Table of Contents

List of Tables

List of Figures

TECHNICAL SPECIFICATION

GLASS REINFORCED THERMOSETTING PLASTIC (GRP) JACKING PIPES

PART 1 – GENERAL

1.1 SCOPE OF WORK

The WORK includes the supply, delivery and testing of Glass Reinforced Thermosetting Plastic (GRP) jacking pipes and tailored or customized fittings.

1.2 SPECIFICATIONS AND STANDARDS

Except as otherwise indicated, the current editions of the following Standards (or equivalent International Standards) shall apply to the WORK of this Specification:

ISO 25780	Plastics piping systems for pressure and non-pressure water supply, irrigation, drainage or sewerage – Glass-reinforced thermosetting plastics (GRP) systems based on unsaturated polyester (UP) resin – Pipes with flexible joints intended to be installed using jacking techniques
ISO 23856	Plastics piping systems for pressure and non-pressure water supply, drainage or sewerage - Glass-reinforced thermosetting plastics (GRP) systems based on unsaturated polyester (UP) resin
ISO 4633	Rubber Seals – Joint Rings for Water Supply, Drainage and Sewerage Pipelines
ISO 7005	Metallic Flanges
ISO 7685	Glass-reinforced thermosetting plastics (GRP) pipes Determination of initial ring stiffness
ASTM A240/ 240M	Standard Specification for Heat-Resisting Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels
ASTM D2996	Standard Specification for Filament-Wound “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
AWWA M45	Fiberglass Pipe Design
DWA - A 161	Static Calculation of Jacking Pipes

1.3 SUBMITTALS

The Contractor shall submit the following:

A. Shop drawings of GRP jacking pipes and tailored or customized fittings.

B. Manufacturer's brochures showing technical data and instruction for installation and jointing.

C. ISO 9000 Certificate in the manufacture of GRP jacking pipes, if any.

1.4 QUALITY ASSURANCE

The Manufacturer/ Supplier is responsible for the performance of all tests and inspection required by this Specification. Manufacturer/ Supplier shall furnish the Maynilad copies of test records certified by an independent laboratory indicating that materials required by this specification have been tested and have complied with all applicable requirements of this Standard. The Manufacturer/ Supplier shall, at his own expense, replace all rejected materials for failure to comply with this Specification or for failure to satisfactorily meet the expected performance during actual installation. Maynilad shall witness any or all prescribed tests and inspection at the manufacturer's plant if such tests are not available at any accredited independent laboratory to ensure that delivered materials conform to this Specification.

PART 2 – PRODUCTS

2.1 GENERAL

GRP jacking pipes and fittings shall be manufactured and tested in accordance with ISO 25780, ISO 23856 & ISO 7685 and shall be resistant to acidic environment found in sanitary sewers for their use in all wastewater applications.

2.2 MATERIAL

GRP jacking pipes shall be made from polyester resin, glass fibres and silica aggregates. To show compliance with the standards and ensure their compatibility and performance, short and long-term testing of these raw materials intended for the manufacture of GRP jacking pipes and fittings must be performed.

2.3 DESIGN

GRP jacking pipes shall be designed to withstand the jacking force and other construction loads in combination with the overburden (earth and live load). The pipe manufacturer shall provide the permissible maximum jacking force which can be applied to the pipe during jacking operations.

The pipe thickness and mechanical properties specified in Section 2.4 below are minimum values. Higher values shall be provided to meet the specified factor of safety, except that the pipe thickness should not exceed 74 mm.

2.4 PIPE SIZE, THICKNESS, DESIGN PROPERTIES, AND ACCEPTANCE CRITERIA

The GRP jacking pipes shall have the following properties and shall meet the acceptance criteria specified herein as regards factor of safety against failure:

Pipe Size, Thickness, and Properties	Values
Nominal Outside Diameter	1499 mm to 1620 mm
Nominal Inside Diameter (Not less than Nominal I.D.)	1350 mm
Pipe Minimum Thickness	64 mm to 74 mm
Pipe Length	2.0 m
Nominal Stiffness Rating, (SN)	≥80,000 N/m^2
Permissible Maximum Jacking Force (PMJF)	5,018 kN
Factor of Safety Against Jacking Force on deflected pipe	≥1.3
Pressure Rating of GRP Pipes and Fittings	PN 06
Factory Hydrostatic Test Pressure	9 bars
Factor of Safety Against Hoop Tension, stress basis	≥8.0
Factor of Safety Against Hoop Tension, strain basis	≥7.0
Maximum Allowable Joint Deflection	0.9°
Axial Compressive Strength	≥90 MPa
Hoop Tensile Modulus	≥14 GPa
Hoop Tensile Strength	≥80 MPa
Hydraulic Design Basis (HDB)	≥0.625 %
Ring Flexural Modulus	≥12.3 GPa
Ring Bending Strength	≥120 MPa
Long-term Ring-bending Strain,	≥0.8 %
Factor of Safety Against Ring Deflection	≥1.1
Permissible Combined Axial Compression and Ring Bending Compressive Stress	≥102 MPa
Factor of Safety Against Combined Compressive Stress	≥ 1.3
Factor of Safety Against Ring Buckling	≥2.0
Length of Short Pipes to be installed at Jacking/Receiving Pits	1x DN to < 2.0 m
Maximum Allowable Joint Deflection for Short Pipes	0.9°
Maximum Allowable Joint Lateral Displacement for Short Pipes	5 mm
Maximum Allowable Joint Axial Displacement for Short Pipes (due to compressive force)	12 mm
Maximum Allowable Joint Axial Displacement for Short Pipes (due to tensile force)	12 mm

2.5 DESIGN CONDITIONS AND INSTALLATION PARAMETERS

Pipes shall be designed to satisfy two loading conditions specified below.

Loading Condition No. 1 – (to be analysed in accordance with DWA-A 161)

Loading Condition No. 1 will occur in/on pipes to be installed by jacking. In this loading condition, pipes will be subjected to axial compressive stress due to the required maximum jacking force computed from the skin friction resistance of the soil on the pipe circumferential surface area for the specified maximum jacking length of 150 m. The computed required jacking force shall be multiplied by a safety factor to take care of increase in frictional resistance after a rest period of more than one day. During pipe jacking operation, the pipe will be subjected simultaneously to overburden due to earth load and traffic load as well as grout pressure at the annular space between the pipe outside circumference and the surrounding soil. During the operational stage, the pipeline will be subjected to internal pressure and overburden, but the critical loading will occur when the internal pressure is zero. Although the pipeline in this project will not be subjected to vacuum owing to momentum of flowing water, the predicted bucking pressure shall be compared with the allowable assuming full vacuum of 1 bar combined with earth load and traffic load. The table below shows the loading and installation parameters for Loading Condition No.1.

Design Conditions and Installation Parameters for Loading Condition No. 1	Values	Units
Factory Hydrostatic Test Pressure	9	bars
Working Pressure (N.A. – for information only)[1]	294	kPa
Surge Pressure (N.A. – for information only)[1]	147	kPa
Vacuum	100	kPa
Cover Depth	6.0	m
Truck Wheel Load, AASTHO HS-25	90,000	N
Native Soil		
Description- Silty Sand		
Skin Friction	5.5	kN/m^2
Jacking Length	150	m
Factor of Safety in Computing the Maximum Permissible Jacking Force	1.29	
Constrained Soil Modulus	11.5	N/mm^2
Specific Weight	18.8	kN/m^3
Ground Water Effects		
Depth below grade	1	m
Shape Factor	5.5	-
Deflection Lag Factor	1.05	-
Deflection Coefficient	0.1	-
Trench Width	N.A.	-
Maximum Permitted Vertical Deflection in percent of pipe mean diameter.	3	%

Note: 1 – The field hydrostatic test, which is the design stress is greater than working pressure + surge pressure. Moreover, the pipeline will not be subjected to surge pressure.

Loading condition No. 2 – (to be analysed in accordance with AWWA M45)

Loading Condition No. 2 will occur in/on the pipes to be laid inside the jacking and receiving shafts which are to be filled with granular materials after the pipe installation. Under this loading condition, the pipes will be subjected to earth load and traffic load, while it is still empty. Although the pipeline will not be subjected to vacuum owing to momentum of flowing water, the predicted bucking pressure shall be compared with the allowable assuming full vacuum of 1 bar combined with earth load and traffic load. The table below shows the loading and installation parameters for Loading Condition No.2

Design Conditions and Installation Parameters for Loading Condition No. 2	Values	Units
Factory Hydrostatic Test Pressure	9	bars
Working Pressure (N.A. – for information only)[1]	294	kPa
Surge Pressure (N.A. – for information only)[1]	147	kPa
Vacuum	100	kPa
Cover Depth	6.00	m
Truck Wheel Load, AASTHO HS-25	90,000	N
Backfill		
Description- Silty Sand, moderately compacted sand at 90 Standard Proctor Density[2]		
Constrained Soil Modulus	11.5	MPa
Specific Weight	18.800	N/m3
Ground Water Effects		
Depth below grade	1	m
Shape Factor	5.5	
Deflection Lag Factor	1.05	
Deflection Coefficient	0.1	
Trench Width	4.0	m
Maximum Permitted Pipe Ring Deflection in percent of pipe mean diameter.	2	%

Notes:

1 – The field hydrostatic test, which is the design stress is greater than working pressure + surge pressure. Moreover, the pipeline will not be subjected to surge pressure.

2 - This is a conservative installation parameter. To be specified in the drawing is compacted sand or granular material.

2.6 PIPES AND FITTINGS PROTECTIVE LINER

Pipes and fittings shall be provided with protective liner of not less than 1 mm and a service life of not less than 50 years with safety factor of not less than 2. Test report on accelerated abrasion test and on acid test in accordance with international standard shall be submitted together with the bid/price quotation. See Annex 1 for the Fittings Specification.

2.7 JOINTS

Pipe joints shall be flush joint couplings made of Type 316 stainless steel sleeve conforming to ASTM A240/ 240M with integral elastomeric seal made of EPDM rubber conforming to ISO 4633 and shall be suitable in contact with wastewater. Couplings for jacking pipes shall have an outside diameter equal to the outside diameter of the jacking pipes, so the resulting connections do not interfere with the installation process. The manufacturer shall declare the maximum allowable installed deflection of pipe joints as specified in Table 2 of ISO 25780.

Flange end connections for customized fittings shall have flange bore dimensions complying with ISO 7005 PN16. Flange gasket shall be made of EPDM rubber conforming to ISO 4633 and shall be suitable in contact with wastewater.

2.8 MARKINGS

Pipes and deflection fittings shall bear permanent identification markings that will remain legible during normal handling, storage, installation and service life. Markings shall be applied (engraved or laser printed) in a manner that will not reduce the strength nor otherwise damage the products.

Markings shall include the following information:

A. Name of product (GRP JP)

B. The number of International Standard (ISO 25780)

C. The nominal stiffness rating (SN)

D. Permissible jacking load (kN)

E. Manufacturer’s name and/ or trademark

F. PN rating

G. Nominal outside diameter in mm

H. Deflection angle in degrees for fittings

I. The date of manufacture

J. The words “For Sewerage”

K. The word “*Maynilad*”

PART 3 – EXECUTION

3.1 TESTING

A. Testing

Testing shall be done in accordance with ISO 25780.

B. A test report or proof of tests for the pipes manufactured and delivered shall be submitted to Maynilad.

3.2 QUANTITY OF GRP JACKING PIPES AND FITTINGS

The quantity of pipes and fittings for manufacturing shall be as shown in Table 1.

Table 1 – Quantity of Pipes and Fittings

Description	Unit	Quantity
GRP Jacking Pipe		
Nominal OD1499 mm x 2 meters (+/- 25mm) GRP Jacking Pipe with Nozzle, PN 06, SN 80,000 with Pressure Jacking Stainless Steel Coupling and EPDM Elastomeric Gasket	piece	330
Nominal OD1499 mm x 2 meters (+/- 25mm) GRP Jacking Pipe, PN 06, SN 80,000 with Pressure Jacking Stainless Steel Coupling, and EPDM Elastomeric Gasket	piece	1,412
Nominal OD1499 mm x 2.70 meters (+/- 25mm) GRP Jacking Lead Pipe, PN 06, SN 80,000 with Pressure Jacking Stainless Steel Coupling, and EPDM Elastomeric Gasket	piece	12
Nominal OD1499 mm x 2.70 meters (+/- 25mm) GRP Jacking Lag Pipe, PN 06, SN 80,000 with Pressure Jacking Stainless Steel Coupling, and EPDM Elastomeric Gasket	piece	12
GRP Customized Fittings (See Annex 1)		
Fabricated and Laminated Fittings		
Nominal OD1499 mm x 90-degree Bend, SN 80,000 with Filament Wound Coupling (FWC) on Both Sides and EPDM Elastomeric Gasket	each	2
Nominal OD1499 mm x 92.47-degree Bend, SN 80,000 with Filament Wound Coupling (FWC) on Both Sides and EPDM Elastomeric Gasket	each	1

Description	Unit	Quantity
Nominal OD1499 mm x 38-degree Bend, SN 80,000 with Filament Wound Coupling (FWC) on Both Sides and EPDM Elastomeric Gasket	each	1
Nominal OD1499 mm x 18.84-degree Bend, SN 80,000 with Filament Wound Coupling (FWC) on Both Sides and EPDM Elastomeric Gasket	each	1
Nominal OD1499 mm x 8-degree Bend, SN 80,000 with Filament Wound Coupling (FWC) on Both Sides and EPDM Elastomeric Gasket	each	1
Nominal OD1499 mm x Branch Tee Nominal OD 616 mm x 550 mm, SN 10,000, PN 16 Fixed Flange	each	4
Nominal OD1499 mm x Branch Tee Nominal OD 220 mm x 400 mm (Eccentric), SN 10,000	each	1
Nominal OD 220 mm x 400 mm PN 16 Flange/ Spigot, SN 10,000 Laminated to Flanged Cover of Tee with Nominal OD 616 mm	each	4

3.3 HAULING/ TRANSPORTING, PACKING, DELIVERY AND STORAGE

A. General

Pipes and fittings shall be loaded at the factories by trained personnel. The packaging provided shall be adapted for the intended means of shipping, e.g. road, rail or sea. Each delivery should be checked for deficiencies upon arrival. Particular attention must be paid to damaged pipe ends, strong abrasion, and pressure marks. Any impact loads shall be avoided. Interim transportation on the construction sites shall preferably be in the original packaging.

The Manufacturer/ Supplier shall coordinate with RII Builders, the Contractor of Central Manila Conveyance System, regarding the delivery schedule and the particular site or location of delivery.

The Manufacturer shall inform Maynilad and the Contractor at least three (3) working days in advance prior to actual deliveries.

Deliveries shall be made in the presence of Maynilad and Contractor's representative/s.

B. Transporting, Packing and Handling

The pipes shall be delivered in lengths of 2 meters and with a pre-mounted coupling. When unloading, the packaging units (Figure 1) must be lifted individually by means of slings.

To guarantee safe transport, single pipes shall be loaded and unloaded according to Fig.2. The limit for the space between the belts and the lifting locations is 0.6 x the total length of the pipe, always taking into account the center point of the pipe as the axis. In certain cases, it may be necessary to transport the pipes with the help of a cross beam inside the pipe (Figure 3). In these cases, the beam shall be padded (cushioned) to prevent mechanical damage to the pipes and couplings.

Do not use hooks, wire rope, chains, or hoisting gear with sharp edges. Do not subject the pipes to point loads (Fig. 4).

Figure 1 – Packaging Unit

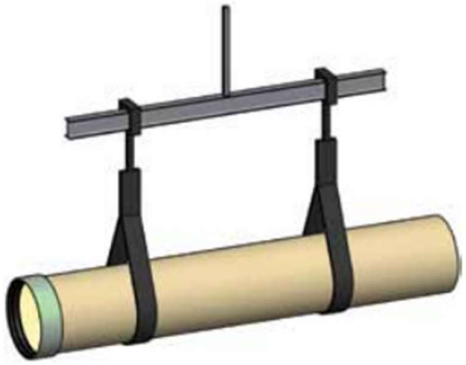

Figure 2 – Loading and Unloading of Pipes

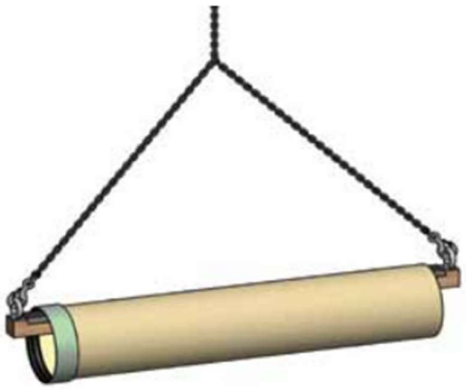

Figure 3 – Transportation with Cross Beam Inside the Pipe

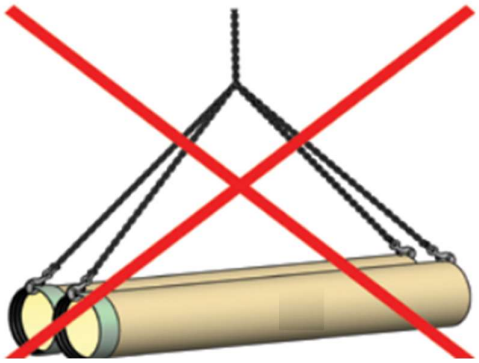

Figure 4 – Hooks and Wire Ropes shall not be Used for Transportation

C. Storage

The original packaging that comes with each shipment shall be suitable for both transportation and storage. The pipes should always be stored on an even surface (Fig. 5), free of rocks and other potentially damaging debris. The materials must not be subject to intense heat, flames, solvents, etc. Pipes must also be protected from mechanical damage and point loads (Fig. 6, 7 & 8).

Pipes shall be protected against vandalism and access by third parties, as well as against damage and displacement. If pipes are subsequently stacked, the acceptable stacking height depends on the soil conditions as well as the loading and safety equipment on site. The number of stackings shall be as recommended by the Manufacturer.

Wooden beams must be placed under the bottom layer of pipes to avoid siltation due to rainwater draining and to prevent the pipes from freezing to the ground. Stacking heights above 3 m are not recommended on construction sites to prevent accidents. The pipes must be secured in position with the help of wooden beams and wedges.

Pipes shall be supplied with a coupling mounted on one pipe end. The inner pipe surface and rubber seals on the couplings must not be subject to UV light for more

than 3 months. Furthermore, they must be protected from grease, oils, solvents, and other damaging substances. It is therefore advised to cover the pipe ends if they are stored outdoors over a longer period.

The pipes' outer layer shall protect the structural layers below and must be resistant from environmental impacts, such as ultraviolet radiation and weathering.

Rubber ring gaskets and locking rods, when shipped separately from the couplings, should be stored in the shade in their original packing and should not be exposed to sunlight except when actively joining pipes. Also, the gaskets must be protected from exposure to petroleum-derivative greases and oils, as well as solvents and other harmful substances.

Gasket lubricant should be stored to prevent contamination. Partially used buckets should be resealed to prevent contamination of the lubricant in any instance.

Figure 5 – Proper Storage in Packaging Unit

Figure 6 – Pipes Should not Rest on Stones

Figure 7 – Pipes Should not Rest on Uneven Surface

Figure 8 – Pipes Should not be Dragged along the Ground

****END OF SPECIFICATION****