## पोली प्रोपलीन रैनडम कोपोल्यमर पी पी आर पाइप
## Polypropylene random Copolymer (PP-R) pipes

1. **General:** This document has been prepared as a ready reckoner for SSEs/JEs and Assistant Engineers to assist them in selecting PP-R pipes for their water supply installation.
   This document fulfills the requirement of PP-R pipes of USSOR-2010 item no.131040 to 131070 and item no. 8626 to 8635 of DSR-2018 of CPWD current edition.
   This document has been prepared based on the requirements of PP-R pipes as per IS-15801:2008 (2017), IS 10910:1984 (2013) & IS 10951:2002 (2016)
2. **Introduction of PP-R:** PP-R stands for Poly Propylene Random Co Polymer.
   **Polypropylene** is a tough, rigid and crystalline thermoplastic produced from propane (or propylene) monomer. The chemical formula of polypropylene is $(C_3H_6)_n$.
   **Polypropylene random Copolymer** is produced by polymerizing together ethane and propane. It features ethane units, usually up to 6% by mass, incorporated randomly in the polypropylene chains.
3. **Designation:** Pipes shall be designated according to the grade of material, SDR and nominal out side diameter.
   For example PP-R, SDR7.4 DN20. It indicate pipe pertaining to material grade PP-R,SDR 7.4 and nominal outside diameter 20 mm.

**3.1 Grade of Material:** Material used as are base resin/ compound for manufacture of pipes as per **IS10951,PP-R,-P-H-N,-10-35-003/006 :** Poly Propylene random Copolymer (**PPR**) intended for pipes and tubes extrusion(**P**), heat ageing established (**H**), natural (not coloured) (**N**) having flexural modulus more than 800 MPa but less than or equal to 1200 Mpa (**10**), an Impact strength more than 30 Kilo Jool per square metre KJ/$m^2$(**35**) and a Melt mass flow ratio (MFR) is more than 0.20 g/ 10 minutes but less than or equal to 0.50 g/ 10 minutes.(**003/006**)

**Or IS10951,PP-R,-P-H-C,-10-35-003/006**

Poly Propylene random Copolymer (**PPR**) intended for pipes and tubes extrusion(**P**), heat ageing established (**H**), coloured (**C**) having flexural modulus more than 800 mega paskal(Mpa) but less than or equal to 1200 mega paskal(**10**), an Impact strength more than 30 Kilo Jool per square metre(**35**) and a Melt mass flow rate (MFR) is more than 0.20 g/ 10 minutes but less than or equal to 0.50 g/ 10 minutes.(**003/006**).

**3.2 SDR (Standard Dimension Ratio (dn/en) :** Ratio of the nominal outside diameter(dn) of a pipe to its nominal wall thickness(en).

**3.3 Nominal diameter:** Specified outside diameter in ($d_{n)}$ in mm .

**4. Dimensions and Visual Requirements of Pipe:**

**4.1 Out side diameter:** The outside diameter of pipes and tolerance on the same shall be as given in Table 1. **No negative tolerance are allowed.**

**4.2 Ovality (Out of roundness):** Difference between the maximum outside diameter and minimum outside diameter at the same cross section. The measurement should be taken minimum 300 mm away from the cut end. The ovality of pipe shall be as given in table 1.

**4.3 Wall thickens:** Minimum and maximum wall thickness of pipes given in Table 2.

Table 1
Outside diameters of pipes, tolerance and ovality of pipes.

| SN | Nominal size | Outside dimensions | Tolerances (only positive) | Ovality |
|---|---|---|---|---|
| | DN | mm | mm | mm |
| 1 | 16 | 16 | 0.3 | 1.2 |
| 2 | 20 | 20 | 0.3 | 1.2 |
| 3 | 25 | 25 | 0.3 | 1.2 |
| 4 | 32 | 32 | 0.3 | 1.3 |
| 5 | 40 | 40 | 0.4 | 1.4 |
| 6 | 50 | 50 | 0.5 | 1.4 |
| 7 | 63 | 63 | 0.6 | 1.6 |
| 8 | 73 | 73 | 0.7 | 1.6 |
| 9 | 90 | 90 | 0.9 | 1.8 |
| 10 | 110 | 110 | 0.9 | 2.2 |
| 11 | 125 | 125 | 1.2 | 2.5 |
| 12 | 140 | 140 | 1.3 | 2.8 |
| 14 | 160 | 160 | 1.5 | 3.2 |
| 15 | 180 | 180 | 1.7 | 3.6 |
| 16 | 200 | 200 | 1.8 | 4.0 |

Table 2
Wall thickness (e) for pipes

| SN | Nominal size | SDR-11 | | SDR 7.4 | |
|---|---|---|---|---|---|
| | DN | Min. mm | Max. mm | Min. mm | Max. mm |
| 1 | 16 | - | - | 2.2 | 2.7 |
| 2 | 20 | 1.90 | 2.30 | 2.8 | 3.3 |
| 3 | 25 | 2.30 | 2.80 | 3.5 | 4.1 |
| 4 | 32 | 2.90 | 3.40 | 4.4 | 5.1 |
| 5 | 40 | 3.70 | 4.30 | 5.5 | 6.3 |
| 6 | 50 | 4.60 | 5.30 | 6.9 | 7.8 |
| 7 | 63 | 5.80 | 6.00 | 8.6 | 9.7 |
| 8 | 73 | 6.8 | 7.7 | 10.30 | 11.60 |
| 9 | 90 | 8.20 | 9.30 | 12.30 | 13.80 |
| 10 | 110 | 10.00 | 11.20 | 15.10 | 16.90 |
| 11 | 125 | 11.40 | 12.80 | 17.10 | 19.10 |
| 12 | 140 | 12.70 | 14.20 | 19.20 | 21.40 |
| 14 | 160 | 14.60 | 16.30 | 21.90 | 24.30 |
| 15 | 180 | 16.40 | 18.30 | 24.60 | 27.30 |
| 16 | 200 | 18.20 | 20.30 | 27.40 | 30.40 |

**4.4 Length of the straight pipe:** Length of straight pipe shall be 3 to 6 meter and a tolerance of +10 mm is allowed on total length of pipe.

**4.5 Visual appearance:** The internal and external surfaces of the pipes shall be Smooth, Clean and free from grooving and other defects. The ends shall he cleanly cut and shall be square with axis of the pipes. Slight shallow longitudinal grooves or irregularities in the wall thickness shall be permissible provided that the wall thickness remains within the permissible limits.

**5. Performance requirements of Pipes:-**

| SN | Name of Test | Test Parameters and relevant code | Acceptance Criteria |
|---|---|---|---|
| 1 | Hydraulic Characteristics (Internal Creep Rupture) | IS 12235 part 8/Sec 1) The temperature, duration of test and hydrostatic stresses for the test shall confirm to table 3. | When subjected to internal hydrostatic pressure test, the pipes under test shall show no sign of localised swelling, leakge or weeping and shall not burst during the prescribed test duration. |
| 2 | Reversion Test | IS 12235 (Part 5/Sec 1) at 135 $\pm$ 2$^0$C for 120 $\pm$ 2 min in air oven. | Value of the longitudinal reversion shall not be > 2 %. |
| 3 | Impact Strength | Charpy impact testing machine IS 13360 (Part 5/Sec 5) | The total numbers of failure shall not exceed 10% of the specimen tested. |
| 4 | Density | IS 12235 (Part 14) | 900– 910 kg/m$^3$<br>900 – 925 kg/m$^3$ for black pipes. |
| 5 | Melt Flow Rate (MFR) | IS 13360 (Part 4/Sec 1) at 230$^0$C with nominal load of 2.16 kgf (Kilo gram force). | MFR < 0.5 g/10 min. |
| 6 | Carbon Black content and Dispersion (applicable only for Blach pipes) | IS 2530 | Carbon black content should be within 2.5 $\pm$ 0.5% and the dispersion of carbon black should be satisfactory. |
| 7 | Thermal Stability by Hydrostatic pressure testing. | IS 12235 (Part 8/Sec 1) at 110$^0$C for 8.76 hrs by applying a hoop stress of 1.9 Mpa.(Mega Paskal) | The pipe should not burst during test period. |
| 8 | Opacity | IS 12235 (Part 3) | The wall of the plain pipe should not transmit more than 0.2% of the visible light. |

**Table 3**
**Requirements of Pipes for Internal Hydrostatic Pressure Test**

| SN | Test | Exposure Medium | Test temperature (Degree centigrade) | Test duration(H) (Minimum holding time) | Hydrostatic (Hoop stress in Mega paskal) Mpa |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| 1 | Acceptance test | Water | 20 | 1 | 16.0 |
| 2 | Acceptance test | Water | 95 | 22 | 4.3 |

## 6.0 Acceptance Test:

6.1 Acceptance test are carried out on sample selected from a lot for the purpose of acceptance of a lot.

6.2 All pipes of the same size, same pressure rating and same grade and also manufactured essentially under similar condition of manufacturer, shall constitute a lot.

## 7.0 Acceptance test for dimensional and visual requirements.

7.1 The numbers of test samples shall be in accordance with Table 4.

7.2 A pipe failing to satisfy any of the requirements of clause 4 above shall be considered as defective.

**Table 4**
**Scale of sampling for visual and dimensional requirement.**

| SN | Nos. of pipes in the lot | Sample No. | Sample size | Cumulative sample size | Acceptance no. | Rejection No. |
|---|---|---|---|---|---|---|
| 1 | Up to 150 | I | 13 | 13 | 0 | 2 |
| | | II | 13 | 26 | 1 | 2 |
| 2 | 151 to 280 | I | 20 | 20 | 0 | 3 |
| | | II | 20 | 40 | 3 | 4 |
| 3 | 281 to 500 | I | 32 | 32 | 1 | 4 |
| | | II | 32 | 64 | 4 | 5 |
| 4 | 501 to 1200 | I | 50 | 50 | 2 | 5 |
| | | II | 50 | 100 | 6 | 7 |
| 5 | 1201 to 3200 | I | 80 | 80 | 3 | 7 |
| | | II | 80 | 160 | 8 | 9 |
| 6 | 3201 to 10000 | I | 125 | 125 | 5 | 9 |
| | | II | 125 | 250 | 12 | 13 |
| 7 | 10001 and above | I | 200 | 200 | 7 | 11 |
| | | II | 200 | 400 | 18 | 19 |

## 8.0 Acceptance Test for Performance Requirements.

8.1 The lot having satisfied dimensional and visual requirements shall be tested for hydraulic characteristic, reversion, density and MFR & opacity. In case of solar heating systems and other prolonged outdoor applications, the carbon black content/dispersion requirements are also to be considered.

8.2 A separate sample size for each of the test shall be taken as stipulated in Table 5 and selected at random from the sample already examine for dimensional and visual inspection. The lot shall be considered to have met the requirements of these sets, if none of the samples tested fails.

**Table 5**
**Scale of sampling for requirement of hydraulic characteristic, reversion, Carbon Black content and Dispersion, Density, Influence on water intended for human consumption (Overall Migration), thermal stability, Fusion compatibility and MFR**

| SN | Nos. of pipes in a lot | Sample size for test |
|---|---|---|
| 1 | 2 | 3 |
| 1 | Up to 150 | 3 |
| 2 | 151 to 500 | 3 |
| 3 | 501 to 3200 | 5 |
| 4 | More than 3200 | 8 |

## 9.0 PP-R pipes-Temperature and correspondence pressure details for information purpose:

When a PP-R piping system is to be operated at a varying degree of temperature and pressures. Maximum operating pressures are given in table given below may be applicable.

**Table 6**
**Allowable Maximum Operating Pressures for Pipes.**

| SN. | SDR-11 | | SDR 7.4 | |
|---|---|---|---|---|
| | Temp. | pressure | Temp. | pressure |
| 1 | 10 | 1.91 | 10 | 3.02 |
| 2 | 20 | 1.63 | 20 | 2.58 |
| 3 | 30 | 1.37 | 30 | 2.17 |
| 4 | 40 | 1.15 | 40 | 1.84 |
| 5 | 50 | 0.98 | 50 | 1.55 |
| 6 | 60 | 0.82 | 60 | 1.28 |
| 7 | 70 | 0.62 | 70 | 0.98 |
| 8 | 80 | 0.39 | 80 | 0.62 |
| 9 | 95 | 0.27 | 95 | 0.40 |

***गुणवत्ता नीति***

आर. डी. एस. ओ. लखनऊ में हम सतत सुधार और ग्राहक मूल्यांकन प्राप्त करने हेतु गुणवत्ता प्रबंध प्रणालियों की आवधिक समीक्षा के माध्यम से रेलों में यात्री और माल यातायात की बढ़ती आवश्यकताओं, माँग और अपेक्षाओं को पूरा करने के लिए गुणवत्ता प्रबंध प्रणाली की व्यवहारिक आवश्यकताओं और अनवरत सुधारों को पूरा करने के समर्पण गुणवत्ता उद्देश्यों को निर्धारित करके अनुसंधान, अभिकल्पों और मानकों में उत्कृष्टता के माध्यम से वैधानिक और नियामक अपेक्षाओं का अनुपालन करते हुए सुरक्षित, आधुनिक और किफ़ायती रेल प्रौद्योगिकी विकसित करने हेतु सेवाओं को बनाए रखने और अद्यतन पारदर्शी मानकों हेतु प्रतिबद्ध हैं। इसे संगठन के अंदर संसूचित एवं लागू किया गया है तथा सभी संबंधित पक्षकारों को भी उपलब्ध कराया गया है।

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# पोली प्रोपलीन रैनडम कोपोल्यमर पी पी आर पाइप

# Polypropylene Random Copolymer (PP-R) pipe




**केमटेक/सिविल/2021/ पी पी आर पाइप/1.0**

**CAMTECH/C/2021/ PP-R pipe/1.0**

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