TECHNICAL SPECIFICATION
FOR
SUPPLY OF MDPE FITTINGS, VALVES AND TRANSITION FITTINGS

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1.0 SCOPE

The scope of this document is to provide the technical specifications for the procurement of PE Fittings, Valves without stem extension & Transition Fittings.

2.0 STANDARDS/REFERENCES

The following National & International codes / standards / references (Latest edition) shall be applicable for PE-100 material as well as Polyethylene pipe.

EN 682	Air-tight rubber seals - specification for air-tight seal materials for gas and hydrocarbon fluid transfer piping
EN 1555-1	Plastic piping systems for combustible gas distribution. Polyethylene (PE). Part 1. General information
EN 1555-3	Plastic piping systems for combustible gas distribution. Polyethylene (PE). Part 3 -Accessories
EN 1555-7	Plastic piping systems for combustible gas distribution. Polyethylene (PE). Part 7. Conformity evaluation.
IS-2530	Methods of test for PE moulding materials and PE compound
ISO-1872- 2B	Plastic: polyethylene (PE) moulding and extrusion material.
ISO- 527	Plastics: Determination of tensile properties.
EN 728	Plastic Piping and Ducting System – Determination of oxidation Induction time
ISO-1133	Plastics – determination of the melt-mass flow rate (MFR) and melt volume flow rate (MVR) of thermoplastic
ISO DIS 11413	Preparation of test assemblies between a polyethylene (PE) pipe and an electrofusion fitting.
ISO DIS 11414	Preparation of test assemblies between a pipe/pipe or pipe/fitting polyethylene (PE) by butt fusion
ISO DIS 12093	Format for a technical brochure for electrofusion joint characteristics
ISO TR 13950	Electrofusion identification methods
ISO-1183:1987	Plastic: Methods for determining the density of non-cellular plastics.
IS-14885	Polyethylene pipes for supply of Gaseous Fuels.
ISO-4437	Buried Polyethylene pipe for supply of gaseous fuels – metric series - specification
EN 1555 -1	Plastic Piping System for the Supply of Gaseous Fuels.
EN 1555-2	Standard PE Pipes and Fitting, Suitable for Gas Transportation System Solutions
EN 1555-7	Gaseous fuels supply polyethylene (PE)

ISO 13949:1997	Method of assessment of the degree of pigment dispersion in polyolefin pipes, fittings and compounds
EN 12099	Polyethylene piping system - Determination of Volatile Content
EN 12118	Plastic Piping system – Determination of moisture content in thermoplastic by coulometer
CEI 60335-1	Safety standards for household appliances and similar equipment.
CEI 364	Electrical installations on buildings (including building sites and other temporary installations)
CEI 449	Voltage domains for building electrical installations

3.0 MATERIAL

i The material grade of polyethylene PE Fittings shall be PE100. The bidder shall submit the details by clearly indicating the make, country of origin, part nos. / Product codes and catalogue number along with catalogues written in English for the Items quoted, in the Unpriced Bid.

ii The PE compound from which the fittings with electrofusion socket are made shall conform to EN 1555-1.

iii The PE compound of the fittings shall be made only from virgin material conforming to EN 1555-1.

iv PE compound shall be cadmium free pigment compound.

v All parts of the fittings in contact with the gas stream shall be resistant to the gas, its condensates and other occurring substances such as dust.

vi The PE fittings made from below listed material are forbidden:

- **a.** Use of recycled materials
- **b.** Mixture of different materials
- **c.** Addition of complementary materials

vii The material and constituent elements used in marking of fittings (including elastomers, greases and any metallic part, if used) shall be resistant to the external and internal corrosion and shall have life expectancy under following conditions at least equal to the PE pipes with which they are intended to be used.

- a During storage
- b Under the effect of the gas conveyed
- c With respect to the services environment and operating conditions
- d Fittings material in contact with the PE pipe shall not adversely affect pipe performance or initiate stress cracking.

viii All metal parts susceptible to corrosion shall be adequately protected. Metal parts must conform to prescribed standards of that particular material for gas distribution, for quality levels, size/gauge and measurements.

ix Cast iron, aluminium and its alloys are not authorised for use.

x The bidder shall provide approvals of internationally recognized authorities for their products along with their un-priced bids.

xi When dissimilar metallic materials are used which can be in contact with moisture, steps shall be taken to avoid the possibility of galvanic corrosion.

xii Greases or lubricants shall not exude onto fusion areas and shall not affect the long-term performance of fitting materials. Other materials conforming to 4.2.1 of EN 1555-3 may be used provided that it is proven that the fittings conform to this standard.

xiii Elastomer seal and other elements manufactured in this material, must comply with EN 682 standards.

APPROVED MANUFACTURER FOR RAW MATERIAL

a. ELENAC
b. BOREALIS
c. TOTAL PETROCHEMICALS
d. DOW
e. INEOS
f. BOROUGE
g. LYONDELLBASELL

However, any other reputed national or international Manufacturer may also be considered for supply of Raw material with approval of BPCL / BPCL's representative.

4.0 TECHNICAL REQUIREMENTS

a. The design of fittings shall be as per European Standards EN 1555-3 and the complementary particular requirement.
b. The fittings are intended to be use in gas distribution networks made of PE and Steel/GI pipes**.**
c. No component of the fitting shall show any signs of damage, scratches, pitting, bubbles, blisters, inclusions or cracks to an extent that would prevent conformity of the fittings to the requirements of this standard.
d. Colour of the PE parts of fittings shall be black as per PNGRB standards. Colour of all accessories to fittings and electrofusion accessories will be black.
e. Allowable pressure drop shall be as per the standard ISO 17778.
f. Any melt exudation shall not cause wire movement in electrofusion fittings such that it leads to short-circuiting, when jointed in accordance with the manufacturer's instructions. There shall be no excessive creasing of the internal surfaces of the adjoining pipes.
g. Fittings joints shall conform to EN 1555-5 and shall be leak proof.

4.1 Electrical characteristic

a. For voltages greater than 25 V, direct human contact with energized parts shall not be possible when the fitting is in the fusion cycle during assembly in accordance with the instructions of the manufacturers of the fittings and of the assembly equipment, as applicable.
b. The manufacturer shall state the tolerance on the electrical resistance of the fitting at 23 °C. The resistance shall not exceed the following value: [nom. value ± 10 %] + 0.1 Ω. Note: 0.1 Ω is the assumed value of the contact resistance. The operating voltage of the fittings shall remain 40 +_ 0.5 V.
c. The surface finish of the terminal pins shall allow a minimum contact resistance in order to satisfy the resistance tolerance requirements. Electrofusion terminal connections shall be as per Annex A of EN 1555-3.

4.2 Mechanical characteristics

a. Fittings shall have mechanical characteristics conforming to the requirements given in Table 4 of standard EN 1555-3.
b. The technical descriptions of the manufacturer shall include the following information:
    i. field of application:
        - pipe and fitting temperature limits
        - pipe series or SDRs

- ovality

ii. Assembly instructions.
iii. fusion instructions
- fusion parameters with limits

iv. data for saddles and tapping tees:
- the means of attachment (tools and/or under clamp)
- Need to maintain the under clamp in position in order to ensure the performances of the assembly.

c. Unless otherwise specified by the applicable test method, the test pieces shall be conditioned at (23 ± 2) °C before testing.
d. Testing of fitting shall be in accordance with the test methods as specified in Table 4 of standard EN 1555-3 sing the indicated parameters.
e. Hydrostatic test pressure and minimum test period shall be as per Table-5 of EN 1555-3.

4.3 **Physical characteristics**

i. Fittings shall have physical characteristics conforming to the requirements given in Table 7 of standard EN 1555-3.

ii. Thermal stability test shall be done at 200 deg. C by means of differential scanning calorimetry (DSC), considering oxygen induction time (OIT) ≥ 20 min.

iii. Melt mass flow rate shall be calculated at 190 deg. C by applying 5 Kg of load on test specimen. It shall be expressed in g/ 10min.

iv. Unless otherwise specified by the applicable test method, the test pieces shall be conditioned at (23 ± 2) °C before testing.

v. Testing of fitting shall be in accordance with the test methods as specified in Table 7 of standard EN 1555-3 using the indicated parameters.

4.4 **Performance requirements**

When fittings are assembled to each other or to components conforming to other parts of EN 1555, the joints shall conform to EN 1555-5.

In case of wall thickness design different from that according to Table-2 of EN 1555-3, fittings and associated joints shall additionally meet the performance requirement listed in Table-6, EN 1555-3.

4.5 **Electro Fusion Fitting Jointing**

i. For Electro Fusion fitting jointing an electrical resistance element is incorporated in the socket of fitting which when connected to an appropriate power supply, melts and fuses the materials of the pipe and fitting together.
ii. The effectiveness of this technique depends on attention to the preparation of the jointing surfaces, in particular the removal of the oxidized surface of the pipe over the socket depth and ensuring the jointing surface are clean. If ovality causes gap between concentrically located pipe and the fitting to exceed 1% of the pipe OD after re-rounding to ensure correct welding. If the gap still exceeds 1% of the pipe OD after re-rounding, then a check should be made of the pipe OD dimensions to determine if it meets specification.
iii. The maximum gap between eccentrically located pipe and fitting i.e. pipe touching fitting at one point must not exceed 2% of the pipe OD.

iv. Sometimes coiled pipes may be too oval to fit into couplers, or the end of the pipe may make the alignment of the ends impossible. In such circumstances the use of a mechanical pipe straightener or rounding tool is necessary.

4.6 Electro-Fusion Saddle Jointing

i. For Electro Fusion fitting jointing an electrical resistance element is incorporated in the socket of fitting which when connected to an appropriate power supply, melts and fuses the materials of the pipe and fitting together.
ii. The effectiveness of this technique depends on attention to the preparation of the jointing surfaces, in particular the removal of the oxidized surface of the pipe over the socket depth and ensuring the jointing surface are clean.
iii. Method of holding the tapping tee saddle during the fusion cycle are used namely top loading and under clamping space around the pipe. In a trench a minimum clearance of 150 mm is required.

4.7 Conditioning Period

Refer below table (Table-1 of ISO 11413) for minimum conditioning required for joints.

Nominal wall thickness, e_n Mm	Minimum conditioning period H
$e_n < 3$	1
$3 \le e_n < 8$	3
$8 \le e_n < 16$	6
$16 \le e_n < 32$	10
$32 \le e_n$	16

5.0 DESIGN

Fittings shall be free from cracks, voids, blisters, distortion, dent or other defects.

Fittings shall be capable of being fusion jointed to pipes using control boxes. The fittings shall exhibit the strengths and fusion compatibility with pipes of respective sizes.

Each fitting shall be bar coded which shall conform to ISO/TR 13950:1997 & ISO/IEC 16390:1999 or latest edition's and shall have a permanent fusion indicator.

Heating coil design shall be such that it should not be damaged during assembly leading to short circuit of heating coil.

5.1 Electrofusion Jointing:

PE pipes, fittings and valves intended to be used for jointing by electrofusion shall be prepared and assembled in accordance with ISO 11413. The conditions for the preparation of the joints are given in clause 4.2.3 of EN 1555-5 for the assessment of fitness for purpose of electrofusion joints.

For joints with electrofusion saddle fittings, the electrofusion saddle fitting shall be fused to the pipe, while it is pneumatically pressurized to the allowable maximum operating pressure. The pipe shall be cut immediately after the manufacturer prescribed cooling time has elapsed.

These joints with electrofusion saddle fitting should be prepared taking into consideration national safety regulations.

For straight equal electrofusion socket fittings (couplers) test joints on selected diameters out of the product range shall be prepared with a gap of 0.05dn between the pipe end and the maximum theoretical depth of penetration of the fitting, where for diameters greater than 225 mm the adjoining pipes shall be arranged to provide the maximum angular deflection possible for the fitting, limited to 1.5°.

Electrofusion Socket Fittings

Electrofusion Socket Fittings shall incorporate a method of controlling pipe penetration within each socket. The inner cold zone of each socket shall not be less than (0.1 d + 5) mm for sizes upto 125 mm & 0.1 d for sizes greater than 125 mm.

Depth of penetration (L1) and Fusion zone length (L2) shall be as per figure-1 & Table-1.

- Elbow/Bends: Both ends of Elbow/Bends shall be electrofusion type with integral stop.
- Coupler: Both ends of coupler shall be electrofusion type with integral stop.
- Reducer: Reducer ends shall be electrofusion type with integral stop.
- Cap: Caps shall be electrofusion end type for leak proof termination of line.
- Equal Tee: Main/Header ends of tee shall be electrofusion type. Branch end shall be plain.

5.2 Tapping Tees & Saddles

Tapping Tees and Saddle shall be Wrap Around type for branch connection for ensuring proper alignment and better fusion process.

The tapping tees shall provide a means of cutting through the pressurized main pipe and allowing the gas flow into the outlet pipe. Internal cutter shall be of SS material. Branch End shall be plain.

Dimensions H, H1, H2 and L shown in figure 2 shall be as per manufacturer standard.

5.3 Transition Fittings

Transition fitting shall be seal tight, pull out resistant and have greater tensile value than that of PE part.
Ends for transition fittings other than electrofusion shall be as per below requirement:

Table – A1

Transition	Size	PE End	Steel / GI End Connection	Min. Length (mm) End to End	Min. Reqd. Steel Length for BE
PE to SS	20mm x 1/2"	EF	Threaded End	80	-
PE to GI	32mm x 3/4"	EF	Threaded End	80	-
PE to CS	32mm x 1"	EF	Threaded End	80	-
PE to CS	63mm x 2"	Plain End	Bevel End	470	400
PE to CS	125mm x 4"	Plain End	Bevel End	570	480
PE to CS	180mm x 6"	Plain End	Bevel End	590	485

5.3.1 PE Pipes to Bevel Ends

To make connection between steel pipe and MDPE pipe, specially fabricated transition pieces consisting of Steel and MDPE pipes should conform to the following requirements:

a. MDPE pipe with one end plain should conform to the specification (EN 1555-2 / ISO 4437-2 /IS-14885/ SDR 11).
b. MDPE end shall be compatible (thickness/ nominal size) to the interconnecting PE pipes of the network.
c. Steel end (CS/SS) shall be compatible (grade of material/ thickness/ nominal size) to the interconnecting steel pipes of the network.

d. Steel end of the fitting should be beveled for welding. Angle of bevel should be 30° + 5°.
e. Steel and MDPE pipes should be so jointed in the factory so as to have a monolithic joint which is leak free and should be mechanically as strong as or stronger than the PE Pipe.
f. Minimum required length of steel for transition fitting is specified in Table A1. Vendor to provide adequate length so that the PE part of the fitting / pipe will not get effected during welding at site.
g. Joint between metallic and non-metallic part of transition fitting shall be leak-proof.

5.3.2 **PE Pipes to Threaded Ends**

a. Transition fitting for jointing of MDPE Pipes conforming to specification SDR 11, IS: 14855/ ISO: 4437/ EN1555-2.
b. The transition fittings shall be electrofusion type for PE connection, NPT Female threading conforming to
ANSI B 1.20.1.
c. Steel end (CS/SS) / GI shall be compatible (grade of material/ thickness/ nominal size) to the interconnecting pipes of the network.
d. Joint between metallic and non-metallic part of transition fitting shall be leak-proof.

Transition fittings shall be supplied in accordance with "Plastic piping systems for supply of gases fuels – Part 3: Fitting" EN 1555-3.

Bidder shall provide catalogues for all the fittings including transition fittings.

The material grade (SS-304 as per ASTM A-479) and end connection (in built EF Ends with integral pipe fixation device) shall be as per MR. Steel and MDPE pipe should be so joined in factory so as to have a monolithic joint, which is leak free and should be mechanically stronger than the PE pipe. On placement of order, the bidder shall submit the drawing with dimensions for approval of BPCL before starting production.

6.0 DIMENSIONS AND TOLERANCES

Dimensions shall be measured in accordance with EN ISO 3126 at (23 ± 2) °C, after being conditioned for atleast 4 h. The measurement shall not be made less than 24 h after manufacture.

6.1. For Electro Fusion Socket Fittings

For electrofusion sockets (see Figure 1) having a nominal diameter given in Table-1, the socket diameter and lengths shall be given by the manufacturer and shall conform to Table 1 with the following conditions:

a) $L_3 \geq 5$ mm;

b) $D_2 \geq d_n - 2e_{min}$

Where,

e_{min} is the minimum wall thickness specified for the corresponding pipe conforming to EN 1555-2

D_1 is the mean inside diameter in the fusion zone measured in a plane parallel to the plane of the mouth at a distance of $L3 + 0.5L_2$ from that face

D_2 is the bore, which is the minimum diameter of the flow channel through the body of the fitting

L_1 is the depth of penetration of the pipe or male end of a spigot fitting. In case of a coupling without stop, it is not greater than half the total length of the fitting

L_2 is the heated length within a socket as declared by the manufacturer to be the nominal length of the fusion zone

L_3 is the distance between the mouth of the fitting and the start of the fusion zone as declared by the manufacturer to be the nominal unheated entrance length of the fitting.

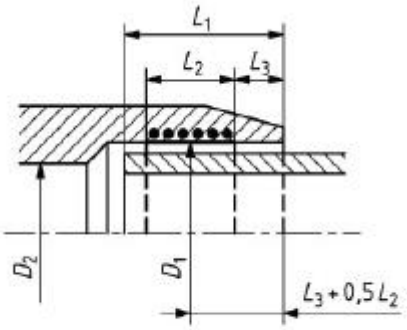


Figure 1 — Dimensions of electrofusion socket fittings

The mean inside diameter of the fitting in the middle of the fusion zone (see L1 in Figure 1) shall be not less than dn.

Table - 1

Nominal Diameter d_n (mm)	Depth of Penetration L_1, min.			Fusion Zone L_2, min.
	Intensity Regulation	Voltage Regulation	L_1, max.	
16	20	25	41	10
20	20	25	41	10
25	20	25	41	10
32	20	25	44	10
40	20	25	49	10
50	20	28	55	10
63	23	31	63	11
75	25	35	70	12
90	20	25	41	10
110	32	53	82	15
125	35	58	87	16
140	38	62	92	18
160	42	68	98	20
180	46	74	105	21

The manufacturer shall declare the actual minimum and maximum values of D_1 to allow the end user to determine their suitability for clamping and joint assembly and fitness for purpose testing in accordance with EN 1555-5.

In the case of a fitting having sockets of differing nominal diameters, each one shall conform to the requirements for the nominal diameter of the corresponding component.

Wall Thicknesses

In order to prevent stress concentrations, any changes in wall thickness of the fitting body shall be gradual.

a. The wall thickness of the body of the fitting at any point, E, shall be greater than or equal to e_{min} for the corresponding pipe at any part of the fitting located at a distance beyond a maximum of $2L_1/3$ from all entrance faces if the fitting and the corresponding pipe are made from a polyethylene having the same MRS.

If the fitting is produced from a polyethylene having an MRS that is different from that of the corresponding pipe, the relationship between the wall thickness of the fitting, E, and the pipe, e_{min}, shall be in accordance with Table 2.

Table 2 — Relation between fitting and pipe wall thicknesses

Pipe and fitting material		Relation between fitting wall thickness, E, and pipe wall thickness, e_n
Pipe	Fitting	
PE 80	PE 100	$E \geq 0{,}8e_n$
PE 100	PE 80	$E \geq e_n/0{,}8$

b. In the case of a wall thickness design different from that according to a), fittings and associated fusion joints shall additionally meet the performance requirement given in Table6 of EN 1555-3.
c. When a fitting leaves the site of the manufacturer, the out-of-roundness of the bore of a fitting at any point shall not exceed $0.015d_n$.
d. The dimensional characteristics appropriate to each manufacturer such as the overall dimensions or mounting dimensions shall be specified in a technical file.

6.2. **For Electro Fusion Saddle Tapping Fittings**

Outlets from tapping tees and branch saddles shall have an electrofusion socket conforming to Clause 6.1 above.

The manufacturer shall specify the overall dimensions of the fitting in a technical file. These dimensions shall include the maximum height of the saddle, H, and for tapping tees the height of the service pipe, H_1 or H_2 (see Figure 2).

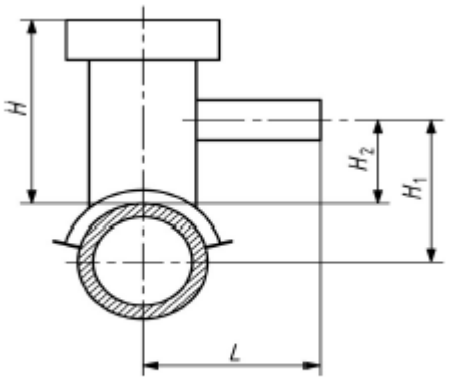


Figure 2 — Dimensions of electrofusion saddle fittings

Where,

H is height of the saddle, which comprises the distance from the top of the main pipe to the top of the tapping tee or saddle

H_1 is height of service pipe, which comprises the distance from the axis of the main pipe to the axis of the service pipe

H_2 is height of service pipe, which comprises the distance from the top of the main pipe to the axis of the service pipe

L is width of the tapping tee, which comprises the distance between the axis of the pipe and the plane of the mouth of the service tee

6.3. **Dimensional Stability:**

Couplers (including all forms of socket fittings):

All coupler dimensions shall conform to their specified value when the fitting has been stored for a period of 12 months at a temperature of 30 + 2°C.

Tapping Tees and Branch Saddle:

All tapping tee and branch saddle dimensions shall conform to their specified agreed values when the fitting has been stored for a period of 12 months at a temperature of 30 + 2°C.

7.0 MDPE PIPE MATERIAL

The raw material of MDPE pipe shall be PE100, thick as per SDR11. The MDPE pipe shall confirm standards for polyethylene pipes for supply of gaseous fuels IS 14885 (latest edition).

8.0 MATERIAL REQUISITION

As per SOR/Contract

9.0 QUALITY ASSURANCE (QA)

Manufacturer to submit their Inspection and Test Procedure (ITP) for the approval of BPCL/PMC.

10.0 DEFECT LIABILITY PERIOD

Defect liability period shall be as per the GCC, of commercial volume I of II.

11.0 INSPECTION/ DOCUMENTS

To Be Submitted Along with Bid

All relevant documents like detailed technical catalogue, technical deviations list (if any) along with quoted price.

Technical File:
The manufacturer of the fittings shall make availability of a technical file (generally confidential) with all relevant data to prove the conformity of the fittings to this specification. It shall include all results of the type testing and shall conform to the specification relevant technical brochure (e.g. ISO 12093 for electro fusion fittings).

The technical description of the manufacturer shall include the following information:

a. Field of appliance (pipe and fitting temperature limits SDR's and out of roundness).
b. Assembly instructions.
c. Fusion instruction (fusion parameters with limits).
d. For saddles and tapping tee
i. The means of attachment (tools and/ or under clamp).
ii. The need to maintain the under clamp in position in order to ensure the performances of the assembly.

For electro-fusion fitting, the format of the technical brochure shall conform to ISO DIS 12093.
In the event of modification of the fusion parameters, the manufacturer shall ensure that the joint conforms to this standard.

12.0 MARKING

Following information shall be embossed upto height of 0.15 mm onto the fitting and also in the Form of bar code:

a. BPCL name as purchaser
b. Manufacturer's name and/or trademark
c. Material and Designation
d. Design application series
e. The size of the fitting in mm
f. Fusion time in seconds
g. Cooling time in minutes
h. Fusion parameters in BAR code
i. Traceability code (fittings) as per standard ISO 12176-4.
j. Number of the system standard. This information can be printed/formed directly on the fitting or on a label associated with the fitting or on an individual bag
k. Production period, year and month. The marking shall stay legible during normal manipulation, storage and installation.

The marking shall not adversely influence the performance of the fitting and prevent the nonconformity of the fitting.

13.0 PACKAGING

All the MDPE fittings of more than one piece shall be kept in single box/packets according to type and size during packaging.

Packing size to be mentioned to ensure uniformity in delivery conditions of the material being procured. Bidder shall submit the packaging details during offer and also complied with at the time of delivery. The material for each SOR Item is essentially required to be packed in one case/packet /box.