

IRogels®



Installation Manual

PIPE AND EQUIPMENT INSULATION



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Pakan recognizes that performance of our state-of-the-art aerogel insulation materials depends on the total thermal integrity of our system. Therefore, we have developed recommended guidelines for installing IRogel® flexible blanket materials.

All of the procedures described in this manual have been field-proven in conjunction with installation partners.

We are constantly striving to develop new application procedures and insulation systems to make our products stand above our competition with quicker delivery times, simpler logistics, and more reliable installation.

We stand behind our products and are willing to work with you to develop application procedures to suit your project-specific execution plan.

For specialized training or recommendations regarding our application procedures, call 021-47-620-670, visit www.IRogel.com, or scan below with mobile device QR reader.



Contact Us

Safety First

Aerogel materials are engineered with safety and performance as our top priorities. Pakan has performed extensive EH&S testing and found our materials to be safe. Our aerogel insulation products are made of amorphous silica impregnated into a non-woven flexible fabric substrate. Amorphous silica is not considered to be a health hazard and, according to the U.S. EPA, "there should be no concerns for human health." The dust from our material is rated by the U.S. Occupational Safety and Health Administration (OSHA) as a "nuisance dust." The silica used in our products is produced synthetically, not mined, and as such contains no crystalline silica.

Handling of aerogel blankets will produce dust. Workplace exposure to all dusts should be controlled with standard industrial hygiene practices. Aerogel dust exposure may produce a sensation of dryness to skin and irritation to eyes, skin, and respiratory track. For worker comfort when working with aerogel, we recommend the use of dust masks, safety eyewear, and work gloves. Aerogel dust can be washed from the skin and clothing using soap and water. Please follow the recommended safety and handling guidelines outlined in our Safety & Handling Guidelines manual, which is available on request. For complete health and safety information, please see our MSDS sheets.

Material Handling

Aerogel insulations when shipped in full rolls are typically 1 m wide and upto 5 m length per roll. Rolls can be moved manually with the use of a metal pipe or wooden 2x4 placed through the center of the roll and picked up from either end, or by using a pallet jack or forklift. Rolls should always be placed or stacked on their sides and should never be positioned upright on their ends as this may damage the exposed ends of the roll.



Preparation and Storage

Aerogel insulation materials should be stored in a clean, dry and protected environment. If material is stored in an outdoor setting, it should be placed on pallets and thoroughly covered with a waterproof tarp or plastic sheeting. Although the aerogel material is hydrophobic, all necessary measures should be taken to protect it from the weather.

: To prepare for installation

- Ensure that pressure testing of piping and fittings has been completed prior to installing insulation .
- Ensure that all pipe and fitting surfaces over which insulation is to be installed are clean and dry .
- Ensure that insulation is clean, dry , and in good mechanical condition. Wet, dirty, or damaged insulation is not . acceptable for installation

Determine pipe size, pipe length, and number of layers of aerogel blanket required for the application.

Do not apply IRogel material to live equipment or piping (e.g. hot install) while the system is operating above 500°C (930°F). See High-Temperature Installation section on page 20 for more details on high-temperature installations

Optimal Work Setup

To achieve the most productive work environment for use with aerogel insulations we suggest the following setup.

BULK CUTTING AREA

This area will be used for cutting aerogel materials from full rolls into lengths required for the application, as well as cutting any preformed parts required to ease the installation process. This area should be setup in a covered and protected area. This area should contain several tables to accommodate the roll width and cutting length required for each component being worked. The roll of aerogel material should be located at the front of the table where it can be placed on a roller rack with a tube placed through the roll. Please refer to the Recommended Cutting Tools chart below for suggested tools for this application. Parts should be placed on pallets and covered, bagged, or wrapped in plastic before bringing to work area.



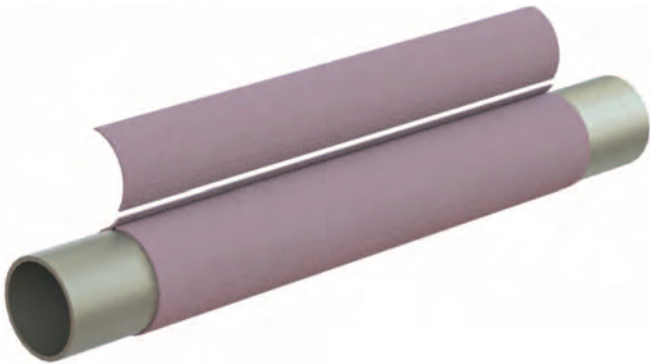
WORK AREA

Ideally the material should be placed as close to the work area as possible. Remove the materials from the packaging and distribute to the work location. Please refer to the cutting tools chart below for suggested tools for field applications.

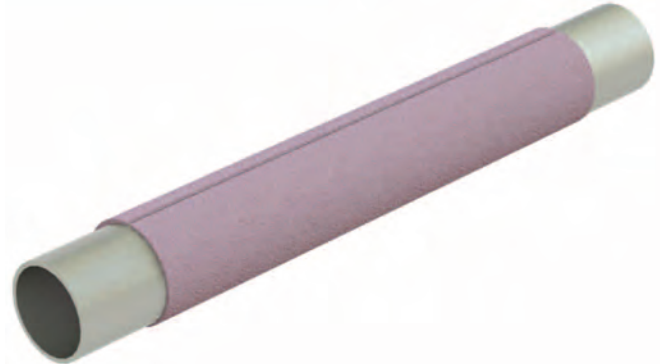
Material	Cutting Tool (FIELD or SHOP)							
	Scissors	Box Cutter	Pizza Wheel/ Electric	Tin Snips	Slitter	Hand Shear	Heated Knife	Dremel Oscillating Tool With MM430 blade
®IRogel	FIELD	FIELD	FIELD	FIELD	SHOP	SHOP		

Single Wrap Pipe

1. Cut aerogel blanket to the length required for a complete wrap. The cut length may be determined by either wrapping a scrap piece around the pipe and marking the place where it overlaps, or consulting the cutting charts. Either a butt joint or lap joint is acceptable for the longitudinal seam.



2. Place the aerogel on the pipe and wrap around the circumference of the pipe. The starting edge of the aerogel can be held in place by hand or with a strip of spray adhesive. The use of spray adhesives is limited to application temperatures below 250°C (480°F), and should never be used on live, operating equipment.



3. Once wrapped around the pipe, the aerogel may be held in place using tape, wire, adhesive spray, or banding. The use of tape and spray adhesives is limited to application temperatures below 250°C (480°F).



4. Completed assembly showing lap joint. It is good practice to orient the overlap with a downward-facing watershed.

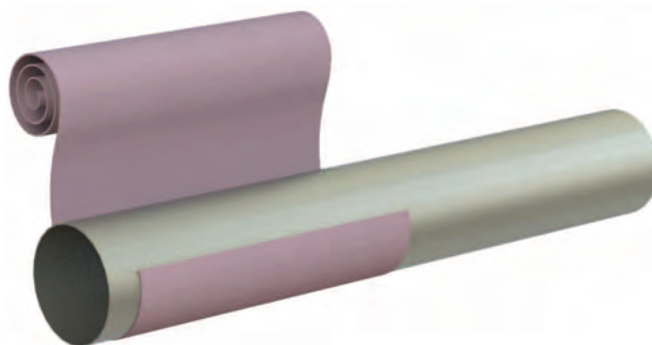


Double Wrap Pipe

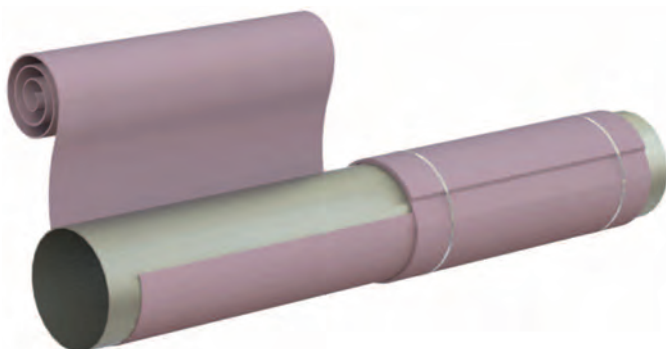
1. Cut the aerogel blanket to the length required for a complete wrap. The cut length may be determined by either wrapping a scrap piece around the pipe and marking the place where it overlaps, or consulting the cutting charts. Either a butt joint or lap joint is acceptable for the longitudinal seam.



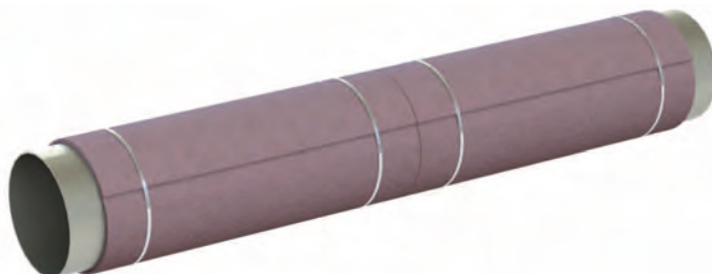
2. Align the leading edge of the aerogel with the long axis of the pipe and wrap around the pipe. The starting edge of the aerogel can be held in place by hand or with a strip of spray adhesive. The use of spray adhesives is limited to application temperatures below 250°C (480°F), and should never be used on live, operating equipment.



3. Overlap and continue around the circumference to achieve the double-layer application.



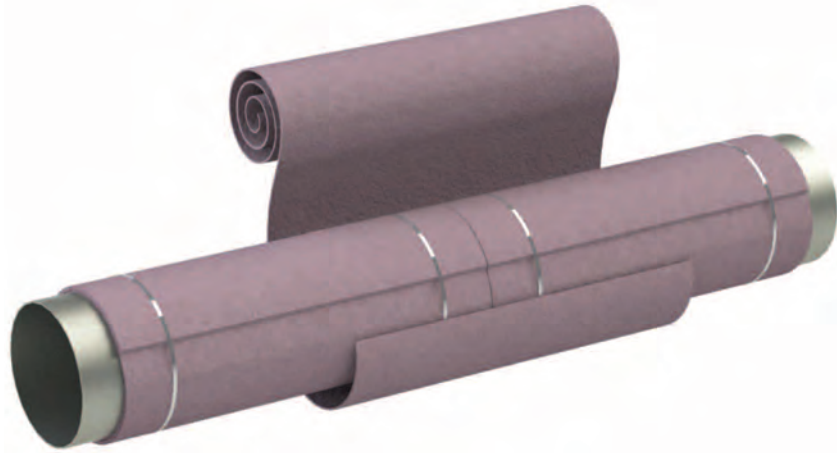
4. Once wrapped around the pipe, the aerogel may be held in place using tape, wire, adhesive spray, or banding. The use of tape and spray adhesives is limited to application temperatures below 250°C (480°F).



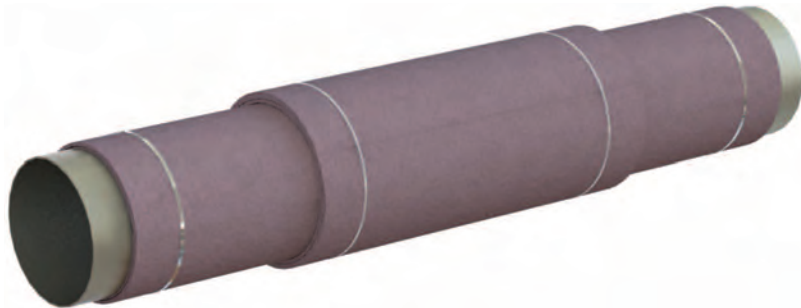
5. Install metal cladding in typical fashion and seal with owner-approved sealant.

Multi-Layer Wrap Pipe

1. For applications that require the use of more than two layers of aerogel blanket, the suggested procedure follows the same steps as the double-layer application, overlapping the circumferential and longitudinal joints.



2. Once wrapped around the pipe, the aerogel may be held in place using tape, wire, adhesive spray, or banding. The use of tape and spray adhesives is limited to application temperatures below 250°C (480°F).



3. Install metal cladding in typical fashion and seal with owner-approved sealant.



Small Bore Pipe - 15 to 100 mm (½ to 4 in) NPS

For piping smaller than 100 mm (4 in) NPS, we suggest the use of V-grooved, cut-to-length materials. Another option is to use 5 mm (0.2 in) materials, as they are more flexible than their 10 mm (0.4 in) counterparts. This can be either wrapped in the traditional fashion, or spiral wound onto the pipe with a 50% overlap. Contact Pakan Aerogels at 021-47-620-670 or info@IRogel.com for details on local suppliers of pre-fabricated elbows and accessories.

V-GROOVE

1. V-grooved pipe cover comes pre-cut to the particular pipe size and insulation thickness so that each layer comes to a perfect, butted closure.
2. For multi-layer applications, align the grooves for better laydown, but stagger the longitudinal seams.

**SPIRAL WRAP**

1. For spiral-wrap installation, strip materials should generally be 5 mm (0.2 in) thick, 50 to 75 mm (2 to 3 in) wide, and provided in rolls measuring 3 to 7.5 m (10 to 25 ft) long.
2. Place the end of the aerogel strip on the pipe and wrap around the circumference of the pipe, overlapping each wrap by 50 percent in a corkscrew pattern. The beginning of the strip can be held in place by hand, or with spray adhesive, tape, or wire.
3. Once wrapped around the pipe, the aerogel may be held in place using tape, wire, or adhesive spray.
4. Repeat this same procedure for subsequent layers.
5. Cladding should be installed in typical fashion. Note that small-bore pipe insulated with aerogel can have a finished diameter that is smaller than most sheet metals can be mechanically rolled. In these cases, the curvature of the jacketing can be tightened by hand. Alternatively, non-metallic jacketings (VentureClad, Fibaroll/Fibaclad, Ulva, etc.) can be used, subject to owner's approval.

Pipe Fittings

PIPE ENDS

Install the aerogel blanket past the pipe end to the same distance as required for the thickness of the insulation.

Cut plugs from the aerogel to the diameter of the opening and install to match the thickness.

REDUCERS

Install the aerogel blanket to the same thickness as would be required for the piping using the same layout pattern as would be required for the metal cladding less the required overlaps.

Install each layer in a staggered fashion.

TEES

Install the aerogel blanket using the same techniques as would be used for installing the cladding. Contact Pakan Aerogels at 021-47-620-670 or info@IRogel.com for details on local suppliers of pre-cut tees



PIPING SHOES

Install the aerogel blanket around the pipe adjacent to the pipe shoe and make a slit the length of the shoe.

Slide aerogel through the shoe area and continue wrapping the aerogel on the other end of the shoe area.

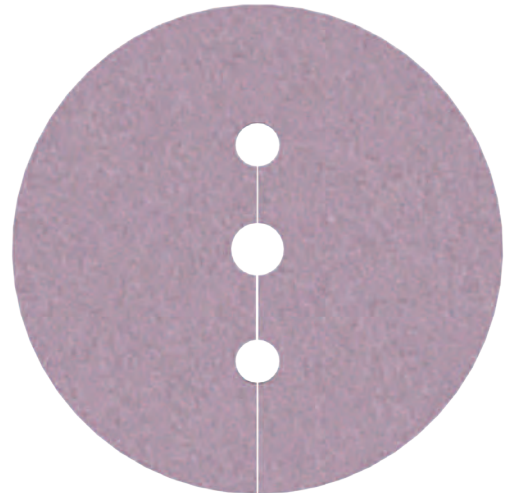
For some shoe types that have a welded section through the center, it may be necessary to apply aerogel from both ends

Contact Pakan Aerogels at 021-47-620-670 or info@IRogel.com for details on local suppliers IRogel® insulated pipe shoes

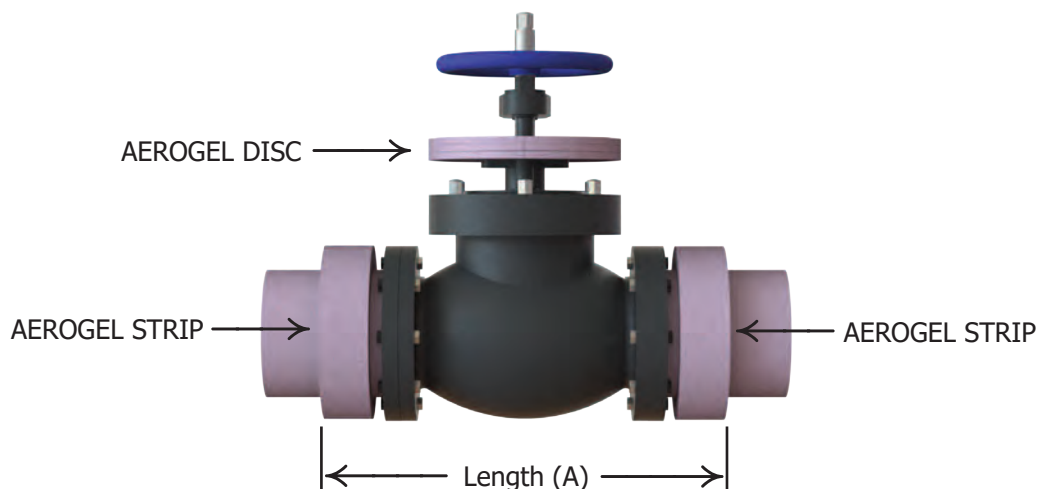
Valves and Flanges

This section gives the general techniques for insulating valves. Because of the variety in valves shapes and designs, some modifications to these instructions may be necessary.

- 1.** Unless the finished aerogel thickness could obstruct the bolt pattern on the flange, insulate the pipe all the way up to the flange face.
- 2.** Wrap a strip of aerogel over the insulated pipe portion to achieve the same diameter as the flange.
- 3.** Cut the disc to the same size as the bonnet end if insulation is required on the bonnet section.

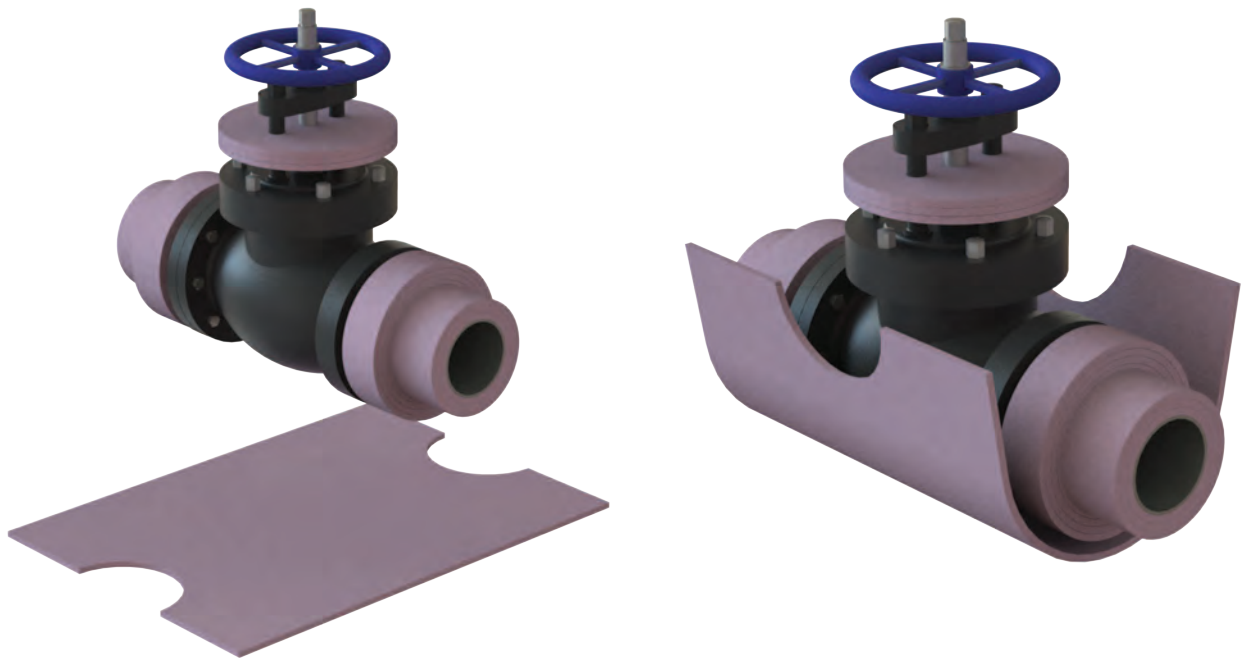
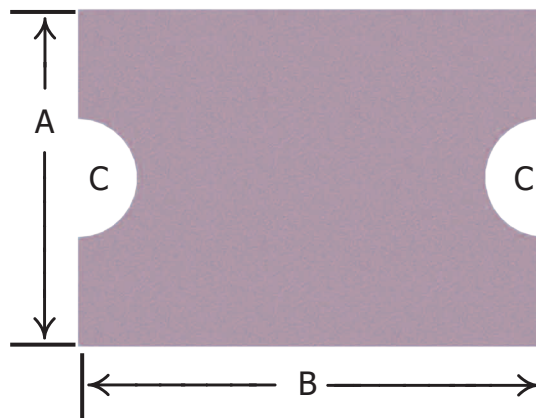


- 4.** Measure the distance between the two outer faces of the aerogel strips.



Valves and Flanges

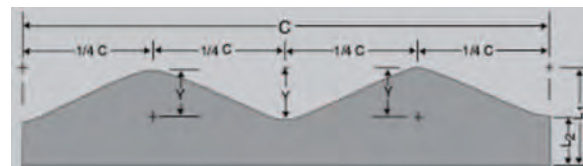
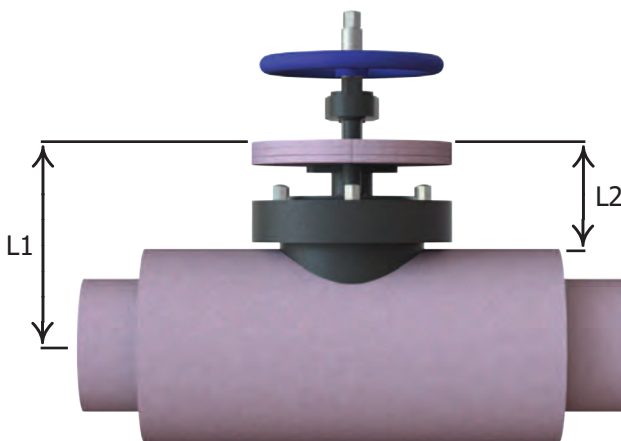
5. Transfer length "A" and circumference "B" to aerogel sheet and mark the cutouts for the bonnet neck "C". Move the cutout on each wrap of aerogel to achieve stagger, and slide over handle section to achieve stagger. Note: on installations above 500°C (930°F), pack void spaces with IRogel® or high-density (96 kg/m³ or 6 lb/ft³) ceramic fiber. See High-Temperature Installation section on page 20.



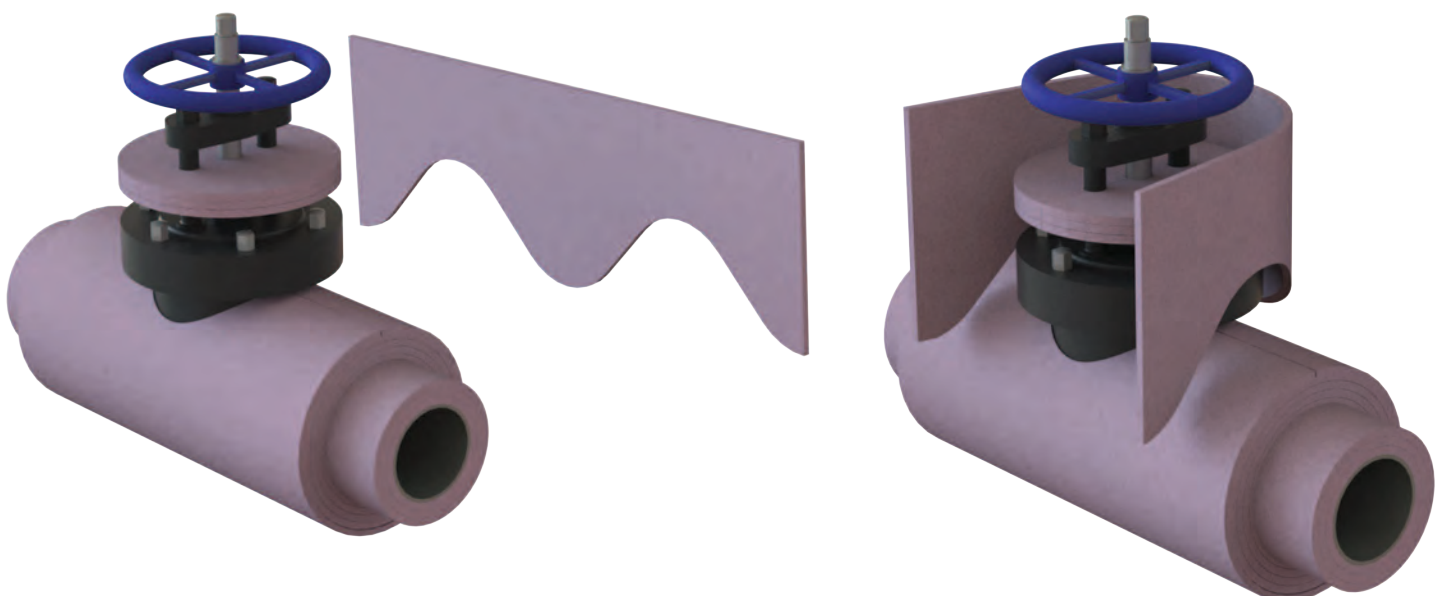
6. The aerogel sheet is now wrapped around the valve body followed by any additional layers with joints staggered. Attachment of the aerogel may be done with tape, wire, adhesive spray, or banding.

Valves and Flanges

7. The last pieces will insulate the bonnet area if required. The bonnet insulation of aerogel is cut to the size of $C \times L1$, then marked in quarters. Next, the scalloped edge of the insulation is determined by swinging an arc from each point marked +. The radius of the arc is equal to Y . These areas are connected with straight lines to give a smooth scalloped edge.

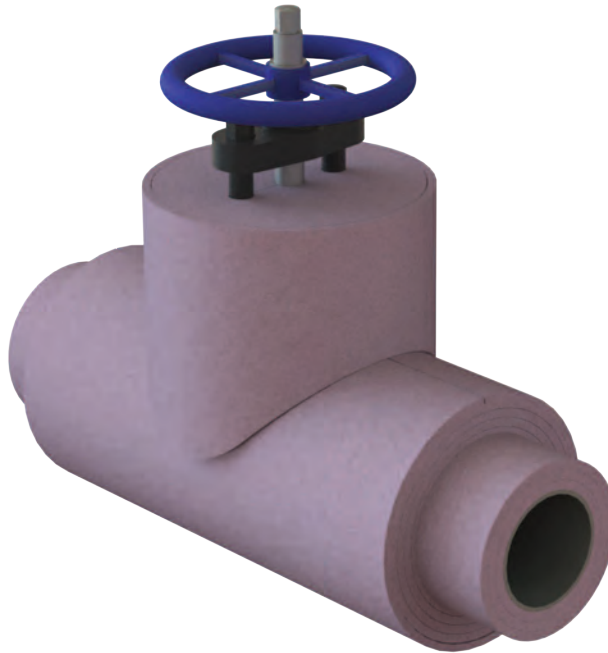


C	Overall length determined by wrapping a strip of aerogel around the bonnet flange and marking where the ends meet
L1	Distance is from the outer surface of the aerogel disc to the approximate middle of the valve body insulation
L2	Distance is from the outer surface of the aerogel disc to the closest surface of the valve body insulation
Y	Difference between L1 and L2



Valves and Flanges

8. Once installation of the aerogel insulation layers is complete, the finished valve should resemble below.



9. Install metal cladding over aerogel and seal with specification approved sealant.

10. Aerogel-lined removable metal or blanket covers may also be an option for valves and flanges. When operating temperature is greater than 500°C (930°F), the inner layers of insulation shall be encapsulated with stainless steel foil.



45 and 90-Degree Elbows

Suggested Elbow Chart

Pipe Size (NPS)		Elbow Type		
mm	inches	Pre-Cut	Gored	Stove Pipe
15 – 40	$\frac{1}{2}$ – $1\frac{1}{2}$	✓		✓
50 – 150	2 – 6	✓	✓	
200 – 300	8 – 12	✓	✓	
350 – 600	14 – 24	✓	✓	
650 – 900	26 – 36	✓	✓	
950 – 1,200	38 – 48	✓	✓	

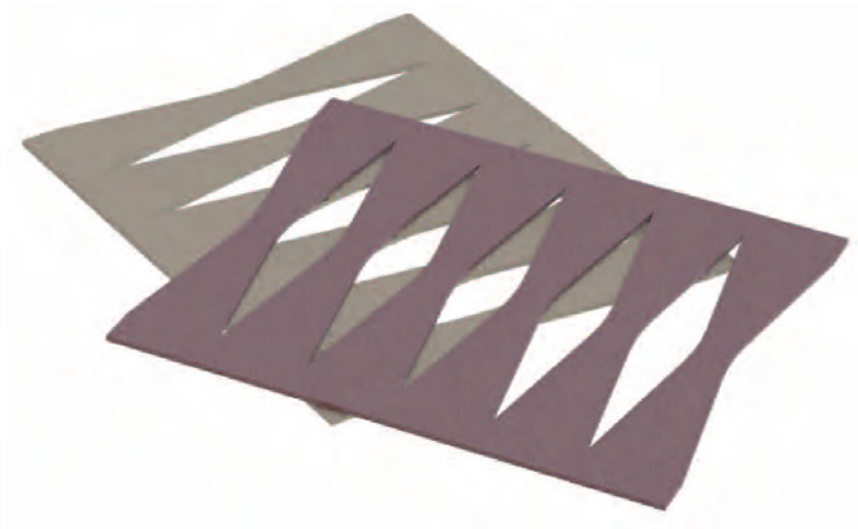
The instructions on the following pages cover three types of elbows available for use with aerogel materials and installation suggestions.

Contact Pakan Aerogels at 021-47-620-670 or info@IRogel.com for details on local suppliers of pre-fabricated elbows and accessories

45 and 90-Degree Elbows

SINGLE-PIECE ELBOW FITTINGS

Pre-fabricated elbows for piping NPS 200 mm (8 in) and smaller are based on a reverse gore-style pattern that gathers in the throat and is closed along the heel. Larger elbows are constructed of individual gores that get applied one at a time in the field, with the seam located in the throat.



1. Place the middle of the fitting along the inside (throat) of the pipe fitting.



45 and 90-Degree Elbows

2. Tightly wrap material around to the heel, aligning the seam with the centerline of the fitting.



3. It is important that the aerogel material is tight to the elbow. Work excess material around the fitting towards the back side of the fitting until the butt joint is closed tightly. Apply tape, wire, or outward-clenching staples to secure each fitting.



45 and 90-Degree Elbows

4. Once all fingers have been secured, push material from both ends of the fitting cover to ensure all gore seams are tightly closed.

5. Apply all subsequent layers in a similar fashion. Note that the seams in some layers are specifically engineered to not line up with the ones beneath it. Also note that in multi-layer fittings, the inner layers will often have an extended tangent to provide a ship-lap joint for the adjacent line insulation.

6. Install metal cladding and seal with specification approved sealant.

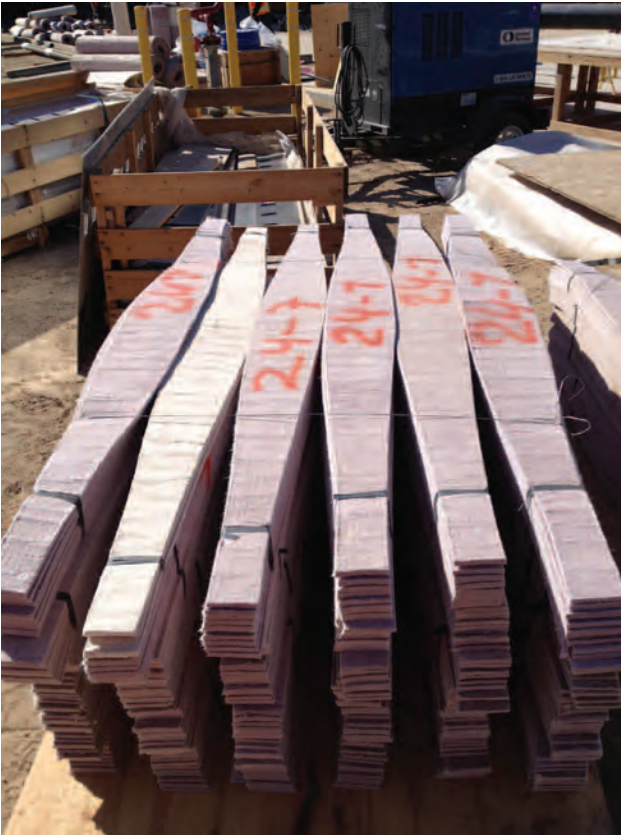


45 and 90-Degree Elbows

GORED ELBOW FITTINGS

This style of elbow can be cut by the contractor using the same principles that are used to fabricate metal gored elbow, minus the overlaps.

Cut the aerogel blanket to the required length and cut as per the gore pattern. Install each layer, staggering the seams where possible. This can be achieved by slitting one of the gored sections down the center to create half a gore. This half section will be used for the starter and finisher of the staggered layer. The gored elbow may also be achieved by separating the pre-cut elbows and installing one gore at a time.



STOVE PIPE

We recommend that this style of elbow only be used on small bore piping where the fabrication of the above elbow styles can not be done due to limited elbow throat space. In order to fabricate this elbow, we recommend that the pre-formed pipe covering be cut at a 45-degree angle with the sections adjoined in the elbow to form the 90-degree elbow.

Installation for Service at Temperature Above 500°C

All hot insulation materials can experience self-heating behavior when first exposed to conditions near their maximum use temperature. This usually occurs as organic ingredients or contaminants within or on the material oxidize and give off heat, raising the insulation's internal temperature and resulting in yet more oxidation. In extreme cases, this thermal feedback loop can result in uncontrolled burn-in and damage to the material, including shrinkage, cracking, and loss of hydrophobicity.

To keep self-heating behavior within a range of acceptability (as defined by the standards of ASTM C447¹ and ASTM C1728²), the installation instructions below must be followed:

- Install insulation tightly, with no visible gaps between layers.

On installations above 250°C (480°F), do not use tapes and/or any organic adhesives. Metallic fasteners (e.g., wire, bands, staples) are acceptable.

- On complex shapes (e.g., valves, flanges, turbine bodies) or vertical configurations, interleave stainless steel foil between one or more layers of IRogel® to block airflow.

Pack void spaces (e.g., around valve bodies and flanges) to prevent the formation of chimneys. IRogel® or high-density >96 kg/m³ (6 lb/ft³) ceramic fiber are both suitable fill materials.

- Metallic jacketing is required, and must be installed and sealed completely before start-up.
- Do not remove or disturb the jacketing or insulation during startup.
- Do not apply IRogel® to live equipment or piping (i.e., "hot installs") while in operation above 500°C (930°F).

1. ASTM C447-03, "Standard Practice for Estimating the Maximum Use Temperature of Thermal Insulations," ASTM International, West Conshohocken, PA, USA.

2. ASTM C1728-13, "Standard Specification for Flexible Aerogel Insulation," ASTM International, West Conshohocken, PA, USA.