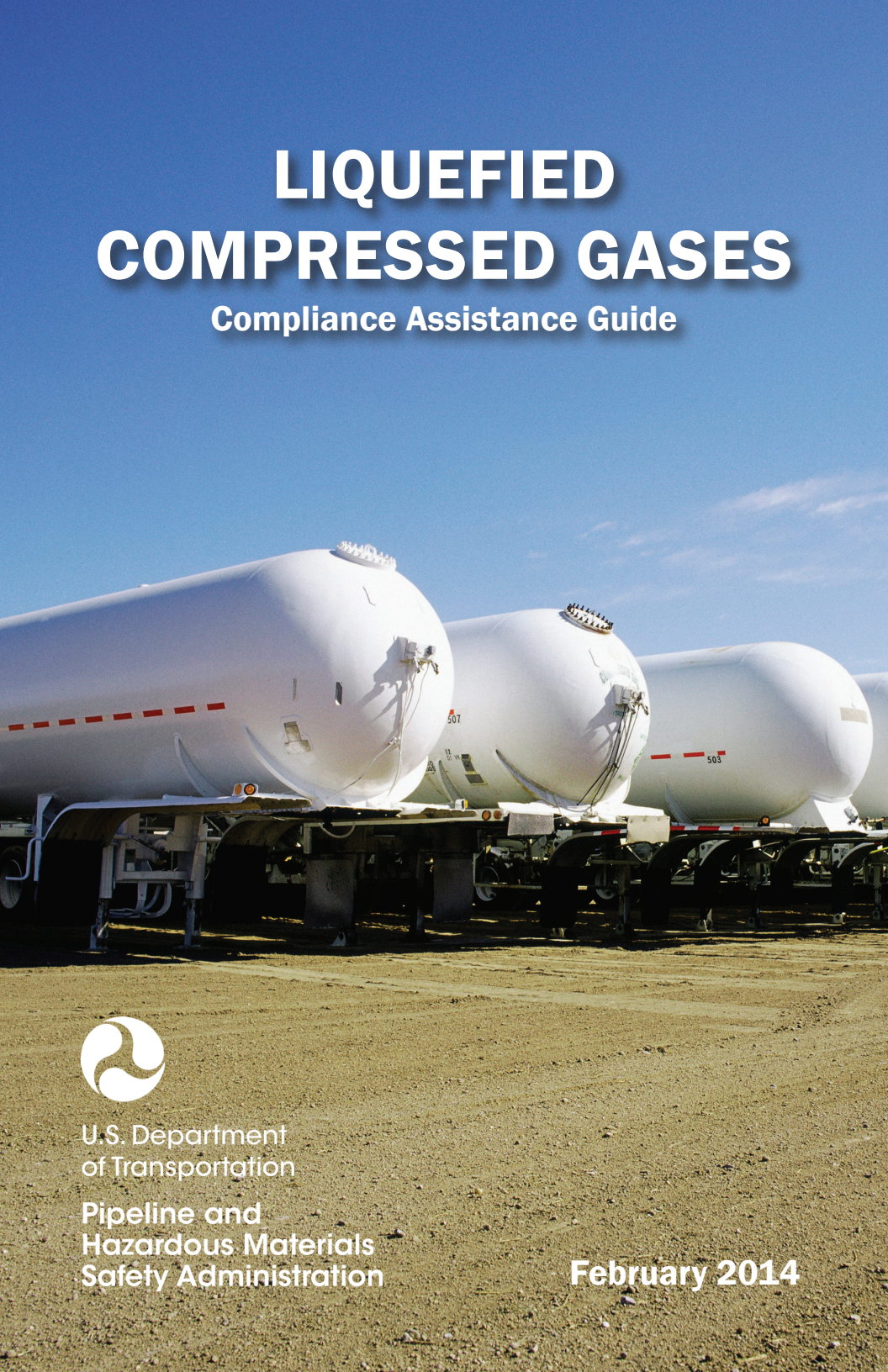
# LIQUEFIED COMPRESSED GASES

## Compliance Assistance Guide



U.S. Department of Transportation

Pipeline and Hazardous Materials Safety Administration

February 2014

**NOTE:** This compliance assistance guide is for information only and should not be used as a substitute for the applicable regulations.

The Hazardous Materials Regulations (HMR), 49 CFR Parts 171-180, are available from the Government Printing Office or may be accessed through our website at http://hazmat.dot.gov.

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## BACKGROUND

The Hazardous Materials Regulations (HMR; 49 CFR Parts 171-180) outline requirements for the operator of either DOT specification (i.e., MC 330 or MC331) or non-DOT specification (authorized under § 173.315(k)) cargo tanks[1] used in liquefied compressed gas (LCG) service, and procedures for unloading LCG from cargo tanks. The regulations help prevent unintentional releases during unloading of LCG, assure prompt detection of unintentional releases, and reduce the consequences of unintentional releases. Several specific provisions include requirements for:

- Emergency discharge control equipment, such as a passive system that will shut down unloading without human intervention and a remote system that enables an attendant to stop the unloading process at a distance from the vehicle;
- Unloading operations of LCG, including attendance requirements;
- Inspection, maintenance, and testing requirements for cargo tank discharge systems; and
- Reporting and recordkeeping.

1 Cargo tank and cargo tank motor vehicle are used interchangeably for purposes of this compliance assistance guide. For purposes of the HMR, these terms have distinct meanings. See § 178.320.

## DEFINITIONS (§§ 171.8 and 180.403)

Some relevant definitions for this compliance assistance guide include:

**DELIVERY HOSE ASSEMBLY:** A liquid delivery hose and its attached couplings. A delivery hose assembly is synonymous with use of the terms delivery hose, cargo hose assembly, cargo hose, and other similar terms. For purposes of the HMR, a delivery hose assembly does not include any adaptors that may be used in service in the field as clarified in the preamble to the final rule HM-225A (64 FR 28030, May 24, 1999).

**DESIGN CERTIFYING ENGINEER:** A person registered with the Department in accordance with 49 CFR Part 107, Subpart F, who has the knowledge and ability to perform stress analysis of pressure vessels and otherwise determine whether a cargo tank design and construction meets the applicable DOT specification. See § 171.8 for a listing of required qualifications.

**METERED DELIVERY SERVICE:** An unloading operation conducted at a metered flow rate of 100 gallons per minute or less through an attached delivery hose with a nominal inside diameter of 1.25 inches or less. This was defined to account for the differences in the design and configuration of cargo tank motor vehicles used to deliver different types of liquefied compressed gases. The regulations for unloading LCG in metered delivery service differ in some respects from those for unloading LCG in other-than-metered delivery service.

**OPERATOR:** A person who controls the use of an aircraft, vessel, or vehicle.

**OWNER:** The person who owns a cargo tank motor vehicle used for the transportation of hazardous material, or that person's authorized agent.

**REGISTERED INSPECTOR:** A person registered with the Department in accordance with 49 CFR Part 107, Subpart F, who has the knowledge and ability to determine whether a cargo tank conforms to the applicable DOT specification. See § 171.8 for a listing of required qualifications.

## EMERGENCY DISCHARGE CONTROL EQUIPMENT (§ 173.315)

The HMR require emergency discharge control equipment on cargo tanks authorized for transport of LCG. The performance standard of the equipment is keyed to the degree of risk of the material to be transported. The HMR specifies two types of emergency discharge controls:

**PASSIVE SHUT-DOWN CAPABILITY:** This performance standard requires that equipment be capable of automatically shutting off the flow of product without human intervention within 20 seconds of an unintentional release caused by complete separation of a liquid delivery hose. Technological advances in equipment since this standard was incorporated into the HMR allows for operation in a much shorter amount of time (i.e., within a half second). Also, this performance standard requires automatic operation in the event of a complete separation of the delivery hose. Current technologies have advanced such that automatic operation can occur in the event of a partial (e.g., a hole or tear) or complete separation of the delivery hose.

**OFF-TRUCK REMOTE SHUT-OFF CAPABILITY:** This performance standard requires off-truck remote shut-off equipment to close the internal stop valve and shut off the engine and auxiliary power when activated by the qualified person attending the unloading operation. It must function reliably at a distance up to 150 feet. Equipment employing a wireless transmitter/receiver must demonstrate that it will close the internal self-closing stop valve and shut off all motive and auxiliary power equipment at a distance of 300 feet under optimum conditions. Equipment not employing a wireless transmitter/receiver must demonstrate functioning at the maximum length of the delivery hose.

Note: Under certain conditions, a query system may be used to satisfy this performance standard. A query system operates on a timing mechanism where the system will automatically shut down unless queried ("triggered") by the operator to keep the system engaged. When such a system is used, it must close the internal stop valve and shut off all motive and auxiliary power equipment unless queried at least once every five minutes.

Each MC 330, MC 331, and authorized non-DOT specification cargo tank in LCG service must have emergency discharge control equipment as follows:

| Material | Cargo Tank Capacity | Delivery Service | Emergency Discharge Control Equipment |
|---|---|---|---|
| Compressed gas (Div. 2.2) with no subsidiary hazard, not including anhydrous ammonia | All | All | None |
| Poison gas (Div. 2.3) | All | All | Passive shutdown |
| Compressed gas (Div. 2.2) with a subsidiary hazard, flammable gas (Div. 2.1), and anhydrous ammonia | All | Other than metered | Passive shutdown |
| Compressed gas (Div. 2.2) with a subsidiary hazard, flammable gas (Div. 2.1), and anhydrous ammonia | 3,500 water gallons or less | Metered | Off-truck remote shut-off |
| Compressed gas (Div. 2.2) with a subsidiary hazard, flammable gas (Div. 2.1), and anhydrous ammonia | Greater than 3,500 water gallons | Metered | Off-truck remote shut-off and, for obstructed view deliveries, an off-truck remote with a query feature or passive shut-down capability |

## CERTIFICATION OF EMERGENCY DISCHARGE CONTROL EQUIPMENT (§ 173.315)

The HMR include specific requirements for certifying the design and installation of emergency discharge control equipment.

**PASSIVE SHUT-DOWN EQUIPMENT:** The design for each passive shut-down system must be certified by a Design Certifying Engineer (DCE). The certification must consider any manufacturing specifications for components used in the system, explain how the system operates, and outline the parameters (such as temperature, pressure, types of product) within which the system is designed to operate. Installation must be performed under the supervision of a Registered Inspector who must certify that the equipment is installed and tested according to the DCE's certification.



**OFF-TRUCK REMOTE SHUT-OFF EQUIPMENT:** Must be installed under the supervision of a Registered Inspector, who must certify that the equipment is installed according to the original component manufacturer's specifications and is tested in accordance with the HMR.

## ADDITIONAL EMERGENCY DISCHARGE CONTROL EQUIPMENT (§ 173.315) (FUSIBLE ELEMENTS)

Cargo tanks authorized for transport of LCG also must have each liquid or vapor discharge outlet fitted with a primary discharge control system as is required for a DOT specification MC 331 cargo tank and defined in § 178.337-1(g). The system must include a thermal means of closure for each internal self-closing stop valve, and remote operators must activate at a temperature of 250° F or less. Links between closures and remote operators must be corrosion resistant and effective in all types of environmental conditions incident to unloading of a product. Conditions for exception from this requirement are referenced in § 178.337-8(a)(4).

## OPERATING PROCEDURES (§§ 177.834 and 177.840)

The HMR includes several additional operating procedure requirements. We also encourage operators of the cargo tanks used in LCG service to use the best available technology to reduce the likelihood of serious consequences from unintentional releases.

**WRITTEN PROCEDURES:** The operator of a cargo tank motor vehicle subject to the emergency discharge control equipment requirement must carry, on or with the vehicle, written emergency discharge control procedures for all delivery operations. The procedures must describe the emergency discharge control system features. For a passive shut-down system, the procedures must describe the parameters within which the system is designed to function. For example, if your vehicle's emergency discharge control system is certified to operate at or above a specific pressure or temperature, you must include this information. The written procedures also must include the process to follow if a facility-provided delivery hose is used when the cargo tank is equipped with a delivery hose assembly meeting the passive shut-down capability requirement.

**ATTENDANCE REQUIREMENTS:** The HMR include general requirements for attendance of loading and unloading operations. The attendance requirements specific to unloading of LCG as they would apply to cargo tank operations are as follows:

- If an LCG other than liquefied petroleum gas (LPG) or anhydrous ammonia (NH3) is being unloaded from a cargo tank, a qualified person must remain within 25 feet of the cargo tank and must have an unobstructed view of the cargo tank and delivery hose to the maximum extent practicable during the unloading operation.

- If LPG or NH3 is being unloaded from a cargo tank in metered delivery service, and the cargo tank has a capacity of 3,500 water gallons or less, a qualified person must remain within 150 feet of the cargo tank and within 25 feet of the delivery hose during the unloading operation. For an unloading operation taking more than five minutes, this person must observe the cargo tank and the receiving container at least once every five minutes.

- If LPG or NH3 is being unloaded from a cargo tank in metered delivery service, and the cargo tank has a capacity greater than 3,500 water gallons, a qualified person must remain within 150 feet of the cargo tank and within 25 feet of the delivery hose during the unloading operation. The qualified person must have an unobstructed view of the cargo tank and delivery hose to the maximum extent practicable. For instances where the qualified person cannot maintain an unobstructed view, the cargo tank must be equipped with a passive shut-down system. For an off-truck remote shut-off system with a query feature that will automatically shut down unloading unless prompted every five minutes, the qualified person must observe both the cargo tank and the receiving container at least once every five minutes.

- If LPG or NH3 is being unloaded from a cargo tank in other-than-metered delivery service, a qualified person must remain within 25 feet of the cargo tank and must have an unobstructed view of the cargo tank and delivery hose to the maximum extent practicable during the unloading operation (for example, except when activating controls or monitoring the receiving container).

Note: A "qualified person" is aware of the nature of the hazardous material being loaded or unloaded, has been instructed on the procedure(s) to be followed in emergencies, and is authorized to move the cargo tank and has the means to do so.

**PRETRANSFER SAFETY CHECK:** Before an LCG is unloaded and after pressure in the discharge system has equalized with the pressure in the cargo tank, a qualified person must check the components of the discharge system (including the delivery hose assembly and piping) to ensure the system is in good operating condition. The connections must be secure and the system must not contain any obvious defects. The check must be done on the components that are readily observed during the normal course of the unloading operation; and good condition, and defects, should be determined through visual observation and by listening for unusual sounds. Review the rejection criteria in this guide to assist with determining whether the discharge system is in good condition for unloading. Operators are not required to have the qualified person use an instrument to assist with the safety check or exceed reasonable lengths to conduct the safety check for those components not readily visible.

**EMERGENCY SHUTDOWN:** In the event of an unintentional release, the qualified person conducting the unloading operation of the cargo tank motor vehicle must promptly shut the internal self-closing valve, or other primary means of closure, and shut down all motive and auxiliary power equipment associated with the cargo tank motor vehicle.

**DAILY TEST OF OFF-TRUCK REMOTE SHUT-OFF ACTIVATION DEVICE:** The operator of a cargo tank motor vehicle equipped with such a system must successfully test the activation device of the system within eighteen (18) hours prior to the first delivery of any given day of planned deliveries. If a wireless device is used, the test of the device must be conducted at least 150 feet from the cargo tank. The test does not have to be conducted from an obstructed view (i.e., the cargo tank may be visible).

**USE OF FACILITY-PROVIDED DELIVERY HOSE ASSEMBLIES:** A cargo tank motor vehicle equipped with a delivery hose assembly that satisfies the passive-shut-down capability performance standard may be unloaded using a delivery hose assembly provided by the receiving facility under the following conditions:

- The qualified person handling the unloading must visually examine the facility delivery hose assembly for obvious defects in the same manner as done under the safety check for the cargo tank motor vehicle discharge system;

- The qualified person must remain within arm's reach of the manual means of closure for the internal self-closing stop valve, except for short periods when it is necessary to activate controls or monitor the receiving container; and

- If the facility-provided delivery hose assembly is such that it satisfies the passive shut-down capability performance standard, the qualified person handling the unloading operation may remain in attendance in accordance with the appropriate attendance requirements outlined above.

**POSSESSION OF ACTIVATION DEVICE:** For a cargo tank motor vehicle with a required off-truck remote shut-off capability, the qualified person attending the unloading operation must be, at all times during the unloading process, in possession of the device that activates the shut-down equipment. The qualified person does not have to be in possession at all times if the device is part of a system that will shut off the unloading operation without human intervention in the event of a leak or separation in the hose (i.e., if it is part of a system with passive shut-down capability).

Note: Unloading of chlorine from a cargo tank motor vehicle must be performed in accordance with Section 3 of the 4th edition (October 2003) of Chlorine Institute Pamphlet 57, "Emergency Shut-off Systems for Bulk Transfer of Chlorine."

## DISCHARGE SYSTEM INSPECTION, MAINTENANCE, AND TESTING (§§ 180.407 and 180.416)

If you operate a cargo tank motor vehicle authorized for LCG service, you must perform the following inspections, maintenance, and testing on the cargo tank discharge system.

**ANNUAL LEAKAGE TEST:** Cargo tanks used in this service must be leakage tested annually. As part of the leakage test for the cargo tank, the delivery hose assembly and piping system must be visually inspected by a Registered Inspector while under leakage test pressure using the rejection criteria outlined in the next section. The leakage test applies to both permanently attached and removable delivery hose assemblies. The owner of a delivery hose assembly not permanently attached to a cargo tank motor vehicle must ensure that it is leakage tested annually. This test may be conducted separately from the cargo tank leakage test, meaning, specifically, a delivery hose assembly not permanently attached may be tested at a time other than during the time the cargo tank is leakage tested and may be inspected by a different Registered Inspector than was employed for the inspection of the cargo tank. This accommodates situations where a hose may not be available at the time of the cargo tank leakage test (e.g., it is under repair), or where a cargo tank motor vehicle may have multiple hoses assigned to the vehicle. As long as the delivery hose assembly is successfully tested within 12 months from the date of the last leakage test documented by the Registered Inspector as part of the written record of inspection, it is considered requalified and can be used regardless of the actual date of leakage test of the cargo tank. However, we encourage the leakage testing of the cargo tank and the delivery hose assembly(ies) used with the cargo tank motor vehicle to be synchronized as much as possible.



**MONTHLY INSPECTIONS AND TESTS:** At least once each calendar month a cargo tank is in LCG service[2], the operator of the cargo tank motor vehicle must:

- Visually inspect each delivery hose assembly used in association with the cargo tank motor vehicle.
- Visually inspect the piping system, including fusible elements, bolts, connections, valves, and seals.
- Operate all emergency discharge control devices designed to close the internal self-closing stop valve to ensure that all component parts work properly. Acceptable test procedures are outlined in Appendix A to Part 180 of the HMR.
- Check the internal self-closing stop valve in the liquid discharge opening for leakage. For a metered cargo tank, a meter creep test as outlined in Appendix B to Part 180 of the HMR, or an equivalent type test, is acceptable. For an unmetered cargo tank, the Appendix B test is one acceptable means of testing the internal self-closing stop valve for leakage.

Note: These inspections and tests apply only to delivery hose assemblies installed or carried on a cargo tank motor vehicle. Accordingly, delivery hose assemblies that are not installed or carried on the cargo tank motor vehicle are not subject to these requirements, although use of such hoses is subject to certain conditions under the HMR. Review the section on operating procedures. We highly encourage owner/operators subject to the HMR that use delivery hose assemblies that are not installed or carried on the vehicle to include assurances that the facility is implementing an equivalent level of inspection, maintenance, and testing of its delivery hose assemblies.

**OPERATOR RESPONSIBILITIES INCLUDE BUT ARE NOT LIMITED TO:**

- Ensuring that each delivery hose assembly is permanently marked with a unique identification number and with the maximum working pressure.
- Ensuring that, after each unloading operation, the portion of the delivery hose assembly that was deployed during unloading is visually checked for defects.

2 "In service" as used in § 180.416, is associated with qualification and maintenance for purposes of hazardous materials transportation and should not be misconstrued as "in use." A delivery hose assembly installed or (to be) carried on a cargo tank motor vehicle in LCG service must be inspected and tested monthly regardless of whether it is used in any given month.

- Ensuring that each new and repaired delivery hose assembly is tested at a minimum of 120 percent of the hose maximum working pressure to include visual examination by the operator while the delivery hose assembly is under pressure and upon successful completion of the test, marking the delivery hose with the month and year of the test.

## REJECTION CRITERIA (§ 180.416)

The operator of a cargo tank motor vehicle transporting LCG may not use a delivery hose assembly or piping system for unloading that has been determined to have any of the following conditions:

**CONDITIONS FOR REJECTION OF A DELIVERY HOSE ASSEMBLY:**

- Damage to the hose cover that exposes the reinforcement;
- Wire braid reinforcement that has been kinked or flattened so as to permanently deform the wire braid;
- Soft spots when the hose is not under pressure or bulging when the hose is under pressure;
- Loose outer covering;
- Damaged, slipping, or excessively worn hose couplings; or
- Loose or missing bolts or fastenings on bolted hose coupling assemblies.

**CONDITIONS FOR REJECTION OF THE PIPING SYSTEM:**

- Any external leak that is identifiable without the use of instruments;
- Loose, severely corroded, or missing bolts;
- Manual stop valves that will not operate;
- Rubber hose flexible connectors with any condition outlined above for hose assemblies;
- Stainless steel flexible connectors with damaged reinforcement braid;
- Internal self-closing stop valves that fail to close or that permit leakage through the valve detectable without the use of instruments; or
- Severely corroded components of the piping system (i.e., pipes or joints).



The operator of a cargo tank motor vehicle may remove or replace damaged portions or correct defects of the delivery hose assembly or piping system discovered during testing and inspection. A repaired delivery hose assembly may be placed back into service if successfully retested at 120 percent of the hose maximum working pressure in the same manner as for each new delivery hose assembly noted in the operator responsibilities above.

## REPORTING AND RECORDKEEPING (§§ 180.407, 180.416, and 180.417)

**ANNUAL LEAKAGE TEST REPORTING:** A written report must be prepared for each test or inspection performed, as specified in §§ 180.407 and 180.417, in the requalification of a cargo tank. In the instance of leakage testing, in addition to this report, the Registered Inspector conducting the test and inspection must note the hose identification number, the date of the test, and the condition of the delivery hose assembly and piping system tested. If the delivery hose assembly is tested separately or tested by a different Registered Inspector than for the leakage test on the cargo tank, the owner/operator of the cargo tank and the Registered Inspector should work together to ensure the additional information is noted with the written report for the cargo tank leakage test. Additionally, the written report for the cargo tank leakage test should be accompanied by inspection information for all delivery hose assemblies used with a particular cargo tank. A copy of each record must be retained by the owner, and the operator if not the owner, at its principal place of business or where the cargo tank motor vehicle is housed. This record must be maintained, at a minimum, until the next test of the same type is successfully completed.

**MONTHLY INSPECTION REPORTING:** The operator of a cargo tank must note, in a record, each monthly inspection and test conducted (i.e., the visual inspection of the delivery hose assembly, the visual inspection of the piping system, the testing of all emergency discharge control devices designed to close the internal self-closing stop valve, and the leakage check of the internal self-closing stop valve in the liquid discharge opening). The record must include the date of the inspection (test), the name of the person performing the inspection (test), the delivery hose assembly identification number, the company name, the date the delivery hose assembly was assembled and tested, and an indication that the delivery hose assembly and piping system passed or failed the tests and inspections. A copy of each record must be retained by the operator at its principal place of business, or where the cargo tank motor vehicle is housed. The record must be maintained until the next test of the same type is successfully completed.

Note: For purposes of the monthly reporting requirement, the internal self-closing stop valve is considered to be part of the discharge piping system. It is therefore an indication of the pass or fail of the testing of the emergency discharge control devices designed to close the internal self-closing stop valve, and the leakage check of the internal self-closing stop valve in the liquid discharge opening, and must be noted in the record.

**NEW OR REPAIRED DELIVERY HOSE ASSEMBLY REPORTING:** The operator of a cargo tank must complete a record documenting the test and inspection of a new or a repaired delivery hose assembly. The record must include the date, signature of the inspector, hose owner, hose identification number, the date of the original delivery hose assembly and test, notes of any defects observed and repairs made, and an indication that the delivery hose assembly passed or failed the tests and inspections.

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