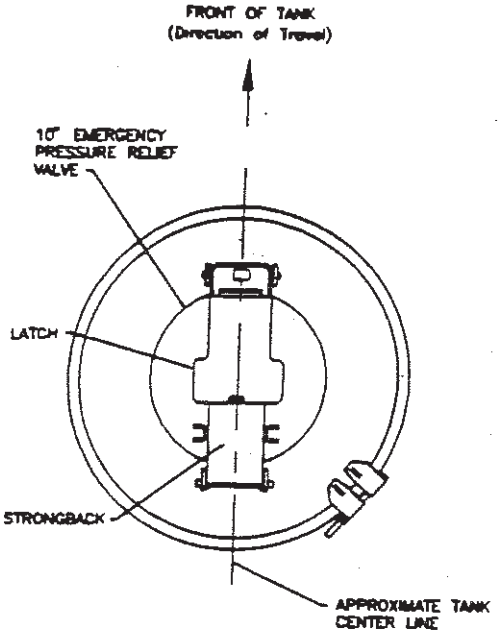


Fig. #1
STANDARD STYLE MANHOLE

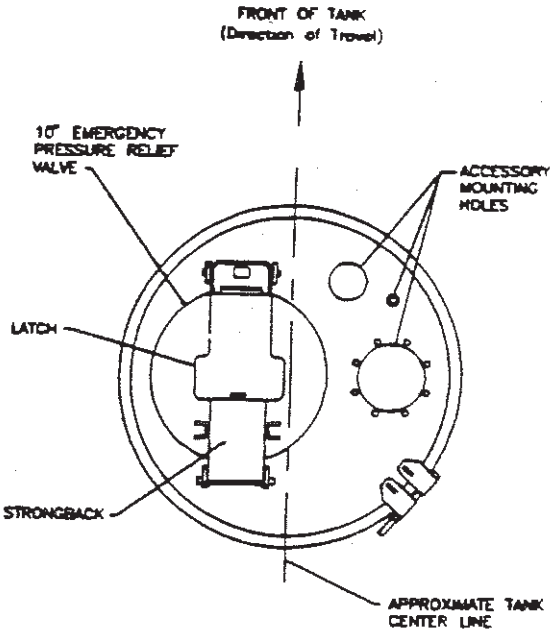


Fig. #2
OFFSET STYLE MANHOLE

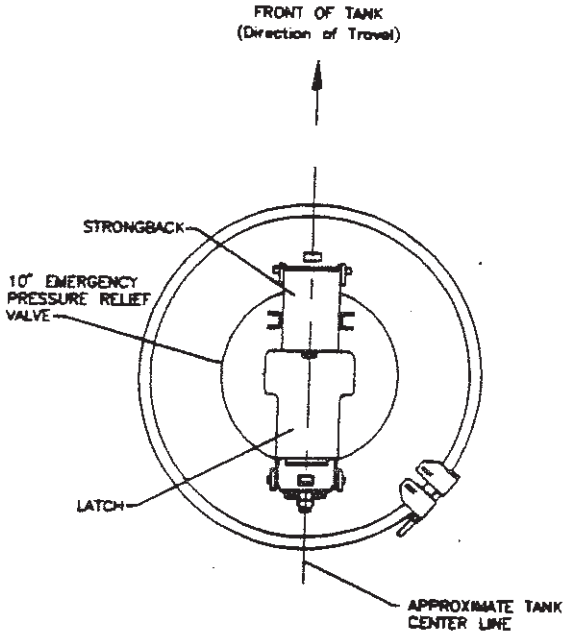


Fig. #3
STANDARD SELF LATCHING STYLE MANHOLE

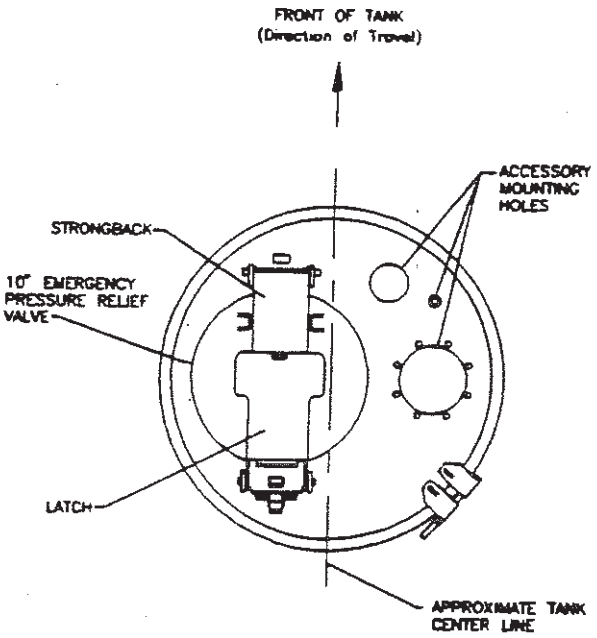


Fig. #4
OFFSET SELF LATCHING STYLE MANHOLE

3. Removal of **Bolted Style** SSRV (Refer to section 2, figure 2)
   3.1. Using a ¾" wrench, **loosen**, but **do not** remove six *hex nuts*.
   3.2. Lift up on SSRV until seal between SSRV and gasket is broken. Once the seal is broken, the 6 hex nuts should be removed.
   3.3. Remove SSRV to work bench.
4. Remove red *Plastic Plug (6)* by prying from top of *Cover (7)* as shown in figure 6.
5. Unscrew *Stem Nut (8)* using a 7/8" socket wrench.
   5.1. If *Stem (9)* turns with *Stem Nut (8)*, grip *Stem Jam Nut (10)* with a 1" wrench from the bottom side to prevent *Stem* from turning while unscrewing *Stem Nut.*
6. To remove *Cover (7),* gently push up from bottom side of SSRV. Push evenly to prevent the *Cover* from jamming in the SSRV bore. See figure 6 sub-view.
7. Remove *Star Washer (11).*
8. If the *Seat O-ring (12)* requires replacement, cut the o-ring with a razor blade, being careful not to damage the o-ring groove.

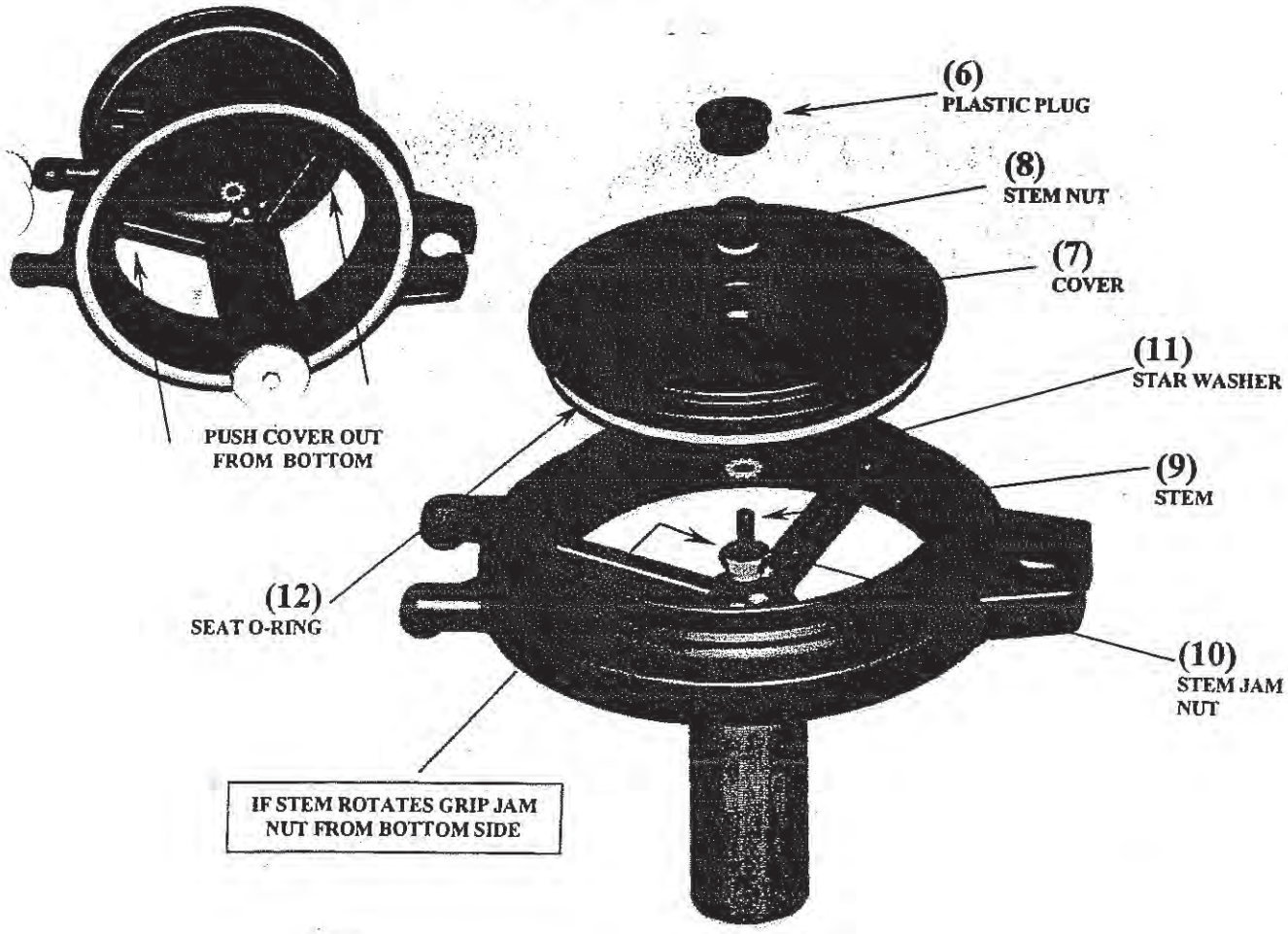


Figure 6

9. Disassembly of the Spring Cylinder

CAUTION **The cylinder contains a compressed spring, which could cause injury if the cylinder is removed improperly. Review the following section carefully before attempting to remove cylinder.**

Note: Under normal circumstances, the disassembly of the spring cylinder is NOT required nor recommended, unless all other attempts to repair the relief valve have failed.

9.1. Remove *Stem Jam Nut (10)* using a 1" wrench.

9.1.1. If *Stem (9)* starts to turn with *Jam Nut*, lock two 3/8"-16 nuts together at top of stem and use to hold *Stem*. See figure 7 Sub-view. Do **NOT** use a pair of pliers to grip stem since nicks on stem can cause o-ring seals to leak.

9.2. Remove the two *1/8" NPT Plugs (13)* from the top of the *SSRV Body (3)* and drain the hydraulic oil from the *Cylinder (14)*.

Note: The 1/8" NPT plugs may require hot water to loosen the teflon thread sealant.

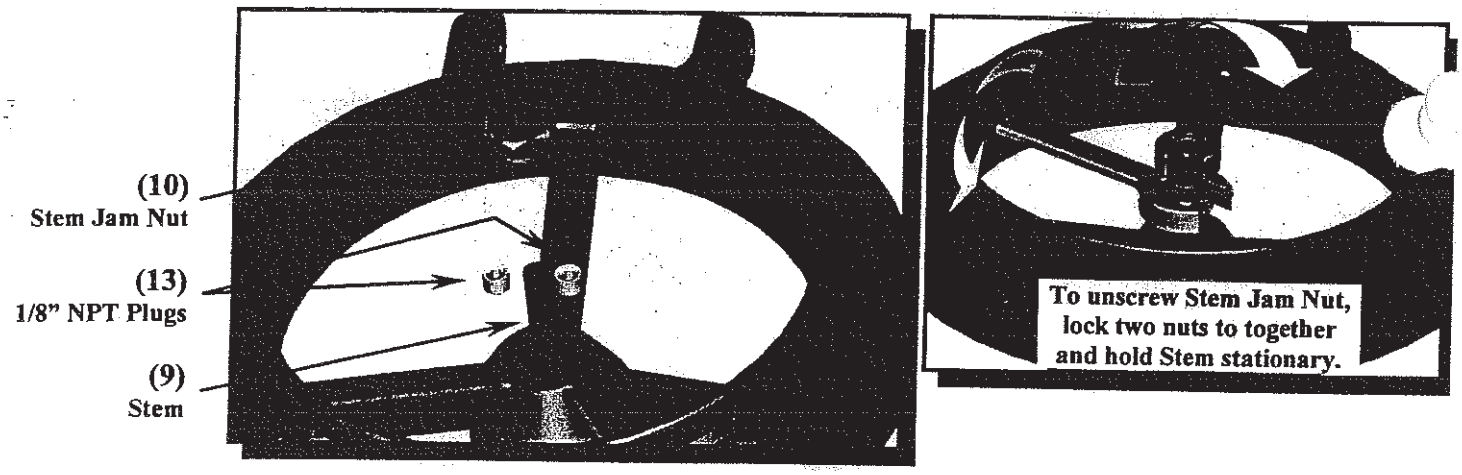


Figure 7

9.3. Apply petroleum jelly to the end of the tool as shown in figure 8, to reduce the chance of damaging the *Stem O-ring (20)*.

9.4. Thread the Betts' Surge *Disassembly Tool (15)*(part # 6684MS) to the 3/8" male thread of the *Stem (9)* as shown in figure 8. Use a 7/32 allen wrench to tighten down the tool.

9.5. Use a 7/32 allen wrench to hold the shaft of the tool stationary with respect to the stem, while an 11/16 wrench is used to turn the *Tool Nut (16)* clockwise.

9.6. Once the *Spacer Tube (17)* has made contact with the *Body (3)*, turn the nut two complete turns to compress the *Spring (18)*.

9.7. The *Cylinder (14)* can now be unscrewed from the *Body (3)*. Do **NOT** unscrew the stem from the tool. If slip joint pliers are required to grip the *Cylinder*, only grip within one inch from the end. Care should be taken not to damage the threads of the *Cylinder*. See figure 9.

CAUTION **After the cylinder is removed, the spring is still under load. Do NOT point the spring toward yourself or a bystander.**

9.8. To release the *Spring (18)*, hold the allen wrench stationary with respect to the *Body (3)*, and turn the *Tool Nut (16)* counter-clockwise. It is imperative that the shaft of the tool does not unscrew from the *Stem (9)* during disassembly process. Continue to back-off the *Tool Nut* until the piston is extended beyond the length of the spring. See figure 9.

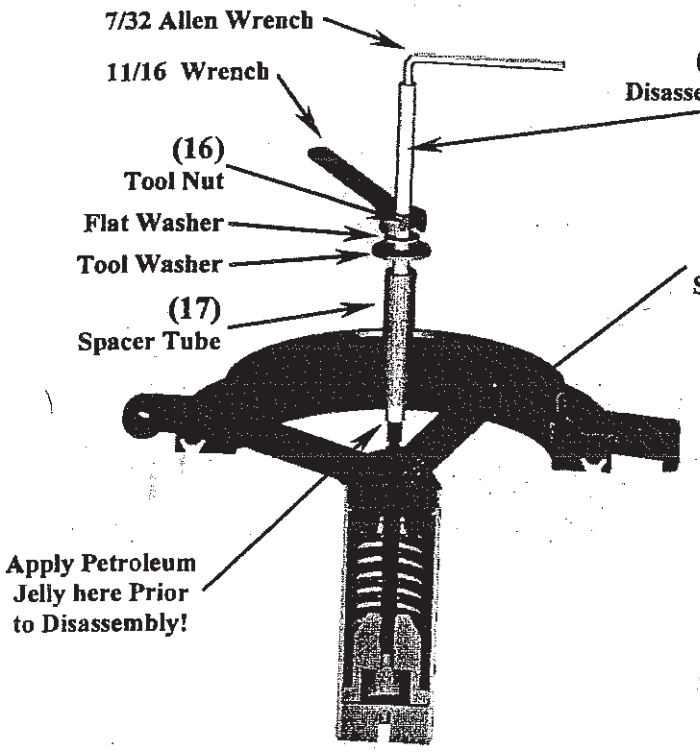


Figure 8

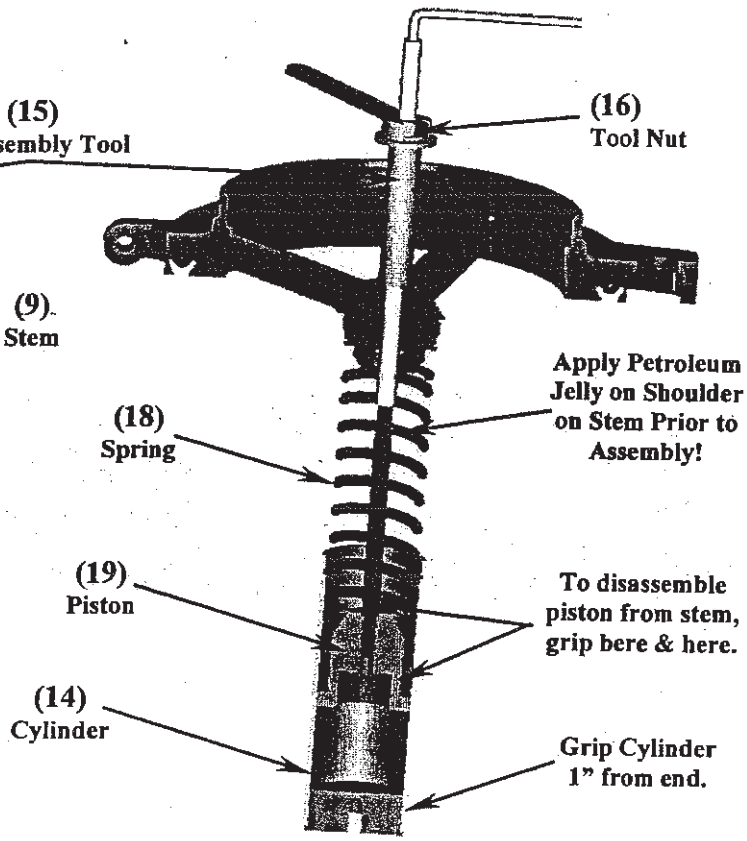


Figure 9

9.9. Insure the spring tension is released, and then unscrew the *Tool (15)* from the *Stem (9)*.

10. If needed, disassemble the stem/piston subassembly.
    10.1. If the assembly uses a lock-nut on the bottom, remove lock-nut
    10.2. Unscrew *Stem (9)* from *Piston (19)*. If tools are required, grip piston on small diameter only and grip stem as close to the piston as possible. See Figure 9.

11. The *Stem O-ring (20)* and *O-ring Retainer (21)* are removed by using a snap ring tool to remove *Snap Ring (22)*. See figure 10.

12. If the *Cylinder O-ring (23)* requires removal, cut the o-ring with a razor blade being careful not to damage the o-ring groove.

13. If the *10" Fill Gasket (24)* requires removal, cut a small slot in the center of the gasket and use a screwdriver to pry gasket out of dovetail groove, being careful not to damage groove. See figure 13.

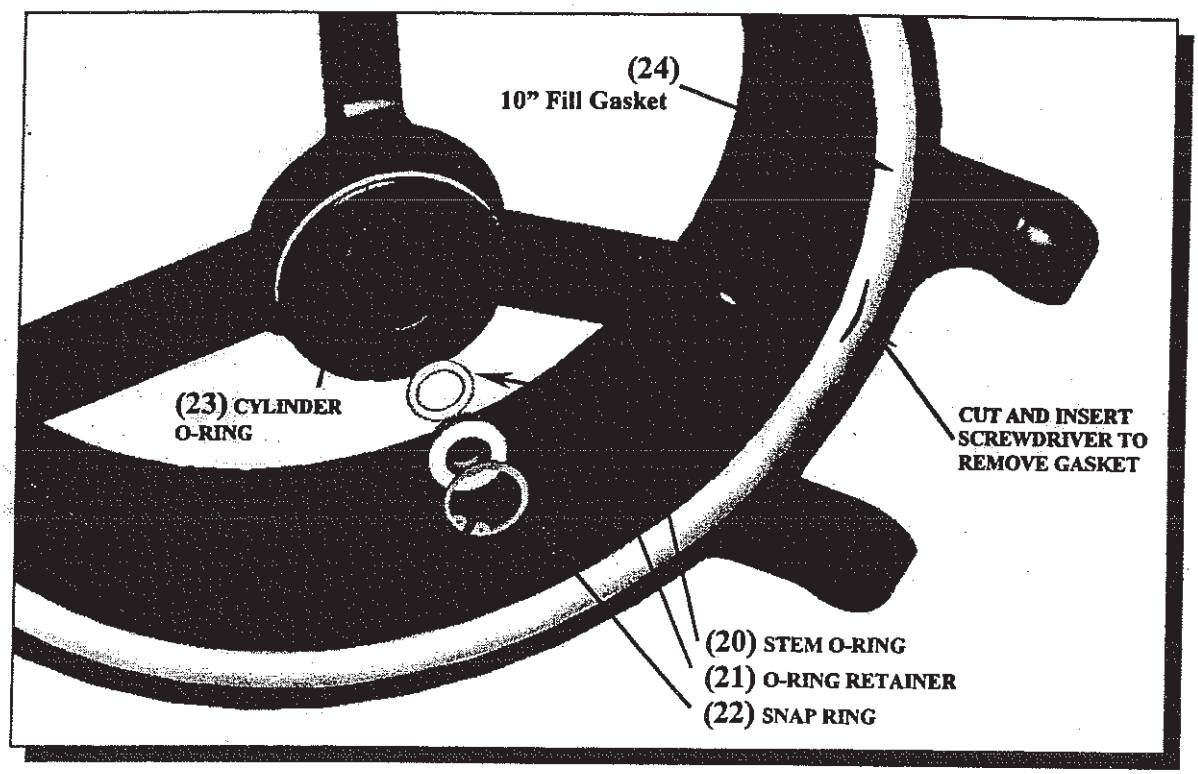


Figure 10

For maintenance or assembly instructions consult appropriate procedures.

SECTION 4:
ASSEMBLY OF 8" SURGE SUPPRESSION RELIEF VALVE

1. Preparation of O-Rings and Components:
   1.1 All parts should be cleaned and degreased to insure the removal of all product build up.
   1.2 All components should be inspected for damage or wear.
   1.3 To insure integrity of the seals, all o-rings and gaskets should be replaced using Betts' replacement parts.
   1.4 Inspect all o-ring grooves for damage (nicks, scratches, or burrs).
   1.5 All Teflon encapsulated o-rings should be pre heated with hot water and lubricated with petroleum jelly to facilitate ease of installation.

2. O-Ring Installation
   2.1 Snap the *Seat O-Ring (12)* into the groove in the *SSRV Cover (7)*. Figure 11
   2.2 Use Betts' O-Ring Tool 3830AL and slide the *Stem Nut O-Ring (25)* onto *Stem Nut (8)* as shown in figure 12.
   2.3 After the o-rings are in place, they must be heated with hot water once again.

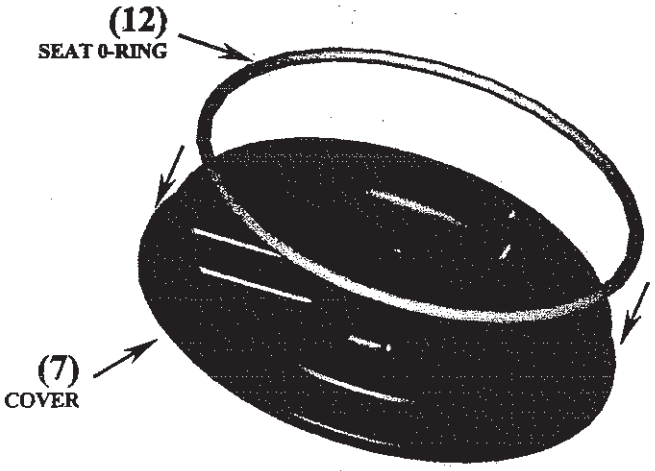


Figure 11

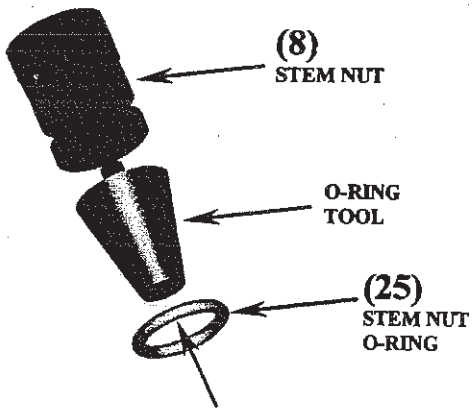


Figure 12

3. Body sub-assembly: Refer to figure 13.
   3.1 Insert *Stem O-ring (20)* into *SSRV Body (3)*.
   3.2 Insert *O-ring Retainer (21)* and secure by inserting the *Snap Ring (22)* into groove.
   3.3 Place *Cylinder O-ring (23)* into o-ring groove on *SSRV Body (3)*.
   3.4 Use Betts' *Dove Tail Gasket Tool (26)* (part # 6504AL) to place *10" Fill Gasket (24)* into *SSRV Body (3)*. See figure 13.
      3.4.1. Lubricate the gasket and dovetail groove with a soap solution.
      3.4.2. Using fingers, pinch the backside of the gasket together and insert a small section of the gasket into the groove.
      3.4.3. Use short strokes with the *DoveTail Gasket Tool (26)* to insert the gasket.
      3.4.4. The last portion of the gasket will need to be pushed in with fingers.
   Note: The gasket can also be installed by hand.

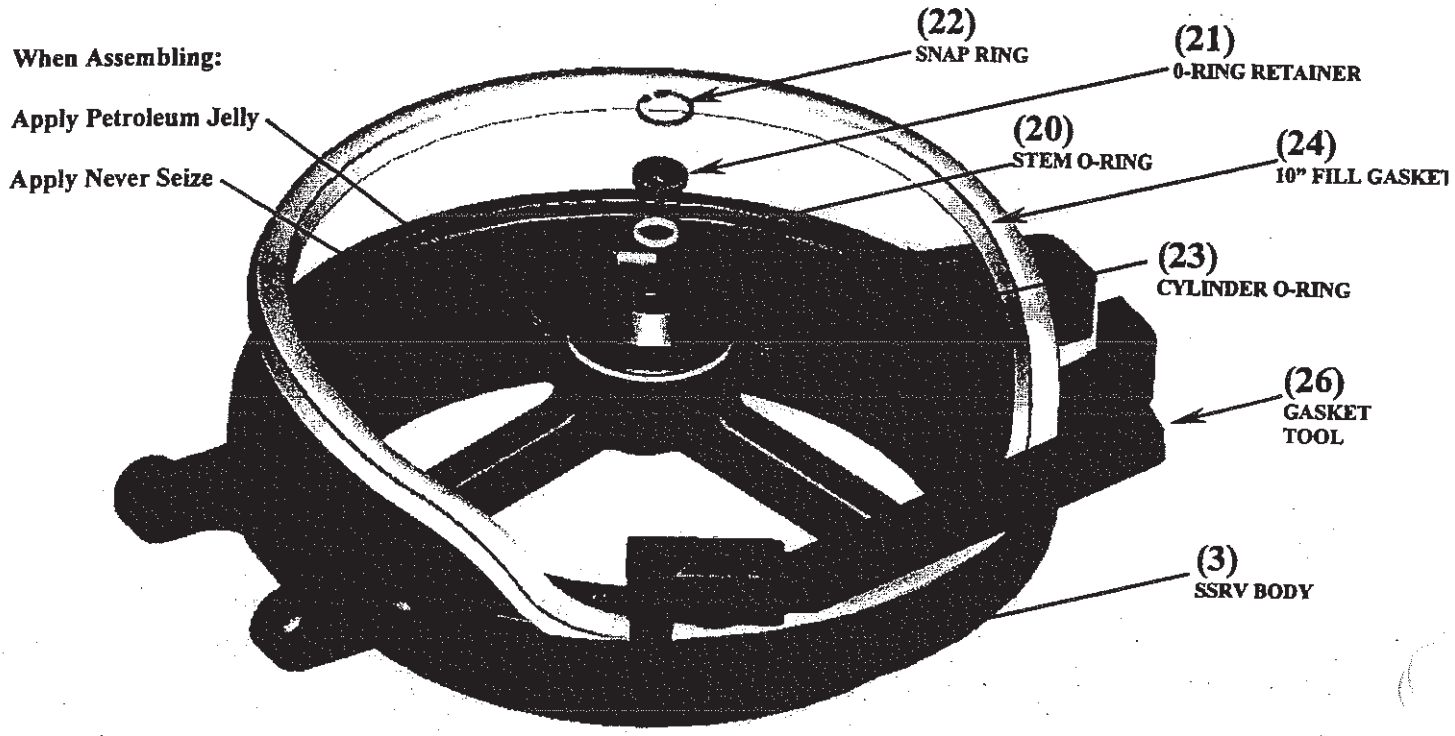


Figure 13

4. Piston/Stem sub-assembly: Refer to figure 14.
   4.1 Inspect *Stem (9)* for signs of wear or corrosion. Replace as required.
   4.2 Ensure the threads of the *Piston (19)* and *Stem (9)* are free from dirt and oil. Apply liquid thread-lock to the shorter threaded end of the *Stem*.
   4.3 Insert the shorter length of threaded *Stem (9)* into *Piston(19)* and tighten down.
      4.3.1.Only grip the *Stem* very close to the *Piston*, and grip the *Piston* on the small diameter. Refer to figure 14.
   4.4 For models with a lock-nut, follow the instructions above and complete with threading the lock-nut on the protruding threads of the *Stem*.

5. Loading the *Spring*: Refer to figure 8 and 9 of section 3.
   5.1 Inspect the inside of the *Cylinder (14)* for damage (dents, scratches, or corrosion). If the cylinder is damaged it must be replaced.
   5.2 Apply petroleum jelly to the 3/8 female thread end of the *Disassembly Tool (15)* (part # 6684MS) and gently insert it into the top center hole of the *SSRV Body (3)*. Care should be taken to ease the tool past the *Stem O-Ring (20)* without damaging it.
   5.3 Place the spring over the piston/stem subassembly and thread the top of the *Stem (9)* into the Disassembly Tool. Petroleum jelly should be smeared on the shoulder of the *Stem* as shown in figure 9 of section 3.
   5.4 Compress the *Spring (18)* by using an 11/16 wrench to turn the *Tool Nut (16)* clockwise. (See figure 8 of section 3.)

CAUTION **After the spring is compressed, do NOT point the spring toward yourself or a bystander.**

5.5 Continue to turn the *Tool Nut (16)* until the *Spring (18)* is fully compressed or the Disassembly Tool bottoms out. Do **NOT** over tighten the Tool.

6. Installing the *Cylinder (14):*

6.1 Smear petroleum jelly around *Cylinder O-ring (23)* and smear never-seize compound on the threads of the *SSRV Body (3)* as shown in figure 10 of section 3.

6.2 Carefully place *Cylinder (14)* over *Piston (19)*. Slowly screw the *Cylinder* onto the *SSRV Body (3)*. Care should be taken not to damage the threads of the *Cylinder*. Beware of cross threading. Insure the *Cylinder* is screwed completely down so there is no gap between the *Cylinder* and *Body*. See figure 8 of section 3.

CAUTION **The Cylinder must be threaded completely on the Cover prior to the Disassembly Tool being removed.**

6.3 The *Spring (18)* can now be released by turning the *Tool Nut (16)* counter-clockwise.

6.4 Once the *Tool Nut (16)* has released the spring pressure, the tool can be unscrewed and removed from the *Stem (9)*.

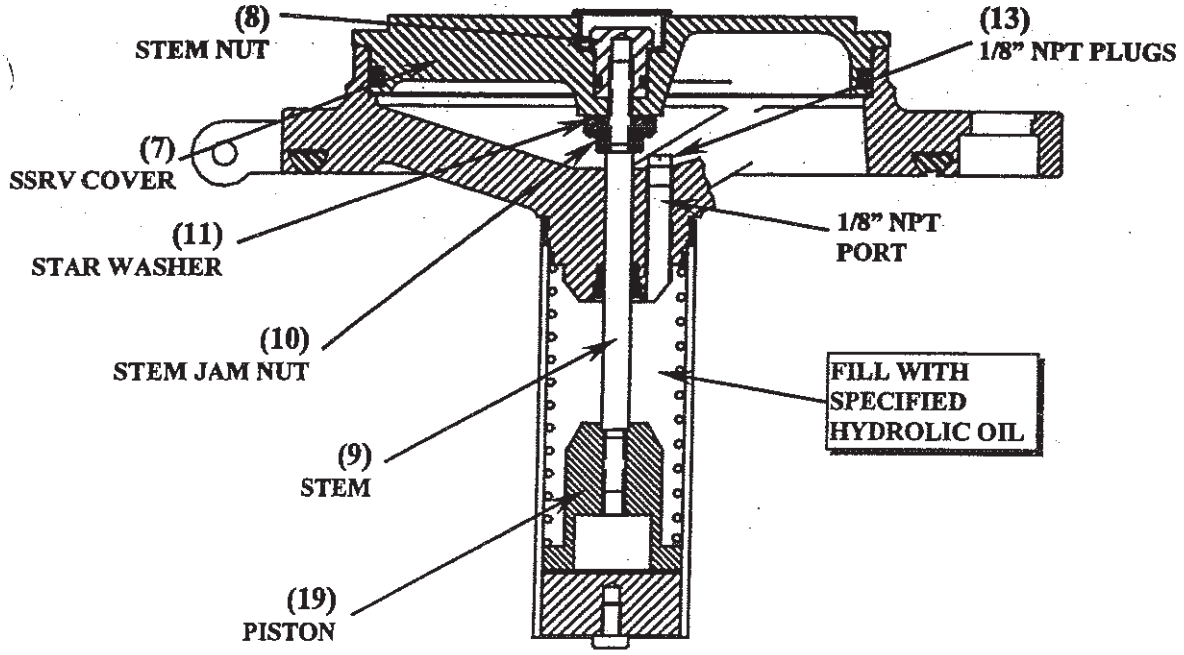


FIGURE 14

7. Re-filling the hydraulic oil: Refer to figure 14.

7.1 **Note:** Replace the oil in the cylinder using Kendall Hyken Glacial Blue Hydraulic Fluid, or a high quality SAE 5W-10W oil with a viscosity of 90 SUS at 100°F and a pour point of no greater than –50°F.

7.2 Pour hydraulic fluid through one of the 1/8" NPT openings at the top SSRV until the cylinder is completely full.

7.3 Place thread sealant on the *NPT Plugs (13)* and insert both into the SSRV.

8. Installation of the SSRV Cover (7)
   8.1 Place removable thread-lock on the threads of the *Stem (9)* and screw *the Stem Jam Nut (10)* all the way until it bottoms out. The round end of the *Jam Nut* faces down. See figure 7 of section 3.
   8.2 Next, place the *Star Washer (11)* on the *Stem* and gently slide the *SSRV Cover (7)* into place over the *Stem*. See figure 6 of section 3.
   8.3 Screw the *Stem Nut (8)* onto the *Stem* ensuring that the o-ring is in place on the *Stem Nut*. Push the *Plastic Cap (6)* into the top of the *Cover*.

9. Installation of 10" Fill Style SSRV to Cargo Tank (Refer to figure 5 section 3)
   9.1 Line up hinge holes on SSRV to holes on lugs and insert *Hinge Pin (5)* through holes.
   9.2 Using hammer, drive the two *Roll Pins (4)* into *Hinge Pin (5)*
   9.3 Tighten down *Wing Nut Assembly (1)*.

10. Installation of Bolted Style SSRV to Cargo Tank (Refer to figure 2 section 2)
    10.1 Place Mounting Gasket over studs.
    10.2 Place SSRV over studs.
    10.3 Place six lock washers and nuts on studs and follow standard flange bolt tightening procedures.

INSTRUCTIONS FOR ASSEMBLY OF EMERGENCY UNLOADING FIXTURE EM46443SS

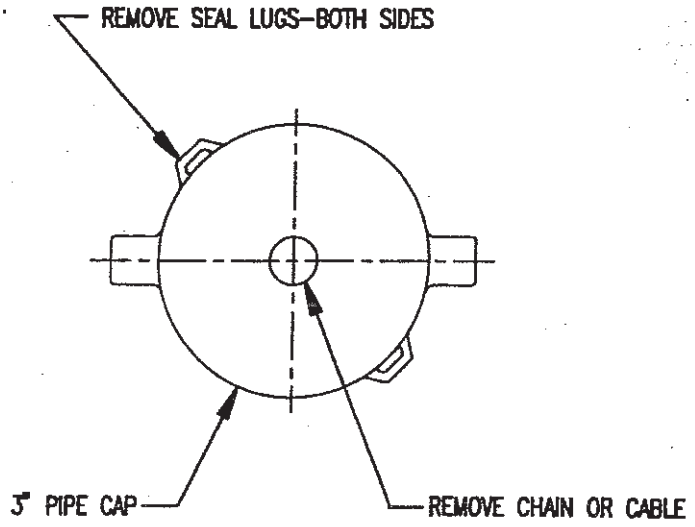


FIG. 1

STEP 1. Break off the seal lugs from the 3" pipe cap and remove any chains or cables.

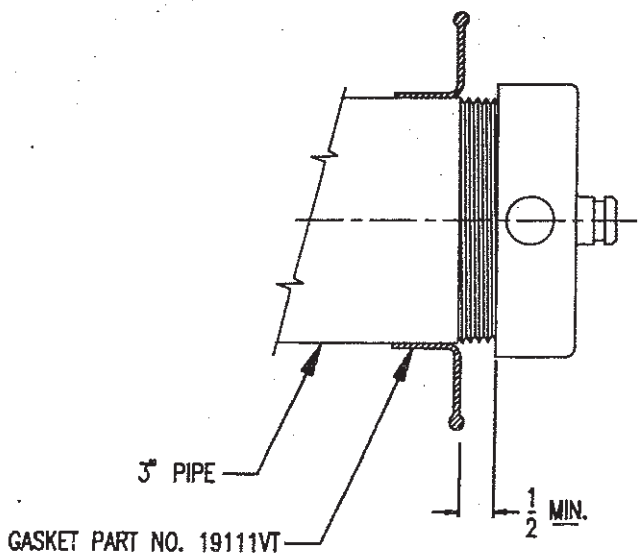


FIG. 2

STEP 2. Stretch the Gasket Part No. 19111VT over the cap and locate on the pipe nipple to the minimum dimension shown in Fig. 2.

Betts™ INDUSTRIES, INC.
WARREN, PA.

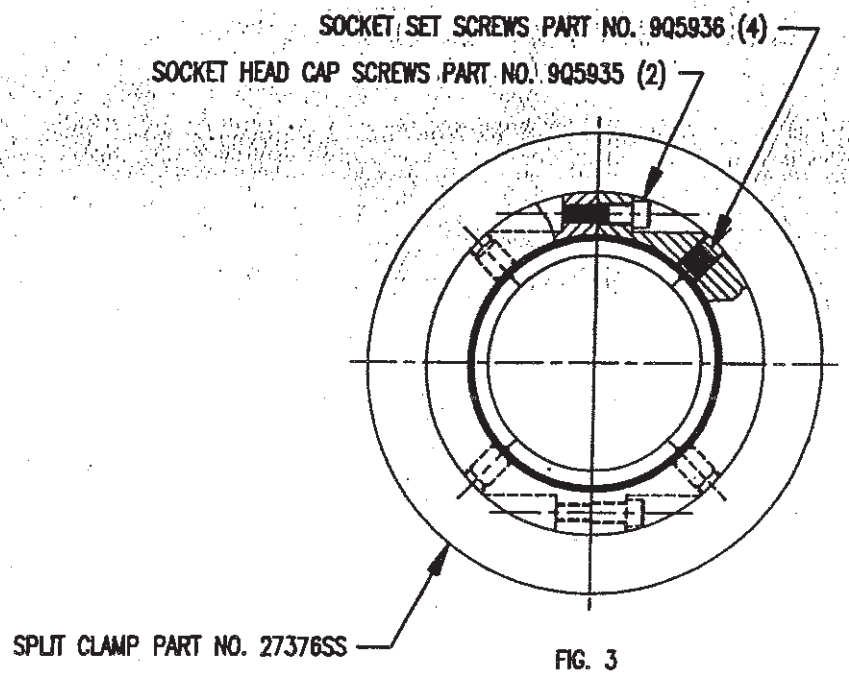


FIG. 3

STEP 3. Remove the 2 Socket Head Cap Screws Part No. 9Q5935 from the Split Clamp Part No. 27376SS. The Split Clamp is now in two pieces.

STEP 4. Loosen the 4 Socket Set Screws Part No. 9Q5936 so they do not interfere with the installation of the Split Clamp Part No. 27376SS

Note: All Socket Screws use $\frac{3}{16}$ key size.

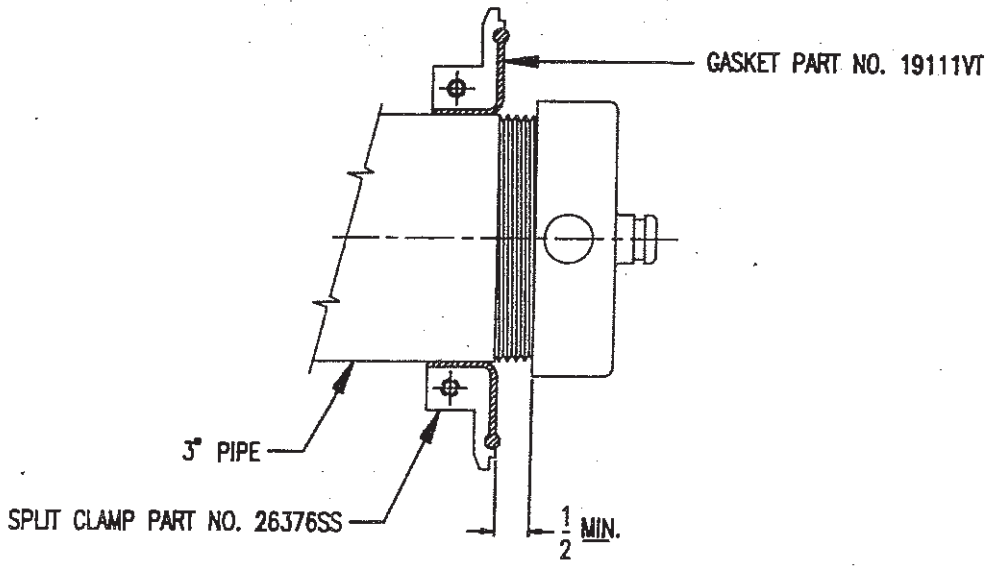


FIG. 4

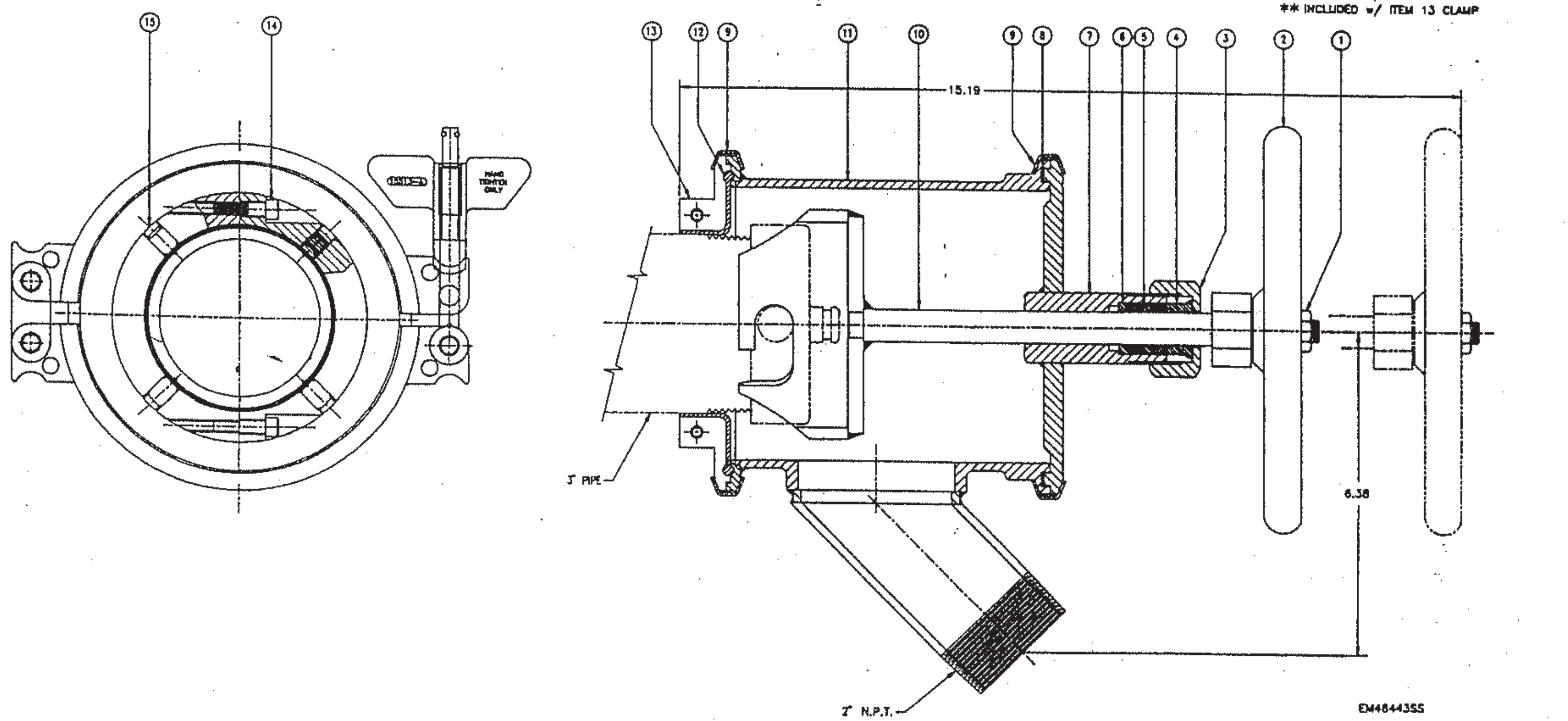
STEP 5. Install the Split Clamp Port No. 27376SS around the Gasket Part NO. 19111VT and the pipe nipple. Secure the Split Clamp by installing and tightening the 2 Socket Head Cap Screws Part No. 9Q5935.

STEP 6. Tighten the 4 Socket Set Screws Part No. 9Q5936.

CAUTION: FAILURE TO PROPERLY TIGHTEN THESE SCREWS COULD RESULT IN THE UNLOADING FIXTURE SLIDING OFF THE PIPE NIPPLE AFTER THE PIPE CAP IS REMOVED.

	NO.	REQ'D	PART NO.	DESCRIPTION
*	1	1	905811	NUT-HANDWHEEL
*	2	1	27423AL	HANDWHEEL
*	3	1	15028	STUFFING BOX NUT
*	4	1	15220SS	TOP GLAND
*	5	3	15227NT	PACKING
*	6	1	15078SS	BOTTOM GLAND
*	7	1	19164SS	TOPHEAD & BONNET
	8	1	15977TF	TOPHEAD GASKET
	9	2	25883SL	Q.R.B. CLAMP ASSEMBLY
*	10	1	27419SS	STEM & ADAPTER ASSEMBLY
	11	1	35342SS	BODY ASSEMBLY
	12	1	18111VT	GASKET
	13	1	27378SS	CLAMP
**	14	2	905935	1/4-20UNC-2A x 1" LG. S.H.C.S.
	15	4	905936	3/4-16UNC-2A x .63 LG. SOCKET SET SCREW

* INCLUDED w/ PART NO. 35368SS
** INCLUDED w/ ITEM 13 CLAMP



EM46443SS

1	NF		ADDED ITEM 14	
NO.	BY	DATE	REVISION	

Betts Industries, Inc.

TITLE: EMERGENCY UNLOADING FIXTURE

TOLERANCES UNLESS OTHERWISE SPECIFIED: .XX ± .015, .XXX ± .005, ANGLES ±1/2°

DRAWN BY NF | DATE | SCALE FULL

46443-1

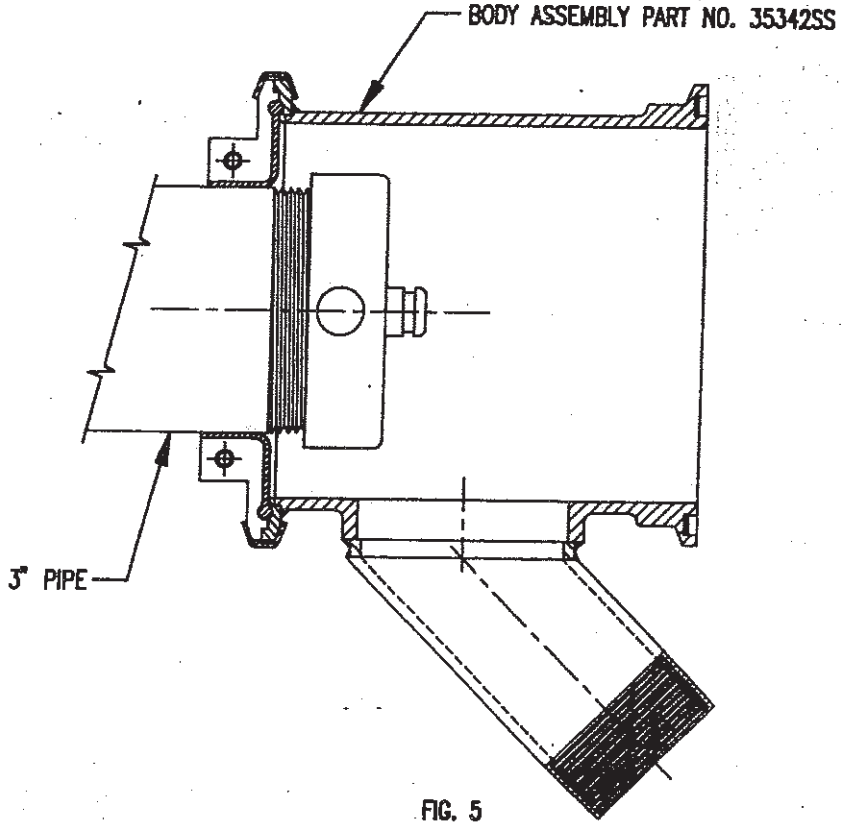


FIG. 5

STEP 7. Position the Body Assembly Part No. 35342SS on the Split Clamp 27376SS. Outlet should be positioned for best unloading.

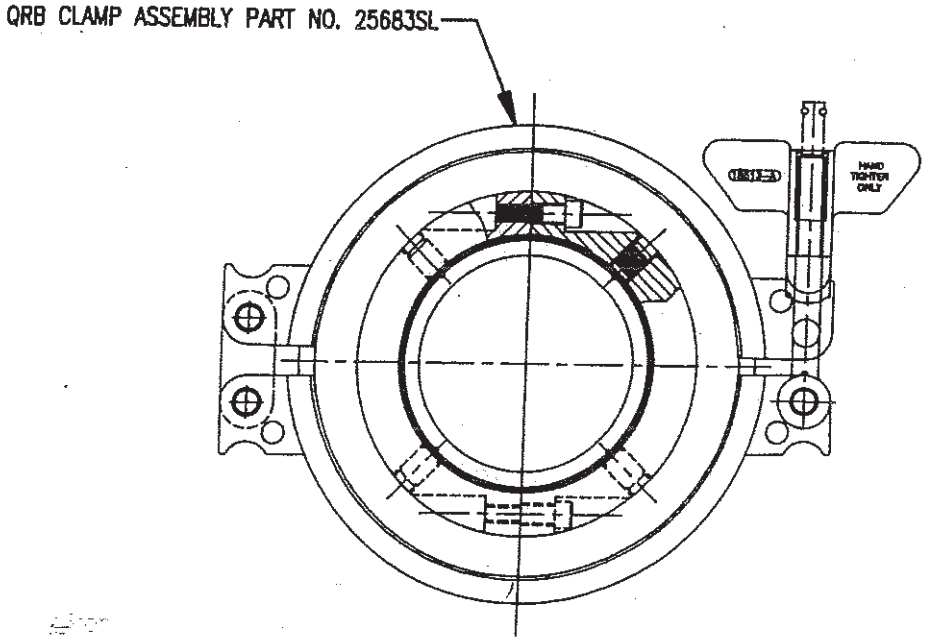


FIG. 6

STEP 8. Install the QRB Clamp Assembly Part No. 25683SL around the flanges of the Body Assembly Part No. 35342SS and Split Clamp Part No. 27376SS and hand tighten the wing nut.

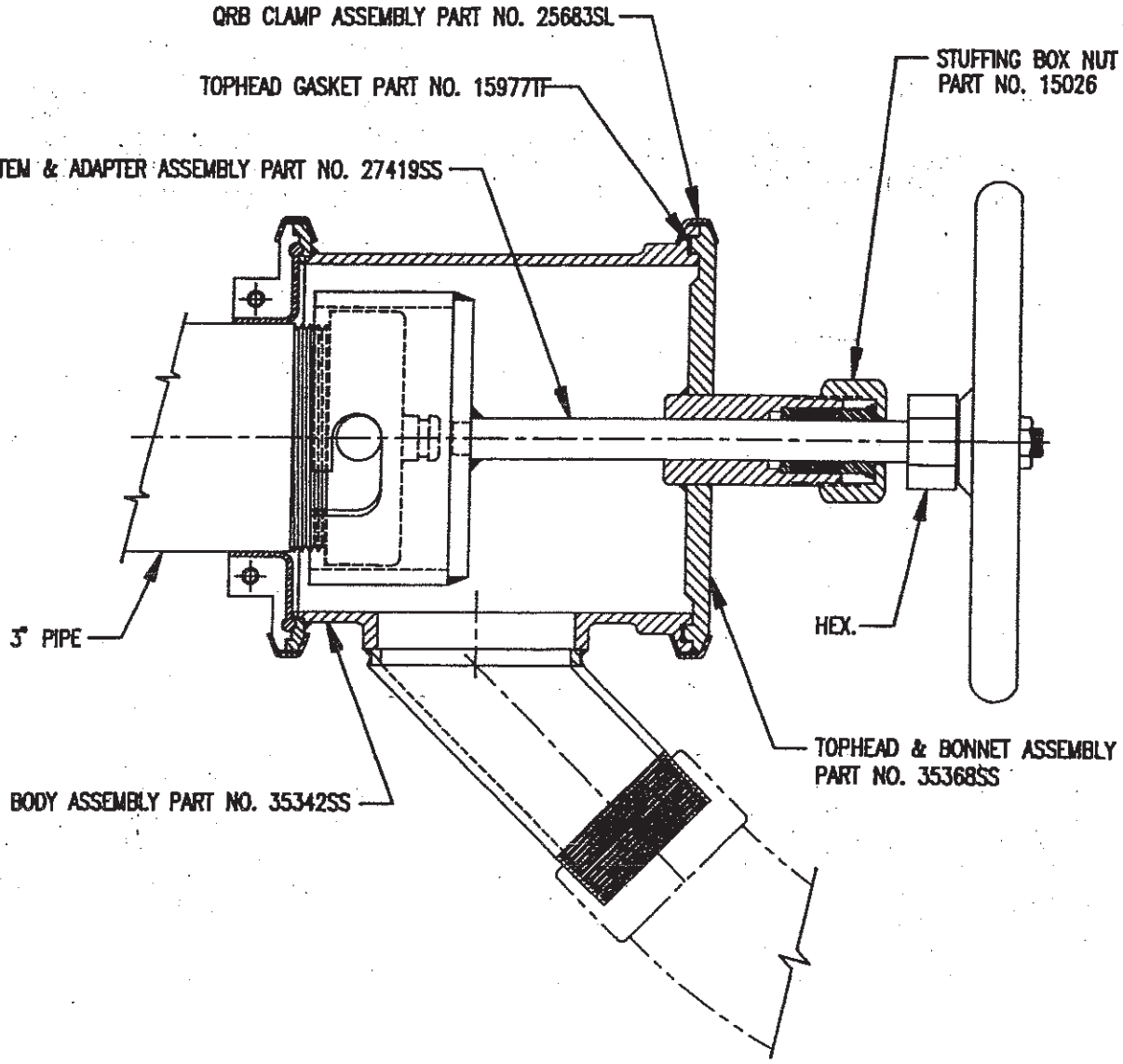


FIG. 7

STEP 9. Position the Stem and Adapter Assembly Part No. 27419SS on the 3" pipe cap. Care should be taken to insure Stem and Adapter Assembly is properly aligned with the pipe cap and is engaged with the pipe cap lugs.

STEP 10. Be certain the Tophead Gasket Part No. 15977TF is in place, and position the Tophead and Bonnet Assembly Part No. 35368SS to the Body Assembly Part No. 35342SS.

STEP 11. Install the QRB Clamp Assembly Part No. 25683SL around the flanges of the Tophead and Bonnet Assembly and hand tighten the Wing Nut.

STEP 12. Tighten the Stuffing Box Nut Part No. 15026 to prevent leakage past the packing.

STEP 13. Attach a Hose to the 2" threaded pipe nipple.

STEP 14. Remove the 3" pipe cap from the pipe nipple by turning the handwheel in a counterclockwise direction.

NOTE: A hex. is provided on the underside of the handwheel if additional leverage is required to unscrew the 3" ppipe cap.

Dec. 1992

NATIONAL TANK TRUCK CARRIERS, INC.

THE NATIONAL ORGANIZATION SERVING THE FOR-HIRE TANK TRUCK INDUSTRY

CLIFFORD J. HARVISON
PRESIDENT

2200 MILL ROAD • ALEXANDRIA, VA 22314-4677
PHONE 703/838-1960 • FAX 703/684-5753

December 12, 1995

TO: OWNERS/OPERATORS OF U.S. DOT REGISTERED CARGO TANK (CT) INSPECTION AND REPAIR FACILITIES.

FROM: CLIFF HARVISON, PRESIDENT, NATIONAL TANK TRUCK CARRIERS, INC.

SUBJ: MANHOLE ASSEMBLIES

Ladies and gentlemen, there has been considerable controversy within the tank truck industry regarding manhole assembly retrofit requirements for specification cargo tanks. This issue grew from concern over requirements in 49 CFR 405(g) titled "Cargo tank manhole assemblies". Some confusion appears to exist with respect to whether or not assemblies on older trailers meet current requirements.

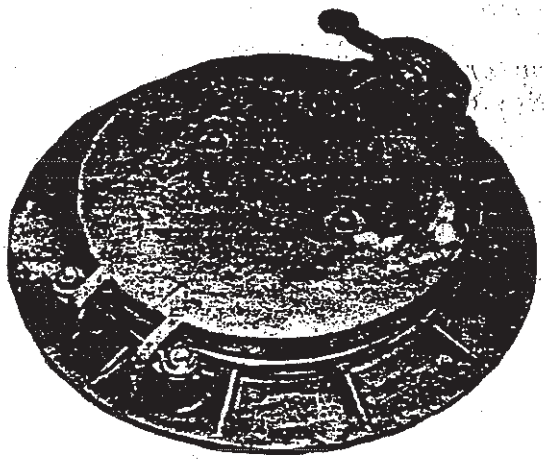
The enclosed document was compiled and prepared by Mr. Paul Horgan of the California Highway Patrol, and reviewed by various officials that the U.S. Department of Transportation. We hasten to note that DOT "review" does not imply "endorsement" of this paper or that it implies any value as a "DOT interpretation". Simply stated, DOT believes that review of this material may resolve uncertainty and assist in compliance.

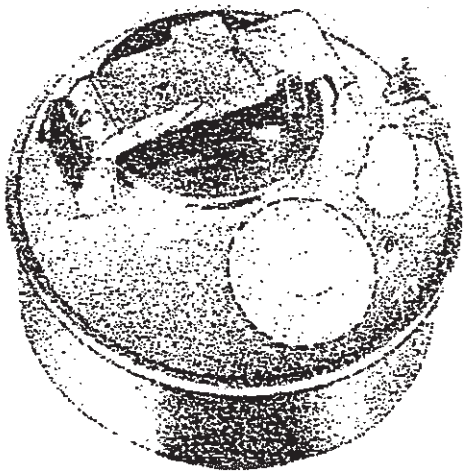
We urge you to read the introductory material (pages 1 and 2) thoroughly prior to reviewing the rest of the publication.

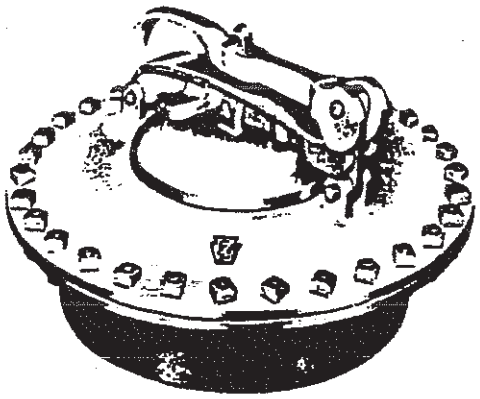
National Tank Truck Carriers, Inc. (NTTC) is pleased to forward this material to you --at no charge--in recognition of your continuing contribution to safety in the tank truck industry.

Have an enjoyable holiday season.

IDENTIFICATION OF AUTHORIZED CARGO TANK MANHOLE ASSEMBLIES







11-7-95

INDEX

This document contains certification information for the majority of the manhole assemblies in use on DOT specification cargo tanks subject to the manhole assembly retrofit requirements and is based on information received from the manhole assembly manufacturers available at the time of this publishing. It is recognized that there are a few additional component manufacturers (e.g., Philadelphia Valve), for which information was not available at the time of this publishing. Several of the cargo tank manufacturers produce their own manhole assemblies. Carriers should contact their specific tank manufacturer to obtain the required manhole assembly certification.

IDENTIFICATION OF AUTHORIZED CARGO TANK MANHOLE RETROFIT ASSEMBLIES

Cargo tank rollover incident data and special studies performed in the 1980's largely pointed out deficiencies in existing manhole assembly product retention capabilities, particularly during product surge conditions generally experienced in rollover situations. As a result of these findings, under rulemaking docket HM-183, the US Department of Transportation (DOT) adopted enhanced (400 series) cargo tank design and construction standards for newly built cargo tanks. Additionally, in order to continue to also utilize existing authorized cargo tanks, Section 180.405(g) of Title 49, Code of Federal Regulations (49 CFR) requires that specified DOT 300 series specification cargo tank manhole assemblies also must meet the enhanced product retention standards. In some instances this may be accomplished through testing and certification of the existing assembly to the new standard. In many cases, however, retrofit of the manhole assembly will be necessary.

This document covers the manhole assembly retrofit requirements for DOT MC 300, 301, 302, 303, 305, 306, [referenced hereafter as **306 type**] and for MC 310, 311, 312 [referenced hereafter as **312 type**] specification **cargo tanks** with a **test** pressure of less than 36 psig.

The manhole assembly retrofit requirement applies as follows:

- By definition a "manhole assembly" is a cover for an opening in a cargo tank compartment that is at least 15 inches (in.) in diameter, or an ellipse of at least 10 in. by 16 in. or 11 in. by 15in. Covers for fill openings or other openings with dimensions less than those listed above are not manhole assemblies, and therefore are not subject to the retrofit or marking requirement in 49 CFR 180.405(g)(2).
- All **306 type** cargo tank **compartments** with a capacity of less than 2,500 gallons are not required to have manhole openings. However, if the compartment is **presently equipped** with a manhole assembly, the assembly **must** meet the requirement in 49 CFR 180.405(g)(2).
- All **312 type** cargo tank compartments are required to be equipped with a manhole regardless of capacity. Additionally, if a cargo tank is marked as a dual specification, one of which is the 312 type (e.g., MC 306/ 312), every compartment that meets the 312 type specification with a test pressure of less than 36 psig **must** be equipped with a manhole in conformance with 49 CFR 180.405(g).

The retrofit requirement does **not** apply to:

- DOT MC 304 or 307 cargo tanks, since the minimum test pressure is 37.5 psig, which exceeds the 36 psig minimum test pressure contained in 49 CFR 178.345-5.
- DOT MC 310, 311 and 312 cargo tanks with a **test** pressure of 36 psig or more.
- Portable tanks, unless it is being used as a DOT specification cargo tank (See 49 CFR 173.33).

Manhole assembly retrofits for these cargo tanks were required to be completed by September 1, 1995, except as specified in the following instances:

- California State Fire Marshal (SFM) cargo tanks operating under the DOT exemption number E-11509 are not required to meet the retrofit and the retest requirements until September 1, 1996.
- Pursuant to the October 3, 1995, Comm-Net message titled, *"Withhold of Enforcement - Cargo Tank Manhole Cover Retrofit and Retest Requirements,"* DOT specification cargo tanks operated by **intrastate** carriers (not directly subject to federal jurisdiction) are not required to meet the retrofit and the retest requirements until January 1, 1996.

Any retrofitting of components to meet the manhole assembly requirements (or any other requirement for a DOT specification cargo tank) which involves welding on the cargo tank wall, must be performed by a person or facility that is currently registered with DOT to perform such function. In order to be properly registered, the person or facility must maintain both **a copy of the DOT registration letter** listing their DOT "*CT number*" ***and*** **a copy of the registration information submitted to DOT** listing the types of operations and cargo tank specifications they certified they are qualified to work on. If the person or facility does not have **both items** they are not authorized to perform any function on a DOT specification cargo tank (See 49 CFR 107.504(e)).

Special attention should be taken to ensure that all manhole assemblies are installed in such a manner as to preclude any portion of the manhole assembly (including latches) from extending above the rollover protection device(s). Although not required, it is recommended that the rollover protection device extend at least one inch, or more, above the manhole assemblies or other product retention devices.

For cargo **tanks** manufactured (e.g., marked and certified) *after* December 31, 1990, each manhole assembly must be marked in accordance with 49 CFR 178.345-5(e). For cargo tanks manufactured ***prior*** to December 30, 1990, **no marking is required** to be on the actual manhole **assembly**.

Manhole **assemblies** manufactured after December 30, 1990, that meet 49 CFR 178.345-5 are marked with the name of the manufacturer, *"Test pressure 36 psig,"* and either *"Certified 49 CFR 178.345-5"* or *"Meets 49 CFR 178-345-5"* in accordance with 49 CFR 178.345-5(e). Any manhole assemblies **marked** in this manner are presumed to **meet** the requirements of 49 CFR 180.405(g) absent any apparent damage or alteration.

Several manhole assembly manufacturers have issued letters certifying that certain manhole assemblies manufactured prior to December 30, 1990, meet the new standard even though the assemblies were not marked as such. Unfortunately, in some cases the certification letters do not provide sufficient information for positive identification of these manhole assemblies (e.g., Knappco's certification letter lists model numbers rather than unique marking that appear on the actual manhole assemblies). The following pages provide a partial cross reference with photographs or drawings of these manhole assemblies along with further clarification of the certification statements to aid in the proper identification of the manhole assemblies. Although several of the manhole assemblies shown in this document have a circular cross section, some of the assemblies were also available with an elliptical or oval cross section with similar markings, and are covered by the certification letters.

In addition to the manhole assemblies certified by the manufacturers as meeting 49 CFR 178.345-5 or 180.405(g). This document contains several examples of manholes assemblies that are *not* certified by the manufacturers. Manhole assemblies not certified by the manufacturer must either be replaced or tested and certified by a DOT registered inspector in accordance with 49 CFR 180.405(g)(2)(i). Alternatively, 49 CFR 180.405(g)(2) allows these manhole assemblies to be tested and either *"marked or certified in writing as conforming to § 178.345-5, TTMA RP No. 61, or are tested and certified in accordance with TTMA TB No. 107."* Truck Trailer Manufacturers Association's (TTMA) Recommended Practice (RP) No. 61 requires each manhole assembly to be "permanently marked" with the manufacturers name and with a statement that it conforms with RP No. 61-xx ("xx" are replaced by the year of the recommended practice). TTMA Technical Bulletin (TB) No. 107 does not require any marking on the manhole assembly or written certification. Any marking or written certification for assemblies tested under TTMA TB 107 would be as required under 49 CFR 180.405(g)(2)(i).

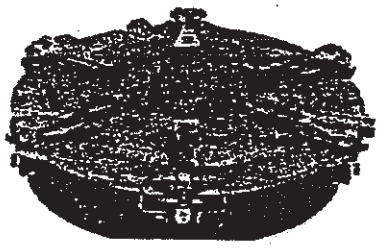
FACTORY CERTIFIED KNAPPCO AND CB™ MANHOLE ASSEMBLIES

Knappco Corporation will certify in writing that the following Knappco and CB manhole assemblies meet the requirements in 49 CFR 178.345-5(b) and 180.405(g). Additional information regarding these or other Knappco or CB manhole assemblies can be obtained from Knappco at (816) 741-6600 or FAX at (816) 741-1061. A copy of the certification letter **must** be maintained in the carrier's files. Page A-1 contains a copy of Knappco's letter which may be used for this purpose. Please note, however, that in some cases the normal vent may need to be replaced. **PLEASE NOTE: "CB" marking on manhole assemblies are covered by Knappco's certification letter. "C&B", "C/B" or "C-B" markings indicate the Clay and Bailey Company, a completely separate company.**

Knappco Aluminum Manhole Assemblies

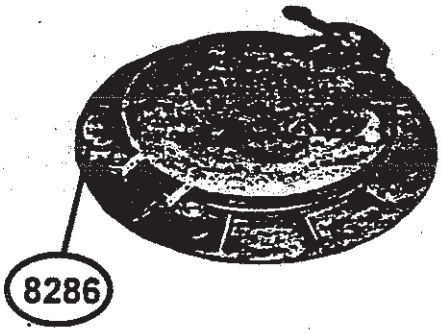
Knappco Model LM

A 20" full opening manhole assembly that does not have any vents and is equipped with six cam locks. These assemblies may not have any casting numbers or other marking on it. **No replacement required.**



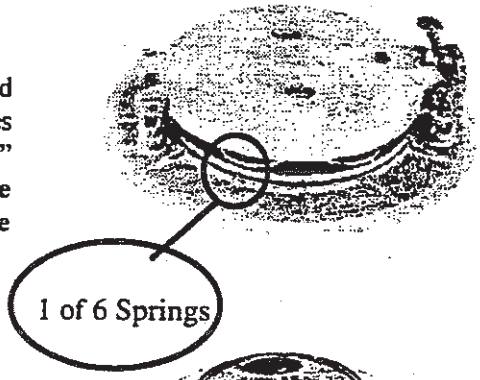
Knappco Model MA -or- CB Model 8200

A 15" manhole assembly with a 10" pressure activated fill cover installed on the cargo tank via four internal studs. These assemblies can be identified by the casting number of 8286 that appears on the 15" manhole assembly or any 8200 series number (8200 through 8299). These assemblies can be differentiated from the similar looking RA model by the six springs under the 10" fill cover as shown for the MB model below. **No replacement required.**



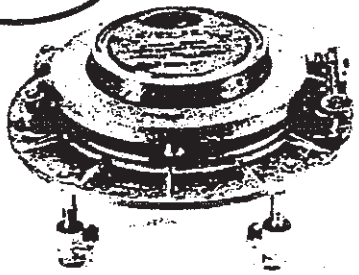
Knappco Model MB -or- CB Model 8200T

A 16" manhole assembly with a 10" pressure activated fill cover, installed on the cargo tank via a single or two piece clamp ring. These assemblies can be identified by the casting number of 8286 that appears on the 16" manhole assembly and the six springs under the 10" fill cover. **No manhole assembly replacement required, however, the clamp ring must be replaced as noted on page 5.**



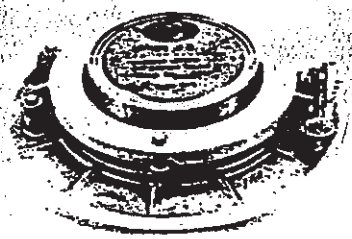
Knappco Model ME

A 15" manhole assembly with the first generation of Knappco's "smart" vent. These assemblies are installed on the cargo tank via four internal studs. The actual 15" manhole is the same as that used for the MA and MB models and have the casting number of 8286 that appears on the 15" manhole assembly. **No replacement required.**



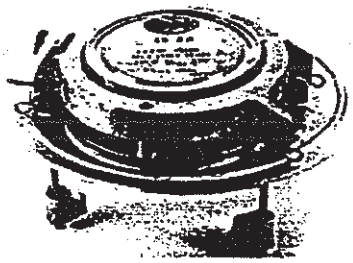
Knappco Model MF

A 16" manhole assembly with the first edition of Knappco's "smart" vent. These assemblies are installed on the cargo tank via a single or two piece clamp ring. The assembly cover is the same as that used for the MA and MB models and have the casting number of 8286 that appears on the 16" or assembly. **No manhole assembly replacement required, however, the clamp ring must meet the requirements on page 5.**



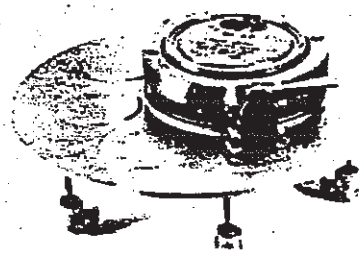
Knappco Model MG

A 16" manhole assembly that can be installed via either the four internal studs or clamp ring. These assemblies are equipped with Knappco's first generation "smart" vent and do not have any casting or stamped numbers on the upper (visible) portion of the manhole assembly when installed. **No manhole assembly replacement required, however, if a clamp ring is used it must meet the requirements on page 5.**



Knappco Model MH

A 20" version of the MG model manhole assembly and can be installed via either the four internal studs or clamp ring. These assemblies do not have any casting or stamped numbers on the upper (visible) portion of the manhole assembly when installed. **No manhole assembly replacement required, however, if a clamp ring is used it must meet the requirements on page 5.**



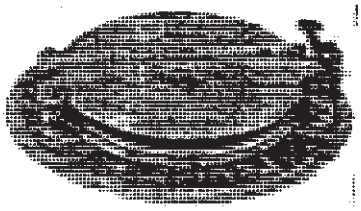
Knappco Models MP and MQ

The MP is a 16" manhole assembly having a manhole cover similar in appearance to that used on the MG model. The MQ is a 20" manhole assembly similar in appearance to that used on the MH model. Both the MP and MQ models vary from the MG and MH models (respectively) in that the "smart" vent is replaced by Knappco's conventional pressure activated vent used on the RA and RB model fill covers. **No manhole assembly replacement required, however, if a clamp ring is used it must meet the requirements on page 5.**

No graphic available for the MP or MQ models.

Knappco Models RA and RB

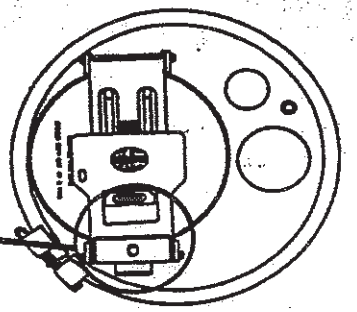
The RA is a 15" manhole assembly mounted via four studs and is similar in appearance to the MA model shown on page 3. These assemblies can be differentiated from the MA model by the lack of the six springs that are visible under the 10" fill opening. **The RB model, shown at right, is a 16" manhole which is mounted via a clamp ring which must meet the requirements on page 5.**



Knappco Steel And Stainless Steel Manhole Assemblies

Most Knappco steel and stainless steel manhole assemblies that meet the requirements of 49 CFR 178.345-5(b) are marked under the latch hinge as illustrated at right with the following:

KNAPPCO
TEST PRESSURE 36 PSIG
CERTIFIED 49 CFR 178.345-5



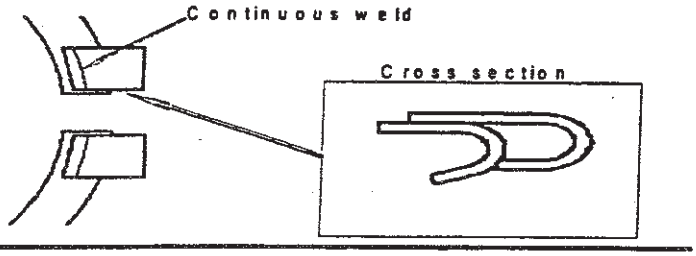
All Knappco steel and stainless steel manhole assemblies without the certification marking which meet the requirements in 49 CFR 180.405(g)(2) are made from 7 gauge material (0.171 to 0.187 inches thick). All of the steel manholes assemblies must be installed with the clamp ring meeting the requirements below.

Knappco and CB™ Clamp Rings

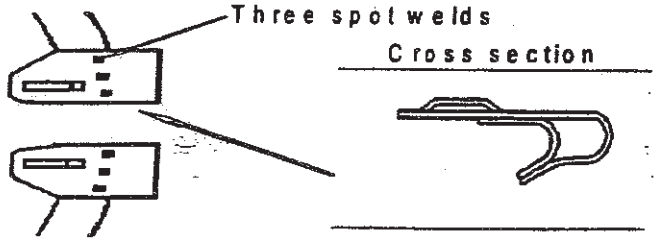
Knappco will only certify the Knappco and CB manholes assemblies when installed with a Knappco clamp ring, not a Tiona-Betts™ clamp ring. Knappco will certify either the single or two piece clamp rings that are gas welded. The previous clamp ring that can be identified by the three spot welds as noted at in the bottom sketch must be replaced..

Identification of Knappco Manhole Clamp Rings
Single or 2-piece Construction

New style clamp rings
in conformance with 49 CFR 178.345-5



Old style clamp ring that must be replaced

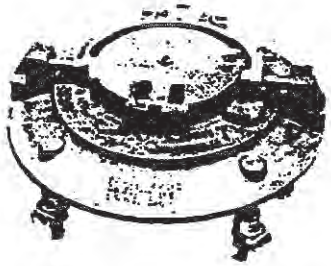


NON-FACTORY CERTIFIED CB™ MANHOLE ASSEMBLIES

Although not certified by Knappco, these CB™ assemblies may be tested and certified in accordance with 49 CFR 180.405(g)(2) by a registered inspector who takes sole liability for this certification. Although, it is believed that the 7355 series assemblies might meet the manhole test criteria in 49 CFR 180.405(g), the vents integrated into these manhole assemblies will not meet the leak rate criteria referenced in 49 CFR 180.405(h) and will have to be replaced beginning September 1, 1998.

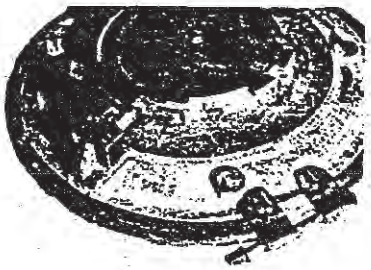
CB™ Model 7355

A 15" manhole assembly with a 10" pressure activated fill cover installed on the cargo tank via four internal studs. These assemblies can be identified by the model number of 7355M cast into the 15" manhole assembly. Also referred to as a "bank vault" assembly due to the locking mechanism for the 10" fill opening. **Must be tested and certified in writing, or replaced on DOT and SFM tanks.**



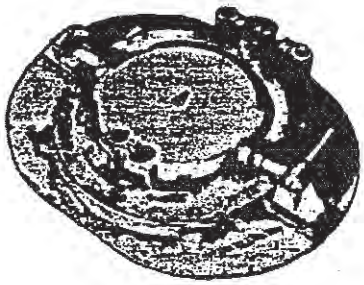
CB™ Model 7355T

A 16" manhole assembly with a 10" pressure activated fill cover installed on the cargo tank via a clamp ring. These assemblies can be identified by the model number of 7355M cast into the 16" manhole assembly. Also referred to as a "bank vault" assembly due to the locking mechanism for the 10" fill opening. **Manhole assembly must be tested and certified in writing, or replaced on DOT and SFM tanks. Clamp ring must meet the requirements shown on page 5 for both DOT and SFM tanks.**



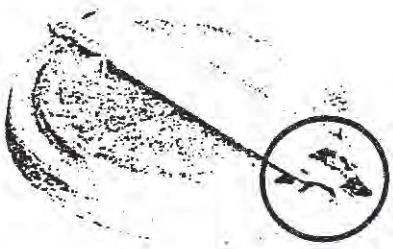
CB™ Model 7355T

An elliptical manhole assembly with a 10" pressure activated fill cover installed on the cargo tank via internal studs. These assemblies can be identified by the model number of 7355 O cast into the manhole assembly. Also referred to as a "bank vault" assembly due to the locking mechanism for the 10" fill opening. **Must be tested and certified in writing, or replaced on DOT and SFM tanks.**



CB™ Model 51-0 and CB Model 51-1F

These assemblies can be recognized by the unique latch on the fill opening as shown at right. **Must be replaced on DOT and SFM tanks.**



NOTE: All other KNAPPCO or CB™ manhole assemblies that are not marked pursuant to 49 CFR 178.345-5(e) must be tested and certified in writing, or replaced on DOT and SFM tanks.

FACTORY CERTIFIED TIONA-BETTS™ MANHOLE ASSEMBLIES

Tiona-Betts will certify all of their manhole assembly assemblies that meet any one of the marking options in ***STEP 1*** when the clamp ring also meets the marking requirements in ***STEP 2***. Tiona-Betts will not certify the manhole assembly if the clamp ring does not meet ***STEP 2***, (e.g., the Knappco clamp ring can not be substituted on a Tiona-Betts, and vise versa). PLEASE NOTE: The certification statement may also use the wording "ICC" in place of "DOT" as indicated below. Additional information regarding these or other Tiona-Bettsor manhole assemblies can be obtained from Betts Industries at (814) 723-1250. If the assembly is not marked, a copy of the certification letter (Page B-1) must be maintained in the carrier's files.

STEP 1

The manhole assembly is marked with any one of the following:

The pressure activated relief cover is marked:
"FLOW TESTED AND MARKED IN ACCORDANCE WITH DOT MC 306, NFPA NO. 385 AND NFPA NO. 407"

-or-

The strong back is marked:
"FLOW TESTED AND MARKED IN ACCORDANCE WITH DOT MC 306, NFPA NO. 385 AND NFPA NO. 407"

-or-

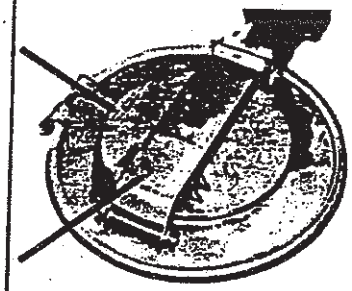
"TESTED AND MARKED IN ACCORDANCE WITH ICC MC 306, NFPA NO. 385, AND NFPA NO. 407 EMERGENCY PRESSURE ACTIVATED VENTING RATED 180,000 CU. FT/HR AT 5 PSIG."

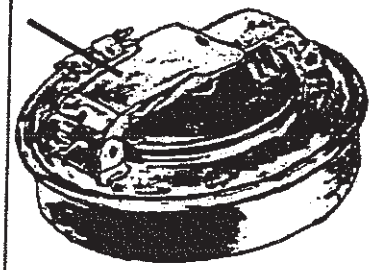
-or-

"Meets DOT 178.345-5 Test Pressure 36 psig."

-or-

"RP-61-xx"
(where "xx" is replaced by the year)

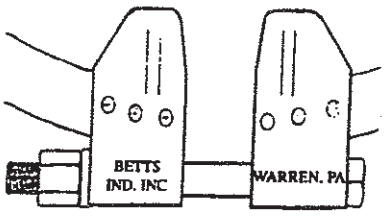




STEP 2

The clamp ring must be marked as indicated at right with:

"BETTS IND. INC WARREN, PA"

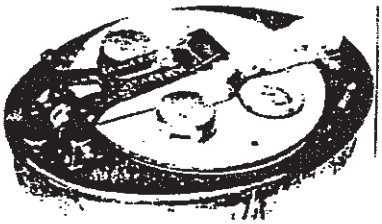


FACTORY CERTIFIED CLAY AND BAILEY MANHOLE ASSEMBLIES

The Clay and Bailey Company (C&B) issued a letter (Page C-1) for all of the manhole assemblies listed below. Carriers should contact Mr. Don David at (816) 924-3900 with the specific model number(s) for any additional information. As of this publication, all of the C&B manhole assemblies must be installed with a clamp ring meeting the marking requirements for either the Knappco clamp ring on page 5 or the Tiona-Betts clamp ring on page 7, ***STEP 2***. C&B will test their clamp ring in the near future and provide supplemental information when available. C&B model numbers 2120, 2140 and 1890 are current production manhole assemblies and are marked in conformance with 49 CFR 178.345-5(e). Models 1197-543 and 887-L-541 meet 49 CFR 180.405(g) pursuant to TTMA RP No. 61. Model numbers 950, 951, 2097 and 2097SL meet 49 CFR 180.405(g) pursuant to TTMA TB No. 107. **PLEASE NOTE: "C&B", "C/B" or "C-B" markings indicate the C&B manhole assemblies which are covered by Clay and Bailey's certification letter. "CB" marking on manhole assemblies indicate C.B. Equipment Co., Lynwood, California which are covered by Knappco's certification letter. In some instances C&B manhole assemblies may only have a "KC, MO" marking (for Kansas City, MO) in lieu of the above markings on the exterior of the assembly, and can be identified by the photos below.**

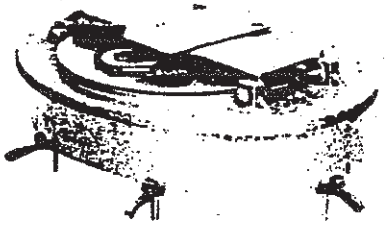
C&B Model 887

A 12" by 16" oval aluminum manhole assembly with fusible vent(s) and triplex (pressure, vacuum and normal) vent(s) mounted on the inside of the 10" fill cover. Manhole assembly is attached to the tank via four internal studs.



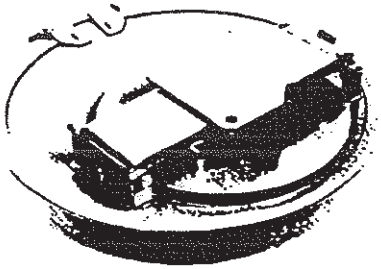
C&B Model 887-L-541

A 12" by 16" oval aluminum manhole assembly with a 10" fill cover with only fusible vents attached to the tank via four internal mounting studs.



C&B Model 950

A 16" or 20" manhole assembly with a 10" pressure activated fill cover for 306 type cargo tanks attached to the tank via a one piece clamp ring. The 16" assembly is shown at right and features the offset 10" fill cover. The 20" version has the 10" fill cover centered in the 20" manhole.

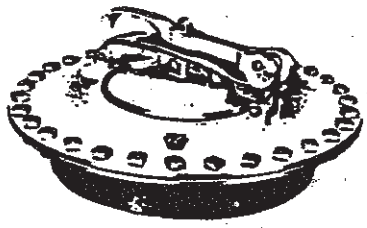


C&B Model 951

A 12" by 16" oval manhole assembly with a 10" pressure activated fill cover for use on 306 type cargo tanks attached to the tank via a one piece clamp ring. Meets 180.405(g) via the criteria established in TTMA TB No. 107.

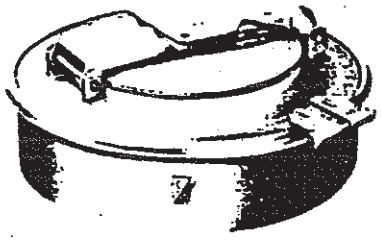
C&B Model 1197-543

A 16" manhole assembly designed for low pressure MC312 type cargo tanks, with an 8" fill opening. The assembly is attached to the tank via a series of bolts around the circumference of the assembly.



C&B Model 2097 -or- 2097SL

A 16" or 20" manhole assembly similar in appearance to the 950 shown on page 9, but without the pressure activated fill cover. It also has the 937 pressure, vacuum and normal vent mounted on the inside of the 10" fill opening.

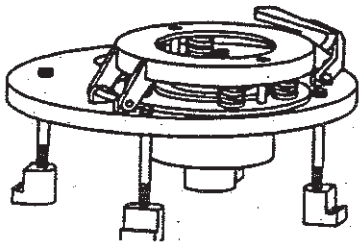


C&B Model 2120

A 16" diameter manhole assembly with pressure activated fill for the DOT 406 cargo tank, and is marked in full compliance with 49 CFR 178.345-5(e).

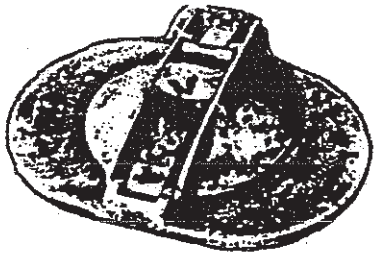
C&B Model 2140

A 20" diameter version of the 2140 above, with pressure activated fill for the DOT 406 cargo tank, and is marked in full compliance with 49 CFR 178.345-5(e).



NON-CERTIFIED A O SMITH™ MANHOLE ASSEMBLIES

As of this publication no information could be obtained for the A O Smith manhole assemblies shown at right. **Absent a letter of certification these manhole assemblies must be replaced.**



NON-CERTIFIED SHAND AND JURS™ MANHOLE ASSEMBLIES

As of 10-25-95, L&J Industries (the parent company for Shand and Jurs) does not have any certification information for any of the manhole assemblies produced under the Shand and Jurs trademark. The Shand and Jurs manhole assemblies are similar in appearance to the A O Smith shown above. Without any evidence, the owner of the tank would have to have the manholes tested and certified, or replaced. Contact Mr. Keith Stark at L&J Technologies at (708) 236-6000 for more information. **Absent a letter of certification these manhole assemblies must be replaced.**

No graphic available, similar to the A O SMITH

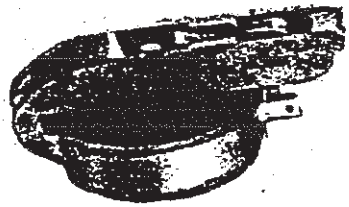
FILL COVERS

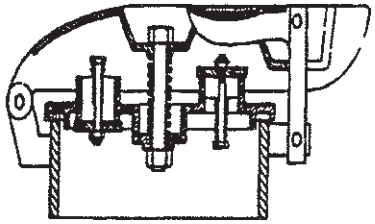
The following **fill** covers are examples of closures that do **not** meet the definition of a manhole assembly and are, therefore, **not** subject to replacement.

Knappco Fill Covers

CB Model 46-6

A 6" fill cover with pressure and normal vents installed. **No replacement required** since this is **not** a manhole assembly. This is one style of cover commonly used on small capacity DOT specification cargo tanks similar to those found on agricultural aircraft refueler trucks.

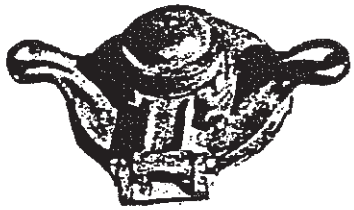




Clay and Bailey Fill Covers

C&B Model 337

A 6 or 8 inch fill opening commonly used on agricultural aircraft refueler (loaded) trucks. **No replacement of the fill opening required, however, in many instances the pressure vent does not meet the requirements for the MC306 specification.** Extra care should be taken to ensure the proper venting is installed. C&B's model 937 pressure vent will screw into the fill opening and will usually provide adequate venting (normal and emergency). The model 937 may, however, require slight modification to the 6 inch version of the C&B model 337 in order to allow the fill opening to open properly. The model 937 fits into the 8 inch fill opening without modification.



KNAPPCO CORPORATION
4304 MATTOX ROAD
KANSAS CITY, MISSOURI 64150

Telephone (816) 741-660
FAX (816) 741-106

July 25, 1995

To Knappco Customers:

This letter is in reference to manhole certification requirements set forth in HM-183, 183A sections 178.345-5, and 180.405(g) (2).

Manholes installed on cargo tanks prior to December 31, 1990:

Knappco Corporation will certify (based on test of current production models) that the following series of manholes met the requirements of 178.345-5(b) when shipped from the factory.

LM, MA (or CB-8200), MB (or CB-8200T), ME, MF, MG,
MH, MP, and MQ

Manholes and non-relieving fill covers installed on cargo tanks as of December 31, 1990:

The following series of manholes manufactured currently are tested and certification marked on each manhole before shipping as meeting the requirements of section 178.345-5. These are the only manholes presently certified by Knappco Corporation.

DT, DU, DV, DW
LM, MA, MB, ME, MF, MG, MH, MJ, MN, MP, MQ, MR,
MS, MT, MU, MV, MW, MX, MY
RA, RB, RP, RQ, RT, RU, RV, and RW

Manholes without marked certification cannot be installed.

Sincerely,

KNAPPCO CORPORATION

Bryan Van De Vyvere
Chief Engineer

KNAPPCO CORPORATION
4304 MATTOX ROAD
KANSAS CITY, MISSOURI 64150

Telephone (816) 741-6600
FAX (816) 741-1061

CERTIFICATION STATEMENT FOR ALUMINUM MANHOLES

All manholes installed on cargo tanks as of December 31, 1990, must meet the manhole certification requirements set forth in DOT 49 CFR 178.345-5, and 180.405(g)(2). Manholes that meet these requirements have the following information cast on the main cover (See figure 1 for location):

TEST PRESSURE
36 PSIG
CERTIFIED HM 183
178 345-5

Manholes installed on cargo tanks before December 31, 1990, that do not have the above cast information may comply with DOT 49 CFR 180.405(g) and conform to TTMA recommended practice number 61 by meeting the following conditions:

1. The main cover must have one of the following part numbers cast onto it:
   A. "8286" - Cover part number.
   B. "Model 8200" - Assembly part number.

2. If the units are equipped with a clamp ring style hold down, the clamp ring must have clips that are gas metal arc welded to the ring. Resistance welded (spot welded) clips are **not** allowed. The clamp ring must be made from material that is 12 gauge (0.096 to 0.112 inches) thick.

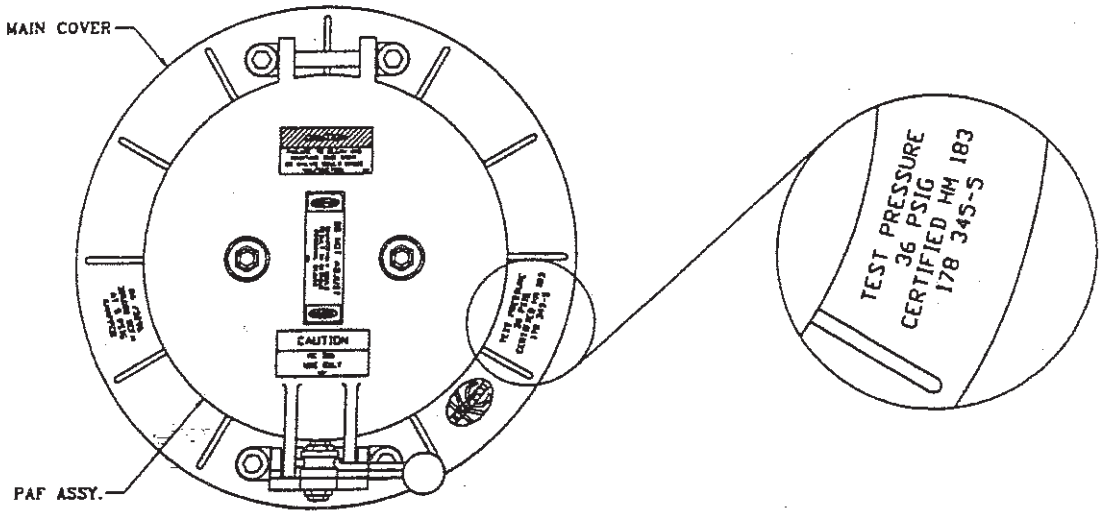


FIGURE 1:

KNAPPCO CORPORATION
4304 MATTOX ROAD
KANSAS CITY, MISSOURI 64150

Telephone (816) 741-660(
FAX (816) 741-106

CERTIFICATION STATEMENT FOR STEEL / STAINLESS STEEL MANHOLES

All steel and stainless steel manholes installed on cargo tanks as of December 31, 1990, must meet the manhole certification requirements set forth in DOT 49 CFR 178.345-5, and 180.405(g)(2). Manholes that meet these requirements have the following information stamped on the main cover between the latch brackets (See figure 1 for location):

KNAPPCO
TEST PRESSURE 36 PSIG
CERTIFIED 49 CFR 178.345-5

Manholes installed on cargo tanks before December 31, 1990, that do not have the above stamped information may comply with DOT 49 CFR 180.405(g) and conform to TTMA recommended practice number 61 by meeting the following conditions:

1. The main steel cover must be made from material that is 7 gauge (0.171 to 0.187 inches) thick. 12 gauge material thickness is **not** allowed.

2. The clamp ring must have clips that are gas metal arc welded to the ring as fabricated from the factory. Resistance welded (spot welded) clips are **not** allowed. The clamp ring must be made from material that is 12 gauge (0.096 to 0.112 inches) thick.

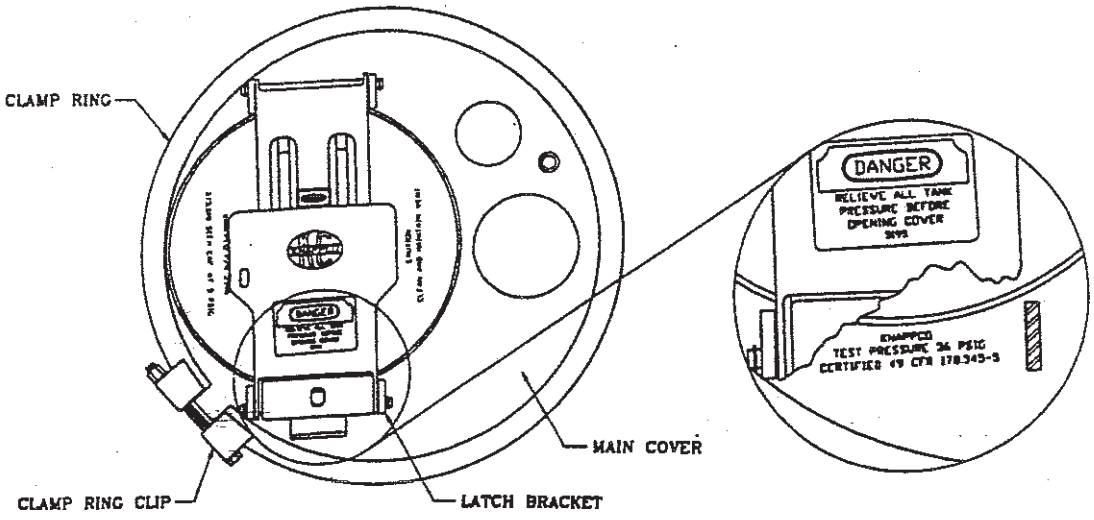


FIGURE 1:

KNAPPCO CORPORATION
4304 MATTOX ROAD
KANSAS CITY, MISSOURI 64150

Telephone (816) 741-660
FAX (816) 741-106

April 17, 1995

KNAPPCO CORPORATION

CERTIFICATION STATEMENT

Knappco manhole assemblies comply with DOT 49 CFR 180.405(g) and conform to TTMA recommended practice number 61 by meeting the following conditions:

1. The main steel cover must be made from material that is 7 gauge (0.171 to 0.187 inches) thick. 12 gauge material thickness is "not" allowed.

2. The clamp ring must have clips that were gas metal arc welded to the ring as fabricated from the factory (resistance welded clips are "not" allowed).

   The clamp ring must be made from material that is 12 gauge (0.096 to 0.112 inches) thick.

KNAPPCO CORPORATION

Bryan Van De Vyvere
Chief Engineer

BV/rb

Betts

TEL 814/723-1250
FAX 814/723-7030

BETTS INDUSTRIES, INC. 1800 PENNA. AVE. W. ■ BOX 885 ■ WARREN, PA. 16365-0885

Since 1901

June 16, 1995

NOTICE TO BETTS-TIONA MANHOLE CUSTOMERS

The U.S. Department of Transportation Requirements for Cargo Tanks, Docket No. HM-183 states that each manhole assembly installed on MC 300, MC 301, MC 302, MC 303, MC 305 and MC 306 cargo tanks must be capable of withstanding a static internal fluid pressure of at least 36 psig without leakage or permanent deformation that would affect its structural integrity.

The owner of a cargo tank manufactured prior to December 31, 1990 must comply with the new regulation either by retrofitting the cargo tank with a manhole assembly conforming to the regulation's specifications or by obtaining a certification from the manufacturer of the manhole assembly that it conforms to Recommended Practice (RP) No. 61 of the Truck Trailer Manufacturers Association (TTMA). The retrofitting or certification must be accomplished by August 31, 1995, except that owners of five (5) or more cargo tanks subject to the regulation must retrofit or certify 20% of such tanks each year beginning in 1990 until all are in compliance.

In cases where the manufacturer of a manhole assembly cannot be identified or the manufacturer cannot certify compliance with RP No. 61, the owner may have the manhole closure tested in accordance with the procedure set forth in TTMA Technical Bulletin No. 107, and if the test is successful, the assembly may be certified as being in compliance with the new regulation.

This memorandum will serve as certification by Betts Industries, Inc. that certain Betts-Tiona manholes (identified below) do conform to TTMA RP No. 61, but only <u>as manufactured</u> and only if <u>properly installed</u> on MC 300, MC 301, MC 302, MC 303, MC 305 and MC 306 cargo tanks. This certification is sufficient to satisfy the new regulation with respect to such manholes. HOWEVER, THIS CERTIFICATION IS NOT A REPRESENTATION OF WARRANTY THAT ANY PARTICULAR BETTS-TIONA MANHOLE CURRENTLY IN USE WOULD PASS THE TEST OUTLINED IN TTMA RP NO. 61 (WHICH OBVIOUSLY DEPENDS ON USAGE AND MAINTENANCE HISTORY) OR THAT SUCH MANHOLE IS IN COMPLIANCE WITH ANY OTHER DEPARTMENT OF TRANSPORTATION REQUIREMENT.

JUNE 16, 1995

Betts

TEL. 814/723-1250
FAX 814/723-7030

BETTS INDUSTRIES, INC. 1800 PENNA. AVE. W. ■ BOX 888 ■ WARREN, PA. 16365-0888
Since 1901

The manhole assembly must meet the following two conditions to be in the class subject to the above certification:

(1A) The pressure activated relief valve cover or in some cases the strongback must bear one of the following legends:

"FLOW TESTED AND MARKED IN ACCORDANCE WITH DOT MC 306, NFPA NO. 385, NFPA NO. 407."

"TESTED AND MARKED IN ACCORDANCE WITH ICC MC 306, NFPA NO. 385, AND NFPA NO. 407 EMERGENCY PRESSURE ACTUATED VENTING RATED 180,000 CU. FT/HR. AT 5 PSIG."

OR

(1B) The strongback will be marked with RP-61.

OR

(1C) Meets DOT 178.345-5.
Test pressure 36 psig.

(2) The top side of the left clip on the clamp ring must be stamped "BETTS IND., INC." and the right clip, "WARREN, PA." (See attached illustration.)

If replacement of the clamp ring is the only step necessary to meet these conditions, replacement should be made only by a qualified dealer or other qualified mechanic.

If you have questions concerning this notice, consult your Betts distributor. Thank you.

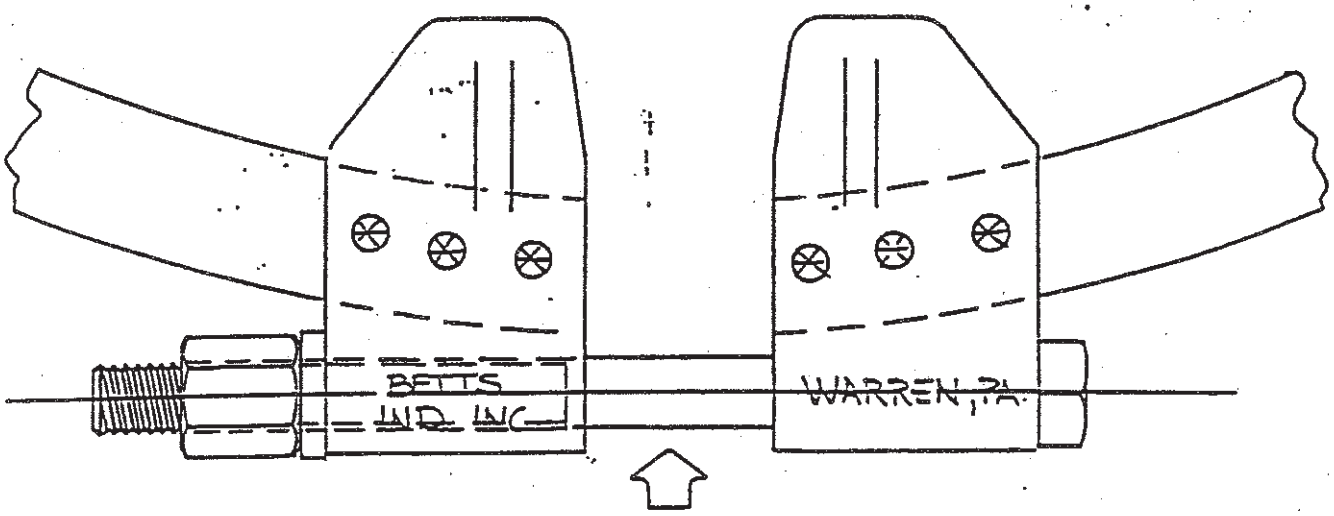
Very truly yours,

BETTS INDUSTRIES, INC.

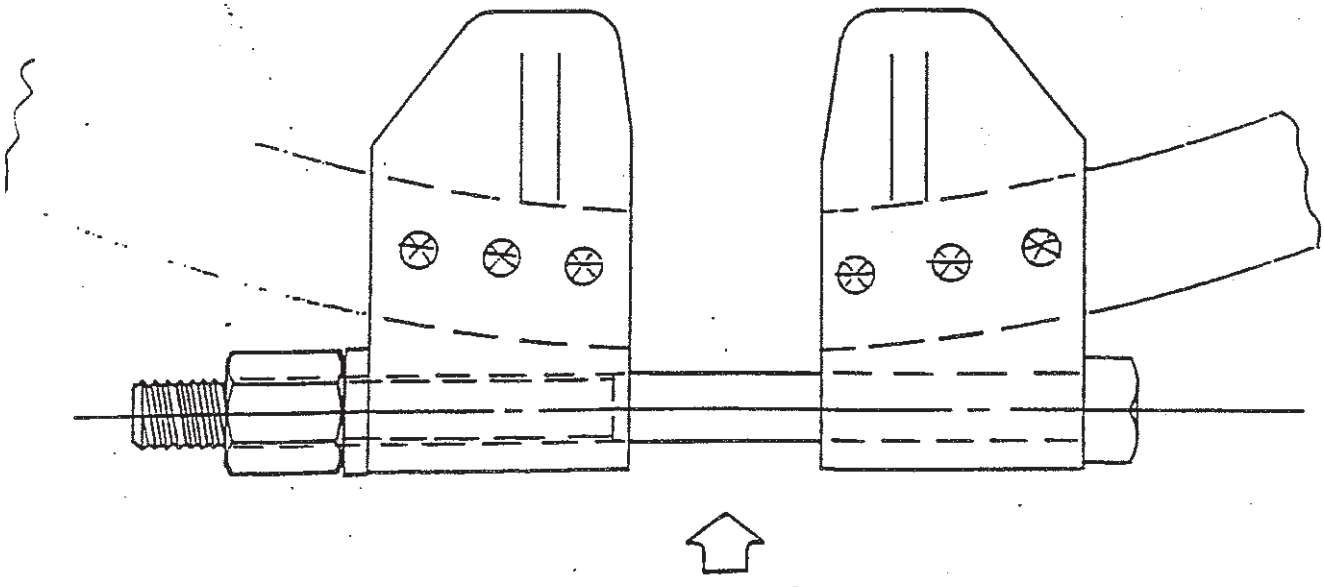
Thomas E. Mooney
Vice President, Sales

TEM:pae

ILLUSTRATIONS FOR STEP TWO



NO REPLACEMENT NEEDED



REPLACE CLAMP RING

Manufacturers (U Stamp)

A common misconception is the Code will lead the user to the required rule; this is not the case. All pertinent code rules are in effect at all times. It is up to the Code user to search for them.

	CT# Current, complete Third party companies (AI, DCEs, NDT, etc.)
	Verify DCE qualifications
	Verify RI qualifications
	Training – including ASME Code
	Certificate of compliance CTMV specific Design type
	Last audit report
	Name Plates UG-119 and UG-116(e)

Manufacturer's Data Report (MDR, U-1A)

	See UG-115
	See separate NBIC checklist
	If no impact testing done, must cite the Code section of exemption (UG-20, UCS-66, UHA-51)
	Nominal – shell
	Minimum – heads
	Certifications – endorsement – new construction = A; in service = IC
	Code case – dash numbers are revisions
	Material specification must be complete ASME material specification, including grade and/or class.
	Weld types (not weld categories) Table UW-12
	Inspection openings
	Head Description: Type of Head — Data Entered torispherical — crown and knuckle radii semi-ellipsoidal — elliptical ratio conical head — conical apex angle toriconical — knuckle radius and conical — apex angle hemispherical — head hemispherical radius flat head — flat diameter
	Nozzle attachment ("welded" is not sufficient, must be sketch type UW-16.1 or weld type UW-12)
	Joint-weld efficiencies
	Complete name and address as shown on the U stamp
	National Board registration number – numerical starting with 1 and no skips or gaps
	Code edition and Addendum
	Construction materials

	Partial Data Reports identified by part name, serial # and manufacturer's name, and attached to the MDR
	Supplemental sheets (when used, must be referenced on MDR) attached
	Size – length and diameter of pressure vessel
	Signature and date
	Handwritten notations on typed forms must be initialed and dated by Mfgr and AI
	Original must be submitted to the National Board

Quality Control System

	Quality Control System/Manual see separate ASME guide see Division VIII, Appendix 10
	Establish authority and responsibility Responsibilities must be assigned to a functional title
	Organizational Chart, including relationship between management and engineering, purchasing, manufacturing, inspection, etc.
	Procedures to ensure use of latest drawings, calculations, specifications, instructions and authorized changes in manufacturing process
	Process to ensure material control
	Description of fabrication operations including examinations
	System to correct nonconformities
	Provisions to comply with Section IX
	Provisions to comply with NDT
	Controls for HT
	Controls for calibration of test equipment
	System for records retentions
	Sample forms
	Process for AI inspections and access to documents
	Procedure for inspection of PRDs
	What are their controls for field work?
	Subcontractors – review, approval process
	Authorized Changes section – not documenting revisions
	UG-90(c)(2) – mass production
	QCS must reference the AI and provide access for the AI at the plant and all documents

Various specification issues

	Pads internal appurtenances, such as baffles external appurtenances proper size
	Proper REPDs Dimensions Split REPD issues
	Manway assembly certification
	Bottom outlet protection devices
	Overturn protection Items above overturn Use of pads
	Proper PRDs, venting capacity
	Complete specification and name plates
	Proper fusible devices
	Review applicable specification sections

Welding

	Welder Performance Qualifications Section IX Article II
	Procedure Qualifications Record Section IX Article II
	Welding Procedure Specification Section IX Article III
	Stamp holder has to maintain certified records of results for WPS and WPQ – original signature of responsible person QW-103
	Changes to essential variables require requalification of the WPS
	Must follow all elements of WPS
	UW-47, Division I – AI shall ensure the welding procedure used is qualified
	UW-48 – AI shall ensure the welders are qualified
	Welders training
	Welder continuity log Must qualify to each procedure – MIG, TIG, etc., manual vs auto
	Proper weld size, quality (too hot, too cold, insufficient, speed, material not cleaned)
	Compatibility of materials, weld material
	Welder mark/symbol
	Third Party Welders – see ASME UW-26
	Compare the WP and PQR
	Welders interview
	Document review plan Section IX requirements Code of Construction (Section VIII) – PWHT, impact testing Work to be performed – does WPS qualify what they are welding?
	Stamp holder has to qualify their welders
	Stamp holder has to maintain certified records of results for WPS and WPQ – original signature of responsible person

	QW-194 – visual examination of welds – no qualification for examiner – cracks, fusion, penetration
	Must use welding procedures allowed by Section VIII
	Section VIII trumps Section IX

Manufacturing Process

	Manufacturer's duties UG-90(b) See separate check list
	Material Test Reports (Mill spec reports) – verify it matches the product
	How do they verify the thickness of the plate and head material at receiving?
	Manufacturer has to test and certify their metal to the Code
	AI responsibilities – see Division VIII, UG-90(c)(1) Must monitor the Quality Control System (UG-91(b))
	Non-Conforming Reports
	AI Bound Diary
	Traveler
	Proper pressure testing (Part 178 and UG-99), documentation
	Proper test gauge range, calibration, and placement UG-102(a), (b), and (c)
	Post weld heat treatment Welders must be qualified with PWHT UW-10 – PWHT
	WFMPE – see separate checklist
	QT Tanks (UHT) Nozzle welds must be full-penetration design (not fillet welds) Impact testing UHT-6 for all materials in Table UHT-23 UHT-82 Specific performance requirements for welding and welding procedures RT, PWHT and WFMPE after completion

Design Calculations

	Must have calculations for EACH DESIGN TYPE
	Must be for ALL GVWRs and Dimensions
	All drawings, calculations, etc. must be **signed and certified** by DCE
	Check for any changes to design type without calculations and certification
	Rollover (overturn) Protection device Device itself Tank shell 178.345-8(c)(1) and 178.345-8(a)(3)
	Rear End Protection Device Dimensions (6" forward; 4" from bottom, 18" from sides) 2g longitudinally distributed 178.345-8(d)(3) 155,000 lbs. (when applicable) from front, side or rear, no more than 6' 178.345-8(b)(1)
	Tank shell – multiple requirements – 178.345-3
	All other accident damage protection devices
	Design calculation data must match mill specs and ASME tables

AI Responsibilities

	UG-90(c)(1) – AI's responsibilities See separate checklist
	UW-47, Division I – AI shall ensure the welding procedure used is qualified
	UW-48 – AI shall ensure the welders are qualified
	AI can call for and witness welding tests at any time of any welder or procedure

Radiography (RT)

	Results must be recorded on a reader sheet
	Must be interpreted by qualified personnel – have to know the acceptance criteria
	With tails – crack is starting
	Slag inclusions – avoid by cleaning after each pass with a wire brush
	Not required to use SNT or other standards
	Exemptions for welds in nozzles and other hard to reach locations
	UW-11 spot radiography
	UW-12 no radiography
	UW-50 – NDT is required prior to pneumatic testing
	UW-51(a) – all welds to be radiographed, written procedure not required
	UW-51 (b) correction of imperfections
	UW-52 allows butt welds to be spot radiographed
	No standard for porosity in spot radiography
	The RT level can only be determined from the name plate; it is not required on the MDR

Manufacturer's Duties (UG-90(b))

The duties of the Manufacturer include, but are not limited to:

	The Certificate of Authorization from the ASME Boiler and Pressure Vessel Committee authorizing the Manufacturer to fabricate the class of vessel being constructed UG-117(a)
	The drawings and design calculations for the vessel or part 10-5 and 10-15(d)
	Identification for all material used in the fabrication of the vessel or part (UG-93)
	securing Partial Data Reports UG-120(c) (for components received from other vendors)
	Access for the AI in accordance with UG-92 and 10-15
	Examination of all materials before fabrication to make certain they have the required thickness, to detect defects (UG-93(d)), to make certain the materials are permitted by this Division (UG-4), and that traceability (UG-77) to the material identification (UG-93) has been maintained
	Documentation of impact tests when such tests are required (UF-5, UCS-66, UHA-51, UHT-6, and ULT-5)
	Concurrence of the Inspector prior to any base metal repairs (UG-78 and UF-37)
	Examination of the shell and head sections to confirm they have been properly formed to the specified shapes within the permissible tolerances (UG-79, UG-80, UG-81, UF-27, and UF-29)
	Qualification of the welding and/or brazing procedures before they are used in fabrication (UG-84(h), UW-28(b), and UB-31)
	Qualification of welders and welding operators and brazers before using the welders or brazers in production work (UW-29, UW-48, UB-32, and UB-43)
	Examination of all parts prior to joining to make certain they have been properly fitted for welding or brazing and that the surfaces to be joined have been cleaned and the alignment tolerances are maintained (UW-31, UW-32, UW-33, and UB-17)
	Examination of parts as fabrication progresses, for material marking (UG-94), that defects are not evident (UG-95), and that dimensional geometries are maintained (UG-96 and UF-30)
	Provision of controls to assure that all required heat treatments are performed (UW-2, UW-10, UG-85, UF-31, and 10-11)
	Provision of records of nondestructive testing examinations performed on the vessel or vessel parts. This shall include retaining the radiographic film if radiographic examinations are performed (UW-51, UW-52, (15) and 10-10)
	Making the required hydrostatic or pneumatic test and having the required inspection performed during such test (UG-99, UG-100, UG-101, and UW-50)
	Applying the required stamping and/or nameplate to the vessel and making certain it is applied to proper vessel (UG-116, UG-118, and UG-119)
	Preparing required Manufacturer's Data Report and having it certified by the Inspector (UG-120)
	Providing for retention of radiographs (UW-51), ultrasonic test reports (12-4), Manufacturer's Data Reports(UG-120), and other documents as required by this Division (10-13)

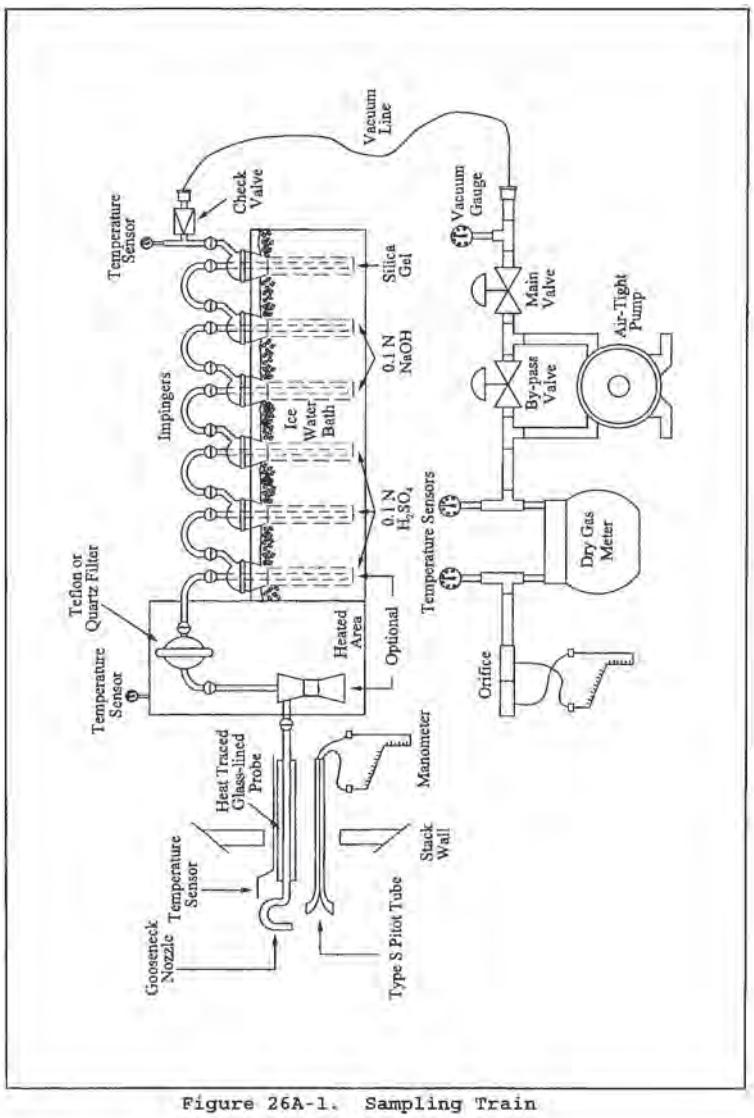


Figure 26A-1. Sampling Train

METHOD 27—DETERMINATION OF VAPOR TIGHTNESS OF GASOLINE DELIVERY TANK USING PRESSURE VACCUUM TEST

1.0 Scope and Application

1.1 Applicability. This method is applicable for the determination of vapor tightness of a gasoline delivery collection equipment.

2.0 Summary of Method

2.1 Pressure and vacuum are applied alternately to the compartments of a gasoline delivery tank and the change in pressure or vacuum is recorded after a specified period of time.

3.0 Definitions

3.1 *Allowable pressure change (Δp)* means the allowable amount of decrease in pressure during the static pressure test, within the time period t, as specified in the appropriate regulation, in mm H_2O.

3.2 *Allowable vacuum change (Δv)* means the allowable amount of decrease in vacuum during the static vacuum test, within the time period t, as specified in the appropriate regulation, in mm H_2O.

3.3 *Compartment* means a liquid-tight division of a delivery tank.

3.4 *Delivery tank* means a container, including associated pipes and fittings, that is attached to or forms a part of any truck, trailer, or railcar used for the transport of gasoline.

3.5 *Delivery tank vapor collection equipment* means any piping, hoses, and devices on the delivery tank used to collect and route gasoline vapors either from the tank to a bulk terminal vapor control system or from a bulk plant or service station into the tank.

3.6 *Gasoline* means a petroleum distillate or petroleum distillate/alcohol blend having a Reid vapor pressure of 27.6 kilopascals or greater which is used as a fuel for internal combustion engines.

3.7 *Initial pressure (P_i)* means the pressure applied to the delivery tank at the beginning of the static pressure test, as specified in the appropriate regulation, in mm H_2O.

3.8 *Initial vacuum (V_i)* means the vacuum applied to the delivery tank at the beginning of the static vacuum test, as specified in the appropriate regulation, in mm H_3.

3.9 *Time period of the pressure or vacuum test (t)* means the time period of the test, as specified in the appropriate regulation, during which the change in pressure or vacuum is monitored, in minutes.

4.0 Interferences [Reserved]

5.0 Safety

5.1 Gasoline contains several volatile organic compounds (*e.g.*, benzene and hexane) which presents a potential for fire and/or explosions. It is advisable to take appropriate precautions when testing a gasoline vessel's vapor tightness, such as refraining from smoking and using explosion-proof equipment.

5.2 This method may involve hazardous materials, operations, and equipment. This test method may not address all of the safety problems associated with its use. It is the responsibility of the user of this test method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to performing this test method

6.0 Equipment and Supplies

The following equipment and supplies are required for testing:

6.1 Pressure Source. Pump or compressed gas cylinder of air or inert gas sufficient to pressurize the delivery tank to 500 mm (20 in.) H_2O above atmospheric pressure.

6.2 Regulator. Low pressure regulator for controlling pressurization of the delivery tank.

6.3 Vacuum Source. Vacuum pump capable of evacuating the delivery tank to 250 mm (10 in.) H_2O below atmospheric pressure.

6.4 Pressure-Vacuum Supply Hose.

6.5 Manometer. Liquid manometer, or equivalent instrument, capable of measuring up to 500 mm (20 in.) H_2O gauge pressure with ±2.5 mm (0.1 in.) H_2O precision.

6.6 Pressure-Vacuum Relief Valves. The test apparatus shall be equipped with an inline pressure-vacuum relief valve set to activate at 675 mm (26.6 in.) H_2O above atmospheric pressure or 250 mm (10 in.) H2O below atmospheric pressure, with a capacity equal to the pressurizing or evacuating pumps.

6.7 Test Cap for Vapor Recovery Hose. This cap shall have a tap for manometer connection and a fitting with shut-off valve for connection to the pressure-vacuum supply hose.

6.8 Caps for Liquid Delivery Hoses.

7.0 Reagents and Standards [Reserved]

8.0 Sample Collection, Preservation, Storage, and Transport

8.1 Pretest Preparations.

8.1.1 Summary. Testing problems may occur due to the presence of volatile vapors and/or temperature fluctuations inside the delivery tank. Under these conditions, it is often difficult to obtain a stable initial pressure at the beginning of a test, and erroneous test results may occur. To help prevent this, it is recommended that prior to testing, volatile vapors be removed from the tank and the temperature inside the tank be allowed to stabilize. Because it is not always possible to completely attain these pretest conditions, a provision to ensure reproducible results is included. The difference in results for two consecutive runs must meet the criteria in Sections 8.2.2.5 and 8.2.3.5.

8.1.2 Emptying of Tank. The delivery tank shall be emptied of all liquid.

8.1.3 Purging of Vapor. As much as possible the delivery tank shall be purged of all volatile vapors by any safe, acceptable method. One method is to carry a load of nonvolatile liquid fuel, such as diesel or heating oil, immediately prior to the test, thus flushing out all the volatile gasoline vapors. A second method is to remove the volatile vapors by blowing ambient air into each tank compartment for at least 20 minutes. This second method is usually not as effective and

often causes stabilization problems, requiring a much longer time for stabilization during the testing.

8.1.4 Temperature Stabilization. As much as possible, the test shall be conducted under isothermal conditions. The temperature of the delivery tank should be allowed to equilibrate in the test environment. During the test, the tank should be protected from extreme environmental and temperature variability, such as direct sunlight.

8.2 Test Procedure.

8.2.1 Preparations.

8.2.1.1 Open and close each dome cover.

8.2.1.2 Connect static electrical ground connections to the tank. Attach the liquid delivery and vapor return hoses, remove the liquid delivery elbows, and plug the liquid delivery fittings.

NOTE: The purpose of testing the liquid delivery hoses is to detect tears or holes that would allow liquid leakage during a delivery. Liquid delivery hoses are not considered to be possible sources of vapor leakage, and thus, do not have to be attached for a vapor leakage test. Instead, a liquid delivery hose could be either visually inspected, or filled with water to detect any liquid leakage.

8.2.1.3 Attach the test cap to the end of the vapor recovery hose.

8.2.1.4 Connect the pressure-vacuum supply hose and the pressure-vacuum relief valve to the shut-off valve. Attach a manometer to the pressure tap.

8.2.1.5 Connect compartments of the tank internally to each other if possible. If not possible, each compartment must be tested separately, as if it were an individual delivery tank.

8.2.2 Pressure Test.

8.2.2.1 Connect the pressure source to the pressure-vacuum supply hose.

8.2.2.2 Open the shut-off valve in the vapor recovery hose cap. Apply air pressure slowly, pressurize the tank to P_i, the initial pressure specified in the regulation.

8.2.2.3 Close the shut-off and allow the pressure in the tank to stabilize, adjusting the pressure if necessary to maintain pressure of P_i. When the pressure stabilizes, record the time and initial pressure.

8.2.2.4 At the end of the time period (t) specified in the regulation, record the time and final pressure.

8.2.2.5 Repeat steps 8.2.2.2 through 8.2.2.4 until the change in pressure for two consecutive runs agrees within 12.5 mm (0.5 in.) H_2O. Calculate the arithmetic average of the two results.

8.2.2.6 Compare the average measured change in pressure to the allowable pressure change, Δp, specified in the regulation. If the delivery tank does not satisfy the vapor tightness criterion specified in the regulation, repair the sources of leakage, and repeat the pressure test until the criterion is met.

8.2.2.7 Disconnect the pressure source from the pressure-vacuum supply hose, and slowly open the shut-off valve to bring the tank to atmospheric pressure.

8.2.3 Vacuum Test.

8.2.3.1 Connect the vacuum source to the pressure-vacuum supply hose.

8.2.3.2 Open the shut-off valve in the vapor recovery hose cap. Slowly evacuate the tank to V_i, the initial vacuum specified in the regulation.

8.2.3.3 Close the shut-off valve and allow the pressure in the tank to stabilize, adjusting the pressure if necessary to maintain a vacuum of V_i. When the pressure stabilizes, record the time and initial vacuum.

8.2.3.4 At the end of the time period specified in the regulation (t), record the time and final vacuum.

8.2.3.5 Repeat steps 8.2.3.2 through 8.2.3.4 until the change in vacuum for two consecutive runs agrees within 12.5 mm (0.5 in.) H_2O. Calculate the arithmetic average of the two results.

8.2.3.6 Compare the average measured change in vacuum to the allowable vacuum change, Δv, as specified in the regulation. If the delivery tank does not satisfy the vapor tightness criterion specified in the regulation, repair the sources of leakage, and repeat the vacuum test until the criterion is met.

8.2.3.7 Disconnect the vacuum source from the pressure-vacuum supply hose, and slowly open the shut-off valve to bring the tank to atmospheric pressure.

8.2.4 Post-Test Clean-up. Disconnect all test equipment and return the delivery tank to its pretest condition.

9.0 Quality Control

Section(s)	Quality control measure	Effect
8.2.2.5, 8.3.3.5	Repeat test procedures until change in pressure or vacuum for two consecutive runs agrees within ±12.5 mm (0.5 in.) H_2O.	Ensures data precision.

What are the Packaging and Marking Requirements for MOTs?

Materials of Trade also have packaging and marking requirements that help increase safety. The packaging must be the manufacturer's original packaging or a package of equal or greater strength and integrity. The packaging must be marked with a common name (such as "gas" or "spray paint") or a proper shipping name from the HMR (such as "Isopropyl Alcohol".) Additionally, the following other requirements apply to MOTs:

- Packagings must be leak tight for liquids and gases, and sift proof for solids.
- Packages must be securely closed, secured against movement, and protected against damage.
- Outer packagings are not required for receptacles (such as cans or bottles) that are secured against movement in cages, bins, boxes, or compartments.
- Gasoline must be transported in a metal or plastic container meeting DOT or OSHA requirements (Section 173.6 (b) (4) and Section 173.202 in the HMR).
- Cylinders and pressure vessels must conform to the HMR except that outer packagings are not required. These cylinders must be marked with the proper shipping name and identification number and have a hazard class warning label.
- If the package contains a reportable quantity of a hazardous substance, it must be marked "RQ". Reportable quantities are found in Appendix A of Section 172.101 in the HMR.
- A tank containing a diluted mixture (not more than 2% concentration) of a Class 9 material must be marked on two opposing sides with the identification number.

PHMSA Hazmat Safety Homepage

To learn more, visit the PHMSA Hazmat Safety Homepage on the Internet, at http://hazmat.dot.gov. There, you can order training CD-ROMs, videotapes, and publications. You can also view or download the HMR, copies of the latest rulemakings, exemptions, clarifications of regulations, hazardous materials publications, and training schedules.

GOT A HAZMAT QUESTION?

http://hazmat.dot.gov

INFO-LINE
1-800-467-4922

U.S. Department of Transportation
Pipeline and Hazardous Materials Safety Administration
400 Seventh Street, SW, PHH-50
Washington, DC 20590
E-Mail: training@dot.gov

PHH50-0062-0905

MOTs Video Available from the Pipeline and Hazardous Materials Safety Administration

To help you better understand Materials of Trade regulations, PHMSA has developed an informative video titled Understanding Materials of Trade Regulations. The video defines Materials of Trade; discusses what hazardous materials may be transported as MOTs; and provides an overview of what hazardous materials regulations apply. It is available from PHMSA's Office of Hazardous Materials Initiatives and Training for a shipping and handling fee of $10.

The Understanding Materials of Trade Regulations video can be ordered on-line by visiting our web site at: http://hazmat.dot.gov/pubs.htm; by e-mail: training@dot.gov; or by filling out the form below and faxing it to: (202) 366-7342, or mailing it to the address indicated at the bottom of the form.

Please send ____ Understanding Materials of Trade Regulations video(s) to:

Name: _____

Company: _____

Address: _____

City: _____

State/Zip: _____

Phone: _____

FAX: _____

E-Mail: _____

$10 (each video) covers shipping and handling.

Credit card #: _____
Expiration date: _____
Signature: _____

We accept:

or personal checks made payable to: USDOT/PHMSA/PHH-50

HAZARDOUS MATERIALS TRANSPORTATION
Compliance Basics Series

WHAT ARE MATERIALS OF TRADE, And What Regulations Apply?

U.S. Department of Transportation
Pipeline and Hazardous Materials Safety Administration

Whether you are self-employed or work for a large company, you may be carrying hazardous materials as part of your job. A hazardous material is "a substance or material which has been determined by the U.S. Department of Transportation (DOT) to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce." This definition is found in the requirements for transporting hazardous materials known as the Hazardous Materials Regulations (HMR), issued by DOT's Pipeline and Hazardous Materials Safety Administration (PHMSA.) The HMR tell you:

- how to classify and package hazardous materials;
- how the package must be marked and labeled;
- how to complete shipping papers;
- how to provide required emergency response information;
- whether the vehicle transporting hazardous materials must be placarded and the specific placards required; and
- what training is required for handlers and shippers of hazardous materials.

The HMR are published in Title 49, Code of Federal Regulations (49 CFR), Parts 171-180.

Certain hazardous materials transported in small quantities as part of a business are subject to less regulation, because of the limited hazard they pose. These materials are known as Materials of Trade.

What Are Materials of Trade, and What Regulations Apply?

Materials of Trade (MOTs) are hazardous materials, other than hazardous waste, that are carried on a motor vehicle:

- to protect the health and safety of the motor vehicle operator or passengers, such as insect repellant or a fire extinguisher;
- to support the operation or maintenance of a motor vehicle (including its auxiliary equipment), such as a spare battery or gasoline; or
- to directly support a principal business of a private motor carrier (including vehicles operated by a rail carrier) that is other than transportation by motor vehicle – for example, landscaping, pest control, painting, plumbing, or welding services.

Be aware that it is your responsibility to know if you are transporting a hazardous material and the requirements in the HMR that apply.

The regulations that apply to MOTs are found in 49 CFR Section 173.6. They include:

- general knowledge of MOTs regulations;
- quantity limitations;
- packaging requirements; and
- marking and labeling requirements.

The MOTs regulations do not require:

- shipping papers;
- emergency response information;
- placarding; or
- formal training or retention of training records.

What Hazardous Materials Qualify as MOTs?

To be a Material of Trade, the hazardous material must fit into any one of the following classes or divisions:

Class or Division	Examples
Flammable Gases (Division 2.1)	acetylene, propane
Non-flammable Gases (Division 2.2)	oxygen, nitrogen
Flammable or Combustible Liquids (Class 3)	paint, paint thinner, gasoline
Flammable Solids (Division 4.1)	charcoal
Dangerous When Wet Materials (Division 4.3)	some fumigants
Oxidizers (Division 5.1)	bleaching compounds
Organic Peroxides (Division 5.2)	benzoyl peroxide
Poisons (Division 6.1)	pesticides
Some Infectious Substances (Division 6.2)	diagnostic specimens
Corrosive Materials (Class 8)	muriatic acid, drain cleaners, battery acid
Miscellaneous Hazardous Materials (Class 9)	asbestos, self-inflating lifeboats
Consumer Commodities (ORM-D)	hair spray, spray paints

What Quantity Limits Apply for Hazardous Materials being Transported as MOTs?

With the exception of tanks containing diluted mixtures of Class 9 materials, no more than a combined gross weight of 200 kg (440 lbs) of Materials of Trade can be transported on any one vehicle. Size limits for individual packages apply to Materials of Trade as described below:

- If a hazardous material is a high-hazard material (Packing Group I), the maximum amount of material in one package is 0.5 kg (one lb) for solids, or 0.5 L (one pt) for liquids.
- If the hazardous material is a medium or lower hazard – that is, if it belongs to Packing Group II or III, other than division 4.3, or is a consumer commodity (ORM-D) – the maximum amount of material in each package is 30 kg (66 lbs) for solids, or 30 L (8 gal) for liquids.
- For Division 4.3 materials (only Packing Group II and III materials are allowed) the maximum amount of material in each package is 30 ml (one oz.)
- Each cylinder containing a gas (Division 2.1 or 2.2) may not weigh more than 100 kg (220 lbs.)
- A diluted mixture of a Class 9 material (not exceeding 2% concentration) may be transported in a tank having a capacity of up to 1500 L (400 gal.)

Repairs (R Stamp)

This document is based on the 2015 edition of the National Board Inspection Code (NBIC). At the time of this document, the HMR only adopts Part 3 of the 1992 edition of the NBIC. All of the references below are from Part 3.

Part 1: Installation (stationary boilers)
Part 2: Inspection (stationary boilers)
Part 3: Repair

General

	NBIC doesn't consider a violation unless the R-1 was issued or the vessel was stamped
	1.2 must follow ASME Code of Construction, when applicable (HMR requires specification to be followed)
	1.6.1 Requires records to be kept for 5 years

AI Responsibilities

	1.3.1 AI authorization required before any repair/alteration Exception for Routine Repairs See 3.3.2
	1.3.2 AI must review drawings, ensure repair done according to code of construction, witness pressure test, ensure any NDE performed correctly, etc.
	1.3.2 AI must verify the stamping/name plate is correct

Quality Control System/Manual

	1.6.1 See separate checklist See NBIC checklist
	1.5.2 QCS must provide for adequate control of R Stamp
	Samples of all forms used must be included in the QCM
	Must have copies of NBIC, DOT CT specifications, ASME Code, as applicable

Welding

	Part 3, Section 2
	2.2 Must follow original code of construction
	2.2.1 Must use a qualified WPS Standard WPS (Table 2.3) don't require PQRs
	2.2.3 Welders must be qualified according to Section IX
	2.2.4 Must maintain records of WPQs
	2.2.5 Must have a system for assignment of a unique identification code for each welder
	2.2.6 Welders must weld on something at least once every six months 2.2.6.1 Must maintain records
	2.5.2 Postweld Heat Treatment (PWHT) As required by original code of construction

Requirements for Repairs and Alterations

	Part 3, Section 3
	3.2.1 Must follow original code of construction for materials Welder must identify material of construction
	3.2.2 b) (or R-307 for 1992) ASME Vessels – replacement part vendors must be ASME certified 3.2.2 c) – new construction of ASME vessels
	3.2.3 and 3.2.4 Drawings generally required Not required if original code of construction and manufacturers data report is available
	3.2.5 Calculations required for alterations
	3.3.2 Routine Repairs (R-402.2) a) AI not required c) Described in the QCS d) R-1 Form required with remark "Routine Repair" e) defined
	3.3.4 Repair Methods 3.3.4.1 Must conduct WFMPE to ensure defect is completely removed If defect is through full thickness, must do a full penetration weld
	3.4 Alterations

Examination and Testing

	Part 3, Section 4
	4.2 NDE as required by the original code of construction
	4.3 Gages and test equipment must be calibrated and documented

	4.4,1 Tests or Examinations for Repairs a) Hydrostatic pressure test procedures b) Pneumatic pressure test procedures e) NDE
	4.4.2 Test or Examination for Alterations a) Hydrostatic pressure test procedures b) Pneumatic pressure test procedures c) NDE
	NDT – focus is on weld integrity, not on structural integrity, allowed in lieu of pressure testing (DOT overrides)

Documentation

	Part 3, Section 5
	5.2 Documentation a) Repairs – R-1 form b) Alterations – R-2 form
	5.2.1 R-1 Forms
	5.2.2 R-2 Forms
	5.3 Distribution of R-1 Forms
	5.4 Distribution of R-2 Forms
	5.5 Registration of R Forms
	5.6 Form "R" Log Must have a sequential log of all R Forms issued, including ID#, date, description of repair, and date form submitted to NBIC
	5.7.2 Stamping Requirements for Repairs (R-504) See also for 5.8.1 Exception for routine repairs if accepted by jurisdiction and AI agrees
	5.7.3 Stamping requirements for Alterations See also 5.8.2 Location to be documented on R-2
	5.7.5 Specific requirements for Stamping and Nameplates
	5.11 Removal of Original Stamping or Nameplate AI must witness and jurisdiction must approve Manufacturer out of business – can't have the stamp, just data plate
	5.13 Example Forms and Instructions

NBIC Quality Control System/Manual checklist

Part 3, 1.6.1

	Title Page
	Contents Page
	Scope of Work
	Statement of Authority and Responsibility
	Manual Control
	Organizational Chart
	Drawings, Design, and Specification Control
	Repair and Alteration Methods Controls NDE, PWHT
	Materials Identification of existing material and ordering, verification and identification of new material
	Method of Performing Work Must have prior approval of AI
	Welding, NDE, and Heat Treatment Title of person responsible for WPS and its qualification, qualification of welders Controls for ensuring WPS is available to welder
	Examination and Tests
	Calibration of equipment
	Acceptance and Inspection of Repair/Alteration Prior to work
	Inspections AI access to all drawings, calculations, specifications, procedures, test results, etc.
	Report Form Title of person responsible for preparing and signing forms
	Exhibits All forms referenced in the manual shall be included
	Construction Code
	Nonconforming Items
	Records Retention See Table 1.6.1, at least 5 years

NON-BULK MARKING CHECKLIST

Non-bulk packages are those packages that have a capacity of less than 119 water gallons for liquids (See definitions, Section 171.8 for solids and gases). The requirements for package markings are found in Subpart D of Part 172. Refer to other guidance for Limited Quantity marking requirements.

General Marking Provisions, Section 172.301

Except for limited quantities and ORM-D materials, all non-bulk packages must be marked with the **identification number** (including NA or UN) and the **proper shipping name**. **Technical names**, if required to appear on the shipping paper by Column 1 of the HM Table, must also appear on the package in relation to the proper shipping name (except for Division 6.2 materials). The **consignee's or the consignor's name and address** must also appear on the package, unless part of a large lot going to one location, or transported by highway and not transferred from one motor carrier to another (see Section 172.301(d)).

Requirements and Prohibitions

Markings for non-bulk packages must appear once on the package, must be durable, in English, and printed on the package or affixed with a tag or sign (Section 172.304). Markings must be displayed on a contrasting background, be unobscured, and located away from other markings. Abbreviations must be authorized by the regulations (Section 172.308). Effective 1/1/2017, non-bulk packages must meet the minimum size requirement specified in Section 172.301(a).

Packages may not be offered or transported with hazardous materials markings unless they actually contain that material or a residue of that material. This provision does not apply to packages that are not visible in transport and are unloaded by the shipper or consignee; to packages whose markings are securely covered in transportation; or a shipping name for a material not regulated under the FHMR (Section 172.303).

Section 173.29(b) provides some relief for empty non-bulk packages. Additionally, Section 173.29(g) and (h) allow the elevated temperature marking and hazardous substance marking, respectively, to remain on packages, even if the remaining quantity no longer meets that definition.

Orientation Arrows

Orientation arrows must be included on any non-bulk package with a liquid in an inner package (and certain other packagings). This requirement does not apply to cylinders inside another package. The arrows must be on **two opposing vertical sides in the correct upright direction** (Sections 172.312 and 177.834(b)).

Hazardous Substances

The letters "**RQ**" must be in association with the proper shipping name on a non-bulk package of a hazardous substance (hazardous substances are determined by Table 1 in Appendix A of Section 172.101). In addition, the technical name must be included if the hazardous substance is not identified by the proper shipping name (Section 172.324).

Liquefied Petroleum Gases (LPG)

DOT Specification Cylinders (except a Specification 2P or 2Q container or a Specification 39 cylinder), that contain an unodorized Liquefied Petroleum Gas (LPG) must be marked NON-ODORIZED or NOT ODORIZED in letters not less than 0.25 inches in height near the marked proper shipping name (Section 172.301(f)).

Radioactive Materials

In addition to other marking requirements, packages of radioactive materials with a gross mass over 110 lbs. (50 kg.) must have the gross mass marked on the outside of the package. Each radioactive material package must be marked with the appropriate TYPE ("TYPE IP-1," "TYPE IP-2," "TYPE IP-3," TYPE A," "TYPE B(U)," or "TYPE B(M)"). Type B packages must have the radioactive trefoil symbol as shown in Appendix B of Part 172. Each package which conforms to an IP-1, IP-2, IP-3 or a Type A package design must be legibly and durably marked on the outside of the package with the international vehicle registration code of the country of origin of the design. Also each Type B(U) and Type B(M) or fissile material package designed for export must be marked "USA" in conjunction with the specification marking, or other package certificate identification. (See Sections 173.471, 173.472, and 173.473.)

Explosives

Most explosives are required to be marked with their assigned "EX" number in addition to the general marking requirements. One of the alternatives allows the EX number, product code, or national stock number to be placed on the shipping paper. See Section 172.320 for all the exceptions.

Poisons

Packages of materials that meet the definition of poison inhalation hazard (PIH) are required to be marked "**Inhalation Hazard**". When the words "Inhalation Hazard" appear on the label or placard, the "Inhalation Hazard" marking is not required. Non-bulk plastic packages for poison materials must be **permanently** marked with the word "POISON" (Section 172.313).

Marking of Large Quantities of Non-Bulk Packages

A transport vehicle or freight container must be marked with the identification number if:

- Transporting 8,820 lbs. or more aggregate gross weight of non-bulk packages of a hazardous material with a single identification number and the same proper shipping name (Limited quantities and ORM-D materials excepted). This provision applies only if it was loaded at one facility and no other materials, hazardous or otherwise, are in the vehicle or container (Section 172.301(a)(3)).

- Transporting 2,205 lbs. or more aggregate gross weight of a Poisonous Inhalation Hazard (PIH) material, Zone A or B, in non-bulk packages with a single identification number and the same proper shipping name, when loaded at one facility (Section 172.313(c)).

Special Permit Marking

Special Permit markings are required if USDOT/PHMSA has issued a special permit from one or more of the package specifications. The outside of the package must be marked plainly and durably with "DOT-SP" (or DOT-E, see Section 173.23), followed by the number assigned by PHMSA. It is the responsibility of the offeror to ensure that the package is authorized by the regulations and compatible for that hazardous material (Section 172.301(c)). Not all Special Permits require the package to be marked.

Marine Pollutants

When transported solely by highway, air, or rail, the marine pollutant marking is not required on non-bulk packages (Section 171.4(c)). If any part of the transportation is by water to its final destination, then non-bulk packages must be display the marine pollutant mark and the proper shipping name or technical name that makes it a marine pollutant (Sections 171.4(c) and 172.322(a)).

LOW PRESSURE CARGO TANKS (SEE 173.33)						
	Superseded Regulations*			Current Title 49**		
Inspection item	**306**	**307**	**312**	**406**	**407**	**412**
Anchors, supports	178.340-6	178.340-6	178.340-6	178.345-6	178.345-6	178.345-6
Bulkhead drains	178.340-7(c)	178.340-7(c)	178.340-7(c)	178.345-1(i)(2)	178.345-1(i)(2)	178.345-1(i)(2)
Certification/Data plate	178.340-10(b)	178.340-10(b)	178.340-10(b)	178.345-14	178.345-14	178.345-14
External ring stiffeners	178.340-7(d)	178.340-7(d)	178.340-7(d)	178.345-7(d)(4)	178.345-7(d)(4)	178.345-7(d)(4)
Fusible devices	178.341-5(a)	178.342-5(a)	product specific	178.345-11(b)(iii)	178.345-11(b)(iii)	178.345-11(b)(iii)
Manhole closures	178.341-3	178.342-3	178.343-3	178.345-5	178.345-5	178.345-5
manhole markings	NA	NA	NA	178.345-5(e)	178.345-5(e)	178.345-5(e)
Overturn protection	178.340-8(c)	178.340-8(c)	178.340-8(c)	178.345-8(c)	178.345-8(c)	178.345-8(c)
Piping protection	178.340-8(d)	178.340-8(d)	178.340-8(d)	178.345-8(a)	178.345-8(a)	178.345-8(a)
Wet lines	173.33(e)	173.33(e)	173.33(e)	173.33(e)	173.33(e)	173.33(e)
Pressure Relief Devices	178.341-4(d)	178.342-4(c)	178.343-4	178.345-10	178.345-10	178.345-10
Additional Venting	178.341-4(d)(3)	178.342-4(d)	same as above	178.346-3(c)	178.347-4	178.348-4
Vent marking	178.341-4(e)	178.342-4(e)	disk 1.5 times MAWP	178.345-10(h)	178.345-10(h)	178.345-10(h)
Additional	173.33(d) and 180.405(h)	173.33(d) and 180.405(h)	173.33(d) and 180.405(h)	173.33(d) and 180.405(h)	173.33(d) and 180.405(h)	173.33(d) and 180.405(h)
Rear End Protection Device	178.340-8(b) and 393.86	178.340-8(b) and 393.86	178.340-8(b) and 393.86	178.345-8(d)	178.345-8(d)	178.345-8(d)
Remote shut off	178.341-5	178.342-5(a)	178.343-5(b)	178.345-11(b)(1)	178.345-11(b)(1)	178.345-11(b)(1)
Marking for shut off	172.328(d)	172.328(d)	172.328(d)	172.328(d)	172.328(d)	172.328(d)
Internal valve	178.341-5	178.342-5(a)	178.343-5(b)	178.345-11(b)	178.345-11(b)	178.345-11(b)
Exceptions (internal)	NA	180.405(f)(1)(ii)	180.405(f)(1)(ii)	N/A 178.346-4(b)	178.345-11(b)	178.345-11(b)
Outlet closures	NA	NA	178.343-5(a)	178.345-11(c)	178.345-11(c)	178.345-11(c)
Shear section	178.340-8(d)(1)	178.340(d)(1)	178.340(d)(1)	178.345-8(a)(4)	178.345-8(a)(4)	178.345-8(a)(4)
Stop valve	NA	NA	178.343-5(a)	178.345-11	178.345-11	178.345-11
Top outlets	NA	NA	178.343-5(a)	NA	NA	178.345-11(b)(2)
Test/Inspection intervals	180.407(c)	180.407(c)	180.407(c)	180.407(c)	180.407(c)	180.407(c)
Test Markings	180.415	180.415	180.415	180.415	180.415	180.415
Manhole Assemblies	180.405(g)	180.405(g)	180.405(g)	180.405(g)	180.405(g)	180.405(g)
Manufacture Dates	180.405(c)	180.405(c)	180.405(c)	180.405(c)	180.405(c)	180.405(c)
Transportation	177.834(j)	177.834(j)	177.834(j)	177.834(j)	177.834(j)	177.834(j)

* Enforcement must be cited with Section 180.405(b) as the primary cite and the specification violation as the secondary cite.

** As of 8/1/16. Note the following cites were amended in a Final Rule issued 12/31/2004. CTMVs manufactured before this date were built to the HMR in effect at that time. Affected Cites: 178.320; 178.345-1, 2, 3, 4, 7, 14, and 15; 178.346-1 and 3; 178.347-1; and 178.348-1. Consult the HMR prior to 1/1/04 prior to enforcement.

HIGH PRESSURE CARGO TANKS (SEE 173.33)				
Inspection item	**330***	**331****	**Non-Spec*****	**338****
Anchors/supports	78.336-13	178.337-13	178.337-13	178.338-13
Certification/data plate	78.336-17	178.337-17	Non-Spec 173.315(k)	178.338-18(b)
Non-Spec CTs	173.315(k)	173.315(k)	see above	173.320(a)
Fusible devices	173.315(p)	178.337-8(a)(4)	178.337-8(a)(4)	178.338-11(c)(2)(i) &(ii)
Manhole closures	NA	178.337-6(a)	178.337-6(a)	178.338-6/173.318(a)(6)
Exceptions	NA	178.337-6(a)	178.337-6(a)	178.338-6(a)
Marking				
Product specific	172.328, 172.313, 172.322	172.328, 172.313, 172.322	172.328, 172.313, 172.322	173.318(g), 172.328, 172.313, 172.322
Inlets and **O**utlets	78.336-9(c)	178.337-9(c)	178.337-9(c)	178.318(b)(10)
QT and **NQT**	172.328(c)	172.328(c)	172.328(c)	NA
Overturn protection	78.336-10	178.337-10(b)	178.337-10(b)	178.338-10(b)
Piping protection	78.336-10	178.337-10(a)	178.337-10(a)	178.338-10(a)
Pressure Relief Devices	173.315(i)(4)/78.336-9	173.315(i)(4)	173.315(i)(4)	178.338-8
Additional Venting	173.315(i)(11)	173.315(i)(II)	173.315(i)(II)	173.318(b)
Rear-end protection	NA	178.337-10(c)	178.337-10(c)	178.338-10(c)
Manual Shutoff	78.337-(8)(a)	178.337-8(a)(4)	178.337-8(a)(4)	178.338-11(c)(2)
Marking	172.328(d)	172.328(d)	172.328(d)	172.328(d)
Off-truck remote shutdown	173.315(n)(3)	173.315(n)(3)	173.315(n)(3)	NA
Passive shutdown	173.315(n)(2)	173.315(n)(2)	173.315(n)(2)	NA
Shutdown daily check	177.840(o)	177.840(o)	177.840(o)	NA
Shutdown instructions	177.840(l)	177.840(l)	177.840(l)	NA
Test/Inspection intervals	180.407(c)	180.407(c)	180.407(c)	180.407(c)
Test markings	180.415	180.415	180.415	180.415
Hose test & marking	180.416(e)(3)	180.416(e)(3)	180.416(e)(3)	NA
Hose identification	180.416(b)	180.416(b)	180.416(b)	NA
Monthly inspection	180.416(d)(5)	180.416(d)(5)	180.416(d)(5)	NA
Annual Hose inspection	180.416(e)	180.416(e)	180.416(e)	NA
Transportation	177.834(j)	177.834(j)	177.834(j)	177.840(h) and 178.338-9
Internal valve	78.336-9	178.337-8(a)(4)	178.337-8(a)(4)	173.33(h)/178.338-11(c)
Exceptions	NA	178.337-8(a)(5) & (c)	178.337-8(a)(5) & (c)	178.338-11(c)
Shear section	NA	178.337-10(f)	178.337-10(f)	178.338-12
Check valve (inlet only)	NA	178.337-8(a)(3)	178.337-8(a)(3)	NA
Excess flow valve	78.33(o)	178.337-8(a)(4)(iv)	178.337-8(a)(4)(iv)	178.338-11
Stop valve	NA	178.337-8(a)(6)	178.337-8(a)(6)	178.338-11(b)

* Enforcement must be cited with Section 180.405(b) as the primary cite and the specification violation as the secondary cite. **

As of 8/1/16. Note the following cites were amended in a Final Rule issued 12/31/2004. CTMVs manufactured before this date were built to the HMR in effect at that time. Affected Cites: 178.320; 178.337-1, 2, 3, 4, 6, 8, 9, 10, 16, 18; and 178.338-1, 2, 3, 4, 5, 6, 13, 15, 16, 17, 18, 19. Consult the HMR prior to 1/1/04 prior to enforcement.

**NFPA 58, 1981, 6.1, requires all vehicles subject to DOT regulations to comply with DOT regulations.

NON SPECIFICATION CARGO TANKS				
Inspection item	**Gasoline**	**Nurse Tanks**	**Elevated Temperature Materials**	**LPG Storage Tanks**
Authority	173.8(b)	173.315(m); Field Truck Mounted Tanks, (m)(3)	Column 8(c)	173.315(j)
Anchors/Supports	state requirements	NA	NA	NA
Capacity (Maximum)	3500 gallons	3000 gallons	NA	(j)(1), NA; (j)(2), 500 gallons
Data Plate	state requirements	ASME plate	173.247(g)(5)	173.315(j)(1) or (2)
Date of manufacture	173.8(d)(1)	NA	NA	NA
Design pressure	state requirements	250 psig	NA	ASME code
Fusible device	state requirements	ASME code	NA	ASME code
Internal valve	state requirements	ASME code	NA	NA
Manhole closures	state requirements	ASME code	173.247(g)(2)	ASME code
Marking				
Exception	172.336(c)	173.315(m)(1)(vii)	173.29(g)	NA
Product specific	172.313, 172.325	172.328, 172.313	172.325	NA
Overturn protection	state requirements	ASME code	NA	NA
Piping protection	state requirements	ASME code	173.247(g)(5)	NA
Pressure Relief Devices	state requirements	173.315(m)(1)(ii)	173.247(g)(1)(iii)(B)	NFPA 58
Test/Inspection intervals	180.407(c)	173.315(m)(2) Illegible/missing ASME plate	NA	NA
Test markings	180.415	173.315(m)(2)(vi) Illegible/missing ASME plate	NA	NA
Transportation	177.834(j)	177.834(j)	173.247(g)(2)	173.315(j)(1) and (2)

Inspection Item	IBC (SEE 173.35)
Specification Markings	178.703 and 178.706; 173.35(b)(2)
Stacking Marking	178.703(b)(7)
Labeling	172.400(a)(2)
Dual Labels	172.406(e)(6)
Marking	
ID#	172.302(a) and (b)(2); 172.331; and 172.514(c)(4)
Product specific	172.322; 323; 325
Placarding	172.504(a)
Exceptions	172.514(c)(4)
Pressure **R**elief **D**evice	178.705(c)(2)
Test intervals	180.352(b)(1) & (2)
Test markings	180.352(f) and 178.703(b)
Transportation	
No HM on outside	173.35(f)(1)
No PG I liquids	173.35(j)
Securement	177.834(a)
Unloading	177.834(h)
Stacking	173.24b(e)
Segregation	177.848
Valves	178.704(d)(3)
Valve protection	178.704(d)(3)
Outlet cap	178.704(e)
Manifolding	Not authorized

Inspection Item	Cylinders*	Tank Car Tank	MEGCs*
Specification Markings	178.35(f)	179.300-18(a)	178.75(j)
Labeling	172.400(a)(1) & (2)	172.400(a)(4)	NA
Exceptions	172.400a(1) & (4)	172.406(e)(3)	172.400a(4)
Marking			
ID#	172.301(a)&(b)	172.302(a)	172.302(a)(3)
Package specific	NA	172.330(a)(2)(i) & (ii)	NA
Product specific	172.313	172.313	172.313
Placarding	172.504(a)	172.504(a)	172.504(a)
Exceptions	NA	172.514(c)(2)	NA
Pressure **R**elief **D**evice	173.301(f)	179.300-15(a)-173.314(l)	178.75(f)
Exceptions	173.301(f)(5)	NA	NA
Prohibited (zone A)	173.301(f)(6)	NA	See 173.40(a) and 178.75(e)(2)
Test intervals	180.209(a)	180.519(a)	180.217
Test markings	180.213	180.515(a)-179.300-18(a)(5)	180.217(e)
Transportation	177.834(a) and 177.840	177.834(a) and 177.834(m)	173.312
Prohibited & Segregation	177.841(c), (e)(1) and 177.848	177.848	173.40(a)
Valve			
Valve protection	173.301(h)	179.300-12(a)	173.312(c) and 178.75(e)
Valve cap (cylinder)	173.40(d)	NA	NA
Manifolding	173.40(e) and 173.301(g)	NA	173.312(a)(6)

*** For UN Cylinders**, see 171.23, 178.71, 173.301b, 173.302b, 173.302c, and 173.304b

*** For TDG (Canada) Cylinders**, see 171.12(a)(4)

***173.40(a), Zone A materials prohibited**

DOT Tube Trailer
178.35(f)
NA
172.400a(4)
172.302(a)(3)
NA
172.313
172.504(a)
NA
173.301(f)
173.301(f)(5)
173.301(f)(6)
DOT Special Permit
DOT Special Permit
177.840
177.841(c)
173.301(i)
NA
173.40(e) and 173.301(g)

SEE 173.32	Superseded Regulations	UN Specification Portable T	
Inspection item	DOT IM 101 and 102*	Low Pressure	High Pressure
Certification/Data plate	178.270-14	178.274(i)	178.274(i)
Frames	178.270-6	178.274(h)	178.274(h)
Fusible devices	178.270-11(c)(3)	178.275(d)(3)(iv)	178.276(c)(4)
Manhole closures	178.270-9	178.275(c)(2)	178.276(c)(6)
Markings			
ID numbers	172.302(a)	172.302(a)	172.302(a)
Outlets	NA	178.274(e)(2)	178.274(e)(2)
Portable tanks	172.326	172.326	172.326
Product specific	172.313, 172.322, 172.325	172.313, 172.322, 172.325	172.313
Piping protection	178.270-8	178.274(e)(1)	178.274(e)(1)
Placarding	172.504(a)	172.504(a)	172.504(a)
Exceptions	172.514(c)(1) and 172.406(e)	172.514(c)(1) and 172.406(e)	172.514(c)(1) and 172.406(e)
Pressure Relief Devices	178.270-11(a)(1) and (2)	178.275(e)	178.276(e)
Additional venting	173.32(c)(3)	178.275(g)	NA
Marking of PRD	178.270-11(e)	NA	NA
Remote shut off	173.32(h)(3)	178.275(d)(3)(i)(D) & (d)(3)(iv)	178.276(c)(4)
Exceptions	NA	178.275(d)(2)	NA
Test intervals	180.605(c)(1)	180.605(c)(1)	180.605(c)(1)
Test markings	180.605(k)(1)	180.605(k)(1)	180.605(k)(1)
Transportation	173.32(g)(1) and 177.834(a)	173.32(g)(1) and 177.334(a)	173.32(g)(1) and 177.334(a)
Segregation	177.848(a)(3)	177.848(a)(3)	177.848(a)(3)
Prohibitions	177.834(n) and (o)(3)	177.834(o)(3)	177.840(h)
Valve	178.270-12	178.275(d)	178.276(c)(3) and (4)
Bottom outlets	Special provision T code	178.275(d)	178.276(d) Prohibited
Check valve	NA	NA	NA
Excess flow valve	NA	178.275(d)(3)	178.276(c)(1)-173.32(i)(9)
Internal valve	178.270-12	178.275(d)(3)(i)	178.276(c)(1)
two closures	Special provision T code	Special provision T code	Special provision T code
three closures	Special provision T code	Special provision T code	Special provision T code
Outlet closures	178.270-12(a)	Special provision T code	178.276(c)(1)
Shear section	178.270-12(d)	178.274(e)	178.274(e)
Stop Valve	Special provision T code	178.275(c)	178.276(c)

ISO: International Standards Organization, sets the regulations for the framework

Inspection item	DOT IM 101 and 102*	Low Pressure	High Pressure

IM: USDOT Intermodal Portable Tank specifications

* Enforcement must be cited with Section 173.32(c)(2) as the primary cite and the specification violation as the secondary cite.

Tanks
Refrigerated Gases
178.274(i)
178.274(h)
178.277(d)
178.277(d)(7)
172.302(a)
178.274(e)(2)
172.326
172.313
178.274(e)(1)
172.504(a)
172.514(c)(1) and 172.406(e)
178.277(e)
NA
NA
NA
NA
180.605(c)(1)
180.605(k)(1)
173.32(g)(1) and 177.334(a)
177.848(a)(3)
177.840(h)
178.277(d)
NA
173.32(i)(9)(iv)
NA, see 173.32(i)(12)
178.277(d)
Special provision T code
Special provision T code
178.277(d)
NA
178.277(d)

Refrigerated Gases

Portable Tanks (SEE 173.32)			
	Superseded Regulations*		
Inspection item	**DOT 56**	**DOT 57**	**DOT 51**
Certification/Data plate	178.251-7	178.251-7	178.245-6(a)
Frames	NA	NA	NA
Fusible devices	NA	NA	178.245-1(d)(4)(iii)
Manhole closures	178.252-2(b)	178.253-2(a)	NA
Markings	172.326(a)	172.326(a)	172.326(a)
ID numbers	172.302(a)	172.302(a)	172.302(a)
Outlets	NA	NA	178.245-6(b)
Portable tanks	172.326	172.326	172.326
Stacking	178.251-7(b)	178.251-7(b)	NA
Product specific	172.313, 172.322, 172.325	172.313, 172.322, 172.325	172.313, 172.322, 172.325
Piping protection	NA	178.253-3	178.245-5(a)
Placarding	172.504(a)	172.504(a)	172.504(a)
Exceptions	172.514(c)(1)	172.514(c)(1)	172.514(c)(1)
Pressure Relief Devices	NA	178.253-4	173.315(i)
Additional venting	178.253-4(a)	178.253-4(a)	NA
Marking of PRD	NA	NA	173.315(i)(4)
Remote shut off	NA	NA	178.245-1(d)(4)(iii)
Exceptions	NA	NA	NA
Test intervals	180.605(c)(3)	180.605(c)(3)	180.605(c)(2)
Test markings	180.605(k)(2)	180.605(k)(2)	180.605(k)(2)
Transportation	177.834(a) and 173.32(g)	177.834(a) and 173.32(g)	177.834(a) and 173.32(g)
Segregation	177.848(a)(3)	177.848(a)(3)	177.848(a)(3)
Prohibitions	177.834(h) and (n)	177.834(h) and (n)	177.834(h)
Valve	178.252-2(a)	178.253-2	178.245-1(d)
Bottom outlets	NA	NA	NA
Excess flow valve	NA	NA	173.32(i)(9)
Internal valve	NA	NA	178.245-1(d)(4)(ii)
two closures	NA	NA	NA
three closures	NA	NA	NA
Marking	NA	NA	178.245-6(b)
Outlet closures	178.252.2(a)	178.253-2(a)(2)	173.32(n)
Shear section	NA	NA	178.245-1(d)(4)(ii)

Inspection item	DOT 56	DOT 57	DOT 51

* Enforcement must be cited with Section 173.32(c)(1) as the primary cite and the specification violation as the secondary cite for D
173.32(c)(2) for DOT Specification DOT 51 portable tanks.

Current Title 49
DOT 60
178.255-14
NA
NA
178.255-4(a)
172.326(a)
172.302(a)
NA
172.326
NA
172.313, 172.322, 172.325
178.255-7
172.504(a)
172.514(c)(1)
173.315(i)
NA
173.315(i)(4)
NA
NA
180.605(c)(4)
180.605(k)(2)
177.834(a) and 173.32(g)
177.848(a)(3)
177.834(h) and 177.840(b)
178.255-5
Prohibited see above
NA
NA
NA
NA
NA
178.255-5(b)
NA

DOT 60

)OT Specification 56 and 57 portable tanks, and

Inspection Item	Large Packaging (SEE 173.36)
Specification Markings	178.910(a)
Stacking Marking	178.910(b)
General Requirements	178.915
Labeling	172.400(a)(2)
Marking	
ID#	172.302(a)
Product specific	172.322
Placarding	172.504(a)
Exceptions	172.514(c)(1)
Test intervals	NA
Test markings	NA
Transportation	
No HM on outside	173.36(d)(1)
No PG I or II materials	173.36(a)
Securement	173.36(d)(2) and 177.834(a)
Stacking	173.24b(e)
Segregation	173.36(h) and 177.848

Flexible Bulk Container (SEE 173.37)
178.1010(a)
NA
178.1015
172.400(a)(2)
172.302(a)
172.322
172.504(a)
172.514(c)(1)
178.102 and 173.37(b)(4)
NA
173.37(c)(1)
NA
173.37(c)(2), (3), and (4)
173.37(c)(5)
177.848

	Special Provision Code					
Package	**Numeric**	**B**	**IB**	**IP**	**N**	**T**
Non Bulk	X				X	
Cargo Tank	X	X				
Portable Tank (DOT or non spec)	X	X				
UN Portable Tank	X					X
IM Portable Tank	X					X
IBC	X		X	X		
Bulk Cylinder	X	X				
Non-Bulk Cylinder	X					
Multi-Unit Tank Car Tanks	X	X				
Large Packaging	X		IB3 & IB8			
Flexible Bulk Container	X					

TP	Important Sections	Test Markings
	173.24	178.503
	173.33	180.415
	173.32	180.605
X	173.32	180.605
X	173.32	180.605
	173.35	180.352
	173.40	180.213 or 217
	173.40	180.213
	173.31	180.519
	173.36	N/A
	173.37	N/A

Reference
Special Provision 380
173.12
173.13
173.226(f)
177.839(a)
177.840(a)(3)
177.841(e)
177.841(f)
177.848(a)(1)
177.848(i)

Description
Relief from segregation for acrolein, stabilized, UN1092 in certain circumstances
Relief from segregation for hazardous wastes in certain circumstances
Relief from segregation for certain Class 3, Division 4.1, 4.2, 4.3, 5.1, 6.1, and Class 8 in certain circumstances
Relief from segregation for Division 6.1, PG I, Zone A materials in certain circumstances
Nitric acid above 50% can't be stacked above anything else
Relief from segregation for Division 2.3, PG I, Zone A materials with Division 2.1, Class 3, 4, 5, and 8 in certain circumstances
Division 6.1 PG I or II and all PIH labeled packages can't be transported with foodstuffs, excepted as provided
Relief from segregation for Division 61, PG I, Zone A materials that are a hazardous waste with Class 3, 4, 5, and 8 in certain circumstances
Segregation table only applies to HM that is labeled or placarded, including subsidiary labels (177.848(e)(6))
Relief from segregation for Division 4.2 with Class 8 in certain circumstances

Inspection Item	IBC (SEE 173.35)
Specification Markings	178.703 and 178.706; 173.35(b)(2)
Stacking Marking	178.703(b)(7)
Labeling	172.400(a)(2)
Dual Labels	172.406(e)(6)
Marking	
ID#	172.302(a) and (b)(2); 172.331; and 172.514(c)(4)
Product specific	172.322; 323; 325
Placarding	172.504(a)
Exceptions	172.514(c)(4)
Pressure **R**elief **D**evice	178.705(c)(2)
Test intervals	180.352(b)(1) & (2)
Test markings	180.352(f) and 178.703(b)
Transportation	
No HM on outside	173.35(f)(1)
No PG I liquids	173.35(j)
Securement	177.834(a)
Unloading	177.834(h)
Stacking	173.24b(e)
Segregation	177.848
Valves	178.704(d)(3)
Valve protection	178.704(d)(3)
Outlet cap	178.704(e)
Manifolding	Not authorized

Inspection Item	Cylinders*	Tank Car Tank	MEGCs*
Specification Markings	178.35(f)	179.300-18(a)	178.75(j)
Labeling	172.400(a)(1) & (2)	172.400(a)(4)	NA
Exceptions	172.400a(1) & (4)	172.406(e)(3)	172.400a(4)
Marking			
ID#	172.301(a)&(b)	172.302(a)	172.302(a)(3)
Package specific	NA	172.330(a)(2)(i) & (ii)	NA
Product specific	172.313	172.313	172.313
Placarding	172.504(a)	172.504(a)	172.504(a)
Exceptions	NA	172.514(c)(2)	NA
Pressure **R**elief **D**evice	173.301(f)	179.300-15(a)-173.314(l)	178.75(f)
Exceptions	173.301(f)(5)	NA	NA
Prohibited (zone A)	173.301(f)(6)	NA	See 173.40(a) and 178.75(e)(2)
Test intervals	180.209(a)	180.519(a)	180.217
Test markings	180.213	180.515(a)-179.300-18(a)(5)	180.217(e)
Transportation	177.834(a) and 177.840	177.834(a) and 177.834(m)	173.312
Prohibited & Segregation	177.841(c), (e)(1) and 177.848	177.848	173.40(a)
Valve			
Valve protection	173.301(h)	179.300-12(a)	173.312(c) and 178.75(e)
Valve cap (cylinder)	173.40(d)	NA	NA
Manifolding	173.40(e) and 173.301(g)	NA	173.312(a)(6)

*** For UN Cylinders**, see 171.23, 178.71, 173.301b, 173.302b, 173.302c, and 173.304b

*** For TDG (Canada) Cylinders**, see 171.12(a)(4)

***173.40(a), Zone A materials prohibited**

DOT Tube Trailer
178.35(f)
NA
172.400a(4)
172.302(a)(3)
NA
172.313
172.504(a)
NA
173.301(f)
173.301(f)(5)
173.301(f)(6)
DOT Special Permit
DOT Special Permit
177.840
177.841(c)
173.301(i)
NA
173.40(e) and 173.301(g)

SEE 173.32	Superseded Regulations	UN Specification Portable T	
Inspection item	DOT IM 101 and 102*	Low Pressure	High Pressure
Certification/Data plate	178.270-14	178.274(i)	178.274(i)
Frames	178.270-6	178.274(h)	178.274(h)
Fusible devices	178.270-11(c)(3)	178.275(d)(3)(iv)	178.276(c)(4)
Manhole closures	178.270-9	178.275(c)(2)	178.276(c)(6)
Markings			
ID numbers	172.302(a)	172.302(a)	172.302(a)
Outlets	NA	178.274(e)(2)	178.274(e)(2)
Portable tanks	172.326	172.326	172.326
Product specific	172.313, 172.322, 172.325	172.313, 172.322, 172.325	172.313
Piping protection	178.270-8	178.274(e)(1)	178.274(e)(1)
Placarding	172.504(a)	172.504(a)	172.504(a)
Exceptions	172.514(c)(1) and 172.406(e)	172.514(c)(1) and 172.406(e)	172.514(c)(1) and 172.406(e)
Pressure Relief Devices	178.270-11(a)(1) and (2)	178.275(e)	178.276(e)
Additional venting	173.32(c)(3)	178.275(g)	NA
Marking of PRD	178.270-11(e)	NA	NA
Remote shut off	173.32(h)(3)	178.275(d)(3)(i)(D) & (d)(3)(iv)	178.276(c)(4)
Exceptions	NA	178.275(d)(2)	NA
Test intervals	180.605(c)(1)	180.605(c)(1)	180.605(c)(1)
Test markings	180.605(k)(1)	180.605(k)(1)	180.605(k)(1)
Transportation	173.32(g)(1) and 177.834(a)	173.32(g)(1) and 177.334(a)	173.32(g)(1) and 177.334(a)
Segregation	177.848(a)(3)	177.848(a)(3)	177.848(a)(3)
Prohibitions	177.834(n) and (o)(3)	177.834(o)(3)	177.840(h)
Valve	178.270-12	178.275(d)	178.276(c)(3) and (4)
Bottom outlets	Special provision T code	178.275(d)	178.276(d) Prohibited
Check valve	NA	NA	NA
Excess flow valve	NA	178.275(d)(3)	178.276(c)(1)-173.32(i)(9)
Internal valve	178.270-12	178.275(d)(3)(i)	178.276(c)(1)
two closures	Special provision T code	Special provision T code	Special provision T code
three closures	Special provision T code	Special provision T code	Special provision T code
Outlet closures	178.270-12(a)	Special provision T code	178.276(c)(1)
Shear section	178.270-12(d)	178.274(e)	178.274(e)
Stop Valve	Special provision T code	178.275(c)	178.276(c)

ISO: International Standards Organization, sets the regulations for the framework

Inspection item	DOT IM 101 and 102*	Low Pressure	High Pressure

IM: USDOT Intermodal Portable Tank specifications

* Enforcement must be cited with Section 173.32(c)(2) as the primary cite and the specification violation as the secondary cite.

Tanks
Refrigerated Gases
178.274(i)
178.274(h)
178.277(d)
178.277(d)(7)
172.302(a)
178.274(e)(2)
172.326
172.313
178.274(e)(1)
172.504(a)
172.514(c)(1) and 172.406(e)
178.277(e)
NA
NA
NA
NA
180.605(c)(1)
180.605(k)(1)
173.32(g)(1) and 177.334(a)
177.848(a)(3)
177.840(h)
178.277(d)
NA
173.32(i)(9)(iv)
NA, see 173.32(i)(12)
178.277(d)
Special provision T code
Special provision T code
178.277(d)
NA
178.277(d)

Refrigerated Gases

Portable Tanks (SEE 173.32)			
	Superseded Regulations*		
Inspection item	**DOT 56**	**DOT 57**	**DOT 51**
Certification/Data plate	178.251-7	178.251-7	178.245-6(a)
Frames	NA	NA	NA
Fusible devices	NA	NA	178.245-1(d)(4)(iii)
Manhole closures	178.252-2(b)	178.253-2(a)	NA
Markings	172.326(a)	172.326(a)	172.326(a)
ID numbers	172.302(a)	172.302(a)	172.302(a)
Outlets	NA	NA	178.245-6(b)
Portable tanks	172.326	172.326	172.326
Stacking	178.251-7(b)	178.251-7(b)	NA
Product specific	172.313, 172.322, 172.325	172.313, 172.322, 172.325	172.313, 172.322, 172.325
Piping protection	NA	178.253-3	178.245-5(a)
Placarding	172.504(a)	172.504(a)	172.504(a)
Exceptions	172.514(c)(1)	172.514(c)(1)	172.514(c)(1)
Pressure Relief Devices	NA	178.253-4	173.315(i)
Additional venting	178.253-4(a)	178.253-4(a)	NA
Marking of PRD	NA	NA	173.315(i)(4)
Remote shut off	NA	NA	178.245-1(d)(4)(iii)
Exceptions	NA	NA	NA
Test intervals	180.605(c)(3)	180.605(c)(3)	180.605(c)(2)
Test markings	180.605(k)(2)	180.605(k)(2)	180.605(k)(2)
Transportation	177.834(a) and 173.32(g)	177.834(a) and 173.32(g)	177.834(a) and 173.32(g)
Segregation	177.848(a)(3)	177.848(a)(3)	177.848(a)(3)
Prohibitions	177.834(h) and (n)	177.834(h) and (n)	177.834(h)
Valve	178.252-2(a)	178.253-2	178.245-1(d)
Bottom outlets	NA	NA	NA
Excess flow valve	NA	NA	173.32(i)(9)
Internal valve	NA	NA	178.245-1(d)(4)(ii)
two closures	NA	NA	NA
three closures	NA	NA	NA
Marking	NA	NA	178.245-6(b)
Outlet closures	178.252.2(a)	178.253-2(a)(2)	173.32(n)
Shear section	NA	NA	178.245-1(d)(4)(ii)

Inspection item	DOT 56	DOT 57	DOT 51

* Enforcement must be cited with Section 173.32(c)(1) as the primary cite and the specification violation as the secondary cite for D
173.32(c)(2) for DOT Specification DOT 51 portable tanks.

Current Title 49
DOT 60
178.255-14
NA
NA
178.255-4(a)
172.326(a)
172.302(a)
NA
172.326
NA
172.313, 172.322, 172.325
178.255-7
172.504(a)
172.514(c)(1)
173.315(i)
NA
173.315(i)(4)
NA
NA
180.605(c)(4)
180.605(k)(2)
177.834(a) and 173.32(g)
177.848(a)(3)
177.834(h) and 177.840(b)
178.255-5
Prohibited see above
NA
NA
NA
NA
NA
178.255-5(b)
NA

DOT 60

)OT Specification 56 and 57 portable tanks, and

Inspection Item	Large Packaging (SEE 173.36)
Specification Markings	178.910(a)
Stacking Marking	178.910(b)
General Requirements	178.915
Labeling	172.400(a)(2)
Marking	
ID#	172.302(a)
Product specific	172.322
Placarding	172.504(a)
Exceptions	172.514(c)(1)
Test intervals	NA
Test markings	NA
Transportation	
No HM on outside	173.36(d)(1)
No PG I or II materials	173.36(a)
Securement	173.36(d)(2) and 177.834(a)
Stacking	173.24b(e)
Segregation	173.36(h) and 177.848

Flexible Bulk Container (SEE 173.37)
178.1010(a)
NA
178.1015
172.400(a)(2)
172.302(a)
172.322
172.504(a)
172.514(c)(1)
178.102 and 173.37(b)(4)
NA
173.37(c)(1)
NA
173.37(c)(2), (3), and (4)
173.37(c)(5)
177.848

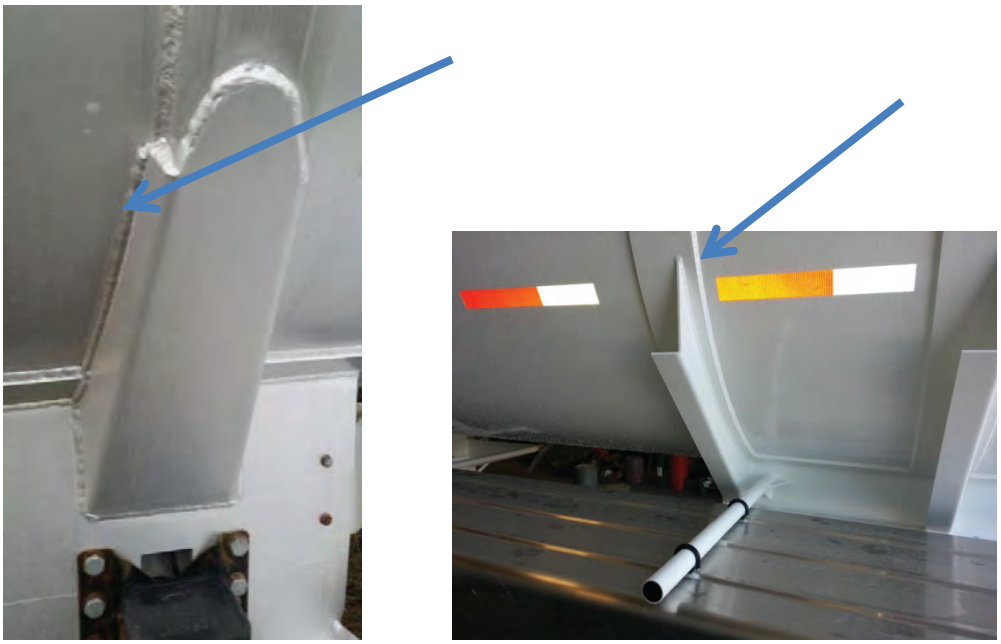
PADS ON DOT SPECIFICATION CARGO TANKS

Pads are required on DOT specification cargo tanks in certain circumstances.

DOT400 series:	Section 178.345-3(f)
MC331:	Section 178.337-3(g)
MC338:	Section 178.338-3(g)
MC300 series:	Section 178.340-8(a)

Structural Support Members

Although the regulations include structural support members in the requirement for pads, PHMSA advises this is an error that will be corrected in a future rulemaking. Pads are not required for structural support members. If pads are present on a structural support member, they are not required to meet the 2" in all directions requirement.



Neither of these CTMVs are in violation

Lightweight Attachments

The current HMR excepts lightweight attachments from the requirement to have pads. Lightweight attachments include:

- Conduit clip;
- Brake line clip;
- Skirting structure;
- Lamp mounting bracket;
- Placard holder; AND
- Must be of a construction having lesser strength than the cargo tank wall materials and may not be more than 72% of the thickness of the cargo tank wall material to which it is attached.

It is the position of PHMSA and FMCSA that catwalks and other driver safety devices are not lightweight attachments.

Accident Damage Protection Devices

Although the current HMR specifies that accident damage protection devices (piping cages, rear end protection, overturn protection devices) must have pads, PHMSA advises that pads are not required if the performance requirements in the design calculations are met.

Requirements for Pads

For appurtenances other than described above, pads must meet the following requirements:

- Thickness of pad must be no less than the thickness of the shell or head and no more than 1.5 times the thickness of the shell/head.
    - MC331: pads may be of a minimum thickness of 0.25” when the shell or head thickness is over 0.25”.
    - DOT400 series: pads may be of a minimum thickness of 0.187” when the shell or head thickness is over 0.187”.

- “Weep-holes” or “Tell-tale holes” are optional, but must be at lowest point of pad.

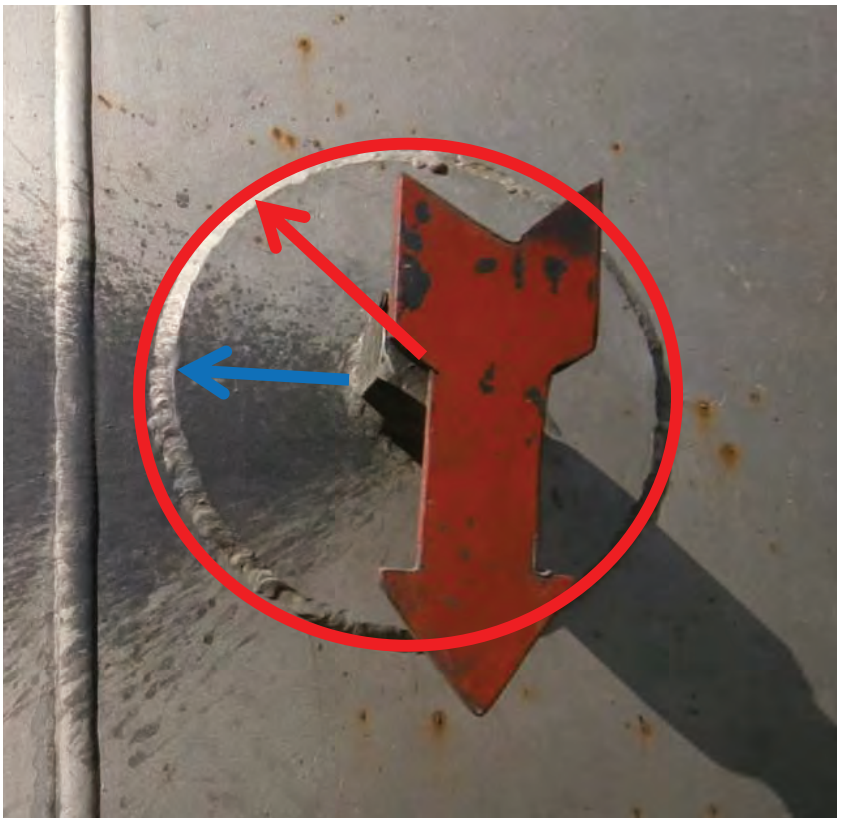
- Pads must have rounded corners or formed in a manner to minimize stress concentrations.

- Pads must be attached with a continuous weld, except for intersections.

- Pads must extend 2” in each direction from any point of attachment of an appurtenance.

  Section 178.345(f)(3)(iii): “*Extend at least 2 inches in each direction from any point of attachment of an appurtenance or structural support member. This dimension may be measured from the center of the structural member attached.”*

  PHMSA advises that the measurement may be made from the center for small appurtenances that because of its location or function would provide for easy measurement from its center, and that the 2” rule would not be applicable to any appurtenance that because of its size could not fit onto or be appropriately attached to a 4” diameter pad.

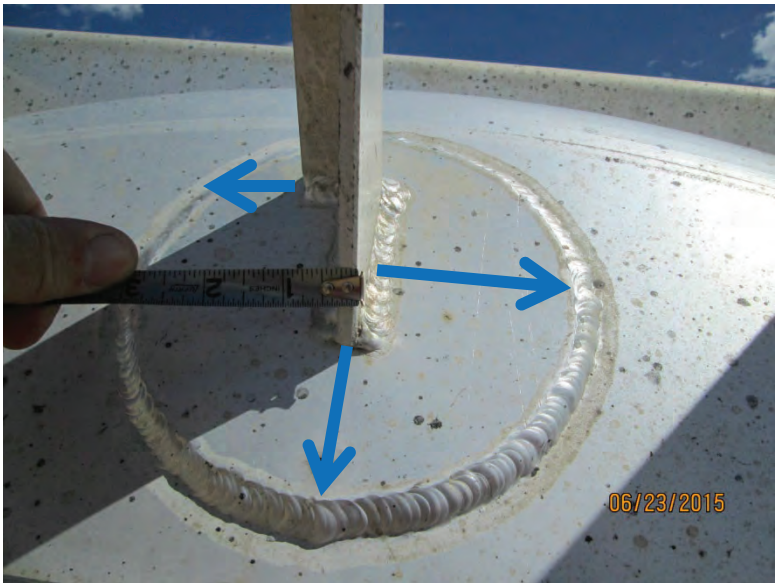


The blue arrow represents the measurement as required by the first sentence in (f)(3)(iii).

The red arrow represents the measurement as allowed by the second sentence in (f)(3)(iii).

It appears this device is eligible for the second sentence.

The statement that the dimension may be measured from the center of the structural member attached, applies to a small attachment that because of its location or function would provide for easy measurement from its center.



The blue arrow represents the measurement as required by the first sentence in (f)(3)(iii).

The statement that the dimension may be measured from the center of the structural member attached, applies to a small attachment that because of its location or function would provide for easy measurement from its center.

The use of this criterion would not be applicable to any appurtenance or structural support member that because of its size could not fit onto or be appropriately attached to a 4" diameter mounting pad.

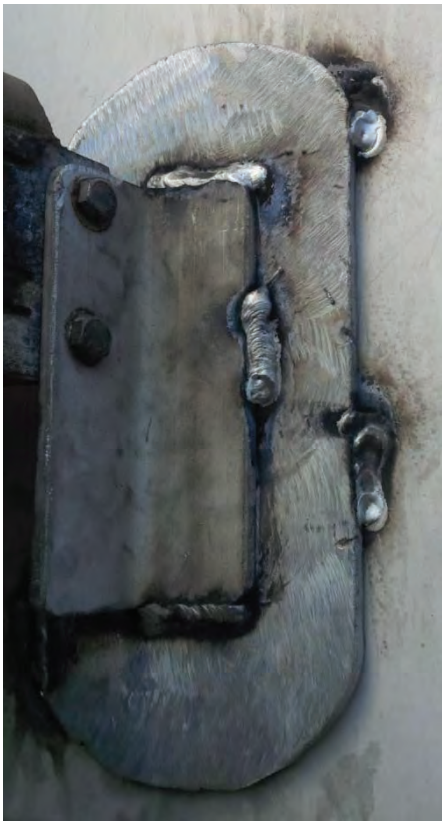
This attachment does not appear to be eligible for the second sentence because it is not a small attachment and is not easily measured from its center.

Older Specifications

While the picture below appears to be a violation because the appurtenance does not have a pad, be sure to check the specification in effect at the time the cargo tank was manufactured. Some of the very old specifications did not require pads.

Retrofitting is not required unless a repair (as defined by Section 180.403) is done. Section 180.413 requires a cargo tank to be brought up to the current specification during any repair or modification.

Examples of pads without continuous welds



Example of Improper Pad

Person Responsible for Compliance Interview

1. How long has the facility been conducting cargo tank tests; what is their company history?
    a. Are they a LLC, corporation, etc.?

2. What are the qualifications and experience of the Person Responsible for Compliance?
    a. Can the person explain the various tests and inspections?
    b. When did they start testing/inspecting cargo tanks?
    c. For what company?

3. What types of tests/inspections are conducted on what types of cargo tanks (including Special Permit), and how many of each are completed annually?
    a. Verify that the facility is registered for all the cargo tanks and test types they are performing.
    b. A facility can be registered for more tests/inspections than what they actually perform.

4. How many RIs do they have, and what are their qualifications and experience (make notes for follow up interviews with the individual RIs)?
    a. Identify all RIs by name, including those that have left in the last year.
    b. Section 107.503(a)(4) specifically requires the Person Responsible for Compliance with the applicable regulations to certify that all RIs and DCEs meet the minimum qualification requirements.

5. Obtain copies of their Cargo Tank Registration letters, and U/R Stamps if appropriate. (Section 107.504(e))

6. Review the MCMIS company profile and verify the information is accurate and current.

7. Do they conduct any mobile testing? Make note to look at mobile testing equipment during the shop assessment.

8. Are they also a motor carrier or HM shipper?

9. Do they perform any repairs (Section 180.413)?
    a. If not, where do they send CTs that need repair to?

10. Do they have a DCE on staff or on contract?
    a. How do they know the person meets the qualifications?

11. Do they perform any assembly or manufacturing functions?

12. Do they have any written procedures for tests/inspections? Obtain copies.

13. What kind of training program do they have?
    a. (Some investigators prefer to hold this question until the RI interviews and the shop assessment have been completed.)

14. Do they have access to the current HMR?
    a. Are they familiar with Parts 107, 172.700, 178, and 180?
    b. Can the RI find a specific section in the HMR?
    c. Have they ever read Section 180.407?

15. Do they perform tests/inspections on Special Permit cargo tanks? If so, which ones?
    a. Do they have copies of the Special Permits?
    b. Have they contacted the manufacturer for instructions on how to perform tests/inspections on these cargo tanks?
    c. Have they provided any training to their Registered Inspectors for these cargo tanks?

16. Do they outsource any portion of any of the tests/inspections (it is common to outsource the wet florescent magnetic particle exam for the pressure test)?
    a. Does that facility have a CT# as required?
    b. Do the employees of that facility meet the RI qualifications?
    c. Are they issuing their own test/inspection reports?

WHAT ARE SOME DIFFERENCES BETWEEN UN PRESSURE RECEPTACLES AND DOT CYLINDERS?

DOT CYLINDERS

- Are acceptable for transport to, from, or within the United States
- Aluminum oxygen cylinders must have straight threads only
- Markings
  - Marks conform to applicable requirements of §178.35
  - Service pressure shown
  - Markings expressed in conventional units

UN PRESSURE RECEPTACLES

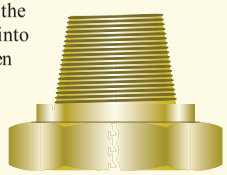
- Must have "USA" country of approval marking to be acceptable for transport to, from, or within the United States
- Aluminum oxygen cylinders may have straight or tapered threads
- Markings
  - Required Part 178 markings displayed in 3 rows in accordance with §178.71
  - Test pressure shown
  - Markings expressed in metric units
  - Thread type must be marked on each receptacle and valve

ALUMINUM CYLINDERS IN OXYGEN SERVICE

The openings on aluminum alloy UN oxygen cylinders may be configured with straight (parallel) or taper threads. The thread type must be marked on the cylinder and on the valve. Any person who installs a valve into a UN aluminum alloy cylinder in oxygen service must verify the valve and the cylinder have the same thread type.

For example:

Straight	Tapered
18P	17E
25P	25E



Taper thread

Straight (parallel) thread

The openings on aluminum alloy DOT specification oxygen cylinders must be configured with straight threads only.

Note: A thread mismatch can lead to an unintentional release of product or a violent expulsion of the valve which can cause personal injury or death. Improper valve torquing can lead to cylinder damage. The correct amount of torque applied to a valve must be obtained from the cylinder manufacturer.

WHAT ARE THE FILLING REQUIREMENTS?

Filling limits for UN pressure receptacles are outlined in §173.302b and §173.304b. UN pressure receptacles may be filled with a gas by using the numerical limits or the formulas provided in P200 of the UN Model Regulations unless otherwise provided.

WHAT ARE THE REQUALIFICATION FREQUENCY AND MARKINGS?

UN pressure receptacles must be requalified at least once every ten years, except that composite cylinders and pressure receptacles used for certain specialized service must be requalified every five years (see §180.207). The requalification markings must conform to the requirements in §180.213.

HOW ARE UN PRESSURE RECEPTACLES REQUALIFIED?

UN pressure receptacles may be requalified by a hydraulic pressure test or ultrasonic examination (UE). The hydraulic pressure test may be either the volumetric expansion or the proof pressure test. UN seamless steel pressure receptacles with a tensile strength ≥950 MPa must be requalified by UE in accordance with ISO 6406 by a requalifier authorized to requalify UN pressure receptacles by UE. Alternative requalification methods may be used if prior approval has been obtained from PHMSA's Associate Administrator for Hazardous Materials Safety.

WHERE TO LEARN MORE

For information about other Hazmat Publications

Visit our web site:
http://hazmat.dot.gov

Write:
U.S. Department of Transportation
Pipeline and Hazardous Materials Safety Administration
400 Seventh Street, SW, PHH-50
Washington, DC 20590-0001

Fax: (202) 366-7342
E-mail: training@dot.gov
Or Phone: (202) 366-2301

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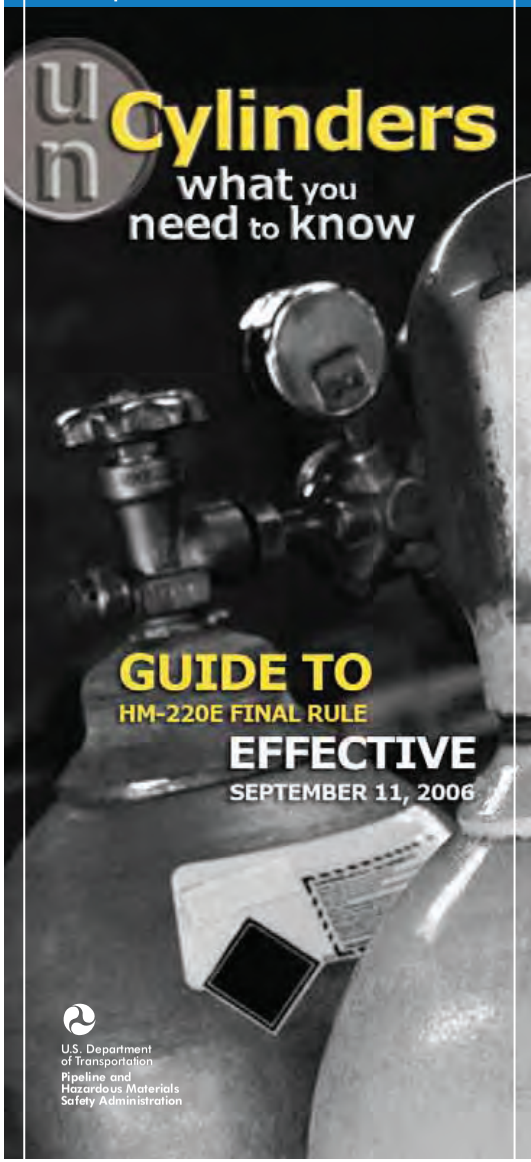
For information about Hazmat Regulations

Contact our Hazmat INFO-LINE:
E-mail: infocntr@dot.gov

PHH50-0078-0706

HAZARDOUS MATERIALS TRANSPORTATION
Compliance Basics Series

UN Cylinders what you need to know



GUIDE TO HM-220E FINAL RULE EFFECTIVE SEPTEMBER 11, 2006

U.S. Department of Transportation
Pipeline and Hazardous Materials Safety Administration

EFFECTIVE SEPTEMBER 11, 2006,

PHMSA adopted standards into the Hazardous Materials Regulations (49 CFR Parts 171-180) for the design, construction, and use of UN pressure receptacles based on the standards contained in the United Nations Recommendation on the Transport of Dangerous Goods (UN Model Regulations).

WHAT DOES HM-220E DO?

The HM-220E final rule:

- Authorizes the design, construction, testing, and use of UN cylinders, tubes, and multiple-element gas containers (MEGCs)
- Specifies requalification methods and intervals for UN pressure receptacles
- Establishes filling requirements for UN pressure receptacles conforming to the UN Model Regulations
- Promotes greater flexibility and permits the use of advanced technology for the manufacture of pressure receptacles
- Provides for a broader selection of pressure receptacles
- Reduces the need for special permits
- Facilitates international transportation

DOES HM-220E AFFECT THE CURRENT REQUIREMENTS FOR DOT SPECIFICATION CYLINDERS?

No. HM-220E allows a shipper to use either a DOT specification cylinder or a UN standard pressure receptacle, as appropriate for individual gases and circumstances.

WHAT ELSE SHOULD I KNOW?

Definitions:

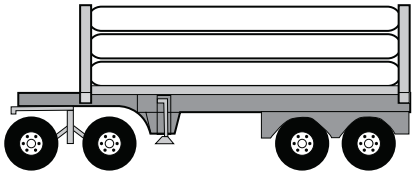
ISO—International Organization for Standardization

UN Cylinder—Transportable pressure receptacle with a water capacity not exceeding 150 L (37.5 gal.)

UN Pressure Receptacle—A UN cylinder or a UN Tube

UN Tube—Transportable pressure receptacle with a capacity exceeding 150 L (37.5 gal.) but not more than 3000 L (750 gal.)

Multiple-Element Gas Container (MEGC)—Assemblies of UN cylinders, tubes, or bundles of cylinders interconnected by a manifold and assembled within a framework. The term includes all service equipment and structural equipment necessary for the transport of gases.



Multiple-Element Gas Container (MEGC)

WHAT ARE THE NEW UN PRESSURE RECEPTACLE DESIGN TYPES?

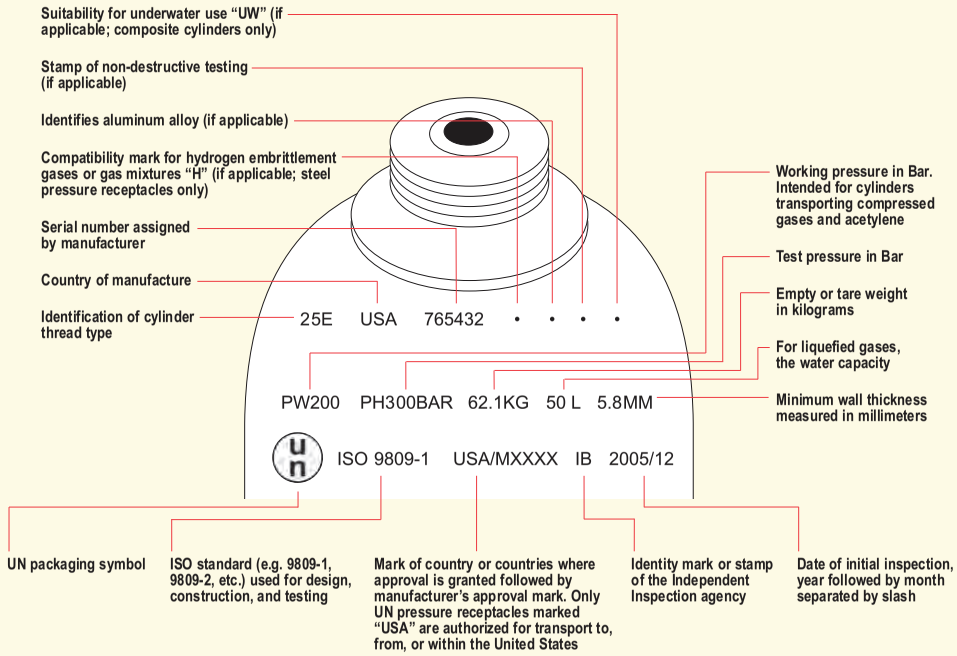
- Acetylene cylinders; except the cylinders must be made of seamless steel, contain a suitable quantity of solvent, and have fusible plugs [§173.303, §178.71(k)]
- Refillable seamless aluminum cylinders conforming to ISO 7866
- Refillable seamless steel cylinders conforming to ISO 9809-1, 9809-2, or 9809-3
- Non-refillable cylinders conforming to ISO 11118
- Composite cylinders conforming to ISO 11119-1, 11119-2, or 11119-3
- Refillable tubes conforming to ISO 11120

WHAT TYPES OF MARKINGS APPEAR ON UN PRESSURE RECEPTACLES?

TOP ROW
Contains manufacturing marks such as the cylinder thread type, the country of manufacture, and the serial number assigned by the manufacturer.

MIDDLE ROW
Contains operational marks such as the test pressure, the tare or empty weight, and the minimum wall thickness.

BOTTOM ROW
Contains certification marks such as the UN packaging symbol, the ISO standard, the country or countries of approval, and the manufacturer's approval mark.



Other markings are permitted in other low stress areas provided they are not on the side wall. Other markings must not conflict with the required markings.

PLACARDING CHECKLIST

This document provides a general overview of the placarding requirements for highway transportation. As always, one should consult the Federal Hazardous Materials Regulations (FHMR) for details on the requirements. Placarding is found in Title 49, CFR, Part 172, Subpart F, 172.500 – 172.560.

Remember: The whole idea of placarding is to *communicate the hazard* to first responders. The best method is to comply with all of the regulations unless you can locate an exception that applies to your particular situation.

These hazardous materials classifications must be placarded regardless of quantity ("Table 1" materials, Section 172.504(e)):

- Explosives, Divisions 1.1, 1.2, 1.3
- Poison Gas, Division 2.3
- Dangerous When Wet, Division 4.3
- Organic Peroxide, Division 5.2, Type B, liquid or solid, temperature controlled
- Poison/Toxic, Division 6.1, PG I, Inhalation Hazard, Zone A and B
- Radioactive, Class 7:
    - Yellow III label
    - All unpackaged LSA-I or SCO-I shipments
    - All exclusive use shipments under Sections 173.427, 173.441, and 173.457
    - All closed vehicles under Section 173.443(d)

Unless operating under a Special Permit or a special provision in the HM Table, placarding is required for Table 1 materials.

All other classes and divisions of hazardous materials fall under Placarding "Table 2" (See 172.504). There are three circumstances to consider for Table 2 materials:

1. A Table 2 material with a mandatory subsidiary hazard must placard regardless of quantity (see Section 172.505). Subsidiary hazards (identified by Column 6 or 7 of the 172.101 Table) that require a placard are:

    A) Poison Inhalation Hazards (PIH);
    B) More than 1,000 lbs. of non-fissile, fissile-excepted, or fissile uranium hexafluoride (must have the Class 7 and Class 8 placards); and
    C) Dangerous When Wet (4.3).

    All other subsidiary hazards *may* be placarded, but are not required to be placarded.

While Table 2 does have a “1,000 lb. exception” (see below), there are two circumstances where a Table 2 material must be placarded for any quantity:

2. A Table 2 material in a package meeting the definition of a “bulk package.” A bulk package is defined as a single container with: 1) a water capacity greater than 450 liters (119 gallons) for liquids; 2) a net mass greater than 400 kilograms (882 lbs.) and a capacity greater than 450 liters (119 gallons) for solids; or 3) a water capacity greater than 454 kilograms (1,000 lbs.) as a receptacle for a gas.

3. If neither of the above applies, and the Table 2 materials are in non-bulk packages, then the “1,000 lb.” rule applies. If the *total aggregate gross weight of all the Table 2 materials* does not exceed 1,000 lbs., then placards are not required. Aggregate gross weight includes the weight of the package and the material. The 1,000 lbs. does not include limited quantities, non-bulk packages of diesel fuel, or other HM that is excepted from the HMR.

Dangerous Placard

The Dangerous placard is an option, not a requirement. The Dangerous placard may be used only when *two or more Table 2 materials in non-bulk packages* are transported in the same vehicle. The Dangerous placard cannot be used for a shipment of one class of 1,000 kg. (2,205 lbs.) or more from a single loading facility.

Exceptions

There are a number of placarding exceptions under Section 172.504(f), which allow a “higher” hazard placard to provide for “lower” hazard materials that are transported on the vehicle. For example, a Nonflammable Gas placard is not required if the vehicle is displaying a Flammable Gas placard, as required.

The Class 9 (Miscellaneous) placard, which includes most hazardous wastes and substances, is an optional placard for shipments within the United States. For international shipments, the Class 9 placard is required under the Table 2 provisions.

Some other placarding exceptions scattered around the HMR:

- Batteries, 173.159(e)
- Combustible liquids in non-bulk packages, 173.150(f)
- Cryogenic atmospheric gases, 173.320
- Empty with residue non-bulk packages, 173.29
- Vehicles, engines, etc., 173.220(h)
- Limited quantities and ORM-D materials, 172.500
- Infectious substances, 172.500
- Small quantities under Sections 173.4, 172.4a, 173.4b
- Materials of Trade, 173.5
- Agricultural operations, 173.5
- Oilfield service vehicles, meter provers, roadway striping vehicles, 173.5a
- Be sure to check Special Provisions in the HM Table – there are communication exceptions there!

Display

Placards must be displayed on bulk packages and on vehicles. When displayed, the placard must read horizontal, left to right, and must be free and clear of dirt and appurtenances such as ladders and piping. Placards must be placed away from wording, such as advertisements, to prevent confusion. Further, “drive safely” and other safety slogans that appear in a placard form are illegal.

Generally speaking, placards must be displayed on all four sides of a package or vehicle (See below). The vehicle is not required to be placarded on any side that the placards on the package are visible. Placard holders are permitted, but not required. Placing tape or similar adhesives on the edge of a placard to affix it to a surface is legal, provided it does not obscure the placard. Placards displayed on mud flaps, low bumpers, and underneath flatbed frames are also illegal.

The following containers may be placarded on two sides or labeled in lieu of placarding:
1) A portable tank having a capacity of less than 3,785 L (1,000 gallons);
2) A DOT 106 or 110 multi-unit tank car tank;
3) A bulk packaging other than a portable tank, cargo tank, or tank car (e.g., a bulk bag or box) with a volumetric capacity of less than 18 m^3 (640 cubic feet); and
4) An intermediate bulk container.
A vehicle transporting these packages must still be placarded on all four sides.

Placards may be displayed on the front of the tractor or on the front of a semitrailer, for combination vehicles. For single vehicles, the placard must be visible when standing at the front of the vehicle.

Placards must meet design, size, and color specifications. Faded placards are a common violation. A good practical method of checking placards for fading is to compare the displayed placard to a new placard. If you can see a difference in colors, it should be replaced.

A shipper is required to offer the appropriate placards to a motor carrier prior to or at the time the material is offered for transportation, unless the vehicle is already placarded as required. A shipper must, however, **affix** the appropriate placards on the package when offering a bulk package (See definition above; see also Section 172.514). A motor carrier may not transport a hazardous material that requires placarding without the appropriate placards displayed properly on the vehicle.

Placarding Checklist

- Table 1 materials?

- Table 2 materials?
  - Bulk packages?
  - Mandatory subsidiary hazards?
  - More than 1,000 lbs. aggregate gross weight?
  - Dangerous Placard?
    - More than 2,205 lbs. at one facility?

- Display
  - Proper class/division
  - Proper size
  - Proper color
  - Not covered, obstructed
  - Vehicle vs. package

- Exceptions
  - Special Permits
  - Special Provisions to HM Table
  - Agricultural operations, 173.5
  - Batteries, 173.159(e)
  - Combustible liquids in non-bulk packages, 173.150(f)
  - Cryogenic atmospheric gases, 173.320
  - Empty with residue non-bulk packages, 173.29
  - Infectious substances, 172.500
  - Limited quantities and ORM-D materials, 172.500
  - Materials of Trade, 173.5
  - Oilfield service vehicles, meter provers, roadway striping vehicles, 173.5a
  - Small quantities under Sections 173.4, 172.4a, 173.4b
  - Vehicles, engines, etc., 173.220(h)

PORTABLE TANKS CHECKLIST

See the PACKAGE CITES spreadsheet for additional criteria for individual specifications. Also be sure to review the Special Provisions Column (7) for portable tank requirements. Use Part 177 for violations on motor carriers.

		Yes/No/NA
1	**PART 172**	
	Marked with ID # in accordance with 172.332 [172.302(a)]	
	Marking is of proper size based on capacity [172.302(b)]	
	Marked with DOT SP number (or E number if permanent) if operating under a Special Permit [172.302(c)]	
	Proper Shipping name marked on two opposing sides [172.326(a)]	
	Marked with owners name [172.326(b)]	
	If ID# not visible then mark transport vehicle as required [172.326(c)]	
	Non-Odorized LPG marking [172.326(d)]	
	For a portable tank less than 1,000 gallons, must be labeled unless placarded [172.400(a)(3)]	
	Bulk packaging placarding requirements [172.514(c)]	
2	**PART 173**	
	Offering /Transporting hazardous materials in an unauthorized portable tank [173.32(a)]	
	Filling/Offering a portable tank with an expired periodic test or inspection [173.32(a)(2)] See also Part 180	
	Authorization to use IM Tank [173.32(b)(2) and (c)(2)]	
	Authorization to use DOT Specification portable tanks [173.32(b)(3) and (c)]	
	Authorization to use TDG Specification portable tanks [173.32(b)(4) and 171.12]	
	Filling and Offering a portable tank for transportation when it does not meet the MAWP, design pressure, or test pressure for the hazardous materials being transported. [173.32(d)]	
	Failing to perform an external inspection prior to filling a portable tank.[173.32(e)]	
	Loading a hazardous material into a portable tank that would damage, react with, or compromise the portable tank. [173.32(f)(1)]	
	Subjecting a portable tank to a pressure greater than the maximum allowable working pressure, or its marked design pressure. [173.32(f)(3)]	
	Loading a portable tank with a gross mass greater than the maximum allowable gross mass specified on the identification plate. [173.32(f)(4)]	
	Offering a portable tank with a leakage through the frangible disk. [173.32(f)(7)]	

	Filling a portable tank when the temperature of the hazardous materials exceeds the limits of the design temperature range. [173.32(f)(8)]	
	Loading a portable tank onto a highway or rail transport vehicle when the portable tank is not entirely within the horizontal outline of the transport vehicle. [173.32(g)(1)]	
	Using an uninsulated portable tank for the transportation of liquefied compressed gas that does not have a significantly reflective exterior surface. [173.32(h)(1)]	
	Transporting a hazardous material in a molten state in a thermally un-insulated portable tank. [173.32(h)(2)]	
3	**PART 180**	
	Conditions requiring test and inspection without regard to previous testing [180.605(b)]	
	IM or UN Tank requires periodic test every 2.5 years [180.605(c)(1)]	
	Specification 51 portable tank test every 5 years [180.605(c)(2)]	
	Specification 56 or 57 portable tank test every 2.5 years [180.605(c)(3)]	
	Specification 60 portable tank test schedule [180.605(c)(4)]	
	Testing procedures [180.605(d)-(i)]	
	Repair of portable tanks [180.605(j)]	
	Inspection and test markings as required [180.605(k)]	
	Retain records of test, inspection and manufacture data [180.605(l)]	

PRESSURE RELIEF DEVICE TESTING PRESSURES

Section 180.407(j)(1)(v) requires that for DOT400 series CTMVs, the pressures identified in the applicable specification are to be used for the PRD bench test. Those pressures are identified in the table below.

Section 180.407(j)(1)(i)-(iv) specifies the pressures to be utilized for the different MC300 series CTMV specifications. For the MC306 specification, the regulation failed to consider that a MC306 CTMV may have a MAWP higher than 3 psig. For these CTMVs, use the pressures identified in Section 180.407(j)(1)(vii): must open between the MAWP and 110% of MAWP and close at no less than 90% of MAWP.

In Section 180.407(j)(1)(i)-(iii), the regulations state that when a DOT400 series PRD is installed on a MC300 series CMTV, that the open and close pressure for DOT400 series CTMVs should be used. However, this provision conflicts with Sections 173.33(d) and 180.405(h), and possibly 180.407(a)(2). PHMSA has stated that their expectation is that the PRD should open and close based on the MAWP of the CTMV and the CTMV specification. An interpretation is expected.

Loading/unloading vents (normal vents, 1 lb. vents) must be tested according to the manufacturer's instructions.

CT SPECIFICATION	CT MAWP	Minimum opening pressure PSIG	Maximum opening pressure PSIG	Minimum closing pressure PSIG
306	**3.0**	**>= 3.0**	**<= 4.4**	**>= 2.7**
406	**3.0**	**>= 110% 3.30**	**<= 138% 4.14**	**>= 3.0**
406	**3.3**	**>= 110% 3.63**	**<= 138% 4.554**	**>= 3.3**
312	**15**	**>= 15**	**<= 110% 16.5**	**>= 90% 13.5**
307 or 312	**25**	**>= 25**	**<= 110% 27.5**	**>= 90% 22.5**
307 or 312	**30**	**>= 30**	**<= 110% 33**	**>= 90% 27**
307 or 312	**35**	**>= 35**	**<= 110% 38.5**	**>= 90% 31.5**
307 or 312	**40**	**>= 40**	**<= 110% 41.1**	**>= 90% 36**
307 or 312	**45**	**>= 45**	**<= 110% 49.5**	**>= 90% 40.5**
307 or 312	**50**	**>= 50**	**<= 110% 55**	**>= 90% 45**
412	**15**	**>= 120% 18**	**<= 132% 19.8**	**>= 108% 16.2**
407 or 412	**25**	**>= 120% 30**	**<= 132% 33**	**>= 108% 27**
407 or 412	**35**	**>= 120% 42**	**<= 132% 46.2**	**>= 108% 37.8**
407 or 412	**30**	**>= 120% 36**	**<= 132% 39.6**	**>= 108% 32.4**
407 or 412	**40**	**>= 120% 48**	**<= 132% 52.8**	**>= 108% 43.2**
407 or 412	**45**	**>= 120% 54**	**<= 132% 59.4**	**>= 108% 48.6**
407 or 412	**50**	**>= 120% 60**	**<= 132% 66**	**>= 108% 54**
330 or 331	**165**	**>= 165**	**<= 110% 181.5**	**>= 90% 148.5**
330 or 331	**250**	**>= 250**	**<= 110% 275**	**>= 90% 225**
330 or 331	**265**	**>= 265**	**<= 110% 291.5**	**>= 90% 225**
338	**33**	**>= 33**	**<= 110% 49.5**	**>= 90% 29.7**
338	**56**	**>= 56**	**<= 110% 84**	**>= 90% 50.4**
338	**70**	**>= 70**	**<= 110% 105**	**>= 90% 63**
338	**75**	**>= 75**	**<= 110% 112.5**	**>= 90% 67.5**
338	**143**	**>= 143**	**<= 110% 214.5**	**>= 90% 129.7**
338	**176**	**>= 176**	**<= 110% 264**	**>= 90% 158.4**

Flammable and Oxygen	**MAWP**	**Primary minimum**	**Primary maximum**	**Secondary minimum**	**Secondary maximum opening**

		opening pressure PSIG	opening pressure PSIG	opening pressure PSIG	pressure PSIG
338	56	>= 56	<110% 61.6	<130% 56	>= 150% 84
338	70	>= 70	<110% 77	<130% 70	>= 150% 105
338	75	>= 75	<110% 82.5	<130% 75	>= 150% 112.5
338	143	>= 143	<110% 157.3	<130% 143	>= 150% 214.5
338	176	>= 176	<110% 193.6	<130% 176	>= 150% 264

Radioactive Materials Checklist

NOTE: Cite motor carriers using Part 177 as the primary cite and a secondary cite listed below, as applicable.

		Yes/No/NA
1	**SHIPPING PAPERS**	
	Name of each radionuclide [172.203(d)(1)]	
	Description of physical and chemical form if not special form [172.203(d)(2)]	
	Activity per package (Bq, Tbq, etc.) [172.203(d)(3)]	
	Category of label applied [172.203(d)(4)]	
	Transport index (TI) for Yellow-II and Yellow-III labeled packages [172.203(d)(5)]	
	“Fissile Excepted” if excepted by 173.453 [172.203(d)(6)(i)]	
	Criticality safety index (CSI) for non-excepted fissile material [172.203(d)(6)(ii)]	
	Package ID marking if approved by DOE or NRC [172.203(d)(7)]	
	Package ID marking if exporting in a foreign made package [172.203(d)(8)]	
	“Exclusive Use Shipment” if applicable [172.203(d)(9)]	
	“Highway Route Controlled Quantity” or “HRCQ” if applicable [172.203(d)(10)]	
2	**MARKING**	
	Gross mass marked on packages with a gross mass greater than 50 kg (110 lb.) [172.310(a)]	
	Package type marked on each Industrial, Type A, and Type B package [172.310(b)]	
	Country of origin of design marked on each IP-1, IP-2, IP-3, and Type A package [172.310(c)]	
	Trefoil mark on each Type B package [172.310(d)]	
	“USA” on each Type B or fissile material package being exported [172.310(e)]	

3	**LABELING**	
	Exceptions [173.421-173.427]	
	Must label two opposite site [172.403(f)]	
	Label category is based on Transport Index and radiation level at external surface [172.403(c)]: White I; Yellow II; Yellow III	
	Highway Route Controlled Quantities must be labeled Yellow-III [172.403(c)]	
	Empty label may be used when allowed by 173.428 [172.403(d)]	
	Criticality Safety Index (CSI) listed on fissile label [172.403(e)]	
	Fissile label must be applied to two opposite sides if not fissile excepted by 173.453 [172.402(d)(2)]	
	Radioactive labels must contain following information: 1. Radionuclide content (except LSA-I) [172.403(g)(1)] 2. Activity (Bq, Tbq, etc. with some exceptions) [172.403(g)(2)] 3. Transport Index (except White I) [172.403(g)(3)]	
4	**PLACARDING**	
	Placards required [172.504(e) Table 1 and Note 1] • For any conveyance bearing a Yellow-III labeled package • All shipments of unpackaged LSA-I material or SCO-I; • All shipments required by Sections 173.427, 173.441, and 173.457 to be operated under exclusive use; • All closed vehicles used in accordance with Section 173.443(d).	
	Placards on square background required for HRCQ [172.507(a)]	
5	**PART 173**	
	Exceptions [173.401]	
	Radioactive material definitions [173.403]	
	Empty packagings [173.428]	
	Exempt quantities [173.436]	
	Transport requirements for LSA and SCO [173.427]	
	Maximum activity allowed in a Type A package [173.435]	
	Exclusive Use [173.441]	
	Fissile Materials [173.420, 173.453, 173.457, and 173.459]	
	Excepted Packages [173.421 and 173.422]	
	Limited Quantities [173.423]	
	Excepted Packages for Instruments and Articles [173.424]	
	General Transportation Requirements [173.448]	
	Shipper Quality Control Requirements [173.475]	
	Packaging, Testing, Documentation Retention [See cite specific to package type]	

6	**PART 177**	
	No more than a cumulative Transport Index (TI) of 50 in any conveyance (except for exclusive use) [177.842(a)]	
	Maintain minimum separation distances between Yellow-II and Yellow-III packages of radioactive material and personnel during transport. [177.842(b)]	
	Packages blocked and braced as required [177.842(d) and 173.448(a)]	
	Segregation and separation requirements [177.848]	
	Fissile Materials Packages CSI total no more than 50 [177.842(f)]	
	Exclusive Use Radiation Limits [173.842(g)]	
	Contamination of Vehicles [177.843]	
7	**PART 385**	
	Hazardous Materials Safety Permit Required for HRCQ [385.403]	
	Communications Plan/Log [385.415(c)(1)]	
	Information required in vehicle [385.415(a)(1)	
	Level VI Inspections required [385.415(b)]	
8	**PART 397**	
	Routing requirements for radioactive material requiring placards [397.101(a)]	
	Routing requirements for HRCQ [397.101(b) and (c)]	
	Required written route plan must be provided to HRCQ drivers [397.101(d)]	
	HRCQ driver must have specific training and have training certificate in his possession along with written route plan [397.101(e)]	
	HRCQ drivers must receive training **every two years** [397.101(e)(1)]	
	Shipper notification of shipments [173.22(c) and 397.101(f)]	
	Required information filed with FMCSA within 90 days by carrier after acceptance of HRCQ shipment [397.101(g)]	

EQUIVALENTS FOR CONVERSION

Quantity (Activity)

TBq	Ci	Ci
1 TBq	27 Ci	27,000 mCi
1 GBq	27 mCi	27,000 uCi
1 MBq	.000027Ci	.027 mCi or 27 uCi
.037, 37 GBq, or 37,000 MBq	1	--
.000037 TBq or 37 MBq	1 mCi	--
.037 MBq or 37,000 Bq	1 uCi	--
.000037 MBq or 27 Bq	1 nCi	--
.37 Bq or 37 MBq	1pCi	--

Radiation Level (dose equivalent rate)

Sv/h	Rem/h	Mrem/h
1	100	100,000
1 m	.1	100
1 u	.0001	.1
.01, 10 mSv, or 10,000 uSv	1	--
.00001, .01mSv, or 10 uSv	--	1

Definitions and Abbreviations Numerical

Number	Multiplication Factors	Prefix	Symbol
1,000,000,000,000	10^{12}	tera	T
1,000,000,000	10^{9}	giga	G
1,000,000	10^{6}	mega	M
1,000	10^{3}	kilo	k
100	10^{2}	hecto	h
10	10^{1}	deka	da
0.1	10^{-1}	deci	d
0.01	10^{-2}	centi	c
0.001	10^{-3}	milli	m
0.000 001	10^{-6}	micro	u
0.000 000 001	10^{-9}	nano	n
0.000 000 000 001	10^{-12}	pico	p

Remounting a Specification Cargo Tank (CT)

(Existing specification cargo tank mounted on a different chassis, Section 180.413)

If the mounting requires welding to the cargo tank wall:

If an ASME U Stamped CT, an R Stamp is required.

If a non-ASME U Stamped CT, an R or U Stamp is required.

The mounting must be certified by a DCE.

If the mounting involves any change to the method of attachment to the chassis:

The mounting must be certified by a DCE

Must be in accordance with the current applicable specification

If the mounting involves any change to the attachment or design of any accident damage protection device, including the piping or the rear end protection device:

The mounting must be certified by a DCE

Must be in accordance with the current applicable specification

If the mounting does not involve any of the above listed circumstances:

The mounting may be done under the supervision of a Registered Inspector

If the piping has been disconnected or repaired, a Leakage Test must be conducted after the piping is reinstalled on the cargo tank

Stretching, Modification, and Rebarrelling a Cargo Tank

General Requirements

If an ASME U Stamped CT, an R Stamp is required.

If a non-ASME U Stamped CT, an R or U Stamp is required.

The design of the modification/stretching/rebarrelling must be certified in writing by a DCE as meeting the structural integrity and accident damage protection requirements of the applicable specification.

Except for MC338 cargo tanks, all new material and equipment affected by the modification/stretching/rebarrelling must meet the specification in effect at the time the work is performed, as specified in Section 180.413(d)(2).

A Registered Inspector must certify that the modified/stretched/rebarrelled cargo tank is in compliance by issuing a supplemental certificate of compliance.

The person performing the modification/stretching/rebarrelling must:

Have knowledge of the original design concept, including structural design analysis, material and welding procedures;

Assure compliance of the rebuilt cargo tank's structural integrity, venting, and accident damage protection with the applicable specification;

Assure compliance with all the applicable FMCSRs

Assure the suitability of each modification/stretching/rebarrelling that affects the lading retention capability of the cargo tank by performing a pressure test.

Apply a supplemental specification plate if any information on the original specification plate has changed

MC300 Series Cargo Tanks

A MC300 series cargo tank may be modified/stretched/rebarrelled and re-certified as a MC300 series cargo tank after 8/1/95, provided:

The work is done in accordance the current DOT400 series cargo tank specification; and

It is done in accordance with Section 180.413

The supplemental specification plate will still reflect the MC300 specification.

If a MC300 series cargo tank has been modified/stretched/rebarrelled, but no documentation of the work exists, then the cargo tank ***cannot*** be recertified as a specification cargo tank per Section 180.405(b)(2)(ii).

How to Recertify a Cargo Tank to the Original Specification

MC306, 307, or 312 Cargo Tanks

Must have a specification plate on the cargo tank, but covered; or

Sufficient records exist to verify that the cargo tank was originally built to a specification AND positive identification of the cargo tank can be made.

If the cargo tank was stretched, rebarrelled, or modified, records are available verifying that the stretching, rebarrelling, or modification was performed in accordance with the National Board Inspection Code and the HMR

Procedure:

A Design Certifying Engineer or Registered Inspector verifies the cargo tank conforms to all applicable requirements of the original specification and furnishes to the owner written documentation that verifies the tank conforms to the original structural design requirements in effect at the time the tank was originally constructed.

The cargo tank meets all applicable tests and inspections required by Section 180.407(c).

The cargo tank is recertified to the original specification in accordance with the reporting and record retention provisions of Section 180.417.

If a U-1A form is required, a copy must be obtained from the National Board and retained.

If the original certificate of compliance exists, it must be retained. If it does not, the owner and Registered Inspector must create a certificate of compliance per Section 180.417(a)(3).

The certification documents required by Section 180.417(a)(3) must include both the date the cargo tank was originally certified to the specification and the date it was recertified. The specification plate on the cargo tank or the cargo tank motor vehicle must display the date the cargo tank was originally certified to the specification.

DOT400 Series Cargo Tanks

If the cargo tank is required to have an ASME U Stamp:

The original manufacturer must have a U Stamp or the cargo tank cannot be certified

The cargo tank must have been built according to the ASME Code or the cargo tank cannot be certified

Obtain the original design and construction records

Have a DCE perform the necessary calculations to verify structural integrity and accident damage protection

Have the cargo tank inspected by a Registered Inspector for compliance with all specification requirements

- Metal properties
- Weld properties
- Structural integrity
- Rollover protection
- Rear end protection device
- Bottom damage protection
- Sketches, drawings, calculations

Have all Part 180 tests and inspections performed by a Registered Inspector

Prepare a certificate of compliance per Section 178.345-15 and a specification plate and name plate per Section 178.345-14.

If the cargo tank is not required to have an ASME U Stamp:

Obtain the original design and construction records

Have material properties and weld joint properties determined by laboratory testing of samples from the cargo tank

Have a DCE perform the necessary calculations to verify structural integrity and accident damage protection

Have the cargo tank inspected by a Registered Inspector for compliance with all specification requirements

- Metal properties
- Weld properties
- Structural integrity
- Rollover protection
- Rear end protection device
- Bottom damage protection
- Sketches, drawings, calculations

Have all Part 180 tests and inspections performed by a Registered Inspector

Prepare a certificate of compliance per Section 178.345-15 and a specification plate and name plate per Section 178.345-14.

Repair (R Stamp) Checklist

- Obtain copy of the most recent certificate from National Board (required every 3 years)

- Ask about their last National Board audit (required every 3 years). Ask to see a copy of the audit report.

- Ask to see their Quality Control Manual (NBIC, Part 3, 1.6.2) – is it current to the last audit?
    - How many control copies do they have?
    - Control copies are required to be current. Part 3, 1.6.5.1 has an outline of what is required in the Quality Control Manual. They must include a section on routine repairs (3.3.2).
    - The shop must have access to copies of the NBIC and ASME Codes (either manuals or electronic access)

- If repairs requiring an R stamp are performed at locations other than the address of the repair facility where the R stamp is issued, the R stamp authorization will indicate that off-site repairs using this R stamp are authorized, but the off-site location must follow the quality control procedures of the location identified in the R stamp application and the documents that support these off-site repairs must be maintained at the main location.

- Note that off-site repairs do not apply to a fixed location. A separate "R" stamp must be issued for each fixed facility location.

- The National Board requires a separate application for each plant or shop. They must notify the National Board of any change in ownership, name, location, or address. The R is the property of the National Board. NBIC can restrict their operations to shop only, field only, or both.

- Section 180.413(b)(6) refers repairs of MC330 and MC331 to Section 178.337-16, which requires various Non-Destructive Exams (NDE) after repairs have been completed to the cargo tank wall.
    - The ASME Code requires personnel conducting these NDE to meet certain qualifications, depending upon the exam. Examples of NDE are post-weld heat treatment, Wet Fluorescent Magnetic Particle Exam (WFMPE), etc.
    - Obtain the names of facility personnel who conduct the NDE, and verify their qualifications.
    - Ask to see their repair documentation, including documentation of the required NDE. A discussion of required NDE documentation is included in the WFMPE section of the CTFR procedures manual.

- Repairs to pressure vessels must comply with CGA Tech Bulletin TB-2 and NBIC Code. Welds to CT wall must comply with Section 178.337-16 (post-weld heat treatment, hydrostatic test, and WFMPE).

- Do they provide the CT owner with all the documentation required by Section 180.413(f)?

- Drawings of repairs are required unless the original code of construction (e.g., CFR 49 and ASME Code) and U-1A form are available.

- If the facility is applying supplemental specification plates or repair plates, ensure the supplemental plate has all required information.

- Cargo tanks must be cleaned and purged prior to welding (180.413(a)(2)). How do they accomplish this and do they keep any documentation (not required)?

- Routine repairs are listed in NBIC, Part 3, 3.3.2(d).

- The WFMPE is required to ensure defect is completely removed and if the defect is through the full thickness, a full penetration weld must be done (3.3.4.1).

    - For wasted areas, the weld build up must have a WFMPE (3.3.4.3(k)).

- Employees conducting CT repairs are hazmat employees and must comply with the training requirements of the HMR.

- RIs certifying repairs under Section 180.413(b) must be knowledgeable in the applicable DOT specifications, Part 180, the ASME Code, and the NBIC.

Reviewing Repair Records

- All welding on CT walls for ASME Code cargo tanks (U Stamped cargo tanks) must be done by an R stamp shop. The R stamp holder must certify all CT repairs. (U Stamp shops may conduct repairs on CTMVs that are NOT marked with a U Stamp.) (180.413(a))

- Sample the repair files maintained by the facility.
    - If less than 10 repairs have been conducted in the last 365 days, all files should be reviewed.
    - If more than 10 repairs have been conducted in the last 365 days, 10% of those files should be reviewed.

- Verify the facility is conducting complete leakage tests after repairs on valves and piping.
    - The leakage test must be done AFTER the installation of piping onto the cargo tank (Section 180.413(c)).
    - Cargo tank owners are required to maintain documentation of leakage or pressure tests completed after repairs.
    - Ask the facility if they provide such documentation (Section 180.413(f)). There is an interpretation that states the documentation must comply with Section 180.417.

- If the repair includes welding on the cargo tank wall, the facility must do a pressure test.
    - The pressure test must be done AFTER the installation of piping onto the cargo tank (Section 180.413(c)).
    - Cargo tank owners are required to maintain documentation of leakage or pressure tests completed after repairs.
    - Ask the facility if they provide such documentation (Section 180.413(f)). There is an interpretation that states the documentation must comply with Section 180.417.

Repairs and alterations to ASME certified cargo tanks must be documented per the NBIC, Part 3, Section 5. These forms must be completed by the U/R Stamp holder.

Copies of these forms must be given to the cargo tank owner and retained by the U/R Stamp holder:

- R-1: Report of Repair
- R-4: Report Supplementary Sheet, when R-1 has insufficient space.
- R-3: Report of Fabricated Parts or Manufacturer's Partial Data Reports (list of parts fabricated by welding), if applicable.
- Copy of the Manufacturer's Data Report, if available.

The following forms are only required for U Stamped CTMVs and only on a "major repair." The HMR does not define a major repair, but the ASME Code defines it as over 100 square inches:

- R-2: Report of Alteration
- R-4: Report Supplementary Sheet, when R-2 has insufficient space.
- R-3: Report of Fabricated Parts or Manufacturer's Partial Data Reports (list of parts fabricated by welding), if applicable.
- Copy of the Manufacturer's Data Report, if available.

For repairs on non-ASME Code cargo tanks (any CT not stamped with a U-Stamp), the following is NOT required: Authorized Inspector (AI) certification; R-Form; or R stamp on CT. (180.413(a)(1)(ii))

If the pressure vessel is originally registered with the National Board, an original R-2 with attachments must be registered with the National Board for any alterations.

Section 5.7.1 (NBIC) requires a repair nameplate to be attached to the pressure vessel and Section 5.7.3 (NBIC) requires an alteration nameplate to be attached to the pressure vessel.

Welder Qualifications, ASME Code, Section IX

Welders that are employed by R Stamp or U Stamp facilities must meet the qualification requirements of Section IX of the ASME Code. The ASME does not certify individual welders, the welder employer does.

When conducting a CTFR at a U/R stamp shop, ask to see the Welding Operator Performance Qualification records which should include:

- Documentation of training and written tests received on various weld procedures
- Welder continuity log (sometimes called "the traveler")-- a list of welding activities broken out by each welder
- Each welder must have a unique stamp (# or letter). Welder must stamp weld every 3 feet or log it on quality control log for each vessel. The employer must have a written procedure on how they identify an individual welder's work.
- Procedure Qualification Record: Each welder must be qualified by the employer for each welding process used in production welding. This must be done by having the welder weld various samples, which are subjected to various tests. These test records must be retained by the employer.
- Are the welders qualified for each type of metal they work with?If welder hasn't welded in 6 months, he/she must be retested. He/she can weld on anything; they don't have to weld on an ASME vessel.
- The facility should have the coupons the welder welded together and the test results showing he/she passed.

Lap Patches

HM-213, which became effective 10/1/2003, amended Section 180.413(a)(1), which requires all repairs to meet the NBIC in effect at the time the repair is done. Therefore, any lap patch installed after 10/1/2003 on a DOT specification cargo tank is in violation of the FHMR.

PHMSA recommends that a RI that encounters a lap patch on a MC306 tank should "note it, report it to the owner or carrier and approve the requalification of the tank. A lap patch installed after 10/1/03 must be removed."

ASME Data Plates

The ASME marking is required by Section 178.337-17.

- The ASME marking requirements are found in UG-116 of the ASME Code. They include: Official Code "U" symbol; name of manufacturer, preceded by the words "certified by"; maximum allowable working pressure (MAWP/design pressure); minimum design metal temperature, in degrees Fahrenheit at MAWP; manufacturer's serial number; year built; type of construction used; etc.

RI Interview

1. Does the person possess the required years of educational and work experience to be a RI?
    a. Does the person have a high school diploma or GED (not required if the person was an RI prior to 9/1/91)?
    b. Ask for copies of diplomas/GEDs (not specifically required by the HMR, but larger facilities often will have them).

2. Where did they obtain their experience?
    a. What kind of cargo tanks did they work on?
    b. What kind of tests did they do?
    c. How long have they been inspecting/testing cargo tanks alone (without direct supervision)?

3. Have they ever had any HM training related to cargo tank testing?
    a. When/where?

4. Can the person explain the inspection and testing procedures?
    a. What tests/inspections do they perform?

5. Are the procedures provided by the RI consistent with the Part 180 inspection and/or testing requirements?
    a. Do the answers that the RI provides indicate that he or she has sufficient knowledge and experience to properly inspect/test a DOT specification cargo tank?

6. Does the person know the location in the regulations for cargo tank re-qualification and maintenance requirements of specification cargo tanks (49 CFR Part 180)?

7. Does the person know the location in the regulations for the design and construction requirements of specification cargo tanks and whether the facility is re-qualifying or maintaining cargo tanks (49 CFR Part 178)?

8. Can the person explain the proper use of the inspecting, testing, and safety equipment in the shop area which should be used to perform the required test and inspection?
    a. Does the RI rely on memory or do they use a checklist every time?

SECURITY CONTACT REVIEW Q&A GUIDANCE

Reminder: Do not make recommendations on specific security measures to take. There are no specific requirements for lighting, alarms, etc. FMCSA, PHMSA, and TSA all have security guidance documents on their respective websites.

Our responsibility is to assess whether or not the company has considered their threats and vuneralibilities, taken steps to reduce them, and documented their analysis and actions in a written document.

Q1 Does plan include a specific assessment of possible HM transportation security risks?

G1 The company must make a written assessment of the possible transportation security risks or vulnerabilities of the operation. The assessment is part of the security plan and must be maintained as such. The assessment must be specific to each site (terminal, loading facility, etc.) that the company controls/operates.

Q2 Does this Security Assessment adequately capture the specific threats and vulnerabilities?

G2 This is a subjective determination, but after reading the risk assessment, does it appear to address issues specific to this company and what HM they work with? Items to consider:
(a) the type of hazardous material they transport;
(b) the frequency and quantity of shipments;
(c) the packaging type and types of vehicles utilized;
(d) the amount stored on-site;
(e) their business practices, such relationships with external partners and typical operations for their industry.

Q3 Does the Security Assessment adequately capture the specific threats and vulnerabilities of personnel security?

G3 Again, determining “adequately” is subjective, but look at what issues were identified in their security plan regarding personnel and the possibility of a terrorist infiltrating their organization.

Q4 Does the Security Assessment adequately capture the specific threats and vulnerabilities of unauthorized access?

G4 Again, determining “adequately” is subjective, but look at what issues were identified in their security plan regarding unauthorized access and the possibility of a terrorist infiltrating their organization.

Q5 Does the Security Assessment adequately capture the specific threats and vulnerabilities of en route security?

G5 Again, determining "adequately" is subjective, but look at what issues were identified in their security plan regarding en route security. Keep in mind that in transit is the most vunerable segement of their operations.

Q6 Does the organization periodically assess its security posture?

G6 The security plan must be revised and updated at least annually, or whenever there is a change in their operations (different HM) or their security measures (they installed lights). When the security plan is updated or revised, the company must ensure that all copies of the plan that are maintained throughout the company are replaced with the most recent revision.

Q7 Does the Security Plan correlate to the Security Assessment in question 2 above?

G7 The security measures they take should address all the threats and vulnerabilities they identified in their assessment. The company should "take credit" for all the various things they already do by identifying those elements in their plan.

Q8 Is the Security Plan "specific" to the organization?

G8 Their plan should be specific to what they transport, where their buildings are situated, how their employees operate, etc. Did they write their own plan or just pull one down from the internet and put their name on it?

Q9 Is there a written procedure on actions to take in the event of a security breach?

G9 Plan should include actions to take in the event of a security breach. Note that this can be as basic as "Call 911," but it should include some discussion of securing their physical location and locating drivers who are on the road.

Q10 Is there a written procedure to report illegal or suspicious activities to law enforcement?

G10 Again, it can be as simple as "Call 911." Determining what is "suspicious" is subjective, but the company should outline to their employees some examples of what kinds of situations to report.

Q11 Does the Security Plan contain measures that "vary commensurate with the level?

G11 There is no regulatory requirement to organize a security plan according to the national threat level, but some companies choose to do so. Ensure that they are using the most current national threat level.

Q12 Are the Security Plan personnel security measures appropriate for the security assessment as written?

G12 Their plan should address their threats and vulnerabilities they identified in their security assessment.

Q13 Are the Security Plan personnel security measures adequate even if the security assessment did not identify all risks?

G13 This is a very subjective question, as it is impossible to identify all possible risks that may occur and FMCSA personnel are not security experts. Select “N/A”.

Q14 Are the Security Plan's personnel security measures being followed?

G14 Compare what is stated in the plan to how the company actually operates. Note that if the company is not performing a stated action item, they can simply remove it from their plan if they so choose.

Q15 Do all drivers required to have valid CDLs with required endorsements have them?

G15 Verify drivers status through CDLIS during investigations per FMCSA policy.

Q16 Does the organization conduct required background checks on drivers?

G16 Verify compliance during investigations per FMCSA policy.

Q17 Does the organization take measures to confirm information provided by job applicants hired for positions that involve access to and handling of the HM?

G17 Verify compliance during investigations per FMCSA policy.

Q18 Is the Security Plan's approach to personnel security based on performance standards?

G18 There is no regulatory requirement to do so.

Q19 Does the organization confirm citizenship or legal residence status on all employees?

G19 Verify compliance during investigations per FMCSA policy.

Q20 Is the Security Plan's approach to unauthorized access operation specific?

G20 Their plan must be specific to their operations, their industry, and their business model. They must have written risk assessments for each location that stores HM, including locations where loaded (including residue) HM vehicles are parked.

Q21 Are the Security Plan's unauthorized access measures appropriate for the security assessment as written?

G21 Their plan should address their threats and vulnerabilities they identified in their security assessment.

Q22 Are the Security Plan's unauthorized access measures adequate even if the security assessment did not identify all risks?

G22 This is a very subjective question, as it is impossible to identify all possible risks that may occur and FMCSA personnel are not security experts. Select "N/A".

Q23 Are the Security Plan's unauthorized access measures being followed?

G23 Compare what is stated in the plan to how the company actually operates. Note that if the company is not performing a stated action item, they can simply remove it from their plan if they so choose.

Q24 Is the Security Plan's approach to en route security operation specific?

G24 Their plan must be specific to their operations, their industry, and their business model. They must have written risk assessments for each location that stores HM, including locations where loaded (including residue) HM vehicles are parked.

Q25 Are the Security Plan's en route security measures appropriate for the security assessment as written?

G25 Their plan should address their threats and vulnerabilities they identified in their security assessment.

Q26 Are drivers of vehicles transporting NRHM (non-RAM) complying with routing designations of a State or Indian tribe?

G26 Is the company familiar with the routing restrictions for the states they operate in? Are they familiar with the National Route Registry on the FMCSA website? Have they been cited on inspection reports for routing violations?

Q27 Are drivers of vehicles transporting Division 1.1, 1.2, and 1.3 materials provided written route plans?

G27 Verify the carrier is familiar with the requirement and is in compliance. Some companies retain copies of their route plan, but there is no requirement to maintain copies after transportation has ended. Have they been cited on inspection reports for route plan violations?

Q28 Are drivers of vehicles transporting HRCQ RAM complying with preferred routing?

G28 Is the company familiar with the routing restrictions for the states they operate in? Are they familiar with the National Route Registry on the FMCSA website? Have they been cited on inspection reports for routing violations? HRCQ shipments are highly regulated, and most carriers use GPS. Investigate compliance with routing as much as possible.

Q29 Are drivers of vehicles transporting NRHM (non-RAM) following routes established?

G29 This question is a repeat of #26. Select "N/A."

Q30 Are hazardous materials delivered expeditiously?

G30 While the HMR prohibits unnecessary delay in movement of shipments, this is a subjective requirement. Select "N/A."

Q31 Are drivers of vehicles transporting Division 1.1, 1.2, and 1.3 materials provided copies of the rules of 49 CFR Part 397 and emergency response Instructions?

G31 Drivers must be provided with and carrier in their vehicle a copy of Part 397, instructions from the company of what to do in an emergency, and the written route plan. A driver must sign for a receipt of Part 397 and the receipt must be retained for one year after hire date.

Q32 Is the Security Plan written?

G32 The plan, and the risk assessment, must be in writing. This is a good place to document whether or not the plan includes the SSI marking.

Q33 Is the Security Plan retained as long as it is in effect?

G33 The company must retain a current copy of the plan at their PPOB and any location where it is to be implemented.

Q34 Are copies of the Security Plan (or relevant portions of it) available to employees who are responsible for implementing?

G34 Employees do not have their own copy of the plan, but it should be available to them, or the appropriate portions, as their duties require. Availability could include posting the plan on the company's intranet or having to ask a supervisor to review a hard copy of the plan.

Q35 Are all copies of the Security Plan updated and revised as necessary to reflect changing circumstances?

G35 Verify the plan is reviewed annually and is revised whenever the company's operations or security posture changes.

Q36 Does the organization have fixed management responsibility for security?

G36 Verify the plan identifies by job title the senior management official responsible for overall development and implementation of the plan; the security duties for each position or department with responsibilities under the plan; and the process for notifying employees when specific elements of the plan must be implemented.

Q37 Has Security Awareness Training been provided to all hazmat employees?

G37 Verify security awareness training has been provided to all HM employees. See the HM Training Checklist.

Q38 Has In-Depth Security Training been provided to all hazmat employees with responsibility for implementing the Security Plan?

G38 Verify in-depth security training has been provided to all employees required to have it.

Q39 Does the In-Depth Security Training Material contain company security objectives?

G39 The HMR requires the training certification identify the location of the training material, but since the in-depth security training is specific to the company's plan, it should be available. The company can simply pull out a copy of the plan and review it with employees if they so choose. There is no specific requirement to have "trainng materials," but the company must be able to articulate that the training was specific to their plan and included all the applicable portions of their plan.

Q40 Does the In-Depth Security Training Material contain organization-specific security procedures derived from the Security Plan for personnel security?

G40 See G39.

Q41 Does the In-Depth Security Training Material contain organization-specific security procedures derived from the Security Plan for unauthorized access?

G41 See G39.

Q42 Does the In-Depth Security Training Material contain organization-specific security procedures derived from the Security Plan for en route security?

G42 See G39.

Q43 Does the In-Depth Security Training Material contain employee responsibilities?

C43 See G39.

Q44 Does the In-Depth Security Training Material contain actions to take in the event of a security breach?

G44 See G39.

Q45 Does the In-Depth Security Training Material contain the organizational security structure?

G45 See G39.

Q46 Has the organization established partnerships with local, state, and federal enforcement agencies; other public safety agencies; and surrounding communities regarding security issues?

G46 There is no regulatory requirement to do so, but many companies with speciality HM that present unusual hazards

Q47 Overall, does the organization's security plan conform to the requirements of this subpart (Part 172, Subpart 1)?

G47 Does the plan meet the overall goals and objectives of the HMR?

Q48 Ensure the individual for security reports to top management.

G48 See G36.

SECURITY PLAN CHECKLIST

This checklist discusses the key items that should be checked when reviewing a security plan for compliance.

Be sure to refer to a current version of the FHMR so you have the most up to date requirements for security plans.

Who Needs One

Anyone who offers or transports any of the HM in the quantities listed in Section 172.800. Review Section 172.800(b) carefully to determine if the company must have a security plan. Some hazard classes/divisions refer to a "Large Bulk Quantity." Remember that Large Bulk Quantity refers to the actual quantity transported, not the capacity of the package. You will need to document the exact amount that was transported. For farmers, review the exception in Section 172.800(c).

Sensitive Security Information Marking

This marking is a USDHS/TSA regulation. It includes specific language that must appear on each page of the security plan, including front and back covers. The words "SENSITIVE SECURITY INFORMATION" goes on the top of each page, and the Warning statement goes on the bottom of each page.

49 CFR § 1520.13 Marking SSI.

(a) *Marking of paper records.* In the case of paper records containing SSI, a covered person must mark the record by placing the protective marking conspicuously on the top, and the distribution limitation statement on the bottom, of—
(1) The outside of any front and back cover, including a binder cover or folder, if the document has a front and back cover;
(2) Any title page; and
(3) Each page of the document.

(b) *Protective marking.* The protective marking is: SENSITIVE SECURITY INFORMATION.

(c) *Distribution limitation statement.*
The distribution limitation statement is:
WARNING: This record contains Sensitive Security Information that is controlled under 49 CFR parts 15 and 1520. No part of this record may be disclosed to persons without a ''need to know'', as defined in 49 CFR parts 15 and 1520, except with the written permission of the Administrator of the Transportation Security Administration or the Secretary of Transportation. Unauthorized release may result in civil penalty or other action. For U.S. government agencies, public disclosure is governed by 5 U.S.C. 552 and 49 CFR parts 15 and 1520.

(d) *Other types of records.* In the electronic and magnetic records, a covered person must clearly and conspicuously mark the records with the protective marking and the distribution limitation statement such that the viewer or listener is reasonably likely to see or hear them when obtaining access to the contents of the record.

Reviewing Security Plans

There isn't a specific number of missing elements that would result in a violation of having a plan that doesn't conform to all the subpart requirements. The use of that cite is a judgment by the investigator that the plan is missing a sufficient number of elements to warrant a violation.

Be cautious about making subjective judgments that the company failed to cover a particular topic sufficiently or requiring the company to have specific security measures. For example, during a review, you find a security plan that discusses a particular required area, such as En Route Security, but is limited in what is included in that section. Normally this is not a violation, due to the vagueness of the regulation. While the SCR asks about the "adequacy" of certain elements, whether a plan is adequate or not is generally not enforceable. If you believe it may rise to the level of a violation, contact your FPM.

When considering enforcement for security plans, be sure to have documentation of HM shipments that are subject to the security plan requirements. In addition, a copy of the security plan should be included in the case evidence. Be sure to treat the security plan like you would Personal Identification Information (PII) – shred paper copies when no longer needed; email attachments should be password protected, etc. Also, you should obtain a copy of any documents that the company presents as their security plan so you can refute defenses that they provided it later.

Another factor to consider when planning enforcement is that the SSI marking is not referenced in the FHMR, so many shippers and motor carriers are not familiar with the requirement. Discretion is recommended if the lack of the SSI marking is the only security plan violation.

Keep in mind that Section 172.804 permits the use of security plans developed under the regulations of other federal agencies, international organizations, or industry organizations, provided the security plan addresses all the requirements of Subpart I of Part 172.

If the company is a pure shipper, they need to acknowledge the "Enroute Security" element in their plan by stating they don't have any vehicles. It should also explain how they work with motor carriers to ensure their shipments are secure enroute.

Avoid recommending specific security measures. The FMCSA, PHMSA, and TSA web sites all have security guidance for trucking companies.

Security Plan Checklist

Y/N	Required Item
	Plan must be written 172.802(c)
	Is the plan specific to their company, or is it something they got off the internet and put their name on?
	Do they keep the plan secured? Are copies lying around or generally available?
	Plan must be reviewed annually and revised/updated as necessary 172.802(c)
	Look for a date the plan was completed or some notation of a review
	Must be retained for as long as it is in effect 172.802(c)
	Must be available to employees who have a responsibility under the plan 172.802(c)
	Does not mean they have to have their own copy
	When revised, all employees who have a responsibility under the plan must be notified and all copies of the plan must be of the date of the most current revision 172.802(c)
	Plan must be retained on site and made available for inspection 172.802(d)
	Must have the SSI marking on every page, including front and back covers
	Must identify by job title the Senior Management Official responsible for overall development and implementation of the plan 172.802(b)(1)
	Must identify the security duties for each position or department that is responsible for implementing the plan and the process of notifying employees when specific elements of the plan must be implemented 172.802(b)(2)
	Must include the following elements:
	Risk Assessment for each site that is site-specific 172.802(a); must be in writing and part of the security plan (172.802(c)). Must identify the threats and vulnerabilities their company faces. Plan must identify how those threats and vulnerabilities will be mitigated.
	Personnel Security 172.802(a)(1)
	Unauthorized Access 172.802(a)(2)
	En Route Security 172.802(a)(3)
	Training Plan 172.802(b)(3) in compliance with 172.704(a)(4) and (5) – every 3 years or when security plan is changed and <u>all</u> employees with duties under the security plan Be sure to check for completion of the training every 3 years. See the HM Training checklist for details.
	NOTE: If the carrier has a HMSP and the security plan is in violation, consider citing them for 390.35, falsification of their MCS-150B certification. The MCS-150B requires a specific certification that the carrier has a satisfactory security plan.
	Are they following the elements of their own plan? Ask for verification of compliance with their plan elements. Note that if they are not following their own plan, the company can choose to just remove those elements.

DEPARTMENT OF TRANSPORTATION
SHORT GUIDE TO HANDLING SENSITIVE SECURITY INFORMATION (SSI) FOR EXTERNAL PARTIES

1) Do not leave SSI unattended on your desk, in your office or any other place you carry it. Remember to check for SSI, when you leave for meetings, lunch, brief trips to the restroom, filing room, a colleague's office or before you leave at night. In these cases be sure to place it in a locked desk drawer, or locked file cabinet.

2) Turn off or lock your computer when working with SSI before you leave your desk to ensure that no SSI is compromised.

3) Only share SSI documents or information with a covered party who has a need to know. When in doubt, contact the DOT Office of Intelligence, Security, and Emergency Response at (202) 366-6525 or SSI@dot.gov. Do not discuss SSI at all with friends or family (unless they are covered parties with a need to know), and do not discuss SSI with colleagues in public places. If you need to discuss SSI over the telephone, make every effort to use a land line and be aware of your surroundings. If forced to discuss SSI in a public place, use common sense and discuss as privately as possible - not within the ear-shot of other people. If it is necessary to mention SSI over a cellular phone, take all precautions to discuss sparingly and privately.

4) Do not deliver any SSI to anyone by leaving it unattended on their desk; personally hand deliver any SSI to the intended recipient. You have a duty to make sure that the SSI recipient knows that the document(s) contain SSI so they can take appropriate steps concerning SSI handling protection.

5) When carrying or delivering SSI, place in an unmarked folder or envelope.

6) Do not take SSI home, either hard or soft-copy, without written permission from your supervisor. If you do take SSI home, always keep the SSI on your person (ideally in a locked briefcase) during transit and protect as you would in your office.

7) Password-protect all SSI documents sent via e-mail. Do not include the password in the body and/or e-mail introduction forward. Passwords shall conform to the following guidelines: eight character minimum length; at least one letter capitalized, contain at least one number; and not be a word in the dictionary. Take the correct password precaution and disclose the password to the recipient in person or by phone.

8) SSI should always be marked as such with a protective marking in the header and a distribution limitation statement in the footer (see below). For paper records, the protective marking must be at the top and the distribution limitation statement at the bottom of (1) the outside of any front and back cover, including a binder cover or folder, if the document has a front and back cover; (2) any title page; and (3) each page of the document. *When in doubt whether* a *document should be marked* SSI, *contact the DOT Office of Intelligence, Security, and Emergency* Response *at (202)* 366-6525 *or* SSI@dot.gov.

9) No SSI should be posted or appear on your Internet or Intranet web sites without prior approval. It is your duty to be diligent in observing any SSI that erroneously appears and contact the appropriate parties to have it removed. You may contact the DOT Office of Intelligence, Security, and Emergency Response at (202) 366-6525 or SSI@dot.gov for assistance.

10) Properly dispose of all SSI in your possession that you no longer need (e.g., extra copies, obsolete versions, etc.) by using a shredder or cutting manually to less than an inch. SSI on electronic media should be destroyed so as to render the media unusable and preclude its reconstruction.

Protective Marking:
(header): SENSITIVE SECURITY INFORMATION Distribution Limitation

(footer): *WARNING:* This record contains Sensitive Security Information that is controlled under 49 CFR parts 15 and 1520. No part of this record may be disclosed to persons without a "need to know", as defined in 49 CFR parts 15 and 1520, except with the written permission of the Administrator of the Transportation Security Administration or the Secretary of Transportation. Unauthorized release may result in civil penalty or other action. For U.S. Government agencies, public disclosure is governed by 5 U.S.C. 552 and 49 CFR parts 15 and 1520.

FMCSA SECURITY TALKING POINTS

These Talking Points are to be utilized when the Department determines that additional security contacts are necessary due to national security concerns. These recommendations may not apply to all carriers, based on their size and scope of operation. Additionally, this list is not all-inclusive and will be changed based on future priorities to address terrorist threats.

GENERAL SECURITY INFORMATION

- If the company is not subject to the security plan requirements of Part 172 Subpart I, recommend that a security plan be developed and implemented. It should include:
    - Personal Security
    - Unauthorized Access
    - En Route Security
    - Technical Innovations
    - Management Prerogatives
    - Communications
    - Readjustment Based Upon Current Conditions
- Request the company include security in all decision-making processes.
- Recommend that management include all levels in security decisions.

PERSONNEL SECURITY

- Ask officials to recognize that employees can be substantial security risks.
- Review a driver list with the official and, if possible, identify those drivers whose names can be linked to one the countries that have been identified that support terrorist activities or otherwise represent a security threat.
- Ensure that detailed background checks have been performed on these individuals as required by the regulations. Recommend more detailed background checks for suspicious individuals. Look at the following for indicators:
    - Gaps in employment
    - Frequent job shifts
    - All names used by the applicant
    - Type of military discharge
    - Citizenship
    - Present and prior residence information
    - Personal references
    - Criminal history
- Verify U.S. citizenship for all employees.
- For those employees who are not U.S. citizens, verify that all immigration papers are on file and properly documented.
- Make sure that interviews are conducted when hiring new drivers/employees. Obtain information that will help to appraise the personality, character, motivation, honesty, integrity, and reliability and to judge his appearance and personnel characteristics face to face.
- Any information or suspicious activity discovered during the review of these files should be reported immediately to your SD/DA for notification of the local FBI office.

UNAUTHORIZED ACCESS

- Is there adequate lighting for the facility grounds?
- Are HM storage areas at the carrier's facility secured in fences or buildings?
- Consider requiring personnel identification cards/badges for access to areas with HM.
- Check the adequacy of locks and other protective measures.
- Require records for removal of HM from secure locations.
- Does the company protect HM using alarms and/or other security systems?
- Reinforce with drivers the importance to remain aware of their surroundings at all times
- Consider if a guard force is appropriate (DOD Shipments, PIH, RAM, other).
- Recommend standard procedures on control of packages
- Educate all personnel on package control measures
- Provide notices to employees on package control procedures. Post procedures prominently at appropriate locations
- Conduct security spot checks of personnel and vehicles
- Do not accept any hazardous materials shipments from unfamiliar shippers.
- Perform credit checks and use other readily available services to determine the authenticity of the business (shippers).
- Be familiar with vendors that service your facility

EN ROUTE SECURITY

- Avoid high population centers, including downtown and/or metropolitan areas where possible.
- Use alternate routes that avoid high population areas.
- Ensure that all Hazardous Materials are delivered expeditiously.
- Instruct drivers to lock vehicles when stopped.
- Avoid tunnels and bridges where possible.
- Reinforce attendance and parking rules in 49 CFR Part 397.
- Consider if a guard is appropriate.
- Instruct drivers not to discuss details of their route, daily routine, or what they transport.

TECHNICAL INNOVATIONS

- Make yourself aware of technical innovations that could assist in security such as cell phones, satellite tracking, and surveillance systems.
- Look at state of the art locks and seals.
- Are access control systems appropriate?
- Consider tamper proof locking features for 5th Wheels (so that trailers can't be stolen).
- Consider use of blanket-type alarms that signal when blanket is moved (more appropriate for small carriers).
- Consider installing electronic engine controls that require a code, in addition to a key, to start a vehicle.

MANAGEMENT PREROGATIVES

- Include fingerprinting and photographs of applicants in the employment process.
- Be aware of personal identify theft such as using stolen social security numbers, references, etc.
- Consider running criminal background checks on individuals with access to very sensitive materials (explosives, poison gases, biological agents)
- Consider implementing security training for employees that includes:
    - Company Security Objectives
    - Specific Security Procedures
    - Employee Responsibility
    - Organizational Security Structure

COMMUNICATIONS

- Develop a communications network with others in the industry in an effort to share information to determine if there is a pattern of activities that, when taken alone are not significant, but when taken as a whole generate concern.
- Develop a means of communication within the physical plant and the vehicle (cell phones, satellite tracking, radios, etc.) Is the system capable of reaching all key personnel?
- Security messages should be presented to employees in various methods such as newsletters, bulletin boards, etc.

READJUSTMENT BASED UPON CURRENT CONDITIONS

- Emphasize that terrorist activities tend to happen in groups. Security should be heightened if new attacks begin.
- Increase security measures if U.S. begins military activity in foreign countries.

OTHER

- Request that drivers watch for any suspicious activities in their vicinity. If drivers should witness any suspicious activities, they should immediately report it through 311 or 911.

	Special Provision Code					
Package	**Numeric**	**B**	**IB**	**IP**	**N**	**T**
Non Bulk	X				X	
Cargo Tank	X	X				
Portable Tank (DOT or non spec)	X	X				
UN Portable Tank	X					X
IM Portable Tank	X					X
IBC	X		X	X		
Bulk Cylinder	X	X				
Non-Bulk Cylinder	X					
Multi-Unit Tank Car Tanks	X	X				
Large Packaging	X		IB3 & IB8			
Flexible Bulk Container	X					

TP	Important Sections	Test Markings
	173.24	178.503
	173.33	180.415
	173.32	180.605
X	173.32	180.605
X	173.32	180.605
	173.35	180.352
	173.40	180.213 or 217
	173.40	180.213
	173.31	180.519
	173.36	N/A
	173.37	N/A

Reference
Special Provision 380
173.12
173.13
173.226(f)
177.839(a)
177.840(a)(3)
177.841(e)
177.841(f)
177.848(a)(1)
177.848(i)

Description
Relief from segregation for acrolein, stabilized, UN1092 in certain circumstances
Relief from segregation for hazardous wastes in certain circumstances
Relief from segregation for certain Class 3, Division 4.1, 4.2, 4.3, 5.1, 6.1, and Class 8 in certain circumstances
Relief from segregation for Division 6.1, PG I, Zone A materials in certain circumstances
Nitric acid above 50% can't be stacked above anything else
Relief from segregation for Division 2.3, PG I, Zone A materials with Division 2.1, Class 3, 4, 5, and 8 in certain circumstances
Division 6.1 PG I or II and all PIH labeled packages can't be transported with foodstuffs, excepted as provided
Relief from segregation for Division 61, PG I, Zone A materials that are a hazardous waste with Class 3, 4, 5, and 8 in certain circumstances
Segregation table only applies to HM that is labeled or placarded, including subsidiary labels (177.848(e)(6))
Relief from segregation for Division 4.2 with Class 8 in certain circumstances

STRAIGHT ROUND SURFACE AREA CALCULATOR
(Barrel Shell + 2 Heads)

(Inputs in Yellow)

2/16/2018

OD	72	in.	
Barrel Shell Length	520	in.	
Head Surface Area	33.43	ft.^2	
Shell Surface Area	816.81	ft.^2	
Total Surface area	884	ft.^2	(2 X Head Surface Area + Shell Surface Area)

Written By Duane Plumski - DCE

ROUND CONICAL SURFACE AREA CALCULATOR
(Symetrical Barrel Shell + 2 Heads)

(Inputs in Yellow)

2/16/2018

Large OD	84	in.
Small OD	68	in.
Barrel Shell Length	468	in.
Small Head Surface Area	29.82	ft.^2
Shell Surface Area	775.97	ft.^2
Total Surface area	836	ft.^2

(2 X Small Head Surface Area + Shell Surface Area)

ROUND CONICAL SURFACE AREA CALCULATOR
(Half Barrel + 1 Small OD Head)

(Inputs in Yellow)

2/16/2018

Large OD	78	in.
Small OD	68	in.
Barrel Shell Length	234	in.
Small Head Surface Area	29.82	ft.^2
Shell Surface Area	372.67	ft.^2
Total Surface area	402	ft.^2

(Small Head Surface Area + Shell Surface Area)

Written By Duane Plumski - DCE

STRAIGHT ELLIPTICAL SURFACE AREA CALCULATOR
(Barrel Shell + 2 Heads)

(Inputs in Yellow) 2/16/2018

Barrel Width	92	in.
Barrel Height	66	in.
Barrel Shell Length	234	in.
Head Surface Area	33.12	ft.^2
Shell Surface Area	408.73	ft.^2
Total Surface area	475	ft.^2

(2 X Small Head Surface Area + Shell Surface Area)

HM SECURITY SENSITIVITY VISIT PROGRAM
SUSPICIOUS ACTIVITY REPORT

Introduction:

The objective of the Security Sensitivity Visits (SSVs) is twofold; (1) To raise awareness about security related issues; and (2) to determine the presence of any suspicious activity. Any suspicious activity that is identified during an SSV must be documented and reported to the SD/DA. The SD/DA will report appropriate activities to the FBI. Additionally, the FMCSA is interested in a broader picture of security issues noted during the SSV process. To document and report suspicious activity the attached form is to be used effective immediately. Use of this form will ensure a uniform reporting process and facilitate efficient tracking of this information. This form is to be used as indicated and is not to be used for all SSVs; it is only designed for use in the cases where suspicious or out of the ordinary situations are discovered. For SSVs conducted to date, it is requested that the form be completed for visits that meet the criteria. This is not to mean a revisit is required – do the best you can from notes taken during the visit.

Activities to be reported:

The types of activities to be reported includes, but are not limited to the following:

- Any suspicious activity reported to the FBI
- Drivers found without proper license and/or endorsement
- Drivers found without proper immigration credentials
- High rate of other CDL/citizenship problems

Reporting Process:

After referral to the FBI, if appropriate, each completed form must be forwarded immediately to the Service Center Coordinator **electronically (no faxed copies)**. The service center will then consolidate these reports and forward to Headquarters as necessary. Service Center Coordinators are:

- Eastern Service Center – Ron Ashby
- Southern Service Center – Charles (Tim) Phillips
- Midwestern Service Center – Joe Delorenzo
- Western Service Center – Bob Brown

UNITED STATES DEPARTMENT OF TRANSPORTATION
FEDERAL MOTOR CARRIER SAFETY ADMINISTRATION

FMCSA
Federal Motor Carrier Safety Administration

HM SECURITY SENSITIVITY VISIT PROGRAM
SUSPICIOUS ACTIVITY REPORT

SECTION I		REASON FOR REPORT *(CHECK ALL THAT APPLY)*
1.		FEDERAL BUREAU OF INVESTIGATIONS (FBI) REFERRAL
DATE:		
FBI CONTACT:		
TELEPHONE:		
E-MAIL:		
ADDRESS:		
2.		Driver(s) found without proper license and/or endorsement.
3.		Driver(s) found without proper immigration credentials.
4.		High rate of other CDL and/or immigration violations.
5.		Other (Explain Below):
OTHER:		

SECTION II	SSV CONTRACT INFORMATION		
DATE:			
MOTOR CARRIER:			
U.S. DOT #:			
ADDRESS:			
CITY:			
STATE:		ZIP:	
CARRIER OFFICIAL:		TITLE:	
TELEPHONE #:			

SECTION III	SUSPICIOUS DRIVER DATA		
NAME:		REASON CODE 1-5 *Reference Section I*	
A.K.A.:			
ADDRESS:			
CITY:			
STATE:		ZIP:	
DATE OF BIRTH:			
DRIVERS LICENSE #:		ISSUE STATE:	
SOCIAL SECURITY #:			

NOTE: USE SECTION III ATTACHMENT FOR ADDITIONAL DRIVERS

SECTION IV — SUSPICIOUS ACTIVITY DESCRIPTION

Provide a description and/or brief summary of activity discovered. If more than one please number.

SECTION V — HOW WAS SUSPICIOUS ACTIVITY DISCOVERED

What was the source that helped you identify the activity, i.e. discussion with carrier official, documentation review, etc.

SECTION VI — SUSPICIOUS ACTIVITY DOCUMENTATION

What document(s) led you or help lead you to discover the activity.

SECTION VII — INVESTIGATING AGENCY & EMPLOYEE

AGENCY:	FMCSA Division or State Agency		
ADDRESS:			
CITY/STATE/ZIP:			
EMPLOYEE NAME:		SI CODE #:	
TELEPHONE #:			

ATTACHMENT

SECTION III	SUSPICIOUS DRIVER DATA		
NAME:		REASON CODE 1-5 *Reference Section I*	
A.K.A.:			
ADDRESS:			
CITY:			
STATE:		ZIP:	
DATE OF BIRTH:			
DRIVERS LICENSE #:		ISSUE STATE:	
SOCIAL SECURITY #:			

SECTION III	SUSPICIOUS DRIVER DATA		
NAME:		REASON CODE 1-5 *Reference Section I*	
A.K.A.:			
ADDRESS:			
CITY:			
STATE:		ZIP:	
DATE OF BIRTH:			
DRIVERS LICENSE #:		ISSUE STATE:	
SOCIAL SECURITY #:			

SECTION III	SUSPICIOUS DRIVER DATA		
NAME:		REASON CODE 1-5 *Reference Section I*	
A.K.A.:			
ADDRESS:			
CITY:			
STATE:		ZIP:	
DATE OF BIRTH:			
DRIVERS LICENSE #:		ISSUE STATE:	
SOCIAL SECURITY #:			

SECTION III	SUSPICIOUS DRIVER DATA		
NAME:		REASON CODE 1-5 *Reference Section I*	
A.K.A.:			
ADDRESS:			
CITY:			
STATE:		ZIP:	
DATE OF BIRTH:			
DRIVERS LICENSE #:		ISSUE STATE:	
SOCIAL SECURITY #:			

SECTION III	SUSPICIOUS DRIVER DATA		
NAME:		REASON CODE 1-5 *Reference Section I*	
A.K.A.:			
ADDRESS:			
CITY:			
STATE:		ZIP:	
DATE OF BIRTH:			
DRIVERS LICENSE #:		ISSUE STATE:	
SOCIAL SECURITY #:			

SECTION III	SUSPICIOUS DRIVER DATA		
NAME:		REASON CODE 1-5 *Reference Section I*	
A.K.A.:			
ADDRESS:			
CITY:			
STATE:		ZIP:	
DATE OF BIRTH:			
DRIVERS LICENSE #:		ISSUE STATE:	
SOCIAL SECURITY #:			

Conversion Factors §171.10

For compatibility with international transportation standards, most units of measure used in Subchapter C of the 49 CFR are expressed using International System of Units (SI).
Where SI units appear (L, kg, kPa) they are the regulatory standard.
U.S. standard or customary units, (gal, lbs, psi) appearing in parentheses following SI units are for information only and not intended to be the regulatory standard.

10 kPa = 1.45 psi
75 kPa = 10.9 psi
95 kPa = 13.8 psi
100 kPa = 14.5 psi
150 kPa = 21.8 psi
250 kPa = 36.3 psi
1 kg = 2.2 lb
25 kg = 55 lb
50 kg = 110 lb
100 kg = 220 lb
150 kg = 330 lb
200 kg = 440 lb
250 kg = 551 lb
0.47 L = 1 pint (US)
0.95 L = 1 quart (US)
1 L = .264 gal (US)
3.8 L = 1 gal (US)
4 L = 1.06 gal (US)
5 L = 1.32 gal (US)
10 L = 2.6 gal (US)

Packing Group (PG)

Packing group means a grouping according to the degree of danger presented by hazardous materials. Class 2, Class 7, Division 6.2 (other than regulated medical wastes), and ORM-D materials do not have packing groups.

Packing Group I-Great Danger
Packing Group II-Medium Danger
Packing Group III-Minor Danger

References for all Hazardous Materials Performance Packaging Standards and Tests can be found in the Code of Federal Regulations, Title 49, Part 178.

PHH50-0099-0807

U.S. Department of Transportation
Pipeline and Hazardous Materials
Safety Administration

TO LEARN MORE...

For information about hazmat publications and other training materials:

Visit our web site:
http://hazmat.dot.gov

Write:
Office of Hazardous Materials
Initiatives and Training
1200 New Jersey Ave, SE, PHH-50
Washington, DC 20590-0001

Fax: (202) 366-7342
E-mail: training@dot.gov
Phone: (202) 366-2301

GOT A HAZMAT QUESTION?
http://hazmat.dot.gov
INFO-LINE
1-800-467-4922

For information about Hazmat Regulations
Contact our
Hazmat INFO-LINE:
Phone: 1-800-467-4922
E-mail: infocntr@dot.gov

SafeTravel
SAFETY TIPS FOR TRAVELERS
HTTP://SAFETRAVEL.DOT.GOV

U.S. Department of Transportation
Pipeline and Hazardous Materials
Safety Administration

GUIDE TO

PERFORMANCE PACKAGING CODES

FOR USE IN HAZARDOUS MATERIALS TRANSPORTATION

NOTE: This document is for general guidance only and must not be used to determine compliance with 49 CFR, Parts100-185.

Non-Bulk Packaging Codes

§§178.504 - 178.521

1A1	Steel drum, non-removable head	4A	Steel box
1A2	Steel drum, removable head	4B	Aluminum box
1B1	Aluminum drum, non-removable head	4C1	Wood box, ordinary
1B2	Aluminum drum, removable head	4C2	Wood box, sift-proof walls
1D	Plywood drum	4D	Plywood box
1G	Fiber drum	4F	Reconstituted wood box
1H1	Plastic drum, non-removable head	4G	Fiberboard box
1H2	Plastic drum, removable head	4H1	Plastic box, expanded
1N1	Metal drum, non-removable head	4H2	Plastic box, solid
1N2	Metal drum, removable head	5H1	Woven plastic bag,unlined or non-coated
2C1	Wooden barrel, bung type	5H2	Woven plastic bag, sift-proof
2C2	Wooden barrel, slack type, removable head	5H3	Woven plastic bag, water-resistant
3A1	Steel jerrican, non-removable head	5H4	Plastic film bag
3A2	Steel jerrican, removable head	5L1	Textile bag, unlined or non-coated
3B1	Aluminum jerrican, non-removable head	5L2	Textile bag, sift-proof
3B2	Aluminum jerrican, removable head	5L3	Textile bag, water-resistant
3H1	Plastic jerrican, non-removable head	5M1	Paper bag, multi-wall
3H2	Plastic jerrican, removable head	5M2	Paper bag, multi-wall water-resistant

§§178.522 and 178.523

6HA1	Plastic receptacle within a protective steel drum
6HA2	Plastic receptacle within a protective steel crate or box
6HB1	Plastic receptacle within a protective aluminum drum
6HB2	Plastic receptacle within a protective aluminum crate or box
6HC	Plastic receptacle within a protective wooden box
6HD1	Plastic receptacle within a protective plywood drum
6HD2	Plastic receptacle within a protective plywood box
6HG1	Plastic receptacle within a protective fiber drum
6HG2	Plastic receptacle within a protective fiberboard box
6HH1	Plastic receptacle within a protective plastic drum
6HH2	Plastic receptacle within a protective plastic box
6PA1	Glass, porcelain, or stoneware receptacles within a protective steel drum
6PA2	Glass, porcelain, or stoneware receptacles within a protective steel crate or box
6PB1	Glass, porcelain, or stoneware receptacles within a protective aluminum drum
6PB2	Glass, porcelain, or stoneware receptacles within a protective aluminum crate or box
6PC	Glass, porcelain, or stoneware receptacles within a protective wooden box
6PD1	Glass, porcelain, or stoneware receptacles within a protective plywood drum
6PD2	Glass, porcelain, or stoneware receptacles within a protective wickerwork hamper
6PG1	Glass, porcelain, or stoneware receptacles within a protective fiber drum
6PG2	Glass, porcelain, or stoneware receptacles within a protective fiberboard box
6PH1	Glass, porcelain, or stoneware receptacles within a protective expanded plastic packaging
6PH2	Glass, porcelain, or stoneware receptacles within a protective solid plastic packaging

Combination Packaging

United Nations Symbol · Packaging Code · Performance Level · Gross Mass in Kilograms · Solids · Year of Manufacture

4GV/X 20/S/05
USA/0000

Country of Authorization · Manufacturer Identification

Single, Combination, or Composite Packaging - Solids

United Nations Symbol · Packaging Code · Performance Level · Gross Mass in Kilograms · Solids · Year of Manufacture

1A2/Z40/S/05
USA/0000

Country of Authorization · Manufacturer Identification

Single or Composite Packaging - Liquids

United Nations Symbol · Packaging Code · Performance Level · Specific Gravity · Hydrostatic Test Pressure · Year of Manufacture

1A1/Z1.4/150/05
USA/0000

Country of Authorization · Manufacturer Identification

Intermediate Bulk Containers (IBC)

United Nations Symbol · Packaging Code · Performance Level · Month of Manufacture · Year of Manufacture

31HA1/Y/04 03
USA/0000/2400/800

Country of Authorization · Manufacturer Identification · Stack Test Load · Gross Mass in Kilograms

Interpreting Markings §§178.502 and 178.503

United Nations Symbol: For embossing metal receptacles, the letters UN may be applied in place of the symbol.

Packaging Code: Designates the type of packaging and material of construction. A letter "W" designates associate administrator approval. A letter "V" designates special "variation" packaging.

Performance Level: Identifies the performance standard for successful testing of the packaging.

X - For packagings meeting **Packing Group I, II and III tests.**
Y - For packagings meeting **Packing Group II and III tests.**
Z - For packagings meeting **Packing Group III tests.**

Specific Gravity: Specific gravity for which the packaging design type has been tested. If the specific gravity does not exceed 1.2, the designation may be omitted.

Gross Mass: Packaging type tested for maximum gross mass in kilograms.

S: Designates that the packaging is intended to contain solids or inner packagings.

Hydrostatic Test Pressure: Internal Hydrostatic Test Pressure in Kilopascals. This test is not required for inner packaging of combination packaging.

Year of Manufacture: Last two digits of year of manufacture. Plastic drums and jerricans (1H and 3H) must be marked with the month of manufacture. The month marking may be located elsewhere on the package.

Country of Authorization: Country designation code indicates where the package is manufactured and marked.

Manufacturer Identification: Name and address or authorized symbol of packaging manufacturer or certifying agency.

Minimum Thickness: For metal or plastic drums, jerricans or the outer packaging of composite packaging intended for reuse or reconditioning.

R: Reconditioned packaging.

L: Reconditioned packaging having successfully passed a leakproofness test. This test is not required for inner packaging of combination packaging.

Note: Additional marking requirements for Reconditioned packaging are found in §178.503.

Additional Requirements for Intermediate Bulk Containers (IBC)

Month and Year: For IBCs, the month and year of manufacture.

Stacking Test Load: For IBCs, the stacked test load in kilograms. A number "0" shows that the IBC is not designed for stacking.

Note: Standards and codes for IBCs are found in §178.702 - 178.710

Required Tests for Non-Bulk Packaging

Drop Test (§178.603) All packaging design types.

Leakproofness Test (§178.604) All packaging design types intended for liquids.

Hydrostatic Test (§178.605) All metal, plastic, and composite design types intended to contain liquids.

Stacking Test (§178.606) All packaging design types other than bags.

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Cooperage Test (§178.607) All bung-type wooden barrels.

Vibration Test (§178.608) All packaging design types.

Infectious Substances See §178.609 for test requirements for packagings for infectious substances.

Pressure Differential (§173.27) Packagings intended for air transport.

Violations that Require Cargo Tank Retest/Reinspection

Violation	Description
180.405(b)	Marking or certifying a cargo tank to a specification no longer authorized. Applies to the marking and/or certification of MC 306, MC 307 and MC 312 cargo tanks after August 31, 1995.
180.407(b)(1)	Failing to test and inspect a cargo tank that has evidence of damage, such as dents, cuts, gouges, corroded or abraded areas, leakage, or any other condition that might render it unsafe for hazardous materials service.
180.407(b)(2)	Failing to test and inspect a cargo tank that has been in an accident and has been damaged to an extent that may adversely affect its lading retention capability.
180.407(b)(3)	Failing to conduct a pressure test in accordance with Section 180.407(g) on a cargo tank which has been out of hazardous materials transportation service for a period of one year or more.
180.407(d)	Failing to perform an external visual inspection as prescribed in that the cargo tank was given an external visual inspection on [enter date within 2 months of current date if applicable] and: (2)(iv) The remote closure device failed to function as required. [date required] (2)(v) There were no fusible links or elements installed on the cargo tank as required. (2)(ix) The upper coupler was not removed to inspect the area above the upper coupler as required for a cargo tank transporting lading corrosive to the tank. (3) The reclosing pressure relief devices (PRD) on the cargo tank carrying lading corrosive to the valve was not removed and bench tested as required. (5) Corroded or abraded areas of the cargo tank were discovered where thickness testing is required and the facility performing the external visual inspection failed to thickness test as required. [date required]
180.407(e)	Failing to perform an internal visual inspection in accordance with Section 180.407(e).
180.407(f)	Failing to perform a lining inspection as prescribed in that the cargo tank was given a lining inspection on [enter date] and: (1)(ii) For the rubber lining that was tested, the facility could not produce a calibration coupon of the same material and thickness of the tank that was given a lining test. (1)(iii) The facility failed to recalibrate the spark tester as required.
180.407(g)	Failing to perform a pressure retest as prescribed in that the cargo tank was given a pressure test on [enter date] and: (1)(ii) The self-closing pressure relief devices were not removed from the cargo tank for inspection and testing as required. (1)(iii) The upper coupler was not removed to inspect the area above the upper coupler

	as required. (1)(iv) The prescribed test pressure of [enter required test pressure] was not used as required by the table in Section 180.407(g)(1)(iv) (1)(vii) All closures which comprise the lading retention area of the cargo tank wall were not in place during the test. (3) The facility failed to perform a wet fluorescent magnetic particle exam on an MC 330/331 cargo tank. (3) The person who performed the wet fluorescent magnetic particle exam does not meet the ASME qualifications to conduct the exam.
180.407(h)	Failing to perform a leakage test as prescribed in that the cargo tank was given a leakage test on [enter date] and : (1) The prescribed test pressure of [enter required test pressure] was not used. (2) Failed to perform the EPA method 27 test as required in accordance Appendix A to 40 CFR Part 60 or the cargo tank was not eligible for the EPA method 27 tests.
180.407(i)	Failing to perform a thickness test as prescribed in that the cargo tank was given a thickness test on [enter date] and: (3) The person performing the test was not trained in the proper use of the thickness testing device used in accordance with the manufacturer's instructions.
180.409	Performing a test or inspection required by Part 180 by a person who does not meet the qualifications required by Section 180.409.
180.413(a)(1)(i)	Performing a repair of a non-ASME Code stamped cargo tank while failing to hold a valid ASME Certificate of Authorization for the use of the "U" Stamp or a National Board Certificate of Authorization for the use of the "R" stamp.
180.413(a)(1)	Performing a (stretching, modification, or re-barreling) of an ASME Code "U" stamped cargo tank while failing to hold a valid National Board Certificate of Authorization for the use of the "R" stamp.
180.413(a)(1)	Performing a repair of an ASME Code "U" stamped cargo tank while failing to hold a valid National Board Certificate of Authorization for the use of the "R" stamp.
180.413(b)	Failing to verify the suitability of a repair affecting the structural integrity of the cargo tank by testing as prescribed in the applicable specification or in Section 180.407(g)(1)(iv).
180.413(a)(1)(i)	Performing a (stretching, modification, or re-barreling) of a non-ASME Code stamped cargo tank while failing to hold a valid ASME Certificate of Authorization for the use of the "U" Stamp or a National Board Certificate of Authorization for the use of the "R" stamp.

180.413(c)(1)	Failing to leak test repairs done to piping or valves.
180.413(d)(3)(iv)	Failing to verify the suitability of a modification affecting the structural integrity of the cargo tank with respect to pressure by testing as prescribed in the applicable specification or in § 180.407(g)(1)(iv). (Use for an inspection facility).

THE WET FLORESCENT MAGNETIC PARTICLE EXAM

There is considerable confusion in the cargo tank industry and the enforcement community regarding the Wet Florescent Magnetic Particle Exam (WFMPE). This bulletin will explain what it is, when it has to be performed, what equipment is required, and who is qualified to perform the exam.

The WFMPE is one type of Non-Destructive Exam (NDE) identified in the ASME Code. ASME refers to the exam as the "magnetic particle exam (MT)." In the field it is commonly called the "wet mag test" or the "black light test." The use of the WFMPE is mandated for certain cargo tank motor vehicles per the Federal Hazardous Materials Regulations (HMR; 49 CFR Parts 100-180).

What Cargo Tank Motor Vehicles are subject to the WFMPE?

Since the WFMPE is an internal exam, it only applies to cargo tank motor vehicles when they are equipped with manholes. It is required on any MC330, MC331, or non-specification cargo tank operated under §173.315(k) when:

It is made of:	And used to transport:
Quenched and Tempered (QT) Steel	• Liquefied petroleum gas; • Anhydrous ammonia; or • Any other hazardous material that causes stress corrosion cracking.
Not Quenched and Tempered (NQT) steel *without postweld heat treatment*	• Anhydrous ammonia; or • Any other hazardous material that causes stress corrosion cracking.

What is QT?

"QT' means Quenched and Tempered and "NQT" means Not Quenched and Tempered." QT is a manufacturing process where the metal is heated until it is cherry red (above its upper critical temperature) and the cooling is controlled by quickly dipping the metal in oil, water, or brine. This is followed by a tempering period in a fired furnace.

This process makes the metal more flexible. The QT process aligns the molecules of the metal in a uniform pattern. It is intended to enhance the toughness of the metal. QT metal is lighter than NQT steel, making it very popular for transport tankers.

QT tanks are approximately ¼" thick; NQT tanks are approximately ½" thick. This is a general rule and not an absolute, and is only intended to assist you with identifying a QT cargo tank.

The reason it is important to know if the tank is QT or NQT is because lading that is corrosive to metal will make QT metal more brittle and subject to stress corrosion cracking. To be corrosive to the metal does ***not*** mean it has to be a Class 8 material.

Anhydrous ammonia and the contaminants in liquefied petroleum gas and can be very corrosive to QT metal. For this reason, the use of QT cargo tank motor vehicles is restricted and specific information must be included on the shipping paper for these two HM:

HM	Shipping Paper Notation for QT CTs	Shipping Paper Notation for NQT CTs	Shipping Paper Reference	Package Authorization Reference
Anhydrous Ammonia	"0.2 PERCENT WATER"	"NOT FOR Q AND T TANKS"	Section 172.203(h)(1)	Section 173.315(a)(2), Note 14
LPG	"NONCORROSIVE" or "NONCOR"	"NOT FOR Q AND T TANKS"	Section 172.203(h)(2)	Section 173.315(a)(2), Note 15

All MC331, MC330, and non-specification cargo tank motor vehicles operated under §173.315(k) must be marked QT or NQT per Section 173.328(c).

Shippers of anhydrous ammonia and liquefied petroleum gas are required to conduct periodic testing of their material to ensure it meets the requirements for the proper type of cargo tank.

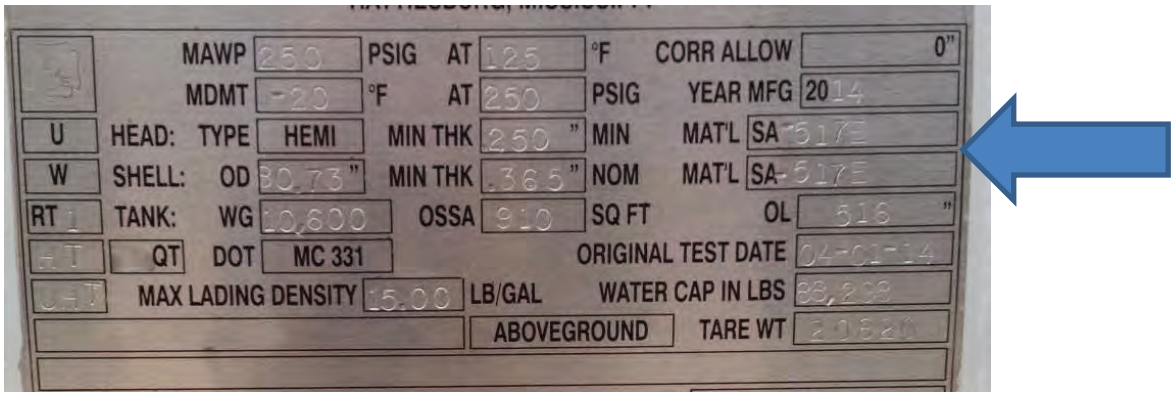
How do I know if I have a QT cargo tank?

While the cargo tank is required to be marked QT or NQT, sometimes the marking may be missing or even incorrect. On either the ASME Name plate or the ASME U-1A form, identify the material the cargo tank is constructed from. If the material code is one of those listed below, it is QT steel:

1. SA-517 with a letter designation listed after (ignore the letter codes after the number)
2. 1204 or with a number designation listed after*
3. 1298 with a number designation listed after*

*1204 and 1298 were numbers given to SA-517 material during the approval period with ASME.

Also, on the ASME U-1A form, look at the Tensile Strength (TS). If it is 115,000, it is QT steel; if it is not QT steel, it will be significantly lower, in the 85,000-89,000 range.

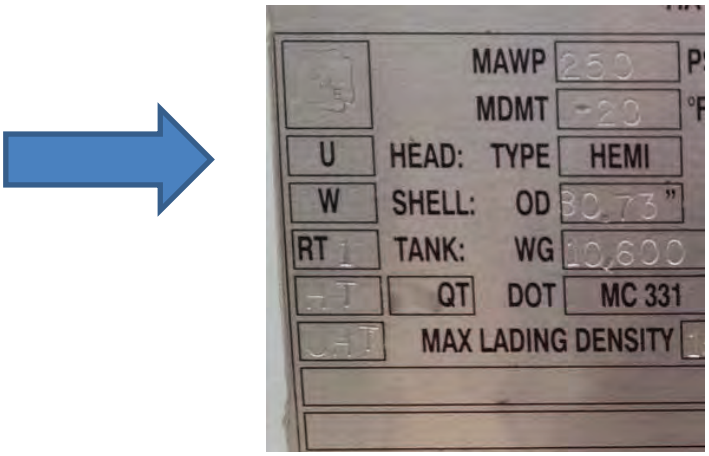


Note: The HMR allows the ASME Name Plate and the DOT Specification Plate to be separate plates or combined into one. The HMR requires the shell and head material to be on the ASME Name Plate.

If I have a NQT cargo tank, how do I know if it was postweld heat treated?

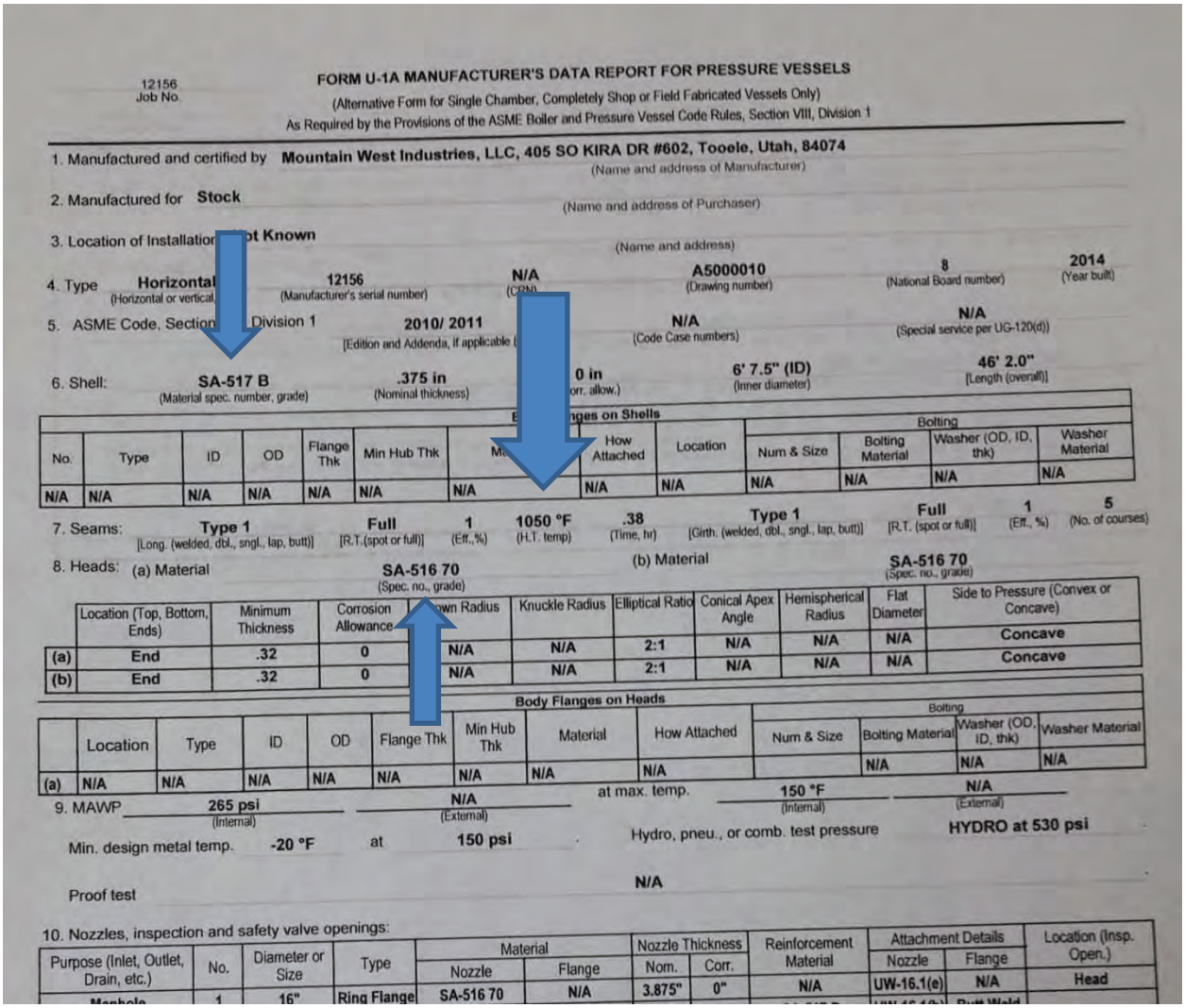
Earlier it was stated that a NQT cargo tank motor vehicle only required the WFMPE if it was not postweld heat treated and transported anhydrous ammonia or any other hazardous material that causes stress corrosion cracking. So how do I determine if it was or was not postweld heat treated?

Like the QT determination, you need to examine either the ASME Name Plate or the ASME U-1A form. The information may not appear on older ASME Name Plates, but on more recent plates it can be verified by the presence or absence of the letters "HT." In the picture below, look at the top left corner. Moving down, in order, the indicators are: ASME Symbol; U Stamp; W – welded; RT1 – all welds were radiographed (x-rayed); HT – Heat Treated, as in postweld heat treated; UHT – manufactured to ASME Code Section VIII, Division 1.



In the picture below, focus on the top left corner. Again, you see the ASME Symbol and U stamp (combined, pre-2013 style); the W indicator; the RT indicator; and the Div. 1 (older marking for UHT), but there is no HT marking, indicating this cargo tank was not postweld heat treated.

On the ASME U-1A form, look for the H.T. Temp indicator on Line 7. If it is blank, then no postweld heat treatment was performed:



12156
Job No.

FORM U-1A MANUFACTURER'S DATA REPORT FOR PRESSURE VESSELS

(Alternative Form for Single Chamber, Completely Shop or Field Fabricated Vessels Only)
As Required by the Provisions of the ASME Boiler and Pressure Vessel Code Rules, Section VIII, Division 1

1. Manufactured and certified by **Mountain West Industries, LLC, 405 SO KIRA DR #602, Tooele, Utah, 84074** (Name and address of Manufacturer)

2. Manufactured for **Stock** (Name and address of Purchaser)

3. Location of Installation **ot Known** (Name and address)

4. Type **Horizontal** (Horizontal or vertical) | **12156** (Manufacturer's serial number) | **N/A** (CRN) | **A5000010** (Drawing number) | **8** (National Board number) | **2014** (Year built)

5. ASME Code, Section Division 1 | **2010/ 2011** [Edition and Addenda, if applicable] | **N/A** (Code Case numbers) | **N/A** (Special service per UG-120(d))

6. Shell: **SA-517 B** (Material spec. number, grade) | **.375 in** (Nominal thickness) | **0 in** (orr. allow.) | **6' 7.5" (ID)** (Inner diameter) | **46' 2.0"** [Length (overall)]

Body Flanges on Shells									Bolting			
No.	Type	ID	OD	Flange Thk	Min Hub Thk	Material	How Attached	Location	Num & Size	Bolting Material	Washer (OD, ID, thk)	Washer Material
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

7. Seams: **Type 1** [Long. (welded, dbl., sngl., lap, butt)] | **Full** [R.T.(spot or full)] | **1** (Eff.,%) | **1050 °F** (H.T. temp) | **.38** (Time, hr) | **Type 1** [Girth. (welded, dbl., sngl., lap, butt)] | **Full** [R.T. (spot or full)] | **1** (Eff., %) | **5** (No. of courses)

8. Heads: (a) Material **SA-516 70** (Spec. no., grade) (b) Material **SA-516 70** (Spec. no., grade)

	Location (Top, Bottom, Ends)	Minimum Thickness	Corrosion Allowance	wn Radius	Knuckle Radius	Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure (Convex or Concave)
(a)	End	.32	0	N/A	N/A	2:1	N/A	N/A	N/A	Concave
(b)	End	.32	0	N/A	N/A	2:1	N/A	N/A	N/A	Concave

Body Flanges on Heads									Bolting		
	Location	Type	ID	OD	Flange Thk	Min Hub Thk	Material	How Attached	Num & Size	Bolting Material	Washer (OD, ID, thk)	Washer Material
(a)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A

9. MAWP **265 psi** (Internal) **N/A** (External) at max. temp. **150 °F** (Internal) **N/A** (External)

Min. design metal temp. **-20 °F** at **150 psi** Hydro, pneu., or comb. test pressure **HYDRO at 530 psi**

Proof test **N/A**

10. Nozzles, inspection and safety valve openings:

Purpose (Inlet, Outlet, Drain, etc.)	No.	Diameter or Size	Type	Material		Nozzle Thickness		Reinforcement Material	Attachment Details		Location (Insp. Open.)
				Nozzle	Flange	Nom.	Corr.		Nozzle	Flange	
Manhole	1	16"	Ring Flange	SA-516 70	N/A	3.875"	0"	N/A	UW-16.1(e)	N/A	Head

Note: In the above example, the shell material (line 6) is SA-517 steel and the head material (line 8) is SA-516. This is a very unusual violation of the ASME Code and the HMR. This is an unauthorized package and the cargo tank motor vehicle must be taken out of service.

When must the WFMPE be performed?

The WFMPE must be performed ***immediately prior to*** and in conjunction with the pressure test, per Section 180.407(g)(3). The reason the WFMPE is done prior to the pressure test is to ensure there are no existing cracks in the cargo tank wall prior to applying pressure to it.

Who can perform the WFMPE?

The manufacturer or facility must certify that their Examiner meets the following requirements:

- Has the vision, with correction, to read a Jaeger Type No. 2 Standard Chart at a distance of not less than 12", and is capable of distinguishing and differentiating contrast between colors used. Glasses may not be photosensitive. ***These requirements must be checked annually.***

- Is competent in the techniques of the WFMPE, including conducting the exam and interpreting and evaluating results.

In addition, the HMR requires:

- That the facility be registered with and hold a valid USDOT CT facility number. Third party facilities that come into a CT facility and conduct the WFMPE **must** have their own CT#.

- The examiner meet the training and testing requirements of 49 CFR Section 172.704, specifically General Awareness, Security Awareness, and Function-Specific Training that includes:

    - Section V, Article 7, including SE-709 of the ASME Code;
    - Section VIII, Division 1, Mandatory Appendix 6 of the ASME Code;
    - CGA Technical Bulletin TB-2; and
    - 49 CFR Part 180 Subpart E.

What equipment is required to conduct the WFMPE?

- Section 180.407(g) prohibits the use of permanent magnets (direct current).

- The Yoke (alternating current magnet) must have a lift capacity of at least 10 lbs. (Use of a 40 lb. weight suggests the magnet is direct current). The yoke must be calibrated annually with a plate that is marked with the weight of the plate.

- The Black Light (ultraviolet light) must be measured with a black light meter prior to use, and whenever the light's power source is interrupted or changed, and at the completion of the exam. It must achieve a minimum of 1000 $\mu W/cm^2$. Light meters must be calibrated once a year.

- The ferromagnetic wet particles must be of a color that sufficiently contrasts with the surface being examined.

    - The particles must be suspended in a suitable liquid medium as recommended by the particle manufacturer.
    - Fluorescent materials should be mixed according to manufacturer's instructions and according to SE-709 (ASME Code Section V).

- The color contrast must be evaluated with a minimum light intensity of 100 foot-candles on the part surface. This must be verified by a calibrated light meter. In the case of U Stamp or R Stamp applications, the light meter must be witnessed and verified by the AI.

- Reflectors, filters, glasses and lenses should be checked, cleaned and repaired as necessary.

How must the WFMPE be performed?

Mandatory Appendix 6 of Section VIII, Division 1 of the ASME Code, "Methods for Magnetic Particle Examination (MT) specifies how the WFMPE is to be performed.

The WFMPE must be conducted following the procedures of Section V, Article 7 of the ASME Code ***and*** CGA Bulletin TB-2, which has been redesignated as CGA Bulletin P-26. The HMR has adopted the 2015 version of the ASME Code and the 1980 edition of the CGA bulletin.

Performing a WFMPE on a transport cargo tank takes a considerable amount of time. It is generally a two-person job.

Examiners should be familiar with and comply with all applicable OSHA confined space regulations.

At the end of this document is Appendix A, which lists specific items that must be followed when conducting the WFMPE.

What are the Acceptable Results?

Per Mandatory Appendix 6, 6-3 and 6-4:

- Defect indications are revealed by the retention of the wet magnetic particles within the defect. Any indication with a dimension greater than 1/16" must be considered relevant.
    - A liner indication is one having a length greater than three times the width.
    - A rounded indication is one of circular design or elliptical shape with a length equal to or less than three times its width.
    - Any questionable indications must be reexamined to determine relevance.

- When indications are discovered, if they exceed these thresholds they must be repaired:
    - Any liner indication described above.
    - Any rounded indication greater than 3/16" (5 mm).
    - Four or more rounded indications described above in a line separated by 1/16" (1.5 mm) or less, edge to edge.

Definitions of terms are found in Section V, Article 1, Mandatory Appendix I, I-121.4.

How are Repairs to be performed?

Per Mandatory Appendix 6, 6-5:

- Defects must be removed or reduced to an imperfection of acceptable size.

- When defects are repaired without welding (chipping or grinding), the area shall be blended into the surrounding surface.

- Welding must be performed in accordance with a qualified welding procedure.

- Indications believed to be non-relevant must be repaired or reexamined to verify the imperfection is of an acceptable size.

- Once a repair is completed and blended into the surrounding surface, the area must be reexamined by WFMPE to verify the defect has been corrected.

- All cracks and deformations must be repaired in accordance with the ASME Code, the NBIC, and the HMR (AI approved written procedure, R Stamp, CT#, qualified welder, proper materials, and when required, PWHT).

- CGA P-26 permits grinding, but the wall thickness cannot be reduced more than .010".

- Post weld heat treatment is required, except for "minor weld repairs" (§180.413(b)(6)). "Minor weld repair" is not defined in the regulations or in interpretations.

- After welding, the area repaired must be inspected using the WFMPE and pressure tested to at least twice the MAWP for QT CTs, 1.5 times for non-QT CTs (per CGA P-26, formerly TB-2).

What has to be in the WFMPE Written Procedure?

Section V, Article 7 requires the WFMPE to be done in accordance with a written procedure (Article 7, T-721). The required elements of the written procedure are contained in Appendix B of this document (Article 7, Table T-721).

The facility may write their own procedure. If they are performing the WFMPE pursuant to the U stamp for manufacturing or the R stamp for repairs, the procedure must be certified by the Authorized Inspector.

What documentation of the WFMPE is required?

The WFMPE report must contain the elements specified in Article 1, T-190(a), and Article 7, T-190(a). A list of the required items is found in Appendix C of this document.

SE-709

SE-709 is a standard within Section V that provides detailed guidance on how the WFMPE should be conducted. It is more of a training manual than a regulatory document and provides excellent background material for how the WFMPE is conducted and what equipment should be used, including pictures of various equipment.

It also specifies the particle suspension formulas and has more detail on how to identify indications. Refer to the Annex of this standard for excellent photographs of cracks discovered by the WFMPE.

APPENDIX A
WFMPE PROCEDURES

	Thorough cleaning of all the welds inside the cargo tank, including scraping off all the rust and removal of any dirt, scale, grease, oils or other liquid residue. On transports, this may take several hours.
	The welds must be visually inspected for any discontinuity surface openings which may not attract and hold magnetic particles because of their width.
	The exam must be in a darkened area and the examiner must be in the darkened area for at least 5 minutes to allow his/her eyes to adapt to the lack of light.
	Every inch of all internal welding must be examined during the WFMPE, including **2"** on either side of the weld, measured from the weld bead; includes exterior welds that are discernable on the interior of the tank (per CGA P-26, formerly TB-2). Verify the yoke is of sufficient width to meet this requirement in one pass.
	All examinations shall be conducted with sufficient overlap to ensure 100% coverage at the required sensitivity.
	The **entire** interior surface of the **front and rear heads** to be examined during the WFMPE (per CGA P-26, formerly TB-2).
	The temperature of the particles and the surface being examined shall not exceed 135ºF.
	The magnetizing current shall be turned on after the particles have been applied, except that particles from an aerosol spray can may be applied before or after the current is applied.
	Each area must be magnetized in directions that would cross any crack regardless of the crack's orientation.
	At least two separate examinations shall be performed. During the second examination, the lines of magnetic flux shall be approximately perpendicular to those used during the first examination.
	Yokes should be positioned to effectively overlap magnetized areas. Black light should be close enough to the cargo tank wall to ensure effectiveness.
	Speed of inspection should be slow enough to allow particle build up at cracks.
	Visible light must be eliminated or substantially reduced.
	Black light output diminishes with use and should be checked periodically according to the manufacturer's instruction. Inspectors should be equipped with a black light meter to verify the accuracy of the black light.
	If the cargo tank wall is coated, it must be demonstrated that indications can be detected through the maximum coating thickness. For the AC Yoke technique, the demonstration must be done in accordance with Mandatory Appendix I of Article 7, Section V.

APPENDIX B
REQUIRED ELEMENTS FOR WRITTEN PROCEDURE

	Magnetizing Technique
	Magnetizing current type or amperage outside range specified by this Article or as previously qualified
	Surface Preparation
	Magnetic Particles (Fluorescent, color, wet)
	Method of particle application
	Method of excess particle removal
	Minimum light intensity
	Existing coatings, greater than the thickness demonstrated
	Nonmagnetic surface contrast enhancement, when utilized
	Performance demonstration, when required
	Examination part surface temperature outside the temperature range recommended by the manufacturer of the particles or as previously qualified

Optional Elements:

- Shape or size of the examination object
- Equipment of the same type
- Temperature (within manufacturer range or as qualified)
- Demagnetizing technique
- Post-examination cleaning technique
- Personnel qualification requirements

APPENDIX C
REQUIRED ELEMENTS FOR EXAMINATION REPORT

	All the items specified in 49 CFR §180.417(b) and (c)
	Procedure Identification
	Identification of area examined
	Identification of equipment, magnetizing process (continuous, true-continuous, residual), magnetic field strength, direction of magnetic field (circular or longitudinal) and type of current (alternating)
	System performance/sensitivity checks
	Type of Magnetic Particles (fluorescent, wet)
	Personnel Identity and qualification level (I, II, or III), if applicable
	Map, Sketch, or photos of areas examined
	Material and thickness
	Lighting equipment
	Date of examination
	Results of Exam All indications must be documented, including the type of indications (linear or rounded), location, and extent (length, diameter, or aligned).

Appendix G - Red Flag Violations

Appendix G – Red Flag Viloations

There is an increased focus on the driver's role in motor carrier safety due to data showing that unsafe driver behavior is a major contributor to commercial motor vehicle (CMV) crashes. The drivers with Red Flag Violations investigation process ensures that certain roadside violations, designated as Red Flag Violations due to their nature and severity, and the drivers receiving these violations are examined and addressed in conjunction with motor carrier investigations. Red Flag Violations are limited to the list of violations provided in the table below:

BASIC	FMCSR Part	Violation Description
Driver Fitness	383.21	Operating a CMV with more than one driver's license
Driver Fitness	383.23(a)(2)	Operating a CMV without a valid CDL
Driver Fitness	383.51(a)-SIN	Driving a CMV while CDL is suspended for a safety-related or unknown reason and in state of driver's license issuance
Driver Fitness	383.51(a)-SOUT	Driving a CMV while CDL is suspended for a safety-related or unknown reason and outside state of driver's license issuance
Driver Fitness	383.91(a)	Operating a CMV with improper CDL group
Driver Fitness	391.11	Unqualified driver
Driver Fitness	391.11(b)(5)	Driver lacking valid license for type vehicle being operated
Driver Fitness	391.11(b)(7)	Driver disqualified from operating CMV
Driver Fitness	391.15(a)-SIN	Driving a CMV while disqualified. Suspended for safety-related or unknown reason and in the state of driver's license issuance
Driver Fitness	391.15(a)-SOUT	Driving a CMV while disqualified. Suspended for a safety-related or unknown reason and outside the driver's license state of issuance
Controlled Substances/Alcohol	392.4(a)	Driver possesses, uses, or is under the influence of controlled substance(s)
Controlled Substances/Alcohol	392.5(a)	Driver possesses, uses, or is under influence of alcohol less than 4 hours prior to duty
HOS Compliance	395.13(d)	Driving after being declared out-of-service (OOS) (Violating Part 395 OOS Order)
Vehicle Maintenance	396.9(c)(2)	Operating an OOS vehicle before making repairs

Appendix H – Acute and Critical Violations

For

eFOTM Redevelopment

Federal Motor Carrier Safety Administration (FMCSA)
U.S. Department of Transportation

Appendix H – Acute and Critical Violations

The FMCSA considers investigation findings (e.g. what FMCSA or State Partners find as a result of a CR or motor carrier investigation) when assessing motor carrier safety performance and prioritizing investigative resources. The discovery of Acute and Critical Violations is incorporated in the following way:

- **Use in prioritization:** Violations of Acute regulations or patterns of violating Critical regulations documented in the most recent investigation* factor into prioritization and investigation scope for six (6) years.

  *If the investigation is conducted Offsite, the offsite sampling requirement must be the same as the onsite sampling requirement in order to result in a violation of a critical regulation.

- **Use in investigation scope:** If the Acute and/or Critical Violation(s) is associated with the Hours-of-Service (HOS) Compliance Behavior Analysis and Safety Improvement Category (BASIC), the Safety Investigator (SI) will investigate the full HOS BASIC (all parts). If the Acute or Critical Violation(s) is not associated with the HOS BASIC, the SI will only investigate the specific violation(s) cited on the most recent investigation.

- **Display and use in BASIC assessment:**
  - Onsite Investigations:
    - If the Onsite Investigation associated with the discovery of the Acute and/or Critical violation is less than 12 months old, the investigation and overall BASIC columns in the Activity Center for Enforcement (ACE) are indicated. This remains for 12 months, unless a new investigation is performed and uploaded.
    - If the investigation associated with the discovery of the Acute and/or Critical Violation is greater than 12 months old, the investigation and overall BASIC columns in ACE are not indicated and is viewable to enforcement users only.
  - Offsite Investigations
    - If the Offsite Investigation associated with the discovery of the Acute Violation(s) is less than 12 months old, the investigation and overall BASIC columns in SMS are indicated: this remains for 12 months unless a new investigation is performed and uploaded.
    - If the Offsite Investigation associated with the discovery of the Critical violation(s) is less than 12 months old, the investigation and overall BASIC columns in SMS will not be displayed publically in the SMS and the information will viewable only to enforcement users.

Acute and Critical Violations are defined as:

- Those violations where noncompliance is so severe that they require immediate corrective action by a motor carrier regardless of its overall safety posture, such as a one-time occurrence (e.g., failing to implement an alcohol and/or controlled substance testing program); or
- Those violations which relate directly to the motor carrier's management and/or operational controls and are indicative of breakdowns in a motor carrier's management controls, such as a pattern of violations [e.g., false reports of records of duty status (RODS)].

A complete list of Acute and Critical Violations is included in the Table below.

Acute and Critical Violations are considered resolved when an investigation of the motor carrier is performed and there are no new Acute and Critical Violations discovered in the associated BASIC. At

that point in time, the Acute and Critical violation will cease to impact prioritization. If there are newly discovered Acute and/or Critical Violations, the investigation and overall column of the associated BASIC are indicated and the 12-month clock is reset.

Discovering Acute and/or Critical Violations Outside of BASICs Requiring Investigation

If the SI discovers occurrences of Acute and/or Critical Violations outside of the investigation scope, it is necessary to expand the number checked in accordance with policies on minimum record sampling. Expanding the number checked does not represent an expansion into full BASIC record sampling. Record sampling should be limited to only the specific Acute and/or Critical Violation discovered.

For example, imagine a motor carrier has 20 vehicles subject to the Federal Motor Carrier Safety Regulations (FMCSR), and the SI is conducting an Onsite Focused Investigation on HOS Compliance. The SI subsequently discovers two occurrences of 396.11(a) violations, which indicate a Vehicle Maintenance-related Critical Violation. The SI should not ignore these violations, but instead document them in the investigative system. Based on record sampling, the SI needs to sample seven (7) vehicles for 30 days for a total of 210 Driver Vehicle Inspection Reports (DVIRs). Expanding the number checked does not represent expansion in scope to a full Vehicle Maintenance BASIC investigation. The SI should only sample DVIRs in this example.

Table: Acute and Critical Violations

	Violation	Violation Description	BASIC	Violation Type
1.	171.15	Carrier failing to give immediate telephone notice of an incident involving hazardous materials (HM)	HM Compliance	Critical
2.	171.16	Carrier failing to make a written report of an incident involving HM	HM Compliance	Critical
3.	172.313(a)	Accepting for transportation or transporting a package containing a poisonous-by-inhalation material that is not marked with the words “Inhalation Hazard”	HM Compliance	Acute
4.	172.704(a)(4)	Failing to provide security awareness training	HM Compliance	Critical
5.	172.704(a)(5)	Failing to provide in-depth security awareness training	HM Compliance	Critical
6.	172.800(b)	Failure to adhere to a required security plan	HM Compliance	Acute
7.	172.800(b)	Transporting HM without a security plan	HM Compliance	Acute

8.	172.800(b)	Transporting HM without a security plan that conforms to Subpart I requirements	HM Compliance	Acute
9.				
10	173.24(b)(1)	Accepting for transportation or Transporting HM in a package with an identifiable release of HM to the environment	HM Compliance	Acute
11	§173.421	Accepting for transportation or transporting a Class 7 (radioactive) material described, marked, and packaged as a limited quantity when the radiation level on the surface of the package exceeds 0.005mSv/hour (0.5 mrem/hour)	HM Compliance	Acute
12				
13	173.431(a)	Accepting for transportation or transporting in a Type A packaging a greater quantity of Class 7 (radioactive) material than authorized	HM Compliance	Acute
14	173.431(b)	Accepting for transportation or transporting in a Type B packaging a greater quantity of Class 7 (radioactive) material than authorized	HM Compliance	Acute
15	173.441(a)	Accepting for transportation or transporting a package containing Class 7 (radioactive) material with external radiation exceeding allowable limits	HM Compliance	Acute
16	173.442(b)	Accepting for transportation or transporting a package containing Class 7 (radioactive) material when the temperature of the accessible external surface of the loaded package exceeds 50° C (122° F) in other than an exclusive use shipment, or 85° C (185° F) in an exclusive use shipment	HM Compliance	Acute
17	173.443(a)	Accepting for transportation or transporting a package containing	HM Compliance	Acute

		Class 7 (radioactive) material with removable contamination on the external surfaces of the package in excess of permissible limits		
18	177.800(c)	Failing to instruct a category of employees in hazardous materials regulations	Driver Fitness	Critical
19	177.801	Accepting for transportation or transporting a material identified in 49 CFR 172.101 as forbidden for highway transportation	HM Compliance	Acute
20	177.817(a)	Transporting a shipment of hazardous materials not accompanied by a properly prepared shipping paper	HM Compliance	Critical
21	177.817(e)	Failing to maintain proper accessibility of shipping papers.	HM Compliance	Critical
22	177.823(a)	Moving a transport vehicle containing HM that is not properly marked or placarded	HM Compliance	Critical
23	177.835(a)	Loading or unloading a Class 1 (explosive) material with the engine running	HM Compliance	Acute
24	177.835(c)	Accepting for transportation or transporting Division 1.1, 1.2, or 1.3 (explosive) materials in a motor vehicle or combination of vehicles that is not permitted	HM Compliance	Acute
25	177.835(j)	Transferring Division 1.1, 1.2, or 1.3 (explosive) materials between containers or motor vehicles when not permitted	HM Compliance	Acute
26	177.841(e)	Transporting a package bearing a poison label in the same transport vehicle with material marked or known to be foodstuff, feed, or any edible material intended for consumption by humans or animals unless an exception in §177.841(e)(i) or (ii) is met	HM Compliance	Acute
27	180.407(a)	Transporting a shipment of HM in a cargo tank that has not been	HM Compliance	Critical

		inspected or retested in accordance with §180.407		
28	180.407(c)	Failing to periodically test and inspect a cargo tank	HM Compliance	Critical
29	180.415	Failing to mark a cargo tank which passed an inspection or test required by §180.407	HM Compliance	Critical
30	180.417(a)(1)	Failing to retain cargo tank manufacturer's data report certificate and related papers, as required	HM Compliance	Critical
31	180.417(a)(2)	Failing to retain copies of cargo tank manufacturer's certificate and related papers (or alternative report) as required	HM Compliance	Critical
32	382.115(a)	Failing to implement an alcohol and/or controlled substance testing program (domestic motor carrier)	Controlled Substance/Alcohol	Acute
33	382.115(b)	Failing to implement an alcohol and/or controlled substance testing program (foreign motor carrier)	Controlled Substance/Alcohol	Acute
34	382.201	Using a driver known to have an alcohol concentration of 0.04 or greater	Controlled Substance/Alcohol	Acute
35	382.211	Using a driver who has refused to submit to an alcohol or controlled substances test required under Part 382	Controlled Substance/Alcohol	Acute
36	382.213(b)	Using a driver known to have used a controlled substance	Controlled Substance/Alcohol	Acute
37	382.215	Using a driver known to have tested positive for a controlled substance	Controlled Substance/Alcohol	Acute
38	382.301(a)	Using a driver before receiving a negative pre-employment controlled substance test result	Controlled Substance/Alcohol	Critical
39	382.303(a)	Failing to conduct post-accident testing on driver for alcohol	Controlled Substance/Alcohol	Critical

40	382.303(b)	Failing to conduct post-accident testing on driver for controlled substances	Controlled Substance/Alcohol	Critical
41	382.305	Failing to implement a random controlled substances and/or an alcohol testing program	Controlled Substance/Alcohol	Acute
42	382.305(b)(1)	Failing to conduct random alcohol testing at an annual rate of not less than the applicable annual rate of the average number of driver positions	Controlled Substance/Alcohol	Critical
43	382.305(b)(2)	Failing to conduct random controlled substances testing at an annual rate of not less than the applicable annual rate of the average number of driver positions	Controlled Substance/Alcohol	Critical
44	§382.309	Using a driver who has not undergone return-to-duty testing with a negative drug test result and/or an alcohol test with an alcohol concentration of less than 0.02 in accordance with 49 CFR 40.305	Controlled Substance/Alcohol	Acute
45				
46				
47	382.503	Allowing a driver to perform safety sensitive functions after engaging in conduct prohibited by Subpart B of Part 382 without being evaluated by a substance abuse professional as required by §382.605.	Controlled Substance/Alcohol	Critical
48	382.505(a)	Using a driver within 24 hours after being found to have an alcohol concentration of 0.02 or greater but less than 0.04	Controlled Substance/Alcohol	Acute
49	§382.605	Failing to subject a driver who has been identified as needing assistance to at least six unannounced follow-up drug and/or alcohol tests in the first 12	Controlled Substance/Alcohol	Critical

		months following the driver's return-to-duty in accordance with 49 CFR 40.307		
50				
51				
52	383.23(a)	Operating a commercial motor vehicle (CMV) without a valid commercial driver's license (CDL)	Driver Fitness	Critical
53	383.37(a)	Knowingly allowing, requiring, permitting, or authorizing an employee who does not have a current CLP or CDL, who does not have a CLP or CDL with the proper class or endorsements, or who operates a CMV in violation of any restriction on the CLP or CDL to operate a CMV	Driver Fitness	Acute
54	383.37(b)	Knowingly allowing, requiring, permitting, or authorizing an employee with a commercial driver's license which is suspended, revoked, or canceled by a state or who is disqualified to operate a commercial motor vehicle	Driver Fitness	Acute
55	383.37(c)	Knowingly allowing, requiring, permitting, or authorizing an employee with more than one commercial driver's license to operate a commercial motor vehicle	Driver Fitness	Acute
56	383.51(a)	Knowingly allowing, requiring, permitting, or authorizing a driver who is disqualified to drive a CMV	Driver Fitness	Acute
57	387.7(a)	Operating a motor vehicle transporting property without having in effect the required minimum levels of financial responsibility coverage.	Insurance/Other	Acute
58	387.7(d)	Failing to maintain at principal place of business required proof of financial responsibility.	Insurance/Other	Critical

59	387.31(a)	Operating a passenger-carrying CMV without having in effect the required minimum levels of financial responsibility.	Insurance/Other	Acute
60	387.31(d)	Failing to maintain at principal place of business required proof of financial responsibility for passenger-carrying vehicles.	Insurance/Other	Critical
61	390.15(b)(2)	Failing to maintain copies of all accident reports required by State or other governmental entities or insurers.	Insurance/Other	Critical
62	390.35	Making, or causing to make fraudulent or intentionally false statements or records and/or reproducing fraudulent records	Vehicle Maintenance	Acute
63	391.11(b)(4)	Using a physically unqualified driver	Driver Fitness	Acute
64	391.15(a)	Using a disqualified driver	Driver Fitness	Acute
65	391.45(a)	Using a driver not medically examined and certified	Driver Fitness	Critical
66	391.45(b)(1)	Using a driver that has not been medically re-examined each 24 months	Driver Fitness	Critical
67	391.51(a)	Failing to maintain a driver qualification file on each driver employed	Driver Fitness	Critical
68	391.51(b)(2)	Failing to maintain inquiries into a driver's driving record in a driver's qualification file	Driver Fitness	Critical
69	391.51(b)(7)	Failing to maintain medical examiner's certificate in driver's qualification file	Driver Fitness	Critical
70	392.2	Operating a motor vehicle not in accordance with the laws, ordinances, and regulations of the jurisdiction in which it is being operated	Multiple BASICs	Critical

71	392.4(b)	Requiring or permitting a driver to drive while under the influence of, or in possession of, a narcotic drug, amphetamine, or any other substance capable of rendering the driver incapable of safely operating a motor vehicle	Controlled Substance/Alcohol	Acute
72	392.5(b)(1)	Requiring or permitting a driver to drive a motor vehicle while under the influence of, or in possession of, an intoxicating beverage	Controlled Substance/Alcohol	Acute
73	392.5(b)(2)	Requiring or permitting a driver who shows evidence of having consumed an intoxicating beverage within 4 hours to operate a motor vehicle	Controlled Substance/Alcohol	Acute
74	392.6	Scheduling a run which would necessitate the vehicle being operated at speeds in excess of those prescribed	Unsafe Driving	Critical
75	392.9(a)(1)	Requiring or permitting a driver to drive without the vehicle's cargo being properly distributed and adequately secured	HM Compliance	Critical
76	395.1(h)(1)(i)	Requiring or permitting a property-carrying CMV driver to drive more than 15 hours (Alaska)	HOS Compliance	Critical
77	395.1(h)(1)(ii)	Requiring or permitting a property-carrying CMV driver to drive after being on duty 20 hours (Alaska)	HOS Compliance	Critical
78	395.1(h)(1)(iii)	Requiring or permitting a property-carrying CMV driver to drive after 70 hours in 7 days (Alaska)	HOS Compliance	Critical
79	395.1(h)(1)(iv)	Requiring or permitting a property-carrying CMV driver to drive after 80 hours on duty in 8 days (Alaska)	HOS Compliance	Critical
80	395.1(h)(2)(i)	Requiring or permitting a passenger-carrying CMV driver to drive more than 15 hours (Alaska)	HOS Compliance	Critical

81	395.1(h)(2)(ii)	Requiring or permitting a passenger-carrying CMV driver to drive after 20 hours on duty (Alaska)	HOS Compliance	Critical
82	395.1(h)(2)(iii)	Requiring or permitting a passenger-carrying CMV driver to drive after 70 hours on duty in 7 consecutive days (Alaska)	HOS Compliance	Critical
83	395.1(h)(2)(iv)	Requiring or permitting a passenger-carrying CMV driver to drive after 80 hours on duty in 8 days (Alaska)	HOS Compliance	Critical
84	395.1(o)	Requiring or permitting a short-haul property carrying CMV driver to drive after 16 hours on duty	HOS Compliance	Critical
85	§395.11(b)	Failing to require a driver to submit supporting documents	HOS Compliance	Critical
86	§395.11(c)	Failing to retain types of supporting documents as required by §395.11(c)	HOS Compliance	Critical
87	§395.11(e)	Failing to retain supporting documents in a manner that permits the effective matching of the documents to the driver's record of duty status	HOS Compliance	Critical
88	395.11(f)	Altering, defacing, destroying, mutilating, or obscuring a supporting document	HOS Compliance	Critical
89	395.30(f)	Failing to retain ELD information	HOS Compliance	Acute
90	395.3(a)(1)	Requiring or permitting a property-carrying CMV driver to without taking an off-duty period of at least 10 consecutive hours prior to driving	HOS Compliance	Critical
91	395.3(a)(2)	Requiring or permitting a property-carrying CMV driver to drive after	HOS Compliance	Critical

		the end of the 14th hour after coming on duty		
92	395.3(a)(3)(i)	Requiring or permitting a property-carrying commercial motor vehicle driver to drive more than 11 hours	HOS Compliance	Critical
93	395.3(a)(3)(ii)	Requiring or permitting a property-carrying commercial motor vehicle driver to drive if more than 8 hours have passed since the end of the driver's last off-duty or sleeper-berth period of at least 30 minutes	HOS Compliance	Critical
94	395.3(b)(1)	Requiring or permitting a property-carrying CMV driver to drive after 60 hours on duty in 7 consecutive days	HOS Compliance	Critical
95	395.3(b)(2)	Requiring or permitting a property-carrying CMV driver to drive after having been on duty more than 70 hours on duty in 8 consecutive days	HOS Compliance	Critical
96	395.5(a)(1)	Requiring or permitting a passenger-carrying CMV driver to drive more than 10 hours	HOS Compliance	Critical
97	395.5(a)(2)	Requiring or permitting a passenger-carrying CMV driver to drive after 15 hours on duty	HOS Compliance	Critical
98	395.5(b)(1)	Requiring or permitting a passenger-carrying CMV driver to drive after having been on duty 60 hours on duty in 7 consecutive days	HOS Compliance	Critical
99	395.5(b)(2)	Requiring or permitting a passenger-carrying CMV driver to drive after having been on duty more than 70 hours on duty in 8 consecutive days	HOS Compliance	Critical

10				
10	§395.8(a)(1)	Failing to require a driver to prepare a record of duty status using appropriate method (critical).	HOS Compliance	Critical
10	§395.8(a)(2)(ii)	Failure to require a driver to submit record of duty status (critical).	HOS Compliance	Critical
10	§395.8(e)(1)	Making, or permitting a driver to make, a false report regarding duty status (critical).	HOS Compliance	Critical
10	§395.8(e)(2) or (3)	Disabling, deactivating, disengaging, jamming, or otherwise blocking or degrading a signal transmission or reception; tampering with an automatic on-board recording device or ELD; or permitting or requiring another person to engage in such activity (acute).	HOS Compliance	Acute
10				
10				
10	395.8(k)(1)	Failing to preserve RODS for 6 months / Failing to preserve supporting documents	HOS Compliance	Critical
10	396.11(a)	Failing to require driver to prepare driver vehicle inspection report	Vehicle Maintenance	Critical
10	§396.11(a)(3)	Failing to correct OOS defects listed by a driver in a driver vehicle inspection report before the vehicle is operated again	Vehicle Maintenance	Acute
11	396.17(a)	Using a CMV not periodically inspected	Vehicle Maintenance	Critical
11	396.17(g)	Failing to promptly repair parts and accessories not meeting minimum periodic inspection standards	Vehicle Maintenance	Acute
11	396.3(b)	Failing to keep minimum records of inspection and vehicle maintenance	Vehicle Maintenance	Critical

11	396.9(c)(2)	Requiring or permitting the operation of a motor vehicle declared OOS before repairs are made	Vehicle Maintenance	Acute
11				
11	397.13(a)	Permitting a person to smoke or carry a lighted cigarette, cigar or pipe within 25 feet of a motor vehicle containing Class 1 materials, Class 5 materials, or flammable materials classified as Division 2.1, Class 3, Divisions 4.1 and 4.2	Unsafe Driving	Critical
11	397.19(a)	Failing to furnish driver of motor vehicle transporting Division 1.1, 1.2, or 1.3 (explosive) materials with a copy of the rules of part 397 and/or emergency response instructions	HM Compliance	Critical
11	397.5(a)	Failing to ensure a motor vehicle containing Division 1.1, 1.2, or 1.3 (explosive) material is attended at all times by its driver or a qualified representative	Unsafe Driving	Acute
11	397.67(d)	Requiring or permitting the operation of a motor vehicle containing explosives in Class 1, Divisions 1.1, 1.2, or 1.3 that is not accompanied by a written route plan	HM Compliance	Critical
11	397.7(a)(1)	Parking a motor vehicle containing Division 1.1, 1.2, or 1.3 materials within 5 feet of traveled portion of highway or street	Unsafe Driving	Critical
12	397.7(b)	Parking a motor vehicle containing HM other than Division 1.1, 1.2, or 1.3 materials within 5 feet of traveled portion of highway or street	Unsafe Driving	Critical

Appendix I - Warning Letter Sample Text

Appendix I – Warning Letter Sample Text

Dear Motor Carrier:

A review of [INSERT MOTOR CARRIER NAME]'s safety data shows a lack of compliance with motor carrier safety regulations and suggests that your safety performance has fallen to an unacceptable level in the area(s) of **[List of BASICs]**. The purpose of this letter is to: 1) inform you of your company's current safety deficiencies; 2) explain how you can view your safety record and correct it if it contains erroneous data; and 3) describe what actions may be taken in the future if your safety performance does not improve.

This review and notice was based on the roadside inspection and crash performance of **[Carrier Name]**. Based upon this review, the Federal Motor Carrier Safety Administration (FMCSA) will continue to assess the regulatory compliance of **[Carrier Name]** on a monthly basis. FMCSA will also evaluate your safety performance through increased roadside inspections that target your company's deficient area(s).

You are encouraged to visit the website **http://ai.fmcsa.dot.gov/sms** to review your company's record. This website also contains instructions for requesting corrections to information that you believe to be incorrect. A password will be required to view your company information. Instructions to obtain a password are found on the website.

We urge you to take this warning letter seriously and improve your safety record. Failure to improve your company's safety performance will result in further investigation of your safety management practices, which may include requests for additional data through offsite or onsite interventions. Continued poor safety performance will result in penalties/sanctions, which could include civil penalties, suspension and/or revocation of State vehicle registration and revocation of your company's operating authority. Further, your operating record is available to other parties, which include shippers, brokers and insurance companies.

You can visit the FMCSA website at http://www.fmcsa.dot.gov to receive information about motor carrier safety rules and regulations. If you have additional questions regarding this matter or need assistance, please contact one of the following:

[Division Office]
[Federal Motor Carrier Safety Administration]
[Street Address]
[Street Address]
[City, State Zip Code]
[Telephone Number]

[State Office]
[Street Address]
[Street Address]
[City, State Zip Code]
[Telephone Number]

Appendix J - Parts by BASIC Tables

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Appendix J – Parts by BASIC Tables

This Reference provides guidance for selecting the appropriate CFR Part (Full or Sub-part) that should be examined depending on which BASIC is being investigated. The following tables provide more detailed explanations (by BASIC). Each table provides guidance for selecting the appropriate CFR Part (Full or Sub-part) that should be examined.

As part of every Investigation the SI will always check the following:

- **Commercial Driver's License Information System** (CDLIS) - following e-FOTM guidance for checking the minimum number of drivers using CDLIS.
- **Authority** - verifying that the motor carrier has the appropriate type of authority using the FMCSA's Licensing and Insurance (L&I) database. It is important for SIs to incorporate the following when performing an investigation of a carrier that transports HM regardless of whether or not it has an HM Compliance BASIC requiring an investigation:
    - Operating Authority Registration

  - Pipeline and Hazardous Materials Safety Administration (PHMSA) HM Registration in accordance with §107.601
  - Proper registration of Manufacturing, Testing, or Repair Facility for carriers performing this function
  - FMCSA HM Safety Permit
  - PHMSA HM Special Permit
- **Insurance** - verifying that the motor carrier has the appropriate level of insurance using the L&I (e.g., MCS−90).
- Red Flag Violations - investigating all drivers with Red Flag Violations as described in Section 3.4.

Appendix J-a: Investigating CFR Parts by by Driver Fitness BASIC

- ● full review of part
  ⊗ partial review of part (relevant subpart is indicated by the number below the symbol, e.g., .21, .23, etc.)

Safety		
CFR Part	**Full or Subpart**	**Description**
40 - Drug & Alcohol Testing		
380 - Special Training	●	Longer Combined Vehicle (LCV) and Entry Level Driver Training Requirements − **Required if** motor carrier has drivers subject to Part 380 training requirements.
382 - Drug & Alcohol Testing		
383 - Commercial Driver's License (CDL)	●	**Required:** Driver Fitness BASIC and part of the CAIR process. Perform Commercial Driver's License Information System (CDLIS) checks in accordance with CDLIS policy memo.
390 - Federal Motor Carrier Safety Regulations (FMCSR) General	⊗ .3, .15, .23, .25	390.3 - General Applicability − ensures drivers are subject to regulations − **Required** 390.15 - Accident Register − **Required if** Crash BASIC Investigation is performed. 390.23/25 - Relief - **Required if** a carrier is claiming relief. Confirm emergency declaration or emergency condition
391 - Driver Qualifications	●	Required: Driver Fitness BASIC
392 - Driving of Motor Vehicles	⊗	392.3 - Ill and Fatigued Driver - **Consideration** when ill and fatigued driving is evident on the profile. Investigator should examine if violations may be related to a medical issue.

	.3, .9a(a)	392.9a(a) Authority - **Required** as part of the CAIR process
393 - Vehicle Parts and Accessories		
395 - Hours of Service (HOS)		
396 - Vehicle Maintenance		
Hazardous Materials		
CFR Part	Full or Subpart	Description
107 - HM Program Procedures (Registration)		
171 - HM General		
172 - HM Table/ Communication	⊗ .704	172.704 – Training Records - **Required if** HM carrier
173 - Shipper Requirements		
177 - Carriage by Highway	⊗ .816	177.816 - Training Requirements – **Required if** HM carrier
178 - Package Specifications		
180 - Package Quality and Maintenance		
397 - HM Driving and Parking		
Other		

CFR Part	Full or Subpart	Description
325 - Noise Emission		
387 - Financial Responsibility	⊗ As applicable	Required as part of CAIR process as applicable to the commodity transported or motor carrier operation type.
398 - Transporting Migrant Workers	⊗ .3	398.3 – Qualification of Drivers and Operators – Required if motor carrier transports migrant workers.
399 - Employee Health and Safety		

Appendix J-b: Investigating CFR Parts by Controlled Substances/Alcohol BASIC

● full review of part

⊗ partial review of part (relevant subpart is indicated by the number below the symbol, e.g., .21, .23, etc.)

Safety		
CFR Part	Full or Subpart	Description
40 - Drug & Alcohol Testing	●	**Required:** Controlled Substances and Alcohol BASIC
380 - Special Training		
382 - Drug & Alcohol Testing	●	**Required:** Controlled Substances and Alcohol BASIC
383 - CDL	⊗ Part of CAIR	**Required** as part of the CAIR process. Perform CDLIS checks in accordance with policy memo.
390 - FMCSR General	⊗ .15	390.15 - Accident Register - **Required** to determine which crashes required post-accident controlled substance and alcohol testing. Additionally **Required if** Crash BASIC Investigation is performed.
391 - Driver	⊗	391.23 (d-m) – Controlled substance and alcohol program driver background checks and carrier

Qualifications	.23(d-m), .41-.45	responsibilities – **Required** 391.41, .43, .45 - Physical qualification for drivers, specific to controlled substances and alcohol issues. **Required if** positive tested driver.
392 - Driving of Motor Vehicles	⊗ .9a(a)	392.9a(a) Authority - **Required** as part of the CAIR process.
393 - Vehicle Parts and Accessories		
395 - HOS		
396 - Vehicle Maintenance		
Hazardous Materials		
CFR Part	Full or Subpart	Description
107 - HM Program Procedures (Registration)		
171 - HM General		
172 - HM Table/ Communication		
173 - Shipper Requirements		
177 - Carriage by Highway		
178 - Package Specifications		
180 - Package Quality and Maintenance		

397 - HM Driving and Parking		
Other		
CFR Part	Full of Subpart	Description
325 - Noise Emission		
387 - Financial Responsibility	⊗ As applicable	**Required** as part of CAIR process as applicable to the commodity transported or motor carrier operation type.
398 - Transporting Migrant Workers		
399 - Employee Health and Safety		

Appendix J-c: Investigating CFR Parts by Vehicle Maintenance BASIC

● full review of part

⊗ partial review of part (relevant subpart is indicated by the number below the symbol, e.g., .21, .23, etc.)

Safety		
CFR Part	Full of Subpart	Description
40 - Drug & Alcohol Testing		
380 - Special Training		
382 - Drug & Alcohol Testing		
383 - CDL	⊗ Part of CAIR	**Required** as part of the CAIR process. Perform CDLIS checks in accordance with policy memo.

390 - FMCSR General	⊗ .3, .15, .21, .23, .25	390.3 - General Applicability, ensures drivers are subject to regulations – **Required** 390.15 - Accident Register - **Required if** Crash BASIC Investigation is performed. 390.21 - Ensure vehicles properly marked. Check if vehicle inspections are conducted or if vehicle is observed during Vehicle Maintenance Investigation - **Consideration** when present on profile 390.23/25 - Relief - **Required if** a carrier is claiming relief. Confirm emergency declaration.
391 - Driver Qualifications	⊗ .13	391.13 - Responsibilities of drivers - **Consideration** when the profile shows evidence of cargo issues related to knowledge and application of the cargo securement rules (393.100-.136). Use "1 of 1" violation citation logic.
392 - Driving of Motor Vehicles	⊗ .2, .9, .62, .9a(a)	392.2 - Applicable Operating Rules - **Required if** state or local routing laws are applicable to the motor carrier under investigation. Use "1 of 1" violation citation logic. 392.9 - Inspection of cargo - **Consideration** when the profile shows evidence of 392.2 Cargo-Related violations. Use "1 of 1" violation citation logic. 392.62 - Safe operation or buses - **Consideration** when evidence of violation exists on the profile. 392.9a(a) Authority - **Required** as part of the CAIR process.
393 - Vehicle Parts and Accessories	●	**Required:** Vehicle Maintenance BASIC – 393 violations noted on the carrier profile may be used as evidence when considering the "1of 1" violation citation logic for 396.3(a)(1) or 392.2. 393.100-.136 - **Consideration** when the profile shows evidence of cargo-related issues. Use "1 of 1" violation citation logic.
395 - HOS		
396 - Vehicle Maintenance	●	**Required:** Vehicle Maintenance BASIC 396.3(a) Inspection, repair, and maintenance - **Consideration** when profile shows evidence that may be related to the maintenance of load securement devices. Use "1 of 1" violation citation logic.
Hazardous Materials (HM)		
CFR Part	Full or Subpart	Description
107 - HM Program		

Procedures (Registration)		
171 - HM General		
172 - HM Table/ Communication		
173 - Shipper Requirements		
177 - Carriage by Highway		
178 - Package Specifications		
180 - Package Quality and Maintenance		
397 - HM Driving and Parking		
Other		
CFR Part	Full or Subpart	Description
325 - Noise Emission		
387 - Financial Responsibility	⊗ As applicable	**Required** as part of CAIR process as applicable to the commodity transported or motor carrier operation type.
398 - Transporting Migrant Workers	⊗ .4	398.4 - Driving of motor vehicles - **Required if** motor carrier transports migrant workers.
399 - Employee Health and Safety		

Appendix J-d: Investigating CFR Parts by Hours-of-Service (HOS) Compliance BASIC

● full review of part

⊗ partial review of part (relevant subpart is indicated by the number below the symbol, e.g., .21, .23, etc.)

Safety		
CFR Part	Full or Subpart	Description
40 - Drug & Alcohol Testing		
380 - Special Training	.503(b), .505, .513	380.503(b) – Entry Level Driver Training Requirements - **Required if** motor carrier has drivers subject to training requirements. 380.505 - Proof of Training - **Required if** motor carrier has drivers subject to entry-level driver training. 380.513 - Training Certificate - **Required if** motor carrier has drivers subject to entry-level driver training.
382 - Drug & Alcohol Testing		
383 - CDL	Part of CAIR	**Required** as part of the CAIR process. Perform CDLIS checks in accordance with policy memo.
390 - FMCSR General	.3, .15, .23, .25	390.3 - General Applicability – ensures drivers are subject to regulations – **Required** 390.15 - Accident Register - **Required if** Crash BASIC Investigation is performed. 390.23/25 - Relief - **Required if** a carrier is claiming relief. Confirm emergency declaration or emergency condition.
391 - Driver Qualifications	.21, .41, .43	391.21 - Application for Employment - **Consideration** in those cases where multiple employers may be contributing to the HOS Compliance BASIC 391.41 - Physical Qualifications of Drivers - **Consideration** in those cases where physical qualifications may be impacting the HOS Compliance BASIC 391.43 - Medical Exam – **Consideration** in those cases where physical qualifications may be impacting the HOS Compliance BASIC The investigator is not required to sample in these areas of consideration. The purpose is to have some other investigative options and documents to examine to better identify process breakdowns. Sampling in

		accordance with the Driver Fitness BASIC is not required since it is not the BASIC under investigation. If the Safety Investigator (SI) does choose to sample in these partial areas, the sample should be consistent with the BASIC under investigation, in this case, the HOS Compliance BASIC. **Example:** A review of 391.21 would be conducted if the SI had reason to believe the driver had driven for another motor carrier by discovering a recent inspection in the SMS or other related evidence. In this case, the SI might want to examine the Employment Application for that particular driver.
392 - Driving of Motor Vehicles	.3, .6, .9a(a)	392.3 – Ill and Fatigued Driver - **Consideration** when ill and fatigue driving is evident on the profile. Investigator should examine if violations may be related to a medical issue. 392.6 - Schedules to conform with speed limits, useful check when drivers are recording hours of service activities that could not be completed in conformance with speed limits, within the hours of service examination – **Required** 392.9a(a) Authority - **Required** as part of the CAIR process.
393 - Vehicle Parts and Accessories		
395 - Hours of Service	●	**Required:** HOS Compliance BASIC
396 - Vehicle Maintenance		
Hazardous Materials		
CFR Part	Full or Subpart	Description
107 - HM Program Procedures (Registration)		
171 - HM General		
172 - HM Table/ Communication		
173 - Shipper Requirements		
177 - Carriage by		

Highway		
178 - Package Specifications		
180 - Package Quality and Maintenance		
397 - HM Driving and Parking		
Other		
CFR Part	Full or Subpart	Description
325 - Noise Emission		
387 - Financial Responsibility	⊗ As applicable	**Required** as part of CAIR process as applicable to the commodity transported or motor carrier operation type.
398 - Transporting Migrant Workers	⊗ .6	398.6 - Hours of Service of Drivers - **Required if** motor carrier transports migrant workers.
399 - Employee Health and Safety		

Appendix J-e: Investigating CFR Parts by Hazardous Materials Compliance BASIC

● full review of part

⊗ partial review of part (relevant subpart is indicated by the number below the symbol, e.g., .21, .23, etc.)

Safety		
CFR Part	Full or Subpart	Description
383 - CDL	⊗	**Required** as part of the CAIR process. Perform CDLIS checks in accordance with policy memo.

	Part of CAIR	
392 - Driving of Motor Vehicles	⊗ .2	392.2 - Applicable Operating Rules – **Required if** state or local routing laws are applicable to the motor carrier under investigation. Use "1 of 1" violation citation logic.
Hazardous Materials		
CFR Part	Full or Subpart	Description
107 - HM Program Procedures (Registration)	⊗ .101 - .405 .501 - .504 .601 - .620	107.101 - 107.405, **required if** carrier/shipper is a party to a special permit. 107.501 - 107.504, **required if** carrier meets any Cargo Tank registration requirements. 107.601 - 107.620, **required if** person meets any of the HM registration criteria found in 107.601.
171 - HM General	⊗ .1, .2, .15, .16	171.1 - Applicability of Hazardous Materials Regulations (HMR) - **Required** to verify applicability of regulations. 171.2 - General requirements - **Required** 171.15 - Immediate notice of certain hazardous material incidents - **Required if** carrier/shipper was involved in an incident that required immediate notice. Refer to criteria in 171.15(b). 171.16 - Detailed hazardous material incident reports - **Required if** carrier has incidents meeting detailed reporting criteria.
172 - HM Table/ Communication	⊗ .200 - .205 .300 -.338 .400 -.450 .500 -.560 .600 -.606 .700 -.704	172.200 - 172.205, Shipping Paper Requirements - **Required** as applicable to each proper shipping name or class/division of hazardous material transported or shipped. 172.300 - 172.338, Marking Requirements - **Required** for each proper shipping name or class/division of non-bulk and bulk packages requiring marking in accordance with Subpart D or Part 172. 172.400 - 172.450, Labeling Requirements - **Required** as applicable to each proper shipping name or class/division of hazardous material being transported or shipped requiring labels in accordance with Subpart E of Part 172. 172.500 - 172.560, Placarding Requirements - **Required** for each proper shipping name or class/division of hazardous material being transported or shipped requiring Placarding in accordance with Subpart F of Part

	.800 -.822	172. 172.600 - 172.606, Emergency Response Requirements - **Required** for each proper shipping name or class/division of hazardous material required to have emergency response information. 172.700 - 172.704, Training Requirements - **Required** for hazardous material employees as defined by Subpart H of Part 172, check all requirements in Subpart H. 172.800 - 172.822, Security Plan Requirements - **Required** for hazardous material transporters and shippers that are required to have a security plan in accordance with Subpart I or Part 172.
173 - Shipper Requirements	●	**Required** for each proper shipping name or class/division of hazardous materials transported or shipped in accordance with Part 173.
177 - Carriage by Highway	● As applicable	177.800 - 177.823, General information and regulations - **As applicable** to the hazardous materials being transported. 177.834 - 177.843, Loading and unloading - **As applicable** to the hazardous materials listed in Subpart B of Part 177. 177.848, Segregation and Separation of Hazardous Materials - **Required if** carrier transports Class 1 materials or a combination of hazardous materials requiring separation or materials are forbidden to be transported in the same transport vehicle in accordance with Subpart C of Part 177. 177.854, Vehicles and shipments in transit - **As applicable** and investigative evidence reveals. 177.870, Regulations applying to hazardous material on motor vehicles carrying passengers for-hire - **Required if** for-hire passenger. Carrier also transports hazardous material for each proper shipping name or class/division of hazardous material transported by a for-hire passenger carrier.
178 - Package Specifications		As applicable to the hazardous material packaging - **Required if** motor carrier is also a package manufacturer, cargo tank manufacturer or cargo tank owner.
180 - Package Quality and Maintenance		Qualification and Maintenance of packaging - Cylinders, IBCs and Cargo Tanks. **Required if** motor carrier is a cargo tank or IBC owner, tester, inspector or manufacturer.
385 - Safety Fitness Procedures	⊗ .401 - .423	385.401 - 385.423, Hazardous Materials Safety Permits - **As applicable** to carriers transporting designated quantities of hazardous materials per 385.403.

397 - HM Driving and Parking	●	Driving and Parking rules - as applicable to the hazardous material investigation.
Other		
CFR Part	Full or Subpart	Description
387 - Financial Responsibility	⊗ As applicable	**Required** as part of CAIR process as applicable to the commodity transported or motor carrier operation type.

Appendix J-f: Investigating CFR Parts by Unsafe Driving BASIC

● full review of part

⊗ partial review of part (relevant subpart is indicated by the number below the symbol, e.g., .21, .23, etc.)

Unsafe Driving

Safety		
CFR Part	Full or Subpart	Description
40 - Drug & Alcohol Testing		
380 - Special Training	●	Longer Combined Vehicle (LCV) and Entry Level Driver Training Requirements – **Required if** motor carrier has drivers subject to training requirements.
382 - Drug & Alcohol Testing		
383 - CDL	⊗ Part of CAIR	**Required** as part of the CAIR process. Perform Commercial Driver's License Information System (CDLIS) checks in accordance with policy memo.
390 - FMCSR General	⊗ .3, .15, .23, .25	390.3 - General Applicability, ensures drivers are subject to regulations – **Required** 390.15 - Accident Register – **Required if** Crash BASIC Investigation is performed. 390.23/25 - Relief - **Required if** a carrier is claiming relief. Confirm emergency declaration.

391 - Driver Qualifications	⊗	A review of driver qualification regulations should be a **consideration** if there is evidence on the profile that might show a link between driver qualification issues and unsafe driving behaviors. Examination and sampling of the driver qualification file is not required unless the investigator has reason to believe that there is a relationship between the two. **Example:** A medical examiner's certificate and long form (if available) may be useful to check when drivers have committed multiple lane change, reckless driving, improper turning, or following too close violations cited on the SMS to see if there is a related medical issue related to the unsafe driving violations.
392 - Driving of Motor Vehicles	●	A review of the profile is **required** for evidence of unsafe driving practices. Review CDLIS checks and other related background information to address unsafe driving practices. Use "1 of 1" violation citation logic. 392.9a(a) Authority - **Required** as part of the CAIR process
393 - Vehicle Parts and Accessories		
395 - Hours of Service		
396 - Vehicle Maintenance		
Hazardous Materials		
CFR Part	Full or Subpart	Description
107 - HM Program Procedures (Registration)		
171 - HM General		
172 - HM Table/ Communication		
173 - Shipper Requirements		
177 - Carriage by Highway	⊗	177.810 - Vehicular Tunnels - **Required if** carrier transports quantities of HM that are prohibited from being transported through tunnels

	.810, .816, .823	177.823 - Movement of motor vehicles in emergency situations – **Required if HM carrier** 177.816 - Training requirements – **Required if HM carrier**
178 - Package Specifications		
180 - Package Quality and Maintenance		
397 - HM Driving and Parking	⊗ .2, .3, .5, .19, .67	A review of the 397.2, .3 and .7 are **required if** the carrier transports placardable HM: 397.2 - Compliance with the Federal Motor Carrier Safety Regulations 397.3 - State and Local Laws, Ordinances, and Regulations A review of 397.5 and 397.19 are required if the motor carrier transports 1.1, 1.2, or 1.3 Explosives: 397.5 - Attendance and surveillance of motor vehicles 397.19 - Instructions and Documents 397.67 - Motor carrier responsibility for routing - **Required if** route controlled HM operation
Other		
CFR Part	Full or Subpart	Description
325 - Noise Emission		
387 - Financial Responsibility	⊗ As applicable	**Required** as part of CAIR process as applicable to the commodity transported or motor carrier operation type.
398 - Transporting Migrant Workers	⊗ .3, .4	398.3 – Qualification of Drivers and Operators – **Required if** motor carrier transports migrant workers. 398.4 - Driving of Motor Vehicles - **Required if** motor carrier transports migrant workers.
399 - Employee Health and Safety		

Appendix K – Reincarnated/Affiliated Carrier Analysis Factors and Checklist

Federal Motor Carrier Safety Administration (FMCSA)
U.S. Department of Transportation

INVESTIGATION ANALYSIS - KEY FACTORS

I. Prior History: Does the predecessor company have a negative safety history? Safety Measurement System (SMS) alerts? Is there an existing:
   a. Out of Service Order _____
   b. Order to Cease Operations _____
   c. Civil Penalty _____

II. Compensation: Was there a valid transfer of assets for compensation?
   a. What, if anything, did the new company pay or exchange to acquire the predecessor company or its assets (vehicles, building, lease)? _____
   b. Are there any written agreements or other records memorializing the transaction? _____
   c. Are there documents, or a lack of documents, indicating a transfer of assets without adequate or any consideration, i.e., compensation? _____

III. Timing: Is there a timing connection between the predecessor ceasing operations and the new company's formation? Did the new company exist but without any activity or documented operations?
   a. What do the company records and State filing documents indicate? _____
   b. What connections can be drawn to prior enforcement action, if any? _____
   c. Do any other factors exist that might explain why the new company was created? _____

IV. Identity: Similarities between the new company and predecessor; list similarities: _____
   a. Is the new company performing the same function as the predecessor? _____
   b. How are the companies identified in State business/corporate filing records? [Articles of Incorporation, Fictitious Name Statement (d/b/a), etc.] _____
   c. Who filed the State business/corporate filing documents? _____
   d. Are the corporate officers the same? What were, and are, their functions? _____
   e. Are the shareholders the same? _____
   f. Do the companies have assets in common (vehicles, equipment, land)? _____
   g. Are the addresses and telephone numbers of both companies the same? _____
   h. Was there any change to any equipment, vehicle, or facility lease, utility bills or insurance contract? _____
   i. Did the vehicle registration(s) change? _____
   j. Are the customers the same? _____
   k. Is the predecessor still in business? If not, what notifications, if any, were the customers given? What is the customer's understanding regarding who will provide transportation services? _____
   l. Did the predecessor file bankruptcy? _____
   m. Is the public face of the new company the same as the predecessor's (name, logo, advertising, vehicle markings)? _____
   n. Is the new company performing services under contracts entered into by the predecessor? _____

o. Are the bank accounts the same (same account number, names on account)? _____
p. In its tax returns, is the new company taking depreciation for assets that belonged to the predecessor company? _____

V. Operational control: Are the employees the same individuals as the employees of the predecessor?

a. Are the managers and supervisors in the same positions with essentially the same job functions? _____
b. Does the new company rely on any of the predecessor's records to establish compliance with the FMCSRs? For example: Did the new company re-qualify the drivers and establish a new controlled substances and alcohol testing program? _____
c. Is the person responsible for safety and FMCSR compliance the same person as in the predeccessor company? _____
d. Is the person(s) with signatory authority on the checking/banking accounts the same as the person with the predecessor company? _____

DOCUMENTS CHECKLIST

□ Copies of all business filings with the Secretary of State (Articles of Incorporation, fictitious business name, amendments, change of corporate name, reports, etc.)

□ Records reflecting business owners, officers, directors, managers, employees, drivers

□ Copies of all applications, compliance reviews, orders, and notices for each carrier maintained in FMCSA files

□ Copies of all vehicle purchase or lease agreements and registration, title, and insurance documents

□ Copies of equipment and facility purchase or lease agreements for each carrier

□ Copies of tax returns for the three years before suspected reincarnation and subsequent

□ Copies of any agreements and/or contracts between Carrier 1 and Carrier 2

□ Copies of marketing materials (e.g. telephone book listings, web pages, trade magazine ads, specialty publications, letterhead, business cards, etc.)

□ Comdata reports, toll accounts (E-Z Pass, IPass)

□ Copy of consortium random pool lists and correspondence to consortium.

- □ Copies of records of Carrier 1 used by Carrier 2 to show compliance with FMCSRs
- □ Copies of any bill of Carrier 2 showing Carrier 1 as the obligated party
- □ Copies of contracts serviced by Carrier 2 that are signed by Carrier 1 or predate Carrier 2
- □ Copies of correspondence regarding Carrier 1 ceasing operations and Carrier 2 assuming operations
- □ Copies of trip pockets for invoices for Carrier 1 where the transportation was completed by Carrier 2
- □ Copies of trip packets for invoices for Carrier 2 where the transportation was completed by Carrier 1
- □ Copies of corporate meeting and shareholder reports for each carrier
- □ Photographs – Take photographs when possible for visual record of business identity, for example, vehicle markings
- □ Insurance documents showing same policy numbers
- □ Company letterhead, business cards
- □ Internet site

Appendix L - Serious Violations - Corrective Action Requirements (100% state)

Appendix L – Serious Violations – Corrective Action Requirements(100% State)

A carrier is subject to intervention based on the discovery of Serious Violations found during a previous investigation. Serious Violations include violations of Acute, Critical, Fundamental, and Essential Safety Management (ESM) regulations. They are briefly described below:

- Violations of **Acute** regulations are those where non-compliance is so severe that they require immediate corrective action by a carrier regardless of its overall safety posture. Discovery of a single Acute Violation constitutes a Serious Violation
- Violations of **Critical** regulations are those which relate directly to the carrier's management and/or operational controls and are indicative of breakdowns in a carrier's management controls. Discovery of violations in at least 10% of the records checked and a pattern (more than one occurrence) results in a Serious Violation.
- Violations of **Fundamental** regulations are those where non-compliance is so severe that they require immediate corrective action by a carrier regardless of its overall safety posture. Discovery of a single Fundamental Violation constitutes a Serious Violation.
- Violations of **Essential Safety Management** regulations are associated with elements of safety management controls necessary to operate. Discovery of violations in at least 10% of the records checked and a pattern (more than one occurrence) results in a Serious Violation.

Verification of Corrective Action can occur in several different ways depending on whether the violation is Type A or Type B

- **Type A Violations**-Serious Violations for which corrective action can be demonstrated through carrier submitted documentation. For these violations, a carrier can supply the evidence of corrective action listed in the table below at any time. Even if corrective action is received, the associated BASIC will remain as Investigation-Identified for 12 months. After 12 months the Serious Violations will no longer impact the overall BASIC assessment but will become a factor in prioritizing the carrier for Intervention.
- **Type B Violations**-Serious Violations for which corrective action can only be demonstrated through a carrier's sustained on-road performance. These are primarily related to the Hours-of-Service (HOS) Compliance, 392.2 (any BASIC), and 392.9(a)(1) (within the Vehicle Maintenance BASIC).
    - For the 392.2 (any BASIC) and 392.9(a)(1) (within the Vehicle Maintenance BASIC) the carrier must have 12 months free of any related violation.
    - For the HOS Compliance BASIC the table to the right gives the number of HOS-violation-free driver inspections that are required to meet the performance-based criteria, based on the carrier's number of Power Units. The inspections must be the most recent.

Type B Serious Violations On road Performance Standards for Serious Violations related to the HOS Compliance

No. of Power Units	Required No. of Clean Inspections (most recent)
1-5	3
6-25	5
26-50	8
51-90	13
91-150	20
151-280	32
281-400	50
401-500	68
501-1,200	80
1,201-3200	125
3,201-10,000	200
10,001-35,000	315
35,001-150,000	500

It should be noted that the corrective actions listed in the following table are minimum requirements designed to ensure correction of a given violation. It is important that the carrier proposes a systematic correction of the discovered violation to prevent the violation from occurring in the future in accordance with 49 CFR Part 390.3(e), knowledge of and compliance with the Federal Motor Carrier Safety Regulations.

Violations marked with an asterisk (*) are ESM/Fundamental Violations that are not Acute or Critical Violations and will not impact the motor carrier's formal safety rating, However, all Serious Violations are subject to the same policy and procedures related to required enforcement action. If enforcement action is not taken, an explanation must be documented in Sentri to explain why enforcement was not initiated.

Part	Violation	BASIC	Type A or B	Corrective Action
171.15	Carrier failing to give immediate telephone notice of an incident involving hazardous materials (HM).	HM Compliance	A	• Provide a copy of the incident report. • Provide a statement on how this issue was handled. • Provide evidence of

				policies, procedures and training that will prevent this violation from occurring in the future.
171.16	Carrier failing to make a written report of an incident involving HM.	HM Compliance	A	• Provide a copy of the incident report. • Provide a statement on how this issue was handled. • Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.
172.200(a)*	Transporting an HM without preparing a shipping paper (§ 172.200(a) and § 177.817(a)) (no shipping paper at all).	HM Compliance	A	• Provide an example of properly prepared shipping paper for each class of HM for which a shipping paper was improperly prepared. • Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.
172.313(a)	Accepting for transportation or transporting a package containing a poisonous-by-inhalation material that is not marked with the words “Inhalation Hazard.”	HM Compliance	A	• Provide evidence to support that required package marking has occurred. • Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.
172.704(a)*	Failing to train HM employees as required (§ 172.704(a) and § 177.800(c)).	Driver Fitness	A	• Provide evidence of policies, procedures and training to prevent this violation from occurring in the future.

172.800(b)	Transporting HM without a security plan (acute) / Transporting HM without a security plan that conforms to Subpart I requirements (acute) / Failure to adhere to a required security plan.	HM Compliance	A	• Provide a copy of a Security Plan that conforms to Part 172.800 and training program for in-depth security training.
173.24(b)(1)	Transporting HM in a package with an identifiable release of HM.	HM Compliance	A	• Provide a copy of the incident report and a copy of shipping paper to identify the HM, and package identification markings in accordance with 178.3. • Provide evidence of policies, procedures and training to prevent this violation from occurring in the future.
173.24b(d)(2)*	Loading a cargo tank with an HM which exceeds the maximum weight of lading marked on the specification plate.	HM Compliance	A	• Provide a copy of the Cargo Tank Manufacturers Certificate of Compliance, loading slips, and HM shipping paper. • Provide evidence of policies, procedures and training to prevent this violation from occurring in the future.
173.30*	Loading HM not in accordance with the segregation table.	HM Compliance	A	• Provide policy procedures and training to prevent this violation from occurring in the future.
173.33(a)(1)*	Transporting HM in an unauthorized cargo	HM Compliance	A	• Provide a copy of the Cargo Tank

	tank.			Manufacturers Certificate of Compliance, loading slips, and HM shipping paper. • Provide evidence of policies, procedures and training to prevent this violation from occurring in the future.
173.33(a)(2)*	Transporting or loading two or more materials in a cargo tank motor vehicle which resulted in an unsafe condition.	HM Compliance	A	• Provide shipping papers to verify that materials were not transported together post-investigation. • Provide evidence of policies, procedures and training to prevent this violation from occurring in the future.
173.33(b)(1)*	Transporting HM in a cargo tank motor vehicle which has a dangerous reaction when in contact with the tank.	HM Compliance	A	• Provide a copy of the Cargo Tank Manufacturers Certificate of Compliance, loading slips, and HM shipping paper. • Provide evidence of policies, procedures and training to prevent this violation from occurring in the future.
173.421(a)	Accepting for transportation or transporting a Class 7 (radioactive) material described, marked, and packaged as a limited quantity when the radiation level on the surface of the package exceeds 0.005mSv/hour (0.5 mrem/hour).	HM Compliance	A	• Provide evidence which demonstrates knowledge of and correct use of radiation meter. • Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.

173.431(a)	Accepting for transportation or transporting in a Type A packaging a greater quantity of Class 7 (radioactive) material than authorized.	HM Compliance	A	• Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.
173.431(b)	Accepting for transportation or transporting in a Type B packaging a greater quantity of Class 7 (radioactive) material than authorized.	HM Compliance	A	• Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future
173.441(a)	Accepting for transportation or transporting a package containing Class 7 (radioactive) material with external radiation exceeding allowable limits.	HM Compliance	A	• Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.
173.442(b)	Accepting for transportation or transporting a package containing Class 7 (radioactive) material when the temperature of the accessible external surface of the loaded package exceeds 50° C (122° F) in other than an exclusive use shipment, or 85° C (185° F) in an exclusive use shipment.	HM Compliance	A	• Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.
173.442(b)	Accepting for transportation or transporting a package containing Class 7 (radioactive) material when the temperature of the accessible external surface of the loaded package exceeds 50° C (122° F) in other than an exclusive use shipment, or 85° C (185° F) in an	HM Compliance	A	• Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.

	exclusive use shipment.			
173.443(a)	Accepting for transportation or transporting a package containing Class 7 (radioactive) material with removable contamination on the external surfaces of the package in excess of permissible limits.	HM Compliance	A	• Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.
177.800(c)	Failing to train HM employees as required (§ 172.704(a) and § 177.800(c))	Driver Fitness	A	• Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future. • Provide documentation that personnel received the training; up to three (3) persons.
177.801	Transporting a material identified in 49 CFR 172.101 as forbidden for highway transportation.	HM Compliance	A	• Provide shipping papers from date of Investigation to ensure that no documented HM that is forbidden was transported.
177.817(a)	Transporting an HM without preparing a shipping paper (§ 172.200(a) and § 177.817(a))(no shipping paper at all)	HM Compliance	A	• Provide an example of properly prepared shipping paper for each class of HM for which a shipping paper was improperly prepared. • Provide evidence of policies, procedures and training to prevent this violation from occurring in the future.
177.823(a)	Moving a transport vehicle containing HM that is not properly	HM Compliance	A	• Provide photographic evidence of properly marked or placarded

	marked or placarded.			vehicle. • Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.
177.834(i)*	Failing to attend a cargo tank during loading/unloading.	HM Compliance	A	• Provide policy, procedures and training to prevent this violation from occurring in the future.
177.835(a)	Loading or unloading a Class 1 (explosive) material with the engine running.	HM Compliance	A	• Provide a statement on how this issue was handled. • Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.
177.835(c)	Accepting for transportation or transporting Division 1.1, 1.2, or 1.3 (explosive) materials in a motor vehicle or combination of vehicles that is not permitted.	HM Compliance	A	• Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.
177.835(j)	Transferring Division 1.1, 1.2, or 1.3 (explosive) materials between containers or motor vehicles when not permitted.	HM Compliance	A	• Provide a statement on how this issue was handled. • Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.
177.841(e)	Transporting a package bearing a poison label in the same transport vehicle with material marked or known to be foodstuff, feed, or any	HM Compliance	A	• Provide a statement on how this issue was handled. • Provide evidence of policies, procedures and training that will

	edible material intended for consumption by humans or animals unless an exception in §177.841(e)(i) or (ii) is met.			prevent this violation from occurring in the future.
177.848(d)*	Loading HM not in accordance with the segregation table.	HM Compliance	A	• Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.
180.407(a)	Transporting a shipment of HM in a cargo tank that has not been inspected or retested in accordance with § 180.407.	HM Compliance	A	• Provide Cargo Tank Certificate and proof of test for up to three (3) units. • Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.
180.407(b)(2)*	Failing to test and inspect a cargo tank which has been in an accident and has been damaged.	HM Compliance	A	• Provide a Cargo Tank Certificate and proof of test for up to three (3) units. • Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.
180.407(b)(3)*	Failing to conduct a pressure test on a cargo tank which has been out of HM service for 1 year or more.	HM Compliance	A	• Provide a Cargo Tank Certificate and proof of test. • Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.
180.407(b)(5)*	Failing to conduct a test or inspection on a cargo tank when required by	HM Compliance	A	• Provide a Cargo Tank Certificate and proof of test. • Provide evidence of

	DOT.			policies, procedures and training that will prevent this violation from occurring in the future.
180.407(c)	Failing to periodically test and inspect a cargo tank.	HM Compliance	A	• Provide a Cargo Tank Certificate and proof of test for up to three (3) units. • Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.
180.413(d)(3)(iv)	Failing to verify mod affecting structure of cargo tank.	HM Compliance	A	• Provide evidence of mod affecting structure of cargo tank. • Provide evidence of policies, procedures, and training that will prevent this violation from occurring in the future.
180.415	Failing to mark a cargo tank which passed an inspection or test required by §180.407.	HM Compliance	A	• Provide proof of proper marking (i.e., photographs) • Provide evidence of cargo tank inspection or test. • Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.
180.417(a)(1)	Failing to retain cargo tank manufacturer's data report certificate and related papers, as required.	HM Compliance	A	• Provide copies of specification cargo tank's manufacturer certificate, the manufacturer's ASME U1A data report, where applicable and required related

				documents; up to three (3) DOT specification cargo tanks. • Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.
180.417(a)(2)	Failing to retain copies of cargo tank manufacturer's certificate and related papers (or alternative report) as required.	HM Compliance	A	• Provide evidence of cargo tank manufacturer's certificate. • Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.
382.115(a)	Failing to implement an alcohol and/or controlled substance testing program.	Controlled Substances/ Alcohol	A	• Provide proof contract with Consortium/Third Party Administrator (C/TPA) and/or collection site if applicable and up to three pre-employment test(s) conducted on all drivers hired during the previous 365 days. • Test results, supervisor reasonable suspension training if applicable. • Control custody forms, policy, active random driver list.
382.115(b)	Failing to implement an alcohol and/or controlled substance testing program.	Controlled Substances/ Alcohol	A	• Provide proof contract with C/TPA and/or collection site if applicable and up to three pre-employment test(s)

				conducted on all drivers hired during the previous 365 days. • Test results, supervisor reasonable suspension training if applicable. • Control custody forms, policy, active random driver list.
382.201	Using a driver known to have an alcohol content of 0.04 or greater to perform a safety sensitive function.	Controlled Substances/ Alcohol	A	• SAP evaluation; evidence of a return to duty test and all follow-up tests results. • If an employee has been terminated, the carrier must submit a written statement providing a date of termination. • Assuming the driver is going to drive: SAP evaluation; evidence of a return to duty test and all follow-up test results if applicable. • Assuming the driver is not going to drive: Statement regarding that fact.
382.211	Using a driver who has refused to submit to an alcohol or controlled substances test required under Part 382.	Controlled Substances/ Alcohol	A	• SAP evaluation; evidence of a return to duty test and all follow-up tests results. • If an employee has been terminated, the carrier must submit a written statement providing a date of termination. • Assuming the driver is going to drive: SAP evaluation;

				evidence of a return to duty test and all follow-up test results if applicable. • Assuming the driver is not going to drive: Statement regarding that fact.
382.213(b)	Using a driver known to have used a controlled substance.	Controlled Substances/ Alcohol	A	• SAP evaluation; evidence of a return to duty test and all follow-up tests results. • If an employee has been terminated, the carrier must submit a written statement providing a date of termination • Assuming the driver is going to drive: SAP evaluation; evidence of a return to duty test and all follow-up test results if applicable. • Assuming the driver is not going to drive: Statement regarding that fact.
382.215	Using a driver known to have tested positive for a controlled substance.	Controlled Substances/ Alcohol	A	• SAP evaluation; evidence of a return to duty test and all follow-up tests results. • If an employee has been terminated, the carrier must submit a written statement providing a date of termination. • Assuming the driver is going to drive: SAP evaluation; evidence of a return to duty test and all follow-up test results if applicable.

				• Assuming the driver is not going to drive: Statement regarding that fact.
382.301(a)	Using a driver before receiving a negative pre-employment result.	Controlled Substances/ Alcohol	A	• Provide pre-employment drug test results on every driver cited. • If a cited driver is no longer employed with the carrier, motor carrier must submit a written statement providing the date the driver ceased employment with the motor carrier. Provide a list of drivers hired since the last investigation, including the first trip date, and negative pre-employment test results.
382.303(a)	Failing to conduct post-accident testing on driver for alcohol.	Controlled Substances/ Alcohol	A	• Provide post-accident test results for any driver involved in a crash requiring a post-accident test since last investigation. • Provide a copy of Controlled Substance and Alcohol policy in accordance with 382.601.
382.303(b)	Failing to conduct post-accident testing on driver for controlled substances.	Controlled Substances/ Alcohol	A	• Provide post-accident test results for any driver involved in a crash requiring a post-accident test since last investigation. • Provide a copy of

				Controlled Substance and Alcohol policy in accordance with 382.601.
382.305	Failing to implement a random controlled substances and/or an alcohol testing program.	Controlled Substances/ Alcohol	A	• Provide evidence of contract with C/TPA and/or collection site, if applicable. • Provide a list of all names of drivers in random testing pool and include information on how the random pool is administered. • Provide test results and CCF if applicable.
382.305(b)(1)	Failing to perform random alcohol tests at the applicable rate.	Controlled Substances/ Alcohol	A	• Provide evidence of contract with C/TPA and/or collection site, if applicable. • Provide a list of all names of drivers in random testing pool and include information on how the random pool is administered. • Provide test results and CCF if applicable.
382.305(b)(2)	Failing to perform random controlled substance tests at the applicable rate.	Controlled Substances/ Alcohol	A	• Provide evidence of contract with C/TPA and/or collection site, if applicable. • Provide a list of all names of drivers in random testing pool and include information on how the random pool is administered. • Provide test results and CCF if

				applicable.
382.309	Using a driver without a return to duty test.	Controlled Substances/ Alcohol	A	• Validate compliance with 49 CFR Part 40 Subpart O. • Provide a copy of Controlled Substance and Alcohol policy in accordance with 382.601.
382.503	Allowing a driver to perform safety sensitive functions, after engaging in conduct prohibited by subpart B of part 382, without being evaluated by a substance abuse professional, as required by § 382.605. (§ 382.503, cross referencing part 40, Subpart O).	Controlled Substances/ Alcohol	A	• SAP evaluation; evidence of a return to duty test and all follow-up tests results. • If an employee has been terminated, the carrier must submit a written statement providing a date of termination. • Assuming the driver is going to drive: SAP evaluation; evidence of a return to duty test and all follow-up test results if applicable. • Assuming the driver is not going to drive: Statement regarding that fact.
382.505(a)	Using a driver within 24 hours after being found to have an alcohol concentration of 0.02 or greater but less than 0.04.	Controlled Substances/ Alcohol	A	• SAP evaluation; evidence of a return to duty test and all follow-up tests results. • If an employee has been terminated, the carrier must submit a written statement providing a date of termination. • Assuming the driver is going to drive: SAP evaluation; evidence of a return

				to duty test and all follow-up test results if applicable. • Assuming the driver is not going to drive: Statement regarding that fact.
382.605(c)(1)	Using a driver who has not undergone a return-to-duty alcohol test with a result indicating an alcohol concentration of less than .02 or with verified negative test result, after engaging in conduct prohibited by part 382 Subpart B.	Controlled Substances/ Alcohol	A	• Validate compliance with 49 CFR Part 40 Subpart O. • Provide a copy of the Controlled Substance and Alcohol policy in accordance with 382.601 and provide proof of supervisory training.
382.605(c)(2)(ii)	Failing to subject a driver who has been identified as needing assistance to at least six unannounced follow-up alcohol and/or controlled substance tests in the first 12 months following the driver's return to duty.	Controlled Substances/ Alcohol	A	• Validate compliance with 49 CFR Part 40 Subpart O. • Provide a copy of the Controlled Substance and Alcohol policy in accordance with 382.601.
383.23(a)	Operating a CMV without a valid CDL.	Driver Fitness	A	• Provide evidence that State Motor Vehicle Records show that the issue has been resolved. • If an employee has been terminated, the carrier must submit a written statement providing a date of termination.
383.3	Knowingly using a driver who does not possess a valid CDL.	Driver Fitness	A	• Current State MVR driving record. If employee has been terminated, carrier must submit a written statement providing a date of

				termination.
383.37(a)	Knowingly allowing, requiring, permitting, or authorizing an employee to operate a CMV with a CDL which is suspended, revoked, or canceled by a State or who is disqualified to operate a CMV as defined in part 383 (§ 383.37(a)) (safety-related reasons).	Driver Fitness	A	• Provide evidence that State Motor Vehicle Records show issue has been resolved. • If an employee has been terminated, the carrier must submit a written statement providing a date of termination.
383.37(b)	Knowingly allowing, requiring, permitting, or authorizing an employee with more than one CDL to operate a commercial motor vehicle.	Driver Fitness	A	• Provide evidence that driver now has only one license, updated Moving Violation Records (MVR). FMCSA/State to confirm through available systems.
383.51(a)	Knowingly allowing, requiring, permitting, or authorizing a driver who is disqualified to drive a CMV.	Driver Fitness	A	• Provide evidence that State Motor Vehicle Records show issue has been resolved. • If an employee has been terminated, the carrier must submit a written statement providing a date of termination.
387.31(a)	Operating a passenger-carrying CMV without having in effect the required minimum levels of financial responsibility.	Insurance/Other	A	• Provide a copy of properly executed insurance endorsement - MCS-90 or MCS-90B.
387.31(d)	Failing to maintain at principal place of business required proof of financial responsibility for passenger-carrying	Insurance/Other	A	• Provide a copy of properly executed insurance endorsement - MCS-90 or MCS-90B.

	vehicles.			
387.7(a)	Operating a motor vehicle transporting property without having in effect the required minimum levels of financial responsibility coverage.	Insurance/Other	A	• Provide a copy of properly executed insurance endorsement - MCS -90 or MCS-90B.
387.7(d)	Failing to maintain at principal place of business required proof of financial responsibility.	Insurance/Other	A	• Provide a copy of properly executed insurance endorsement - MCS-90 or MCS 90B.
390.15(b)(2)	Failing to maintain copies of all accident reports required by State or other governmental entities or insurers.	Insurance/Other	A	• Provide copies of accident report(s) for the past one year as required by 49 CFR section 390.15(b)(2).
390.35	Making, or causing to make fraudulent or intentionally false statements or records and/or reproducing fraudulent records.	Applies to Multiple BASICs	A	• Division discretion
391.11(b)(4)	Knowingly using a physically unqualified driver.	Driver Fitness	A	• Provide a current medical certificate with waiver if applicable.
391.11(b)(5)*	Using a driver without a currently valid motor vehicle operator's license or permit.	Driver Fitness	A	• Provide a copy of state DMV record check.
391.15(a)	Knowingly using a disqualified driver.	Driver Fitness	A	• Provide evidence to show driver is no longer disqualified (current MVR). • If an employee has been terminated, the carrier must submit a written statement providing a date of termination.

391.23(a)*	Failing to investigate a driver's background.	Driver Fitness	A	• Provide a copy of State DMV/MVA check.
391.45(a)	Using a driver not medically examined and certified.	Driver Fitness	A	• Provide evidence of a valid medical examiner's certificate or proof of waiver and/or exception issued by Agency for requested drivers.
391.45(b)(1)	Using a driver not medically re-examined each 24 months.	Driver Fitness	A	• Provide evidence of a valid medical examiner's certificate or proof of waiver and/or exception issued by Agency for requested drivers.
391.51(a)	Failing to maintain a driver qualification file on each driver employed.	Driver Fitness	A	• Provide complete DQ files; up to three (3) files which include newly hired drivers if applicable.
391.51(b)(2)	Failing to maintain inquiries into driver's driving record in driver's qualification file.	Driver Fitness	A	• Provide evidence of inquiry of driver's record.
391.51(b)(7)	Failing to maintain medical examiner's certificate in driver's qualification file.	Driver Fitness	A	• Provide copies of ME certificates.
392.2	Operating a motor vehicle not in accordance with the laws, ordinances, and regulations of the jurisdiction in which it is being operated (§ 392.2) (safety-related violations only).	Multiple BASICs	B	• Division discretion.
392.4(b)	Requiring or permitting a driver to drive while	Controlled	A	• Provide evidence of policies, procedures

	under the influence of, or in possession of, a narcotic drug, amphetamine, or any other substance capable of rendering the driver incapable of safely operating a motor vehicle.	Substances/ Alcohol		and training that will prevent this violation from occurring in the future.
392.5(b)(1)	Requiring or permitting a driver to drive a motor vehicle while under the influence of, or in possession of, an intoxicating beverage.	Controlled Substances/ Alcohol	A	• SAP evaluation; evidence of a return to duty test and all follow-up tests results. • If an employee has been terminated, the carrier must submit a written statement providing a date of termination. • Assuming the driver is going to drive: SAP evaluation; evidence of a return to duty test and all follow-up test results if applicable. • Assuming the driver is not going to drive: Statement regarding that fact.
392.5(b)(2)	Requiring or permitting a driver who shows evidence of having consumed an intoxicating beverage within 4 hours to operate a motor vehicle.	Controlled Substances/ Alcohol	A	• SAP evaluation; evidence of a return to duty test and all follow-up tests results. • If an employee has been terminated, the carrier must submit a written statement providing a date of termination. • Assuming the driver is going to drive: SAP evaluation; evidence of a return to duty test and all follow-up test results if applicable.

				• Assuming the driver is not going to drive: Statement regarding that fact.
392.6	Scheduling a run which would necessitate the vehicle being operated at speeds in excess of those prescribed.	Unsafe Driving	B	• Must provide evidence of 12 months with no violations in the Unsafe Driving BASIC.
392.9a(a)(1)	Operating without the required operating authority.	Insurance/Ot her	A	• Evidence of authority
392.9(a)(1)	Requiring or permitting a driver to drive without the vehicle's cargo being properly distributed and adequately secured.	HM Compliance	B	• Must provide evidence of 12 months with no violations related to load securement.
395.1(h)(1)(i)	Requiring or permitting a property-carrying CMV driver to drive more than 15 hours (Alaska).	HOS Compliance	B	• Refer to the table at the beginning of this Reference for the number of HOS-violation free driver inspections, which are required to meet the performance-based criteria (based on carrier's number of power units).
395.1(h)(1)(ii)	Requiring or permitting a property-carrying CMV driver to drive after being on duty 20 hours (Alaska).	HOS Compliance	B	• Refer to the table at the beginning of this Reference for the number of HOS-violation free driver inspections, which are required to meet the performance-based criteria (based on carrier's number of power units).
395.1(h)(1)(iii)	Requiring or permitting a property-carrying CMV driver to drive	HOS Compliance	B	• Refer to the table at the beginning of this Reference for the

	after 70 hours in 7 days (Alaska).			number of HOS-violation free driver inspections, which are required to meet the performance-based criteria (based on carrier's number of power units).
395.1(h)(1)(iv)	Requiring or permitting a property-carrying CMV driver to drive after 80 hours on duty in 8 days (Alaska).	HOS Compliance	B	• Refer to the table at the beginning of this Reference for the number of HOS-violation free driver inspections, which are required to meet the performance-based criteria (based on carrier's number of power units).
395.1(h)(2)(i)	Requiring or permitting a passenger-carrying CMV driver to drive more than 15 hours (Alaska).	HOS Compliance	B	• Refer to the table at the beginning of this Reference for the number of HOS-violation free driver inspections, which are required to meet the performance-based criteria (based on carrier's number of power units).
395.1(h)(2)(ii)	Requiring or permitting a passenger-carrying CMV driver to drive after 20 hours on duty (Alaska).	HOS Compliance	B	• Refer to the table at the beginning of this Reference for the number of HOS-violation free driver inspections, which are required to meet the performance-based criteria (based on carrier's number of power units).
395.1(h)(2)(iii)	Requiring or permitting a passenger-carrying CMV driver to drive after 70 hours on duty in 7 consecutive days	HOS Compliance	B	• Refer to the table at the beginning of this Reference for the number of HOS-violation free driver

	(Alaska).			inspections, which are required to meet the performance-based criteria (based on carrier's number of power units).
395.1(h)(2)(iv)	Requiring or permitting a passenger-carrying CMV driver to drive after 80 hours on duty in 8 days (Alaska).	HOS Compliance	B	• Refer to the table at the beginning of this Reference for the number of HOS-violation free driver inspections, which are required to meet the performance-based criteria (based on carrier's number of power units).
395.1(o)	Requiring or permitting a short-haul property-carrying CMV driver to drive after 16 hours on duty.	HOS Compliance	B	• Refer to the table at the beginning of this Reference for the number of HOS-violation free driver inspections, which are required to meet the performance-based criteria (based on carrier's number of power units).
395.13(c)(1)*	Knowingly requiring or permitting a driver declared out-of-service to operate a CMV before that driver may lawfully do so under the rules of Part 395.	HOS Compliance	A	• For each driver selected, provide proof that the driver obtained 10 or 34 hours off prior to the next dispatch.
395.3(a)(1)	Requiring or permitting a property-carrying CMV driver to drive more than 11 hours.	HOS Compliance	B	• Refer to the table at the beginning of this Reference for the number of HOS-violation free driver inspections, which are required to meet the performance-based criteria (based on carrier's number

				of power units).
395.3(a)(2)	Requiring or permitting a property-carrying CMV driver to drive after 14 hours on duty.	HOS Compliance	B	• Refer to the table at the beginning of this Reference for the number of HOS-violation free driver inspections, which are required to meet the performance-based criteria (based on carrier's number of power units).
395.3(b)(1)	Requiring or permitting a property-carrying CMV driver to drive after 60 hours on duty in 7 days.	HOS Compliance	B	• Refer to the table at the beginning of this Reference for the number of HOS-violation free driver inspections, which are required to meet the performance-based criteria (based on carrier's number of power units).
395.3(b)(2)	Requiring or permitting a property-carrying CMV driver to drive after 70 hours on duty in 8 days.	HOS Compliance	B	• Refer to the table at the beginning of this Reference for the number of HOS-violation free driver inspections, which are required to meet the performance-based criteria (based on carrier's number of power units).
395.3(c)(1)	Requiring or permitting a property-carrying CMV driver to restart a period of 7 consecutive days without taking an off-duty period of 34 or more consecutive hours.	HOS Compliance	B	• Refer to the table at the beginning of this Reference for the number of HOS-violation free driver inspections, which are required to meet the performance-based criteria (based on carrier's number of power units).

395.3(c)(2)	Requiring or permitting a property-carrying CMV driver to restart a period of 8 consecutive days without taking an off-duty period of 34 or more consecutive hours.	HOS Compliance	B	• Refer to the table at the beginning of this Reference for the number of HOS-violation free driver inspections, which are required to meet the performance-based criteria (based on carrier's number of power units).
395.5(a)(1)	Requiring or permitting a passenger-carrying CMV driver to drive more than 10 hours.	HOS Compliance	B	• Refer to the table at the beginning of this Reference for the number of HOS-violation free driver inspections, which are required to meet the performance-based criteria (based on carrier's number of power units).
395.5(a)(2)	Requiring or permitting a passenger-carrying CMV driver to drive after 15 hours on duty.	HOS Compliance	B	• Refer to the table at the beginning of this Reference for the number of HOS-violation free driver inspections, which are required to meet the performance-based criteria (based on carrier's number of power units).
395.5(b)(1)	Requiring or permitting a passenger-carrying CMV driver to drive after 60 hours on duty in 7 days.	HOS Compliance	B	• Refer to the table at the beginning of this Reference for the number of HOS-violation free driver inspections, which are required to meet the performance-based criteria (based on carrier's number of power units).
395.5(b)(2)	Requiring or permitting a passenger-carrying	HOS Compliance	B	• Refer to the table at the beginning of this

	CMV driver to drive after 70 hours on duty in 8 days (§ 395.5(b)(2)).			Reference for the required number of HOS-violation free driver inspections, which are required to meet the performance-based criteria (based on carrier's number of power units).
395.8(a)	Failing to require a driver to make a record of duty status. No records of duty status.	HOS Compliance	B	• Refer to the table at the beginning of this Reference for the required number of HOS-violation free driver inspections, which are required to meet the performance-based criteria (based on carrier's number of power units).
395.8(e)	False reports of records of duty status.	HOS Compliance	B	• Refer to the table at the beginning of this Reference for the required number of HOS-violation free driver inspections, which are required to meet the performance-based criteria (based on carrier's number of power units).
395.8(i)	Failing to submit a record of duty status within 13 days.	HOS Compliance	B	• Refer to the table at the beginning of this Reference for the required number of HOS-violation free driver inspections, which are required to meet the performance-based criteria (based on carrier's number of power units).

395.8(k)(1)	Failing to preserve records of duty status for 6 months. Failing to preserve supporting documents.	HOS Compliance	B	• Refer to the table at the beginning of this Reference for the required number of HOS-violation free driver inspections, which are required to meet the performance-based criteria (based on carrier's number of power units).
396.11(a)	Failing to require driver to prepare driver vehicle inspection report.	Vehicle Maintenance	A	• Produce requested DVIRs
396.11(c)	Failing to correct out-of-service defects listed by a driver in a driver vehicle inspection report before the vehicle is operated again.	Vehicle Maintenance	A	• Provide evidence requested vehicles were repaired prior to next dispatch
396.17(a)	Using a CMV not periodically inspected (§ 396.17(a)) (Requires a violation threshold of 51 percent or more of examined records to trigger automatic failure).	Vehicle Maintenance	A	• Provide a copy of the vehicle annual inspections or equivalent; up to three (3) vehicles.
396.17(g)	Failing to promptly repair parts and accessories not meeting minimum periodic inspection standards.	Vehicle Maintenance	A	• Provide proof of repairs.
396.3(b)	Failing to keep minimum records of inspection and maintenance.	Vehicle Maintenance	A	• Provide complete maintenance file for requested vehicles; up to three (3) vehicles, in accordance with 396.3 and proof of periodic inspection required under 396.17. • Provide evidence of Preventive

				Maintenance Plan.
396.9(c)(2)	Requiring or permitting the operation of amotor vehicle declared "out-of-service" before repairs are made (§ 396.9(c)(2))	Vehicle Maintenance	A	• Provide an example of proof of repair from applicable OOS inspections since last Investigation.
397.101(d)	Requiring or permitting the operation of a motor vehicle containing a highway-route-controlled quantity of radioactive materials as defined in §173.403 without an accompanying written route plan.	HM Compliance	A	• Provide a statement on how this issue was handled. • Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.
397.13(a)	Permitting a person to smoke or carry a lighted cigarette, cigar or pipe within 25 feet of a motor vehicle containing Class 1 materials, Class 5 materials, or flammable materials classified as Division 2.1, Class 3, Divisions 4.1 and 4.2.	Unsafe Driving	A	• Provide a statement of how this issue was handled. • Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.
397.19(a)	Failing to furnish driver of motor vehicle transporting Division 1.1, 1.2, or 1.3 (explosive) materials with a copy of the rules of part 397 and/or emergency response instructions.	HM Compliance	A	• Submit a copy of a driver's signed document indicating receipt of Part 397 and emergency response instructions. • Provide a statement on how this issue was handled. • Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.
397.5(a)	Failing to ensure a motor vehicle	Unsafe Driving	A	• Provide a statement on how this issue

	containing Division 1.1, 1.2, or 1.3 (explosive) material is attended at all times by its driver or a qualified representative.			was handled. • Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.
397.67(d)	Requiring or permitting the operation of a motor vehicle containing explosives in Class 1, Divisions 1.1, 1.2, or 1.3 without an accompanying written route plan.	HM Compliance	A	• Provide a statement on how this issue was handled. • Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.
397.7(a)(1)	Parking a motor vehicle containing Division 1.1, 1.2, or 1.3 materials within 5 feet of traveled portion of highway or street.	Unsafe Driving	A	• Provide a statement of how this issue was handled. • Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.
397.7(b)	Parking a motor vehicle containing hazardous material(s) other than Division 1.1, 1.2, or 1.3 materials within 5 feet of traveled portion of highway or street.	Unsafe Driving	A	• Provide a statement of how this issue was handled. • Provide evidence of policies, procedures and training that will prevent this violation from occurring in the future.

Appendix M – Part C Remarks Template

Appendix M – Part C Remarks Template

Part C pdf template

PART C Template:

PURPOSE: The purpose of this template is two-fold - it documents the investigation and aids in penalty assessment if applicable. This template is intended to increase the uniformity of the investigative process. Each section should be completed as applicable. The content and context of each section should be completed with details from the investigation.

HOW TO USE: Provide details of the investigation that are not obvious or evident from reading Parts A and B of the report. All remarks should be based in fact or actual statements made by carrier staff. All information contained in this report must be accurate and legally defensible.

Items noted as [REQUIRED] are required to be in Part C. Those noted as [SUGGESTED] are suggested items for Part C.

REMARKS:

INVESTIGATIVE REPORT RECEIVED BY:
[REQUIRED] Name:
[REQUIRED] Title:
[REQUIRED] Carrier/Shipper Name:
[REQUIRED] Date:
[REQUIRED] Telephone Number (if different from Part A):

If carrier refuses to accept investigative report or closeout was with less than highest ranking official provide mailing details below:

[REQUIRED] Name to whom it was sent:
[REQUIRED] Mailing method (i.e. FedEx UPS, etc.):
[REQUIRED] Date Sent:
[REQUIRED] Tracking/Confirmation Number:
[REQUIRED] Telephone Number (if different from Part A):

[REQUIRED] List of drivers (indicate part/full time) or where this information is stored. (Note: Use discretion, lengthy driver lists or vehicle lists would be unmanageable to include in Part C)
[REQUIRED] List of vehicles in use or where this information is stored.
[REQUIRED] Significant findings regarding accuracy of registration data (MCS-150 data.
[REQUIRED] Note recurring violations, both serious and non-serious, discovered during prior investigations.
[REQUIRED] Note techniques used in discovering violations for use in subsequent investigations
[REQUIRED] Note aspects of the carrier's maintenance program.

[REQUIRED]Note any coordination/discussion with Division office or Service Center (IH, reincarnation, etc.).

REASON FOR INVESTIGATION:
[REQUIRED] Note if there is more than one reason for initiating this review (i.e., High-Risk List, Complaint, etc.)

SCOPE OF INVESTIGATION:
[REQUIRED] If an Onsite Focused Investigation was conducted, document any reasons why items outside of the originally assigned scope were reviewed.

CARRIER OPERATION DESCRIPTION: [Include information in this section describing the Carrier operation, such as, commerce, goods, operating area, etc.]
[REQUIRED] Explain interstate versus intrastate operations.
[REQUIRED] Describe the financial condition of the subject, focusing on any information that impacts the carrier's safety operation. The objective is to gather information to support making safety assessments, determining ability to pay and reincarnated carrier.

Include:
Gross Revenue - If carrier refuses to provide, explain how the amount was determined.
List major assets such as buildings, land, airplanes, other companies, etc.
Document the officers of the company.

List all partners not listed on Part A, where applicable.

[REQUIRED] Note the names and titles of any relevant company official or employee who were interviewed, but were not listed on Part A of the Investigative Report.
[REQUIRED] Provide names of household goods agents of motor carriers when applicable.
[REQUIRED] (Required if motor carrier were involved in emergency relief) Note whether motor carrier was involved in emergency relief efforts or operating under an exemption or waiver.
[REQUIRED] Provide names and USDOT numbers of affiliated motor carriers when applicable.
[SUGGESTED] Provide enough detail to fully understand the nature of the business and how it is structured. Include a description of the business profit model, that is how do they make money, what is acceptable profit, how do they make up for losses, etc.
[SUGGESTED] Describe the company location and the principal place of business, maintenance facilities, etc. Provide the extent and nature of any divisions or business locations of the subject.
[SUGGESTED] Describe anything that is a typical about the subject's operation.
[SUGGESTED] Include general overview of carrier's safety operation and identify the personnel responsible for safety management.

PRE-INVESTIGATION:
[REQUIRED] Provide a listing of the specific supporting documents that were requested and when. Include whether or not the carrier was given 48 hours to produce records not located at the principal place of business.
REQUIRED] Note why the carrier's company profile was NOT obtained, if applicable
[SUGGESTED] Document issues that posed barriers to the pre-investigation process, such as locating or reaching the carrier, availability and accuracy of information, etc. If extremely difficult to locate motor

carrier explain how motor carrier was contacted.
[SUGGESTED] Provide date(s) on which investigation was conducted and reasons for delays, extensions, etc.
[SUGGESTED] Note any specific details in conversations or observations that influenced the investigation process.

CDLIS (DRIVER LICENSE) CHECK:
[REQUIRED] If applicable explain why a CDLIS licensing check was not conducted or that other methods were used to verify licenses.

AUTHORITY (If applicable):
[REQUIRED] Does the motor carrier have the appropriate type of authority? Yes or No and explain and note any lapses.
[REQUIRED] If applicable, provide the following:
PHMSA Registration Number:
PHMSA Registration Expiration Date:
FMCSA HMSP Number:
FMCSA HMSP Expiration Date:

INSURANCE:
[REQUIRED] Does the motor carrier have the appropriate level of insurance? Yes or No and explain, noting any lapses and whether the appropriate proof of insurance was on file at the PPOB.
[SUGGESTED] The amount noted on the 90 or 90B

DRIVERS WITH RED FLAG VIOLATIONS:
[REQUIRED] How many Drivers with Red Flag Violations were identified as needing an investigation?
[REQUIRED] What was the outcome of the Drivers with Fed Flag Violations Investigations?
Carrier NOV/NOC: Yes or No
Driver NOV/NOC: Yes or No
No further action required

CONTROLLED SUBSTANCES AND ALCOHOL SUPPLEMENTAL REVIEW:
[REQUIRED] Was a CONTROLLED SUBSTANCES AND ALCOHOL SUPPLEMENTAL REVIEW performed? Yes or No
[REQUIRED] If Yes - did this result in a full investigation of the CONTROLLED SUBSTANCES AND ALCOHOL BASIC? Yes or No
[Suggested] Number of CDL required drivers hired in the past 365 days.

HAZARDOUS MATERIALS SUPPLEMENTAL REVIEW:
[REQUIRED] Was a HM Supplemental Review performed? Yes or No

INVESTIGATION:
[REQUIRED] Describe what specific supporting documents were produced, when and by whom. Include the name and title of the person providing documents.
[REQUIRED] List documents that were not provided as requested and actions taken to obtain them
[REQUIRED] Describe where the supporting documents are located and how are they are maintained (by

driver, by trip, in trip envelopes filed by date, etc),
[REQUIRED] Explain why sampling was expanded beyond minimum amount or could not be reached in accordance with the FOTM
[REQUIRED] When the CRASH calculation is required, number of crashes missing from profile, description of all recordable crashes, and method of discovery of missing crashes.
[REQUIRED] Explain how mileage was determined. Note if mileage was extrapolated because company has been in business less than 12 months.
[REQUIRED] As applicable for HOURS OF SERVICE related investigations if supporting documentation was available and/or presented that did not contain valid or vital information that could be used to check the accuracy of the RODS. Explain how and why.
[REQUIRED] For VEHICLE MAINTENANCE-related investigations, explain why vehicles were not inspected IF three or more inspections were not on profile or a non-motor coach operation.
[REQUIRED] For VEHICLE MAINTENANCE-related investigations, explain sampling used for Part A vehicle OOS rates.
[REQUIRED] For VEHICLE MAINTENANCE-related investigations, explain findings and disposition of any vehicle inspections performed during investigation.
[REQUIRED] For VEHICLE MAINTENANCE-related investigations, note aspects of the carrier's maintenance program and facilities.
[SUGGESTED] During an investigation of the CONTROLLED SUBSTANCES AND ALCOHOL BASIC document any problems discovered with the consortium.
[SUGGESTED] Note statements made by officials relative to correcting the violations discovered during the investigation.
[SUGGESTED] Note any other information that explains and/or complements the cited violations in Part B, and would increase the accuracy of the evaluation process, and would aid the follow-up investigator.

FOLLOW-ON ACTION:
[REQUIRED] Note the reason for NOT taking enforcement action for acute violations
[SUGGESTED] Note the reason for NOT initiating enforcement action in response to any discovered pattern of critical violations
[SUGGESTED] Provide information about the selection of the Follow-on action
[SUGGESTED] Document areas of weakness that may be future problem areas for the carrier

DOCUMENTS PROVIDED TO CARRIER:
[REQUIRED] List materials provided to the carrier and any materials the carrier had on hand

Appendix N - Record Sampling Requirements

For

eFOTM Redevelopment

Federal Motor Carrier Safety Administration (FMCSA)
U.S. Department of Transportation

Appendix N: Record Sampling Requirements

The sampling requirements presented in this reference are the minimum number required in each case.

- Depending on the scope of the investigation, determine which CFR Parts, full or sub–parts, should be checked for applicable documents. Offsite and Onsite Focused Investigations require only the documents associated with the CFR Parts for the Behavior Analysis and Safety Improvement Categories (BASICs) requiring an investigation. If an investigation is being conducted due to a previous Acute and/or Critical Violation(s), only the documents associated with the specific violation(s) are required to be sampled, unless the violation is associated with the Hours-of-Service BASIC (HOS) in which case the full BASIC (all parts) must be reviewed. A Crash BASIC Investigation (CBI) or an Onsite Comprehensive Investigation require documents associated with all CFR Parts listed in the table.
- Review record sampling requirements for documents and records associated with each selected CFR Part. Determine the number of documents/records required for the applicable drivers, vehicles, and/or crashes to meet the sampling requirements.

CFR Parts: 382 - Drug & Alcohol Pre-employment
Considerations: Review the carrier records to determine the drivers hired within the past 365 days. Select drivers with the highest BASICs percentiles first, and then select the ones that were involved in accidents.

Onsite		**Offsite**		**CBI**	
# of Drivers Hired	**# of Pre-employment Tests to Review**	**# of Drivers Hired**	**# of Pre-Employment Tests to Review**	**# of drivers to review**	**Sample Size: # # of Pre-employment Tests to Review**
1-5	All	1	1	All drivers involved in **RECORDABLE** crashes that were **hired in the last 365 days**	All pre-employment tests of drivers involved in RECORDABLE crashes that were hired in the last 365 days.
6-25	5	2	2		
26-50	8	≥3	3		
51-90	13				
91-150	20				
151-280	32				
281-400	50				
401-500	68				
501-1,200	80				
1,201-3,200	125				
3,201-10,000	200				
10,001-35,000	315				
35,001-150,000	500				

Additional Guidance: If the motor carrier failed to provide you with the requested pre-employment records requested because they either did not perform the test or didn't maintain the record, then you should not request additional test records to meet the minimum sample size for checking pre-employment controlled substances. If you request additional records, it will be considered an expansion of the sample size for checking controlled substances pre-employment testing and an explanation must be provided in the Investigation Report/Part C .

CFR Parts - 382 Post-Accident Testing		
Onsite	**Offsite**	**Crash BASIC Only**
# of Post Accident D&A Tests to Review	**# of Post Accident D&A Test to Review**	**# of Post-Accident D&A Tests to Review**
All drivers involved in recordable crashes require post-accident testing regardless of # of drivers employed.	Same as Onsite	Same as Onsite

CFR PART 382 Random Testing					
Onsite		**Offsite**		**Crash BASIC Only**	
# of Random Tests (T)		**# of Random Tests (T)**		**# of Random Tests (T)**	
Controlled Substances	**Alcohol**	**Controlled Substances**	**Alcohol**	**Controlled Substances**	**Alcohol**
T = .25 X D/P	T = 1 X D/P	Same as Onsite.		N/A	
D = Number of drivers subject to be tested by employer or employer's Consortium/Third Party Administrator (C/TPA). P = Number of test periods per year.					

CFR PART 383
Commercial Driver's License Information System (CDLIS) Checks
Criteria/Time Frame: All drivers employed who are subject to Commercial Driver's License (CDL) requirements.

Onsite		**Offsite**		**Crash BASIC Only**	
# of Drivers Subject to CDL Requirements	**# of CDLIS Records to Check**	**# of Drivers Subject to CDL Requirements**	**# of CDLIS Records to Check**	**# of Drivers Subject to CDL Requirements**	**# of CDLIS Records to Check***
1–20	All	Same as Onsite.		1–20	All
21–150	20			21–150	20
151–280	32			151–280	32
281–400	50			281–400	50
401–500	68			401–500	68
501–1200	80			501–1200	80
1201–3200	125			1201 and above	125
3201–10,000	200				
10,001–35,000	315				
35,001 and above–150,000+	500				

*Additional Guidance: prioritize drivers involved in crashes.

Additional Guidance: If additional drivers are checked in CDLIS, provide an explanation of the reason(s) you expanded the original sample size in the Investigative Report/Part C. A list of driver name(s) for each driver checked in CDLIS must be provided in Part C of the investigation report; or include a notation in Part C of the investigation report that the same information was scanned into the Electronic Document Management System (EDMS) in a separate document.

CFR Parts - Part 391 – Driver Qualification (DQ) Files						
Considerations: Select DQ files for drivers with the highest percentiles within the BASIC requiring an investigation and drivers who were involved in recordable crashes.						
Onsite		**Offsite**		**Crash BASIC Only**		
# of Drivers Subject to the FMCSR	**# of DQ Files to Review**	**# of Drivers Subject to the FMCSR**	**# of DQ Files to Review**	**# of Drivers Involved in Recordable Crashes**	**# of DQ Files to Review (for drivers involved in crashes)**	**Sample Selection**
1-5	All	1	1	1-5	All	Select from drivers involved in crashes.
6-25	5	2	2	6-25	5	
26-50	8	≥3	3	26-50	8	
51-90	13			51-90	13	
91-150	20			91-150	20	
151-280	32			151-280	32	
281-400	50			281-400	50	
401-500	68			401-500	68	
501-1,200	80			501-1,200	80	
1,201-3,200	125			1,201 and above	125	
3,201-10,000	200					
10,001-35,000	315					
35,001-and above	500					

CFR PARTS 393 & 396 Vehicle Inspections (for calculating OOS rates)

Considerations: Select vehicles involved in accidents; then, select vehicles that have been placed out–of–service (OOS) (profile) or cited for equipment violations during roadside inspections within the previous 365 days. Verify if the OOS violations and other equipment violations were repaired.

Onsite		**Offsite**		**Crash BASIC Only**
# of Vehicles* subject to the FMCSR	**Vehicle Inspections to Conduct**	**# of Vehicles subject to the FMCSR**	**Vehicle Inspections to Conduct**	The Vehicle OOS rate should only be completed if the investigation expands into Onsite sampling in the Vehicle Maintenance BASIC or during an Onsite Comprehensive Investigation. Expansion occurs when Acute and/or Critical Violations are found during the assessment of regulatory compliance in the VM based on CBI sampling outlined in the tables below (e.g. DVIRs, maintenance files).
1–5	3	N/A		
6–25	5			
26–50	8			
51–90	13			
91–150	20			
151–280	32			
281–400	50			
401–500	68			
501–1,200	80			
1,201–3,200	125			
3,201–10,000	200			
10,001–35,000	315			
35,001 and above	500			

*Each power unit is considered a vehicle for determining the number to be sampled

CFR PARTS–PART 393 & 396 DVIRs

Criteria/Time Frames: The review of DVIR should cover the number of DVIRs that have defects noted during the previous three months. One month of DVIRs should be reviewed for each vehicle selected, regardless of the number of RODS that have been reviewed for compliance with Part 395 within the previous six months.

Onsite		**Offsite**		**Crash BASIC Only**		
# of Vehicles Subject to FMCSR	**# of Vehicles to Select**	**# of Vehicles Subject to FMCSR**	**# of Vehicles to Select**	**# of Vehicles Involved in Crashes**	**# of Vehicles to Select**	**# of DVIRs to Request**
2–5	All	N/A		2–5	All	Carrier is required to provide all DVIRs with defects noted on the X vehicles selected during a 30-day period occurring in the previous 3 months. **X = # of Vehicles to Select**
6–15	5			6–15	5	
16–50	7			16–50	7	
51–150	11			51–150	11	
151–500	17			151–500	17	
501 and above	27			501 and above	27	

CFR PARTS 393 & 396 Maintenance Files						
Onsite		**Offsite**		**Crash BASIC Only**		
# of Vehicles Subject to the FMCSR	**# of Maintenance Files to Review**	**# of Vehicles Subject to the FMCSR**	**# of Maintenance Files to Review**	**# of Vehicles Involved in Recordable Crashes**	**# of Maintenance Files to Review**	**Sample Selection**
1–5	All	N/A		1–5	All	Select from vehicles involved in crashes.
6–25	5			6–25	5	
26–50	8			26–50	8	
51–90	13			51–90	13	
91–150	20			91–150	20	
151–280	32			151–280	32	
281–400	50			281–400	50	
401–500	68			401–500	68	
501–1,200	80			501–1,200	80	
1,201–3,200	125			1,201 and above	125	
3,201–10,000	200					
10,001–35,000	315					
35,001–150,000	500					

Additional Guidance: If the motor carrier failed to provide the requested Vehicle Maintenance files you requested because they either did not maintain or prepare the file, you should not request additional files to meet the minimum sample size for checking Vehicle Maintenance files. Any violation(s) discovered while reviewing the individual documents provided, will be cited in the Violations Tab/Part B based on the number of individual records required and checked. Provide a list of vehicle(s) sampled/reviewed in the Investigation Report/Part C; or include a notation in the Investigation Report/Part C that the same information was scanned into the Electronic Document Management System (EDMS) in a separate document.

CFR Parts - Part 395 - Hours-of-Service (HOS)								
Onsite			**Offsite**		**Crash BASIC Only**			
# of Drivers Employed	**# of Drivers to Select**	**Minimum # RODs to Review**	**# of Drivers Employed**	**Minimum # RODS to Review**	**# of Drivers Involved in Crashes**	**# of Drivers Selected**	**Minimum # of RODS to Review**	**Sample Selection**
1-5	All	# of drivers x 30	1	1 x 30 = 30	1-5	All	# drivers x 9	Select from drivers involved in crashes.
6-15	5	5 x 30 =150	2	2x30 = 60	6-15	5	5 x 9 = 45	
16-50	7	7 x 30 =210	≥3	3x30 = 90	16-50	7	7 x 9 = 63	
51-150	11	11 x 30 =330			51-150	11	11 x 9 = 99	
151-500	17	17 x 30 =510			151-500	17	17 x 9 = 153	
501-Over	27	27 x 30 =810			501-Over	27	27 x 9 = 243	
					Additional Guidance: For each driver involved in a recordable crash for previous 6 months, conduct HOS review for day of crash and previous 8 days from date of crash (9 days total). • If carrier has no RODS available for drivers involved in crashes within previous 6 months, first select drivers with the highest percentile in			

		the Hours of Service (HOS) Compliance BASIC (to meet the required sample size) at the carrier's place of business who were placed OOS during roadside inspections and then those found in violation during roadside inspections.

Additional Guidance: A list of driver name(s) for each RODS sampled must be provided in the Investigation Report/Part C ; or include a notation in the Investigation Report/Part C that the same information was scanned into the Electronic Document Management System (EDMS) in a separate document.

CFR Parts - Part 172 - Shipping Papers				
Onsite		**Offsite**		**Crash BASIC Only**
Variable	**# of Documents to Review**	**Variable**	**# of Documents to Review**	NA
One shipping paper, at a minimum, shall be examined for each proper shipping name or class/division of HM offered or transported when roadside data has shown HM-related violations.		Same as Onsite.		

HM Shipping Papers
CFR Parts 177 - 172 - Shipping Papers
Considerations - Select shipping papers with violations cited during roadside inspections or shipping papers tied to loads with other HM violations roadside, when applicable. Ensure that the sample includes shipping papers with different Hazard Classes/Divisions and different ID Numbers (IDs) and /or Proper Shipping Names (PSNs) whenever possible, and that shipping papers are sampled from different shippers (if applicable). Shipping papers should be sampled from loads offered or transported within the year prior to the investigation.

Onsite (full HM BASIC investigation)		**Offsite (full HM BASIC investigation) OR HM Supplemental Investigation (onsite or offsite)**		**Crash BASIC Only**
# of Hazard Classes/Divisions Offered or Transported	**Minimum # of HM Shipping Papers to Review**	**# of Hazard Classes/Divisions Offered or Transported**	**# of HM Shipping Papers to Review**	NA

1-2	6	1	1	
3-4	12	2	2	
5-6	18	≥3	3	
7-8	24			
≥9	30			

HM Training

49 CFR Parts 177 and 172 - Hazardous Materials (HM) Training

Considerations - Select HM training records for drivers with the highest percentiles within the HM BASIC and drivers involved in HM incidents. Additionally, select HM training records for HM Employees (drivers and non-drivers) involved with HM incidents or violations (e.g. the person who created erroneous shipping papers, the employee who improperly packaged the HM, etc.). When possible, ensure that the sample includes examples of both initial and recurrent training.

Onsite (full HM BASIC investigation)		**Offsite (full HM BASIC investigation) OR HM Supplemental Investigation (onsite or offsite)**		**Crash BASIC Only**		
# of HM Employees Subject to HM Training	**# of HM Training Records to Review**	**# of HM Employees Subject to HM Training**	**# of HM Training Records to Review**	**# of Drivers Involved in Recordable Crashes When Transporting HM**	**# of HM Training Records to Review (for Drivers Involved in HM Crashes)**	**Sample Selection**
1-5	All	1	1	1-5	All	Select from drivers involved in crashes when transporting HM
6-25	5	2	2	6-25	5	

26-50	8	≥3	3	26-50	8	
51-90	13			51-90	13	
91-150	20			91-150	20	
151-280	32			151-280	32	
281-400	50			281-400	50	
401-500	68			401-500	68	
501-1,200	80			501-1,200	80	
1,201-3,200	125			1,201 and above	125	
3,201-10,000	200					
10,001-35,000	315					
35,001 and above	500					

Cargo Tank Files - for motor carriers using specification cargo tanks		
49 CFR Part 180 - Specification Cargo Tank Files		
Considerations: Select documents for specification cargo tanks involved in accidents and/or HM incidents. Include cargo tanks with roadside inspection violations related to cargo tank specifications. When a carrier utilizes multiple specification types (DOT 406, MC 331, etc.), ensure that the sample includes at least one of each specification type utilized by the motor carrier.		
Onsite (full HM BASIC investigation)	**Offsite (full HM BASIC investigation) OR HM**	**Crash BASIC Only**

		Supplemental Investigation (onsite or offsite)				
# of Specification Cargo Tanks Subject to the HMR	**# of Cargo Tank Files to Review**	**# of Specification Cargo Tanks Subject to the HMR**	**# of Cargo Tank Files to Review**	**# of Specification Cargo Tanks Involved in Recordable Crashes**	**# of Cargo Tank Files to Review (for Specification Cargo Tanks Involved in Crashes)**	**Sample Selection**
1-5	All	1	1	1-5	All	Select from specification cargo tanks involved in crashes
6-25	5	2	2	6-25	5	
26-50	8	≥3	3	26-50	8	
51-90	13			51-90	13	
91-150	20			91-150	20	
151-280	32			151-280	32	
281-400	50			281-400	50	
401-500	68			401-500	68	
501-1,200	80			501-1,200	80	
1,201-3,200	125			1,201 and above	125	
3,201-10,000	200					
10,001-35,000	315					
35,001 and above	500					
Additional Guidance: A cargo tank file, although not a regulatory term or requirement, collectively refers to the specification cargo tank documents required by the HMR. These cargo tank records include: Manufacturer's Certificate, ASME U-1A Data Report, Cargo Tank Test/Inspection Reports, and related documents.						

Cargo Tank Test/Inspection Reports - for CTFR
49 CFR Part 180 - Tests and Inspections of Specification Cargo Tanks
Considerations: When a facility tests/inspects multiple specification types (DOT 406, MC 331, etc.), ensure that your sampling includes at least one of each specification type tested/inspected by the facility.

Number of Specification Cargo Tanks Tested/Inspected Annually	Number of Specification Cargo Tanks to Review	Minimum # of Test/Inspection Reports to Review
1-5	All	Review all of the current test/inspection reports for each tank. Generally, this will include: Pressure (P), Leakage (K), External Visual (V), and Internal Visual (I), but may also include Lining (L) and Thickness (T) tests/inspections if applicable.
6-25	5	
26-50	8	
51-90	13	
91-150	20	
151-280	32	
281-400	50	
401-500	68	
501-1,200	80	
1,201-3,200	125	
3,201-10,000	200	
10,001-35,000	315	
35,001 and above	500	
Additional Guidance: Current test/inspection reports may be dated up to 10 years prior to the date of the investigation, depending on the type of test. It is permissible (and is, in fact, required) to review test/inspection reports created more than one year prior to the investigation. Since CT test/inspection facilities are not required by regulation to maintain these documents, it may be necessary to obtain a customer list and contact the CTF's customers to obtain copies of the required reports.		

Appendix O –Other (content hyperlinked throughout the eFOTM)

Table of Contents

Using Hazardous Material Package Inspection Program (HMPIP) Software

HMPIP Policies and Procedures

Goal of Using HMPIP

The goal of performing HMPIP inspections is to reduce the risk of HM incidents (spills) by identifying HM shippers that are not in compliance with the HMR. HMPIP package inspections shall be performed at dockside, less-than-truckload motor carriers, intermodal facilities, shippers with inbound shipments made to a shipper, or other locations where a wide variety of HM packages from various shippers are available for inspection.

- HM package inspections will be recorded using HMPIP and distributed according to the procedures outlined in this section.
- All package inspections will be recorded using the HMPIP program, even if no violations are found.
- USDOT numbers should be assigned to newly identified shippers prior to exporting the data to the national HMPIP database.
- For purpose of FMCSA tracking, 30 package inspections, by a given investigator using HMPIP, will continue to constitute an HM package inspection CR and counted toward their certification.

- The HMPIP software shall be used to record information on a package inspection that occurs at any location other than the place where the HM package originated.
- The CAPRI software should be utilized when conducting inspections at an HM shipper's facility when the package originates from that shipper's facility.
- See Illustration HM-4: Package Inspection Questions and Answers

Assigning USDOT Numbers when Conducting an Inspection Using the HMPIP

Illustration HM-20 describes the process for assigning USDOT numbers during a shipper check and when conducting HM package inspections.

Time to Take Enforcement Action

The person performing the HMPIP inspection should take enforcement action, as appropriate, when violations are discovered during HM package inspections or shipper reviews.

- The HM portion of the eFOTM provides lists of critical and acute HM violations, as well as lists of severe HM shipper and cargo tank regulations.
- The regulations should be used as guidelines for when to initiate enforcement action.
- Throughout the HM portion of the eFOTM, violations and enforcement procedures discuss documentation requirements and procedures to be followed when preparing an HMPIP enforcement case report.
- For HMPIP, select the "HM roadside" category in UFA for the appropriate penalty assessment.

Notification of Packaging Violations

Number of HMPIP Report Copies that Should be Printed and How to Distribute

HMPIP reports should be printed for inspections that identify violations of the HM regulations. Three copies of the HMPIP report should be made and distributed as follows:

- One copy of the HMPIP report, with your notes, should be provided to a responsible official representing the facility where the inspections were performed. This copy may be mailed later, if the report is not generated onsite.
- One copy of the HMPIP report, with your notes, should be mailed to the shipper's facility where the HM shipment originated.
    - A copy of the attached sample letter should accompany the report.
    - At the discretion of the DA/SD, an additional copy of the report and cover letter may be sent to the shipper's PPOB.
    - *Illustration HM-21* is a Sample Letter to Accompany HMPIP Violation Reports.
- You should maintain a copy of the HMPIP report, with your notes, along with a copy of the cover letter used to notify the shipper at the Division Office performing the HM Package Inspection CR. These documents may also be used as the basis for an enforcement action.

You should be careful to ensure that the notes entered in the report are appropriate for release. In the event that the notes contain information that should not be released, copies can be printed without notes.

HM Packaging Inspection CR

Ways in which HMPIP Supports the HM Packaging Inspection CR

To develop an effective prioritization system for targeting high-risk HM shippers, FMCSA must increase the use of the HMPIP software. To increase the use of the HMPIP software, and therefore, the shipper data we are collecting, FMCSA is implementing an additional compliance and enforcement process that will be known as an HM Package Inspection CR. The HM Package Inspection CR will involve the inspection of HM packages on the docks of less-than-truckload carriers, or at other locations where HM packages from a variety of shippers can be inspected.

- The packages can be either inbound or outbound.
- For purposes of FMCSA tracking, 30 package inspections using HMPIP by an investigator will constitute an HM Package Inspection CR.
- NOTE: A HMPIP can also be completed during a roadside inspection.

Package Inspections are Credited in this Manner

A package inspection will be credited for each separate HM shipment reviewed for compliance. Please note that a pallet, group, or truckload of packages all packaged, labeled and marked in the same manner, would be counted as one package or one shipment.

- The 30 package inspections can be conducted at more than one location over an extended period of time.
- The aggregate of 30 package inspections will constitute an HM Package Inspection CR.
- When an aggregate total of 30 package inspections are attained, the Division Office will receive credit for the HM Package Inspection CR for investigator certification.

A HM Package Inspection CR will be credited to the SI and the division the same as a CR of a motor carrier, an HM shipper CR, or a cargo tank facility CR. DAs/SDs will report the number of package inspections completed in their divisions by their SIs on their monthly reports to HQ.

Individuals who Should take HMPIP Enforcement Action

Division Offices should take enforcement action, as appropriate, when violations are discovered during HM package inspections. Guidance on enforcement of HM violations against shippers can be found in the eFOTM. Generally, violations that are Acute, Critical or Severe violations should be considered for enforcement.

Guidance on enforcement of HM violations against shippers can be found in *Investigations of HM Carriers and Shippers: General*.

Guidance concerning Electronic signatures and Documents

Anyone may use electronic methods, so long as the electronic documents, or signatures, accurately reflect the information in the record and remain accessible in a form that can be accurately viewed and/or reproduced according to Agency rules. Electronic documents will not be considered the legal equivalent

of traditional paper documents, if they are not capable of being retained and accurately reproduced for reference by any individual, or entity, entitled to access by law for the period of time required by the Agency's recordkeeping requirements; for example, if an entity is required to produce documents on demand, those documents may be stored electronically, so long as that entity can produce them in accordance with the Agency's substantive requirements (e.g., immediately and without risk of losing or altering data).

This guidance applies to documents required by FMCSA regulations to be generated and maintained or exchanged by private parties, regardless of whether the Agency subsequently requires them to be produced or displayed at the request of an FMCSA official or other parties entitled to access. This guidance does not apply to documents that individuals or entities are required to file directly with the Agency. The Agency, however, has already established electronic filing methods for certain documents.

Question 1: May motor carriers use electronic methods to store records or documents to satisfy a document retention requirement in Chapter III of Subtitle B of Title 49, Code of Federal Regulations (49 CFR Parts 300-399)?

Guidance: Yes. Anyone may, but is not required to, use electronic methods to create and store records or documents to satisfy document retention requirements in Chapter III of Subtitle B of Title 49, Code of Federal Regulations (49 Parts CFR 300-399). This guidance applies only to documents required to be generated and maintained or exchanged by private parties, regardless of whether FMCSA subsequently requires them to be produced or displayed to FMCSA staff or other parties entitled to access. This guidance does not apply to documents filed directly with FMCSA. The Agency, however, has already established electronic filing methods for certain documents. Interested parties can find out about available filing methods by consulting specific program information on FMCSA's website (http://www.fmcsa.dot.gov).

Question 2: How much time does a motor carrier have to produce records if the motor carrier maintains all records in an electronic format?

Guidance: A motor carrier must produce records within the time frame FMCSA's regulations require, regardless of whether the motor carrier maintains its records in an electronic or paper format; for example, if Agency rules require that a document be produced upon demand, you must be able to provide the Agency with an accurate copy of your electronic record upon demand. Similarly, if you are a motor carrier with multiple offices, and are allowed 48 hours to produce a document in accordance with 49 CFR Section 390.29, you must be able to provide the Agency with an accurate copy of your electronic record within 48 hours.

Question 3: Using record scanning technology, these requirements can be fulfilled. Is my understanding of 49 CFR Section 390.31(c) correct that once qualifying documents have been suitably scanned, original paper documents may be destroyed?

Guidance: Yes, scanned records, which include a verifiable signature, would fulfill the requirements of 49 CFR Section 390.31 and the original paper documents may be destroyed as stated in 49 CFR Section 390.31(c).

Question 4: If my understanding of 49 CFR Section 390.31 and its associated interpretations is correct, will this negate the necessity to maintain the original road test document as required by 49 CFR Section 391.31(g)(1)?

Guidance: Yes, as long as the road test document has been properly scanned.

Question 5: What is an electronic signature?

Guidance: An electronic signature is a method of signing an electronic communication that: (1) identifies and authenticates a particular person as the source of the electronic communication; and (2) indicates such person's approval of the information contained in the electronic communication. An electronic signature may be made using any available technology that otherwise satisfies FMCSA's requirements.

Question 6: What is an electronic "captured image" signature and does it qualify as an electronic signature?

Guidance: An electronic "captured image" signature is a scripted name or legal mark that, while conventionally created on paper, may also be created using electronic devices; for example, many supermarkets and package delivery services use electronic captured image technology when they permit customers to sign their names in script using a stylus on an electronic pad. This qualifies as an electronic signature, so long as the signature and its related document are electronically bound and can be reproduced together.

Question 7: May anyone use electronic signatures to satisfy a requirement in Chapter III of Subtitle B of Title 49, Code of Federal Regulations (49 CFR Parts 300-399) that a party sign or certify a document?

Guidance: Yes. Anyone may, but is not required to, use electronic signatures to satisfy the requirements of Chapter III of Subtitle B of Title 49, Code of Federal Regulations (49 CFR Parts 300-399) that he or she sign or certify a document. This guidance applies only to documents requiring signatures that are generated and maintained or exchanged by private parties, regardless of whether the Agency subsequently requires them to be produced or displayed to FMCSA staff or other parties entitled to access. This guidance does not apply to documents filed directly with the Agency. The Agency, however, has already established electronic filing methods for certain documents. Interested parties can find out about available filing methods by consulting specific program information on FMCSA's website (http://www.fmcsa.dot.gov).

Question 8: Are motor carriers and other interested parties required to use electronic methods?

Guidance: No. Interested entities may choose whether or not to use electronic methods or traditional paper methods. Where there are two parties to a transaction, both parties must agree to conduct business using electronic methods.

Question 9: Will a document generated using any available electronic methods satisfy the requirements of Chapter III of Subtitle B of Title 49, Code of Federal Regulations?

Guidance: No. An electronic document must fulfill the same function as a paper document. Documents generated using electronic methods may be used only if they accurately reflect the information in the record and remain accessible in a form that can be accurately reproduced for later reference. Documents generated using electronic methods will not be considered the legal equivalent of traditional paper documents, if they are not capable of being retained and accurately reproduced for reference by any party entitled to access; for example, if FMCSA rules require that a document be produced upon demand, you must be able to provide the Agency with an accurate copy of your electronic record upon demand. Similarly, if you are a motor carrier with multiple offices and are allowed 48 hours to produce a document

in accordance with 49 CFR Section 390.29, you must be able to provide the Agency with an accurate copy of your electronic record within 48 hours. It would not be sufficient to display the information on your computer terminal in your place of business. You must produce a copy that the Agency can refer to at a later date. Similarly, it would not be sufficient to provide a document with incomplete information or without a signature (whether electronic or handwritten), if required. Your electronic storage system must be capable of transferring a complete, accurate copy of the document to the Agency. Unless the agent requesting the information specifies otherwise, you should be prepared to produce paper copies of the electronically-stored records or documents within the applicable time frame. This means that if you are required to produce documents on demand, those documents may be stored electronically, so long as you can produce them in accordance with the Agency's substantive requirements (e.g., immediately and without risk of losing or altering data). For an electronic document to be the legal equivalent of a paper document, it must be the functional equivalent with respect to integrity, accuracy and accessibility.

Question 10: If FMCSA or another agency that is entitled to access documents, requests that I produce a copy of a document or signature, may I produce an electronic copy?

Guidance: Yes, however, you must be able to reproduce or transmit the document so the Agency can refer to it at a later date. The acceptable method of transmission may vary, depending on compatibility with the information systems and how the Agency, or other entity entitled to access, plans to use the document. Under some circumstances, electronic transfer may be acceptable. In other cases, you may be required to print paper copies of the electronically-stored records or documents. You should be prepared to produce paper copies within the time frame specified in the applicable regulations, unless the particular investigator specifically advises you that he or she is capable of accepting electronically-transferred copies.

Question 11: May I use electronic methods to generate, sign, maintain and/or exchange any record the FMCSA regulations require without requesting an exemption or obtaining prior permission?

Guidance: You may use electronic methods to generate, sign, maintain and/or exchange any document that is generated and maintained or exchanged by private parties, regardless of whether FMCSA subsequently requires them to be produced or displayed to Agency staff or other parties entitled to access. You do not need to request an exemption, or obtain prior permission, so long as the electronic record meets all of the regulation's substantive requirements and remains accessible in a form that can be accurately reproduced for later reference. (This does not apply to documents filed directly with the Agency. See Question No. 6.) Examples of documents generated, maintained or exchanged by private parties include, but are not limited to, employment applications, driver histories and other qualification records, leases formed under 49 CFR Part 376, driver-vehicle inspection reports, and RODS. These are only examples of documents about which FMCSA received specific questions, not an exhaustive list of the types of documents that can be generated, signed, maintained or exchanged electronically.

Question 12: May I convert a paper document to an electronic document by typing the substantive information on the paper document into an electronic format, such as a database?

Guidance: By typing the substantive information from a paper document into an electronic format such as a database, you are creating a new electronic record, not creating an electronic copy of the original. While you may generate and maintain such documents for your own use, they do not take the place of the original documents. To preserve an accurate copy of the original paper document, you must use scanning or other "image capture" technology. See Questions 3 and 4 for additional guidance.

Question 13: Is an electronic signature valid if a person only has access to an excerpt or summary at the time he or she signs a document?

Guidance: No. If you only provide an excerpt or summary at the time someone signs a document, you may not subsequently attach his or her electronic signature to the complete document.

Investigations of HM Carriers and Shippers - General

HM Shipper and HM Carrier investigations consist of a review of the following HM areas, as applicable, in addition to the review of all applicable Safety Regulations:

- HM Registration (see Part 107)
- HM Incident reporting and Special Permits (see Part 171)
  - Shippers also must be reviewed for compliance with classification of HM, if they are manufacturing a hazardous material.
- Validation of HMSP (see Part 385)
  - Ensure Shipper checked Carrier's HMSP prior to loading.
  - Ensure Carrier followed all requirements of program.
- HM Shipping papers
  - Preparation and offering for Shippers (see Part 172 Subpart C)
  - Carrying and accessibility for Carriers (see Part 177)
- Marking and labeling of packages (see Part 172 Subparts D and E)
- Placarding of CMV or bulk packages (see Part 172 Subpart F)
- Emergency response information and telephone numbers (see Part 172 Subpart G)
- HM Training (see Part 172 Subpart H)
- Security (see Security Assessment of HM Companies)
- Packaging (see Parts 173 & 178)
  - Selection of appropriate packaging for shippers
  - Closure, loading, unloading, securement, and segregation for both shippers and carriers (see Part 177)
  - Maintenance, inspection and testing of packaging
- Shippers using reusable packaging i.e. IBCs, drums, cylinders (see Parts 173 & 178)
- Carriers owning cargo tanks (see Part 180) plus verifying test dates and integrity of packaging
  - Conducting HMPIPs on HM packages entering or exiting transportation, if available (see Using HMPIP Software)
- Motor vehicle operations (see Part 397 and portions of Part 392) – carrier only
- Oil spill response plans (see Part 130) – carrier only

Enforcing our Denial of Access Authority

Introduction

The primary goal of Section 4103 is to provide FMCSA an additional tool to compel parties subject to the FMCSR and/or HMR to promptly produce relevant records and to promptly allow for the inspection and examination of equipment, lands, buildings, or other property upon demand during investigations, reviews and inspections conducted under FMCSA's investigation authorities. In circumstances involving investigations of for-hire motor carriers, Section 4103 also provides FMCSA a tool to compel parties to allow a contractor or Motor Carrier Safety Assistance Program (MCSAP) partners designated by FMCSA to inspect equipment of the motor carrier and/or inspect and copy records of the motor carrier. The

purpose of Section 4103 is to assist FMCSA in determining compliance with applicable Federal Statutes and Regulations enforced by FMCSA. Section 4103 enables the Agency to assess a civil penalty against a person subject to the HMR or a motor carrier, broker, freight forwarder, or owner or operator of a CMV that fails, upon demand, to allow authorized FMCSA personnel prompt access to inspect and copy any record or inspect and examine equipment, lands, buildings, and other property. The non-existence of the records at the time of FMCSA's request to inspect and copy, or the inability to timely produce the records without unreasonable expense or effort may be raised as defenses to a civil penalty assessed under Section 4103.

Investigators and auditors should cite a denial of access violation when taking enforcement as follows:

- For private carriers of non-hazardous materials, cite 49 USC § 504(c) - *Failing to promptly allow, upon demand, FMCSA to inspect and copy any record and/or inspect and examine equipment.*
- For hazardous materials shippers and carriers, cite 49 USC 5121(c) - *Failing to promptly allow, upon demand, FMCSA to inspect and investigate records and property.*
- For for-hire carriers, cite 49 USC 14122(b) - *Failing to promptly allow, upon demand, FMCSA to inspect and copy any record and/or inspect and examine equipment, lands, buildings or other property.*

Persons subject to the HMR or motor carriers, brokers, freight forwarders, CMV owners, and operators of CMVs may be penalized up to $1,000 for each day authorized FMCSA personnel are denied prompt access to inspect and copy any record and/or inspect and examine equipment, lands, buildings, and other property. The total of all civil penalties against any violator for all offenses, related to a single violation, shall not exceed $10,000. The employee and carrier uniform penalty assessment worksheets (UPAWs) should be used to establish the per offense amounts for drivers and carriers, respectively. The Division should prepare and serve the NOC within 10 days of the failure to allow access. If other violations of Federal statutes or regulations were discovered, the Division should contact the Service Center Enforcement Team (SCET) and SC Attorney to discuss including the additional violations in the NOC.

If an enforcement action is initiated for failing, upon demand, to promptly allow FMCSA to inspect and copy and/or inspect and examine equipment, lands, building, or other property, the modified language in the attached NOC should be used. The opening paragraph of the NOC should be modified, and the appropriate charge, abatement, and applicable statutes should be included.

Click here for questions and answers related to the enforcement of denial access authority.

Enforcement Discretion

If the motor carrier, broker, freight forwarder, or person subject to the HMR makes available the demanded records to FMCSA and/or allows FMCSA the demanded access to inspect and examine equipment, buildings, land, or other property before a NOC is issued, and the integrity of the investigative process has not been jeopardized, the Division may consider discontinuing enforcement proceedings for denial of access.

Settlement Guidelines

If a NOC is issued for failure to promptly allow, upon demand, FMCSA to inspect and copy records and/or inspect and examine equipment, lands, buildings, or other property, FMCSA should ensure any settlement of the NOC enables FMCSA to conduct or complete its original review or investigation. No settlement agreement resulting in a reduction, suspension or payment plan for the penalty set forth in the NOC should be considered unless and until the respondent has produced the demanded records and/or provided access allowing FMCSA to inspect and examine the demanded equipment, buildings, land or other property.

Coordination with Use of Subpoenas

FMCSA also has broad authority to subpoena records in an investigation; subpoenas are enforced through the Federal District court. In some circumstances, the Divisions may want to consider using Section 4103 authority in conjunction with a subpoena. While Section 4103 allows FMCSA to assess penalties for failure to allow access to review and copy records, enforcement of a subpoena through the Federal District court provides an additional tool to ensure FMCSA is able to access records necessary to complete a review or investigation. If the Division believes a subpoena may be appropriate, before serving a Demand and/or initiating an action using Section 4103 authority, the Division should contact the SC Attorney and Enforcement Program Coordinator.

Probing Questions Related to AOBRD Systems

The following are probing questions the investigator should consider asking a motor carrier that uses AOBRD technology. This list will not cover every possible question but will assist the investigator in establishing most of the system basics. Every motor carrier's operation is different and your questions must be tailored to the facts you discover during your review.

Type and Function

Part 49 CFR 395.15 requires AOBRDs to meet minimal technical specifications. Each AOBRD manufacture includes unique features within their systems. The following questions are intended to assist the investigator with identifying the type of AOBRD the motor carrier is operating so that the investigator can become familiar with the AOBRD's functionality.

1. What type of AOBRD is the motor carrier using (brand, model, etc.)?
2. Is the motor carrier's AOBRD electronic hours of service system maintained internally or by an outside source?
    a. If the motor carrier maintains their AOBRD electronic hours of service system internally identify the person responsible.
    b. If the motor carrier uses an outside source to keep track of the AOBRD data, what is the name of the company and what services does that company provide?
3. Does the AOBRD system utilize telematics (cellular or satellite data)?
    a. If not telematics, how does the system transmit data from the vehicle to the service provider/ motor carrier?
4. What vehicle positioning system (mapping/tracking) is integrated with the AOBRD?
5. Does the AOBRD use satellites, cell towers, or both?
6. How often are the AOBRD locations calculated (duty status change only, every minute, every hour, half-hour, etc.) and transmitted (every hour, when communications are sent, etc)?

System Settings/Parameters

Most AOBRD systems are designed to be tailored to the motor carrier's operations. Because of this motor carriers can define parameters that do not meet the standards of 49 CFR Part 395. The following questions are intended to aid the investigator in identifying parameters which may conflict with the 49 CFR Part 395.15 requirements or conceal hours of service violations.-

1. Who enters driver's name, vehicle, etc. for a particular AOBRD unit?
2. Who sets the parameters for the AOBRD system?
3. What setting activates the automatic drive duty status change on the AOBRD?

   Miles per hour? _____ Distance?_____

4. Does the system automatically default to on-duty not driving?
5. What is the setting for the automatic default? How many minutes?
6. Does the system offer a location radius parameter in which a driver may move the vehicle without changing their duty status to drive?
7. If this location customization is utilized, what is the maximum mileage radius?

Installation and Repair

Each vendor offers different installation methods. Some systems may have connectivity issues. This may occur do to a software or hardware malfunction/JBUS communication fault. Installation methods may also leave the system vulnerable to tampering by the driver. The following questions are intended to assists the investigator in determining if there is a means to tamper with the AOBRD system and if there may be connectivity issues that need to be addressed.

1. Was the installation of the AOBRD performed internally or by an external source/vendor.
   a. Who were the individuals involved in the AOBRD installation process?
2. How is the AOBRD integrated with the vehicle? (Hardwire, Bluetooth)
3. Does the system utilize J1708 or J1939 or both data bus?
4. Are there devices installed on older pre-ECM vehicles? What sensors do these devices use to record engine data?
5. Where does the device get its power?
6. Who ensures the device is synchronized properly with the vehicle?
7. Who is responsible for repairing/maintaining equipment?
8. What is the carrier's policy/procedure for reporting malfunctions with the device?
9. Who monitors the system for reported and/or unreported malfunctions and what is the process for handling such instances?

System Reporting and Monitoring Capabilities

There may be occasions when the motor carrier has not installed AOBRDs in all of their vehicles and may have a combination of electronic records and paper records of duty status. These questions are designed to assist the investigator with becoming familiar with the support system and identify available information to aid in the investigation.

1. Are all vehicle/drivers using AOBRDs?

2. In what form, web-based or software, does the motor carrier access and store AOBRD data?
3. Does the system report a driver's hours of service in real time?
    a. If not, how often do drivers transmit/download their electronic hours of service?
4. Do operations dispatchers/planners have access to drivers real time hours of service?
5. Does the motor carrier operate with a Fleet Management System (FMS)
    a. If so, is the AOBRD incorporated into the FMS?
6. What individuals have authority to edit driver RODS?
7. Do drivers have edit rights?
    a. Can a driver edit driving time?
    b. How does the system track edits?
    c. Does the system support an edit report?
    d. How is the original data retained? (hard copy, electronic, etc.)
8. Does the system allow drivers to manually enter a location (city, state) at duty status changes?
9. Does the system have manual logging capabilities? (Manual selection of the driving status by the driver during periods of no connectivity with the ECM)
    a. If so, is this option utilized?
10. Can the system parameter be set to not use manual logging capabilities?
11. Does the system note (in printed or electronic form) the difference between a manual driving mode and an automatic recorded driving status?
12. Does the system provide a report of those drivers utilizing a manual logging mode?
13. Does the system give drivers the option to delay the recording of driving or override the driving time duty status?
14. Does the system support off duty driving or personal conveyance?
15. Are the drivers given rights to utilize off duty driving?
    a. If so, is the amount of time at this status off duty driving limited and/or monitored?
    b. Do drivers receive training on when it is acceptable to use off duty driving or personal conveyance?
    c. What does the training consist of and what is the company's policy on utilizing personal conveyance?
16. Does the system offer alerts? (by e-mail? reports?)
    a. What alerts does the system provide? (HOS violations, Malfunction, Unassigned driving, etc.)
    b. Who is responsible for Monitoring system alerts?
    c. What is the carrier policy/system for handling eHOS system alerts?
17. What sensor failures are reported by the system?
    a. Where are the sensor failures/system malfunctions found in the support system?
    b. How are sensor failures monitored?
    c. What sensor failures or series of sensor failures indicates no connectivity with the ECM (no Data Bus)?
18. Does the device communicate a malfunction to the driver? How?
19. Does the system have connectivity issues with particular year model or makes of vehicles?
20. Does the system report unassigned driving?
    a. How does it report unassigned driving?
    b. What system parameters trigger unassigned mileage? (ex. driving without a driver logged into the system, location radius parameter, etc.)
    c. Who is responsible for reassigning unassigned miles to the correct driver?
    d. Are the reassignments supported in the system or are they manual edits?
21. Does the system require the driver's verification of edited data?
22. Does the system report power failures?
    a. If not, how are periods of power failure detected?
    b. How are periods of power failure handled/addressed?

23. What is the carrier's policy for tampering with the system?
24. How does the system report hours of service violations?
25. What is the carrier's system for monitoring hours of service violations?
26. Does the system send alerts to the driver letting him/her know they are near their driving limitations?
27. What procedures does the motor carrier use to check for false records of duty status.

Appendix P – eFOTM Systems Guidance

For

eFOTM Redevelopment

Federal Motor Carrier Safety Administration (FMCSA)
U.S. Department of Transportation

Appendix P – eFOTM Systems Guidance

Understanding the IT Systems Used During the Investigative Process

Below is a brief description of the IT systems referenced throughout the Compliance Manual and how they each are used throughout the investigative process. This section will cover the following systems:

- Activity Center for Enforcement (ACE)
- ACE Intervention Management (AIM) system
- Compliance Analysis and Performance Review Information (CAPRI)
- Crash Analysis Tool (CAT)
- Safety Measurement System (SMS)

Activity Center for Enforcement (ACE)

ACE is an online system used by enforcement personnel to manage intervention activities and carrier data. The current version is available to enforcement users with a Portal username name and password. Access to different modules and capabilities are based on the user's role. ACE can be customized based on user preferences.

For Managers:

Managers use ACE to track, prioritize, and assign carriers to SIs. The Manager should use the information available in ACE modules and dashboards, along with any other relevant information, to create assignments in accordance with current policy and agency goals. The Manager will also review and approve all CSA investigations (Offsite, Onsite Focused, and Onsite Comprehensive) completed in the ACE Intervention Management (AIM) system. For more information on how managers can maximize efficiency using ACE, click this for the ACE User guide: https://csa.fmcsa.dot.gov/DownloadFile.axd?file=ACE-User-Guide.pdf and this link for AIM User Guide: https://csa.fmcsa.dot.gov/downloadFile.axd?file=/AIM_UserGuide_2019_Jan_V1.0.pdf

Managers use ACE (and data within ACE) to:

- Track, prioritize, and assign carriers to SIs.
- Make intervention assignments in accordance with current policy and Agency goals.
- Review and approve all CSA investigations (Offsite, Onsite Focused and Onsite Comprehensive) completed in the ACE Intervention Management (AIM) system.

- For more information on how Managers can maximize efficiency using ACE, click this https://csa.fmcsa.dot.gov/DownloadFile.axd?file=ACE-User-Guide.pdf.

For SIs: The SI will use ACE to view, track, and prioritize assignments upon receiving them from their Manager. The SI should use ACE to conduct the Pre-Investigation and Risk Assessment process. ACE enables the SI to create Document Request Letters, review documents submitted by the carrier, and reject documents provided noting 'Revision required'. Documents collected through ACE during Risk Assessment can be synced to populate corresponding sections in AIM.

SIs use ACE to:

- Review information about carriers from various FMCSA systems in one coordinated location.
- View, track, and prioritize assignments received from Managers.
- Conduct the Pre-Investigation and Risk Assessment processes.
- Create Document Request Letters to carriers.
- Review, accept, or reject documents submitted electronically by carriers for investigations.
- Documents collected in ACE through the Risk Assessment process can be synced to AIM.

ACE Intervention Management (AIM) System

AIM is a desktop application that collects investigation data and has the ability to work both online and offline. AIM will notify the user if a newer version is available for installation anytime the user is logged into the web-version of AIM. AIM User Guide: https://csa.fmcsa.dot.gov/downloadFile.axd?file=/AIM_UserGuide_2019_Jan_V1.0.pdf

SIs use AIM to:

- Conduct, complete, and submit their investigation reports for Onsite Comprehensive, Onsite Focused, and Offsite Investigations.
- Data collected in ACE during the Risk Assessment portion of the investigation is automatically synced to populate AIM, eliminating the need for re-entry.
- Manually sync data from the ACE Risk Assessment if it changes after the investigation is started.
- An Internet connection is needed to submit investigation reports for Manager approval and sync information with other FMCSA systems.

Compliance Analysis and Performance Review Information (CAPRI)

CAPRI is a desktop application that collects investigation data and has the ability to work both on and offline. CAPRI will be used when conducting Security Contact Reviews (SCRs), Shipper Reviews, Cargo Tank Facility Reviews (CTFRs), and other reviews that cannot currently be completed using AIM. It also creates the proposed Safety Fitness Rating and various reports for motor carriers. An Internet connection is needed during the upload/transfer process.

SIs use CAPRI to:

- Conduct, complete, and submit investigation reports for SCRs, Shipper Reviews, and CTFRs.

Crash Analysis Tool (CAT)

The Crash Analysis Tool is a desktop application, available through AIM, which will be used by SIs during the course of a Crash Basic Investigation (CBI) to identify trends among crashes, if all of the following three criteria are met:

- The carrier has three crashes or more in the 2-year period;
- Factor 6 is Unsatisfactory; and
- No violations were discovered that indicate there may be underlying patterns that contributed to the crash.

When use of CAT is required, the CBI Carrier Summary Report must be provided to the motor carrier at closeout, along with the Carrier Investigative Report from AIM.

SIs use CAT to:

- Produce a customized CBI Carrier Summary Report that show trends and related Crash BASIC countermeasures.
- Provide the CBI Carrier Summary Report to the motor carrier at closeout, along with the Carrier Investigative Report from AIM.

Safety Measurement System (SMS)

The Safety Measurement System (SMS) is an online system that quantifies motor carrier safety data collected from roadside inspections, investigations, and crash reports. It serves as a central location for law enforcement to access carrier safety data. SMS offers three user roles (Public, Logged in Motor Carrier, and Logged in Enforcement Official). An increasing amount of data is visible to each type of user. While SMS is used for a myriad of tasks, we have only described the specific things that carriers and enforcement officials will use SMS for as part of the investigative process.

Carriers use SMS to:

- Upload documents requested by the Safety Investigator during an investigation.
- Track the status of their in-progress investigations (including due dates, document revision requests, etc.)
- Access how-to instructions to help them use SMS to comply with requests from Safety Investigators.
- View their final Investigation Report (if completed in AIM) and following closeout and manager approval of report.

SIs use SMS to:

- See a mirror image of the carrier view of SMS to help carriers understand how to use SMS to see their safety record and upload documents.
- View information related to the carrier's safety performance and their BASIC results.
- Much of the information available in SMS is also visible to enforcement users in ACE.

How Investigation Reports from AIM and CAPRI Differ

CAPRI is FMCSA's legacy system for completing investigation reports. Over time, all tasks currently completed in CAPRI will be migrated to new systems. In 2019, FMCSA introduced AIM as a replacement for CAPRI when conducting Onsite Comprehensive, Onsite Focused, and Offsite Investigations.

However, since AIM does not yet include all CAPRI functionality, the two systems will be maintained concurrently for a time. AIM will be used as widely as possible, but CAPRI will continue to be used for SCRs, CTFRs, and other investigations that AIM currently does not accommodate.

While the process for completing investigations remains generally the same, CAPRI and AIM produce investigation reports that are organized differently. This section shows how each section of the CAPRI report generally maps to the AIM report to help orient safety officials familiar with the CAPRI report and terminology to AIM. For clarity, the eFOTM will refer to sections using the names from both systems, for example "Pre-investigation/Part A."

AIM	CAPRI
Pre-investigation	Part A
Violations Tab	Part B
Investigation Report	Part C

Appendix Q – CSA Probing Questions

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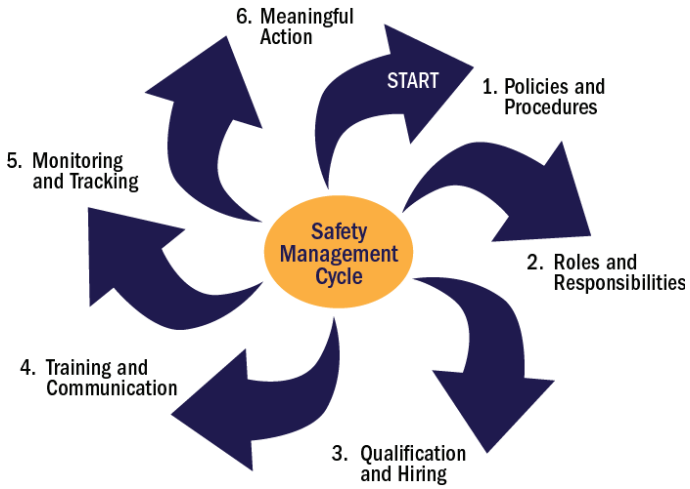
Appendix Q: Controlled Substances Probing Questions

This job aid provides a list of Investigative Probing Questions for the Controlled Substances/Alcohol Behavior Analysis and Safety Improvement Category. This job aid can be used to engage the carrier in a collaborative exchange designed to review the Safety Management Cycle and identify where a breakdown has occurred in the Safety Management Process (Process Breakdown), understand the reasons why the Process Breakdown(s) occurred and its consequences (e.g., violations), and develop a plan for improvement. Prior to beginning the discussion, the Safety Investigator should review the questions and identify those that may be most relevant to his or her discussion. Additional information on how the job aid can be used is provided below.



The Safety Management Cycle

How can I use this job aid? The probing questions can be used to:

- Start the discussion with the carrier;
- Develop an appropriate line of questioning; and
- Spark additional questions.

What should I keep in mind when using this job aid? Keep in mind the following guiding principles while engaging the carrier during the investigative questioning and remedy development process:

- Frame the questions so that the exchange moves toward determining the Process Breakdown(s);
- Stay focused on the goal of the exchange; steer away from discussions that stray from the goal;
- Engage the carrier so that he or she plays a role in diagnosing the issue and developing the remedy for improvement;
- Remember that participation in this self-assessment increases the likelihood that the carrier will change his or her behavior and is a key factor in gaining 'buy-in' to implement remedies; and
- Once the breakdowns are identified, ask the carrier why he or she believes these breakdowns are occurring and consider this information when selecting appropriate remedies for the carrier.

1. Policies and Procedures	
General Questions	**Carrier Response**
• Do you have a **policy in place that is in accordance with Part 382.601**? o If so, request the document. o If not, why not?	
• Are all **drivers given a copy of the company's policies**? o Where do you store the certificate of receipt that is signed by each driver?	

1. **Policies and Procedures**	
• Is there a **testing program in place**? o Is the testing program the **same for Department of Transportation (DOT)-regulated employees and non-DOT-regulated employees**? If not, explain the differences. o What **methods are used to select drivers** for testing? How do you notify drivers that they have been selected? (Is it verbal, written, or through Qualcomm?) o Do you **conduct reasonable suspicion** controlled substances or alcohol testing? o Do you **conduct post-accident testing**? If so, when? o What **collection facilities are you using**? o Are you doing your own collections or using an external source or agent?	
• How can you **tell if a driver has been consuming alcohol or using controlled substances**? o How do you recognize observable symptoms? o Who decides whether to conduct a reasonable-suspicion test? o How do you conduct reasonable suspicion drug and/or alcohol testing? o Where is the collection done, and where is the sample tested? o When is the observed behavior/reasonable-suspicion record completed?	
• What is your **company policy regarding drivers who test positive**?	
• Does your **policy ensure that positive-tested employees are removed from duty** and do not return before obtaining proper clearance, according to regulations? o If so, is it written or verbal? o If written, request the document. o If verbal, describe it. o If there's no policy, why not?	
• **Please explain the processes/procedures for removing positive-tested drivers from safety-sensitive functions** and the return-to-duty requirements. o Who developed the processes/procedures within your organization? o Did you have internal or external assistance developing this procedure?	
• Are you **familiar with all of the return-to-duty steps**? o Do you conduct a return-to-duty test on drivers who have tested positive?	
• Do you have **drivers currently going through the return-to-duty process**? o Did you have to remove anyone in the last year on the	

1. Policies and Procedures	
basis of controlled substances and alcohol findings?	
o Do you always have enough drivers for operations?	
• What is your **policy for drivers who have previously tested positive** for controlled substances or alcohol? For example, do you continue to use them? o Do you always have enough drivers for operations?	
• Have you had any **drivers who refused to test or tested positive on a drug test, or who tested positive or had a blood alcohol concentration greater than 0.04**? o If so, were the drivers removed from duty? o Are they currently working for you in a safety-sensitive function? Have they been through the return-to-duty process? o If not, why are you allowing them to perform safety-sensitive functions?	
• What is your **process for random drug testing**? o When do you send the driver for random drug testing? o Do you have a separate testing pool for non-DOT-regulated employees? o How do you receive the results back from the drug-testing facility? o Does the Designated Employer Representative (DER) understand the role of the Medical Review Officer (MRO)?	
• How often do you **update your random selection pool list**? o How do you ensure that your random eligibility-pool lists are current?	
• Where do you **store the results of random drug tests**? o How do you get drivers who test positive home? o Do you pretest drivers before dispatch?	
• Where is **controlled substances and alcohol test information kept, including results of all tests**? o Is it in a secured area? o Who has access to it?	
• Do you have a system that **ensures that controlled substances and alcohol test results are safeguarded from disclosure to subsequent employers** and other parties, according to regulations? o If you have such a system, is it written or verbal? o If written, request the document. o If verbal, describe it. o If you don't have a system in place, why not?	
• Do you require **prospective employers to obtain a specific written release from the driver**? o Do you accept blanket releases from prospective employers? (Be specific.)	

1. Policies and Procedures	
o Who is responsible for handling inquiries from prospective employers?	
• Do you **contract with anyone (e.g., C/PTA) to manage your controlled substances and alcohol program**? o If so, request the name and contact information of the provider.	
• Are you **familiar with the record-retention requirement, Part 382**?	
• Request the **testing records for the past calendar year**. (Records include selection, eligibility-pool list, statistical lab summaries, annual summaries, and documentation of all tests conducted with their results.	
• How do you **receive your DOT test results**? o Is this process documented? o Request the documentation.	
• Are you **familiar with requirements for employing persons** performing safety-sensitive functions?	
• Do you **conduct non-DOT testing**? o Is it a separate pool from DOT-regulated employees? o Do you conduct reasonable-suspicion testing? o Do you conduct post-accident testing when required?	
• Do you have a **contract with a Substance Abuse Professional (SAP) to conduct DOT positive-tested controlled substance** and/or alcohol evaluations? o Request his/her name, number, and copies of his or her certificate/credentials and agreement.	

2. Roles and Responsibilities	
General Questions	**Carrier Response**
• What are the **roles and responsibilities of managers in providing training and qualification** for all employees regarding controlled substances and alcohol regulations and company policies/procedures? o Is this role documented? o If so, request the documentation. o How do you ensure that this role is aligned with company policies and regulations? o Request the company's written policies and procedures. (See if they align with the role.)	
• Who is the **coordinator of your controlled substances and alcohol program**? o What are the coordinator's other responsibilities? o Who administers the random pool? o Who has daily contact with most or all drivers?	
• Who is involved in your controlled substances and alcohol	

2. Roles and Responsibilities	
process? o Are there both internal and external roles?	
• For big companies with safety directors: Request the organizational charts. o Which controlled substances and alcohol training and qualification roles does the safety director serve within the company?	
• **To all managers:** How long have you held this position? o Have you ever been through a Safety Audit (SA), Compliance Review (CR), or Onsite Investigation? o Have you gone through a formalized controlled substances and alcohol program training?	
• What are the **roles and responsibilities of the SAP?** o Does the role include informing management of implications of regulatory requirements and best practices? o Is this role documented? · If so, request the documentation. o Request the company's written policies and procedures. o How do you ensure that this role is aligned with company policies and regulations? (See if they align with the role.)	
• Who is in charge of **driver qualification (DQ) files**?	
• Who is in charge of adhering to **testing policies**?	
• Have you hired drivers who have had **positive results and completed the return-to-duty process**? o Do you have all the necessary paperwork on file to document that the return-to-duty process was completed?	
• With regard to drivers who **tested positive and have been released from your company,** did you give them a list of SAPs as required?	
• Does the company have a **DER**? o Who is the DER? o Do you have backup for when the DER is on vacation?	
• Please **explain the roles and responsibilities of the DER in monitoring test procedures and checking results**? o Is this role documented? o Request the documentation. o How do you ensure that this role is aligned with company policies and regulations? o Request the company's written policies and procedures. (See if they align with the role.)	
• **To DER:** How long have you held this position? o Have you ever been through an SA or CR? o Have you undergone formalized training?	

2. Roles and Responsibilities	
• **To DER:** Do you know whether you are meeting your 50% for drugs and 10% for alcohol per average number of drivers per calendar year, or do you rely on the consortium? o How often do you check the controlled substances and alcohol results?	
• **To DER:** Do you have issues with your service agents? o If so, how do you handle these issues?	

3. Qualification and Hiring	
General Questions	**Carrier Response**
• **Please explain the process for hiring a driver.** o Do you check previous-employer documents? o Do you have the employment application, copy of medical card, and previous-employer response? o Are these documents in a DQ file and/or investigative file?	
• What are **the minimum requirements for hiring drivers regarding age, experience, and number of crashes**? o Is your hiring decision based solely on the insurance company being willing to insure or not?	
• Do you **review and evaluate gaps in employment, frequent job changes, incomplete applications, within-company applications** and reassignments, and controlled substances and alcohol involvement history? o If so, describe this process. o Request the documentation that supports this.	
• Do you ask the **driver or other safety-sensitive job applicant about controlled substances and alcohol use and violations**? o How do you do that?	
• Do you **conduct background checks to see if the driver or other safety-sensitive job applicant** has had previous controlled substances and alcohol violations? o Do you ask the applicant's previous employer? o If so, how? o Do you ask the 4025J question? (Has driver tested positive or refused to test in last two years?) o Do you ask the previous employer if the applicant has exhibited addictive, aggressive, or antisocial behavior indicative of substance or alcohol abuse?	
• When you **check with the applicant's previous employer, do you have proof (e.g., dates of calls, letters sent)** that you made a good-faith effort to obtain documentation?	
• Do you **obtain a release from the driver to obtain**	

3. Qualification and Hiring	
completed medical examination (long form), and have you reviewed the long form medical examination for your drivers? o Do you check medical histories for conditions related to controlled substances and alcohol abuse using this form or any other source?	
• **Describe all methods for obtaining background information.** o Do your background checks include other types of pre-employment controlled substances and alcohol screening?	
• **Do you have an outside source for pre-employment screening**? o If so, what is the name and number of the person?	
• Do you **conduct pre-employment drug testing**? Pre-employment alcohol testing is not a requirement. o When do you make exceptions? o Do you have documentation from other carriers/consortiums indicating that the driver was in a drug-testing pool prior to applying at your company, which would exempt the company from conducting a pre-employment drug test? o When in the application process, do you send the applicant for testing? o How do you receive the results from the drug-testing facility?	
• Do you have a **cost issue with conducting pre-employment testing**? o Why didn't you do the pre-employment test for [employee name]? o How quickly are test results reported back to you, and what is the process chain? (Is there a delay?)	
• Describe **your process for making sure that all your drivers, including part-time employees, are in your or another carrier's controlled substances and alcohol sample pool**. o Do you have documentation that shows the controlled substances and alcohol pool for each of your employees? · Request the document.	
• How do you **verify that the testing program manager applicant can do the job successfully**? o Describe the process in detail. o Do you check with the applicant's previous employer? o Do you test the applicants? o Do you use case studies and ask the applicant how he or she would handle various situations?	

3. Qualification and Hiring	
• Has the **testing program manager attended formalized training** to verify his/her knowledge of regulations?	
• What **other responsibilities does the testing program manager have** besides controlled substances and alcohol?	
• Do you **obtain documentation for all of the service agents you are using (SAPs, BATs, STTs)**?	
• How do you **ensure that the service agent can perform his or her job successfully**? o Describe the process in detail. o Do you ask the applicant's previous employer? o Do you test applicants? o Do you use case studies and ask the applicant how he or she would handle the situation?	
• **To service agents**: Are you familiar with Part 40 of the regulations and its requirements? o Are you affiliated with any industry associations?	
• **To DER:** Did you **verify the qualifications of the service agents (through C/TPA)?** o How did you obtain references?	
Passenger Carrier Only Questions	**Carrier Response**
• If you **operate school buses intrastate or transit vehicles, do you check for** driver Commercial Driver's License (CDL) qualifications and adhere to controlled substances and alcohol regulations?	
• **Please describe your qualification and testing requirements for drivers involved in intrastate school-bus operations**.	

4. Training and Communication	
General Questions	**Carrier Response**
• Do you have a **wellness program or do you provide healthy lifestyle training**?	
• How do you **inform and remind all safety-sensitive employees of the importance of responsible lifestyle behaviors and personal choices in** adhering to controlled substances and alcohol regulations and minimizing other aspects of safety risk. o Describe all formal and informal methods. o What documentation is used to support this communication? o Request the documentation.	
• Describe how **training on driver fitness issues is reinforced in the field.** o Do you use job aids, communication, coaching, and	

4. Training and Communication	
mentoring?	
• How do you **communicate with senior leaders about controlled substances and alcohol issues on a regular basis**?	
• Do **drivers have direct access to the safety director or owner/company executives** about these issues? o Do they hash them out first with the terminal manager, dispatcher, and/or parts/inventory person(s)? o How do all parties interface with each other?	
• Do you offer **yearly update training to all HR staff on current practices for hiring and qualifying drivers, and contracting service agents**?	
• How do you **maximize job appeal to recruiters so as to attract personnel who are most likely to adhere to regulations and company policies/procedures**? o Describe how you train recruiters on how best to screen and qualify applicants. o Describe all formal and informal methods for both types of training. o What sort of documentation is used to support both trainings? · Request the documentation.	
• **For third party administrators:** Do you ask for credentials? o Request them. (SAP – AAMRO has MRO credentials.) o What is your relationship to your referral?	
• Do you **routinely obtain a copy of the carrier profile**?	
• How do you **stay current with recent changes to regulations about DUIs**?	
• Do you **provide any training for current drivers for consequences of getting a DUI**?	
• How do you **provide awareness training to drivers to promote full disclosure in re-applying for their CDLs**? o Please discuss how this is done for new and existing employees? o Describe all formal and informal methods? o What sort of documentation is used to support this communication? · Request the documentation.	
• Have you had any **drivers who received a DUI, on the job or in their private lives**?	

4. Training and Communication	
• Describe how you **ensure that contracted service agents are trained and qualified to facilitate** your company's adherence to controlled substances and alcohol regulations and company policies/procedures. o How is this done for new and existing service agents? o How is this done when new controlled substances and alcohol policies and procedures are implemented? o Describe all formal and informal methods. o What documentation is used to support this training? · Request the documentation.	
• **For service agents**: Are you familiar with Part 40 of the regulations and its requirements? o Are you, as a service agent, affiliated with any industry associations?	
• When you **perform reasonable-suspicion training, how do you know how to coordinate with service agents**? o Request the provided training materials. o Who provides training for service agents on company policies/procedures? o Do you perform refresher training? o Have you done this in the last year?	
Passenger Carrier Only Questions	**Carrier Response**
• How are **passenger complaints generally handled**? o Is senior management involved? o If so, when and how? o Describe in depth your communications program with senior company leaders to address passenger complaints that have safety implications.	

5. Monitoring and Tracking	
General Questions	**Carrier Response**
• Do you **monitor driver behavior**? o If so, how?	
• What is your **process for monitoring and tracking of controlled substances and alcohol regulations and company policies**? o Are the process documented? · Request the documentation. o Who does this monitoring and tracking?	
• Do you have a **process for monitoring adherence to all alcohol and controlled substance rules and regulations**, fitted to company operations? o If you have a process, is it written or verbal? · If written, request the policy. · If verbal, describe it.	

5. Monitoring and Tracking	
o If you don't have a process, why not? o Are you part of a consortium? · If not, have you considered joining one?	
• Describe **your process for monitoring, tracking, and evaluating employees subject to controlled substances and alcohol regulatory compliance and compliance** with company policies and procedures? o Are the process documented? o Request the documentation. o Who does this monitoring, tracking, and evaluating?	
• Do you **track and document all employees' training needs and training received**? o How do you do this? o Who does this? o How is this information used? o Request the documentation.	
• **Who has received reasonable-suspicion training**? o How much reasonable-suspicion training have they received? o How knowledgeable were they before training? o How do you know if the training was adequate?	
• How do you **monitor and track hiring and training processes (including qualification of service agents)** to ensure adherence with controlled substances and alcohol regulations and company policies/procedures? o Are the process and the results of the process documented? · Request the documentation. o Who does this monitoring and tracking?	
• How **does your organizational structure ensure that all personnel responsible for** hiring, training, and qualification of service agents are doing their jobs?	
• **To DER:** Did you verify the qualifications of the service agents? o How? (Through C/TPA, obtaining references?)	
• How do you **track records to ensure that you are meeting periodic inspection and recordkeeping requirements**? o Request samples of reports and records.	
• Do you **review your roadside inspection results via the Internet**? o How often? o Who does this? o How is this information disseminated throughout the organization and who receives the information? o How is the information used in the organization?	
• Have you **taken any action(s) to address the violations**	

5. Monitoring and Tracking	
noted in your warning letter?	
• What is your **process for monitoring and tracking an employee's removal from and return to duty according to regulations and company policies/procedures**? o Are the process and results documented? o Request the documentation. o Who does this monitoring and tracking?	
• Do you **monitor the driver's adherence to return-to-duty rules and company policies/procedures**?	
• Have you **employed drivers who had positive results and completed the return-to-duty process**? o Do you have all necessary paperwork on file (SAP-qualification documentation, SAP letters, follow-up testing plan, test results from plan, return-to-duty test results) to document that the return-to-duty process was completed?	
• With **regard to drivers who tested positive and have been released from your company, have you received any prospective-employer requests about them**? o Do you give them a list of SAPs (as is required)?	
• For any **drivers removed, what were the results of their return-to-duty alcohol and/or controlled substances tests**? o Are they undergoing follow-up testing, as prescribed by DOT guidelines?	
• What is your **process for monitoring and tracking of all test records for adherence to retention dates and non-disclosure requirements**? o Are the process and the results of the process documented? · Request the documentation. o Who does this monitoring and tracking?	
• If the **person responsible is the safety director or DER, is anyone assisting him**?	
• Where do you **store your driver controlled substances and alcohol records/paperwork**? o Where do you store results of the post-accident alcohol and/or controlled substances testing?	
• How **does the organization ensure that those responsible for test records are doing their jobs? (Monitoring the monitors.)**	
• Describe your **process for monitoring, tracking, and adjusting the annual driver drug and controlled substance sampling program**? o Request the documentation. o Who does this monitoring and tracking?	
• How many **drivers are currently in your pool?**	

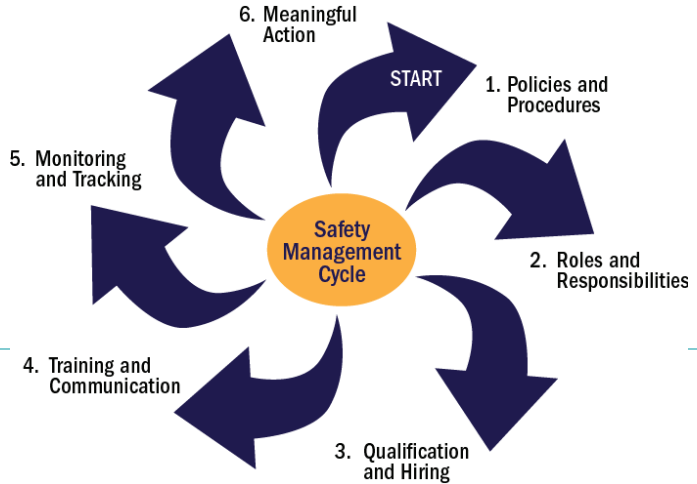
5. Monitoring and Tracking	
• Do you **pre-test drivers before dispatch if you have not received their pre-employment drug-test results**? o Request the records.	
• How many **refusals for tests have you had in the last year**?	
• How many **positive tests have you had in the last year**? o Did the positive drivers see the SAP? o Did the positive drivers complete the SAP's treatment program? o Did the positive drivers take a return-to-duty alcohol and/or controlled substances test? o What was the result of the return-to-duty alcohol and/or controlled substances test? o Were there any crashes resulting in fatalities?	
• How **many Federal Motor Carrier Safety Administration-recordable crashes has your company had within the last 12 months**? o Were there any crashes in which vehicles were disabled and towed from the scene, and did anyone have a bodily injury that required immediate medical attention?	
• Were your **drivers tested for alcohol within two hours but not more than eight hours after the accident**? o If more than two hours but less than eight hours, do you have a record stating why the alcohol test was not conducted within the first two hours? o Were the drivers tested within 32 hours after the accident for controlled substances? o Who conducted the post-accident alcohol and/or controlled substances testing? o How did you receive the results from the drug-testing facility? o What were the results of the post-accident alcohol and/or controlled substances testing?	

6. Meaningful Action	
General Questions	**Carrier Response**
• How do **managers and employees typically react when they see coworkers not fulfilling their responsibilities**? o Do they give immediate and direct feedback? o Do they ignore the problem? o Do they inform their supervisor?	

6. Meaningful Action	
• When it is **clear that employee(s) are deficient in understanding regulations and company policies, do you have mandatory refresher training that helps the employee(s) get the necessary information in a timely manner**? o What triggers this mandatory refresher training? o Who makes these decisions? o Describe some instances when this has occurred. o Request the documentation of some instances when this has occurred (in the form of training materials and a list of people who received the training.)	
• Do you **have a progressive disciplinary program, ultimately leading to termination, focused on taking corrective action to ensure that drivers comply with regulations and company policies**? o Request a copy of it. o Describe some instances of when this program was used. o Who is involved in implementing it? o Describe the program.	
• Do you **continue to use a driver after he/she tests positive for drugs or alcohol**? o Do you always have enough drivers for operations?	
• Are there **circumstances when job demands take priority over controlled substances and alcohol testing and training tasks**? o Describe these situations and how they are managed.	
• Have you **addressed observed consumption with the driver**? o Has the driver been disciplined? · Request the disciplinary file.	

Appendix Q: Crash Indicator Probing Questions

This job aid provides a list of Investigative Probing Questions for the Crash Indicator Behavior Analysis and Safety Improvement Category. This job aid can be used to engage the carrier in a collaborative exchange designed to review the Safety Management Cycle and identify where a breakdown has occurred in the Safety Management Process (Process Breakdown), understand the reasons why the Process



Breakdown(s) occurred and its consequences (e.g., violations), and develop a plan for improvement. Prior to beginning the discussion, the Safety Investigator should review the questions and identify those that

The Safety Management Cycle

may be most relevant to his or her discussion. Additional information on how the job aid can be used is

1. Policies and Procedures	
General Questions	**Carrier Response**

provided below.

How can I use this job aid? The probing questions can be used to:

- Start the discussion with the carrier;
- Develop an appropriate line of questioning;
- Spark additional questions.

What should I keep in mind when using this job aid? Keep in mind the following guiding principles while engaging the carrier during the investigative questioning and remedy development process:

- Frame the questions so that the exchange moves toward determining the Process Breakdown(s);
- Stay focused on the goal of the exchange; steer away from discussions that stray from the goal;
- Engage the carrier so that he or she plays a role in diagnosing the issue and developing the remedy for improvement;
- Remember that participation in this self-assessment increases the likelihood that the carrier will change his or her behavior and is a key factor in gaining 'buy-in' to implement remedies; and
- Once the breakdowns are identified, ask the carrier why he or she believes these breakdowns are occurring and consider this information when selecting appropriate remedies for the carrier.

• What is your **policy** or expected behavior regarding **crashes and crash involvement**?	
• What is your **crash or incident review program**?	
• What is your **unsafe driving policy**?	
• What are your **policies for Hours-of-Service**?	
• What is your **policy on driver traffic citations**?	
• What are your **dispatch policies/processes**? o How are they maintained? o Who is responsible for them? o How are they communicated?	

2. Roles and Responsibilities

General Questions	Carrier Response
• Who is **responsible for safety management** at your company?	
• Do you **have a safety officer**? If so, is the safety officer independent of operations?	
• Who is **responsible for driver oversight**? What do they do?	
• Do you have **dispatch systems/operations**? If so, how is it organized? Who performs these tasks?	
• Who is **responsible for dispatch policies/processes**?	

3. Qualification and Hiring

General Questions	Carrier Response
• How **do you hire and promote drivers**? What are your processes and criteria?	
• What **background/reference checks do you perform to validate the information** provided by potential new hires? What is the process? o *Request sample documents verifying the process (e.g., company policy on hiring, previous employee checks, dispatch records).*	
• What are the **driving record standards for your company**?	
• Before hiring drivers, **do you require them to take a road test in your vehicles?**	
• How do you **validate a driver's "on-road skills"**? What is the process? (For example, when, how, and who?)	

Hazmat Carrier Only Questions	Carrier Response
• Do you **query applicants and previous employers to see if physical and stress demands have led to fatigue and/or reckless-driving violations in the past**? o In what other ways do you screen to see if physical and stress demands might lead to fatigue and/or reckless-driving violations for specific drivers?	
• Are drivers held accountable for **specific driver incidents**? If so, how are they accountable?	

4. Training and Communication	
General Questions	**Carrier Response**
• **How do you communicate with your drivers**? With other employees?	
• **How are dispatch policies/processes communicated**?	
• **Is dispatcher training offered?** New hire, refresher, specialties?	
• Is **driver training offered**? New hire? Refresher?	
• Do you **require your drivers to attend/pass training**? What is the process? (For example, when, why, and how?)	
• What **kind of training do you offer**? Do you offer training on specific violation regulations (e.g., moving violations, failure to stop, improper use of signals, obeying local laws, parking commercial motor vehicles, and hazmat)? Which ones, when, and how?	
• **How do you make drivers aware of unsafe driving regulations**? What means of communication and/or training are used?	
• Does your **company have safety meetings**? o If so, are the possible consequences of an unintentional release of hazmat discussed during these meetings?	
• How much **information does a dispatcher know about a particular driver's level of experience and/or skills**? How is this communicated?	
• Do you **provide driver education that includes function-specific training**, for example, on customer communications, breakdown procedures, evacuation, and route diversion? If so: o Who gets this training? o Does it include checking the prior seven-day duty statement? o How often is it given? o What triggers its delivery?	
• Do you **prepare drivers for new routes**? If so, how?	
• Do your **drivers share knowledge/information with each other**? If so, how (formal/informal?)?	
• *Request documentation on a **specific sample of employees** that shows frequency, content, attendance at, etc., the training required by the carrier.*	
• Do you **request documentation to verify training of employees while at previous employers**?	
• Do you request **sample documents to verify type, content, and attendees of training**?	

4. Training and Communication	
Passenger Carrier Only Questions	**Carrier Response**
• Do you **provide training on pedestrian awareness for bus drivers in inner cities**? If so: o Who gets this training? o How often is it given? o What triggers its delivery?	
• How are **passenger complaints generally handled**? o Is senior management involved? o If so, when and how? o What is your communications program with senior company leaders to address passenger complaints that have safety implications?	
• Have you had any **incidents involving injuries while loading or unloading passengers in the last year**?	
Hazmat Carrier Only Questions	**Carrier Response**
• How do you **ensure that all drivers, purchasing/parts-inventory agents, dispatchers, and managers receive training as** required by regulations and/or company policy/procedures? o Do you train drivers of fluid loads on how to counteract sloshing? o For each type of training: • How often is it offered? • What triggers it? • Do you have job aids to help drivers learn the material?	
• How many **years of cargo-tank operating experience** must a driver have?	
• How was **training on Parts 172 and 177 requirements performed**?	
• Do **drivers have the ability to report perceived problems with equipment to management**? o Is this done verbally or in writing? o Does the company have a written policy on reporting problems with equipment? · *If so, request a copy.*	

5. Monitoring and Tracking	
General Questions	**Carrier Response**
• Do you **monitor driver behavior**? If so, how?	

5. Monitoring and Tracking	
• How **often do you review the driving records of your drivers**? Who does the review?	
• What **documentation do you keep regarding drivers and driving records?** o *Request descriptions and samples.*	
• How do you **track your drivers while they are on a trip**? Do you use automated systems to track your drivers? If so, what is the process? (For example, who is responsible for the tracking/monitoring?)	

6. Meaningful Action	
General Questions	**Carrier Response**
• How do **managers and employees typically react when they see coworkers not fulfilling their responsibilities**? o Do they give immediate and direct feedback? o Do they ignore the problem? o Do they inform their supervisor?	
• Is **driver behavior included in performance reviews**? If so, how?	
• Is **safe driving recognized with respect to employee incentives and/or reward/recognition programs**? How?	
• What **kind of follow-up action do you take on reported unsafe driving actions and/or other driver citations/violations**? What is your process and what are the consequences of driver violations?	
Hazmat Carrier Only Questions	**Carrier Response**
• Do you **discipline drivers who ignore company policy and fail to drive safely with hazardous loads**? o If so, what are the measures? · *Request a written copy of the measures.*	

Appendix Q: Driver Fitness Probing Questions

This job aid provides a list of Investigative Probing Questions for the Driver Fitness Behavior Analysis and Safety Improvement Category. This job aid can be used to engage the carrier in a collaborative exchange designed to review the Safety Management Cycle and identify where a breakdown has occurred in the Safety Management Process (Process Breakdown), understand the reasons why the Process Breakdown(s) occurred and its consequences (e.g., violations), and develop a plan for improvement. Prior to beginning the discussion, the Safety Investigator should review the questions and identify those that may be most relevant to his or her discussion. Additional information on how the job aid can be used is provided below.

The Safety Management Cycle

How can I use this job aid? The probing questions can be used to:

- Start the discussion with the carrier;
- Develop an appropriate line of questioning; and
- Spark additional questions.

What should I keep in mind when using this job aid? Keep in mind the following guiding principles while engaging the carrier during the investigative questioning and remedy development process:

- Frame the questions so that the exchange moves toward determining the Process Breakdown(s);
- Stay focused on the goal of the exchange; steer away from discussions that stray from the goal;
- Engage the carrier so that he or she plays a role in diagnosing the issue and developing the remedy for improvement;
- Remember that participation in this self-assessment increases the likelihood that the carrier will change his or her behavior and is a key factor in gaining 'buy-in' to implement remedies; and
- Once the breakdowns are identified, ask the carrier why he or she believes these breakdowns are occurring and consider this information when selecting appropriate remedies for the carrier.

1. Policies and Procedures	
General Questions	**Carrier Response**
• What is your **driver qualification (DQ) process/policy**? o *If written, provide a description.* o *If verbal, describe it.*	
• What are your **procedures for maintaining and updating DQ files**? How do **you keep track of what your drivers** are doing on the road in terms of violations? o Does your policy include addressing **DQ violations** recorded during roadside inspections in a timely manner? o Do you require **drivers to submit a list of violations** annually?	

1. Policies and Procedures	
o Do you run the **Motor Vehicle Records (MVRs) annually**? o Do you subscribe to an **automated Commercial Driver's License (CDL) monitoring system**? o Do you **subscribe to any outside service for driver record checks** (e.g., DAC)?	
• Do you have a **policy that requires regular updates and timely reviews of DQ files**, providing controls and sanctions for falsifications and for sole reliance on third-party sources (e.g., insurance carriers)? o *If so, is it written or verbal?* o *If written, request the document.* o *If verbal, request description.* o *If there is no policy, why not?*	
• How do you **ensure that your DQ files and associated records and documents are organized and retained for the required periods**?	
• Do you have **a policy on document retention and recordkeeping, including onboard possession of medical cards**? o *If so, is it written or verbal?* o *If written, request the document.* o *If verbal, request description.* o *If there is no policy, why not?*	
• Do you have a **policy for checking on new drivers' entry-level training in accordance with Part 380 rules**?	
• Do you have a **procedure to prevent assignment and dispatch of drivers on operations for which they are not qualified**? o *If so, is it written or verbal?* o *If written, request the document.* o *If verbal, request description.* o *If there is no policy, why not?*	
• Do you **require a new hire to undergo a medical examination even if his/her medical certificate is still current**?	
• Do you have a system that **dispatch uses to reference and/or verify drivers' credentials prior to assigning them?** o To loads involving hazardous materials? o To vehicles that may require specific license endorsements, depending on equipment fleet?	

1. Policies and Procedures	
• Do you **use team driving**? o Does dispatch do alternative-route or scenario planning? o How do you track your drivers while they are on a trip? o Who does the tracking/monitoring?	
• What is your **policy regarding how medical examinations are performed**? o Are all drivers directed to specific health-service providers selected by the motor carrier? o Do you use an occupational health-service provider to perform Department of Transportation (DOT) medical examinations? o Do you supply drivers with a DOT medical form when they obtain another DOT medical examination (as required)?	
• What is your **policy regarding medical examination documentation**? o Do you **require all new hires to undergo a medical examination** even if their medical certificate is still current? o Does your **company check the accuracy of each driver's DOT medical card**? o Does your **company check each driver's medical long form to ensure that it hasn't been falsified or altered**?	
• How do you **ensure that your drivers' DOT medical cards remain current**?	
• Is **documentation kept when company personnel notify drivers** about the need for medical card renewal?	
• Do you have a **medical card in the DQ file**? o If not, why not? o How do you update drivers' medical records? o What is your driver medical card submission policy? o Do you require drivers to submit a long form? o Do drivers go to the carrier's doctor or their own doctor?	
• How do you **ensure that your drivers are medically qualified and have valid medical certificates**?	
• Do you have a **policy that requires all drivers to submit copies of all inspections and moving violations to carrier management** within a designated timeframe, and to notify carrier management of suspended CDLs immediately following notification of suspension? o *If so, is it written or verbal?* o *If written, request the document.* o *If verbal, request description.* o *If there is no policy, why not?*	
• Do you maintain **driver reports of driver MVRs**? o What are your update procedures? o Do you require drivers to report their violations in both commercial and non-commercial motor vehicles, both at inspection and on the road? o What about suspended CDLs? o Do you subscribe to an automated CDL monitoring system?	

1. Policies and Procedures	
• Do you have a **policy requiring all new CDL drivers operating Longer Combination Vehicles (LCV) (hired since 2003)** to submit documentation of entry-level training? o *If so, is it written or verbal?* o *If written, request the document.* o *If verbal, request description.* o *If there is no policy, why not?*	
Hazmat Carrier Only Questions	**Carrier Response**
• What is the size **of the driver pool, and how many drivers have an "H" or "N" endorsement** on their CDL?	
• If your **company hauls both HAZMAT and regular cargo, have you established policies and procedures that ensure that only drivers with an "H" or "N" endorsement** are assigned to placardable HAZMAT loads? o *If so, are they written or verbal?* o *If written, request the documents.* o *If verbal, request description.* o *If there is no policy, why not?*	

2. Roles and Responsibilities	
General Questions	**Carrier Response**
• **What are the roles and responsibilities of drivers, dispatchers, and other personnel**? o Are these roles/responsibilities documented? ▪ *If so, request the documents.* o How do you ensure that roles/responsibilities are aligned with company policies and Driver Fitness regulations? o Are your company's written policies and procedures aligned with roles/responsibilities?	
• **Who is responsible for DQ**? o Does that person maintain a list of all company vehicles? o How do you ensure that non-CDL drivers don't drive CDL-required vehicles? o How do you ensure that CDL drivers have the proper endorsements to drive CDL-required vehicles? o Does dispatch have a system to reference or verify driver credentials prior to assignment of load?	
• Who is **responsible for DQ files**? What **system do you have to update** these files? o How long has that person been assigned this task? o What level of training was provided to perform this task? o What other duties is this person responsible for?	

2. Roles and Responsibilities	
• Who is in **charge of doing background checks on drivers and reviewing CDL information**?	
• Do **you have dispatch systems/operations**? o If so, how are they organized? o Who makes sure that assignments are made in accordance with DQs?	
• How do **dispatch and safety management work together**? o How much does the dispatcher know about individual driver experience, qualifications, and skills?	
• **What are the roles and responsibilities of managers in providing training and maintaining qualifications for all employees**? o Are these roles and responsibilities documented? · *If so, request the documents.* o How do you ensure that roles and responsibilities are aligned with company policies and regulations? · *Request the company's written policies and procedures. (Check to see if they are aligned with roles/responsibilities.)* o Who generally provides training for you? o Who checks to see if all of your employees have proper driver-entry training? · If nobody is assigned to that task, why not?	
• What is the **process that senior managers use to monitor compliance with policies and regulations**? o Is this process documented? · *If so, request the document.*	
• Who in the **company is in charge of enforcing policy**?	
• How **long has your safety manager been in that position? What type of** past experience does he/she have?	
• Are **safety duties split amongst employees? If so with whom**?	
• Who **conducts your drivers' DOT medical certifications**? o Do you direct drivers to a company-approved physician versus a driver-selected physician?	
• Do you **use an occupational health physician**?	
• Do you have a **means for verifying the accuracy of information on medical cards**? o If so, who is responsible for this? o Is this person trained to know what a falsified medical card looks like? · If not, why not?	
• Do you have a **process for tracking medical card expiration dates and notifying drivers** of the need to be examined when his/her medical card expires?	

2. Roles and Responsibilities	
o If so, what is the process and who is responsible for it? o If not, why not?	
• Who is in **charge of conducting background checks on drivers and reviewing CDL information**?	
• **Do you have anyone assigned to check MVRs**? **If not, why not? If so, when and how often?** o Where can I find copies of MVRs? o Does your insurance carrier give you paper copies of MVRs? o How do you keep track of medical card expiration dates? Who does this? o Do you have someone who checks medical cards for falsification? Does this person know what a falsified medical card looks like? If not, why not? o Do you have the means to verify that the information is correct? If not, why not? o Do you send drivers to a trusted doctor? o Do you direct drivers to a company-selected physician verses a driver-selected physician?	
• Have any of your **drivers had recent illnesses or crashes that may have caused a sudden health concern/change** or have resulted in the driver having been off work for an extended period of time?	
Hazmat Carrier Only Questions	**Carrier Response**
• Are your **managers and dispatchers for companies that haul HAZMAT and regular cargo responsible for ensuring that only drivers with an "H" endorsement** are assigned to placarded HAZMAT loads? o If so, is this role documented? · *Request the documents.*	
• Are your **managers and dispatchers for companies that haul HAZMAT in tank vehicles (tanks with 1000-gallon capacity or more)** responsible for ensuring that only drivers with an "N" endorsement are assigned to the HAZMAT loads? o If so, is this role documented? · *Request the documents.*	

3. Qualification and Hiring	
General Questions	**Carrier Response**
• What is **your company's process for hiring new employees**? o Is this process written? · *If so, request the documents.* o Is your DQ process/policy in writing? · *If so, request the documents.*	

3. Qualification and Hiring	
• Do you have **trouble attracting and retaining an adequate supply of drivers**?	
• Do you **query applicants, check with previous employers, and obtain necessary documents regarding previous violations,** CDL, operational qualifications, dispatch records, and training, as well as information on related background, medical conditions, and driver behavior? o If so, what is this process? · *Request the supporting documentation.* o Do you have a checklist of questions that you ask applicants and their previous employers? · *If so, request the documents.*	
• How do you **ensure that information from the driver's application and previous employers is complete and accurate**? · *Request the DQ files for these drivers.* o If documents are missing, are they in another location? · *If so, request the documents.* o If they're not in another location, do you conduct MVR checks? · *If not, why not?*	
• Do you **review and evaluate gaps in employment,** frequent job changes, incomplete applications, within-company applications and reassignments, operational limitations (e.g., LCV, HAZMAT), physical impairments, and drug and alcohol involvement history? o If so, what is this process? · *Request the supporting documentation.*	
• Do you **look at driver violations as part of the hiring process**? o If not, why not? o If so, do you obtain this information from the driver's previous employers, the insurance company, or others?	
• Who is in **charge of maintaining the DQ files**?	
• Does your **staff understand the DQ/medical requirement process**?	
• How closely **do you examine the drivers' medical conditions - physical qualifications and medical history**? o Do you evaluate whether there are any obvious medical conditions, such as diabetes, high blood pressure, or being very overweight? o Do you have any drivers with special waivers? · *If so, request to speak to them.* o Do your drivers operate in intrastate, interstate commerce, or both? o If they operate wholly in intrastate commerce, do they	

3. Qualification and Hiring	
meet a state exemption that would allow them to waive a DOT medical examination or that may allow for medical waivers (e.g., for diabetes or impaired vision)?	
• Is a **copy of the driver's latest medical certificate enough documentation for your company's DQ process** (regulatory minimum)?	
• Do you **ensure medical examiners are certified through the appropriate state regulatory agency**?	
• How have you **found and selected your medical examiner**? o Have you contacted a local medical group/clinic to find out if it conducts DOT medical examinations? o Have you contacted other local truck companies to find out what medical examiner they use to conduct DOT medical examinations? o Have you looked at classified ads in the phonebook or online to locate a local DOT medical examiner?	
• How much **does your company pay for a DOT medical examination**? o Do you **require drivers to pay the cost for their DOT medical exam**? o How much does **each driver pay for a DOT medical** examination? o Do you reimburse drivers for the cost of the DOT medical examination?	
• Have any of your **drivers not passed the DOT medical examination?**	
• Where do **you obtain your DOT medical examination forms**? • Does your medical examiner supply your drivers with a DOT medical long/short form when they are examined? Do you obtain a release from drivers to obtain records of the completed medical examination (long form), and have you reviewed the long form for your drivers?	
• Do you **screen newly hired drivers or monitor experienced drivers for medical conditions** that put them at increased risk of becoming medically unqualified?	
• Do you **check medical histories for conditions** such as sleep apnea, hypertension, or diabetes?	
• Do any of your **drivers require a diabetic/vision waiver**?	
• Do any of your **drivers require a Skill Performance Evaluation due to limb impairment or loss**?	
• Do any of **your drivers have limb impairment/loss**?	
• Do any of **your drivers have vision problems or require insulin** for diabetes?	
• Do you have any **drivers that have been in a recent accident** resulting in permanent injury?	

3. Qualification and Hiring	
• Do you have any **drivers who have taken an extended leave** of absence due to illness or injury?	
• What **provisions of the state grandfathering exemption do your drivers meet**?	

3. Qualification and Hiring	
• Do you **operate tank and double- or triple-trailer-combination trucks**? o Do your drivers have proper endorsements? o Have you done a road test with the drivers who actually operate the tanks and/or double- and triple-combination trailers? · If not, why not? o How do you ensure that each driver has the proper endorsement on his/her CDL for the equipment being operated? (Used generally for private carriers with multiple types of vehicles and trailers.)	
Passenger Carrier Only Questions	**Carrier Response**
• When **hiring for passenger carriers, how do you ensure that applicants have the proper class of license "P" or "S," and do you check to see** if there are any restrictions on their license? o What is your process? o Do you check with the applicant or the previous employer? o Do you check the MVR?	
• Does **anyone check drivers for fitness prior to dispatching** them? o Is the dispatcher trained to determine fitness for duty?	
Hazmat Carrier Only Questions	**Carrier Response**
• **What are your hiring procedures for HAZMAT drivers**?	
• How do you **ensure that driver applicants can meet physical and intellectual requirements for, and withstand additional stress associated with**, multiple HAZMAT transportation responsibilities? o What kinds of questions do you ask applicants and their references? o Do you administer any physical or stress tests?	
• Do you use a **check sheet for the DQ process**?	
• How do you **track inquiries into driving records, past employers, and drug and alcohol testing results**?	
• What **follow-up procedures does your company use to obtain personal information during the hiring process** that could not be obtained during the initial qualification process?	
• What type of **security checks do you perform when hiring HAZMAT drivers**?	
• How do **you test your HAZMAT employees after providing training**? o What is considered a passing score on your company's HAZMAT tests? o Are incorrect answers reviewed, or are tests administered a second time?	

3. Qualification and Hiring	
• Do you **haul flammables, fuel, or gasoline**? o If so, what kind of expertise is needed? o Are qualified drivers hard to find? o What is your rate of turnover? o Does this exacerbate the hiring problem?	
• What is your **hiring process for drivers transporting flammable HAZMAT?**	
• How do you **screen new candidates for hauling flammable materials to allow only nonsmokers**? o What kinds of questions do you ask applicants and their references?	

4. Training and Communication	
General Questions	**Carrier Response**
• What is your **training/orientation program for DQ and fitness?**	
• What is your **process for entry-level driver training?** o In which areas do you train your drivers? · *Request the training materials.* · *Request the recordkeeping (i.e., certificates) from the training.*	
• Do you have a **list of recurring training for each employee, with corresponding endorsements**? o *Request the training records for all employees assigned to special loads (e.g., HAZMAT, passenger).*	
• How do you **ensure that drivers are capable of handling your equipment even though they may be "qualified**"?	
• How do you **consistently communicate all driver fitness policies and procedures to staff so that senior managers** are confident that each employee understands the information? o How is this done for new and existing employees? o How is this done when new policies and procedures are implemented? o What are all formal and informal methods? o What sort of documentation is used to support this communication? · *Request the documentation.*	

4. Training and Communication	
• What is the **process that you use to consistently transmit and receive DQ and fitness information**? o How is this done for new and existing employees? o How is this done when new policies and procedures are implemented? o What are all formal and informal methods? o What sort of documentation is used to support this communication? · *Request the documentation.*	
• What is the **process for ensuring that hiring officials and safety managers have current knowledge and experience regarding driver fitness rules (both interstate and intrastate),** interpretations, training, recordkeeping requirements, and compliant practices of other companies? o What are all formal and informal methods? o What sort of documentation is used to support this communication? · *Request the documentation.*	
• How does the **training system accommodate employee turnover, part-time employees, employees covering for others** on vacation/sick leave, and the training of new employees?	
• **How is training on driver fitness issues reinforced**? o Do you use job aids, communication, coaching, mentoring?	
• How **do you communicate with senior leaders about driver fitness issues**? o How often is this done? o Do drivers have direct access to the safety director or owner/company executives about these issues? o Do they hash them out first with the terminal manager, dispatcher, and/or parts/inventory person(s)? o How do all parties interface with each other?	
• Does your **staff understand the DQ/medical requirement process**?	
• Are your **drivers/company officials aware of the company disciplinary process concerning driver and medical qualifications**?	
• How **often do you have an internal safety-meeting discussion without drivers present**?	
• Do you provide a **health and wellness program for drivers**?	
Passenger Carrier Only Questions	**Carrier Response**

4. Training and Communication	
• How are **passenger complaints generally dealt with**? o Is senior management involved? o If so, when and how? o What is your communications program with senior company leaders to address passenger complaints that have safety implications?	
Hazmat Carrier Only Questions	**Carrier Response**
• Who **conducts the HAZMAT training, and what are this person's qualifications**?	
• How does your company conduct **initial training** of a new driver? o How long is the training? o What materials do you use when conducting the training? o Is a test administered after the training, and how are the results evaluated?	
• How does your **company conduct recurrent HAZMAT training**? o How long is the training? o What materials do you use when conducting the training? o Is a test administered after the training, and how are the results evaluated?	
• How do you **ensure that drivers understand which loads they are qualified to haul**? o Do you offer training on this topic? o If so, how often, and what triggers the training? o Do you have job aids to help drivers learn the material?	

5. Monitoring and Tracking	
General Questions	**Carrier Response**
• How do you **maintain up-to-date DQ files**?	
• How long do you **maintain DQ information**?	
• **How do senior and middle management monitor and document staff compliance with driver fitness regulations and company policies**? o Where is the documentation kept? · *Request a copy of it.*	
• Do you have a **method for keeping track of drivers with one serious traffic violation currently on their CDL?** (A second serious moving violation subjects the driver to DQ.)	

5. Monitoring and Tracking	
• Do you **check the accuracy of each driver's DOT medical card**?	
• What is **your process for monitoring and documenting all drivers' job functions**, training, qualifications, renewal dates, medical conditions, and operational restrictions? o How do you ensure that driver assignments are covered by the appropriate driver? o Do you employ any driver who operates under a Skill Performance Evaluation (medical waiver)? o Where is the documentation kept? · *Request a copy of it.* o Who tracks this information, and how often is it updated? o With whom do you communicate when a driver is taking on an inappropriate assignment?	
• Do you have **methods and controls for ensuring that changes in qualifications are accurately obtained, verified, and recorded**?	
• Do you **track and document all employees' driver fitness training needs and training received**? o Who does this? o What is the process? o How is this information used? · *Request the supporting documentation.*	
• Do you **periodically review each driver's MVR to ensure compliance with company policies, federal regulations, and local laws and ordinances?** o If so, how do you this? o How often do you do it? o Who is involved? o What is done with the information?	
• Do you **rely on the insurance company to examine MVRs**? o Does your insurance company inform you when one of your drivers has been convicted of a violation? o Do you monitor your drivers by acquiring an MVR on your own? · *If so, how often?* o Where do you maintain the copies of MVRs? o How do you track whose (annual) MVRs you need to acquire?	
• Do you **maintain a record of disciplinary actions (written or verbal) for each drive**r? o *If so, request the document.* o If not, why not?	

5. Monitoring and Tracking	
• Do you **review your roadside inspection results via the Internet**? o If so, how often? o Who does this? o How is this information disseminated throughout the organization, and who receives it? o How is the information used in the organization?	
• How does **the company track DOT medical expiration dates** to ensure that drivers aren't operating while being DOT-medically unqualified? o Have you used drivers that have had expired DOT medical cards? o How do you monitor the roadside performance of your drivers?	
• Do you **check each driver's medical long form to ensure that it hasn't been falsified or altered**?	
• Have any of your **drivers been cited for medical violations during roadside inspections**?	
• Have any of your **drivers been in a DOT-recordable accident due to a medical problem**?	
• Have any of your drivers had recent illnesses or crashes that may have caused a sudden health concern/change?	
• Do you use **part-time or intermittent drivers**? o Do you review each driver's MVR to ensure compliance with driver fitness company policies, federal regulations, and local laws and ordinances? o Does your monitoring process for compliance rely on self-reporting? o Do you have a process for monitoring and documenting all drivers' job functions, training, qualifications, renewal dates, medical conditions, and operational restrictions to ensure that driver assignments are covered by the appropriate driver?	
• How do you **monitor your intermittent drivers for physical and license qualifications**? o Is this information tracked? · *Request the tracking document.* o Who does this? o How often is it done?	
Hazmat Carrier Only	**Carrier Response**

5. Monitoring and Tracking	
• How do you **ensure that assignments are allocated according to qualification requirements**? o Is this information tracked? · *If so, request the tracking documents.*	
• What is the **size of the driver pool, and how many drivers have an "H" or "N" endorsement on their CDL?**	
• Do your **drivers have the ability to reject a** load that they have been dispatched to transport?	
• How do you **back-reference a trip, and what information can you provide in relation to**: o The driver? o The vehicle? o The type of cargo? o The destination? o Pick-up and delivery times?	
• Do you **monitor the smoking habits of drivers and attendants of HAZMAT vehicles?** o If so, how? o Do you verify that habitual smokers are monitored for smoking while transporting flammable or incendiary loads or operating equipment by checking the vehicle and the equipment before and after the assignment? o Is this information tracked? · *If so, request the tracking documents.*	

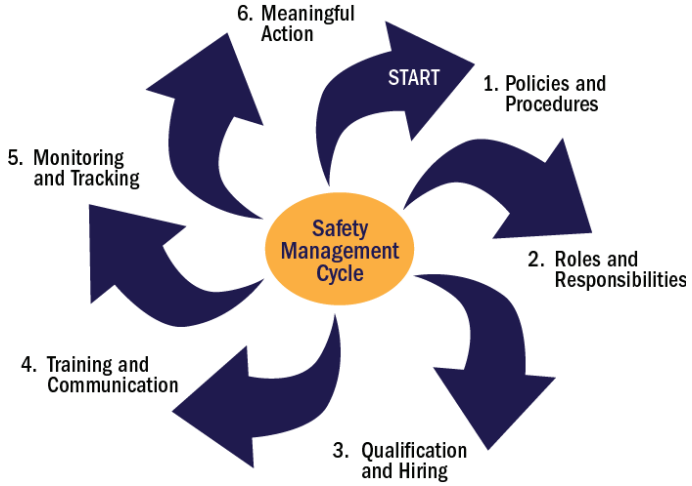
6. Meaningful Action	
General Questions	**Carrier Response**
• How do **managers and employees typically react when they see coworkers not fulfilling their responsibilities**? o Do they give immediate and direct feedback? o Do they ignore the problem? o Do they inform their supervisor?	
• What are your **current policies/practices regarding employee incentives and reward/recognition programs?** For example: o How is compensation calculated, by the hour/load/mile/timeliness of delivery? o How are people promoted? o How are bonuses calculated? o How are safety-incentive awards dispersed (quarterly/annually) and/or adjusted for non-performance?	

6. Meaningful Action	
• Do you have a **progressive disciplinary program, ultimately leading to termination, focused on taking corrective action** to ensure that drivers comply with regulations and company policies? o If so, what is the program? · *Request a copy of it.* o What are some instances when this program was used? o Who is involved in implementing it?	
o When it is **clear that regulations and company policies are not well understood, and do you have a mandatory refresher training program/class** that helps employees understand the necessary information in a timely manner? What triggers when this mandatory refresher training is needed? o Who makes these decisions? o What are some instances when you have done this? · *Request documentation of some instances when this has occurred in the form of training materials and a list of people who received the training.*	
• What are the **incentives and reward and recognition programs for each employee (or for Employee X)?** o Did you align your incentives and reward/recognition programs in such a way that they motivate the behaviors needed to successfully achieve employee's roles and responsibilities? o Does anybody check on a regular basis to make sure that this alignment is actually occurring, especially when the job or incentives change? o How do you complete this alignment process? o Who does it? o *Request a written copy of the incentives and/or reward/recognition programs.*	
• Do you **provide safety-performance incentives to your drivers**? o If yes, do roadside violations related to medical certificates/licensing affect safety-performance awards?	
• If the **company does not provide safety-performance incentives, is there a disciplinary program** that addresses roadside violations related to medical certification/licensing?	
• Are your **drivers/company officials aware of the company disciplinary process** concerning driver and medical qualifications?	

6. Meaningful Action	
• Do you **maintain a record of disciplinary actions** (written or verbal) for each driver? If not, why not?	
• Do you have a **system that dispatch uses to reference and/or verify driver credentials prior to assigning drivers**: o To loads involving HAZMAT? o To vehicles that may require specific license endorsements, depending on equipment fleet?	
• Have you **taken any action(s) to address the violations noted in your Driver Fitness warning letter** (if applicable)?	
Hazmat Carrier Only	**Carrier Response**
• Do you **provide incentives and disciplinary measures for drivers who accept loads without required qualifications**? o If so, what are these incentives and measures? · *Request a written copy of them.*	

Appendix Q: HM Compliance Probing Questions

This job aid provides a list of Investigative Probing Questions for the Hazardous Materials (HM) Compliance Behavior Analysis and Safety Improvement Category. This job aid can be used to engage the carrier in a collaborative exchange designed to review the Safety Management Cycle and identify where a breakdown has occurred in the Safety Management Process (Process Breakdown), understand the reasons why the Process Breakdown(s) occurred and its consequences (e.g., violations), and develop a plan for improvement. Prior to beginning the discussion, the Safety Investigator should review the questions and



The Safety Management Cycle

identify those that may be most relevant to his or her discussion. Additional information on how the job aid can be used is provided below.

How can I use this job aid? The probing questions can be used to:

- Start the discussion with the carrier;
- Develop an appropriate line of questioning; and
- Spark additional questions.

What should I keep in mind when using this job aid? Keep in mind the following guiding principles while engaging the carrier during the investigative questioning and remedy development process:

- Frame the questions so that the exchange moves toward determining the Process Breakdown(s);
- Stay focused on the goal of the exchange; steer away from discussions that stray from the goal;
- Engage the carrier so that he or she plays a role in diagnosing the issue and developing the remedy for improvement;
- Remember that participation in this self-assessment increases the likelihood that the carrier will change his or her behavior and is a key factor in gaining 'buy-in' to implement remedies; and
- Once the breakdowns are identified, ask the carrier why he or she believes these breakdowns are occurring and consider this information when selecting appropriate remedies for the carrier.

1. Policies and Procedures	
General Questions	**Carrier Response**

• What types and quantities of HAZMAT does your company:
  o Ship (offer for transportation)?
  o Transport?
• Have you:
  o **Registered with US DOT/Pipeline and Hazardous Materials Safety Administration (PHMSA)** as a carrier that transports HAZMAT (if required)?
  · **If so, what is your DOT HAZMAT registration number?**
  · **Request a copy of your registration form.**
  o Obtained a **HAZMAT Safety Permit (HMSP) from US DOT/Federal Motor Carrier Safety Administration (FMCSA) (if required)**?
  · *If so, request a copy of your HMSP.*
  o Registered with US DOT/ FMCSA to obtain a Cargo-Tank Testing Facility number (if required)? (NOTE: See Part 107, Subpart H.)
  · *If so, request a copy of your certificate.*
  o Had any HAZMAT incidents requiring reporting? Note: there are a number of exceptions to HM Incident Reporting. Please reference 171.15 and 171.16 for these exceptions.
  · *Request a copy of these reports.*
• Does your company operate/utilize any US DOT Special Permits? (NOTE: If Special Permits (SPs) are used, the investigator should look for additional training records pertaining to the specifics of the SP.)
  o If so, are you the original holder/applicant for the SP?
  o If not, are you a party to the SP?
• *Request the SPs.*	

1. Policies and Procedures	
• **What are your overall safety program and policies**? o *Request a copy.*	
• *Request the HAZMAT shipping papers for the last year.* • Who handles emergency response information for your company? o Is it the company, itself? o Is it a contractor? · If so, what is the contract number and contact information? • What documentation do you carry in your vehicles to comply with the emergency response information requirements? • Do you have processes in place to test emergency response telephone numbers? *(Note: While at the carrier/shipper, the investigator should randomly test numbers for validity.)*	
• Do you have a policy that **ensures that regulatory requirements for HAZMAT-transportation registration, recordkeeping, packaging, securement, marking, labeling, placarding, reporting, documentation, security, and emergency response** are addressed? o If so, is it written or verbal? o *If written, request documents.* o *If verbal, request description.* o If there is no policy, why not?	
• Do you have **policy/procedures for accepting loads, assigning drivers, and establishing delivery schedules** to meet safety-risk objectives? o If so, are they written or verbal? o *If written, request documents.* o *If verbal, request description.* o If there is no policy, why not?	
• Do you package HAZMAT for transportation? • Are you familiar with the requirements to package HAZMAT for transportation? • Do you have written procedures on how to package HAZMAT? • Do you provide these **written procedures on how to package HAZMAT** to your employees? o *Request the written procedures.*	
• Do you have **policy/procedures for drivers and other designated personnel for packaging, marking, labeling, placarding, shipping papers, and inspection tasks**? o If so, are they written or verbal? o *If written, request document.* o *If verbal, request description.* o If there is no policy, why not?	

1. Policies and Procedures	
• Are you required to have a Security Plan according to the HAZMAT regulations? o If so, do you have a written plan? · *Request the plan.* o If not, why not? • How does the company report and record security threats? • NOTE: If *a Security Compliance Review has not been conducted within the last 12 months, the investigator should conduct one at this time.*	
• How often do you **review the effectiveness of HAZMAT policies and procedures**? o Who is responsible for writing policy, and how is information obtained for its development? o Are company policies in writing and available to all employees who are responsible for their implementation? o Does your company have written policies and procedures in place to ensure compliance with the Hazardous Materials Regulations?	
• Who does your cargo-tank testing and inspection? Do you have policies/procedures for cargo-tank **testing and inspecting**? o If so, are they written or verbal? o *If written, request procedures.* o *If verbal, request description.* o If there is no policy, why not?	

2. Roles and Responsibilities	
General Questions	**Carrier Response**
• Who in your company is responsible for the following HAZMAT functions *(Note: there may be more than one person responsible for each function. For example – one person for developing the procedures and another for providing the information to the driver.):* o Training? o Security? o Preparing shipping papers, including emergency response information? o Packaging HAZMAT (if applicable)? o Marking and labeling HAZMAT (if applicable)? o Placarding of transport vehicles (if applicable)? o Classifying HAZMATs offered (if applicable)? o Loading and securement? o Separating and segregating HAZMAT on transport vehicles (including segregation requirements applicable to poisons and foodstuffs)? • Are these roles documented? o *If so, request the documentation.* • How do you ensure that these roles are aligned with company policy?	
• What are the **roles and responsibilities of drivers, dispatchers, managers, and other designated personnel** in relation to regulations and company policy/procedures involving HAZMAT handling functions for: o Packaging, testing and monitoring test results, and inspecting cargo tanks? o Securement, marking, labeling, placarding, and reporting? o Transportation registration, documentation, recordkeeping, security, emergency response, and training? o Are these roles documented? · *If so, request the documents.* o How do you ensure that the roles are aligned with company policies and regulations? · *Request the company's written policies and procedures. (Check to see if they align with the roles.)*	
• Who is **responsible for developing a HAZMAT Security Plan and providing training** to employees who are assigned to implement it?	

2. Roles and Responsibilities	
• Who is **responsible for preparing HAZMAT shipping papers and obtaining emergency response** information? o Who monitors the preparation of these papers and provides emergency response information to drivers?	
• What are the **roles and responsibilities of managers and dispatchers who are accountable** for ensuring that drivers are in compliance with the Commercial Driver's License (CDL) requirements, if applicable? o Do drivers who transport HAZMAT requiring placards hold a CDL with an "H" endorsement? o Do drivers who transport liquid or gaseous HAZMAT in bulk packages, with aggregate capacities meeting or exceeding 1,000 gallons hold a CDL with a "T" endorsement? o Are these roles/responsibilities documented? · *If so, request the documents.*	

3. Qualification and Hiring	
General Questions	**Carrier Response**
• What is your **process and criteria for hiring and promoting employees**?	
• What are your processes and criteria for **hiring and promoting drivers and other HAZMAT personnel?**	
• How do you **find and attract qualified** applicants? o How do you advertise openings? o Who is part of the network of people you talk to in order to find an applicant?	
• How do you **determine if the applicant is a good fit** for the opening?	
• Do you look for applicants with **experience directly applicable to your operations**?	
• Do **prospective employees fill out employment applications**?	
• Does the employment application include questions about **qualifications for transporting** the company's particular HAZMAT loads?	
• How do you **ensure that your drivers have sufficient skills and credentials for performing HAZMAT responsibilities**? What is the process?	
• How do you **verify if the driver or other HAZMAT personnel performs HAZMAT tasks effectively**?	

3. Qualification and Hiring	
• Do you **look at driver and other HAZMAT personnel violations as part of the hiring** process? Do you check to see if the driver has had previous HM violations? o If not, why? o If so, what are your methods? • Do you obtain information from: o The driver? o Previous employers? o The insurance company? o Others?	
• Do you get **copies of driver Motor Vehicle Records**?	
• Do you **check references**?	
• Do you **check with previous employers**?	
• What is your **rate of turnover**?	
• Do you **have trouble attracting and retaining an adequate supply of HAZMAT qualified personnel**?	
• When hiring, do you **query applicants and check with previous employers regarding prior HAZMAT–transportation violations,** qualifications, experience, and responsibilities? o If so, what is this process? · *If the process or its results are documented, request the documentation.*	
• When senior positions are difficult to fill, **do you recruit and hire at the apprentice level and provide the training** necessary for qualification? o What is this process? o For which positions have you done this, and when?	
• At what **company did your cargo-tank inspector/tester obtain experience**? o Does this person have at least three years of experience in inspecting and testing cargo tanks? o Did the individual graduate from high school or obtain a GED? o *Request employee's application for this position.*	
• Do you **prohibit the hiring of drivers (or attendants) who smoke, to perform the loading, unloading, attending, or transporting flammable and/or explosive loads** and other incendiary materials or equipment? o If so, how is this accomplished? o Do you have written procedures? · *If so, request the documents.*	

3. Qualification and Hiring	
• Do you **prohibit the assignment of drivers (or attendants) who smoke, to perform the loading, unloading, attending, or transporting flammable and/or explosive loads** and other incendiary materials or equipment? o If so, how is this accomplished? o Do you have written procedures? · *If so, request the documents.*	

4. Training and Communication	
General Questions	**Carrier Response**
• What is the **process that you use to consistently communicate expectations regarding policies/procedures** to drivers and other HAZMAT personnel so that senior managers can feel confident that the policies/procedures are understood by employees? o How is this done for new and existing employees? o How is this done when new policies/procedures are implemented? o What are all formal and informal methods? o What sort of documentation is used to support this communication?	
• How do you ensure that your employees are properly trained in each HAZMAT function that they perform? • Do you conduct your own training? • Is the training contracted? o *If so, what is the name and contact information for the contractor?* • What kinds of **HAZMAT training** do you offer: o To new hires? o As a refresher? o *Request copies of these training materials.*	
• Do you **require your drivers and other HAZMAT personnel to attend/pass HAZMAT training**? (Note: Investigators should check for compliance with training requirements in section 177.816, in addition to those is Part 172, Subpart H.) o If so, why, when, and how? o *Request copies of these training materials.*	
• Do you **require your dispatchers to attend/pass HAZMAT training**? o If so, why, when, and how? o *Request copies of these training materials.*	

4. Training and Communication	
• Have you **provided specialized training or counseling to drivers and other HAZMAT personnel on the basis of roadside inspections**? o *Request copies of these training materials.*	
• How do you **address drivers or other HAZMAT personnel** who need new skills? o Does skill upgrading happen in-house? o What combination of methods do you use (e.g., coaching, training, and/or mentoring)? o Is your training interactive? o Does it include hands-on demonstration? o *Request the training materials.*	
• Describe how **HAZMAT training is reinforced in the field**. o Do you use job aids, communication, coaching, and/or mentoring? o *Request copies of these training materials.*	
• How do you **communicate with senior leaders about HAZMAT safety issues** on a regular basis?	
• Do **drivers have direct access to the safety director or owner/company executives** about HAZMAT safety issues? o Do they hash them out first with the terminal manager, dispatcher, and/or parts/inventory person(s)? o How do all parties interface with each other?	
• Are there **any business-related barriers that might affect communications between HAZMAT personnel and/or drivers regarding vehicle maintenance**? o If so, do these barriers pertain to: • Geography? • Functional reporting? • Competition? • Rewards/recognition? • Incentives? • Other?	
• How much **information does a dispatcher know about a particular driver's level of experience and/or skills related to HAZMAT**? o How is this communicated?	
• Do you use **an automated logistics Management Information System**? o If so, which one? o Are managers and dispatchers trained on this system? o *Request training materials and records of attendance.*	

4. Training and Communication	
• What is the **process you use to consistently communicate expectations for adhering to all HAZMAT-handling regulations and policies/procedures** to drivers, dispatchers, managers, and other designated personnel, and to provide new-hire and refresher training for meeting those expectations with regard to packaging, testing and inspection of cargo tanks; securement, marking, labeling, placarding and reporting; and transportation registration, documentation, recordkeeping, security, and emergency response? o How is this done for new and existing employees? o How is it done when new policies and procedures are implemented? o What are all formal and informal methods? • What sort of documentation is used to support this communication? o *Request the documentation.*	
• Have you **trained your HAZMAT employees on the Security Plan (if applicable)**? o *If so, request documentation verifying where and when the training took place and a list of personnel who attended.* • How are en route security threats communicated to the company and what happens if one is received? o **Do you have written procedures for this?** · *If so, request the documents.* · If not, why not?	
• What is **the process you use to ensure that drivers understand which loads they are qualified to haul and that dispatchers know how to confirm load requirements with shippers and to verify that drivers** have the proper endorsements and qualifications? o What are all formal and informal methods? • What sort of documentation is used to support this communication? o *Request the documentation.*	
• How do you **prepare your employees for cargo-tank testing**? o Do you have an apprenticeship program to provide individualized training and certification for cargo-tank testing and inspection to new hires and transfers? o What sort of documentation is used to support this education? · *Request the documentation.*	

4. Training and Communication	
• How do train your drivers and other HAZMAT personnel to comply with the requirements specific to PHMSA Special Permits (if applicable)? o Do you have documentation for this training? · *If so, request a copy of the documentation.* · If not, why not?	

5. Monitoring and Tracking	
General Questions	**Carrier Response**
• How do you **monitor and track tasks, schedules, and costs for HAZMAT-related tasks?**	
• Do you **track compliance with HAZMAT regulations**?	
• Do you monitor **HAZMAT violations**?	
• Does a **company official review roadside inspection reports for HAZMAT violations**?	
• Do you **review your roadside inspection results via the Internet**? o If so, how often? o Who does this? o How is this information disseminated throughout the organization, and who receives it? o How is the information used in the organization?	
• How do you **check on the driver's and other HAZMAT personnel's performance**?	
• Do you **regularly review and evaluate records of HAZMAT methods, procedures, equipment, and devices used**? o If so, how often? o Who is involved? o What are some recent reviews and the corresponding changes that were made as a result? o Is this process documented? · *If so, request the documentation.*	
• How do you know that **your HAZMAT training** is effective?	
• Do you receive **complaints about HAZMAT handling or packaging** when it arrives at a destination?	

5. Monitoring and Tracking	
• How do **senior and middle management monitor and document staff compliance with HAZMAT regulations and address complaints of shippers and receivers**? o Where is the documentation kept? · *Request a copy of it.* o Do you keep a log of complaints and whether they have been handled appropriately?	
• Do you **track and document all employees' HAZMAT training needs and training received**? o What is the process that is used? o How is this information used? o *Request the documentation.*	
What is your process **for monitoring and tracking compliance of all designated employees according to HAZMAT-handling regulations and company policies**?	
• How do you **monitor, and who is responsible for monitoring, the performance of individuals who**: o Fill out the appropriate HAZMAT registration and other forms? o Prepare shipping papers and emergency response information? o Provide emergency response information to drivers?	
• What is your **process for monitoring systems and databases, including reminders, alerts, and internal audits, that are used for compliance with HAZMAT-handling regulations and company policies**? o Do you **routinely obtain a copy of the carrier profile**? o Do you routinely visit the Safety Measurement System online?	
• Do you use **computer programs in the preparation of HAZMAT documentation and as tools for compliance**? o How often are your computer applications updated? o When did you start using computer programs, and what steps were taken in making that decision? o What advantages and disadvantages did your company experience with the adoption of computer-generated documents and tools?	
• What is **your process for regularly tracking and evaluating the effectiveness of company policies, procedures, and systems related to HAZMAT transportation**?	
• How do you **monitor to see if drivers (or other employees) who smoke are assigned to flammable loads**?	

5. Monitoring and Tracking	
• What is **your process for monitoring and tracking to ensure that cargo tanks are inspected and tested for replacement or repair as needed**? o *Request the documentation.* o Who tracks this information, and how often is it updated? o Who is made aware, and by whom, when repair and replacement are not done as needed?	
• What is your process for monitoring and tracking attendance of Division 1.1, 1.2, or 1.3 Explosive Loads, if applicable? o Do you have documentation for this process? o *Request the documentation.*	
• What is your process for tracking and reporting movements of HAZMATs subject to the HMSP requirements, if applicable? *(NOTE: Refer to Part 385, Subpart E, Section 385.415(c)).* o Do you have documentation for this process? · *Request the documentation.*	

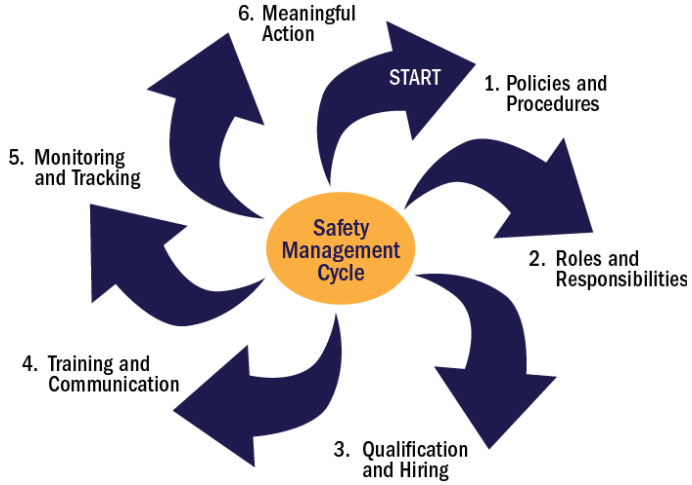
6. Meaningful Action	
General Questions	**Carrier Response**
• How **important do you think that compliance with HAZMAT regulations is for ensuring highway safety**?	
• How **concerned are you about your ongoing HAZMAT issues**?	
• How does **HAZMAT safety impact your operations**?	
• Have you **aligned your incentive programs so that they motivate the behaviors needed to achieve employee roles and responsibilities**? o Does anybody check on a regular basis to make sure that this alignment is actually occurring, especially when the job or incentives change? · If so, how do you complete this alignment process? · Who does it?	
• **What are these incentives and/or reward/recognition programs**? o Are they documented? · *If so, request a copy.* o *If not documented, request a verbal description.*	
• Do you test your **drivers and other HAZMAT personnel on their knowledge of HAZMAT safety policies and procedures**?	

6. Meaningful Action	
• How do you **respond to drivers and other HAZMAT personnel who have HAZMAT problems (violations, complaints, etc.)?** o Do you provide specific training?	
• How do **managers and employees typically react when they see coworkers not fulfilling their responsibilities**? o Do they give immediate and direct feedback? o Do they ignore the problem? o Do they inform their supervisor?	
• Do you have a **progressive disciplinary program ultimately leading to termination, which focuses on taking corrective action** to ensure that drivers comply with regulations and company policy? If so- o *Request a copy of it.* o Describe the program and some instances in which it was used? o Who is responsible for implementing it?	
• Do **drivers execute HAZMAT procedures under difficult conditions**? o Do you reward drivers for time spent learning and/or completing procedures, especially under difficult conditions?	
• When it is **clear that regulations and company policy are not well understood, do you have mandatory refresher training** that helps employees understand the necessary information in a timely manner?	
• What **triggers referral to mandatory refresher training**? o Who makes these decisions? o Describe some instances when you have made such a referral.	
• **Have you had instances when refresher training was required?** o *If so, request documentation.* ***(Note: This documentation could be in the form of training materials*** *and a list of people who received the training.)*	
• Do **you factor drivers' and other HAZMAT personnel's performance** into training programs?	
• Is there a **disciplinary and/or recognition program for performance on the basis of roadside inspections**?	
• Have you taken any **action to address the violations noted in your Warning Letter (if applicable)**?	

6. Meaningful Action	
• What are the **incentive and reward/recognition programs for each employee (or Employee X) who has a role in HAZMAT handling**? o Have you aligned your incentive programs so that they motivate the behaviors needed to achieve employees' roles and responsibilities? o Does anybody check on a regular basis to make sure that this alignment is actually occurring, especially when the job or incentives change? o Who completes this alignment process, and how? o *Request a written copy of the programs.*	
• Do you **provide incentives and disciplinary measures for drivers who accept loads without required qualifications**? o If so, what are these measures? • *Request a written copy of the documentation of these incentives and disciplinary measures?*	
• What is an **example of a driver who has participated in your disciplinary program**?	

Appendix Q: HOS Compliance Probing Questions

This job aid provides a list of Investigative Probing Questions for the Hours-of-Service (HOS) Compliance Behavior Analysis and Safety Improvement Category. This job aid can be used to engage the carrier in a collaborative exchange designed to review the Safety Management Cycle and identify where a breakdown has occurred in the Safety Management Process (Process Breakdown), understand the reasons why the Process Breakdown(s) occurred and its consequences (e.g., violations), and develop a plan for improvement. Prior to beginning the discussion, the Safety Investigator should review the questions and identify those that may be most relevant to his or her discussion. Additional information on how the job aid can be used is provided below.



The Safety Management Cycle

How can I use this job aid? The probing questions can be used to:

- Start the discussion with the carrier;
- Develop an appropriate line of questioning; and
- Spark additional questions.

What should I keep in mind when using this job aid? Keep in mind the following guiding principles while engaging the carrier during the investigative questioning and remedy development process:

- Frame the questions so that the exchange moves toward determining the Process Breakdown(s);
- Stay focused on the goal of the exchange; steer away from discussions that stray from the goal;
- Engage the carrier so that he or she plays a role in diagnosing the issue and developing the remedy for improvement;
- Remember that participation in this self-assessment increases the likelihood that the carrier will change his or her behavior and is a key factor in gaining 'buy-in' to implement remedies; and
- Once the breakdowns are identified, ask the carrier why he or she believes these breakdowns are occurring and consider this information when selecting appropriate remedies for the carrier.

1. Policies and Procedures	
General Questions	**Carrier Response**
• Explain your **dispatch system/processes** in detail.	
• Do dispatch and safety management work together?	
• Is there a **clearly stated company policy that addresses HOS regulations**? o If so, is it written or verbal? · *If written, request the document.* · *If verbal, request description.*	
• Is there a policy that requires **drivers to report their available hours to dispatch during "check-in" calls**?	
• Is there a **policy that prohibits dispatchers from assigning a load to drivers without hours available** to complete the load on time?	
• Do you **use team driving**?	
• What **tools do you use in route planning**?	
• How do you **determine which drivers get what loads and routes**?	
• Does the company have a policy that requires dispatch to know **about individual driver experience and skills**?	
• Do you **have schedule constraints such as morning-delivery only**, problems waiting for the shipper, or problems with loading/unloading?	

1. Policies and Procedures	
• Does the **dispatcher consider traffic and time of day** when making routes?	
• How **much slack time do dispatchers allow** in the schedule for drivers?	
• Does **dispatch do alternative route or scenario planning**?	
• How do **you correct errors to the logs? And what documentation do you maintain of the correction**? (Part 395.8(k))	
• What is **your disciplinary policy**? Is it written or verbal?	
Passenger Carrier Only Questions	**Carrier Response**
• Is there a company policy that requires that you have **someone who is trained/certified to recognize fatigue or fitness-for-duty issues**?	
• Do you have a **policy that prohibits drivers from deviating from the scheduled itineraries**, and do you advise customers of it? o If so, are they written or verbal? · *If written, request the documents.* · *If verbal, request description.* o If you don't have such policy/procedures, why not?	
• Do **you have established policy/procedures that account for available hours for separate operations within-company, for intermittent drivers, and for "extended day"**? o If so, are they written or verbal? · *If written, request the documents.* · *If verbal, request description.* o If you don't have such policy/procedures, why not?	
• Do **you use part-time or intermittent drivers**? If so: o Do you require them to fill out the seven-day duty statement? o Do you require drivers to report secondary employment hours?	
• How often do you **book trips that depart at night**?	
• Do you **have a policy that discourages long-distance trips that depart at night** and outlines acceptable route-scheduling procedures? Does the procedure include **checking prior driver rest, not just off-duty time**? o If so, are they written or verbal? · *If written, request the documents.* · *If verbal, request description.* o If you don't have such policy/procedures, why not?	

1. Policies and Procedures	
• Do you **have a procedure that includes checking prior driver rest, not just off-duty time?**	
• What is **your disciplinary policy**? Is it written or verbal?	
Hazmat Carrier Only Questions	**Carrier Response**
• Do you **have policy/procedures for all personnel involved in accepting HAZMAT loads, assigning drivers, and establishing delivery schedules**? o If so, do they take into account the full operational process and enable dispatchers to safely manage all types of loads within HOS? o If so, are they written or verbal? · *If written, request the document.* · *If verbal, request description.* o If you don't have such policy/procedures, why not?	
• At what **level are decisions being made prior to dispatch** that a load is to be taken for transportation by the company?	

2. Roles and Responsibilities	
General Questions	**Carrier Response**
• Who **does the dispatching and to whom do the dispatchers report**? How many dispatchers are there?	
• Do **dispatch and safety management work together**? If so, what is the relationship?	
Passenger Carrier Only Questions	**Carrier Response**
• Whose **responsibility is it to verify that HOS are available within the company, for intermittent and relief drivers, and for "extended day"?** o What is the person's role? · *If it is documented, request the document.* o Who is assigned to monitor Records of Duty Status (RODS) for accuracy, communicate the results, and take meaningful action?	
• Do you **assign drivers to multiple operations within a short timeframe (co-mingling)?** o Do you use part-time, intermittent, or relief drivers, or are drivers shared between employers? o Do you require drivers to complete the seven-day duty statement? o Is there a policy that outlines reasons why drivers need to complete this statement?	

2. Roles and Responsibilities	
Hazmat Carrier Only Questions	**Carrier Response**
• When **assigning roles and responsibilities, are you careful not to overburden drivers who are already time-stressed**? o If so, how do you ensure this? o Do you ask for driver feedback on this issue?	
• Are your **drivers involved in making business decisions**? o If so, does this interfere with their safety performance?	
• Do **your drivers have the authority to park the vehicle** and, if so, for how long?	
• Do you have **restrictions as to when your drivers can load and unload at terminals** that you service?	

3. Qualification and Hiring	
General Questions	**Carrier Response**
• What are your **employee hiring and promoting** procedures?	
• **What do you look for in the ideal employee?**	
• What is your **driver training program for new hires**?	
• Do you **have trouble attracting/retaining enough drivers**?	
• What is your **turnover rate**?	
• Do you **screen newly hired drivers for medical conditions that put them at increased risk for fatigue**, sleep disorders, or excessive daytime sleepiness?	
• How **many dispatchers** do you have?	
Passenger Carrier Only Questions	**Carrier Response**
• Do you **hire part-time or intermittent drivers**? o If so, do you require them to fill out the seven-day duty statement? o Is there a policy that outlines reasons why these drivers need to fill out the statement? • Do you **require drivers to report secondary employment hours other than for other carriers**?	
• What is **your process for verifying current and recent RODS as well as prior HOS violations of part-time or intermittent drivers** with concurrent employment/other employers?	
Hazmat Carrier Only Questions	**Carrier Response**
• What are **your hiring procedures?**	

3. **Qualification and Hiring**	
• What are the **driving-record standards for your company**?	
• Before **hiring your drivers, do you require them to take a road test in your vehicles**?	
• Do you **query applicants and previous employers to see if physical and stress demands** have led to fatigued and/or reckless-driving violations in the past? o Do you have other ways in which you screen to identify high risk-applicants as a result of physical and stress demands?	
• What is your **busiest season**, and why?	
• How do you **plan recruitment and hiring of seasonal and part-time drivers to meet demands** without exceeding HOS limitations? o How do you perform forecasting? o What kinds of agreements do you make with seasonal/part-time staff to manage their expectations and HOS?	
• Do you **have a list of part-time drivers, or is your driver pool hired on the basis of the current needs of the company**? o *Request the list of part-time drivers.*	

4. **Training and Communication**	
General Questions	**Carrier Response**
• Do you have **any type of training program** (e.g., new employee training, experienced employee training, etc.)?	
• How does the **company make the drivers aware of the HOS regulations**?	
• Have your **employees been trained on the Federal Motor Carrier Safety Regulations**?	
• Do **employees receive on-going training**?	
• Who **provides your training**?	
• Do you have a **wellness program or do you provide healthy lifestyle education**?	
• Do you **offer training/education in fatigue management for your drivers, including countermeasures and operational strategies (e.g., taking rest and/or exercise breaks)?** o If so, how is this training on fatigued driving reinforced in the field? o Do you use job aids, communication, coaching, and mentoring?	

4. **Training and Communication**	
• How do you **communicate with senior leaders about fatigued driving issues on a regular basis**?	
• Do **drivers have direct access to the safety director or owner/company executives about issues related to fatigue**? o Do they hash them out first with the terminal manager, dispatcher, and/or parts/inventory personnel? o How do all parties interface with each other?	
• Do you **provide training on tracking and communicating HOS to the appropriate employees for all drivers, including intermittent drivers**? o If so, who gets this training? o Does it include checking the prior seven-day duty statement? o How often is it given? o What triggers its delivery?	
• Do you **use part-time or intermittent drivers**? o If so, do you require these drivers to fill out the seven-day duty statement? o Do you train them on how to fill it out? o Do you require them to report secondary employment hours other than for other carriers? o Do you train dispatchers on how to evaluate and communicate the secondary employment hours?	
• Do you **train drivers on proper use of sleeper berths to obtain rest**? o If so, how often is this training given? o What triggers its delivery?	
• How **do your drivers get the required rest during their trips even if they are not in violation of HOS**? o Can they rest on the vehicle when it is stopped? o How do your drivers fail to get adequate rest? o Does the extended-day rule work for you and your drivers? o Do you use relief drivers or practice "cushioning" (i.e., the use of extra drivers on buses to deploy in different cities when needed)?	
Passenger Carrier Only Questions	**Carrier Response**
• How are **passenger complaints generally handled**? o Is senior management involved? o If so, when and how? o What is your communications program with senior company leaders to address passenger complaints that have safety implications?	

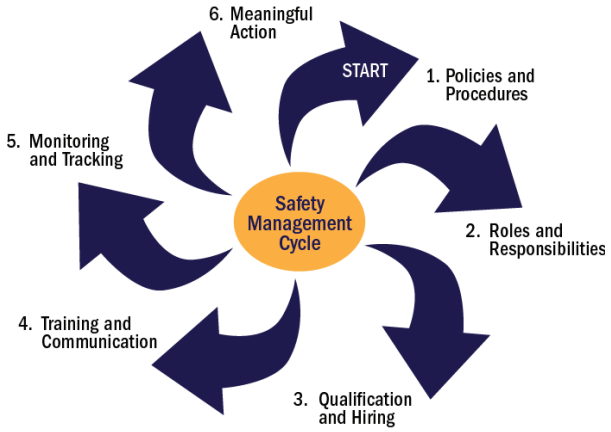
5. Monitoring and Tracking	
General Questions	**Carrier Response**
• How do **you monitor driver behavior**?	
• How **can you tell if your drivers are driving safely**?	
• How do you **track or communicate with your drivers during their trips**? Do you have real-time tracking of driver location?	
• **How do you check a driver's driving record and log books**?	
• What **documentation do you use to verify the accuracy of logs**?	
• How **often do you review your drivers' driving records and log books**?	
• Does **anybody review driver RODS**?	
• What **tools do you use for route planning**?	
• **Does dispatch monitor driver hours**?	
• How are **driver hours used by dispatch**?	
• How do you **ensure that a driver has enough hours prior to dispatch for a planned route**?	
• How **do you know if your drivers are moonlighting**?	
• Do you **monitor experienced drivers for medical conditions that put them at increased risk for fatigue**, sleep disorders, or excessive daytime sleepiness?	
• **Can you verify the training programs your drivers have received** since your company has employed them? o *Request documentation.*	
Passenger Carrier Only Questions	**Carrier Response**
• How do you **ensure that drivers' available hours account for rest periods**, separate operations within-company, intermittent and relief drivers, and "extended day"? o Do you check in with drivers at pre-designated intervals? o Is this information tracked? · *Request the tracking document.* o Who does this? o How often is it done?	
• How do you **monitor part-time, intermittent, and relief drivers, and abuse of the "extended day"?**	
• What is your **system for monitoring the accuracy of RODS**? o What is the disciplinary process for drivers who	

5. Monitoring and Tracking	
violate RODS? o What documents would you look at to verify the accuracy of RODS? o Do you require drivers to report hours worked in secondary employment?	

6. Meaningful Action	
General Questions	**Carrier Response**
• How do **managers and employees typically react when they see coworkers not fulfilling their responsibilities**? o Do they give immediate and direct feedback? o Do they ignore the problem? o Do they inform their supervisor?	
• Do you have a **driver disciplinary program**? If so, **how has it been implemented?**	
• Do you **provide incentives to employees for on-time delivery**?	
• Do you **specifically discipline drivers for exceeding HOS? If yes, explain the process**. Give examples of recent cases.	

Appendix Q: Unsafe Driving Probing Questions

This job aid provides a list of Investigative Probing Questions for the Unsafe Driving Behavior Analysis and Safety Improvement Category. This job aid can be used to engage the carrier in a collaborative exchange designed to review the Safety Management Cycle and identify where a breakdown has occurred in the Safety Management Process (Process Breakdown), understand the reasons why the Process Breakdown(s) occurred and its consequences (e.g., violations), and develop a plan for improvement. Prior to beginning the discussion, the Safety Investigator should review the questions and identify those that may be most relevant to his or her discussion. Additional information on how the job aid can be used is provided below.



The Safety Management Cycle

How can I use this job aid? The probing questions can be used to:

- Start the discussion with the carrier;
- Develop an appropriate line of questioning; and
- Spark additional questions.

What should I keep in mind when using this job aid? Keep in mind the following guiding principles while engaging the carrier during the investigative questioning and remedy development process:

- Frame the questions so that the exchange moves toward determining the Process Breakdown(s);
- Stay focused on the goal of the exchange; steer away from discussions that stray from the goal;
- Engage the carrier so that he or she plays a role in diagnosing the issue and developing the remedy for improvement;
- Remember that participation in this self-assessment increases the likelihood that the carrier will change his or her behavior and is a key factor in gaining 'buy-in' to implement remedies; and
- Once the breakdowns are identified, ask the carrier why he or she believes these breakdowns are occurring and consider this information when selecting appropriate remedies for the carrier.

1. Policies and Procedures	
General Questions	**Carrier Response**
• What is your **unsafe driving policy**?	
• Do you have a **policy on driver traffic citations**? • Are **drivers required to report moving violations, on and off the job**?	
• Do you **require driver training on topics specific to your operations**?	
• Do **company policies promote safe driving**?	
• What policies exist for **drivers to report unsafe conditions**?	
• What are your **guidelines for scheduling**? What variables are considered? (Time of day? How tight are schedules? How much slack is factored into scheduling? How are delays/weather conditions, etc., factored in?) • Do you have **other potential scheduling constraints** (e.g., morning-only deliveries, loading problems, problematic shippers, etc.) that have to be considered in scheduling drivers/routes?	
• What is the **process for a driver to communicate with dispatchers when they are not able to follow the assigned route**?	
• Do you have **dispatch policies/processes**? How are they maintained? Who is responsible? How are they communicated?	
• How **does your dispatcher assign work**? (For example, what factors/criteria are considered?)	

1. Policies and Procedures	
• What are **your current policies/practices regarding employee incentives and reward/recognition programs?** (For example, how is compensation calculated − by hour, by load, by mile, by timeliness of delivery, etc. How are people promoted? How are bonuses calculated?)	
Hazmat Carrier Only Questions	**Carrier Response**
• Do you have **standards for safe driving and special procedures for specific types of loads and equipment** on different roadways and in varying conditions? o If so, are they written or verbal? · *If written, request the documents.* · *If verbal, request description.* o If you don't have such standards/procedures, why not?	

2. Roles and Responsibilities	
General Questions	**Carrier Response**
• Who is **responsible for monitoring and maintaining driving records, including moving violations, on and off the job**?	
• Who is **responsible for dispatch policies/processes**?	
• Who is responsible **for communicating with drivers or taking action after citations or other evidence of unsafe driving**?	
• Who is responsible **for checking moving violation history prior to hiring or a new operating assignment**?	
• Do you have **dispatch systems/operations? If so, how are they organized? Who performs these tasks**?	

3. Qualification and Hiring	
General Questions	**Carrier Response**
• What are **your hiring procedures?**	
• How do you **hire/select and promote drivers**? What are your processes and criteria?	
• What **background/reference checks do you perform to validate the information provided by potential new hires**? What is your process? o *Request sample documents verifying process (e.g., company policy on hiring, previous employer checks, dispatch records).*	
• What are **the driving-record standards for your company**?	
• Do you **query applicants and previous employers to see if**	

3. Qualification and Hiring	
physical and stress demands led to fatigue and/or reckless-driving violations in the past? o **In what other ways do you screen** to see if physical and stress demands might lead to fatigue and/or reckless-driving violations in order to help identify high-risk applicants?	
• Before **hiring your drivers, do you require them to take a road test in your vehicles**?	
• How do you **validate a driver's "on-road skills"?** (For example, when is it done? How is it done? Who does it?)	
• What **background/reference checks do you perform to validate the information provided by potential new hires**? What is your process? o *Request sample verification documents (e.g., company policy on hiring, previous employer checks, dispatch records).*	
Hazmat Carrier Only Questions	**Carrier Response**
• How **many years of cargo-tank-operating experience must a driver have to operate a tank truck**?	

4. Training and Communication	
General Questions	**Carrier Response**
• How do you make **drivers aware of unsafe driving regulations**? What means of communication and/or training are used?	
• What is your **view of driver training**? New hire? Refresher?	
• What is your **view of dispatcher training**? New hire? Refresher? Specialties?	
• How are **dispatch policies/processes communicated**?	
• Who **besides drivers are required to receive training**? o Purchasing agents? o Mechanics/technicians? o Parts/inventory personnel? o Dispatchers? o Managers?	
• Do you **offer training on specific regulation subject areas (e.g., moving violations; failure to stop; improper use of signals; obeying local laws; parking commercial motor vehicles)**? If so, which ones, when, and how? o *Request **sample documents to verify type, content, attendees, etc., of training**.*	

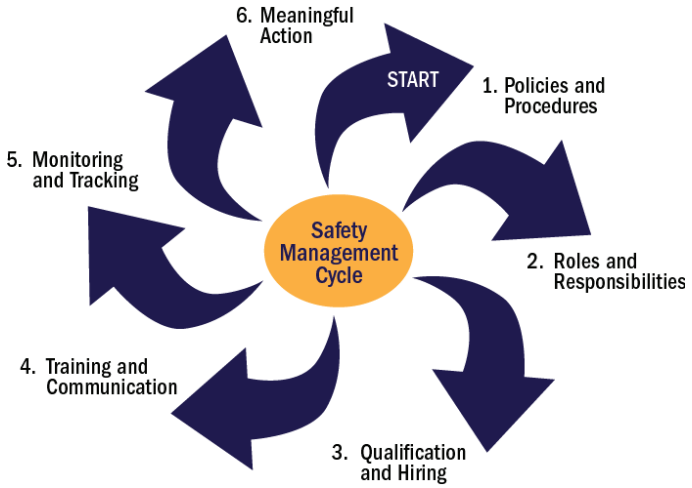
4. Training and Communication	
• Do you **prepare drivers for new routes**? If so, how?	
• Do you require your **dispatchers to attend/pass training**? If so, when, why, and how?	
• How much **information does a dispatcher know about a particular driver's level of experience and/or skills**? How is this communicated?	
• What **tools/resources support/assist your dispatchers with driver/route planning**?	
Passenger Carrier Only Questions	**Carrier Response**
• How **are passenger complaints generally handled**? o Is senior management involved? o If so, when and how? o What is your communications program with senior company leaders to address passenger complaints that have safety implications?	
• Do you **provide driver education that includes function-specific training, for example**, on customer communications, breakdown procedures, evacuation, and route diversion? If so: o Who gets this training? o Does it include checking the prior seven-day duty statement? o How often is it given? o What triggers its delivery? o Do you have job aids to help drivers learn the material?	
• Do you **provide training on pedestrian awareness for drivers in inner cities**? If so: o Who gets this training? o How often is it given? o What triggers its delivery?	
• Do you **provide training to drivers on how to safely load and unload passengers**? If so: o Who gets this training? o How often is it given? o What triggers its delivery?	
Hazmat Carrier Only Questions	**Carrier Response**
• Does your **company have safety meetings**? What topics are discussed?	
• Do **drivers have the ability to report perceived problems with equipment to management**? o Is this done verbally or in writing? o Does the company have a written policy? · *If so, request a copy.*	

5. Monitoring and Tracking	
General Questions	**Carrier Response**
• Do you **monitor driver behavior**? If so, how?	
• How do **you ensure that all drivers, purchasing/parts-inventory agents, dispatchers, and managers receive training as required by regulations and/or company policy/procedures**?	
• How do you **track your drivers while they are on a trip?**	
• How often do you **review the driving records of your drivers?**	
• What documentation **do you keep regarding drivers and driving records?** o *Request descriptions and/or samples.*	

6. Meaningful Action	
General Questions	**Carrier Response**
• Is **safe driving a component of your company values**? If so, how?	
• Is **safe driving recognized with respect to employee incentives** and/or reward/recognition programs? If so, how?	
• Is **driver behavior included in performance reviews**? If so, how?	
• How **do managers and employees typically react when they see coworkers not fulfilling their responsibilities**? o Do they give immediate and direct feedback? o Do they ignore the problem? o Do they inform their supervisor?	
• What is your **business model for pricing**? **Customer service**?	
Hazmat Carrier Only Questions	**Carrier Response**
• Do you **discipline drivers who fail to drive safely with hazardous loads, according to company policy**? o If so, what are your measures? *Request a written copy of them.*	
• Do you discuss the **possible consequences of an unintentional release of HAZMAT** during safety meetings?	

Appendix Q: Vehicle Maintenance Probing Questions

This job aid provides a list of Investigative Probing Questions for the Vehicle Maintenance Behavior Analysis and Safety Improvement Category. This job aid can be used to engage the carrier in a collaborative exchange designed to review the Safety Management Cycle and identify where a breakdown has occurred in the Safety Management Process (Process Breakdown), understand the reasons the Process Breakdown(s) occurred and its consequences (e.g., violations), and develop a plan for improvement. Prior to beginning the discussion, the Safety Investigator should review the questions and identify those that may be most relevant to his or her discussion. Additional information on how the job aid can be used is provided below.



The Safety Management Cycle

How can I use this job aid? The probing questions can be used to:

- Start the discussion with the carrier;
- Develop an appropriate line of questioning;
- Spark additional questions.

What should I keep in mind when using this job aid? Keep in mind the following guiding principles while engaging the carrier during the investigative questioning and remedy development process:

- Frame the questions so that the exchange moves toward determining the Process Breakdown(s);
- Stay focused on the goal of the exchange; steer away from discussions that stray from the goal;
- Engage the carrier so that he or she plays a role in diagnosing the issue and developing the remedy for improvement;
- Remember that participation in this self-assessment increases the likelihood that the carrier will change his or her behavior and is a key factor in gaining 'buy-in' to implement remedies; and
- Once the breakdowns are identified, ask the carrier why he or she believes these breakdowns are occurring and consider this information when selecting appropriate remedies for the carrier.

1. Policies and Procedures	
General Questions	**Carrier Response**
• What are your maintenance **procedures**? What is your **periodic maintenance and inspection program**?	
• What is your **policy/process/program for fleet maintenance and/or logistics planning** (e.g., parts supply, fleet size, etc.)? o If you **don't have a policy, why** not?	
• When a **vehicle is being serviced for maintenance, how does this affect your operations**? Do you have enough equipment to maintain operations while performing maintenance?	
• What are your **standards and policy to determine when components should be repaired or replaced**?	
• **How do you set your maintenance intervals**? By warranty? By regulatory requirements? Based on performance experience?	
• What are your **guidelines for placing vehicles out of service**?	
• What are your **standards and policy for indicating out-of-service conditions** for brake components, tire wear and deterioration, wheel and rim deterioration, and steering wheel play and deterioration?	
• How **frequently are your company's maintenance and repair records reviewed**?	
• Do you **use an automated equipment maintenance system**? If so, which Management Information System (MIS) do you use?	
• Are your **records cross-referenced with other logistics** (e.g., parts supply) and transport operations?	
• Do **drivers and mechanics follow standard procedures for hitching and coupling equipment**?	
• How do your **mechanics/technicians and drivers communicate and/or share equipment knowledge and information with each other (e.g., reports, emails telephone calls, etc.)?** How frequently?	
• What is **the process to maintain your vehicles**? o Do you have the necessary specialized facilities and/or diagnostic equipment − e.g., inspection lane for brake adjustments − to support maintaining your vehicles?	
• What is **the process to find, buy, and/or pay for compatible equipment to service your vehicles**? Have you had any problems in this area when it's been used? *If so, request an*	

1. Policies and Procedures	
explanation.	
• Do you **lease your vehicles**? o Who is responsible for maintenance?	
• What is the process for **selecting equipment purchases and controlling inventory**?	
• What is your policy for having **drivers communicate with dispatch when "planned" procedures** go awry?	
• What is your **emergency maintenance plan** when vehicles break down on the road?	
• What is your policy on requiring all **drivers to submit copies of all roadside inspections to carrier management** within a designated timeframe? o Is it written or verbal? o *If written, request a copy.* o *If verbal, request a description.* o *If there is no policy, why not?*	
• What is your policy to ensure that **purchasing agents supply, verify, and communicate requirements for adequate securement devices, equipment, and spare parts**? o Is it written or verbal? o *If written, request a copy.* o *If verbal, request a description.* o *If there is no policy, why not?*	
• Is it clear how and when to **resupply equipment and securement devices** and to **verify equipment requirements** (e.g., working load limits)?	
• Do you have **schedule constraints** such as morning-delivery only, problems waiting for the shipper, or problems loading/unloading?	
• Are you aware of any **relationship between the commodities that you carry and any particular type of maintenance and/or repair issues**, **cargo-loading or securement issues** (e.g., flatbed-load securement, container failures, and, passenger egress)?	
Cargo-Related Questions	**Carrier Response**
• What is your company policy to address **cargo-loading/securement regulations**? Is it clearly stated? o *Request a copy of the policy.*	
• How does the **policy adhere to the North American Cargo Securement Standard**?	
• What is your policy to ensure that **drivers are able to perform procedures according to regulations** for:	

1. Policies and Procedures	
o Load-limit verification? o Securement? o Loading/unloading? o En route inspections? o Is it written or verbal? o *If written, request a copy.* o *If verbal, request a description.* o *If there is no policy, why not?*	
• Do you provide **purchasing agents with specific tie-downs or other securement-equipment requirements**, and how are these **requirements coordinated with dispatchers**?	
• What is your **policy that clarifies shipper and receiver expectations** for timely delivery and condition of cargo, and procedures for **handling unmet expectations**? o Is it written or verbal? o *If written, request a copy.* o *If verbal, request a description.* o *If there is no policy, why not?*	
• What is the **process to correct out-of-service defects** when a vehicle is placed out of service for load-securement violations?	
• Are you **familiar with the regulations related to securement devices and equipment**?	
• Do you **carry anything for which proper cargo loading** or securement is a problem?	
• How do cargo **loading and securement impact your road-safety risk** in terms of your accident and/or breakdown records?	
• Do **cargo-loading or securement tasks affect your bottom line**?	
• What is your policy for **training and retraining drivers on cargo securement**? o Is it written or verbal? o *If written, request a copy.* o *If verbal, request a description.* o *If there is no policy, why not?*	
• What is your policy for **tracking cargo securement violations and administering appropriate discipline** when necessary?	
Passenger Carrier Only Questions	**Carrier Response**
• Do you **perform and document emergency-exit testing every 90 days**? o Is this area covered in pre-trip and post-trip	

1. Policies and Procedures	
inspections?	
• What are your **systematic procedures for critical maintenance items, such as** checking wheel-hub-lubrication levels according to the manufacturer's recommended inspection intervals and regular inspection of wiring and electrical systems, passenger seats, and emergency exits? o Is it written or verbal? o *If written, request a copy.* o *If verbal, request a description.* o *If there is no policy, why not?*	
• Do you **adhere to the manufacturer's recommended maintenance inspection intervals on wheel hubs**? o Is this area covered in pre-trip and post-trip inspections?	
• Do you **regularly inspect vehicle wheel-hub-lubrication levels, electrical components, passenger seats, and emergency exits**?	
• Have you **installed fire-detection-and-suppression systems on your current fleet**? o If not, why not?	
• Have you had any **fires or near-fires on your coaches**? o Are you aware of the increasingly recognized occurrence of bus fires? o Do you account for the risks of a fire on your coaches in terms of monetary loss as well as passenger casualties? o Has your insurance company raised these risk issues?	
• Have you **purchased or leased motor coaches built since 2004**? o Did the supplier offer an option for fire-detection or suppression equipment? o Are you aware of the effectiveness of these systems?	
• How would you **handle a passenger asking to stow luggage or other items that would block** an emergency exit?	
• What is your **policy to ensure that drivers establish procedures for loading and securement** of oxygen canisters and for preventing obstruction of emergency exits? o Is it written or verbal? o *If written, request a copy.* o *If verbal, request a description.* o *If there is no policy, why not?*	
• What is your **policy to ensure that drivers adhere to procedures for loading and securement** of oxygen canisters/cylinders and for preventing obstruction of	

1. Policies and Procedures	
emergency exits? o Is it written or verbal? o *If written, request the documents.* o *If verbal, request a description.* o *If there is no policy, why not?*	
• Have you conducted a trip where you **transported oxygen cylinders** for your passengers? o How many passengers with canisters/cylinders were there? o How were the canisters/cylinders stored? o Where were they stored? o How were they secured?	
• Does the passenger carrier allow the transportation of other hazardous materials (hazmat), such as ammunition, propane, gasoline-powered equipment, etc.? o If so, do you have written policies and procedures on accepting from passengers and transporting these materials? · *If so, request a copy of these procedures.* · *If not, why not?*	

2. Roles and Responsibilities	
General Questions	**Carrier Response**
• What are your **performance standards for equipment maintenance tasks and roles**? To whom do the standards apply (e.g., mechanics, technicians, drivers, etc.)?	
• Who is **responsible for ensuring that your maintenance procedures** are followed?	
• Who is **responsible for reviewing your company's maintenance and repair records**?	
• Are your **performance standards for maintenance tasks and roles addressed in performance reviews**? If so, how? • What are the incentives for meeting or exceeding standards, and the consequences for failure to meet standards?	
• Are there **circumstances when job demands will take priority over equipment maintenance tasks?** • **What are these situations and how are they managed**?	
• Who is **responsible for equipment purchases and inventory**? Is that **person qualified** to select proper equipment?	
• Who is **responsible for monitoring and training newer drivers** and **purchasing/parts-inventory agents** on a daily	

basis until these employees have mastered their jobs?	
• How **do dispatch and safety management work together**? o Who does the dispatching? o To whom in your organization does the dispatcher report? o Do you have dispatch systems/operations? o If so, how are they organized? o Who performs which tasks?	
• If you lease your vehicles, to what extent do you **hold the leasing company responsible for compliance with cargo-loading and securement and maintenance regulations**?	
Cargo-Related Questions	**Carrier Response**
• Who **oversees the securement/compliance function**? o What are that individual's responsibilities for specific loads or securement in general?	
• **Who are the cargo-securement roles and responsibilities** for: o The driver? o The dispatcher? o Managers (e.g., operations, safety, and terminal)? o The purchasing/parts-inventory agent? • Are these roles **documented**? o *If so, request the documents.* • How do you ensure that the roles are aligned with company policy and regulations? o *Request the company's written policies and procedures. (Check to see if they align with the roles.)*	
• What are your **performance standards for equipment maintenance and cargo-loading and securement tasks and roles**? o To whom do the standards apply (e.g., mechanics, technicians, drivers, purchase/supply agents, drivers, etc.)?	
• Who is responsible for **monitoring the driver's performance regarding cargo-securement violations**? o Do you routinely inspect securement equipment and devices on the vehicles?	
• Do your **drivers have copies of the North American Cargo Securement Standards' Driver's Handbook**?	
• What is the **process that senior managers use to monitor compliance** with cargo-loading and securement regulations? o Is this process documented? · *If so, request the documentation.*	

3. Qualification and Hiring	
General Questions	**Carrier Response**
• What **vehicles do you have in your fleet**? o What are the makes, models, and ages of your vehicles? o How do your existing and prospective mechanics keep up with technology?	
• Do you have **problems finding and/or retaining qualified mechanics, technicians, repair-savvy drivers, and/or trustworthy outsourced personnel**?	
• How do you **ensure that your safety director has sufficient skills** and credentials to oversee maintenance programs and tasks?	
• What are your **process and criteria for hiring and promoting employees**?	
• What are your **process and criteria for hiring and promoting drivers?**	
• How do you **find and attract qualified** applicants? o How do you advertise openings? o What is the network of people you talk to in order to find an applicant?	
• Do you look for applicants with **experience directly applicable to your operations**?	
• Do **prospective employees fill out employment applications**?	
• Does the employment application include questions about **qualifications for transporting** the company's loads?	
• Do you get **copies of driver Motor Vehicle Records**?	
• Do you **check references**?	
• Do you **check with previous employers**?	
• What is your **rate of turnover**?	
• Do you **have trouble attracting and retaining an adequate supply of drivers qualified** to adequately perform cargo-securement procedures?	
• **What is your process to ensure that the mechanics and technicians that you hire have sufficient skills and credentials** to perform maintenance- and cargo-related tasks?	
• What is your process to ensure that the **drivers that you hire have sufficient skills and credentials to perform maintenance- and cargo-related tasks**?	

3. Qualification and Hiring	
• Do you **look at driver violations as part of the hiring** process? Do you check to see if the driver has had previous securement violations? o If not, why? o If so, what are your methods? Do you obtain information from: o The driver? o Previous employers? o The insurance company? o Others?	
Cargo-Related Questions	**Carrier Response**
• What is your process to **ensure that your dispatchers and purchasing/parts-inventory agents have sufficient skills and credentials** to support cargo-securement tasks?	
• **What is your process to ensure that your drivers have sufficient skills and credentials to perform loading and cargo-securement tasks**?	
• How do you **verify if the driver can secure your cargo**?	
• Do you have **applicants secure cargo during the interview process**?	
Passenger Carrier Only Questions	**Carrier Response**
• During the hiring process, **how do you ensure that your mechanics and technicians have up-to-date bus technology training and experience**?	

4. Training and Communication	
General Questions	**Carrier Response**
• How do you **ensure that your safety director receives appropriate training to oversee maintenance programs and tasks?**	
• How do you **ensure that your drivers have sufficient skills and credentials to perform maintenance tasks**?	
• How do you **ensure that your mechanics and technicians have sufficient skills and credentials to perform maintenance tasks?**	
• Do you **offer/provide training to maintenance personnel**? If so, what kind (e.g., new hire, refresher, specialty, etc.)? How is the training delivered? How do maintenance personnel keep their certifications up to date?	
• Do your **performance standards for mechanics and**	

4. Training and Communication	
technicians include continuing professional training?	
• How is **training on your policy/process/program for fleet maintenance and/or logistics planning delivered**? Is training customized and/or directed to specific levels or job functions? How so?	
• Is **company management trained on maintenance requirements and performance standards**?	
• Do you **provide training on equipment parts, accessories, and maintenance and repair regulations**? o If so, who receives this training: office managers, safety managers, drivers, and/or technicians?	
• Are there any **barriers that might affect the communications between your mechanics, technicians and drivers regarding vehicle maintenance**? If so, what (e.g., geography, functional reporting, competition, rewards, recognition)?	
• What is the **process that you use to consistently communicate expectations regarding policies and procedures** to drivers, purchasing/parts-inventory agents, dispatchers, and managers so that senior managers can feel confident that the policies/procedures are understood by employees? o How is this done for new and existing employees? o How is this done when new policies and procedures are implemented? o What are all of the formal and informal methods? o What sort of documentation is used to support this communication?	
• Do you **offer driver training** in general: o To new hires? o As a refresher?	
• Do you **require your drivers to attend/pass training**? o If so, why, when, and how?	
• Do you **require your dispatchers to attend/pass training**? o If so, why, when, and how?	
• Do you **require your parts-supply and inventory agents to attend/pass** training? o If so, why, when, and how?	
• How do **you check on drivers' performance**? o How is this factored into training programs?	
• Have you **provided specialized training or counseling to drivers on the basis of roadside inspections**?	

4. Training and Communication	
• How do you **address drivers** who need new skills? o Is skill upgrading done in-house? o What combination of methods do you use (e.g., coaching, training, and/or mentoring)? o Is your training interactive? o Does it include hands-on demonstration?	
• Are there **any business-related barriers that might affect communications between your mechanics/technicians and/or drivers regarding vehicle maintenance**? o If so, do these barriers pertain to: • Geography? • Functional reporting? • Competition? • Rewards/recognition? • Incentives? • Other?	
• How much **information does a dispatcher know about a particular driver's level of experience and/or skills**? o How is this communicated?	
• Do you use **an automated logistics MIS**? o If so, which one? o Are managers and dispatchers trained on this system? · *Request training materials and records of attendance.*	
Cargo-Related Questions	**Carrier Response**
• Do you **have a training/retraining program specific to load-securement procedures**? o What does it involve? How often do you provide it? o When was the last time you provided it? o Is training provided to all drivers? o If not, how are drivers chosen?	
• Has **training in cargo-loading and securement regulations been provided to your drivers**? To your office, safety, and terminal managers? To your purchasing and parts-supply/inventory agents?	
• Does your **cargo loading and securement policy include a policy for training and retraining** drivers?	
• How is **training on cargo loading and securement reinforced in the field**? o Do you use job aids, communication, coaching, and/or mentoring?	
• How do you **communicate with senior leaders about cargo-loading and securement issues** on a regular basis?	
• Do **drivers have direct access to the safety director or owner/company executives** about cargo-loading and	

4. Training and Communication	
securement issues? o Do they hash them out first with the terminal manager, dispatcher, and/or parts/inventory person(s)? o How do all parties interface with each other?	
• Are **your drivers trained to perform basic maintenance and repairs to securement equipment**? o If so, how?	
• Do you **have the necessary specialized facilities and/or diagnostic equipment** (e.g., an inspection lane for brake adjustments) to support securing your loads?	
Passenger Carrier Only Question	**Carrier Response**
• Do you provide **training on procedures to check wheel-hub-lubrication levels according to the manufacturer's recommended inspection intervals and for regular inspectio of wiring and electrical systems, passenger seats, and emergency exits**? If so: o How often is it given? o What triggers its delivery?	
• Do you provide **training on performing and documenting emergency-exit testing**? o Is this area covered in pre-trip and post-trip inspections?	
• How are **passenger complaints** generally handled? o Is senior management involved? o If so, when and how? o What is your communications program with senior company leaders to address passenger complaints that have safety implications?	

5. Monitoring and Tracking	
General Questions	**Carrier Response**
• Are **maintenance and repair records reviewed on a regular basis**?	
• Do you **"gauge" or measure the effectiveness of your maintenance procedures**?	
• How do **vehicle maintenance tasks affect your" bottom line"?**	
• Do you **test your personnel on maintenance policy and program knowledge**?	
• How do you **ensure that you are meeting periodic inspection and recordkeeping requirements**?	

5. Monitoring and Tracking	
o *Request samples of reports and records.*	
• Do you **use your records:** o **To calculate the average service life per component**? o To adjust replacement intervals?	
• How do **you follow up on reported problems and defects**?	
• What **maintenance and repair statistics** do you track?	
• Do you **track breakdowns**?	
• Do you know to what **extent maintenance was a contributing factor in crashes and/or breakdowns**?	
• How many **field changes were performed on different vehicles over the past two years**?	
• How **many repairs were performed on different vehicles over the past two years**?	
• How many **retrofits were performed on different vehicles over the past two years**?	
• Does a **company official review roadside inspection reports**?	
• Do you **review your roadside inspection results via the Internet**? o If so, how often? o Who does this? o How is this information disseminated throughout the organization, and who receives it? o How is the information used in the organization?	
• Do you **track how well you meet periodic inspection and recordkeeping requirements**?	
• How do you **check on the driver's performance**?	
• Do you **track and document all employees' training needs and training received**? o If so, how do you do this? o Who does this? o What is the process that is used? o How is this information used? · *Request the documentation.*	
• Do you **routinely obtain a copy of the carrier profile**?	
• If you lease your **vehicles and hold the leasing company responsible for regulatory compliance, how do you monitor its compliance**?	
• Does your **maintenance program recognize the wear of**	

5. Monitoring and Tracking	
consumables? o Does it use indicators of deterioration? o Does it account for conditions that cannot be detected by drivers?	
• How do you **monitor and track tasks, schedules, and costs for maintenance, repair, inspection, cargo loading and securement**?	
• Do you **track compliance with regulations related to**: o Accessories? o Equipment parts? o Maintenance and repairs? o **Cargo loading and securement?** o **Securement equipment and devices?**	
• Do you **routinely inspect equipment and securement devices** on the vehicles?	
Cargo-Related Questions	**Carrier Response**
• Do you monitor **driver cargo-securement violations**?	
• Do you **regularly review and evaluate records of cargo loading and securement methods, procedures, equipment, and devices used**? o If so, how often? o Who is involved? o What are some recent reviews and the corresponding changes that were made as a result? o Is this process documented? · *If so, request the documentation.*	
• How do you know that **your cargo-securement training** is effective?	
• Do you receive **complaints about the condition of cargo** when it arrives at a destination?	
• How do **senior and middle management monitor and document staff compliance with cargo-loading and securement regulations and address complaints of shippers and receivers**? o Where is the documentation kept? · *Request a copy of it.* o Do you keep a log as to whether complaints have been received and handled appropriately?	
• How frequently are **your company's securement and related inventory records** reviewed?	
• Do you track **near-misses of crashes, delays, and/or breakdowns caused by cargo shifting, failure of securement equipment or devices, etc.?**	

5. Monitoring and Tracking	
• How do you **ensure that loads on your leased vehicles are properly secured**?	
• Do you use your **records to calculate the average service life per securement device or equipment component**? • Do you use this information to adjust replacement intervals?	
Passenger Carrier Only Questions	**Carrier Response**
• How do you **monitor industry recalls and field changes for proactive maintenance, especially with pre-owned buses**? o Is this information tracked? · *Request the tracking document.* o Who does this? o How often is it done?	

6. Meaningful Action	
General Questions	**Carrier Response**
• What happens when your **maintenance procedures are not followed**?	
• How do you **follow up on reported problems and defects**?	
• Do you have **performance standards for equipment maintenance tasks and roles**? To whom do the standards apply (e.g., mechanics, technicians, drivers, etc.)?	
• Are your **performance standards for maintenance tasks and roles addressed in performance reviews**? If so, how? • What are the incentives for meeting or exceeding standards, and the consequences for failure to meet standards?	
• If you **lease your vehicles, to what extent do you hold the leasing company responsible** for regulatory compliance?	
• What is **your response to the noted violations**?	
• Have you **taken any action(s) to address the violations discussed and reviewed in your previous investigation**?	
• What action(s) **have you taken to address the violations noted in your warning letter**?	
• Have you **aligned your incentive programs so that they motivate the behaviors needed to achieve employee roles and responsibilities**? o Does anybody check on a regular basis to make sure that this alignment is actually occurring, especially when the job or incentives change? o If so, how do you complete this alignment process? o Who does it?	

6. Meaningful Action	
• *Request a **written copy of these incentives and/or reward/recognition programs**.* o *If not documented, request a verbal description.*	
• How do **managers and employees typically react when they see coworkers not fulfilling their responsibilities**? o Do they give immediate and direct feedback? o Do they ignore the problem? o Do they inform their supervisor?	
• Do you have a **progressive disciplinary program ultimately leading to termination, which focuses** on taking corrective action to ensure that drivers comply with regulations and company policy? If yes: o *Request a copy of it.* o Describe the program and some instances in which it was used. o Who is responsible for implementing it?	
• What are the **incentives and reward/recognition programs** for each employee (or Employee X)?	
• Do **drivers execute securement procedures under difficult conditions**? o Do you reward drivers for time spent learning and/or completing procedures, especially under difficult conditions?	
• When it is **clear that regulations and company policy are not well understood, do you have mandatory refresher training** that helps employees understand the necessary information in a timely manner?	
• What **triggers referral to mandatory refresher training**? o Who makes these decisions? o Describe some instances when you have made such a referral.	
• *Request **documentation of some instances when refresher training was required, in the form of training materials,** and a list of people who received the training.*	
• Have you **provided specialized training or counseling to drivers on the basis of roadside inspections**?	
• Is there a **disciplinary and/or recognition program for performance on the basis of roadside inspections**?	
• Are you **concerned about your ongoing maintenance and cargo-loading and securement issues**?	
Cargo-Related Questions	**Carrier Response**
• How **important do you think that cargo securement is in**	

6. Meaningful Action	
ensuring highway safety?	
• How do **cargo loading and securement impact your operations**?	
• Do you test your **personnel on their knowledge of cargo-loading and securement policy and procedures**?	
• How do you **respond to drivers who have cargo-securement problems (violations, complaints, etc.)?** o Do you provide specific training to address these problems?	

Appendix R Crash Preventability Determination

For

eFOTM Redevelopment

Federal Motor Carrier Safety Administration (FMCSA)
U.S. Department of Transportation

Appendix R

Attachment A - Sample Determination Letter to Motor Carrier

[DATE]

[CARRIER OFFICIAL NAME AND TITLE]
[CARRIER NAME]
[CARRIER ADDRESS]
[CITY, STATE ZIP]

Dear Mr. or Ms. [CARRIER OFFICIAL LAST NAME]

On [DATE], [CARRIER NAME] submitted evidence for the Federal Motor Carrier Safety Administration (FMCSA) to review in order to determine the preventability of [a crash OR crashes] that caused your company's Factor 6 recordable crash rate to be [unsatisfactory OR contribute to a failure] in an [investigation OR audit] conducted on [DATE].

After reviewing the evidence provided, FMCSA finds that [CARRIER NAME][presented OR did not present] compelling evidence that the [crash or crashes] [was/were] not preventable. Our decision is based on the facts described below:

[EXPLAIN WHY IT WAS DETERMINED THAT THE CRASH WAS/WAS NOT FOUND TO BE NOT PREVENTABLE. NOTE: IF MORE THAN ONE CRASH WAS REVIEWED, A DETERMINATION AND SPECIFIC INFORMATION SHOULD BE PROVIDED FOR EACH CRASH REVIEWED.]

As a result, your Factor 6 recordable crash rate will [remain the same OR was updated and a revised [investigation OR audit] is enclosed.]

Include if Preventable or Undecided determinations were made:

Pursuant to 49 CFR section 385.15, you may petition FMCSA to conduct an administrative review, if you believe the Agency committed an error in assigning your proposed safety rating. Your request should be submitted in writing to the Chief Safety Officer, Federal Motor Carrier Safety Administration, 1200 New Jersey Avenue, SE, Washington, DC 20590-0001. The filing of a petition for an administrative review will not stay the effect of any pending prohibition on your company's operations of commercial motor vehicles in interstate or intrastate commerce unless you request a stay and it is granted.

Should you have any questions, please contact FMCSA's [STATE] Division Office at [NUMBER] or [EMAIL].

Sincerely,

[DIVISION ADMINISTRATOR'S NAME]

Division Administrator

Attachment B -Crash Preventability Determination Program Eligibility Guidelines

1. Struck in rear - Crashes would qualify when the striking vehicle was directly behind the submitter's vehicle prior to crash. This crash type does not include side swipes or when the point of impact was on the side toward the rear of the truck/trailer.
2. Legally stopped or parked - Crashes would qualify if the commercial motor vehicle (CMV) was stopped at a light, stop sign or other traffic control device, stopped for railroad crossings or school buses, or was parked. This crash type does not include when the CMV is stopped in traffic.
3. Suicides or Suicide Attempts - Crashes would qualify if evidence of the suicide or attempt was provided. This crash type does not include action where a vehicle or pedestrian enters the CMV's path for no apparent reason.
4. Wrong Direction - Crashes would qualify only if the other vehicle fully crossed the center line or median and was operating in the opposing direction before the crash. This crash type does not include when the vehicle partially crosses the center line or when the involved vehicles were traveling in the same direction. This crash type also does not include when the CMV crossed into the other lane.
5. Animal Strikes - Crashes would qualify only if the CMV struck the animal. This would not include crashes where the CMV crashed avoiding the animal.
6. Individuals Under the Influence - This crash type would require evidence that the individual was operating at the legal level of "under the influence" (or related violation such as operating while intoxicated) to include either alcohol or drug test results, an arrest, a citation/violation, or a refusal.
7. Infrastructure failure or struck by cargo, equipment or debris - This would be changed to include any cargo and equipment, not just fallen cargo and equipment. This would include crashes when the cargo or equipment on a vehicle shifts or extends into the path of travel. This crash type would not include when the CMV was struck by another vehicle that was not being transported as cargo.
8. When the CMV is struck by a vehicle that was operating from behind the CMV but in another lane prior to the crash - These crashes are when the CMV is struck in the rear but the other driver was in another lane before the crash and strikes the CMV at the side. For example, this would include when the police accident report indicates that the CMV was struck at the 5:00 or 7:00 point of impact.
9. When the CMV is struck by a vehicle that did not stop or slow in traffic - These crashes are when the CMV is stopped in a traffic lane due to traffic. This would include when the CMV is struck on the side.
10. When the CMV is struck by a vehicle that failed to stop at a traffic control device (e.g., stop sign, red light or yield).
11. When the CMV is struck by a vehicle that was making a U-turn or illegal turn.
12. When the CMV is struck by a driver who experiences a medical issue which causes the crash.
13. When the CMV is struck by a driver who admits falling asleep or admits distracted driving (e.g., cellphone, GPS, passengers, other).
14. When the CMV is involved in a crash that was the result of an individual under the influence, even if the CMV was struck by another vehicle involved in the crash. The standards for test results, arrest or a citation would continue to apply.
15. When the CMV is involved in a crash that was the result of a driver operating in the wrong direction, even if the CMV was struck by another vehicle involved in the crash. The standard for

the other wrong direction vehicle to be completely operating in the wrong lane (e.g., completely across the center line or over a median) would continue to apply.

16. When the CMV is involved in a crash that was the result of a rare or unusual event. For example, striking a skydiver.

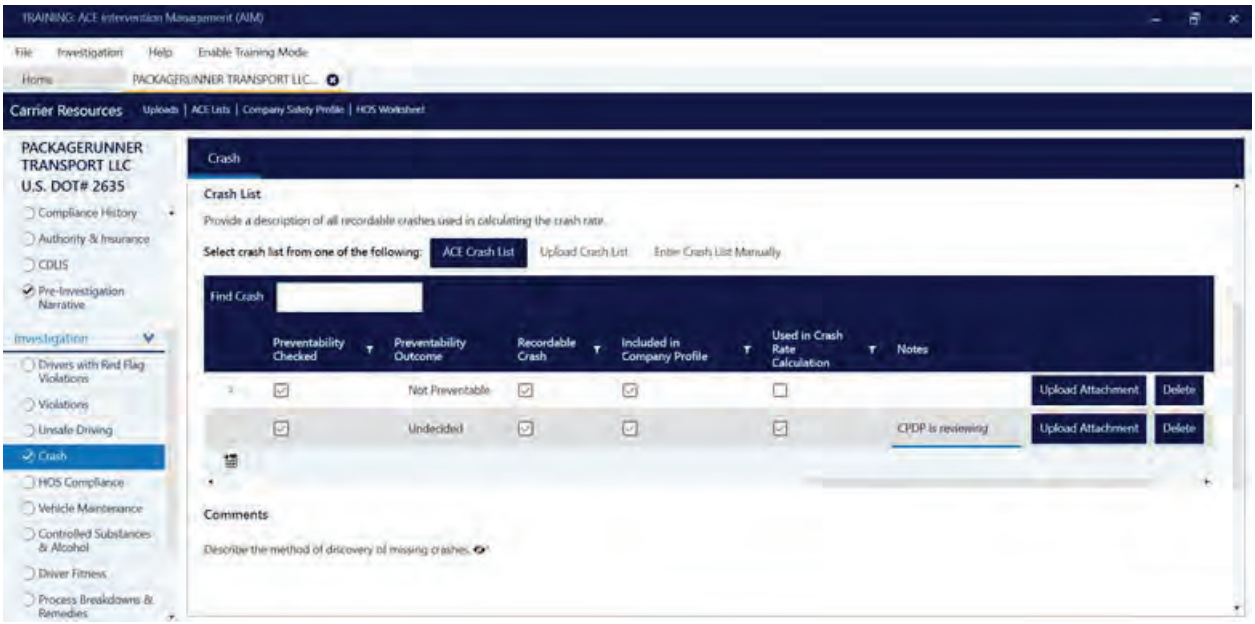
Attachment C - Preventability Guidelines

Preventable crashes may include, but are not limited to, crashes when:

- Driver failed to control speed so that he/she could stop within available sight distance
- Driver failed to check cross-traffic and wait for it to be clear before entering intersection
- Driver collided with vehicle in front of him/her
- Driver failed to maintain a safe following distance
- Driver misjudged rate of overtaking
- Driver came too close before pulling out to pass
- Driver was not in his/her proper lane
- Vehicle was improperly parked
- Driver rolled or otherwise backed into vehicle
- Driver failed to yield the right of way when necessary to avoid a crash
- Driver failed to check behind vehicle parked at curb before attempting to leave parking space
- Driver attempted to cross tracks ahead of train
- Driver passed where view of road ahead was obstructed
- Driver failed to signal change of lanes
- Driver failed to stay in own lane
- Driver did not reduce speed in heavy pedestrian area
- Driver was under the influence
- Driver's cargo or equipment struck another vehicle
- Defect was a type that should have been detected during a pre-trip inspection
- Driver misjudged available clearance
- Driver was in violation of company operating rules or special instructions, the regulations of any Federal or State regulatory agency or any applicable traffic laws or ordinances.
- Pre-crash out of service violation was identified on post-crash inspection
- Driver was not properly licensed with a current medical certificate

Attachment D

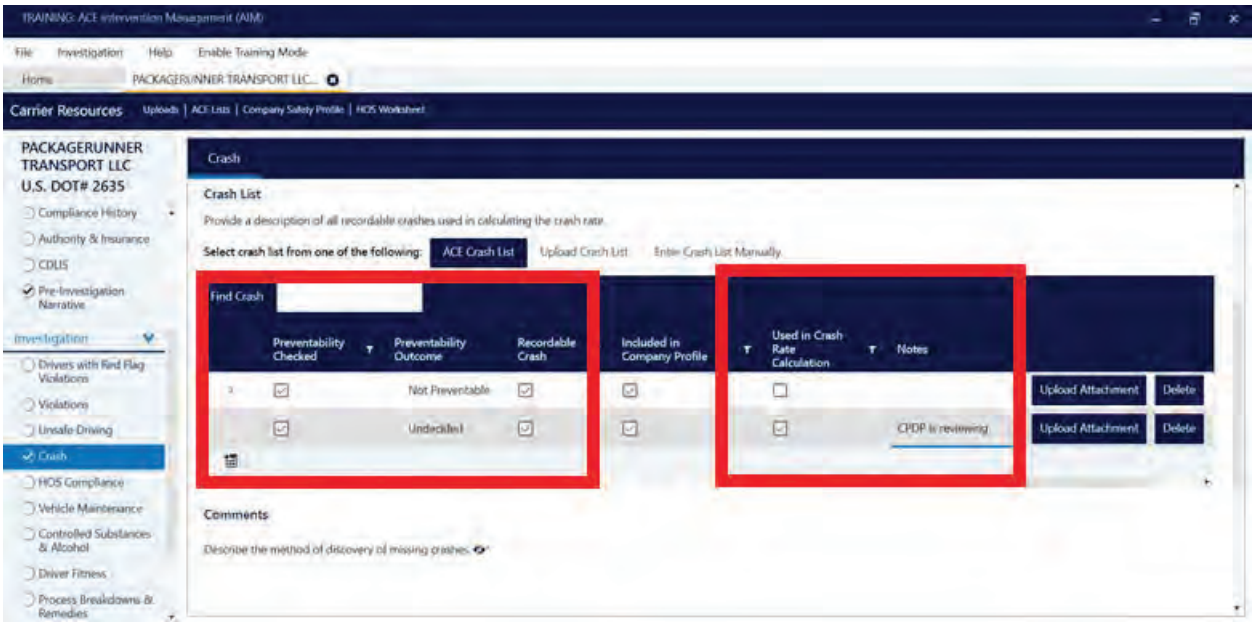
Adding Crashes to AIM



When crashes are reviewed for preventability as part of an investigation, the determinations should be documented in AIM as follows:

- Click on the "ACE Crash List" tab. This will display all crashes currently in MCMIS. If the carrier uploaded additional crashes using the Excel-based Accident Register template provided with the initial document request letter, those crashes are also displayed on this list.
- Additional crashes should be added to this list by entering the data manually.
- It is recommended that this list be used to document all crashes and determination reviews.

Recording Crash Preventability Determinations in the ACE Crash List



- To document the determinations in the ACE Crash List tab, scroll right in the crash list table to find the following columns:

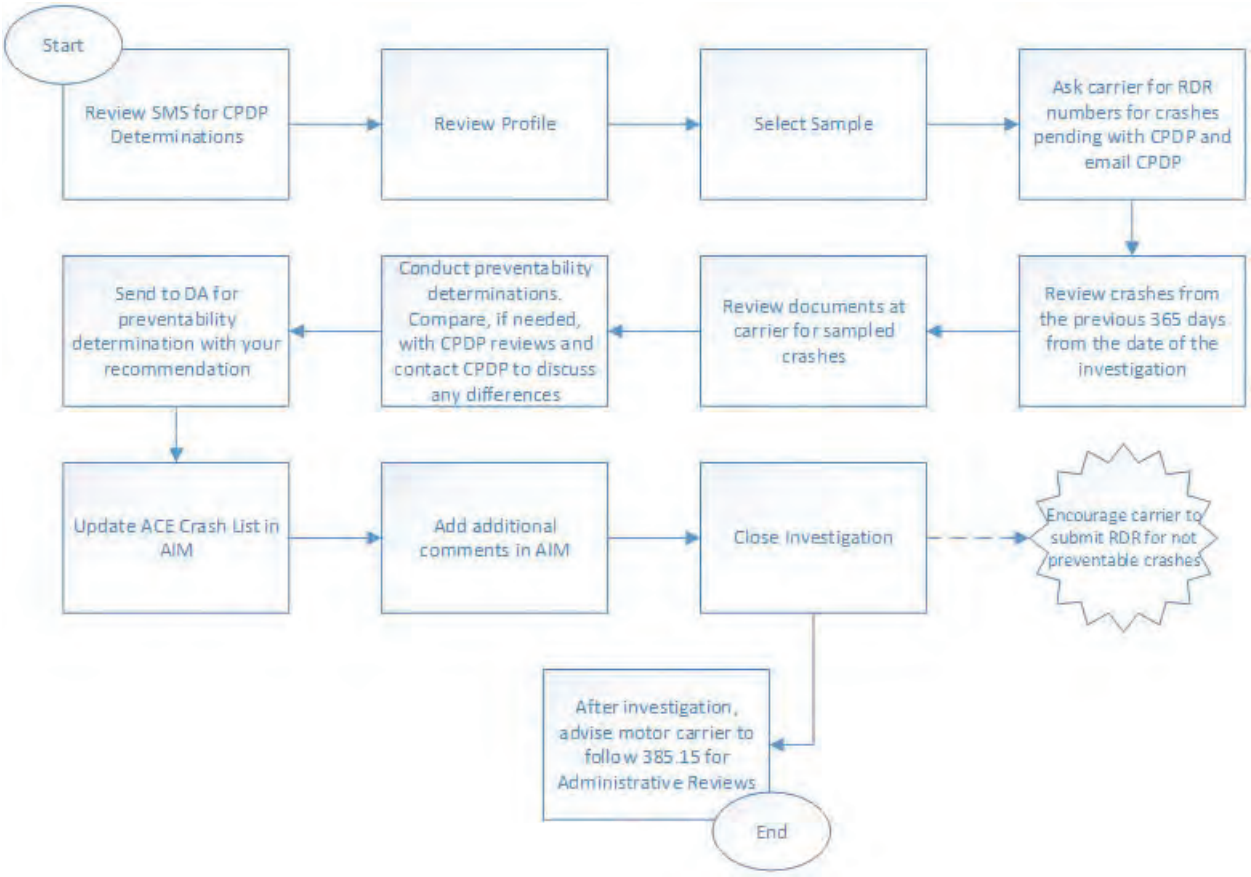
- If the crash listed was reviewed, check the “Preventability Checked” box
- Select the preventability determination made by the Division Administrator in the Preventability Outcome dropdown (Preventable, Not Preventable, or Undecided)
- Recordable Crash
- Included in the Company Profile
- If the crash was reviewed, document if it was “Used in Crash Rate Calculation” by checking boxes to indicate yes. As a reminder, recordable crashes with not preventable determinations should not be included in the calculation
- Add any notes, as appropriate, recognizing that these notes will appear on the carrier’s copy of the investigation report
- Upload any additional documentation about the crash that should be retained with the investigation report.

The ACE Crash List is the preferred method of documenting crashes and determination reviews. If the Safety Investigator uses the “Upload Crash List” to import a crash list into AIM, the Safety Investigator should document the crash preventability determinations for each crash reviewed in the General Comments section of the “Upload Crash List” tab.

The “Enter Crash Manually” tab should not be used to document preventability determinations. If crashes are going to be entered manually to document determinations, it should be in the “ACE Crash List” tab.

Reviewers on the Crash Preventability Determination Program team will use the AIM investigation report to access determinations from investigations as part of their review of submitted crashes.

Attachment E



Overview Flow Chart

Attachment F

Procedures by Investigation Phase

Attachment G

Procedures by Role

Before Investigations Reviewing Crashes or Safety Audits		
SI or Auditor	**DA**	**Determination Letter**
1. Review carrier profile for crashes 2. Review list of final determinations in CPDP available on SMS profile 3. Ask motor carrier for "RDR Numbers" of any crashes submitted to CPDP that have NOT received a determination 4. E-mail list to FMCSACrashes.Preventability@dot.gov, **SUBJECT LINE – Expedited Review** a. CPDP will provide status to SI or Auditor b. Will expedite review of those crashes c. Note added to RDR in DataQ's d. CPDP Reviewer will contact SI/Auditor before making a determination	No action required prior to Investigation or Audit	NA
During Investigations Reviewing Crashes or Safety Audit		
SI or Auditor	**DA**	**Determination Letter**

Only NOT PREVENTABLE Crashes are removed from Factor 6 during investigations (Attachment D AIM Procedures) Safety Audits – preventability reviews will be documented in **Part C**	Preventability Reviews requested by the carrier in relation to Factor 6 of the rating methodology	**YES** – draft and send determination letter
	If the DA's preventability review differs from CPDP Determination: 1. DA sends an email to FMCSACrashes.Preventability@dot.gov 2. Office of Enforcement CPDP will reply within 2 business days to discuss determinations and documents reviewed 3. CPDP will expedite determinations not yet reviewed 4. DA should not close out Investigation or SA until consultation occurs and one determination is made for the crash	NA
	IF DA determines crash was **NOT PREVENTABLE** prior to closeout – SI makes proper crash rate data adjustment in AIM	
After Investigations Reviewing Crashes or Safety Audit -Prior to Close Out		
IF motor carrier is UNSATISFACTORY in Factor 6, or motor carrier FAILED the SA and Crash contributed to that SA failure:		
SI or Auditor	**DA**	**Determination Letter**
SI or Auditor informs the carrier of option to provide evidence to the DA for a Crash Preventability Review if the carrier thinks the crashes were NOT-Preventable **before the investigation is closed**	Preventability Reviews requested by the carrier in relation to Factor 6 of the rating methodology. If carrier submitted a crash to the CPDP, DA will consult with CPDP as previous noted	**YES** – send determination letter
SI must explain in Part C, upload a revision to the Investigation or SA, and upload the Determination letter to EDMS	If DA determines crash was not-preventable,	yes

For crashes that meet one of the 16 CPDP categories, SI provides information for carrier to submit RDR to the CPDP for removal from the Crash BASIC in SMS. Also, encourage motor carrier to include the DA's determination letter in the RDR submission. (Would be proper to draft and save a canned recommendation in the Investigation and SA recommendations section of the report.)	No action required	Carrier provides copy along with other documentation for the RDR to the CPDP
IF a motor carrier wants crashes reviewed **after investigation or audit is closed** out to change the Safety Rating:		
SI advises motor carrier to pursue review under 49 CFR 385.15	DA advises carrier to pursue review under 49 CFR 385.15	NA
	If the CPDP receives an RDR that received a final determination of: undecided or preventable from a closed investigation, the CPDP will close the RDR and advise the motor carrier they must make the request for preventability through the 49 CFR 385.15	

Appendix S– AIM Investigation Report

For

eFOTM Redevelopment

Federal Motor Carrier Safety Administration (FMCSA)
U.S. Department of Transportation

UNITED STATES DEPARTMENT OF TRANSPORTATION

	U.S. DOT#: 1 **MC/MX#:**	**Legal:** JOHN DOE TRUCKING **Operating (DBA):**	**Investigation Date:** 10/15/19

Investigation Type: Onsite Focused Investigation

Location of Investigation:
Extent of Operations:

Physical Address

1234 Street
Springfield, MO
United States

Mailing Address

1234 Street
Springfield, MO
United States

Contact Information

Contact Name: John Doe
Email:
Phone: (11)111-1111 **Cell**: ()- **Fax:** ()-

Business and Financial

Business Type: Other
Gross Revenue: $800,000.00 **For Year Ending:** 10/15/18
Federal Tax ID: (N/A)

Operation Classification and Type

Type of Operation:

Operation Classification

Cargo

Meat

Equipment

	Owned	Term Leased	Trip Leased
Straight Trucks	3		

Power units used in the U.S.: 3
Percentage of time used in the U.S.: 100%

Driver Information

Drivers

	Intrastate	Interstate
< 100 Miles		5
>= 100 Miles	1	

Average trip leased driver/month:
Drivers with CDL: 0
Total Drivers: 6

Person(s) Interviewed

Questions	
Questions about this report or the Federal Motor Carrier Safety or Hazardous Materials regulations may be addressed to the Federal Motor Carrier Safety Administration at:	1990 K STREET, NW, SUITE 510 WASHINGTON, DC 20006 Phone: (202) 219-3576 Fax: (202) 219-3546
This report will be used to assess your safety compliance.	

Checked

Violations

1. Primary: 392.6

Scheduling a run which would necessitate the vehicle being operated at speeds in excess of those prescribed.

C **Critical**

At least 10% of the number checked had violations

Violations Discovered

Fed	State	Total
5		5

Fed Checked	State	Total
5		5

BASIC Impacted
Unsafe Driving

Rating Factor 3: Operational = Part 392

Example/Notes:

Driver name,
Trip date, etc.

Drivers / Vehicles

In Violation	Checked

2. Primary: 393.9

Operating a motor vehicle without a required operable lamp.

Violations Discovered

Fed Checked	State	Total
5		5

Fed	State	Total
5		5

Drivers/Vehicles

Example/Notes:

Company number OR Vehicle license number,
Trip date.

In Violation	Checked

3. Primary: 395.8(f)

Failing to require driver to prepare record of duty status in form and manner prescribed.

Violations Discovered

Fed	State	Total
3		3

Checked

Fed	State	Total
3		3

Example/Notes:

Driver name(s),
Trip date

Additional types of form and manner violations (If cite is 395.8(f)(12), include other relevant subparagraphs such as (4) and (11))

Drivers / Vehicles

In Violation	Checked
2	2

Safety Fitness Rating

This Investigation is Not Rated

You must take corrective actions for any violations (deficiencies) identified in the Violations section of this report.

This was a focused investigation, which did not review in full all factors in the safety fitness rating methodology in 49 CFR part 385, Appendix B. A focused investigation may be unrated or it may result in a Conditional or Unsatisfactory rating if sufficient violations are discovered in the factors examined.

DataQs: If you dispute the violations recorded in the Violations section of this investigation report, and the violations were not used in the calculation of your safety rating, you may submit a Request for Data Review (RDR) through DataQs. The DataQs system is the method to remove violations that did not affect your safety rating. DataQs is an online system that allows a motor carrier or driver to request and track a review of Federal and State issued data that it believes to be incomplete or incorrect. To submit an RDR, go to https://dataqs.fmcsa.dot.gov.

Process Breakdown and Remedies

BASIC: Unsafe Driving

Process Breakdown: Monitoring and Tracking

Specific Recommended Remedies

To implement Safety Improvement Practices, the following list are recommended practices related to Monitoring and Tracking:

1. Implement a system for keeping accurate records of employee driving-safety training needs and completed training, via software, a checklist in the driver's file, and/or another appropriate method.

2. Evaluate personnel who are monitoring drivers' safety performance by making sure that they are using inspections and other data; applying performance standards fairly, neatly, and equitably; and documenting evaluations.

3. Place a "How am I driving?" sticker on every truck to get feedback from the public on drivers exhibiting unsafe behaviors on the road. Assess feedback for safety implications.

Recommendations

1. **Notice of Claim Violations**
   PLEASE NOTE: The violations discovered during this compliance review may affect the civil penalty proposed in any subsequent Notice of Claim. In addition, your history of prior violations of the Federal Motor Carrier Safety Regulations, Federal Hazardous Material Regulations, or the Federal Motor Carrier Commercial Regulations may also affect the civil penalty proposed in any subsequent Notice of Claim. Receipt of this report acknowledges your understanding that the violations discovered by the FMCSA during this review may be used to calculate any civil penalty proposed as a result of this review.
   Attached to this report is Table 1, which identifies all the documented violations which were discovered during the course of this review.
2. **Acute and Critical Violations**
   Acute and/or Critical violations were recorded on this investigation report. These violations will impact your safety record. NOTICE: A pattern and/or repeated violations of the same or related acute or critical regulations (violations of the same Part in Title 49, Code of Federal Regulations) will cause the maximum penalties allowed by law to be assessed under Section 222 of the Motor Carrier Safety Improvement Act of 1999 (MCSIA). A pattern of violations means two or more violations of acute and/or critical regulations in three or more Parts of Title 49, Code of Federal Regulations discovered during any eligible investigation. Repeated violations means violation(s) of an acute regulation of the same Part of Title 49, Code of Federal Regulations discovered in an investigation after one or more closed enforcement actions within a six-year period and/or violation(s) of a critical regulation in the same Part of Title 49, Code of Federal Regulations discovered in an investigation after two or more closed enforcement actions within a six-year period.
3. **Additional Information**
   Please visit the CSA outreach site for additional guidance: https://csa.fmcsa.dot.gov.
4. **Physically unqualified drivers cannot drive in interstate commerce**
   Do not allow physically unqualified drivers to drive in interstate commerce.
5. **Registration required.**

Cease all interstate or foreign transportation until properly registered with the Federal Motor Carrier Safety Administration.

Safety Investigator Narrative

Investigators who contributed to the review:

Name	Title	Inspector ID (e.g., SI Code)
John Doe	**Primary SI**	**11111**

Investigation Scope

Start Date: 10/1/19

Investigation Type: Onsite Investigation, Focused, selected BASICs

Selected BASICs

The Following BASICs were selected to be reviewed for the investigation:

Unsafe Driving	Full - due to Other
Driver Fitness	Full - due to Complaint

The investigation type changed from the assigned investigation because:

N/A

Reason(s) for Investigation:

Comments

Company Information

Company Owners and Partners/Officers/Members of the Company

Name	Title	In Charge of Safety Management?	Received Report?	Present for Close-Out?

Comments

Business Information And Finance

The financial condition of the subject, focusing on any information that impacts the carrier's safety, is as follows: (The objective is to gather information to support making safety assessments determining if the carrier is reincarnated)

N/A

The carrier's major assets such as buildings, land, airplanes, other companies, etc. are:

N/A

Description of the carrier's business process model:

N/A

Major impacts to the business that affected the financial condition were:

N/A

Operations & Cargo Classification

Driver/Vehicle Information

Compliance History

Prior Investigations

Date	Type	Reasons for Investigation	Proposed Rating	Rating Date	Rating
02/03/10	Focused CR	Complaint	Not Rated		

Safety Audits

No SafetyAudits

Closed Enforcement Cases

No Closed Enforcement Cases

Comments

All recurring violations discovered during prior investigations were:

N/A

Techniques used in discovering violations for use in subsequent investigations were:

N/A

Authority & Insurance

Does the motor carrier have the appropriate type of authority?

Does the motor carrier have the appropriate level of insurance?

CDLIS (Driver's License Check)

Was a CDLIS check conducted?

Pre-Investigation Narrative

Carrier Operations Description

Provide the approximate length of time the carrier/shipper has been in business:

N/A

Explanation of interstate versus intrastate operations:

N/A

Significant findings regarding accuracy of registration data (MCS-150 data), including an explanation of the source(s) of information used to evaluate the accuracy of the information, are:

N/A

Was the motor carrier involved in emergency relief efforts?

Affiliation or Reincarnation

Date New Applicant Screening (NAS) was run:

Description of potential affiliated and reincarnated carrier(s), and the method by which they were determined not to be affiliated/reincarnated carrier(s):

N/A

Requested Documents

List of documents requested including the date requested

Description	ACE Status	Subject	Date Requested	Date Produced	Produced By	Reviewed to meet sample	BASICs	Carrier Name	U.S. DOT#

Reasons for delays or extensions

None

Pre-Investigation Comments

Was Carrier Profile obtained: Yes

Date Carrier Profile was obtained: 10/11/2019

Explanation of where the carrier maintains its documents, including where documents are maintained someplace other than at the principal place of business (includes whether or not the motor carrier was given 48 hours to produce records not located at the principal place of business):

N/A

Were there any issues that posed barriers to the pre-investigation process? (e.g., locating or reaching the motor carrier, availability and accuracy of information, etc.)

Drivers with Red Flag Violations

No drivers with red flag violations

Comments

Violations with Planned Enforcement Action

Violations with planned enforcement action:

395.8(f) - Failing to prepare RODS in form and manner prescribed

392.6 - Scheduling a run which would require exceeding speed limits

Unsafe Driving

Sampled Drivers

List of the driver(s) for the sample, and if applicable, the timeframe reviewed.

Name	Date of Birth	License Information	Phone	Employment Dates	Sample Dates

Requested Documents

List of the documents requested and produced by the motor carrier.

Description	ACE Status	Subject	Date Requested	Date Produced	Produced By	Reviewed to meet sample

Comments

The records reviewed to meet the sample were:

N/A

Driver Fitness

Sampled Drivers

List of the driver(s) for the sample, and if applicable, the timeframe reviewed.

Name	Date of Birth	License Information	Phone	Employment Dates	Sample Dates	Medical Examer Information	Date of MEC Issuance	MEC Inquiry Results

Requested Documents

List of the documents requested and produced by the motor carrier.

Description	ACE Status	Subject	Date Requested	Date Produced	Produced By	Reviewed to meet sample

Comments

Medical exemptions or variances discovered for drivers during the investigation:

N/A

The records reviewed to meet the sample were:

N/A

Conclusio

n SI

Comments

Conclusion

Planned Action

The following are selected enhanced enforcement action(s): Notice of Claim ()

Comments

Documents Provided to Carrier

Completed Date: 10/15/19

List of materials provided to the motor carrier: Investigation Report

Comments

Indicate if an amendment was made to the compliance investigation report after the close-out and provide an explanation of the changes made to the report. The method used to provide the motor carrier with an amended copy was as follows:

N/A

Carrier Acceptance

Company Owners and Partners/Officers/Members of the Company Carrier refused to accept the investigation report: No

Closeout was performed with the highest ranking official: Yes

ACE Driver List

To view the ACE Lists, please go to Attachments by clicking the paper clip icon in the Navigation Pane. To access the Navigation Pane, click on View in the menu --> Show/Hide --> Navigation Pane --> Attachments.

ACE Equipment List

To view the ACE Lists, please go to Attachments by clicking the paper clip icon in the Navigation Pane. To access the Navigation Pane, click on View in the menu --> Show/Hide --> Navigation Pane --> Attachments.

Appendix SACN

Table of Contents

Illustration SACN-1: Part C - Comments

REQUIRED

1. What specific supporting documents were requested and when (was the carrier given 48 hours to produce records not located at the PPOB?)
2. What specific supporting documents were produced and when?
3. What is the name and title of the person from whom you requested the documents?
4. Where are the supporting documents located and how are they maintained (by driver, by trip, in trip envelopes filed by date, etc.)?
5. If supporting documentation was available and/or presented that did not contain valid or vital information, that could be used to check the accuracy of the RODS, explain how and why.
6. Explain why sampling is expanded beyond minimum amount.
7. Explain why a CDLIS licensing check was not conducted or that other methods were used to verify licenses.
8. Explain why vehicles were not inspected IF three or more inspections were not on profile.
9. Note inspections in the motor carriers possession, but not on the profile that were used to calculate the OOS rate.
10. Explain reason for NOT taking enforcement action for acute violations.
11. Explain if gross revenue figure was refused and how the amount you entered was figured.
12. Show names of household goods agents of motor carriers, when applicable.
13. Note if there is more than one reason for initiating compliance review (i.e., complaint and Case Follow-up)
14. Enter the following language if investigation was initiated due to a complaint: “This investigation was initiated as the result of a letter alleging violations of (appropriate 49 CFR section).” The identity and occupation of the complainant should not be mentioned.
15. Operated as other company or relationship to other trucking company (for example: was owned by XXX, went bankrupt, and brother-in-law bought this company that is operated by XXX).
16. Explain inter-/intra- operation and how it affects the numbers on the CR.
17. Problems discovered with consortium.
18. If extremely difficult to locate motor carrier, explain how motor carrier was contacted.

19. The SI or Auditor must record the name, title, carrier/shipper name, date and telephone number (if different from the information in MCMIS) of the motor carrier/shipper official or designated representative who received a copy of the Investigative Report (CR, SA or intervention).
20. Note if a HM Supplemental Review was completed.
21. Expansion of a stand-alone SCR to a comprehensive review.
22. Note if an SSV was completed and the Security Talking Points provided.
23. Anything unusual about the carrier, representatives, operations, routes or any other information you feel should be noted in the Part C.

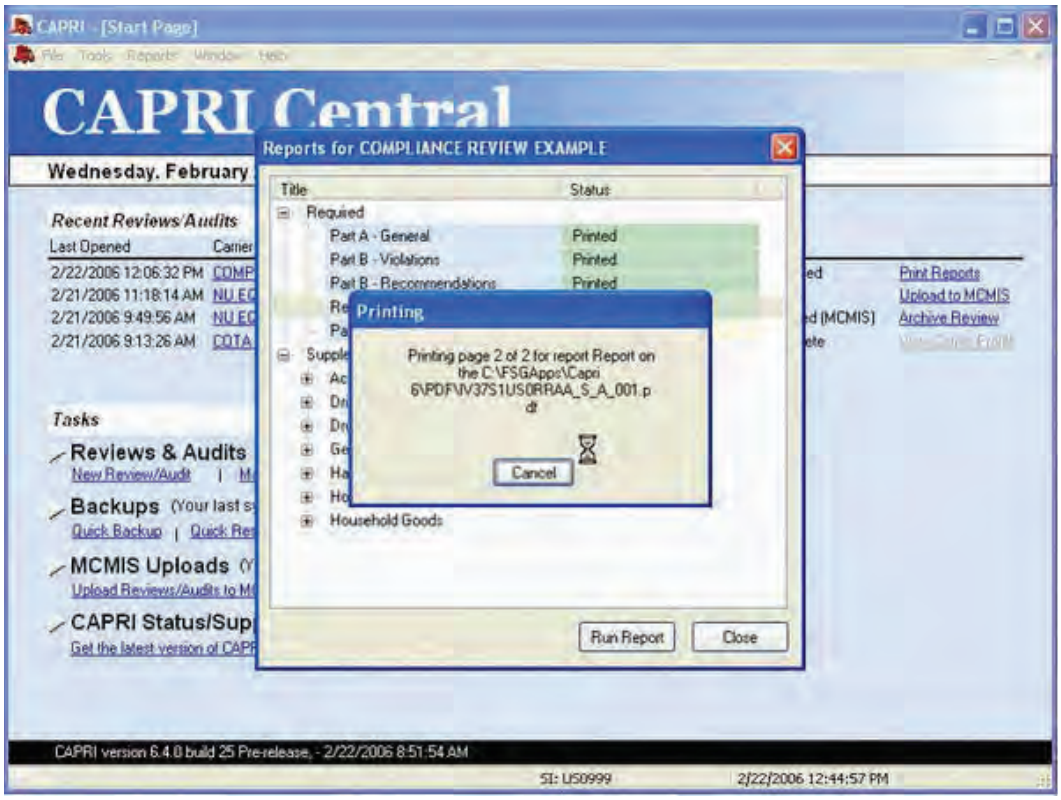
Illustration SACN-2: Automatic Rendering

This handy guide outlines the procedures to be used to automatically render a PDF version of an investigation or SA to EDMS. It will cover the following steps in the automatic rendering process:

- Rendering a PDF version of an investigation report or SA to EDMS
- Making a change to an investigation report or SA after it has been uploaded to MCMIS
- Making a change to an investigation report or SA after it has been approved in MCMIS and automatically rendered to EDMS
- Printing, viewing on screen, or printing to a file an investigation report or SA and the data in the investigation report or SA has not changed
- Uploading an investigation report or SA to MCMIS
- Retaining paper originals of the documents stored in EDMS

How do I render a PDF version of an investigation report or SA to EDMS?
The process to render a PDF version of an investigation or SA to EDMS follows.

The investigtion or SA is completed.
↓
Reports (Parts A, B, and Recommendations) are printed.
↓
A PDF is automatically generated of Parts A, B, and Recommendations.
↓
Part C is printed. A “printing window” will appear after Part C is printed, viewed on screen, or printed to a file (see example below).



↓

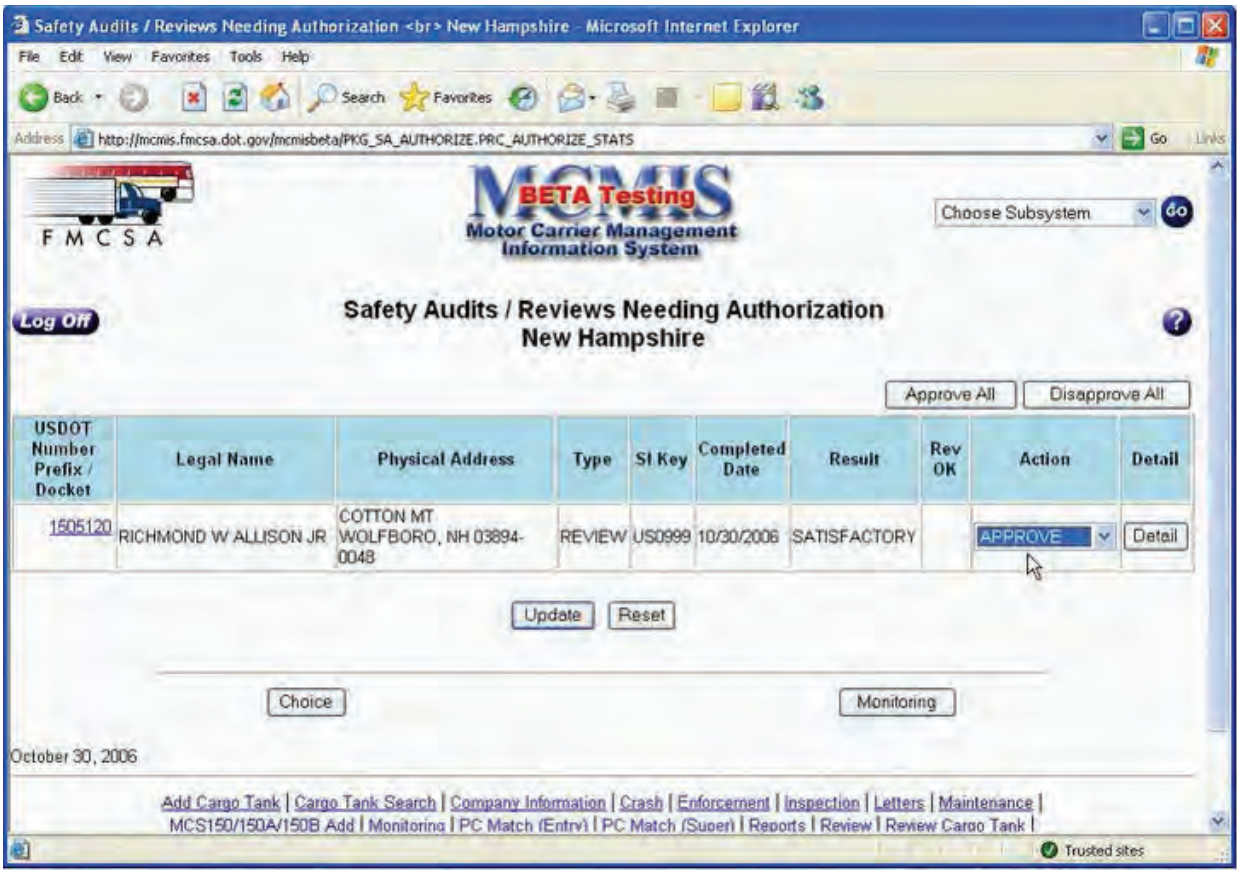
A PDF is automatically generated of Part C.

↓

The PDF versions of Parts A, B, Recommendations, and C of the investigation report or SA are uploaded to MCMIS. This is an automatic process.

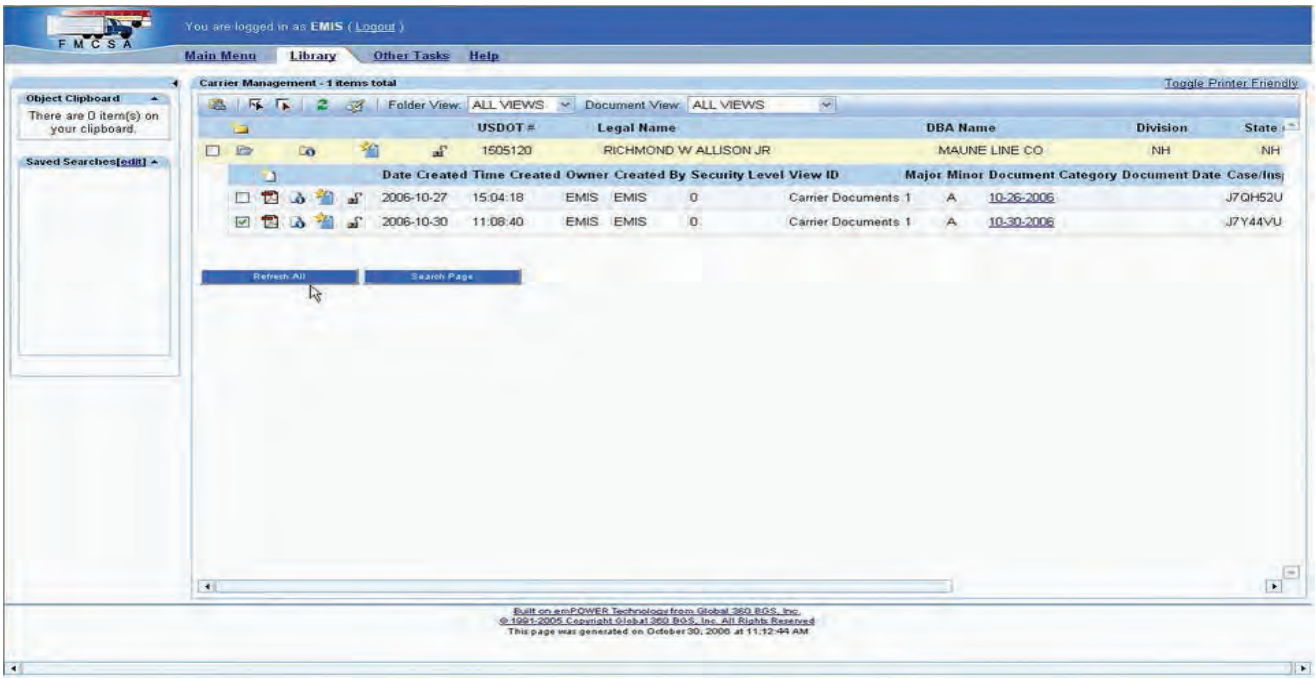
↓

The investigation report or SA is approved in MCMIS (see example below).



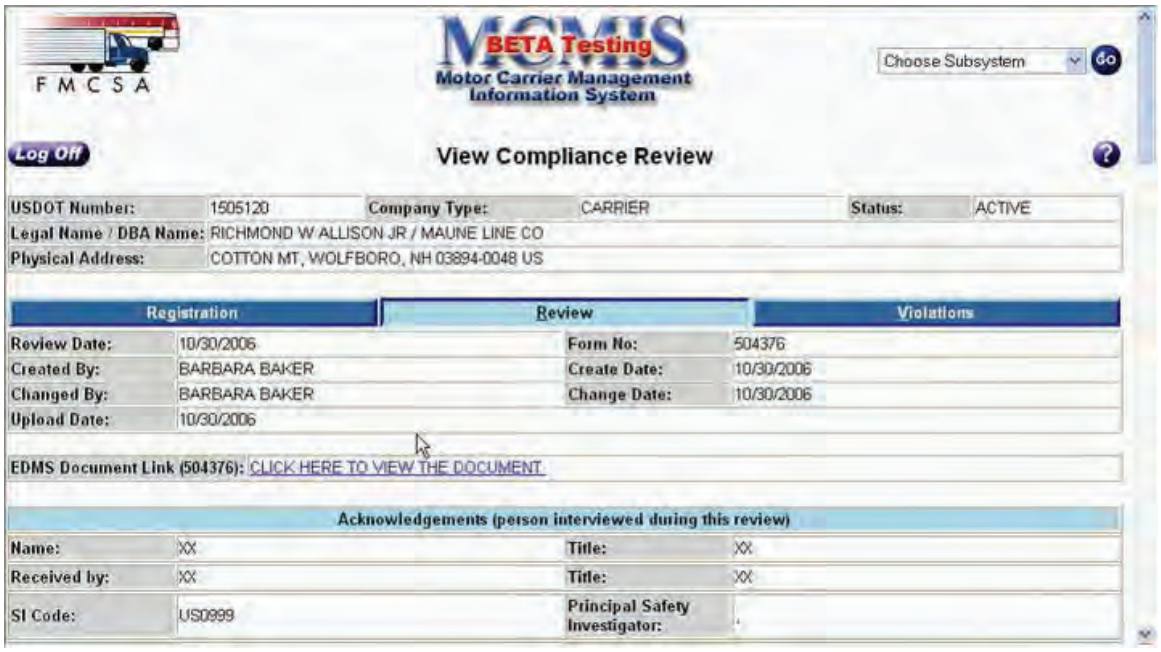
↓

The investigation report or SA is automatically sent to EDMS (see example below).



↓

A link to the document is created in MCMIS (see example below).



↓

What procedures should I follow if I need to make a change to an investigation or SA after it has been uploaded to MCMIS?

Once an investigation or SA has been uploaded to MCMIS and you discover you need to make a change, you should adhere to the following procedures.

The SI or auditor makes the appropriate change(s) to the investigation or SA in CAPRI. The SI or auditor must provide a corrected copy of the investigation report or SA to the carrier.

↓

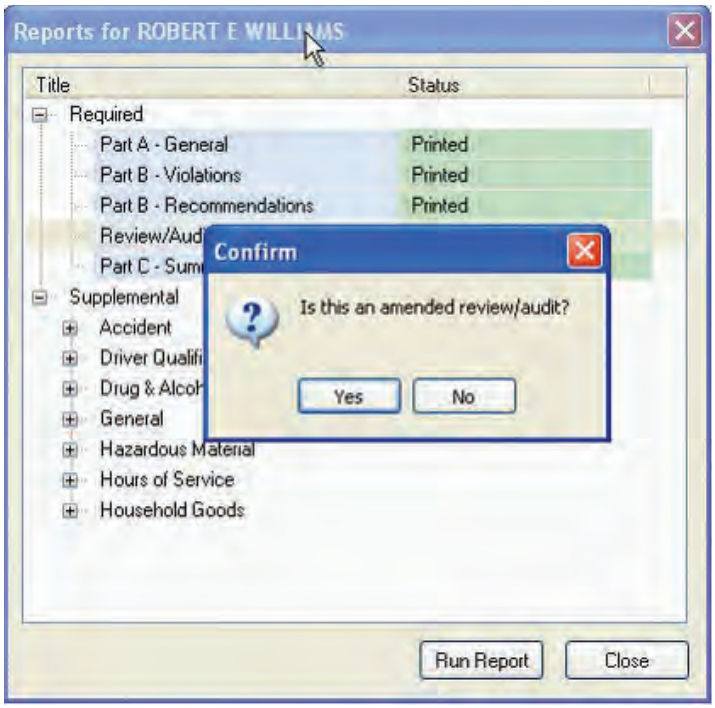
Reports (Parts A, B, and Recommendations, if they were changed) are printed.

↓

The message "Is this an amended review/audit?" will appear.

↓

You should answer "Yes" at this time (see example below). This will generate a new report.



↓

A PDF is automatically generated of Parts A, B, and Recommendations.

↓

Part C is printed.

↓

A PDF is automatically generated of Part C.

↓

The PDF versions of Parts A, B, Recommendations, and C of the investigation report or SA are uploaded to MCMIS. This is an automatic process.

↓

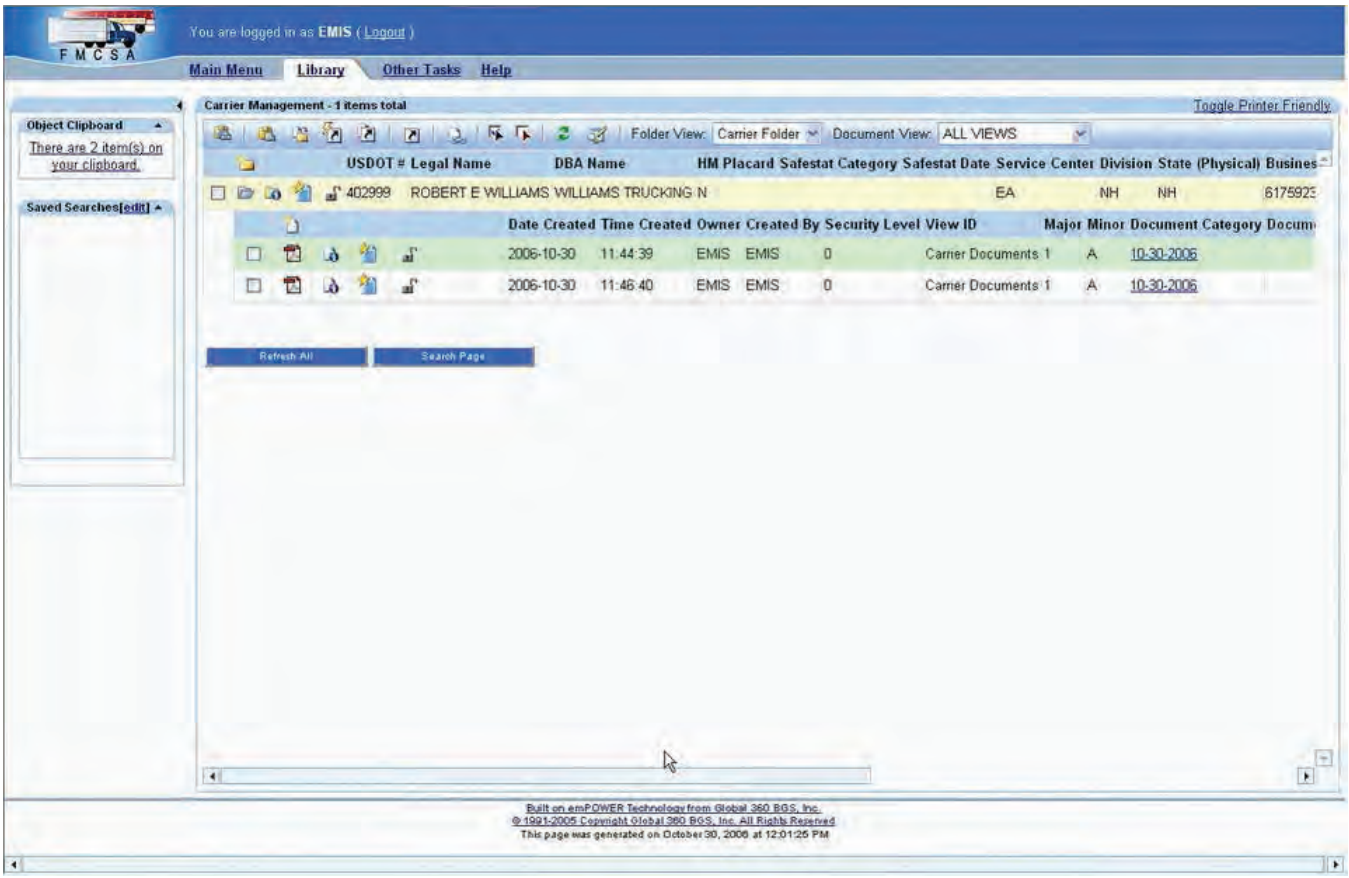
The investigation report or SA is approved in MCMIS.

↓

The investigation report or SA is automatically sent to EDMS.

↓

Two documents are now in EDMS, the earlier version (the first document listed) and the later version (the second document listed). See example below.



↓

One link to the document is created in MCMIS. The second version will open from this link (see example below).

What procedures should I follow if I need to make a change to a investigation report or SA after it has been approved in MCMIS and automatically rendered to EDMS?
Once an investigation report or SA has been approved in MCMIS and automatically rendered to EDMS and you discover you need to make a change, you should adhere to the following procedures for either modifying the investigation data (STEP 1) or deleting an investigation report or SA in order to upload the correct review or audit (STEP 2).

STEP 1 - MODIFICATIONS

The SI consults with his or her DA and/or his FA or his designee to determine whether the investigation should be modified or deleted. **NOTE**: SAs cannot be modified.

↓

If it is determined that the investigation report should be modified, the SI makes the appropriate changes in CAPRI and provides a corrected copy of the investigation report to the motor carrier.

↓

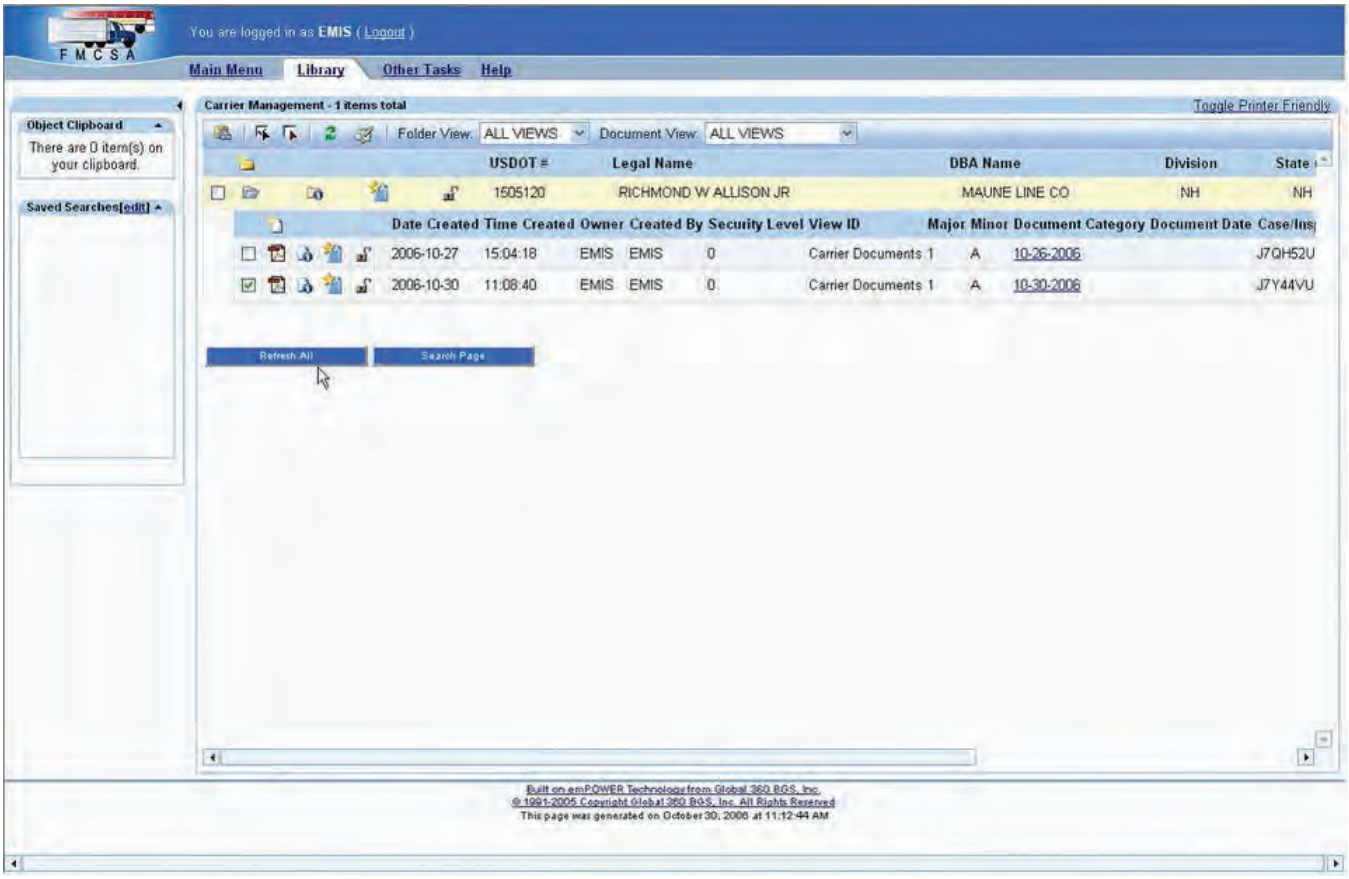
The corrected version of the investigation report or a detailed list of modifications is forwarded to the FA or his designee to modify the investigation report in MCMIS.

↓

Once the changes are made in MCMIS, the SI must manually scan the investigation report into EDMS.

↓

There will be two versions of the investigation report in EDMS (see below).



Only one link to the document will be in MCMIS. The first version will open from this link (see example below). MCMIS only creates a link from EDMS if the investigation report or SA is automatically rendered. Links in MCMIS are not created from documents that are scanned into EDMS.

STEP 2 - DELETIONS

The SI consults with his or her DA and/or his FA or his designee to determine whether the investigation should be modified or deleted.

↓

If it is determined that investigation report or SA should be deleted, the SI or auditor forwards his or her data change request to his or her DA or his or her designee. The data change request should explain the error and indicate that the investigation report or SA needs to be deleted from MCMIS. If the data change request is for an SA, the auditor must complete a Data Change Request Form. Data Change Request Forms can be obtained from the KnowZone or Infosys website.

↓

The DA approves the data change request or the Data Change Request Form and forwards to the FA or his designee for action.

↓

The FA or his designee concurs with the DA's approval and initiates the deletion of the incorrect investigation report or SA from MCMIS.

↓ (for investigations) **- OR -** ↓ (for SAs)

The FA or his designee will delete the review from MCMIS. This will allow the SI to upload the corrected review.

The FA or his designee forwards the Data Change Request Form to FMCTechSup@volpe.dot.gov. Volpe will delete the SA from MCMIS, allowing the safety auditor to upload the corrected audit.

↓

The SI or auditor should now follow the instructions under the "How do I render a PDF version of an investigation report or SA to EDMS" section to upload the corrected review. The SI or auditor must provide a corrected copy of the investigation report or SA to the carrier.

↓

NOTE: After the SI or auditor uploads the corrected review, there will be two versions of the investigation report or SA in EDMS.

What procedures should I follow if I print, view on the screen, or print to a file an investigation report or SA and the data in the investigation report or SA has not changed?
You should adhere to the following procedures if you print, view on the screen, or print to a file an investigation report or SA and the data has not changed.

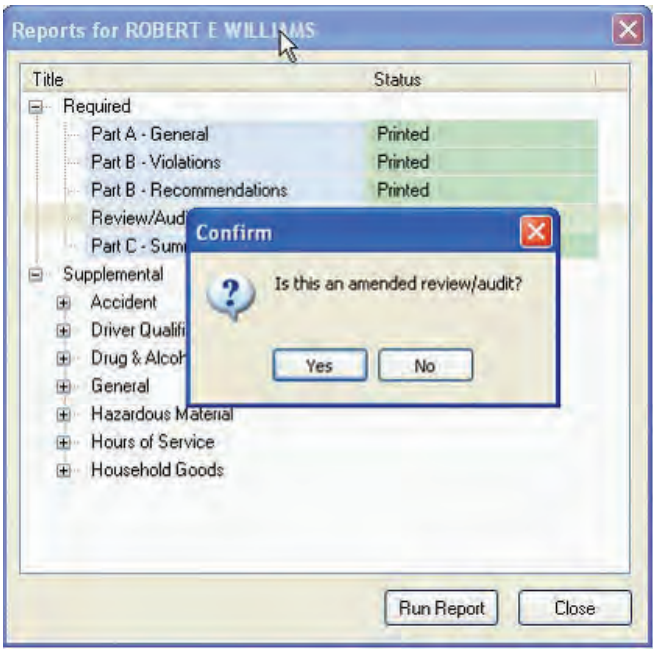
Reports (Parts A, B, and Recommendations, if they were changed) are printed, viewed on screen, or printed to a file.

↓

The message "Is this an amended review/audit?" will appear.

↓

You should answer "No" at this time (see example below). The previous rendered PDF file will be overwritten. This will not generate duplicate reviews in EDMS.



A PDF is automatically generated of Parts A, B, and Recommendations.

↓

Part C is printed.

↓

A PDF is automatically generated of Part C.

↓

The PDF versions of Parts A, B, Recommendations, and C of the investigation report or SA are uploaded to MCMIS. This is an automatic process.

↓

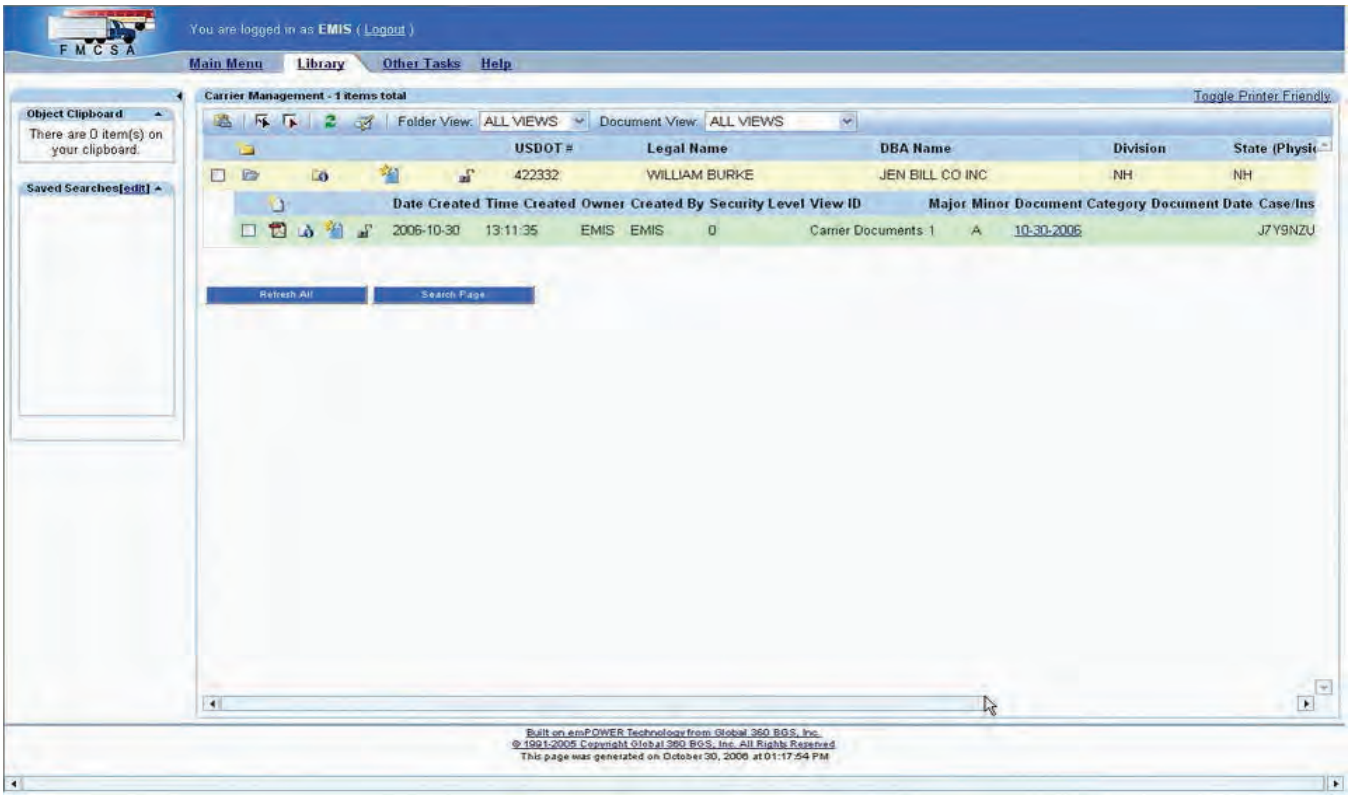
The investigation report or SA is approved in MCMIS.

↓

The investigation report or SA is automatically sent to EDMS.

↓

One version of the document will remain in EDMS (see example below).



What steps should I follow if I am unable to upload an investigation report or SA to MCMIS?
There will be instances when you will not be able to upload an investigation report or SA to MCMIS because of your travel status, issues with the information system, error messages, etc. You should adhere to the following procedures in the event you encounter these problems.

The SI or auditor should contact Volpe for technical support.

↓

For investigations: If Volpe is unable to assist because of network, system, communication, development issues, the SI will be required to send (e.g., fax, mail, email) a hard copy to his FA or his designee for manual entry.

For SAs: FMCSA does not have the ability to manually enter SAs into MCMIS. Therefore, the auditor will need to continue to work with technical support at Volpe until the issue is resolved. Once the issue is resolved, the auditor should follow the procedures under the "How do I render a PDF version of an investigation report or SA to EDMS?" section to complete the automatic rendering process.

↓

Once the investigation report is manually entered, the SI must manually scan the investigation report into EDMS.

How long should I retain paper originals of the documents stored in EDMS?
Divisions should follow the Quality Assurance Procedures (Attachment C) of the EDMS Manual with regards to the retention of paper originals of documents stored in EDMS. The EDMS Manual states:

> "It is imperative that paper originals of documents stored into EDMS are retained until a full backup cycle of EDMS has occurred. If no failure notification has been received by Wednesday afternoon, then the paper documents may be properly disposed."

Illustration SACN-3: Quality Assurance Procedures

I. PURPOSE

An electronic document management system, when properly used, offers superior accessibility, storage, and retrieval of mission critical information.

This document outlines procedures to be used to safeguard the accuracy, quality and integrity of documents stored in the FMCSA's Electronic Document Management System (EDMS). These procedures will be used to defend the accuracy of documents utilized in regulatory and enforcement proceedings.

II. SCOPE

This document will cover Quality Control and Assurance procedures for preparing, scanning and indexing of Review and Enforcement documentation.

III. OVERVIEW

This document will cover the following steps in the document imaging process:

- Document Preparation
- Quality Control
- Document Indexing
- Quality Assurance
- Document Backups

An example of a typical scanning process will be outlined step by step.

IV. DOCUMENT PREPARATION

There will be two types of documents prepared for scanning into EDMS: those documents that are currently stored in paper format ("back-scanning") and documents prepared after implementation of EDMS.

a. Back scanning of existing documents: Existing documents may utilize a variety of features hat are not compatible with efficient document scanning- the documents were prepared without anticipation of the requirements for electronic scanning. Persons preparing existing documents for back-scanning should ensure the following:
    1. Remove all paper clips and other fastenings
    2. Place document pages into office standard sequential ordering
    3. Repair or recopy damaged pages
    4. Copy post-it notes containing pertinent information to full size sheets of paper and remove.
    5. Examine highlighted areas for scan-ability- any color other than yellow will most likely scan as completely black, obscuring the highlighted text. Pages with dark highlighting should be flagged for grey-scale scanning.
    6. Flag photos and color prints using temporary post-its or other means, for color scanning.
    7. Copy non-standard paper types and sizes onto 8.5 X 11 inch standard letter sized paper.

b. Preparation off new documents, post-EDMS implementation -- Documents created after implementation of EDMS should take the needs of efficient scanning into consideration. Standard office procedures should be developed to minimize the amount of pre-processing required to scan a new document:
    1. Do not use staples- paper clips or other quick release fasteners may be used, or simply avoid fastener use altogether in smaller documents.
    2. Use standard sizes, weights, and type of paper only.
    3. Document a standard sequential order for pages within scanned documents. (For example- Enforcement cover page, then UFA, then NOC, etc.)
    4. Do not use post-it notes or highlighters on documents- in enforcement reports, such information should be outlined in exhibit abstracts. Light yellow highlighting may be used if compatible with your scanner.
    5. Photocopies that may be difficult to scan (ex- very light copies, color photos or printouts) should be flagged using tabs or temporary post it notes for the attention of the person scanning.
    6. The preferred method of imaging digital photos into the system is to store the images into the TIFF or other file directly, rather than printing and scanning the photos. For example, utilize the "virtual printer" capability available in some scanning packages to print digital camera images directly into TIFF files, and then insert the TIFF images into a scanned case.

c. When to scan a document -- Most documents will be scanned after all Division level processing is completed- for example, enforcement reports should be scanned after the Notice of Claim is generated and mailed out, investigations and SAs after review and upload into MCMIS.

V. QUALITY CONTROL

The quality control process begins during the scanning of the document. The document page count and image quality will be verified at this time.

Kofax Scanning Solution

a. Hardware and Software Standards - If scanning with the Kofax solution, the scanner needs to be compliant with the recommended scanners that are certified by Kofax to be utilized in connection with the Ascent Capture 6.0 or higher. All other settings will be the same.
b. Page Count (to be done in the scanning phase) - Scan like documents (investigation reports, Inspection Reports, Cases, etc.) in batches of whatever number the document feeder can handle. The only limitation to this process is the hardware feeder limit. As each batch is scanned, verify the page count as it increments in the scanning software. Note the total page count and attach to the document (after scanning) via post-it note, or other temporary note. If there is a problem with the scanning count, correct by inserting missing pages, or by rescanning the affected pages, after deleting the faulty pages.
c. Image Quality (to be done in the scanning phase) - To balance quality of images vs. file size, the scanner settings should be set to 300 DPI, black and white scanning (or "line-drawing"). Utilize grey-scale or color image scanning for pages flagged as potentially being a problem for standard black and white scanning. When possible, integrate digital camera images directly in the scanned document by using the virtual printer function.
d. Quality Assurance of Documents (to be done in the Quality Assurance phase) -- To balance quality of images vs. the original document, the user will view the document in the QA phase of the scanning process. The user can verify the document content and image quality during this phase. The user will verify the readability and image quality of each document by visually checking each document. If any pages are found to be faulty, the user will correct any problem pages by rescanning and replacing bad scans, or rescan the entire document. If a page is faulty due to problems with the paper original, adjust scanner settings to allow faithful reproduction and rescan (utilize grey-scale or color settings). This is normally handled by the Virtual Rescanning option if available on the scanner purchased.
e. Verification of Documents (to be done in Verification phase) - As each scanned image is indexed into EDMS, verify that the correct file is being attached into EDMS by checking the USDOT number and document date, enforcement case number, or other unique identifier as documented by the Division office. This needs to be done for each individual document in the batch.
f. Accurate Index Values (to be done in Verification phase) - Scanned documents should be indexed by utilizing the original paper document as reference; as each set of index values in entered, use the paper original for key values, like USDOT number, Carrier Name, etc. As this step is now automated, the user must verify the information for each document before moving on to the next phase.

g. Next Steps - Retain the paper documents for the Quality Assurance and the document backup steps.

Non-Kofax Scanning Solution

a. Hardware and Software Standards - At a minimum, scanning should be conducted on Twain compliant (scanner driver interface) scanner with a minimum scan image quality capability of 300 DPI. Scanner software should produce a standard multi-page TIFF format file with G4 compression, readable by standard graphics programs, including the Windows built in image viewer.
b. Page Count - Scan documents in batches of 25 pages. As each batch is scanned, verify the page count as it increments in the scanning software. Note the total page count and attach to the document (after scanning) via post it note, or other temporary note. If there is a problem with the document count, correct by inserting missing pages, or by rescanning the last batch of 25 pages, after deleting the faulty batch.
c. Image Quality - To balance quality of images vs. file size, the scanner settings should be set to 300 DPI, black and white scanning (or "line-drawing"). Utilize grey-scale or color image scanning for pages flagged as potentially being a problem for standard black and white scanning. When possible, integrate digital camera images directly in the scanned document by using the virtual printer function available in some scanning programs. After feeding the document through the scanner, verify the readability and image quality of the document by visually checking the first, last, and 10 percent of the middle of the document. (For example, in a 50-page enforcement report, randomly check 5 pages in the body of the document, in addition to the first and last pages). If any pages are found to be faulty, the entire document should be verified. Correct any problem pages by rescanning and replacing bad scans, or rescan the entire document. If a page is faulty due to problems with the paper original, adjust scanner settings to allow faithful reproduction and rescan (utilize grey-scale or color settings).

VI. DOCUMENT INDEXING

EDMS utilizes a browser-based client that minimizes the amount of technical support necessary to enter and access scanned and electronic documents. The use of a browser client necessitates that documents are initially stored on a local or network disc, then later attached to a document index in EDMS. Steps must be taken to ensure that the correct document is attached to the corresponding index.

a. **File Naming Convention** - All offices will adopt and document a standard directory structure and file name convention for temporary storage of scanned documents on local or shared network drives. For example, all investigation reports could be scanned to a directory named “EDMS_REVIEWS", and all enforcement reports to "EDMS_CASES". Investigation reports could be stored using a filename consisting of the Carrier USDOT number underscore Carrier Name underscore Review Date. (Ex-456998_Smith Trucking_09-09-2003.TIF) Enforcement reports would be saved using the full enforcement case number. (Ex: MI-2003-0128-US0405.TIF).

b. **Verification of Documents** - As each scanned image is indexed into EDMS, verify that the correct file is being attached into EDMS by checking the USDOT number and document date, enforcement case number, or other unique identifier as documented by the Division office.
c. **Accurate Index Values** - Scanned documents should be indexed by utilizing the original paper document as a reference- as each set of index values is entered, use the paper original for key values like USDOT number, Carrier Name, etc.
d. **Next Steps** - Retain the paper documents for the Quality Assurance and document backup steps.

VII. QUALITY ASSURANCE

The Quality Assurance (QA) process is a sampling procedure to verify the accuracy and completeness of the document scanning process. The QA review will ensure that the document retains the proper page count, image legibility, and document index accuracy.

a. Utilize Paper Originals for Verification - After documents have been scanned into TIFF files and indexed into EDMS, the originals will now be verified in EDMS for QA.
    - NOTE: The same individual that scanned the image and entered the document into EDMS can do this verification process. If the DA determines a second individual needs to perform this verification, the DA will assign an individual to do this.
b. Sampling Procedure - The QA review will consist of a 25 percent sampling of investigation reports/SAs/other reviews and a 25 percent sampling of enforcement reports. (Example: If processing 6 completed investigations, the QA review will verify completeness, accuracy, and image quality for a minimum of 6 X .25 = 1.5, or 2 reviews.)
c. Verify Accuracy of Index Values - Retrieve each sampled document from EDMS and compare the index values, as entered into EDMS, against the values on the original paper document.
d. Page Count Verification - The reviewer will note the page count of the document [see IV (B) above] and compare that against the scanned document by opening the document and verifying that the counts match (page count as indicated by the scanning software).
e. Image QA - The reviewer will review the first, last, and 10 percent of the middle of a document for image legibility and retention of information.
f. Next Steps - The reviewer will retain all paper originals until a complete backup cycle has been completed.

VIII. DOCUMENT BACKUPS

It is imperative that paper originals of documents stored into EDMS are retained until a full backup cycle of EDMS has occurred. EDMS will conduct incremental backups nightly, with a full backup cycle over the weekend. All documents scanned during a week should be kept until the following Wednesday. In the event of a backup system failure, notification will be sent out via email; hard copies of documents must be retained until such time as a full backup has been successfully achieved.

If no failure notification has been received by Wednesday afternoon, then the paper documents may be properly disposed.

IX. A TYPICAL SCANNING CYCLE

The following is an example of process outlined above, as it would be conducted in a typical day-to-day operation.

1. An SI submits a paper enforcement report to the Federal Program Specialist (FPS).
2. The FPS reviews the report, and sends it back to the SI for a correction (1 dropped count).
3. The SI resubmits the corrected report.
4. The FPS approves the case report, prints a final NOC and Statement of Charges, and forwards the paper document to the DA for review and signature.
5. The DA signs the paper report, and forwards to the TA for mailing of the NOC.
6. The TA processes the report for scanning- removes paper clips, checks for any post-it notes or highlighting, and arranges the report in the correct order.
7. The TA counts off 25 pages, scans them, then 23 pages, and scans the remainder (of a 48 page report).
8. The TA checks the page count as reported by the scanning software and notes that it shows 48 pages, the correct page count.
9. The TA places a post-it on the paper report, and notes a page count of 48.
10. The TA opens up "Thumbnail" view and verifies that the first, last and 5 random middle pages (10 percent sampling) are clean scans, with no reproduction problems, by clicking and viewing each of the sampled pages.
11. The TA saves the report file to a shared network directory- H:\EDMS_CASES, utilizing the filename MI-2004-0011-US405.TIF.
12. The TA processes several investigations and Cases, following the Document Preparation and Quality Control Procedures.
13. After completing a batch of investigations and Cases, the TA logs in to EDMS and begins indexing the scanned files into storage.
14. The TA refers to the stack of processed and scanned paper investigation reports and Cases- as he or she moves each paper document from the scanned-but-not-indexed to the scanned-and-indexed stack, he or she uses the USDOT number, carrier name, and case number etc., values from the paper documents to complete each EDMS index.
15. As the TA completes each set of indexing values, he or she hits the browse button in EDMS and navigates to the appropriate directory (in the case noted above, H:\EDMS_CASES) and then finds the correct file by comparing the information on the paper report against the standard filename. (MI-2004-0011-US405.TIF)
16. After the TA has completed a batch of paper documents, the scanned-and-indexed paper documents are forwarded to the FPS for the QA review.
17. The FPS randomly selects and sets aside every 4th investigation report or SA and every 4th enforcement report for a QA review

18. For each selected paper investigation report and Case, the FPS searches EDMS and locates the stored scanned document. The FPS compares the paper document to the index values in EDMS to verify a match.
19. The FPS opens the document from EDMS, and compares the page count as noted on the paper original against the page count as indicated by the viewer program. For the case noted above, the software shows 48 pages.
20. The FPS then goes into "Thumbnail" view and verifies the legibility of the first, last, and 5 random middle pages.
21. After completing the QA review of all sampled paper documents, the FPS sets the reports into an outbox marked "Awaiting Backup." Other batches of scanned and quality checked documents are already in the box.
22. On Wednesday, the FPS notes that the Division has received no notice of an EDMS backup system failure. The FPS forwards the fully processed documents in the "Awaiting Backup" box to the TA for proper disposal.

NOTE: Although this is the typical process, the TA or the individual that originally scanned the document into EDMS, can also perform the EDMS verification process.