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1.0 PURPOSE

1.1 This work instruction represents a composite of petroleum industry safe practices for Safe Use of Vacuum Trucks. This is to be considered minimum acceptable standards and Marathon Petroleum Company Louisiana Refining Division policy under normal conditions. More stringent requirements may augment this standard for any situation.

2.0 SCOPE

2.1 This procedure applies to all persons working on LRD property, including contractors and visitors.

3.0 STANDARDS/REFERENCES

3.1 API 2219 Safe Operation of Vacuum Trucks in Petroleum Service

3.2 Work Permit Standard Practice RSW-0102-GV

3.3 DOC. LIB. NO.: 311.705

4.0 DEFINITIONS

Vacuum Truck Types	Application:
Air Mover (Dry Vac)	Typically used to pick up dry solids. They move product into the tank by generating extremely high airflow through the hose.
Liquid Vacuum Truck	Typically used for picking up liquids and liquid sludge. Often referred to as wet vacuum truck and liquid ring trucks. • A wet vacuum truck uses a vane driven pump, whereas liquid ring have an impeller which pushes liquid into a ring around the housing creating a vacuum.

4.1 Bonding- Prevents the formation of different electrostatic potentials between vacuum trucks and pumps and the source or receiving tank, container or vessel by bringing all parts of the connected system to an equivalent electrical potential.

4.2 Combustible Dust- fine particles that present an explosion hazard when suspended in air under certain conditions

4.3 Grounding- Minimizes the electrical potential differences between objects and the earth to prevent a static charge. Grounding brings all parts of any system to zero electrical potential by allowing electrical currents to dissipate to earth ground.

4.4 Vacuum Truck- A transportable vacuum system consisting of a positive displacement vacuum pump, vacuum cargo tank and accessory equipment mounted on a motor vehicle.

5.0 RESPONSIBILITES

5.1 Vacuum Truck Supervision

5.1.1 Observe field activities periodically to ensure compliance with this work instruction.

5.1.2 Train vacuum truck operators in the proper transfer, handling, and transportation of flammable and combustible liquids and hazardous materials, including proper method of checking continuity of grounding.

5.1.3 Ensure daily inspections of the equipment are conducted with appropriate documentation completed, including a test of the electrical continuity of the bonding or grounding cables provided with the truck.

5.2 Vacuum Truck Operators

5.2.1 Follow the requirements specified by this procedure.

5.2.2 Perform all DOT required inspections on the vehicle and maintain a copy in the cab as required by DOT.

5.2.3 Be knowledgeable about required PPE, be trained in its use and wear it correctly.

5.2.4 Have as a minimum a Class B CDL.

5.2.5 Be knowledgeable about the safe operation and shutdown systems on the vacuum truck to be operated.

5.2.6 Have a thorough understanding of grounding and bonding as required by this procedure.

5.2.7 Have current certification as a HAZMAT Technician before working at a release of hazardous materials.

5.2.8 Know what material was last contained in the vacuum truck and inform the permit writer if it is not compatible with the material to be loaded. **Note: Do not mix acids and caustics or hot products and water.**

5.2.9 Obtain a safe work permit before vacuuming hydrocarbon or unknown materials.

5.2.10 Understand how to safely operate the fire extinguisher located on the truck.

5.2.11 Monitor all operations, remain within 25 feet of the vehicle during all operations and be able to stop the pump if necessary.

5.2.12 Be trained in the operation and emergency shutdown procedures of the truck.

5.2.13 Be aware of the overall height, width, and approximate weight of their truck (empty and unloaded) and operate them safely around stationary equipment, overhead piping, and other hazards.

5.2.14 All personnel shall leave the truck cab during loading and unloading.

5.2.15 Performs continuity checks as described in this work instruction.

5.2.16 Perform a pre-operation inspection to include at a minimum valves, electrical conductivity, filters, floats, shutoffs, hoses and compatibility.

5.2.17 Be trained in the operation and use of an ohm meter. The operator will have to perform an ohm test to verify that less than 10 ohms exists between the truck and plant ground.

5.3 MPC Coordinator

5.3.1 Ensure that all contractors required to operate equipment are informed of and meet, or exceed, the requirements of this procedure.

5.4 Permit Writer

5.4.1 Issue permits in accordance with the Work Permit Standard Practice, RSW-0102-GV.

5.4.2 Discuss the material that was last contained in the tank with the vacuum truck operator to ensure that it is compatible with the material to be vacuumed. The last material contained must be documented on the work permit.

5.4.2.1 If the compatibility is unknown of the product last contained in the tank with the material to be vacuumed work will not be permitted. The Tech Service Engineer shall be contacted for further determination.

5.4.3 When the potential exists for exposure to airborne contaminants atmospheric monitoring shall be conducted by the Owning Department. Personal protective equipment shall be specific as needed for the vacuum truck operators and other personnel in the affected area.

5.4.4 Verify that continuity was checked and below 10 ohms. Document the readings on the Work Permit in the Equipment Preparation section, next to “Other”.

5.4.5 Establish a 20’ perimeter around the vent hose emission to protect employees from over exposure. The perimeter shall be demarcated with the appropriate barricade tape and barricade tags.

5.4.6 Conduct atmospheric monitoring, as necessary, to assure no exposure exceeds outside the barricaded area.

6.0 Requirements

6.1 Permitting

6.1.1 A Work Permit must be completed anytime that a vacuum truck is used in a process area.

6.1.2 If there are flammable liquids or there is a possibility of unknown products (e.g. sewer box, drain pan, or oily sewer system with many branch lines) being vacuumed, the hot work section of the Work Permit must be obtained and completed prior to the start of vacuuming.

6.1.3 Combustible dust (sulfur, coke, etc.) is explosive and should not be vacuumed. Do not vacuum combustible dust in dry state. Combustible dust should be picked up by mechanical means. The combustible dust may be vacuumed wet by adding a water or slurrying prior to and during vacuum operations with approval from the Maintenance Zone Coordinator, or the Operations Supervisor only. The Safety Department should be consulted prior to vacuuming any dust material.

6.1.4 During the joint job site visit consideration must be given to where the vacuum pump exhaust will discharge.

6.1.4.1 The permit writer will perform an initial test of the atmosphere (gas test).

6.1.4.2 Together the Operations representative and the vacuum truck operator will discuss and decide the best location for the exhaust hose. The hose will be placed in such a manner so as to vent it downwind from where personnel are working.

6.1.4.3 When discussing respiratory PPE consideration must be given to where the vacuum pump exhaust will discharge.

6.2 Vacuum Truck Specifications & Operations

6.2.1 All vacuum truck tanks shall meet ASME certification and shall have a specification plate or other means of certification with the truck.

6.2.2 Only vacuum trucks equipped with a liquid ring vacuum pump with a maximum air flow rating of 1300 CFM are permitted to vacuum materials containing flammable liquids (flash point <140F).

6.2.3 The vacuum truck shall be staged on stable ground with the brakes set and the wheels chocked before loading and off-loading operations.

6.2.3.1 Consideration shall be given to additional weight of the load with selecting the staging location.

6.2.4 Vacuum trucks shall be equipped with run-away protection for diesel engines.

Note: All vacuum trucks will be required to comply with this by January 1, 2016.

6.2.5 Vacuum truck cargo tanks must be equipped with a properly maintained and accurate level indicator to prevent overloading and gauges to monitor vacuum and pressure inside of the tank.

6.2.5.1 Wet Vac Vacuum Trucks

6.2.5.1.1 A separate conductor must connect the truck frame and the work to achieve an electrical bond. (In case of a metal container or piece of work i.e. metal tank, sump, etc. the conductor must be clamped directly to the work.) If a metal drain pan or container is used, it must be grounded or bonded to the plant grounding system.

6.2.5.1.2 In case of a nonmetal container such as plastic containers, open unlined or concrete sump, ditch, etc., a metal rod shall be placed in the liquid being vacuumed, with a conductor ran from the rod to the truck frame.

6.2.5.1.3 Bonding ground wires shall be sized to provide adequate electrical and mechanical strength to sustain harsh abuse without suffering appreciable damage.

6.2.5.1.4 An ohmmeter shall be used to verify that less than 10 ohms exists between the truck and plant ground. This check shall be performed by an individual competent at operating an Ohm Meter.

6.2.5.1.5 A recheck of the resistance shall be necessary when suspected damage has occurred to the bonding ground wire or attachment point or each time the Hot Work Permit is renewed.

Note: These trucks are normally used for nonhazardous products such as sewage.

6.2.5.2 Liquid Ring Vacuum Trucks

6.2.5.2.1 A liquid ring vacuum truck must be used to vacuum naphtha or other light end products with flash point of 140 degree or below.

6.2.5.2.2 All wet-ring/liquid seal vacuum trucks, used in the Louisiana Refinery, must be equipped with a continual monitoring system. If electrical continuity from hose end to ground ever exceeds 10 ohms, immediate repairs and/or corrections to ground connections must be made.

6.2.5.2.3 The use of continual monitoring on wet-ring/liquid seal vacuum trucks hereby eliminate the need/requirement that a ground check be performed by a competent person prior to beginning of vacuum truck work.

6.2.5.2.4 It is required that the contractors keep their continual ground monitoring in proper working order.

6.2.5.2.5 Liquid Ring Vacuum trucks are to be equipped with a system that disengages the PTO powering the pump and/or closes the suction valve if a failure of continuity to ground is detected.

6.2.5.2.6 Only liquid-ring vacuum systems with a 1,300 CFM maximum flow rate can be used to vacuum any products with a reading greater than 0% LEL on a four-gas meter.

Note: Wet ring vacuum trucks with the continual ground monitoring do not require the truck to be grounded. Static dissipation will occur through the system wire attached to the work.

6.3 **Vacuum Hose**

6.3.1 Quick disconnects of heavy-duty construction such as Camlock, Welding, Burndy ground, "C" type clamp or similar connectors shall be permitted to allow for ease of disconnection and connection of the hose to truck

ground for unloading.

6.3.2 The connection of any end coupling, fitting and/or flange (coupling to coupling) must be mechanically and electrically bonded together. A bonding ground wire sized to provide adequate mechanical strength to sustain harsh abuse without suffering appreciable damage is required.

6.3.3 Hoses and fittings when connected together shall form an electrically continuous path from the working end of the hose to the plant ground. Hoses that have broken ground wires or that cannot form an electrically continuous path shall not be used. They shall either be discarded or repaired such that they do form the electrically continuous ground path.

6.3.4 **Safe Handling of Hoses**

6.3.4.1 Never attempt to dislodge material from the vacuum hose opening by hand before shutting off vacuum.

6.3.4.2 No part of your body should ever be placed near the hose opening.

6.3.4.3 The recommended practice for movement of the vacuum hose is through the use of ropes or a pole attached near the hose opening.

6.3.5 **Conductive Hoses**

6.3.5.1 Only vacuum hoses constructed of conductive material or thick walled hoses with imbedded conductive wiring shall be used when transferring flammable and combustible liquids.

6.3.5.2 Hoses made of nonconductive material must have an internal ground wire integral with the construction of the hose or an external grounding wire or braid that is integral with the construction of the hose. It must be attached to the end couplings, fittings and/or flanges and be in contact with the hose material.

6.3.5.3 Conductive hose sections shall not be required to have additional grounds.

6.3.6 **Nonconductive Hoses**

6.3.6.1 If nonconductive hose must be used the following conditions shall be met:

6.3.6.1.1 Hoses and fittings when connected together shall form an electrically continuous path from the working end of the hose to the plant ground. If the normal connection of any end coupling; fitting and/or flange (beware of

insulated types) does not provide this continuous path that connection must be bonded.

6.3.6.1.2 A drilled/tapped hole on each fitting should allow for a ground cable with lugs on each end to be secured to the coupling.
NOTE: Flex hose cannot be used for hydrocarbons.

6.4 **Bonding and Grounding**

6.4.1 The vacuum truck owner shall establish a schedule and maintain recordkeeping for inspecting and testing the electrical conductivity of grounding and bonding cables and hoses provided with the vacuum truck.

6.4.2 The vacuum truck frame must be grounded to earth via conductor bonded to plant ground or grounded structure close to the truck.

6.4.3 A recheck of the resistance shall be necessary when suspected damage has occurred to the bonding ground wire or attachment point, hose is reattached or each time the Safe Work Permit is renewed.

6.4.4 Lightweight stamped steel alligator type connectors shall not be used.

6.4.5 An ohmmeter shall be used to verify that less than 10 ohms exists between the working end of the hose and the work. This check shall be performed by an individual competent in the operation of the Ohm meter.

6.4.6 Conductive hoses securely attached to properly grounded structural steel shall be considered bonded to plant ground.

6.4.7 The use of non-conductive transfer items, such as plastic funnels, strainer, etc., is prohibited. Refer to Appendix 3 Trouble Shooting Resistance for Vacuum Trucks.

6.4.8 Continuous Bonding/Grounding Monitoring Systems

6.4.8.1 The following provisions shall apply to vacuum trucks equipped with a continuous bonding/grounding monitoring system:

6.4.8.1.1 The vacuum truck owner shall establish a schedule and maintain recordkeeping for inspecting, calibrating, and testing the operability of the system.

6.4.8.1.2 The vacuum truck operator shall check the operability of the system prior to each job by disconnecting the ground and ensuring the system properly trips.

6.4.8.1.3 In the event the system fails to function properly, the vacuum truck shall be pulled from service and repaired by a competent person.

6.4.8.1.4 The use of continuous bonding/grounding monitoring systems eliminates the provisions in this standard that the continuity checks be performed manually by a competent person prior to beginning vacuuming.

6.4.9 Drain Pan Grounding (or container to be vacuumed)

6.4.9.1 The vacuum truck and drain pan grounds shall be within 10 ohms of each other.

6.4.9.2 The drain pan shall be grounded to earth via conductor bonded to plant ground with at least #8 AWG or equivalent wire (insulated or non-insulated is acceptable).

6.4.9.3 Drain pans, totes, and buckets should be metal with no internal coating or paint. (Galvanized metal containers are approved for use).

6.4.9.4 Totes, pans, buckets or other containers shall be bonded to the piping, vessel or fill spout with approved bonding jumpers. Bonding wire shall be tight and secure on both ends.

6.4.9.5 In all cases, bonding wires shall be in good condition and secure on both ends. The size of these bonding wires and jumpers is dictated by mechanical strength rather than by current carrying capacity. The bonding wires are made to have enough strength to sustain some physical abuse without suffering appreciable damage.

6.4.10 The grounding/bonding is considered acceptable only if the resistance is measured to be less than 10 ohms with an ohm meter.

6.4.11 If the bonding and grounding requirements of this standard are not understood, consult an electrician or Electrical Supervisor.

6.5 Off Loading Product From Vacuum Trucks

6.5.1 Consideration shall be given to the method of off-loading vacuum trucks to mitigate the formation of a pressurized flammable vapor-air mixture inside the cargo tank. The approved off-loading methods are gravity, pressure, and pump-off.

6.5.2 Gravity Method - When feasible, gravity off-loading is the safest and preferred method.

6.5.3 Pressure Method - Pressure off-loading with air is accomplished by reversing the vacuum pump on the truck. The use of external sources of compressed air to pressurize the cargo tank is prohibited. Pressure off-loading of combustibles, flammables, or materials that are reactive to air or moisture shall be performed with nitrogen. The pressure shall not exceed the pressure relief valve setting, or maximum allowable working pressure indicated by the vacuum truck cargo tank data plate.

6.5.4 Pump-Off Method - An external pump may be used to off-load products which are difficult or infeasible to transfer by pressure or gravity.

6.5.5 When off-loading from a truck into a tank/vessel both shall be bonded together and grounded with an approved grounding method (approved clamp and wire). The product is contained inside the hose and flow rates

are usually low. The bonding wire shall be tight and secure on both ends.

6.5.6 When offloading is performed into a vessel or tank containing a liquid level, a check valve shall be installed to prevent the risk of backflow from the tank into the vacuum truck.

6.5.7 When connected directly to piping or a vessel, vacuum hoses shall be connected in a manner which permits a bleeder to be used to provide a means to verify that the hose is drained and does not contain pressure prior to disconnecting the hose from the piping/vessel. The bleeder may be on the piping/vessel or on the vacuum truck, depending upon the set up.

6.5.8 Never make transfers from vacuum trucks directly into tanks with floating roofs by pressuring off the vacuum truck with a gas/vapor motive force. Pushing excessive air or hydrocarbon vapor into the bottom side of an IFR could lead to upsetting and sinking of the IFR. Transfers for such applications will require the use of the truck's side pump or a portable centrifugal pump.

6.6 Vapor Control and Recovery

6.6.1 When flammable or toxic liquids are loaded, the vacuum pump exhaust shall be vented downwind of the truck by attaching a length of hose sufficient to reach an area that is free from hazards and personnel.

6.7 Special Precautions

6.7.1 All vacuum trucks used in the refineries must meet API RP-2219 and shall have a specification plate or other means of certification with the truck.

6.7.2 Vacuum trucks are prohibited from being utilized for servicing neat and/or unblended liquefied petroleum gases (LPG).

6.7.3 If the Reid Vapor Pressure (RVP) of the material is 14.0 psi or greater, or does not meet the limitations of Tables 1 and 2 in Attachment #4, the material shall not be loaded into a vacuum truck.

6.7.4 A 360 walk-around must be completed before driving truck, with a special emphasis that hoses have been stored and secured to truck.

6.7.5 Decontamination procedures must be utilized where necessary, (e.g. HF Acid, Caustic, Benzene, etc.).

6.7.6 Do not add liquids together where steam could be produced inside of the vacuum truck (e.g. hot product into water).

6.7.7 Do not add materials with differing pH, which may cause an exothermic reaction inside of the vacuum truck.

6.7.8 Be aware that combustible liquids transferred at or above their flash point temperatures must be handled as if they were flammable liquids.

6.7.9 Toxic vapors that are not hazardous prior to handling may become concentrated, and thereby hazardous, at or near the discharge port of the vacuum pump.

6.7.10 Sources of ignition that must be considered include vacuum truck engine

and exhaust heat, pump overheating, faulty electrical equipment on the truck, static electrical discharges, and motor vehicles in the area.

6.7.11 Be aware that whenever non-flammable materials such as produced water or spent acid that has the potential to contain trace amounts of hydrocarbon, condensate, or H_2S are placed under a vacuum. Flammable vapors and toxic gasses can be released, creating potential ignition and toxic exposure hazards.

6.7.12 Material compatibility, reactivity, toxicity, and temperature must be considered and care must be taken to assure the materials being loaded are compatible with materials previously loaded and that mixing of these materials will not present a hazard.

6.7.13 Physical entry into a vacuum truck is considered confined space entry. The keys for the truck must be placed in a lock box and the door must be held open by a locking mechanism or a substantial block placed in the gap.

7.0 **TRAINING**

7.1 All employees who may be exposed to vacuum trucks must be trained in these associated instructions. The training should encompass provisions contained in this procedure.

7.2 Vacuum truck owners must ensure that vacuum truck operators are trained and qualified for their work assignments and follow all OSHA, EPA, and DOT applicable standards.

8.0 APPENDICES

8.1 Typical Liquid Ring Vacuum Truck

8.2 Typical Wet Vac Vacuum Truck

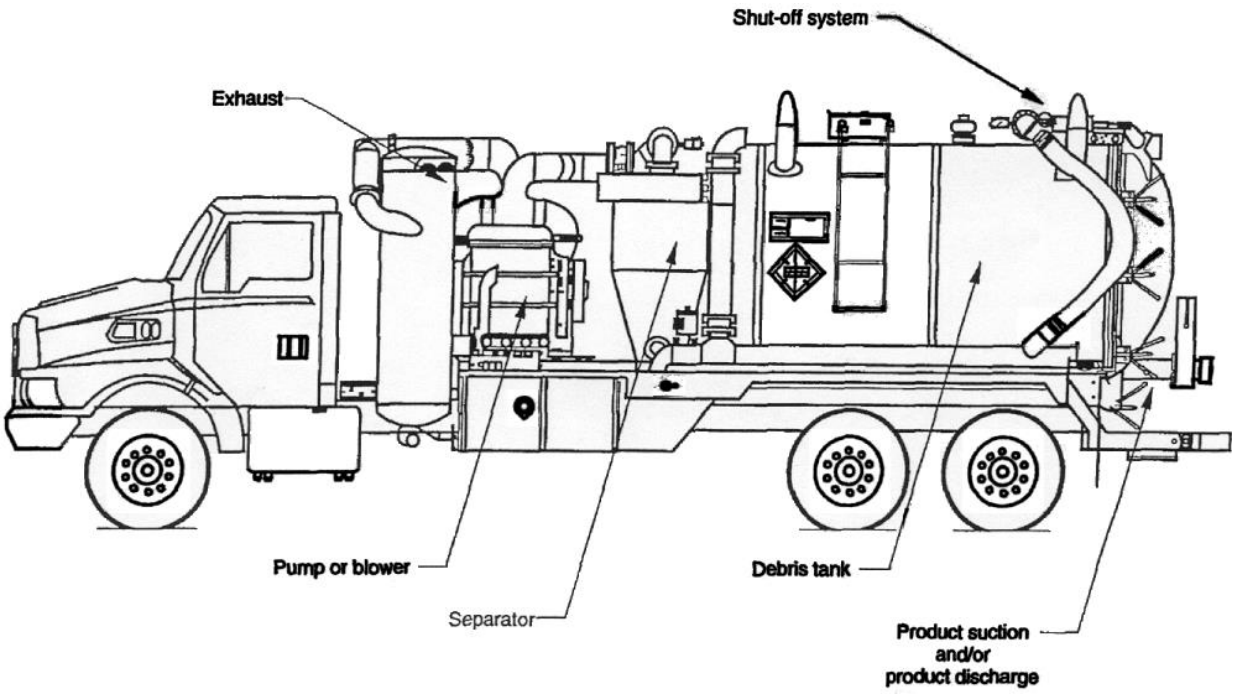
8.3 Checking and Troubleshooting Resistance for Vacuum Trucks

8.4 Finished Products Temperature Crude Oil Temperature Criteria Table

9.0 REVISION HISTORY

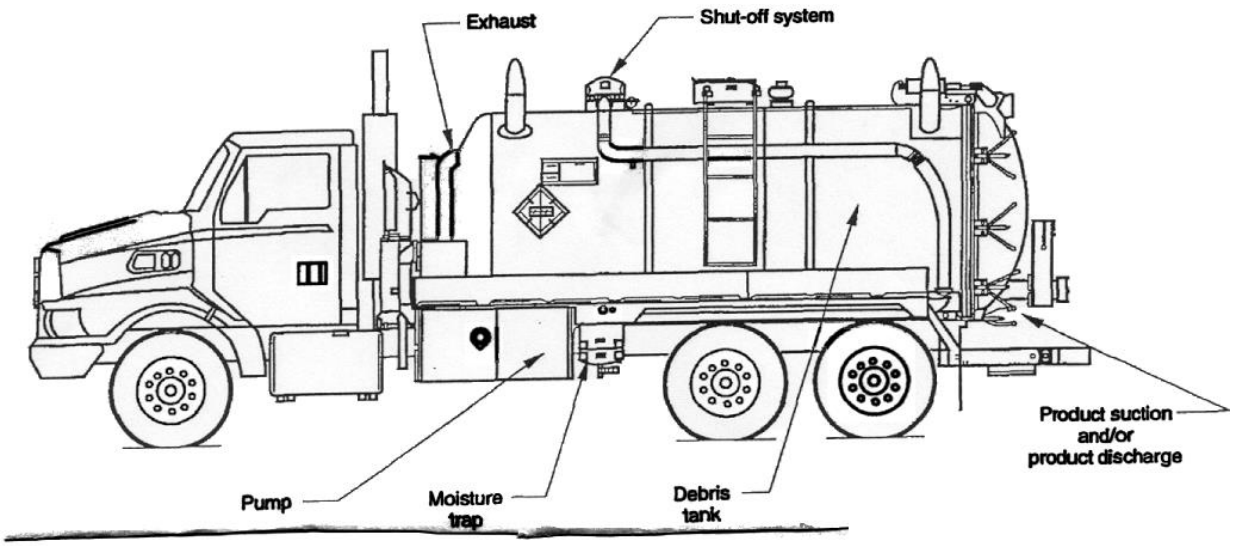
Revision Number	Description of Change	Written by	Approved by	Revision Date	Effective Date
0	New Standard implementation	Amanda Hall	VPP- 4/23/2015 RLT-5/21/2015	5/21/2015	5/21/2015
1	Added verbiage to include 360 walk-around before driving truck in section 6.7.2	Paul Davies	VPP – 4/20/17 RLT – 4/27/17	4/27/17	5/1/17
2	Routine triennial review, no changes	Doug Senette	Safety	5/21/18	5/21/18
3	Offloading updates per PSA Recommendations	Quinn LeBlanc	Safety	11/23/2020	1/1/2021

Attachment #1
Typical Liquid Ring Vacuum Truck



Attachment #2

Typical Wet Vac Vacuum Truck



Attachment #3

Checking and Troubleshooting Resistance for Vacuum Trucks

1.0 Overview

1.1 Purpose

1.2 This document explains the procedure for checking resistance on conductive vacuum hoses, vacuum trucks to ground location(s) and troubleshooting unacceptable resistance readings at the Louisiana Refining Division (LRD).

1.3 Scope

1.3.1 This document applies to all:

1.3.1.1 Vacuum truck contractors, and

1.3.1.2 Vacuum truck operators.

1.4 Health, Environmental and Safety

1.4.1 The potential buildup for static electricity exists if a resistance reading is greater than 10 Ohms.

1.4.2 Verify resistance of all connections at the start of each shift, and

1.4.2.1 Every time the configuration changes (such as adding a stinger or coupling).

1.4.3 Do not operate the vacuum truck if a resistance reading is greater than 10 Ohms.

1.5 Tools and Equipment

1.5.1 To perform this task the **Vacuum Truck Operator** needs the following tool.

Item	Function or Description
Multimeter	Used to determine voltage and resistance

2.0 Roles and Responsibilities

2.1 The following are roles and responsibilities within this document.

Role	Responsibility
Permit Writer	Verifies Truck Operator conducts all resistance checks as specified in this document, including: • All hoses and attachments, and • From the vacuum truck to the ground location. Writes resistance reading on the Work Permit in the Equipment Preparation section, next to "Other".
Truck Operator	Before operating the vacuum truck: • Verifies all resistance readings as specified in this document: • On all hoses and attachments, and • From the vacuum truck to the grounding location. Properly bonds vacuum truck and source location as specified in this document.

3.0 Verifying Resistance- Hoses, Vacuum Truck, Ground Location

3.1 The **Truck Operator** completes the following to help eliminate static electricity between the vacuum truck and the source.

Important: The Permit Writer must be present to document the resistance readings on the Work Permit in the Equipment Preparation section next to "Other".

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>1</td><td>Verify vacuum truck is at the recommended operating distance from source.</td></tr>
<tr><td>2</td><td>Visually verify the multimeter test leads are in good condition.</td></tr>
<tr><td>3</td><td>Verify test leads are plugged into the correct jacks:

• Turn the meter on,
• Set the multimeter to the Ohms setting,
• Touch the tips of the leads together, and
• Verify the reading on the meter indicates less the 0.2 Ohms.
 

<table>
<tr><th>If…</th><th>Then….</th></tr>
<tr><td>The reading does not indicate less than 0.2 Ohms</td><td>While the leads are touch each other, push the Zero button or turn the Zero dial to reset the reading to zero.</td></tr>
</table>
</td></tr>
</table>

	The reading does not indicate less that 0.2 Ohms and does not have a zero function	• Check meter connections, • Test leads, and • Repeat steps above.
4	Check the resistance of all vacuum hoses and applicable connections (stingers or couplings) before attaching to the vacuum truck. • If using multiple hoses, test each hose separately. • Place the black test lead tip on one end of the metal hose coupling, and • Place the red test lead tip on the other end of the metal hose coupling. **Notes:** • To verify a proper reading, do not allow fingers or devices to touch the test lead tips, and • Do not allow the ends to make contact with any other surfaces. • See the picture below for correct placement of test leads. 	
5	Verify the Ohm resistance is less than 10 Ohm for each section of hose.	

If…	Then….
resistance is less than or equal to 10 Ohm	continue to step 6
resistance is greater than 10 Ohm	follow procedures in Section 4.0 Trouble Shooting Resistance

<table>
<tr><td>6</td><td colspan="2">Connect the vacuum truck to an existing grounding location.

Existing grounding locations include:
• Dedicated grounding locations
• Pipe supports
• Cable tray supports, or
• Building steel.</td></tr>
<tr><td></td><td>If…</td><td>Then….</td></tr>
<tr><td></td><td>there is no existing or accessible grounding location</td><td>Utilize an alternative grounding location by installing a temporary grounding rod.

Important: Only use a temporary grounding rod, if an existing grounding location is not accessible.</td></tr>
<tr><td></td><td colspan="2">Attach grounding clips from a suitable grounding attachment point on the vacuum truck to existing grounding location or alternative location.

Verify the attachment points on the vacuum truck and the grounding location are touching bare metal that is free of:
• Oil
• Dirt
• Paint
• Tape, or
• Other material.</td></tr>
<tr><td>7</td><td colspan="2">Verify the grounding integrity from the vacuum truck to the grounding location.

• Place the red test lead tip or clamp on an exposed, bare metal location on the vacuum truck, and
• Place the black test lead tip or clamp on an exposed, bare metal area on the grounding location.</td></tr>
<tr><td></td><td>If…</td><td>Then….</td></tr>
<tr><td></td><td>resistance is less than or equal 10 Ohm</td><td>continue to step 8</td></tr>
<tr><td></td><td>resistance is greater than 10 Ohm</td><td>Continue to the procedures in Section 4.0 Troubleshooting Resistance.</td></tr>
</table>

<table>
<tr><td>8</td><td colspan="2">Verify the integrity from the end of the attached hoses to the vacuum truck.
Place the red test lead tip or clamp on an exposed, bare metal location on the unconnected end of hose, and
Place the black test lead tip or clamp on an exposed, bare metal location on the vacuum truck.</td></tr>
<tr><td></td><td>If…</td><td>Then….</td></tr>
<tr><td></td><td>resistance is less than or equal 10 Ohm</td><td>continue to step 9</td></tr>
<tr><td></td><td>resistance is greater than 10 Ohm</td><td>Continue to the procedures in Section 4.0 Troubleshooting Resistance.</td></tr>
<tr><td>9</td><td colspan="2">Bond the vacuum truck to the source location.
Attach a bonding cable from an exposed bare metal location on the vacuum truck to an exposed bare metal location from where the product is being removed (such as a tank).</td></tr>
<tr><td></td><td>If…</td><td>Then..</td></tr>
<tr><td></td><td>draining into a source container such as a metal pan</td><td>bond the pan to the product's location</td></tr>
<tr><td></td><td colspan="2">Note: A maximum of 2 Ohms is acceptable for the bonding cables.</td></tr>
</table>

Important: Do not remove bonding cables until all transfer operations have stopped and all hoses and/or attachments have been removed from the source.

3.2 The Truck Operator completes the procedures for checking resistance and verifies the readings are within the parameters stated in this document before operating the vacuum truck. The resistance readings are documented on the Work Permit in the Equipment Preparation section, next to “Other”.

4.0 Troubleshooting Resistance

4.1 To troubleshoot excessive resistance readings before operating the vacuum truck, the Truck Operator completes the following.

4.2 Greater than 10 Ohms

If…	Then..
Resistance reading for vacuum hoses are greater than 10 Ohms	Check the following: • Multimeter • Tightness of hose connections and attachments, and • Test points. Replace vacuum hose (or attachment). Note: An external bonding wire securely attached is acceptable to meet resistance requirements, only if other methods in this document have been attempted and are not able to reach the 10 Ohm requirements. Go to Step 3.1 Verifying Resistance and continue with the procedure.
Resistance readings are greater than 10 Ohms from vacuum truck to grounding location	Complete the following: • Check the multimeter and test leads • Check test points (free of dirt, paint, and so on), and/or • Check bonding/grounding cables.

Important: If the resistance readings are still not within the limits stated in this document after completing the above procedures, then check with local Operations personnel before operating the vacuum truck.

Attachment #4
Finished Products Temperature Crude Oil Temperature Criteria Table

Table 1 Finished Products Temperature Criteria Graph

With the known material temperature, the maximum RVP can be calculated as follows:
Maximum RVP = 25.446 - 0.160 * Material Temperature

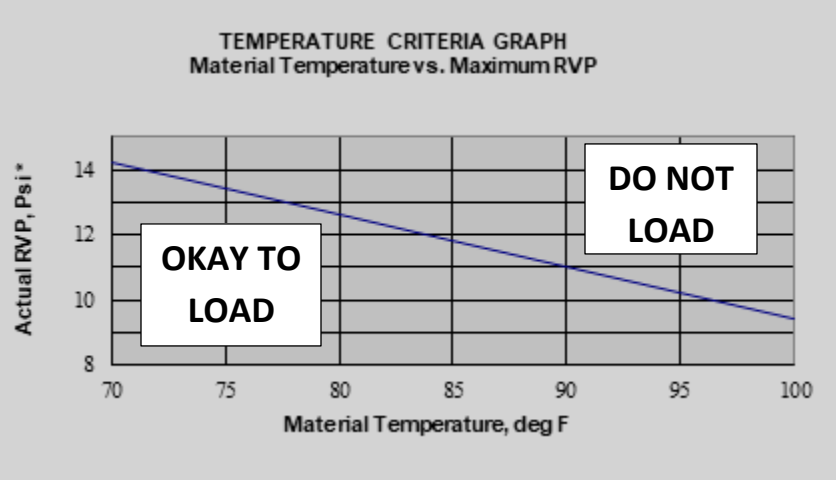
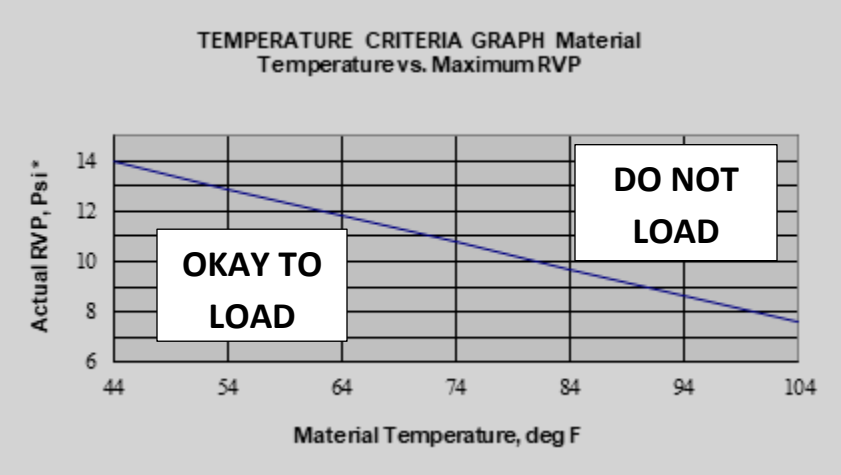


Table 2 Crude Oil Temperature Criteria Graph

With the known material temperature, the maximum RVP can be calculated as follows:
Maximum RVP = 18.625 - 0.106 * Material Temperature



* Actual Reid Vapor Pressure (RVP) as measured by the Lab