

Plastic-steel-plastic Composite Pressure Pipe

1 Range of Application

The Standard specifies the definition, classification, symbol, requirements, test methods, inspection rules, marking, operation instruction, packing, transportation and storage of plastic-steel-plastic composite pressure pipe (Hereinafter called PSP for short).

The Standard is applicable to those PSP pipes used for the transport of cold/hot water in cities and towns or inside/outside the buildings, drinking water, heating, fuel gas in cities and towns, and special fluids such as industrial waste water, corrosive gas and solid powder.

2 Reference Files for Normalization

The Standard makes reference to some articles in the following files, so as to make them become the articles of this Standard. For every reference file with clear indication of date, all of its subsequent modifications (excluding corrigenda) are inapplicable to the Standard. However, it is encouraged for both parties who come to an agreement according to this Standard to research if it is practicable to use the latest editions of these reference files. For those reference files without clear indication of date, their latest editions are applicable to this Standard.

- GB 708 Dimensions, shape, weight and tolerances for cold-rolled plates and sheets
- GB 709 Dimensions, shape, weight and tolerances for hot-rolled plates and sheets
- GB/T 1844.1 Symbols of plastics and resins---Part 1: Basic polymers and their special characteristics (neq ISO 1043-1:1987)
- GB/T 2035 Terms and definitions for plastics (eqv ISO 472:1988)
- GB/T 2790 Adhesives, 180° peel strength test method for a flexible-bonded-to-rigid test specimen assembly
- GB/T 2791 Adhesives, T peel strength test method for a flexible-to-flexible test specimen assembly
- GB/T 2828 Sampling procedures and tables for lot-by-lot inspection by attributes (Apply to inspection of successive lots or batches)
- GB/T 2829 Sampling procedures and tables for periodic inspection by attributes (Apply to inspection of stability for productive process)
- GB/T 2918 Plastics--Standard atmospheres for conditioning and testing (idt ISO 291:1997)
- GB/T 4217-2001 Thermoplastic pipes used for the transport of fluids---Nominal outside diameters and nominal pressures (idt ISO 161-1:1996)
- GB/T 6671-2001 Thermoplastic pipes---Determination of longitudinal reversion (eqv ISO 2505: 1994)
- GB/T 7735 Steel tubes--The inspection method on eddy current test (eqv ISO 9304: 1989)
- GB/T 8806 Method for dimension measuring of plastic pipes (eqv ISO 3126: 1974)
- GB 9969.1 General principles for preparation of instructions for use of industrial products
- GB/T 13663-2000 Polyethylene (PE) pipes for water supply (neq ISO 4427:1996)
- GB 15558.1-1995 Buried polyethylene pipes for the supply of gaseous fuels
- GB/T 15560 Standard test method for short-time hydraulic failure and resistance to constant internal pressure of the plastics pipes for the transport of fluids
- GB/T 17219 Standard for safety evaluation of equipment and. Protective materials in drinking water system
- GB/T 18256-2000 Welded steel tubes (except submerged arc-welded)---Ultrasonic testing for verification of hydraulic leak-tightness (eqv ISO 10332:1994)
- GB/T 18742.1-2002 Polypropylene piping systems for hot and cold water installation--Part 1: General

CJ/T 159-2002	Polyethylene-Aluminum-Polyethylene composite pressure pipe (butt welding)
CJ/T 175-2002	Polyethylene of raised temperature resistance (PE-RT) piping systems for hot and cold water installations

3 Terms, Definitions, Symbols and Abbreviations

3.1 Terms and Definitions

The following terms and definitions specified in GB/T 1844.1 and GB/T 2035 are applicable to this Standard.

3.1.1

Plastic-steel-plastic composite pressure pipe

PSP

This composite pipe is made with dedicated thermosol by means of extrusion, using welded steel pipe as its intermediate layer and polyethylene/polypropylene plastics as its internal layer and external layer. (For details, see Fig. 1).

3.1.2

Nominal outside diameter

D_n

Namely, specified outside diameter. Unit: mm.

3.1.3

Maximum operating pressure

MOP

The maximum fluid pressure allowable for continuous use in the piping system. Unit: MPa.

3.2 Symbol

The following symbol is applicable to the Standard:

D_n: Nominal Outside Diameter

3.3 Abbreviations

The following abbreviations are applicable to the Standard:

MOP: Maximum operating pressure

PE: Polyethylene

PE-RT: Polyethylene of raised temperature resistance

PEX: Crosslinked polyethylene

PP-R: Poly propylene random

4 Classification & Symbol

4.1 Classified by pressure rating

The PSP pipes are classified as the following two series: ordinary pipes and strengthened pipes.

4.2 Classified by usage

The PSP pipes are classified by usage as the following series and their code names:

——PSP pipe for the supply of cold water, with its code name of L;

——PSP pipe for the supply of hot water, with its code name of R;

——PSP pipe for the supply of gaseous fuels, with its code name of Q;

——PSP pipe for the transport of special fluids, with its code name of T.

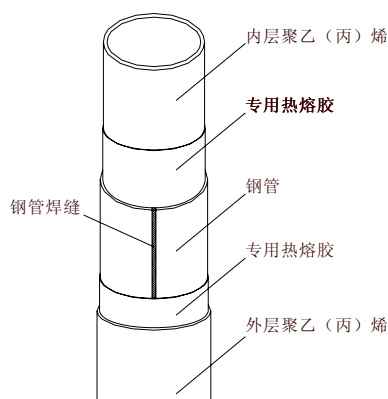


Fig. 1 Structural Drawing of Plastic-steel-plastic composite pressure pipe

内层聚乙(丙)烯	Internal layer: polyethylene/polypropylene
专用热熔胶	Dedicated thermosol
钢管	Steel pipe
专用热熔胶	Dedicated thermosol
外层聚乙(丙)烯	External layer: polyethylene/polypropylene
钢管焊缝	Welded seam of steel pipe

4.3 Symbol

For the meaning of PSP pipe symbol, you can refer to Fig. 2.

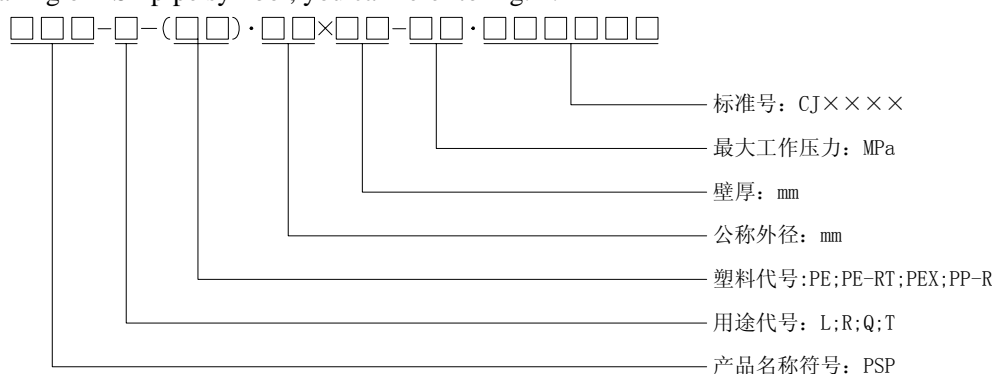


Fig. 2 Symbol of Plastic-steel-plastic composite pressure pipe

标准号	Serial number of the Standard
最大工作压力	Maximum operating pressure
壁厚	Pipe wall thickness
公称外径	Nominal outside diameter
塑料代号	Code name of plastics
用途代号	Code name of usage
产品名称符号	Abbreviation of product name

For example:

A type of PSP composite pressure pipe, which is manufactured for the supply of hot water according to this Standard and made with welded steel pipe and crosslinked polyethylene, with its nominal outside diameter of 75mm, pipe wall thickness of 5.5mm, and maximal operating pressure of 2.0 MPa, should be marked with the symbol of PSP-R-(PEX) · 75×5.5-2.0 · CJ××××.

5 Requirements

5.1 Operating temperature

The operating temperature of PSP pipes should meet the requirements given in Table 1.

Table 1 Operating Temperature of PSP Pipes

Code Name of Usage	Code Name of Plastics	Operating Temperature ℃
L	PE	≤60
R	PE-RT; PEX; PP-R	≤95
Q	PE	≤40
T	PE	≤40
	PE、PE-RT; PEX; PP-R	≤80

5.2 Materials

5.2.1 Steel Strip

5.2.1.1 Surface quality: The surface of steel strip should have no such dirt as oil stain, rusty spot and dust, as well as no such defects as breakage and dent that will do harm to the usage of PSP pipes.

5.2.1.2 Mechanical properties: As the steel strip used for the production of PSP pipes, its coefficient of extension should not be less than 30%, and its tensile strength should not be less than 275MPa.

5.2.1.3 Thickness and its tolerance: The thickness and tolerance of steel strip should meet the requirements of GB708 or GB 709.

5.2.2 Plastics

5.2.2.1 For the PSP pipes for the supply of cold water, PE plastics should be selected from Table 1 of GB/T 13663-2000, of which the basic performance should meet the requirements given in Table 2 of GB/T 13663-2000.

5.2.2.2 For the PSP pipes for the supply of hot water, the performance of polyethylene/polypropylene plastics should meet the following requirements:

——If PEX is selected, its performance should meet the requirements given in Table 1 of CJ/T 159-2002;

——If PE-RT is selected, its performance should meet the requirements given in Chapter 5.1 of CJ/T 175-2002;

——If PP-R is selected, its performance should meet the requirements given in Chapter 5 of GB/T 18742.1-2002.

5.2.2.3 For the PSP pipes for the supply of gaseous fuels, the performance of PE plastics should meet the requirements given in Table 1 of GB 15558.1-1995;

5.2.2.4 For the PSP pipes for the transport of special fluids, the categories and requirements of polyethylene/polypropylene plastics should be determined by the customer and the manufacturer via negotiation.

5.2.3 Thermosol

The dedicated thermosol used for PSP pipes should meet the requirements given in Table 2.

Table 2 Main Indicators of Dedicated Thermosol

Item	Indicators		
	L、Q	R (PE category)	R (PP-R category)
Density / (g/cm ³)	≥0.915	≥0.915	≥0.89
Vicat Softening Point (Temperature) /℃	≥100	≥120	≥120

5.2.4 Reused Material

For the clean remainder of plastics used in the production of PSP pipes according to this Standard, as long as PSP pipes can be made to meet the requirements of the Standard, the remainder can be mixed into new material in small quantity after the comminution re-granulation process. It is inadvisable to use reused material in the quantity of more than 5% plastic material, and the reused material should be uniformly dispersed. The application of reused material from other sources is forbidden.

5.3 External Appearance & Color

5.3.1 External Appearance

5.3.1.1 The external surface of PSP pipes should be in uniform color and luster, without such defects as obvious scuffing, blister, pinhole, decrustation and other defects that will have an impact on the usage of PSP pipes.

5.3.1.2 The internal surface of PSP pipes should be smooth, without any maculation, peculiar smell, foreign body, pinhole or crack.

5.3.1.3 The end surface seal of PSP pipes is well connected with pipe material, without any steel pipe uncovered.

5.3.2 Color

The colors of PSP pipes should meet the following requirements:

a) According to their various usage purposes, the external-layer colors of PSP pipes are as follows:

——PSP pipe for the supply of cold water: White or Blue;

——PSP pipe for the supply of hot water: Orange red;

——PSP pipe for the supply of gaseous fuels: Yellow or Black, and there must be a conspicuous yellow color strip on black PSP pipe;

——PSP pipe for the transport of special fluids: Red.

b) According to the customer's requirements, the other colors could be determined by the customer and the manufacturer via negotiation

5.4 Specifications and MOP

5.4.1 For ordinary-series PSP pipes, the nominal outside diameter and tolerance should conform to the provisions in Chapter 4 of GB/T 4217-2001 and meet the requirements given in Table 3.

5.4.2 For strengthened-series PSP pipes, the nominal outside diameter and tolerance should conform to the provisions in Chapter 4 of GB/T 4217-2001 and meet the requirements given in Table 4.

5.4.3 For ordinary-series PSP pipes, the pipe wall thickness, internal-layer polyethylene/polypropylene thickness, external-layer polyethylene/polypropylene thickness, steel strip thickness and tolerance should meet the requirements given in Table 3.

5.4.4 For strengthened-series PSP pipes, the pipe wall thickness, internal-layer polyethylene/polypropylene thickness, external-layer polyethylene/polypropylene thickness, steel strip thickness and tolerance should meet the requirements given in Table 4.

Table 3 Specifications of Ordinary-Series PSP Pipes

Dn/ mm	Dn tolerance/ mm	Minimum thickness of internal-layer polyethylene or polypropylene / mm	Minimum thickness of steel strip/ mm	Minimum thickness of external-layer polyethylene or polypropylene / mm	Pipe wall thickness/ mm	Pipe wall thickness tolerance/ mm
50	+0.5 0	1.4	0.3	1.0	3.5	+0.5 0
63	+0.6 0	1.6	0.4	1.1	4.0	+0.7 0
75	+0.7 0	1.6	0.5	1.1	4.0	+0.7 0
90	+0.8 0	1.7	0.6	1.2	4.5	+0.8 0
110	+0.9 0	1.8	0.8	1.3	5.0	+0.9 0
160	+1.6 0	1.8	1.1	1.5	5.5	+1.0 0

200	+2.0 0	1.8	1.4	1.7	6.0	+1.2 0
250	+2.4 0	1.8	1.7	1.9	6.5	+1.4 0
315	+2.6 0	1.8	2.2	1.9	7.0	+1.6 0
400	+3.0 0	1.8	2.8	2.0	7.5	+1.8 0

Table 4 Specifications of Strengthened-Series PSP Pipes

Dn/ mm	Dn tolerance/ mm	Minimum thickness of internal-layer polyethylene or polypropylene / mm	Minimum thickness of steel strip/ mm	Minimum thickness of external-layer polyethylene or polypropylene / mm	Pipe wall thickness/ mm	Pipe wall thickness tolerance/ mm
16	+0.3 0	0.8	0.3	0.4	2.0	+0.4 0
20	+0.3 0	0.8	0.3	0.4	2.0	+0.4 0
25	+0.3 0	1.0	0.4	0.6	2.5	+0.4 0
32	+0.3 0	1.2	0.4	0.7	3.0	+0.4 0
40	+0.4 0	1.3	0.5	0.8	3.5	+0.5 0
50	+0.5 0	1.4	0.6	1.5	4.5	+0.8 0
63	+0.6 0	1.7	0.6	1.7	5.0	+0.9 0

Table 4 Specifications of Strengthened-Series PSP Pipes (Continued)

Dn/ mm	Dn tolerance/ mm	Minimum thickness of internal-layer polyethylene or polypropylene / mm	Minimum thickness of steel strip/ mm	Minimum thickness of external-layer polyethylene or polypropylene / mm	Pipe wall thickness/ mm	Pipe wall thickness tolerance/ mm
90	+0.8 0	2.0	0.8	2.0	6.0	+1.2 0
110	+0.9 0	2.0	1.0	2.2	6.5	+1.4 0
160	+1.6 0	2.0	1.7	2.2	7.0	+1.6 0
200	+2.0 0	2.0	2.2	2.2	7.5	+1.8 0
250	+2.4 0	2.0	2.8	2.3	8.5	+2.2 0
315	+2.6 0	2.0	3.5	2.3	9.0	+2.4 0
400	+3.0 0	2.0	4.5	2.3	10.0	+2.8 0

5.4.5 For ordinary-series PSP pipes, the maximal operating pressure should meet the requirements given in Table 5.

5.4.6 For strengthened-series PSP pipes, the maximal operating pressure should meet the requirements given in Table 6.

Table 5 MOP of Ordinary-Series PSP Pipes

Code Name of Usage	Dn /mm									
	50	63	75	90	110	160	200	250	315	400
	MOP /MPa									
L、R、T	1.25									
Q	0.5									

Table 6 MOP of Strengthened-Series PSP Pipes

Code Name of Usage	Dn /mm														
	16	20	25	32	40	50	63	75	90	110	160	200	250	315	400
	MOP /MPa														
L、R、T	2.5							2.0							
Q	1.0							0.8							

5.4.7 PSP pipes are supplied in the form of straight pipe, with the standard lengths of 4m, 6m, 9m and 12m and the length tolerance of ± 20 mm. If the customer makes special demands on the length of PSP pipes, it could be determined by the customer and the manufacturer via negotiation.

5.5 Mechanical properties

5.5.1 Short-term Static Fluid Pressure

According to the provisions of Article 6.5.1, while the PSP pipes are tested for the short-term static fluid pressure as required by the provisions in Table 7, there should not be any break or leakage phenomenon, and the maximal operating pressure should meet the requirements given in Table 5 or Table 6.

Table 7 Requirements of PSP Pipe Static Fluid Pressure Test

Code name of usage	Test temperature/ °C	Static fluid pressure/ MPa	Test time/ h
L、T	80 ± 2	MOP $\times 2$	165
R	95 ± 2	MOP $\times 2$	165
Q	80 ± 2	MOP $\times 2 \times 2.5$	165

5.5.2 Bursting Strength

According to the provisions of Article 6.5.2, while the PSP pipes are tested for their bursting strength, the minimum bursting strength should meet the requirements given in Table 8.

Table 8 Requirements of PSP Pipe Bursting Strength Test

PSP pipe series	Dn / mm														
	16	20	25	32	40	50	63	75	90	110	160	200	250	315	400

	Minimum Bursting Pressure /MPa	
Ordinary-series pipes	≥ 3.75	
Strengthened-series pipes	≥ 7.5	≥ 6.0

5.5.3 Anti-cracking Stability

While the PSP pipes are tested according to the provisions of Article 6.5.3, there should not be any cracking or fracture phenomenon.

5.5.4 Adhesive Property

5.5.4.1 Peel strength: While the PSP pipes are tested according to the provisions of Article 6.5.4.1, the peel strength should be no less than 100N/25mm.

5.5.4.2 Adhesive strength between layers: While the PSP pipes are tested according to the provisions of Article 6.5.4.2, there should not be any detachment or gapping phenomenon between internal or external polyethylene/polypropylene layer and steel pipe layer.

5.5.5 Welding Quality of Steel Pipe

5.5.5.1 Nondestructive flaw detection: The welded steel pipe should be tested by eddy current testing or ultrasonic flaw detection testing one by one according to the provisions of Article 6.5.5.1. By means of eddy current testing, the steel pipe tested should meet the requirements of A-class artificial flaw (drill hole) acceptance check by contrasting test samples given in GB/7735, and by the means of ultrasonic flaw detection testing, the steel pipe tested should meet the requirements given in GB/T 18256.

5.5.5.2 Strength of welded seam: While the PSP pipes are tested according to the provisions of Article 6.5.5.2, there should not be any tearing phenomenon at the butt joint between steel pipe and welded seam or on the steel strip.

5.6 Sanitary Property

While the PSP pipes for the supply of cold water are tested according to the provisions of Article 6.6, the sanitary property should meet the requirements of GB/T 17219, and the other PSP pipes for the supply of drinking water or foods should meet the requirements for the above-mentioned sanitary property as well.

5.7 Chemical Resistance

5.7.1 According to the provisions of Article 6.7, while the PSP pipes for the transport of special fluids are tested for chemical resistance as required by the provisions in Table 9, there should not be any fissuration, sticking tendency or unusual phenomenon on the test sample's internal and external layers.

Table 9 Chemical Resistance

Item of Chemicals	Quality Variation/ mg/cm ²
10% sodium chloride solution	± 0.2
30% nitric acid	± 0.1
40% nitric acid	± 0.3
40% sodium hydroxide solution	± 0.1
95% alcohol (volume fraction)	± 1.1

5.7.2 Except the requirements given in Table 9, if the custom makes special demands on the chemical resistance property of PSP pipes, some other testing requirements could be attached by the customer and the manufacturer via negotiation.

5.8 Resistance to Gas Constituents

While the PSP pipes for the supply of gaseous fuels are tested according to the provisions of Article 6.8, the resistance to gas constituents should meet the requirements given in GB15558.1-1995.

5.9 Crosslinking Degree

While the PEX-made PSP pipes for the supply of hot water are tested according to the provisions of Article 6.9, the crosslinking degree by means of radiation crosslinking process should be no less than 60%, and the crosslinking degree by means of silane crosslinking process should be no less than 65%.