



TECHNIGUARD® R-SERIES / B-SERIES

Vacuum-Jacketed Pipe Installation Manual

CRANE

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This document covers the installation of Techniguard Vacuum Jacketed Pipe. Additional information for initial startup and system operation is included in the Owner's Manual (Technifab Part Number LT-30121).

Symbols Used in this Manual



Warning - indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



Caution - indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

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Introduction & Overview

Whether it is a simple section of B-Series Vacuum Jacketed Pipe (VJP) or a complete VJP system, how the product is installed can be critical to system operation. This manual covers information on how to properly install Technifab's Techniguard R-Series and B-Series vacuum insulated pipe so it will perform best in your operation. This manual is written to govern the installation of all cryogenics, with the exceptions of oxygen, hydrogen, and methane. For the installation of oxygen, hydrogen, and methane systems, please see the section entitled "Installing Oxygen, Hydrogen, and Methane Systems".

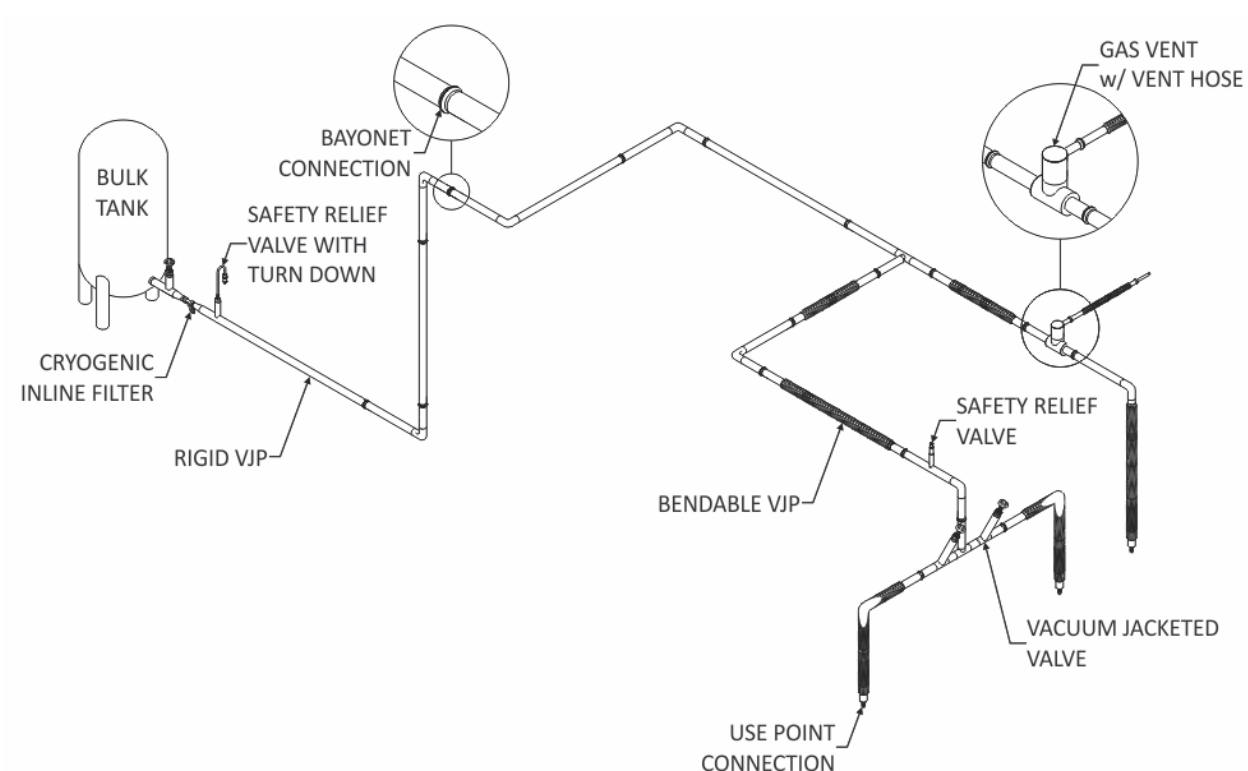


Figure 1 - Typical liquid cryogen delivery system.

A typical system is shown in Figure 1. Liquid cryogen flows from a storage tank or dewar through insulated pipe to the point at which the cryogen is used, typically called a *use point*. The sections (or *spools*) of vacuum jacketed pipe are connected together by bayonets or by a *field joint* (which is made by welding the spools together and evacuating the space between the inner and outer pipe). Your system designer should have located bayonets and designed spool arrangements to allow for installation through and around non-moveable, fixed objects.

Spools are made up of rigid VJP (Techniguard R-Series), bendable VJP (Techniguard B-Series), or a combination of both. Each spool will have at least one evacuation port, which is used during manufacturing to create the ultra-low vacuum between the inner and outer jacket of the pipe. Rigid pipe has internal or external expansion joints to compensate for the internal pipe's contraction as the pipe is brought down to cryogenic temperatures.

A typical system also includes:

- *Valves* are used in a cryogenic liquid delivery system typically to shut off liquid cryogen to a particular portion of the system. Valves may be either vacuum jacketed (which provide the lowest heat transfer rate) or non-vacuum jacketed.
- A *Safety Relief Valve* (SRV) provides a way to prevent system pressurization from exceeding the safe operating limits of the piping system. An SRV should be located between every set of valves so that liquid cryogen does not get trapped between valves and over-pressurize the system. Pointing SRV's down will prevent potential problems if located outside.



Caution - Failure to install a SRV can result in injury.

- A *Gas Vent* (or *cryovent* or *vapor vent*) can be used to allow cryogen gas that vaporizes from the liquid cryogen heating up to escape from the system. A gas vent can reduce trapped gas in a system to provide nearly instant liquid to your use point. Gas vents may be located in-line or at the end point of a system (see Figure 1). A gas vent will be typically located at the highest point in the system. Technifab recommends that a vacuum jacketed vent line be used to carry the excess gas away from the system. The outlet of the vent line should not be in a location where it could injure people or damage anything should cold cryogens be expelled. Some applications include a vent heater to vaporize liquid cryogens if expelled.

All system components will have a rated Maximum Allowable Working Pressure (MAWP), but that may not be the rating for the system. The lowest rated component in a system determines the MAWP, thus relief valves should be set for the lowest rated component.



Caution - The cracking pressure of the safety relief valves should not exceed the rated MAWP of your system.

Installation Guidelines

Before installing the system, it is worth going over some general guidelines that apply to all installations:

- The piping support system shall meet all expectations and/or requirements of the customer.
- Installed rigid and bendable VJP should not interfere with operation or access to existing machines and equipment.
- The assembly order of your system can be affected by nearby immovable objects. The location of wall and roof penetrations, spool design, field joint, and bayonet locations may also affect the assembly order.
- Installed VJP must not be in contact with moving parts that could damage the pipe.
- All evacuation valves on pipe and accessories shall be accessible for re-evacuation as necessary.
- Use the best possible piping system supports while keeping intrusion into the facility to a minimum.
- The piping system should be aesthetically pleasing in regard to normal expectations of industrial pipe systems.
- Technifab can supply equipment manufactured to ASME standards like B31.3. Installation procedures, like field joint welds and pressure testing, will impact ASME system compliance.
- Technifab recommends that final connection / disconnection of the system to the cryogen supply tank be performed by the customers' gas supplier.
- Large diameter pipe is generally very heavy. It is required that installers not manually lift more than 75 lbs per person. The use of lifting equipment is required due to the weight of the pipe spools. See Table 1 for weights.

NOTE: Any pipe support system should meet or exceed all applicable industry and governmental standards along with safety requirements. None of the instructions within this document shall supersede the safety requirements of any worksite.

NOTE: The installation can affect product life and may even be included in some system requirements and standards. Technifab cannot be responsible for systems which the requirements have not been expressed or system installations which have not been approved by Technifab. We are also not responsible for modified designs and installations which have changed after Technifab approval.



Caution - No welding to the outer jacket of any spool is permitted. Welding against the outer jacket will result in vacuum loss. Welding to the outer jacket of an evacuated spool voids the warranty for the spool.

System Installation

There are four major steps in installing a system:

- 1. Review & plan the system.**
- 2. Remove the existing cryogenic system components that will not be used.**
- 3. Install the mounting system.**
- 4. Install the VJP spools.**

After system installation the system should be tested for leaks and operation.

1. Review & Plan the System

First, before installing a system, review the overall system layout and design for necessary items before starting the actual installation. Several steps will help you to make sure you have what is needed for the installation:

1. Verify all items on the pack list have been received and that each spool contains a clamp (if used) and o-ring for each male bayonet. If parts are missing, contact your Technifab Products sales representative before starting installation.
2. Included in the packing list will be an isometric system drawing that will be needed during the installation process. This drawing will show how the individual spools are connected. The drawing usually has “S” as the first digit of the drawing number.
3. Identify the serial numbers on each spool and match with the isometric system drawing provided by Technifab. The spool serial numbers will be located near the evacuation port. This drawing will help you visualize how the system was laid out by the design engineers and can be used to determine the order of system assembly.
4. Verify that the maximum system tank outlet pressure is lower than the maximum allowable working pressure (MAWP) of the designed pipe system.

NOTE: The MAWP can be found in the top left corner of the isometric system drawing spool drawings.

As you look over the appropriate drawings and review the facility in person consider where you will want to start and end the installation. Two common strategies are beginning at cryogen supply tank or starting somewhere in the middle (often through or around a permanent obstruction). The strategy you choose will depend on the particular facility and system.

A common method is starting at a particular location and work through the system a spool at a time until the system is connected to all of the supply and use points. By using the isometric system drawing, each spool can be installed by first installing the hangers/supports for the spool, hanging the pipe section, and then making sure the system slope (see Section 3 - *Install the VJP Mounting System*) is correct for that particular spool. This process is repeated for each spool until the system is completed.

System accessories (such as SRV's or gas vents) can be installed as each spool is installed or after all of the VJP installation is completed.

System Installation (continued)

If starting installation from storage tank, verify that each piece can be connected continuously without running into obstacles.

2. Remove Existing Cryogenic System Components

If the VJP system is to be connected to an existing tank or system, the existing system must first be allowed to warm gradually from cryogenic temperatures to ambient temperature.

1. Close the bulk storage tank outlet valve to stop liquid flow.
2. Install a valve lockout device on the shutoff valve so it is not inadvertently turned back on while work is being done on the system.
3. Open all valve(s) except for the shutoff valve and leave open.
4. Allow the system to vent for 24 hours.

NOTE: The remaining cryogenic fluid will boil out of pipe and pipe will slowly begin to warm up.

5. Remove any components that will not be used in the new installation.

3. Install the VJP Mounting System

Some general mounting/installation comments:

- Connecting spools must be carefully aligned so bayonets and field joints can connect easily.
- All structural mounting components should be either zinc coated or stainless steel, other than the pipe flashing, to prevent corrosion unless specified otherwise by the customer. Hardware for mounting can be obtained from any industrial supply house.
- Select hardware capable of supporting the pipe weight. Estimated VJP weight is included in the section entitled "Specifications". Note that when the VJP is full of liquid cryogen it will increase the weight of the pipe. For larger diameter pipe this difference can be significant. For example, B100 or R75 VJP pipe weight will increase approximately 10% for liquid nitrogen. Larger diameter pipe increase even more dramatically, exceeding 25% for 2 inch (5 cm) inside diameter pipe like Techniguard R200.
- For proper slope, horizontal sections should rise at least 4 inches every 100 feet (10 cm/30 meter) from the low point to the high point in the system. This is generally from the storage tank to the system drop point.

System Installation (continued)

Mounting techniques vary depending on whether rigid or bendable VJP is used, each will be covered separately.

Techniguard R-Series VJP Mounting

A common horizontal rigid mounting arrangement is to use appropriately sized clevis hangers that are suspended from a ceiling or other structure to support the VJP (see cover of this manual for an example). Care should be taken to mount to a structure that can support the weight, is securely attached to the structure, and to use a threaded rod that will support the weight of all of the components. If hanging large diameter pipe from a building structure (ceiling joists, etc) the Owner must approve the weights of the piping prior to install.

- Hangers for horizontal installations should be pre-hung before installing each spool and should be placed no more than 10 feet (3 meters) apart and at each vertical drop.
- Vertical sections also require the proper support, although clevis hangers are not typically used. Typically, the rigid pipe is clamped to a bracket to prevent any movement.
- Large diameter pipe is generally very heavy. It is required that installers not manually lift more than 75 lbs per person. The use of lifting equipment is required due to the weight of the pipe spools. See Table 1 for weights.

Techniguard B-Series VJP Mounting

Mounting of Techniguard B-Series VJP can be more involved than rigid VJP due to the bendable pipe's flexible nature. Cryogenic line pressure fluctuations can cause line movement unless the bendable piping is properly attached and supported. Key points:

- Keep bendable pipe routing as straight as possible unless it is necessary to avoid immovable obstacles.
- When installing flex pipe use an appropriate sized structural channel (such as Unistrut® or equivalent) to support the bendable line. The bendable pipe and channel should be clamped together with stainless steel clamps every 3 feet (1 meter).

All horizontal runs of flexible piping shall lay flat against its support channel to prevent trapping gas within the system (see Figure 2).

The placement of the clamps and the support channel endpoint influences the VJP bend radius. B-Series VJP minimum bend radius is listed in Table 2 at the back of this document. Note that the minimum bend radius is based on the centerline of the pipe.

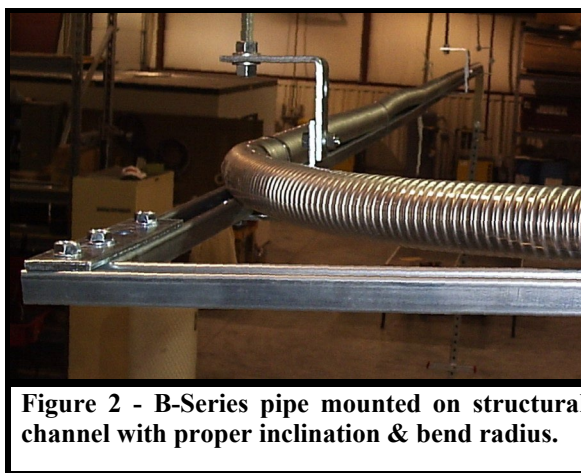


Figure 2 - B-Series pipe mounted on structural channel with proper inclination & bend radius.

System Installation (continued)

Figure 3 shows the bend radius and proper clamp placement which should be a minimum of 6 inches (15 cm) from the end of the support channel. Also, note that the bend radius is defined by the end of the structural channel in this case, not the clamp location.



Caution - Failure to follow minimum bend radius specifications can result in pipe frosting or line failure.

When transitioning from a horizontal to a vertical run, use of a corner support (see Figure 3) is recommended when space allows it.

All Techniguard Bendable Piping installed in a vertical orientation shall adhere to the following guidelines:

- All vertical runs within the pipe system shall be as close to true vertical as possible.
- Structural channel should be used as a track for vertical runs. No free-hanging flex runs are allowed.
- Any vertical span exceeding 8 feet (2.5 meter) in height shall be supported at the top of the vertical section.

Short pieces of channel attached perpendicular to the vertical run for wall attachment may be necessary (see Figure 4).



Caution - Do not locate attachments which may create a hazard to personnel, at or near eye level. Always remember to cover the ends of any structural channel with red rubber caps.

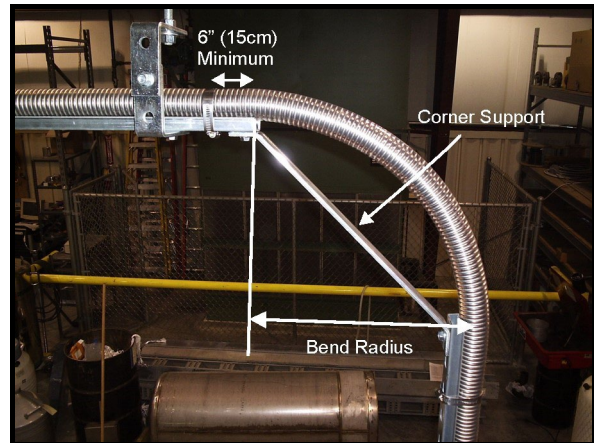


Figure 3 - B-Series pipe with proper band clamp placement and bend radius as it transitions from a horizontal to a vertical run.



Figure 4 - Structural channel used for mounting vertical routing.

System Installation (continued)

Overhead Suspension Specific Guidelines

Overhead suspension of bendable pipe requires special mounting because of the need for structural channel support.

- All Techniguard B-Series Piping installed overhead should use threaded rod to suspend all piping and the channel it's mounted on from the building structure. Supports should be spaced no more than 10 feet (3 meters) apart. Size of the threaded rod will depend on the total weight that it needs to support. Actual weights should be calculated for your installation; but generally, 3/8" threaded rod can support up to B100 and 1/2" threaded rod up to B200.
- The structural channel must be secured to the threaded rod using the appropriate brackets.

Roof Mounted Specific Guidelines

All Techniguard Piping installed on an exterior roof surface shall adhere to the following guidelines:

- Composite deck board shall be used to mount all support structures of the piping system.
- When running across a roof, be sure the stands and pipe can be supported by the roof.
- A protective piece of roofing material should be placed between the stand and the roof.
- No holes shall be placed in the roofing material that may allow structural leakage to occur.
- Position the support assemblies for the system at intervals not to exceed 10 feet (3 meters).
- On R600 and larger, the mounting system MUST be approved by the Owner or the Owner's Representative.
- Position all angled bracing in the least obstructive position to not create a tripping hazard.

System Installation (continued)

Wall & Roof Penetration

All Techniguard piping installed through an existing weatherproof wall or roof will need to adhere to the following guidelines:

- All wall and roof penetrations must be sealed and watertight. Flashing for the penetration should be used to maintain a seal around the pipe, example pipe flashings are shown in Figure 5.
- Roof penetrations, especially with membrane type roofs, may impact your roofing warranty. Consult your roofing contractor for additional information.
- The opening shall not exceed the requirements for a reasonable installation of the pipe spool. VJP clearance guidelines are included in the section entitled "Specifications".
- Do not allow the flashing to support any of the weight of the system. The channel support structure must not be attached to B-Series piping through the penetration. Locate support structure as close as possible to the penetration.



Figure 5 - Examples of preferred pipe flashing to be used for a roof or wall penetration.

Do not split or cut the flashing in any way other than that which it is intended.

When properly installed, there is no need for sealant where the flashing contacts the piping. Apply silicon sealant around the bottom flange of the weatherproof penetration flashing (see Figure 6). Be sure that the flashing flange contacts the penetration surface completely and that the sealant is adequate to prevent leaks.

Roof penetrations must be sealed by a qualified roofing contractor. This is typically the customer's responsibility.



Figure 6 - Pipe flashing sealant location.

System Installation (continued)

4. VJP Spool Installation

Some general guidelines for spool installation:

- Rigid spools may come in lengths longer than one individual can handle. Do not attempt to raise or install pipe without proper installation and safety equipment.



Caution - When transporting spools, do not handle or lift by the male bayonet. Balance the load, moving in 5-10 feet (2-3 meters) from each end.

- Make sure all bayonet surfaces are properly cleaned before assembly. Technifab recommends using a tack cloth to wipe off the bayonet and flange before putting the two mating surfaces together.
- When the spools are clamped down all globe valve stems should be oriented within 45 degrees of the vertical axis.

With the VJP mounting system in place, the VJP spools can be installed. Each installation will vary depending on the assembly method planned in Section 3 - *Install the VJP Mounting System*. Mounting the spools to the structural channel or brackets and connecting the spools will be required. Smaller diameter spools are usually connected using bayonets, larger diameter spools will be connected using a field joint. Mounting, bayonets and field joints are discussed later in this section.

NOTE: R600 and larger must not be clamped to any non-moving supports. The pipe system must be allowed to expand and contract freely.

The most common method is mounting a spool at a time and then connecting the spools as each additional spool is put onto the system. The steps involved:

1. Assemble the bayonets between the two spools or the spool and the tank or end point. If using field joints you will be welding the VJP which is not covered in this manual. When assembling bayonets, be sure to remove protective sleeves that were in place while hanging the spools. Bayonet assembly is detailed later in this section.
2. Connect the spool to the mounting system. For B-Series mounting see the section entitled “Attaching Bendable VJP to the Structural Channel” for more details on spool mounting.
3. Continue working your way through the system using the isometric system drawing until you reach the use point.
4. Add any extra items to the spool/system that may be needed (such as SRV valves or vapor vents). Some installers will add these accessories as the spool section is installed, but final plumbing/venting/mounting will need to be checked again at this time.



Caution - The outlet of the vent line should not be in a location where it could injure people or damage anything should cold cryogenics be expelled.

Make sure all fasteners are secure after all mounting components have been installed.

System Installation (continued)

Bayonet Assembly

The majority of Technifab systems utilize a close-fit bayonet. For other bayonet designs consult the manufacturer.

There are three steps in assembling a bayonet connection:

1. Install the o-ring. O-rings should be lubricated before assembly.
2. Couple the bayonet components.
3. Install the bayonet clamp.

Step 1 - Install the Bayonet O-Ring

Bayonet flange o-rings should be lubricated and installed on each male bayonet flange after hanging.

Do not use anti-seize compound to lubricate the o-rings. For inert gas systems, any standard vacuum silicone grease will be sufficient.

Inspect both groove and o-ring for damage and/or debris. Using your fingers, apply a very small amount of grease to the o-ring specific to your bayonet size (see Figure 7). Wipe off excess before proceeding.



Figure 7 - Lubricating bayonet o-ring.

Place the o-ring over the end of the male bayonet, taking care not to contaminate or damage the surface to prevent debris collection (see Figure 8). Fit the o-ring into the groove in the male bayonet flange. Inspect the groove and o-ring for damage or debris.



Figure 8 - Installing o-ring on male bayonet.

Step 2 - Insert the Bayonet Joints Together

With a close-fit bayonet design the insertion should require pressure to assemble.

System Installation (continued)

NOTE: Alignment of the mating spools is critical to correct installation of the bayonet system. Misalignment may result in difficult installation and/or damage to the vacuum jacketed system. A poorly aligned installation, which can result in damaged spools or a loss of vacuum, will void your manufacturer's warranty.

Technifab uses both uncoated and teflon coated male bayonets. Teflon coated bayonets can be identified by the gray coating. The bayonet on the upper right in Figure 9 is a teflon coated bayonet.

Technifab recommends male bayonet tubes be coated with lubricant compound prior to assembly. Only a light coating is needed; do not over apply. Also, take care to not contaminate the lubricant with debris. TriboGel Medium 1078 is recommended.

Gently push the male and female bayonet together. Twisting the components slightly while inserting the male bayonet may help the installation process (see Figure 10). Bayonets should fit tightly; you should feel some resistance making the connection. Make sure the o-ring remains in place.

If the bayonet joint assembly is too difficult and twisting the connection does not help, check for alignment problems and/or damage to the male bayonet. This may require removing the male bayonet from the female. If the male bayonet does not appear damaged and the pipe system is aligned correctly, inspect the inside of the female bayonet for damage and/or debris. If this does not solve the problem, it may be necessary to exert more force to the bayonet joint. If additional force is required to mate the bayonet joint, apply steady pressure evenly on both sides of the pipe to prevent misalignment and damage.

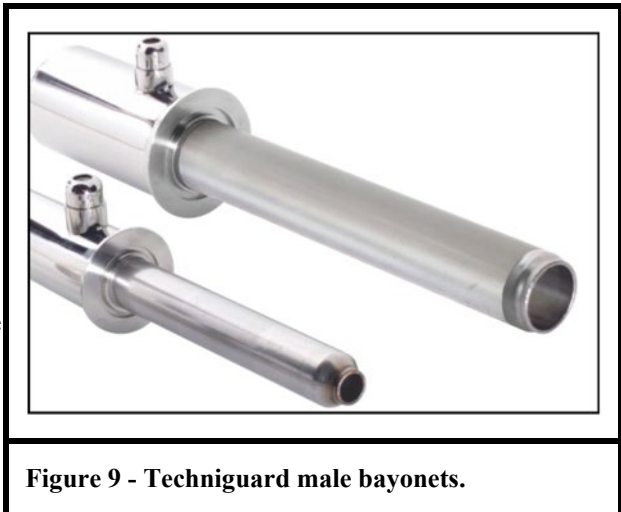


Figure 9 - Techniguard male bayonets.

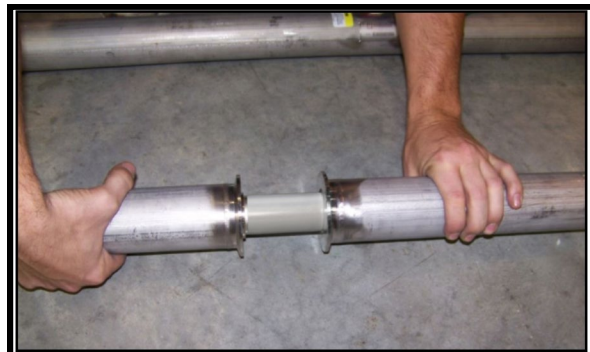


Figure 10 - Assembly of bayonet joint.

System Installation (continued)

Step 3 - Install the bayonet clamp

Once the bayonet flanges are in contact with each other, spread clamp apart enough to fit over the bayonet joint flange.

Fit the clamp onto the mated flange and insert the clamp bolt through the clamp sleeve as shown (see Figure 11). Squeeze the clamp body to thread the retention nut onto the clamp bolt. Attach bayonet clamps open end down; this will allow any moisture to escape.

NOTE: Only use the lock nut supplied by the bayonet clamp manufacturer.

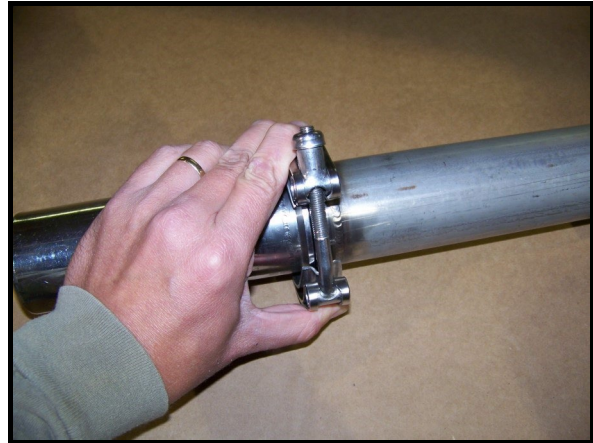


Figure 11 - Installation of bayonet clamp.

Once the nut is started at least two complete turns, release the pressure on the clamp. ***Be sure the nut is on well enough to hold the clamp tension.***

Tighten the retention nut to approximately 160 in.-lbs (18 Nm) for a t-bolt band clamp. For a wing nut band clamp hand tighten. Inspect the clamp and joint for non-uniform tightening. If the alignment of the vacuum jacketed pipe system is not straight or the bayonet joints are not connected properly, system damage may occur.

Once the VJP bayonets are assembled, the VJP should be secured firmly to the mounting brackets. Be careful when tightening that it does not cause stress at the bayonet connections, which could result in a possible leak.

Field Joints

Field Joints are typically used on Techniguard systems greater than two inches in diameter (R300 & larger series VJP) or special applications. In addition to the ability to weld pipe that can withstand a vacuum, it also requires the installer to be able to evacuate the field joint section between the inner and outer pipe. Technifab recommends that only qualified individuals assemble and install sections of pipe with field joints. Refer to the Field Joint Installation Guide (Technifab Part Number LT-29995).

In most instances welders are required to be ASME Qualified.

System Installation (continued)

Attaching Bendable VJP to the Structural Channel

To install the Techniguard B-Series VJP onto the structural channel:

1. Carefully place the flexible piping onto the support channel and secure the piping with stainless steel band clamps (see Figure 12).



Caution - Do not over-tighten band clamps used to hold down the VJP.

2. The stainless steel clamps should be placed no more than 3 feet (1 meter) apart.
3. Each straight run of flexible piping shall be secured with a minimum of two clamps.



Figure 12 - Techniguard B-Series VJP installation showing proper clamp placement.

Make sure guidelines discussed in depth in Section 3 – *Install the VJP Mounting System* are followed. Clamp locations in bends are particularly important as discussed in that section.

System Options and Accessory Mounting

In most systems there will be various options and accessories that require installation. The exact procedure will depend on the option and specific installation, but keep several things in mind:

Safety Relief Valves

- For Safety Relief Valves (SRVs) with a turndown, do not use more tubing than is needed for the turndown.
- SRV outlets should be oriented vertically, Technifab recommends within 45 degrees of vertical. The exit port should be oriented downward on all pipe systems that are located outside.

Gas Vents

- Gas vents also need to be oriented within 2 degrees of the vertical plane. Many Technifab gas vents will have a sticker on them to assist in correct alignment.
- We highly recommend that all gas vents be equipped with a vacuum jacketed vent line to carry the vent gas outside the building. If it is impractical to vent outside then, at a minimum, the vacuum jacketed vent line should carry the vent gas away from the vacuum jacketed piping system to a location free of personnel and not sensitive to moisture or dripping water.



Caution - The outlet of the vent line should not be in a location where it could injure people or damage anything should cold cryogenics be expelled.

Testing the System

Technifab Products Inc. recommends that connection of the system to a liquid cryogen bulk tank or supply be performed by customer's liquid cryogen supplier.

Starting Up a Techniguard Cryogenic System

When initiating flow into a VJP system it is necessary to gradually cool down the pipe from ambient temperature to cryogenic temperature.

NOTE: If Field Joints are installed, the Owner or the Owner's Representative may specify Inspection requirements. Be sure to verify Inspections are complete prior to proceeding.

1. Visually inspect the VJP system to ensure all connections are joined and the installation meets the requirements listed previously. This includes but is not limited to:
 - All bayonet clamps are installed and tightened.
 - Piping clamps and hangers are correctly installed and tightened.
 - Safety relief valves have been installed and are in the proper locations. Verify liquid cannot be trapped anywhere in the system.
2. Next charge the system with cryogen to look for leaks:
 - Make sure the use point valves and valves in portions you do not want to test are closed. You will need to remove any valve lockout devices before opening.
 - Slowly *crack open* the cryogen supply valve on the bulk storage tank and allow the pressure to equalize between the system and the tank.
 - Inspect the system once the bulk tank valve has been cracked open.

NOTE: On systems with a gas vent the pressure will not equalize until the line is full.

3. Once the system has been pressurized, cool down the system and check for system operation.
 - On systems with a gas vent, gas will expel from the vent until system is cooled.
 - Go to the farthest end point, open the use point valve, and let the system fill up with cryogen to cool the system down.
 - Continue to watch for leaks, which can indicate an assembly problem, and frost on insulated connections that could indicate an improperly assembled o-ring.
 - After liquid begins to flow from the farthest use point, you can test any additional legs of the system that may be required.
 - For systems with a gas vent, make sure the gas vent is operating correctly.
4. The bulk tank valve may now be fully opened. The use point valve(s) may now be closed or left open as desired.

NOTE: The cool down process involves rapid pressure changes and metal contractions. You may see or hear evidence of these changes such as pipe vibrations and/or popping sounds. As these changes subside, slowly throttle open the tank outlet valve to push liquid further into the system.



Caution - If in any instance the liquid flow must be stopped during the cool down process, either the bulk tank valve or at least one valve at a use point must stay open to relieve the rapid pressure changes until the pressure has dissipated.



Caution - If in any instance the liquid flow must be stopped during the cool down process, either the bulk tank valve or at least one valve at a use point must stay open to relieve the rapid pressure changes until the pressure has dissipated.

Installing Pipe with External Expansion Joints

- Piping with External Expansion Joints must have the ability to move freely from end-to-end for cool-down and warm-up of the pipe system. A good rule of thumb is 3/8" per 10ft of piping. Example: A system 30ft long must be able to expand and contract 1-1/8" minimum axially, end-to-end.
- In most cases, mounting systems must be specifically engineered to allow for all contraction and expansion of the system and joints.
- Mounting Systems must be designed with slides or rollers to account for varying lengths upon expansion and contraction.
- Mounting Systems must take into account weight of pipe with liquid.
- Refer to the Field Joint Installation Manual (Technifab Part Number LT-29995) for installation of all field joints.

Installing Oxygen, Hydrogen, and Methane Systems



Warning - The installation information provided within this section is intended to serve only as a helpful reminder for a qualified installer. The information provided within this section is in no way comprehensive and in no way fully governs the safe installation of oxygen, hydrogen, and methane systems. Only extremely well-trained personnel should install oxygen, hydrogen, and methane systems.

Oxygen Systems

- Oxygen both promotes and accelerates combustion.
 - At certain temperatures and pressures, most materials will auto-ignite in the presence of oxygen. Intentional material selection and ensuring cleanliness (to prevent the inclusion of undesirable, unsafe materials) is thus extremely important.
 - Oxygen piping is delivered clean, but depending on the methods that are employed for maintaining cleanliness during installation, piping may require additional cleaning post-installation. Installers should ensure that no contamination (such as cleaning agent, corrosion, scale, particulate matter, weld spatter, flux, cutting chips, sand, crayon, paint, mill lacquer, oil, grease, sealant, adhesive, or residues thereof) is present after installation is complete. Cleanliness verification should be conducted via methods such as a bright white light test.
 - For your reference, on oxygen systems, Technifab uses viton o-rings and PTFE full-face gaskets. Technifab also, minimally but as necessary, uses Krytox NRT 8904 as an o-ring and male bayonet lubricant. Technifab makes threaded joints with oxygen-compatible PTFE products.
- Oxygen-enriched atmospheres present many safety concerns.
 - Oxygen monitors should be worn by installers. Appropriate site surveys should periodically be conducted, paying very close attention to confined spaces. Work should never be completed in an oxygen-enriched atmosphere.

Hydrogen and Methane Systems

- Hydrogen and methane are both combustible. Hydrogen and methane have lower explosion limits of 4% and 5%, respectively. They both have relatively high upper explosion limits. These facts equate to there being countless scenarios in which combustion is possible.
 - Special care should be taken to ensure no potential sources of ignition exist or are created when working with or around hydrogen and methane. For your reference, Technifab uses anti-static/anti-spark tools and permanently grounds all piping.
 - An in-field pressure test and bubble test of all piping should be carried out. Seal welding of items like threaded fittings should be seriously considered, as should specialized fittings and components that are less likely to experience leakage.
 - Existing hydrogen and methane systems require careful purging with non-condensable gas prior to opening. New systems require similar purging practices during commissioning. Failure to adequately purge will result in a combustible gas mixture being generated during system opening and/or commissioning.
- Hydrogen-enriched and methane-enriched atmospheres present many safety concerns.

- Multi-gas monitors should be worn by installers. Appropriate site surveys should periodically be conducted, paying very close attention to confined spaces and entrapped areas such as the area near ceilings. Work should never be completed in a hydrogen-enriched, methane-enriched, or oxygen-deficient atmosphere.
- Open-air venting of hydrogen and methane should never occur. Hydrogen and methane should always be routed to recapture containers or flare stacks.

Techniguard Vacuum Jacketed Pipe Specifications

Table 1 - Techniguard R-Series VJP

Model	Nominal Pipe Size	Outside Diameter in Inches (mm)	Clearance Hole Min Diameter in Inches (cm) ¹	Clearance Hole Min Diameter in Inches (cm) ²	Dry Weight lb/ft (kg/m)	Filled Weight in lb/ft (kg/m) ³	MAWP in psig (bar) ⁴
R50T	1/2" ⁵ x 1-1/2" ⁵	1.50 (38)	3.3 (8.4)	2.4 (6.0)	1.2 (1.7)	1.2 (1.8)	150 (10.3)
R65T	5/8" ⁵ x 1-1/2"	1.9 (48)	3.7 (9.4)	2.4 (6.0)	1.5 (2.2)	1.6 (2.3)	150 (10.3)
R50	1/2" x 2"	2-3/8 (60)	4.27 (11)	3.75 (9.5)	2.2 (3.2)	2.3 (3.4)	150 (10.3)
R75	3/4" x 2"	2-3/8 (60)	4.27 (11)	3.75 (9.5)	2.3 (3.4)	2.5 (3.8)	150 (10.3)
R100	1" x 2-1/2"	2-7/8 (73)	4.77 (12.1)	4.0 (10.1)	3.4 (5.0)	3.6 (5.3)	150 (10.3)
R150	1-1/2" x 3"	3-1/2 (89)	5.4 (8.04)	4.25 (11)	4.3 (6.4)	5.2 (7.7)	150 (10.3)
R200	2" x 4"	4-1/2 (114)	6.4 (16.3)	6.0 (15.2)	5.5 (8.2)	7.0 (10.3)	150 (10.3)
R300	3" x 5"	5-9/16 (141)	9.24 (23.5)	7.75 (19.7)	9.4 (14)	12.5 (18.6)	150 (10.3)
R400	4" x 6"	6-5/8 (168)	9.24 (23.5)	7.75 (19.7)	11.5 (17)	16.8 (25)	150 (10.3)
R600	6" x 8"	8-5/8 (219)	13.5 (35)	11.5 (29)	18 (8.2)	29.2 (13.3)	150 (10.3)
R800	8" x 10"	10.75 (273)	16 (40.7)	11 (28)	28.6 (13)	47.5 (21.5)	150 (10.3)
R1000	10" x 12"	12-3/4 (323.9)			37 (55.1)	64.2 (95.7)	150 (10.3)

Inner piping and outer jacket piping are constructed from 300 series stainless steel, schedule 5, ASTM A312 welded or seamless pipe. Other ratings are available upon request.

¹ Clearance Diameter includes spool flange, clamp, and the evacuation valve.

² Clearance Diameter includes spool flange only.

³ Filled weight using liquid nitrogen.

⁴ Maximum Allowable Working Pressure (MAWP) is a nominal rating for liquid nitrogen. For other liquid cryogenics, such as CO2 which may be rated higher, please contact your Technifab representative.

⁵ Stainless Steel Tubing, not Nominal Pipe Size (NPS).

Table 2 - Techniguard B-Series Pipe Dimensions & Performance

Model	Inner Diameter Inches (mm)	Available Outer Coverings	Outside Diameter Inches (mm)	Minimum Bend Radius Inches (cm) ¹	Clearance Hole Min Diameter in Inches (cm) ²	Clearance Hole Min Diameter in Inches (cm) ³	Dry Weight in lb/ft (kg/m)	Filled Weight in lb/ft (kg/m) ⁴	MAWP in psig (bar) ⁵
B50	1/2 (13)	Heat Shrink, Braid, Armor	1-7/8 (48), 2 (51)	10 (25)	3.25 (8.3)	2.25 (6)	1.0 (1.5)	1.1 (1.6)	150 (10.3)
B65	5/8 (16)	Heat Shrink, Armor	2-1/4 (57), 2-1/2 (64)	15 (38)	3.65 (9.3)	2.75 (7)	1.6 (2.4)	1.7 (2.5)	150 (10.3)
B100	1 (25)	Heat Shrink, Armor	2.8 (71), 3 (76)	15 (38)	4.27 (11)	3.75 (9.5)	2.8 (4.2)	3.1 (4.6)	150 (10.3)
B125	1-1/4 (32)	Heat Shrink, Braid, Armor	3.5 (89), 3.8 (97)	20 (51)	4.77 (12.1)	4.0 (10.1)	3.1 (4.5)	4.7 (7.0)	150 (10.3)
B150	1-1/2 (38)	Braid	4 (100)	20 (51)	5.4 (8.04)	4.25 (11)	3.8 (5.7)	4.5 (6.7)	150 (10.3)
B200	2 (51)	Braid	5.1 (130)	30 (76)	6.4 (16.3)	6.0 (15.2)	4.6 (6.9)	5.8 (8.6)	150 (10.3)

Inner and outer flex are constructed from 300 series stainless steel, ASTM A312 convoluted pipe.

¹ Exceeding the Techniguard B-Series bend radius initially may cause additional heat leakage, frost or icing, and eventual product failure.

² Clearance Diameter includes spool flange, clamp, and the evacuation valve.

³ Clearance Diameter includes spool flange only.

⁴ Filled weight using liquid nitrogen.

⁵ Maximum Allowable Working Pressure (MAWP) is a nominal rating for liquid nitrogen. For other liquid cryogenics, such as CO₂ which may be rated higher, please contact your Technifab representative.

Troubleshooting

Problem	Action
Liquid is not getting to the use point.	• Check cryogen supply to make sure there is pressure to deliver liquid to the use point. • Check all valves in the system to make sure they are open. • Inspect the cryogenic inlet filter, if equipped, to make sure it is not plugged. • For systems with a gas vent a plugged vent will cause slow initial liquid delivery.
Pressure of cryogenic liquid is too low or too high.	• Make sure the cryogenic liquid supply pressure is at a higher pressure than needed at the use point. • Make sure all valves are opened properly. • If there is a cryogenic strainer in the system, make sure it is not dirty or full.

****Abide by all Lock out / Tag-out procedures when performing maintenance or troubleshooting the liquid nitrogen system.**

If the problem continues contact Technifab Products, Inc for further assistance.

Support Information

Crane Cryogenics™ continuously seeks to improve its products. Customer feedback is an essential element of this process. Should any issue arise regarding this product's performance, please immediately notify:

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