



U.S. Department  
of Transportation

Research and  
Special Programs  
Administration

# Memorandum

Date **OCT 25 2001**

Reply to Attn. of:

Ref. No. 01-0247

Subject: **INFORMATION: Request for Clarification**

From: **Delmer F. Billings**  
Chief, Standards Development, DHM-11

To: **William Quade**  
Chief, Hazardous Materials Division. MC-ECH

This is in response to your September 19, 2001 letter asking for a confirmation of the following questions and answers you provided concerning cargo tank regulations in the Hazardous Materials Regulations (HMR; 49 CFR Parts 171-180). Your questions are answered as follows:

- Q1. A specification MC-307 cargo tank has a design pressure of 25 psig. Is it permissible to replace the original pressure actuated vent with a 400 series pressure relief device that will limit tank pressure to 130% of design pressure (32.5 psig) as required by § 178.342-2(b), but will not open until 30 psig?
- A1. No, a self closing pressure relief device set above a cargo tank's design pressure would allow the unit to be operated above its designed pressure which is in violation of § 180.407(a)(2). For example an MC-307 cargo tank with a design pressure of 25 psig must have a pressure relief device which opens at 25 psig so to not allow the tank to continually operate over pressurized. The pressure relief device must be able to limit tank pressure to 130% of the design pressure.
- Q2. Section 173.33(b)(4) allows pressure in a cargo tank during loading/unloading of up to 130% of the MAWP of the cargo tank, but § 173.33(c)(1)(vi) states that the MAWP of the cargo tank cannot exceed the maximum pressure during loading or unloading. Do these two requirements conflict?
- A2. No. Section 173.33(b)(4) is only applicable in an accident situation. In the preamble to the HM-183 Final rule published on September 7, 1990 (55 FR 37092) relating to this question RSPA stated the following regarding § 173.33:

"Paragraph(c)(1)(vi) relates to pressure within a cargo tank during normal loading or unloading. In contrast, paragraph (b)(4) relates to the maximum surge pressure that may be applied to the tank as a result of an overfill or over pressurization during a loading or unloading accident. There is no inconsistency between these requirements . . ."

In addition, § 180.407(a) prohibits operating a cargo tank at a pressure greater than its design pressure/MAWP.

- Q3. According to § 173.33(d)(3) the pressure relief system on a 300 series cargo tank may be upgraded to a pressure relief system meeting the requirements of a 400 series cargo tank, as long as "the venting capacity requirements of the original specification are met when a pressure relief valve is modified." However, the methods for determining venting capacity are different for the 300 series and 400 series cargo tanks. According to § 178.345-10(g) the 400 series pressure relief devices are to be flow rated at a pressure not to exceed the test pressure for the cargo tank. DOT-407 vents are typically tested and rated at 1.5 times MAWP. The MC-307 specification (§ 178.342-4) requires the devices to be tested at 130%. For a 300 series cargo tank that is equipped with a pressure relief device manufactured in accordance with 400 series requirements, at what pressure should the flow capacity be determined?
- A3. The flow capacity must be determined using the requirements of the original specification, as stated in § 173.33(d)(3). Therefore, in the example you included above, the DOT-407 vent used on an MC-307 cargo tank must be flow tested at 130% of the design pressure to accurately determine compliance with the minimum venting requirements of § 178.340-4. This information should be supplied by the manufacturer of the pressure relief device.

#

Date: 09/19/2001 07:22 am -0400 (Wednesday)  
 From: Theodore Turner  
 To: Shelton, Daniel  
 Subject: Re: Fwd: FW: Request for Interpretation

Johnsen  
 123.33  
 180.407

Cargo Tanks

01-0247

Yes a signed one is best. The next step will be to notify the venting manufacturers that they need to "inform" their customers of the flow rates of 400 series vents installed on 300 series cargo tanks. There is a significant difference especially for a 25 psig design pressure tank, since you will need two vents to get the required capacity instead of the one device now used. I have a table of flow rates for Fort Vale. I have not yet gotten the Girard information. Thanks Ted

theodore.turner@fhwa.dot.gov

>>> Daniel Shelton 09/18/01 11:37AM >>>

Here is the response to your e-mail request concerning venting questions. If you need a signed interpretation please let me know.

WANTS INTERP FOR ATTACHED QUESTIONS.

ADDRESS

~~THEODORE TURNER~~

DANIEL SHELTON

Q. A specification MC-307 cargo tank has a design pressure of 25 psig. Is it permissible to replace the original pressure actuate vent with a 400 series pressure relief device that will limit tank pressure to 130% of design pressure (32.5 psig) as required by 178.342-2(b), but will not open until 30 psig?

A. No, a self closing pressure relief device set above a cargo tanks design pressure would allow the unit to be operated above the units designed pressure in violation of 180.407(a)(2). For example an MC-307 cargo tank with a design pressure of 25 psig must have a pressure relief device which opens at 25 psig so to not allow the tank to continually operate down the road over pressured. The pressure relief device must be able to limit tank pressure to 130% of the design pressure.

Q. 173.33(b)(4) allows pressure in a cargo tank during loading/unloading up to 130% of the MAWP of the cargo tank, but 173.33(c)(1)(vi) states that the MAWP of the cargo tank cannot exceed the maximum pressure during loading or unloading. Do these two sections conflict?

A. No. 173.33(b)(4) is only applicable in an accident situation. In the preamble to the HM-183 Final rule published on September 7, 1990 (55 FR 37092) relating to this question RSPA stated the following regarding 49 CFR 173.33:

"Paragraph(c)(1)(vi) relates to pressure within a cargo tank during normal loading or unloading. In contrast, paragraph (b)(4) relates to the maximum surge pressure that may be applied to the tank as a result of an overfill or over pressurization during a loading or unloading accident. There is no inconsistency between these requirements . . ."

In addition, 180.407(a) prohibits operating a cargo tank at a pressure greater than its design pressure/MAWP.

Q. According to 173.33(d)(3) the pressure relief system on a 300 series cargo tank may be upgraded to a pressure relief system meeting the requirements of a 400 series cargo tank, as long as "the venting capacity requirements of the original specification are met when a pressure relief valve is modified." However, the methods for determining venting capacity are different for the 300 series and 400 series cargo tanks. According to 178.345-10(g) the 400 series pressure relief devices are to be flow rated at a pressure not to exceed the test pressure for the cargo tank. DOT-407 vents are typically tested and rated at 1.5 times MAWP. The MC-307 specification (178.342-4) requires the devices to be tested at 130%. For a 300 series cargo tank that is equipped with a pressure relief device manufactured in accordance with 400 series requirements, at what pressure should the flow capacity be determined?

A. The flow capacity must be determined using the requirements of the original specification, as stated in 173.33(d)(3). Therefore in the example you included above, the DOT-407 vent used on an MC-307 vent must be flow tested at 130% of the design pressure to accurately determine compliance with the minimum venting requirements of 178.340-4. This information should be supplied by the manufacturer of the pressure relief device.



Nov 12, 2002

11/12/2002 - 178.345-10

Mr. John Freiler  
Reference No. 01-0295  
Girard Equipment, Inc.  
1004 Route 1  
Rahway, NJ 07065

Dear Mr. Freiler:

This is in response to your November 9, 2001 letter and subsequent conversations with members of my staff requesting clarification on the replacement of vents on MC 300 series cargo tank with vents designed for DOT 400 Series cargo tanks meeting the performance requirements of § 178.345-10(b)(3) in the Hazardous Materials Regulations (HMR:49 CFR Parts 171-80). In addition to clarifying RSPA's position on this issue, you also request that RSPA allow 25 psig maximum allowable working pressure (MAWP) MC 307 tanks to have their vents upgraded to DOT 407 vents having a set pressure of 30 psig as required by the requirements for DOT 407 vents as described in § 178.345-10. I apologize for the delay in responding to your letter.

The interpretation issued by this office by Hattie Mitchell in 1996 is correct. Section 173.33(d)(3) required the replacement DOT 407 series valve only to meet the original MC 307 cargo tank venting capacity requirements. Thus, the letter to Bill Quade (Ref. No. 01-0247) should be amended to clarify that only the venting capacity requirements for the 300 series tank need be met.

In addition, your request to allow MC 307 cargo tanks with a maximum allowable working pressure (MAWP) of 25 psig to have their vents upgraded to DOT 407 vents having a set pressure of 30 psig (as required in

§ 178.345-10 for DOT 407 vents) must be submitted as a petition for rulemaking under the requirements of

§ 106.31 in order for RSPA to consider a rule change.

We hope this satisfies your request.

Sincerely,

Robert A. McGuire  
Associate Administrator  
Office of Hazardous Materials Safety  
178.345-10

September 7, 2016

Danny Shelton  
Hazmat Resources, Inc.  
124 Rainbow Drive  
Livingston, TX 77399

dshelton@hazmatresources.com

Re: Your Venting Memo dated July 16, 2015.

Dear Mr. Shelton,

TTMA recently became aware of the Hazmat Resources Inc. "Cargo Tank Safety Advisory Notice" titled Vent Testing – The Basics and dated Friday, July 16, 2015 (Copy Attached). The Tank Conference Engineering Committee has reviewed this item and has identified one area where you are in error and may well be misleading your clients.

I am referring in this instance to your section titled Installing 400 Series on 300 Series Cargo Tank. In that section you wrongly conclude:

I believe this phrase means that a 400 series vent installed on this MC 307 cargo tank must provide the minimum venting capacity that is identified in the table in 178.342-4 at pressure (flow rating) of 130% of the tank design pressure.

While you present a reasoned argument based on carefully tailored excerpts from the HMR, you omit three crucial facts. First is the plain intent expressed by DOT during the code development. I had personal involvement in the development of HM-183 and know that your interpretation was not the intent of the authors. Second, and more significantly, DOT issued an interpretation dated June 10, 1996 and signed by Hattie L Mitchell which said:

*...Specifically, you asked if §173.33(d)(3) prohibits upgrading vents on MC 307 and MC 312 cargo tanks to DOT 407 and DOT 412 vents that are flow rated in accordance with §178.345-10.*

...

*The answer is no. ...*

Those two facts make it clear that while the capacity requirements in 178.342-4, Table III need to be met, the pressure at which these requirements are figured are according to the requirements laid out in 178.345-10, i.e. at the cargo tank test pressure for 407 vents installed on upgraded MC-307 cargo tanks. This is in accordance with approximately 24 years of industry practice and confirmed DOT regulation.

Finally, the recent rules change creating bench testing regulations in §180.407(j) specifically states that 300 series cargo tanks with upgraded vents have the new vents set at the 400 series levels. 400 series vents are **required** to open from 120-132% of MAWP. We believe this to demonstrate that the idea that an upgraded vent should be flow rated at 130% of MAWP is incorrect as the vent is permitted to still be closed at that pressure.

We believe your interpretation to be misleading to the industry and to be promoting a non-upgrade that could potentially promote non-compliance. You can reassure anyone who followed your “very conservative” advice that they are not necessarily out of compliance with the code so long as they acknowledge that they simply have not upgraded their vents. A vent set at the 300 series levels meets the requirements for the original specification and so can continue in use, if a user fails to note this, then their vent will certainly be out of compliance with the required test in 180.407(j) and need to be replaced with one set at the proper 120% and marked with flow ratings at the tank test pressure.

The Tank Conference Engineering Committee decided to issue a formal statement detailing the issue and a copy of that is attached for your reference. The Committee takes strong exception to any interpretation that DOT-400 series venting on MC-300 Series cargo tanks must be qualified at the 130% threshold. Thousands of upgraded units are in service, and public safety is better assured with these cargo tanks using DOT-400 series venting systems in lieu of the old PRD systems.

Sincerely,

*John Freiler*

John Freiler

Engineering Manager

cc:

David Ford, FMCSA

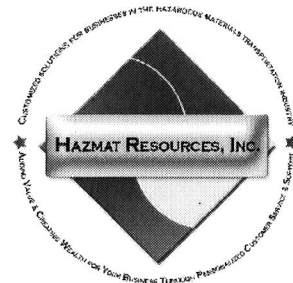
Stan Staniszewski, PHMSA

# Hazmat Resources, Inc.

## Cargo Tank Safety Advisory Notice

### Vent Testing – The Basics

Friday, July 16, 2015



The bench testing of pressure relief devices (PRD's) creates more questions than answers. The regulations that cover the specifications for PRD's do not, in some instances, provide the clarity that is required to ensure a PRD is the correct PRD for the cargo tank motor vehicle (CTMV). Another issue is the lack of definition of terminology that is used to describe how a PRD must be inspected and tested. Following are some definitions that will be used in an attempt to explain why things are the way they are and how to connect the dots. Not all definitions are in the DOT regulations so one must look elsewhere for common ground. Another way to look at this could be to utilize "the reasonable person standard" or "common law standard".<sup>1</sup>

#### **DEFINITIONS**

**Set pressure (Set-to-discharge Pressure) found in 49 CFR §178.345-10(d)** - The set pressure of the pressure relief system is the pressure at which it starts to open, allowing discharge.

Comment: The regulations are defining Set Pressure but they are describing in the definition start-to-discharge pressure or crack pressure.

**Set pressure found in 29 CFR 1910.168.(a)(5)** - The set pressure of a safety relief valve is the pressure marked on the valve and at which the valve is set to start-to-discharge.

**Start-to-Discharge pressure found in 29 CFR 1910.168.(a)(6)** - The start to discharge pressure of a safety relief valve is the pressure at which the first bubble appears through a water seal of not over 4 inches on the outlet of the valve.

**Start-to-Discharge pressure found in WAC Title 296 Section 296-24-93001** - The "start-to-discharge pressure" of a safety relief valve is the pressure at which the first bubble appears through a water seal of not over 4 inches in the outlet of the safety relief valve.

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<sup>1</sup>Reasonable person standard is one of many tools for explaining the law to a jury. The "reasonable person" is an emergent concept of common law. While there is (loose) consensus in black letter law, there is no universally accepted, technical definition. As a legal fiction, the "reasonable person" is not an average person or a typical person. Instead, the "reasonable person" is a composite of a relevant community's judgment as to how a typical member of said community should behave in situations that might pose a threat of harm (through action or inaction) to the public. The standard also holds that each person owes a duty to behave as a reasonable person would under the same or similar circumstances. While the specific circumstances of each case will require varying kinds of conduct and degrees of care, the reasonable person standard undergoes no variation itself. The "reasonable person" construct can be found applied in many areas of the law. The standard performs a crucial role in determining negligence in both criminal law—that is, criminal negligence—and tort law.



**Start-to-Discharge pressure described for DOT Portable Tanks found in 49 CFR §**

**178.276(e)** - Portable tanks must be provided with one or more reclosing pressure relief devices. The pressure relief devices must open automatically at a pressure not less than the MAWP and be fully open at a pressure equal to 110% of the MAWP. ***These devices must, after discharge, close at a pressure not less than 10% below the pressure at which discharge starts*** and must remain closed at all lower pressures. The pressure relief devices must be of a type that will resist dynamic forces including liquid surge. A frangible disc may only be used in series with a reclosing pressure relief device.

Comment: This same phrase ***10% below the pressure at which discharge starts*** is used in 49 CFR §178.276 for the design, construction, inspection and testing of portable tanks intended for the transportation of non-refrigerated liquefied compressed gases and in 49 CFR §178.277 for the design, construction, inspection and testing of portable tanks intended for the transportation of refrigerated liquefied gases. There is no descriptive term used in the 49 CFR §180.400 series to define start-to-discharge pressure for the re-qualification of cargo tanks. Just because the definition of start-to-discharge pressure is not defined in the DOT regulations for cargo tanks does not really change the meaning of the phrase. There is just more discussion on what one thinks start-to-discharge pressure should mean so one must refer to other source material for the guidance.

**49 CFR §180.407(g)(1)(ii)(A)** - Each self-closing pressure relief valve that is an emergency relief vent must open at no less than the required set pressure and no more than 110 percent of the required set pressure, and must reseal to a leak-tight condition at no less than 90 percent of the start-to-discharge pressure ***or the pressure prescribed for the applicable cargo tank specification.***

**Bench Testing of MC 307 Pressure Relief Devices**

Using the definitions stated above a 300 series PRD for a MC 307 cargo tank motor vehicle should be bench tested as follows:

MAWP	Set Pressure	Start to Discharge Pressure (STDP) (100% to 110% of the MAWP)	Re-Seat Pressure (90% of STDP)
25	25	PRD must open between 25 to 27.5 PRD opens at 27.4 PRD opens at 25.1	Reseat no less than 24.66 Reseat no less than 22.59
30	30	PRD must open between 30 to 33 PRD opens at 32.9 PRD opens at 30.1	Reseat no less than 29.61 Reseat no less than 27.09
35	35	PRD must open between 35 to 38.5 PRD opens at 38.4 PRD opens at 35.1	Reseat no less than 34.56 Reseat no less than 31.59
40	40	PRD must open between 40 to 44 PRD opens at 43.9 PRD opens at 40.1	Reseat no less than 39.51 Reseat no less than 36.09





For the sake of simplicity 1/10<sup>th</sup> of a pound above the minimum opening range and 1/10<sup>th</sup> of a pound below the maximum opening range as examples. The reseal pressure is a moving number and is based on the start to discharge pressure that as defined in various publications including the DOT just not specifically in the cargo tank regulations. Just because it is not defined in the cargo tank regulations specifically, does not make the definition invalid or unusable when applying this guidance to the bench testing of pressure relief devices in cargo tank motor vehicles.

### Installing 400 Series on 300 Series Cargo Tank

Let's address the process of installing a 400 series vent on a MC307 CTMV with a MAWP of 25. One can upgrade the vent on a 300 series cargo tank to the more recent specifications identified in 180.405(h)(3) which states the following:

(h)(3) As provided in paragraph (c)(2) of this section, the owner of a cargo tank may elect to modify reclosing pressure relief devices to more recent cargo tank specifications. However, replacement devices constructed to the requirements of §178.345-10 of this subchapter must provide the minimum venting capacity required by the original specification to which the cargo tank was designed and constructed.

There are a variety of versions about what 180.405(h)(3) really means and it all depends on who you ask, their understanding of the issue and special interests. We are going to try and just understand the Kings English and try that approach and see what the outcome might be. We will start with the second sentence in 180.405(h)(3) which states the following: However, replacement devices constructed to the requirements of §178.345-10 of this subchapter **must** provide the minimum venting capacity **required** by the **original specification** to which the cargo tank was designed and constructed.

When the term **MUST** is used it imposes a legal obligation on those who are required to comply. So the real question becomes "What is the minimum venting capacity **required** by the **original specification**." Here is what the old regulations say about the minimum venting capacity of a MC307 cargo tank. 178.342-4 states the following in paragraph c:

Pressure-actuated venting (spring loaded). Every cm-go tank compartment shall be equipped with pressure-actuated vent or vents set to open at no less than the tank design pressure. The minimum venting capacity for pressure actuated vents shall be 12,000 cubic feet of free air per hour (14.7 psig and 60( F.) per compartment or 12,000 cubic feet of free air per hour (14.7 psig and 60F.) for each 350 square feet of exposed tank area, whichever is greater. This **minimum capacity shall be measured at a pressure of 130 percent of the tank design pressure**. Pressure actuated devices shall be designed to function in case of pressure rise when in any condition of rollover attitude. If pressure (maximum limits to be included on the metal certification plate §178.340-10(b)) unloading devices are provided, the relief



valve shall have sufficient capacity to limit the tank internal pressure to 130 percent of design pressure.

The important words in this section are highlighted in bold: **minimum capacity shall be measured at a pressure of 130 percent of the tank design pressure.**

I believe this phrase means that a 400 series vent installed on this MC 307 cargo tank must provide the minimum venting capacity that is identified in the table in 178.342-4 at pressure (flow rating) of 130% of the tank design pressure. In this case the tank design pressure (MAWP) is 25 so the vent must provide the minimum venting capacity at 32.5 PSI (130% of 25). If the vent is not marked with this flow rating then it is a marking violation.

### Summary

There has been a lot of misinformation published regarding venting, especially the phrase that you can use our vent and eliminate your fusible caps. That phrase can be misleading although fusible caps can be eliminate if the replacement device provides the minimum venting capacity at 130% of the design pressure. If the PRD will do that it is also required to be marked reflecting this information. If it is not marked accordingly then it is a violation. There have been many reasons floating around in the industry as to why things are the way they are and the best one that I have heard is the following: "The DOT has not said anything and we have been doing it this way for years" and another good one is this is the way we have always done it and no one has ever said anything.

As a reminder one should also verify the PRD is properly marked with the manufacture's name, model number, set pressure and rated flow. The Truck Trailer Manufacturers Association (TTMA) did petition the Pipeline and Hazardous Materials Safety Administration (PHMSA) to change the rules for venting. This rulemaking closed on March 23, 2015 but no decisions have been made by PHMSA on the publication of a final rule or what the contents of the final rule will be.

This document takes a very conservative approach to the ambiguous rules related to the testing, marking and application of pressure relief devices for CTMV's. One may choose to take an alternative approach and there may never be any consequences unless you become the subject of an investigation by the competent authority. Once one is in the eye of the tiger, the perspective on what should or should not happen often changes. Following the recommendations in this notice you provide one an excellent chance to be successful when the competent authority knocks at your door. It is my recommendation that one should always take the position that it is not a matter of if the DOT will show up but a matter of when the DOT will show up.

**NOTE: FMCSA recognizes that PRD's are not being properly tested and the results documented. A copy of FMCSA's previous Safety Advisory Notice on Vent Testing is attached for your reference.**



## TTMA Position on MC 307 to DOT 407 Venting Upgrades

*Updated December 17, 2015.*

### ABSTRACT

TTMA summarizes the history and rationale behind the venting changes made when DOT authorized new 400 series cargo tanks. The HMR allowed owners of older cargo tanks to upgrade their venting systems to the new code, and the industry embraced this. However, a small minority of users have some confusion, both about what the HMR requirements actually specify and what is best practice. This paper describes the requirements as laid out in the HMR and in official code interpretations from DOT.

### BACKGROUND

The Truck Trailer Manufacturers Association (TTMA) is an international trade association formed in 1941 representing approximately 90% of the trailers manufactured in the United States. TTMA works closely with both regulators and end users.

In September of 1990, Docket HM-183 was advanced and the Code of Federal Regulations was modified for construction of cargo tanks. Prior to 1990, DOT had spent a number of years investigating the design, construction and safety of cargo tanks hauling hazardous materials. The old Motor Carrier (MC 306, 307, 312) codes would not be used for cargo tank construction after September 1, 1995. All cargo tanks would be constructed to the new DOT 407 code, three notable differences were:

- Removal of fusible and/or frangible disc from the pressure relief system.
- Set to discharge changed from (MAWP to +10%) to (120% to 132% of MAWP).
- Flow rate calculation threshold shifted from 130% of MAWP to 150% of MAWP.

In reviewing actual performance of cargo tanks, DOT concluded the safety record of tanks could be improved. For venting, the MC codes were designed primarily around preventing catastrophic failure of the tank. However many accidents didn't involve catastrophic scenarios, but were less severe (more common) sorts of events; for example, a tank rolling-over on a highway exit ramp. In these events, the design of the MC code venting allowed release of product - when it could possibly have been prevented. Changes were put forward to continue to provide catastrophic levels of protection, while also increasing cargo retention in less severe incidents.

Fusible and frangible devices as stand-alone pressure relief devices were removed from cargo tanks (about) 25 years ago. This was done to provide improved containment of the hazardous materials. Industry embraced this change, and it has been a great improvement to the cargo tank design.

The set-to-discharge pressure range was increased a slight amount from MC 307 to DOT 407. This increase in pressure range does not have any negative affect on the structural integrity of the cargo tank, since both designs are subject to test pressures of at least 150% of MAWP. The higher set-to-

discharge pressure allows for variations and hysteresis within acceptable limits of use. This change allows the pressure relief device to reseal and seal before dropping below the MAWP.

Both of these changes serve to contain the product in the cargo tank in the event of a rollover far better than the earlier designs. In a rollover, a fusible or frangible device that had opened could allow the entire cargo to escape the tank. The increased set-to-discharge pressure served to protect the tank from discharging when the weight of the cargo (head) was added to any internal pressure (when the tank was inverted).

## **CHALLENGE**

The HMR allow for pressure relief devices to be upgraded to the newest specification in §§180.405(c)(2) and 173.33(d)(3). Thousands of MC 307 cargo tanks were produced between 1990 and 1995 with DOT 407 compliant vents. Moreover, many owners of older cargo tanks from the MC 307 years desired an upgrade to newer pressure vents. WHY? Industry didn't want to maintain the older style of cargo tanks with fusible devices that needed to be constantly replaced. They wanted to be environment friendly with robust re-closing pressure relief devices. It made sense then and still does today. They wanted higher flow rates from the DOT 407 pressure relief devices.

On the other hand, some groups have misconstrued or misunderstood the wording and intent of the changes to the Code of Federal Regulations. Their misguided interpretations would allow fusible devices back on MC 307 cargo tanks with DOT 407 compliant venting, along with greatly reduced pressure relief devices. Seemingly, they don't understand the applicable engineering principles.

Will the design of the MC 307 cargo tank be compromised in any form or fashion if the set to discharge pressure is increased by 10%? Should the flow rates be calculated at 130% or 150%? Both of these questions are technical in nature and are answered best by design certifying engineers familiar with cargo tank design and construction.

## **UNDERSTANDING THE DESIGN**

### *Fusible and/or frangible device background:*

Fusible vents have been used on cargo tanks since the 1950's. Typically, a fusible device consists of a threaded connection holding a fusible element and a disc. The fusible device is designed to yield at an approximate temperature of 250°F. The fusible device communicates with the vapor space of the tank. In a fire emergency, the fusible element would melt and provide an outlet for vapor pressure to escape from the tank vessel. In a catastrophic fire, the boiling liquid could cause a rupture resulting in damage, possible injury and release of the lading. The fusible device creates an inexpensive form of venting the cargo tank's pressure, potentially suppressing the rupture.

During the 40 year period from 1950 to 1990 many improvements were made to manufacturing fusible vents. With all of the improvements, the fact remains that this type of relief device is non-reclosing. Once opened, it will stay open until manually replaced. Tank trucks are subject to high shock and vibration loads on a regular basis. Fusible vents are not able to withstand the high vibration load over an extended period of time. When subject to these vibration loads, the fusible vent may open at an

inopportune time. The surrounding environment would then unnecessarily be exposed to toxic, harmful vapors. Heat systems are used on some tank trucks that transport thick viscosity ladings. These heating systems sometimes operate very near to the temperature range that a fusible device is required to yield. The high heat eventually degrades the fusible vent and causes it to open. Another form of adverse heat to the fusible vent is steam from tank cleaning operations.

*Guidance from DOT:*

In the 1980's, when DOT was contemplating re-writing cargo tank regulations, they held several public meetings that TTMA members attended. Officials from DOT clearly and succinctly stated their thoughts and intentions regarding fusible devices in the passage, below.

In the Federal Register (Volume 50, No.180, p.37776, Tuesday September 17, 1985) DOT stated:

***5. We believe that the risk from hazardous material transportation is substantially reduced when packaging is designed to retain the lading in non-catastrophic accidents and to minimize the quantity of lading released when release is inevitable. However in a cargo tank accident, particularly an overturn followed by a fire, the functioning of a frangible disc or a fusible element would result in the release of a substantial quantity of lading. A reclosing pressure relief device on the other hand would minimize the quantity of lading released. Further we believe that a frangible disc and fusible elements particularly in low pressure applications are much more likely to fail as a result of impact and liquid surge than reclosing pressure relief devices. Accordingly, for all cargo tanks constructed after the effective date of the final rule, we are proposing that all pressure relief devices be re-closing except a frangible disc may be used in series with a reclosing pressure relief device.***

TTMA believes that DOT had a thorough understanding of fusible/frangible devices and focused a great deal of their attention to eliminating the use of non-reclosing devices. This greatly enhances tank safety and protects public interest. How, one might ask? First, when a rollover occurs with an opened fusible device, lading is almost always released; conversely, reclosing pressure relief devices release lading only when there is pressure on the tank. Secondly, the release of non-accident vapors to the atmosphere is prevalent when using fusible devices that have failed due to impact and/or liquid surge. This inadvertent release of vapors is greatly reduced or eliminated with the use of reclosing pressure relief devices.

*MC 307 Venting systems:*

49 CFR 178.342-4, (a) through (d) specifies safety relief vents on MC 307 Cargo Tanks. The device will consist of pressure-actuated spring loaded device, otherwise known as a reclosing safety relief device. When necessary to meet the venting capacity of Table III, one or two fusible and/or frangible devices would be added to the total venting system. The spring loaded safety relief device in this system makes up a subpart of the total capacity of the pressure relief system. The fusible or frangible device(s) are used to augment this system.

*DOT 407 venting systems:*

49 CFR 178.345-10 (a) through (h) specifies the requirements for DOT 406, 407 and 412 series pressure relief system. Specifically, 178.345-10 (b) (1) requires that each primary pressure relief system consist of one or more reclosing pressure relief valves. Furthermore, non-reclosing (e.g., fusible disc) pressure relief devices are not authorized in any cargo tank. The venting capacities from Table I will require one or more reclosing pressure relief devices.

*Note: reclosing pressure relief manufacturers were able to meet the higher flow requirements of 178.345-10 by changing the design pressure of the relief device, increasing the flow rates by up to 10 times.*

The clear intent by the DOT was to remove any fusible and/or frangible disc from trailers hauling hazardous cargo, due to safety concerns for the general population.

#### *Upgrading MC 307 to DOT 407:*

There are three different sections of code that address upgrading MC 307 cargo tanks to DOT 407 cargo tanks. §173.33(d) (3) specifies that the pressure relief devices may be modified from MC 307 to DOT 407. Again, §180.405 (c) (2) states that an MC 307 cargo tank may have its pressure relief devices modified to conform to the DOT 407 specification. Lastly, §180.405(h) (3) says the owner of a cargo tank may elect to modify reclosing pressure relief devices to more recent cargo tank specifications, however it must provide minimum venting capacity required by the original specification. The Federal Government clearly wanted cargo tank owners to willfully consider upgrading MC 307 pressure venting systems to DOT 407 code. None of the three cited codes suggests leaving fusible vents in place, nor does it mention having to update the set to discharge pressure from 120% of MAWP to MAWP, or calculating the flow rates at 130% of MAWP. Instead, they clearly state how to upgrade the pressure system to the new code requirements.

While some have misinterpreted the caution to ensure that upgraded vents have sufficient capacity to prevent cargo tank rupture as meaning that the pressure vents must be rated at the original pressures, this was settled when the DOT issued an interpretation dated June 10, 1996 and signed by Hattie L Mitchell which said:

***...Specifically, you asked if §173.33(d)(3) prohibits upgrading vents on MC 307 and MC 312 cargo tanks to DOT 407 and DOT 412 vents that are flow rated in accordance with §178.345-10.***

***...***

***The answer is no. ...***

#### **HOW TO MEET THE REQUIREMENTS**

Fusible devices shall not be employed on cargo tanks with DOT 400 series compliant venting, including MC 307 units. The results are evident! There is a much lower non-accident release record. Lading is not being poured out needlessly when trucks are involved in rollover accidents without explosions. Toxic vapors are not being released to our atmosphere.

Set-to-discharge requirements of the DOT 400 series venting regulations are easily met. The increased tolerance range of 120% to 132% MAWP is easier to qualify during bench testing, the possibility of set-

to-discharge going under the MAWP has been eliminated, and reseal (or reseal) of the pressure relief device occurs before reaching MAWP. The change in set-to-discharge pressure does not have adverse effects on the structure or integrity of the shell design for the cargo tank.

As a general physics statement, mass flow proportionally increases with pressure. During a catastrophic event, a rapid temperature rise will consequently increase flow rates. The older, outdated pressure requirement of 130% to MAWP for the mass flow calculation has been abandoned. All transportation industries embrace the updated flow pressure requirement of 150%. This calculation is applied to trains, ships, and other forms of transporting hazardous materials. TTMA fully embraces this shift and sees no reason to apply an outdated standard to cargo tanks.

TTMA has noted an untarnished safety record for upgraded MC 307 cargo tanks using the modified DOT 407 pressure relief systems over the past 25 years. This track record stands by itself. Thousands of cargo tanks have been built and continue to be in service using this system, working safely, as intended.

#### **ABOUT THE USERS WHO HAVE MISINTERPRETED THE UPGRADE REQUIREMENTS**

TTMA is aware of some people advancing the idea that pressure relief devices, especially those on MC 307 cargo tanks cannot be upgraded to DOT 407 vents set and flow rated according to the DOT 407 requirements. This small group of users continues to operate cargo tanks with the misunderstanding and misinterpretation that requires a fusible device and flow rate calculations at 130% of MAWP. They feel it is the only way to be in complete compliance with the code. However, by applying pressure relief devices that are set and flow rated according to the original specification, they have simply forgone upgrading. They are operating their cargo tanks with pressure relief meeting the requirements when the cargo tank was built as provided for in 173.33(h)(2). They do not necessarily gain the benefits of having better lading retention and fully reclosing devices of the DOT-400 series requirements.

TTMA does not recommend mixing devices: A DOT-407 venting system is not designed to be operated in conjunction with non-reclosing vents alongside it. DOT's intent was to eliminate non-reclosing devices to maximize retention of hazardous materials, and allowing fusibles to continue to operate on otherwise upgraded systems would be contrary to that mission. Further, this is most often done due to operator error: There is no need to provide a fusible vent alongside DOT 400 series reclosing device as these are adequately sized to provide sufficient flow to protect the cargo tank from rupture.

#### **CONCLUSIONS**

The clear intent by DOT is to have all fusible devices removed. Neither the integrity of the MC 307 cargo tank, nor the pressure relief system will be degraded - if the set to discharge pressure is increased from MAWP to 120%. It is a correct interpretation of the CFR - and also safe - to install DOT 407 pressure relief devices on MC 307 cargo tanks. Lastly, a calculated flow rate of 150% of MAWP is a standard used throughout transportation industries around the world.



U.S. Department  
of Transportation

Federal Motor Carrier  
Safety Administration

# Memorandum

Subject: **SAFETY NOTICE ON BENCH TESTING  
OF PRESSURE RELIEF DEVICES (PRDs)**

Date: **OCT 27 2014**

From: Federal Motor Carrier  
Safety Administration

Reply to  
Attn. of: MC-ECH

To: All Cargo Tank Manufacturing,  
Testing, and Repair Facilities

Recent investigations conducted by the U.S. Department of Transportation, Federal Motor Carrier Safety Administration (FMCSA) on USDOT specification cargo tank testing and repair facilities have resulted in a consistent pattern of non-compliance regarding bench testing of Pressure Relief Devices (PRD). Specifically, cargo tank testing and repair facilities are either failing to bench test PRDs or failing to test them appropriately by not determining the proper start-to-discharge and closing pressures.

Due to the extent of this problem, FMCSA is issuing this Safety Notice to increase awareness of the regulatory requirements for PRDs.

Pursuant to 49 CFR Section 180.407(g)(1)(ii), ALL self-closing pressure relief valves, including emergency relief vents and normal vents, MUST be removed from the cargo tank for inspection and testing prior to the pressure test being conducted. In addition, per Section 180.407(d)(3), ALL reclosing pressure relief valves on cargo tanks transporting lading corrosive to the valve must be removed annually for inspection and testing during the external visual inspection.

Section 180.417(b)(2)(iii) requires test report forms to include information about pressure relief vents that are removed, inspected and tested or replaced, including the type of device, set-to-discharge pressure, pressure at which device opened, pressure at which device reseated, and a statement of disposition of the device (e.g., reinstalled, repaired, or replaced).

The PRDs are an integral part of the safety mechanisms for specification cargo tanks and are vital to ensuring highway safety of hazardous materials. Failing to properly conduct bench testing of a hazardous materials cargo tank during the pressure test is not only a safety hazard, but is a violation of the Federal Hazardous Materials Regulations (FHMR). **A specification cargo tank that has had a pressure test where the pressure relief devices have NOT been tested as prescribed is NOT authorized for the transportation of hazardous materials.**

Registered Inspectors who have not bench tested the PRDs during a pressure test should NOT sign the report form indicating the cargo tank is qualified and meets the requirements of the DOT

specifications.

Registered Inspectors are also required to ensure that the PRD is correct for the cargo tank in which it is placed, and for ensuring that the venting capacity is sufficient for the cargo tank.

Cargo tank testing facilities are responsible for ensuring their Registered Inspectors (RIs) are trained and qualified to conduct bench testing of PRDs. This safety notice should be included as part of the HM training requirements specified in 49 CFR Section 172.700 of the FHMR.

If you have any questions regarding this safety notice, please contact the FMCSA Hazardous Materials Division at 202-385-2400.



# Hazmat Resources, Inc.

## Cargo Tank Safety Advisory Notice

### Vent Testing – The Basics

Friday, July 16, 2015



The bench testing of pressure relief devices (PRD's) creates more questions than answers. The regulations that cover the specifications for PRD's do not, in some instances, provide the clarity that is required to ensure a PRD is the correct PRD for the cargo tank motor vehicle (CTMV). Another issue is the lack of definition of terminology that is used to describe how a PRD must be inspected and tested. Following are some definitions that will be used in an attempt to explain why things are the way they are and how to connect the dots. Not all definitions are in the DOT regulations so one must look elsewhere for common ground. Another way to look at this could be to utilize "the reasonable person standard" or "common law standard".<sup>1</sup>

#### **DEFINITIONS**

**Set pressure (Set-to-discharge Pressure) found in 49 CFR §178.345-10(d)** - The set pressure of the pressure relief system is the pressure at which it starts to open, allowing discharge. Comment: The regulations are defining Set Pressure but they are describing in the definition start-to-discharge pressure or crack pressure.

**Set pressure found in 29 CFR 1910.168.(a)(5)** - The set pressure of a safety relief valve is the pressure marked on the valve and at which the valve is set to start-to-discharge.

**Start-to-Discharge pressure found in 29 CFR 1910.168.(a)(6)** - The start to discharge pressure of a safety relief valve is the pressure at which the first bubble appears through a water seal of not over 4 inches on the outlet of the valve.

**Start-to-Discharge pressure found in WAC Title 296 Section 296-24-93001** - The "start-to-discharge pressure" of a safety relief valve is the pressure at which the first bubble appears through a water seal of not over 4 inches in the outlet of the safety relief valve.

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<sup>1</sup>Reasonable person standard is one of many tools for explaining the law to a jury. The "reasonable person" is an emergent concept of common law. While there is (loose) consensus in black letter law, there is no universally accepted, technical definition. As a legal fiction, the "reasonable person" is not an average person or a typical person. Instead, the "reasonable person" is a composite of a relevant community's judgment as to how a typical member of said community should behave in situations that might pose a threat of harm (through action or inaction) to the public. The standard also holds that each person owes a duty to behave as a reasonable person would under the same or similar circumstances. While the specific circumstances of each case will require varying kinds of conduct and degrees of care, the reasonable person standard undergoes no variation itself. The "reasonable person" construct can be found applied in many areas of the law. The standard performs a crucial role in determining negligence in both criminal law—that is, criminal negligence—and tort law.



### **Start-to-Discharge pressure described for DOT Portable Tanks found in 49 CFR §**

**178.276(e)** - Portable tanks must be provided with one or more reclosing pressure relief devices. The pressure relief devices must open automatically at a pressure not less than the MAWP and be fully open at a pressure equal to 110% of the MAWP. ***These devices must, after discharge, close at a pressure not less than 10% below the pressure at which discharge starts*** and must remain closed at all lower pressures. The pressure relief devices must be of a type that will resist dynamic forces including liquid surge. A frangible disc may only be used in series with a reclosing pressure relief device.

Comment: This same phrase ***10% below the pressure at which discharge starts*** is used in 49 CFR §178.276 for the design, construction, inspection and testing of portable tanks intended for the transportation of non-refrigerated liquefied compressed gases and in 49 CFR §178.277 for the design, construction, inspection and testing of portable tanks intended for the transportation of refrigerated liquefied gases. There is no descriptive term used in the 49 CFR §180.400 series to define start-to-discharge pressure for the re-qualification of cargo tanks. Just because the definition of start-to-discharge pressure is not defined in the DOT regulations for cargo tanks does not really change the meaning of the phrase. There is just more discussion on what one thinks start-to-discharge pressure should mean so one must refer to other source material for the guidance.

**49 CFR §180.407(g)(1)(ii)(A)** - Each self-closing pressure relief valve that is an emergency relief vent must open at no less than the required set pressure and no more than 110 percent of the required set pressure, and must reseal to a leak-tight condition at no less than 90 percent of the start-to-discharge pressure ***or the pressure prescribed for the applicable cargo tank specification.***

### **Bench Testing of MC 307 Pressure Relief Devices**

Using the definitions stated above a 300 series PRD for a MC 307 cargo tank motor vehicle should be bench tested as follows:

MAWP	Set Pressure	Start to Discharge Pressure (STDP) (100% to 110% of the MAWP)	Re-Seat Pressure (90% of MAWP)
25	25	PRD must open between 25 to 27.5 PRD opens at 27.4 PRD opens at 25.1	Reseat no less than 22.5
30	30	PRD must open between 30 to 33 PRD opens at 32.9 PRD opens at 30.1	Reseat no less than 27.0
35	35	PRD must open between 35 to 38.5 PRD opens at 38.4 PRD opens at 35.1	Reseat no less than 31.5
40	40	PRD must open between 40 to 44 PRD opens at 43.9 PRD opens at 40.1	Reseat no less than 36.0



### Installing 400 Series on 300 Series Cargo Tank

Let's address the process of installing a 400 series vent on a MC307 CTMV with a MAWP of 25. One can upgrade the vent on a 300 series cargo tank to the more recent specifications identified in 180.405(h)(3) which states the following:

3 (h)(3) As provided in paragraph (c)(2) of this section, the owner of a cargo tank may elect to modify reclosing pressure relief devices to more recent cargo tank specifications. However, replacement devices constructed to the requirements of §178.345-10 of this subchapter must provide the minimum venting capacity required by the original specification to which the cargo tank was designed and constructed.

There are a variety of versions about what 180.405(h)(3) really means and it all depends on who you ask, their understanding of the issue and special interests. We are going to try and just understand the Kings English and try that approach and see what the outcome might be. We will start with the second sentence in 180.405(h)(3) which states the following: However, replacement devices constructed to the requirements of §178.345-10 of this subchapter **must** provide the minimum venting capacity **required** by the **original specification** to which the cargo tank was designed and constructed.

When the term **MUST** is used it imposes a legal obligation on those who are required to comply. So the real question becomes "What is the minimum venting capacity **required** by the **original specification**." Here is what the old regulations say about the minimum venting capacity of a MC307 cargo tank. 178.342-4 states the following in paragraph c:

Pressure-actuated venting (spring loaded). Every cm-go tank compartment shall be equipped with pressure-actuated vent or vents set to open at no less than the tank design pressure. The minimum venting capacity for pressure actuated vents shall be 12,000 cubic feet of free air per hour (14.7 psig and 60( F.) per compartment or 12,000 cubic feet of free air per hour (14.7 psig and 60F.) for each 350 square feet of exposed tank area, whichever is greater. This **minimum capacity shall be measured at a pressure of 130 percent of the tank design pressure**. Pressure actuated devices shall be designed to function in case of pressure rise when in any condition of rollover attitude. If pressure (maximum limits to be included on the metal certification plate §178.340-10(b)) unloading devices are provided, the relief valve shall have sufficient capacity to limit the tank internal pressure to 130 percent of design pressure.

The important words in this section are highlighted in bold: **minimum capacity shall be measured at a pressure of 130 percent of the tank design pressure**.

I believe this phrase means that a 400 series vent installed on this MC 307 cargo tank must provide the minimum venting capacity that is identified in the table in 178.342-4 at pressure (flow rating)





of 130% of the tank design pressure. In this case the tank design pressure (MAWP) is 25 so the vent must provide the minimum venting capacity at 32.5 PSI (130% of 25). If the vent is not marked with this flow rating then it is a marking violation.

### Summary

There has been a lot of misinformation published regarding venting, especially the phrase that you can use our vent and eliminate your fusible caps. That phrase can be misleading although fusible caps can be eliminated if the replacement device provides the minimum venting capacity at 130% of the design pressure. If the PRD will do that it is also required to be marked reflecting this information. If it is not marked accordingly then it is a violation. There have been many reasons floating around in the industry as to why things are the way they are and the best one that I have heard is the following: "The DOT has not said anything and we have been doing it this way for years" and another good one is this is the way we have always done it and no one has ever said anything.

As a reminder one should also verify the PRD is properly marked with the manufacture's name, model number, set pressure and rated flow. The Truck Trailer Manufacturers Association (TTMA) did petition the Pipeline and Hazardous Materials Safety Administration (PHMSA) to change the rules for venting. This rulemaking closed on March 23, 2015 but no decisions have been made by PHMSA on the publication of a final rule or what the contents of the final rule will be.

This document takes a very conservative approach to the ambiguous rules related to the testing, marking and application of pressure relief devices for CTMV's. One may choose to take an alternative approach and there may never be any consequences unless you become the subject of an investigation by the competent authority. Once one is in the eye of the tiger, the perspective on what should or should not happen often changes. Following the recommendations in this notice you provide one an excellent chance to be successful when the competent authority knocks at your door. It is my recommendation that one should always take the position that it is not a matter of if the DOT will show up but a matter of when the DOT will show up.

**NOTE: FMCSA recognizes that PRD's are not being properly tested and the results documented. A copy of FMCSA's previous Safety Advisory Notice on Vent Testing is attached for your reference.**

