

A cryogenic transport trailer buyer's guide

Part one: the first in a two-part series on what to consider when buying a cryogenic transport trailer

By Keith Hall, Applied Cryogenic Technologies

Are you a small industrial gas distributor and cannot afford to have a cryogenic fleet engineer on staff? What do you need to know when purchasing a cryogenic transport trailer?

Each end use application is unique. However, below are a few thoughts for consideration when making the decision on which trailer to buy. Obvious things like out the door price, delivery date, nominal evaporation rate (NER) or Hold Time are important considerations, but the purchase decision should never be made solely based on such items. As for price, when it comes to quality, you often get what you pay for. It is difficult to directly compare price offerings from one manufacturer to another due to the amount of optional customizations available. In this article pricing considerations will be left up to you, the reader. Some options and features are nice, but will they make you money over the life of the transport trailer? Will they differentiate service to your customers? Will they make operation and maintenance easier for your employees? Only you can answer such questions.

Tare weight/capacity

Perhaps the most important physical characteristic to evaluate and compare when purchasing a cryogenic transport trailer is capacity versus tare weight. The lighter the trailer, the larger its volumetric capacity. Every pound you save in tare weight on the trailer can equate to additional product sold, and hence added

profit for every load you deliver for the next 30 plus years.

For liquid nitrogen and liquid argon transports you definitely should consider buying a lightweight aluminum trailer. Oxygen, LNG, ethane, ethylene, and nitrous-oxide are only carried in stainless steel inner vessel trailers. Inquire around about the durability of a given manufacturer's aluminum trailers. Most of them today hold up well.

Depending upon the bridge laws in your state, or where you will operate the trailer, you may be able to legally run over the road above 80,000 pounds. If a sleeper is not required, a daycab tractor can be used, and more product can be transported (due to the lighter tractor). Work with the selected trailer manufacturer to do a weight distribution before purchasing a tractor. On a new tractor it is important to get the correct wheel base, frame length (back-of-cab to center of rear axles and axle to end-of-frame), cab-to-fifth wheel swing clearance/fifth wheel location, loaded fifth wheel height, and front axle rating.

Sometimes tridem tractors and trailers (or with lift-up tag axles) make sense. A trailer manufacturer can also assist you with proper power take off (PTO) and hydraulic pump specifications, if required, and include those along with the weight distribution calculations. An optimized tractor and lightweight yet durable trailer combination is perhaps the most important consideration when purchasing a cryogenic transport trailer. If using an

“Work with the selected trailer manufacturer to do a weight distribution before purchasing a tractor...”

existing tractor, the trailer manufacturer can optimize the trailer design to “fit” the existing tractor. It is common to ask the trailer manufacturer for a guarantee on tare weight or payload (e.g., +/- 3% variance from design tare weight).

Vacuum

Vacuum is the key technology in the cryogenic equipment world and is crucial to a trailer manufacturer's reputation. Every trailer manufacturer has their own proprietary process to obtain a hard, long-lasting vacuum. But also important are the welding processes followed to ensure a vacuum-tight tank, and the type and quantities of vacuum maintenance materials used: molecular sieve 5A to grab onto stray moisture and atmospheric gases, and the Lothar, palladium-oxide or silver-zeolite hydrogen getter included in the annular space to maintain a hard vacuum over time.

Questions to ask a potential trailer manufacturer about their vacuum technology are:

1) What is the guaranteed out-the-door vacuum level for the trailer? It should be

lower than ten microns when the trailer is at ambient temperature (vacuum is always lower/better when the trailer is cold with product).

2) How long is the vacuum warranty?

Do not settle for less than three years, however five or more years may be negotiated if purchasing multiple trailers.

3) At what cold vacuum level will warranty repair be required? Note, if a vacuum gets as high as 25 microns it definitely needs attention. Hopefully, however, this will never be a problem.

Before purchasing a trailer, ask other distributors (and their drivers and maintenance personnel) about the vacuum performance and reliability of various trailer manufacturers. You can get a good idea of a trailer manufacturer's vacuum reputation if you speak with end users. Upon request, the trailer manufacturer should be able to provide references with whom you can speak to of customers who have purchased their equipment.

Design specification

For non-flammable products (liquid nitrogen, liquid oxygen, or liquid argon), as long as the tank pressure remains below 25.3 psi when operating over-the-road, a DOT design specification is not required

and the trailer can be designed to the Compressed Gas Association (CGA) standard CGA-341 (or TC-341 Canada). Generally, CGA trailers are lighter weight. A road-relief regulator (which acts like a relief valve) is provided to permit the tank to vent while driving over the road, thus keeping the tank pressure below 25.3 psi. An isolation valve will block-off the road-relief regulator and the pressure can be built higher than 25.3 when you are off-loading. When comparing trailers from different manufacturers, please note that maximum allowable working pressure (MAWP) ratings may vary, as well as other characteristics such as inner vessel diameter and lengths. Such differences affect capacity and tare weight.

For flammables, and also for atmospheric gases that will be transported over the road above 25.3 psi, DOT's MC-338 code is followed when designing and manufacturing a cryogenic trailer cargo tank. If transporting ethane, DOT requires a 100 psi MAWP minimum trailer. MC-338 trailers require a five-year test, for example, that CGA-341 trailers do not. This is added cost and down time that must be considered.

The US has a reciprocity agreement with Canada which permits operation of MC-338 trailers in Canada. CGA-341

trailers may not be operated in Canada unless they are also TC-341 certified with a TCRN number.

To save weight and cost, and to keep the lading saturated at as low a pressure as reasonable, where possible it is generally recommended to use a CGA-341 trailer in the US (or TC-341 in Canada) for liquid nitrogen, liquid oxygen, or liquid argon.

You can purchase a "swing" trailer with fill connection fittings that can be swapped out along with product placards, to give you the flexibility to transport liquid nitrogen, liquid oxygen, or liquid argon. But as the density of each product is different, if you know you will be using a trailer for only one product it is in your best economic interest to purchase a trailer optimized to transport as much of that product as possible.

Liquid oxygen is not flammable, but is obviously an oxidizer. It is current industry practice in the US for CGA-341 trailers, and TC required in Canada, to include an emergency shut-off valve (with a fusible link) on the liquid withdrawal line (pump inlet/feed line) on all new liquid oxygen trailers. New MC-338 trailers are required to have an on-vehicle remotely controlled self-closing shut-off valve on all liquid filling and discharge lines.

Even if your company is not large ►

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► enough to have a fleet of trailers, it would be wise to maintain a trailer specification. Start with the manufacturer's standard offering (and their specification) with one or two options. The specification will now become a living document that can be revised as the company grows and additional trailers are purchased, so that no matter the manufacturer, the trailers can all be standardized. This is helpful for operator and back-up operator training, and spare parts.

NER/hold time

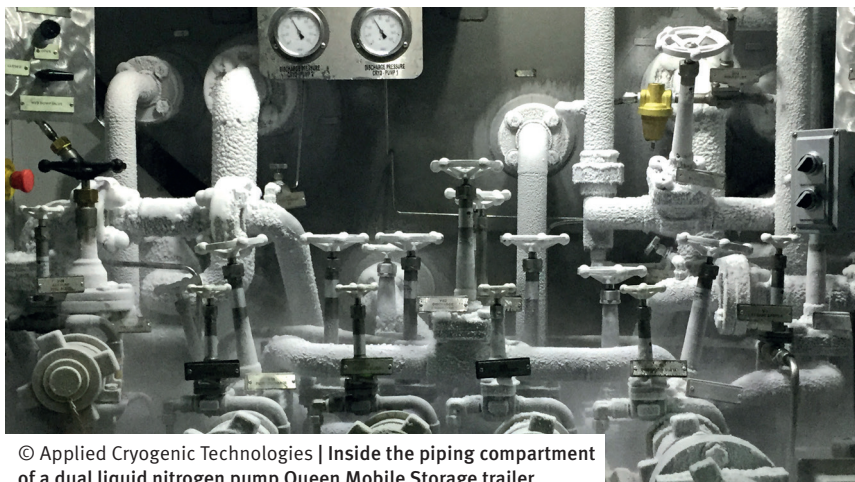
You may have noticed that nominal evaporation rate (NER) and hold time were not at the top of this article. While they are important values when comparing transport trailer manufacturers, they are really not as important to you as would they be if you were buying a bulk storage tank. You are not making money with your transport trailer if you are using it to store product. You need to be dumping a load of product as frequently as possible, so there is no need to pay for extra super-insulation, for example, and its added weight.

What is important is that a manufacturer have a proven, robust, low heat-in-leak inner vessel support design, with a relatively low NER or good hold time – without being excessively good. You do not expect to see the gas mileage of a four-cylinder engine from the tractor pulling your cryogenic transport trailer.

Likewise, paying extra for better thermal performance on your trailer, and taking a weight hit for it, is not in your best interest. A trailer is made to transport liquid, not store it. The exception may be when purchasing an MC-338 trailer, as venting during transit is not permitted. Depending upon the product being transported, and how long you are transporting it, you may want better thermal performance with an extended hold time/one way transit time (OWTT).

Delivery performance

Ask potential manufacturers how they are currently doing on meeting promised delivery dates, and ask other distributors



© Applied Cryogenic Technologies | Inside the piping compartment of a dual liquid nitrogen pump Queen Mobile Storage trailer.

if the various manufacturers' promised delivery dates were met. You do not want to buy a trailer from a manufacturer who promises to meet your needed delivery date just so they can get your order. You want to do business with someone you can trust. But remember, it is better to have a high quality trailer built correctly than a rushed trailer with quality issues that pop up later. Be somewhat flexible and understanding with the manufacturer if they do run into a delay. Sometimes there are problems with getting materials or components in time, or dealing with and resolving manufacturing issues. You might consider adding a bonus clause for on-time delivery with an associated penalty clause for each week late. But my advice to you is that if you do, also allow a grace period before the penalty clause kicks in.

Again, you want a quality trailer when it is delivered, not one that is rushed to avoid a penalty. On the other hand, when given a promised delivery date by a manufacturer, you do not want a date that is overly padded. Thus it is difficult to compare delivery dates from manufacturers unless you have some feedback on their reputation for delivery.

Features you should have

Features that trailers must have to effectively meet your delivery requirements include:

- One of the most obvious requirements for a transport trailer is to be able to off-

load product. Knowing what customer storage tank pressures the trailer will have to push against, and the pressures that will have to be maintained in customer stations during filling, will help you determine if you need a pump or not; but you probably will. You can purchase a heavier, thick-walled inner vessel, high pressure trailer, and can pressure-transfer product by building pressure in your trailer and or by venting down the customer station (while the customer sees gas they paid for being vented into the air). But pump off-loading is recommended.

Pumps can be externally mounted or submerged (no waiting for a pump to cool down before using). One of the most common methods for off-loading using an external cryogenic pump is using the proven jack-shaft technology (sheaves and belts) driven by a pony motor slung under the belly of the trailer to turn the cryogenic pump. A pony motor adds weight but makes the trailer self-sufficient; you can pull it with any rented tractor.

Perhaps even more popular these days is to use a hydraulic driven cryogenic pump. The hydraulic pump can be driven by a pony motor slung under a self-container trailer (like the jack-shaft drive), or a hydraulic wet-kit can be mounted on the tractor and be PTO-driven off the tractor's transmission. A trailer manufacturer can assist with such details as hydraulic pump sizing and

rotational direction and hydraulic fluid reservoir and cooling system selection, as well as engine RPM calculations for when the PTO is engaged. Note, while inclusion of a pony motor gives you flexibility with tractors, it is a big weight hit. Using a hydraulic wet kit driven off the tractor's PTO will save weight, permitting you to purchase a larger capacity trailer.

- A third option is an electric motor driven pump (internal or external pump). Sometimes a generator is mounted on the tractor, but in many parts of the world the customer is required to supply an electrical outlet with the proper voltage and phase at their bulk tank location.
- The capacity of the pressure building unit (PBU) is important. A pump may run for 60-90 minutes to off-load a trailer. The pressure building unit must keep up with the pressure demand, especially if a forced-feed pressure building circuit is included in the piping circuit (recommended). For every gallon of liquid decanted that same volume of vapor, at the same pressure, must be put back into the tank. If not, the pressure in the tank will drop and the liquid will boil. To prevent pump cavitation, you need to maintain a minimum of 5 psi subcool pressure to keep the liquid from boiling and to provide artificial head pressure to assist in meeting the pump's Net Positive Suction Head pressure requirement. During winter, the operator may occasionally need to stop by a car wash and thaw the PBU of ice.
- Generally you need to invoice your customer for the precise quantity of product delivered. Due to different product saturation levels in the trailer over time, differential pressure liquid level gauges and liquid level contents charts cannot be used for billing. They only "indicate" approximately how much product is in a tank, much like the gas gauge on your car indicates how much fuel you have in the tank, and is not used to charge you for gasoline purchased; rather a weights and measures approved

meter on the dispenser does. Therefore, a weights and measures approved meter is also required on most trailers. It can be a turbine flowmeter (very common), an orifice plate, Coriolis, Vortex, or any other of various proven and approved, temperature compensated, metering technologies. Most meters have a pump cool down timer feature. This is highly recommended. Making sure the pump is properly cooled down before operating it will help prevent cavitation and extend the life of the pump's seal. Pump cool down lock-out timers can even be used to protect jack-shaft driven pumps. A solenoid can be used to lock out the clutch from being engaged until the pump is properly cooled down.

- You need a cryogenic delivery hose (wire braid over stainless steel convolutes) to connect to your trailer and to the customer station. Make sure the hose is of the proper pressure rating and of sufficient length, but not too long, as ambient heat is transferred through the hose to the product during loading and delivery. Typically, hoses are 15 to 18-feet in length. Shorter is better. Always request 18-inch armor strain-relief cuffs on each end of the hose. Due to the weight of the hose hanging down when attached to the fill connections, the hose will tend to kink and leak over time. The armor cuff strain-reliefs will greatly extend the life of your hose. The hose tube will be about a foot longer than the hose to also accommodate the fill connections attached to the ends of the hose. Hose tubes can be aluminum, PVC (not recommended for LOX), or stainless steel. You can have a standard side-of-the-trailer-mounted hose tube with doors on each end. Or have your hose permanently attached to the discharge piping with the side-mounted hose tube opening routed into the piping compartment (no hose tube doors). A large radius gentle bend is made when the loose end of the hose is inserted into the hose tube before the piping compartment doors can be closed.

This way your operator need only make one hose connection at each delivery location, and is not dragging the entire hose through the dirt.

- You must have DOT placards on all four sides of your cryogenic trailer for the intended gas service. Note that for CGA 341 trailers you can apply the orange panels, i.e., 1977 for nitrogen, instead of the green diamond hazardous material decals which have stringent driver Haz Mat certification and reporting requirements.
- LED piping compartment working lights and external work lights are recommended.
- A DOT energy absorbing bumper is required if the back of the rear wheels are more than 12-inches ahead of the bumper. Otherwise an aluminum channel bumper is the standard.
- Make sure to get an inexpensive, yet important to have, anti-tow system which locks your trailer's brakes whenever the piping compartment door is opened.

See next month's issue for part two of this article, including topics such as after sales support, optional considerations, and items to inspect when taking delivery of a trailer. [gw](#)

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A cryogenic transport trailer buyer's guide

Part two: what to consider when buying a cryogenic transport trailer

By Keith Hall, Applied Cryogenic Technologies

Part one of *A Cryogenic Transport Trailer Buyer's Guide* in last month's issue of *gasworld* discussed important pre-purchase considerations such as: tare weight versus capacity, vacuum insulation integrity, trailer design specifications, nominal evaporation rate (NER) and hold time considerations, manufacturer delivery performance, and recommended cryogenic transport features to include on a new trailer.

Part two will address options to consider when buying a trailer, and after sales support. It will also include a discussion of a few items you should inspect when taking delivery of your new cryogenic trailer.

After Sales Support

Ask around the industry about after sales support provided by the trailer manufacturers you are considering buying from. What training do they provide for your operators? Most will provide some training at their plant when your operator picks up the new trailer. It is often worth paying a bit more, if necessary, to get good training for all of your operators, back-up drivers, and maintenance personnel. You may even want to hire training assistance for some of your end-use customers.

Make sure you receive a good operating manual. It should include step-by-step descriptions to perform all operations. It should also include copies of the



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pipng schematic and legend, liquid level contents chart, electrical schematic, brake schematic, pneumatic schematic, and hydraulic schematic. Request a hard copy of the manual to keep with the trailer, as well as electronic copies for the office. If you have a back-up operator with a question, you can pull up the page in the manual to reference, and over the phone have the operator pull up the same page, and review it with him or her.

Also, make sure you receive a complete documentation package with your purchase. Generally, this should include such things as: certificates of conformance

to CGA-341 TC-341, or MC-338; vacuum retention test, records and certificate; oxygen cleaning certificate; copies of the ASME U1A form, and inner vessel pressure test certificate.

We briefly discussed vacuum warranty in part one of this article. As far as warranty for the rest of the trailer, historically, manufacturers generally warranty their workmanship for one to three years, and pass along the various component manufacturers' warranties (valves, pumps, gauges, axles, dolly legs, etc), whether a component warranty be one week or ten years. A good trailer

manufacturer will have a reputation for assisting you to obtain component warranties from the component manufacturer should you ever have a problem.

If you purchased an MC-338 transport for example, make sure you know where you can get the required annual and five-year tests performed (to minimize down time)?

Finally, ask your driver operators and maintenance personnel their opinions on which type trailers and trailer manufactures they like or dislike, and why, and what specific features they like or dislike. Talk to other distributors and their operators of trailers made by the manufacturer you are considering in order to get their opinion on what they like and dislike. Consider asking the opinions of oil-field operators of equipment made by that manufacturer. They will let you know how that manufacturer's equipment holds up in a harsh use environment. Consider his or her opinions when developing your specification and choosing a manufacturer. But make sure the opinions you receive are regarding relatively new equipment. Technology is constantly improving and manufacturers are constantly trying to improve quality, decrease weight, decrease cost, and improve delivery. A problem experienced with a ten or 20-year old trailer may no longer be an issue with today's designs.

Optional considerations

Below is a list of typical options available, and other considerations. The list is not comprehensive, nor in any particular order.

- Pressure off-load versus external pump, submerged pump, or ground-mounted pump (i.e. typical at LNG customer bulk tank locations)? Size, brand, capacity, and model of pump? Other useful options might include a hand-held pendant for remotely controlling the pump.
- Pony motor jack-shaft driven; pony motor hydraulic driven; Tractor-PTO with hydraulic wet kit driven; or electric driven pump?
- If a PTO is required it is recommended that you go with a high gear ratio to keep the tractor engine speed low when operating the cryogenic delivery pump (minimizes noise and engine wear).
- Have the tractor dealer run a wire from the PTO engage switch/light to the tractor engine's ECM, and then have them program the cruise idle set RPMs and ramp rate. Have the dealer program the accelerator pedal to not function when the PTO is engaged. This will prevent the driver from driving off with the PTO still engaged. Alternately you can wire an annoying back-up beeper to alarm in the cab when the PTO is engaged. A driver getting back into the cab will definitely want to turn the beeper off before driving away.
- Dolly leg type and brand.
- Electronic Roll Stability and anti-lock brakes (recommended).
- Axle type and brand.
- Dual rear side-hinged "barn door" style piping compartment doors are standard. You might want to consider a lift up door that provides weather and sun protection, or a roll up door. The latter works well if you are frequently backing up to unloading docks.
- Side compartment doors for ease of access for maintenance, and for ventilating the compartment of fog while off-loading.
- Tridem or lift-up tag axle.
- Aluminum weight saving wheels.
- Super-single wheels and tires (weight saving).
- Loose lug-nut indicators.
- Hubometer to track mileage on the trailer.
- Wheel chock blocks and holder.
- Fire extinguisher.
- Orange emergency cones and holder.
- Tool box (operators need a few tools to keep valve packings, valve top works, and flanges tightened).
- Snow/mud chain hangers.
- Brass hammer holder.
- A CGA fill connection wrench (instead of using a brass hammer on the hose end fill connections).
- Extra CGA fill connection gaskets.
- Telemetry: GPS, tank pressure, and/or tank liquid level. Such systems aid in tracking product levels and pressures. And metered deliveries can also be wired to cellular SCADA systems for instant billing.
- Dry quick disconnect hose connections.
- Hose break-away connections.
- Do you want a PVC wiring and pneumatic tubing conduit running down the side of the trailer, or other wiring and tubing mounting arrangement?
- Zinc enriched primer applied to the underside belly of the trailer (recommended).▶

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- ▶ Rock shield on the front of the pressure building unit (see photo on page 56).
- Pressure Building Regulator (rated for the pump's discharge pressure when the forced feed is open) to prevent over-pressurizing and opening the relief valve if the operator is not watching the tank pressure closely while off-loading.
- Inclusion of an orifice in the Forced Feed Pressure Building circuit to limit the flow to the PBU to aid in preventing flooding into the PBU with liquid.
- Check valve on the fill line (for bobtails) if you want a trailer to be able to fill into the bobtail truck, as there is concern for back-contamination.
- Other decals: No Smoking; This Vehicle Stops at Railroad Crossings; Venting of Product During Transit is Normal; etc.
- Avoid the use of piping compartment steps. All controls should be easily operated from ground level. In the rare event that a step is required, make sure it is designed with a shear-pin to fold away in the event you back into a dock or other obstruction.
- If you are purchasing a queen mobile storage trailer, which would be too heavy to transport over the road full of product anyway, check into ordering it without slosh baffles. If you always move it over the road purged of product, and with the placards covered, you might save on the 12% Federal Excise Tax as well as the cost and weight of the baffles.

A few items to inspect when taking delivery of a new trailer

Below are a few random recommendations of things to inspect before you accept delivery of a new cryogenic transport trailer. The list is by no means a compressive inspection checklist.

- Verify that all gauges can easily be viewed, and that all valves and pump controls can be easily and conveniently operated, while standing flat-footed.
- Verify that there are no pinch points, especially when valve handles are fully extended to their open positions.
- Verify that all liquid valves are oriented



with their top works extending outward at no lower than 45 degrees below the vertical position (no lower than 30 degrees is preferred).

- Verify that all piping circuits are well supported with Stauff clamps in the horizontal plane. When cold, the piping contracts in diameter (as well as length), and can slip if gripped and supported in the vertical plane. There should be no vibration when you hit the piping. The Stauff clamps must also be located to permit, not restrict, thermal contraction along the lengths of piping circuits (often the bolts in the clamps are finger tightened and then held in places with a small tack weld).
- Avoid flanges wherever possible (especially for flammable service). There is an old wives' tale that flanges are needed to remove the piping for maintenance. But often the piping circuits are intertwined and you cannot remove them without cutting a line anyway. Seldom does the piping have to be removed for maintenance. Flanged joints are required at the pump, at the aluminum pressure building unit piping to the stainless piping going to the tank, and for containing witch's hat strainers. You can request that flanges be avoided in other locations. Otherwise they will have to be retightened after a few hot/cold and pressure cycles, and due to over-the-road vibration. And an operator

needs the correct tools to keep them tightened. Where you must have flanges, request flange guards to cover the flanged joint when flanges are oriented with the joint oriented outward, to protect a leak under pressure from spraying onto the operator.

- Verify that the cryogenic pump, and any sheaves and belts or hydraulic systems and controls, are easily accessible and easy to remove and swap out.
- For oxygen service, a small compartment should be built around the hydraulic motor to enclose it to protect any hydraulic leaks from getting into the main piping compartment where liquid oxygen could be present (a flammability concern as many materials spontaneously combust in an oxygen enriched environment).
- To facilitate cool down of the pump, verify that the recirculation line never goes downhill. From the point where it leaves the pump discharge nozzle until it goes back into the top of the tank the line should always be level or oriented upward (preferred), but never downward, or a vapor trap will result when trying to cool down the pump with a partial load of product.
- Never permit that the hydraulic motor's (which turns the cryogenic pump) Case Drain line be tied into the hydraulic Return Line. Always run the Case Drain

line separately all the way back to dump directly into the hydraulic reservoir.

- Verify that all required data plates are legible and easy to see on the landing gear, or located as per code.
- Verify that there are durable, easy to read, piping schematic with legend and liquid level contents charts mounted in the rear compartment area. They should be high quality plastic decals or engraved or etched aluminum or stainless steel plaques (not laminated paper print-outs).
- Travel to the manufacture's site and perform a run-test to ensure that everything operates correctly: that the hydraulic system achieves the correct pressures and flow rates and does not heat up; that the cryogenic pump achieves the required discharge pressure and flow rate ranges (for the intended gas service); that the metering system functions correctly; in short that everything preforms as advertised.
- Make sure there is a small rain gutter lip above the working compartment door opening to prevent moisture from dripping down onto the operator. Make sure there are small condensation drain holes in the bottom lips of all compartment doors.
- If any pneumatic actuated valves are used in your piping, verify that the required Pressure Protection Valve was installed on that auxiliary pneumatic circuit at the pneumatic reservoir. In the event there is an airline leak or break, the PPV acts like a back pressure

regulator and will close off, for example, when the air pressure in the reservoir drops to 85 psi, thus guarding the remaining air for the brake system.

- Make sure there are no air lines, brake hoses, wiring, hydraulic hoses, anywhere that are able to rub and chaff. Get a creeper and crawl under the trailer and inspect with the air suspension lowered and raised.
- Request that loom clamps be used wherever possible, and that plastic zip ties be avoided to the maximum extent possible. Plastic zip ties embrittle due to UV exposure. And they are not as strong as loom clamps. Make sure all hoses, lines, and wiring are tied up as high as possible so that mud and ice does not buildup on them excessively and pull them down.
- If the thermal line relief valves on the piping circuits are piped away to the vent stack (i.e., for oxygen or flammable service), make sure there are no weep holes in the thermal relief valve bodies. Make sure thermal line reliefs that are piped-away are not tied in together with piping circuit purge/drain valves. When draining a circuit, you do not want the cold liquid to be introduced to the back side of thermal line relief valves.
- Make sure any vent manifolds and vent stack circuits have a low-point condensation drain weep hole. Flammable products and oxygen should only be vented upward and not under the trailer. A drain valve (preferable a ball valve with a spring-

return-closed handle) should be on the condensation drain low point(s) for flammable gas vent circuits. The operator must open them frequently to ensure no condensation can be trapped to freeze in the line.

- Make sure all piping circuit drains that exit below the piping compartment deck do not discharge to spray onto brake hoses, electrical wiring, or tires.
- Make sure all sharp corners that an operator could brush up against have been ground round.

Given good communication with the manufacturer, and a good specification, everything should be as expected. However, if it is noted that something should be changed, even though the trailer may be completed, it is best to discuss the issue with the manufacturer and get it resolved before the trailer leaves the factory. The manufacturer wants a happy, repeat customer.

If the issue is the manufacturer's responsibility it will likely be taken care of immediately. If the issues is a beneficial new change that you note, the manufacturer may ask you to pay for the change. For a piece of equipment that will be used for the next 30 plus years, it is a good idea to get everything taken care of before putting the trailer into service. [gw](#)

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