



GUJARAT ENERGY

TECHNICAL SPECIFICATIONS

FOR PE-100- PE PIPE

Document No: GEL/TS/PE-PNG/SUPPLY/PE-100 PIPE/SPEC

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1 GENERAL

Gujarat Energy Limited (formerly Gujarat Gas Limited) is a Government of Gujarat undertaking engaged in the City Gas Distribution (CGD) business, with operations across the states of Gujarat, Rajasthan, Madhya Pradesh, Haryana, Punjab, Maharashtra, and the Union Territory of Dadra & Nagar Haveli and Daman & Diu. GEL is committed to developing environmentally sustainable gas infrastructure and promoting cleaner transportation fuels in the geographical areas authorized by the Petroleum and Natural Gas Regulatory Board (PNGRB) from time to time.

The intent of this specification is to establish minimum requirements to manufacture and supply of PE pipes for supplying natural gas.

The scope will include manufacture, supply, inspection, testing, marking, packaging, handling and despatch of PE pipes of ratings and grades as per IS: 14885: 2022 with latest amendments.

2 REFERENCE CODES AND STANDARDS:

2.1 Governing Standards

PNGRB T4S:	Technical Standards and Specifications including Safety Standards for City or Local Natural Gas Distribution Networks.
ISO 4437:	Buried polyethylene (PE) pipes for the supply of gaseous fuels — Specifications
IS 14885:	Polyethylene pipes for the supply of Gaseous Fuels -- Specifications

2.2 Reference Standards

IS 7328:	High density polyethylene materials for moulding and extrusion — Specification
IS 2530:	Method of test for polyethylene moulding materials & polyethylene compound
EN 12099:	Plastic Piping Systems — Polyethylene piping materials and components — Determination of volatile content
ISO 18553:	Method for the assessment of the degree of pigment or carbon black dispersion in polyolefin pipes, fittings and compounds
ISO 8085-3:	Polyethylene fittings for use with polyethylene pipes for the supply of gaseous fuels — Specifications — Part 3: Electrofusion fittings
ISO 11413:	Plastic pipes and fittings — Preparation of test piece assembly between a polyethylene (PE) pipe and an electro fusion fitting
ISO 1133:	Plastics- Determination of melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics
ISO 1167-1:	Thermoplastic pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 1: General method



ISO 1167-2:	Thermoplastic pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 2: Preparation of pipe test pieces
ISO 1183:	Plastics — Methods for determining the density of non cellular plastics
ISO 2505:	Thermoplastic pipes — Longitudinal reversion — Test method and parameters
ISO 6259-1:	Thermoplastic pipes — Determination of Tensile properties — Part-1: General test method
ISO 6259-3:	Thermoplastic pipes — Determination of Tensile properties — Part-1: Polyolefin pipes
ISO 9080:	Plastics piping and ducting systems - Determination of the long-term hydrostatic strength of thermoplastics materials in pipe form by extrapolation
ISO 11357-6:	Plastics — Differential scanning calorimetry (DSC) — Part 6: Determination of oxidation induction time (isothermal 01T) and oxidation induction temperature (dynamic 01T)
ISO 13477:	Thermoplastic pipes for the conveyance of fluids — Determination of resistance to rapid crack propagation (RCP) — Small scale steady-state test (S4 test)
ISO 13478:	Thermoplastic pipes for the conveyance of fluids — Determination of resistance to rapid crack propagation (RCP) — Full-scale test (FST)
ISO 13479:	Polyolefin pipes for the conveyance of fluids — Determination of resistance to crack propagation — Test method for slow crack growth on notched pipes (notch test)

In case of conflict between the requirements of this specification and the Reference Codes & Standards, the requirements of the specification, having stringent requirement, shall govern. Vendor shall obtain prior permission from GEL in such cases.

3 DEFINITIONS

For this specification the following definitions shall apply:

OWNER/ CLIENT:	Gujarat Energy Limited (GEL)
CONSULTANT :	Consultant engaged by GEL for evaluation of vendor
MANUFACTURER:	Means the Manufacturer of PE pipes.
VENDOR:	The person(s), firm, company, organization from whom Client / Contractor procures materials
TPIA:	Third Party Inspection Agency to be appointed by Vendor/ Contractor for inspection of brought out items

EIC: Engineer – in – charge

4 MATERIAL

The material grade of polyethylene PE Pipes shall be PE-100. Material shall conform to the requirement of Cl. No. 5 of IS 14885: 2022 with latest amendments. Raw material of PE pipe shall be virgin quality. Approved manufacturers for virgin raw material of PE -100 are as below:

S. No.	Manufacturer	Grade (PE-100)
1.	Borealis	Borsafe™ HE 3492-LS-H (orange)
2.	Borouge	Borsafe™ HE 3492-LS-H (orange)
3.	LyondellBasell	Hostalen CRP 100 orange
4.	INEOS O&P	ELTEX® TUB 125 N2025 (orange)
5.	Total Petrochemicals	Total HDPE XSC 50 (Orange)

- For PE compounds, the long term hydrostatic strength – calculated and classified according to the standardised method (ISO 9080 and ISO 12162) for a temperature of 20 °C, a period of 50 years and a reliability of 97.5% - must be at least 10 MPa.
- PE Compound Characteristics are as per the following:

Characteristics	Units	Requirement	Test Parameter	Test Method
Tested as PE Compound				
Conventional Density (of base polymer)	kg / m ³	≥ 930 (Base Polymer)	23°C	IS 7328
Melt Flow Rate	g / 10 min	$0.20 \leq \text{MFR} \leq 1.40$ The tested value of MFR shall be within ± 20 percent of the nominated value declared by the compound manufacturer	190°C / 5 kg	IS 2530
Volatile Content	mg / kg	≤ 350	Number of test pieces- 1	Annex C of IS 4984
Water Content	mg / kg	≤ 300 (equivalent to <0.03 percent by mass)	105 $\pm$ 2°C	Annex D of IS 4984
Thermal stability	min	≥ 20	200 °C	Annex B of IS 4984



Pigment Dispersion	Grade	≤ 3		ISO 18553/ IS 14885 (Annex A)
Tested in Pipe Form				
Resistance to gas constituents	Hour	≥ 20	80°C 2 MPa	IS 4984 (Annex E) / IS 14885 (Clause 5.5)
Resistance to rapid crack propagation (RCP)	Bar	$P_c \geq 1.5X \text{ MOP with}$ $P_c = 3.6 \times P_{cs} + 2.6 \text{ (in bar)}$	0 °C	ISO 13477
Resistance to slow crack growth	Hour	165, 500	80°C; 9.2 bar	ISO 13479, Annex J & E of IS 4984
Resistance To Weathering (Exposure to sunlight)				IS 14885 (Annex B & Cl 5.6)
Hydrostatic Strength	–	$\geq 1000 \text{ h}$	80°C; 5.0 MPa	Annex E of IS 4984
Elongation at Break of pipe	–	$\geq 350 \%$	23 °C	ISO 6259-1 & 3 / IS 14885 (Cl 5.6)
De-cohesion of an Electrofusion joint — brittle failure	–	$\leq 33.3\%$	23 °C	ISO 13954/ISO 11413/ ISO-8085-3

5 PRESSURE RATING

The pressure rating of pipe shall be PE-100 shall be as per Table -7 of Clause 8.1 & 9.1 of IS: 14885: 2022 with latest amendments.

6 NOMINAL DIAMETER (DN)

The nominal diameter of pipes covered in this standard is DN 20, DN 32, DN 63, DN 90, DN 125 and DN 160.

7 DIMENSION, WALL THICKNESS, LENGTH OF PIPES

- 7.1 The Dimension of PE-100 shall be as per Table -4 of Clause 6.1 & 8.2.2 of IS: 14885 : 2022 with latest amendments
- 7.2 The wall thickness of PE-100 shall be as per Table -6 of Clause 6.2.1 of IS: 14885: 2022 with latest amendments

Nominal Diameter DN	SDR/thickness	Straight / Coil Length
20	9 (3mm Minimum)	Coil – 200 mtr.
32	11	Coil – 200 mtr.
63	11	Coil – 100 mtr.
90	17	Coil – 100 mtr.
125	17	Coil – 50 mtr.



160	17	Straight – 12 mtr.
125	11	Coil – 50 mtr.

- 7.3 Minimum inner diameter of coil shall be as per table 17 Annexure D of IS: 14885:2022 with latest amendments. For SDR 17 pipe, the internal diameter of the coil shall not be less than 18 d_n

8 TOLERANCE

- Tolerances for Length of Pipes
- Tolerances for each rolled pipes : - 0 / +0.5m
- Tolerances for Outside diameter shall be as per Table 4 of IS: 14885: 2022 with latest amendments.
- Ovality of Pipes shall be as per Table 5 of IS: 14885: 2022 with latest amendments.

9 COLOUR

Colour of PE – 100 pipes shall be orange as per Clause 4.4 of IS: 14885: 2022 with latest amendments

10 APPEARANCE/ FINISH

When viewed without magnification, the internal and external surfaces of the pipes should be smooth, clean and free from grooving, rings and poke marks and other surface defects which may affect the pipe performance. The ends shall be cut cleanly and square to the axis of the pipe and within the tolerance as per IS 14885.

11 SAMPLING, FREQUENCY OF TEST

- Type tests as defined in clause 9.1 and in Table 11 of IS 14885:2022 shall be done at least once in two years on each pressure rating for each grade/class of material. However, hydrostatic pressure resistance test at 80° C for 1000 h shall be done at least once in 4 years and at 20° C for 100 h once in two years in accordance with IS 14885.
- Three samples of the same pressure class and same size should be selected at random for each type test and shall be tested for compliance with the requirements as indicated against each tests mentioned in IS 14885 QAP.
- Scale of sampling for visual and dimensional requirements shall be in accordance with IS 14885.
- Scale of sampling for tests for hydraulic characteristics (including Notched pipes), Reversion test, Density, MFR, Thermal stability (OIT), Pigment dispersion and Tensile test shall be in accordance with IS 14885.
- These pipes shall be selected at random from the lot and in order to ensure the randomness of selection, a random number tables given in IS 4905 may be referred.

12 MARKING

12.1 Owner name shall be marked on each pipe.

- All pipes shall be permanently and legibly marked along their length with a legend by inkjet marking or by embossing which shall be impressed to a depth of not more than 0.2 mm.



- Marking details shall be formed in such a way that marking does not initiate cracks or other type of failure and in such a way that with normal storage weathering and processing and permissible method of installation use legibility shall be maintained for the pipe.

12.2 Legends shall be repeated at intervals of 1 m and shall consist of following information:

- a) Owner Trade mark / Name or Brand (i.e. GUJARAT ENERGY)
- b) Material and designation (i.e. D-32, SDR-11, PE-100)
- c) Manufacturer's identity name or trade name
- d) Code & Standard (i.e. IS – 14885:2022)
- e) Batch no. or lot no
- f) Length of Coil at every meter.
- g) Manufacturing Date
- h) Service (i.e. GAS)

13 INSPECTION/DOCUMENTATION

- Inspection shall be carried out as per Owner Technical Specification.
- Owner Representative shall carry out stage wise inspection during manufacturing / final inspection.
- Manufacture /Vendor shall furnish all the material test certificates, proof of approval / licence from specified authority as per specified standard, if relevant, internal test / inspection reports as per Owner Tech. Spec. & specified code for 100% material, at the time of final inspection of each supply lot of material. All the codes / documents shall be made available for reference of TPIA at the time of inspection.
For any control, test or examination required under the supervision of TPIA/Owner/Owner's representative, latter shall be informed in writing one (1) week in advance by vendor about inspection date and place along with production schedule. GEL will hire TPIA for production witnessing and testing as per approved QAP.
- Even after third party inspection, Owner reserves the right to select a sample of pipes randomly from each manufacturing batch & have these independently tested. Should the results of these tests fall outside the limits specified in Owner technical specification, then Owner reserves the right to reject all production supplied from the batch.
- Pipe shall be free from any sign of localized swelling, no leakage or bursting during hydro testing as well as delivery at site.
- Pipe shall be free from scoring, cavities and other surface defects and pipe end shall be cut cleanly and square to the axis.
- Pipe end shall cleanly cut, square with the axis of pipe and protected against shocks and ingress of foreign bodies by appropriate end caps.
- Pipe end shall cleanly cut, square with the axis of pipe and protected against shocks and ingress of foreign bodies by appropriate end caps.
- Manufacture /Vendor to submit QAP along based on indicative QAP enclosed in the tender. However, the same QAP shall be submitted for approval to the Owner / Owner's representative before manufacturing. Manufacturing shall start only after approval of QAP.
- The successful Manufacture /Vendor shall submit following for approval of Owner/Owner's Representative after placement of order:
 - The quality assurance plan



- Material test report as per clause 5 of IS: 4984: 1995 with latest amendments.
 - Performance requirements as per clause 5, 8, & 9 of IS: 14885: 2022 with latest amendments.
 - Type test as per clause no. 9.1 of IS: 14885: 2022 with latest amendments.
- As per the requirement of Owner for meeting amendments if any, in IS 14885, QAP may be modified without any additional cost implication.

14 PACKAGING

- Packing shall be done for Pipe end cleanly cut, square with the axis of pipe and protected against shocks and ingress of foreign bodies by appropriate end caps.
- Both PE Films & hessian cloth packing to be done only for coils and only hessian cloth packing shall be sufficient for Straight length PE pipes, to avoid direct sunlight and facilitate out door storage and the ends shall be protected by proper end caps to prevent from shocks and ingress of the foreign body.
- Packing size to be mentioned to ensure uniformity in delivery conditions of the pipe being procured. Manufacturer shall submit the packaging details and also complied with at the time of delivery.
- Contractor or Manufacturer shall make an arrangement for unloading of pipes at Owner's premises.

15 ENCLOSURE:

- **ANNEXURE-1: QAP of PE 100 – Orange, Raw Material as per IS – 14885-2022**

ANNEXURE-1**Raw Material (As per IS 14885:2022) Properties:**

Sr. No.	Test Parameter	Specification / Tolerance	Unit	Instrument	Test Method	Sample size / Frequency for TPIA	Inspection by		Remarks
							Manufacturer	TPIA	
1	Conventional Density (Base Polymer)	≥ 930 at 23°C	Kg/m ³	Electronic Weighing Balance	IS 7328:2020	One sample for each lot/ batch of raw material used	P	W	
2	Melt Flow Rate (MFR)	±20% of values nominated by compound producer at 190 °C & 5 kg load	gm/10 min.	Melt flow tester	IS 2530:1963		P	W	
3	Thermal Stability (OIT)	≥ 20 minutes @ 200°C	Minutes	OIT Tester	Annex B of IS 4984:2016		P	W	
4	Volatile Matter Content	≤ 350	mg/kg	Electronic balance, Oven	Annex C of IS 4984:2016		P	W	
5	Water Content	≤ 300	mg/kg	Electronic balance, Oven	Annex D of IS 4984:2016 & Table 2 of IS 14885:2022		P	W	Applicable if volatile content is not in conformity
6	Pigment Dispersion	≤ 3 grade	-	Hot Plate, Microscope	Annex A of IS 14885:2022		P	W	
7	Resistance to gas constituents	> 20 hours at 80 °C at an induced stress 2 Mpa	-	-	CI 5.5 & Table 3 of IS 14885:2022		R	R	
8	Colour	Orange	-	--	CI 4.4 of IS 14885:2022		R	R	
9	Anti-Oxidant UV Stabilizer	The percentage of Antioxidant used shall not be more than 0.3 % by mass & the percentage of UV Stabilizer used shall not be more than 0.5% by mass of finished resin	%	--	CI 5.3 & 5.4 of IS 14885:2022	--	R	R	



10	Material (PE Compound Quality Evaluation)	Minimum required strength of material shall be 10 Mpa at 20 °C and material designation PE 100, For 10000 hrs shall be carried out once	-	--	Cl. 4.2.1 & Table 1 of IS 14885:2022	--	R	R	Type Test certificate Review
11	Resistance to slow cracking (SCR)	As per ISO 13479, ≥ 500 hrs at 80°C	-	-	As per ISO 13479		R	R	Raw material supplier TC review
12	Resistance to rapid crack propagation (RCP)	As per ISO 13477, $\geq 1.5 \times \text{MOP}$ bar at 0°C	-	--	As per ISO 13477, Ann E of IS 4984:2016	As per Table 11 of IS:14885	R	R	Raw material supplier TC review
13	Resistance to Weathering		-	--	As per clause no 5.6 & Annex B of IS:14885 -2022		R	R	Raw material supplier TC review

QAP of PE 100 – Orange, Finished Gas Pipes/Coils as per IS – 14885-2022

Sr. No.	Test Parameter	Specification / Tolerance	Unit	Instrument	Test Method	Sample size / Frequency for TPIA	Inspection by		Remarks
							Manufacturer	TPIA	
1	Dimensions	As per IS 14885:2022			As per IS:14885 –2022/ GEL Technical Specification	As per clause No. 9.2.3 Table 13 of IS 14885:2022, 100% on-line witness of all pipes by TPIA			
	a) Wall Thickness of pipe	As per Cl 6.2, Table 6&7 of IS 14885: 2022	mm	Ball ended micrometer			P	W	
	b) Outer Diameter	As per Cl 6.1, Table 4 of IS 14885:2022	mm	Vernier calliper/PI Tape			P	W	
	c) Ovality	As per Cl 6.1, Table 5 of IS 14885:2022	mm	Vernier calliper			P	W	



2	Visual Check	Internal surface of pipe shall be smooth, clean & free from grooving, rings & poke marks(As per clause No. 7 & Table 8 of Is 14885-2022)	----	---			P	W	
3	Length	20mm-200 Mtr. Length 32mm-200 Mtr. Length 63mm-100 Mtr. Length 90mm-100 Mtr. Length 125mm-50 Mtr. Length	Mtr.	Measuring Tape			P	W	Shorter length pipes shall not be accepted.
4	Marking	Printing shall be done by Inkjet printers in black Colour. Legends shall be repeated at intervals of 1 m and shall consist of following information: i) Owner Trade mark / Name or Brand (i.e. GUJARAT ENERGY LTD) j) Material and designation (i.e. D-32, SDR-11, PE-100) k) Manufacturer's identity name or trade name l) Code & Standard (i.e. IS – 14885:2022) m) Batch no. or lot no n) Length of Coil at every meter. o) Manufacturing Date p) Service (i.e. GAS)		Visual		100%			
5	Density(Base Polymer)	≥ 930 at 23 °C	Kg/m ³	Electronic Balance			P	W	
6	Melt Flow rate(MFR)	$\pm 20\%$ of values nominated by compound manufacturer at 190 °C with normal load of 5 kgf	g/10 min	Melt flow tester			P	W	
7	Thermal stability(OIT)	≥ 20 at 200° C	Minut es	Vendor to specify			P	W	
8	Longitudinal reversion Test	Shall not be greater than 3 percent	%	Oven, vernier calliper			P	W	
	Circumferenti al Reversion of Pipes with $d_o \geq 250$ mm	Shall not be greater than the range on mean outside diameter specified in Table 4	mm	Hot water bath, PI tape/Verni er Calliper		Cl 8.2.2 of IS 14885:2022	P	W	



9	Resistance to slow crack growth	≥ 500 hrs at induced stress of 4.6 Mpa	Hrs	80°C	ISO 13479	ISO 13479	P	R	To be carried out on manufactured pipe once for each type of raw material and each manufacturer (Type Test)
10	Resistance To Weathering (Exposure to sunlight)				IS 14885	Annex B	P	R	Review of Type test Certificates
HYDRAULIC CHARACTERISTICS									
11	Plain Pipes	165 Hrs. at 80° C & Induced stress 5.4 Mpa (No sign of localized swelling, leakage or weeping, and shall not burst during the prescribed test duration)	Hrs.	Hydraulic test machine with accessories	IS 14885-2022	All samples for hydro test will be taken from first batch Nos. of pipe, clause No. 8.1 Table 14, 9 of IS 14885-2022	P	W	
12	Notched Pipes	165 Hrs. at 80° C & Induced stress 4.6 Mpa (No sign of localized swelling, leakage or weeping, and shall not burst during the prescribed test duration)	Hrs.				P	W	Applicable to Pipes of size 63 mm & above
13	Plain pipes	Hydrostatic strength at 80° C for 1000 h. Induced stress 5 Mpa	Hrs				P/R	R	Type test- Once in 4 years



14	Plain Pipes(Type Test)	100 Hrs. at 20° C & Induced stress 12.0 Mpa (No sign of localized swelling, leakage or weeping, and shall not burst during the prescribed test duration)	Hrs			One sample per lot testing as per Table 9,11 of IS 14885-2022	P	W	
15	Squeeze off Test(Type Test)	165 Hrs. at 80° C & Induced stress 5.4 Mpa (No sign of localized swelling, leakage or weeping, and shall not burst during the prescribed test duration)	Hrs				P	W	
16	Volatile content	≤350	mg/K g	Electronic balance & Hot air oven		As per clause No. 9.2.4 Table 14 of IS: 14885-2022	P	W	
17	Tensile Test	Min 15	Mpa	Tensile tester			P	W	
18	Elongation at break	Min 350	%	Tensile Tester			P	W	
19	Pigment Dispersion	≤3	Grade	Microscope			P	W	
20	Packing & transportation of coiled & plain pipes	Annex K of IS 14885-2022, & for SDR 17 pipe 18dn (minimum)	---	Visual Check		Every coil or length of pipe extruded	P	W	PE film and hessian cloth wrapping shall be done after inspection

Note:-

- 1) TPIA-Third Party Inspection Agency, P-Perform, W-Witness, R-Review internal test record
- 2) On issuance of work order, vendor shall follow furnished QAP in GEL Tender. In case of any revision/amendment GEL shall furnish QAP in line with IS 14885: latest edition.
- 3) All external labs, if used for testing shall be NABL accredited.
- 4) All MDPE Gas pipes shall be manufactured, tested and designed as per IS 14885:2022 or latest

Reinitiate: Technical scope with Internal coiling diameter for SDR 17 pe pipe

-Digitally Signed-

Shubhi Gupta, Deputy Manager-Tech. Services