NEPC

CARGO TANK

MAINTENANCE MANUAL

National Tank Truck Carriers

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SECTION 1: INTRODUCTION

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TO THE USER OF THIS MANUAL:

Perhaps no other segment of trucking bears a greater obligation to the concept of highway safety than does the tank truck industry. This obligation extends to the men and women who inspect, test, maintain and repair the cargo tanks that transport millions of gallons of hazardous materials safely every day.

This 4th edition of NTTC's Cargo Tank Maintenance Manual updates the 2004 edition and is intended to contribute the quality and professionalism of tank truck maintenance. It contains changes to the Federal cargo tank regulations made through December 2013. NTTC is most grateful to those supplier companies who have permitted the reproduction of illustrations and graphics showing various cargo tank components and appurtenances. Likewise, we thank the regulatory and enforcement communities for their contributions as we seek to achieve our common goal of safe highway transportation by tank truck. We especially want to remember the late Dave Fellows of The Heil Company who edited the previous edition of this manual and was a great representative of his company and the tank truck industry for a long and productive career.

Why do you do cargo tank test, inspections, maintenance and repair? Perhaps it is just for regulatory compliance. Hopefully, you train your employees to perform these important tasks to protect the investment you have made in your equipment and to contribute to tank truck safety. Regardless, this manual will help you reach your objectives.

While the manual is geared to operations and maintenance personnel to help them comply with regulations and to prolong the service life of their equipment, this publication also can benefit other personnel in your company as it offers "the language of the tank truck industry" to help everyone from the CEO to the sales executive to the dispatcher to better do their jobs.

The manual contains a number of suggested "Forms" upon which inspection and test results can be recorded. While there are no "official government report forms" mandated for compliance with any element of 49 CFR Part 180, the reader should note that in the past these forms, together with other documentation have been accepted by DOT enforcement personnel as indicia of compliance with Part 180.

Dan Furth

President

National Tank Truck Carriers, Inc.

SECTION 1: INTRODUCTION

SPECIAL NOTICE REGARDING APPLICABLE DOT REQUIREMENTS

The United States Department of Transportation (DOT) has specific and comprehensive regulations regarding certain testing, inspection, maintenance and repair of cargo tank motor used in the transportation of hazardous materials. Throughout this publication, those portions of the DOT rules are generally referred to as "Part 180" (referencing Title 49, Code of Federal Regulations (CFR)). It is imperative that users of this publication familiarize themselves with these important regulations and track and implement changes made to those regulations.

The Federal regulations governing cargo tank manufacture, operation, test, maintenance and repair are written by the Pipeline and Hazardous Materials Safety Administration (PHMSA) which was formerly known as the Research and Special Projects Administration (RSPA.) The regulations are enforced by the Federal Motor Carrier Safety Administration (FMCSA) and state and local law enforcement personnel who have been trained and certified on those regulations.

Proposed changes to those regulations must be published in the *Federal Register* and are subject to public comment. Regulations are updated on Department of Transportation websites including www.phmsa.gov and www.fmcsa.gov. Members of National Tank Truck Carriers will be notified of any proposed and actual changes to the regulations and encouraged to comment on those changes as the regulatory process develops.

The reader should be aware of those DOT regulations which require certain persons to" register with DOT prior to perform regulated functions specified in Part 180. DOT spells out these requirements in 49 CFR at Sections 107.501 through 107.504. If you have questions concerning the applicability of these regulations, contact NTTC. An equally important section is 171.8 which includes official DOT definitions that will be used throughout this publication. Definitions also are included in other sections of the regulations, as we will detail.

1.0 AN OVERVIEW OF DOT REGULATIONS

1.1 INTRODUCTION

Federal regulations make Cargo Tank Maintenance a vital part of operating "MC" or "DOT" Specification Cargo Tanks. You may still hear some people refer to the "HM183" changes. Prior to 1990, the U. S. Department of Transportation had few regulatory test and inspection requirements. "HM183" was the rulemaking that led to the current regulations that are now found in Title 49 Part 180 of the Code of Federal Regulations. (CFR.) There is little disagreement that cargo tank safety has been improved by this effort which was largely supported by industry. The regulations mandate the type and frequency of tests that are required to keep cargo tanks in service. They also mandate minimum requirements for personnel who will supervise and perform different tasks and record keeping procedures for these tests.

The manual also contains information on maintenance, test, and inspection procedures that are recommended for Non-Specification Cargo Tanks, FRP tanks built under Special Permits, Intermodal Tank Containers, food, and dry bulk pneumatic tanks. Obviously, many of the steps are the same. Keep in mind, however, that Part 180 requirements are not "mandated" for application to Non-Specification cargo tanks. Even if you perform a Part180 test or inspection on a non-spec tanker, do not place the compliance marking and dates on the non-spec trailer.

Those using this manual should be familiar with DOT Hazardous Materials transportation requirements and be knowledgeable about testing methods and inspection procedures. The Manual is not intended to be used as the sole information source required for the broad mechanical and record keeping skills necessary to perform these functions. Please note Section 1.3 regarding the above.

It is a carrier's responsibility to have the tests performed reliably and to have the proper documentation in their flies, whether you make your own inspections or have them done in Registered Inspection Facilities. Be sure your contractor is following the regulations.

1.2 MAINTENANCE AND THE LAW

As mentioned, the Federal Motor Carrier Safety Administration (FMCSA) has the responsibility for enforcement of DOT HazMat regulations which are promulgated by the Pipeline and Hazardous Materials Administration (PHMSA.) Both FMCSA and PHMSA are independent agencies within the U.S. Department of Transportation. Currently, no regulations covering these cargo tank subjects are promulgated by other agencies such as OSHA or EPA. The Environmental Protection Agency does have a leakage test requirement for gasoline tankers. That test can be used to satisfy DOT regulations under certain conditions.

FMCSA has an active enforcement program using both federal and state employees to carry out audits of carriers, manufacturers, inspectors and repairers of Hazardous Materials Specification Cargo Tanks. That agency has statutory authority to levy fines for violations and does not hesitate in carrying out their authority. Additionally, the nature of some violations may subject a company or individual to criminal penalties. Violations will be included in the FMCSA Compliance, Safety, Accountability (CSA) data used for additional enforcement actions. (For information on CSA, visit: https://csa.fmcsa.dot.gov/yourrole/drivers.aspx.

The test and record keeping procedures recommended in this manual are important. Assume you will be audited and remember that most violations found in facility audits are paperwork violations. If you did not properly write it down on the record, you did not do it.

1.3 DISCLAIMER

As publisher, NTTC believes the practices and procedures covered in this manual can assist the user in achieving and maintaining a high level of cargo tank maintenance quality. Implementation of this manual, in whole or in part, is entirely discretionary and voluntary on the part of any user, and NTTC makes no recommendation or suggestion that anyone use this manual other than on a purely voluntary basis.

This manual presents an aggregation of opinions, views and interpretations of government regulations by a wide variety of individuals in the tank truck industry. Much of this publication pertains to implementation of government regulations, violations of which are subject to severe civil and criminal penalties. This manual is not a substitute for government regulations. A current copy of applicable government regulations should be on hand and should be used as the primary guide to regulatory compliance. This manual is based upon the regulations of the United States Department of Transportation (DOT) in 49 CFR, Parts 171-180 (inclusive), as amended. The user should recognize that these regulations are not static. They continue to evolve and to change. In addition, government agencies are authorized to interpret and to grant exemptions from their regulations. It is the obligation of the user of this manual to assure compliance with the most current government regulations, and to recognize that significant changes to the regulations or interpretations may have been adopted or issued since publication of this manual. Government regulations are binding legal obligations, and, in the event any discrepancy appears between those regulations and this manual, the regulations should guide the user.

Because of the potential for error inherent in the translation and transcription of data, no express or implied warranty, guarantee or other representation is made by NTTC as to the correctness or sufficiency of any statement in the manual; and, NTTC assumes no responsibility or liability whatsoever in connection therewith.

The user should recognize that not every acceptable safety measure has been presented in the manual. Some alternative approaches may be equivalent in terms of safety and compliance. It is equally important to recognize that under certain circumstances additional precautions may be necessary for safety.

Specific products and components identified in this manual are not endorsed by NTTC as being effective or the best available. Some manufacturers' identifications have been used to facilitate understanding of the instructions for various tank systems, particularly when manhole assemblies and pressure relief devices are discussed. Generic representation is intended on the basis of configuration of item functions. With all products and components, whether mentioned in the manual or not, follow the instructions given by the manufacturer or supplier of those items.

CAUTION — Some maintenance services, including the performance of leakage and pressure tests, require the pressurization of cargo tanks. The DOT's regulations authorize both hydrostatic and pneumatic test methods for those purposes. Safety hazards are involved in both methods. Users of this manual must exercise extreme

caution and should provide protection of employees and other persons when pressurizing tanks. DOT requires specific protection of employees and other persons when pressurizing cargo tanks. DOT requires specific protection for the pneumatic retest method in 49 CFR 180. 407(g)(1) (viii). Similarly, 49CFR 180.407(h) requires that suitable safeguards be provided for the leakage test.

Although DOT's regulations authorize performance of the pneumatic method; NTTC recommends extreme caution using this method. Nonetheless, in order to provide guidance to the reader in all aspects of regulatory activity authorized by the government, information on the performance of the pneumatic test method is included in this manual. In no respect should inclusion of this information on pneumatic testing be considered to be an NTTC endorsement or recommendation of the use of such a method.

Some operations may require an employee to enter the cargo tank vessel. It is incumbent on the facility to develop, train and test proper tank entry, confined space requirements, and rescue procedures. Too many employees have died or been injured in assuming that a tank is safe for entry. All tankers, including both specification and non-spec tanks, must be assumed to have an unsafe environment until tested and proven otherwise. OSHA does have and exercise jurisdiction over tank truck maintenance facilities.

1.4 PURPOSE

The manual is intended to be instructive to Specification Cargo Tank users so they may develop the appropriate testing and inspection procedures that meet the DOT requirements by providing:

- Instructions on how to perform tests;
- Information on when tests are required;
- Information on who is qualified to perform tests;
- Information on paper work required to document tests and inspections.
- Selected regulatory interpretations issued by the Department of Transportation.
- Information to keep trailers in good operating condition.

1.5 MANUAL ORGANIZATION

The manual is organized so a user can quickly recognize requirements for the specific type(s) of HM Tank with which they are involved.

General information supplied in three introductory sections of the manual on Quality Systems, Cargo Tank Maintenance Procedures and Cargo Tank Regulations will be helpful in training those not experienced in Cargo Tank regulations and operations.

- Section 1 Introduction
- Section 2 The Quality Program Process
- Section 3 Glossary
- Section 4 Regulatory Process and Resources.
- Section 5 Maintenance Procedures
- Section 6 MC-306, DOT 406 Cargo Tanks
- Section 7 MC-307, DOT-407 Cargo Tanks
- Section 8 MC-312, DOT-412 Cargo Tanks
- Section 9 MC-331 Cargo Tanks
- Section 10 MC338 Cargo Tanks

- Section 11 Fiberglas Reinforced Plastic (FRP) Trailers
- Section 12 Interpretations
- Section 13 Portable Tanks
- Section 14 Additional Figures and Photographs

Editor's note: Certain sections of this manual refer to publications of the Truck Trailer Manufacturers Association (TTMA). Such may include TTMA "Technical Bulletins" or "Recommended Practices". Visit http://ttmanet.org.

SECTION 1: INTRODUCTION

SECTION 2: THE QUALITY PROGRAM PROCESS

SECTION 2 THE QUALITY PROCESS

2.0 QUALITY INTRODUCTION:

The repair and inspection of cargo tanks cannot be done successfully and on a consistent basis by a shop without a "Quality System". Put quality concepts, environment and processes into use in your shop if you are going to enhance its performance and to enjoy good customer relations and successful DOT audits.

A Quality System requires (at least) five functions.

- Determine, then list what your goals or activities are (e.g. inspect cargo tanks, repair cargo tanks etc);
- List program elements needed to meet your goals (e.g. visual inspections with forms used, safe entry procedures, welding, thickness testing, metal finishing, etc.);
- Train and properly document those individuals capable of performing those tasks;
- Create and maintain records that document what work you have done and by whom it was done.
- Engage all participants in the tank maintenance process to provide input for continuous improvement.

If your operation already has a system or you are a part of a company that has an established quality system you may still find this section valuable as a basis of comparison. If you do not have a quality system with a quality manual, or you think it may be outmoded by new regulations, a review of this section will be time well spent to assure yourself that you have a viable quality program.

2.1 QUALITY SYSTEM MANAGEMENT

Is quality a buzzword, or a way of life? If it is a way of life, is it driving the culture of your company?

Quality has become a strategic issue for successful companies. The thinking process that most companies devote to revenue shifting or large expenditures must be employed when it comes to quality. Maintaining a quality driven culture can be a significant challenge in any organization.

Making quality a strategic issue places greater emphasis on planning, analyzing, selecting, communicating, justifying, allocating resources, measuring, and managing the overall process. The analysis should focus on questions such as the where, how, who will be involved, when can we start, and who will lead? Selection processes should be routine and based on planning. Need drives selection. If the need is a totally new work environment forged from quality, then the best option might be "Total Quality Management" (TQM). If the need is to perform major repairs or tank modifications, the selection could be an ASME 'U' or National Board 'R' stamp, or it may be based on customers' request to become certified by the International Standards Organization (ISO).

Quality, just as any strategic issue, must be justified. Will it decrease operating cost? Add customers? Increase productivity? Even quality requirements imposed through regulations can be economically justified when designed, implemented, and managed correctly. Resource allocation requires ample investments of time and money.

Managing the overall process demands commitment, and here are five ways of demonstrating that commitment:

1. Communicate prior to implementing each action phase of the strategic plan;
2. Participate actively in the design and implementation of the selected process;
3. Evaluate effectiveness by seeking out problems and spearheading corrective action;
4. Encourage suggestions for improvement and act on them when warranted;

5. Provide visible recognition to all involved in improvement activities.

Experience has demonstrated that starting small has its advantages. As an example, implementing a National Board 'R' stamp program affects only certain personnel and revises few operating systems. Yet, it fosters a new mind set. Welders learn how certain variables affect the integrity of the weld. Buyers learn that not all material is good material. Service Managers learn proper methods for performing repairs and the reason behind them. Most importantly the quality process establishes a foundation that opens the door to TQM.

In the QUALITY SYSTEMS subsection the ASME 'U', National Board 'R' and ISO 9000 systems are discussed in detail. Preventive maintenance and training are also featured since they are extremely integral to the effectiveness of a quality directed maintenance function.

2.2 PREVENTIVE MAINTENANCE (PM)

The interval periods for retest and inspection under 49CFR 180.407 (c) were established by DOT to ensure the continuous qualification of cargo tanks. As most industries have discovered, PM is a value added cost. Traditionally, the trucking industry has had an excellent track record on the PM of power units, but to a lesser extent for the trailer. The Part 180 section has proven successful in adding very specific processes and functions for enhanced safety and fewer product loss incidents.

Tank truck carriers have found that this increased focus on trailer preventive maintenance enhances trailer productivity. Even carriers who perform only those tests and inspections required by regulation have seen improvement. Managing the quality system must address how PM is viewed. Maintenance managers and personnel need to be assured that they have the organizational freedom to perform their functions completely and in total compliance with DOT requirements.

2.3 TRAINING

A hazardous material employee is a person employed by a hazardous material employer and who directly affects hazardous materials transportation safety. Under the definitions in Section 171.8, this includes a person who:

> *Designs, manufactures, fabricates, inspects, marks, maintains, reconditions, repairs or tests a package, container, or packaging component that is represented, marked certified, or sold by that person as qualified for use in transporting hazardous materials in commerce.*

The hazardous material employee training requirements are specified in 49 CFR 172.704 and mandate that each hazardous material employer must:

- train, test, and certify its hazardous material employees;
- retain records of current training (including previous three years) for each hazardous material employee for the duration of his/her employment and 90 days thereafter.

The regulation further states that the hazardous material training must include:

- general awareness, function-specific, safety training and security training;
- driver training if transporting hazardous materials;

Additionally, carriers and/or shop personnel may require additional training in certain EPA and OSHA regulations. Required OSHA training can be used to meet certain DOT training requirements. The regulations also mandate the frequency of training to be within 90 days of hire and/or a change of duties, and that retraining is required within a three year period.

Maintaining records of these certifications and meeting the recurrent requirements should not be difficult. When it comes to cargo tank testers and inspectors, however, the responsibility for the training, testing and certification rests almost entirely on the employer. It is worth noting the "failure to properly train" is consistently among the

violations cited in cargo tank test and inspection facilities. If you do not have a record of the training, it did not happen.

With regard to the test or inspection itself, training should ensure understanding, comprehension and complete and consistent performance. The training should also include the proper use of any test or inspection equipment, fixtures, tools, the criteria for acceptance or rejection, and the correct method of reporting.

When a hazardous materials employee will take on new responsibilities, function specific training must be provided and certified.

Taking each inspection and test independently, let's review some of the training the inspector/tester should receive.

EXTERNAL VISUAL INSPECTION 180.407(d)

- Minimum kingpin diameter, upper skid plate wear or deformation;
- Identification of the various types of weld defects;
- Measuring depths of gouges or scratches;
- Maximum allowable depth of dents including and not including a weld;
- Required location of fusible plugs and acceptable condition;
- Various types of structural defects in tank attachments and its connecting structure;
- Areas of potential leakage.

INTERNAL VISUAL INSPECTION 180.407(e) (in addition to above)

- Measuring depth of pits;
- Maximum depth of corrosion removal;
- Acceptable criteria for internal lines and marker rods;
- Checking overlay patches (if authorized) and pads for weep holes;
- Problem areas that retain product or are of high stress.

THICKNESS TESTS 180.407(i)

- The use and limitations of the testing device;
- Determining minimum thickness of the shell and heads using 49 CFR (especially mandates for annual testing);
- High probability areas for decreased material thickness;
- Use of a grid, or other type of vessel diagram, to record findings.

MAGNETIC PARTICLE INSPECTION 180.407(g)(3)

- Preparation of involved areas for inspection;
- Use of alternating current yoke;
- Importance of ensuring particle suspension in solution;
- Maximum area covered by solution prior to inspection;

- Distance black light should be from inspection surface;
- Maximum travel speed of the yoke;
- Various types of relevant linear and rounded indications;
- Maximum depth, from specification plate thickness, allowed by grinding.

LEAKAGE TEST 180.407(h)

- Preparation of the tank to ensure all closures in place and valves open to include the testing of product piping;
- Location of test fittings and calibrated pressure gauge(s);
- Required test pressures;
- Minimum hold time and acceptable drop in pressure. (include both cargo tanks without vapor recovery systems and the EPA Method 27 Pressure/Vacuum requirements, for cargo tanks equipped with vapor recovery systems).

PRESSURE RETEST I80.407(g)

- Required test pressure;
- Testing requirements of pressure reclosing valves;
- Inspection of area covered by the upper skid plate;
- Location of test fittings and calibrated pressure gauge(s);
- Testing of operable heating systems;
- Ensuring openings in void areas;
- Proper removal and plugging of fittings rated at less than test pressure;
- Required test pressure.

LINING INSPECTION I80.407(f)

- The calibration of and use of spark tester and tester accessories;
- Color of the spark in a sound lining and when a hole is detected;
- Areas highly prone to lining failure;
- Inspection of a defective area after removal of lining material.

In all cases the Registered Inspector should fully understand the acceptance criteria, how to properly and completely fill out the inspection or test report, the required markings and location of markings on the cargo tank.

Workplace safety training is also very critical. OSHA Part 1910 in 29CFR covers a multitude of requirements that would impact a maintenance function. While we in the cargo tank industry are very familiar with Part 1910.146 (Permit-Required Confined Space Entry), Part 1910.132-138 (personal Protective Equipment) and Part 1910.147 (Energy Control Program), employers need to understand the full scope of OSHA' s regulations and address — through training and implementation — those requirements that pertain to the business functions.

2.4 QUALITY SYSTEMS

49CFR Part 180 introduced many cargo tank manufacturers, assemblers, carriers and repair facilities to the ASME 'U' Stamp and the National Board 'R' Stamp. Each of these quality systems carries requirements that directly impact the maintenance function.

American Society of Mechanical Engineers (ASME) 'U' Stamp
www.asme.org

DOT has mandated that manufacturers and assemblers that weld directly to the cargo tank to submit with their registration statement, a copy of their Certificate of Authorization for use of the ASME 'U' Stamp.

To obtain a 'U' Stamp the company must prepare a quality manual that addresses:

- Authority and Responsibility;
- Manual Control;
- Preparation of drawings, specifications and design calculations;
- Material Control;
- Weld Procedure(s) and welder qualifications;
- Incoming, in-process and final inspection;
- Non Destructive Examination (NDE) (if applicable);
- Heat Treatment (if applicable);
- Calibration;
- Record Retention;
- Non-conforming Items.

The full scope of the manual must be demonstrated in a system implementation. A third party, known as an Authorized Inspection Agency, defined in the National Board Inspection Code as, "a jurisdiction which has adopted and does administer one or more sections of the ASME Boiler and Pressure Vessel Code as a legal requirement and has a representative serving as a member of the ASME Conference Committee, or an insurance company which has been licensed or registered by the proper authority of a state of the United States or a province of Canada to write boiler or pressure vessel insurance in such state or province ", is required to be under contract, and must be involved in the pre-approval of construction documents and the witnessing of specific tasks in the construction of the demonstrated item.

The manual and the system implementation, after completion, are then reviewed by an ASME appointed team leader, and a member of the Authorized Inspection Agency. If all deficiencies are corrected during the review, a recommendation is forwarded to ASME to award the Stamp and Certificate of Authorization for its use.

When the 'U' Stamp is used exclusively for manufacturing and assembly, few (if any) of the responsibilities impact maintenance personnel. However, DOT allows a 'U' Stamp holder to perform welded repairs to non Code, MC 306/DOT 406 and MC 307/DOT 407, tanks. In those situations, the impact on the maintenance function is similar to what is described under the National Board 'R' Stamp system.

The National Board of Boiler and Pressure Vessel Inspectors (National Board.) 'R' Stamp and Certificate of Authorization
https://www.nationalboard.org/

An 'R' Stamp holder is authorized by DOT to perform welded repairs to any MC or DOT specification cargo tank. The National Board is empowered to issue the Stamp and Certificates of Authorization to cover Repairs and/or Alterations, for shop work, field work, or both.

The term Alteration applies to Code Stamped tanks (MC 312/DOT 412, MC 330, MC 331, MC 338), and is defined as: *"Any change in the item described on the original Manufacturer's Data Report, which affects the pressure containing capability of the pressure retaining item. Nonphysical changes such as an increase in the internal or external maximum allowable working pressure, or design temperature of a pressure retaining item, shall be considered an alteration."*

To obtain an 'R' Stamp, the facility must prepare a quality control manual and demonstrate their system, described in the manual, through a repair or alteration demonstration.

Unlike a 'U' Stamp shop where the quality department generally takes on the responsibility for preparing the Quality Control Manual and the system implementation, the 'R' Stamp shop generally assigns these responsibilities to the Maintenance Manager.

Generally, the Maintenance Manager quickly recognizes that this assignment may need to be farmed out. Resultantly, many organizations retain consultants to guide the process. The right type of consultant is one that knows and understands the National Board Inspection Code, The ASME Code, DOT requirements, and most importantly, how to apply all of these requirements to your business.

When employing a consultant who knows the Codes, be sure to determine that person's knowledge of the Department of Transportation cargo tank regulations.

The Quality Control Manual, in an 'R' Stamp system, must address the following:

- Scope of work;
- Authority and Responsibility;
- Manual Control;
- Drawings, design and specifications;
- Materials;
- Method for performing work;
- Welding, Non Destructive Examination (NDE) and Heat Treatment;
- Pressure Tests;
- Calibration;
- Non-conforming Items.

The Maintenance Manager will generally take on the responsibilities of the Quality Control Manager (QCM). As such, the Maintenance Manager needs to fully understand the wording of the manual, and to which specification cargo tanks the requirements apply.

Since not all Authorized Inspection Agencies operate the same, the consultant should be involved in the selection process.

In addition to preparing a useful quality manual, and recommending an Inspection Agency, the consultant should also;

- Review the sections and specific requirements of the various ASME Code books applicable to the scope of work detailed in the Quality Control Manual;
- Review the National Board Inspection Code relative to repair practices and procedures on Code tanks.
- Review the quality system exemptions allowed by DOT on the MC 306 and MC 307 and DOT 406, MC 407 specification cargo tanks;
- Prepare and review the demonstration drawing, calculations (for alterations), sketches covering a weld coupon bend tester, position stand and in-house calibration system;

- Prepare all weld documents (weld procedures and qualification records) utilizing current parameters;
- Assist in the preparation of procedure coupons, welder position coupons and the performance of the bend tests;
- Demonstrate how to prepare material purchase orders, perform receiving inspection and verify test reports, in accordance with the Code;
- Provide documentation and review methods covering material control, material release, in-process control, calibration, pressure test and control of non-conforming items;
- Assist in preparing system demonstration, review the role of the Authorized Inspection Agency, determine readiness for final review by a representative of the National Board, and discuss events that will occur during the final review.

Cargo tank owners are required by DOT to only use 'R' or 'U' shops for welded repairs on the cargo tank shell or heads. The best way to ensure that your repairs are performed by a legitimate repair facility is to request, from the facility, a copy of their 'R' or 'U' Stamp Certificate of Authorization. Maintain the certificate copy and note the expiration date, (so you know when to request a copy of their renewed certificate), and avoid using any facility that refuses your request.

ISO 9000 SERIES OF QUALITY STANDARDS

http://www.iso.org/iso/iso_9000

In the United States alone, thousands of companies have received ISO 9000 Registration. While the 'U' Stamp and 'R' Stamp processes are strictly related to the manufacturing, assembly or repair functions of a business, ISO 9000 is not. A very comprehensive list of twenty system elements, listed below, must be addressed through extensive documentation. Carriers and cargo tank test, inspection and repair facilities interested in the ISO Standards may want to employ a consultant to help develop a selection and implementation process.

SECTION 2: THE QUALITY PROGRAM PROCESS

SECTION 3: GLOSSARY

3.0 GLOSSARY

ABBREVIATIONS, ACRONYMS AND TERMINOLOGY

ACRONYMS	DESCRIPTION
49CFR	Title 49 of the Code of Federal Regulations (in general, dealing with the U.S. Department of Transportation)
40 CFR	Title 40 of the Code of Federal Regulations (in general, dealing with the U.S. Environmental Protection Agency)
29CFR	Title 29 of the Code of Federal Regulations (in general, dealing with the Occupational Safety & Health Administration)
A.I.	Authorized Inspector: Inspector who is currently commissioned by the National Board of Boiler and Pressure Vessel Inspectors
AL	Aluminum
ASME	American Society of Mechanical Engineers
API	American Petroleum Institute
ASTM	American Society for Testing and Materials
B-620	Highway Tanks and Portable Tanks for the Transportation of Dangerous Goods
CFR	Code of Federal Regulations
CGA	Compressed Gas Association
CT FACILITY	Generally, a place of business which has registered with DOT as performing inspections, testing, maintenance and/or repair of Specification Cargo Tanks.
DECERTIFY	Revocation of cargo tank certification. Cargo tank may not be represented as complying with Federal Hazardous Materials Regulations.
DESIGN PRESSURE	The pressure used in the design of a vessel for the purpose of determining the minimum permissible thickness of physical characteristics of the different parts of the vessel

SECTION 3: GLOSSARY

ACRONYMS	DESCRIPTION
USDOT	The United States Department of Transportation
DOT MCID#	Department of Transportation Motor Carrier Identification Number (issued to all motor carriers registered with DOT)
DOWNGRADE	Change to a lesser design strength specification: example, DOT 412 to DOT 407; or "12 pounds per gallon to 10 pounds per gallon"
DRY ANHYDROUS AMMONIA	Anhydrous ammonia lacking required water content (0.2 percent by weight) to prevent SCC.
EPA	U.S. Environmental Protection Agency
FMCSR	Federal Motor Carrier Safety Regulations
FMVSS	Federal Motor Vehicle Safety Standards
FMCSA	The Federal Motor Carrier Safety Administration
GFRP	Glass Fiber Reinforced Plastic, more commonly referred to as FRP cargo tanks
GPI	Gallons per inch (the number of gallons in a one inch "slice" of the interior capacity of a cargo tank motor vehicle)
GPM	Gallons per minute
HAZ	Heat affected zone
HAZMAT	Hazardous Materials as defined by U.S. DOT
HERESITE	Brand name for an interior lining
HG	Mercury
HM	Hazardous material(s) as defined by the U.S. DOT
HM 183	A series of U.S. DOT rulemakings (also referred to as a "docket") dealing with the design, construction, maintenance, testing and repair of cargo tank motor vehicles.
HSLA	High-strength low alloy (steel)

ACRONYMS	DESCRIPTION
HT	Postweld heat treated
HTI	Hose Technical Information (manuals by RMA)
I	Tank marking for internal visual inspection
ID	Inside diameter
K	Tank marking for leakage test
K-EPA 27	Tank marking for EPA Method 27 vapor tightness test
L	Tank marking for lining test
LPG	Liquefied petroleum gas
M	Denotes mandatory items (by DOT) on inspections and tests checklists (in this manual)
MAWP	Maximum allowable working pressure
MC	Motor Carrier
MFR	Manufacturer (In this manual, this refers to manufacturers of cargo tank motor vehicles)
MS	Mild Steel
MSEC	Millisecond
MVSS	Motor Vehicle Safety Standards
NB	National Board of Boiler and Pressure Vessel Inspectors
NBIC	National Board Inspection Code
NDE	Nondestructive examination
N.O.S.	Not otherwise specified

SECTION 3: GLOSSARY

ACRONYMS	DESCRIPTION
NPGA	National Propane Gas Association (formerly: National Liquefied Petroleum Gas Association)
NPRM	Notice of Proposed Rulemaking
NPT	American National Standard Taper Pipe Threads
NQT	Non-quenched and tempered (steel)
NTTC	National Tank Truck Carriers, Inc.
OD	Outside diameter
OSHA	Occupational Safety and Health Administration
OS&D	Oil suction and discharge (hose)
P	Tank marking for pressure retest
PART 180	Refers to a specific body of regulations within 49 CFR dealing with the inspection, testing, repair and maintenance of DOT Specification Cargo Tanks
PAV	Pressure-actuated venting
PHMSA	Pipeline and Hazardous Materials Safety Administration
PM	Preventive maintenance
*PSI[1]	Pounds per square inch
*PSIG	Pounds per square inch gauge
PTO	Power take-off
QC	Quality control
QT	Quenched and tempered (steel)

ACRONYMS	DESCRIPTION
"R" STAMP	A certification, issued by the National Board of Boiler and Pressure Vessel Inspectors ("NE"), authorizing the holder to perform certain repairs on ASME vessels. (NOTE: DOT requires an "R" stamp for any facility performing welded repairs on non-ASME Specification cargo tanks)
RI	Registered Inspector
R-1	Short term for ASME Report of Welded Repair or Alteration
RE-RATE	Change in tank MC/DOT specification
RMA	Rubber Manufacturers Association
RP	Recommended Practice
RT	Fully radiographed: data plate entry for compressed gas tanks to show all welds x-rayed
SCC	Stress corrosion cracking
SCFM	Standard cubic feet per minute
SCFH	Standard cubic feet of free air per hour
SHOP METHOD	Local procedure for performing a specific maintenance function, (e.g., leak detection, upper coupler service, or sensor system checks).
SOUR GAS	LPG contaminated by hydrogen sulfide sufficiently to cause
SCC	Stress Corrosion Cracking
SPEC	Specification
SS	Stainless steel
T	Tank marking for thickness test
TB	Technical Bulletin

SECTION 3: GLOSSARY

ACRONYMS	DESCRIPTION
TEED	Term applied to piping run that turns left and right (or up and down) 90 degrees from straight run
TTMA	The Truck Trailer Manufacturers Association
"U" STAMP	A certification, issued by the American Society of Mechanical Engineers (ASME), authorizing construction or repairs to ASME certified vessels. A "U" Stamp holder will employ the services of an "Authorized Inspector" (AI). (NOTE: DOT requires manufacturers of Specification Cargo Tanks to hold valid "U" Stamp accreditation)
U-1A	Short term for ASME Manufacturers Data Report of Pressure Vessels
U-2	Short term for ASME Manufacturers Partial Data Report
UT	Ultrasonic thickness test
V	Tank marking for external visual inspection

(Footnotes)

[1] * *All of the pressures, referenced in the manual, are "gauge pressures". This means that they are the actual pressures above or below atmospheric pressure. In this manual, they are all designed as 'psi. "for simplicity. The correct scientific designation for pressures are either 'pounds per square inch Absolute" (psia.) or "Pounds per square inch Gauge" (psig.). Virtually all pressure gauges used on cargo tanks read in "Psig.". They read zero "Psig." (14.7 Psia.)*

SECTION 4: REGULATORY PROCESS

Section 4.0 Regulatory Process and Resource Information

The U.S. Department of Transportation regulates the design, construction, testing, maintenance, repair and modification of specification cargo tanks. Minimum design and construction standards are found in Part 178 while test and inspection requirements are found in Part 180.

Regulations covering the Registration of Cargo Tank and Cargo Tank Motor Vehicle Manufacturers, Assemblers, Repairers, Inspectors, Testers, and Design Certifying Engineers are found in 49CFR Subpart F 107.501. That section details the process for applying to the Federal Motor Carrier Safety Administration for a CT number which is required for each facility that will perform the covered functions.

49CFR 171.8 contains many of the definitions that cover terms used throughout the regulations. However, that section does not include all definitions. Other key definitions are contained in Parts 178 and 180.

It is the responsibility of the regulated community to know and comply with the regulations. Changes to the regulations are issued by the Department of Transportation through the established rulemaking process. DOT will provide further information on its regulations through interpretations in response to requests from industry or other government agencies. Several key interpretations that affect cargo tank tests and inspections can be found in Section 16 of this manual.

The U.S. Department of Transportation, trade associations like National Tank Truck Carriers and the American Trucking Associations, and several commercial suppliers provide excellent training materials and conduct classes on hazardous materials transportation. Again, it is the responsibility of the party who must comply with these regulations to not only know the regulatory requirements, but also to be aware of changes to those regulations.

Regulations governing cargo tank tests and inspections are developed by the Pipeline and Hazardous Materials Safety Administration (PHMSA) of the U.S. Department of Transportation. Those regulations are enforced by the Federal Motor Carrier Safety Administration (FMCSA) and by state and local enforcement agencies whose inspectors have qualified to enforce the Federal regulations.

Proposed changes to the Federal Regulations are published by PHMSA in the Federal Register which is available in both on-line and printed versions. The public is invited to comment on the proposed changes as part of the regulatory process. Here are the basic steps to developing a new regulation or change to the current regulations:

1. PHMSA publishes the proposal in the Federal Register and provides contact information for comments as well as a deadline for comments.
2. PHMSA has several options on how to introduce a proposed regulation into the process. Here are some of the steps but not all steps are followed in each case.

   Request for information: PHMSA may use the Federal Register to solicit information on an issue it is considering a rulemaking. This Request often takes the form of questions. It is the way PHMSA solicits input from interested parties.

   Advanced Notice of Public Rulemaking (ANPRM): An ANPRM tells the regulated community that PHMSA is developing a rule and is used primarily to obtain information on how that rule should be written. This step may contain more formalized questions. The agency used the information developed to write its regulatory proposal.

   Notice of Proposed Rulemaking (NPR): PHMSA informs the regulated public what its proposed rule will contain and again solicits input. The NPR is basically what the new regulation will be unless changed based on further consideration.

   Final Rule Publication (FR): The final rule published in the Federal Register is the new rule and shows how the existing regulations will be added to or modified. Information published with the Final Rule will include when voluntary compliance is authorized and then when mandatory compliance is required.

SECTION 4: REGULATORY PROCESS

While there are steps that can be taken to request a reconsideration of the contents or compliance dates of a Final Rule, those requests are not often granted. It is essential that the regulated public, either individually or through their trade associations like National Tank Truck Carriers or the Truck Trailer Manufactures Association, be part of the regulatory process. The professional government officials at PHMSA and the other regulating agencies do rely on and seriously consider input from industry. Do not wait until the Final Rule state to get involved in the process which will impact your business.

While every effort is made to make the regulations clear to the regulators and the regulated public, questions do arise about the meaning of a regulation. There is a formal "Request for Interpretation" process through which an individual or group can ask for further guidance as to the intent of a regulation. Examples of interpretations can be found in Section 16. Interpretations are not published in the Federal Register, but they are listed by regulatory section on the PHMSA website http://www.phmsa.dot.gov/hazmat/regs/interps.

KNOW THE REGULATIONS:

The Department of Transportation regulations are the minimum requirements for specifying, manufacturing, operation, testing and inspecting, and repairing your specification cargo tank fleet. DOT will expect and require you to know those regulations. During an inspection of a cargo tank registered facility, the inspector will ask you to show knowledge of the regulations, show how you train people who will work on the cargo tanks, and to show how you maintain your knowledge of and compliance with the regulations. Here are some government and trade association contacts for you to help manage your business and to use the regulations.

Pipeline and Hazardous Materials Safety Administration (PHMSA)
U. S. Department of Transportation
1200 New Jersey Ave. S.E.
Washington DC 20590
202/366-4545
HM Information Center: 1/800-467-4922
www.phmsa.dot.gov/hazmat This website contains several publications of value to the regulated community.

Federal Motor Carrier Safety Administration (FMCSA)
U. S. Department of Transportation
1200 New Jersey Ave. S.E.
Washington DC 20590
202/366-1927
www.fmcsa.dot.gov This website contains information on how to register for a CT number.

National Tank Truck Carriers (NTTC)
950 N. Glebe Rd.
Arlington VA 22203
703/838-1960
www.tanktruck.org This website can be used to order the NTTC Bulk HazMat Compliance Guide and to learn of training classes regarding tank truck tests and inspections and other safety events.

Truck Trailer Manufacturers Association (TTMA)
7001 Heritage Village Plaza Suite 220
Gainesville VA 20155
703/549-3010
www.ttmanet.org This website can be used to review and order the various Recommended Practices developed by the TTMA Tank Engineering Committee.

American Society of Mechanical Engineers (ASME)
Three Park Ave.
New York NY 10016-5990
800/843-2763

www.asme.org This website can be used to learn more about the U stamp needed to build DOT specification cargo tanks and other information of interest to cargo tank operators.

National Board of Pressure Vessel Inspectors (National Board)
1055 Crupper Ave.
Columbus OH 43299
614/888-8320
www.nationalboard.org This website can be used to learn more about the R stamp which a cargo tank facility must hold in order to repair product containment portions of a cargo tank.

Commercial Vehicle Safety Alliance (CVSA)
6303 Ivy Lane, Suite 310
Greenbelt MD 20770
301/830-6143
www.cvsa.org CVSA represents state highway law enforcement agencies.

Compressed Gas Association (GCA)
14501 George Carter Way
Chantilly VA 20151
703/788-2700
www.cganet.com This website can be used to review and order publications on MC338 and other compressed gas trailers and equipment.

National Propane Gas Association (NPGA)
1899 L St. NW Suite 350
Washington DC 20036
202/466-7200
www.npga.org This website can be used to review and order publications on MC331 propane tankers.

National Association for Hose and Accessories Distributors (NAHAD)
105 Eastern Ave. Suite 104
Annapolis MD 21403
410/940-6350|
www.nahad.org (NAHAD publishes a hose maintenance manual and other publications regarding hose use and safety issues.)

SECTION 4: REGULATORY PROCESS

SECTION 5: MAINTENANCE PROCEDURES

5.0 MAINTENANCE PROCEDURES (A GENERAL OVERVIEW OF 49 CFR, PART 180)

Editors Note: Users of the manual should be aware that current official editions of Title 49, Code of Federal Regulations do not contain copies of the MC "300 series" cargo tank specifications (except MC 331 and MC338.) Copies of these specifications are included in NTTC's Bulk HazMat Compliance Guide" published annually. (www.tanktruck.org.)

The Pipeline and Hazardous Materials Safety Administration (PHMSA) created Part 180 to provide for "Continuing Qualifications" of specification cargo tanks. The term stems from the concept that when a cargo tank is manufactured it is "Qualified" as a hazardous materials package by the manufacturer. After varying periods of time, depending on the type tank, it must be inspected and maintained or it will no longer be "qualified".

Part 180 lays the ground rules for those inspections and required maintenance procedures necessary for a HM cargo tank to continue to be qualified and to be used in hazardous material transportation. They may continue in service for as long as they are able to meet part 180 requirements and the specification to which they were built.

This section of the Maintenance Manual is an explanation of those requirements in general. The individual sections covering Specification DOT-406/MC-306, DOT-407/MC-307, DOT-412/MC-312, MC 330/331 and MC338 will explain in detail the requirements for each type. There may be some duplication. Additionally, recommendations are included for FRP tanks IM Tank Containers and certain non-specification tanks.

In summary, Part 180 establishes six different inspections as follows:

1. External Visual Inspection;
2. Internal Visual Inspection;
3. Lining Inspection;
4. Leakage Test;
5. Pressure Retest;
6. Thickness Test.

Part 180 establishes minimum standards of repairs for deficiencies found as a result of inspections as well as record keeping and marking requirements for the tests and markings to put on the cargo tank to indicate the date they have passed the inspections. While Part 180 is the primary section of interest, maintenance personnel will also need access to other sections of the regulations, including those Section 178 regarding cargo tank construction requirements. Likewise, critical definitions of terms used throughout the regulations will be found in Section 171.8 and other sections.

In addition to mechanical requirements, Part 180 requires that Inspectors and testers must meet minimum requirements and be registered with DOT for each type test they intend to perform, and that facilities which perform welded repairs and modify cargo tanks must be registered with DOT and hold a valid 'R' or 'U' stamp.

When a new cargo tank is completed and certified, the manufacturer will have performed the original tests and may, but is not required to, mark the tank with the appropriate letters that signify each type test. The certification date determines the beginning of the test and inspection cycle. Shown below is a table of Test or Inspections required and the interval at which they are required after the original certification. Manufactures are not required to mark trailers with test dates on new trailers since those dates are intended for retests. However, many manufacturers will mark the tank with the date of the test or inspection to avoid confusion to those enforcement personnel or shippers who do not fully understand the regulations.

SECTION 5: MAINTENANCE PROCEDURES

COMPLIANCE DATES - INSPECTIONS AND RETESTS UNDER 180.407(C)

(As of September 30, 2013)

Without regard to any other test or inspection requirement, a specification cargo tank must be tested and inspected prior to further use, if any of the following occur.

The cargo tank shows evidence of dents, cuts, gouges, corroded or abraded areas, leakage, or any other condition that might render it unsafe for hazardous materials service. Any signs of leakage must be repaired. The suitability of any repair affecting the structural integrity of the cargo tank must be determined either by the testing required in the applicable manufacturing specification or in 49 CFR 180.407(g)(1)(iv). Repairs must be made in accordance with 49 CFR §180.413.

If a cargo tank has sustained damage to an extent that may adversely affect its lading retention capability or it has been out of hazardous materials transportation service for a period of one year or more then it must be successfully pressure tested prior to use.

The DOT may also require additional inspections or tests based on "probable cause" that a cargo tank is in an unsafe condition. Generally this requirement would be as a result of a compliance review based on evidence collected by the investigator in support of their position the cargo tank is unsafe to operate. This would result in the issuance of a legal order, consent agreement, notification published in the Federal Register or other means to ensure unsafe cargo tanks do not continue to operate.

Shown below is a table of tests or inspections required and the periodic interval at which they are required after the original certification.

COMPLIANCE DATES - INSPECTIONS AND RETESTS UNDER 180.407(C)

Test or Inspection (cargo tank specification configuration)	Interval Period (After First Test and service)
External Visual Inspection: V	
All cargo tanks designed to be loaded by vacuum with full opening rear heads —	6 months
All other cargo tanks —	1 year
Internal Visual Inspection: I	
All insulated cargo tanks, except MC 330, 331, MC 338 (See Note 4)	1 year
All cargo tanks transporting lading corrosive to the tank —	1 year
All other cargo tanks, except MC 338 —	5 years
Lining Inspection: L	
All lined cargo tanks transporting lading corrosive to the tank —	1 year
Leakage Test: K	
All other cargo tanks except MC 338 —	1 year
MC 330 and MC 331 cargo tanks in chlorine service —	2 years

Test or Inspection (cargo tank specification configuration)	Interval Period (After First Test and service)
Pressure Retest: **P**	
(Hydrostatic or Pneumatic) (See Notes 2 and 3)	
All cargo tanks which are insulated with no manhole or insulated and lined, except MC 338 —	1 year
All cargo tanks designed to be loaded by vacuum with full opening rear heads —	2 years
MC 330 and MC 331 cargo tanks in chlorine service —	2 years
All other cargo tanks —	5 years
Thickness Test: **T**	
All unlined cargo tanks transporting material corrosive to the tank, except MC 338 —	2 years

Note 1: If a cargo tank is subject to an applicable inspection or test requirement under the regulations in effect on December 30, 1990, and the due date (as specified by a requirement in effect on December 30, 1990) for completing the required inspection or test occurs before the compliance date listed in table I, the earlier date applies.

Note 2: Pressure testing is not required for MC 330 and MC 331 cargo tanks in dedicated sodium metal service.

Note 3: Pressure testing is not required for uninsulated lined cargo tanks, with a design pressure or MAWP 15 psig or less, which receive an external visual inspection and lining inspection at least once each year.

Note 4: Insulated cargo tanks equipped with manholes or inspection openings may perform either an internal visual inspection in conjunction with the external visual inspection or a hydrostatic or pneumatic pressure-test of the cargo tank.

MAINTENANCE SCHEDULE

Your viewpoint on scheduling non-mandated work during an inspection will vary depending on if you are a carrier doing your own maintenance or you are in the business of doing tank inspections and repairs for others. It will, however, make good sense to try to coordinate all maintenance requirements for items like running gear, lights, brakes and etc. with the DOT mandated items. You are not required to include this information on your Part180 Inspection Report, but you may want to inform carrier supervisors or the customer.

Most of the time more than one inspection is going to be done during one shop visit, like external visual inspection, internal visual inspection & leakage test. The sequence of these jobs should be thought through so you don't spend a lot of time on one, then disqualify the tank quickly with the second test. For instance, an internal inspection might precede the external inspection for a single compartment cleanbore tank. Any pressure testing should be done last.

NAME PLATES OR SPECIFICATION PLATES

Prior to doing any tests or inspections, carefully note the information stamped on the Cargo Tank Motor Vehicle Specification Plate. Information varies and is somewhat brief on 300 series tanks, but 400 series tanks will have additional information and will provide a data base for the inspections.

SECTION 5: MAINTENANCE PROCEDURES

HOW TO INSPECT:

Sections in this Manual provide detailed information not only on how to perform DOT required tests and inspections, but also covers recommended inspections and maintenance for components such as ladders, walkways, hose tubes, cabinets, etc. Components such as these are defined as appurtenances and are required to be inspected during the external visual inspection and are essential to the safe operation of the cargo tank motor vehicle.

INSPECTION & TEST FORMS:

Inspection requirements vary depending on the DOT/MC Specification of the tank being inspected. The separate sections covering each type cargo tank has an inspection guide that will take you through each type inspection and provides a "Checklist/Inspection Report" (C/IR) on which to enter the results of the inspection.

WARNING - FOLLOW INDUSTRY AND GOVERNMENT SAFETY PROCEDURES:

Hazardous Material Cargo Tanks can be dangerous to work on unless they are thoroughly cleaned and are free of any flammable, poisonous or otherwise harmful commodities or vapors. Work in confined spaces is often necessary and needs to be done in a manner that meets all company and government requirements. Remember, shop work is covered by OSHA.

5.1 EXTERNAL VISUAL INSPECTION:

(Ref., Paragraph 180.407 (d) of 49 CFR) (All cargo tanks including MC338.)

The most important tool in performing the External Visual Inspection is a trained set of eyes. Select the appropriate inspection guide and C/IR (checklist/inspection report) for the type of cargo tank you are inspecting from the appropriate section of this manual.

Compare the information on the tank documents you have with the tank certification plate and other carrier markings to be sure you have the correct cargo tank and that the data matches.

Name Plates or Specification Plates: Verify that the plates are secure and that the entries are legible, free of paint and decipherable. Plates must be permanently attached to the cargo tank or its integral supporting structure, by brazing, welding or other suitable means. These plates must be affixed on the left side (right side prior to July 1, 1985) of the vehicle near the front of the cargo tank (or the front most cargo tank of a multi-cargo tank motor vehicle), in a place readily accessible for inspection. The plates must be permanently and plainly marked in English by stamping, embossing or other means in characters at least 3/16 inch high. Contact manufacturer for missing data, or for duplicate plates if possible.

Shell and Heads: Visually and carefully inspect all of the exposed area of the shell and heads for dents, distortions, cuts, digs, metal cracks, gouges, scrapes, cracks or for previously performed welded repairs not completed in accordance with the Code, like "lap" patches.

Pay particular attention to shell longitudinal and girth welds and shell to head weld joints. Look for fatigue cracks in bolsters, outriggers frame members, cross members, suspension system attachments and connecting structures. Inspect other suspect areas around piping, bottom center of tank and areas near openings.

Any cargo tank with a weld defect such as a crack, pinhole, or incomplete fusion, or a structural defect must be taken out of hazardous materials service until repaired. When practical, run your finger or small tool over the surface of welds for thoroughness.

Cargo tanks that have been in service for some time with minor blemishes in the shell are not a matter for concern. Conversely, signs of previous repairs, or multi-pass repair welds, etc., should alert you to the need for a more thorough inspection of the area to determine if the original problem is really fixed.

Repair is required if dents have a depth that is one tenth of the greatest bridge dimension of the dent area, but in any case deeper than one inch. An example of an unacceptable dent is shown in Figure 1 in the graphics section.

The depth to bridge dimension in the example dent is 0.375"/2.875" or 0.13 which exceeds 0.1, and has to be repaired. See an example in Figure 1 in the graphics Section.

Cuts or gouges longer than 4" should be thoroughly inspected. The material thickness underneath any damaged area has to comply with minimum shell thickness requirements and should be thickness tested in accordance with Part 180.407(i). If questionable, clean out defect and carefully repair with a filler weld. Buff out any distortion and metal finish as necessary.

On tanks with external ring stiffeners, check the shell to ring welds, look for small cracks where bolsters terminate on the ring, and check rings and bolsters for drain holes at the bottom. Ring stiffeners or other appurtenances, installed on cargo tanks constructed of mild steel or high-strength, low-alloy steel, that create air cavities adjacent to the tank shell that do not allow for external visual inspection must be thickness tested, at least once every 2 years.

At least four symmetrically distributed readings must be taken to establish an average thickness for the ring stiffener or appurtenance. If any thickness reading is less than the average thickness by more than 10%, thickness testing must be conducted from the inside of the cargo tank on the area of the tank wall covered by the appurtenance or ring stiffener. Thickness testing is conducted in accordance with 49 CFR 180.407(i)(2) and (i)(3). Excessive corrosion or staining near drain holes may indicate corrosion in the shell under the ring, and thickness testing from the inside may be necessary. (See Section 5.5)

INSULATED TANKS:

Where insulation precludes a complete external visual inspection, the cargo tank also must be given an internal visual inspection. If external visual inspection is precluded because any part of the cargo tank wall is externally lined, coated, or designed to prevent an external visual inspection, those areas of the cargo tank must be internally inspected. If internal visual inspection is precluded because the cargo tank is lined, coated, or designed so as to prevent access for internal inspection, the tank must be hydrostatically or pneumatically tested. Damage found to the outside jacket may indicate inner shell damage and require further inspection. The internal visual inspection procedure is covered in Section 5.2.

Upper Coupler Assembly: Inspect the attachment of the upper coupler assembly to the tank structure, usually bolted to the tank frame. Look for loose, corroded or missing bolts. Replacement bolts should be of grade 5 quality or better.

Look for deformation or caving in of the fifth wheel plate, particularly near the side rails, and also look for circular gouges in this area which indicates the plate is wearing at the sides.

Inspect the king pin itself for damage to the bottom collar and to the necked down area. See TTMA RP 76-92 for further information.

As much as possible, inspect the top of the plate for contamination with road salt and dirt. Clean if necessary, and if it looks suspicious, remove it for further inspection.

CARGO TANKS TRANSPORTING LADING CORROSIVE TO THE SHELL MATERIAL: For cargo tanks transporting lading corrosive to the tank, areas covered by the upper coupler (fifth wheel) assembly must be inspected at least once in each two year period for corroded and abraded areas, dents, distortions, defects in welds, and any other condition that might render the tank unsafe for transportation service. The upper coupler assembly is generally required to be removed for this inspection for non-insulated cargo tank motor vehicles. Exceptions to the removal are defined in US DOT PHMSA interpretation Reference #11-0059 and FMCSA Safety Alert of June 2005 Included in Section 4.

Void Areas: These are the sections of the tank found between a set of double heads. They can also occur at the front or rear of the tank, put there for weight balance purposes. Voids have to be drained. Venting voids through the top of a cargo tank may cause premature corrosion of the void space as a result of water penetration.

Allowing the vent to be plugged will make it easier to identify when there is actually a leak in the bulkhead. Hazardous materials leaking from the drain will cause an obvious stain and/or dirt build up. With the top vent plugged there would be no water entering the void from the top vent and any leaking would likely be coming from the adjacent bulkheads. PHMSA has revised § 178.345–1 to clearly indicate that any void area within the connecting structure of a cargo tank between double bulk heads must be vented to the atmosphere through the required drain or through a separate vent.Any void within the connecting structure must be equipped with a drain located on the bottom centerline that is accessible and kept open at all times. This revision was effective on August 19, 2011 and will ensure that void spaces in the connecting structure of DOT 406, 407, and 412 cargo tank motor vehicles are properly vented to allow for the escape of product vapors. Stains or corrosion around drains may indicate internal problems and trigger a thickness test.

CAUTION: Trapped product in voids can be flammable and can explode if heated by a torch or by welding. If product is found in a void, remove cargo tank from building and open vents mechanically without heating. Then degas the void area until satisfied it is safe to work on.

Manhole Covers, Collars and Seals: Before inspecting a manhole cover be sure there is no pressure in the tank. Then position yourself so if the cover pops open or if gasses rush out you will be out of harms way. A small amount of pressure on a 10" fill or a 20" cover can generate considerable force.

Inspect the cover, hinge and closing hardware to assure it is not warped and that the hardware is in good workable condition and free of excessive corrosion.

Inspect the collar to assure it is level and true enough to make a good seal. Inspect shell adjacent to collar for signs of leaking (e.g. stains etc.). If the tank is lined check condition of lining on collar and inside lid areas.

Gaskets or seals vary depending on the design of manhole assemblies; some have more than one gasket, such as a petroleum unit with a small fill cover. Also some covers will have their gasket in the collar, while others retain it in the cover. Inspect the gasket to determine if it is in good shape free of cuts, cracks or evidence of leakage and capable of sealing. Manhole integrity is one of the most important features of a HazMat tank. The gaskets on any full opening rear head must be visually inspected for cracks or splits caused by weather or wear; and replaced if cuts or cracks which are likely to cause leakage, or are of a depth ½ inch or more, are found.

If the manhole is secured to the collar with a clamp ring and is on a tank manufactured prior to 1990, check to be sure that it has been updated per Para. 180.405 (g) (2). All tanks not meeting the requirements of that section should have been modified prior to August 31, 1995. If this update has not been performed, the tank is not in compliance, and the procedure should be performed at once.

Grounding Wires and Marker Rods: When inspecting the manhole, it is an appropriate time to check the condition of any grounding wires and marker rods inside most modern gasoline tanks. Inspect the marker rods' attachment to the collar. Ground wires will be attached to the bottom of the marker rod or if no marker rods, to the collar itself.

Vents: Venting devices are a critical part of Specification cargo tanks. A large portion of DOT cargo tank Specifications deal with vents and venting. The requirements vary widely for the various Specifications 406/306; 407/307; 412/312; and MC 330/331. Cargo tank vent manufacturers have established procedures for bench testing their devices. Please refer to each cargo tank's section for details on how to deal with these varying requirements, and to determine the varying pressure settings for each type tank.

No matter the type cargo tank, you will need to bench test vents or replace them at the required test interval. If bench testing devices is your choice you will have to check the type of device, set to discharge pressure, pressure at which device opened, pressure at which device re-seated, and a statement of disposition of the device (e.g., reinstalled, repaired, or replaced). Figure 2 (see graphics section) is a sketch of a typical vent tester that will allow those settings to be determined. There are many designs that will work.

For the external visual inspection all that can be determined is that the correct vents are in place and that they appear to be properly functioning, mounted and installed, are not loose and show no evidence of stains or corrosion. All reclosing pressure relief valves on cargo tanks carrying lading corrosive to the valve must be removed from the cargo tank for inspection and testing. Each reclosing pressure relief valve on 300 series cargo tank motor vehicles required to be removed and tested must open at no less than the required set pressure and no

more than 110 percent of the required set pressure, and must reseat to a leak-tight condition at no less than 90 percent of the start-to-discharge pressure. Operating parameters for 400 series vents are identified in the applicable cargo tank specification. You cannot expect a 400 series vent to operate in accordance with the design of a 300 series vent. Additionally some 300 series cargo tank motor vehicles have 400 series vents installed. Make sure you test the vent based on the type of vent, not the type of cargo tank and that the vent installed on the cargo tank is authorized for that tank.

NORMAL AND EMERGENCY VENTING: PRIMARY AND SECONDARY VENTING:

DOT Specifications use the above terms in a variety of ways depending on the Specification, i.e. MC 306, DOT 406, 407 & 412. The concept evolved from the need for vents in normal operation (such as pressure changes due to product temperature changes, pressure imposed by pressure unloading systems etc.).

Emergency venting, (300 series) and total venting, (400 series tanks) describe the amount of venting required. Pressure is actuated by tank vapor pressure. The vent protects the tank from over-pressurization due to fire engulfment or overfilling. Capacity is rated in Standard Cubic Feet of air per Hour (SCFH) at a specific test pressure. Air flow capacity requirements are based on tank exposed area. The capacity is based on the total surface area of the cargo tank's vessel and is taken from 49 CFR §178.345-10(e) Table I (Minimum Emergency Venting Capacity). The same table is reprinted in several other references in the Specifications.

Table I—Minimum Emergency Vent Capacity

[In cubic feet free air/hour at 60 °F and 1 atm.]

Exposed area in square feet	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
180	142,300
200	158,100
225	191,300
250	203,100
275	214,300
300	225,100
350	245,700
400	265,000
450	283,200
500	300,600
550	317,300
600	333,300
650	348,800
700	363,700
750	378,200
800	392,200
850	405,900
900	419,300
950	432,300
1,000	445,000

Note 1: Interpolate for intermediate sizes.

MC 306/DOT 406 specification cargo tanks designed primarily to transport petroleum products may be equipped with a relief vent set well below the tanks MAWP.

The MC 306 tank was designed as a non pressure tank and prior to vapor recovery had to have an opening of 0.44 sq. in. actually open to atmosphere. The need to recover vapors required that the vessel have some pressure holding ability in order to transfer vapor into and out of the tank.

This low pressure vent, set to open at 1 psi., is used on MC 306/DOT 406 tanks to maintain the tank pressure very close to atmospheric. There is a small difference in the set to open pressure for normal vents designed for MC 306 or for DOT 406 tanks. Please refer to each cargo tank's section for details on how to deal with these varying requirements, and to determine the varying pressure settings for each type tank.

DOT does not require the use of this vent, but manufacturers and users of tanks believe them to be necessary. These vents are not marked with any venting capacity and may not be included in meeting total venting capacity.

There are several safety reasons for the low pressure vent. One, if the shell were punctured in an accident, the product will not spew more than a short distance from the tank wall. Also, opening a fill cover under pressure is very dangerous.

A large portion of the total venting in MC 306 and MC 307 tanks was commonly supplied by fusible vents, or rupture discs. These vents, once opened by heat or excessive pressure, would not reclose. DOT does not allow these types of vents on 400 series tanks. All 400 series tanks require vents that are the reclosing type. MC 300 series tanks equipped with fusible or frangible vents may continue in service.

Overfill Systems and Sensors: There is no DOT requirement for inspection or maintenance of overfill systems. These are systems designed to prevent a tank, which is being bottom loaded, from being over filled at the loading rack by shutting down the rack. Many systems provide overfill protection, as well as grounding verification, on-board overfill prevention, retained product monitoring systems, automatic and continuous self-checking circuitry for tank trucks that carry/haul petroleum and liquid chemicals.

It will be prudent to do a visual inspection and check of the top sensors to determine if they are functioning properly, secure in their mounting, connecting wires and harnesses. A complete inspection of these systems will require electronic test equipment and knowledge of the system installed. Follow the manufacturer's recommendations for testing and inspection.

Gauging Devices: DOT Specifications address gauging devices, but do not require them for cargo tanks "expected to be filled by weight". Common practice is to load by weight in order to meet weight law requirements, even when loaded by meter the load is translated to weight. Although DOT calls for gauging devices they provide no specification for their design. A marker rod is a gauging device.

Emergency Valves or Internal Self Closing Stop Valves: Emergency Valves (EV's) are a critical part of a cargo tank's safety equipment, and as such deserve special attention when doing an inspection. Most Specification cargo tanks have an emergency valve mounted to the sump of the tank or of each compartment. They have many names, belly valves, fire valves or safeties. In the DOT 400 series Specifications they are called "internal, self closing, stop valves".

Not all HazMat tanks will require an emergency valve. In special cases other type valves are allowed but have to have substantial guards, and some tanks are top unloaded. However most tanks will have what is most commonly called an "emergency valve". An emergency valve has four important features.

1. An internal, spring loaded, self closing, seat mounted in the top flange of the valve;
2. An external shear section designed to fail leaving the seat in tact if struck in an accident;
3. A means of being closed at a location remote from the emergency valve operator;
4. A fusible device that if heated above 200 degrees will fail and allow the valve to close.

Mechanical emergency valves are activated, or operated through cables and a mechanical operator. Emergency valves are also operated by air pressure or by hydraulic pressure.

Each Specification section (in this manual) will have illustrations of common valves used.

Inspect EV's carefully by visually looking for loose bolts, signs of leaks, misalignment, gasket deterioration and that the operating mechanism is in good condition.

They may be connected to the piping by bolted flanges or by victaulic couplings.

Inspect these for tightness and corrosion.

All internal or external self-closing stop valves must be tested for leak tightness during the leakage test.

Per 172.328 (d), the location of manually operated remote emergency valve activators must be marked. "Emergency Shutoff" in letters at least 0.75 inches in height in a color that contrast with the background and is located in an area immediately adjacent to the means of closure.

Piping: Depending on the type cargo tank, they may have one valve at the rear or under the center directly connected to the emergency valve and no piping. Alternatively, they may have many compartments, lines, pump off lines, cross over lines etc.

Look for obvious flaws like dents, corrosion, pitting or repair welds. Piping support brackets and hangers should also be inspected to assure they are supporting the lines in the correct alignment and that the lines have not been bent or deformed, nor are they loose or corroded.

On-Off Valves, Outlet and Other Operating Valves: Inspect all valves and couplers, looking for evidence of loose bolts and gaskets, signs of leaking either through the outlet or through packing glands. Operate each valve. **CAUTION:** assure yourself that the tank is empty and keep clear when opening valves. If valves are hard to operate or have a sloppy action investigate further and repair or replace as necessary.

Remove camlock fittings and dust covers and inspect gaskets and condition of the locking ears. Check the security and condition of retaining chains.

Vapor Recovery Piping: There are no DOT requirements for a vapor recovery system, but, if the cargo tank is equipped with a vapor recovery system, the piping, valves, couplers and vent valves should be inspected in a manner such as the piping and valves as described above.

Most V/R systems have an interlock system for opening the vapor vents on the top of the tank. Some are air activated by opening a cabinet door, some by the EVO, and some open by air when the air operated emergency valve is pressurized. Determine how the system is designed and assure that it is operating properly.

Miscellaneous Equipment: Equipment on cargo tanks can vary widely and some have a variety of systems, such as brake interlock systems, brake interlock bars, pumps, meters, hoses, hydraulic drive systems etc. There is no DOT requirement covering these components, but a prudent inspection of the cargo tank will include a close look at these items for obvious problems and malfunctions. Remember any condition that might render the tank unsafe for transportation service should be addressed.

Ladders and Walkways: Again, there is no DOT Specification covering these important components. Newer cargo tanks have been designed with ladders, walkways, hand holds and other safety items in accordance with TTMA Recommended Practices covering these items. Inspect them to assure they are not damaged, are securely mounted and that their mountings are not corroded or cracked.

Older cargo tanks may have ladders and walkways that do not meet current industry practice for traction of rungs, toe clearance, availability of hand holds etc. These items should be considered for modification depending on how the cargo tank is being operated.

Fenders, Hose Tubes, Troughs and Cabinets: These components and other ancillary tank mounted equipment get a lot of abuse from use, in traffic, maneuvering in loading areas and particularly from vibration when traveling empty. Inspect for cracks, worn or loose brackets.

The design, construction, and installation of an attachment, appurtenance to a cargo tank, structural support member between the cargo tank and the vehicle or suspension component must conform to the requirements in 49 CFR § 178.345-3(f) or 178.337-3(g).

Placards, DOT Markings and Conspicuity Striping (reflective tape): Inspect and note the need for replacement of faded placards, mounting of placard holders, DOT markings permanently painted or decaled on the tank and note any loss of or deterioration of conspicuity striping. Requirements for markings are covered in 172.300 and requirements for placarding are covered in 172.500

All markings required by 172, 178 and 180 must be legible - DOT Markings: All markings on the cargo tank required by 49 CFR §178 and 180 must be legible. Placarding and other markings should be checked during the external visual inspection.

Warning or Caution Signs and Decals: If warning signs or decals are not legible or are obviously missing, take some action to remedy this condition. Contact the original manufacturer for instructions on what warning signs or decals should be on the tank and take appropriate action.

Trailer Components and FMCSA Inspection: The cargo tank inspector may consider performing the FMCSA annual inspection required by 49 CFR §396.21 including inspection of DOT conspicuity or retroreflective sheeting (49 CFR 393.13) and maintenance of all trailer components such as lights, brakes, suspension system, tires, wheels and rims during this visual inspection. Again, these are NOT covered by the Part180 requirements and if conducted should generate their own paperwork.

Markings and Reports: A report containing the information, required by Paragraph 180.417, must be completed signifying a thorough visual inspection has been made. Sections 6.0 to 12.0 have sample forms for this purpose for each type cargo tank.

Old markings of previous inspections must be removed and replaced with the correct markings and dates for this visual inspection as required by Paragraph 180.415. In this case, mark the date by month and year followed by the letter "V". "How to Install Markings" is described in each cargo tank type section.

5.2 INTERNAL VISUAL INSPECTION

(Ref. Paragraph 180.407 (e) of 49 CFR) (All cargo tanks except MC 330 and 331, See Section 9.0 of this publication)

When the cargo tank is not equipped with a manhole or inspection opening, or the cargo tank design precludes an internal inspection, the tank shall be hydrostatically or pneumatically tested in accordance with 49 CFR §180.407(c) and (g).

Select the appropriate "Internal Visual Inspection" guide and C/IR (checklist/inspection report) for the type of cargo tank you are inspecting from Section 6.0,7.0,8.0.9.0, 10.0, 11.0, or 12.0 in this manual.

WARNING: FOLLOW INDUSTRY AND GOVERNMENT SAFETY PROCEDURES.

The Internal Visual Inspection requires entry into the cargo tank's vessel by the inspector.

Hazardous Material Cargo Tanks can be dangerous to work on unless they are professionally cleaned and are free of any flammable, poisonous or otherwise harmful commodities. "Work in Confined Spaces" is often necessary and needs to be done in a manner that meets all company and government requirements.

Do not enter the vessel or compartment until assured that oxygen levels are safe as indicated by an oxygen level indicator, and that the interior is free of flammable vapors as indicated by an Explosimeter. Ventilate vessel with fresh air, the most effective way is suction, keeping the end of the suction hose near the inspector.

Be sure to purge all liquid and vapor lines and any void areas on the cargo tank. If it is discovered that there are flammable vapors in any of these components, REMOVE THE CARGO TANK FROM THE BUILDING, and take the appropriate action.

Before you start the inspection procedure explained below, remove any foreign objects that may have been lost into the tank and clean out any other debris or coatings that would interfere with the visual inspection.

If the inspection and or subsequent maintenance work is time consuming, recheck the oxygen and flammable levels on a regular basis.

Marker Rods or Gauging Devices: If cargo tank is equipped with this type equipment, check that mountings are secure, that they are not bent or deformed, and if equipped with a grounding wire, that it has good electrical connection to the device.

Lined Tanks: If the tank is lined, perform the inspection described in Section 5.6. If the inspection shows defective areas in the lining, these must be removed and repaired according to the lining manufacturers recommendations. The shell underneath must be inspected for material thinning. A thickness test may have to be performed in accordance with Section 5.5.

Shell, Heads, Baffles and Internal Structures: The most common defects found inside cargo tanks are corrosion of the tank's material, cracked welds on internal components, vacuumed areas or deformation over support areas. Cracks in the shell or heads may have resulted in leaks.

Also inspect for prior repairs such as repair welds, section inlays, appurtenances, added structural components and patches. The design, construction, and installation of an attachment, appurtenance to a cargo tank, structural support member between the cargo tank and the vehicle or suspension component must conform to the requirements in 49 CFR § 178.345-3(f) or 178.337-3(g). This applies both internally and externally. See US DOT PHMSA interpretation reference #06-0046 dated May 2, 2006, included in Section 4 of this manual.

Be suspicious of multi-pass built up welds, patches or section inlays that are poorly shaped or fitted. Inlays should conform to the tanks shape and have rounded corners and be welded both internally and externally. DOT prohibits the use of "lap patches" on any "cargo carrying" element of a specification cargo tank. A lap patch installed prior to October 1, 2003 would not be a violation of the DOT regulations; however, a lap patch installed after that date must be removed and the repair performed in accordance with the National Board Inspection Code.

CORROSION:

Corrosion is most common in stainless tanks, it can be general thinning of the material, but is not apparent visually. It is more common to find pitting or selective corrosion in weld "heat affected zones" (the narrow band each side of a weld that is heated to near melting point during the welding process). Selective corrosion also commonly occurs in weld material itself, particularly very short or spot type welds. These occur in heating sections or if structures are skip welded to the outside of the vessel.

Pitting can occur throughout the shell or heads, but may be more common at the liquid level line, in the area over shell heating sections, locations with high stresses, and near fittings.

Minor shallow pitting can be repaired by buffing out material around the pits replacing the material with weld material and metal finishing consistent with the cargo tank's use.

Deep pits can be repaired by drilling through the material to assure all contaminants are removed then re-welding and finishing.

Severely pitted tanks generally are not economical to repair. If the depth of pits can be determined, a judgment can be made to determine if the cargo tank is suitable for continued qualification as a HM tank and for what type ladings it may carry. If a cargo tank no longer conforms to the minimum thickness prescribed for the design as manufactured the owner may use the cargo tank to transport authorized materials at reduced maximum weight of lading or reduced maximum working pressure, or combinations thereof, provided a Design Certifying Engineer certifies that the cargo tank design and thickness are appropriate for the reduced loading conditions by issuance of a revised manufacturer's certificate, and the cargo tank motor vehicle's nameplate must reflect the revised service limits.

If general thinning is suspected or specific areas appear to be thinned, a thickness test per Section 5.5 must be performed and any noted deficiency corrected before returning the tank to HM service.

SECTION 5: MAINTENANCE PROCEDURES

CRACKS IN STRUCTURES:

Inspect baffles, head stiffeners, internal ring stiffeners, shoes or other internal components for cracks or tears or cracks in the welds connecting them to the vessel. If the tank has operated for a number of years and some small cracks exist that appear to have occurred some time prior to the inspection they may not be serious enough to repair, but they should be noted in the inspection report. Large cracks, splits or tears in baffles, rings, welds and etc., should be repaired. If they appear severe in relatively new tanks, contact the manufacturer for instructions.

DEFORMATION OVER SUPPORTS OR VACUUMED AREAS:

Note any deformation over the external frame rails near the fifth wheel structure and suspension structure. Also look for shell deformation between the flanges of external ring stiffeners. Minor deformation on tanks in service for some time probably is not a concern. Serious deformation in relatively new tanks may indicate failure of or inadequate external support structures. Investigate the reason or contact the manufacturer.

Check the upper sections of the shell and heads for any sucked in areas. These can occur due to plugged or missing vents and can lead to buckling of the tank. They should be pushed out and stabilized.

Tanks in hot product service may have buckles in the floor or lower sides. A judgment needs to be made relative to their severity and the age of the cargo tank. If they are deemed severe, they have to be pushed out and stabilized.

Welds: A visual inspection of the welds should be made using a bright light. A visual inspection, however, can only determine if it is cracked or is not cracked. Cracks in shell seams, shell to head welds or fitting welds will cause leaks and would cause failure of the leakage test.

Welds connecting baffles and other internal components to the vessel should be carefully inspected for defects. Use of a magnifying glass will improve your inspection.

Internal Tank Fittings: Inspect valves, high level sensors, vapor vents, internal vapor or drain lines, connecting linkage between valves and vents if they exist, and check any other internal fittings for tight bolts, correct alignment and other defects.

5.3 LEAKAGE TEST

(Ref. Paragraph 180.407 (h) of 49 CFR) (All cargo tanks except MC 338 (See Section 9.0) of this publication)

Each cargo tank, except MC 338 and MC 330/331 in chlorine service, must be tested for leaks annually. MC 330/331 in chlorine service are required to be leak tested every two years. The leakage test must include testing product piping with all valves and accessories in place and operative, except that any venting devices set to discharge at less than the leakage test pressure must be removed or rendered inoperative during the test. All internal or external self-closing stop valves must be tested for leak tightness. Each cargo tank of a multi-cargo tank motor vehicle must be tested with adjacent cargo tanks empty and at atmospheric pressure. Test pressure must be maintained for at least 5 minutes. Cargo tanks in liquefied compressed gas service must be externally inspected for leaks during the leakage test. Suitable safeguards must be provided to protect personnel should a failure occur. Cargo tanks may be leakage tested with hazardous materials contained in the cargo tank during the test. Leakage test pressure must be no less than 80%of MAWP marked on the specification plate except as noted in this section. The logical time to perform this test is when you do the annual external inspection.

The leakage test should be performed after the external inspection or other inspections which are being done in conjunction with the external visual inspection, such as the internal visual inspection or thickness test.

As a practical matter, the leak testing of a cargo tank which is in regular service is only useful to find leaks which may exist in top tank fittings, and if the emergency valve seat is leak tight. If a leak occurs in the tank the leak will be detected when it occurs and will have to be dealt with immediately to keep the cargo tank in service.

The leakage test may be performed hydrostatically or pneumatically, and is to be done at a minimum of 80% of the cargo tanks MAWP and may never exceed the MAWP with certain exceptions noted below.

A cargo tank with an MAWP of 690 kPa (100 psig) or more may be leakage tested at its maximum normal operating pressure provided it is in dedicated service or services; or an MC 330 or MC 331 cargo tank in dedicated liquified petroleum gas service may be leakage tested at not less than 414 kPa (60 psig).

An MC 330 or MC 331 cargo tank in dedicated service for anhydrous ammonia may be leakage tested at not less than 414 kPa (60 psig).

A specification MC 330 or MC 331 cargo tank, and a nonspecification cargo tank authorized under 49 CFR §173.315(k), equipped with a meter may check the leak tightness of the internal self-closing stop valve by conducting a meter creep test. (See 49 CFR § 180 Appendix B in Section 12)

See Section 9.0 for requirements for leak testing MC 330 and 331 cargo tanks.

A non-specification cargo tank required by 49 CFR §173.8(d) to be leakage tested, must be leakage tested at not less than 16.6 kPa (2.4 psig), or in accordance 49 CFR § 180.407(h)(2), EPA Method 27 and noted in the next paragraph.

There is an exception for MC 306, DOT 406 cargo tanks, transporting petroleum distalate fuels equipped with vapor collection systems. The EPA Method 27 is used to determine the leak tightness of the vapor system of the cargo tank and may be substituted as an alternative to the 80% leakage test method.

The leakage test is to be performed with all tank closures such as valves, manholes and vents in place and operative. Again there is an exception, MC 306/DOT 406 cargo tanks are vented at 1 psig which is less than 80% of their MAWP. The 1 psi. vents must be removed and plugged or blanked by tape or rubber sheeting.

The Specifications for the leakage test clearly allows you to remove or render this breather type vent inoperative during this test, but do not describe a maintenance requirement for this primary vent during the leak test.

Good practice would indicate that the vent should be inspected for cleanliness and that it is in good mechanical condition. Checking its 1 psi. opening pressure is not mandated and would take a special fixture as the vent must be oriented in the same position as it exists when mounted on the tank. Further, pressure is applied externally to the vent and it exhausts through the threaded fitting. A fixture would have to surround the vent.

As mentioned above, the Specifications give the option of performing the test pneumatically or hydrostatically (more simply, with air pressure with the tank empty or with water pressure while the vessel is shell full with water). Cargo tanks may be leakage tested with hazardous materials contained in the cargo tank during the test. Other gasses or liquids may be used, but such a variation is not common.

A discussion of air versus hydrostatic testing may be useful in helping you determine the method you choose.

The primary advantage of hydrostatic testing is that if a failure in the vessel or fittings occurs during testing, a very small loss of fluid reduces the pressure to atmospheric pressure almost instantaneously, and the failure will not propagate.

This is an important safety feature and one that should be used if the pressures are above 5 psi and the vessel is new, or has had extensive welded repairs, or has not been subjected to pressure for a long period of time.

The advantage of pneumatic testing is that the vessel need not be filled with liquid and the pressure can be applied quickly. The disadvantage of pneumatic testing (particularly above 5 psi.)., is that if a failure occurs in the vessel it takes a longer time for the pressure to dissipate through the failure allowing that failure to propagate very quickly and (perhaps) catastrophically. In addition to damaging the vessel these failures can be **DANGEROUS TO PERSONNEL**, who may be close to the failure while inspecting the vessel.

The first consideration when doing pneumatic testing is to have a pressure source that is controlled so that the test pressure is not accidentally exceeded.

Most shops have compressed air sources at 100 psi. or above. These are considerably higher than almost all cargo tank testing requirements. When using high pressure sources be extremely careful and recognize the danger of not controlling them properly.

The most common method used to control pressure is by use of an air regulator. Those that are well maintained are reliable and should provide a safe source, but nothing beats constant monitoring of the test pressure.

The use of an air regulator does slow the flow of air into the vessel and adds time to the process of raising the vessel to test pressure. DO NOT get impatient and bypass the regulator. OVER PRESSURIZING IS DANGEROUS, AGAINST THE LAW, AND CAN CAUSE SERIOUS INJURY OR DEATH.

Manhole covers will open most forcefully even at pressures as low as 2 psi. Do not attempt to open or adjust a manhole cover while the vessel is under pressure. If adjustment is required reduce the test pressure to zero before opening or adjusting.

A PRESSURE OF JUST 2 PSI. ON A 20" DIAMETER MANHOLE EXERTS A FORCE OF 628.3 POUNDS AGAINST THE COVER ENOUGH TO LIFT A LARGE MAN.

Pneumatic testing is widely used in the tank truck industry and can be done safely if you are aware of, and prevent against, the dangers just described.

If a tank has been air unloaded on a regular basis, there is reason to believe it will not fail catastrophically when subjected to 80% of its normal MAWP.

If an MC 306 or DOT 406 tank is not equipped with a vapor recovery system, subjecting it to 80% of 3.3. psi or 2.65 psi., pressure is not going to be a significant risk.

Play it safe. If you are air testing a tank do not position yourself between the tank and a wall while raising it to its test pressure. Arrange your set up so the tank can be pressurized from a safe distance preferably in front of or behind the tank. Figure 3 (sees graphics section) shows a typical pressurizing kit for air testing.

If you are going to inspect the tank while under pressure, raise the tank to test pressure while standing clear and observing the tank for a few minutes then start your inspection. To be sure your equipment doesn't allow the pressure to rise as you inspect, disconnect the pressure hose from pressurizing fittings.

Air testing, particularly at lower pressures, from 1.0 psi. to 5.0 psi. as discussed, is reasonably safe and is very effective if done using a soap solution on the exterior welds and fittings.

Establishing and then stabilizing a test pressure, then closing off the pressure source and monitoring for a drop in pressure is allowed, but if the cargo tank does not pass the test, the location of the leak or leaks are still not known, and further investigation must be done.

When air testing an insulated tank it will be practical to use a soap solution to check tank fittings and piping, but you will have to rely on the pressure drop method for testing the vessel walls.

TESTING WITH WATER:

There are safety precautions necessary when using hydrostatic pressure with the tank filled. Water is heavy and the cargo tank should be supported at the landing legs and by a sturdy support under the fifth wheel plate if it is not connected to a tractor.

The tank should be leveled and filled shell full trying to eliminate any air bubbles along the top of the shell.

Pressure can be introduced through a top fitting or through one of the piping outlets, however the test pressure must be measured at the top of the vessel. A second gauge at the pressure inlet source will be useful in raising the tank to the test pressure, and allows the operator to raise pressure while not on top of the tank.

Most water systems can develop enough pressure to achieve leak test pressures for all but the high pressure tanks and can be directly applied through a control valve in the supply line.

Figure 3 (see graphics section) shows a typical pressurizing kit to safely test using water or air pressure. Always have an exhaust valve down stream from the pressure control valve so accidental over pressures can be dumped quickly.

Refer to Sections 6 through 12 for specific information on how to perform, evaluate and document the leakage test for each type Specification cargo tank.

5.4 PRESSURE TEST

(Ref. Paragraph 180.407(g) of 49 CFR)

Refer to Section 9.0 for information on pressure testing MC 330 & MC 331 cargo tanks. The primary purpose of the "Pressure Retest" is to check the cargo tank's ability to structurally withstand being subjected to its original test pressure.

An external and internal visual inspection must be conducted immediately prior to and in conjunction with the pressure test. It will be necessary to follow the pressure test with a leakage test, because some of the fittings are not in place during the pressure test.

Insulated cargo tanks equipped with manholes or inspection openings may perform either an internal visual inspection in conjunction with the external visual inspection or a hydrostatic or pneumatic pressure-test of the cargo tank. (See Note #4 in 49 CFR §180.407(c). For this reason when a tank is in for a five year pressure test, all four test (V, I, K, & P) should be performed at the same time. Table 2, below, lists the required test pressure based on the Specification type of the cargo tank being tested.

TABLE 2

Specification	Test Pressure
MC 300,301,302,303, 305, 306 —	20.7 kPa (3 psig) or design pressure, whichever is greater
MC 304, 307 —	275.8 kPa (40 psig) or 1.5 times the design pressure, whichever is greater
MC 310,311, 312 —	20.7 kPa (3 psig) or 1.5 times the design pressure, whichever is greater
MC 330, 331 —	1.5 times either the MAWP or the re-rated pressure, whichever is applicable
MC 338 —	1.25 times either the MAWP or the re-rated pressure, whichever is applicable
DOT 406 —	34.5 kPa (5 psig) or 1.5 times the MAWP, whichever is greater
DOT 407 —	275.8 kPa (40 psig) or 1.5 times the MAWP, whichever is greater
DOT 412 —	1.5 times the MAWP .

DOT allows either a hydrostatic or pneumatic test, however, industry engineers, many fleet superintendents and repair shop managers believe this test should be performed hydrostatically with the shell filled with water. The weight of the water adds a heavy load to the tank while it is pressurized to its test pressure and is a better test of the structure than air testing an empty tank.

The pneumatic test procedure may be useful for special cases where product residue is difficult or nearly impossible to remove. There may be other special cases, therefore we have included procedures for pneumatic testing in the separate sections for each Specification type.

IF YOU NEED TO USE THE PNEUMATIC TEST PLEASE REVIEW SAFETY ISSUES COVERED UNDER PNEUMATIC TESTING IN THE LEAKAGE TEST SECTION 5.3

SECTION 5: MAINTENANCE PROCEDURES

HYDROSTATIC TESTING:

The cargo tank being tested should be positioned so all sides, top and bottom can be viewed during testing and clear of other shop work. It should be placed on a durable level surface capable of supporting the cargo tank loaded with water.

The cargo tank's upper fifth wheel plate must be removed for this test. This makes supporting the tank more difficult. Care should be taken to provide a support under the fifth wheel area that allows for inspection but is not so concentrated that it damages the cargo tank's frame rails. The landing gear SHOULD NOT be relied on for the sole support of the loaded vessel, but if it is a load bearing type landing gear, it should be used in conjunction with the front end support.

Level the cargo tank so when it is filled there will be no air spaces in the ends of the tank or compartments. Fill the tank and product piping so the liquid is to the top of the manhole collar. Make every effort to eliminate any air space in the compartments or tank.

To fill air pockets caused by a manhole collar, insert a "U" tube or small hose around the bottom of the collar getting one end as close to the top of the shell as possible and vent the free end, then continue filling.

Like the hydrostatic leakage test the tank can be pressurized from a typical water supply up to 50 psi. If the available water supply cannot reach the required test pressure, a hand operated booster pump can be added to the system, or air pressure can be applied on top of the liquid.

Pressurizing the tank from ground level through a bottom fitting is desirable from a safety and convenience standpoint. Use a test pressurizing device as shown in Figure 3 (see graphics section).

IF YOU USE AIR ON TOP OF THE LIQUID, BE SURE THE TANK IS REALLY LIQUID FULL.

Air may be used to raise the pressure, but when the test pressure is achieved shut off the air supply after the pressures is stabilized. You may eliminate the safety advantage of the hydrostatic test if you have a large high pressure source of air available to the tank.

All reclosing pressure relief valves must be removed, bench tested and re-installed or replaced after completion of the pressure test. NOTE: New vents are not required to be bench tested prior to installation.

All closures, including manholes, must be in place during the test. If the manhole has a pressure activated fill opening it may be jammed shut or replaced with a test fill cover.

Each compartment must be raised to the required test pressure and held for a period of ten minutes while the adjacent compartments are at atmospheric pressure.

Apply the pressure in four or five increments and observe the system for a few minutes at each increment. For instance if the test pressure is 40 psi. typical increments may be as follows: 10 psi., pause, 20 psi., pause, 30 psi., pause 35 psi., pause and then apply 40 psi. Then hold for a minimum of 10 minutes.

While the tank or compartment is at test pressure make a careful inspection for leaks at fittings, seams or in the shell and head structure itself.

If the tank is insulated, inspect those areas that are visible for leaks. Leaks which may occur under the jacket probably will not be apparent, but may be revealed by leaking out the bottom portion of the jacket.

The lack of leaks on insulated tanks shall be determined by closing off the source of pressure and determining if the cargo tank loses pressure during the 10 minutes hold time.

If the cargo tank is equipped with internal and external valves, test the liquid holding capability of both while at test pressure. This can be done by first opening the internal valve and observing if the external valve leaks, then reclose the internal valve, carefully drain the external line and observe for signs of leakage past the internal valve while maintaining the test pressure on the tank.

If a leak occurs that makes it difficult to maintain pressure, it will be necessary to stop the test, correct the leak and then continue. Any leak detected must be fixed and the pressure test repeated until no leaks occur in the tank or compartment.

TANK HEATING SECTIONS:

49 CFR 180.407(g)(4) requires that all pressure bearing portions of a cargo tank heating system employing a medium such as, but not limited to, steam or hot water for heating the lading must be hydrostatically pressure tested at least once every 5 years. The test pressure must be at least the maximum system design operating pressure and must be maintained for five minutes. A heating system employing flues for heating the lading must be tested to ensure against lading leakage into the flues or into the atmosphere.

If the heating section fails to maintain the appropriate pressure during the retest, the tank may remain in service as an unheated cargo tank, providing lading cannot leak into the heating system and the heating system information plate is changed to indicate the tank has no working heating system.

Another alternative would be to determine what pressure the heating section can achieve and modify the heating section specification plate to indicate a design pressure equal to two-thirds of the achieved test pressure. Many heating sections are used at relatively low pressures.

EXCEPTIONS:

Pressure testing is not required for non-insulated lined cargo tanks, with a design pressure or MAWP less than 15 psi., and which receive external and lining inspections at least every year.

5.5 THICKNESS TEST

(Ref. Paragraph 180.407 (I) of 49 CFR)

GENERAL:

It is important to note that thickness testing is only required when a Specification cargo tank has been transporting ladings (or commodities) that are corrosive to that cargo tank's shell and head material, or if corrosion is discovered during any inspection of the cargo tank. The following two terms come into play when thickness testing. They are defined in 49 CFR §180.403.

Corroded or abraded: which means any visible reduction in the material thickness of the cargo tank wall or valve due to pitting, flaking, gouging, or chemical reaction to the material surface that effects the safety or serviceability of the cargo tank. The term does not include cosmetic or minor surface degradation that does not effect the safety or serviceability of the cargo tank.

Corrosive to the tank or valve: The term "corrosive to the shell material" has caused confusion in the industry. The term does not mean the same as Hazard Class 8 Corrosive found in 173.136. A product which is Hazard Class 8 may or may not be "corrosive to the shell material" covered in Part 180 and a material which is not a Hazard Class 8 material may meet the requirement for testing. The definition that must guide the maintenance person is found in Part 180.403:

> **Corrosive to the tank or valve** means that the lading has been shown through experience of test data to reduce the thickness of the material of construction of the tank wall or valve.

Many commodities that are classed as "corrosives" do not corrode stainless steel or even steel tanks and there may be no need to perform thickness tests.

Conversely, there are some products not classed as "corrosives" or are even listed as a hazardous commodity that will corrode stainless steel, aluminum or steel. Specification tanks that have transported these commodities need to be thickness tested.

An example is an aluminum Specification cargo tank transporting certain crude oils that are corrosive to aluminum or a Specification stainless steel tank transporting certain fatty acids containing minute quantities of free chlorines. Even some waters, like well water, may cause biological corrosion and cause severe pitting in stainless steels.

Corrosion is seldom of the uniform type that eats evenly at the shell material. Most corrosion found in cargo tanks is selective or causes pitting.

If a commodity corrodes the shell, usually it will attack the following areas initially: The heat affected zone of welds which occurs in a narrow band along each side of the weld; highly stressed areas like over frame members or bolsters; ring stiffeners; head stiffeners; around sumps and nozzles and in integral heat panels.

Pitting corrosion will occur selectively (as above) including the liquid level line of the product. It can also occur generally through out the vessel, depending on the severity of the attack.

Pitting will not necessarily show up as thinning when using a thickness tester and continued use of a pitted tank will have to be a judgment call of the owner and/or inspector.

Small amounts of shallow pitting may be able to be repaired, however, a severely pitted tank can not be economically repaired. Worse, once severe pitting is started the process is irreversible as the contaminant that caused pitting to start, cannot be removed from the bottom of the pits and the pitting continues until it goes completely through the shell.

Corrosion of cargo tanks has been, and can be very expensive for cargo tank owners. If unexpected corrosion is discovered in a tank, the employment of a qualified metallurgist will usually be a wise choice.

CONDUCTING THICKNESS TESTS

DETERMINING CORRECT MINIMUM THICKNESS

Prior to performing a thickness test it is necessary to determine the minimum thickness acceptable for the cargo tank being inspected.

The definition for "Minimum Thickness" as found in 49 CFR §178.320 means the minimum required shell and head (and baffle and bulkhead when used as tank reinforcement) thickness needed to meet the specification.

The minimum thickness is the greatest of the following values:

For MC 330, MC 331, and MC 338 cargo tanks, the specified minimum thickness found in the applicable specification(s); or

For DOT 406, DOT 407 and DOT 412 cargo tanks, the specified minimum thickness found in Tables I and II of the applicable specification(s) or

For MC 300, MC 301, MC 302, MC 303, MC 304, MC 305, MC 306, MC 307, MC 310, MC 311, and MC 312 cargo tanks, the in-service minimum thickness prescribed in Tables I and II of 49 CFR §180.407(i)(5) for the minimum thickness specified by Tables I and II of the applicable specification(s); or

The thickness necessary to meet with the structural integrity and accident damage requirements of the applicable specification(s); or

The thickness as computed per the ASME Code requirements (if applicable).

Many cargo tanks are constructed with material thickness significantly thicker than the Specifications require. The DOT 400 series tanks will have the minimum shell thickness stamped on their certification plates and is, therefore, easy to determine.

Paragraph 178.340, the general section for the MC 300 series tanks, required that the certification plate for these Specifications show only the shell and head material, but not the manufactured or minimum thickness.

So, MC 300 series cargo tanks, which were manufactured from 1967 to 1995, may not have any shell thickness stamped on their certification plates, or they may have the thickness of the material of which they were constructed. If the thickness is stamped it may be expressed as a "decimal" thickness or as a "gauge" thickness. This thickness is not necessarily the minimum to which the tanks could have been manufactured.

There are several ways to determine the minimum thickness for the tank you are testing. The best is to contact the manufacturer and provide them with the tank's year of manufacture and serial number. If contact with the manufacturer is not an option, you may use the minimum shell and head thickness tables which are a part of MC 306, 307 and 312.

These tables require that you have considerable design information about the tank to use them properly. TTMA, (Truck Trailer Manufacturer's Association) has published a Technical Bulletin # 113, on how to determine the correct thickness. In some cases it may also be necessary to employ the services of a Design Certifying Engineer .

When you have determined the correct minimum nominal thickness for the tank being inspected, the thickness may be described using a gauge thickness. Table I, Part 180.407 (i) provides the minimum decimal thickness for that gauge number for steel and stainless steel cargo tanks.

If the thickness is described using a nominal decimal thickness, Table II shows the minimum decimal thickness for aluminum tanks giving decimal minimums for the decimal nominal thickness' required in the MC 300 series Specifications.

MEASURING SHELL THICKNESS

TAKING THICKNESS READINGS

Thickness readings are taken using an Ultrasonic Thickness Tester available from several manufacturers. These instruments are capable of reading thickness within, plus or minus .002" (when properly calibrated) and that accuracy meets the requirements of Paragraph 180.407 (i).

LOCATION AND NUMBER OF THICKNESS MEASUREMENTS

49CFR 180.407(i)(4) lists ten areas of the vessel (cargo tank wall) which must be tested. Although DOT is not more specific, they have shown through audits of thickness tests, that they expect more detail and numerous readings are necessary to pass the audit. As a practical matter, setting up to take readings is time consuming, but readings are made quickly, so it is reasonable to take quite a few readings to insure a thorough test.

TTMA Technical Bulletin No.113, dated May 18, 2007, suggests seven points on each bulkhead, and six points around the circumference at each circumferential weld or shell stiffener location, such as a ring stiffener or baffle. They also suggest thickness readings at all tank openings.

If you are performing thickness tests, it will be necessary for you to determine the minimum number of readings with the cargo tank owner, and/or the local DOT auditing agency. If you cannot get that information, use the TTMA procedure and document that fact in your inspection report.

DOCUMENTATION OF THICKNESS TESTS:

Figure 4 (see graphics section) shows the most typical format used to report readings. It consists of a diagram for each of the bulkheads, with the locations and designations for each reading, and a flat layout of the vessel.

Clock designations along the ends of the layout are used for each circumferential reading taken, with 12: 00 o' clock representing the top centerline of the tank.

Bands through the pattern indicate longitudinal locations for each set of circumferential readings. The location of openings such as outlets and manholes can also be shown with designations for those readings.

Readings may be recorded directly on the layout if there is room, or they may be tabulated in tables which reference the designated points. See Figure 4 (see graphics section).

SECTION 5: MAINTENANCE PROCEDURES

CARGO TANKS NOT MEETING THICKNESS REQUIREMENTS:

If a cargo tank fails to pass the thickness requirement for its specific designation, it cannot be continued in service until changes are made. Typical examples are MC 312 or DOT 412 cargo tanks which have been manufactured with a corrosion allowance which has been used up by the commodities carried, or MC 312 tanks manufactured for a high density commodity which would still be authorized for lower density commodities because the shell and head thicknesses are within the Specification's allowances for such products.

In the case of the MC 312 tanks, they may be stamped for the lower density commodity as determined by Table II in Paragraph 178.343. However, it is important to note that, under present DOT interpretation, an MC 312 cargo tank MAY NOT be recertified as (for example) an MC 307 cargo tank.

An MC 312 may also qualify for transportation of a variety of flammable materials if its venting meets MC 306 or 307 requirements. The same would be true for a DOT 412. It may qualify as a DOT 407 or 406 cargo tank.

Again, a cargo tank manufactured to one of the 300 series Specifications may no longer be converted to another MC 300 Specification.

The owner of a cargo tank that no longer conforms to the minimum thickness prescribed for the design as manufactured may use the cargo tank to transport authorized materials at reduced maximum weight of lading or reduced maximum working pressure, or combinations thereof, provided a Design Certifying Engineer certifies that the cargo tank design and thickness are appropriate for the reduced loading conditions by the issuance of a revised manufacturer's certificate, and the cargo tank motor vehicle's specification plate is changed to reflect the revised service limits.

An inspection report prepared in accord with 180.407(b) is required;

Markings: Inspect test and inspection markings as required by 180.415, including marking required for this service: Inspection date (month and year), followed by the letter "T".

LINING INSPECTION:

(Ref. Paragraph 180.407 (f) of 49 CFR)

Lined cargo tanks transporting lading corrosive to the tank are required to have the integrity of their linings tested at least once each year.

The testing and inspection of tank linings is not a task normally carried out in a typical tank repair shop. Special inspection tools are required and knowledge of linings and use of the inspection tools are required. Lining applicators are a source for this information and they may provide training for the testing of their type lining.

Three basic types of lining are used in the cargo tank industry; Elastomeric ("rubber like"); Spray type (which also may be baked in (phenolic, epoxies & etc.); and Applied linings which use a variety of sheetings or composite materials bonded to the shell with a bonding agent.

All are dielectric, meaning they do not conduct electricity and may be tested with a spark tester. DOT provides rather complete test instructions in 49 CFR 180.407(f), for rubber linings including calibration of the Spark Tester. They refer testing of other type linings to the manufacturer or applicator.

Detailed instructions on how to determine the integrity of each type lining is outside the scope of this manual. It is imperative that you check with the lining manufacturer (or applicator) for accurate testing tolerances and procedures before initiating this test.

Listed below are the common sense steps that may be followed to inspect a lining if you are trained in the proper use and calibration of the appropriate inspection tool for the type lining in question.

1. Degas, clean and make safe the tank interior, ensuring forced air ventilation during test;
2. Dry the interior, making it as moisture free as possible;
3. Provide all persons who enter the tank with soft appropriate approved footgear;

4. Cushion the bottom of ladders used for entry through manholes;
5. Provide explosion-proof lighting that illuminates all interior surfaces;
6. Starting at either end of the tank, systematically inspect the entire inner surface of the tank.
7. Pay particular attention to corners, lining seams, recesses, and where structure is joined (baffles, bulkheads, etc.), looking for stains or discoloration in the liner material. Inspect for blisters and separation, and also pay attention to liner material termination at valve sumps and all drains;
8. Verify lining and shell integrity with a low-pressure pneumatic test. Using shop method, systematically eliminate the usual leakage sources, e.g., manhole gaskets, valves, vents, etc.
9. Lining and tank should hold pressure after this. If not, leaks in the lining and shell should be investigated, following the procedures outlined in Section 5.3;
10. Refer to the lining manufacturer's recommended procedure and follow the tester manufacturer's procedure for the involved lining process;
11. Calibrate the spark tester in accord with 180.407 (f) and the manufacturer's instruction;
12. Starting at either end of the tank, pass the probe over all lining surfaces. Adopt a consistent, overlapping pattern in making the probe pass over the liner, not allowing it to remain still over anyone place. CAUTION: Holding the probe stationary may burn a hole through the lining;
13. Pay particular attention to liner stains and discoloration, and do repeat passes with the probe in such areas;
14. Use chalk to mark leaks as they are detected, then record any leaks detected by location references that can be identified on the tank exterior. These areas should then be examined with a UT device (as used in Section 5.5. for thickness testing.);
15. After inspection and testing is completed, remove all equipment, then do a thorough check to make sure that no test material is left in the tank;

An inspection report prepared in accord with 180.407(b) is required;

Markings: Inspect test and inspection markings as required by 180.415, including marking required for this service: Inspection date (month and year), followed by the letter "L".

A lining inspection report form is included in the specific cargo tank sections for MC 307 /DOT 407, MC 312/ DOT 412 AND MC330/331.

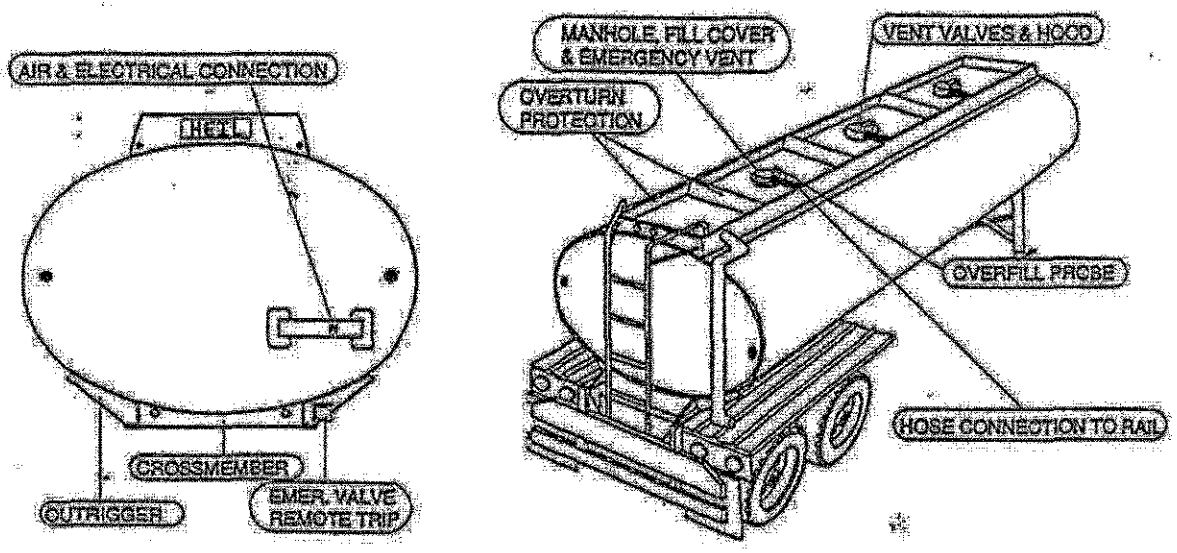
REMEMBER, CARGO TANK FACILITIES PERFORMING PART 180 TESTS, INSPECTIONS AND REPAIRS MUST FIRST REGISTER WITH THE DOT'S FEDERAL MOTOR CARRIER SAFETY ADMINISTRATION AND RECEIVE A "CT" NUMBER. REGISTRATION INFORMATION CAN BE FOUND IN 49CFR107.501. FACILITIES CAN REGISTER ONLINE AT:

www.fmcsa.dot.gov/registration-licensing/online-registration/onlineregdescription.htm.

SECTION 5: MAINTENANCE PROCEDURES

SECTION 6: MC306/DOT 406

SECTION 6: MC 306 DOT 406 CARGO TANKS



6.0 MC 306/DOT 406 CARGO TANKS

Editors Note: Users of the manual should be aware that current official editions of Title 49, Code of Federal Regulations do not contain copies of the MC "300 series" cargo tank specifications (except MC 331 and MC338.) Copies of these specifications are included in NTTC's Bulk HazMat Compliance Guide" published annually. (www.tanktruck.org.)

References: (from 49 CFR)
178.340, General Design & Construction Requirements
178.341, Specification MC 306 Cargo Tanks
178-345, General Design and Construction Requirements
178-346, Specification DOT 406 Cargo Tanks

The MC306/DOT406 family of cargo tanks is the most common of all the different types of cargo tanks. It is believed there are in excess of 100,000 tanks of this type currently in service. Predecessor Specifications are MC 300, 301, 302, 303 and 305. No MC-303 or 305 cargo tanks have been constructed since 1967, but a few may remain in service. MC-303 units were low pressure tanks for flammables and were constructed of steel or stainless steel. MC-305 was the Specification for aluminum gasoline tanks until superseded by MC 306 in 1967. MC306 series tanks were not authorized after August 31, 1995.

This section's cover sheet shows typical features of an MC 306/DOT 406 tanks. Most have elliptical cross-sections and are multi-compartmented tanks.

MC 306/DOT 406 tanks are used mostly for middle distillate petroleum products. The "gasoline tanker" as it is most often called, is a familiar vehicle on all roadways. Because they may make several trips per day or even per shift, their operating systems are used more often than other types of HM tanks. This causes frequent functioning of loading and unloading systems. Maintaining these components is critical to the safe operation of the cargo tank. These CTMV's unload in very public places, such as midtown service stations; therefore, they merit expert care. DOT qualification and maintenance requirements focus on the proper operation of vents, verifying the leak tightness of piping components and the vessel as well as the structural integrity of the cargo tank. This section will guide you through the various inspections required for the MC 306 DOT 406 cargo tanks.

SECTION 6: MC306/DOT 406

6.1 DESIGN CHARACTERISTICS

6.1.1 DESIGN PRESSURE/MAXIMUM ALLOWABLE WORKING PRESSURE, (MAWP)

Since 1989 MC 306 tanks have been manufactured with a design pressure (MAWP) of 3.3 psi. and a test pressure of 5 psi. The reason for this change is that the static head of the liquid creates about 2.5 psi. in the bottom of the tank. DOT felt that if they were not stamped with at least the equivalent of the static head, such would be confusing to inspectors.

DOT 406 tanks must have an MAWP no lower than 2.65 psi. and no higher than 4 psi. Cargo tank and vent manufacturers agreed to standardize on an MAWP of 3.3 psi. and a test pressure of 5 psi. This was done so vents could all be designed to the same "set to open and re-closing pressures".

6.1.2 MATERIAL

MC 306/DOT 406 tanks can be constructed of mild steel, high strength low alloy steel (HSLA), stainless steel or aluminum, but aluminum construction accounts for 95 percent, or more, of the current US trailer fleet. Steel is most commonly used for small truck mounted cargo tanks however, most domestic truck and trailer combinations are constructed of aluminum.

6.1.2.1 MINIMUM SHELL AND HEAD THICKNESS

Test or inspection reports must show the cargo tanks minimum shell and head thickness when thickness testing is performed. Minimum shell and head thicknesses are specified in Paragraph 178.341-2 (Tables I & II) for MC-306 tanks and Paragraph 178.346-2 (Tables I & II) for DOT-406 tanks. For 400 series cargo tanks the minimum thickness is shown on the nameplate.

Aluminum shell and head thickness ranges from 0.096 to 0.250" with most manufacturers providing thicker metal for shell bottoms and tops. Refer to these tables to determine the minimum thickness for the cargo tank being inspected. Most tanks have minimum thicknesses as listed below, but may be thicker for very large capacity tanks and thinner for those below 8,000 gallons.

The minimum thickness of shell and heads for aluminum MC 306 cargo tanks is 0.096 inches. The minimum thickness of shell and heads for DOT-406 cargo tanks over 8,000 gallons is 0.173 inches.

6.1.3 MANHOLE ASSEMBLIES

The MC 306 Specification requires a manhole with a size of at least 11" x 15" for any compartment in excess of 2,500 gallons. It must provide for secure closure and 1% of those produced must withstand a manufacturer's proof test of 36 psi.internal pressure without experiencing structural deformation.

The DOT 406 Specification requires a cover with a minimum diameter of 15" for any compartment in excess of 400 gallons. It must withstand the manufacturer's 36 psi. internal pressure test. Most 306/406 manholes are either 16" or 20" in diameter with a 10" diameter fill opening.

Manholes must be stamped with the manufacturers name, the test pressure and a statement that it meets the requirements of 49 CFR. 178.345-5.

A manhole assembly consists of a collar and the cover. The flanged collar is welded into the top of the compartment, and the cover is attached to the collar with a clamping ring or by lugs extending down and under the bottom edge of the collar. Most 306/406 covers have 10" diameter hinged, fill covers which are spring loaded and act as a pressure activated vent (PAF) and have a high volume venting capacity. The cover may have other openings to install vapor recovery vents or overfill sensors. Figure 5 (see graphics section) shows typical manhole assemblies with Pressure Activated fill vents, and clamping rings.

6.1.4 VENTING

Two types of venting are required for MC 306 cargo tanks: normal and emergency venting. Typical normal vents are in-breathing and out-breathing. They vent at 1 psi. pressure and 6 oz. of vacuum. They are designed to prevent product leakage in any position of roll over. They are designed to maintain the tank's internal pressure near atmospheric during normal operation.

Emergency venting is provided to keep the tank from becoming over pressurized in the event of fire exposure. Older MC-306 cargo tanks may have their emergency venting supplied by a fusible vent. This is a fitting with a cap soldered in place which will melt out and provide an opening to relieve pressure.

Emergency venting can also be provided by spring loaded vents such as the spring loaded fill cover, or the PAF vent. See more detail on venting below.

DOT-406 tanks use a primary and secondary vent system to meet the total venting capacity required in Paragraph 178.345-10 More about that below. The primary pressure relief vent must open at not less than 1 psi. and have a vent capacity of 6000 CFH at 125% of test pressure (usually 6.25 psi.). A vacuum vent is also required which will open at 6 oz. of vacuum. A normal vent meets both of these requirements, as described above for MC-306 tanks.

The secondary venting is required for fire exposure. The total amount of venting required in standard cubic feet per hour (SCFH) depends on the total amount of exposed shell and head area of the cargo tank vessel. DOT 406 secondary vents are required to open at not less than 110 percent of the MAWP or 3.3 psig, whichever is greater, and not more than 138 percent of the MAWP. The vent must close at not less than the MAWP and remain closed at lower pressures. Remember, the only time this condition exists is if the tank is exposed to a large fire or in the case of an over fill. The purpose of the vents is to keep the tank from becoming over pressurized and rupturing.

The total volume of venting is shown in a table in 49CFR 178.341-4 (c) for MC-306 and 178.345-10 (e) (Table I) for DOT-406 tanks. As a note both tables have the same information. The tables list exposed surface area in one column and vent capacity in the other column. A typical gasoline tank has about 925 sq.ft. of exposed surface and would require 430,000 CFH of venting capacity. Most tanks have four compartments, so the total can be divided by the number of compartments. Typical modern PAF vents have a capacity of over 300,000 CFH. Meeting the requirement is generally not a problem but has to be analyzed as part of the External Visual Inspection.

Most MC 306/DOT 406 tanks are now equipped with manhole cover assemblies which supply all the venting required for either type tank. The normal vent is affixed to the underside of the 10" fill cover in a 1-1/4 NPT pipe thread. Emergency and/or secondary venting is supplied by the spring loaded 10" fill. As stated above, they are required to open between 3.63 and 4.55 psi for a DOT 406 cargo tank with an MAWP of 3.3 psi and are flow rated at 6.25 psi.

The reason they are rated at a pressure which is slightly above test pressure is that these vents can and do open at impact if a cargo tank turns over. Setting the opening pressure to 110% of MAWP and the flow rate at 6.25 psi. assures the impact pressure is relieved, but controls the amount of spilled fuel to just one liter per compartment.

On older MC 306 tanks, it was permissible to use fusible vents to make up part of the total venting requirement. If they are in good condition, (visual appearance) they may be retained. They make up part of the emergency venting total capacity and must be marked with a flow rate, Fusible vents are generally threaded plugs that screw into 1-1/4 inch or 2 inch openings in the manhole fill or dome cover, or as caps that screw onto 3" dia. cleanout openings. They are filled with a mixture of bismuth and lead which melts at 250 degrees Fahrenheit, releasing the cap and leaving an open hole. Their melting temperature need not be tested.

To determine if venting meets compliance for a compartment, inspect and tabulate the capacity markings on each emergency venting device. All vents must be marked with their rated flow capacity in standard cubic feet of free air per hour. (SCFH.) Typical exposed shell areas for some common sized petroleum tank compartments are as follows: 120 sq. ft. is typical for a 1,000 gallon compartment on a smaller sized tank; and 350 sq. ft. is typical for a 4,000 gallon compartment on a large petroleum tank.

To determine the correct amount of surface area, it is necessary to know the circumference of the shell and the length of the compartment in feet, and calculate the area of the shell. It will be necessary to add the area of both front and rear head for a single compartment tank, or just one head if it is a front or rear compartment. Do not add the head area for an intermediate compartment.

Typical gasoline tanks, 8,500 to 9,750 gallons, will have a head area of about 35 sq. ft. and have a circumference of about 20 feet. If in doubt run a tape around the entire tank and subtract about 12" for bridging over the flashing rails and frame members.

Vapor recovery vents, sometimes referred to as "positive vents" or "loading/unloading vents", are not specified in the DOT specifications, but have to meet EPA Requirements. They need to be tested annually by the EPA Method 27 test.

Most vapor vents are operated by air connected to the operation of the internal valve. Some are connected to the emergency valves poppet with a push rod. They are covered by a metal or flexible hood and are a part of the cargo tank's vapor recovery system. Today most load/unload vents are air operated and open into the tank instead of opening outward.

6.1.5 VENT TESTING:

Pressure relief vents have to be removed and bench tested during the five year pressure test or replaced. When you test vents, mount them in a test fixture in the same orientation as when they are mounted in the tank. A test chamber which provides you the flexibility of mounting either a 16" or 20" diameter manhole assembly will be a good investment.

The normal vent is mounted internally on the fill cover. Its 1-1/4 inch threaded end is the exhaust port. Only its opening pressure need be tested to be sure it does not open below 1 psi. Use either a 3 or 5 psi gauge or a water manometer to test. The vacuum side can be tested by blowing into the exhaust end. Please note that 180.407(g)(1)(ii) requires that normal vents be removed from the cargo tank and bench tested "or replaced" during the pressure test. It goes on to say these "normal vents" must be tested according to criteria established by the valve manufacture. Always follow the instructions from the manufactures of the normal vent.

Emergency vents have to be tested to determine that they operate in accordance with the specifications of the manufacture. In the absence of manufacturing specifications, in general vents must open between the set pressure marked on the vent and 110% of the set pressure marked on the vent and they must re-close at 90% of the set to discharge pressure. It is not necessary to test their flow rate.

For an MC 306 cargo tank with a 300 series vent on the tank the specification requirements identified in 178.341-4(d)(2) states "Each cargo tank compartment shall be equipped with pressure-actuated vent or vents set to open at not less than 3 psig and close when pressure drops to 3 psig or below. The minimum venting capacity for pressure actuated vents shall be 6,000 cubic feet of free air per hour (14.7 psig and 60°F.) from a tank pressure of 5 psig." This means the vent must open at 3 psi or above and must close when the pressure drops to 3 psi or below. Use the following table as a guide for 300 series vents on MC 306 cargo tanks.

Column 1	Column 2	Column 3	Column 4
M.A.W.P.	**Set Pressure (Marked on the Vent)**	**Vent Must Open**	**Vent Must Close**
3	3	Greater than 3 psi but less than 5 psi	At 3 psi or below

For a DOT 406 cargo tank and an MC 306 cargo tank with 400 series vents the regulations provide specific operating parameters. 178.346-3(c)(1) states the set pressure of each primary relief valve must be not less than 110 percent of the MAWP or 3.3 psig, whichever is greater, and not more than 138 percent of the MAWP. The valve must close at not less than the MAWP and remain closed at lower pressures. Use the following table as a guide for 400 series vents on DOT 406 and MC 306 cargo tanks.

Column 1	Column 2	Column 3	Column 4
M.A.W.P.	Set Pressure (Marked on the Vent)	Vent Must Open Between (110% - 138% of MAWP)	Vent Must Reseat No Less Than
3.3	3.63	3.63 – 4.55	3.3

EPA regulations specify the leak tightness requirements for cargo tanks transporting petroleum distillate fuels equipped with vapor recovery systems. Certification of that integrity may have to be performed more often than DOT re-test requirements. EPA Method 27 test is used to test the systems and may be substituted for the DOT Leakage test covered separately in Section 6.2.3.1.

6.1.6 PIPING

MC 306/DOT 406 piping must be capable of a burst pressure of at least 100 psi. or not less than four times the tank's MAWP and not allow damage as a result of expansion, contraction, jarring and vibration. Generally, this is not a problem. Aluminum tubing, valves and fittings normally used are easily capable of those requirements. It is not necessary to test piping to this requirement. Part 180 tests of piping should be to the tank's leakage test pressure.

Since MC 306 and DOT 406 cargo tanks are bottom loaded there will be product in the piping during transportation when first loaded. Wet lines are permitted. For this reason it is important for one to verify the presence of piping protection on these cargo tanks. In most cases, a shear section or sacrificial device is used to meet this requirement.

The type of accident damage protection required by MC 306 Specifications, used on the great majority of MC 306's, is provided by a shear section just outside the emergency valve seat. A shear section is a circumferential groove cut in the body of the valve to a depth equal to 20 percent of wall thickness.

The DOT 406 Specification refers to the shear section as a "sacrificial device". It must be located outside of the "self-closing internal stop valve" (commonly called the emergency valve) and break at a load no more than 70 percent of the load expected to fail the valve seat mechanism. It is not possible to inspect for this feature, but you can determine if there is a reasonable shear groove in the system.

Most MC 306/DOT 406 tanks have four compartments and have four individual lines (or one per compartment if more than four). The lines terminate near the center of the tank (usually) curbside. Piping originates at the emergency valve which is bolted to the tank sump. A 4" dia. line runs to a common point at curbside and terminates with the product valves. In most cases, the discharge valve is a combination bottom load and discharge valve. These come in a variety of types and are shown in Figure 7 (see graphics section). Some tanks may have manifolded lines accomplished by using a fabricated manifold or by manifolding the lines together with tees and crosses and cross valves (see Figures 7 (see graphics section). Specific piping configurations are not covered in DOT Specifications and varies as a result of industry practice by geographic location.

6.1.7 VALVES

Figure 8 (See graphics section) shows a variety of piping components used on MC 306/DOT 406 tanks.

Testing the integrity of valves and maintaining them is an important part of the continuing qualification of MC 306/DOT 406 cargo tanks. MC 306 cargo tank specification requires that a cargo tank compartment be equipped with a self closing shut off valve, protected with a shear section, and having its seat inside the tank or within the welded flange, commonly called an internal valve (emergency valve, or EV).

In addition to these requirements it must be equipped with three means of closure: Manual, remote and thermal. Thermal means the self-closing system is thermally activated and the thermal device (fusible) must be located as close as practicable to the primary loading/unloading connection and must actuate the system at a temperature not over 250 °F Figure 12 shows a typical mechanical emergency valve.

Internal self-closing stop valves (emergency valves) are also air operated. The remote closure is generally located at the drivers side front corner of the cargo tank and is either a cable device connected to the internal valve operator or is a valve capable of releasing the air in the operating system. These remote closures must be functioned and should be checked for operation on a regular basis. The heat actuated device(fusible link) can be located within the internal valve operator or individually at each valve The fusible device is more effective when it is located next to the internal valve and this location clearly meets the requirements (as close as practicable to the loading/unloading connection). Air operated systems have a fusible plug that, in the event of a fire, will melt causing a loss of air pressure to the actuator and the spring inside the internal valve will close the valve. Remember that the location of emergency remote closures must be clearly marked.

DOT 406 Specifications call for essentially the same as MC 306 but use different terminology, and they must be designed to self-close within 30 seconds of actuation. There is also a difference in how the regulators specify the shear section (which was covered above) in "piping". Both Specifications call for a secondary valve in addition to the internal valve (emergency valve). On gasoline tanks they are usually combined with an API bottom load adapter.

Other types include the cast "Y" valve where the bottom of the "Y" is an outlet and the top leg is the API B/L adapter. Figure 8 (see graphics section) shows a variety of valves commonly used. Materials used for seats, seals, discs and O-rings vary with application. Be sure to follow manufacturers recommendations for these materials with special consideration given to the type of service they experience.

Virtually all loading racks are standard on the 4 inch API adapters. When off-loading through an API fitting it is done by use of a combination API dust cap/ 4" hose adapter. See Figure 8 (see graphics section)

Dust caps should be attached by chains or cables, and should be available for all adapters for discharge valves. They prevent damage to exposed parts of adapters and valves, prevent leakage and are called for in API-1004, the standard for the bottom load adapter published by the American Petroleum Institute (API).

6.1.7.1 BRAKE INTERLOCK SYSTEMS:

Most gasoline tanks are equipped with brake interlock devices. Their purpose is to assure the tank brakes are set when loading or unloading, and to assure that the vehicle cannot be driven away from a loading rack with product hose, vapor recovery hose or overfill connectors still attached to the CTMV.

They affect the supply side of the airbrake system. They assure that the supply line is exhausted and blocked unless all tank fittings are secure and external fittings are removed. The trailer brake valve sets the brakes by the same system. It is standard procedure for the driver to set the trailer brakes when leaving the cab. The tank brake interlock systems prevent the tractor valve from releasing the brakes in the event that the loader fails to disconnect the rack connections.

Brake interlocks can consist of single or multiple valves on a variety of fittings. It is common for tanks to have an interference bar over all the fittings with just one brake interlock valve. Assuring that these systems are working properly is an important part of tank maintenance.

6.1.8 OVERFILL SENSORS:

Overfill sensors are electronic devices installed in the top of the tank or manhole cover that are designed to shut down the loading rack in case a compartment is over filled during bottom loading. There are several manufacturers and several different operating systems, but they all perform the same function. When the primary rack control system fails and allows the liquid to rise too high in the tank vessel, they have the ability to shut down the rack system.

Overfills occur for several reasons. One, the loader may miss-read the capacity of the compartment and set the primary meter control incorrectly; the compartment may have product retained from a previous load; or there may be a failure of some component.

So a cargo tank may accommodate three or four different loading rack systems, it is common for the tank to have three or four overfill receptacles mounted on a bracket or in the cabinet. The systems perform best with

good ground systems and the manufacturers of overfill systems provide devices that act as ground provers and determine polarity. Electrical connections need to be maintained.

Overfill systems may also be interlocked with other systems on the tank so that it will not allow loading if, for instance, the vapor recovery line is not connected to the tanks vapor system.

An overfill system is not required by either MC 306 or DOT 406 and there are no requirements for inspection of the system in part 180. Maintenance of the systems is important to the safe operation of the tank and tank inspectors and repairers should become familiar with the systems.

Establishing procedures for maintenance of these systems is beyond the scope of this manual and you are advised to obtain that information from the overfill system manufacturers. However, some common sense maintenance can be performed such as, noting if the probe is mounted securely in its mounting, that the wires secured, and connections tight.

Mechanics with knowledge of electrical systems and knowledgeable in the use of electrical test equipment will be able to perform maintenance and trouble shoot these systems using the manufacturer's instructions.

6.1.9 DATA PLATE ENTRIES

The MC 306 tank data plate (or metal certification plate as identified in 49 CFR), should contain the following information:

1. Vehicle Manufacturer
2. Manufacturer's Serial Number
3. MC Specification, including Material of Construction
4. Date of Manufacture
5. Original Test Date
6. Certification Date
7. Design Pressure (PSI)
8. Test Pressure (PSI)
9. Head Material
10. Shell Material
11. Weld Material
12. Lining Material
13. Nominal Tank Capacity by compartment (front or rear) (US gal)
14. Maximum Product Load (lbs)
15. Loading Limits (gpm. and/or psi)
16. Unloading limits (gpm. and/or psi)

DOT 406 Cargo tanks will have a nameplate containing this information:

1. DOT Specification Number
2. Original Test Date (month & year)
3. Tank MAWP (PSI.)
4. Tank Test Pressure (PSI.)
5. Tank Design Temperature Range (degrees F)
6. Nominal water capacity (gal)
7. Maximum Design Density of Lading (lb/Gal)
8. Shell Material Specification Number*
9. Head Material Specification Number*

*Note: When the shell and head materials are the same thickness, they may be combined, (Shell and head matl, yyy***).

10. Weld Material
11. Shell Minimum Thickness (in) (top, side, bottom)
12. Head Minimum Thickness (in)
13. Manufactured Shell Thickness (in) (top, side, bottom)**
14. Manufactured Head Thickness (in)**
15. Exposed Surface Area (sq. ft)

**NOTE: Required when additional thickness is provided for corrosion allowance.

DOT 406 Cargo tanks will also have a Specification plate containing this information:

1. Cargo Tank Motor Vehicle Manufacturer
2. Cargo Tank Motor Vehicle Certification Date.
3. Cargo Tank Manufacturer
4. Cargo Tank Date of Manufacture (month & year)
5. Max. Weight of Lading (maximum payload) (lb)
6. Max. Loading Rate (GPM.) at max. loading pressure (PSI)
7. Max. Unloading Rate (GPM.) at max. unloading pressure (PSI)
8. Lining Material (if applicable)
9. Heating System Design Pressure (PSI), if applicable
10. Heating System Design Temperature (degrees F), if applicable

6.2 INSPECTION AND TESTS

The following inspections and tests are required on MC 306/DOT 406 cargo tanks:

INSPECTION	FREQUENCY	REFERENCES (in 49 CFR) AND IN THIS MANUAL
External Visual Inspection	Annual	180.407 (d); Section 5.1
Internal Visual Inspection	5 years	180.407 (e); Section 5.2
If insulated	Annual	
If transporting lading corrosive to the tank	Annual	
Lining Inspections (Only lined tanks transporting lading corrosive to the tank)	Annual	180.407 (f); Section 5.6
Leakage Test	Annual	180.407 (h); Section 5.3
Pressure Retest	5 years	180.407 (g); Section 5.4.
If insulated and no manhole, or insulated & lined)	Annual	
Thickness Test (Unlined tanks in service corrosive to vessel)	2 years	180.407 (I); Section 5.5

Any tank with, or suspected to have, shell and head material thickness less than the prescribed minimum requirements, including scrapes or gouges, must receive a thickness measurement test at the time such discrepancy is discovered.

NOTE: Conditions may exist requiring test and inspection of cargo tanks, **irrespective** of the periodic requirements for tests and inspections. (See Section 180.407 (6) (b). Such will be required if:

1. The cargo tank shows evidence of dents, cuts, gouges, corroded or abraded areas or other condition that may make it unsafe,
2. The cargo tank has sustained damage to the extent it may effect its lading retention capability, and
3. The cargo tank has been out of hazardous material service for a year or more. Refer to Paragraph 180.407 (b), for more detail.
4. The Department so requires based on the existence of probable cause that the cargo tank is in an unsafe operating condition

6.2.1 EXTERNAL VISUAL INSPECTION

Follow the procedure in Section 5.1 to complete a thorough PM service on all tank systems. Use the checklist in this section to ensure attention to all details.

Coverage of the following items is a mandatory DOT Requirement:

1. Inspect tank shell and heads for corroded or abraded areas, dents, distortions, defects in welds, and other structural defects apparent through visual detection.
2. Inspect piping, valves and gaskets for corrosion, weld defects, and leakage.
3. Inspect that manhole covers are operative, with no leakage from covers or gaskets.
4. Inspect that all valves and emergency devices are functioning properly. Check that all manual and automatic safety components are present and functional. Check operation of internal valves, valve operators, remote operators, fusible elements, etc.
5. Inspect and replace (as necessary) all missing hardware. Tighten loose bolts and nuts.
6. Inspect all tank markings for legibility, faded, defaced, torn, displayed square point on point.
7. Perform safety of operation and corrosion damage inspection of fifth wheel assembly, suspension system attachments, and connecting structures. If the vehicle has transported lading corrosive to the tank, this will require removal of the upper coupler assembly at least once in a two year period. See 49 CFR 180.407(d)(2)(ix).
8. Remove and bench test all spring-loaded pressure relief devices if tank has transported lading corrosive to the tank. Otherwise, inspect for corrosion or damage while installed. Verify the proper display of markings on the pressure relief device.
9. Perform thickness test on corroded or abraded areas, if observed.
10. Each on-vehicle, manually-activated, remote shutoff device for closure of the internal self-closing stop valve, **must be identified by marking "EMERGENCY SHUTOFF"** in letters at least .75 inches in height in a color that contrasts with its background, and located in an area immediately adjacent to the means of closure. Refer to Paragraph 172.328 (d).
11. Record the results of the service in an inspection/test report.

Use the checklist/inspection report in Figure 6-1.0 to accomplish the service. Review 180.411 before completing the "Tank Disposition" entry.

6.2.2 INTERNAL VISUAL INSPECTION

WARNING! PRIOR TO ENTERING TANK BE SURE INTERIOR IS FREE OF FLAMMABLE VAPORS AND HAS SAFE LEVEL OF OXYGEN PRESENT. COMPLY WITH ALL COMPANY AND REGULATORY REQUIREMENTS FOR WORK IN CONFINED SPACES.

Review the procedure in Section 5.2 for this inspection, also the thickness testing procedure in Section 5.5. and, if appropriate, the lining inspection procedure in Section 5.6. Use the checklist in this section to ensure attention to all details.

The following items are mandatory DOT requirements:

1. Inspect all shell, head and baffle surfaces for cracks, corrosion, abrasion, dents, distortions, weld defects, or any unsafe condition.
2. If lined, inspect all interior surfaces for blisters or discoloration, then use appropriate spark tester for leak detection. Remove degraded or defective lining areas, then perform shell or head thickness tests in pertinent areas beneath liner.
3. Perform thickness test, if any corroded and abraded areas appear serious enough to cause concern. Record thickness readings as described in section 5.5 of Maintenance Procedures.
4. Inspect internal fittings, particularly tank emergency valves, stand pipes, internal vapor lines or miscellaneous fittings.
5. Pay particular attention to shell or shell structures over the fifth wheel and suspension areas.
6. Record the results of the service in an inspection/test report.

6.2.3 LEAKAGE TEST

Follow the procedure in Section 5.3 to obtain a thorough leak test on all tank system and components. Use the checklist in this section to ensure attention to all safety and procedural details.

Important Note: Cargo tanks transporting petroleum distillate fuels equipped with vapor recovery systems may use the EPA Method 27 test, a pneumatic leak test at very low pressures, in lieu of the test at 80% of MAWP. In most areas of the United States, the EPA Method 27 Test must be performed if the tank is to be used for the transportation of gasoline (or other petroleum distillate products). This is a loading rack requirement to verify the leak tightness of the cargo tank and the vapor recovery system. In such circumstances, DOT regulations allow the user to substitute the EPA Method 27 test for the DOT Leakage test. (See Section 6.2.3.1 and Checklist/ Inspection Report) The mandatory DOT leakage test requirements are summarized below:

1. Each cargo tank must be leakage tested each year.
2. All valves and accessories must be in place and operative.
3. Normal vents designed to open below test pressure may be removed and plugged.
4. Test pressure is not less than 80% of design pressure or MAWP, and hold time is five minutes.
5. Product piping must be tested.
6. EPA vapor tightness test is an acceptable alternative procedure. (When unit is transporting petroleum distillate fuels and equipped with vapor recovery)
7. Provide suitable personnel safeguards in event of a structure failure.
8. Record the results of the test in an inspection/test report.
9. Mark the tank with "K" (or "K-EPA 27" (if the Method 27 test is used)) and the appropriate date. Mark the tank with both a "K" and a "K-EPA 27" if both tests are performed.

Manhole covers, vents and internal valves have been identified as most probable source of leaks.

Section 5.3 contains test equipment and procedural information for performing a leakage test. This test can be performed either hydrostatically or pneumatically. Review Section 5.3, then make the choice as to whether a hydrostatic or pneumatic procedure will be used. In view of the low pressure required for this test, most shops will find the pneumatic test more efficient and effective at locating small leaks.

Follow the Checklist/test reports (Figures 60-3.0 and 60-4.0) for either test. Review 49 CFR 180.411 before performing test.

If hydrostatic procedure is used, remember that full load of water will weigh approximately 32 percent more than most petroleum products. Provide adequate support for this load under the fifth wheel upper plate assembly. Also, make sure all water is removed from the tank systems after test.

6.2.3.1 EPA METHOD 27 TEST LEAKAGE TEST ALTERNATIVE

If a cargo tank is equipped with at vapor collection system, Paragraph 180.407 (h) (2) allows the EPA Method 27 pressure vacuum test to be used in lieu of the hydrostatic or pneumatic leakage test. The citation for this test is 40 CFR, Part 60 Appendix A. (It is included in the NTTC Bulk HM Compliance Guide.) **The test must be performed using air pressure**

The advantage of using this method is that many cargo tanks have to have this vapor recovery test performed as part of State Environmental requirements and may be combined with Part 180 test obligations. Secondly, the pressures used are considerably below the 80% of MAWP used in the leakage test. Most MC 306 tanks will require 2.4 psi and DOT 406 tanks 2.64 psi for the leakage test pressure. EPA method 27 requires 18 inches of water column, about 0.65 psi. One pound per square inch (psi) is equal to 27" of water column.

Method 27 test pressures are stated in millimeters of water column. Most testers prefer to convert these values to inches of water.

The test consists of applying an initial pressure to the cargo tank's vapor system, letting it stabilize, then sealing off the pressure source and watching for a loss of pressure due to leaks. Likewise, the test is repeated with vacuum.

Currently for cargo tanks with a capacity of 2,500 gallons or more, the Method 27 test, in most states, requires an initial pressure of 18" of water column with a final reading of no less than 17" after 5 minutes and an initial vacuum of 6" of water column with a final reading no less than 5" after 5 minutes. Two consecutive tests must be performed with the results being with ½ of each other.

A simple water manometer can be constructed using 1/2" plastic tubing formed into a "U" and fastened to a board with a scale mounted between the legs of the "U", and is an accurate method of measuring pressure. Digital manometers are recommended.

The top of one leg is connected to the vapor system and the other leg left open to atmosphere. The amount of water pressure is determined by the difference in the height of the water column on each side of the "U".

To measure pressures of 18", you will need a "U" at least 24" high which will require about 50" of tubing. The "U" is filled about half full. Zero pressure is at the equal level point. 18" of water would be indicated when the water on the pressure side is 9" below center and the open end 9" above center.

California requires the same initial pressures but limits the drop in pressure to 1/2" in both the pressure and vacuum tests.

This test should be done after the external visual inspection. To ensure a successful test, the manhole assembly including manhole covers, fill covers vents, vent valves and vapor system valves caps and gaskets need to be in good condition.

Purging the tank of flammable vapors is recommended and the test should be performed where temperature changes can be kept to a minimum. If testing outside, the tank should be in the shade.

The test must be performed with the cargo tank's vapor recovery hose attached to the vapor system. The capped end of the vapor hose is a logical place to apply the positive and negative pressure.

The test is conducted with all the compartments' vapor valves open. This interconnects the entire volume of the tank into the vapor system. Conventional pressure and vacuum sources can be used but these sources should be well below the tank's test pressure and safe vacuum pressure.

When conducting the Method 27 test it is recommended that you also determine that the tank's vapor recovery vents are leak tight.

To perform this test apply pressure to the tank and once the pressure test successfully reaches 18 inches W/C close the internal valves. This will close the vapor recovery vents. Relieve the pressure on the vapor rail by disconnecting the manometer and pressure source. With the vapor recovery rail at atmosphere connect the manometer to the vapor connection and watch for a pressure rise in the vapor rail. The maximum allowable pressure rise in the vapor rail is 5 inches in 5 minutes. This test is performed one time.

Neither DOT nor EPA require testing the integrity across the vent valves, but it is recommended that you do so. One easy way to verify the leak tightness of the internal valve is as follows: With the cargo tank still pressurized and the internal valves closed, open the external load/unload valve, place a rubber glove over the "hog nose" connection and watch for the glove to expand. Glove expansion indicates the internal valve is leaking and repairs must be made. Use the checklist/inspection report in figure 60.VR to record the test. Local environmental agencies may also require their inspection report be completed.

6.2.4 PRESSURE RETEST

With few exceptions, an External Visual Inspection per Section 6.2.1 and an Internal Visual Inspection per Section 6.2.2 must be accomplished concurrent with the pressure retest. Refer to Section 5.4 for pressure retest procedures.

Test pressure for all MC 306-type tanks is 3 psi. or design pressure, whichever is greater. For DOT 406 tanks, test pressure will be 5 psi. or 1.5 x MAWP, whichever is greater. Hold time varies as to whether a hydrostatic or pneumatic procedure is used. Refer to the table in 180.407(g)(1)(iv) for the required test pressures.

All re-closing pressure relief devices must be removed, inspected, and tested or replaced as part of the pressure test. For the test, vapor vents with ratings less than test pressure can be blocked and left installed, or removed and openings flanged off. Operation of all vents must be restored after testing and before returning the tank to service.

If hydrostatic procedure is used, make sure that support is provided under the upper coupler area, adequate to support the weight of tank and ensure the dolly legs are at least 2 inches off the ground.

The Mandatory DOT requirement for hydrostatic is as follows:

1. Tank, including domes, must be filled with water.
2. Adjacent compartments must be empty and at atmospheric pressure.
3. Test liquid temperature: not over 100 degree F.
4. Test pressure is specified (Table 2, Section 5.4 herein)
5. Gauge pressure at top of tank.
6. Hold time: 10 minutes.
7. Inspect for leakage, bulging or other defects.
8. Record the results of the test in an inspection/test report

The mandatory DOT requirements for the pneumatic test is as follows:

1. Use air or similar gas.
2. Adjacent compartments must be at atmospheric pressure.
3. Pressure up to one-half of test pressure, then increase pressure in one-tenth increments until full test pressure is attained.
4. Hold for five minutes.
5. Reduce pressure to MAWP.
6. Maintain MAWP while tank surfaces are inspected for leaks.
7. Record results of test on an inspection/test report.

For either procedure, a tank cannot be returned to service if it: leaks; fails to retain test pressure; shows distortion or excessive permanent expansion or other structural defects; and, until all such defects are repaired or corrected.

Review the safety instructions and procedures in Section 5.4, then use the checklist/test reports (Figure 60-5.0 and 60-6.0) that follow for a hydrostatic test or a pneumatic test (3). Review S180.411 before completing the "Tank Disposition" entry on test reports.

6.2.5 THICKNESS TESTING

For MC 306 tanks, thickness testing will be required to measure metal thickness in areas considered to be corroded or abraded (or thinned for any reason), as discovered during External Visual Inspection (Section 6.2.1) or Internal Visual Inspection (Section 6.2.2). Measurements are made with an ultrasonic sensor, as discussed in Section 5.5.

If thickness testing is done because of mechanical damage, only the area of damage need be tested. A complete thickness test is only required for unlined cargo tanks transporting material corrosive to the tank. If general thinning is suspected, the recommended coverage of the cargo tank is as follows:

1. Areas of the shell and heads area around any piping that retains lading.
2. Areas of high shell stress, such as the bottom center of the tank.
3. Areas near openings.
4. Areas around weld joints.
5. Areas around shell reinforcements.
6. Areas around appurtenance attachments.
7. Areas near upper coupler assembly attachments.
8. Areas near suspension system attachments and connecting structures.
9. Known thin areas in the tank shell and nominal liquid level lines.

Figures 5 and 6 (Section 5.5) present blank form concepts for recording UT measurement data.

Review the instructions in Section 5.5, then use the checklist/test report in Figure 60-7.0 to conduct the testing, and determine if the cargo tank can be returned to Specification service. Normally aluminum MC 306 and DOT 406 CTMV's are not lined and they are not in corrosive service so it is not recommended that the tank be marked with a "T" to indicate a thickness test was performed. The thickness test was performed for your own verification not because of a DOT requirement.

SECTION 6: MC306/DOT 406

TEST & INSPECTION REPORT FORMS:

Included below are forms designed to help tank mechanics assure compliance with DOT requirements for each type of test or inspection, and in many cases include optional items we believe are important to good tank maintenance. For purchasers of this Manual, these forms may be reproduced.

MC 306/DOT 406 CHECKLIST/INSPECTION REPORT FOR EXTERNAL VISUAL INSPECTION (page 1 of 3)

CARRIER/OWNER _____ DATE_____

FLEET # _____ SERIAL/VIN # _____ C.T. MFG _____

DOT SPEC NO. _____ MATL. _____ DATE MFG._____

MAWP_____ psi. TEST PRESS. _____ psi MINIMUM THICKNESS SHELL_____ HEADS_____.

COMPARTMENT SIZES, F to R 1,_____ 2, _____ 3, _____ 4, _____ 5, _____ GAL.

TOTAL CAPACITY. _____ GAL, DBL. BULKHEADS? _____ INSULATED? _____ LINED?_____

TYPE SERVICE: CORROSIVE TO SHELL?_____ DEDICATED SERVICE?_____ PRODUCT(s)_____

DOT mandatory items indicated with "M" on checklist.

Item No.	Activity	Complies	Repairs Needed	See Remarks
1	Data plate: Attachment to tank, entries legible, no paint, corrosion			
2M	Shell and heads: Condition of welds, dents, gouges, corrosion or abrasion, possible need for thickness testing. Obvious structural defects in shell, frames, outriggers, X-Members or welds.			
3	Double head voids: If present, verify bottom vent open, no accumulated product in void.			
4M	Upper coupler assembly: Condition of plate, corrosion, deformation, lubrication, bolt tightness, king pin wear or deformation			
5	Landing gear: Corrosion or rust, condition of welds, frame distortion above gear, bolt tightness, support braces secure, gear operation.			
6	Placard holders: Attachment to tank, condition of clips and hinges.			
7M	Bolted attachments: Under carriage, landing gear structure, cabinets, ladders, fenders, rear bumper or other important attachments.			
8	Hose tubes, troughs, or racks: Condition of tube, end covers and latches,			
9M	Piping, valves and gaskets: Check security of hangers, bolted connections and gaskets, operation of valves, adapters and caps. Assure brake interlock bars are securely mounted and function as designed.			

MC 306/DOT 406 CHECKLIST/INSPECTION REPORT FORM
EXTERNAL VISUAL INSPECTION (page 2 of 3)

Item No.	Activity	Complies	Repairs Needed	See Remarks
10M	Internal, self, closing, stop valve operations: System must have three means of closure, normal, remote (or emergency trip) and fusible. Verify proper function of valve and trip. Check cable or air operating system: Cable, adjustment, condition and lubrication of cables and tubing system and presence of fusible devices, often located in E.V. operator. Air system, check function and leak integrity of air operating system including remote trip, presence of fusible device, function of any associated brake interlocks	_____	_____	_____
11	Overfill sensors: Leak and moisture integrity, installation tightness, condition of electrical connections.	_____	_____	_____
12	Ladders, vertical rails straight and structurally sound. Rungs, clear of obstructions and secure to verticals. Mounting to tank structure sound	_____	_____	_____
13	Walkways: level, well mounted and walking surface clean and slip resistant. note particularly condition of paint on non-slip coatings	_____	_____	_____
14	Vapor Recovery System: Condition of flexible components, integrity of connections, condition of vapor return line, adapter and dust cap.	_____	_____	_____
15	Static Grounding Connections: Present and tight, including condition and connection of internal grounding cables.	_____	_____	_____
16	Gauging Devices: Security of marker, rod, braces and supports.	_____	_____	_____
17M	Manhole Assemblies, Evidence of leakage, impact damage to cover or fill covers, condition of collar and fill cover gaskets and sealing surfaces, clamping ring and other attaching hardware	_____	_____	_____
18M	Pressure Relief Devices: Verify presence and condition of normal and emergency vent for each compartment, verify correct amount of vent capacity for size of vessel	_____	_____	_____
19	Caution and Safety Labels: Check condition and presence of all labels, replace as necessary.	_____	_____	_____
20	Supply "Emergency Shutoff" decal near internal valve remote closure device per Paragraph 172.328 (d) after October 3, 2004.	_____	_____	_____
21M	Tank Markings: Date (month & year) and service symbol (V) if cargo tank is qualified to return to service	_____	_____	_____
22	Rear bumper: check for damage and appearance to meet Specifications	_____	_____	_____

NOTE: If, in the unusual event, the cargo tank being inspected, is fabricated with a steel shell and steel external rings, thickness test the rings as instructed on following page.

MC 306/DOT 406 CHECKLIST/INSPECTION REPORT FORM
EXTERNAL VISUAL INSPECTION (page 3 of 3)

REMARKS (use additional sheets if necessary)

_____

_____

_____

_____

_____

Ring thickness test, when required: Measure ring thickness in four symmetrical positions around the circumference. If any reading varies from the average, by more then 10%, thickness test shell internally, in area, covered by the ring.

Meets minimum thickness?_____ Does not comply?_____[Refer To Part-180 407 (d)(4)]

Defects found and corrected:_____

_____

_____

_____

_____

Disposition of unit: Return to Service_____ Removed From Service_____

Inspector or CT Facility	Cargo Tank Owner or Representative
Name _____	Name _____
Address _____	Address _____
_____	_____
Signed _____	Signed _____
Date _____	Date _____
DOT CT # _____	DOT MC ID. # _____ (If appropriate)

IMPORTANT: Certification of the annual External Visual Inspection must be signed by both the Inspection Agency/CT. Facility, and the cargo tank owner, and must be retained in the owner's cargo tank file throughout his ownership and one year thereafter.

MC 306/DOT 406 CHECKLIST/INSPECTION REPORT FOR INTERNAL VISUAL INSPECTION (page I of 2)

CARRIER/OWNER _____ DATE_____

FLEET # _____ SERIAL/VIN # _____C.T. MFG _____

DOT SPEC NO. _____ MATL. _____DATE MFG._____

MAWP_____ psi. TEST PRESS. _____psi MINIMUM THICKNESS SHELL_____HEADS_____.

COMPARTMENT SIZES, F to R 1,_____ 2, _____ 3, _____ 4, _____ 5, _____ GAL.

TOTAL CAPACITY. _____GAL,. DBL. BULKHEADS? _____ INSULATED? _____LINED?_____

TYPE SERVICE: CORROSIVE TO SHELL?_____DEDICATED SERVICE?_____PRODUCT_____

DOT mandatory items indicated with "M" on checklist.

Item No.	Activity	Complies	Repairs Needed	See Remarks
	WARNING! PRIOR TO ENTERING TANK, BE SURE INTERIOR IS FREE OF FLAMMABLE VAPORS AND HAS SAFE LEVEL OF OXYGEN PRESENT. COMPLY WITH ALL COMPANY AND REGULATORY REQUIREMENTS FOR WORK IN CONFINED SPACES.			
1	Marker Rods: Inspect security of mounting brackets and that grounding cables are connected as originally installed.	_____	_____	_____
2M	Vessel: Inspect shell, baffles, bulkheads and any stiffening members for cracks, corrosion, abrasion, dents, pitting, or distortion. Note any overlay patches inside tank. Give special attention to areas around manholes, emergency valves, splash deflectors and areas above the upper coupler and suspension. Remove any foreign material found. See Section 5 of this Manual regarding "lap patches".	_____	_____	_____
3M	Welds: Check all visible welds in tank for cracks. Give special attention to bulkhead or baffle to shell welds and to welds in stress areas such as above upper coupler.	_____	_____	_____
4	Valves and fittings: Check internal workings of emergency valves and any vent links, or airlines which operate top vapor vents inspect general condition of valve and mounting gaskets, clean and secure valve screens and remove foreign materials in valves and sumps, inspect any fittings related to overfill sensors if present.	_____	_____	_____
5	Remove all equipment brought into tank, then inspect again before leaving tank.	_____	_____	_____
6M	Tank Markings: Date (month & year) and service symbol (I) if cargo tank is qualified to return to service.	_____	_____	_____

MC 306/DOT 406 CHECKLIST/INSPECTION REPORT FOR INTERNAL VISUAL INSPECTION (page 2 of 2)

REMARKS (use additional sheets if necessary)

_____

_____

_____

_____

Defects found and corrected._____

_____

_____

Disposition of unit: Return to Service_____ Removed From Service_____

Inspector or CT Facility	Cargo Tank Owner or Representative
Name _____	Name _____
Address _____	Address _____
_____	_____
Signed _____	Signed _____
Date _____	Date _____
DOT CT # _____	DOT MCID. # _____ (If appropriate)

MC 306/DOT 406 CHECKLIST/TEST REPORT FOR HYDROSTATIC LEAK TEST (page 1 of 2)

PRODUCT CARRIER/OWNER _____ DATE _____

FLEET # _____ SERIAL/VIN # _____ C.T. MFG _____

DOT SPEC NO. _____ MATL. _____ DATE MFG. _____

MAWP _____ psi. TEST PRESS. _____ psi MINIMUM THICKNESS SHELL _____ HEADS _____.

COMPARTMENT SIZES, F to R 1, _____ 2, _____ 3, _____ 4, _____ 5, _____ GAL.

TOTAL CAPACITY. _____ GAL,. DBL. BULKHEADS? _____ INSULATED? _____ LINED? _____

TYPE SERVICE: CORROSIVE TO SHELL? _____ DEDICATED SERVICE? _____ PRODUCT _____

DOT mandatory items indicated with "M" on checklist.

Item No.	Activity	Complies	Repairs Needed	See Remarks
	Each compartment must be tested with adjacent compartments empty and at atmospheric pressure.			
1M	Close external valves leave internal valves open, fill tank, or compartment and connected product lines being tested with the manhole cover open, check for obvious leaks before pressurizing tank.	_____	_____	_____
2M	Close fill cover and apply pressure at top of tank and adjust test pressure to 80% of MAWP, let pressure stabilize. Inspect for leaks and shell or head distortion. Take your time.	_____	_____	_____
3M	While tank is still pressurized, close internal valve, drain product line, or lines, and monitor for leakage past internal valve	_____	_____	_____
4M	Hold test pressure for 5 minutes for successful test.	_____	_____	_____
5	Restore operation of all vents and reinstall removed fittings.	_____	_____	_____
6M	Tank Markings: Date (month & year) and service symbol (k) if cargo tank is qualified for return to service	_____	_____	_____

FIGURE 60-3.0MC 306/DOT 406 CHECKLIST/TEST REPORT FOR HYDROSTATIC LEAK TEST (page 2 of 2)

REMARKS (use additional sheets if necessary)

_____

_____

_____

_____

Defects found and corrected._____

_____

_____

Disposition of unit: Return to Service_____ Removed From Service_____

Inspector or CT Facility	Cargo Tank Owner or Representative
Name _____	Name _____
Address _____	Address _____
_____	_____
Signed _____	Signed _____
Date _____	Date _____
DOT CT # _____	DOT MCID. # _____ (If appropriate)

MC 306/DOT 406 CHECKLIST/TEST REPORT FOR PNEUMATIC LEAK TEST (page 1 of 2)

CARRIER/OWNER _____ DATE _____

FLEET # _____ SERIAL/VIN # _____ C.T. MFG _____

DOT SPEC NO. _____ MATL. _____ DATE MFG. _____

MAWP _____ psi. TEST PRESS. _____ psi MINIMUM THICKNESS SHELL _____ HEADS _____.

COMPARTMENT SIZES, F to R 1, _____ 2, _____ 3, _____ 4, _____ 5, _____ GAL.

TOTAL CAPACITY. _____ GAL,. DBL. BULKHEADS? _____ INSULATED? _____ LINED? _____

TYPE SERVICE: CORROSIVE TO SHELL? _____ DEDICATED SERVICE? _____ PRODUCT _____

DOT mandatory items indicated with "M" on checklist.

Item No.	Activity	Complies	Repairs Needed	See Remarks
	Each compartment must be pressurized individually with adjacent compartments at atmospheric pressure.			
1M	Close manhole, open internal valve, and pressurize compartment to 80% of MAWP. (inducing pressure through compartment product line is a convenient method) let pressure stabilize. Check all fittings and valves with soap solution and note any leaks, correct as necessary.	_____	_____	_____
	Close air supply source and hold for 5 minutes without decay.	_____	_____	_____
	Close tank internal valve, open outlet valve to exhaust product line. Close outlet and monitor for pressure in line. A pressure build up indicates Leakage past internal valve.	_____	_____	_____
2M	Vapor Recovery System: all hoods and hose connections in place, open vapor valves and re-establish pressure in vessel and vapor system, to stated test pressure, Check for leaks at all vapor recovery fittings and connections, and correct as necessary.	_____	_____	_____
3M	Close vent valves, reduce vessel pressure to atmosphere and monitor vapor line for pressure decay.	_____	_____	_____
4M	Restore operation of all vents, remove red flags.	_____	_____	_____
5M	Tank Markings: Date (month & year) and service symbol (K) if cargo tank is qualified to return to service	_____	_____	_____

EDITORS NOTE: Tank mechanics may find many equally correct ways to accomplish the purpose of this test.

MC 306/DOT 406 CHECKLIST/TEST REPORT FOR PNEUMATIC LEAK TEST (page 2 of 2)

REMARKS (use additional sheets if necessary)

_____

_____

_____

_____

Defects found and corrected._____

_____

_____

Disposition of unit: Return to Service_____ Removed From Service_____

Inspector or CT Facility	Cargo Tank Owner or Representative
Name _____	Name _____
Address _____	Address _____
_____	_____
Signed _____	Signed _____
Date _____	Date _____
DOT CT # _____	DOT MCID. # _____ (If appropriate)

MC 306/DOT 406 CHECKLIST/TEST REPORT FOR EPA METHOD 27 TEST ALTERNATIVE LEAKAGE TEST

CARRIER/OWNER _____ DATE _____

FLEET # _____ SERIAL/VIN # _____ C.T. MFG _____

DOT SPEC NO. _____ MATL. _____ DATE MFG. _____

MAWP _____ psi. TEST PRESS. _____ psi MINIMUM THICKNESS SHELL _____ HEADS _____.

COMPARTMENT SIZES, F to R 1, _____ 2, _____ 3, _____ 4, _____ 5, _____ GAL.

TOTAL CAPACITY. _____ GAL,. DBL. BULKHEADS? _____ INSULATED? _____ LINED? _____

TYPE SERVICE: CORROSIVE TO SHELL? _____ DEDICATED SERVICE? _____ PRODUCT _____

a. PRESSURE TEST: Pressure tank to 18 inches of water. Allow manometer to stabilize.					
	1	2	3	4	5
d. MANOMETER READING AFTER 5 MINUTES (in inches of water)					
e. VACUUM TEST: Evacuate tank to 6 inches of water. Allow manometer to stabilize.					
f. INITIAL MANOMETER READING (in inches of water)					
g. MANOMETER READING AFTER 5 MINUTES (in inches of water)					

TANK DOES _____, DOES NOT _____, MEET THE STANDARD OF NO MORE THAN 3" OF WATER DROP.

Tank Markings: Date (month & year) and service symbol (K)* if cargo tank is qualified to return to service.
* After October 1, 2004 marking is (K-EPA27)

I certify that the tank unit listed on this application was tested on this date _____ in compliance with the test procedures as defined in Appendix A "Control of Volatile Organic Compound Leaks from Gasoline Tank Trucks and Vapor Collection Systems" (EPA-450/2-78-051, OAQPS 12-119. DECEMBER 1978), and the test data given above is true and accurate at the time of testing.

Test Conductor. _____ Date, _____ Owner or Representative, _____ Date, _____

DOT Reg. No. _____ DOT MCID #. _____

SECTION 6: MC306/DOT 406

MC 306/DOT 406 CHECKLIST/TEST REPORT FOR HYDROSTATIC PRESSURE TEST (page 1 of 2)

CARRIER/OWNER _____ DATE _____

FLEET # _____ SERIAL/VIN # _____ C.T. MFG _____

DOT SPEC NO. _____ MATL. _____ DATE MFG. _____

MAWP _____ psi. TEST PRESS. _____ psi MINIMUM THICKNESS SHELL _____ HEADS _____.

COMPARTMENT SIZES, F to R 1, _____ 2, _____ 3, _____ 4, _____ 5, _____ GAL.

TOTAL CAPACITY. _____ GAL,. DBL. BULKHEADS? _____ INSULATED? _____ LINED? _____

TYPE SERVICE: CORROSIVE TO SHELL? _____ DEDICATED SERVICE? _____ PRODUCT _____

DOT mandatory items indicated with "M" on checklist.

Item No.	Activity	Complies	Repairs Needed	See Remarks
	NOTE: This test must be performed in conjunction with an External and Internal Inspection. If unit is a cargo tank motor vehicle, its upper coupler plate must be removed. If compartmented each compartment must be tested with adjacent compartments empty			
	CAUTION: Be sure to level and support cargo tank in view of the heavy weight of water.			
1M	Remove, inspect, and bench test all re-closing emergency and normal vents, remove vapor recovery hoods and block or blank vapor vent valves,	_____	_____	_____
2M	With all discharge valves and fittings in place and closed, fill, tank to top of manhole collar with water or other medium. Check all surfaces as filling occurs.	_____	_____	_____
3M	Install test cover and pressurize tank or compartment to test pressure 3 or 5 psi. for MC-306: 5 psi for DOT-406. Inspect system for leaks, Give special attention to the shell and structures above removed upper coupler. Hold for 10 minutes. If unable to hold pressure take corrective action..	_____	_____	_____
	ACTUAL TEST PRESSURE APPLIED _____ psi,			
4M	Repressurize tank, and hold for 10 minutes, after all repairs.	_____	_____	_____
5M	Replace all removed manholes and vents. Record results of bench testing of vents below or on separate document	_____	_____	_____
6M	Upper Coupler Assembly Examined	In Place _____	Removed _____	
7M	Tank Markings: Date (month & year) and service symbol (V)(I)(P) if cargo tank qualifies for return to service.	_____	_____	_____

MC 306/DOT 406 CHECKLIST/TEST REPORT FOR HYDROSTATIC PRESSURE TEST (page 2 of 2)

REMARKS (use additional sheets if necessary)

_____

_____

_____

Emergency Vent Performance:_____

Type of device:

Compartment: 1_____, 2_____, 3_____, 4_____, 5_____, 6_____

Set to discharge pressure: 1,_____2,_____3,_____4,_____5,_____6_____

Pressure device opened: 1,_____2,_____3,_____4,_____5,_____6_____

Pressure at which device re-seated: 1,_____2,_____3,_____4,_____5,_____ 6_____

Disposition of the device (Mark X): reinstalled _____ , repaired, or replaced_____

Defects found and corrected._____

_____

_____

Disposition of unit: Return to Service_____ Removed From Service_____

Inspector or CT Facility	Cargo Tank Owner or Representative
Name _____	Name _____
Address _____	Address _____
_____	_____
Signed _____	Signed _____
Date _____	Date _____
DOT CT # _____	DOT MCID. # _____ (If appropriate)

MC 306/DOT 406 CHECKLIST/TEST REPORT FOR PNEUMATIC PRESSURE TEST (page 1 of 2)

CARRIER/OWNER _____ DATE _____

FLEET # _____ SERIAL/VIN # _____ C.T. MFG _____

DOT SPEC NO. _____ MATL. _____ DATE MFG. _____

MAWP _____ psi. TEST PRESS. _____ psi MINIMUM THICKNESS SHELL _____ HEADS _____.

COMPARTMENT SIZES, F to R 1, _____ 2, _____ 3, _____ 4, _____ 5, _____ GAL.

TOTAL CAPACITY. _____ GAL,. DBL. BULKHEADS? _____ INSULATED? _____ LINED? _____

TYPE SERVICE: CORROSIVE TO SHELL? _____ DEDICATED SERVICE? _____ PRODUCT _____

DOT mandatory items indicated with "M" on checklist.

NOTE: This test must be performed in conjunction with an External and Internal Inspection
If unit is a cargo tank motor vehicle, its upper coupler plate must be removed.
If compartmented, each compartment must be tested with adjacent compartments at atmosphere.

No.	Activity	Complies	Repairs Needed	See Remarks
1M	Remove, inspect and bench test all re-closing emergency and normal vents	_____	_____	_____
2M	Install test cover and pressurize tank or compartment with all bottom valves and fittings in place. 3 or 5 psi. for MC-306: 5 psi for DOT-406 Apply pressure gradually to ½ test pressure and observe for any problems. Then raise pressure to test pressure in 0.5 psi. increments. Hold pressure for five minutes and observe for leaks or other problems.	_____	_____	_____
	ACTUAL TEST PRESSURE APPLIED _____ psi.			
3M	Reduce pressure to the tanks MAWP, and inspect system for leaks with soap solution. Give special attention to the shell and structures above removed upper coupler.	_____	_____	_____
4M	Correct any leaks and retest at MAWP. Hold pressure for five minutes.			
5M	Replace all removed manholes and vents. Record results of bench testing of vents below or on separate document.	_____	_____	_____
6M	Upper Coupler Assembly Examined	In Place _____	Removed _____	
7M	Tank Markings: Date (month & year) and service symbol (V)(I)(P) if cargo tank qualifies for return to service.	_____	_____	_____

MC 306/DOT 406 CHECKLIST/TEST REPORT FOR PNEUMATIC PRESSURE TEST (page 2 of 2)

REMARKS (use additional sheets if necessary)

_____

_____

_____

Emergency Vent Performance_____

Type of device:

Compartment: 1_____, 2_____, 3_____, 4 _____,5_____,6 _____

Set to discharge pressure: 1,_____2,_____3,_____4,_____5,_____6_____

Pressure device opened: _1,_____2,_____3,_____4,_____5,_____6_____

Pressure at which device re-seated: 1____2,_____3,_____4,_____5,_____ 6_____

Disposition of the device (Mark X): reinstalled _____ , repaired, or replaced_____

Defects found and corrected._____

_____

_____

Disposition of unit: Return to Service_____ Removed From Service_____

Inspector or CT Facility

Name _____

Address _____

_____

Signed _____

Date _____

DOT CT # _____

Cargo Tank Owner or Representative

Name _____

Address _____

_____

Signed _____

Date _____

DOT MCID. # _____
(If appropriate)

MC 306/DOT 406 CHECKLIST/TEST REPORT FOR THICKNESS TEST (page 1 of 2)

FLEET # _____ SERIAL/VIN # _____ C.T. MFG _____

DOT SPEC NO. _____ MATL. _____ DATE MFG. _____

MAWP _____ psi. TEST PRESS. _____ psi MINIMUM THICKNESS SHELL _____ HEADS _____.

COMPARTMENT SIZES, F to R 1, _____ 2, _____ 3, _____ 4, _____ 5, _____ GAL.

TOTAL CAPACITY. _____ GAL,. DBL. BULKHEADS? _____ INSULATED? _____ LINED? _____

TYPE SERVICE: CORROSIVE TO SHELL? _____ DEDICATED SERVICE? _____ PRODUCT _____

DOT mandatory items indicated with "M" on checklist.

NOTE: Thickness testing is only required on 306/406 tanks if inspection of thinning is evident. The preferred method of thickness testing is by use of an Ultrasonic Thickness Tester

Item No.	Activity	Complies	Repairs Needed	See Remarks
1	Identify areas of shell or heads suspected to be thinned by mechanical damage or corrosion and record locations on next page or on separate diagram attached to this report.			
2	Clean and buff affected areas prior to measuring.			
3M	Calibrate Thickness Tester using a test specimen that matches the tank, material and thickness.			
4M	Take measurements within suspected thinned area, being sure to identify the margins of the thinned area and record on diagram. **Readings, less than those shown in Table II, Part-180.407 (i) for the minimum shell thickness entry, listed above, must be remedied, or the cargo tank removed from Hazardous Material Service.**			
5M	If thinning has occurred due to corrosion by product, perform full Thickness test per MC-307/DOT-407 "Thickness Test" as described in figure 70-7 of this manual.			
6M	Tank Markings: NONE ! Record testing and repair in cargo tank file, if tank is qualified to return to service.			

MC 306/DOT 406 CHECKLIST/TEST REPORT FOR THICKNESS TEST (page 2 of 2)

REMARKS (use additional sheets if necessary)

Describe area tested, or attach diagram _____

_____

_____

_____

Defects found and corrected. _____

_____

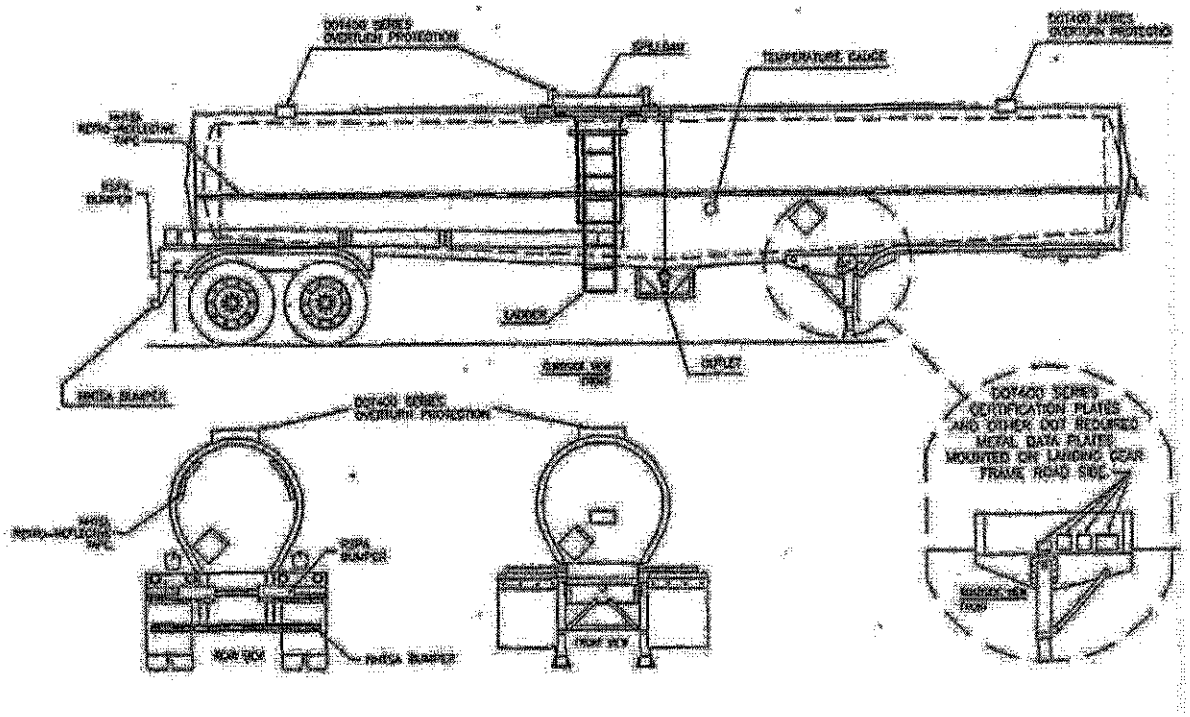
_____

Disposition of unit: Return to Service _____ Removed From Service _____

Inspector or CT Facility	Cargo Tank Owner or Representative
Name _____	Name _____
Address _____	Address _____
_____	_____
Signed _____	Signed _____
Date _____	Date _____
DOT CT # _____	DOT MCID # _____ (If appropriate)

SECTION 7: MC307/DOT 407

SECTION 7 MC 307 DOT 407 CARGO TANKS



7.0: MC 307/DOT 407 CARGO TANKS

Editors Note: Users of the manual should be aware that current editions of Title 49, Code of Federal Regulations do not contain copies of the MC "300 series" cargo tank specifications (except MC 331). Copies of these specifications are included in NTTC's "Cargo Tank Hazardous Materials Regulations", published annually. See the cover page of this publication for how to contact NTTC in order to purchase this publication.

Regulatory References: (From 49 CFR)
MC 307 — 178.340 & 178.342
DOT 407 — 178.345 & 178.347

This family of tanks is the primary type used to carry chemicals. The tank is authorized to carry a wide variety of hazardous chemicals, both flammable and some corrosives, and is widely used for non-hazardous chemicals like plastic resins, chlorinated solvents, fatty acids and many others. They have a minimum design pressure or MAWP of 25 psi. and minimum test pressure of 40 psi.

This tank family had its origin back in the early 1950's. Tank truck carriers were transporting casing head gasoline direct from the well site to the refinery. These gasolines had very high vapor pressures, above 3 psi. and could not be contained in MC 303 or MC 302 cargo tanks. Industry and the Bureau of Motor Carrier Safety of the ICC, created this intermediate pressure tank and gave it the designation of MC 304. The specification had a minimum design pressure of 25 psi. and a test pressure of 40 psi. Early MC 304 cargo tanks were round steel or aluminum, internally stiffened or baffled units.

The fact that this intermediate pressure tank did not have to meet all the requirements of an ASME vessel had many advantages. Most important was that bulkheads could be inserted within the shell and did not have to be butt welded to the shell. This feature made multi-compartment tanks structurally more reliable. This family of tanks has had an enviable safety record for over 40 years as structurally sound and pressure reliable.

SECTION 7: MC307/DOT 407

The transportation of chemicals in cargo tank motor vehicles grew at a rapid rate in the late fifty's and early sixty's, and chemical haulers recognized the MC 304 specification as a very useful tank for chemicals. The pressure capability, seldom needed by the lading, was utilized to unload the tank saving the cost of a pump plus the cleaning of the pump. This is still an economic advantage of this model today.

Today, most MC 307/DOT 407 cargo tanks are constructed of stainless steel, either type 316 or type 304 alloys. Many are insulated. They can be constructed of aluminum and steel. Most aluminum cargo tanks are non-insulated. The typical crude oil cargo tank is a non insulated, aluminum, double tapered, MC307 or DOT-407 cargo tank.

There are important differences in the re-certification rules for the two different specifications (DOT 407 and MC 307) primarily involving shell thickness determination and data required to be stamped on the cargo tank's certification plate. These are covered as we get into test procedures.

7.1.1 IMPORTANT DESIGN CHARACTERISTICS

It is not practical to provide detailed information on all the design details of these complicated tank trailers. The information included herein will give the user general information of the cargo tanks' important features.

7.1.2 DESIGN PRESSURE, MAWP AND ASME CERTIFICATION

The minimum design pressure for a MC 307 is 25 psi. and the minimum MAWP for DOT 407 is 25 psi. Design pressure and MAWP are used interchangeably in the DOT regulations. The term MAWP, (Maximum Allowable Working Pressure), is the more modern term, is used in the ASME Code, and is preferred.

DOT 407 cargo tanks can be rated to 35 psi., and MC 307 cargo tanks can be rated to 50 psi. without the "U" stamp designation. If either is rated above that pressure the cargo tank motor vehicle or any cargo tank motor vehicle built to the DOT 407 specification designed to be loaded by vacuum must be constructed and certified in accordance with Section VIII of the ASME Code.

Minimum test pressure for both specifications is 40 psi. or 1 ½ times MAWP, whichever is greater.

7.1.3 MANHOLE COVERS

Although the specification calls for a minimum diameter of 15", most cargo tanks of these models have a 20" diameter six lug, full opening cover, with the sealing gasket in the cover. See Figure 7.1 at end of this section.

DOT 407, MC 307 aluminum crude oil cargo tanks use either a cam actuated aluminum cover, similar to those used on dry bulk tanks, or a 16" or 20" diameter bolted plate with an 8" fill cover having one strong back and single hold down (see Figure 9 of graphics section).

Aluminum 407/307 cargo tanks often use an aluminum collar with a stainless cover like used on stainless tanks.

Checking manhole fittings like swing bolts, hinges, hold down ears and gaskets is an important part of any inspection procedure.

7.1.4 VENTING

The venting requirements for DOT 407 and MC 307 are different. The total amount of venting for both specifications, however, is the same and is based on the exposed area of the shell and head material and is determined from tables printed in the specification (see Figure 10 of graphics section).

Reference Paragraph 178.342 (b) (Table 3) and Paragraph 178.345 (d) (Table 1). The table gives SCFH (Standard Cubic Feet per Hour) values for differing vessel surface areas.

This large amount of venting is required based on the theoretical case of the cargo tank being totally engulfed in a fire. Under these conditions a large volume of venting is required to keep the cargo tank from rupturing by

pressure from boiling liquid. The values are based on Federly's formulas derived years ago and used by fire safety organizations for many years.

When inspecting a DOT 407/MC 307 cargo tank it is necessary to determine if the correct amount of venting is provided by the vents currently installed. Vents used on specification cargo tanks must be rated and stamped to show their capacity.

You will have to estimate the exposed shell area on MC 307 cargo tanks or, if possible obtain it from the original manufacturer. To make an estimate of the exposed area on a round MC 307 cargo tank, measure the inside diameter of the shell in inches, and determine the length of the cargo tank shell or compartment in inches. Determine the shell area using the following formula:

$$A\ shell = \frac{Dia" \times 3.14 \times Length"}{144} = Shell\ Area\ in\ Sq.\ Ft.$$

To the shell area, add the area for both heads on a single compartment cargo tank and only one head of a compartment in a multi-compartment cargo tank. You can calculate head area in a round cargo tank by the formula below, but typically MC 307 cargo tanks have a head area of about 20 Sq. Ft.

$$A\ head = \frac{Dia" \times Dia" \times .7854}{144} = Head\ Area\ in\ Sq.\ Ft.$$

Venting of MC 307 cargo tanks allows two types of vents to make up the total venting capacity specified in the regulation. Mechanical or spring loaded vents for "normal venting" and either spring loaded, fusible or frangible vents for "emergency venting".

A fusible vent is one that the cover is held in place by low temperature solder and, in a fire situation, melts out leaving an opening. A frangible vent is one designed where the cover or closure device ruptures or splits at a pre-determined pressure. If activated accidentally, they obviously have to be replaced unlike a spring activated vent which will reclose if the pressure is reduced. DOT has prohibited the use of non-reclosing vents in 400 series tanks, except when they are placed in series with a reclosing vent. They are still allowed in 300 series tanks.

Normal venting is required because of temperature changes, closed loading etc. These vents are the self-closing type. MC 307 tanks commonly use fusible vents to provide the emergency venting portion of the total CFH required. A three inch fusible vent will have a typical flow capacity of 275,000 CFH at 130% of the design pressure (25 x 1.3=32.5). The vent will be marked venting capacity and the pressure at which they are flow rated.

As an example, a typical 6000 gallon to 7000 gallon MC 307 will have a shell and head area of 700 to 750 square feet. The table in MC 307 shows that total venting of from 363,000 CFH to 378,200 CFH is required.

Mechanical vent capacity required (reference Paragraph 178.342-4 (c)), is 12,000 cubic feet for each 350 square feet of exposed tank area, so in this case at least 24,000 SCFH is required.

A typical MC 307 pressure vent for a cargo tank with a MAWP of 25 has a capacity of 26,700 CFH at 32.5 psi., which is enough capacity to satisfy the mechanical, or normal venting requirement for either tank. This leaves (378,200 - 26,700) or 351,500 CFH of emergency venting required. It would require two three inch fusibles to meet the total requirement. (See Figure 11 (graphics section) for typical DOT 407/MC307 vents.).

DOT 407 VENTING

As noted, the total venting capacity for DOT 407 is the same as MC 307 tanks. DOT 407 tanks, however, will have the exposed shell and head area stamped on their certification plate. You can determine the total amount of vent capacity required using the table in the specification or as shown in Figure 10 (see graphics section).

The DOT 407 specification does not allow "non-reclosing" pressure relief devices. That means that all of the venting must come from spring activated vents.

These vents have to have a set pressure (the pressure at which they start to open) of at least 120% of MAWP and a maximum set pressure of 132% of MAWP. These values on a 25 psi. MAWP tank would be a minimum of 30 psi. and a maximum of 33 psi. The vents must reclose at 108% of MAWP or 27 psi.

The specification requires 12,000 SCFH of Primary Vent Capacity, for each 350 square feet of shell and head area like MC 307, and allows for a secondary system for the balance of capacity required. However, since the secondary system has to be self closing the industry has determined that the most practical way to do this is with one large spring loaded vent for the primary and secondary pressure relief systems. As a result most DOT 407 tanks have 4" vents which are heavier and more costly.

Remember, our typical MC 307/DOT 407 tank had to have a total of 378,200 CFH. The 4" vent has only 354,800 CFH at 40 psi., but it has 388,000 CFH at 45 psi. Manufacturers of DOT 407 cargo tanks have raised the "test pressure" for a 25 MAWP cargo tank to 45 in order to meet the venting capacity requirements of the specification. Be sure you check the data plate for the actual test pressure used when determining if the correct amount of venting is installed.

7.1.5 VALVES AND PIPING

As we have discussed, there are two quite different designs of DOT 407/MC 307 cargo tanks. The chemical tanks and the crude oil tanks. The largest number of cargo tanks in the chemical tank fleet are the round or double tapered stainless steel insulated tanks. Most are single compartment and have just one outlet.

Piping starts with the sump welded into the cargo tank bottom or mitered into the rear head. All piping must withstand 100 psi. or four times the tanks MAWP and typical 3" and 4" stainless steel or aluminum pipe, flanges and valves meet that easily. The piping need only be tested to the tank's leakage test pressure when doing re-certification tests.

DOT 407/MC 307 cargo tanks must have what the industry calls an "Emergency Valve"(internal self closing stop valve) fastened to sump, or alternatively, an external stop-valve located as close as practicable to the cargo tank. DOT 407 cargo tanks have different terminology for an emergency valve. It is referred to as an "internal self closing stop valve" (49 CFR 178.345-11).

Most internal valves (emergency valves) have internal seats, are spring loaded, the normal position is closed, and have a shear section near the valve mounting flange that will cause the valve to fail at this point if impacted during an accident.

A shear section is a machined groove which must abruptly reduce the wall thickness by 20% for MC 307, and (on DOT 407 tanks) assure that the groove will fail at 70% of strength of the device it is protecting. This is impossible for an inspector to evaluate (without destructive testing), so just look for a shear section on the valve. If it is present, it can be considered appropriate.

Not all chemical tank internal valves (emergency valves) have shear sections. This is allowed in MC 307 tanks if you protect the valve from accidents with a piping guard which will withstand 8000 lbs of horizontal force in any direction. Many MC 307 cargo tanks have this guard arrangement. Be sure to inspect for the guard on double conical or multi-compartment tanks where the valves are in the middle of the tank. Inspection should include confirmation that the piping protection is structurally sound, there are no cracks, dents or deformations and that the methods and means of attachment of the piping guard to the cargo tank are sound and the bracing adequate. If the valve is at the rear over the suspension, it is adequately guarded.

DOT 407 cargo tanks however, must have a guard capable of withstanding 155,000 lbs. from any direction if their emergency valve does not have a shear section. A valve within the suspension frame probably meets the requirement.

There are some valve configurations (See Figure 12 in graphics section), wherein the entire valve is inside the tank and it is used with an external elbow with a shear section. This is a common setup of DOT 407 chemical cargo tanks.

In addition to the internal valve (emergency valve), a second external valve (or means of closure) is required. In some cases it will be directly bolted to the emergency valve; while, in other cases, there will be 3" or 4" stainless steel or aluminum line running between the two valves. Figure 13 (see graphics section) shows some typical valves used as outlet valves and internal valves (emergency valves) on chemical tanks. Aluminum crude oil

tanks frequently have piping very similar to MC 306 gasoline cargo tanks and may have vapor recovery systems. Refer to the MC 306/DOT 406 section for typical valves used on crude oil cargo tanks.

Valves, bolted flanges, gaskets, seals, seats and other piping components require careful inspection when re-certifying tanks. Visual inspection of the piping components and leak testing using good shop practice will assure good performance.

7.1.6 ACCIDENT DAMAGE PROTECTION

Like all Specification Hazardous Materials cargo tanks, these models have overturn protection devices and rear end protection devices (rear bumpers). Please reference 49 CFR 178.340-8 and 178.345-8 for additional information. It will not be practical for a tank re-certifier to perform the calculations done by the cargo tank manufacturer. You should make an inspection of these components and assure yourself that they appear structurally sound and the bumper is at least 6 inches aft of the rearmost portion of any vehicle component used for loading or unloading or that may contain lading while the vehicle is in transit.. This measurement should be taken from the innermost surface of the bumper. For a split bumper this measurement can be taken from outboard surface of the bumper.

7.1.7 THICKNESS TESTING DOT 407/MC 307 TANKS

If an unlined DOT 407/MC307 cargo tank has been carrying lading corrosive to the tank thickness, testing is required.

IMPORTANT: Merely handling some materials that are classed as or placarded as corrosive may not trigger thickness testing. Only if those corrosives erode the shell material is there a need to thickness test. Many corrosives will burn flesh, but will not corrode stainless steel. If it is necessary to thickness test an MC 307 or DOT 407 tank, it is important to know the original thickness, the minimum thickness and you should determine any corrosion allowance from this information. Check with the original specification and/or the tank manufacturer.

7.1.8 MINIMUM SHELL & HEAD THICKNESS:

Part-180 requires that the minimum shell and head thickness be recorded as part of any Test or Inspection report when performing a thickness test. There is space for this entry on all Test and Inspection report forms included in this manual.

Knowledge of the original shell and head thickness will also be required when performing Thickness tests. Determining the original minimum thickness is not always easy. The instructions for each Specification, 307/407, follows.

DOT 407 certification plates will show the minimum shell and head thickness needed to meet the structural integrity requirements of the specification. The MC 307 Specification did not require the "Minimum Shell and Head Thickness" to be stamped on the certification plate. The tables and formulas allow thinner materials with which many MC-307 tanks are actually constructed. The manufacturer may have used the extra shell thickness to meet the structural requirements called for in the Specification. Stamped thicknesses are subject to the tolerance shown in Table I of Part-180.

If no shell or head thickness is indicated, the thickness of MC 307 tanks is determined first by formulas for shell and head thickness (reference Paragraph 178.342-2). A second requirement for thickness is shown in Tables I & II (reference 49 CFR 178.342-2). These usually establish the allowable thickness.

The tables require you to know the cross sectional area of the head in "gallons per inch" (GPI). The concept of gallons per inch is commonly used by tank designers. It is determined by how many gallons are carried by one inch of length of the shell. It is easy to calculate for a round tank.

There are 231 cubic inches in one gallon, so if you know the area of the circle made by the diameter of the cargo tank, a section of tank one inch long would have the same number of cubic inches as the area. Just divide that number by 231 and you have the volume per inch in gallons, for instance, for a 65" diameter tank, it would be calculated as follows:

$$GPI = \frac{65 \times 65 \times 0.7854}{231} = 14.365 \text{ GPI.}$$

Table I of the MC 307 Specification for "head thickness" has a category for heads from 14 to 18 GPI. You will note that a 13 gauge stainless head, or 0.151" aluminum head is required. However, heavier is authorized.

Table II for "shell thickness" has two qualifiers in the table, GPI and the "distance between (not center to center) bulkheads, baffles or ring stiffeners". Typical MC 307 cargo tanks have rings spaced between 36" and 54". Measure if in doubt. Again you see that for a tank having a GPI of from 14 to 18 and with rings no more than 54", a 14 gauge stainless steel shell is OK.

As previously noted, minimum shell and head thickness has to be shown on any Test or Inspection report. Enter either the stamped thickness for a DOT 407 cargo tank or that determined from the table for an MC 307 cargo tank

49CFR 180.407 (i) (Table I) titled "Minimum Thickness for MC 300 (etc.)", provides the minimum acceptable decimal thickness for the listed gauges. As an example 10 gauge has a nominal thickness of 0.1345", material as thin as 0.121" still qualifies as 10 gauge.

Table II also shows the minimum acceptable decimal thickness of aluminum sheets. It is common for aluminum to be purchased as a decimal (as a nominal thickness) and the mill has some tolerance above and below that thickness when actually making the material.

If you obtain a reading, when thickness testing which is below the nominal thickness but at or above the minimum allowed in Table I in Part-180 the tank is in compliance. It is common practice, however, to build MC 307 tanks of materials several gauges above the minimum, so you may find thickness well above the minimum allowed.

7.1.9 CERTIFICATION OR NAME PLATES

The information provided on a cargo tanks' certification, or name plate, is key to any inspection of the cargo tank. The information on the MC 307 and DOT 407 plates are different and are listed below as they are spelled out in the specifications.

When starting an inspection, start with taking down the information off the plate, then take a little time to plan your inspection using that data. It will be obvious how to use this information when using the test instructions and reporting forms which are part of this manual.

MC 307 CERTIFICATION PLATE, REF. 49 CFR 178.340-10

VEHICLE MANUFACTURER _____
VIN _____
SPECIFICATION IDENTIFICATION _____
DATE OF MANUFACTURE _____
ORIGINAL TEST DATE _____
CERTIFICATE DATE _____
DESIGN PRESSURE _____ PSI.
TEST PRESSURE _____ PSI.
HEAD MATERIAL _____
SHELL MATERIAL _____
WELD MATERIAL _____
LINING MATERIAL _____
NOMINAL TANK CAPACITY BY COMPARTMENT (front or rear)
MAXIMUM PRODUCT LOAD _____LBS.
LOADING LIMITS _____GPM AND/OR PSI.
UNLOADING LIMITS _____ GPM AND/OR PSI.

DOT 407 PLATES:

The markings on a DOT 407 tank are more complicated than MC 307 tanks. There is a "Name Plate" which goes on the Cargo Tank, and there is a "Specification Plate" that is required on the "Cargo Tank Motor Vehicle". Finally both plates may be combined (and probably will be) on most typical DOT 407 tank semi-trailers.

NAME PLATE DATA:

DOT SPECIFICATION NUMBER _____
ORIGINAL TEST DATE _____
TANK MAWP _____ PSI.
TANK TEST PRESSURE _____PSI.
TANK DESIGN TEMP. _____ DEGREES F.
NOMINAL CAPACITY _____ GAL.
MAXIMUM LADING DENSITY, _____ LB/GAL.
SHELL MATERIAL SPEC. NUMBER _____
HEAD MATERIAL SPEC. NUMBER _____
WELD MATERIAL _____
MINIMUM THICKNESS, SHELL IN INCHES _____
MINIMUM THICKNESS, HEADS IN INCHES _____
MANUFACTURED THICKNESS, SHELL IN INCHES*_____
MANUFACTURED THICKNESS, HEADS IN INCHES*_____
EXPOSED SURFACE AREA _____ SQ. FT.

*** Required when additional thickness is provided for corrosion allowance**

SECTION 7: MC307/DOT 407

SPECIFICATION PLATE DATA:

CARGO TANK MOTOR VEHICLE MANUFACTURER _____
CERTIFICATION DATE _____
CARGO TANK MANUFACTURER _____
CARGO TANK DATE OF MFG. _____
MAXIMUM LADING WEIGHT _____ LBS.
MAXIMUM LOADING RATE _____ GPM OR PSI.
MAXIMUM UNLOADING RATE _____ GPM OR PSI.
LINING MATERIAL _____
HEATING SYSTEM DESIGN PRESSURE _____ PSI.
HEATING SYSTEM DESIGN TEMPERATURE _____ F.

7.2 INSPECTIONS AND TESTS

The following inspections and tests are required on MC 307/DOT 407 Cargo Tanks:

INSPECTION	FREQUENCY	REFERENCES (in 49 CFR) AND IN THIS MANUAL
External Visual Inspection	Annual	180.407 (d); Section 5.1
Internal Visual Inspection	5 years	180.407 (e); Section 5.2
If insulated	Annual	
If transporting lading corrosive to the tank	Annual	
Lining Inspections (Only lined tanks transporting lading corrosive to the tank)	Annual	180.407 (f); Section 5.6
Leakage Test	Annual	180.407 (h); Section 5.3
Pressure Retest	5 years	180.407 (g); Section 5.4.
If insulated and no manhole, or insulated & lined)	Annual	
Thickness Test (Unlined cargo tanks	2 years	180.407 (I); Section 5.5
Transporting material corrosive to the tank)		

Any tank with (or suspected to have) shell and head material thickness less than the prescribed minimum requirements, including scrapes or gouges, must receive a thickness measurement test at the time such discrepancy is discovered.

Copies of the checklist/reports needed to accomplish the MC 307/DOT 407 services are enclosed with this manual. Follow the instructions for each inspection or test.

NOTE: Conditions may exist requiring test and inspection of cargo tanks, **irrespective** of the periodic requirements for tests and inspections. Such will be required if:

1. The cargo tank shows evidence of dents, cuts, gouges, corroded or abraded areas or other condition that may make it unsafe,
2. The cargo tank has sustained damage to the extent it may effect its lading retention capability, and
3. The cargo tank has been out of hazardous material service for a year or more. Refer to Paragraph 180.407 (b), for more detail.
4. The Department so requires based on the existence of probable cause that the cargo tank is in an unsafe operating condition

7.2.1 EXTERNAL VISUAL INSPECTION

The procedure in Section 5.1 describes a complete PM service on all tank systems. Use the checklist in this section to insure attention to all details. DOT does not require inspection of all tank trailer systems, but it probably makes good sense to perform the complete check while performing the mandatory DOT requirements. Mandatory items are listed below.

1. If cargo tank is insulated, an internal inspection must be performed.
2. Inspect the outside of the tank shell and heads for corroded or abraded areas, dents, distortions, cracks, defects in welds, and other apparent structural defects.
3. If cargo tank is constructed of steel with steel reinforcing rings, the rings must be thickness tested in four symmetrical positions around the circumference. If any reading varies from the average by more than 10%, thickness test shell internally, in the area covered by the ring (refer to Part-180.407(d) (4)).
4. Inspect piping, valves and gaskets for corrosion, weld defects and leakage.
5. Inspect that manhole covers are operative, with no leakage from covers or gaskets.
6. Inspect that all valves and emergency devices are functioning properly and free of any deterioration. Assure that all manual and automatic safety components are present and functional. This inspection must assure proper operation and three means of closure of internal valves, normal, remote and fusible. Verify the remote closure closes the internal valve.
7. Inspect and replace (as necessary) all missing hardware and fusibles. Tighten loose bolts and nuts.
8. Inspect all tank markings for compliance and legibility. Replace faded, defaced, torn or not displayed square point on point placards or markings.
9. Inspect major appurtenances and structural attachments like suspensions and landing gears. Visible parts of the upper coupler assembly that can be inspected without disassembly must be inspected for corrosion, loose bolts or other defects. Perform safety of operation and corrosion damage inspection of fifth wheel assembly, suspension system attachments, and connecting structures. If the vehicle has transported lading corrosive to the tank, this will require removal of the upper coupler assembly at least once in a two year period for non-insulated cargo tank motor vehicles. See 49 CFR 180.407(d)(2)(ix). Check any other components critical to the cargo tank's safe operation.
10. Externally inspect any reclosing relief valves for corrosion or other damage which may affect their operation. Remove and bench test all spring-loaded pressure relief devices **if the tank was transporting lading corrosive to the** valve. Otherwise, inspect for corrosion or damage and verify markings on the valve while installed.
11. Record the results of the service on an inspection/test report.
12. Each on-vehicle, manually-activated, remote shutoff device for closure of the internal self-closing stop valve, must be identified by marking "EMERGENCY SHUTOFF" in letters at least 0.75 inches in height, in a color that contrasts with its background, and located in an area immediately adjacent to the means of closure. Refer to Paragraph 172.328(d).
13. Add Part-180 Marking: Date: month/year followed by (V) if cargo tank qualifies for continuing service.

7.2.2 INTERNAL VISUAL INSPECTION

WARNING! PRIOR TO ENTRY, TEST INTERIOR AIR SPACE FOR FLAMMABLE VAPORS AND ADEQUATE OXYGEN LEVELS, AND COMPLY WITH ALL OSHA REGULATIONS.

Review the procedure in Section 5.2 for this inspection, also see the thickness testing procedure in Section 5.5.

SECTION 7: MC307/DOT 407

The following items are mandatory DOT requirements.

1. Perform an internal inspection of shell, heads and welds. Check areas around manhole, internal tank fittings, outlet valves pitting or corrosion, deformation at rings, and over the upper coupler and suspension area.
2. If cargo tank is lined, perform lining test described in Part-180.407 (f), also described in this manual below.
3. Perform thickness tests on any corroded and abraded areas found in unlined tanks. If test shows areas below minimum, allowable shell thickness, perform a complete thickness test as described in Part-180.407 (i), also described in this manual below.
4. Record all results of the service in an inspection/test report.

Use the checklist/inspection report in Figure 70-2.0 to accomplish the service. Review 49 CFR 180.411 before completing the "Tank Disposition" entry.

7.2.3 LINING INSPECTION

Information is provided in Section 5.6 to make sure that all areas are covered and the proper test equipment is used. Use the checklist in this section to ensure attention to all safety and procedural details.

The following items are mandatory DOT requirements.

NOTE:

Lining Testing takes special training and knowledge of lining materials. This manual cannot provide the necessary instructions to develop these skills

1. Integrity of lining must be verified once each year.
2. Rubber linings must be tested for holes with a high frequency spark tester capable of producing sufficient voltage to ensure proper calibration for the lining being tested. Refer to Paragraph 49 180.407(f), for more details on testing instruments and techniques.
3. Inspect metal beneath any defective parts of liner that are removed and perform ultrasonic testing, as necessary.
4. Using chalk, mark any leaks for repair.
5. Linings made of other than rubber must be tested in accord with manufacturer instructions.
6. Record the results of the service in an inspection/test report.

Use the checklist in Figure 70-2.0 to accomplish the lining inspection. Review 49 CFR 180.411 before completing the "Tank Disposition" entry.

7.2.4 LEAKAGE TEST

Follow the procedure in Section 5.3 to obtain a thorough leak test on all tank systems and components. Use the checklist in this section to ensure attention to all safety and procedural details.

1. Each cargo tank must be leak tested each year.
2. If cargo tank is compartmented, each compartment shall be tested with adjacent compartments at atmospheric pressure
3. All valves and accessories must be in place and operative.
4. Test pressure is no less than 80 percent of design pressure or MAWP, and hold time is at least five minutes.

5. Product piping must be tested.
6. Tank must pass the test before being returned to service as a Specification tank.
7. Provide suitable personnel safeguards in event of a structure failure.
8. Record the results of the service in a test report.

Section 5.3. contains test equipment and procedural information on leak testing, which can be a hydrostatic or pneumatic test. Review Section 5.3., then make the choice as to whether a hydrostatic or pneumatic procedure will be used. Checklist/Test reports follow (Figures 70-3.0 and 70-4.0) for both tests. Review 49 CFR 180.411 before completing "Tank Disposition" entry.

WARNING: IF TANK ENTRY IS NECESSARY, PRIOR TO ENTRY, TEST INTERIOR AIR SPACE FOR FLAMMABLE VAPORS AND ADEQUATE OXYGEN LEVELS, AND COMPLY WITH ALL OSHA REGULATIONS.

If hydrostatic procedure is used, remember that full load of water will weigh 8.3 pounds/gallon. Provide adequate support for this load under the fifth wheel upper coupler assembly. Also make sure all water is removed from the tank systems after test.

7.2.4.1 HYDROSTATIC LEAK TEST

1. With internal valve open, and external valve closed, fill tank or compartment with water and carefully raise pressure through top fitting to 80% - 100% of MAWP (in most cases 20 - 25 psi.). Raise pressure in 5 psi. increments. Inspection at each level is recommended.
2. Inspect for visible leaks. Cut off pressure source to vessel and watch for falling pressure indicating a leak. When pressure is stable, hold for five minutes without pressure loss.
3. With pressure in vessel, close the internal valve, open the external valve and verify the leak tightness of the internal valve.

7.2.4.2 PNEUMATIC LEAK TEST

US DOT authorizes pneumatic testing as an alternative to hydrostatic testing for the leakage test. NTTC does not recommend the use of pneumatic testing. If you choose pneumatic testing take the following precautions:

1. Leaks can be detected at just a few pounds pressure by sound, by application of soap solutions or by closing the pressure source and monitoring for a drop in the test pressure. Selection of a method is recommended prior to the application of the full test pressure.
2. Be sure the pressure source used to pressurize the cargo tank is equipped with a pressure regulator so the intended test pressure cannot be exceeded.
3. Before pressurizing, place the tank in an open area and be able to initially raise the pressure to test pressure from a remote location at least 20' in front of or behind the cargo tank.
4. When you are assured that the cargo tank has successfully held the test pressure for several minutes you can proceed with the test . You must maintain pressure for five minutes..
5. Use extreme caution around manhole covers or fill covers while tank is under pressure.

7.2.5 PRESSURE RETEST

An External Visual Inspection and an Internal Visual Inspection, must be accomplished concurrently with the pressure retest.

All MC 307/DOT 407 tanks must undergo pressure retest at least once every five years. Test pressure for MC 304/307 and DOT-407 tanks is 40 psi. or, 1.5 x design pressure or MAWP (whichever is greater) Hold time is 10 minutes for hydrostatic test and 5 minutes for pneumatic test.

All spring-actuated vents must be removed, inspected, and bench tested or replaced as part of the test, however during the test, vents can be blocked off and left in place, or removed and openings closed off. Operation of all vents must be restored after testing and before the tank is returned to service.

If hydrostatic procedure is used, make sure that support is provided under fifth wheel upper coupler adequate to support weight of tank.

Mandatory DOT requirements for hydrostatic testing are as follows:

1. The upper coupler (fifth wheel) assembly must be removed and areas covered by the upper coupler have to be inspected for any defect that would render the tank unsafe
2. Tank, including domes, must be filled with water.
3. Test liquid temperature; not over 100 degrees Fahrenheit.
4. Test pressure is specified (Table 2, Section 5.4 herein) usually 40 psi
5. Gauge pressure at top of tank.
6. Hold time: 10 minutes.
7. Inspect for leakage, bulging, or other defects.
8. A test report is required.

The DOT requirement for pneumatic testing (if selected) is as follows: (BUT IS NOT RECOMMENDED, EXCEPT IN SPECIAL CIRCUMSTANCES).

1. Use air or a similar gas.
2. Adjacent compartments must be empty and at atmospheric pressure
3. Pressure up to one-half of test pressure, then increase pressure in one-tenth increments until full test pressure is attained.
4. Hold for five minutes.
5. Reduce pressure to MAWP or design pressure.
6. Maintain MAWP or design pressure while tank surfaces are inspected.
7. Use approved method for leak detection, like soap and water solution, etc.
8. A test report is required.

For either procedure, a tank cannot be returned to service if it leaks, fails to retain test pressure, shows distortion, exhibits excessive permanent expansion (or other structural defects) until all such defects are repaired or corrected.

Review the safety instructions and procedures in Section 5.4, then use the checklist/inspection reports that follow (Figures 70-5.0 and 70-6.0) for a hydrostatic test or a pneumatic test.

7.2.6 THICKNESS TESTING

Thickness testing of unlined DOT407/MC307 cargo tanks is required if the cargo tank has transported materials corrosive to the tank or shows corrosion or pitting is present. (not because they have transported materials placarded as corrosive). Reference 49 CFR 180.407(i).

Many corrosive materials do not corrode shell materials, for instance as a practical matter, neither Nitric Acid nor Caustic Soda corrodes stainless steel, and transporting them (in stainless steel) would not trigger the need for a thickness test.

Conversely, other materials not normally thought of as corrosive (nor placarded as a corrosive) can cause pitting or selective corrosion due to small amounts of, for instance, free chlorines.

If it is determined that a thickness test should be performed, because of the transportation of materials known to attack the shell and head material, or an inspection indicates corrosion has taken place, a thorough thickness test should be performed as described in Section 5.5. Use the ultrasonic thickness testing report form included in this section to make the appropriate readings and for documentation.

While only specific small areas may be suspected, DOT ultrasonic testing requires coverage of the following, as a minimum:

1. Areas of the shell and heads, areas around any piping that retains lading.
2. Areas of high shell stress, such as the bottom center of the tank, or front and rear support structures.
3. Areas near openings.
4. Alongside welds and weld joints.
5. Areas around shell reinforcements.
6. Areas around appurtenance attachments.
7. Areas near upper coupler and suspension assembly attachments.
8. Known thin areas in the tank shell and nominal liquid level lines.

Other thickness testing procedures are permitted, such as the TTMA Technical Bulletin 113.

If thickness testing reveals conditions that will prohibit return of the tank to service as an MC-307 DOT-407, the cargo tank owner must decide if repair is practical. Localized pitting or corrosion may be repairable. General thinning below minimum shell thickness would require that the tank be taken out of service or downgraded to non-specification service.

TEST & INSPECTION REPORT FORMS:

Included below are forms designed to help tank mechanics assure compliance with DOT requirements for each type of test or inspection, and in many cases include optional items we believe are important to good tank maintenance. Purchasers of this Manual can obtain extra forms from the National Tank Truck Carriers, Inc. or they may be reproduced from this manual.

SECTION 7: MC307/DOT 407

MC307/DOT 407 CHECKLIST/INSPECTION REPORT FOR EXTERNAL VISUAL INSPECTION (PAGE 1 OF 3)

CARRIER/OWNER _____ DATE_____

FLEET # _____ SERIAL/VIN # _____ C.T. MFG._____

DOT SPEC NO. _____ MATL. _____ DATE MFG. _____

MAWP _____psi. TEST PRESS. _____psi. MINIMUM THICKNESS: SHELL_____HEADS_____

COMPARTMENT SIZES, F to R 1,_____ 2, _____ 3, _____ 4, _____ 5, _____ GAL.

TOTAL CAPACITY _____GAL. DBL. BULKHEADS? _____ INSULATED? _____LINED?_____

TYPE SERVICE: CORROSIVE TO SHELL?_____DEDICATED SERVICE?_____PRODUCT_____

DOT mandatory items indicated with "M" on checklist.

Item No.	Activity	Complies	Repairs Needed	See Remarks
1	Data Plate: Tank attachment, entries legible, no paint, or corrosion.			
	NON-INSULATED TANK:			
2M	Shell and Heads: Condition of welds dents, gouges, corrosion or abrasion, possible need for thickness testing. Obvious structural defects in shell, rings, frames, outriggers, X members and welds.			
	INSULATED TANK|			
3M	Internal inspection of the shell and heads, areas around manhole, tank fittings, valve outlets, pitting or corrosion, deformation at rings or over fifth wheel and suspension area. Perform thickness test if condition merits.			
4	Outer Jacket: Condition of attachments dents, digs, scrapes, gouges, perforations, loose sheets and fastening devices.			
	ALL UNITS:			
5M	If cargo tank is fabricated with a steel shell and steel external rings, thickness test the rings as follows. Measure ring thickness in four symmetrical positions around the circumference. If any reading varies from the average by more than 10%, thickness test shell, internally, in area of shell covered by the ring.			
6M	Upper Coupler Assembly: Condition of plate, corrosion, deformation, lubrication, bolt tightness, kingpin wear or deformation. (Every two years if transporting material corrosive to tank) Examined	In Place_____ Removed_____		
7M	Void Areas: Signs of corrosion fittings and drains unplugged.			

MC 307/DOT 407 CHECKLIST/INSPECTION REPORT FOR EXTERNAL VISUAL INSPECTION (PAGE 2 OF 3)

Item No.	Activity	Complies	Repairs Needed	See Remarks
8	Landing Gear: Corrosion and rust condition of welds, frame distortion above gear , bolt tightness, support braces secure gear operation.			
9	Placard Holders & Caution signs attachment to tank, condition of clips and hinges, condition & color of decals. Replace as necessary	_____	_____	_____
10M	Bolted Attachments: Under carriage, landing gear structure cabinets, ladders, fenders, rear bumper and other important components	_____	_____	_____
11	Hose Tubes, Troughs or Racks: Condition of tube, end doors and latches,	_____	_____	_____
12M	Piping, valves and gaskets: Check security of pipe hangers, bolted joints and gaskets, operation of valves, adapters and caps.	_____	_____	_____
13M	Internal Valve Operation: Three means of closure, normal, remote and thermal, check valve operation, hydraulic or air leaks, cable adjustment, if so equipped, Check presence of shear section, lubrication points.	_____	_____	_____
14	Vapor Recovery System: Check general condition of vapor vent, vapor valves and vapor lines, securement to tank and condition of gaskets.	_____	_____	_____
15	Pumps: Drive shaft alignment, condition of bearings, seals mounting bolts, lubrication points. Presence of safety guards on shaft and U joints	_____	_____	_____
16	Ladders, vertical rails straight and structurally sound. Rungs, clear of obstructions which limit toe clearance, and rungs secure to verticals. Mounting to tank structure sound	_____	_____	_____
17	Walkways: level, well mounted and walking surface clean and slip resistant	_____	_____	_____
18	Static Grounding Connections: If present, connections solid.	_____	_____	_____
19M	Manhole Area: Evidence of leakage, impact damage to covers or fittings condition of cover, gaskets hold down fittings and hinges, overturn protection structure is appropriate, manhole dam drains and hoses OK.	_____	_____	_____
20M	Pressure Relief Devices: Verify all vents present, verify venting capacity adequate for tank using markings on vents, check vent connections on inside of manhole cover. Remove and bench test vents if questionable. Carrying lading corrosive to tank:	_____	_____	_____
	Emergency Vent Performance:			
	Type of device:			
	Compartment: 1_____, 2_____, 3_____			

Set to discharge pressure: 1,_____2,_____3,_____

Pressure device opened: 1,_____2,_____3,_____

Pressure at which device re-seated: 1,_____2,_____ _3,_____

Disposition of the device (Mark X): reinstalled _____, repaired, or replaced_____

21M Supply "Emergency Shutoff" decal near internal valve remote closure device per Paragraph 172.328 (d) after October 3, 2004

22M Tank Markings: Date (month & year) service symbol (V) if cargo tank is qualified to return to service. _____ _____ _____

MC 307/DOT 407 CHECKLIST/INSPECTION REPORT FOR EXTERNAL VISUAL INSPECTION (PAGE 3 OF 3)

REMARKS (use additional sheets if necessary)

_____

_____

_____

_____

_____

_____

_____

_____

Defects found and corrected._____

_____

_____

Disposition of unit: Return to Service_____ Removed From Service_____

Inspector or CT Facility	Cargo Tank Owner or Representative
Name _____	Name _____
Address _____	Address _____
_____	_____
Signed _____	Signed _____
Date _____	Date _____
DOT CT # _____	DOT MCID # _____ (If appropriate)

IMPORTANT: This certification must be signed by both the Inspection Agency/CT. Facility, and the cargo tank owner, and it must be retained the Owner's equipment file throughout his ownership and one year thereafter.

MC 307/DOT 407 CHECKLIST/INSPECTION REPORT FOR INTERNAL VISUAL INSPECTION (page 1 of 2)

CARRIER/OWNER _____ DATE _____

FLEET # _____ SERIAL/VIN # _____ C.T. MFG. _____

DOT SPEC NO. _____ MATL. _____ DATE MFG. _____

MAWP _____psi. TEST PRESS. _____psi. MINIMUM THICKNESS: SHELL _____ HEADS _____

COMPARTMENT SIZES, F to R 1, _____ 2, _____ 3, _____ 4, _____ 5, _____ GAL.

TOTAL CAPACITY _____GAL. DBL. BULKHEADS? _____ INSULATED? _____ LINED? _____

TYPE SERVICE: CORROSIVE TO SHELL? _____ DEDICATED SERVICE? _____ PRODUCT _____

DOT mandatory items indicated with "M" on checklist.

WARNING! PRIOR TO ENTERING TANK, BE SURE INTERIOR IS FREE OF FLAMMABLE VAPORS AND HAS SAFE LEVEL OF OXYGEN PRESENT. COMPLY WITH ALL COMPANY AND REGULATORY REQUIREMENTS FOR WORK IN CONFINED SPACES.

Item No.	Activity	Complies	Repairs Needed	See Remarks
1M	Internal inspection of the shell and heads, areas around manhole, tank fittings, valve outlets, pitting or corrosion, deformation at rings or over fifth wheel and suspension area. Perform thickness test if condition merits.	_____	_____	_____
2M	Welds: Inspect internal welds in tank, look for pits, bleeding stains from welds. Check for cracks and buckles, give special attention to welds in area above upper coupler and suspension. See Section 5 of this Manual regarding "lap patches".	_____	_____	_____
3	Piping and Valves: Check installation tightness, inspect valve seat travel and make visual inspection of valve surfaces, clear and secure any screens, or splash deflectors, inspect for foreign matter in valves and sumps.	_____	_____	_____
4	Remove all equipment brought into tank, then inspect again before leaving tank.	_____	_____	_____
5M	Tank Markings: Date (month & year) service symbol (I) if cargo tank is qualified for return to service.	_____	_____	_____

MC 307/DOT 407 CHECKLIST/INSPECTION REPORT FOR INTERNAL VISUAL INSPECTION (page 2 of 2)

REMARKS (use additional sheets if necessary)

_____

_____

_____

_____

_____

_____

Defects found and corrected._____

_____

_____

Disposition of unit: Return to Service_____ Removed From Service_____

Inspector or CT Facility	Cargo Tank Owner or Representative
Name _____	Name _____
Address _____	Address _____
_____	_____
Signed _____	Signed _____
Date _____	Date _____
DOT CT # _____	DOT MCID # _____ (If appropriate)

IMPORTANT: This certification must be signed by both the Inspection Agency/CT. Facility, and the cargo tank owner, and it must be retained the Owner's equipment file throughout his ownership and one year thereafter.

MC 307/DOT 407 CHECKLIST/INSPECTION REPORT FOR LINING INSPECTION (page 1 of 2)

CARRIER/OWNER _____ DATE _____

FLEET # _____ SERIAL/VIN # _____ C.T. MFG. _____

DOT SPEC NO. _____ MATL. _____ DATE MFG. _____

MAWP _____psi. TEST PRESS. _____psi. MINIMUM THICKNESS: SHELL _____HEADS _____

COMPARTMENT SIZES, F to R 1, _____ 2, _____ 3, _____ 4, _____ 5, _____ GAL.

TOTAL CAPACITY _____GAL. DBL. BULKHEADS? _____ INSULATED? _____LINED? _____

TYPE SERVICE: CORROSIVE TO SHELL? _____DEDICATED SERVICE? _____PRODUCT _____

DOT mandatory items indicated with "M" on checklist.

Item No.	Activity	Complies	Repairs Needed	See Remarks
1	Dry tank interior surfaces.			
2	Conduct Visual Inspection of all Surfaces: Inspect for lining discoloration, product stains, blisters, and lining separation around baffles and bulkheads, corners and recesses, along all seams. Record locations in Remarks.			
3	Conduct I to 3 psi. low,-pressure leak test of compartment. Correct all leaks. Record location of other-than-component leaks. Relieve pressure in tank to 0 psi.			
4M	Calibrate spark tester (outside the tank).			
5M	Pass probe over all lining surfaces. * Repeat passes over suspect areas and all areas identified in Item 2. Record location of lining defects in Remarks in a manner that can be correlated with external locations.			

***CAUTION:** Holding the probe stationary bay burn a hole through the lining.

6M	If degraded or defective parts of liner are removed, inspect exposed metal thoroughly; perform thickness tests, if necessary.			
7	Remove all equipment from tank, then inspect to make sure tank is clear, clean, and free of foreign materials.			
8M	Tank Markings: Date (month & year) and service symbol (L) if cargo tank is qualified for return to service			

MC 307/DOT 407 CHECKLIST/INSPECTION REPORT FOR LINING INSPECTION (page 2 of 2)

REMARKS (use additional sheets if necessary)

_____

_____

_____

_____

Defects found and corrected._____

_____

_____

Disposition of unit: Return to Service_____ Removed From Service_____

Inspector or CT Facility	Cargo Tank Owner or Representative
Name _____	Name _____
Address _____	Address _____
_____	_____
Signed _____	Signed _____
Date _____	Date _____
DOT CT # _____	DOT MCID# _____ (If appropriate)

IMPORTANT: This certification must be signed by both the Inspection Agency/CT. Facility, and the cargo tank owner, and it must be retained the Owner's equipment file throughout his ownership and one year thereafter.

MC 307/DOT 407 CHECKLIST/TEST REPORT FOR HYDROSTATIC LEAK TEST (page 1 of 2)

CARRIER/OWNER _____ DATE _____

FLEET # _____ SERIAL/VIN # _____ C.T. MFG. _____

DOT SPEC NO. _____ MATL. _____ DATE MFG. _____

MAWP _____psi. TEST PRESS. _____psi. MINIMUM THICKNESS: SHELL _____ HEADS _____

COMPARTMENT SIZES, F to R 1, _____ 2, _____ 3, _____ 4, _____ 5, _____ GAL.

TOTAL CAPACITY _____GAL. DBL. BULKHEADS? _____ INSULATED? _____ LINED? _____

TYPE SERVICE: CORROSIVE TO SHELL? _____ DEDICATED SERVICE? _____ PRODUCT _____

DOT mandatory items indicated with "M" on checklist.

Item No.	Activity	Complies	Repairs Needed	See Remarks
	NOTE: If compartmented, each compartment must be tested with adjacent compartments empty.			
	CAUTION: Be sure to level and support tank in view of the weight of water.			
1M	Close external valves, leave internal valve open, fill tank, or compartment, and compartment lines with the manhole open. Check for obvious leaks before pressurizing tank.	_____	_____	_____
2M	Close manhole cover and apply pressure at top of tank with water pressure and adjust pressure to test pressure, 80 % of design pressure or MAWP, in 5 psi increments. Usual pressure is 20 psi. When pressure is stabilized, inspect for leaks or distortions. All fittings, except vents, shall be in place during test. Actual Test Pressure _____ psi.	_____	_____	_____
3M	Inspect all surfaces and components for leaks, particular attention to manhole assembly area.	_____	_____	_____
4M	While tank is still pressurized, close internal valve, drain product line or lines, and monitor for leakage past internal valve.	_____	_____	_____
5M	With any leaks identified and fixed, hold pressure for five minutes	_____	_____	_____
6	Drain and dry cargo tank.	_____	_____	_____
7M	Tank Markings: Date (month & year) and service symbol (K) if cargo tank qualified to return to service.	_____	_____	_____

MC 307/DOT 407 CHECKLIST/TEST REPORT FOR HYDROSTATIC LEAK TEST (page 2 of 2)

REMARKS (use additional sheets if necessary)

_____

_____

_____

_____

Defects found and corrected._____

_____

_____

Disposition of unit: Return to Service_____ Removed From Service_____

Inspector or CT Facility	Cargo Tank Owner or Representative
Name _____	Name _____
Address _____	Address _____
_____	_____
Signed _____	Signed _____
Date _____	Date _____
DOT CT # _____	DOT MCID # _____ (If appropriate)

IMPORTANT: This certification must be signed by both the Inspection Agency/CT. Facility, and the cargo tank owner, and it must be retained the Owner's equipment file throughout his ownership and one year thereafter.

MC 307/DOT 407 CHECKLIST/TEST REPORT FOR PNEUMATIC LEAK TEST (page 1 of 2)

CARRIER/OWNER _____ DATE _____

FLEET # _____ SERIAL/VIN # _____ C.T. MFG. _____

DOT SPEC NO. _____ MATL. _____ DATE MFG. _____

MAWP _____psi. TEST PRESS. _____psi. MINIMUM THICKNESS: SHELL_____HEADS_____

COMPARTMENT SIZES, F to R 1,_____ 2, _____ 3, _____ 4, _____ 5, _____ GAL.

TOTAL CAPACITY _____GAL. DBL. BULKHEADS? _____ INSULATED? _____LINED?_____

TYPE SERVICE: CORROSIVE TO SHELL?_____DEDICATED SERVICE?_____PRODUCT_____

DOT mandatory items indicated with "M" on checklist.

NOTE: If compartmented, each compartment must be tested with adjacent compartments empty and at atmospheric pressure.

CAUTION: Minimum Leak Test pressure for this family of tanks is 20 psi. Be sure you understand the dangers which can be associated with large volumes of air at this pressure.

Item No.	Activity	Complies	Repairs Needed	See Remarks
1	Perform leak detection procedures at 3 to 5 psi., to locate and correct any existing leaks, prior to application of test pressure. The manhole cover must be in place for this Test. Applying pressure through a dust cap on the outlet line, is convenient for this Test.	_____	_____	_____
2M	Close manhole and product valves, open internal valve, and induce air pressure gradually, with cursory inspections at 50%, and 75% prior to applying full test pressure. Re-inspect for leaks at test pressure Actual Test Pressure_____psi.	_____	_____	_____
3M	Inspect visible external surfaces, welds, lines and fittings. Give special attention to manhole covers, top tank fittings, piping and valves.	_____	_____	_____
4M	While vessel is at test pressure, close internal valve and vent outlet line, then close outlet valve. A pressure build up in the line is evidence of leaking past the internal valve seat.	_____	_____	_____
5M	After thorough inspection to assure unit leak free, hold test pressure for 5 minutes.	_____	_____	_____
6M	Tank Markings: Date (month and year) and service symbol (K) if cargo tank is qualified for return to service	_____	_____	_____

MC 307/DOT 407 CHECKLIST/TEST REPORT FOR PNEUMATIC LEAK TEST (page 2 of 2)

REMARKS (use additional sheets if necessary)

_____

_____

_____

_____

Defects found and corrected._____

_____

_____

Disposition of unit: Return to Service_____ Removed From Service_____

Inspector or CT Facility	Cargo Tank Owner or Representative
Name _____	Name _____
Address _____	Address _____
_____	_____
Signed _____	Signed _____
Date _____	Date _____
DOT CT # _____	DOT MCID# _____ (If appropriate)

IMPORTANT: This certification must be signed by both the Inspection Agency/CT. Facility, and the cargo tank owner, and it must be retained the Owner's equipment file throughout his ownership and one year thereafter.

MC 307/DOT 407 CHECKLIST/TEST REPORT FOR HYDROSTATIC PRESSURE RETEST (page 1 of 2)

CARRIER/OWNER _____ DATE_____

FLEET # _____ SERIAL/VIN # _____ C.T. MFG._____

DOT SPEC NO. _____ MATL. _____ DATE MFG. _____

MAWP _____psi. TEST PRESS. _____psi. MINIMUM THICKNESS: SHELL_____HEADS_____

COMPARTMENT SIZES, F to R 1,_____ 2, _____ 3, _____ 4, _____ 5, _____ GAL.

TOTAL CAPACITY _____GAL. DBL. BULKHEADS? _____ INSULATED? _____LINED?_____

TYPE SERVICE: CORROSIVE TO SHELL?_____DEDICATED SERVICE?_____PRODUCT_____

DOT mandatory items indicated with "M" on checklist.

Item No.	Activity	Complies	Repairs Needed	See Remarks

NOTE: This test must be performed in conjunction with an External and Internal Visual Inspection.
If unit is a cargo tank motor vehicle, its upper coupler plate must be removed and the area covered by the upper coupler inspected.
If compartmented, each compartment must be tested with adjacent compartments empty.

CAUTION: Be sure to level and snpport cargo tank in view of the heavy weight of water.

1M Remove, inspect and bench test all re closing vents. Blank off vent openings, and any other openings necessary to seal vessel. Manhole covers, must be in place for this test. _____ _____ _____
Emergency Vent Performance:

Type of device:

Compartment: 1_____, 2_____, 3_____

Set to discharge pressure:1,_____2,_____3,_____

Pressure device opened: 1,_____2,_____3,_____

Pressure at which device re-seated: 1,_____2,_____3,_____

Disposition of the device (Mark X): reinstalled _____, repaired, or replaced_____

2M Close external valves, leave internal valve open and fill tank to top of manhole collar, with manhole open. Check for obvious leaks, before pressurizing tank. _____ _____ _____

3M Close manhole cover and pressurize tank up to test pressure, a dust cap on the outlet line is a good choice. Raise pressure using a small diameter water line to provide sensitive control. Raise pressure slowly, watch vessel carefully until test pressure is attained, Usually 40 psi. Actual test pressure_____psi.

4M	Close outlet valve and observe for pressure drop, find and correct any leaks, if necessary. Inspect all fittings and visible shell and head surfaces. Hold pressure for 10 minutes.	_____	_____	_____
5M	With tank at test pressure, close internal valve, drain outlet line and observe for leaking past internal valve.	_____	_____	_____
6M	Drain tank, reinstall fifth wheel plate and all vents.	_____	_____	_____
7M	Upper Coupler Assembly Examined	In Place_____	Removed_____	
8M	Tank Markings: Date (month and year) and service symbol (P)(V)(I) if tank qualifies for return to service	_____	_____	_____

MC 307/DOT 407 CHECKLIST/TEST REPORT FOR HYDROSTATIC PRESSURE RETEST (page 2 of 2)

REMARKS (use additional sheets if necessary)

_____

_____

_____

_____

Defects found and corrected._____

_____

_____

Disposition of unit: Return to Service_____ Removed From Service_____

Inspector or CT Facility	Cargo Tank Owner or Representative
Name _____	Name _____
Address _____	Address _____
_____	_____
Signed _____	Signed _____
Date _____	Date _____
DOT CT # _____	DOT MCID # _____ (If appropriate)

IMPORTANT: This certification must be signed by both the Inspection Agency/CT. Facility, and the cargo tank owner, and it must be retained the Owner's equipment file throughout his ownership and one year thereafter.

SECTION 7: MC307/DOT 407

MC 307/DOT 407 CHECKLIST/TEST REPORT FOR PNEUMATIC PRESSURE RETEST (page 1 of 2)

CARRIER/OWNER _____ DATE _____

FLEET # _____ SERIAL/VIN # _____ C.T. MFG. _____

DOT SPEC NO. _____ MATL. _____ DATE MFG. _____

MAWP _____psi. TEST PRESS. _____psi. MINIMUM THICKNESS: SHELL_____HEADS_____

COMPARTMENT SIZES, F to R 1,_____ 2, _____ 3, _____ 4, _____ 5, _____ GAL.

TOTAL CAPACITY _____GAL. DBL. BULKHEADS? _____ INSULATED? _____LINED?_____

TYPE SERVICE: CORROSIVE TO SHELL?_____DEDICATED SERVICE?_____PRODUCT_____

DOT mandatory items indicated with "M" on checklist.

Item No.	Activity	Complies	Repairs Needed	See Remarks

NOTE: This test must be performed in conjunction with an External and Internal Visual Inspection.
If unit is a cargo tank motor vehicle, its upper coupler plate must be removed and the area covered by the upper coupler inspected.
If compartmented, each compartment must be tested with adjacent compartments empty.

CAUTION: Minimum test pressure for this family of tanks is 40 psi. Be sure you understand the dangers which can be associated with large volumes of air at this pressure

1M Remove, inspect and bench test all re closing vents. Blank off vent openings, and any other openings necessary to seal vessel Manhole covers must be in place for this test.
Emergency Vent Performance:

Type of device:

Compartment: 1_____, 2_____, 3_____

Set to discharge pressure: 1,_____2,_____3,_____

Pressure device opened: 1,_____2,_____3,_____

Pressure at which device re-seated: 1,_____2,_____3,_____

Disposition of the device (Mark X): reinstalled _____, repaired, or replaced_____

2 Close external valves, leave internal valve open and close manhole, then introduce air pressure into tank. For safety reasons, air source should be controlled with a regulator set just above test pressure. Conduct low pressure leak test at 3 to 5 psi.

3M Raise pressure in tank or compartment, to test pressure in stages with cursory inspections at each level as follows: 50, 60, 70, 80, 90, and 100% of test pressure. Hold pressure for 5 minutes.

Actual Test Pressure_____psi.

SECTION 7: MC307/DOT 407

4M	Reduce pressure to tank's MAWP. Inspect tank's visible surfaces, manhole cover and all fittings for leaks, distortion, or any other defects Close internal valve and vent outlet line, then close outlet valve. A pressure Build up in line is evidence of leaking past the internal valve seat.	_____	_____	_____
5M	Restore operation of all vents,	_____	_____	_____
6M	Tank Markings: Date (month and year) and service symbol (P)(V)(I) if tank qualifies for return to service	_____	_____	_____
7M	Upper Coupler Assembly Examined	In Place_____	Removed_____	

MC 307/DOT 407 CHECKLIST/TEST REPORT FOR PNEUMATIC PRESSURE RETEST (page 2 of 2)

REMARKS (use additional sheets if necessary)

_____

_____

_____

_____

Defects found and corrected._____

_____

_____

Disposition of unit: Return to Service_____ Removed From Service_____

Inspector or CT Facility	Cargo Tank Owner or Representative
Name _____	Name _____
Address _____	Address _____
_____	_____
Signed _____	Signed _____
Date _____	Date _____
DOT CT # _____	DOT MCID # _____ (If appropriate)

IMPORTANT: This certification must be signed by both the Inspection Agency/CT. Facility, and the cargo tank owner, and it must be retained the Owner's equipment file throughout his ownership and one year thereafter.

SECTION 7: MC307/DOT 407

MC 307/DOT 407 CHECKLIST/TEST REPORT FOR ULTRASONIC THICKNESS TESTING (page 1 of 2)

CARRIER/OWNER _____ DATE _____

FLEET # _____ SERIAL/VIN # _____ C.T. MFG. _____

DOT SPEC NO. _____ MATL. _____ DATE MFG. _____

MAWP _____ psi. TEST PRESS. _____ psi. MINIMUM THICKNESS: SHELL _____ HEADS _____

COMPARTMENT SIZES, F to R 1, _____ 2, _____ 3, _____ 4, _____ 5, _____ GAL.

TOTAL CAPACITY _____ GAL. DBL. BULKHEADS? _____ INSULATED? _____ LINED? _____

TYPE SERVICE: CORROSIVE TO SHELL? _____ DEDICATED SERVICE? _____ PRODUCT _____

DOT mandatory items indicated with "M" on checklist.

Item No.	Activity	Complies	Repairs Needed	See Remarks
	WARNING: PRIOR TO ENTERING TANK, BE SURE INTERIOR IS FREE OF CHEMICAL OR FLAMMABLE VAPORS, AND HAS SAFE LEVEL OF OXYGEN PRESENT. COMPLY WITH ALL COMPANY AND REGULATORY REQUIREMENTS FOR WORK IN CONFINED SPACES.			
1	Clean, dry or buff down to bare metal, all surfaces to be measured.	_____	_____	_____
2	Calibrate the thickness tester with coupon representative of shell material and thickness.	_____	_____	_____
3M	Use test grid as described in Section 5.5 to cover entire vessel and fittings. Ensure grid has adequate coverage of the vessel over the 5th wheel, suspension, manhole and valve areas plus locations, near shell stiffeners, like rings, near welds, around fittings and the liquid level line and any other suspected areas.	_____	_____	_____
4M	Record readings on the referenced documentation form or similar document.	_____	_____	_____
5M	Tank Markings: Date (month and year) and service symbol (T) if cargo tank is qualified for return to service.	_____	_____	_____

MC 307/DOT 407 CHECKLIST/TEST REPORT FOR ULTRASONIC THICKNESS TESTING (page 2 of 2)

REMARKS (use additional sheets if necessary)

_____

_____

_____

_____

Defects found and corrected._____

_____

_____

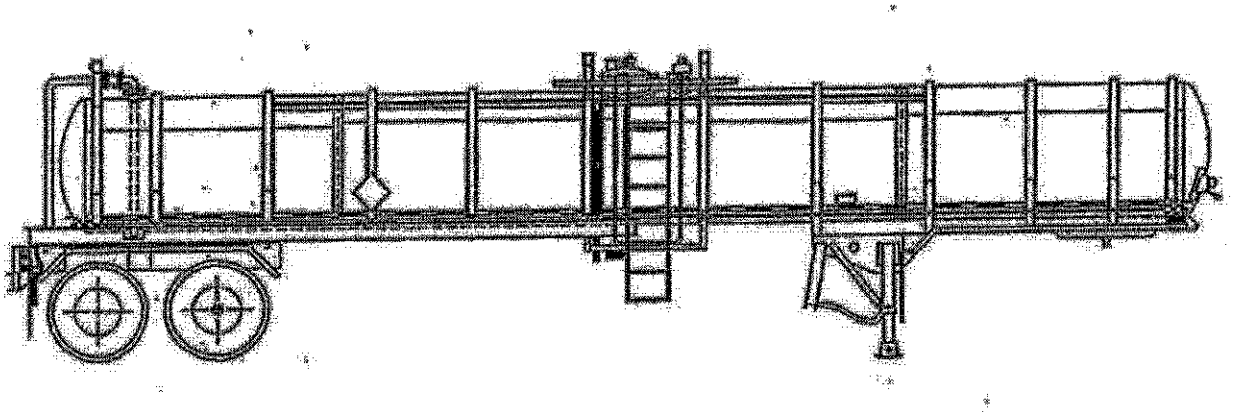
Disposition of unit: Return to Service_____ Removed From Service_____

Inspector or CT Facility	Cargo Tank Owner or Representative
Name _____	Name _____
Address _____	Address _____
_____	_____
Signed _____	Signed _____
Date _____	Date _____
DOT CT # _____	DOT MCID # _____ (If appropriate)

IMPORTANT: This certification must be signed by both the Inspection Agency/CT. Facility, and the cargo tank owner, and it must be retained the Owner's equipment file throughout his ownership and one year thereafter.

SECTION 8: MC312/DOT 412

SECTION 8: MC 312 DOT 412 CARGO TANKS



SECTION 8: MC 312/DOT 412 CARGO TANKS

Editors Note: Users of the manual should be aware that current editions of Title 49, Code of Federal Regulations do not contain copies of the MC "300 series" cargo tank specifications (except MC 331). Copies of these specifications are included in NTTC's "Cargo Tank Hazardous Materials Regulations", published annually. See the cover page of this publication for how to contact NTTC in order to purchase this publication.

References: (49 CFR)
178.340 — General Design & Const. Req. (MC 312)
178.343 — Specification MC 312 Cargo Tanks
178.345 — General Design & Const. Req. (DOT 412)
178.348 — Specification DOT 412 Cargo Tanks

The MC 312/DOT 412 cargo tanks are commonly called acid tanks or corrosive liquid tanks. They make up probably less than 10% of all HazMat cargo tanks. This includes predecessor Specifications MC-311, built until 1967 and maybe a few MC-310 (a much earlier model that had very thick shells with no ring stiffeners).

When the DOT 412 specification was published, the Research and Special Programs Administration called for vents appropriate for flammable liquids into the base specification. This opened this family of cargo tanks up to many flammable commodities. Since then flammable vents are allowed in MC-311 cargo tanks, and flammable vents can be removed from DOT-412 cargo tanks if they are not going to be used to carry flammables. Both specifications can thus be used for corrosive or flammable commodities if properly equipped. See Paragraph 173.242(b)(1).

A DOT-412 cargo tank may eliminate the need for a dual Specification tank like an MC-307/312 tank.

Almost all of these tanks are built with a pressure rating of from 35 to 50 psi. and must comply with the ASME Code. If the tank is going to transport PIH (poison by inhalation) commodities requiring special provision B32, it must have an MAWP of 87 psi. The MC 312/DOT 412 Specifications allow construction of tanks with MAWP's under 15 psi. which do not meet all the requirements of the ASME Code, but they are uncommon.

SECTION 8: MC312/DOT 412

8.1 DESIGN CHARACTERISTICS:

8.1.1 MAXIMUM ALLOWABLE WORKING PRESSURE, MAWP

MC 312 Specifications require that the "design pressure" be not less than the pressure used to unload the tank. As a practical matter you will be able to determine the design pressure from the Specification plate, and as previously stated, most will be about 35 to 50 psi.

DOT 412 cargo tanks must have a minimum MAWP of 5 psi., but few will be manufactured with this low rating. If they are built with a MAWP, from 5 to 14.9 psi., they must still meet most of the requirements of the ASME Code. If they have a MAWP over 15 psi. they must be constructed and certified in accordance with the ASME Code.

8.1.2 MATERIAL OF CONSTRUCTION AND SHELL THICKNESS

The two Specifications allow construction with mild steel, (MS) high strength low alloy, (HSLA) steels, stainless steel (SS) and aluminum. They require minimum shell thickness sufficient to meet the structural requirements like other HazMat Specification tanks, but may require a thicker shell based on the density of the commodities carried. 49CFR 178.343-2 contains Tables I & II which lists the thickness of the heads and shells based not only on the density of the products carried, but also on: (1) the size of the cross section, stated in GPI (the number of gallons a 1" slice of tank carries); and (2) the distance between rings, baffles or heads.

Editors' note: Table II also lists a category for maximum shell radius which can be used for each other variable, but the smallest one listed is 70" which would occur in a 140" diameter vessel. These Radii restrictions were included in case someone tried to build a nearly square or semi-rectangular vessel. Almost all 312/412 tanks will have a shell radius of less than 70".

DOT 412 head and shell thickness is referenced in paragraph 178.348-2, Tables I & II which are similar to MC 312.

Common sizes of cross sections in both MC 312/MC 412 cargo tanks will generally be: (1) "under 10 GPI"; or, (2) "10 GPI to 14 GPI" for capacities of 4800 to 6500 gallon tanks with diameters of 54" to 64". Common ring spacing is 54" to 60". Once you know the those factors you can select the correct thickness by the density of the commodity. As an example, a 5000 gallon steel cargo tank to haul a 13 lb/gal product would need a head thickness of 8 gauge for MC 312 and head thickness of .157" for DOT 412. Shell thickness for the same tank would be 8 gauge for MC 312 and 0.157" for DOT 412. The tables for MC 312 are in gauge while DOT 412 thickness is expressed in minimum decimal thickness after forming. The decimal tables simplify determining correct minimum material thickness.

NOTE: Tables I & II in Part 180.407(l), may be used to determine minimum decimal thickness when thickness is expressed in gauge. This is its only purpose. The Tables are not to be used to determine minimum shell thickness.

If an MC 312 carries products which subject it to corrosion, it must be lined, or be thick enough to withstand ten years exposure without the vessel being corroded below its minimum allowed thickness. Many such vessels are lined.

It is common to manufacture both mild steel and stainless steel MC 312 and DOT 412 tanks with a corrosion allowance which will be subject to slow corrosion rates from the products they carry, such as Sulfuric Acid.

8.1.3 MANHOLE ASSEMBLIES

There are several manhole designs used on corrosive liquid tanks. Some such designs are:

1. 20" diameter, full opening, dished cover similar to chemical tanks with six or eight hold downs, usually of the threaded type. The covers and collars must meet and be stamped as ASME Certified, 20" diameter dished cover. Smaller fill opening fill covers, also secured with hold downs, are seen in some applications.

2. 16" to 20" flat covers made of rather thick material. The cover is bolted to a flanged collar with 16 to 24 bolts. A 6" or 8" diameter flat fill cover is installed on the manhole cover and may be secured by a "strong back" hinged on one end with a threaded hold down dog on the other. The flat covers are frequently used as locations for pressurizing fittings, relief valves or rupture discs and etc. See Figure 14 (See graphics section) which shows typical manhole arrangements.

Many corrosive liquid cargo tanks are top unloaded (see "Piping" below) and have their manhole located at the rear. This keeps all the piping, manhole and other fittings in one location.

8.1.4 VENTING

Venting on MC 312 cargo tanks is fairly simple and straightforward. Venting generally consists of a reasonably sized pressure relief valve set to open between 100% and 110% of the design pressure. The size of the vent need only handle the volume of air equal to the pressurizing device, such as a compressor. The vent is usually located near the manhole, protected by the manhole overturn protection device.

MC 312 cargo tanks are not subject to emergency venting requirements unless they are transporting flammables. At the time MC 312 was written this was not a very common practice. If the tank was expected to transport flammables it was built to a dual Specification such as MC-307/312.

MC 312 cargo tanks that transport products corrosive to metals, including stainless steel, are often vented by a rupture disc designed to burst at 150% of the design pressure. Once ruptured these vents cannot reclose and need to be replaced. In some cases a rupture disc has a spring loaded relief valve mounted on top of it so the cargo tank can be used temporarily until the rupture disc can be replaced.

MC 312 requires that if the tank is equipped with an air inlet fitting, the expected air flow rate be shown on the data plate and the relief device limit the tank pressure to 130% of the design pressure when being unloaded at that rate.

Venting on DOT 412 cargo tanks is quite different. When this Specification was written the DOT's Research and Special Programs Administration (noting that some MC 312 tanks were dual code tanks) included flammable venting on all DOT 412 tanks.

DOT 412 allows different venting on tanks not expected to transport flammables, but the computation is difficult because you have to know some very special characteristics about each of the corrosives you plan to handle. Consequently the industry is using the DOT-407 type vent on most DOT 412 tanks.

Further, DOT 412 does not allow the use of "non-reclosing" vents like a rupture disc, the same as in DOT-406 & 407. Lined tanks which transport products corrosive to most metals frequently are equipped with a rupture disc with a spring loaded vent piggybacked on top. The rupture disc can be made immune to corrosive attack. If it fails, the spring loaded vent may last long enough to get the tank back to a facility where (probably) both vents would have to be replaced.

Another complication of DOT 412 vent requirements is that they must be placed within 10% of the center of the tank or compartment. Prior to DOT 412, if the tank has a rear manhole location, it was common practice to place the vent near the manhole so the accident damage protection devices (overturn guards) could protect the vent as well as other top fittings. The DOT 412 requirement for a center vent usually results in the need for additional guarding, and an additional walkway or ladder for access to the vent.

8.1.5 PIPING AND VALVES

Most MC 312/DOT 412 cargo tanks are top loaded and many are top unloaded. The top unloaded tanks are equipped with a dip tube extending down from the top of the tank to a blanked sump at the rear, the lowest point in the vessel. There is an external stop valve on the top of the pipe and usually a line down the rear head, or over the side, at the rear. A secondary closure is required on the end of the discharge line which may be a valve or a bolted, blank flange.

SECTION 8: MC312/DOT 412

Top unloaded MC 312 cargo tanks commonly use a wheel operated rubber lined diaphragm valve for products like Hydrochloric Acid, Hydrofluoric Acid and similar strong corrosives, and stainless steel or PVC plug valves and Teflon lined valves.

DOT 412 Specifications require that all primary product retention valves, top or bottom, be of the self-closing type similar to the requirement for bottom emergency valves. The same type valves can be used but the industry has had to adapt air actuators to meet the self closing requirement. Secondary valves can still be manually operated.

They must also be capable of being remotely closed from a distance of more than 10 feet, and some require a means of being closed thermally by a fusible device. Figure 14 (see graphics section) shows typical DOT 412/ MC 312 manhole areas.

Many corrosive products do not affect stainless steel and even carbon steel. These may be carried in tanks with piping and valves identical to MC-307/DOT-407 cargo tanks with bottom located emergency valves that are mechanically, air or (more commonly) hydraulically actuated. Pipe lines are generally short and are 3" or 4" diameter and terminate with gate valves or ball valves.

Some products that are viscous such as concentrated Sulfuric Acid or sludge acids are carried in mild steel or stainless steel unlined tanks that use bottom outlets such as flanged type steel plug valves. These valves must be protected by a guard, usually a solid or split bumper.

8.I.6 RESERVED

8.1.7 DATA PLATE ENTRIES

The MC 312 tank data plate, or metal certification plate as identified in 49 CFR, should contain the following information:

1. Vehicle Manufacturer
2. Manufacturer's Serial Number
3. MC Specification, Including Material of Construction
4. Date of Manufacture
5. Original Test Date
6. Certification Date
7. Design Pressure (psi.)
8. Test Pressure (psi.)
9. Head Material
10. Shell Material
11. Weld Material
12. Lining Material
13. Nominal Tank Capacity by Compartment (front to rear) (US Gal.)
14. Maximum Product Load (lbs.)
15. Loading Limits (gpm. and/or psi.)
16. Unloading Limits (gpm. and/or psi.)

DOT 412 Cargo Tanks will have a nameplate containing this information:

1. DOT Specification Number
2. Original Test Date
3. Tank MAWP (psig.)
4. Tank Test Pressure (psig.)

5. Tank Design Temperature Range (°F)
6. Nominal Water Capacity (gal.)
7. Maximum Design Density of Lading (lb./gal.)
8. Shell Material Specification Number
9. Head Material Specification Number
10. Shell Minimum Thickness (in.) (top, side, bottom)
11. Head Minimum Thickness (in.)
12. Manufactured Shell Thickness (in.) (top, side, bottom)*
13. Manufactured Head Thickness (in.)*
14. Weld Material
15. Exposed Surface Area (sq. ft.)

* Required when additional thickness is provided for corrosion allowance

DOT 412 Cargo Tank Motor Vehicles will also have a specification plate containing the following:

1. Cargo Tank Motor Vehicle Manufacturer
2. Cargo Tank Motor Vehicle Certification Date (if different from cargo tank certification date)
3. Cargo Tank Manufacturer
4. Cargo Tank Date of Manufacture
5. Maximum Weight of Lading (lbs.) (maximum payload)
6. Maximum Loading Rate (gpm.) at Maximum Loading Pressure (psig.)
7. Maximum Unloading Rate (gpm.) at Maximum Unloading Pressure (psig.)
8. Lining Material
9. Heating System Design Pressure (psig.), if applicable
10. Heating System Design Temperature (°F), if applicable

8.2 INSPECTION AND TESTS

The following inspections and test are required on MC 312/DOT 412 Cargo Tanks:

INSPECTION	FREQUENCY	REFERENCES (in 49 CFR) AND IN THIS MANUAL
External Visual Inspection	Annual	180.407 (d); Section 5.1
Internal Visual Inspection	5 years	180.407 (e); Section 5.2
If insulated	Annual	
If transporting lading corrosive to the tank	Annual	
Lining Inspections (Only lined tanks transporting lading corrosive to the tank)	Annual	180.407 (f); Section 5.6
Leakage Test	Annual	180.407 (h); Section 5.3
Pressure Retest	5 years	180.407 (g); Section 5.4.
If insulated and no manhole, or insulated & lined)	Annual	
Thickness Test (Unlined tanks in service corrosive to vessel)	2 years	180.407 (l); Section 5.5

SECTION 8: MC312/DOT 412

Any tank with (or suspected to have) shell and head material thickness less than the prescribed minimum requirements, including scrapes or gouges, must receive a thickness measurement test at the time such discrepancy is discovered.

Copies of the checklist/reports needed to accomplish the MC 307/DOT 407 services are enclosed with this manual. Follow the instructions for each inspection or test.

NOTE: Conditions may exist requiring test and inspection of cargo tanks, **irrespective** of the periodic requirements for tests and inspections. Such will be required if:

1. The cargo tank shows evidence of dents, cuts, gouges, corroded or abraded areas or other condition that may make it unsafe,
2. The cargo tank has sustained damage to the extent it may effect its lading retention capability, and
3. The cargo tank has been out of hazardous material service for a year or more. Refer to Paragraph 180.407 (b), for more detail.
4. The Department so requires based on the existence of probable cause that the cargo tank is in an unsafe operating condition

Copies of checklists/reports needed to accomplish the MC 312/DOT 412 Tests and Inspections are included in this section.

8.2.1 EXTERNAL VISUAL INSPECTION

Follow the procedure in Section 5.1 for a thorough inspection of all tank systems.

1. If cargo tank is insulated, an internal inspection must be performed.
2. Inspect tank shell and heads for corroded or abraded areas, dents, distortions, defects in welds and other structural defects apparent through visual detection.
3. If cargo tank is constructed with steel reinforcing rings, thickness test the rings as follows. Measure ring thickness in four symmetrical positions around the circumference. If any reading varies from the average by more than 10%, thickness test shell, internally, in area of shell covered by the ring.
4. Inspect piping, valves and gaskets for corrosion, weld defects, and leakage.
5. Inspect that manhole covers are operative, with no leakage from covers or gaskets.
6. Inspect all emergency devices such emergency valves, self closing stop valves, check valves, excess flow valves, vents and remote operating devices that they are functional and free of corrosion, distortion or other defect which would effect their operation. Verify the remote closure closes the internal valve.
7. Inspect tighten and replace any missing bolts fusible vents, or other safety devices.
8. Inspect that tank markings such as placards, Specification plates, warning and caution signs and Part-180 markings, are present and legible. Replace faded, defaced, torn, or markings or placards not displayed square point on point.
9. Inspect upper coupler, suspension and other structural attachments, and connecting structures, that they are sound and properly secured.. For tanks transporting lading corrosive to the tank vessel material, the upper coupler assembly must be removed and inspected, at least once every two year period, for any condition that might render the cargo tank unsafe.
10. Remove and bench test all spring-loaded pressure relief devices if tank was transporting lading corrosive to the devices or replace them. Otherwise, inspect for damage while installed.
11. Perform thickness test if corroded or abraded areas are present.
12. Record results on the Inspection/checklist, sign and provide to owner.

13. Each on-vehicle, manually-activated, remote shutoff device for closure of the internal self-closing stop valve, must be identified by marking "EMERGENCY SHUTOFF" in letters at least .75 inches in height, in a color that contrasts with its background, and located in an area immediately adjacent to the means of closure. Refer to Paragraph 172.328(d).
14. Add Part-180 marking of (V) if cargo tank qualifies for continuing service.

8.2.2 INTERNAL VISUAL INSPECTION

Review the procedure in Section 5.2 for this inspection, also the thickness testing procedure in Section 5.5. and, if appropriate, the lining inspection procedure in Section 5.6. Use the checklist in this section to ensure attention to all details. Coverage of the following items is a mandatory DOT requirement:

1. Inspect all shell and head surfaces for corrosion, abrasion, dents, distortions, weld defects, or any unsafe condition.
2. If cargo tank is lined, inspect all interior surfaces for blisters or discoloration, then use appropriate spark tester for leak detection. Remove degraded or defective liner areas, then perform shell or head thickness tests in pertinent areas beneath liner.
3. Perform thickness tests on all corroded and abraded areas found in unlined tanks.
4. Record results on the Inspection/checklist, sign and provide to owner.

8.2.3 LINING INSPECTION

Information is provided in Section 5.6 to make sure that all areas are covered and the proper test equipment is used. Use the checklist in this section to ensure attention to all safety and procedural details.

The mandatory DOT requirement is summarized below:

1. Integrity of lining must be verified once each year.
2. After calibrating the probe in accordance with &180.407 (F), pass the probe over the lining in an uninterrupted stroke.
3. Inspect metal beneath any defective parts of the liner that are removed; perform ultrasonic testing (UT) if necessary.
4. Using chalk, mark any leaks for repair.
5. Linings made of other than rubber must be tested in accord with manufacturer instructions.
6. Record results on the Inspection/checklist, sign and provide to owner.

8.2.4 LEAKAGE TEST

Follow the procedure in Section 5.3 to obtain a thorough leak test on all tank systems and components. Use the checklist in this section to ensure attention to all safety and procedural details.

The mandatory DOT requirement is summarized below:

1. Each cargo tank must be leak tested each year.
2. All valves and accessories must be in place and operative.
3. Test pressure is at least 80 percent of design pressure or MAWP and hold time is greater than or equal to five minutes.
4. Product piping must be tested.

5. Tank must pass the test before being returned to service as a spec tank.
6. Provide suitable personnel safeguards in event of a structure failure.
7. Test failure precludes return to service as a spec cargo tank.
8. Record results on the Inspection/checklist, sign and provide to owner

Section 5.3 contains test equipment and procedural information on leak testing, which can be a hydrostatic or pneumatic test. Review Section 5.3, then make the choice as to whether a hydrostatic or pneumatic procedure will be used. Review 49 CFR 180.411 before completing the "Tank Disposition" entry.

Have explosimeters, oxygen level detectors, and ventilation ducts available if it becomes necessary to enter the tank.

COMPANY TANK ENTRY SAFETY PROCEDURES AND ALL OSHA REGULATIONS MUST BE COMPLIED WITH.

If hydrostatic procedure is used, remember that water will weigh 8.3 pounds/gallon. Provide adequate support for this load under the fifth wheel upper coupler assembly. Also, make sure all water is removed from the tank systems after test.

8.2.5 PRESSURE RETEST

An external visual inspection (Section 8.2.1) and an internal visual inspection (Section 8.2.2) must be accomplished concurrent with the pressure retest.

All tanks in this category must undergo pressure retest once every five years. Test pressure for MC 310, 311, 312 tanks is 3 psi. or, 1.5 times design pressure (whichever is greater); test pressure for DOT 412 tanks is 1.5 x MAWP. Hold time varies as to whether a hydrostatic or pneumatic procedure is used.

All spring-actuated vents must be removed, inspected, and bench tested as part of the service. For the test, all vents should be removed and openings blanked or flanged-off. Operation of all vents must be restored before returning the tank to service.

If hydrostatic procedure is used, make sure that support is provided in the upper coupler area adequate to support weight of tank. The fifth wheel plate is removed for this test, complicating the method of support.

The mandatory DOT requirement for **hydrostatic** is as follows:

1. Tank, including domes, must be filled with water.
2. Areas covered by the upper coupler assembly must be inspected for corroded and abraded areas, dents, distortions, defects in welds, and any other condition that might render the tank unsafe. THE UPPER COUPLER ASSEMBLY MUST BE REMOVED FROM THE CARGO TANK FOR THIS INSPECTION. **NOTE: ONLY FOR NON-INSULATED CARGO TANKS OR WHEN THE AREA OF THE TANK ABOVE THE UPPER COUPLER CANNOT BE INSPECTED DURING THE PRESSURE TEST.**
3. Test liquid temperature: not over 100 °F.
4. Test pressure is specified (Table 2, Section 5.4 herein).
5. Gauge pressure at top of tank.
6. Hold time: 10 minutes.
7. Inspect for leakage, bulging or other defects.
8. Record results on the Inspection/checklist, sign and provide to owner.

The mandatory DOT requirement for **pneumatic** is as follows:

1. Use air or a similar gas. Air pressure source should be equipped with a pressure regulator set just above test pressure to prevent accidental over pressurizing the vessel.
2. Areas covered by the upper coupler assembly, must be inspected for corroded and abraded areas, dents, distortions, defects in welds, and any other condition that might render the tank unsafe. The upper coupler assembly must be removed during this test and the area covered by the upper coupler inspected. **NOTE: ONLY FOR NON-INSULATED CARGO TANKS OR WHEN THE AREA OF THE TANK ABOVE THE UPPER COUPLER CANNOT BE INSPECTED DURING THE PRESSURE TEST.**
3. Pressure up to one-half of test pressure, then increase pressure in one-tenth increments until full test pressure is attained.
4. Hold for five minutes.
5. Reduce pressure to MAWP.
6. Maintain MAWP while tank surfaces are inspected.
7. Use approved method for leak detection, e.g., ultrasonic detector, soap-and-water solution, etc.
8. Maintain a safe position while inspecting a vessel under pneumatic pressure.
9. Record results on the Inspection/checklist, sign and provide to owner.

For either procedure, a tank cannot be returned to service if it leaks, fails to retain test pressure, shows distortion, excessive permanent expansion, or other structural defects until all such defects are repaired or corrected. Review the safety instructions and procedures in Section 5.4, then use the checklist/test reports that follows.

8.2.6 THICKNESS TESTING

Thickness testing of MC 312/DOT 412 tanks is required if the cargo tank has transported materials corrosive to the tank. Not necessarily because they have transported materials placarded as corrosive. See 49 CFR 180.407(i). Many corrosive materials do not corrode shell materials, for instance neither Nitric Acid nor Caustic Soda corrodes stainless steel, and transporting them may not trigger the need for a thickness test. Conversely, other materials not normally thought of as corrosive nor placarded as a corrosive can cause pitting or selective corrosion due to small amounts of (for instance) free chlorines.

If it is determined that a thickness test should be performed, due to either the transportation of materials known to attack the shell of head material, or because an inspection indicates corrosion has taken place, a thorough thickness test should be performed as described in Section 5.5. Use the ultrasonic thickness testing report form included in this section to make the appropriate readings and for documentation.

While only specific small areas may be suspected, the mandatory requirement is coverage of the following, as a minimum:

1. Areas of the shell and heads and areas around any piping that retains lading.
2. Areas of high shell stress, such as the bottom center of the tank and areas over the suspension and fifth wheel.
3. Areas near openings.
4. Areas around weld joints.
5. Areas around shell reinforcements.
6. Areas around appurtenance attachments.
7. Areas near upper coupler assembly attachments.

8. Areas near suspension system attachments and connecting structures.
9. Known thin areas in the tank shell and nominal liquid level lines.

If thickness testing reveals conditions that will prohibit return of the tank to HM service, the tank owner must decide if repair is an economic practicality, or if the tank must be disposed of. Options available include: (1) repair if practical, (2) If thinning is general, downgrade to a lower density rating, (3) downgrade the tank to non-specification status. Review &180.407 (I) (5) and (6) as well as &180.411 (a) before making final entry in "Tank Disposition" on test report. **NOTE: ONLY A DCE CAN DOWNGRADE THE TANK AND MAKE CHANGES TO THE SPECIFICATION PLATE.**

TEST & INSPECTION REPORT FORMS:

Included below are forms designed to help tank mechanics assure compliance with DOT requirements for each type of test or inspection, and in many cases include optional items we believe are important to good tank maintenance. These forms are available from the National Tank Truck Carriers, Inc. or they may be reproduced from this manual.

MC 312/DOT 412 CHECKLIST/INSPECTION REPORT FOR EXTERNAL VISUAL INSPECTION (page 1 of 3)

CARRIER/OWNER _____ DATE_____

FLEET # _____ SERIAL/VIN # _____C.T. MFG _____

DOT SPEC NO. _____ MATL. _____DATE MFG._____

MAWP_____ psi. TEST PRESS. _____psi MINIMUM THICKNESS SHELL_____HEADS_____.

COMPARTMENT SIZES, F to R 1,_____ 2, _____ 3, _____ 4, _____ 5, _____ GAL.

TOTAL CAPACITY. _____GAL,. DBL. BULKHEADS? _____ INSULATED? _____LINED?_____

TYPE SERVICE: CORROSIVE TO SHELL?_____DEDICATED SERVICE?_____PRODUCT_____

DOT mandatory items indicated with "M" on checklist.

Item No.	Activity	Complies	Repairs Needed	See Remarks
1	Data Plate: Tank attachment, entries legible, no paint, corrosion	_____	_____	_____
	NON-INSULATED TANK:			
2M	Shell and Heads: Condition of welds, dents, gouges, corrosion or abrasion, possible need for Thickness Testing. Obvious structural defects in shell, rings, frames, outriggers, X members and welds.	_____	_____	_____
	INSULATED TANK:			
3M	Internal inspection of shell and heads, areas around manhole, tank fittings valve outlets, pitting or corrosion, deformation at rings or over the fifth wheel and suspension area. Perform thickness test if condition merits.	_____	_____	_____
4	Outer Jacket: Condition of attachments, dents, digs, scrapes, gouges, perforations, loose sheets and fastening devices.	_____	_____	_____
	ALL UNITS:			
5M	If cargo tank is fabricated with a steel shell and steel external rings, thickness test the rings as follows. Measure ring thickness in four symmetrical positions around the circumference. If any reading varies from the average by more than 10%, thickness test shell, internally, in area of shell covered by the ring.	_____	_____	_____
6M	Upper Coupler Assembly: Condition of plate, corrosion, deformation, and lubrication, bolt tightness, king pin wear or deformation. (Every two years if transporting material corrosive to tank) Examined	_____ In Place	_____ Removed	_____
7	Landing Gear: Corrosion and rust, condition of welds, frame distortion above gear, bolt tightness, support braces secure and gear operation.	_____	_____	_____
8	Void Areas: Signs of corrosion, fittings and drains unplugged and operable	_____	_____	_____

FIGURE 80-1.0
MC 312/DOT 412 CHECKLIST/INSPECTION REPORT FOR
EXTERNAL VISUAL INSPECTION (page 2 of 3)

Item No.	Activity	Repairs Complies	See Needed	Remarks
9	Placard Holders & caution signs: Attachment to tank, condition of clips and hinges, condition & color of decals suggest replacement if poor.			
10M	Bolted Attachments: Suspension, landing gear structure, cabinets ladders, fenders, rear bumper and other important components			
11	Hose Tubes, Troughs or Racks: Condition of tube, end doors latches and tie-downs.			
12M	Piping Valves & Gaskets: Check security of pipe hangers, bolted joints and gaskets, operation of valves, adapters and caps.			
13M	Internal Valve Operation: (if so equipped), Three means of closure, normal, remote and thermal. Check valve operation, hydraulic or air leaks, cable adjustment if so equipped.			
14M	External stop valve, top or bottom mounted, check function of valve if securely mounted and protected by bumper or guard.			
15M	Air unloading lines or vapor recovery system. Check security of all lines condition of valves and connectors.			
16	Pumps or Compressors: Security of mounting and connecting hardware, including hoses fittings and gauges.			
17	Ladders, vertical rails straight and structurally sound. Rungs, clear of obstructions which limit toe clearance and rungs secure to verticals. mounting to tank body secure.			
18	Gauging Devices (if present) check operation and mounting			
19M	Manhole Area: Evidence of leakage, impact damage to covers or fittings condition of cover gaskets, hold down fittings and hinges, overturn protection structure is appropriate, manhole dam, drains and hoses OK.			
20M	Pressure Relief Devices: Verify all vents present, verify venting capacity adequate for tank size, check vent connections to tank. Visually check rupture disc if present, remove and bench test vents if questionable.			

Carrying lading corrosive to tank:

Emergency Vent Performance:

Type of device:

Compartment: 1_____, 2_____, 3_____

Set to discharge pressure: 1,_____2,_____3,_____

Pressure device opened: 1,_____2,_____3,_____

Pressure at which device re-seated: 1,_____2,_____ _3,_____

Disposition of the device (Mark X): reinstalled _____, repaired, or replaced_____

21M Supply "Emergency Shutoff" decal near internal or external remote closure device per Para. 172.328(d) after October 3, 2004. _____ _____ _____

22M Tank Markings: Date (month and year) and service symbol (V) if cargo tank is qualified for return to service. _____ _____ _____

MC 312/DOT 412 CHECKLIST/INSPECTION REPORT FOR EXTERNAL VISUAL INSPECTION (page 3 of 3)

REMARKS (use additional sheets if necessary)

_____

_____

_____

_____

_____

_____ _____

Defects found and corrected._____

_____

_____

Disposition of unit: Return to service_____ Removed From Service_____

Inspector or CT Facility	Cargo Tank Owner or Representative
Name _____	Name _____
Address _____	Address _____
_____	_____
Signed _____	Signed _____
Date _____	Date _____
DOT CT # _____	DOT MCID# _____ (If appropriate)

IMPORTANT: This certification must be signed by both the Inspection Agency and the cargo tank owner and it must be retained in the Owner's equipment file throughout his ownership and one year thereafter.

SECTION 8: MC312/DOT 412

MC 312/DOT 412 CHECKLIST/INSPECTION REPORT FOR INTERNAL VISUAL INSPECTION (page 1 of 2)

CARRIER/OWNER _____ DATE_____

FLEET # _____ SERIAL/VIN # _____ C.T. MFG _____

DOT SPEC NO. _____ MATL. _____ DATE MFG._____

MAWP_____ psi. TEST PRESS. _____psi MINIMUM THICKNESS SHELL_____HEADS_____.

COMPARTMENT SIZES, F to R 1,_____ 2, _____ 3, _____ 4, _____ 5, _____ GAL.

TOTAL CAPACITY. _____GAL,. DBL. BULKHEADS? _____ INSULATED? _____LINED?_____

TYPE SERVICE: CORROSIVE TO SHELL?_____DEDICATED SERVICE?_____PRODUCT_____

DOT mandatory items indicated with "M" on checklist.

WARNING! PRIOR TO ENTERING TANK, BE SURE INTERIOR IS FREE OF HARMFUL VAPORS AND HAS SAFE LEVEL OF OXYGEN PRESENT. COMPLY WITH ALL COMPANY AND REGULATORY REQUIREMENTS FOR WORK IN CONFINED SPACES.

Item No.	Activity	Complies	Repairs Needed	See Remarks
1M	Internal inspection of the shell and heads, areas around manhole, tank fittings valve outlets and internal sumps for pitting or corrosion, look for discoloration of material. Check for deformation over rings, fifth wheel and suspension area. Perform thickness test if condition merits.	_____	_____	_____
2M	Welds: Inspect internal welds in tank, look for pits, bleeding stains from welds. Check for cracks and buckles give special attention to girth seams, head to shell welds, at areas over fifth wheel and suspension area, and at rings and heating sections. See Section 5 of this Manual regarding "lap patches".	_____	_____	_____
3	Piping and Valves: Check installation tightness of fittings and valves Check valve function, condition of flanges, gaskets and piping support brackets. Inspect for foreign matter in sumps or valves	_____	_____	_____
4	If tank is a multi compartment, ASME Code Stamped vessel, inspect void area and wrapper band as much as possible for accumulation of product and cracks in girth band welds.	_____	_____	_____
5M	Tank Markings: Date (month and year) and service symbol (I) if cargo tank is qualified for return to service.	_____	_____	_____

MC 312/DOT 412 CHECKLIST/INSPECTION REPORT FOR INTERNAL VISUAL INSPECTION (page 2 of 2)

REMARKS (use additional sheets if necessary)

_____

_____

_____

_____

Defects found and corrected._____

_____

_____

_____

_____

Disposition of unit: Return to service_____ Removed From Service_____

Inspector or CT Facility	Cargo Tank Owner or Representative
Name _____	Name _____
Address _____	Address _____
_____	_____
Signed _____	Signed _____
Date _____	Date _____
DOT CT # _____	DOT MCID # _____ (If appropriate)

IMPORTANT: This certification must be signed by both the Inspection Agency and the cargo tank owner and it must be retained in the Owner's equipment file throughout his ownership and one year thereafter.

MC 312/DOT 412 CHECKLIST/INSPECTION REPORT FOR LINING INSPECTION (page 1 of 2)

CARRIER/OWNER _____ DATE_____

FLEET # _____ SERIAL/VIN # _____C.T. MFG _____

DOT SPEC NO. _____ MATL. _____DATE MFG._____

MAWP_____ psi. TEST PRESS. _____psi MINIMUM THICKNESS SHELL_____HEADS_____.

COMPARTMENT SIZES, F to R 1,_____2, _____ 3, _____ 4, _____ 5, _____ GAL.

TOTAL CAPACITY. _____GAL,. DBL. BULKHEADS? _____ INSULATED? _____LINED?_____

TYPE SERVICE: CORROSIVE TO SHELL?_____DEDICATED SERVICE?_____PRODUCT_____

DOT mandatory items indicated with "M" on checklist.

Item No.	Activity	Complies	Repairs Needed	See Remarks
1	Dry tank interior surfaces	_____	_____	_____
2	Conduct visual inspection of all surfaces. Check for lining discoloration, product stains, blisters, and lining separation around baffles and bulkheads, corners and recesses, along all seams. Record locations in Remarks	_____	_____	_____
3	Conduct a 1 to 3 psi., low,-pressure, leak test of compartment. Correct all leaks and record location. Exhaust pressure in tank.	_____	_____	_____
4M	If rubber lining, calibrate spark tester (outside the tank) If lining not rubber, use method recommended by Lining Applicator	_____	_____	_____
5M	Pass probe over all lining surfaces. Repeat passes over suspect areas and all areas identified in Item 2. Record location of lining defects (if any) in Remarks in a manner that can be correlated with external locations., **Holding the probe stationary may burn a hole through the lining.**	_____	_____	_____
6M	If degraded or defective parts of liner are removed, inspect exposed metal thoroughly & perform thickness test.	_____	_____	_____
7	Remove all equipment from tank, then inspect to make sure tank is clear, clean and free of foreign materials	_____	_____	_____
8M	Tank Markings: Date (month and year) and service symbol (L) if cargo tank qualified for return to service	_____	_____	_____

MC 312/DOT 412 CHECKLIST/INSPECTION REPORT FOR LINING INSPECTION (page 2 of 2)

REMARKS (use additional sheets if necessary)

_____

_____

_____

_____

Defects found and corrected._____

_____

_____

Disposition of unit: Return to service_____ Removed From Service_____

Inspector or CT Facility	Cargo Tank Owner or Representative
Name _____	Name _____
Address _____	Address _____
_____	_____
Signed _____	Signed _____
Date _____	Date _____
DOT CT # _____	DOT MCID # _____ (If appropriate)

IMPORTANT: This certification must be signed by both the Inspection Agency and the cargo tank owner and it must be retained in the Owner's equipment file throughout his ownership and one year thereafter.

MC 312/DOT 412 CHECKLIST/TEST REPORT FOR HYDROSTATIC LEAK TEST (page 1 of 2)

CARRIER/OWNER _____ DATE_____

FLEET # _____ SERIAL/VIN # _____C.T. MFG _____

DOT SPEC NO. _____ MATL. _____DATE MFG._____

MAWP_____ psi. TEST PRESS. _____psi MINIMUM THICKNESS SHELL_____HEADS_____.

COMPARTMENT SIZES, F to R 1,_____ 2, _____ 3, _____ 4, _____ 5, _____ GAL.

TOTAL CAPACITY. _____GAL,. DBL. BULKHEADS? _____ INSULATED? _____LINED?_____

TYPE SERVICE: CORROSIVE TO SHELL?_____DEDICATED SERVICE?_____PRODUCT_____

DOT mandatory items indicated with "M" on checklist.

Item No.	Activity	Complies	Repairs Needed	See Remarks
	NOTE: If compartmented, each compartment must be tested with adjacent compartments empty.			
	CAUTION: Be sure to level and support tank in view of the weight of water.			
1M	Close external valves, leave tank primary stop valve open, fill tank, or compartment and product lines with manhole cover open. Inspect tank for obvious leaks before pressurizing tank.	_____	_____	_____
2M	Close manhole cover and apply water pressure at top of tank, and adjust pressure in 5 psi. increments, to 80% of the cargo tank MAWP When pressure is stabilized, inspect for leaks or distortions. All Fittings and vents shall be in place during test.	_____ Actual Test Pressure_____psi.	_____	_____
3M	Inspect all surfaces and components for leaks, give particular attention to manhole assembly area.	_____	_____	_____
4M	With any leaks identified and repaired, hold test pressure for 5 minutes	_____	_____	_____
5	While tank is still pressurized, close internal or tank stop valve. open external valves, drain product lines and monitor for leaks past internal valve.	_____	_____	_____
6M	Tank Markings: Date (month and year) and service symbol (K) if cargo tank qualified for return to service.	_____	_____	_____

MC 312/DOT 412 CHECKLIST/TEST REPORT FOR

HYDROSTATIC LEAK TEST (page 2 of 2)

REMARKS (use additional sheets if necessary)

_____

_____

_____

_____

Defects found and corrected._____

_____

_____

Disposition of unit: Return to service_____ Removed From Service_____

Inspector or CT Facility	Cargo Tank Owner or Representative
Name _____	Name _____
Address _____	Address _____
_____	_____
Signed _____	Signed _____
Date _____	Date _____
DOT CT # _____	DOT MCID # _____ (If appropriate)

IMPORTANT: This certification must be signed by both the Inspection Agency and the cargo tank owner and it must be retained in the Owner's equipment file throughout his ownership and one year thereafter.

MC 312/DOT 412 CHECKLIST/TEST REPORT FOR PNEUMATIC LEAK TEST (page 1 of 2)

CARRIER/OWNER _____ DATE_____

FLEET # _____ SERIAL/VIN # _____C.T. MFG _____

DOT SPEC NO. _____ MATL. _____DATE MFG._____

MAWP_____ psi. TEST PRESS. _____psi MINIMUM THICKNESS SHELL_____HEADS_____.

COMPARTMENT SIZES, F to R 1,_____ 2, _____ 3, _____ 4, _____ 5, _____ GAL.

TOTAL CAPACITY. _____GAL,. DBL. BULKHEADS? _____ INSULATED? _____LINED?_____

TYPE SERVICE: CORROSIVE TO SHELL?_____DEDICATED SERVICE?_____PRODUCT_____

DOT mandatory items indicated with "M" on checklist.

Item No.	Activity	Complies	Repairs Needed	See Remarks
	NOTE: If compartmented, each compartment must be tested with the adjacent compartments empty and at atmospheric pressure			
	CAUTION: Test Pressures for this family of tanks can be fairly high. Be sure you understand the dangers which can be associated with large volumes of air at these pressures. Use pressure regulator on air source to prevent accidental over pressuring of tank.			
1	Perform leak detection procedures at 3 to 5 psi. to locate and correct any existing leaks prior to application of full test pressure. The manhole cover must be in place for this test, Applying pressure through a dust cover cap on the outlet line, is convenient for this test.	_____	_____	_____
2M	Close manhole, and product valves, open internal, or tank stop valve, and induce air pressure, raise pressure to required test pressure of 80% of MAWP, pausing at 50% and 75% of test pressure, to inspect for leaks, or other problems. All vents and fittings are to be in place for this test. Actual Test Pressure_____psi.	_____	_____	_____
	WARNING: When inspecting, keep in a position of safety and respect the power of compressed air. Any leaks will be obvious at these pressures			
3M	With tank at test pressure make a careful inspection for leaks, particularly in the manhole area and of piping and fittings. Hold pressure for 5 minutes	_____	_____	_____
4	With tank at test pressure, close internal or tank stop valve, and vent outlet line, then close outlet valve. A pressure build up in the line is evidence of leaking past internal or external stop valve.	_____	_____	_____
5M	Tank Markings: Date (month and year) and service symbol (K) if tank qualified for return to service.	_____	_____	_____

MC 312/DOT 412 CHECKLIST/TEST REPORT FOR PNEUMATIC LEAK TEST (page 2 of 2)

REMARKS (use additional sheets if necessary)

_____

_____

_____

_____

Defects found and corrected._____

_____

_____

Disposition of unit: Return to service_____ Removed From Service_____

Inspector or CT Facility	Cargo Tank Owner or Representative
Name _____	Name _____
Address _____	Address _____
_____	_____
Signed _____	Signed _____
Date _____	Date _____
DOT CT # _____	DOT MCID # _____ (If appropriate)

IMPORTANT: This certification must be signed by both the Inspection Agency and the cargo tank owner and it must be retained in the Owner's equipment file throughout his ownership and one year thereafter.

MC 312/DOT 412 CHECKLIST/TEST REPORT FOR HYDROSTATIC PRESSURE RETEST (page 1 of 2)

CARRIER/OWNER _____ DATE_____

FLEET # _____ SERIAL/VIN # _____C.T. MFG _____

DOT SPEC NO. _____ MATL. _____DATE MFG._____

MAWP_____ psi. TEST PRESS. _____psi MINIMUM THICKNESS SHELL_____HEADS_____.

COMPARTMENT SIZES, F to R 1,_____ 2, _____ 3, _____ 4, _____ 5, _____ GAL.

TOTAL CAPACITY. _____GAL,. DBL. BULKHEADS? _____ INSULATED? _____LINED?_____

TYPE SERVICE: CORROSIVE TO SHELL?_____DEDICATED SERVICE?_____PRODUCT_____

DOT mandatory items indicated with "M" on checklist.

Item No.	Activity	Complies	Repairs Needed	See Remarks

NOTE: This test must be performed in conjunction with an External and Internal Visual inspection. If unit is a cargo tank motor vehicle, its upper coupler plate must be removed and the area covered by the upper coupler inspcted. If compartmented, each compartment must be tested with adjacent compartments empty.

CAUTION: Be Sure to level and support cargo tank in view of the heavy weight of water.

1M Remove, inspect, and bench test all re-closing vents. Blank off vent. openings, and any other openings necessary to seal vessel. Manhole covers must be in place for this test. _____ _____ _____

Emergency Vent Performance:

Type of device:

Compartment: 1_____, 2_____, 3_____

Set to discharge pressure: 1,_____2,_____3,_____

Pressure device opened: 1,_____2,_____3,_____

Pressure at which device re-seated: 1,_____2,_____ _3,_____

Disposition of the device (Mark X): reinstalled _____ , repaired, or replaced_____

2M Upper Coupler Assembly: Condition of plate, corrosion, deformation. and lubrication, bolt tightness, king pin wear or deformation. Examined _____ In Place_____Removed_____

3M Close external valves, leave internal or tank stop valve open, and fill tank to top of manhole collar with manhole cover open. Check for obvious leaks before pressurizing vessel. _____ _____ _____

4M Close manhole cover and pressurize tank up to test pressure. A dust cap on the outlet line is a good choice. Raise pressure using a small diameter water line to provide sensitive control. Raise pressure slowly, watch _____ _____ _____

vessel carefully until test pressure is attained, 1-1/2 times MAWP. Actual Test Pressure_____psi.

5M	Close off pressure source and observe for pressure drop, find and correct any leaks, if necessary. Inspect all fittings, manhole area and other visible shell and head surfaces, particular attention to area over fifth wheel, Hold pressure for 10 minutes.	_____	_____	_____
6M	With tank at test pressure, close internal or tank stop valve, drain outlet line and observe for leaking past primary valve.	_____	_____	_____
7M	Drain and dry tank, reinstall fifth wheel plate and all removed fittings.	_____	_____	_____
8M	Tank Markings: Date (month and year) and service symbol (P)(V)(I) if tank qualifies for return to service.	_____	_____	_____

MC 312/DOT 412 CHECKLIST/TEST REPORT FOR HYDROSTATIC PRESSURE RETEST (page 2 of 2)

REMARKS (use additional sheets if necessary)

_____

_____

_____

_____

Defects found and corrected._____

_____

_____

Disposition of unit: Return to service_____ Removed From Service_____

Inspector or CT Facility

Name _____

Address _____

_____

Signed _____

Date _____

DOT CT # _____

Cargo Tank Owner or Representative

Name _____

Address _____

_____

Signed _____

Date _____

DOT MCID # _____

(If appropriate)IMPORTANT: This certification must be signed by both the Inspection Agency and the cargo tank owner and it must be retained in the Owner's equipment file throughout his ownership and one year thereafter.

MC 312/DOT 412 CHECKLIST/TEST REPORT FOR PNEUMATIC PRESSURE RETEST (page 1 of 2)

CARRIER/OWNER _____ DATE_____

FLEET # _____ SERIAL/VIN # _____C.T. MFG _____

DOT SPEC NO. _____ MATL. _____DATE MFG._____

MAWP_____ psi. TEST PRESS. _____psi MINIMUM THICKNESS SHELL_____HEADS_____.

COMPARTMENT SIZES, F to R 1,_____ 2, _____ 3, _____ 4, _____ 5, _____ GAL.

TOTAL CAPACITY. _____GAL,. DBL. BULKHEADS? _____ INSULATED? _____LINED?_____

TYPE SERVICE: CORROSIVE TO SHELL?_____DEDICATED SERVICE?_____PRODUCT_____

DOT mandatory items indicated with "M" on checklist.

Item No.	Activity	Complies	Repairs Needed	See Remarks

NOTE: This test must be performed in conjunction with an External and Internal Visual Inspection. If unit is A cargo tank motor vehicle, its upper coupler plate must be removed. If compartmented, each compartment must be tested with the adjacent compartments at atmospheric pressure.

CAUTION:
Test pressures for this family averages from 37.5 to 52.5 psi. or higher. If you choose the pneumatic method, be sure you understand the dangers associated with large volumes of air at this pressure.

1M Remove, inspect, and bench test all re-closing vents. Blank off vent openings, and any other openings necessary to seal vessel. Manhole cover must be in place for this test. _____ _____ _____

Emergency Vent Performance:

Type of device:

Compartment: 1_____, 2_____, 3_____

Set to discharge pressure: 1,_____2,_____3,_____

Pressure device opened: 1,_____2,_____3,_____

Pressure at which device re-seated: 1,_____2,_____ _3,_____

Disposition of the device (Mark X): reinstalled _____, repaired, or replaced_____

2M Upper Coupler Assembly: Condition of plate, corrosion, deformation. and lubrication, bolt tightness, king pin wear or deformation. Examined _____ In Place_____ Removed_____

3 Close external valves, leave internal or tank stop valve open and close manhole, then introduce air pressure to tank. For safety reasons, air source _____ _____ _____

should be controlled by a regulator set just above test pressure. Conduct low pressure leak test at 3 to 5 psi.

WARNING: **Keep In a safe position while inspecting tank. Leaks will be obvious at these pressures**

4M Raise pressure in tank or compartment in stages with cursory inspections at each level as follows, 50, 60, 70, 80, 90, and at 100%. Hold pressure for 5 minutes. If pressure stable, test is successful _____ _____ _____

Actual Test Pressure_____psi.

5M Restore operation of all vents.

6M Tank Markings: Date (month and year) and service symbol (P)(V)(I) if cargo tank qualified for return to service. _____ _____ _____

MC 312/DOT 412 CHECKLIST/TEST REPORT FOR PNEUMATIC PRESSURE RETEST (page 2 of 2)

REMARKS (use additional sheets if necessary)

_____

_____

_____

_____

Defects found and corrected._____

_____

_____

Disposition of unit: Return to service_____ Removed From Service_____

Inspector or CT Facility	Cargo Tank Owner or Representative
Name _____	Name _____
Address _____	Address _____
_____	_____
Signed _____	Signed _____
Date _____	Date _____
DOT CT # _____	DOT MCID# _____ (If appropriate)

IMPORTANT: This certification must be signed by both the Inspection Agency and the cargo tank owner and it must be retained in the Owner's equipment file throughout his ownership and one year thereafter.

MC 312/DOT 412 CHECKLIST/TEST REPORT FOR ULTRASONIC THICKNESS TESTING (page 1 of 2)

FLEET # _____ SERIAL/VIN # _____ C.T. MFG _____

DOT SPEC NO. _____ MATL. _____ DATE MFG. _____

MAWP _____ psi. TEST PRESS. _____ psi MINIMUM THICKNESS SHELL _____ HEADS _____.

COMPARTMENT SIZES, F to R 1, _____ 2, _____ 3, _____ 4, _____ 5, _____ GAL.

TOTAL CAPACITY. _____ GAL,. DBL. BULKHEADS? _____ INSULATED? _____ LINED? _____

TYPE SERVICE: CORROSIVE TO SHELL? _____ DEDICATED SERVICE? _____ PRODUCT _____

DOT mandatory items indicated with "M" on checklist.

Item No.	Activity	Complies	Repairs Needed	See Remarks
	WARNING: PRIOR TO ENTERING TANK, BE SURE INTERIOR IS FREE OF CHEMICAL OR FLAMMABLE VAPORS, AND HAS A SAFE LEVEL OF OXYGEN PRESENT. COMPLY WITH ALL COMPANY AND REGULATORY REQUIREMENTS FOR WORK IN CONFINED SPACES.			
1	Clean, dry or buff down to bare metal all surfaces to be measured	_____	_____	_____
2	Calibrate thickness tester with coupon representative of shell material and thickness.	_____	_____	_____
3M	Use test grid as described in Graphics Section, Fig. 4, or similar pattern. Grid selected should provide adequate coverage of the vessel in areas over the 5th wheel, suspension, manhole and valve areas plus locations near shell stiffeners, near welds around fittings and the liquid level line and any other suspected areas.	_____	_____	_____
4M	Record readings on thickness documentation form shown in Graphics Section, Figure 4, Sheet 2, or on a similar form.	_____	_____	_____
5M	Tank Markings: Date (month and year) and service symbol (T) if cargo tank qualified for return to service.	_____	_____	_____

MC 312/DOT 412 CHECKLIST/TEST REPORT FOR ULTRASONIC THICKNESS TESTING (page 2 of 2)

REMARKS (use additional sheets if necessary)

_____

_____

_____

_____

Defects found and corrected._____

_____

_____

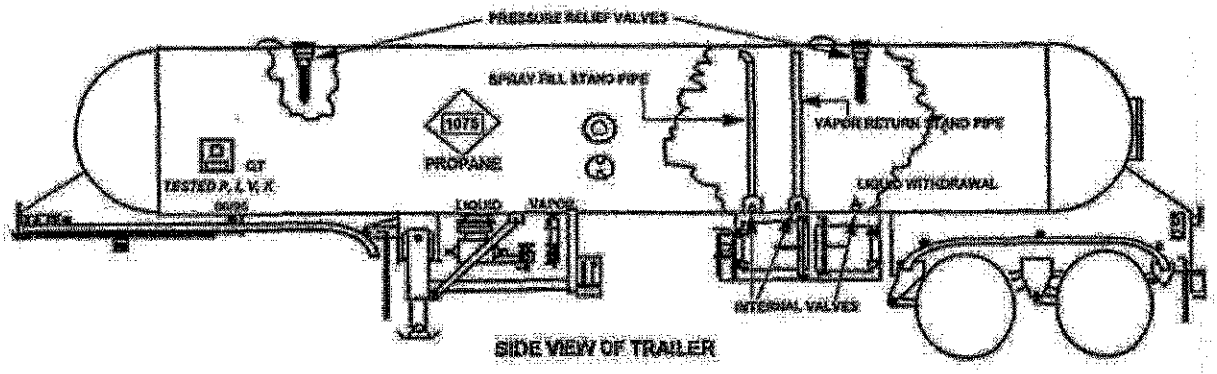
Disposition of unit: Return to service_____ Removed From Service_____

Inspector or CT Facility	Cargo Tank Owner or Representative
Name _____	Name _____
Address _____	Address _____
_____	_____
Signed _____	Signed _____
Date _____	Date _____
DOT CT # _____	DOT MCID # _____ (If appropriate)

IMPORTANT: This certification must be signed by both the Inspection Agency and the cargo tank owner and it must be retained in the Owner's equipment file throughout his ownership and one year thereafter.

SECTION 9: MC331

SECTION 9: MC330 AND MC331 CARGO TANKS



9.0 MC 330 and MC-331 CARGO TANKS

(Reference: 49 CFR 178.337, Specification MC-331 cargo tanks)

MC-331 cargo tank motor vehicles (CTMV's) both transports and bobtails account for approximately ten percent of all the HM CTMV's used in the United States. This estimate includes the predecessor of the MC-331, the MC-330, which was manufactured until 1968.

MC-330 and 331 CTMV's are used to transport liquefied compressed gasses under pressure and also certain other dangerous goods such as pyrophoric liquids. The compressed gasses transported include but are not limited to propane (probably the most popular), butane, anhydrous ammonia, refrigerants, aerosol propellants, sulfur dioxide, methylamines, chlorine, and carbon dioxide. MC 331 units are sometimes lined to keep products pure, and are sometimes jacketed and insulated to either keep products cold, or, in the case of chemicals which are poisonous by inhalation, for added puncture resistance and fire protection. Because the hazard potential for most MC-331 commodities is high, care should be exercised to ensure leak free operation of all valves and piping systems.

The product handling systems employed are constant pressure closed loops. Loading and unloading is accomplished by creating differential pressure between the cargo tank and either the storage or receiving vessel. This differential pressure can be created with the use of a pump or compressor, either stationary (mounted at the load site) or mounted on the CTMV. CTMV mounted pumps are usually driven direct incorporating a power-take-off (PTO) from the engine or the PTO is used to operate a hydraulic motor that is used to operate the pump. Each drive system has various positive and negative aspects. This section's cover sheet is a labeled view of a typical MC-331 transport showing various points of interest on the inside and outside of the unit.

9.1 DESIGN CHARACTERISTICS

MC-331 tanks must be designed and constructed in accordance with the edition of the ASME Code currently accepted by the DOT. In addition to the calculated shell and head thickness requirements generated by the ASME Code, additional calculations must be performed to check compliance with the structural integrity requirements contained in 49CFR 178.337-3. These additional considerations are necessary because of the dynamic loads that are exerted on the shell and heads of the CTMV because the pressure vessel sometimes acts as the frame of the vehicle in addition to containing product.

SECTION 9: MC331

9.1.1 DESIGN PRESSURE

Design Pressure cannot be less than 100 PSI. nor more than 500 PSI., however, the most common design pressures used are 250 PSI for propane and 265 PSI for anhydrous ammonia. The design pressure requirements for various commodities can be found at 49 CFR 173.315.

9.1.2 MATERIAL OF CONSTRUCTION

The most common material used in the fabrication of MC 331 transports is carbon steel. Various types and grades of carbon steel are used depending on factors such as corrosion resistance, minimum design metal temperature of the vessel, and tare weight. When ambient temperatures apply and maximum payload is required, quenched and tempered steels (QT steels) are used. These steels have had their tensile properties enhanced by special thermal treatments which permit the design engineers to use thinner shell and head plates for a given pressure requirement. This reduction in shell thickness reduces the weight of the shell, thereby increasing the cargo capacity of the transport. Typical thickness used in the fabrication of a 250 PSI. vessel are 0.375 inch (9.52mm) for shell plates and 0.250 inch (6.35 mm) for hemispherical heads. In no case can steel shell plates less than 0.187 inch (4.76 mm) or aluminum shell plates less than 0.270 inch (6.86 mm) be used for construction.

Other materials such as aluminum and stainless steel are authorized for construction and are used where low temperature service or product contamination is a problem. Anhydrous hydrogen chloride, for example, is shipped as a refrigerated liquid at low temperatures (-50 degrees F.) and requires the use of special steel in fabrication so that the minimum design metal temperature of the vessel is adequate (-100 degrees F.).

Most vessels of this type undergo some level of weld examination and are post weld heat treated after welding. Weld examination is usually by radiography (x-ray). QT steel vessels must also be examined using the wet fluorescent magnetic particle method ("black light inspection"" immediately prior to and in conjunction with the initial hydrostatic test.

9.1.3 MANHOLES

All MC-331 vessels fabricated after April 21, 1994 must have a manway which complies with paragraph UG-48 (g)(1) of the ASME Code. On tanks manufactured after June 30, 1979 this manway cannot be located in the front head of the vessel. Manways are usually located in the center top of the rear head.

9.1.4 PRESSURE RELIEF DEVICES

Called vents in similar applications for tanks transporting other hazardous liquids, MC-331 vents are called relief valves. A sample relief valve is shown in Figure 15 (see graphics section). Relief valves must be designed, constructed, and marked for a rated pressure not less than the tank design pressure. They must be set to start-to-discharge at a pressure no greater than 110 percent of the tank design pressure. They must have enough relieving capacity to limit the maximum pressure in the tank to 120 percent of the design pressure. Based on the venting requirement formula contained in CGA pamphlet S-1.2, each transport tank usually contains two relief valves.

Each relief valve must be permanently marked with the set-to-discharge pressure, the rate of discharge in cubic feet per minute, and the manufacturer's name and catalog number. Each must also be protected from accident damage, roll over, and outside elements such as rain and dirt. Generally, relief valves are installed in the top of the vessel and are protected by rubber covers that will be blown away when the relief valves start to discharge.

9.1.5 PIPING AND FITTINGS

The burst pressure of all piping, pipe fittings, hose, and other pressure parts must be at least four times the design pressure rating of the tank in which they are installed. All pipe joints must be threaded, welded or flanged and no slip joints may be used. Pipe shall be at least schedule 80 or greater wall thickness. Valves and fittings shall be manufactured of malleable metals rather than cast.

9.1.6 EMERGENCY DISCHARGE CONTROL

Because of several accidental and unintentional discharges of compressed gasses over the past ten years, the DOT has changed the requirements for emergency discharge control significantly. For certain flammable and high hazard compressed gasses and anhydrous ammonia, both on truck and off truck emergency shut down systems are now required. Refer to the table in 173.315(n) for the specific type of emergency discharge control for the class of product and the capacity and configuration of the CTMV.

All MC-331 transport vessels now require on truck emergency discharge control equipment. All units with liquid or vapor ***discharge*** openings greater than or equal to a 1-1/4 inch NPT (National Pipe Thread), must be equipped with a remotely controlled internal self closing stop valve (see Figures 16 and 17 in graphics section). For smaller vessel connections, an excess flow valve, back check valve (Figure 18), or a remotely controlled stop valve may be used. All self closing stop valves must close automatically when any valve attachments are sheared. Also, each internal self-closing valve, excess flow valve, or back check valve must be located inside the tank or inside a welded nozzle which is an integral part of the tank. The valve seat itself must be located inside the tank flange, coupling, or nozzle and must be compatible with the lading in the tank. Each filling and discharge line must be provided with a manual stop valve located as close as possible to the tank (Figure 19 (see graphics section)). These final close off valves are to be used in conjunction with the automatic closing valves as discussed above. An opening shall be provided on each vessel to allow for complete drainage of liquefied materials.

On vessels over 3500 water gallons capacity, each internal valve must be provided with a remote means of automatic closure. In most cases the remote means of closure must include both mechanical and thermal (fused), mounted on diagonally opposite ends of the tank in at least two locations. On vessels under 3500 water gallon capacity, each internal valve must be provided with at least one remote means of automatic closure and must be installed on the end of the tank farthest away from the loading/unloading area. All linkages, either air or cable, must also be fused at the internal valve itself. Please note that a A primary discharge control system is not required on a CTMV used to transport refrigerated liquids such as argon, carbon dioxide, helium, krypton, neon, nitrogen, and xenon, or mixtures thereof. Small outlets for gauges and thermometers do not require internal valves. All other openings in the vessel must be closed with a plug, cap, or bolted flange. All outlets except relief valve connections must also be marked as to whether they communicate with the vapor or liquid space of the vessel when the tank is filled to the maximum permitted filling density.

In addition to the on truck emergency protection requirements described above, off truck remote systems are also required for certain commodities. For this purpose cargo tanks and cargo tank motor vehicles have been divided into two size groups, those 3500 gallon capacity or less, and those greater than 3500 gallon capacity essentially differentiating between tank trucks (also referred to as bobtails) and transports. This group is further divided into "metered delivery service" and "non-metered delivery service". The requirements for off truck systems is contained in the Shipping Requirements in §173.315(n). Please note that emergency discharge control is a operating requirement not a specification requirement. Essentially the smaller tank trucks (<3500 gallon capacity) in metered delivery service that are delivering flammable compressed gasses or anhydrous ammonia are required to have an off truck remote system that will close the liquid internal valve and stop all motive power (truck engine) upon activation of a remote control device by the delivering driver or attendant who is making the delivery. This system must be tested to work initially at a distance of 300 feet and must routinely operate at a minimum distance of 150 feet. All such systems (remote or passive) are to be certified by a Design Certifying Engineer and installed under the supervision of a Registered Inspector. The Registered Inspector must certify that the remote control equipment is installed in accordance with the original component manufacturer's specifications and is tested in accordance with the requirements. The Registered Inspector must provide the owner of the cargo tank motor vehicle with this certification.

For larger transportation units (>3500 gallon capacity), passive and/or remote systems are required. The passive systems used must have a means to automatically shut off the flow of product without the need for human intervention within 20 seconds of an unintentional release caused by a complete separation of a liquid delivery hose. Again, the system must be certified by a Design Certifying Engineer and installation must be performed under the supervision of a Registered Inspector unless the equipment is installed and removed as part of regular operation (e.g., a hose). The Registered Inspector must certify that the equipment is installed and tested, if it

is possible to do so without damaging the equipment, in accordance with the Design Certifying Engineer's certification. The Registered Inspector must provide the certification to the owner of the cargo tank motor vehicle.

9.1.7 PROTECTION OF FITTINGS

All valves, fittings, piping, and relief devices must be protected from any damage as could be caused by accident, overturn, jack-knifing, or other impact. Any protective guarding used to accomplish this must be designed to withstand a static load in any direction equal to twice the weight of the vessel (2g load) filled with lading.

A rear end tank protection device (rear bumper) must also be installed on cargo tank motor vehicle. This device must protect the cargo tank and all the valves and fittings located on the rear from damage that could result in loss of lading in the event of a rear end collision. This device must be designed to withstand certain loadings as contained in §178.337-10 (c) (1) or it can be designed to §178.345-8(d) which is contained in the DOT 400 series CTMV's section.

9.1.8 DATA PLATE DESCRIPTION

MC-330 and 331 data plates can appear at almost any location on the vessel. Prior to July 1, 1985, the plate was supposed to be located curbside near the front of the tank. Each cargo tank certified after October 1, 2004 must have a corrosion-resistant metal name plate (ASME Plate) and specification plate permanently attached to the cargo tank by brazing, welding, or other suitable means on the left side near the front, in a place accessible for inspection.

NAMEPLATE REQUIREMENTS:

1. DOT specification number (MC-331).
2. Original test date.
3. MAWP in psig.
4. Cargo tank design temperature range.
5. Nominal capacity (water) in pounds.
6. Maximum design density of lading in pounds per gallon.
7. Material specification number for the shell.
8. Material specification number for the heads.
9. Minimum thickness of the shell.
10. Minimum thickness of the heads.
11. Manufactured thickness of the shell.
12. Manufactured thickness of the heads.
13. Exposed surface area in square feel.

SPECIFICATION PLATE REQUIREMENTS:

1. Cargo tank motor vehicle manufacturer.
2. Cargo tank motor vehicle certification date.
3. Cargo tank manufacturer.
4. Cargo tank date of manufacturer.
5. Maximum weight of lading.
6. Lining materials (if applicable).
7. Heating system design pressure and temperature.
8. Cargo tank serial number, assigned by the cargo tank manufacturer (CT number).

In addition to those DOT entries shown above, the following ASME markings are required:

1. The official "U" Code symbol stamp
2. Maximum allowable working pressure in PSI at degrees F.
3. Minimum design metal temperature
4. RT-x to show degree of radiography
5. HT if vessel is heat treated

Inspections and Tests Required under 180.407(c)

Test or Inspection, tank configuration and type of service	**Test and Inspection Interval**
EXTERNAL VISUAL INSPECTION	
All CTMV's designed to be loaded by vacuum with full opening rear heads	EVERY 6 MONTHS
All other CTMV's	EVERY 12 MONTHS
INTERNAL VISUAL INSPECTION – see note 4	
All insulated CTMV's except MC330, MC331, MC338	EVERY 12 MONTHS
All CTMV's transporting lading corrosive to the tank	EVERY 12 MONTHS
All other CTMV's, except MC338	EVERY 5 YEARS
LINING INSPECTION	
All lined CTMV's transporting lading corrosive to the tank.	EVERY 12 MONTHS
LEAKAGE TEST	EVERY 2 YEARS
MC330 & MC331 CTMV'S IN CHLORINE SERVICE	
All other CTMV's except MC338	EVERY 12 MONTHS

PRESSURE TEST – see notes 2 & 3	
All CTMV's which are insulated with manhole or insulated and lined, except MC338	EVERY 12 MONTHS
All CTMV's designed to be loaded by vacuum with full-opening rear heads.	EVERY 2 YEARS
MC330 & MC331 CTMV's in chlorine service	EVERY 2 YEARS
All other CTMV's	EVERY 5 YEARS
THICKNESS TEST	
All unlined cargo tanks transporting lading corrosive to the CTMV	EVERY 2 YEARS

Note 1 no longer applicable

Note 2 - Pressure testing is not required for MC 330 and MC 331 cargo tanks in dedicated sodium metal service.

Note 3 - Pressure testing is not required for uninsulated lined cargo tanks, with a design pressure or MAWP 15 psig or less, which receive an external visual inspection and lining inspection at least once each year.

Note 4 - Insulated cargo tanks equipped with manholes or inspection openings may perform either an internal visual inspection in conjunction with the external visual inspection or a hydrostatic or pneumatic pressure-test of the cargo tank.

Without regard to any other test or inspection requirements, a specification cargo tank must be tested and inspected prior to further use if the cargo tank shows evidence of dents, cuts, gouges, corroded or abraded areas, leakage, or any other condition that might render it unsafe for hazardous materials service. At a minimum, any area of a cargo tank showing evidence of dents, cuts, digs, gouges, or corroded or abraded areas must be thickness tested in accordance with the requirements and evaluated in accordance with the criteria prescribed in §180.411. Any signs of leakage must be repaired in accordance with §180.413. The suitability of any repair affecting the structural integrity of the cargo tank must be determined either by the testing required in the applicable manufacturing specification or in paragraph (g)(1)(iv) of this section.

Additionally, testing and inspection is required if the CTMV has sustained damage to an extent that may adversely affect its lading retention capability. A damaged cargo tank must be pressure tested in accordance with the procedures set forth in the requirements; If the CTMV has been out of hazardous materials transportation service for a period of one year or more. Each cargo tank that has been out of hazardous materials transportation service for a period of one year or more must be pressure tested in accordance with §180.407(g) prior to further use; or the Department so requires based on the existence of probable cause that the cargo tank is in an unsafe operating condition.

9.2.1 TESTING REQUIREMENTS SPECIFIC TO MC-330/331 UNITS

Although the various tests required by 49CFR Part 180 apply to all the HM cargo tanks, there are specific differences between each type. Below is a list of the required tests and inspections with some specific requirements as they pertain to MC-330/331 transports.

9.2.1.1 PRESSURE TEST (P)

All compressed gas transports must undergo a pressure retest once every five years, except for chlorine vessels which are to be tested every two years. Insulated vessels that do not have a manway are to be tested annually. The test pressure is 1.5 times the maximum allowable working pressure (MAWP) as shown on the manufacturers' data report, vessel nameplate or pressure rerate plate. Although not recommended by NTTC because of safety considerations, these vessels may be pneumatically tested to using nitrogen, air, or some other inert gas. It should also be mentioned that suitable supports should be placed under the vessel to be filled with water and tested. Water weighs 8.33 pounds per gallons, so an 11,000 water gallon transport would weigh close to 115,000 pounds when full.

When the pressure test is performed, the relief valves must be removed from the tank. The upper coupler plate must also be removed if the shell and head of the tank is not visible during the pressure test. Please note there is no requirement to remove the upper coupler for insulated CTMV's It is NTTC's recommendation that relief valves be replaced during the 5 year pressure test instead of removing the relief valves, performing a bench test to verify correct opening and reseating pressures and then re-installing the vents The start to discharge pressure for all relief valves that are tested, repaired or rebuilt must be recorded on the forms.

Vessels manufactured from quenched tempered steel (QT) or other than QT steel (NQT) but without post weld heat treatment, used for the transportation of anhydrous ammonia, or any other hazardous material that may cause stress corrosion cracking (SCC), must be internally inspected using the wet fluorescent magnetic particle (black light) method as prescribed in Compressed Gas Association bulletin TB-2. QT tanks that have hauled liquefied petroleum gas must be inspected using this method.

A CTMV cannot be returned to hazardous materials service if it leaks, fails to retain test pressure, shows signs of distortion, excessive permanent expansion, or other structural defects, until all such defects have been repaired or corrected. Repairs to this type of vessel require care. The repair shop selected to make welded repairs to QT vessels should be familiar with this type of steel and the correct weld procedures. They are also required to have a National Board "R" stamp, qualified weld procedures, and qualified welders in accordance with Section IX of the ASME Code.

9.2.1.2 EXTERNAL VISUAL INSPECTION (V)

The external visual inspection should include all appurtenances to the vessel proper. The important items to inspect have been included on the check sheet. Special attention should be given to the internal valve operator system and remote closures. Most systems today are air operated but some are cable operated, adjustments should be made to insure the valves are properly adjusted. When the control handle is in the closed position, so should the valve be in the fully closed position. The same is true for the valve in the open position.

MC-330/331 vessels are usually fabricated from carbon steel. The frames attaching the upper coupler and suspension systems are also typically carbon steel and are subject to corrosion. Unseen areas under these assemblies can rust without notice and cause an unsafe condition. All loose scale should be removed to allow for a good inspection. Any suspicious areas can be measured for thickness with a properly calibrated ultrasonic thickness (UT) gauge.

9.2.1.3 INTERNAL VISUAL INSPECTION (I)

Most MC330/331 transports are baffled to reduce product slosh during transportation. These baffles are usually fabricated from aluminum to save weight. They are bolted to clips which have been welded to the inside of the shell. Bolts can loosen due to road vibrations, fall out of the baffles and lay on the floor of the vessel. Product can "wash" these items into valve seats jamming them in the open condition. Similarly, when product hoses are allowed to drain on the ground and then put into the hose tubes, sometimes small stones are picked up from delivery areas and, on subsequent loads, washed into the tank. These loose pieces should be removed from the tank during inspection.

Internal stacks and fixed liquid level gauge tubes should be checked for cracks. Cracks in stacks (internal vapor pipes welded to bottom connections) can cause liquid product to show up in the vapor return lines, creating problems during unloading.

9.2.1.4 THICKNESS TESTING

Vessels that transport materials corrosive to the tank such as chlorine or sulfur dioxide are to be thickness tested every two years. Records should be kept for the life of the vessel and comparisons should be made between tests to show trends in metal loss. Product piping, valves and all appurtenances should also be examined and tested in addition to the testing required of the vessel itself.

The inside of the vessel should be visually examined for pits. These pits may not cause thin readings with the UT (ultrasonic testing) gauge, but can cause problems or even leaks if not repaired. Employees performing UT thickness testing are required to be trained in the use of the device. Also, the UT thickness equipment must be calibrated for the material being measured as different materials (carbon steel, stainless steel, aluminum, etc.) yield different readings. Test blocks of known materials with specified thicknesses can be used for calibration. UT thickness measurement devices must be capable of accurately measuring thickness to within +/- 0.002".

9.2.1.5 LEAKAGE TESTING

As stated previously, propane and anhydrous ammonia transports make up the majority of the compressed gas fleet. These transports can be leak tested with product in the tank using a minimum test pressure of 60 psi. It would be prudent to do this testing during the summer months when pressures are typically above 100 psi. Other commodities must be tested to a pressure of 80 percent of design pressure. For example, for dimethyl ether, which has a minimum required design pressure of 200 PSI should be leakage tested at 160 psi if the CTMV has a design pressure of 200. Remember, unless otherwise excepted, the leakage test pressure must be between 80% and nor more than 100% of the design pressure or MAWP. This can be generated by using a compressor during warmer months. If the transport has an MAWP greater than or equal to 100 psi and is in dedicated service, the test can be made at the highest operating pressure the vessel encounters during the one year period between tests. In other words, if the transport will never exceed 75 psi. and is in dedicated service, it can be leak tested to 75 psi. and be in compliance with the regulations, provided it will never exceed this pressure during operation. Once again it is always important to maintain documentation in support of any leakage test pressure that deviates from the standard requirement of not less than 80% of the design pressure or MAWP.

Internal valves should be checked separately from final shut off valves. The valve operators should be used to function the internal valves. Follow the sequence on the testing sheets to be sure both type valves are tested satisfactorily. You must verify the leak tightness of the internal valve while the cargo tank is under leakage test pressure. CTMV's in metered delivery service may use the meter creep test, described in Appendix B of Part 180, to verify the leak tightness of the internal self-closing stop valve.

Care should be exercised while testing units containing hazardous commodities. Never test units in a confined location. Always allow for adequate ventilation. Make sure test area is signed off to keep unexpected visitors from casually getting close.

9.2.1.6 Delivery HOSE Assembly TESTING

All delivery hose assemblies are to be permanently identified with the test date, a unique identification number and maximum working pressure. Test results shall be documented. Those hoses not permanently attached to a CTMV must be given a leakage test at least once a calendar year with the results being documented. All new or repaired delivery hoses must be tested to 120 percent of the hose maximum working pressure and are to be fully inspected while under pressure test pressure. The hoses that are tested are to be marked with the month and year of each successful test and a test record is to be created showing test results. That record shall include the delivery hose assembly ID number, the delivery hose assembly test date and an indication that the delivery hose assembly either PASSED or FAILED the inspection. Delivery hose assemblies that show signs or leakage, abrasion, damage to the cover showing reinforcement, soft spots, loose couplings or missing coupling bolts are not to be returned to service until repaired or replaced. See 49 CFR 180.416 (g) for rejection criteria. It is

important to note that these specific record keeping and testing requirements apply to the "operator" (generally, the "carrier").

9.2.1.7 LINING INSPECTION

Few MC-330/331 transports are lined for corrosion prevention. Some are lined to keep product purity high. If any vessel in corrosive service is lined, the lining should be inspected annually. Unl ess the CTMV is rubber lined, always use guidelines published by the manufacturer/installer of the lining. Guidelines similar to those shown in the MC 312/ DOT412 section can be used.

9.2.2 INSPECTION FORMS FOR THE VARIOUS INSPECTIONS AND TESTS REQUIRED

The following pages show recommended forms for the inspection and testing of MC-330/331 transport vessels. These forms are also used to record the results of such examinations. The mechanic doing the tests should be careful to record data accurately.

SECTION 9: MC331

V

TRAILER REPORT

MC330/331 CHECKLIST / INSPECTION REPORT FORM

EXTERNAL VISUAL INSPECTION

(REQUIRED ANNUALLY)

Work Order Number _____

PAGE 1 OF 2

CARRIER _____ DATE _____

LAST KNOWN COMMODITY _____ PLACARD NUMBER _____

UNIT NUMBER _____ _____ MAWP _____

MANUFACTURER _____ YEAR BUILT _____

VESSEL SERIAL NUMBER _____ NATIONAL BOARD NUMBER _____

VESSEL CAPACITY _____ GALLONS COMPARTMENTS _____

VESSEL MATERIAL OF CONSTRUCTION SHELL _____ HEADS _____

IS VESSEL LINED? _____ (Y/N)

LAST SERVICE (TYPE) _____ ON _____

LAST PRESSURE RETEST (P) _____

ITEM NUMBER	OPERATION	COMPLIES	NEEDS REPAIRS	SEE REMARKS
1	Data plate (ASME & DOT): tank attachment - entries legible - no paint or corrosion.			
2	Shell and heads: condition of welds - dents - gouges - corrosion or abrasion - need for UT testing.			
3	Outer jacket: condition of attachments - dents - digs - gouges - scrapes - perforations.			
4	Upper coupler assembly: condition of plate - corrosion - deformation - lubrication - bolt tightness - king pin wear or deformation (drop and service plate as required). Dye penetrant test 12" diameter area around kingpin attachment on face of plate. ***Note: If unit is in corrosive service, the upper coupler must be dropped to inspect the covered areas, every two years.***			
5	Landing gear: corrosion or rust - condition of welds - bolt tightness - gear operation.			
6	Void areas: signs of corrosion - fittings and drains unplugged			
7	Placard holders: attachment to tank - condition of clips and hinges.			
8	Bolted attachments: piping brackets and supports - valve installations - valve operator installation - dust cap retainers - all tank-to-frame or undercarriage attachments.			
9	Hose tubes, troughs, or racks: condition of tube, doors, latches, or tiedowns.			
10	Piping and all valves: attachments - handles and levers - shear sections - dust caps - gaskets and o-rings - lubrication points - protection devices. Inspect for leakage, corrosion and distortion.			

V

MC330/331 CHECKLIST / INSPECTION REPORT FORM

EXTERNAL VISUAL INSPECTION
(REQUIRED ANNUALLY)

ITEM NUMBER	OPERATION	COMPLIES	NEEDS REPAIRS	SEE REMARKS
11	Internal valve operation: three means of closure (normal, remote, and thermal) - function check - cable adjustment - condition of cables and guide systems - fusibles - lubrication points.			
12	Pump drive shaft: driveshaft alignment - condition of bearings and mounting bolts - lubrication points.			
13	Hose: condition of covers - reinforcement damage - condition of couplings, fittings, and other hardware. ***Complete hose test report.***			
14	Ladders, catwalks, and platforms: attachments to vessel - tightness of bolts - deformation of structures - ground clearance.			
15	Static grounding connections: brass connectors or grounding reel present - flammable only.			
16	Gauging devices: glass not broken - gauge dial in good condition - manually operated fixed liquid level gauges - rotary/float gauge operation - rotogauge indicator lever stays in position.			
17	Manhole assembly area: evidence of leakage - condition of gasket condition of studs (if cover removed) - ***note: do not tighten or or loosen stud nuts if tank is under pressure.***			
18	Pressure relief valves: verify venting capacity is adequate for tank and commodity - required markings on relief valves - protective covers in place - satisfactory roll over protection. Inspect all gaskets or o-rings before reinstallation. ***18 (a): If unit is in corrosive service, the relief valves must be removed and tested.***			
19	Tank outlet labels: liquid or vapor as required.			
20	Caution and safety labels: condition and presence of all labels.			
21	Tank markings: Date (month/year) and service symbol (V) in 1-1/4" high characters. QT or NQT in 2" high characters near specification plate. ***Note: service symbols to be applied only after all defects are corrected.***			

Test Information	Set Pres	Open	Re-Seat
Relief Valve #1			
Relief Valve #2			

Note: Relief valves must start to open at set pressure and must close at 90% of the set pressure.

(DOT Registration Number)

(Inspector or Tester) (Date) (Owner or Representative) (Date)

(Tank disposition - unit returned/not returned to service)

K

TRAILER REPORT

MC330/331 CHECKLIST / INSPECTION REPORT FORM

LEAKAGE TEST
(REQUIRED ANNUALLY)

ITEM NUMBER	OPERATION	COMPLIES	NEEDS REPAIRS	SEE REMARKS
1	Close all valves - pressurize vessel and all components using air or nitrogen to 80% of the MAWP or design pressure. Must hold for five (5) minutes.			
2	Inspect all surfaces for leaks at test pressure - see item 6 below - inspect all gasketed, threaded, welded joints and hose connections for leaks.			
3	Liquid delivery hoses that are not attached to the cargo tank must be inspected visually and pressure tested. Complete a "Hose Test Report" for each liquid delivery hose per acceptance criteria in Part 180.416g.			
4	Inspect internal valves for leaks. Open final shut off valves with internal valves closed. Inspect for main seat and bonnet leakage.			
5	Inspect discharge valves for leaks. Open internal valves with discharge valves closed and inspect for main seat and bonnet leakage. Bonnet should be inspected for leakage with the valve in the open and closed position (cap or plug discharge end of valve to inspect in the open condition).			
6	Remote valve operators: open internal valve with normal valve operator - close with remote operator - open discharge valve and drain or blow down piping - inspect for continued leakage - open and close internal valve with normal operator - piping should fill with air, nitrogen, or product (whichever applies).			
7	With all valves closed, hold test pressure for five (5) minutes for an acceptable test. ***Note: A cargo tank with a MAWP of 100 PSIG or more may be leak tested at its maximum normal***			

SECTION 9: MC331

	operating pressure provided it is in dedicated service(s). An MC330/331 cargo tank in dedicated liquefied petroleum gas service may be leak tested at not less than 60 PSIG.			
8	Tank markings: Date (month/year) and service symbol (K) in 1-1/4" high characters. QT or NQT in 2" high characters near specification plate. ***Note: service symbols to be applied only after all defects are corrected.***			

(Name and address of Inspection Company) (DOT Registration Number)

(Inspector or Tester) (Date) (Owner or Representative) (Date)

(Tank disposition - unit returned/not returned to service)

P

TRAILER REPORT

MC330/331 CHECKLIST / INSPECTION REPORT FORM

HYDROSTATIC PRESSURE RETEST (REQUIRED EVERY FIVE YEARS)

(annually if insulated with no manway - chlorine every two years)

Work Order Number _____

PAGE 1 OF 2

CARRIER _____ DATE _____

LAST KNOWN COMMODITY _____ PLACARD NUMBER _____

UNIT NUMBER _____ MC/DOT _____ MAWP _____

MANUFACTURER _____ YEAR BUILT _____

VESSEL SERIAL NUMBER _____ NATIONAL BOARD NUMBER _____

VESSEL CAPACITY _____ GALLONS COMPARTMENTS _____

VESSEL MATERIAL OF CONSTRUCTION SHELL _____ HEADS _____

IS VESSEL LINED? _____ (Y/N)

LAST SERVICE (TYPE) _____ ON _____

LAST PRESSURE RETEST (P) _____

NOTE: OSHA REGULATIONS AND ALL COMPANY SAFETY PROCEDURES MUST BE FOLLOWED

ITEM NUMBER	OPERATION	COMPLY	NEEDS REPAIRS	SEE REMARKS
1	Inspect for contents: be sure vessel is at zero (0) PSIG.			
2	Remove relief valves and plug openings.			
3	Fill vessel with water, making sure vessel has been purged free of all trapped air or last known commodity.			
4	Using water connection with suitable pressure gauge, pressurize vessel to test pressure_____PSIG (1.5 times MAWP) hold for 10 minutes. Test ga. No._____ Calibrated _____			
5	Monitor pressure gauge. If pressure falls during the ten minute hold time, inspect all areas of the unit for leaks.			
6	Tag or identify all leaks - drain vessel into sanitary system.			
7	Drop the upper coupler plate (5^{th} wheel) and inspect area covered by same for corrosion, abraded areas, dents, distortions, defects in welds, or any condition that might render the tank unsafe. ***Note: upper coupler must be removed for this test.***			
8	Open manway if available, and clean and dry interior of vessel.			
9	Units constructed of quenched tempered steel (QT) or other than QT steel but without post weld heat treatment, and used for the transportation of anhydrous ammonia or any commodity that may cause stress corrosion cracking (SCC), must be internally inspected by the wet fluorescent magnetic particle method. QT vessels used to haul liquefied petroleum gas must be inspected. ***Note: Black light findings and repairs shall be recorded on a separate inspection report and chart.***			

P

MC330/331 CHECKLIST / INSPECTION REPORT FORM

HYDROSTATIC PRESSURE RETEST (REQUIRED EVERY FIVE YEARS)

(annually if insulated with no manway - chlorine every two years)

ITEM NUMBER	OPERATION	COMPLY	NEEDS REPAIRS	SEE REMARKS
10	Repair leaks - advise customer and get approval.			
11	Reinstall manway cover using new gasket if manway exists. Test and reinstall original relief valves if satisfactory, otherwise replace with new. Make sure new valves have suitable relieving capacity, materials of construction and correct set pressure.			
	Test Information / **Set Pres** / **Open** / **Re-Seat** **Relief Valve #1** **Relief Valve #2** ***Note: Relief valves must start to open at set pressure and must close at 90% of the set pressure.***			
12	Tank markings: Date (month/year) and service symbol (P) in 1-1/4" high characters. QT or NQT in 2" high characters near specification plate. ***Note: service symbols to be applied only after all defects are corrected.***			

(Name and address of Inspection Company)

(DOT Registration Number)

(Inspector or Tester) (Date)

(Owner or Representative) (Date)

(Tank disposition - unit returned/not returned to service)

I

TRAILER REPORT

MC330/331 CHECKLIST / INSPECTION REPORT FORM

INTERNAL VISUAL INSPECTION (REQUIRED EVERY FIVE YEARS)

NOTE: OSHA REGULATIONS AND ALL COMPANY SAFETY PROCEDURES MUST BE FOLLOWED

ITEM NUMBER	OPERATION	COMPLIES	NEEDS REPAIRS	SEE REMARKS
1	Gauges: inspect pipes, arms and floats - tightness and condition of braces or supports - condition of rotary gauge tube.			
2	Internal structures (baffles, rings, etc.): inspect for corrosion, abrasion, dents, pitting, or distortion - around valve or drain sumps and splash deflectors - look for discoloration - inspect all structures for deformation. Note: identify in remarks any areas requiring UT testing. Identify all defects regardless if repairs are required.			
3	Welds: inspect every inch of every weld in vessel, making hand contact where possible - special attention to baffle support clips - special attention to welds in areas above suspension and upper coupler.*			
4	Piping and valves: inspect poppet travel and make visual inspection of valve seat surfaces - clean and make secure all screens - check for foreign matter in valves and sumps - inspect for rust build up or corrosion on internal valves or seats.			
5	Baffles: inspect all attachment areas or support clips - tighten all loose hardware - account for all missing hardware.			
6	Remove all equipment brought into vessel, then inspect again before exiting vessel - make sure vessel is clean.			
7	Tank markings: Date (month/year) and service symbol (I) in 1-1/4" high characters. QT or NQT in 2" high characters near specification plate. ***Note: service symbols to be applied only after all defects are corrected.***			

_____ _____

(Name and address of Inspection Company) (DOT Registration Number)

_____ _____ _____ _____

(Inspector or Tester) (Date) (Owner or Representative) (Date)

_____

(Tank disposition - unit returned/not returned to service)

T

MC330/331 CHECKLIST / INSPECTION REPORT FORM

THICKNESS TESTING
REQUIRED EVERY TWO YEARS -
CORROSIVE SERVICE ONLY

ORIGINAL SHELL THICKNESS _____ ORIGINAL HEAD THICKNESS _____

NOTE: CHECK WITH D.C.E. FOR REQUIRED MINIMUM ALLOWABLE THICKNESSES

NOTE: OSHA REGULATIONS AND ALL COMPANY SAFETY PROCEDURES MUST BE FOLLOWED

ITEM NUMBER	OPERATION	COMPLIES	NEEDS REPAIRS	SEE REMARKS
1	Clean, dry, or buff down to bare metal, all surfaces to be measured.			
2	Calibrate the UT instrument on the same material used in the fabrication of the vessel. Re-calibrate every time the thickness changes (i.e. from shell to head).			
3	Exterior surfaces of shell and heads: suspect areas in parent metal and along welds - areas around internal valve installations, manways, and weld pads.			
4	Upper coupler assembly: inside and outside of vessel			
5	Suspension system attachments and connecting structures: longitudinal frames - bolsters - gussets.			
6	Known thin areas: identified during prior inspections.			
7	Internal compartment surfaces: along product level lines - around splash deflectors - around valve sumps - along bottom of vessel.			
8	Tank markings: Date (month/year) and service symbol (T) in 1-1/4" high characters. QT or NQT in 2" high characters near specification plate. ***Note: service symbols to be applied only after all defects are corrected.***			

Note: record all measurements by number location on form below. Compare with prior UT records. Remeasure any suspect areas or "bad data readings".

_____ _____

(Name and address of Inspection Company) (DOT Registration Number)

_____ _____ _____ _____

(Inspector or Tester) (Date) (Owner or Representative) (Date)

_____

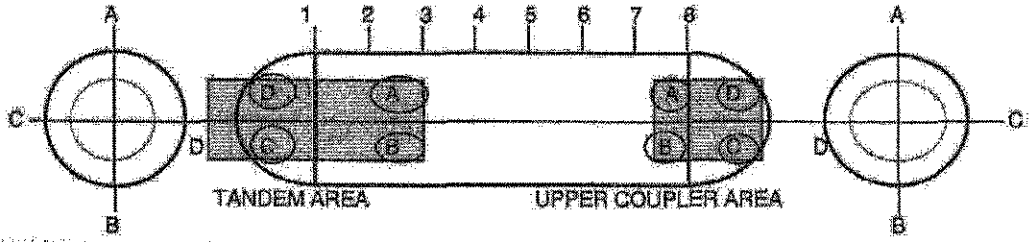
(Tank disposition - unit returned/not returned to service)

Company: _____

MC330/331 Ultrasonic Thickness Chart

NAME OF CARRIER _____ DATE 04/20/2004 16:10
UNIT NUMBER _____ DESIGN PRESSURE _____ S.O. NO. _____
VESSEL MANUFACTURER _____ YEAR BUILT _____
MATERIAL OF CONSTRUCTION _____ SERIAL NUMBER _____
ORIGINAL SHELL THICKNESS _____ ORIGINAL HEAD THICKNESS _____

NOTE: OSHA REGULATIONS AND ALL COMPANY SAFETY PROCEDURES MUST BE FOLLOWED



FRONT AND REAR HEADS

A	B	C	D	
				FRONT INSIDE
				FRONT OUTSIDE
				REAR INSIDE
				REAR OUTSIDE

ORIGINAL HEAD THICKNESS (U1A) = _____
MINIMUM HEAD THICKNESS FOUND = _____
DIFFERENCE = _____ INCHES

NOZZLES (show location on sketch)

NUMBER	A	B	C	D
1				
2				
3				
4				
5				
6				

MINIMUM THICKNESS FOUND = _____

SHELL

	1	2	3	4	5	6	7	8	TANDEM AREA	UPPER COUPLER
A										
B										
C										
D										

ORIGINAL SHELL THICKNESS (U1A) = _____
MINIMUM SHELL THICKNESS FOUND = _____ (includes nozzle areas)
DIFFERENCE = _____ INCHES

NOTE: Inspector is to test areas around weld joints, shell reinforcements, and vessel openings. Use additional paper as required

INSPECTION & REPAIR REPORT FORM FOR MC-330, 331 CARGO TANKS INSPECTED BY THE WET FLUORESCENT MAGNETIC PARTICLE METHOD

SECTION ONE: CARRIER IDENTIFICATION

Name of Carrier: _____

Principal address: _____ (Street or P.O. Box) _____ (City) _____ (State) _____ (Zip Code)

Carrier's Telephone No.: _____ (Area Code)

SECTION TWO: DOT NAMEPLATE INFORMATION

Tank Mfr's Name: _____ Mfr's Serial No. _____ Nat'l Bd No. _____

ICC - DOT Spec. No.: MC- _____ Shell Material: _____ Heads Material: _____

Water Capacity: _____ Lbs. and/or _____ Gals. Year Built: _____

Orig. Test Date: _____ Retest Date: _____ Tank Retested at: _____ P.S.I.G.

Design Maximum Working Pressure: _____ P.S.I.G. Stress Relieved After Fabrication: Yes _____ No _____

Carrier Equipment Number: _____

SECTION THREE: ASME NAMEPLATE INFORMATION

X-Rayed: Yes _____ No _____ Shell Thick: _____ " Head Thick: _____ " Head Radius: _____

SECTION FOUR: INSPECTION AND REPAIR INFORMATION

Kenni Service Corporation Work Order Number: _____

Name of Inspection/Repair Shop (or person performing inspection/repair): _____

Address: _____ (Street or P.O. Box) _____ (City) _____ (State) _____ (Zip Code)

Date of Inspection: _____ Defect(s) Found: Yes _____ No _____ If defect(s) were found, use table below to indicate type, number of each and repair method employed. If no repairs were made, state, "NOT REPAIRED". Show location of defects using sketch and instructions on other side of form.

	INDICATIONS FOUND			REPAIR METHOD		
TYPE	LIQUID PHASE	VAPOR PHASE	NUMBER	GRINDING	WELDING	NEW SECTION
1. Transverse Crack, Butt Joint						
2. Longitudinal Crack, Butt Joint						
3. Mill Defect						
4. Fabrication Defect						
5. Fillet Weld Crack						
6. Crack Over Exterior Attachment						
7. Crack within 2" of Weld						
8. Crack In Parent Metal						
9. Linear Discontinuity, Butt Joint						
10. Stress Corrosion						
11. Others (State Type)						

Interpretation based upon visual observation

Date of Repair: _____ Wet Fluorescent Magnetic Particle Retest of Repaired Areas: Yes _____ No _____

If welded: Date of Hydrostatic Retest: _____ X-Rayed: Yes _____ No _____

Tank Stress Relieved after Repairs: Yes _____ No _____ ; If yes: Full _____ Local _____

Signature, Inspection Repair Shop _____ Shop Inspector _____

(Name, Title (Type or Print))

_____ (Signature) _____ (Date)

SECTION FIVE: CARGO TANK LADING

Tank has hauled: LP-Gas _____ Anhydrous Ammonia _____ Other _____ (Commodity)

If Anhydrous Ammonia, was it certified by Shipper as containing 0.2% water: Yes _____ No _____

SECTION SIX: CARGO TANK DISPOSITION INFORMATION

Scrapped _____ Out of Service _____ Returned to Service _____

Authorized Signature, Carrier _____

(Name, Title (Type or Print))

_____ (Signature) _____ (Date)

D.O.T. PERIODIC INSPECTION REPORT FORM
PER 49CFR 396.17
IN ACCORDANCE WITH APPENDIX "G"
TRAILERS

OWNER OF VEHICLE _____

VEHICLE SERIAL NO. _____ NB NO. _____ STATE _____

VEHICLE I.D. NO. _____ LICENSE NO. _____

D.O.T./MC SPECIFICATION _____

INSPECTOR'S NAME _____ SIGNATURE _____

INSPECTION DATE _____ LOCATION _____

		SATISF.	UNSATISF.	REPAIRED OR CORRECTED
I.	**BRAKE SYSTEM**			
	a. Service brakes			
	b. Parking brakes			
	c. Brake drums and rotors			
	d. Brake hoses			
	e. Brake tubing			
	f. Air chambers			
	g. Air tanks and valves			
II.	**COUPLING DEVICES**			
	a. Upper fifth wheel substructure			
	b. Upper fifth wheel plate and pin			
III.	**LIGHTING DEVICES AND REFLECTORS**			
IV.	**SAFE LOADING**			
V.	**SUSPENSION SYSTEM**			
	a. U-bolts and spring hangers			
	b. Spring assemblies (steel, rubber, air)			
	c. Torque arms, radius rods			
VI.	**FRAME**			
	a. Frame members			
	b. Tire and wheel clearance			
	c. Sliding subframe assemblies			
VII.	**TIRES**			
VIII.	**WHEELS AND RIMS**			
	a. Lock or slide rings			
	b. Wheel and rims			
	c. Fastners			
	d. Welds			

CERTIFICATION: THIS VEHICLE HAS PASSED ALL THE INSPECTION ITEMS FOR THE ANNUAL

SECTION 9: MC331

VEHICLE INSPECTION REPORT IN ACCORDANCE WITH 49 CFR, 396.

Hose Test Report

Customer : _____

Customer Location (District) : _____

Truck unit number : _____

Original Hose Information

Make of hose : _____

Diameter of hose : _____

Length of hose : _____

Previous test I.D. or Shop Order number : _____

Original hose test date : _____

Hose Maximum Working Pressure: **PSIG**

New Test Information

New Identification Number : _____

Customer Identification Number: _____

New Test Date : Month : _____ Day : _____ Year : _____

Test Pressure : **PSIG**

(120% of maximum work pressure- 350 Rated hose=420 Lbs.test. New or repaired hoses only, otherwise reference 180.407h.)

Inspection Criteria

	PASS	FAIL
1- Damaged, slipping or excessively worn hose couplings.		
2- Damage to hose cover that exposes the reinforcement.		
3- Wire braid reinforcement has been kinked or flattened so as to permanently deform the wire braid.		
4- Soft spots when not under pressure, bulging under pressure or loose outer covering.		
5- Loose or missing bolts or fasteners on bolted hose coupling assemblies.		

Inspector Print : _____ Inspector Signature : _____

COMMENTS: _____

Certification For Remote Shutdown

System Installation

Issued by:

_____

Owner

To:_____

The Off-Truck Remote Control Equipment manufactured by the company or companies as shown below, has been installed in accordance with the original component manufacturer's specifications and has been tested in accordance with paragraph 173.315 (n)(3)(I) as contained in the current version of 49CFR

Name and Address of Off Truck Remote Control System Used:

_____

_____

Model Number of System Used For This Application:_____

Unit Number This Equipment Installed On:_____

System Testing:

Initial Shutdown Test, Performed at 300 Feet: ___Pass ___Fail

Will the Internal Valve re-open From Remote Operator After Shutdown? ____Pass ____Fail

If a Query System, Will It Shutdown After 5 Minutes? ____Pass ____Fail

Annual Shutdown Test, Performed at 150 Feet: ____Pass ____Fail

Will the Internal Valve re-open From Remote Operator After Shutdown? ____Pass ____Fail

If a Query System, Will It Shutdown After 5 Minutes? ____Pass ____Fail

DOT Registration Number: _____

Signature of Registered Inspector:_____

Inspection and Certification Date:_____

SECTION 9: MC331

SECTION 10: MC338

10.0: MC 338 CARGO TANKS

Editors Note: Users of the manual should be aware that current editions of Title 49, Code of Federal Regulations do contain copies of" cargo tank specifications for MC331 and MC338 Cargo Tanks. Copies of these specifications are included in NTTC's "Cargo Tank Hazardous Materials Regulations", published annually. Any changes to MC331 and MC338 regulations will be covered in the NTTC Regulations book. See the cover page of this publication for how to contact NTTC in order to purchase this publication.

Regulatory References: (From 49 CFR)

MC 338 178.338

MC338 Cryogenic Trailers

MC338 cargo trailers and bobtails haul a variety of cryogenic liquids used in a variety of industries from hospitals to computers to aerospace to oilfields. The growth of shale development in North America has resulted in an increase in demand for cryogenic transportation services, trucking carriers and tank manufacturers.

The Department of Transportation in 49CFR173.115 (g) defines Cryogenic Liquids as:

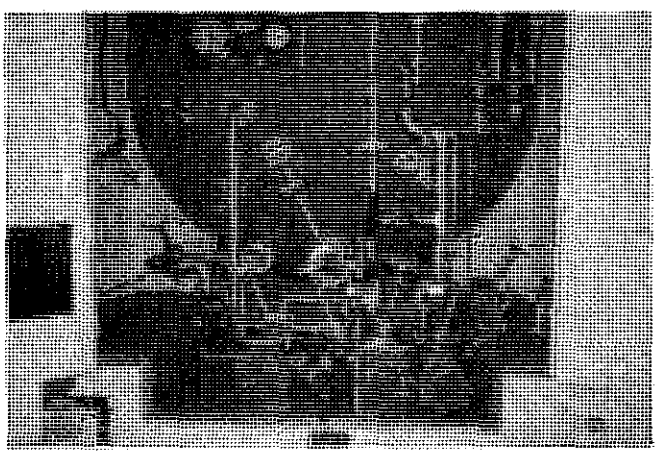
(g) Cryogenic liquid. A cryogenic liquid means a refrigerated liquefied gas having a boiling point colder than --90 °C (–130 °F) at 101.3 kPa (14.7 psia) absolute. A material meeting this definition is subject to requirements of this subchapter without regard to whether it meets the definition of a non-flammable, non-poisonous compressed gas in paragraph (b) of this section.

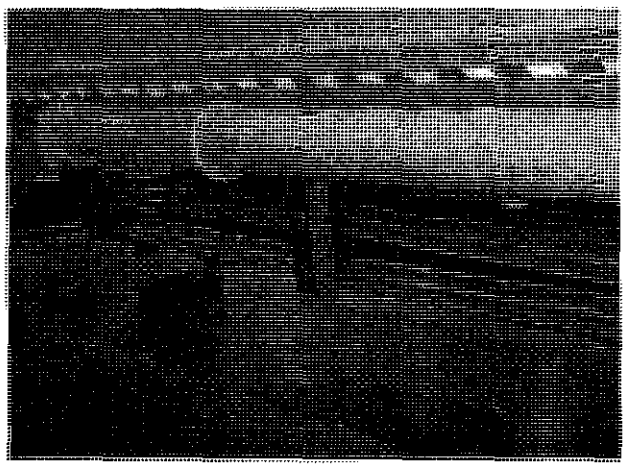
Commonly transported cryogenic materials include helium, argon, liquefied nitrogen, oxygen and carbon dioxide. MC338 cargo tanks are not required for all cryogenic materials. Consult the Hazardous Materials Table 172.101 with the proper shipping name to determine packaging requirements. 49CFR173.318 covers the transportation of cryogenic liquids in cargo tanks.

Unlike other specification cargo tanks which are subject to several Part 180 required tests and inspections, only the external visual inspection and pressure test in 180.407 (d) is mandated by regulation. MC338s are exempted from other inspections found at Part 180 (c). It might be useful to carry a copy of Part 180.407 (c) on the MC338 vehicle in case a roadside inspector is not familiar with the requirements.

Please note that the general safety requirements found in Part 392 that cover such things as lights, brakes and running gear do apply to MC338 trailers. Carriers should work closely with MC338 equipment manufacturers to develop maintenance and repair procedures. Remember, MC338 trailers are ASME Code vessels and any repair work must be done by a shop holding a National Board of Pressure Vessel Inspectors "R" stamp.

The Compressed Gas Association has developed several copyrighted publications on the operation and inspection of cryogenic trailers and loading/unloading systems. For information, see http://www.cganet.com/customer/Publication.aspx.





SECTION 10: MC338

SECTION 11: FIBERGLAS TANKS

SECTION 13: FIBERGLAS REINFORCED PLASTIC (FRP) CARGO TANKS

Editors Note: FRP is not currently a U.S. Department of Transportation authorized material of construction for specification cargo tanks. However, the Department does permit manufacturers to build cargo tanks from FRP under Special Permits issued by the Department. Those trailers are permitted to transport the hazardous materials covered in the Special Permits. (Users may see the terms "exemption" or "DOT-E" which were the former names of Special Permits used until 2005.)

49CFR171.8 defines special permit as:

Special permit means a document issued by the Associate Administrator, or other designated Department official, under the authority of 49 U.S.C. 5117 permitting a person to perform a function that is not otherwise permitted under subchapter A or C of this chapter, or other regulations issued under 49 U.S.C. 5101et seq. (e.g., Federal Motor Carrier Safety routing requirements).

49CFR Subpart B 107.101 details the process for applying for a Special Permit. The manufacturing Special Permit is unique to the holder of the permit, but other Special permits to allow for an individual to apply for party status. The holder also is responsible for renewing the Special Permit.

Cargo tanks built under a Special Permit must be marked with the number of the Special Permit ie. DOT-SP12345678 and a copy of the Special Permit must be carried on the vehicle and made available at roadside or other law enforcement inspectors. (See 172.302 (c).

Transport Canada, the Canadian equivalent of the U.S. Department of Transportation, does permit the use of FRP as an authorized material of construction for cargo tanks. Canada does not recognize the use of Special Permits. This cross-border regulatory inconsistency results in a situation where FRP cargo tanks built in Canada for use in the United States must be built under a Special Permit and FRP cargo tanks built under a Special Permit outside of Canada cannot be operated in Canada unless they were constructed to TC trailer requirements by a manufacturer hold TC authorization.

There are several manufacturers of TC or Special Permit FRP trailers in North America. It is incumbent on anyone who will test or inspect an FRP trailer to obtain a copy of the Special Permit to ensure the requirements of the permit are observed.

NTTC asked Chris Kellogg, President of Corrosion Shield Inc. (CSI) to provide information on FRP tanks for this publication. Some of this information was also obtained from discussions with George Felix of Polycoat Systems. Cargo tank users should consult with the manufacturer of their tank for test, inspection and repair guidance for FRP cargo tanks built under that manufacturer's Special Permit. This is especially important so that any repairs or modifications do not invalidate the manufacturer's warranty. The opinions and recommendations shown here are those of Mr. Kellogg and are based on many year's experience in the FRP composite industry.

Fiberglas Reinforced Plastic (FRP) Test, Maintenance and Repair

FRP composite cargo trailers have been around for over 30 years and composite tanks for transport of hazardous chemicals for over 50 years. These vessels are referred to by many names.

1. FRP (Fiber reinforced Plastic.)
2. GFRP (Glass Fiber Reinforced Plastic.)
3. Composite

Some of the terms used in the lining composite business are:

- Laminate
- Liner
- Corrosion Barrier

- Hand lay-up
- Filament wound
- Conductivity
- Resin
- Glass
- Roving

These terms need to be understood by the lining inspector and any inspection shop that is going to, or is doing a lining inspection, needs to follow the criteria listed in DOT 180.407 and as listed on each Special Permit.

In the US they have Special Permits granted by PHMSA and in Canada they are referred to as TC 412. Each fabricator who manufacturers a Special Permit Composite cargo trailer for US use must present an application stating and demonstrating that the design and use are equal to the ASME 407/412 requirements without the application of the ASME code and as described in each Special Permit granted.

Each one of these cargo tankers is built a bit different, with specific fabrication techniques. There are however several items that are the same in these vessels.

- They all have MAWP's of 35 and test pressures of 52.5 PSI.
- They all have Corrosion Liners, Liners, or Corrosion Barriers. Interpretation #12-0254 confirms the controversy of this matter.

Whether you call it a corrosion liner, liner, or corrosion barrier, this layer or layers is the thickness that keeps the chemicals from getting to the structural layer of the shell and needs to be checked for contamination and all the items that the DOT 180.407 (f) looks for.

This interior should be referred to as the "Liner", since the DOT refers to them as lined vessels and the marking should have an "L" on them, so the inspection shop does the proper inspection.

Regardless of whether the material in the liner is the same or different resin, the purpose is the same, " To shield the chemicals against reaching the structure of the cargo tanker.

Each SP (special permit) is a bit different, but they are all consistent in what and when the structural and liner need to be inspected.

Compliance Dates—Inspections and Test Under §180.407(C)

Refer to the manufacturers Special Permit for the inspection timing.

Print in bold is taken from the 49cfr 180.407 specification. Non-bold print is the opinion and experience of the author.

This section describes when each lined cargo trailer needs a lining inspection and it states the interval at "Each year" or "once every year".

Section (b)(1) Begins to explain what needs to be looked at, specifically **"the cargo tank shows evidence of dents, cuts, gouges, corroded or abraded areas, leakage, or any other condition that might render it unsafe for hazardous materials service. At a minimum, any area of a cargo tank showing evidence of dents, cuts, digs, gouges, or corroded or abraded areas must be thickness tested in accordance with the procedures set forth in paragraphs (i)(2), (i)(3), (i)(5), and (i)(6) of this section and evaluated in accordance with the criteria prescribed in §180.411. Any signs of leakage must be repaired in accordance with §180.413. The suitability of any repair affecting the structural integrity of the cargo tank must be determined either by the testing required in the applicable manufacturing specification or in paragraph (g)(1)(iv) of this section".**

Then the lining section 180.407

(e) *Internal visual inspection.* (1) When the cargo tank is not equipped with a manhole or inspection opening, or the cargo tank design precludes an internal inspection, the tank shall be hydrostatically or pneumatically tested in accordance with 180.407(c) and (g).

(2) The internal visual inspection must include as a minimum the following:

(i) The tank shell and heads must be inspected for corroded and abraded areas, dents, distortions, defects in welds, and any other condition that might render the tank unsafe for transportation service.

(ii) Tank liners must be inspected as specified in §180.407(f).

(f) *Lining inspection.* The integrity of the lining on all lined cargo tanks, when lining is required by this subchapter, must be verified at least once each year as follows:

(1) Rubber (elastomeric) lining must be tested for holes as follows:

(i) Equipment must consist of:

(A) A high frequency spark tester capable of producing sufficient voltage to ensure proper calibration;

(B) A probe with an "L" shaped 2.4 mm (0.09 inch) diameter wire with up to a 30.5 cm (12-inch) bottom leg (end bent to a 12.7 mm (0.5 inch) radius), or equally sensitive probe; and

(C) A steel calibration coupon 30.5 cm x 30.5 cm (12 inches x 12 inches) covered with the same material and thickness as that to be tested. The material on the coupon shall have a test hole to the metal substrate made by puncturing the material with a 22 gauge hypodermic needle or comparable piercing tool.

(ii) The probe must be passed over the surface of the calibration coupon in a constant uninterrupted manner until the hole is found. The hole is detected by the white or light blue spark formed. (A sound lining causes a dark blue or purple spark.) The voltage must be adjusted to the lowest setting that will produce a minimum 12.7 mm (0.5 inch) spark measured from the top of the lining to the probe. To assure that the setting on the probe has not changed, the spark tester must be calibrated periodically using the test calibration coupon, and the same power source, probe, and cable length.

(iii) After calibration, the probe must be passed over the lining in an uninterrupted stroke.

(iv) Holes that are found must be repaired using equipment and procedures prescribed by the lining manufacturer or lining installer.

(2) Linings made of other than rubber (elastomeric material) must be tested using equipment and procedures prescribed by the lining manufacturer or lining installer.

All manufacturers refer to this specification. The intent is to thickness test the lining to determine the thickness loss of the corrosion barrier and record. Again, most of the linings are .100 inches thick minimum and are usually recorded on the data plate. So when the inspector is doing the internal lining inspection, a "Divot test. "Pit gauge test" or "fracture depth" test needs to be performed by an experienced inspector to confirm the loss of corrosion protection. Once this is confirmed, a determination can be made if the lining is suitable for chemical transport as long as the chemical is not penetrating the structural layers of the vessel.

(3) Degraded or defective areas of the cargo tank liner must be removed and the cargo tank wall below the defect must be inspected. Corroded areas of the tank wall must be thickness tested in accordance with paragraphs (i)(2), (i)(3), (i)(5) and (i)(6) of this section.

(4) The inspector must record the results of the lining inspection as specified in §180.417(b).

Requirements for inspection and repairs of lined or all composite cargo tankers.

This list has been developed to show the training and experience a shop would want to have to repair or inspect DOT 49 CFR 180.407 lined or FRP Composite cargo tankers. If the inspection involves a Special Permit trailer,

then a copy of the special permit will be obtained, and the manufacturer notified if the permit requires, of any work to be performed. This list is to be used to qualify any shop that is considering doing any repair or inspection.

Items that are mandatory:

1. DOT CT registration number.
2. Meet all the requirements of 49 CFR parts 180.407 including but not limited to:
   - Registered inspector with the proper credentials per 171.8. Including case histories showing actual experience in lined cargo tank inspections and work.
   - Required training and record keeping per 172.700
   - Required documentation and training in 180.407 all parts including 180.407 (e) and (f), including calibration plates.
   - Minimum qualifications of 180.409.
   - Responsible inspection reports per 180.417.
   - Marking per 180.415 "I" or "L".

Recommendations for Inspecting FRP Cargo Tank Trailers

The following information is provided as an experienced opinion of the author on how to get the most out of your composite cargo tanker. The following are recommendations given consideration to practical implementation as well as the intention of Part 180 annual inspection requirements to ensure a minimal safety standard for composite FRP DOT 407/412 specification cargo tanks including DOT 180.407 inspection interpretations.

The corrosion liner on composite tankers is usually 100 mils thick, or .100". This is made up of surface veil layers 10-20 mils thick, which are 80-90 percent resin and keep the chemicals from attack. Then this is followed by usually 2 layers of ECR mat of 40 mils each of 60-70 percent resin, for a total of 100-200 mil. This is just shy of 1/8"-3/16" of Corrosion liner thickness.

This thickness has shown through industry experience to be the optimum thickness to give good service life before a reline or maintenance is needed. More information can be obtained at the Ashland website www.derakane.com under corrosion recommendations.

Following the liner is the structural layers of the substrate, which can be a combination of a structure with a core material like balsa or a solid composite with stiffeners or ribs on the exterior. In either case, what we are inspecting when we do an internal "L" lining inspection, is to see how deep the corrosion and degradation is, mark and document this, and determine the life left in the liner for safe handling and transport of the chemicals. When the liner begins to degrade it affects the veils first, then works its way through the lining through permeation. It is possible that 30-50 mils of the liner is contaminated and falling off getting into the product prior to the liner being fully degraded. Even though there is good liner left, a reline may be necessary if the product hauled can't withstand any contamination.

1. Visual inspection for delamination, excessive corrosion or, corrosion beyond the liner hollow spots in the liner (corrosion barrier) including secondary bonds around nozzles, blisters, fiber wicking or exposed dry fibers, cracking, or other abnormality such as bulging, softening of the surface, or resin degradation. If any of the above are found, they are to be recorded per 180.407, and if the corrosion is not found to be in detriment of the structural, then the unit would pass the visual inspection and be returned to service.

2. Should any defects be found, additional inspection is required and a detailed description including photographs of the defect both before and after repairs should be included in the inspection report and maintained by the owner, and the CT inspection company, If any defects are found that are beyond the corrosion barrier or that would affect the structural integrity of the cargo tank, the unit should be inspected by the manufacture, or its approved CT company.

3. Cargo Tank Motor Vehicles fabricated with a conductive layer behind the lining or corrosion barrier can be spark tested at the required spark calibration volts to determine integrity of the lining in addition to the visual inspection. Generally, symptoms due to ageing will pass a spark test well after symptoms are visible. Conditions that are not severe in nature and do not interfere with normal operation of the tanker should be ok to return to service if no sparking is found. However, common sense should be used and the manufacture notified if any serious defects are found even if the tanker passes a spark test.

NOTE: It is possible for a conductive layer to have small void spaces that will not spark. For this reason, it is important that a thorough visual inspection be performed by a qualified person in addition to a spark test. Any defects should be photographed and reviewed by the manufacture of the equipment.

Additional Inspection Procedures:

Corrosion liners:

Corrosion liners are of varying thicknesses from .100-.250". Each tanker should be discussed with the manufacturer to determine the corrosion liner thickness so that accurate degradation monitoring can be done annually.

A. Cracks

Small surface cracks are not uncommon in various types of service, and are allowable as long as the liner fracture does not penetrate into the structural layers. Large cracks longer than 1.5" should be examined to determine depth. This can be done by grinding the crack until it appears to be ground out and disappears. If more than one crack is present and all appear similar in nature, only a random sampling needs to be inspected in this manner. Cracks completely through the liner would indicate that repair is needed. All cracks inspected in this manner should be repaired according to a written specification obtained from the manufacture, or by an authorized repair shop approved by the manufacturer, or as described in the special permit, before being returned to service. Large structural cracks should be evaluated by the manufacturer and only repaired by the manufacture of the cargo tank motor vehicle, or an authorized repair facility.

B. Blisters

Blisters are a normal part of common acid service, especially small molecule acids such as hydrochloric acid, (HCL). Once liquid is bleeding out of the blisters, an inspection should be performed by grinding off a blister. Inspection of 3 blisters is considered to be representative of the condition of the corrosion barrier. Inspected area shall be repaired according to a written specification obtained from the manufacturer. Blisters that exceed the corrosion barrier require repair or a new corrosion barrier installed before returning to service. In most cases, a complete re-lining repair will be required.

C. Fiber Bloom, Veil and Resin Degradation

Fiber bloom, veil and resin degradation are characterized by resin dryness on the surface of the corrosion barrier and is a result of wear in most cases. Veil is sometimes missing in spots and exposed fiber is present. If the affected areas do not have visible "loose" fiber or delamination then a photographic record shall be taken and cargo tank may be returned to service if the degradation is not more than 80 percent and expected corrosion will not exceed the liner in the next 12 months. Minimal loose fiber that does not interfere with normal operations of the cargo tank should be referred to the manufacture for recommendation. This can be done with a photographic record and description of the chemical service of the cargo tank.

E. Barcol Hardness Test

A barcol hardness test is recommended to be performed to determine the retention of physical properties of the cargo tank after every year of service to establish a baseline measurement. This tool is used mostly for repairs and new relines to determine the cure of the laminate. Barcol hardness should be 90% of the original resin specification. Test instrument should be calibrated with test discs before

testing by an experienced inspector. A small portion of the test area should be sanded to remove chemically exposed resin and fiber to obtain an accurate reading. Corrosion barriers that test below 80% should be reported to the manufacture for further review. Barcol testing is only a tool to be used in addition to a visual inspection.

NOTE: Some products can produce lower barcol levels at the surface, yet still continue to provide adequate chemical resistance for a long period of time. These situations must be evaluated on a case by case basis with consideration given if the tanker is in dedicated service, and product is well know to have a slow rate of degradation to the resin system. The material manufacture can be consulted to assist with this evaluation. Many factors can affect barcol hardness. Hardness data should not be relied on solely for evaluations.

F. Structural Cracks or defects.

Any crack or other defect that extends beyond the corrosion barrier will be deemed to be structural and require the original cargo tank manufacture, or their approved affiliate, to perform inspection and necessary repairs if they exceed a total surface area of 2 sq. ft.

G. Photographic Record

All DOT-SP cargo tanks found to have any defects or excessive wear shall be required to have a photographic record included in the inspection. This record shall be sent to the manufacture or approved shop for review if required by the special permit.

H. Conclusions

FRP composite cargo tanker motor vehicles are versatile and are known to be one of the safest forms of chemical transfer. With good inspections by experienced companies, these vessels can provide long lasting equitable performance.

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