During transportation sulfur will solidify in the railcars. Prior to unloading, the railcars must be steamed out to melt the sulfur. The purpose of this procedure is to ensure safe and efficient sulfur steaming and unloading process, followed by proper examination of empty railcars before shipping.

This procedure applies to all Concentrate sites in the Phosphate Business Unit that unload molten sulfur railcars.

1 GENERAL INSTRUCTIONS TO SECURE THE CARS AND TRACKS.

1.1 The railcars must have the handbrakes set and the wheels(s) blocked against movement before any unloading activities are started.

1.2 When the cars are positioned for unloading, the hazmat employee responsible for unloading a sulfur tankcar must secure access to the track by use of derails, aligned and lock switches. Derailers must be slide to the on both ends of the track.

1.3 While a car is connected for steaming or unloading, a blue flag must be placed on the track as required by OSHA and DOT regulations and company procedure.

1.4 After unloading is completed for the day, both derailers will be unlocked so the rail crew can spot the steaming tracks and pull out the empty cars.

2 CAR STEAMING PROCESS. CONNECTING STEAM AND CONDENSATE HOSES.

This step requires two people to be present. The correct attachment of the steam lines will ensure proper steaming of the railcar contents and reduce the length of time require to keep the cars on steam.

2.1 Safety Equipment and Tools

2.1.1 See Section 6 for complete list of PPE

2.1.2 Pipe wrench

2.2 Lock Out Requirements

2.2.1 Set the derailer and Blue Flag on the East and West unloading rail

2.2.2 Each separated string of cars must have wheel chocks set on at least one of the cars in the string

2.2.3 Each separated string of cars must have handbrakes set on at least one of the cars in the string.

2.2.4 Shuttle wagon (railcar mover) must be detached, with key removed

2.3 Safety Hazards

2.3.1 Steam and Condensate burns. Steam and condensate present two significant hazards: pressure and heat. Steam will normally be 30-80 psi and approximately 300°F. Condensate will normally be 0-70 psi and 200-300°F. Not all steam lines are totally insulated. All lines are high pressure and caution should be taken when turning the valves on. Open all steam valves slowly and allow the line to pressurize. Opening a steam valve too quick can result in hammering effect of the line or splitting of the steam hose.

2.3.2 Molten sulfur. Molten sulfur can cause severe burn upon contact with skin. Proper PPE must be worn at all times when handling molten sulfur. See SDS for additional handling information.

2.3.3 Trip hazards. Many hoses and fittings are utilized in the process of steaming cars. Please be aware of all potential trip hazards. Proper housekeeping will help minimize these hazards.

2.3.4 Movement of railcars. Railcars are moved frequently in the process of unloading. The following rules (not all inclusive) must be followed:

- Rail crossing between cars must occur at least 25 feet from cars. Cars must be spaced at least 50 feet to allow this. If there is not enough space between cars for a safe crossing, a “No Crossing” sign shall be placed on the track for notification.
- When riding railcars always face the direction of movement.
- Riding on railcars can only be done on the side of cars, not between or on the platform of the car. Three points of contact must be maintained. Equipment must be moving a speed slower than a “brisk-walk” when getting on or off.

2.4 Car Steaming Process - Hose attachment procedure.

2.4.1 Verify the placards or orange panels and commodity stencil on the sides of the railcar to confirm they are Molten Sulfur and placard number 2448

2.4.2 Inspect fittings and steam hoses and replace as necessary if damaged.

2.4.3 Attach 2 inch reducing fittings to the railcar steam inlet and outlet.

2.4.4 When using the condensate return system, follow this procedure:

- Connect a hose form the outlet fitting of the sulfur car to the condensate line. The outlet valve is marked on the car.
- Connect a hose from the steam supply line to the inlet fitting on the car. This valve is marked on the car.

- After the hoses have been secured with a wrench, slowly open the condensate valve that is located on the steaming stations next to the sulfur car.
- Slowly open the steam valve located next to the condensate valve.
- Inspect the system for leaks. If the steam fitting or hose have a leak, shut off the steam, change the fitting or hose and start again.

2.4.5 If the steaming station has bad steam trap, follow these steps:

- Connect a hose from the steam supply line to the inlet fitting on the sulfur car. Again, this valve is marked on the car.
- After the hose has been secured, slightly open the steam outlet valve
- Slowly open the steam valve off of the steam supply line
- Check for leaks. Adjust the outlet valve so that both water and steam come out of the outlet fitting valve. Be sure to stay out of the line of fire of the exiting steam.

2.4.6 If there are no leaks, record the following data on the "Sulfur Cars on Steam" report sheet.

- I.D. of the railcar
- Car number
- Date and time car put on steam

2.4.7 At this point, it will take 36 to 48 hours for the car's contents to melt, so it can be unloaded using a bottom outlet valve.

3 CAR STEAMING PROCESS. DISCONNECTING STEAM AND CONDENSATE HOSES

Cars must be kept on steam for a minimum of 36 hours before they are unloaded. Each track of cars should be unloaded in the same order that they were put on steam. Steam pressure to the railcars should be 70 to 80 psi and must be checked daily.

3.1 Safety Equipment and Tools

3.1.1 See Section 6 for complete list of PPE

3.1.2 Pipe wrench, spark-resistant, 18-36" long

3.1.3 T-Bar with spark-resistant sockets.

3.1.4 Pneumatic Impact Wrench with spark-resistant sockets

3.2 Lockout requirements

3.2.1 Set the derailer and blue flag on the East and West unloading rail

3.2.2 Each separate string of cars must have wheel chock set on at least on car in the string

3.2.3 Each separate string of cars must have hand brake applied on at least one of the cars in the string

3.2.4 Railcar mover (Shuttle wagon) must be uncoupled with key removed

3.3 Safety Hazards

3.3.1 See section 2.3

3.4 Procedure for disconnecting steam and condensate hoses

3.4.1 If the sulfur car is ready to be unloaded, then the steam and condensate hoses need to be disconnected.

3.4.2 Close the valves for the steam and condensate lines on the steaming station. Close the valves on the railcar steam and condensate line and bleed off pressure from the hoses. Ensure ear plugs are properly fitted when bleeding off steam pressure. Leave steam blocked to the car until is spotted and ready to unload. Steam inside the heating coils keeps the unloading valves warm allows the valve to be opened.

⚠ **Warning:** Do not stand in front of steam exhaust line while bleeding off hoses. Check your surroundings to verify the area is clear of other personnel.

3.4.3 The lead car is now ready to be spotted over the pit. Be certain that cars are disconnected from hoses before attempting to move them. Remove blue flags and stand clear from moving equipment.

3.4.4 Remove wheel chocks from the first and last cars.

3.4.5 Couple the Shuttle Wagon to the first car and release the brakes.

3.4.6 Pull the sulfur cars and position them over the pit where they are to be unloaded.

3.4.7 Spot the cars over the unloading pit making sure their bottom outlet valve (BOV) is centered.

3.4.8 Place wheel chocks on the cars about to be unloaded, front set of wheels on lead car and on the rear set of wheels of the back car.

3.4.9 Replace blue flags on spotted string of cars coupled together.

3.4.10 Set the brake on at least one car per string of cars coupled together.

⚠ **Warning*:*** At no time shall anyone walk between railcars while cars are in motion. Hand brakes shall be set on same side that the brake wheel is mounted on the last car in the cut.

3.4.11 Disconnect the Shuttle Wagon and empty cars from unloading cars East end. Park the Shuttle Wagon and empty cars at least 50 feet from the railcars about to be unloaded.

3.4.12 Disconnect the Shuttle Wagon from the empty cars. Remove the Shuttle Wagon key.

3.4.13 Any loaded cars, located west of the cars about to be unloaded, must be uncoupled from the string, chocked and the car closest to the cars to be unloaded must have handbrake applied.

3.4.14 Reference next diagrams for recommended railcar separation, wheel chocks and hand brakes to be applied while cars are spotted over unloading pit.

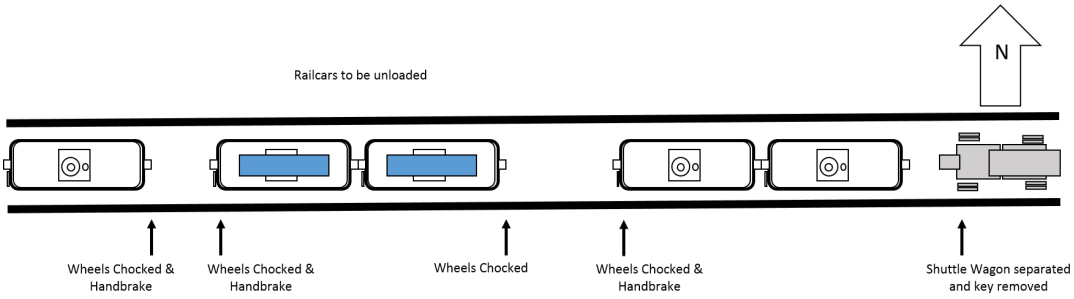


Figure 1 - Cars to be unloaded positioned between other cars

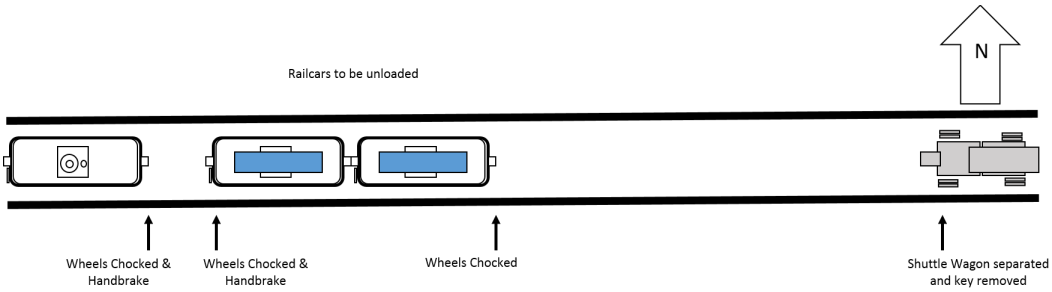


Figure 2 - Cars to be unloaded positioned between other cars and shuttle wagon

4 CAR UNLOADING

Sulfur Unloading Perimeter. The area where sulfur unloading occurs must have a defined perimeter to keep unauthorized personnel for entering the area.

- Keep unauthorized personnel from entering the area.
- Indicate the border for which personal exposure monitors and area exposure monitors are required.
- This can be accomplished using signage and barriers.

Each molten sulfur car can react different during the unloading process. The bottom outlet valve (BOV) may be slightly plugged or the molten sulfur may catch the chute causing sulfur to splash out of the pit. **ALL SAFETY PROCEDURES ARE TO BE FOLLOWED NO EXCEPTIONS.**

No car may be moved at any time while the dome lid is open. This present a risk to the handler and may splash molten sulfur out the car without notice.

4.1 Safety Equipment and Tools

- 4.1.1 See Section 6 for complete list of PPE
- 4.1.2 36-inch long spark proof pipe wrench
- 4.1.3 14 - 24-inch long spark proof pipe wrench
- 4.1.4 T-bar with appropriate spark resistant socket
- 4.1.5 Pneumatic Impact Wrench with spark resistant sockets
- 4.1.6 Spark proof sulfur crust breaking tool
- 4.1.7 Chute, Chute-on-wheels or Thread-on-chute

Note: *See Appendix H2 for a list of additional devices and tools to help reduce sulfur exposure risk during car unloading.*

4.2 Lock Out Requirements

- 4.2.1 Set derailer and blue flag on East and West unloading rail
- 4.2.2 Set wheel chocks on at least one car in the string
- 4.2.3 Set the handbrake on at least one car in the string
- 4.2.4 Railcar mover (Shuttle wagon) must be uncoupled and key removed.
- 4.2.5 Cars to be unloaded must have wheel chocks on at least one wheel
- 4.2.6 Cars to be unloaded must be detached from any other cars. Chocks must be on cars closest to the unloading pit
- 4.2.7 Cars being unloaded must have at least one hand brake set
- 4.2.8 A 50-feet clearance must be observed between cars for safe crossing in the unloading area.

4.3 Safety Hazards

All steam must be released from the car prior to unloading.

⚠ **Warning:** Do not stand in front of the steam exhaust lines while bleeding hoses off. Be aware of your surroundings and watch for other personnel working in the immediate area.

Occasionally a crust of sulfur may be discovered when opening the dome lid. Pressure may be trapped under this crust, which may cause the car to burp while unloading. If this occurs, molten sulfur may splash out of the car dome. If a crust is discovered, make sure to break through it using the supplied spark proof crust breaking tool.

Workers involved in unloading molten sulfur railcars should be aware there is a risk of exposure to Hydrogen Sulfide (H_2S) gas while working on top of cars. The air supplied full mask respirator must be worn at all times while working on the tankcar dome platform with the dome lid open. Sulfur handlers must have available their 5-minute escape pack, and a second person must be similarly suited and equipped at ground level in communication at all time with the handler working on top of the cars.
Note: *See Appendix H3 Air monitoring for H2S Exposure for more details on evaluating and controlling this risk.*

Sulfur, steam and associated piping create the possibility for burns. Wear proper PPE to protect yourself always.

From time to time a car determined to have a blockage in the bottom outlet valve, must be placed back on steam while it sits over the sulfur unloading pit to unthaw the valve. Before reconnecting the steam hoses, slowly open car inlet and outlet valves and drain any condensate built up. When valves are visually clear of condensate, close inlet steam valve and reconnect inlet steam hose; then open main valve at the steam header. Inform anyone working in the area that the car is on steam; monitor the car for at least 10 minutes for any visual or audible changes out of the ordinary. If a change is noted, close the main steam valve and Bad Order the railcar.

Note: Due to a potential safety risk, we will no longer accept and unload railcars from the DVLX2100s series. These cars can be identified by the car number DVLX21**, with ** being any number). The car owner has been notified and are not supposed to send these cars. If we receive one of these cars, they will not be place on steam and will be Bad Ordered.

4.4 Car unloading procedure

4.4.1 Remove pit covers and proceed with caution as these chutes are open during movement of cars.

4.4.2 Position car(s) over the sulfur pit opening following the procedure on Section 6.4

4.4.3 Complete Pre-UNLOADING section of the checklist. Appendix H1

4.4.4 Verify Track Lock Out Requirements outlined on Section 4.2 are met.

4.4.5 Put on the proper protection equipment

4.4.6 Check no one is standing close to the car steam inlet or outlet valve. Bleed the steam off slowly at this point. Do not continue to the next step until all the steam and condensate had been drained.

4.4.7 Remove the car bottom outlet valve (BOV) cap. Secure the cap out of the way from the outlet nozzle to ensure it doesn't contact the molten Sulphur during unloading.

⚠ **Warning:** Do not stand in or place feet in the unloading chute at any time.

4.4.8 Place the sulfur discharge chute extension or "Chute on wheels" over the center of the car drain valve. The purpose of this chute is to prevent molten sulfur from splashing. Make sure it is locked in the correct position.

4.4.9 Open the car drain valve (Bottom Outlet Valve – BOV) for sulfur to discharge. This should be done slowly.

4.4.10 Continue to open the drain valve slowly. If the sulfur flow appears to be steady, open the valve all the way.

Note: *If the valve cannot be opened safely of easily, "Bad Order" the car.*

4.4.11 Once molten sulfur flow is established open the car dome lid. The car dome is opened after the car is draining so that a vacuum is applied to the car, preventing the discharge of excess fumes from the dome.

Note: *Be sure to put on the proper protective equipment and use the spark resistant tools for opening car dome lids*.

4.4.12 To open the car dome lid, loosen the swing bolt nuts on the dome cover, using the T-bar or Impact wrench. The railcar may be pressurized so leave two bolts opposite the hinge until last so the lid won't suddenly spring open. Loosen these last two bolts and carefully crack open the dome cover with a non-sparking tool.

4.4.13 If a sulfur crust is present under the cover/lid, maintain a safe position and use a Spark Resistant Crust Breaking Tool to break it. Use caution as pressure may be trapped under this crust.

4.4.14 Once the dome seal is broken, leave the dome lid partially open for venting, use one of the swingbolts to keep lid the up.

4.4.15 Record date and car number

5 EMPTY RAILCAR CLOSING AND EXAMINATION BEFORE SHIPPING

5.1 Once the railcar is empty, close the Bottom Outlet Valve (BOV). Make sure the valve operating handle is fully engaged and secure the valve in the close position.

5.2 Disengage the Bottom Outlet Valve handle and secure the handle in the bracket and apply securement pin.

Note: *Tank car regulations now require bottom outlet valve handles to disconnect (disengage) from the BOV during transit to prevent accidental actuation of the valve, whether caused by improper securement or derailment.*

Figure 3 - BOV Handle

Figure 4 - BOV Handle

5.3 Remove the chute extension and steam fittings.

5.4 Examine the bolts and nuts that fasten the threaded downleg to the bottom outlet valve to make sure they are tight.

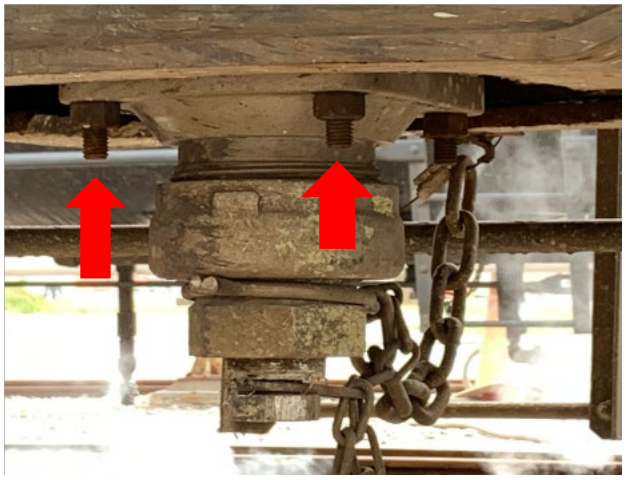


Figure 5 - Bottom Outlet bolts

Figure 6 - Bottom Outlet Nozzle or Threaded Downleg

5.5 Inspect the gasket inside the bottom outlet valve cap before replacing on the threaded nozzle. Tighten the cap with a 36-inch non-spark pipe wrench or equivalent tool.

Note: *Check for Tool Tightness. All valves, fittings, closures, plugs, caps, and fasteners are to be checked for tool tightness, even for fittings that were not used during the car off-loading process.*

Hinged and Bolted Manway Securement. Use the picture below as reference.

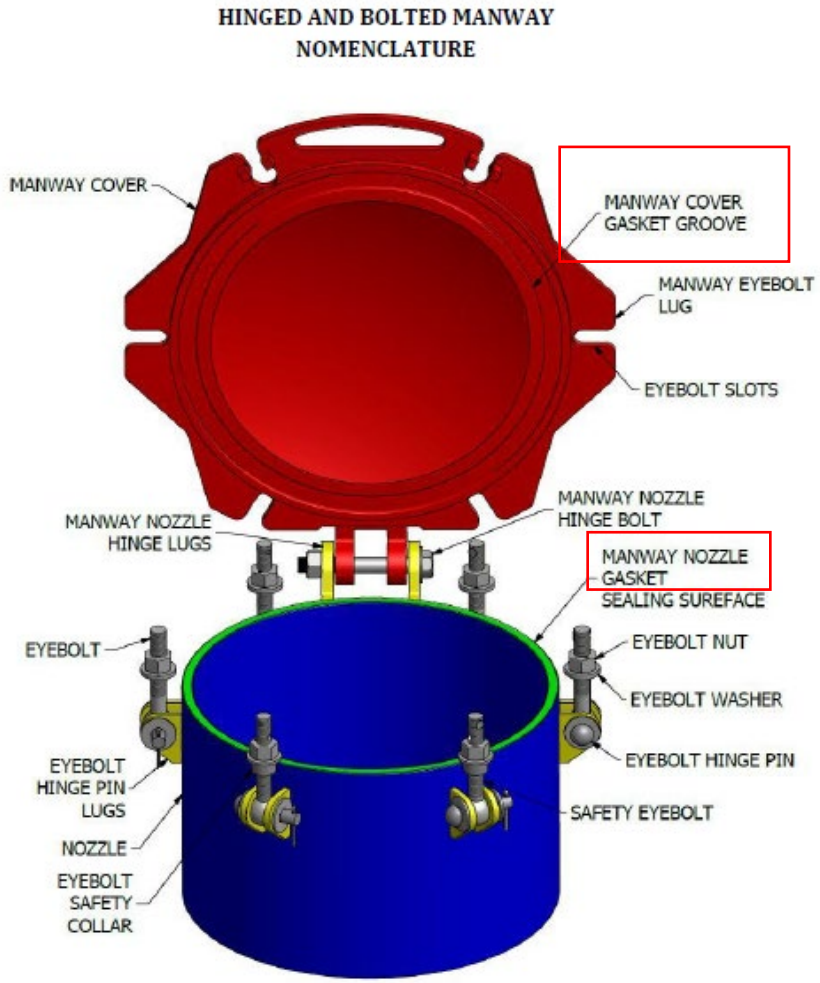


Figure 7 - Hinged and Bolted Manway

5.6 Molten Sulfur railcar can have a manway cover gasket or a manway nozzle gasket. Note that only one type of gasket is used at a time.

5.7 Examine the top side of manway cover (or lid) for imperfections. The manway cover or lid should not be cracked, bent, cut or damaged, and the eyebolt slots or lugs should not be bent, worn, damaged or deformed.

Figure 8 - Manway cover top side cracked

5.8 Visually inspect the manway gasket. Only one gasket is required to seal the manway. Gasket can be found on the manway cover/lid or on the nozzle.

5.9 If the car has a manway cover gasket, inspect the groove and gasket for damage looking for cuts, tears, or degraded areas that would prevent a proper seal. If any of these conditions is identified, bad order the railcar for further inspection and repair by Authorized Mobile Repair Unit. A manway lid gasket is either Black or White.

5.10 If the car is equipped with a manway nozzle gasket, the gasket will rest over the lip of the nozzle. Inspect the gasket for damage.

Figure 9 - Manway Cover Gasket

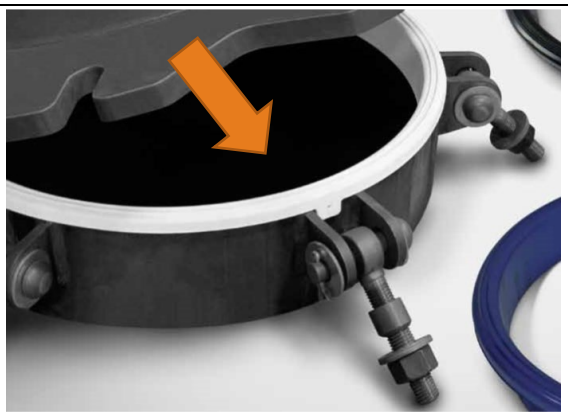


Figure 10 - Manway Nozzle Gasket

Figure 11 - Manway cover gasket

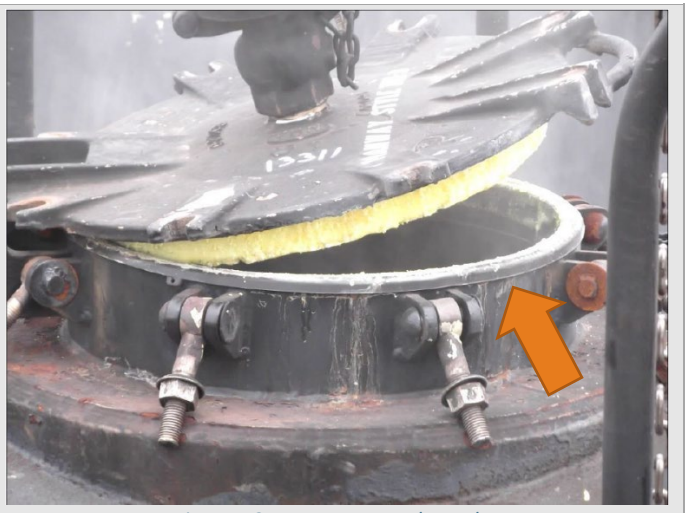


Figure 12 - Manway nozzle gasket

5.11 Safety eyebolts are located on the handle side of the manway cover. There are three types of safety eyebolts that can be found on a sulfur railcar. One railcar manway can have one or two safety eyebolts. See next table for number of safety eyebolts required based on the type.

Collar Type Safety Eyebolt	Pin Type Safety Eyebolt	Wedge Type Safety Eyebolt
One eyebolt	Two eyebolts	Two eyebolts

Figure 13- Safety eyebolts

5.12 Inspect the eyebolts threads and hinged pins for signs of damage, wear and galling.

5.13 Inspect to ensure that all manway eyebolt nuts on a given car are of the same configuration and size (heavy square or heavy hex) they cannot be mixed. Washers should be flat. Look for cupped or missing washers.

Figure 14 - Eyebolt flat washer

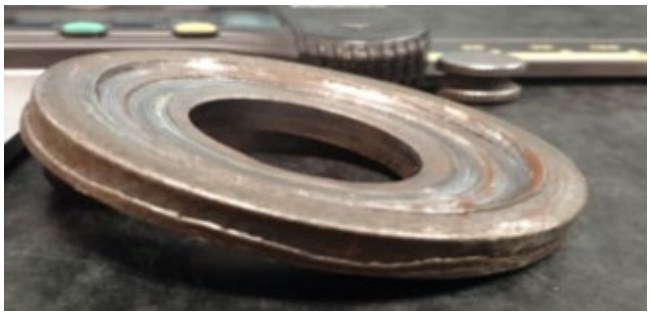


Figure 15 - Eye bolt flat washer cupper due to overtorque

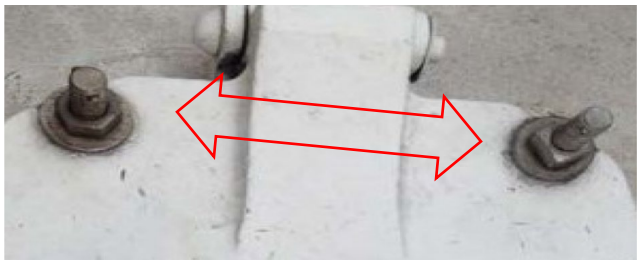


Figure 16 - Eyebolt nuts must be same type, cannot be mixed

5.14 Inspect the safety eyebolt collar is in the correct position. If the collar is engaged with the lid, the eyebolt will not swing down when you loosen the nut. If the collar is not engaged with the lid, bad order the railcar.

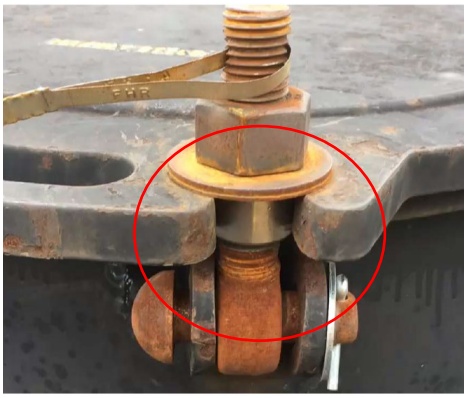
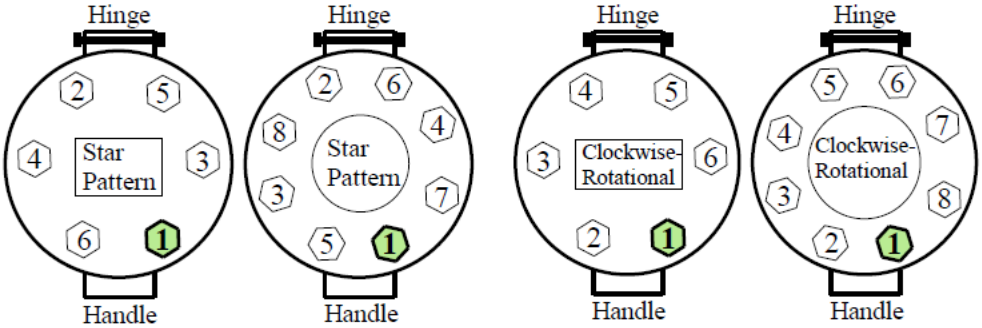


Figure 17 – eyebolt collar engaged with lid. OK to ship

Figure 18 - Collar not engaged with lid. Do not ship

5.15 Secure the manway cover bolts with an impact wrench or T-bar. All bolts must be tool tight following the sequence below. The numbering and sequence (Star Pattern) is a critical step in truly securing the manway. This step ensures the manway is properly closed. Recognize the importance of numbering eyebolts beginning with the safety eyebolt near the right side of the lifting handle and then following the numbered sequence in a star pattern when tightening each bolt.



Sequence	Manway with 6 or 8 Bolts
1st pass (Star Pattern)	1 second count
2nd Pass (Star Pattern)	5 second count
3rd Pass (Clockwise/Rotational)	5 second count
Check by hand (Clockwise/Rotational)	Check by hand

5.16 Rupture Disc Inspection. Visually inspect the rupture disc assembly by removing the metal top cover or the plastic threaded top cover. Verify the disc is not damaged. If the disc

appears to be in good order, close the metallic rupture disc cover and secure it with the pin. If the car is equipped with a black plastic rupture disc holder, this type of rupture disc cover is threaded and goes in hand tight, DO NOT over tighten the inspection cap or it will crack.

5.17 We are required to visually inspect the rupture top side of an empty railcar for possible defects, we do not need to remove the disc from its holder. If the rupture disc appears to be damaged or leaking. Bad Order the car. After inspecting the disc, close the cover or reapply the threaded plastic cap and apply the pin.

Figure 19 - Midland Rupture Disc Assembly

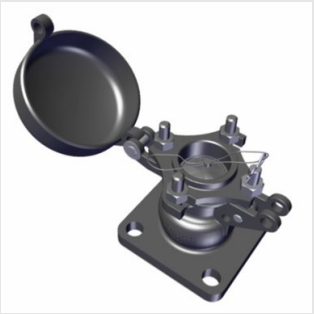


Figure 20 - Lift cover to inspect disc

Figure 21- Visually inspect rupture disc

Figure 22 - Salco Rupture Disc Assembly

Figure 23 - Remove Cap to inspect disc

Figure 24 - Rupture disc

5.18 Finish filling out the Railcar Inspection Checklist.

Note: Use *Appendix H1 Sulfur Railcar Unloading Checklist to document the car examination before shipping.*

5.19 Inspect the railcar markings, placards. Note that Molten Sulfur railcars moving to or from US or Canada, do not required placards, provided the identification number 2448 appears

on an Orange Panel on both sides and both ends, and the words "MOLTEN SULFUR (or MOLTEN SULPHUR) appears on each side of the tank car.

Marking Orange 4-Digit Panel	Domestic Placard	International Placard
		

5.20 Make sure required stenciling is readable, and all test dates are current.

5.21 Take pictures of the of empty car as required to verify the following items were inspected and good order

5.21.1 Dome bolts and nuts are tool tight

5.21.2 Hinge pin is in good condition

5.21.3 Rupture disc cover is pinned and secured properly

5.21.4 Bottom outlet valve and cap are closed and tool tight

5.21.5 BOV handle is disengaged and secured in closed position

5.21.6 Car surface is free from excessive sulfur spillage

5.22 Perform a visual inspection of the car for any obvious defects. If car is in bad order, do not sign to ship. Complete a Bad Order tag and follow the instructions on the bad order form.

Visually inspect the railcar ends to confirm the car is equipped with Double Shelf Couplers. Molten Sulfur cars must be equipped with Double Shelf Coupler. If the car doesn't meet this requirement, bad order the car.

Figure 25- No Shelf Coupler

Figure 26 - Bottom Shelf Coupler

Figure 27- Double Shelf Coupler

Note: *If in doubt contact supervisor or bad order the railcar. IF CAR IS NOT SECURED CORRECTLY OR THE UNLOADING SHEET IS NOT FILLED OUT PROPERLY IT WILL RESULT IN DISCIPLINARY ACTION UP TO AND POSSIBLY INCLUDING TERMINATION.*

5.23 After all cars have been unloaded for the day, the troughs need to be covered. When covering the sulfur unloading pits, follow these steps:

5.23.1 Two people are required to perform this task

5.23.2 One person on each side of the cover

5.23.3 Each person should use the troughs covering tools and pull at the same time.

5.23.4 Sign off at the bottom on the “Sulfur Car on Steam” checklist

6 PERSONAL PROTECTIVE EQUIPMENT (PPE)

6.1 Basic PPE. Hard hat, safety glasses, steel toe boots, hearing protection, please see table for additional PPE requirements.

Task	Location	PPE
Secure cars and tracks	Not over unloading pit	Long Sleeve shirt; Leather gloves
Connecting steam lines and fittings.		FR Suit or long sleeve shirt or welding jacket. Leather gloves
Replacing Railcar BOV cap.		
Disconnecting steam lines and fittings.		Face shield; Leather gloves FR Suit or long sleeve shirt or welding jacket
Removing Railcar BOV cap.		
Opening / Closing Railcar dome lid.	On top of the railcar	FR Suit; FR hood; Air supplied respirator; Leather gloves
Replacing Railcar BOV cap	Over unloading pit	FR Suit; FR hood; Air Supplied respirator; Leather gloves
Opening/ Closing Railcar BOV		
Unplugging BOV (top or bottom method)		

7 RECORD RETENTION

Records of examining the tank car such as inspection checklist and photographs will help dispute DOT/FRA presumption during an inspection, that a proper inspection was not performed before shipping. Each loaded tank car must have a written report (inspection checklist) that must be retained until successfully completing the next inspection of the same type.