grp

GLASS FIBER REINFORCED POLYESTER PIPES AND FITTINGS INSTALLATION MANUAL


kuzeyboru ø GRP


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about us

Kuzeyboru was established in 2001 with the vision of a global brand offering innovative solutions for infrastructure and superstructure piping systems. Kuzeyboru is specializes in the production of GRP, HDPE, Corrugated, PPR pipes and fittings with its world-class production facilities and wide product range and offers comprehensive solutions for infrastructure and superstructure projects.

Acting with a sustainable production approach, Kuzeyboru has been a professional solution partner in many infrastructure and superstructure projects in 105 countries in 5 continents since its establishment. It has become one of Turkey's largest manufacturers in GRP, Corrugated Pipe, HDPE and PPR product groups with its modern facilities built on a total area of 200.336,23 m². Having the title of "The First Ministry Certified R&D Center" in the plastic pipe sector, Kuzeyboru aims to develop innovative production techniques, process optimization and create an ecosystem that can respond quickly to the changing needs of the market with this center. The R&D Center is one of the important building blocks that contribute to Kuzeyboru's sustainable production targets.

Beyond being a professional solution partner, Kuzeyboru also makes a difference with its projects that add value to society. In line with its social responsibility principles, it prioritizes women's employment and equal opportunities and takes important steps in this field. With the "Etkiniz" project, the Company aims to create social benefit by reducing the environmental impact of production, increasing energy efficiency and developing projects for future engineer candidates. In addition, the Company strengthens the place of women in society and contributes to national sports by supporting the women's volleyball team in the Sultans League.

200.336,23 m²
production
area

5 continents
Export to
105 countries

Among the 100 fastest
growing companies
according to TOBB data

%100
domestic capital

environment and sustainability

Kuzeyboru holds the TS EN ISO 14001 Environmental Management System certification, emphasizing its commitment to environmental safety. The company prioritizes health and environmental considerations in the development of its innovative products. Recognizing the environment as a precious treasure, Kuzeyboru places significant importance on sustainability, carbon footprint monitoring, and the use of renewable energy.

Kuzeyboru effectively and efficiently manages natural resources by employing environmentally friendly technologies. It also raises awareness among its employees and stakeholders to protect biodiversity.

Sustainability is a strategic priority for Kuzeyboru and an integral part of all its activities. The company meets its energy needs for production from sustainable sources, thanks to its land-based and rooftop solar energy systems.

glass fiber reinforced polyester (grp) pipes & fittings installation manual

Introduction

This manual has been prepared to help field practitioners fully understand the steps required for the correct and safe handling, loading, unloading, and installation of Kuzeyboru GRP pipes in accordance with international standards.

When using the installation catalog, safe engineering principles and widely accepted practices should always be considered. It is important to remember that the information presented here is for reference only. Project-specific specifications take precedence over the general information in this catalog, and Kuzeyboru should be contacted in case of any uncertainty.

This catalog is not a substitute for the decisions and instructions of the engineer who has final approval authority on behalf of the owner. If any doubt arises as to the information presented herein, it is recommended that you contact Kuzeyboru or the responsible engineer to avoid errors.

Field Services

The field service supervisor provides support to installers, ensuring that Kuzeyboru GRP pipes and fittings are unloaded, stacked, and installed according to technical guidelines. This support can be provided at the beginning of the installation or periodically throughout the work process, as required. Field services can be permanent or temporary, depending on the project's needs, the intensity of the on-site work, and the results of the installation applications.

Safety

GRP pipes, like other pipes made of petrochemical materials, are flammable. Due to these characteristics, they are not recommended for use in areas with high temperatures or open flames. When laying pipes, care should be taken to avoid exposure to sparks from welding machines, oxygen welding flames or hot, fiery, electrical sources, otherwise these factors may cause ignition of the pipe material. Necessary precautions should be taken to avoid unfavorable situations.

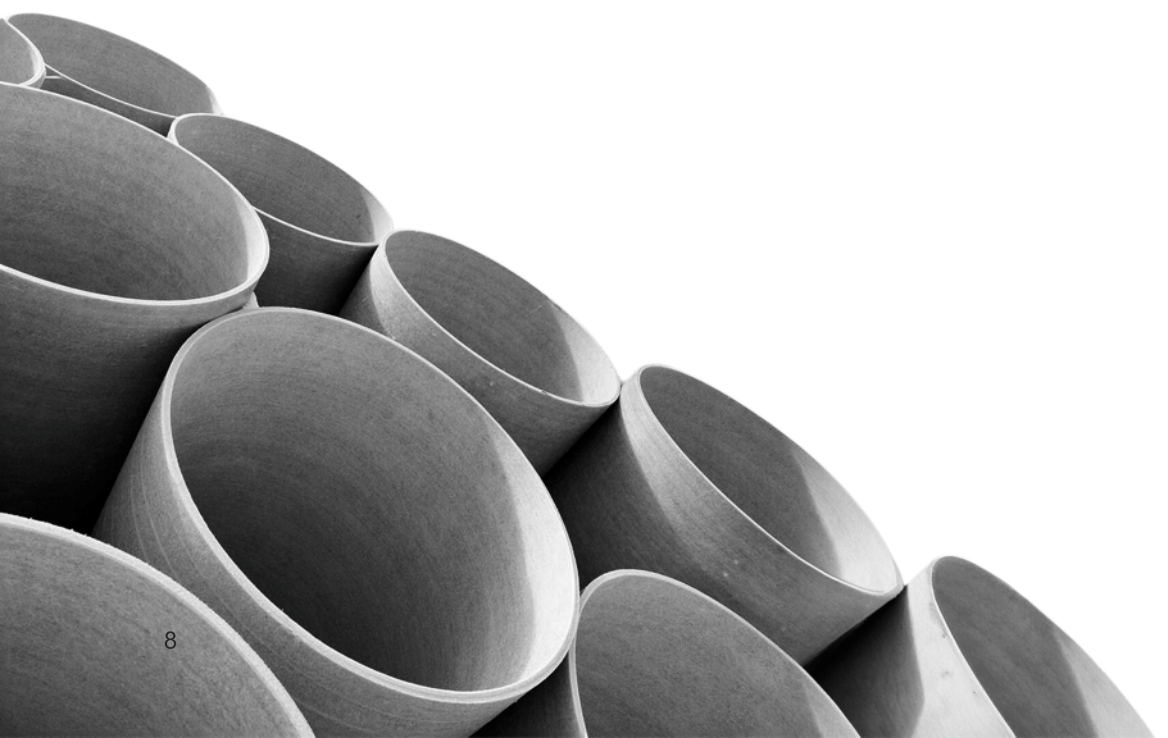
Pipes are potentially unstable during storage, transportation and installation. Movement of pipes and fittings in the stockpile and during transportation must be prevented to avoid hazardous situations caused by rolling, turning and falling of pipes at all stages on the construction site.

From delivery to the construction site to commissioning of the pipeline, all legal and operational requirements regarding occupational health and safety, fire protection and technical safety must be complied with. All instructions and standards must be checked before each application and individually according to the conditions on site.

references and standards

Commonly used standards related to the design, production and installation of GRP pipes are given below.

AWWA MANUAL M45	Fiberglass Pipe Design
AWWA C 950	Fiberglass Pressure Pipes
ANSI B 16.5	Flanges
ASTM D3262	Standards for Fiberglass Wastewater Pipes
ASTM D3517	Standards for Wastewater and Industrial Pipes
ASTM D3754	Pressurized Pipes
ISO 25780	GRP Jacking Pipes, Clean water, wastewater, drainage irrigation pipes
ISO 23856	GRP pressurized, unpressurized clean water, wastewater, drainage and irrigation pipes



1. Inspection and repair of delivered pipes

1.1. Pipe Inspection

All pipes and fittings should be checked upon arrival at site to ensure that no damage has occurred to GRP pipes and fittings during transportation. Considering other factors such as stock conditions of GRP pipes and fittings, duration, distance from the stock location to the installation site, environmental conditions, etc., it is recommended to check the GRP pipes and fittings again before installation. The points to be considered during the delivery of GRP pipes and fittings on site are as follows;

1.!The general condition of the load should be reviewed. If the load is properly positioned, a simple inspection during unloading should be sufficient to detect any damage to the piping.

2. If load placement is disturbed, a thorough inspection of all GRP pipes and fittings is required. A visual external inspection is usually sufficient to identify damage, but if the dimensions of the pipe and fittings are appropriate, it may be useful to inspect the visible problem area from the inside to determine the extent of damage.

3. All materials must be checked against the delivery note.

4. Any damage or loss that may have occurred during transportation must be recorded on the delivery note and the signature of the relevant person must be obtained on the copy that will remain in the hands of the person receiving the delivery.

5. If defective or damaged pipes and fittings are found, the damaged pipes and fittings must be removed and the supplier must be contacted.

1.2. Repair of Damaged Pipes

Slightly damaged GRP pipes and fittings can be quickly and easily repaired on site by specialized teams. However, if you are unsure of the condition of the pipe, avoid using it. The field technician can guide you as to whether repairs are required and whether the existing conditions are suitable.

Repair methods may vary depending on the thickness of the pipe, its structural characteristics, its area of use and the type and extent of damage. Therefore, do not attempt to repair damaged pipes without consulting Kuzeyboru.

Repairs must be carried out by trained technicians. Pipes that are not repaired correctly may not perform as expected.

2. transportation, storage and handling of grp pipes

2.1. Loading and Unloading of GRP Pipes

According to the length, diameter and weight of the pipes coming from the factory, the carrying capacity and length of the cloth ropes and the adequacy of the carrying capacity of the crane or excavator that will lower the pipes should be checked.

Flexible straps, slings or ropes must be used for lifting GRP pipes and fittings. Steel cables are not suitable for lowering and lifting. For lowering and lifting of GRP pipes and fittings, cloth is generally used. and polyester ropes (with sufficient capacity: length, length, width) are used.

To prevent damage to pipes and pipe ends during lowering and lifting Care must be taken. The pipe should not be lifted by hooks from the ends.

Necessary precautions must be taken in terms of occupational safety and security during unloading, lifting and loading of pipes.

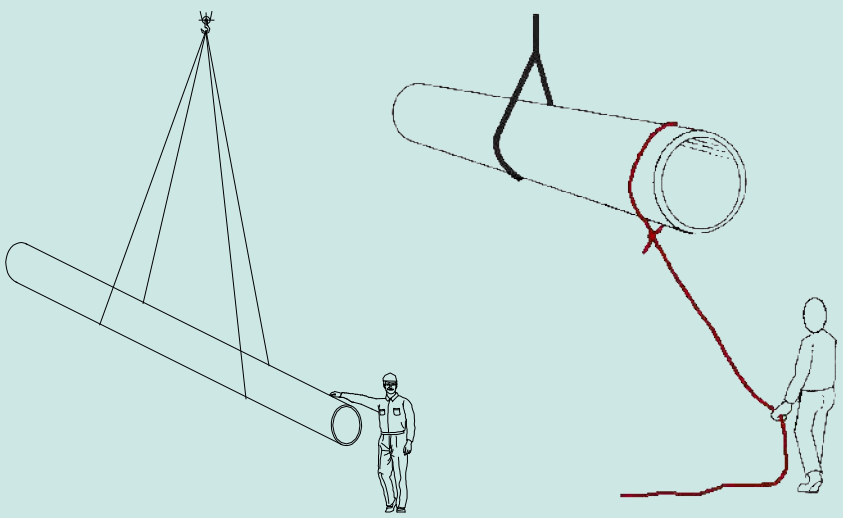


Figure 1 Lifting GRP pipes by connecting them at one or two points

2.2. Unloading of Nested Pipes

One of the key advantages of Kuzeyboru GRP pipes is their ability to be shipped by nesting, allowing for efficient packaging and transportation. Here are some important guidelines for the transportation, unloading, and handling of nested pipes:

•Nested pipes must be lifted using 2 slings. The slings used must have adequate capacity and length to lift this weight safely.

•Never stack nested pipe bundles on top of each other.

•Kuzeyboru employs special packaging and connection forms to prevent inner pipes from falling during transportation.

•The most common method for removing nested pipes is to attach a boom to one of the forklift's transport forks. The boom is usually a steel pipe with a plastic covering. During the removal process, the forklift operator carefully inserts the boom into the innermost pipe and, lifts it slightly upwards without damaging the other pipes, and then slowly pulls it out. It is crucial to ensure that the pipe being removed is not damaged during this process.

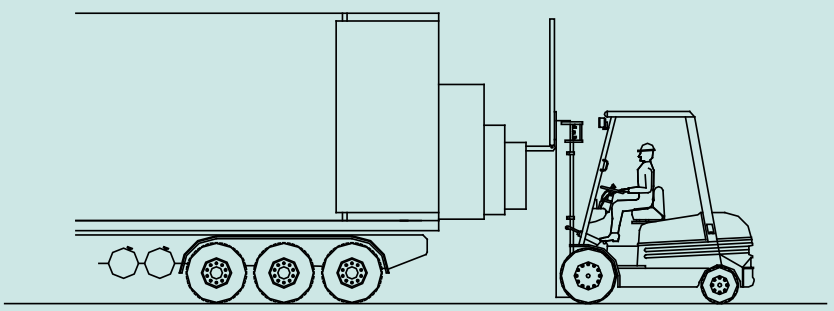


Figure 2 Removing nested pipes with a forklift truck

2.3. Stacking of GRP Pipes

GRP pipes and fittings should be placed on wooden wedges or pallets on a flat surface.

If pipes are to be stacked, at least three wooden wedges should be used for each pipe section. It is recommended to store pipes separately according to their class and pipe diameter.

Stock heights should not exceed the values shown in the table below

Table 1 Stack height and number of pipe layers

	DN 250-500	DN 600-800	DN 900-1400	DN > 1500
Number of layers	9-4	4-3	2	1
Total stack height	< 2.4 m	< 2.6 m	< 2.8 m	DN

Stocks should be supported on the sides with wooden wedges to prevent the pipes in the stack from rolling. Otherwise, when pipes are stored in the open, they may move or fall due to high winds.

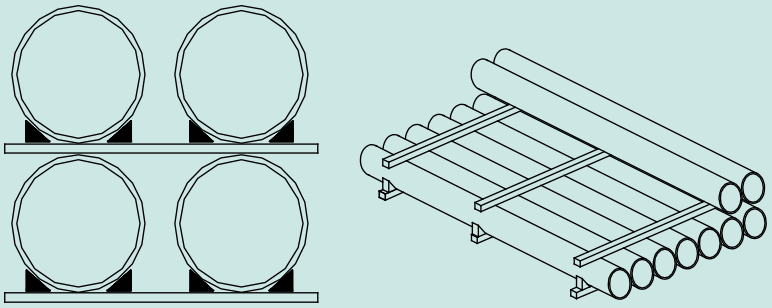


Figure 3 Securing GRP pipes in the stock area

2.4. Safety of GRP Pipes in Stock

If GRP pipes and fittings are to be stored at a temperature higher than 50 C and for long periods, it is recommended that the stack height should not exceed 2 m to avoid deflection of the pipes in the lower row. Additionally, any work involving open flames should be avoided in the immediate vicinity of the pipes.

2.5. Transportation of GRP Pipes from Stock Area to Installation Site

- *When pipes are transported to the installation site, they must not be loaded above the carrying capacity of the transportation vehicle.*
- *It must be ensured that the pipes do not come into contact with each other to prevent any damage caused by movement and vibrations during transportation.*
- *The pipes should be supported with wedges to prevent damage by moving.*
- *The maximum stacking height of the pipes on the vehicle is approximately 2.5 meters and they should be secured to the vehicle with the help of slings or straps over the support points. If steel cables or chains are used to secure the pipes, suitable buffers must be placed between the pipe and the cable or chain to prevent abrasion on the pipe surface.*

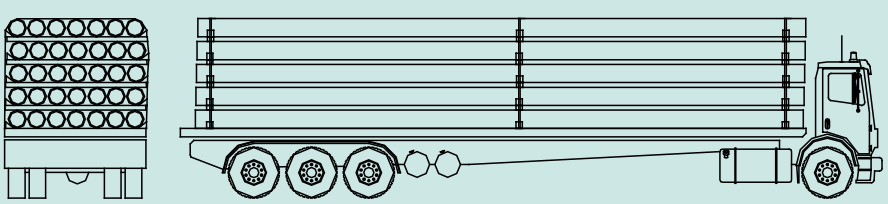


Figure 4 Handling of GRP pipes during shipment

2.6. Delivery of GRP Pipes by Ship

GRP pipes can be shipped abroad in containers and can also be loaded as open cargo in ship warehouses and decks. When preparing pipes for shipment by container, consider the outer diameter of the sleeve and the length of the pipe with the sleeve attached. For example, pipes to be loaded in a 40 DC or 40HC container (approximately 12.03m in length) should not exceed 11.80m in length.

For open loading by ship, verify the dimensions of the ship's hold and deck. Note that in some ships, the dimensions of the forward hatch may differ from the drawings provided in the section.

Correct lashing of the cargo is crucial for delivery by ship.

3. standard trench details for grp pipes

Laying methods and trench cross-section of GRP pipes vary depending on the stiffness of the pipe, the depth of soil cover, soil properties and backfill materials which is used.

3.1. Trench Excavation for GRP Pipes

The following points should be taken into consideration when preparing the GRP pipe trench.

- *Trench excavation must be carried out in a way that ensures the safety of workers.*
- *Trench walls should be opened vertically if possible.*
- *Water entry into the trench from outside should be prevented.*
- *There should be no plant roots on the walls and bottom of the trench.*
- *The trench bottom should be stable and solid.*
- *The bottom of the trench should be leveled and the trench should be cleared of materials that can damage the pipe such as stone, rock, iron, concrete.*
- *The trench should be wide enough for compaction on both sides of the pipe.*
- *If there is water in the trench bottom, the water should be completely drained before bedding.*
- *The material removed during excavation should be placed at least 2-3 meters outside the trench.*
- *If the trench bottom is not stable enough and the ground water level is high, the trench bottom should be excavated further to create a trench foundation.*

3.2. Trench Width

The width of the GRP pipe trench should be sufficient to allow for the placement of fittings and the operation of the compactor used to compact the pipe zone backfill material.

In poor quality natural soil conditions, the trench width can be increased depending on the pipe stiffness and burial depth.

3.3. Standard Trench Section

The figure shows the dimensions of a typical trench section. Dimension "A" must be wide enough to allow sufficient backfill material to be placed and compacted at the bottom of the pipe and to prevent damage to the pipe by the compaction equipment. Except for small diameters, this width should be a minimum of 0.4 DN.

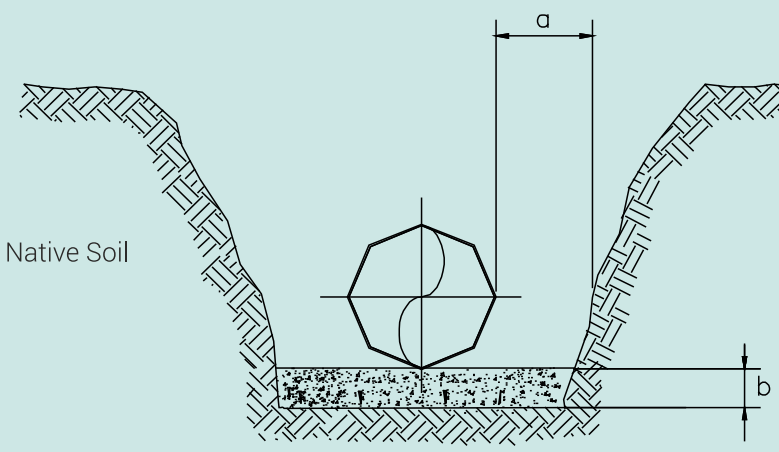


Figure 5 Standard trench type

Table 2 Standard trench dimensions

DN (mm)	min a (mm)	min b (mm)
300 - 900	400	150
1000 - 1600	500	150
1800 - 2400	600	150
2800 - 3000	900	150

3.4. Pipe Bedding

The bedding layer should be placed after the trench bottom has been compacted to provide proper support. The bedding layer should be compacted to a minimum of 90% relative compaction.

The finished bedding layer should be flat to provide regular and continuous support to the pipe. In the parts of the bedding layer corresponding to the sleeves, a sleeve pit should be opened in accordance with the thickness of the sleeve. After the pipe joint is completed, the space under the coupling should be backfilled appropriately.

After the bedding layer has been leveled and compacted, a 150 mm section in the center of the bedding can be loosened by lightly gouging to a depth of no more than 50 mm to provide a soft contact area around the bottom of the pipe.

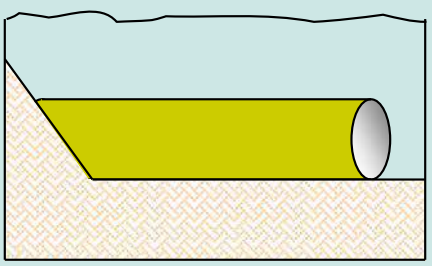


Figure 6 Appropriate bed support

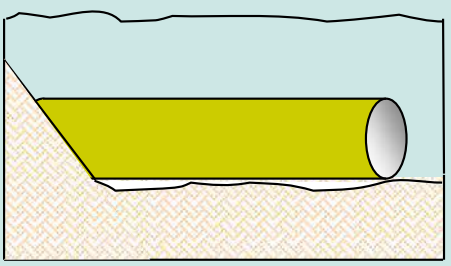


Figure 7 Inappropriate mattress support

3.5. Pipe Zone Backfill Materials

Table 3 Backfill material types

Backfill Material Class	Properties of Backfill Materials
SC1	Crushed stone, containing less than 15% sand, passing 10mm sieve rate max 25%, fine-grained soil max 5%
SC2	Clean coarse-grained material containing 12% or less fine-grained fraction,
SC3	Clean coarse-grained material containing 12% or less fine-grained fraction,
SC4	Fine-grained materials containing more than 70% fine-grained fraction

Type SC1 and SC2 materials are very reliable backfill materials for the pipe zone. These materials are less sensitive to moisture. The backfill can be easily compacted into 200 - 300 mm thick layers using a vibratory plate compactor. Very rarely, the use of gravel and crushed stone and the use of geotextiles may be required to prevent fine material penetration causing loss of pipe support.

SC3 type materials are more readily available and can be used as backfill material. A significant portion of the soils along the pipeline routes are SC3 type, and the material from the trench excavation can be used as pipe zone backfill if it meets the criteria. These soils should be used with caution as they can be sensitive to moisture. The properties of SC3 type materials are often determined of the properties of the fine-grained fraction contained within them. The moisture content may need to be controlled so that the desired density can be easily achieved using a reasonable compaction energy. Compaction can be carried out in layers 100 - 200 mm thick using an impact compactor.

Although the use of SC4 type material is not recommended, it can be used as pipe zone backfill material if the following conditions are met;

- *Moisture content should be controlled during filling and compaction.*
- *Should not be used on weak and unstable trench bottoms or where the ground water level is high.*
- *Since the compaction technique may require considerable energy, the application limits of the relative compaction ratio and the resulting soil stiffness should be considered.*
- *For compaction, an impact or air compactor should be used with a layer thickness of 100 - 150 mm.*
- *Periodically, tests should be carried out to ensure that the desired degree of relative compression is achieved.*

SC1

Crushed Stone SC2 Sand

3.6. Pipe Zone Backfilling

Backfilling of the pipe zone is done by compacting the pipe in layers up to a height of 300 mm. The backfill height difference on both sides of the pipe should be limited to one compacted layer. During backfilling, stones or other foreign materials that may damage the pipe should be prevented from hitting the pipe.

It should be checked that the pipe is properly laid on the bedding layer and that there are no voids and irregularities under the pipe.

After the completion of the pipe zone lining process, the trench should be filled up to the natural ground level to complete the pipe installation.

For compaction in the pipe zone, equipment such as impact rammers, rammers, compactors and rollers can be used depending on the trench conditions.

In cases where incompatible materials with incompatible gradation are used, it is recommended to use geotextile between different types of backfill materials to prevent penetration of the materials.

Stones larger than 200 mm should not be dropped from a height of more than 2 meters onto the 300 mm layer covering the pipe.

3.7. Backfill Material Dimensions

Backfill material dimensions used around GRP pipes are given in the table below.

Table 4 Maximum grain size of backfill material according to diameters

DN (mm)	Maximum Dimension (mm)
Up to 450	13
500-600	19
700-900	25
1000-1200	32
1300 and above	38

3.8. Compaction of Backfill Above the Pipe

The minimum ground cover thickness required for working on the pipe during compaction of the backfill above the pipe zone are given in the table below.

During compaction, it is important that the soil on the pipe is not too loose, but not too compacted.

Table 5 Minimum backfill height above pipe for compaction equipment

Equipment Weight (kg)	Impact (mm)	Vibratory (mm)
Less than 100 kg	250	150
100- 200	350	200
200- 500	450	300
500- 1000	700	450
1000- 2000	900	600
2000- 4000	1200	800
4000- 8000	1500	1000
8000- 12000	1800	1200
12000- 18000	2200	1500

3.9. Pipe Deflection Control

The deflection of the backfilled pipe is an important measure of the quality of the installation. In most installation applications, it is expected that the initial vertical deflection after trench backfill should not exceed 2%. Any deflection above this value indicates that the installation has not achieved the targeted performance and that corrections are required in future applications. Corrections may include increasing the compaction of the pipe zone backfill, using coarser grained backfill materials or widening the trenches. The maximum allowable initial deflection values are shown in the table below. If the initial deflection values remain within the limits, the long term deflection of Kuzeyboru GRP pipes is expected to be less than 5%. Maximum allowable long term deflection limit.

Table 6 Maximum allowable initial deflection values

Pipe Diameter (mm)	Vertical Deflection (% of Diameter)
Large Diameter (Dn≥300)	3.0
Small Diameter (Dn≤250)	2.5

4. Joining of grp pipes

4.1. Coupling Joints

Two types of sleeves are used in Kuzeyboru GRP pipes.

REKA Type GRP Couplings:

•First of all, the gasket groove of the REKA Type couplings and the rubber gaskets to be inserted into the groove must be thoroughly cleaned to ensure that they are free from dirt and oil.

•EPDM gasket is installed in the gasket groove of the coupling with the rubber protrusions facing out of the groove (usually 2 or 4). Do not apply lubricant into the groove or on the gasket during gasket installation. However, the gasket and the groove can be moistened with water to help the gasket to adjust and install smoothly.

•Each EPDM gasket pot should be pushed into the sleeve groove with even pressure. In order to distribute the compressive stress on the EPDM gasket evenly, the gasket should be pulled carefully in the center direction along its entire circumference after it has been fully compressed in the groove. Check that both sides of the gasket protrude evenly from the groove along its entire circumference. A rubber mallet can be used for this operation.

GRP Couplings with Integrated Gasket Type:

•This type of couplings are produced by wetting the fiber with resin and wrapping it on the EPDM gasket mounted on a mold. Since the gasket is integral with the coupling, there is no need to install a gasket on the sleeve.

Kuzeyboru GRP pipes and fittings are shipped to the field with REKA or Integrated Gasket Type Coupling on one end unless there is a special situation.

The ends of the pipe should be cleaned with a brush and the ends of the pipe should be checked to make sure that there is no delamination (separation of the layers forming the pipe). The gasket inside the coupling attached to the end of the pipe must first be cleaned, make sure that there are no pebbles, stones, etc. in the gasket, and apply lubricant with a rag or sponge. Petroleum or derivatives should not be used as lubricant.

In order to facilitate the jointing process during the laying of the pipe and to ensure full contact with the ground along the body of the pipes, a pit should be dug in the ground where the coupling will sit. This pit should not be too big and should be such as facilitating the jointing process. After completion of the jointing process, these pits should be filled with bedding material and compacted.

4.1.1. Lowering the GRP Pipe into the Trench

GRP pipe is lowered into the trench with the help of excavator and polyester slings. The use of competent personnel in pipe installation works will increase productivity and minimize the possibility of occupational accidents. This is also very useful in ensuring that installation work is performed in a safe and healthy manner.

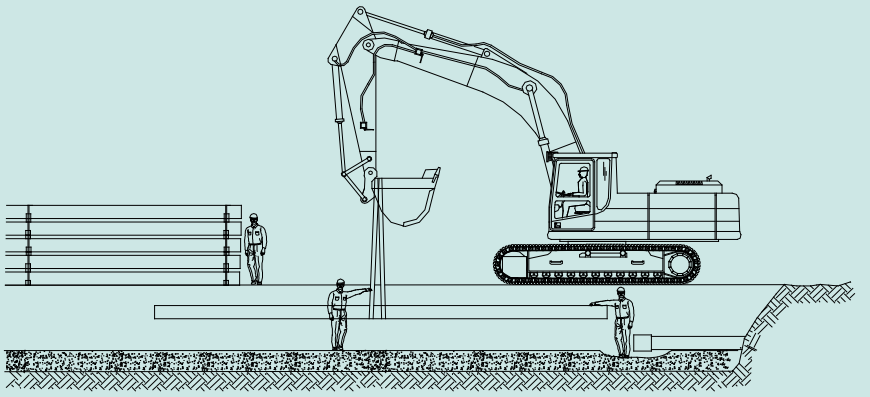


Figure 8 Lowering the GRP pipe into the trench

4.1.2. Coupling Mounted GRP Pipes Joining

Laying should be done after the trench and bedding layer have been prepared according to the instructions.

Before placing a pipe in the trench, the free coupling in the trench and the end of the pipe to be installed must be cleaned of debris and dirt such as soil, sand or mud.

Ensure to dig a small hole under the sleeve so that it is well separated from the sand or gravel at the bottom of the trench.

Secure the first pipe by lining the center of the first pipe laid. Leave the ends of the pipe free for the installation of the next pipe.

Lower the next pipe into the trench, perform the necessary control procedures for the joint. Clean the joint area of the joint once more with a cloth, lubricate the elastomeric gasket by applying lubricant (paraffin) with a brush.

The approximate amount of lubricant that is required per coupling joint is given in the table below.

Table 7 Lubricant material requirement per joint

DN (mm)	KG
300 - 400	0.10
400- 800	0.15
900 - 1000	0.20
1100 - 1300	0.30
1400 - 1600	0.40
1700 - 1900	0.50
2000 - 2200	0.60
2300 - 2600	0.70
2700 - 3000	0.80

Align the two pipe sections to be joined by means of their orthogonal axes. Insert the free end of the pipe to be joined into the coupling very slowly and continue joining until you reach the stopper. Installation methods for coupling joints are detailed below according to the tools and equipment used.

4.1.2.1. Pipe Joining using a lever

For small diameter pipes (DN < 300), the joint can be made by hand or by pushing the pipe with a lever. In this case, a wooden wedge should be placed between the lever and the pipe and direct pressure should not be applied to the pipe end.

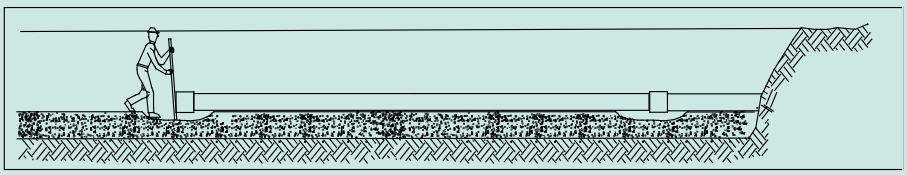


Figure 9 Installation of GRP pipe with lever

4.1.2.2. Joining Using Come Along Jack

Both small and large diameter pipes can be joined using pullers of sufficient capacity. This is the most frequently used joining method, especially for fittings connections.

After the slings are wrapped around the pipes to be joined, these slings. Are pulled with pullers until a coupling joint is achieved.

In this installation method, steel clamps can also be used instead of slings. When using steel clamps, the part of the clamp touching the pipe should be covered with a flexible material such as rubber.

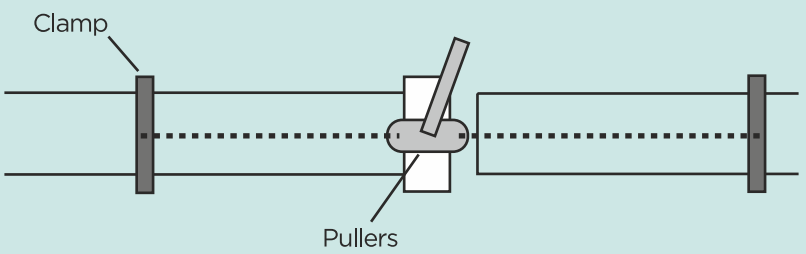


Figure 10 Installation of GRP pipe with puller

4.1.2.3. Joining with Excavator or Bulldozer Bucket

The end of the pipe lowered into the trench for installation and the gasket inside the coupling in the trench are cleaned and lubricant is applied. The pipe to be installed is aligned. A wooden wedge is placed between the pipe and the excavator bucket at the end where the excavator will push the pipe. The pipe is pushed by means of this wedge until the pipe end rests against the stopper. Since the joint cannot be checked from the inside in small diameter pipes, the part that will enter the coupling is marked in the calibration area outside the pipe. This mark is followed while making the joint.

Installation with an excavator can be carried out by pushing the pipe with the help of a wooden wedge or by pulling the sling that wrapped around the pipe with a bucket as shown in the drawing below.

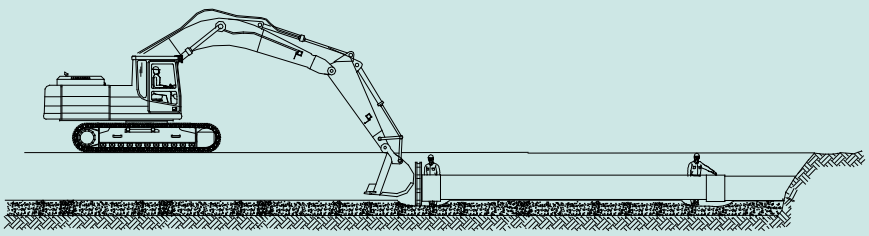


Figure 11 Installation by pushing wedge with excavator

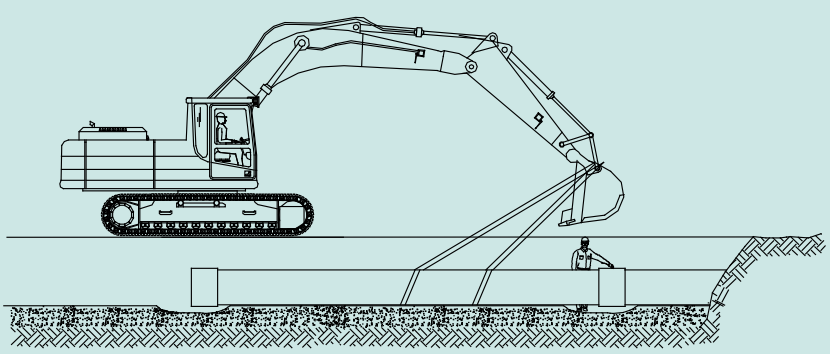


Figure 12 Installation by pulling sling with excavator

4.1.3. Allowable Max Angular Deflection in Coupling Joints

If angular deflection is to be given in GRP pipe joints, this should be done after the pipes are installed in full alignment. Attempting to join the pipes while giving angular deviation may damage the gasket at the joint.

Maximum allowable angular deflection values for coupling joints in GRP pipes are provided in the table below.

Table 8 Maximum allowable angular deflection values for sleeved joints

DN (mm)	Degree
DN 500	3.0
500 < DN < 900	2.0
900 < DN < 1800	1.0
DN > 1800	0.5

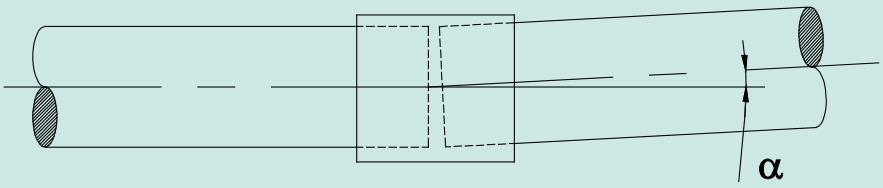


Figure 13 Angular deflection in GRP pipe

4.2. Butt Wrap Connections

These joints are made of glass fiber fabrics and polyester resin. They are typically applied where the joint must resist axial forces or as a repair method. The length and thickness of the butt wrap joint depends on the pipe diameter and pressure class (Figure 14). More detailed information will be available from Kuzeyboru according to project conditions.

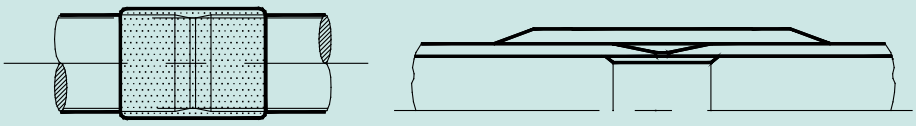


Figure 14 Butt Wrap connection

4.3. Flanged Connections

GRP flanged connections can be made according to the following procedure; (Figure 15)

- *Thoroughly clean the flange face and 'O' ring groove*
- *Ensure the 'O' ring gasket is clean and undamaged. Defective gaskets must not be used*
- *Insert the 'O' ring gasket into the groove, fixing it in place with small pieces of adhesive tape.*
- *Align the flanges to be joined.*
- *Insert bolts, washers, and nuts. They must be clean, and the bolts and studs must be lubricated before assembly.*
- *Washers must be used on all GRP flanges.*
- *Comply with the bolt tightening torques provided by Kuzeyboru.*

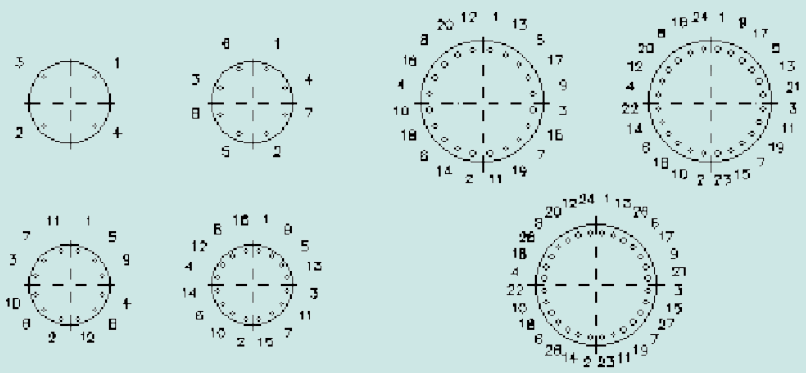


Figure 15 Flanged connection bolt tightening procedure

4.4. Other Joining Methods

4.4.1. Flexible Steel Coupling

Flexible steel couplings can be used to join Kuzeyboru GRP pipes with other pipes. Commonly, the outer surface of flexible steel couplings is made of stainless steel, while sealing is provided with an EPDM gasket on the inner surface. Generally, flexible steel coupling are used for field repair or GRP pipeline field closure (line connection) joints.

It is important to check the tightening torque during installation Bolts should not be over -tightened and manufacturer's instructions should be followed. Torque values should not exceed the limits recommended by Kuzeyboru.

5. thrust blocks, concrete encasement and rigid connections

5.1. Thrust Blocks

Unbalanced impact forces occur on fittings such as elbows, reducers, T-pieces in pipelines under pressure. These forces must be supported in some way to prevent the joints from separating. The most common method used for this is the formation of a thrust block. The determination of the need for these blocks and their design is the task of the structural engineer.

The thrust blocks must limit the displacements at the joint to ensure that the joint is sealed. Thrust blocks should limit the movement of the fitting to the smaller of 0.5% of the diameter or 5 mm. The block should encircle the joint over its entire length and circumference and rest on undisturbed ground. Where this is not possible, it should be backfilled with backfill material compatible with the natural ground.

These blocks are required for the following fittings when the line pressure exceeds 1 bar (100 kPa);

- *Elbows*
- *Reducers*
- *Tee pieces*
- *Blind Flanges*

5.1.1. Valves

Valves must be sufficiently secured to withstand the pressure thrust.

5.1.2. Nozzles

Nozzles are T-pieces that meet the following criteria and it is not necessary to embed the Nozzle connections in concrete.

- *Nozzle diameter ≤ 300 mm.*
- *Main pipe diameter ≥ 3 nozzle diameter.*
- *If the nozzle is not concentric with the main pipe or perpendicular to the main pipe axis, the nozzle diameter is taken as the longest distance above the main pipe at the main pipe / nozzle intersection.*

5.2. Concrete Encasement of GRP Pipes

When pipes have to be encased in a concrete for the construction of a thrust block, stress block or for handling unusual loads, it is important to pay attention to special additions in the installation procedures.

5.2.1. GRP Pipe Anchoring

To prevent the pipe from moving due to buoyancy forces during concrete pouring, it should be anchored. This is commonly achieved by tying the pipe with straps to a foundation slab or other anchors. The straps should be made of a smooth material with a minimum width of 25 mm, strong enough to withstand the buoyancy forces. The straps should be stretched enough to prevent the pipe from floating but should not deform the pipe. Additionally, a minimum of two straps must be placed along each section, and the maximum spacing between these belts must comply with the values given in the table below.

Table 9 Maximum distance between straps

DN (mm)	Maximum range (m)
<200	1,5
200 – 400	2,5
500 – 600	4
700 – 900	5
≥ 1000	6

5.2.2. Pipe supports

Pipes should be bedded in such a way that the concrete is completely under the pipe and does not prevent it from wrapping the pipe. Additionally, the supports should be constructed to ensure that the vertical deflection does not exceed 3% with no bumps or flat areas. Supports are normally located at the strap connection points (not exceeding 4 meters apart).

5.2.3. Concrete pouring for encasement of Grp Pipes

Concrete should be poured in layers. Each layer should be allowed to set before pouring the next one. The maximum layer thickness varies depending on the pipe's nominal stiffness. Maximum layer thicknesses are given in the table below

Table 10 Concrete layer thicknesses

SN	Maximum Layer Thickness
2500	0.3 m or larger than DN/4
5000	0.45 m or larger than DN/3
10000	0.6 m or larger than DN/2

5.3. Rigid Structure Connections

When connected to a rigid structure on the pipeline, excessive movements of the structure or pipe may subject the pipe to additional forces. This can occur at wall penetrations (valve chamber, manhole...), at anchor blocks, or at connections to pumps, valves, or other rigid structures. Angular deflection should be avoided in joints where rigid structure connections are made.

A short pipe must be used at the inlet and outlet of the rigid structure connection. For this purpose, a coupling joint is created inside the structure at the inlet and outlet of the rigid structure. Alternatively, the pipe can be wrapped with a rubber material to facilitate passage.

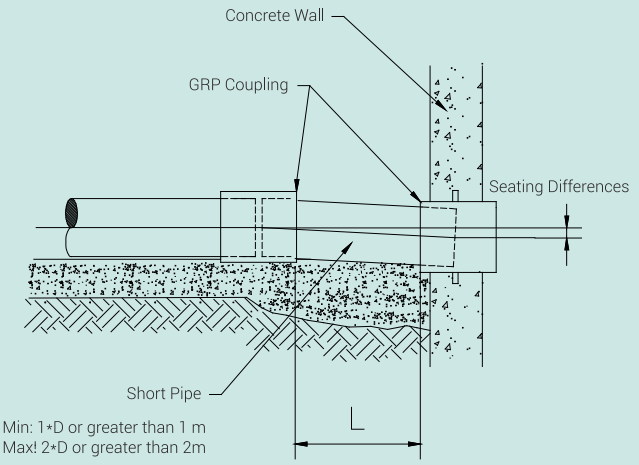


Figure 16 GRP pipe rigid connection

6. installation details for different trench conditions

6.1. Unstable Trench Bottom

If the trench bottom contains soft, loose, or expansive soils, it is considered unstable and should be stabilized before laying the pipe. A foundation should be built to prevent differential settlement of the trench bottom. It is recommended to use gravel or crushed stone as the foundation layer, with a thickness of not less than 150 mm, depending on the condition of the trench bottom. Normal bedding should be placed on top of this foundation layer. Using geotextile to completely cover the foundation layer prevents the bedding and foundation layers from penetrating into each other, thus maintaining the support under the pipe. Additionally, the maximum pipe length between joints should be 6 meters.

6.2. Flooded Trench

When an unstable soil condition caused by the water table is encountered, the bottom of the trench should be stabilized before laying the pipes. This can usually be accomplished by lowering the water level by pumps to about 30 cm below the pipe bottom level and stabilizing the trench bottom.

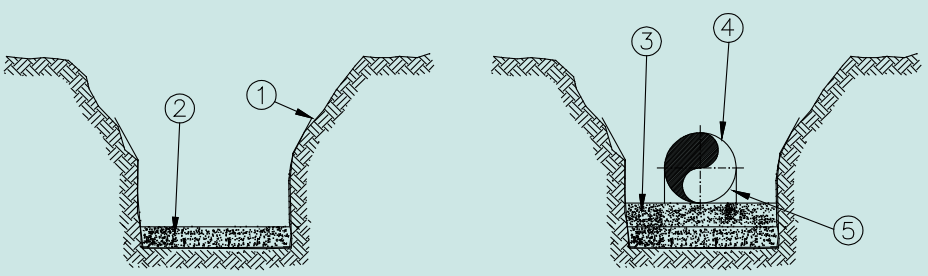


Figure 17 Geotextile use in trench

Steps

1.Place the geotextile on the boundary of the trench.

2.Place and compact the foundation.

3.Insert and tighten the bearing.

4. Place the pipe on the bed.

5. Fill under the spring line of the pipe.

6.3. Trench Construction in Rock

In rock trenches, flexible joints should be formed where the rock ends and the pipe continues in the soil trench. Trench construction shall be carried out by a method suitable for natural ground conditions. When transitioning from rock to soil, short pipes should be Used to accommodate different settlements that may occur.

Short Pipe Usage:

Minimum 1 meter or greater than 1*DN

Maximum 2 meters or greater than 2*DN

6.4. Multiple GRP Pipes in the Same Trench

It is recommended to lay pipes of different diameters in the same trench at the same bottom level. If this is not possible, it is necessary to backfill with selected backfill material up to the bottom level of the higher pipe ensuring the appropriate degree of compaction is achieved.

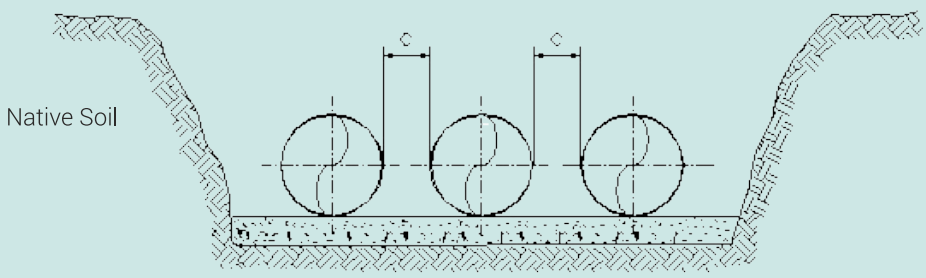


Figure 18 Installation of multiple pipes in the same trench

Table 11 Distances between pipes in the same trench

DN (mm)	min C (mm)
300 - 900	400
1000 - 1600	500
1800 - 2400	600
2800 - 3000	900
3000 - 4000	1500

6.5. Crossing Lines

In case of intersection of two pipelines, a gap of H=(D1+D2)/4 should be maintained between the pipes. This value should never be reduced below 30cm.

In some cases, it may be necessary to run a pipe under an existing pipeline. Extreme care must be taken not to damage the existing pipe. This pipe should be protected by connecting it to a steel beam crossing the trench. Additionally it is recommended to wrap the pipe to protect it against impacts. Once the new pipe is in place, the selected backfill material should be placed in the trench and compacted by hand to ensure it wraps both pipes well and reaches the desired density.

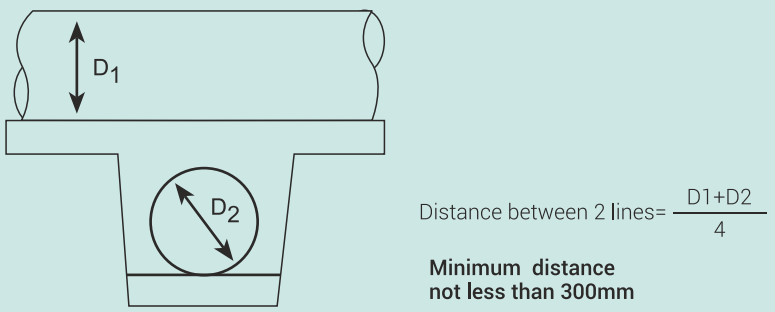


Figure 19 Crossing lines in the same trench

6.6. Pipe Installation on Slopes

6.6.1. General

•The angle at which slopes can lose their stability varies according to the nature of the soil. The risk increases with the angle.

•Generally, pipes should not be laid on slopes steeper than 15 degrees or on slopes of doubtful stability without geotechnical investigation and assessment of the situation.

6.6.2. Aboveground Installation on Slopes

•On steep slopes, laying the pipe above ground is the preferred method. This approach allows for better control over the pipe laying quality and makes it easier to recognize any settlements.

6.6.3. Buried Pipe Installation on Slopes

•If pipes are planned to be laid on slopes greater than 15 degrees, consultation of a geotechnical engineer is recommended. Kuzeyboru GRP pipes can be laid on slopes steeper than 15 degrees if the following conditions are met.

•The long-term stability of the line should be guaranteed with proper geotechnical design.

•For slopes above -15 degrees, cement stabilized or SC1 backfill material should be used in the pipe zone.

•Each pipe must have a sufficient number of ribs.

•Installation should be started from the bottom up and the filling of each pipe

should be completed before the next pipe is installed.

•The surface above the pipe trench must be protected against erosion.

•Pipes must be installed in the correct alignment (with a tolerance of +/- 0.2 degrees) and the gap between pipe ends must be kept to a minimum.

•The axial movement of the filling material must be less than 20 mm.

•Drainage of the material should be ensured and water transportation or loss of shear strength should be prevented.

•The stability of the pipes should be checked regularly during the construction process and in the initial phase of operation.

6.6.4. Installation of Pipes Perpendicular to the Slope

If pipe installation is to be done perpendicular to the slope, it is necessary to ensure that the slope structure remains stable. For this reason, it is recommended to consult geotechnical engineering in areas with slopes exceeding 15 degrees.

The surface of the completed trench should be leveled to prevent ponding on the pipeline and slope, as water accumulation on slopes can reduce the stability.

7. alternative grp pipe installation methods

Depending on pipe stiffness, site conditions and natural soil properties, alternative installation methods should be preferred if embedment depths require compaction beyond reasonable limits. There are three alternative methods;

1. Wide trench

2. Sheet Piling

3. Cement stabilized backfill

7.1. Wide Trench

In conditions where the natural ground is weak and the trench walls cannot provide the necessary support, the trench can be opened wider than standard section and SC1 class backfill material can be placed instead of the weak natural ground removed. This method can be used to bury the pipes deeper, especially in cases where there is a

7.2. Sheet Piling

Especially in cases where trench walls are weak and continuous collapses may occur due to trench conditions, trench excavation can be done using shoring. Sheet piling can be permanent or temporary sheet piling method can be used where sheet piles is removed after backfilling. In this application type, care should be taken to maintain appropriate support between the backfill and natural ground while sheet pile is being removed. Sheet piles should not be removed all at once but in stages. If the pipe area backfill is placed tightly on the trench walls during this process, both pipe support is provided and gap formation behind the backfill is prevented. If sheet piles is removed after the backfilling process is completed, the support of the backfill decreases and the pipe support is weakened. Using vibration while sheet piles is being removed can minimize this loss. It should be ensured that there is no gap between the natural ground and the backfill up to 1 meter above the pipe top. SC1 or SC2 type backfill compacted to at least 90% Standard Proctor Density should be preferred as backfill material.

When permanent sheet piles is used, the sheet piles should extend at least 300 mm above the top of the pipe and should be of a size that will evenly distribute the lateral loads of the pipe. The permanent sheet piling should have sufficient strength for the life of the pipe. The backfill procedure and maximum soil cover thicknesses shall be the same as standard laying procedures. Permanent sheet piles may be considered as Group 1 natural

7.3. Cement Stabilized Backfill

In general, adding 4-5% cement to the sand is sufficient to prepare this filling material. The sand passing through the 200-number sieve should be at most 15%. The 7-day compressive strength of the stabilized material should be between 690 and 1380 kPa. The stabilized filling should be compacted in layers of 150-200 mm thickness each at 90% Standard Proctor density. It is not recommended to make soil filling up to the natural ground level before 24 hours have passed after filling with stabilized material.

8. field adjustments

8.1. Length Adjustment

Steps for cutting and preparing the pipe

***1.!Select the required pipe and mark the point to be cut**. At this stage, it is important that the marking is clear and accurate.*

***2. Measure the pipe diameter in the area to be cut with a measuring tape (e.g. PI tape).** This measurement will provide the basic data for making the cut correctly.*

***3. Compare this measurement with the pipe end tolerance ranges. A special mark is added to the pipes that are within the end tolerances.** These pipes are called "adjusting pipes". If available on site, choose such a pipe that does not need calibration.*

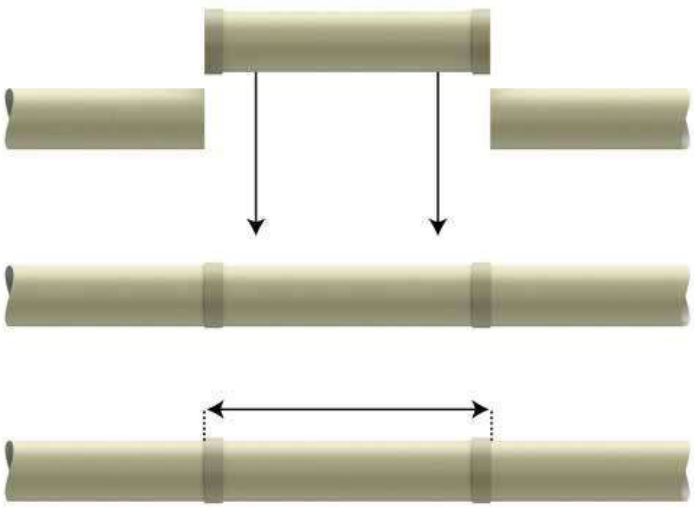
***4. Cut the pipe at the designated point with a circular cutting wheel (spiral cutter).** During the cutting process, make sure to take the necessary safety precautions such as eye, ear and respiratory protection. For more information about cutting, consult the Kuzeyboru.*

***5. If the pipe diameter is within the tolerance of the end, clean the surface to be joined,** Smooth the rough parts with sandpaper and slightly chamfer the edge of the pipe with a spiral motor to ensure the surface is smoother after cutting. Avoid unnecessary grinding.*

***6. If the pipe diameter is outside the tolerances,** use a field lathe or spiral motor to bring the end of the pipe within the tolerance limits given by Kuzeyboru. Smooth the edge of the cut pipe by chamfering. These steps ensure that the pipe is cut smoothly, brought into tolerances and installed safely.*

8.2. Field Closures and Repair Methods

8.2.1. Connection with Sliding Coupling



1.!Measure the location of the pipe to be joined; the piece should be 50 mm shorter than the existing opening and centered between the two pipe ends.

2. Use a pipe with special calibrated ends.

3. Choose coupling without stoppers.

4. Lubricate the pipe ends and gaskets, then insert the sleeve into the calibrated ends of the pipe and pull it back. Be careful when inserting the second gasket.

5. Clean and lubricate the ends of the pipes to be joined.

6. Place the connecting pipe in place and pull the coupling over the other pipe.

7. Ensure the grout around the line joint is well compacted and supported.

8.2.2. Connection with Butt Wrap

These connections are made with glass fiberglass-reinforced materials impregnated with polyester resin. This type of connection requires special design, clean, controlled conditions and qualified, trained personnel. Special instructions will be provided by Kuzeyboru where this type of connection is required.

8.2.3. 8.2.1.Steel Flexible Coupling

Flexible steel coupling can be used for field closures.. For this, the following operations are performed.

-Measure carefully where the pipe to join the lines will be placed. The joining piece must be 20 mm shorter than the existing location and centered equidistantly between the two line ends.

-Lower the cut pipe to the point where the line joint will be made, ensuring the pipe ends are not damaged, and fix the pipe in place.

-Connect the pipe ends to the pipes in the trench with steel sleeves to complete the installation.

9. grp pipe burial depth limits

9.1. Trafic Loads

If GRP pipes are laid in areas subject to heavy traffic, the backfill must be completely compacted in layers up to the natural ground. Local regulations must also be complied with in this regard. The minimum embedment depths given in the table below can be reduced in cases where special solutions are applied, such as enclosing the pipes in a reinforced concrete envelope at points that will be subjected to traffic load or using reinforced concrete slabs under the road to press into the natural ground.

The embedment depths are based on the AASHTO H20 load. Generally, a minimum embedment depth of 1 meter is recommended, assuming a pipe zone backfill modulus (E'b) of 6.9 MPa or higher. Minimum embedment depths for other trafic loads are given in the table below

At lower backfill modulus, it is necessary to increase the thickness of the soil cover to compensate for soil stiffness under traffic loading.

Table 12 Trafic loads

	Traffic (wheel) Load		Minimum Depth
Load Type	Kilo Newton	kgf	Meter
AASHTO H20 (C)	72	7200	1,0
BS 153 HA (C)	90	9000	1,5
ATVLKW 12 (C)	40	4000	1,0
ATVLKW 30 (C)	50	5000	1,0
ATVLKW 60 (C)	100	10000	1,5
COOPER E 80	Railroad		3,0

9.2. Construction Phase Loads

In some cases, cranes and ground vibration devices may be present at or near the installation site. If this equipment passes over the pipeline during the construction phase, high local loads may occur. The effect of these loads, if any, should be analyzed and necessary precautions should be taken.

9.3. High Pressure

High pressures require that possible upward forces at joints be taken into account during operation and field pressure testing.

For pressures of 16 bar and higher, the minimum burial depth for pipes with diameters DN300 and larger should be 1.2 meters, and for diameters smaller than DN300 the minimum burial depth should be 0.8 meters.

During the field pressure test, at pressures less than 16 bar, the couplings should be backfilled at least to the top and the pipes should be backfilled to the minimum required soil cover thickness.

9.4. High Water Level

To prevent an empty pipe from floating, it should be covered with soil cover (minimum bulk density of 1900 kg/m3 dry soil) at a minimum depth of 0.75 pipe diameter. Alternatively, installation can be accomplished by anchoring the pipes. If this is foreseen, the anchoring straps should be of a smooth material at least 25 mm wide and spaced at a maximum interval of 4 meters. Kuzeyboru can be contacted for anchoring details and the minimum depth of soil cover in the anchored condition.

9.5. Frost Level

GRP pipes should be installed below the minimum frost level required for the intended installation site. Local building regulations should be used to determine the frost level.

10. post installation checking

10.1. Deflection Control

Care must be taken not to exceed the maximum allowable initial deflection of 3% in installed GRP pipes. Pipes must not have bumps or sudden changes in the roundness of the pipe wall. Exceeding these limits may result in the pipes not achieving the desired performance.

The first deflection check is simple and should be carried out after the pipes have been installed (usually within 24 hours of reaching the fill height).

Deflection checks should be carried out when the first pipes are filled and should continue regularly throughout the project.

Nonconformities should be detected and corrected early through measurements and controls. For details on the limitations of this procedure, refer to the chapter "Correction of Over-Deflected Pipe."

The following procedure should be followed to check the initial diametrical vertical deflection of the installed pipes:

- *Complete backfilling to the natural ground level.*
- *Remove the temporary supporting elements (if equipped).*
- *Stop the water extraction system (if used).*

- *Measure and record the vertical diameter of the pipe.*
- *Note: For small diameter pipes, the vertical diameter can be measured using a deflectometer or similar device.*

Initial deflections should be strictly controlled to avoid exceeding long-term acceptable deflection limits for GRP pipes. Pipe deflection refers to the percentage reduction in vertical diameter due to vertical forces after the installation is completed. Long-term deflections are difficult to measure as they occur at least 6 months after installation is completed.

The recommended method is to measure the initial deflection no later than 3 days after reaching the final stage of pipeline backfill. Performing deflection measurements simultaneously with the pipe installation process allows for timely corrective measures and helps to reduce the time and costs associated with incorrect installation. The maximum allowable initial deflection value is 3%. If below this value, the long-term deflection is expected to be less than 5%.

10.1.1 Deflection Measurement

After completing backfilling following pipe installation, the initial deflection measurement should be carried out within 24 hours.

The deflection value (% deflection) is calculated as follows;

$$\%\text{Deflection} = \frac{\text{Actual ID} - \text{Installed Pipe ID}}{\text{Actual ID}} \times 100$$

The actual inside diameter is determined by measuring the diameters of a pipe that has not yet been laid and on which no other pipe is present on a reasonably flat surface. To calculate the actual inside diameter;

$$\text{Actual ID} = \frac{\text{Vertical Inner Diameter} + \text{Horizontal Inner Diameter}}{2}$$

10.1.2 Correction of Over Deflected Pipe

Pipes exceeding %3 the initial deflection limit should be straightened to ensure the long-term performance of the pipe. The following procedure should be applied for correction of pipes according to deflection value:

Pipes with deflection value up to %8

Excavate up to approximately 85% of the diameter of the pipe. The top and sides of the pipe should be excavated by hand and should not be impacted with heavy machinery.

Check the pipe for damage. Damaged pipes must be repaired or replaced.

The backfill at the bottom of the pipe must be compacted again, ensuring it does not mix with unacceptable substances.

Fill the circumference of the pipe with the appropriate material in layers and compact each layer to the required relative compaction density.

Pipes with deflection value exceeding %8

Pipes with more than 8% deflection should be removed and replaced with new ones.

Important: Do not attempt to make over deflected pipes round again using wedges, jacks or similar tools; this may damage the pipe.

10.2. Field Hydrostatic Pressure Test

Hydrostatic field testing is mandatory before the commissioning of pipelines in projects. This test allows early detection and correction of potential defects in the line. If this test is planned to be carried out on site, it should be conducted at regular intervals as the pipe installation process progresses. The test should be carried out before the installed pipeline exceeds 1 kilometer. In addition to standard procedures, the following points should be noted

10.2.1. Pre-test preparation

The completed pipeline should be inspected before testing. Important points are:

- *•The deflection values of the pipe must be within the specified limits.*
- *•Make sure that the connections are made correctly.*
- *•Support and fixing structures of the system must be completed.*
- *•Flange bolts must be tightened to the appropriate torque values.*
- *•Filling operation must be completed and minimum burial depth must be ensured.*
- *•Valves and pumps must be properly secured.*
- *•Backfilling must be completed at line joints and at the entrances and exits of art structures.*

10.2.2. Filling the line with water

When filling the line, the air release valve must be opened to release the air. Pressure should be applied slowly, and a sudden increase in pressure should be avoided. The point in the line with the highest pressure should be selected for measurement. The maximum pressure must not be exceeded during the test. Maximum field test pressures are given in the table below. If the pipeline cannot maintain a constant pressure, temperature changes, expansion of the pipe, or trapped air in the line should be checked as possible causes. If the line is leaking, it can be checked by the following methods:

- *-Inspect flanges and valves.*
- *-Review the distribution connection points.*
- *-Search for leaks using a sonic detector.*
- *-Test by dividing the line into smaller pieces.*

Table 13 Maximum field test pressures

Pressure Class	Maximum Field Test Pressure
100 kpa	150 kpa
250 kpa	375 kpa
600 kpa	900 kpa
1000 kpa	1500 kpa
1600 kpa	2400 kpa

Note: Maximum pressure loss and water volume limits may vary from project to project. Consult the manufacturer for more information.

10.3. Field Joint Test

DN 700 mm and larger diameter pipes coupling connections can be tested from the inside using a joint tester (gasket testing equipment). This equipment can be used to check joints before or after backfilling. The joint tester does not test the line but the joints. The pressure value that can be applied to the joint with this equipment should be based on the information given by the manufacturer.

Notes

Notes

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