

**INSTALLATION PROCEDURE**  
**For**  
**ABOVEGROUND GRP PIPELINES**

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## Installation Procedure: Aboveground GRP Pipes

### 1.1 Introduction

This manual is intended to provide the basic requirements and procedures for the successful handling and installation of GRP pipes in Above Ground Installations. The manual addresses most common circumstances that may be encountered in the field.

The excellent corrosion resistance and many other benefits of GRP pipe will be realized if the pipe is properly installed.

The installation guidelines outlined in this manual, when carefully followed, will ensure a proper long-lasting installation.

### 2.0 Fire Safety

Glass-reinforced polyester (GRP) pipe can burn. During installation, care must be taken to avoid exposure of the pipe to welder's sparks, cutting-torch flames or other heat/flame/electrical sources which could ignite the pipe material.

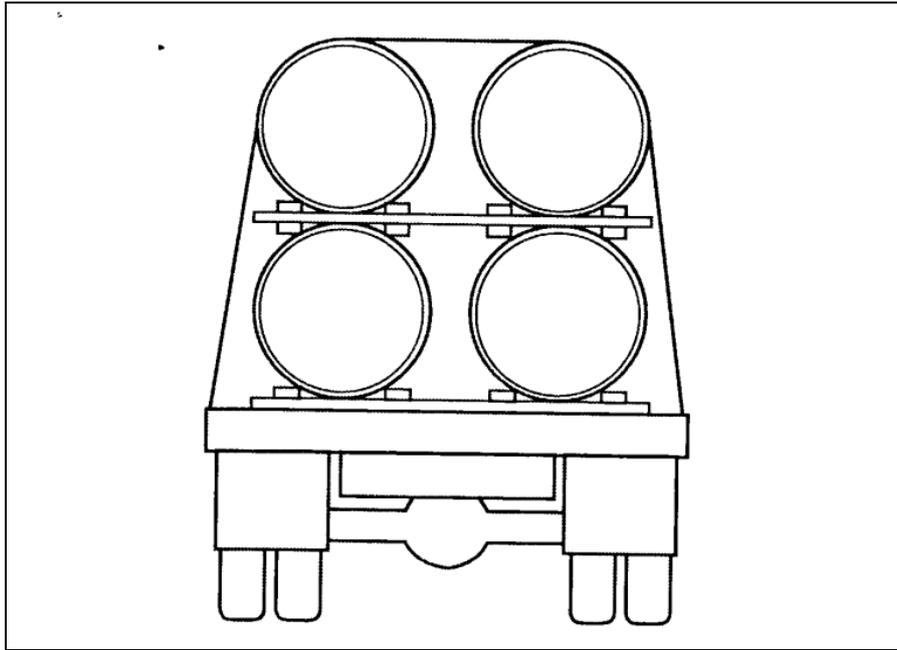
This precaution is particularly important when working with chemicals in making lay-up joints, repairing or modifying the pipe in the field.

### 3.0 Transporting Pipe

When the pipes are transported from the manufacturer's place to project site, **support all pipe sections on flat or arched timber** spaced on a maximum of 4 meters centers (3 meter for small diameter) with 2 meters maximum overhang. **Locate the pipes** to maintain stability and separation. **Ensure that no pipe-to-pipe contact happens during transportation**, so that the vibrations during transport will not cause abrasion.

Strap pipe to the vehicle over the support points using pliable straps or rope – **never use steel cables or chains without adequate padding** to protect the pipe from abrasion.

The transport loading arrangement is shown in Fig.1.

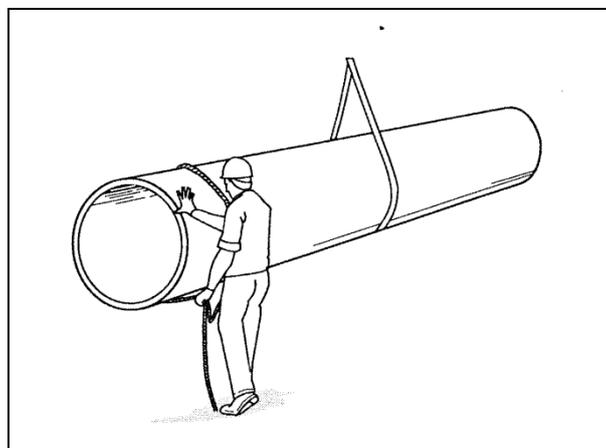


**Fig. 1 Transporting Pipe**

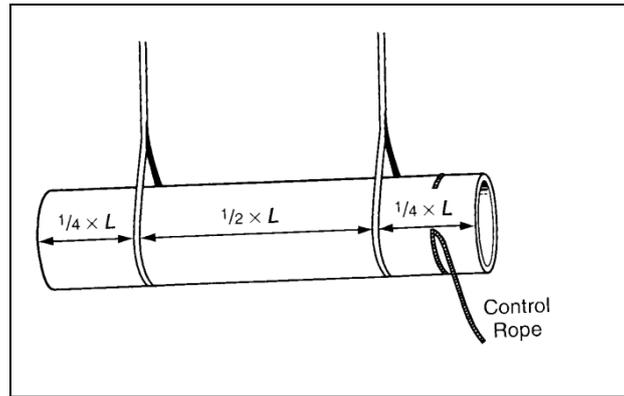
#### **4.0 Unloading and Handling Pipe**

Be sure to maintain control of the pipe during unloading. Guide ropes attached to pipes or packages will enable easy manual control when lifting and handling. Spreader bars may be used when multiple support locations are necessary. ***Do not drop, impact, or bump the pipe, particularly at ends.***

Individual pipe sections can usually be lifted with a single sling (Fig.2), if properly balanced, but two slings, as shown in Fig.3 (located at the pipe quarter points), make the pipe easier to control. Do not lift pipe with hooks or rope inserted through the pipe ends.

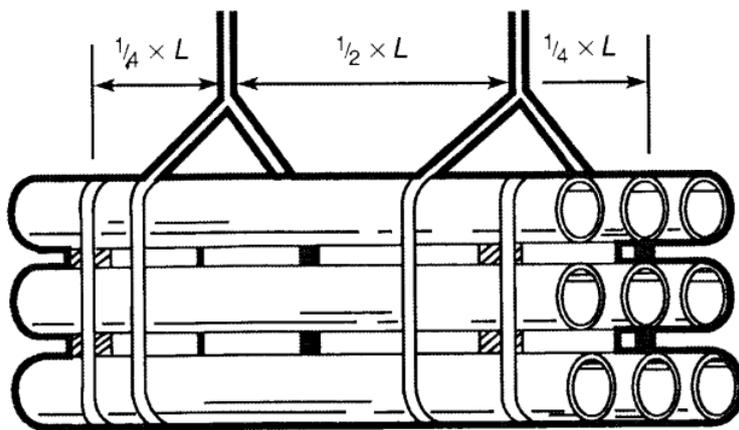


**Fig.2 Lifting Pipe at One Support Point**



**Fig.3 Lifting Pipe at Two Support Points**

Packages may be handled using a pair of slings as shown in Fig. 4.



**Fig. 4 Lifting Pipe Package**

#### 4.1 Handling Instructions

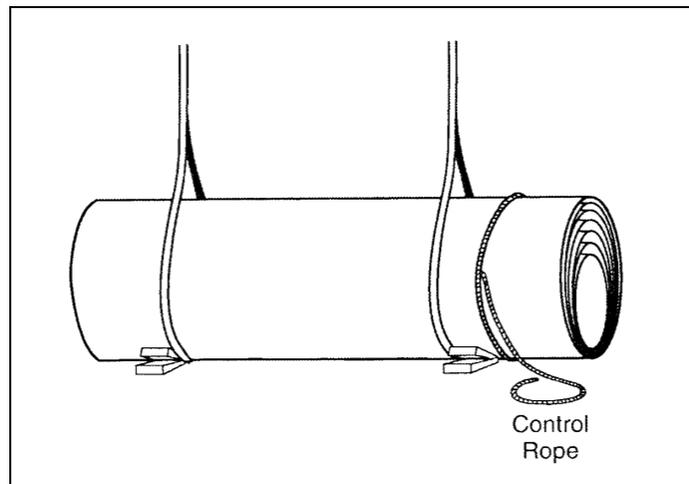
- Pipe and fittings should never be thrown or dropped under any circumstances.
- Pipe lifting is done with slings of adequate strength and of such construction as not to damage pipe. Running of lifting rope inside the pipe shall never occur. Pipe assemblies fabricated of multiple sections may require two points lifting.
- While handling the pipes, impacts must be avoided, particularly of pipe ends.
- Whenever pipe or fittings in contact with wood or metal, rubber sheet padding should be used.
- The pipe should be securely fastened with tie-downs consisting of nylon straps or manila rope. Avoid over-tightening, which may cause excessive localized deformation in the pipe.
- GRP pipe is a light load, particularly with larger diameter pipe. Therefore, reduce speed on rough loads to minimize bouncing.

**Caution:** Do not place supports under bells, spigots or factory made joints.

## 5.0 Handling of Nested Pipes

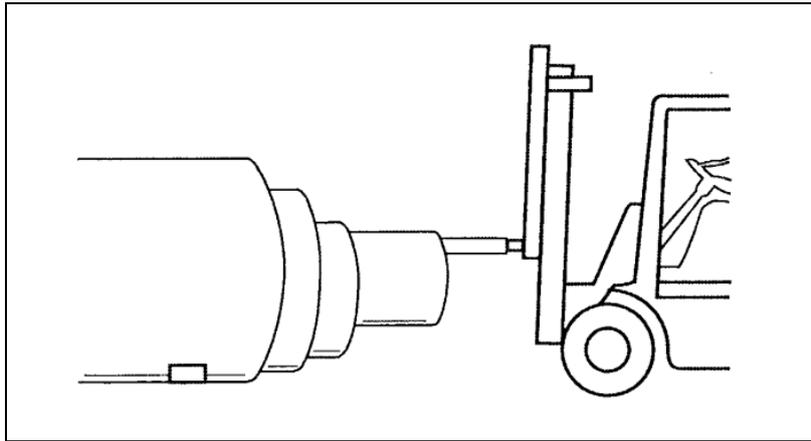
GRP pipes may be delivered nested (i.e. one or more small pipes inside a larger pipe). Nested pipes must always be lifted using at least two straps or slings. De-nesting is accomplished by inserting a forklift/mobile crane boom. Proper padding is essential on the boom. Rubber or wraps of corrugated cardboard sheets over the boom are suitable options to avoid damaging the inside of the pipes. The operator should lift the innermost pipe above the pipe around it sufficiently so the pipes do not touch each other when the inner pipe is being pulled out.

Always lift the nested bundle using at least two pliable straps (Fig.5). Limitations, if any, for spacing between straps and lifting locations will be specified for each project. Insure that the lifting slings have sufficient capacity for the bundle weight. This may be calculated from the approximate pipe weights.



**Fig. 5 Double Support Point**

- a. Nested pipes are usually best stored in the transport packaging. Stacking of these packages is not advisable unless otherwise specified.
- b. Nested pipe bundles can only be safely transported in the original transport packaging. Special requirements, if any, for support, configuration and/or strapping to the vehicle will be specified for each project.
- c. De-nesting of the inside pipe(s) is accomplished, starting with the smallest size by lifting slightly with an inserted paddle boom to suspend the section and carefully moving it out of the bundle without touching the other pipes (Fig. 6). When weight, length and/or other equipment limitations preclude the use of this method, procedures for sliding the inside pipe(s) out of the bundle will be recommended depending on the pipe sizes for each project.

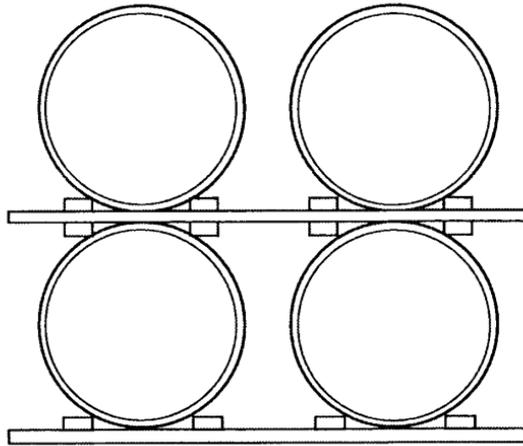


**Fig. 6 De-nesting with Padded Boom**

## **6.0 Storage**

GRP pipes may be stored outside for extended periods provided the following procedures are observed.

- a) GRP pipes may be stored on the plain ground or on wooden logs acting as supports. In case of pipes kept on supports, supports should have a minimum 100 mm wide bearing surface and spaced evenly.
- b) It is generally advantageous to store pipes on flat timber to facilitate placing and removal of lifting slings around the pipe.
- c) When storing pipe directly on the ground, be sure that the area is relatively flat and free of rock and other potentially damaging debris. All pipes should be located to prevent rolling in high winds.
- d) If it is necessary to stack pipes, it is best to stack on flat timber supports at maximum 6 meter spacing (3 meter for small diameter) with chocks (Fig. 7).
- e) GRP pipes may be stacked upto a maximum of 3 stacks or to a stack height not exceeding 3.0 m. Stacking shall be provided with side supports or blocks to prevent rolling or slipping in the stack.
- f) Protective end coverings on machined spigot surfaces should be left in place until the time of installation to protect the pipe ends and to prevent dirt or other material coming in contact with machined surfaces.



**Fig. 7 GRP Pipe Storing Arrangement**

### **7.1 Storing Gaskets, Resin and Field Joint Kits**

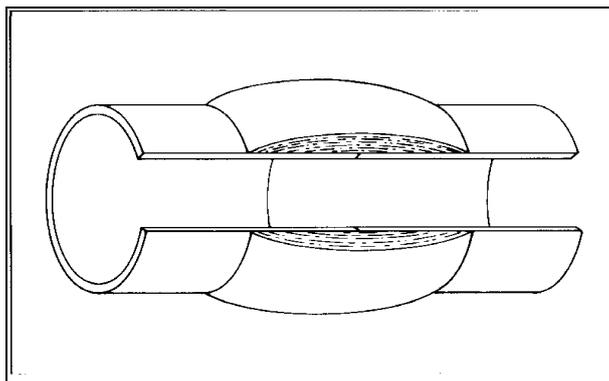
**Rubber ring gaskets for flanges** should be stored in the shade and **should not be exposed to sunlight**. The gasket **must be protected from exposures to grease or oils**, which are petroleum derivatives, **and from solvents** and other deleterious substances.

**Field joint kits** should also be stored in their original packing and should not be subjected to moisture, or contamination.

**Resin and catalyst** for the joints shall also be stored in shade and in suitable temperature.

### **8.0 Joining Pipes**

Above Ground pipe sections are typically joined using GRP lay-up joint, called as Butt & Wrap joint (Fig. 8).



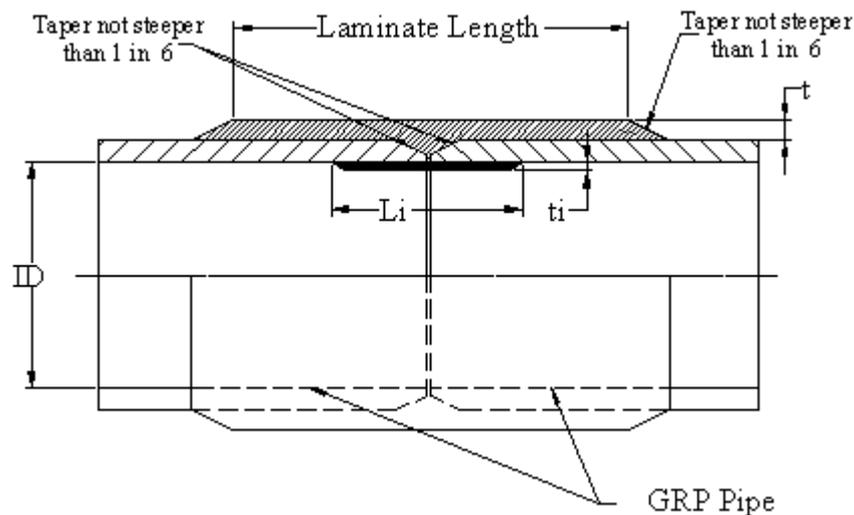
**Fig. 8 Butt & Wrap Joint - Cut-Section view**

Other joining systems such as flanges, are common in A/G piping and are usually needed to connect the pipe with other equipments such as valves, Expansion Joints, Pumps etc.

Flexible coupling and mechanical couplings joints may also be used with GRP pipe. These are mostly used in Underground (U/G) rigid piping system inside chambers or near rigid structures to absorb the possible settlements.

## 8.1 BUTT & WRAP JOINT

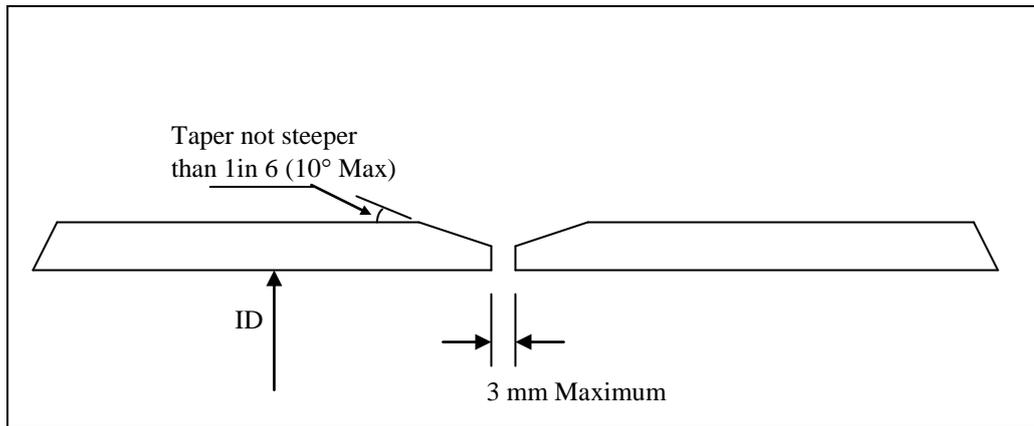
The Butt & Wrap joint consists of plain-ended pipes and fittings, prepared, aligned and laminated with reinforcing fibers and resin.



**Fig. 9 Butt & Wrap Joint – Lay-up Diagram**

Before the lamination joint is started, all necessary equipment for completing the joint must be available. A jig or other holding device should be used to ensure that the pipes are maintained with joint faces held tightly together without offset. The restraints should be left in place until the joints has fully cured.

- The ends of the pipe are chamfered to leave a root face square to the axis of the pipe and 2mm to 3mm thick.
- The pipe ends are chamfered with a taper not steeper than 1 in 6 (10° Maximum)
- Pipe ends are held rigidly in position with a maximum gap of 3mm.
- The chamfered, abraded and cut surfaces should be coated with the specified resin and the gap between the ends filled with resin paste.



**Fig.10 Pipe Ends for Butt & Wrap Joint**

The sequence of the joining procedure is given hereunder.

### 8.1.1 Cutting & Surface Preparation

- Gaps between pipe sections should not exceed 3 mm. Therefore a wrap-around should be used to ensure square cuts. Pipe can be cut readily with circular saws or a hacksaw. Achieving a gap of 3mm or less may require rotation or sanding of the pipe and/or fitting.
- The glossy resin surface must be removed prior to making the joint. A sander machine with coarse 36 grit sandpaper should be used to grind the surfaces.
- The sanded areas should be slightly greater than the width of the last layer of mat to be applied and equal in distance on both sides of the butt joint.
- Grease, oil, dirt, paper, tape, moisture, solvents, etc. will prevent proper adhesion of the material. Bonding surfaces that are dirty must be re-sanded to a fresh surface. Surface must be clean and free from all grinding dust residue, which will act as a barrier and weaken the bond of the over wrap.
- Freshly sanded surfaces should be dusted with a clean dry cloth just prior to applying the over wrap. These surfaces must be protected from subsequent contamination if bonding operation is interrupted.
- Sanded joints left for extended periods, such as overnight, should be re sanded.
- All surfaces must be free from water or other solvents prior to over wrapping.

### 8.1.2 Pre-sealing of Cut Faces of Pipe/Fitting

During the installation of GRP pipeline, Lamination joints are done for pipe-to-pipe or pipe-to-fitting. Before bringing the cut faces together for joining, each cut face must be sealed separately, so that the cut faces are completely sealed independently. This is very essential for achieving pressure-tightness of the butt & wrap lamination joint.

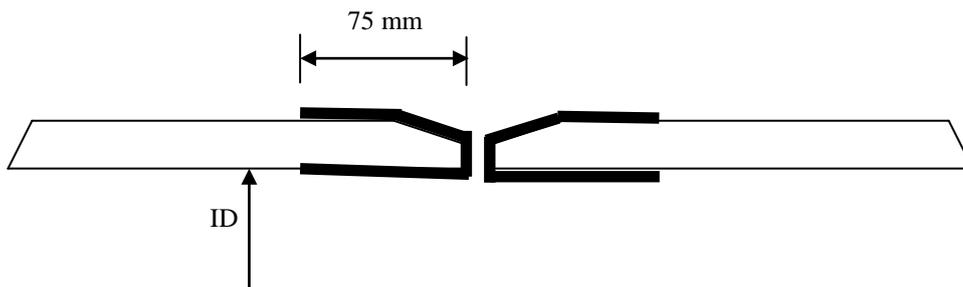
The layer sequence for pre-sealing is CSM225/ SM30.

The first layer is CSM225.

SM30 is applied over the CSM225 layer.

The width is about 75mm on both the inner and outer surfaces.

The glassy inner surface of the pipe must be sanded properly for achieving the bonding. The outer surface need also to sanded and cleaned before the pre-sealing layers are applied.



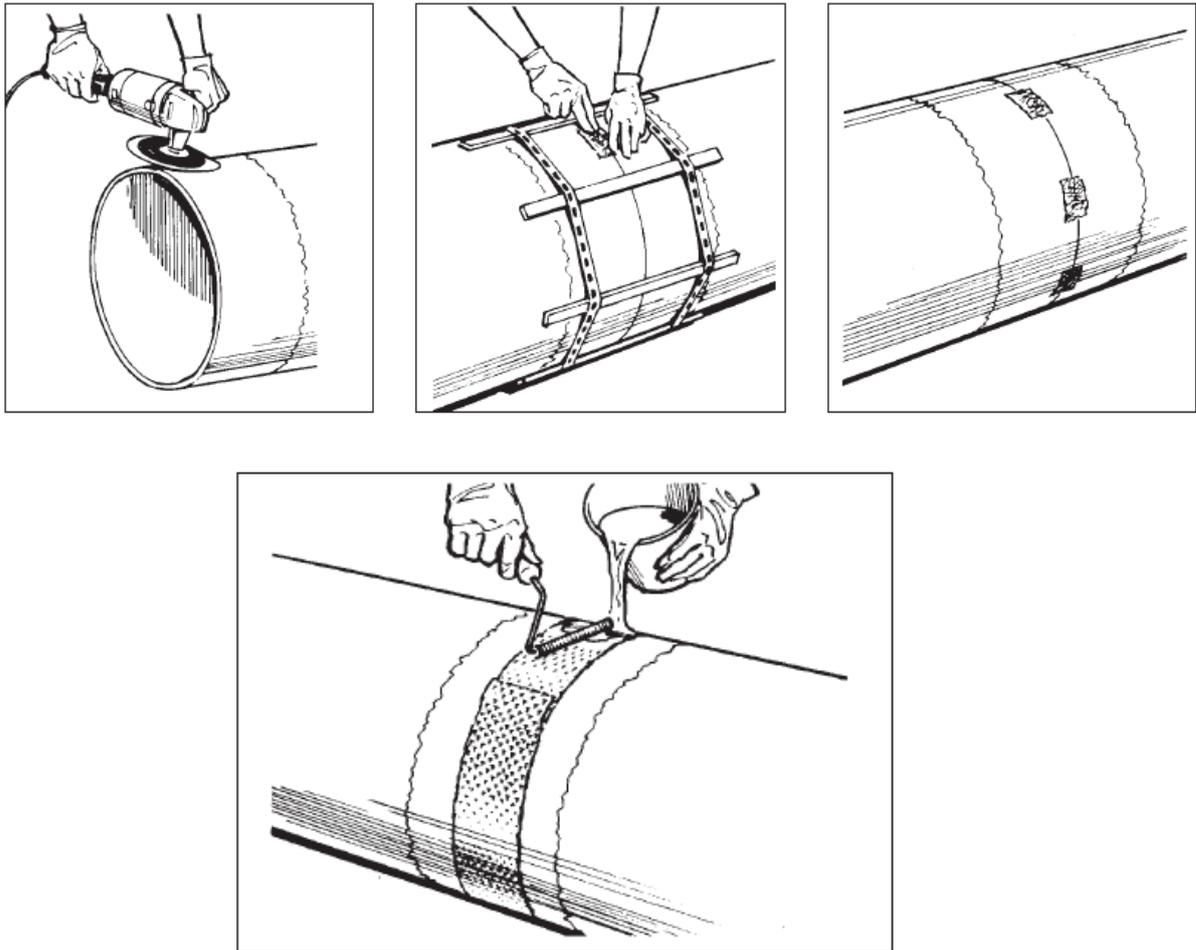
**Fig. 11 Pre-sealing of Cut Faces**

*Note: Pre-sealing is an important technical requirement for sealing the exposed pin-holes on the cut faces and hence this has to be done with utmost care by experienced laminators. A mat width of about 150mm has to cover both the inner and outer surfaces. Mat has to be wrapped around the cut faces without wrinkles and completely wetted with resin to achieve the desired sealing.*

## 8.2 Butt & Wrap Lamination

- After the pre-sealing is completed on cut faces of the joining ends, the main butt & wrap lamination is done.
- The pipe must be held securely in place to prevent any movement during the butt and wrap procedure. This may be accomplished by clamping the pipe into its hangers or by using stationary blocks to prevent any pipe movement.
- Initially, a fitment layer of SM/CSM 225 is applied over the tapered surface of the joining ends for a width of 50mm; subsequently unidirectional roving layers are tightly wrapped around the joint over the tapered surface to achieve a even surface. Further layers are added as per the given layer sequence provided in the Butt & Wrap joint drawing.

- **Inner Sealing:** Where ever accessible, the inner joining gap is first filled with resin paste and subsequently two layers of chopped strand mat, followed by one layer of C-glass mat should be applied to the inside diameter (I.D.) after removing the resin gloss. Refer the internal and external lamination joint thickness and width dimensions supplied by the design department for different diameters and pressure rating.
- Use a chemical vapor mask to prevent exposure to high concentrations of fumes when working inside the pipe.



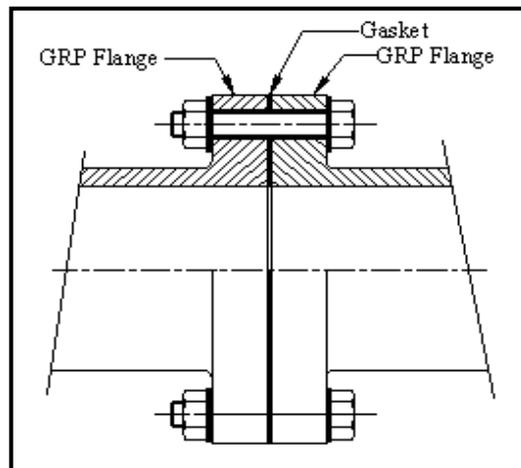
**Fig. 12 Stages of B & W Jointing**

- The resin and catalyst should be measured, mixed in proper proportions. A separate container should be used for mixing the resin. Do not attempt to make an over-wrap with resin containing lumps or partially cured resin in the mixing bucket.
- Using amounts of catalyst outside of the recommended range can produce a poor joint. After one or two mixes, the installation crew can determine the proper resin-to-catalyst ratio to obtain the desired curing time. For best results, the material should be applied at temperatures between 25°C and 42°C.

- Apply a thin coat of catalyzed resin to the cleaned, sanded surface where the mat will be applied. Layers of chopped strand mat and/or woven rovings impregnated by resin shall be applied as per layer sequence.
- Each layer must be completely saturated and free from voids or air bubbles. Using excessive amounts of resin may cause resin runs and/or glass sagging on the bottom of the joint. A joint that cures too rapidly may generate excess heat due to exotherm and cause delaminations.
- A joint that contains delaminations, air bubbles, etc. is structurally weak and should be removed. Laminates over 6mm thick (2 or 3 layers) often have to be done in two operations to prevent exotherm and weak joints. Applying succeeding layers to the first layers that have cured does not require re-grinding to remove gloss if the elapsed time is less than 24 hours and if the first layers cured without generating excess heat. If joint is made in two steps, make sure that the first stage does not become contaminated by covering the joint with clean plastic or other waterproof material. Remove temporary covering and sand rough edges prior to applying succeeding layers.
- The last layer of chopped strand mats prevents external corrosion and improves the appearance of the joint. To further improve the appearance, the O.D. may be lightly sanded and resin coated.

## 9.0 ASSEMBLY OF GRP FLANGES

GRP Flanges are used to connect GRP pipes or to connect GRP pipe with other metallic or non-metallic pipe. Valves and other instrumentation parts are connected to the piping system using Flanges. Maximum Care should be taken when joining the GRP flanges to other steel flanges or with valves.



**Fig.13 Assembly of GRP Flanges**

Elastomeric gasket to suit the service pressure and service temperature shall be used for joining the flange. Steel washers are used to avoid excess surface pressure on the flange faces. Proper bolt tightening torque should be ensured while assembling of flanges. Full-face gasket shall be preferred when joining of GRP flanges with another GRP flange. Refer Fig 13.

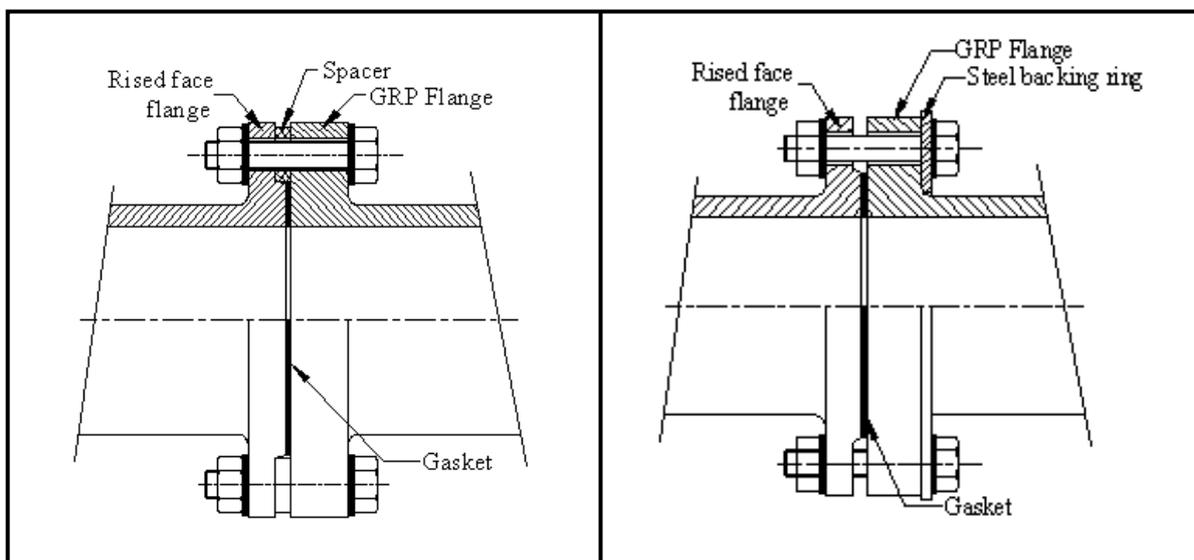
### 9.1 Flange Assembly Procedure

- a) Align the flanges properly
- b) Clean and lubricate the bolt and nut to attain proper torque
- c) Finger tight all the nuts.
- d) Tighten all the nuts in proper tightening sequence given and ensure the torque should not exceed the required.
- e) Recheck the torque on each bolt in the same sequence, since previously tighten bolts may have relaxed.
- f) **Do not exceed the torque. Always use torque wrench. Excess torque can damage the flanges.**

### 9.2 Connection of GRP Flanges to Raised Face Steel Flanges

GRP flanges are used to connect against steel flanges having raised face or to the valve special precautions to be taken

1. The gap between the raised face and the flat face must be filled with a steel washer or a hard gasket of a thickness equal to the raised face. Refer fig 14.
2. As an alternative to the above method fix a steel-backing ring behind the GRP flange. Refer fig 15.



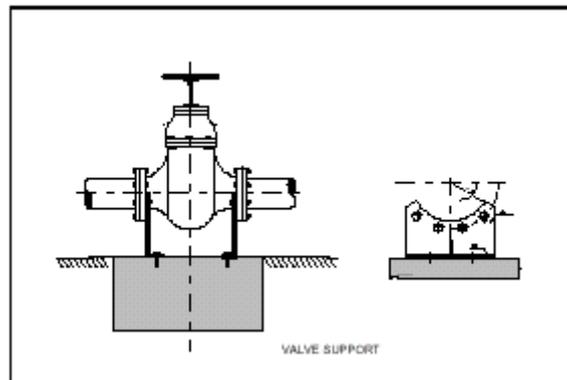
**Fig.14** Assembly of GRP flange with Metallic Raised face flanges using spacers

**Fig.15** Assembly of GRP flange with Metallic Raised face flanges Steel-backing ring.

### 9.3 Connection of GRP Flanges to Valve Flanges

When GRP flanges are used to connect wafer valve, butterfly valves or other heavy valves, proper support is to be given to the side of the valve to avoid over stressing of GRP flanges. Refer fig 16.

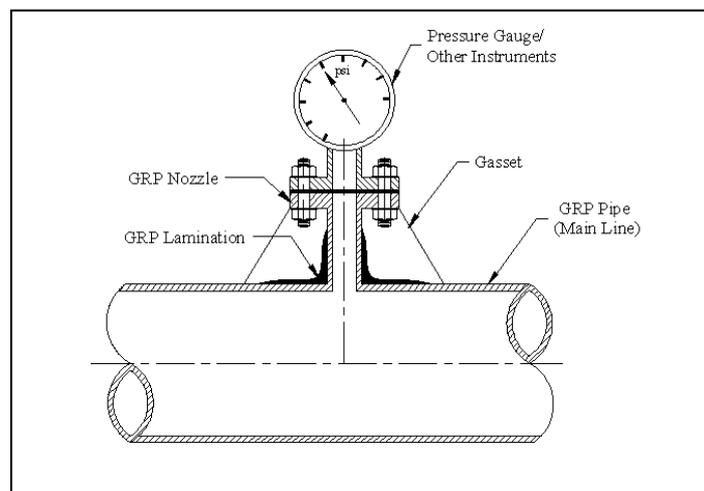
GRP flanges should always be tension free, hence the flanges should be accurately aligned. The pipelines must not be pulled together by means of the flange bolts. If a GRP pipeline is connected to metal pipeline using flanged joint then the metal pipe should be properly anchored to avoid any load or misalignment of the GRP flange.



**Fig.16 Valve fixed to GRP pipe**

### 9.4 Tapping for Instrument Connection:

Instruments can be connected to GRP piping system through flanged joints. Taping will be done to the main pipe at site. Proper gussets are to be given for the nozzle. In case the instrument is very heavy, proper support to be given to the flanges.



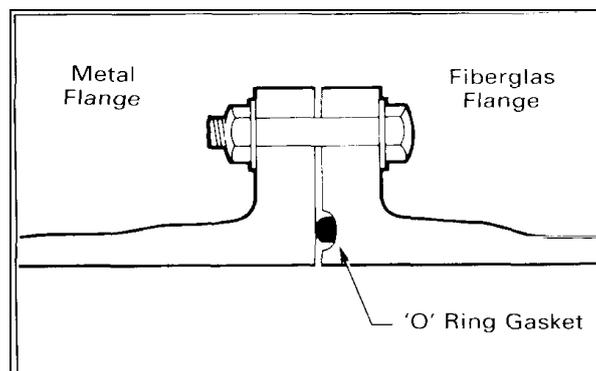
**Fig.17 Typical Arrangement of Instrument Connection**

## 9.5 Flanged Joints with O-Rings

GRP flanges are also designed with O-Rings confined in flange facial groove for better pressure sealing characteristics. This design is normally adopted for higher pressure and larger diameter category of flanges. The assembly of this type of flange jointing shall be jointed according to the following procedure.

- a) Thoroughly clean the flange face and the 'O' ring groove.
- b) Ensure the 'O' ring gasket is clean and undamaged. Do not use defective gaskets.
- c) Position the 'O' ring in the groove and secure in position, if necessary, with small strips of adhesive tape.
- d) Align flanges to be jointed.
- e) Insert bolts, washers, and nuts. All hardware must be clean and lubricated to avoid incorrect tightening. Washers must be used on all GRP flanges.
- f) Using a torque wrench, tighten all bolts to 35 N.m torque, following standard flange bolt tightening sequences.
- g) Repeat this procedure, raising the bolt torque to 70 N.m or until the flanges touch at their inside edges. Do not exceed this torque without consulting SSCPL for advice. To do so may cause permanent damage to the GRP flange.
- h) Check bolt torque one hour later and adjust if necessary to 70 N.m.

**Note:** When connecting two GRP flanges, only one flange should have a gasket groove in the face.



**Fig. 18 Flanged Joints With Facial O-Rings**

To avoid excessive loads on the flange, ensure proper flange alignment before fixing the flange final position with the connecting flange. Do not try to absorb any misalignment between two flanges by over tightening the bolts. This could cause damage to the flanges.

## 10.0 Above Ground Installation On Pipe Supports

The type of the pipe support shall be kept as per the final isometric drawings. All supports must be rubber lined when in contact with the pipe surface.

GRP Pipe supports can be either of a hanger type, guide type or anchor type. The selection of the particular type depends upon the piping layout, other accessories like pumps, valves etc. that are fitted in the pipe lines and also the field configuration.

Most of the clamps that are used for steel piping can be used for GRP pipes. However an important aspect of GRP pipe clamping is that line contacts and point loads should be avoided. Therefore, a protective rubber layer should be provided between pipe and steel collar to minimize abrasion.

### 10.1 Support Types

- a. **Hangers:** Hangers are free to move laterally or longitudinally with reference to the pipe. Hangers include band, ring, clevis or roller.
- b. **Guides:** Guides restrict lateral movement but may permit longitudinal and rotational movement. Guides are recommended for lines which are subjected to side loads or uplift. Examples include lines subjected to pressure surges, lines emptied and filled during operation and lines (especially empty) which can be lifted or moved by wind or other external loads.
- c. **Anchors:** Anchors restrict movements in all directions and divide the pipe system into individually expanding sections. Anchors prevent the pipe axial movement against applied forces and can be installed in both horizontal and vertical directions.

### 10.2 Guide Design

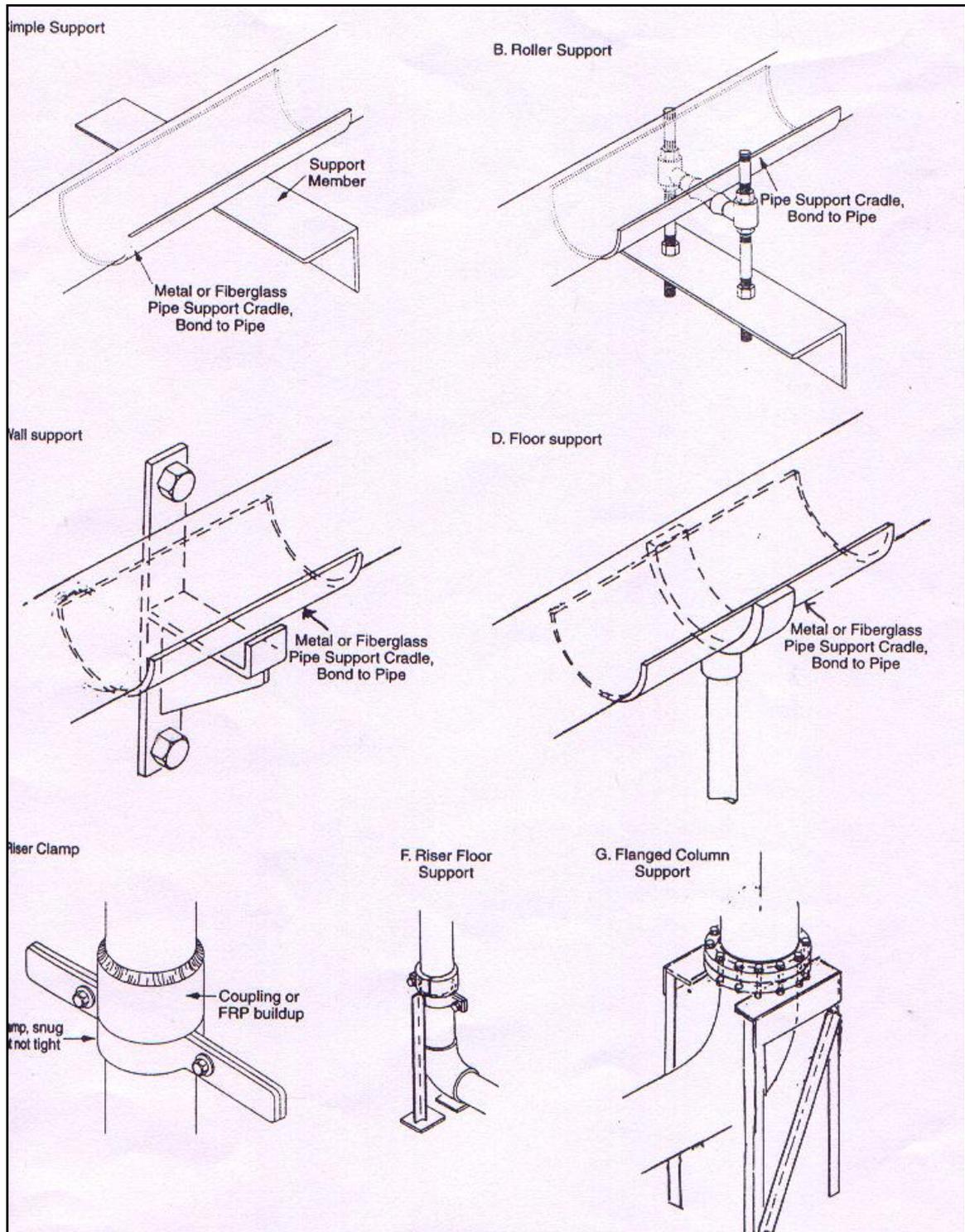
#### 10.2.1 Typical Guide Usage

1. Between anchors to prevent buckling of pipeline at elevated temperatures.
2. Near entry points of expansion joints and loops to ensure proper functionality.
3. To provide system stability.

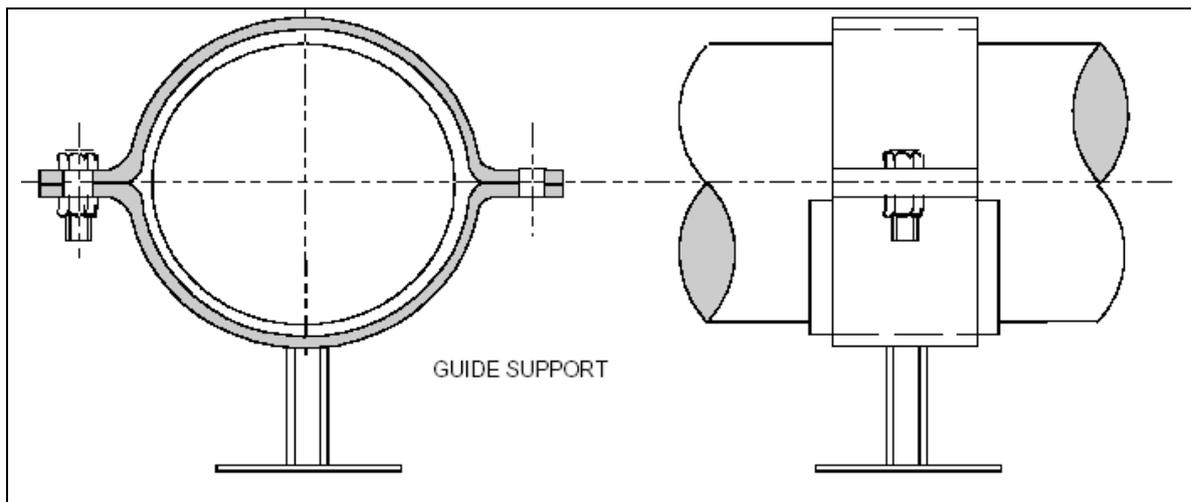
Properly designed and installed guides prevent the pipe from sliding off support beams and allow the pipe to freely move in the axial direction. A 180° support "wear" saddle is recommended to prevent point contact between the bolt and pipe wall.

The U-bolt should not be tightened down onto the pipe. It should be tightened to the structural support member using two nuts and appropriate washers. Clearance is recommended between the U-bolt and the top of the pipe. Another design practice is to use U-straps made from flat rolled steel instead of U-bolts. Flat U-straps are less apt than U-bolts to "point" load the pipe wall. U-strap use is most common when guiding

pipe sizes greater than 6-inches diameter. It is appropriate to gently snug the U-bolt if a 3mm thick rubber pad is positioned between the U-bolt and the saddle.



**Fig. 18 Typical GRP Pipe Support Methods**

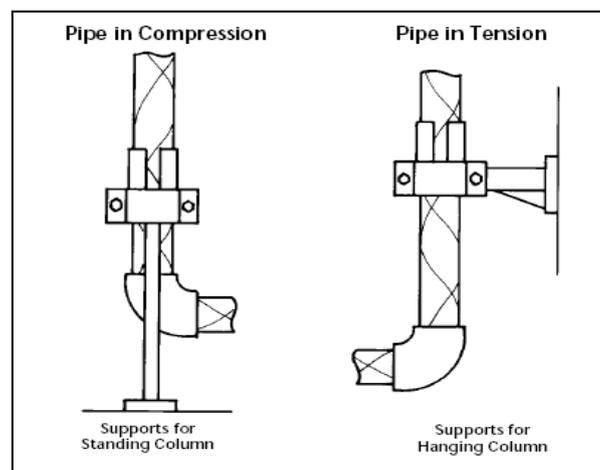


**Fig. 19 Typical Guide Support**

Horizontal pipe should be supported at intervals suggested by the support spacing data. For the supporting of pipe systems several types of pipe clips can be used. The clips must fit firmly but must not apply excessive force to the pipe wall. This could result in deformations and excessive wall stresses. The pipe must be allowed to expand within its clamps. A 3mm rubber sheet is provided between the GRP pipe and the metallic clips.

#### **Avoid Excessive Loading in Vertical Runs**

Vertical pipe runs should be supported as in Figures. Fig. 20(a) illustrates the preferred method. If Fig.20(b) is used, take care to keep the tensile load on the pipe below the recommended tensile loads. Install guide collars at the same spacing as supports for the horizontal piping. The clamp in figures is placed below anchor sleeves that have been bonded to the pipe.



(a)

(b)

**Fig. 20 Vertical Pipe Support Arrangement**

### 10.3 Anchor Design

Pipe anchors restrain the pipe against axial movement or applied forces. These forces may result from thermal loads, water hammer, vibrating equipment, or externally applied mechanical loads under compressive loading. For example: When anchors are used to control thermal expansion, guides are always required.

#### Anchor Usage

1. To protect piping at "changes-in-directions" from excessive bending stresses.
2. To protect major branch connections from primary pipeline induced shears and bending moments. Particular consideration should be given to saddle and lateral fitting side runs.
3. Installed where fiberglass piping is connected to steel piping.
4. To protect a piping system from undesirable movement caused by water hammer.
5. To reduce thrust and movement at line diameter changes.
6. To protect sensitive in-line equipment.
7. To absorb axial thrust at in-line reducer fittings when fluid velocities exceed 2.2 m/s.
8. To provide stability in long straight runs of piping.

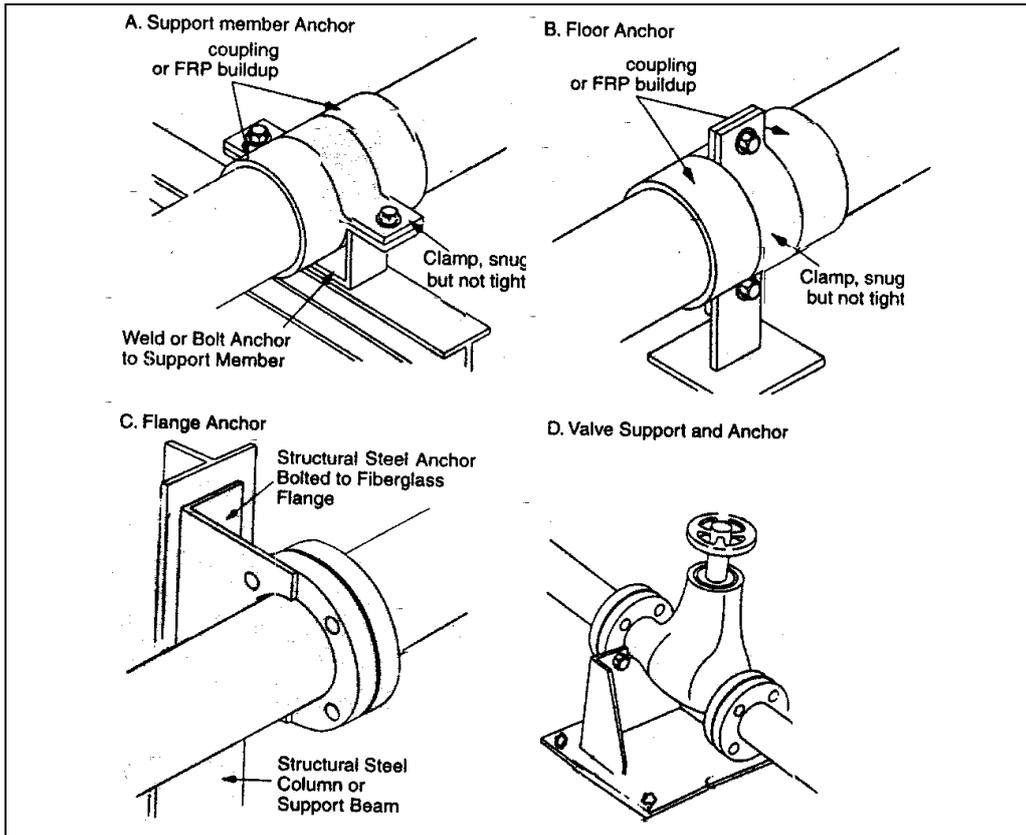
An anchor must positively restrain the movement of the pipe against all applied forces. Anchors can be installed in both horizontal and vertical directions.

Pipe anchors divide a pipe system into sections and must be attached to structural material capable of withstanding any applied forces. In some cases pumps, tanks and other similar equipment function as anchors. Additional anchors are usually located at valves, changes in direction of piping and major branch connections.

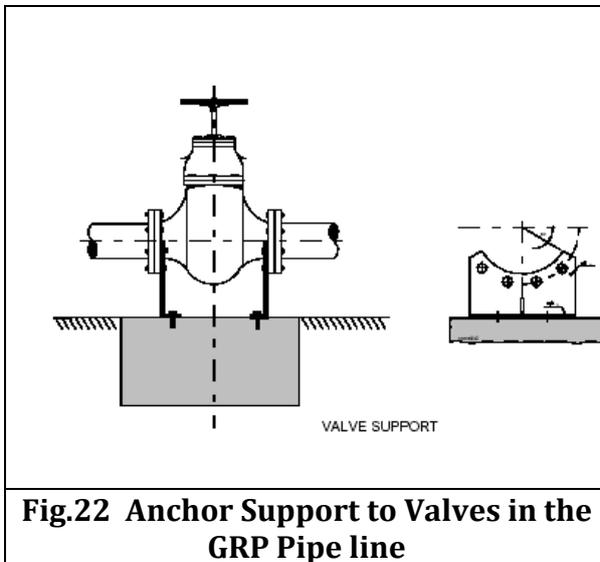
When applying unrestrained joints or mechanical couplers, pipelines must be anchored at each change of direction. Anyway the correct location of anchor points shall be settled after a detailed stress analysis.

To be effective, an anchor must be attached to a substructure capable of supporting the applied forces. In practice, pumps, tanks, and other rigidly fixed equipment function as anchors for fiberglass piping systems. Figure given below show typical methods of anchoring fiberglass piping systems. The reactions generated at anchors when restraining large thermal loads can be significant and should be calculated. The anchors brackets and substructure design should be designed with sufficient stiffness and strength to withstand these loads combined with any other system loads. Other system loads may include water hammer, the static weight of the pipe, fluid and any external loads such as insulation, wind, ice, snow, and seismic.

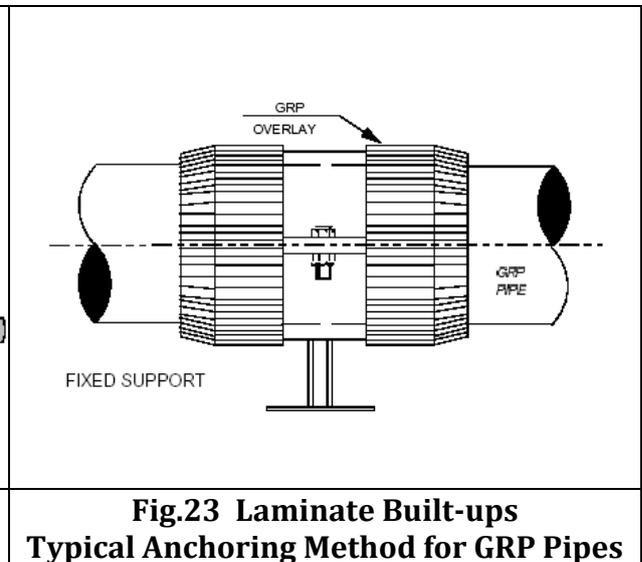
Heavy equipments (valves etc.) have to be supported independently from the pipe to avoid overloading in both horizontal and vertical directions.



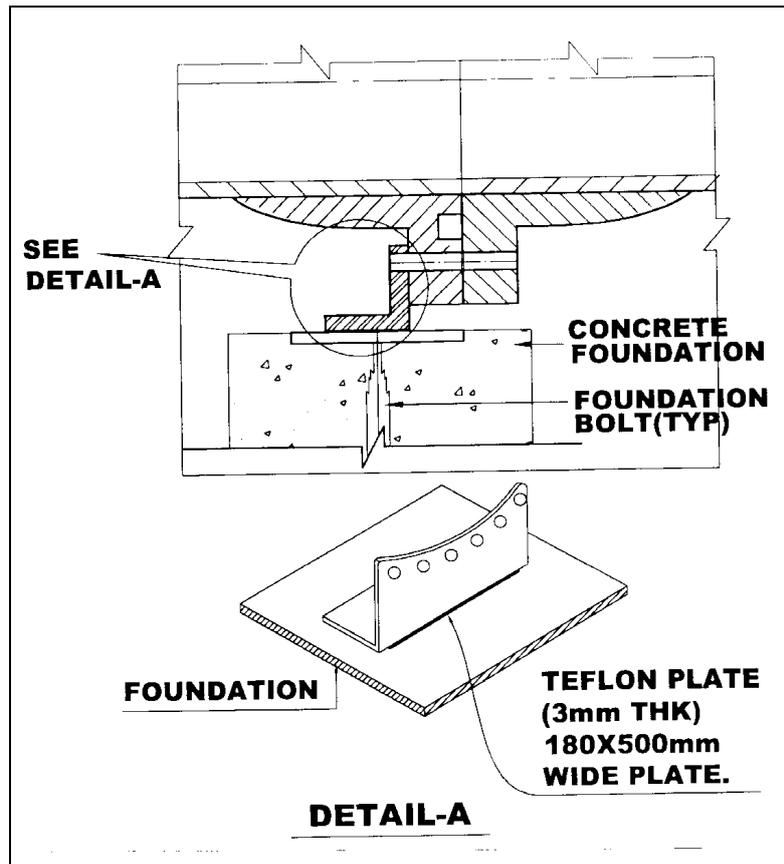
**Fig.21 Different Anchoring Arrangement**



**Fig.22 Anchor Support to Valves in the GRP Pipe line**



**Fig.23 Laminate Built-ups Typical Anchoring Method for GRP Pipes**



**Fig.24 Typical Flange Anchor Support**

#### 10.4 Summary On Supports

- a) Do not exceed the recommended support span.
- b) Support valves and heavy in-line equipment independently. This applies to both vertical and horizontal piping.
- c) Protect pipe from external abrasion.
- d) Avoid point contact loads.
- e) Avoid excessive bending. This applies to handling, transporting, initial layout, and final installed position.
- f) Avoid excessive vertical run loading. Vertical loads should be supported sufficiently to minimize bending stresses at outlets or changes in direction.
- g) Should connections be necessary with machinery or bodies subject to vibrations, such as pumps or other equipment, it is a good engineering practice to avoid a direct link with such systems, because vibrations induce stresses on GRP pipe, which may prevail over the allowable value. The usual method to avoid vibrations is to install a flexible joint between the source of vibration and the pipe.