	VT-0050R110	006	11-19	CWH
CHART®	LNG Tank General Troubleshooting (non-fuel gauge)			

OVERVIEW

Chart LNG tanks provide years of dependable service but do require some general maintenance on occasion. This service bulletin will provide general instructions on the diagnosis and testing of Chart LNG tanks. Proper service will insure the tank is safe and functional before being returned to service.

Note: Fuel gauge troubleshooting will not be covered in this bulletin.

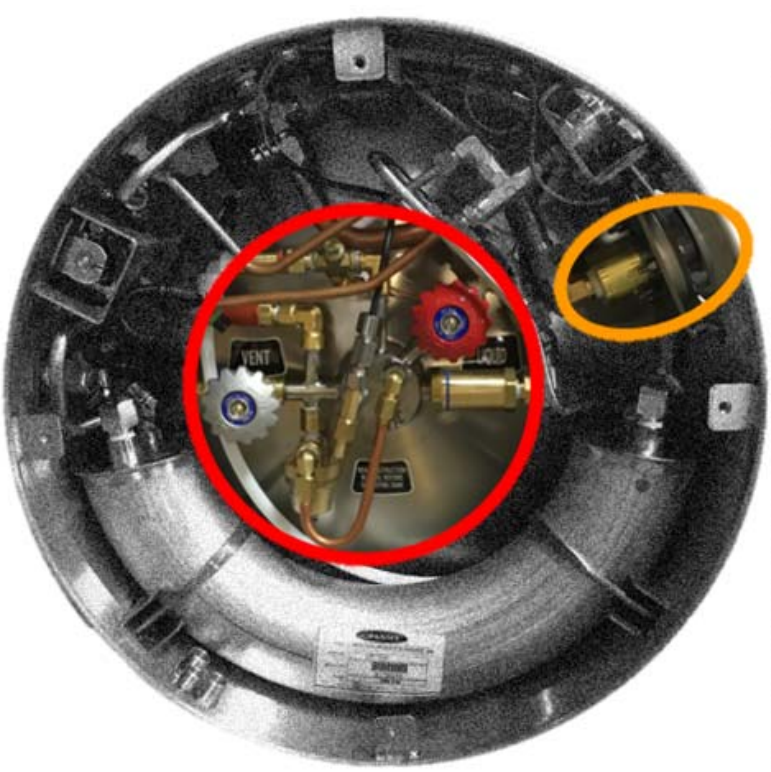
TOOLS NEEDED

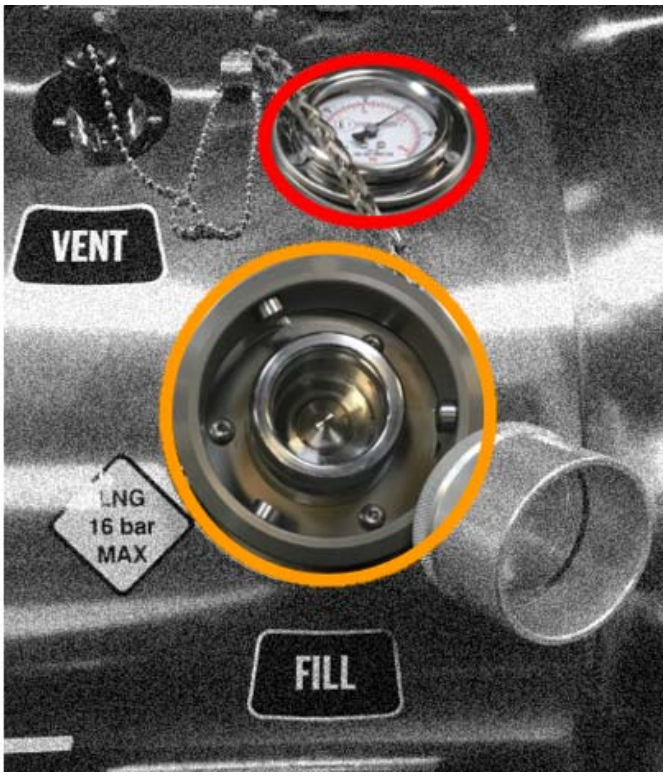
Liquid Leak Detector Solution
Nickel Impregnated Thread Sealant Tape
Wire Brush/Brushes Internal & External
Economizer Test Tool (Chart Part Number 20837106)
High Pressure Nitrogen Bottle
Assorted Wrenches Adjustable & Open End
Flaretite Seals
Chart LNG Service bulletins (VT-00XX)
Appropriate Personal Protective Equipment

Troubleshooting Chart LNG Tanks

This procedure is intended for use by trained technicians with experience on systems using LNG. Review all applicable safety documents before beginning this procedure.

Is De-fueling Needed for Repairs?





De-fueling is <u>REQUIRED</u> for all component and plumbing repairs within the RED circled areas.

De-fueling is recommended by Chart Industries for component repairs within the ORANGE circled area and its plumbing up to the fill check valve.

All other components will require closing both valves and depressurizing the component's plumbing prior to repairs.

For de-fueling and depressurizing procedures refer to VT-0017

This procedure is intended for use by trained technicians with experience on systems using LNG. Review all applicable safety documents before beginning this procedure.

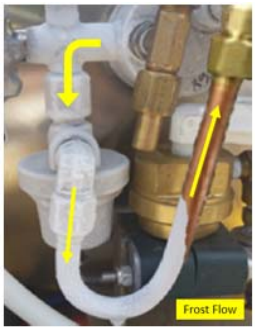
Low Pressure

Causes of low pressure issues with Chart LNG tanks:

Faulty Economizer – If the economizer is stuck in the open position it will allow the vapor pressure to continue to flow to the engine after the economizer is supposed to be closed.

Testing the economizer:

1. Using Chart's Economizer Test Tool (P/N: 20837106) & following the instructions in VT-0014 will determine if the economizer is operating at the proper set point or operating properly.
2. Once the set point is determined, the economizer can be tested for leak by. With tank pressures (minimum 1.7 bar) below economizer set point & tank plumbing de-iced the economizers can be tested one at a time (if dual tanks). Close the red handled valve on one tank if it is a dual tank system, if it is a single tank system keep the red valve open. Start the truck and allow it to idle while observing the economizer tube for frost pattern on the open tank. With the tank pressure below the economizer set point there should be no flow through the economizer and will be observed as no frost on the economizer or left side of the economizer tube.
   If within the first few minutes of running (with tank pressures 1.7 bar below economizer set point) a frost pattern is observed flowing through the economizer and left side of the economizer tube towards the red handled valve (see photo below), an open economizer condition exists, and the economizer should be replaced. Refer to VT-0011 for economizer replacement.



Note: After several minutes of operation frost will begin appearing throughout the plumbing due to radiant cooling and liquid settling to low points in the plumbing.

Excess Flow Valve (EFV) Issues – a tripped EFV, a blockage in the EFV, or faulty EFV can prevent regular tank pressures from passing through continually. Close red handled valve for ~5minutes. Slowly re-open red handled valve. See Fuel Flow Issues section for resetting the EFV.

Shut-off Solenoid (S.O.S.) Issues – voltage, wiring, &/or ground issues can prevent the valve from opening properly. Additionally, valve orientation or a blockage in the EFV can prevent regular tank pressures from passing through continually.

Vapor Leaks – Leaks on the vapor side of the plumbing circuit will allow the vapor pressure inside the tank to escape, possibly lowering the tank pressure and de-saturating the tank.

1. Vapor leaks can be at plumbing connections, vent QDV, primary & secondary relief vales, and other components.
2. To find vapor leaks, open the red handled (liquid) valve, turn the key to the ON position, and apply liquid leak detector to components & plumbing connections. If bubbles indicate an unacceptable leak. Repair as needed.
3. Do not put liquid leak detector into the relief valves, a latex glove or similar can be clamped around the valve and allowed to sit for some time to see if the glove inflates indicating a leak. Repair as needed.
4. Test for leaks again before returning to service.

Cold Fuel – Seldom an issue, but a fuel station may deliver cold (de-saturated) fuel during the fueling process. This can be caused by issues with the fuel station, or possibly fueling a truck during the time the station is getting a fuel delivery if the station has a single tank. Cold (de-saturated) fuel most commonly can be caused by leaks in the vapor circuit, leaking relief valve(s), bad economizer(s), & improper de-fueling.

Cold fuel can be resolved several ways:

1. Repair leaks & replace faulty parts as needed. (defueling prior to repairs may be needed, see de-fueling section above)
2. Allow the fuel (liquid) to warm on its own. Generally allowing the fuel to warm on its own is not acceptable due to a pressure rise of only 0.5 - 0.7 bar per day.
3. If the cold fuel issue was caused by an improperly de-fueled tank, i.e. de-fueled through the grey vent valve, adding fuel from a fueling station should create enough pressure to de-fuel the tank. Additionally, a false head pressure can be created by putting **nitrogen gas only** into the tank as needed to de-fuel the de-saturated fuel prior to refilling.
4. De-fueling the tank and refilling with properly saturated fuel. For proper de-fueling procedures, refer to VT-0017

High Pressure

Note: If high tank pressures are present (above primary PRV set-point), determine the primary cause of increased pressure and repair before returning the truck to service.

Causes of high pressure issues with Chart LNG tanks:

Long Park Times – Due to the extremely low boiling temperature of LNG it will naturally boil inside of the tank. With long periods of non-use, the tank pressure will continue to rise to the opening point of the primary relief valve. Operating the truck will consume the vapor pressure in the tank, and if operated (causing the pressure to decrease) to the economizer set-point, will reset the hold time.

Filling Issues – High tank pressures can be created through improper filling, and hot filling tanks. Follow proper filling procedures when filling a tank with LNG. Refer to VT-0013 & VT-0048

Overfilling - During normal filling, if the start button on the fuel station is continually pressed to try to "top-off" the tank the tank will overfill. When overfilled, the tank has a very small expansion space to accommodate vapor from normal liquid boil-off. This small space and liquid boil-off will create high tank pressures. Operating the truck will lower the tank pressures to the normal operating pressures.

Hot filling - Filling a hot tank (a hot tank is any tank that is being filled for the first time (or has been empty of liquid for more than a few days) with extremely cold (-129°C) liquid will cause the liquid to boil rapidly. This rapid boiling will cause pressure to build rapidly. Follow VT-0013 for proper hot fill procedure.

Faulty Economizer – An economizer that remains closed when tank pressures rise above its set-point or has a clogged filter(s) will not allow the vapor in the tank to be consumed first as designed. This will result in tank pressures remaining high at all times, even after long driving periods, and the majority of the tanks liquid has been consumed. Refer to VT-0011 for economizer replacement.

This procedure is intended for use by trained technicians with experience on systems using LNG. Review all applicable safety documents before beginning this procedure.

Faulty 0.1 bar Knuckle Check Valve – A 0.14 bar knuckle check valve that is stuck open will not allow the vapor in the tank to be consumed first as designed. This may result in tank pressures remaining high at all times even after the majority of the tank's liquid has been consumed. To replace the knuckle check valve the tank will need to be de-fueled per VT-0017. The knuckle check valve can be removed using the knuckle check valve wrench (P/N: 11188766), after removing the economizer J-tube and the elbow at the top end of the J-tube. When re-installing the check valve apply a single small drop of red Loctite to the threads and tighten to just snug.

Faulty Primary and/or Secondary Relief Valve – Not relieving tank pressure as it builds above the relief valve setting will result in high tank pressure.

NOTE: A faulty relief valve can be a dangerous situation and should be repaired immediately. Severe damage and personal harm can occur if a faulty relief valve is not repaired in a timely manner.

1. If tank pressures rise above the relief set-point the valve should relieve enough pressure to lower the tank pressures to the relief valve opening set point or below the set-point, then it should reset to closed.
2. If tank pressures are above a relief valve set-point and the relief valve is not releasing pressure, the valve needs replaced immediately. The tank and its relief valve system must be inspected and repaired per VT-0035.
3. Tank pressures can be raised to test relief valve set-points by attaching a high pressure natural gas bottle to the tank vent port and raising the pressure to the primary relief valve set-point to test the opening pressure. To prevent having to use a large volume of natural gas it is advised to perform this test with at least ½ to ¾ tank of liquid. Refer to VT-0035
4. A general guideline is to replace both relief valves if one is bad. They are usually both about the same age and a faulty valve may expose the other relief valve to undue pressures.

NOTE: Over pressurization is a dangerous situation, any tank with pressure that has been in excess of the Secondary Relief Valve should be removed from service immediately. Contact the Chart Technical Service Department for assistance after removing the tank from service.

Soft Vacuum – Soft vacuum issues will allow heat to enter the tank at a higher than designed rate. This heat will cause the liquid to boil more rapidly, causing the pressure to rise. Soft vacuum issues can cause leaking relief valve problems. High tank pressure does **not necessarily** equal soft vacuum. Proper diagnosis is important, as an incorrect diagnosis could involve costly unnecessary shipping, downtime, and repairs. Visual/Touch & Pressure testing are needed to properly diagnose vacuum issues.

Visual/Touch Testing – Tanks with a vacuum issue will likely have visible sweating and/or frost on the exterior of the tank. Frost and/or sweating inside of a dented area may not mean an issue with the vacuum of the tank, but it may need to be assessed for needed repairs (contact Chart LNG technical services).
After visual inspection a touch inspection will be needed. After several hours of the truck being parked, use the palm of a bare hand to first touch the outer shell of the tank, then touch the shroud with same hand. The temperatures should be very close. If the shell of the tank is noticeably colder, a vacuum issue may exist.
Verify any possible issues found with visual/touch testing by continuing to pressure testing.

Pressure Testing – By comparing a rise in tank pressure over a fixed period, the state of vacuum integrity can be determined:

1. Follow previously listed high pressure troubleshooting steps prior to performing vacuum pressure testing. By doing so, all other issues will have been eliminated from possible causes of high pressure issues.
2. Tank will need to be between ½ & ¾ full of liquid to ensure a proper vapor expansion area exists in the tank.
3. Tank pressure will need to be at operating pressure (economizer set-point)
4. Vehicle needs to remain motionless for at 15 minutes prior to testing to insure stability
5. Record tank pressure and the time
6. Allow tank to sit undisturbed for at least 8 hours
7. Compare pressure rise to the chart below:

Rate of Pressure Rise	Recommended Service Action
Rise in 8 Hours < 1.4 bar	Tank is normal
Rise in 8 Hours > 1.4 bar but < 3.4 bar	Monitor tank and schedule for vacuum maintenance at next PM inspection
Rise > 3.4 bar	Perform vacuum maintenance as soon as possible

If both a pressure rise above the specifications listed and a cold or sweating outer shell are noted, vacuum maintenance is necessary. If pressure rise alone is noted the problem could be elsewhere in the LNG plumbing system.

Heat Exchanger

Heat Exchanger – Leaks and insufficient vaporization are potential issues with heat exchangers.

External leaks – External leaks may be found on the coolant lines or the LNG lines. Coolant leaks will show visible coolant around the leak. LNG leaks may be either liquid (visible) or vapor (non-visible) depending on the location of the leak. Non-visible external leaks can be found using a leak detector solution. External leaks can be repaired by cleaning and re-tightening fittings if the leak is a thread seal leak. If the external leak is through damaged or faulty welded fittings a replacement heat exchanger will be needed.

Internal leaks – Internal leaks may be found on the heat exchangers internal LNG tubing. LNG/vapor leaks will allow natural gas to enter the coolant system causing high coolant pressures and possible alarms due to coolant loss. If internal leaks are found replace the heat exchanger.

Fueling Issues

Fueling – Fueling issues discussed will be limited to issues with Chart LNG tanks, and an assumed proper functioning fuel station. For proper fueling procedures refer to VT-0048.

Will Not Fill – If a Chart LNG tank will not take fuel, check the following:

1. Verify the fuel nozzle is fully engaged onto the receptacle and in the forward locked position.
2. Tank pressure should be below 10.3 bar, if not, follow proper fueling procedures in VT-0048.

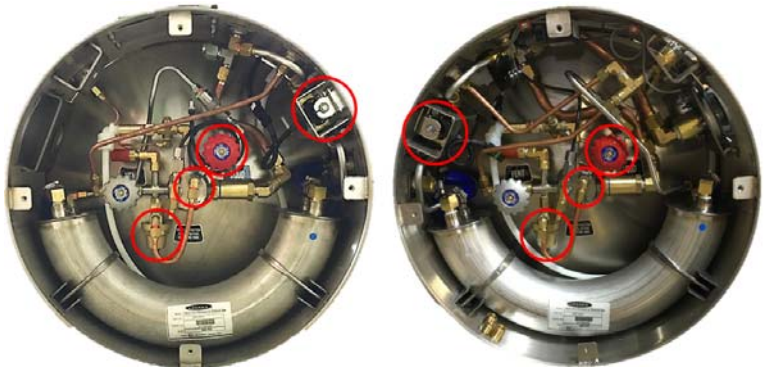
This procedure is intended for use by trained technicians with experience on systems using LNG. Review all applicable safety documents before beginning this procedure.

3. Check the fuel level indicated on dash gauge. Low tank pressure does not equal low fuel level.
4. Dual tank systems may not fill equally. This condition is ok if both tanks are full when the fuel station shuts down.
5. If 1 through 4 are correct, the fill check valve may be faulty and may need replaced. Follow De-Fueling VT-0017 prior to repairs.

Leaks – Leaks may be found during filling of a Chart LNG tank.

1. Bubbling may occur around the filling receptacle poppet area for a few moments after filling, as some residual LNG may sit on the valve surface, any remaining liquid should dissipate quickly.
2. After the fueling nozzle is disconnected form the receptacle, any spraying liquid or vapor in the fill receptacle poppet area will indicate a leak.
3. If spraying liquid or vapor in the fill receptacle is present, or bubbling continues for an extended amount of time, the receptacle seal may have debris/ice under it or need replaced. Leaks in the receptacle seal should vent the fill tube to zero bar after a few minutes. Refer to VT-0009 for seal replacement
4. If the leak continues without stopping, the fuel receptacle seal and fill check valve will need replaced. Refer to VT-0017, & VT-0009
5. Leaks in the fill line connections may require de-fueling the tank prior to repairs. Follow De-Fueling VT-0017 prior to repairs if needed.
6. If fuel receptacle replacement is needed refer to VT-0018

Fuel Flow Issues



Excess Flow – In the event of a damaged fuel line downstream of the heat exchanger, Chart uses an excess flow valve on standard tanks and a normally closed electric shut-off solenoid on integrated tanks. The tank may have one device or the other, depending on the model of tank. They are used to shut off the flow of fuel in the event of an accident or damaged fuel line downstream of the heat exchanger.

1. If the excess flow valve was set due to damaged plumbing, close the red (liquid) shut off valve, then make any necessary repairs to the system before re-opening the red hand valve.
2. If the excess flow valve was set and there was no damage to the plumbing, it can be reset by closing the red handled liquid valve and waiting for several minutes for the line pressures to equalize on both sides of the excess flow valve. If in a quiet enough area there may be an audible "plink" sound from the excess flow valve resetting. Open the red valve and test the operation of the truck.
3. The shut-off solenoid will be reset automatically when power is re-applied to the valve. Open red valve and test the operation of the truck.

Low Flow – Several components may cause low fuel flow issues. Low fuel flow issues will usually be accompanied by low power complaints or active/inactive low fuel pressure fault codes present in the engines ECM memory.

1. Check fuel level and tank pressure to verify there is sufficient fuel, and it is at adequate pressure levels to operate the truck.
2. Check to ensure red handled liquid valve is open fully.
3. Key is in the "ON" position and shut-off solenoid is operating properly.
4. Check that the shut-off solenoid is operating properly: voltage issues, resistance issue, wiring issues, damage, clogs/debris, or ground issues
5. Reset the excess flow valve if necessary. See above section.
6. Check tank plumbing & truck fuel line plumbing for leaks or signs of damage or kinks.
7. Check the coolant level tank in the engine compartment for proper coolant level and check the heat exchanger coolant lines for proper flow through the heat exchanger. Also check for frosting on its outlet side. If frost is present, check for closed coolant valves on the truck or coolant lines for damage or kinks. Replace heat exchanger or coolant lines as needed.
8. Check outlet pressure of OPR. Outlet pressure should be at tank pressure, or at maximum the preset level of OPR/approximately 1.7 bar over economizer set point. If adjustment is needed refer to VT-0031 or replace as needed.
9. If all items listed above are normal, and tank pressures are below the economizer set-point, the 0.14 bar knuckle check may be clogged or faulty. Refer to **Faulty 0.14 bar Knuckle Check Valve** section from earlier in this document.

Damage

Damaged Plumbing – Plumbing that has been damaged may be able to be repaired in the field according to the components damaged. To determine if damage can be repaired in the field, contact Chart LNG Technical Services (contact info on last page) with pictures of the damage.

Dents – Dents on a Chart LNG fuel tank may or may not affect the performance of the tanks depending on their size. To determine if a dent will affect performance, contact Chart LNG Technical Services (contact info on last page) with pictures of the damage.

Fire – Tanks exposed to fire damage must be removed from service due to unseen possible damage to welds & inner tank. Contact Chart LNG Technical Services (contact info on last page) with pictures of the damage.

This procedure is intended for use by trained technicians with experience on systems using LNG. Review all applicable safety documents before beginning this procedure.

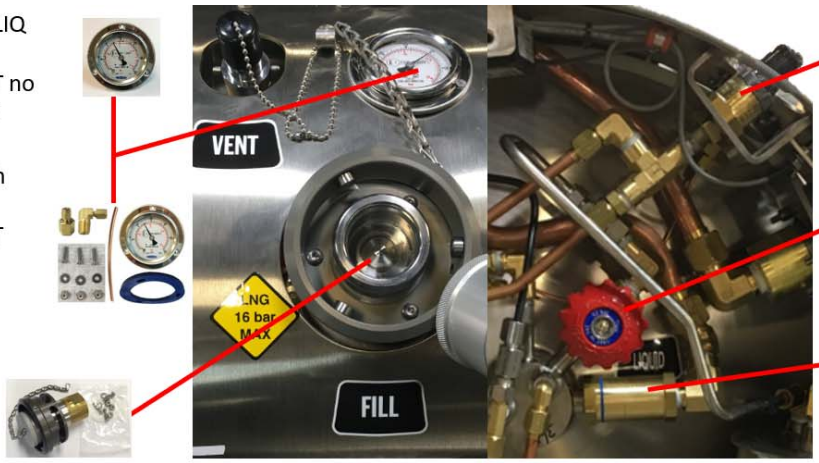
General Component Part Numbers

General components on the most common tanks are listed below. For assistance in locating other part numbers/variances of them or questions please contact Technical Service, refer to the contacts on the last page of this document.

20813355 SHROUD GAUGE no LIQ FILL
20592558S SHROUD GAUGE KIT no LIQ FILL; INCLUDES HARDWARE

21217567 SHROUD GAUGE with LIQ Fill
21217566S SHROUD GAUGE KIT with LIQ FILL; INCLUDES HARDWARE

14636392 RECEPTACLE S/A FUELING KODIAK



13843015 QDV RECEPTACLE W/FLATS

13500901 REGO VALVE REPAIR KIT

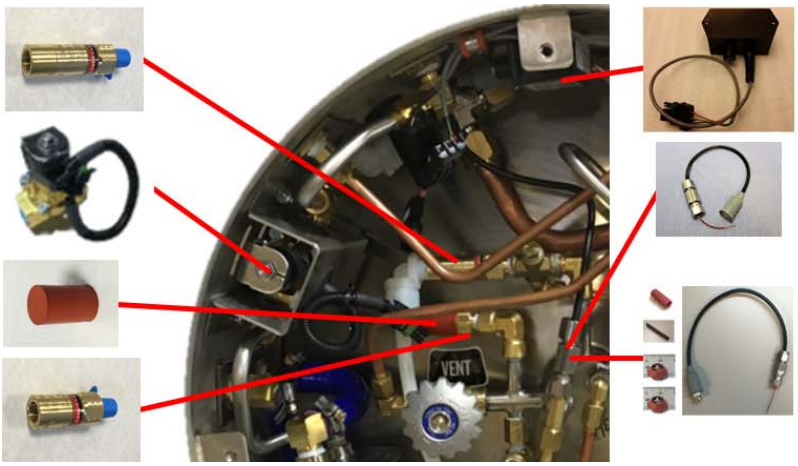
20845025 FILL CHECK VALVE

20537940 16 bar Relief Valve R110

SOLENOID VALVE 24V - Contact Technical Services (see last page)

20809620
RED CAP - SILICONE

13907496 24 bar Relief Valve R110



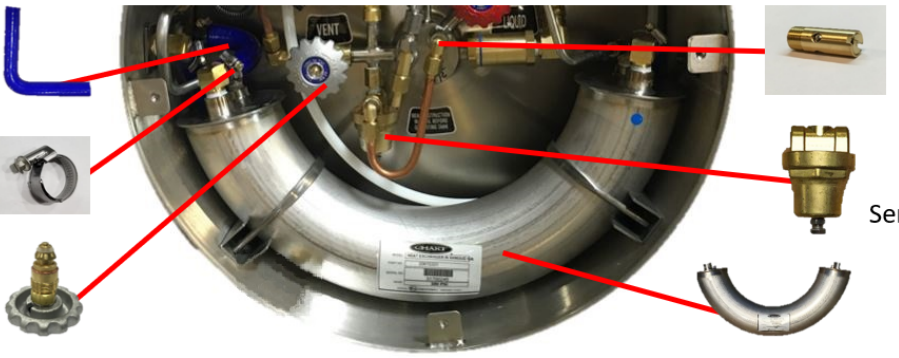
Sending Unit - Contact Technical Services (see last page)

20977526 CORD PATCH 15"W/BOOT 2.0-R110

21267955
15in Feed Through Kit
Includes Flaretite seals, heat shrink, red feed through cap, and 15in cable with BNC connector R110

This procedure is intended for use by trained technicians with experience on systems using LNG. Review all applicable safety documents before beginning this procedure.

LNG Tank General Troubleshooting (non-fuel gauge)



20698805 COOLANT HOSE 90DEG ELBOW

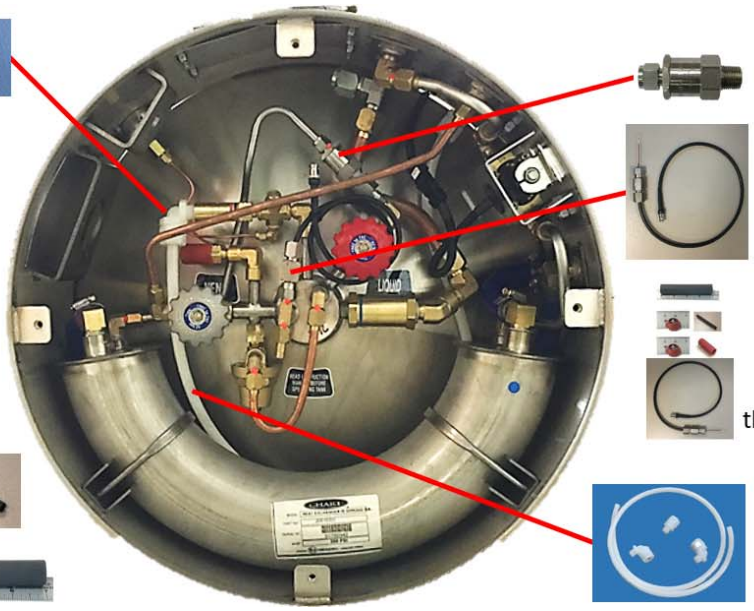
21147927 12MM WIDE HOSE CLAMP

9715759 REGO VENT VALVE KIT

21335176 2PSI KNUCKLE CHECK VALVE

ECONOMIZER Contact Technical Services (see last page)

20615331 450HP INTEGRATED HEAT EXCHANGER



1013356 ELBOW NYL 90D WHITE 1/2ODX3/8

Flaretite Seals are used at all flared connections

11751571 3/4ODT FLARETITE SEAL

20619633 1/2ODT FLARETITE SEAL

11751555 3/8 ODT FLARETITE SEAL

10576775 Solder Joint Heat Shrink 3/16" OD

11502575 4 in. BNC Connection Heat Shrink

20997963 EXCESS FLOW CHECK VALVE

21017010 27" CORD PATCH 27" BNC 2.0-R110

21267956 27in Feed Through Kit Includes Flaretite seals, heat shrinks, red feed through cap, and 27in cable with BNC connector R110

21334967 HLNG TUBE PIPEAWAY KIT

This procedure is intended for use by trained technicians with experience on systems using LNG. Review all applicable safety documents before beginning this procedure.

For Technical Assistance & Part Numbers Contact:

Jaime del Alamo (EU)

Mobile: +34 659 50 7984

Jaime.Alamo@chartindustries.com

Bruce Keneagy (US)
Office: 1-770-721-7635
bruce.Keneagy@chartindustries.com

Clifford Herr (US)
Office: 1-770-721-7649
Cell: 1-678-935-8899
cliff.herr@chartindustries.com

Ed Kern (US)
Office: 1-770-721-7605
Cell: 1-404-229-3973
ed.kern@chartindustries.com

For Parts Ordering & Pricing:

Toll-Free: 1-800-400-4683

Parts Can Also Be Ordered Through:

ChartParts.com
Follow the LNG Vehicle Tank link on the left side of the page

This procedure is intended for use by trained technicians with experience on systems using LNG. Review all applicable safety documents before beginning this procedure.