SEPMA

شركة صناعة الأنابيب المحدودة ش.م.م

Composite Pipes Industry L.L.C.

TECHNICAL BROCHURE
GRE SITE ACTIVITIES

44 Years Experience

www.cpioman.com

THE LEADING MANUFACTURER OF FIBRE GLASS PIPES

CONTENT

ROLES & RESPONSIBILITIES OF GRE SUPERVISOR

a) Ensure compliance with Company's HSE regulations while on site for installation, testing and commissioning of GRP piping system.

b) Inspection of all GRP materials on site and report if any discrepancies are found.

c) Inspection and ensure availability of proper equipment and other related GRP installation tools and materials.

d) Ensure installation of pipe work in accordance with vendor's specification and approved procedures.

e) Identify any specialized enclosures / stops / ends required for field test.

f) Check pipe work layout and supporting arrangements and make recommendations on any unforeseen problems regarding installation of the pipe.

g) Supervise installation, handling and testing of the complete GRP pipe work.

h) Witness hydrotesting of the pipe system and verify that it is in accordance with the appropriate field test specification.

i) Present and Ensure the correct alignment and make up of all flange connections.

j) Sign all the joints records to confirm that the joints constructed are as per the approved procedure.

1. Job description of GRE Bonder:

a) Ensure compliance with Company's HSE regulations while on site for installation, testing and commissioning of GRP piping system.

b) Ensure installation of pipe work in accordance with vendor's specification and approved procedures.

c) Report all defects of GRP product found during handling or installation.

d) Any deviation to procedure or malfunction of tools and equipment during jointing work shall be identified to Company, Contractor and vendor representative

LOGISTICS, HANDLING AND SHIPPING PROCEDURE

All pipes and fittings ends shall be protected with end caps which can withstand long duration of storage and handling Pipes shall only be transported on trucks (side booms and other lifting equipment shall not be used to transport pipe on site for distances in excess of 50 meters).

All chemicals and adhesives shall be transported in temperature controlled (20°C to 25°C) vehicles.

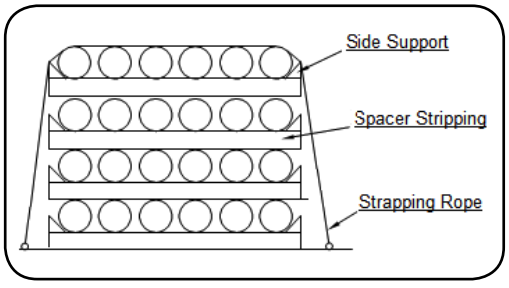
Trucks used to transport pipes shall be flat-bottomed and free of any projections or loose materials.

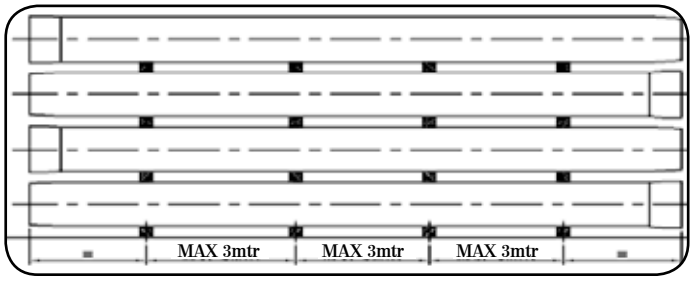
Pipes shall be protected against truck beds and side metallic protrusions by means of non-metallic soft materials.

Support the pipe and spool layers on the wooden planks (4 Supports should be provided for each layer and should be located no more than 3 meter apart and up to 2 meter from the pipe ends).

The pipes shall be stacked to a height of 1.5 to 2 mtrs. Always place the wooden planks between layers. Pipes shall be stacked with bell ends in alternative directions.

Secure the pipes with nylon slings (securing with metal rope or chains shall not be permitted) and lock them with wooden wedges.





Single pipes can be lifted with help of excavator mounted Vacuum lift of sufficient size and capacity. Other than Vacuum lifting and Roller cradles, short pipe sections up to 6 m in length may be lifted with a crane using at least 100 mm wide canvas or nylon sling. Longer pipe sections may be lifted with a 6 mtr spreader bar and two 100 mm wide nylon slings. The lifting point or points shall be such that the pipes are well balanced.

Lifting of pipes at CPI yard shall be using fork lift.





Small size Fittings shall be packed in a wooden box for transporting and site storage. Wooden pallets shall be used for larger fittings.

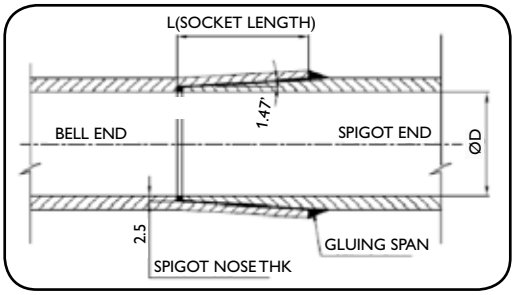
Installation contractor's stores in charge shall ensure to keep the latest version of MSDS/ SHOC cards for the chemicals stored at site.

Adhesive kits shall be stored in a controlled temperature of 20° C to 25°C away from direct sunlight and excessive humidity (not more than 75%). A continuous record (Either chart recorder or Graph or Manual recording after every 1 hour) of temperatures of storage conditions shall be maintained. Same procedure should be followed during site works also i.e. during bonding activities the adhesive kits, which is sufficient for one day's work shall be stored in a controlled temperature of 20 – 25°C.

- The solvents used for cleaning must be stored separately with the statutory notices as these materials are highly inflammable.
- The storage of the adhesive kit shall be in accordance with the Material Safety Data Sheet (MSDS). The MSDS will be sent from CPI along with the delivery of this material.
- No consumable batch shall be stored or used beyond its stated shelf life.
- Ancillary materials (Gaskets, centralisers, end seals etc), all equipment & tools (Heating blankets, Calibration machines, arbors, power drive, flapper wheel, grinder etc) shall be stored inside a lockable enclosure protecting them from sand, dust, humidity and direct sunlight.
- All rejected material shall be quarantined, packaged and transported to proper location as agreed with Company for disposal.

TYPES OF JOINTING SYSTEMS

Adhesive Bonding Joint: The adhesive-bonded joint consists of a tapered bell end and a tapered or cylindrical spigot end, bonded with an adhesive/hardener mixture, the tapered bell and tapered spigot joint has two matching tapered surfaces and does not make up to a shoulder. Taper/taper joint is a stronger joint but is more prone to positional errors if incorrectly assembled, which can weaken the joint. Preparation and make-up of the adhesive joint tends to become more difficult with increasing diameter, particularly for diameters above 450 mm



Standard Precautions:

Before forming the joint every precaution shall be taken to ensure that all the moisture has been removed. If necessary, moisture, absorbed by fiberglass or subsisting on surface of the socket and spigot, must be removed by localized preheating, using heating blankets.

It is also recommended not to go for bonding during sand storms.
During the time of adhesive bonding the atmospheric humidity shall be less than 75%. Bonding surface must have a temperature of at least 23°C and less than 40°C prior to application of adhesive. If the pipes have been stored in direct sunlight for several hours and their surface temperature was 40°C (or) more, they must be allowed to cool down by utilizing shade or special designed tents before bonding.

Surface Preparation Prior to Adhesive Bonding

Check pipes and fittings to be installed, in particular for any signs of impact damage, crack or crush.

Remove the end protectors and check these areas carefully for any possible damage.

Roughening and Cleaning of the Surfaces

- Factory f ormed spigot & socket ends have to be roughened using a flapper wheel (40-60 grit) mounted on a 13 mm hand drill or Pencil Grinder, with a 2500-3000 rpm and by hand with a sheet of emery paper (40-60 grit).

Over abrading of the spigot and socket will cause the loose fit of the joint during trial fit (dry fit).

After roughening, the surfaces to be bonded should show a dull fresh finish, not a polished appearance.

- Dust removal from ends to be jointed shall be carried out using a clean, dry brush or compressed air that is dry and free from oil / moisture.
- The surface of the spigot & socket shall be cleaned by swabbing with acetone prior to the bonding using clean white cotton cloth. No other solvent shall be used.
- The cleaned surfaces shall not be touched or contaminated by oil, moisture or bare hands prior to bonding. If surfaces become wet or contaminated they must be cleaned, re-roughened made dust free using brush or clean cloth and re-swabbed with acetone.

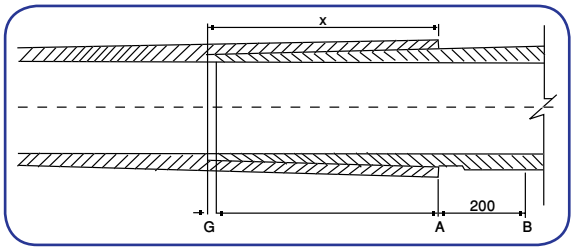
Trial Assembly

A trial assembly is required for each joint prior to bonding, to check the machining of the pipes and to determine the length of spigot penetration. There must be a gap between the stub of the socket and the spigot end that shall not be less than the dimensions given in the table 1.

a) Measure and note the length of socket (X) prior to trial fit.

b) Align and engage the end of the spigot into the socket without turning the pipe, push it home until the tapered surfaces are touching.

c) Draw two reference marks on the spigot: the first (A) in line with the leading edge of the socket and the second (B) 200 mm further along the pipe from the first .



Trial Assembly for Adhesive Bonding

d) Measure the distance L between mark A and end of spigot.

e) Assembly penetration dimension (gap) is the difference between the length of the socket X and this measure, (G = X — L).

f) If gap (G) is less than the value stated in the table 1, spigot is too long or wrong dimensions, and may touch stub of socket when bonding. Check the spigot dimensions (length and taper angle) and take the suitable corrective action. Cut back the end so it is positioned within the range. Repeat step (b) to (f) until the gap meets table 1 requirements.

g) If G is more than the value stated in the table 1, it shall be shaved more to satisfy the recommended range. The length and angle of the spigots shall be checked after shaving.

Table 1: Recommended Dimensions for Gap Before and After Bonding

Diameter (mm)	Dimension of the trial assembly penetration G = (X - L), mm	Gap after adhesive bonding, mm
25 to 100	2 to 5	1 to 2
125 to 250	3 to 7	1 to 3
300 to 450	3 to 10	1 to 5
500 to 600	3 to 12	1 to 7

Cutting and Machining

The pipes and fittings are delivered ready for use. However, sometimes it is necessary to cut pipes to the required length on site. In this case, the end shall be calibrated for adhesive bonding. It is recommended that the number of site adjustments of this type be kept to a minimum wherever possible.

Cutting of the pipes is to be carried out by using diamond-tipped tools and the shaving (calibration) using portable site calibration machine.

Cutting

1) To cut the pipe, mark the cutting line. The cutting line can be marked on the pipe with the help of a band of steel or aluminum wrapped outside the pipe.

2) Mount the diamond-tipped disk on an electric grinding machine for the cutting purpose. The cut must be made perfectly perpendicular to the axis of the pipe. Avoid the use of metal-cutting saws, which will damage the pipe internal surface.

3) Cut cleanly through the wall of the pipe, leaving an edge completely free of irregularities/ delamination.

Machining of Tapered Ends

The equipment for the machining of the pipe ends comprising of:

• Portable site calibration machine • Power Drive • Clamping device to hold the pipe

• Calibration head • Set of wooden wedges.

Machining procedure (for site)

- Check the shaving machine, tools and ensure proper support before starting.
- The pipe piece to be calibrated shall be held securely on a stand using clamping devices and with set of wedges. The calibration head along with the calibration machine shall be fitted on the pipe end to be calibrated.
- Align the calibration head as true as possible and tighten the calibration head using a spanner with the rotational support in the back to avoid oval movement of the tool.
- Check and ensure that there will be no vibration while operating the calibration machine.
- The cutting tool should be adjusted to give a cut of maximum 1 mm depth, until the nose thickness reaches to 5mm.

- Maximum of 1mm cutting depth by one full clockwise turn reduces the pipe spigot diameter by 2 mm.
- Start up the power drive and hold it tightly. The cutting tool will advance automatically as the calibration machine is rotating around the pipe.
- Once the cutting tool reaches the end, stop the power drive and bring the tool to its original position and provide feed again. Start the power drive again and repeat the steps until the taper is formed.
- After attaining 5mm nose thickness, rest of the cut should not be more than 0.5mm depth.
- Minimum Spigot nose thickness should not be less than 2.5mm.
- The taper shall be visually and dimensionally inspected after completing the tapering operation. Factory calibrated/certified jig shall be used to check the taper.

Note: Speed, Feed and depth of cut shall not create vibrations while calibrating the spigot.

Below Table shows the types of calibration machine to be used depending on the diameter.

Sl.No	Pipe Size	Type of Calibration Machine
1	15 - 80	CPI M80
2	80 - 150	CPI M86
3	150 - 400	CPI M87
4	400 - 600	CPI M87XL

CPI M80

CPI M86

CPI M87

CPI M87XL

Adhesive Systems

Adhesive will be supplied in kits consists of two cans each Epoxy Adhesive Resin and Epoxy Adhesive Hardener). Adhesive kits shall be stored in the original packaging in an air-conditioned environment with a controlled temperature between 20 to 25°C.

Adhesives shall be used on a first in – first out basis

Note: 1) The constituents of the adhesive shall be handled with care. It is recommended to wear gloves and goggles. The adhesive shall be prepared in a well-ventilated area.

Note: 2) In the event of adhesive contact with the skin, the affected area shall be washed with soap and water. In case, the adhesive enter into the eyes, immediately rinse thoroughly with water and refer to an eye specialist.

Note: 3) For more details refer the MSDS and technical data sheet supplied along with adhesive kits.

Adhesive Mixing

Check the expiry of adhesive kit before use. Expired adhesive shall not be used. The complete hardener shall be removed from the can and added to the resin can. The entire resin and the hardener shall be mixed by spatula. Mixing shall continue until the adhesive mixture has a uniform and consistency colour. This shall be reached in the minimum possible time (3 min).



Bonding shall not be carried out when the bonding surface temperature is below 23°C or above 40°C prior to the application of the adhesive.

The exothermic reaction between the resin and hardener would start immediately after mixing, if the adhesive starts to heat up in the mixing can; it has started to get harden and must be discarded. If lumps or gels are apparent in the can, the adhesive must be discarded safely.

Applying the Adhesive

The adhesive must be applied to both the spigot and the socket and more importantly on the leading edge of the spigot.

A thin uniform coating of adhesive shall be applied to the bonding surfaces, taking care to avoid an excessive resin bead on the inside of the pipe which will cause flow disturbance. Excessive adhesive bead shall be removed immediately after jointing by the use of a pull through. The height of adhesive bead shall not extend into the pipe more than 5% of the inner diameter or 10mm whichever is smaller.


First the socket internal surfaces shall be applied with a layer of adhesive mix. The layer applied on the inside of the socket must be as thin as practically possible. Spigot surface can have thicker layer of adhesive uniformly distributed over the circumference.



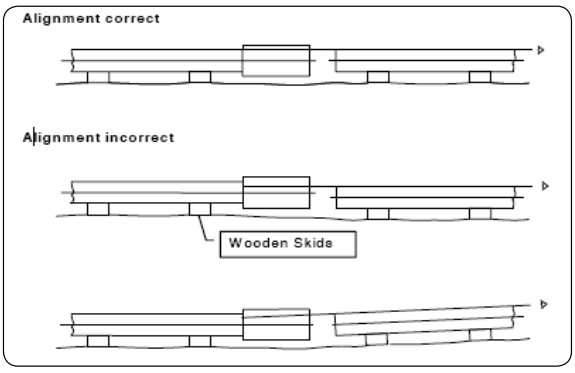
All machined surfaces including end of the spigot shall be coated with adhesive.

In the event of water or impurities coming in contact with the adhesive once it has been applied, it is essential that the adhesive to be removed entirely. The surfaces must then be thoroughly cleaned using Acetone. No other solvents shall be used. Apply it using a brush or a clean cloth. Dry the contact surfaces by heating them and re-start the bonding operation again from the beginning.

Assembly

Pipe and fittings joint connections shall be aligned as true as possible. Any visually detectable misalignment is not permitted. The alignment can be achieved horizontally as well as vertically by matching the centerlines of either pipe-to pipe or pipe-to fittings.

Depending on the pipe diameter, the axial force can be applied to get proper insertion of the spigot into the socket. *The joint should be straight at the time of insertion it should not be turned or shake.*



Proper and Improper
Alignment Demonstration

Pipe of 4" and above shall be assembled using mechanical pullers; care shall be taken to prevent the connections from being damaged during this operation. The applied tension using mechanical pullers shall be equal at both sides and in sequence to have proper alignment.

Avoid placing the pipes in bending during this operation.

During the application of tension, it shall be ensured that there shall be no direct metal contacts with GRE. Where required, rubber padding shall be provided .

Tensioning applied during bonding must remain in place until complete curing and post curing has been achieved Bonding shall be carried out without any hammering or other impact to the pipes.

Assembly of the adhesive joint up to full insertion shall be performed as a single action to avoid entrapment of air into the adhesive. Where the joint has been pulled out again, the old adhesive shall be wiped off and the bonding procedure repeated.

Assembly of a Joint Using Mechanical Pullers

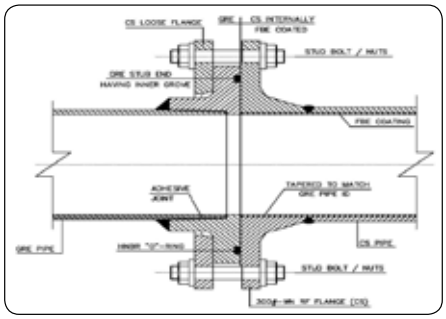
With a piece of paper smooth down the excess of adhesive that has formed around the outside of the joint to form the fillet.

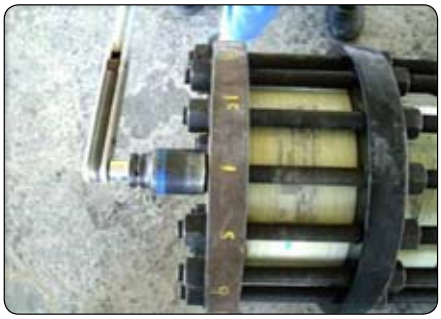
After completion of the bonding, the joint is allowed for ambient curing; for epoxy adhesive bonded connections heat assisted curing is required using the heating blankets. Monitor the curing temperature between 130 oC to 160 oC for a minimum duration of 1 1/2 hour. It is recommended to record temperature at an interval of 15 minutes for every joint To record Tg value of cured joints, bonder must keep sample (a small portion of adhesive) under heating blanket during curing process.

Site Flanged Jointing

Flanged joints facilitate connections of piping network with Steel to GRE or GRE to GRE and allow for easy assembly and disassembly of piping systems.

Typical arrangement of GRE stub end to CS flange connection using 'O' ring, GRE flange to CS flange connection using gasket & spacer ring, GRE stub-end to GRE stub-end connection using 'O' ring.





Assembly of joints

Ensure that the flat surface is clean, there was effective internal cleaning for the adhesive joint. The flanges must always be accurately aligned and not subject to any stress. The flange must be connected perpendicular to the axis of the pipe. Insert the NBR 'O' ring or gasket between the 2-flanged elements. Ensure that the correct size & material of bolting is used, only use clean & rust free nut & stud bolts. Insert the studs with nuts and washers on the flanges and tighten the nuts initially by hand until they are snug. Tightening of the bolts of flange connections must be done diagonally or crisscross using a Torque Wrench and shall be done according to the sequence up to the allowable bolt torque. Applying over-torque to compensate for poor alignment of flanges or other discrepancies is not allowed.

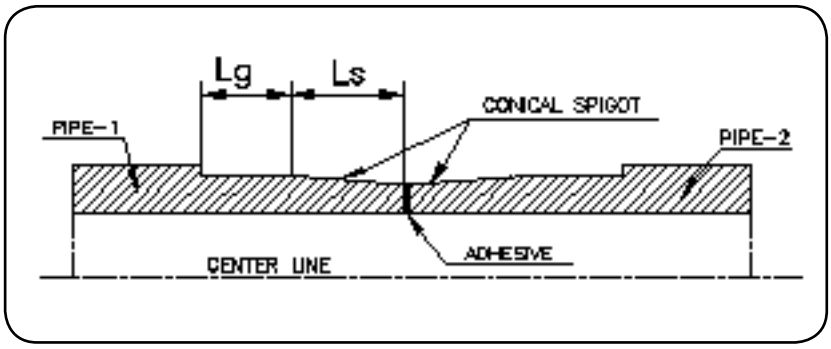
Lamination (Butt & Wrap) Jointing

Marking & Cutting

After proper measurement and identification of joint location, location shall be marked all around the pipe using marker and pipe wrap to have correct alignment. Angle grinder shall be used for cutting the pipe, square ness shall be maintained. Cutting has to be always in vertical direction.

Machining

The pipe ends to be joined shall be prepared as conical spigot by using calibration machine / emery disc. Grind over a length after spigot using emery disc and to a depth of 0.5 mm it is required to expose the glass fibre.



Pipe End (Conical Spigot)

Minimum Requirement of Grinding

The Grinding depth from outer diameter of pipes is minimum 0.5 mm and grinding length shall be enough to achieve a slope of 1:6 on both end of lamination.

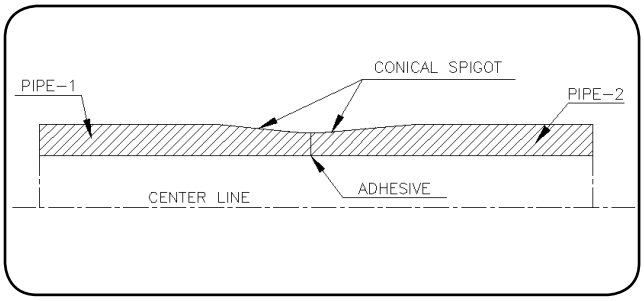
The grinded surfaces shall be cleaned using a clean dry brush/cloth or with compressed air that is dry and free from oil. Make sure that the tapered surfaces shall be free of traces of oil or grease. Do not touch the surfaces once they have been prepared. If the surfaces become wet or contaminated by oil or moisture, they must be cleaned, re-ground and made dust free. The cleaning of the surface to remove the oil or grease shall be done with acetone. No other solvent shall be used. Apply acetone using clean cloth.

Wedging of Pipes

The pipe ends shall be wedged carefully and should be secured such that the center lines should not be disturbed during application process and avoid any other reason for misalignment of the two parts so as to prevent relative movement to one another during jointing until complete curing has taken place. Please note: the maximum gap allowed between the pipes after wedging shall not be more than 3 mm. It is recommended to have the gap as minimum as possible.

Building up the joints

Before making the lamination, join the two pipe/fitting ends by applying the adhesive glue on the ends. Ensure that the adhesive glue penetrates into the gap.



Do not apply any glue on the grinded surface. After hardening the adhesive, grind the surface of adhesive to get an even lamination area.

Fit layers

The bonding surfaces must have a temperature of at least 23°C and less than 40°C prior to application of resin. Also the relative air humidity at the bonding site shall be 75% or less.

Mix the resin and hardener by shuffling buckets to get the homogeneous blend, i.e. uniform colour and consistency. Avoid air bubbles during mixing. The mixing operation shall be carried out in a dry place away from direct sunlight.

Apply the resin hardener mix on the bonded surface using the roller or brush. Wind five layers of woven roving with 100% over lap around the bonded surface, width of fit layer shall be 100mm. Apply the resin hardener mix until woven roving is fully impregnated and remove any air pockets or air bubbles using the rollers.

Resin mixture shall be mixed to ratio of 100:23:1 (Epoxy Resin : Hardener : Lactic acid) parts per weight. Allow the laminate to harden, then wrap heating blanket around the lamination and cure between 130°C to 160°C for 30 minutes. Cool the joint in free air for 30 minutes and remove heating blanket. Grind the fit-up area using 4" – 60 Grit grinding disc mounted on grinding machine and clean entire joint area (spigot + grinding length) with brush then with cotton rag and acetone.

Main Reinforcement

The main reinforcement (lamination) shall be done using resin mixture that shall be mixed to ratio of 100:23 parts per weight. (Epoxy Resin: Hardener), as used to manufacture the parent pipes and fittings.

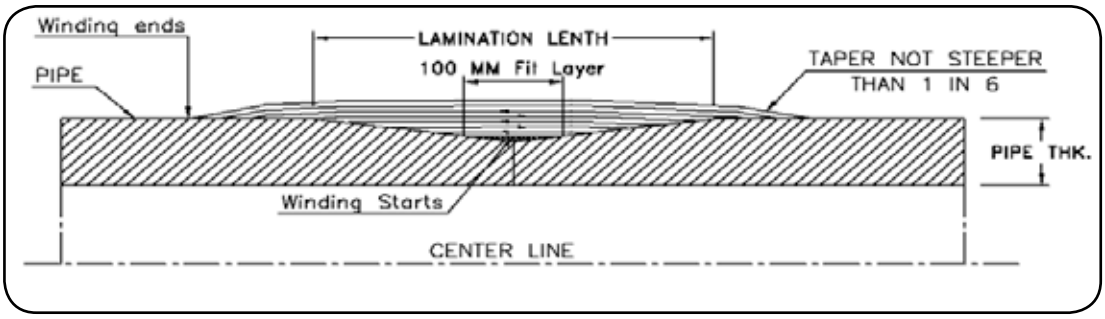
• Apply the resin hardener mix on the prepared joint and wind the layers of woven roving with 50% over lap.
• Start winding from the middle of the joint and increasing winding length in each pass on both sides in a filling manner up to the level of the pipe.
• Once the winding reach equal to the level of the pipe, each pass length shall be increased step by step (1 cm for each 3 passes) to construct the lamination in a way of tapered end until getting the required thickness of the lamination.
• Winding length shall be continued till the extended length (Lg. + Ls.).
• Remove the air bubbles (if any) using the Steel roller during the lamination process.
• Top coat shall be applied after achieving the required thickness.

The winding can be temporarily stopped and restarted by keeping the following procedure.

• Make sure, laminate surface is even and no dry areas.
• Lay-up or wind tear off tape on entire laminate with minimum 10mm overlap.
• Make sure, no air entrapment.
• Allow the laminate to harden in ambient temperature for two hours.
• Pull out tear off tape just before restarting
    - Make sure laminate surface is clean and even
• Continue the winding process
• In case tear off tape not available hardened laminate shall be grinded with emery disk to remove the resin rich top coat, to obtain an even and clean surface to continue lamination.

Once the butt & wrap joint done, PI tape or Circometer used to check the Outside diameter of butt & wrap joint. The achievement of required thickness (1.5 times the pipe wall thickness) shall be checked.

As required lamination thickness reached, finish the lamination by applying a layer of polyester veil (T1702) with 10% overlap. Allow the laminate to get hardened.



Curing

Heat assisted curing shall be performed using heating blankets with temperature controller immediately after the hardening of the laminate. Curing process shall continue for 3 hours at temperature of 150˚C.

The Butt & Wrap joint shall not be moved or disturbed until it is fully cured. The pipes end shall be covered during curing process this shall stop air cooling the inside of the joint.

PROCEDURE FOR LAYING OF UNDERGROUND GRE NETWORKS

Excavation of the Trench

The trench shall be excavated and graded sufficiently deep and wide to allow for 300mm bedding below, 150mm padding on both sides and 300mm padding on top of the pipe after compaction for the continuous length of the pipeline.

At locations where it is necessary to do jointing the trench (e.g. tie-ins) a bell hole shall be excavated to provide a minimum of 500 mm working space on both sides and below the pipe. The trench profile after excavation shall be such that the radius of curvature in any plane is greater than the minimum allowable bending radius of the GRE pipe.

Also the local high and low points in the trench bottom shall be levelled off to provide a smooth continuous profile. Clear the bottom of the trench from all sharp particles. The trench bottom and sides shall be kept free of all brush, skids, pipe protectors, rocks, large clods, sticks, projecting rocks and other hard objects at all times after stringing of the pipe.

Any such items encountered shall be removed prior to pre-padding operations so that the pipe is not damaged, punctured or abraded. Any stonework or rock outcrops encountered in the trench shall be cut back below the level of the bottom of the trench.

Hand work shall be done in the trench as is necessary to free the bottom of the trench of loose rock, stones and all other irregularities so as to leave the trench bottom in a clean and suitable condition to receive the pipe. The trench work and depth shall be in line to the approved "AFC" alignment sheet drawings, typical details and crossing drawings.

Pipe Bedding

Fine clean dune sand is permitted. Sieve size of screening machine shall be 3 X 3mm, No padding shall be placed until the trench bottom profile complies with the minimum bending radius of the GRE pipe. All trenches shall be fully pre-padded before lowering in or jointing in the trench. The installed padding material shall be free from sharp rocks, stones, metal parts, roots, clods, etc. and without sharp edges which could damage the GRE pipe. Base materials from which pre/ postpadding material will be produced shall consist mainly of sandy material and the maximum particle size of the sand padding is 3 mm.

The bottom of the trench shall be padded with sand throughout its length, whether in normal ground or rock, so as to provide a minimum compacted padding thickness of 300 mm below the invert of the pipe.

Pipe Stringing

Pipes shall not be placed directly on the ground; pipes shall be placed on sand bags or wooden skids with proper protective padding (rubber sheet). Dragging, skidding or dropping of the pipe is not permitted. Wooden wedges shall be used to prevent movement of each strung pipe.

Where possible the skid elevations shall be planned such that minor differences between grade profile and bottom of trench profile (e.g. at locations where an increased trench depth is required) can be accommodated without requiring an additional tie-in. The distance between the trench edge and the pipe string shall be planned such that safe working space is provided.

Pipe stringing shall be in such a manner so as to cause no interference with public roads, footpaths, tracks, etc. Suitable gaps shall be left at intervals as necessary to permit the passage of livestock and/or equipment across the Right-of-Way and as directed by the Company.

The length of pipe string shall be planned with due consideration of thermal expansion and other expected or accidental movement of the pipe string. Special attention shall be paid to strings with one or more bends, in view of the inherent increased risk of failure of skids due to movements of the pipe.
Length of individual pipe strings shall be subject to Company approval and shall generally not exceed 1 km.

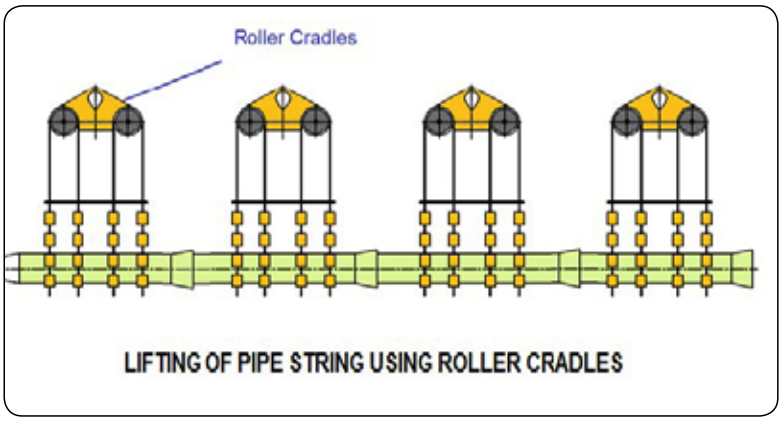
Pipe Laying

The trench shall be maintained in a dry condition during lowering-in and backfill operations. During lowering in operations the pipe shall not be subject to bending in excess of the minimum allowable bending radius of the GRE pipe.

The pipe shall be restrained in the trench by means of 'plugging', i.e. placing sand on top and around the pipe at regular intervals (one 6m 'plug' in the middle of every pipe) or by any other approved equivalent method. Strings longer than 100 meters shall not be allowed to lay in the trench without sand plugging. This is to avoid 'snaking' and abrasion of the pipe due to thermal movement. Sand padding shall be placed around and above the pipe, so as to fill the trench to a depth of 300 mm above the crown of the pipe, with the sand padding shaped to its natural angle of repose and with a minimum of 150 mm each side of the pipe and 300 mm below the pipe. (Joints shall be left fully exposed around the joint circumference for inspection until completion and acceptance of the hydro test).

Out-of-Trench Assembly

Place sand bags at 400 mm from each end of the pipe to be joined. Leave the space between the two pipes that are greater than twice the length of the socket. Check the pipes for line and level and adjust if necessary. Before jointing the pipes, check that nothing has been left inside the pipes and clean the ends carefully. Spreader bar and minimum 200mm wide nylon slings can be used for lowering the pipes. Do not attempt to handle the pipes until complete curing of the joint has been done.



LIFTING OF PIPE STRING USING ROLLER CRADLES

In-Trench Assembly

The lack of space coupled with the risk of falling sand, stones or other debris are critical conditions. The trench shall be excavated and graded sufficiently deep and to provide a minimum of 500 mm working space on both sides of the pipe (In case, jointing is done in the trench) in a safe, properly prepared bell hole and space for 300 mm of padding material after compaction below the pipe and minimum of 150 mm on both sides and for the continuous length of the pipeline.

Back filling

Backfilling shall be performed as soon as possible after padding has been approved, but not prior to the successful completion of the hydro test. Initial padding should be 300mm over the pipe for hydro testing only and later upon the successful test, balance padding at the joints and back filling should be performed.

In areas containing buried cables, backfilling shall not be performed until all tiles have been replaced and protected and/or all cables have been supported. The backfill around all underground services shall be thoroughly compacted by hand.

For foreign pipeline crossings special precautions required against damage by equipments and vehicles. The minimum distance / gap between the pipe and crossings shall be 500mm, the backfill and compacting shall be carried out by hand.

Anchor / Thrust blocks

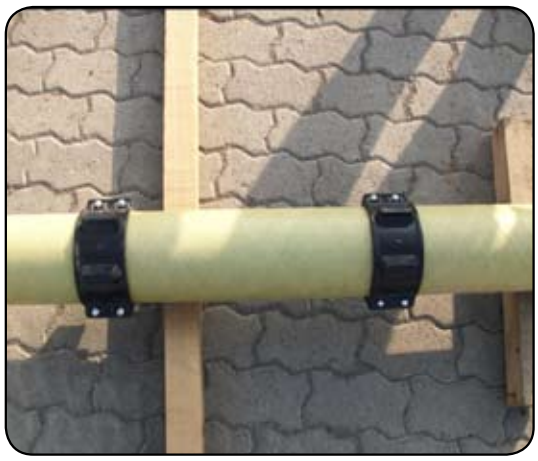
Anchor / Thrust blocks shall be installed at the specified locations as per the stress analysis before doing the hydrotest. Trench shall be sufficiently deep and wide to accommodate them. The anchor/thrust blocks needs to be cast against stable/undisturbed soil otherwise the backfill between the block and native soil shall be compacted to 100% SPD.

Road crossing

The GRE pipe has to be installed and protected with Casing pipes at road crossings as per drawings. Centralisers shall be used to support the GRE pipe inside the sleeve; distance between centralisers shall be max.3000mm. The end seals shall be used to prevent the entering of any dust or sand particles.

Installation of Centralizer and End Seal

1. All Pipes shall be protected with correct Centralizers with 3 meter spacing.
2. Place the parts of the centralizer on either side of the pipe and tight the stud bolt which is coming along with the set.
3. Insert the GRE pipe inside the casing pipe slowly and carefully and make sure that centralizer coming at the end of the casing pipe should not be more than 300 mm from the end of the casing pipe.
4. Wrap the End seal on the GRE pipe and casing pipe together in such a way that bigger side of the end seal coming at casing end and smaller side on GRE with overlap on top side.
5. Tight the end seal with Juggle clamp on both sides which shall be supplied along with End Seal.



Cenralizers fixed on pipe

Pipe fixed with centralizer inserting inside the casing

Fixing of End Seal

Tightening the endseal with juglee clamp

End seal with Juglee clamp

Cenralizers with Stud bolts & nuts

Flange Pits

The GRE pipe has to be installed and protected with CS sleeve pipes at all Flange pit wall crossings. Link seals are provided to seal the annular opening between the GRE pipe and the CS sleeve to avoid seepage and tight proof GRP pipe. In addition, it protects GRP pipe against the concrete wall / CS sleeve to have direct contact and rubbing at operating conditions.

PROCEDURE FOR LAYING OF ABOVEGROUND GRE NETWORKS

Civil Work & Supports:

Supports shall be fixed on the piping system as per the approved drawings for construction. These drawings shall show location and type of supports. Supports shall not exert any additional force on the piping, no twisting, no bending shall apply. Foundation of the support and sub-supports shall be in place ahead of jointing activities.

It should be ensured that all the supports as indicated in the drawings are installed in correct positions.

Valves or other heavy piping equipment shall be independently supported before installing the GRE pipe system on them.

GRE piping materials shall be supported during installation using scaffolding and temporary supports. However, permanent supports shall be put in position as per stress analysis recommendations before the jointing is carried out.

Handling

Installation personnel's should strictly observe the Storage and Handling procedure of GRE pipe, fittings and spools. Move pipes / spools on the support, racks, sleepers, etc. with proper alignment. It is recommended to identify the Centre of gravity of spools so that the slings and spreader bar can be put in correct position. GRE spools and fittings shall be handled with proper care and proper alignment using of suitable slings.

Dragging pipes / spools on hard surfaces shall not be permitted.

Alignments and Levelling

During installation alignment shall be maintained properly. Proper alignment shall be considered whenever adhesive joint, flange joint is made. GRE technicians shall use spirit level & right angle toidentify the alignment of the flanges.

Pipes can be cut to the required length by Hack saw or abrasive coated disc. Pipe fitters wrap around can be used for marking and cutting the pipe to achieve the required squareness.

All piping components shall be installed stress free maintaining all required alignments. Bending of pipe to achieve change in direction, or forcing misaligned flanges together by over torqueing bolts is not permitted.

For details on tolerances and alignments please refer to table 1 & 2 of ISO 14692-4. It is recommended to aim at zero Tolerances while installation. The tolerances shall be used in worst case scenario and has to be avoided as much as possible

Jointing

All pipe jointing methods shall be strictly respected while making joints.

Installation crew shall offer the pipe / spools installed to the approved GRE Inspector at every stage so that surprises / recurring defects do not appear during installation.

Approved spacer ring and gaskets only shall be installed in the piping system. Gasket shall be thoroughly inspected before installing it between the flange parts.

Valves, check valves and other Gauges shall be installed in the piping system taking into account direction of flow. If any instrumentation or flanges needs to be dismantled due to wrong assembly; then unbolting shall be carried out in the same sequence and method they were torqued.

Supports

Supports clamps shall put on the GRE pipes after wrapping 6 mm layer of rubber sheet. There shall be no direct contact between the GRE pipe and clamps.

Moreover, due to proprietary nature of GRE piping system, standard-size supports will not match the pipe OD. Therefore, it is imperative to make sure that the support and cradle with elastomeric pads match the pipe OD precisely. Clamps shall be fixed using the required bolts torque.

Guidance to span lengths (simply supported)

Pipe Size	Span (m)
25	2,0
40	2.4
50	2.6
80	2.9
100	3.1
150	3.5
200	3.7
250	4,0
300	4.2
350	4.8
400	4.8
450	4.8
500	5.5
600 >=	6,0

HYDROSTATIC TESTING REQUIREMENTS & PROCEDURES

Test Preparation

1. All supports, guides, and anchors must be in place prior to pressure testing. All pipe sections shall be adequately supported and restrained before the start of Hydro testing.

2. The pipeline shall be completely backfilled prior to the hydrotest except for the test-ends, tie-in connections and joints. These exposed sections shall be kept as short as possible.

3. All valves must be independently supported prior testing.

4. All joints shall be fully cured completed in accordance with manufacturer's specifications before pressure testing.

5. Before carrying out any pressure test, the area of the test shall be tapped with warning tape and warning signs erected at all access points.

6. Water sources and disposal shall be discussed and approved from the principal/ facility owner.

7. Filling the test section shall be done by pigging.

8. Pipe soil temperature shall be measured and recorded at each end and one at the mid length of pipeline using thermocouple type instrument with digital read out and print out.

9. Temporary test header shall be hydrostatically tested 1.25 times of testing pressure before connect to pipelines.

10. Temporary pig launchers and receivers shall be approved by the Company prior to use and shall be flanged if a permanent flange is available.

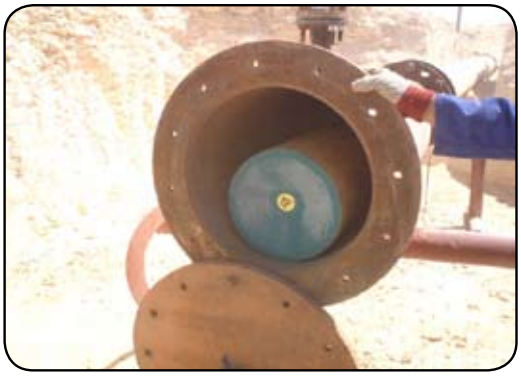
11. All the GRE joints should be left exposed.

12. Road / wadi crossings shall be tested separately before the installation.

Flushing

On completion of installation, GRE piping systems should be flushed in order to avoid any debris to damage or block portion of the network during the hydraulic pressure testing or service.

The medium used for flushing shall be soft pig, seawater or freshwater. Flushing is most effective when carried out from the highest entry point in the network. Flushing should be continued until effluent from the low point drains runs clear.



If compressed air is to be used as the driving medium for the pig , the air should be oil-free and the inlet line of the driving medium should be fitted with a pressure relief valve set at 7 bar (g).

All necessary precautions shall be taken to ensure that debris is not flushed into associated equipment or dead ends.

Flushing of pipe systems into tanks and/or vessels is not permitted unless approved by principal. The main headers, in general, shall be flushed out first and then all branches which connect to any equipment.

All instrument, vent and drains connections shall also be inspected for debris. The flushing and debris checking shall continue until all debris has been removed.

The main headers shall be flushed for 30 minutes and branches for 15 minutes or until clear water is seen, whichever is the longer. Alternatively, temporary strainers can be installed on discharge outlets in order to determine when the debris has been removed. When there is no further build-up evident on the strainer mesh, flushing can cease.

On completion of flushing and debris checking, all flanged connections shall be made up, with new gaskets to suit the relevant line specifications.

All GRE piping systems shall be hydraulic pressure tested after installation.

Systems, which are open to atmosphere, shall at least be subjected to a hydrostatic leak test, and may require full hydrostatic pressure, test if they could be subject to system pressure. The following test stages shall be carried out:

Water Filling

• Water shall be admitted at a suitable point in the piping or pipeline system and provision shall be made for bleeding the air at high(er) points (e.g. loosening of flange connection).

Any compressed air in the system may give erroneous results and all necessary measures shall be taken to remove air during filling.

For pipelines, this includes control of back-pressure, a steady, controlled filling rate, the use of a break tank and of at least two foam pigs with water in front and in between. If possible, the line should be filled from the lower end. Venting shall be carried out repeatedly at points in the test section where air might accumulate, e.g. at ancillary piping. The filling pig speed shall be controlled at approximately 0.6 m/s and should not exceed 1.8 m/s.

Temperature Stabilization

The temperature of the line-fill water should be stable before testing commences, prior to commencing the hydrostatic test, the water temperature should be within 1.0 °C of ground or seabed temperature. This shall be determined as the difference between average pipe temperature and average ground temperature over the test section length.

Pressure and temperatures, including ambient, shall be recorded every hour during the stabilization period.

The test section temperature and the ambient temperature (ground/air/water) shall be plotted against time during the temperature stabilization period.

Air Content Determination

The air content of the filled line shall be determined during initial pressurization.

Percentage air content = (Volume of air / Volume of line) 100

If the air content exceeds 0.2% of the line volume, testing shall be terminated and an

Investigation shall be carried out to determine the cause. The test section should be emptied and refilled at the discretion of the Company.

Hydrostatic Strength Test

The (Strength test) shall be carried out at rate of 2 bar per minute till the required pressure, value of which is achieved with 1.5 times the Design Pressure or 0.89 times the qualified pressure, whichever is lower and held for a period of 1 hour. After the test the line has to be inspected to see indication of any leakage or damage occurred during test.

Hydrostatic Leak-Tightness Test

After successful completion of the (Strength test), pressure shall be released on intervals that not exceeding 2 bar per minute. Leak-Tightness Test shall be carried out at a value equal to 1.1 times the design pressure.

The test pressure shall be held for a minimum of 24 hours for all buried pipelines and flow lines and 3 hrs duration of testing for aboveground station pipework and above ground pipelines and flow lines (or) any agreed duration.

During Leak Tightness no water shall be added to or removed from the piping system. During both tests, the pressure and temperature shall be recorded continuously. Pressure and temperature recorder shall be used.

In the event of a pressure drop during the leak-tightness test, a «step-test» shall be performed. In this test, due to several parameters like the temperature variation, the pressure has to be controlled and monitored.

In this test, the test section shall be re-pressurized to the leak-tightness test pressure (i.e. 1.1 times design pressure) and after each hour the pressure shall be recorded and the section re-pressurized by adding water.

The quantity of water required to bring the section back up to test pressure shall also be recorded. If the quantity of water added each hour shows a decreasing trend, then it may be considered that the pipeline is tight. If the quantity of water added remains constant, then it can be assumed that the pipeline is not leak-tight.

This can be considered as an additional check to determine whether any pressure variation has been caused due to temperature changes can eliminate the doubt of piping system leakage.

GRE installation contractor shall provide a list of the testing equipment he is intending to use along with the testing procedure.

Water shall be admitted at a low point in the system and provision shall be made for bleeding the air at high points. Any air pockets may give erroneous result as well as damage the piping during the pressure test.

Venting shall be carried out repeatedly at points in the test section where air might accumulate, e.g. at ancillary piping.

Therefore, the line must be equipped with flanged head with valve and manometer for filling at lower point, and flanged head with bleed valve at upper point.

It is advised to contractor to use a pressure safety valve adjusted at 3% above specified test pressure.

Over-torque of flanges to stop leaks during the filling stage is not permitted. Leaking flanges shall be remade with new gaskets and re-tested. If leakage still occurs, flanges must be replaced.

Insertion of «Manual Piping Shutter» between Composite Flanges shall not be used. Hydraulic test has to be done from fixed metallic closing device to fixed metallic closing device.

Depressurization

After the satisfactory completion of the strength and leak tightness tests, the test section shall be depressurized to hydrostatic head plus 1 bar so that air does not enter into the test section.

Under normal circumstances the depressurization rate shall not exceed 1 bar per minute until the pressure has been reduced to 40% of the test pressure. Then depressurization should continue at a rate of less than 2 bar per minute.

After controlled depressurization, all remaining vent and low point drain valves shall be opened and the system thoroughly drained. Temporary blinds and testing equipment shall be removed as well as the temporary supports.

Gaskets at flanged joints, which have been broken for testing, shall be renewed, unless otherwise agreed with the Principal.

Flanged Spool Hydrotesting

Flanged spools, spools that have flanged ends and can be blinded independently using steel blind flanges, pressure heads or the Hydrotesting launcher and receiver, shall be hydrotested separately if the hydrotest of the entire pipeline is not required.

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