



شرکت ملی گاز ایران

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امور تدوین استانداردها

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P.E. Gas Piping : part(2) P.E. Fittings



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# Polyethylene electrofusion fittings

## 1. Scope

This standard specification replaces IGS-M-PL-014-2(1) and provides NIGC'S requirement for material ,manufacturing , testing , inspection , dimension , tolerances, marking , packing , handling , storage , transportation etc, for polyethylene electrofusion fittings in accordance with BS-EN 1555, part 3: 2008 edition except otherwise have been specified in this standard at max operating pressure of 4 bar and operating temperature of -20 to 40 C . They are intended for use with polyethylene pipes conforming to IGS-M-PL-014-1(2)

## 2. References

Through out this standard specification the following standard and codes are referred to, the edition of these standards and codes that are in effect at the time of issues of this standard specification.

The applicability of changes in standard and codes that occur after the date of standards that referred shall be mutually agreed upon by the purchaser and supplier and / or manufacturer.

### 2.1. Normative reference

EN 1555-1:2008,	Plastics piping systems for the supply of gaseous fuels- Polyethylene (PE) - Part 1: General
EN 1555-2:2008,	Plastics piping systems for the supply of gaseous fuels- Polyethylene (PE) - Part 2: Pipes.
EN 1555-3:2008,	Plastics piping systems for the supply of gaseous fuels- Polyethylene (PE) - Part 3: fitting
EN 1555-5:2008,	Plastics piping systems for the supply of gaseous fuels- Polyethylene (PE) - Part 5: Fitness for purpose of the system
EN 1716 1997,	Plastics piping systems – polyethylene (PE) tapping tees – test method for impact resistance of an assembled tapping tee.

EN 12117,1998,	Plastics piping systems – fittings, valves and ancillaries – determination of gaseous flow rate / pressure drop relationships.
EN ISO 1133:2005,	Plastics – determination of the melt mass – flow rate (MFR) and the melt volume – flow rate (MVR) of thermoplastics).
EN ISO 1167-1:2006,	Thermoplastics pipes, fittings and assemblies for the conveyance of fluids – determination of the resistance to internal pressure – Part 1 : general method
EN ISO 1167-2,2006,	Thermoplastics pipes, fittings and assemblies for the conveyance of fluids – determination of the resistance to internal pressure – Part 2 : preparation of pipe test pieces
EN ISO 1167-3,2006,	Thermoplastics pipes, fittings and assemblies for the conveyance of fluids – determination of the resistance to internal pressure – Part 3 : preparation of components
EN ISO 1167-4,2006,	Thermoplastics pipes, fittings and assemblies for the conveyance of fluids – determination of the resistance to internal pressure – Part 4 : preparation of assemblies
ISO /FDIS 11357 – 6:2002,	Plastics – differential scanning calorimetry (DSC) – part 6 : determination of oxidation induction time ( isothermal OIT) and oxidation induction temperature (dynamic OIT)
ISO 13954 ,1997,	Plastics pipes and fittings – peel decohesion test for polyethylene (PE) electrofusion assemblies of nominal outside diameter greater than or equal to 90 mm.
ISO 13955 , 1997,	Plastics pipes and fittings – crushing decohesion test for polyethylene ( PE) electrofusion assemblies .
GIS/PL2-4: 2008,	Polyethylene pipes and fittings for natural gas and suitable manufactured gas part 4: fusion fitting with integral heating element (s)

## 2.2. Informative reference

- EN ISO 3126,2005,                   Plastics piping systems – plastics piping components – measurement and determination of dimensions).
- ISO 228-1,2002,                   Pipe threads where pressure – tight joints are not made on the threads – part 1: dimensions, tolerance and designation.
- ISO 18553 ,2002,                   Method for the assessment of the degree of pigment or carbon black dispersion in polyolefin pipes , fittings and compounds

## 3. Terms and definition

### 3.1. Electrofusion socket fitting

polyethylene (PE) fitting which contains one or more integral heating elements, that are capable of transforming electrical energy into heat to realize a fusion joint with a spigot end or a pipe.

### 3.2. Inner cold zone

Unheated distance between the end of the fusion zone as declared by the manufacturer and the end face of the insert pipe or spigot .

### 3.3. Minimum apparent fusion length, L2

Heated length within a socket fitting as declared by the manufacturer to be the nominal length of the fusion zone .

### 3.4. Mean inside diameter, ds

Arithmetical mean of a number of measurements of the inside diameter of a socket through its cross – section regularly spaced around the circumference and in the same cross section , including the measured minimum and the measured minimum and the measured maximum values of the inside diameter in that cross section, rounded to the next greater 0.1 mm .

### 3.5. Nominal outside diameter, dn

Specified outside diameter, in millimeters, assigned to a nominal size DN/OD .

### **3.6. Type testing (TT)**

Testing performed to prove that the material, component, assembly is capable of conforming to the requirements given in the relevant standard. (Such as EN 1555 part 7)

In addition, relevant type tests shall be carried out and relevant certificate shall be submitted when ever there is a change in design, and /or in the production method other than routine in-process adjustment and any change in raw material such as brand , production designation , production location etc. In case of no changes in mentioned above items every five years the type tests certificate shall be renewed.

### **3.7. Virgin material**

Material in form of granules that has not been subjected to use or processing other than that required for its manufacture and to which no reprocessible or recyclable materials have been added.

## **4. Technical specification for PE electrofusion fitting**

Electofusion PE gas fittings, black, minimum density at least 945 kg/m<sup>3</sup>, SDR 11, PE 100 suitable for operating pressure of 4 bar. The employed PE material shall be compound (in the form of granules), virgin and relevant certificate shall be submitted to purchaser. Processed PE material not allowed.

material , manufacturing , testing , inspection , dimension , tolerances , marking , packing , handling , storage , transportation etc. In accordance with EN 1555 part 1,3,5,7:2008 and this standard .

Manufacturer shall guarantee the design and production fully comply with the requirements of this standard.

## **5. Fitting aspect, geometry and dimension**

### **5.1. General**

Fitting shall be designed for connection to pipes using electrofusion socket and saddle jointing methods. Fitting shall be free from cracks, voids, blisters, distortions, dents, injurious damage, inclusions or other defects likely to impair their performance

All fitting shall have fusion indicator at both sides and to be operated simultaneously.

All fittings up to and including 160 mm shall have internal stopper which can be removed easily without any damage to the fitting and coiled wire.

For easy entry of pipe into fitting , all inside edges of socket fitting shall be preferably tapered .

### 5.2. Couplers

The inner cold zone of each socket fitting shall not be less than  $0.1 d_n + 5\text{mm}$

After removing the end stop/ stops, the coupler shall be easily slipped over the pipe.

The remaining parts of end stops as well as other sections of fitting internal surface shall not prevent easy slipping of couplers.

**Table 1 - Socket fitting dimensions**

Dimensions in millimeters	
Pipe size , $d_n$	Maximum of mean internal diameter , $d_s$ <sup>a)</sup>
25	25.8
32	32.8
63	64.2
90	91.5
110	111.8
125	127.2
160	162.1
200	202.4
225	227.7
a) $d_s$ is the mean bore diameter of the socket as measured along the apparent fusion length $L_2$ .	

The mean inside diameter of fitting in the middle of fusion zone shall not less than  $d_n$

## 6. Electro fusion fitting for gas distribution network

**Table 2**

CAP	ELBOW 45	ELBOW 90	EQUAL TEE	UNEQUAL TEE	REDUCER	COUPLER	REPAIR/REINFORCING SADDLE*
25	25	25	25			25	
32	32	32	32		32×25	32	
63	63	63	63			63	63
90	90	90	90	90×90×63	90×63	90	90
110	110	110	110	110×110×63	110×63	110	110
				110×110×90	110×90		
125	125	125	125	125×125×63	125×90	125	125
				125×125×90	125×110		
				125×125×110			
160	160	160	160	160×160×63	160×110	160	160
				160×160×90	160×125		
				160×160×110			
				160×160×125			
200	200	200	200	200×200×125	200×160	200	200
				200×200×160			
225	225	225	225	225×225×125	225×160	225	225
				225×225×160			

\*Used for minor damage of pipe.

\*These fitting shall not be purchased and used before relevant IGS(code of practice ) issued.

## 7. Required characteristics

**Table 3**

characteristics	Requirements	Test parameters		Test method	Type of test
		Parameter	Value		
Hydrostatic Strength (20°C , 100 h )	No failure during test periods of any test piece	End caps Orientation Conditioning time  Number of test pieces <sup>a</sup> Type of Test Circumferential(hoop) stress In pipe for : PE 80 PE 100 Test period Test temperature	Type a ) of EN ISO 1167-1:2006 Free Shall conform to EN ISO 1167-1:2006 3 Water – in –water  10,0 MPa 12.4 MPa b 100 h 20°C	EN ISO 1167-1 and EN ISO 1167-2, EN ISO 1167-3, or EN ISO 1167-4, as applicable	TT
Hydrostatic strength (80°C , 165 h)	No failure during test period of any test piece <sup>b</sup>	End caps Orientation Conditioning time  Number of test pieces <sup>a</sup> Type of test Circumferential (hoop) stress In pipe for : PE80 PE100 Test period Test temperature	Type a ) of EN ISO 1167-1:2006 Free Shall conform to EN ISO 1167-1:2006 3 Water – in –water  4,5 MPa 5,4 MPa 165 h 80°C	EN ISO 1167-1 and EN ISO 1167-2, EN ISO 1167-3, or EN ISO 1167-4, as applicable	TT BRT
Hydrostatic Strength (80°C , 1000 h) (type test)	No failure during test period of any test piece	End caps Orientation Conditioning time  Number of test pieces <sup>a</sup> Type of test Circumferential (hoop) stress in pipe for : PE80 PE100 Test period Test temperature	Type a ) of EN ISO 1167-1:2006 Free Shall conform to EN ISO 1167-1:2006 3 Water – in –water  4,0 MPa 5,0 MPa 1000 h 80°C	EN ISO 1167-1 and EN ISO 1167-2, EN ISO 1167-3, or EN ISO 1167-4, as applicable	TT
Decohesive resistance (type test)	Length of initiation * rupture $\leq(L2)/5$ in brittle failure	Test temperature Number of test pieces <sup>a</sup>	23°C Shall conform to ISO 13954:1997 and ISO 13955:1997	ISO 13954 ISO 13955	BRT TT
Decohesive resistance (Strip bend test)	Length of initiation* rupture $\leq(L2)/5$ in brittle failure	Test temperature number of test pieces <sup>a</sup>	23°C Shall conform to ISO-TC 1381/SC 5/WG12 2007	ISO-TC 1381/SC 5/WG12 2007	BRT

\* Brittle failure length in the fusion plane

## Continue

Conventional density conforming to EN ISO 1872 -1 (type test)	$\geq 945 \text{ kg/m}^3$ (base polymer)	Test temperature Number of test pieces <sup>a</sup>	23 <sup>0</sup> C Shall conform to ISO 1183	EN 1183-1/2	BRT TT
Oxidation induction time (thermal stability ) (type test)	> 20 min	Test temperature Number of test Piece <sup>a</sup>	200 <sup>0</sup> C <sup>c</sup> 3	ISO/FDIS 11357-6	TT BRT
Melt mass – flow Rate (MFR) (type test)	$0.2 \leq \text{MFR} \leq 0.7 \text{ g/10min}$ After processing maximum deviation of $\pm 10\%$ of the value measured on the batch used to manufacture the fitting	Loading mass Test temperature Time Number of test Piece <sup>a</sup>	5kg 190 <sup>0</sup> C 10 min Shall conform to EN ISO 1133:1999	EN ISO 1133:1999	TT BRT
Carbon black content <sup>1</sup>	(2 to 2.5) % ( by mass)	Shall conform to ISO 6964	ISO 6964	Carbon black content <sup>1</sup>	TT BRT
Carbon black dispersion	Grade $\leq 3$	Preparation of test pieces Number of test pieces <sup>a</sup>	Free shall conform to ISO 18553	Carbon black dispersion	TT BRT
<p>a – The number of test pieces given indicate the numbers required to establish a value for the characteristic described in the table. The numbers of test pieces required for factory production control and process control should be listed in the manufacturer's quality plan. For guidance see pr EN 1555-7:1999.</p> <p>b- Only brittle failures shall be taken into account. If a ductile failure occurs before 165 h, the test may be repeated at a lower stress. The stress and the associated minimum test period shall be selected from table 4 from a line based on the stress / time points given in table 4.</p> <p>c- Test may be carried out at 210<sup>0</sup>C providing that there is a clear correlation to the results at 200<sup>0</sup>C, in case of dispute reference temperature shall be 200<sup>0</sup>C.</p>					

**8. Circumferential (hoop) stress at 80°C and associated minimum test period**

**Table 4**

<b>PE 80</b>		<b>PE 100</b>	
Stress Mpa	Minimum test period h	Stress Mpa	Minimum test period h
4,5	165	5,4	165
4,4	233	5,3	256
4,3	331	5,2	399
4,2	474	5,1	629
4,1	658	5,0	1000
4,0	1000	--	--

**9. Marking**

The marking elements shall be printed or formed directly on the fitting on such a way that after storage, handling and installation legibility is maintained during the use of the fitting.

Marking shall not initiate cracks or other types of defects which adversely influence the performance of the fitting.

**9.1. Minimum required marking**

All fitting shall be marked with the data of table 5.

**Table 5**

<b>Aspects</b>	<b>Mark symbol</b>
Number of the system standard	EN 1555
manufacturer's name and / or trademark	Name or symbol
nominal outside diameter (s)of pipe ; d <sub>n</sub>	e.g. 110
material and designation	e.g. PE 100
design application series	e.g. SDR 11
Applicable SDR fusion range of pipe	e.g. SDR 11
manufacturer's information	
internal fluid	Gas
Production date *	Year / month / day
Fusion voltage *	Volt
Fusion time *	Second
Cooling time *	Minute
NIGC symbol *	NIGC

\* These requirements may be appear on a label firmly fixed to the fitting .

## 10. Delivery conditions

All types of Electrofusion fittings must come individually packaged in a plastic bag They shall then be placed in cardboard boxes or cartons to prevent any oxidation prior to installing The cartons and the individual bags shall bear at least one label with the manufacture's name, type and dimensions of the part, number of units in the box, and any special storage conditions and storage time limits.

## 11. Documentation

The technical bid shall include as follows.

- 1) original technical catalogue/drawing showing materials , dimensions, fusion wire electrical resistance and so on.
- 2) material specification for PE 100 issued by granules manufacturer
- 3) approval test report required by this standard shall be issued by certification body which is accepted by NIGC. Mentioned reports shall include following items :
  - a) hydrostatic strength (80<sup>0</sup>C,1000h)
  - b) cohesive strength
  - c) conventional density
  - d) oxidation induction time
  - e) melt mass – flow rate

**ANNEX A (Normative) – Data Sheet for Polyethylene electrofusion fitting**

P.O. NO / Contract No.	
Manufacturer's name and address	
Product	
Product designation	
Granule manufacturer & designation	

**Raw Material**

Item	Property	Unit	Test method	Requirement	Manufacturer's remark
1	Density	g/cm <sup>3</sup>	ISO 1183	> 0.945	
2	Oxidation induction time	Min	ISO 11357-6	≥ 25 (T= 210 <sup>0</sup> C) ≥ 50 (T=200 <sup>0</sup> C)	
3	Melt mass flow rate ( MFR)	g/10 min	ISO 1133	0.2 ≤ MFR ≤ 0.7	
4	Carbon black content	% (by mass)	ISO 6964	2 to 2.5	
5	Carbon black dispersion		ISO18553	Grade ≤ 3	
6	Designation			PE 100	

**Finished product**

Item	Property	Unit	Test method	Requirement	Manufacturer's remark
1	SDR	---		11	
2	Melt mass flow rate ( MFR)	g/10 min		After processing, maximum deviation of ±10% of the value measured on the raw material used to manufacture the fitting	

**Notes:**

- 1- This data sheet shall be filled, signed, and stamped by manufacturer / supplier.
- 2- Any deviation from this standard specification shall be clearly specified by manufacturer / supplier.
- 3- Any change in raw material shall be requalified .
- 4- Requirements for material, manufacturing, testing, inspection, packing, etc are in accordance with EN 1555: 2008 & IGS-M-PL-014-2 .
- 5- Processed PE material (recycled ) are not allowed .