



NSF International
Special Engineered Specification
NSF SE 9164

SDR 7.7 PE-RT Pipe and Fittings System

The Public
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SPECIFICATIONS FOR A SPECIAL ENGINEERED (SE) PRODUCT NSF SE 9164 SDR 7.7 PE-RT Pipe and Fittings System

1. Purpose:

This document defines the product-specific requirements for SDR 7.7 PE-RT Pipe and Fittings Systems, which are not currently covered by a standard identified in Section 2 of NSF/ANSI Standard 14. A system is comprised of polyethylene of raised temperature (PE-RT) pipe in standard dimension ratio 7.7 and PE-RT fittings joined by induction-welding. This specification serves as guide for producers, specifiers, contractors, installers and regulators to provide a basis for evaluation and acceptance.

2. Scope of Specification:

This specification establishes the minimum testing, marking, and in-plant QC requirements for SDR 7.7 PE-RT Pipe and Fittings Systems. The interchangeability of pipe and fittings defined by different manufacturers' systems is not addressed in this specification.

3. Application:

SDR 7.7 PE-RT and Fittings Systems tested against these requirements are for use in hot- and cold- water distribution and radiant heating applications.

4. Reference Documents:

ASTM Standards

ASTM D618 – Practice for Conditioning Plastics for Testing

ASTM D638 – Test Method for Tensile Properties of Plastics

ASTM D883 – Terminology Relating to Plastics

ASTM D1598 – Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure

ASTM D1599 – Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings

ASTM D1600 – Terminology for Abbreviated Terms Relating to Plastics

ASTM D1898 – Practice for Sampling Plastics

ASTM D2122 – Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings

ASTM D2447 – Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter

ASTM D2837 – Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials

ASTM D3140 – Practice for Flaring Polyolefin Pipe and Tubing

ASTM D3350 – Specification for Polyethylene Plastics Pipe and Fittings Materials

ASTM D3895 – Test Method for Oxidative-Induction Time of Polyolefin's by Differential Scanning Calorimetry

ASTM F412 – Terminology Relating to Plastic Piping Systems

ASTM F1055 – Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing

ASTM F2023 – Test Method for Evaluating the Oxidative Resistance of Crosslinked Polyethylene (PEX) Tubing and Systems to Hot Chlorinated Water

ASTM F2769 – Polyethylene of Raised Temperature (PE-RT) Plastic Hot and Cold-Water Tubing and Distribution Systems

NSF Standards

NSF/ANSI Standard 14 – Plastic Piping System Components and Related Materials

NSF/ANSI Standard 61 – Drinking Water Systems Components – Health Effects

Plastic Pipe Institute (PPI) Technical Report

TR-3 – Policies and Procedures for Developing Hydrostatic Design (HDS), Pressure Design Basis (PDB), Strength Design Basis (SDB), and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe



5.0 Material Requirements:

5.1 Materials used in production of Polyethylene of Raised Temperature (PE-RT) pipe and fittings shall have a minimum cell classification per Table 1 as determined by ASTM D3350.

5.2 PE-RT pipe material shall have a Hydrostatic Design Basis (HDB) rating at 73°F (23°C) and 180° F (82°C) per Plastic Pipe Institute’s TR-3.

5.3 PE-RT pipe material shall have a pressure rating as per Table 2.

5.4 PE-RT material shall meet or exceed a PENT of 500 hours at 90°C (194°F).

5.5 Plastic used in the production of PE-RT pipe and fittings systems shall be virgin or clean rework of the same formulation. Plastic material used in the production of PE-RT pipe shall not consist of recycled material.

5.6 Pipe and fitting materials for use in potable water applications shall comply with NSF/ANSI Standard 61.

Table 1 - Required ASTM D3350 Cell Classifications for PE-RT	
Density	2, 3 or 4
Melt Index	2, 3, 4 or 5
Flexural Modulus	≥ 3
Tensile Strength	≥ 2
Slow Crack Growth Resistance	7
Hydrostatic Strength Classification	3 , 4, 5 or 6

Table 2 - Pressure Ratings for PE-RT SDR 7.7 Pipe					
Rated Temperature		Minimum Hydrostatic Design Stress		Minimum Pressure Rating for Water	
°F	°C	psi	MPa	psi	MPa
73.4	23	800	5.52	235	1.62
140	60	630	4.34	185	1.28
180	82.2	400	2.76	115	0.79

6.0 Dimensions and Tolerances:

6.1 Pipe Dimensions:

6.1.1 Dimensional verification of PE-RT pipe shall be in accordance with Table 3.

6.1.2 PE-RT pipe is authorized to have an EVOH barrier layer. The PE-RT pipe must meet all dimensional requirements with and without the barrier.

6.2 Fitting Dimensions:

6.2.1 Dimensional verification of the fittings shall be in accordance with Table 4 and Figure 1.

6.2.2 The diameter of the fitting shall correspond to the outside diameter of the pipe. The fitting wall thickness in contact with water shall be equal to or greater than the corresponding wall thickness of the pipe.



Table 3 - Dimension Requirements for SDR 7.7 Pipe (Inches)					
Nominal Pipe Size	Average Outside Diameter	Tolerance for Average Diameter	Out of Roundness	Minimum Wall Thickness	Thickness Tolerance
3/8 CTS	0.500	± 0.003	0.012	0.064	+0.010
1/2 CTS	0.625	± 0.004	0.016	0.080	+0.010
5/8 CTS	0.750	± 0.004	0.016	0.096	+0.010
3/4 CTS	0.875	± 0.004	0.016	0.113	+0.010
1 CTS	1.125	± 0.005	0.020	0.145	+0.013
1 IPS	1.315	± 0.005	0.020	0.171	+0.013
1-1/4 IPS	1.660	± 0.005	0.020	0.216	+0.015
1-1/2 IPS	1.900	± 0.006	0.024	0.247	+0.019
2 IPS	2.375	± 0.006	0.030	0.308	+0.024
2-1/2 IPS	2.875	± 0.007	0.038	0.373	+0.030
3 IPS	3.500	± 0.008	0.045	0.454	+0.033

Figure 1 – Fitting Dimensions

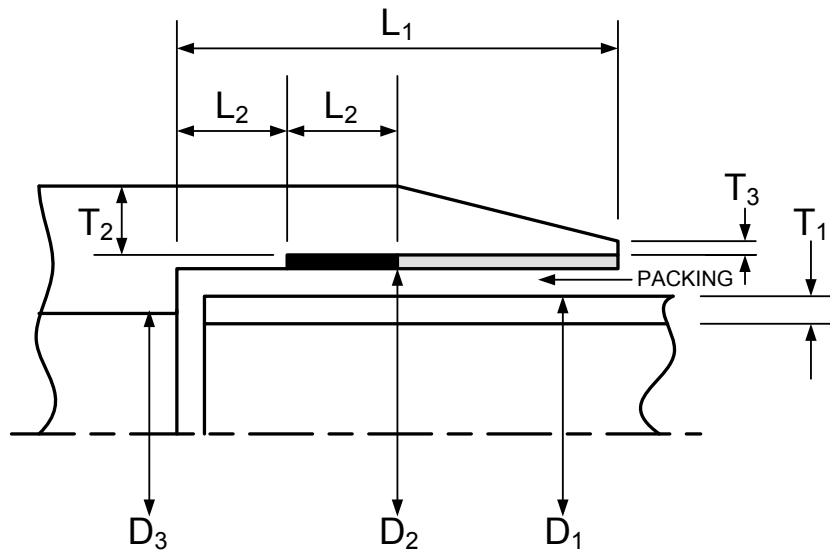


Figure 1 Key:

D ₁	Nominal Diameter of the Fitting
D ₂	Nominal Diameter of the Welding Zone
D ₃	Minimum Diameter of the Flow Channel = (D ₂ -T ₁)
L ₁	Insertion Depth of Pipe
L ₂	Nominal Length of Welding Zone and Pipe Extension
T ₁	Nominal Pipe Thickness
T ₂	Thickness of the Fitting's Weld Zone and Fluid Contact Surface = T ₂ ≥ T ₁
T ₃	Thickness of the Fitting at the Pipe Insertion Point = T ₃ ≥ ½(T ₁)



Table 4 - Fitting Dimension Requirements (Inches)

D ₁	D ₂ Minimum	L ₂ Minimum	L ₁ Minimum
3/8 CTS	0.504	0.290	1.61
1/2 CTS	0.630	0.290	1.61
5/8 CTS	0.755	0.290	1.61
3/4 CTS	0.880	0.290	1.61
1 CTS	1.131	0.415	2.24
1 IPS	1.321	0.415	2.24
1-1/4 IPS	1.666	0.415	2.24
1-1/2 IPS	1.907	0.540	3.00
2 IPS	2.382	0.540	3.00
2-1/2 IPS	2.883	0.540	3.00
3 IPS	3.509	0.665	3.00

Piping systems that involve pipe cutting or trimming shall conform to the Manufacturer's specifications.

7.0 Testing Requirements:

7.1 Conditioning:

All specimens shall be conditioned per Section 7.1 of ASTM F2769 prior to testing.

7.2 Sustained Pressure:

7.2.1 Testing shall be performed and evaluated in accordance with Section 7.5 of ASTM F2769. PE-RT pipe and fitting assemblies shall meet the pressure requirements identified in Table 5. Testing shall be performed at 73.4° F (23°C) and 180° F (82°C).

7.2.2 PE-RT pipe and fitting assemblies shall also comply with the sustained pressure requirements in Section 5.2.2 of ASTM F1055.

Table 5 - Sustained Pressure Requirements for SDR 7.7 Pipe and Fittings

Nominal Size	73.4° F (23°C)	180° F (82°C)
3/8"	520 psi	250 psi
1/2"	405 psi	195 psi
5/8" and greater	400 psi	190 psi



7.3 Burst Pressure:

7.3.1 Testing shall be performed and evaluated in accordance with Section 7.6 of ASTM F2769. PE-RT pipe and fitting assemblies shall meet the pressure requirements identified in Table 6. Testing shall be performed at 73.4° F and 180° F.

7.3.2 PE-RT pipe and fitting assemblies shall also comply with the hydrostatic burst requirements in Section 5.2.1 of ASTM F1055.

Table 6 - Burst Pressure Requirements for SDR 7.7 Pipe and Fittings		
Nominal Size	73.4° F (23°C)	180° F (82°C)
3/8"	945 psi	345 psi
1/2"	730 psi	270 psi
5/8" and greater	720 psi	265 psi

7.4 Chlorine Resistance:

PE-RT pipe for use in potable water applications shall be tested for resistance to chlorine using test method ASTM F2023. A chlorine classification code from Table 7 shall be determined based on a minimum extrapolated time-to-failure of 50 years.

Table 7 - Chlorine Resistance Classification Codes			
Standard	CL1	CL3	CL5
Usage Ratios	75% @ 73°F & 25% @ 140°F	50% @ 73°F & 50% @ 140°F	100% @ 140°F

7.5 Bent Tube:

Bent tube test shall be performed and evaluated in accordance with Section 6.7 of ASTM F2769. Testing shall be performed on six pipe samples at 180° F.

7.6 Thermocyclic:

Thermocyclic test shall be performed and evaluated in accordance with Section 6.5 of ASTM F2769. Fitting assemblies shall be subjected to 1,000 cycles of alternating temperatures of 60°F and 180°F.

7.7 Excessive Temperature:

Excessive temperature test shall be performed and evaluated in accordance with Section 6.8 of ASTM F2769. Testing shall be conducted at 150 psi and 210°F on six joints for 720 hours.

7.8 Joint Crush Testing:

Couplings shall meet the minimum requirements identified in ASTM F1055 Section 5.5 when performed and evaluated in accordance with Section 9.4.1.



7.9 *Evaluation of Voids:*

Couplings shall meet the minimum requirements identified in ASTM F1055 Section 5.5 when performed and evaluated in accordance with Section 9.5.

7.10 *Tensile Strength Testing:*

Couplings shall meet the minimum requirements identified in ASTM F1055 Section 5.3 when performed and evaluated in accordance with Section 9.3.

8.0 Product Marking:

8.1 *Pipe:*

8.1.1 Each 5' pipe length shall be marked with the following as a minimum:

- Corporate name, trademark, or trade designation
- Nominal piping size – CTS or IPS
- Material designation, PE-RT
- Standard dimension ratio, 7.7
- NSF pw – SE (for potable water systems), or other authorized Mark depending on specific end use application
- Cell classification per ASTM D3350- for example “PE223273”
- Pressure rating at 73°F, 140°F, and 180°F
- Product identifier or lot code

8.1.2 All pipe marking shall be applied in such a manner that it remains legible under normal handling and installation.

8.2 *Fittings:*

8.2.1. Fittings shall be marked with the following as a minimum:

- Nominal size code – identifying CTS or IPS
- Material designation, PE-RT
- Corporate name, trademark, or trade designation
- NSF pw – SE (for potable water systems), or other authorized Mark depending on specific end use application

8.2.2 All fitting marking shall be applied in such a manner that it remains legible under normal handling and installation.

8.2.3 Fittings shall be shipped with the following information:

- Critical dimensions as defined by NSF/ANSI Standard 14, including coupling inside diameter and pipe insertion length
- Weld time for joining based on Manufacturer's specified equipment setting for a pipe size diameter



9.0. In-Plant Q.C. Requirements

The following tests are to be performed at start-up and at the designated frequencies thereafter.

Test	Frequency
Dimensions	
Fittings - Socket Entrance ID	24 hr
Fittings - Socket Length Min.	24 hr
Pipe - OD	2 h
Pipe - Wall thickness min.	2 h
Burst Pressure	Weekly
Joint Crush ¹	Weekly
Tensile Strength ¹	Weekly
Sustained Pressure	Annually
Bent Tube	Annually
Thermocyclic	Annually
Excessive Temperature	Annually
Chlorine Resistance ²	Three years
¹ For couplings as specified in ASTM F1055	
² For PE-RT pipe	