INTERNATIONAL STANDARD

ISO 25780

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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

Systèmes de canalisations en matières plastiques pour l'alimentation en eau avec ou sans pression, pour l'irrigation ou l'assainissement — Systèmes en matières plastiques thermodurcissables renforcés de verre (PRV) à base de résine de polyester non saturé (UP) — Tubes avec assemblages flexibles destinés à être installés par les techniques de poussée

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 25780 was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 6, *Reinforced plastics pipes and fittings for all applications*.

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

1 Scope

This International Standard specifies the properties of the piping system and its components made from glass-reinforced thermosetting plastics (GRP) based on unsaturated polyester resin (UP) for water supply, irrigation, drainage or sewerage systems with or without pressure.

This International Standard is applicable to GRP-UP piping systems, with flexible joints, intended to be installed using jacking techniques. It specifies the characteristics of pipes made from GRP-UP, with or without aggregates or fillers and also specifies the test parameters for the test methods referred to in this International Standard.

NOTE Pipes referred to in this International Standard are, because of their intended use, required to have a minimum nominal stiffness of at least SN 20000 (see 5.2.1).

This International Standard is applicable to pipes and joints with a size range from DN100 to DN4000 which are intended to be used for the conveyance of water or sewage at temperatures up to 50 °C, with or without pressure.

It covers requirements to prove the design of the joint and specifies type test performance requirements for the joints as a function of the declared nominal pressure rating of the pipeline system and the required joint deflection capability of the system.

GRP-fittings, used between pipe systems covered by this International Standard, shall be in accordance with ISO 10639 for water supply systems or ISO 10467 for drainage and sewerage systems, as applicable. In a pipe-work system, pipes of different nominal pressure and stiffness ratings may be used together.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 75-2:2004, *Plastics — Determination of temperature of deflection under load — Part 2: Plastics and ebonite*

ISO 604:2002, *Plastics — Determination of compressive properties*

ISO 2078, *Textile glass — Yarns — Designation*

ISO 3126, *Plastics piping systems — Plastics components — Determination of dimensions*

ISO 4633, *Rubber seals — Joint rings for water supply, drainage and sewerage pipelines — Specification for materials*

ISO 7685, *Plastics piping systems — Glass-reinforced thermosetting plastics (GRP) pipes — Determination of initial specific ring stiffness*

ISO 8639, *Glass-reinforced thermosetting plastics (GRP) pipes and fittings — Test methods for leaktightness of flexible joints*

ISO 10466, *Plastics piping systems — Glass-reinforced thermosetting plastics (GRP) pipes — Test method to prove the resistance to initial ring deflection*

ISO 10467, *Plastics piping systems for pressure and non-pressure drainage and sewerage — Glass-reinforced thermosetting plastics (GRP) systems based on unsaturated polyester (UP) resin*

ISO 10468, *Glass-reinforced thermosetting plastics (GRP) pipes — Determination of the long-term specific ring creep stiffness under wet conditions and calculation of the wet creep factor*

ISO 10471, *Glass-reinforced thermosetting plastics (GRP) pipes — Determination of the long-term ultimate bending strain and the long-term ultimate relative ring deflection under wet conditions*

ISO 10639, *Plastics piping systems for pressure and non-pressure water supply — Glass-reinforced thermosetting plastics (GRP) systems based on unsaturated polyester (UP) resin*

ISO 10928, *Plastics piping systems — Glass-reinforced thermosetting plastics (GRP) pipes and fittings — Methods for regression analysis and their use*

ISO 10952, *Plastics piping systems — Glass-reinforced thermosetting plastics (GRP) pipes and fittings — Determination of the resistance to chemical attack for the inside of a section in a deflected condition*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
manufacturer's declared pipe outside diameter
d_{OD}
external diameter of the pipe barrel, excluding the spigot

NOTE Manufacturer's declared pipe outside diameter is expressed in millimetres (mm).

3.2
jacking diameter
d_e
calculated maximum outside diameter of the external profile of the pipe barrel at all cross-sections

$$d_e = d_{OD} + \Delta^+ \quad (1)$$

where

Δ^+ is the plus tolerance on the outside diameter;

d_{OD} is the manufacturer's declared outside diameter.

NOTE Jacking diameter, which is derived using the equation above, outside diameter and its tolerance are expressed in millimetres (mm).

3.3
mean diameter
d_m
diameter of the circle corresponding with the middle of the pipe wall cross-section

NOTE Mean diameter is derived using the following equation with the outside diameter and wall thickness expressed in millimetres (mm):

$$d_m = d_{OD} - e$$

where

e is the pipe's wall thickness;

d_{OD} is the manufacturer's declared outside diameter.

3.4
internal diameter
ID
d_i
external diameter minus twice the wall thickness, e

NOTE 1 Internal diameter is derived using the following equation

$$d_i = d_{OD} - 2 \times e$$

NOTE 2 Internal diameter, outside diameter and wall thickness are expressed in millimetres (mm).

3.5
spigot or groove diameter
d_g
external diameter of the spigot [see Figure 1 a) diameter], or in the groove of the spigot [see Figure 1 b) diameter, if applicable]

NOTE Spigot or groove diameter is expressed in millimetres (mm).

3.6
minimum cross-sectional area at the spigot
A_s
minimum area of the cross-section of the pipe at the spigot, or in the groove of the spigot, if applicable

NOTE Minimum cross-sectional area at the spigot is derived using the following equation and is expressed in square millimetres (mm^2)

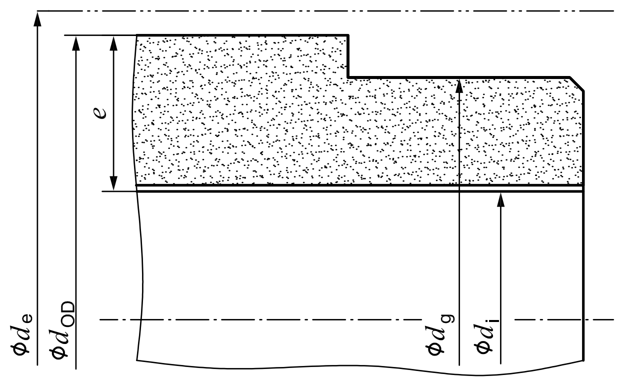
$$A_s = \pi \left[\left(0{,}5 \cdot d_g \right)^2 - \left(0{,}5 \cdot d_i \right)^2 \right]$$

3.7
buried pipeline
pipeline which is subjected to the external pressure transmitted from soil loading, including traffic and superimposed loads and, possibly, the pressure of a head of water

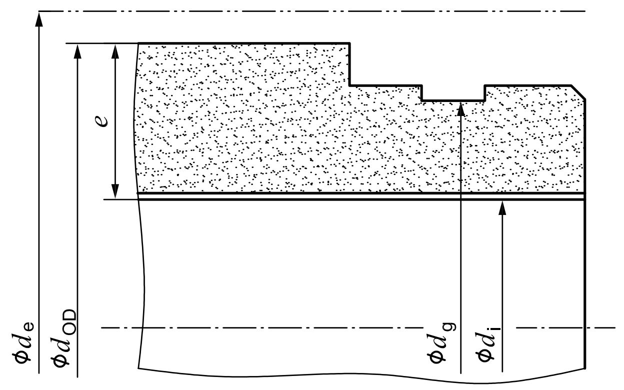
3.8
jacking
trenchless construction method which installs a pipeline by inserting pipes one by one under the ground by pressing with one or more hydraulic jacks, while the excavated ground is simultaneously evacuated from the cutting head

3.9
nominal length
numerical designation of a pipe length, which is numerically equal to the laying length (3.11), when expressed in metres (m) and rounded to the nearest whole number

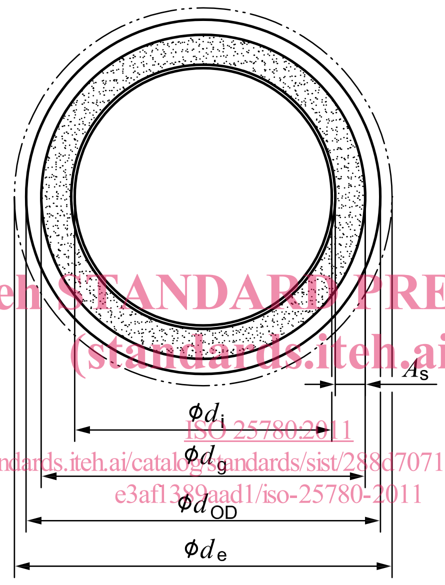
NOTE Nominal length is a dimensionless number rounded to the nearest whole number.



a) Section through a rebated un-grooved spigot



b) Section through a rebated grooved spigot



c) Cross-section through spigot

Key

d_{OD} outside diameter of pipe (see 3.1)

d_e jacking diameter (see 3.2)

d_i internal diameter of pipe (see 3.4)

d_g rebated spigot or groove diameter (see 3.5)

e wall thickness of pipe

A_s Minimum pipe cross-sectional area at spigot (see 3.6).

Figure 1 — Diameters referred to in these definitions

3.10
total length
distance between two planes normal to the pipe axis and passing through the extreme end points of the pipe

NOTE Total length is expressed in metres (m).

3.11
laying length
l
total length of a pipe minus, where applicable, the manufacturer's recommended insertion depth of the spigot(s) in the socket

NOTE Laying length is expressed in millimetres (mm).

3.12
specific initial longitudinal compressive stress at break (derived from a spool test-piece)
$\sigma_{b,s}$
compressive stress at break (3.46) of a spool test-piece, during a short-term compressive test with the test-piece loaded along its longitudinal axis, including, if applicable, spigots with rebates

NOTE When tested in accordance with Annex B, specific initial longitudinal compressive stress is expressed in megapascals (MPa).

3.13
minimum specific initial longitudinal compressive stress at break
$\sigma_{b,s,min}$
manufacturer's declared minimum value for the specific initial longitudinal compressive stress at break of the pipe

NOTE Minimum specific initial longitudinal compressive stress at break is expressed in megapascals (MPa).

3.14

initial longitudinal compressive stress at break (derived from rebated or un-rebated test-pieces)
$\sigma_{b,r}$
$\sigma_{b,u}$
compressive stress at break of the test-piece during a short-term compression test using either a rebated (r) or unrebated (u) test-piece

NOTE When tested in accordance with Annex A, the initial longitudinal compressive stress at break is expressed in megapascals (MPa).

3.15
sample de-rating factor
f_s
factor correcting for the relationship between compression test results obtained on full size pipes (spool test-pieces, 3.12) and results obtained using test-pieces with the same spigot geometry (3.14)

NOTE Sample derating factor is a dimensionless number.

3.16
de-rated initial longitudinal compressive stress at break
$\sigma_{b,d}$
calculated compressive stress obtained from the test results at break using either un-rebated or rebated test-pieces and the applicable de-rating factor

NOTE Derated initial longitudinal compressive stress at break is expressed in megapascals (MPa).

3.17
initial longitudinal compressive modulus
$E_{c,m}$
ratio of the applied stress to the resulting strain below the elastic limit, both measured concurrently during a short-term compression test

NOTE When tested in accordance with either Annex A or B, the initial longitudinal compressive modulus is expressed in megapascals (MPa).

3.18
ultimate longitudinal load
F_{ult}
calculated value of the concentric longitudinal load that the pipe withstands just before break

NOTE Ultimate longitudinal load is expressed in kilonewtons (kN).

3.19
longitudinal compressive (material) safety coefficient
γ
safety factor applied to the ultimate longitudinal load to determine the theoretical design jacking load $F_{j,\ calc}$ (3.21)

3.20
design jacking load
F_j
manufacturer's declared value of the longitudinal compressive load that a pipe can withstand during a jacking operation, taking into account the material safety coefficient, γ

NOTE Design jacking load is expressed in kilonewtons (kN).

3.21
theoretical design jacking load
$F_{j,\ calc}$
calculated value of the concentric longitudinal compressive load that the pipe can be expected to withstand during a jacking operation, taking into account the material safety coefficient, γ

NOTE Theoretical design jacking load is expressed in kilonewtons (kN).

3.22
permissible eccentric jacking force on the pipe
$F_{perm,\ p}$
calculated value of the permissible eccentric longitudinal load that the pipe can withstand during a jacking operation, taking into account the material safety coefficient, γ (3.19), and the estimated angular deflection, δ

NOTE Permissible eccentric jacking force on the pipe is expressed in kilonewtons (kN).

3.23
permissible eccentric jacking force on the system
$F_{perm,\ s}$
value declared by the pipe manufacturer of the permissible eccentric longitudinal force that the system can withstand during a jacking operation, taking into account the material safety coefficient, γ, and the estimated angular deflection, δ

NOTE Permissible eccentric jacking force on the system is expressed in kilonewtons (kN).

3.24
nominal stiffness
SN
S_N
alphanumerical designation for stiffness identification purposes (see 4.2.3), which has the same numerical value as the minimum initial specific ring stiffness value, when expressed in newtons per square metre (N/m^2)

NOTE Nominal stiffness is a dimensionless number used for identification or marking purposes consisting of the letters SN plus a number.

3.25
specific ring stiffness
S
physical characteristic of the pipe which is a measure of the resistance to ring deflection per metre length under external load

NOTE Specific ring stiffness is determined using the following equation and is expressed in newtons per square metre (N/m^2)

$$S = \frac{E \times I}{{d_\mathrm{m}}^3}$$

where

E is the apparent modulus of elasticity, which can be derived from the result of the ring stiffness test, i.e. ISO 7685, expressed in newtons per square metre (N/m^2);

d_m is the mean diameter of the pipe (3.3), in metres (m);

I is the second moment of area in the longitudinal direction per metre length, in metres to the fourth power per metre, (m^4/m)

$$I = \frac{e^3}{12}$$

where e is the wall thickness, in metres (m).

3.26
initial specific ring stiffness
S_0
value of specific ring stiffness, S, obtained when tested in accordance with ISO 7685

NOTE Initial specific ring stiffness is expressed in newtons per square metre (N/m^2).

3.27
wet creep factor
$\alpha_{x,\mathrm{creep,wet}}$
ratio of the long-term specific ring stiffness, $S_{x,\mathrm{wet}}$ at x years, to the initial specific ring stiffness, S_0

NOTE When tested in accordance with ISO 10468, using sustained loading under wet conditions, the long-term specific ring stiffness, $S_{x,\mathrm{wet}}$ is obtained and when this value is divided by the initial specific ring stiffness, S_0, the wet creep factor, $\alpha_{x,\mathrm{creep,wet}}$, is obtained (see the following equation)

$$\alpha_{x,\mathrm{creep,wet}} = \frac{S_{x,\mathrm{wet}}}{S_0}$$

3.28
calculated long-term specific ring stiffness
$S_{x,\mathrm{wet}}$
calculated value of specific ring stiffness, S, at x years

NOTE Long-term specific ring stiffness is obtained using the following equation

$$S_{x,\mathrm{wet}} = S_0 \times \alpha_{x,\mathrm{wet}}$$

where

x is the elapsed time in years specified in this International Standard (see 4.6);

$\alpha_{x,\mathrm{wet}}$ is the wet creep factor at x years;

S_0 is the initial specific ring stiffness.

3.29
pressure pipe
pipe having a nominal pressure (PN) (3.31) classification greater than 1 bar and which is intended to be used with the internal pressure equal to or less than its nominal pressure when expressed in bars

3.30
non-pressure pipe
pipe subjected to an internal pressure not greater than 1 bar

3.31
nominal pressure
PN
alphanumeric designation for pressure classification purposes, which has a numerical value equal to the resistance of a component of a piping system to internal pressure

NOTE Nominal pressure is a designation for reference or marking purposes that consists of the letters PN plus a number which is related to a component's pressure rating in bars.

3.32
normal service conditions
conveyance of water or sewage, in the temperature range 2 °C to 50 °C, with or without pressure, for 50 years

3.33
design service temperature
maximum sustained temperature, at which the system is expected to operate continuously

NOTE Design service temperature is expressed in degrees Celsius (°C).

3.34
rerating factor
R_{RF}
multiplication factor that quantifies the relation between a mechanical, physical or chemical property at the service condition compared to the respective value at 23 °C and 50 % relative humidity (RH)

3.35
relative ring deflection
y/d_{m}
ratio of the change in diameter of a pipe, y, in metres, to its mean diameter, d_{m}, in metres

NOTE Relative ring deflection is derived as a percentage, %, i.e.:

$$\left(\frac{y}{d_{\mathrm{m}}}\right)\times 100$$

3.36
minimum initial relative specific ring deflection at 2 min **before bore cracking occurs**
$\left(y_{2,\mathrm{bore}}/d_{\mathrm{m}}\right)_{\mathrm{min}}$
initial relative specific ring deflection at 2 min which a test-piece is required to exceed without bore cracking when tested in accordance with ISO 10466

NOTE Minimum initial relative specific ring deflection at 2 min before bore cracking occurs is expressed in % of mean diameter, i.e.:

$$\left(\frac{y_{2,\,\mathrm{bore}}}{d_{\mathrm{m}}}\right)_{\mathrm{min}}\times 100$$

3.37
type test
tests carried out in order to assess the fitness for purpose of a product or assembly of components to fulfil its or their function(s) in accordance with this International Standard

3.38
flexible joint
joint which allows relative movement between components being joined

3.39
flush coupling
joint component with either an external diameter equal to the pipe's outside diameter or an inside diameter equal to the pipe's inside diameter

3.40
closed joint
joint condition where the pipe-ends, initially separated with a pressure transfer ring, are in close contact with each other without any gap around the whole circumference

3.41
open joint
joint condition where the pipe-ends are partly or totally not in close contact with each other thereby forming a gap

3.42
angular deflection
δ
angle between the axes of two adjacent pipes

NOTE Angular deflection (see Figure 2) is expressed in degrees (°).

3.43
draw
D
longitudinal movement of a joint

NOTE Draw (see Figure 2) is expressed in millimetres (mm).

3.44
total draw
T
sum of the draw, D, and the additional longitudinal movement, J, due to the presence of angular deflection

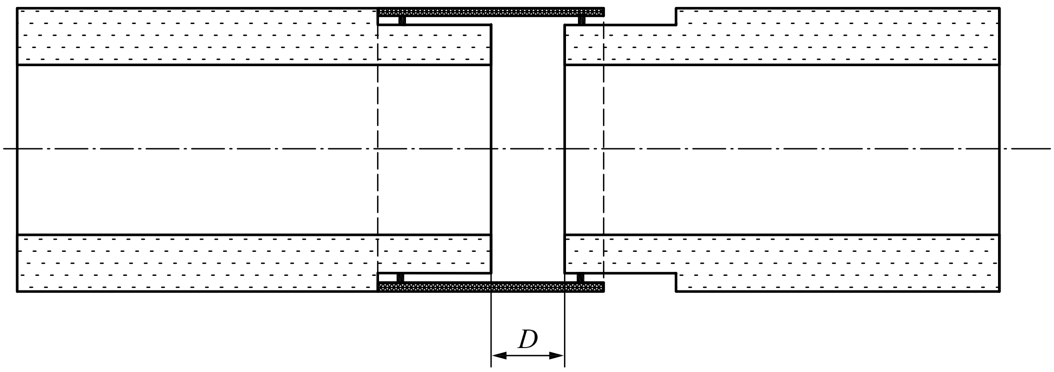
NOTE Total draw (see Figure 2) is expressed in millimetres (mm).

3.45
misalignment
M
amount by which the centrelines of adjacent pipes fail to coincide

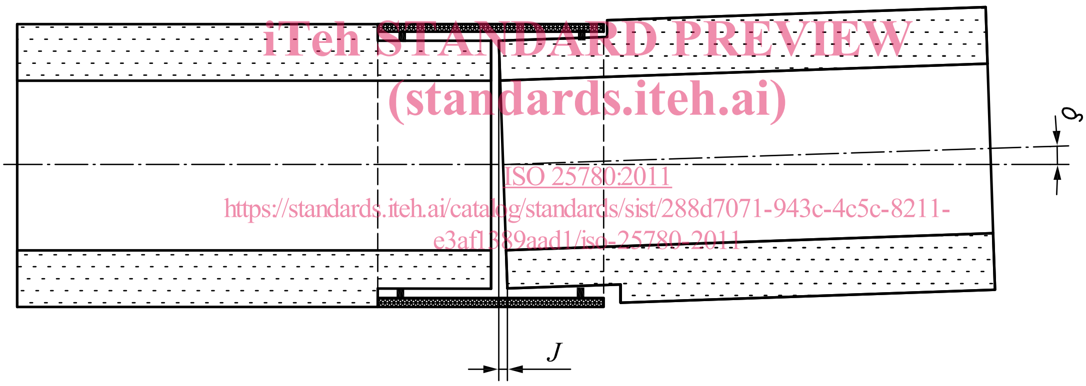
NOTE Misalignment (see Figure 2) is expressed in millimetres (mm).

3.46
break
condition where the test-piece can no longer carry the load to which it is being subjected

3.47
overcut
area between the bored wall formed in the native soil and the external surface of the pipe, created by the cutting head or shield of the jacking machine



a)



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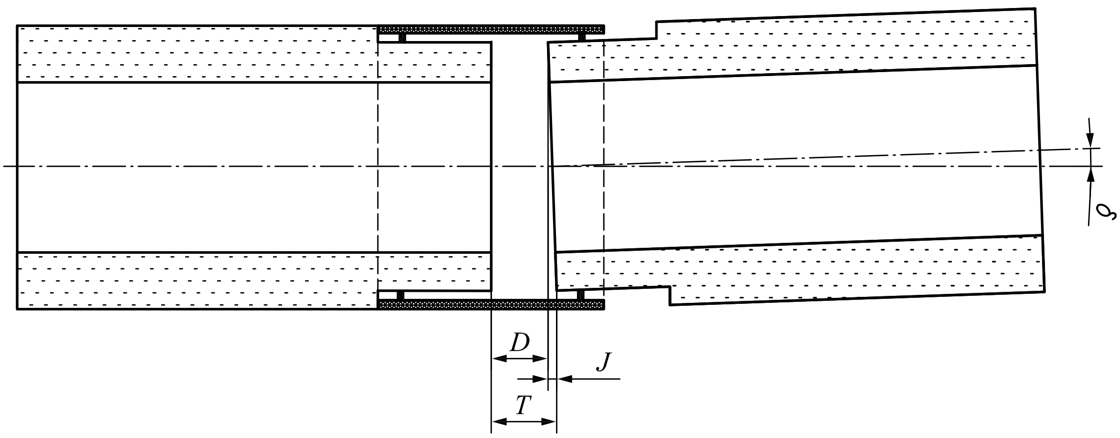
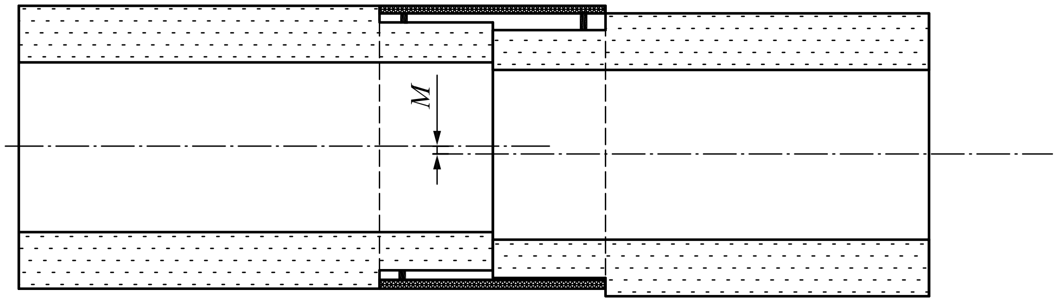


c)

Figure 2 — Joint movements (*continued*)



d)

Key

D draw

J longitudinal movement arising from angular deflection of the joint

δ angular deflection of the joint

T total draw

M misalignment

NOTE The joint in this figure is an example of a typical joint but is not intended to fix design. Other joints are available.

Figure 2 — Joint movements

4 Requirements

4.1 Classification

Pipes shall be identified according to the manufacturer's declared pipe outside diameter, d_{OD} (see 3.1), maximum jacking load (see 4.1.3), nominal stiffness (SN) (see 3.24), nominal pressure (PN) (see 3.31) and joint type (see 4.2.2).

Couplings for use on the outside of a pipe shall be identified according to the pipe jacking diameter, d_e, nominal pressure (PN) and joint type. Couplings for use on the inside of a pipe shall be identified according to the pipe's internal diameter, d_i (see 3.4), nominal pressure (PN) and joint type.

4.2 Pipe properties

4.2.1 Manufacturer's declared diameters

The outside diameter of GRP pipes conforming with this International Standard shall conform to the requirements given in Table 4 and be designated by the manufacturer's declared pipe outside diameter, d_{OD} (see 3.1). The manufacturer shall also declare the internal diameter, d_i (see 3.4).

4.2.2 Maximum jacking load

The manufacturer shall declare the maximum load that can be applied to the pipe during the jacking operation, in tonnes. The customer shall detail in his enquiry the maximum load that is required for the pipe to be capable of carrying during the jacking operation.

4.2.3 Nominal stiffness

For jacking applications, the pipe shall have a nominal stiffness (see 3.24) of at least SN 20000.