Summary of Substantive Changes
the 2013 edition including Updates No. 1, No. 2 and No. 3 dated March 2015, October 2015 and November 2015 and 2017of

CSA B137 Series-17 "Thermoplastic pressure piping compendium"

Presented to the IAPMO Standards Review Committee on July 9, 2018

General: The change reported in this summary are limited to the following component standards of this compendium: CSA B137.0, CSA B137.1, CSA B137.5, CSA B137.6, and CSA B137.9. The change to these standards may have an impact on currently listed products. The significant changes are:

CSA B137.0, Definitions, general requirements, and methods of testing for thermoplastic pressure piping

- Added a requirement for compliance with NSF 372, included dezincification and stress corrosion testing for copper alloys, specified allowed UNS for crimp rings and included corrosion resistance requirements for ferrous material (see Section 4).
- Added a new tensile strength test (see Section 6.3).
- Changed the HDB determination from inclusion in the standards to reference ASTM D2837 (see Section 6.6).
- Revised the impact resistance test for pipe (see Section 6.7)
- Added a resistance to rapid crack propagation test (see Section 6.11)

CSA B137.1, Polyethylene (PE) pipe, tubing, and fittings for cold-water pressure services

- Expanded the materials covered to include a new compound and added additional crack growth testing specific to the new compound PE 4710 PLUS (see Section 4.2, Table 1 and Table 8).
- Added a 230 Series classification of PE pipe (see Section 5.1.3 and Table 7).

CSA B137.5, Crosslinked polyethylene (PEX) tubing systems for pressure applications

- Removed the allowance to use reworked material for PEX Tubing (see Sections 4.2.1 and Former Sections 6.10 and 7)
- Added requirements to apply a PEX material designation code (see Sections 4.2.2, 7 and Table 4).
- Revised the requirements for mechanical fittings to include those made of materials compliant with applicable nationally recognized standard (see Section 4.2.3).
- Included requirements for push fit fittings (see Section 4.2.5).
- Expanded the detailed requirements for multiple fitting types (see Section 5.1)
- Added requirements to mark tubing with the PEX designation code and the standard designation of the associated fitting (see Section 7).

CSA B137.6, Chlorinated polyvinylchloride (CPVC) pipe, tubing, and fittings for hot- and cold-water distribution systems

- Added requirements for push-fit fitting compliance with ASSE 1061 (see Section 5.3)

CSA B137.9, Polyethylene/aluminum/polyethylene (PE- AL-PE) composite pressure-pipe systems

- no changes

CSA B137.0 “Definitions, general requirements, and methods of testing for thermoplastic pressure piping”

Section 2, Reference publications: The following standards were added, revised or deleted as follows:

CSA Group

CAN/CSA-B125-01 (withdrawn) Plumbing fittings
C22.1-~~09~~15 Canadian Electrical Code, Part I
CAN/CSA-C22.2 No. 0-~~M91 (R2006)~~10 (R2015) General requirements — Canadian Electrical Code, Part II
ANSI/CSA-C448 Series-~~02 (R2007)~~16 Design and installation of earth energy systems
CAN/CSA-Z234.3-89 ~~(R2008)~~ (withdrawn) Guide for the selection and use of preferred numbers
Z662-~~11~~15 Oil and gas pipeline systems
CAN/CSA-ISO 9001-~~08~~16 Quality management systems — Requirements

ASME (The American Society of Mechanical Engineers)

B1.20.1-~~1983 (R2006)~~2013 Pipe Threads, General Purpose, Inch
B16.18-~~2001 (R2005)~~2012 Cast Copper Alloy Solder Joint Pressure Fittings
B16.22-~~2001 (R2005)~~2013 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
B16.40-~~2008~~2013 Manually Operated Thermoplastic Gas Shutoffs and Valves in Gas Distribution Systems
B16.51–2013 Copper and Copper Alloy Press-Connect Pressure Fittings

ASSE (American Society of Sanitary Engineering)

1061-2015 Performance requirements for Push-Fit Fittings

ASTM International (American Society for Testing and Materials)

A240/A240M-~~08a~~16 Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
B858-16 Standard Test Method for Ammonia Vapor Test for Determining Susceptibility to Stress Corrosion Cracking in Copper Alloys
B16/B16M-~~05~~10 (2015) Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines
B62-~~02~~15 Standard Specification for Composition Bronze or Ounce Metal Castings
B75/B75M-~~02~~11 Standard Specification for Seamless Copper Tube
B124/B124M-~~08~~16 Standard Specification for Copper and Copper Alloy Forging Rod, Bar, and Shapes
B140/B140M-~~07~~12 Standard Specification for Copper-Zinc-Lead (Red Brass or Hardware Bronze) Rod, Bar, and Shapes
B283/B283M-~~08~~16a Standard Specification for Copper and Copper-Alloy Die Forgings (Hot-Pressed)
B584-~~08a~~14 Standard Specification for Copper Alloy Sand Castings for General Applications
D395-~~03(R2008)~~16 Standard Test Methods for Rubber Property — Compression Set
D412-~~06ae1~~15a Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers — Tension
D471-~~06ae1~~16 Standard Test Method for Rubber Property — Effect of Liquids
D618-~~08~~13 Standard Practice for Conditioning Plastics for Testing
D638-~~08~~14 Standard Test Method for Tensile Properties of Plastics
D695-~~08~~15 Standard Test Method for Compressive Properties of Rigid Plastics
D746-~~07~~14 Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
D789-~~07~~15 Standard Test Methods for Determination of Solution Viscosities of Polyamide (PA)

D792-~~08~~13 Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
D883-~~08~~12e1 Standard Terminology Relating to Plastics
D1149-~~07~~16 Standard Test Method for Rubber Deterioration — Cracking in an Ozone Controlled Environment
D1238-~~04c~~13 Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
D1505-~~03~~10 Standard Test Method for Density of Plastics by the Density-Gradient Technique
D1598-~~02 (2008)~~15a Standard Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure
D1599-~~99 (2005)~~14e1 Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings
D1600-~~08~~14 Standard Terminology for Abbreviated Terms Relating to Plastics
D1603-~~06~~14 Standard Test Method for Carbon Black in Olefin Plastics
D1693-~~08~~15 Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics
D1784-~~08~~11 Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
D2104-03 (withdrawn) Standard Specification for Polyethylene (PE) Plastic Pipe, Schedule 40
D2122-~~98 (2004)~~ 16 Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
D2152-~~95 (2003)~~ 13 Standard Test Method for Adequacy of Fusion of Extruded Poly(Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion
D2240-~~05~~15 Standard Test Method for Rubber Property — Durometer Hardness
D2290-12 Standard Test Method for Apparent Hoop Tensile Strength of Plastic or Reinforced Plastic Pipe
D2412-11 Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel- Plate Loading
D2464-~~06~~15 Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
D2466-~~06~~15 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
D2467-~~06~~15 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
D2564-~~04e1~~12 Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
D2581-~~02~~09 Standard Specification for Polybutylene (PB) Plastics Molding and Extrusion Materials
D2609-~~02 (2008)~~15 Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe
D2765-~~01 (2006)~~ 11 Standard Test Methods for Determination of Gel Content and Swell Ratio of Crosslinked Ethylene Plastics
D2837-~~08~~ 13e1 Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
D3035-~~08~~15 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
D3261-~~03~~15 Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
D3350-~~08~~14 Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
D4066-~~01a (2008)~~13 Standard Classification System for Nylon Injection and Extrusion Materials (PA)
D6394-~~08~~ 14 Standard Specification for Sulfone Plastics (SP)
E4-~~08~~ 16 Standard Practices for Force Verification of Testing Machines
E8/E8M-~~08~~ 15a Standard Test Methods for Tension Testing of Metallic Materials

F477-~~08~~ 14 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
F493-~~04~~ 14 Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
F610/F610M-~~00a (2005)~~2015 Standard Test Method for Evaluating the Quality of Molded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings by the Heat Reversion Technique
F656-~~08~~ 15 Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings
F905-~~04~~2011 Standard Practice for Qualification of Polyethylene Saddle-Fused Joints
F1057-~~87 (2005)~~10 Standard Practice for Estimating the Quality of Extruded Poly(Vinyl Chloride) (PVC) Pipe by the Heat Reversion Technique
F1281-~~07~~11 Standard Specification for Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe
F1282-~~06~~10 Standard Specification for Polyethylene/Aluminum/Polyethylene (PE-AL-PE) Composite Pressure Pipe
F1473-~~07~~16 Standard Test Method for Notch Tensile Test to Measure the Resistance to Slow Crack Growth of Polyethylene Pipes and Resins
F1807-~~13~~15 Standard Specification for Metal Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing
F1960-~~12~~15 Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) Tubing
F2023-~~08~~15 Standard Test Method for Evaluating the Oxidative Resistance of Crosslinked Polyethylene (PEX) Tubing and Systems to Hot Chlorinated Water
F2080-~~12~~16 Standard Specification for Cold-Expansion Fittings With Metal Compression-Sleeves for Cross-Linked Polyethylene (PEX) Pipe1
F2098-~~08~~15 Standard Specification for Stainless Steel Clamps for Securing SDR9 Cross-linked Polyethylene (PEX) Tubing to Metal Insert and Plastic Insert Fittings
F2159-~~11~~14 *Standard Specification for Plastic Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing*
F2263-~~07e1~~14 *Standard Test Method for Evaluating the Oxidative Resistance of Polyethylene (PE) Pipe to Chlorinated Water*
F2657–12 Standard Test Method for Outdoor Weathering Exposure of Crosslinked Polyethylene (PEX) Tubing

ANSI/AWWA (American National Standards Institute/American Water Works Association)
C800-~~05~~14 Underground Service Line Valves and Fittings

AWWA (American Water Works Association)
M23 (2002 Edition) PVC Pipe — Design and Installation

ISO (International Organization for Standardization)
1183-1:~~2004~~ 2012 Plastics — Methods for determining the density of non-cellular plastics — Part 1: Immersion method, liquid pyknometer method and titration method
3501:~~1976~~ 2015 Plastic piping systems – Mechanical joints between fittings and pressure pipes – Test method for resistance to pull-out under constant longitudinal force
6509:2014 Corrosion of metals and alloys – Determination of dezincification resistance of copper alloys with zic
6957:1988 Copper alloys — Ammonia test for stress corrosion

9080:~~2003~~ 2012 Plastics piping and ducting systems — Determination of the long-term hydrostatic strength of thermoplastics materials in pipe form by extrapolation
11357-3:~~1999~~ 2011 Plastics — Differential scanning calorimetry (DSC) — Part 3: Determination of temperature and enthalpy of melting and crystallization
12162:~~2008~~ 2009 Thermoplastics materials for pipes and fittings for pressure applications — Classification, designation and design coefficient
15512:~~2008~~ 2014 Plastics — Determination of water content
~~*TR 9080:1992/Cor 1:1995 (superseded by ISO 9080:2003)*~~
~~*Thermoplastics pipes for the transport of fluids — Methods of extrapolation of hydrostatic stress rupture data to determine the long-term hydrostatic strength of thermoplastics pipe materials*~~

NSF/ANSI (National Sanitation Foundation International/American National Standards Institute)
NSF/ANSI 61-2008 2015 *Drinking Water System Components — Health Effects*
NSF/ANSI 372-2016 Drinking Water System Components — Lead content

PPI (Plastics Pipe Institute)
TR-3/~~*2008*~~ *2016 Policies and Procedures for Developing Hydrostatic Design Basis (HDB), Pressure Design Basis (PDB), Strength Design Basis (SDB), and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe*

PVC Pipe Association
Handbook of PVC Pipe Design and Construction (Fifth Edition – 2012)

Section 3, Definitions and abbreviations: Additional definitions and abbreviation were included as follows:
3.1 Definitions
Push-fit fitting — a mechanical fitting that joins pipes or tubes and achieves a seal by pushing the mating pipe or tube into the fitting by hand. The fitting can be removable or non-removable.

3.2 Abbreviations
PP-RCT – random copolymerized polypropylene with enhanced temperature performance
S4 – small-scale steady-state

Section 4, Material requirements: Added a requirement for compliance with NSF 372, included dezincification and stress corrosion testing for copper alloys, specified allowed UNS for crimp rings and included a corrosion resistance requirements for ferrous materials as follows:
4.2.1.2
Pipes and fittings intended to convey or dispense water used for human consumption, through drinking or cooking, shall not contain a weighted average lead content in excess of 0.25% when evaluated in accordance with NSF/ANSI 372.

4.4 Metallic materials
4.4.1 Nonferrous materials
4.4.1.1 General

Fittings manufactured from copper alloys and intended for use in potable and reclaimed water applications shall have a copper content of no less than 58% by weight and shall meet the requirements of NSF/ANSI 61 and Clauses 4.4.1.2 and 4.4.1.3 of this Standard.

4.4.1.2 Resistance to dezincification
Fittings, manufactured from copper alloys containing more than 15% zinc by weight, shall be tested in accordance with ISO 6509. The maximum depth of dezincification shall not exceed 200 µm.
4.4.1.3 Resistance to stress corrosion
Valves and fittings, manufactured from copper alloys containing more than 15% zinc by weight, shall be resistant to stress corrosion. There shall be no evidence of cracking at 10X magnification when those products are tested in accordance with ISO 6957 or ASTM B858 in a test solution of 9.5 pH.
Note: The requirements for resistance to dezincification and resistance to stress corrosion are intended to establish a minimum level of performance for products intended for use in potable water systems. These requirements are not a guarantee that erosion or corrosion will not occur
4.4.1.4
Crimping rings shall be made of copper alloys UNS C10200, C12000, or C12200. The crimping rings shall have a hardness of 35 to 45 measured on the Rockwell 15T scale.
4.4.2 Ferrous materials
Ferrous metals, when tested as part of an assembly, shall comply with the corrosion-resistance requirements of Clause 6.1.1 of CAN/CSA-B125.

Section 6, Test methods:
Section 6.3, Chemical resistance: Added a new tensile strength test as follows:
6.3.2 Change in tensile strength
6.3.2.1
Where pipe samples are available, testing shall be performed as per Clause 6.3.2.2 to determine the change in apparent tensile yield strength. For materials that are not readily available in pipe form, testing shall be performed using test plaques of the material as per Clause 6.3.2.3 to determine the change in tensile strength at yield.

6.3.2.3
For materials that are not readily available in pipe form, the test specimens shall be plaques of material 6.3 by 50.8 by 101.6 mm (nominal) with a 25.4 mm wide reduced section, instead of the piece of pipe January 2017 detailed in Clause 6.3.2.2. The change in tensile strength at yield due to each chemical reagent shall be determined in accordance with ASTM D638.

Section 6.6, Hydrostatic sustained pressure test: Changed the HDB determination from inclusion in the standards to a reference of ASTM D2837, Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
6.6.2 Calculating circumferential (hoop) stress
6.6.2.1
When plastic pipe is sized by the outside diameter ~~and the ratio OD/t is greater than 10~~, the hoop stress shall be calculated as follows:

6.6.2.2

When plastic pipe is sized by the inside diameter ~~and the ratio ID/t is greater than 8~~, the hoop stress shall be calculated as follows:

~~*6.6.2.3*~~

~~*When the ratio OD/t for outside diameter-sized pipe is less than 10 or the ratio ID/t for inside diameter-sized pipe is less than 8 (e.g., on very thick-walled pipe), the variable tangential stress at any point within the wall of the pipe shall be calculated as follows:*~~

$$S_T = p\frac{(r_i)^2}{(r_o)^2-(r_i)^2}\left[1+\frac{(r_o)^2}{(r)^2}\right]$$

~~*where*~~

~~*S_T = variable tangential stress at any given point within the wall of the pipe between ri and ro, kPa*~~

6.6.3 Calculating pressure ratings

6.6.3.1

Pressure ratings of pipe of various dimensions shall be calculated from the hydrostatic design basis (HDB) or the minimum required strength (MRS) value for the specific compound used to make the pipe.

The introduction of a second method (minimum required strength, MRS) for determining the hydrostatic design strength in a pipe has led to the possibility of calculating different pressure ratings for a pipe made with a given PE compound. The designer shall determine the appropriate usage of either the MRS or HDB rating system, in combination with the appropriate service design factors (for HDB) or service design coefficient (for MRS), when calculating a pressure rating for a given application.

The pressure rating shall be calculated by using the equations in Clause 6.6.2 in reverse and applying a service (design) factor for pipe made from an HDB-rated compound, or service (design) coefficient for pipe made from an MRS-rated compound, using one of the following:

for HDB rating method:

$p = (2000\ f\ HDB\ t) \div (OD - t)$

or

$p = (2000\ HDS) \div (DR - 1)$

or

$p = (2000\ f\ HDB\ t) \div (ID + t)$

or

$p = (2000\ HDS\ t) \div (ID + t)$

~~*$p = 1000\ fS\ (r_o^2 - ri2) \div (r_{o2} - r_{i2})$*~~

where

f_a = the portion that makes allowance for manufacturing and testing variables, such as normal variations in material, manufacture, dimensions, proper handling techniques, as well as evaluation procedures

f_b = the portion that makes allowance for application and use, such as installation, environment, temperature, hazards, desired life expectancy, and selected degree of reliability

Note: *Neither f_a nor fb should exceed 1.0.*

HDB = hydrostatic design basis, MPa

HDS = hydrostatic design stress HDB x f, MPa

DR = dimension ration OD ÷ t

~~*S = hoop stress or tangential stress in the pipe wall when r = r_i, MPa*~~

T = minimum wall thickness, mm
OD = average outside diameter, mm
ID = average inside diameter, mm
~~*r_o =average outside pipe radius, mm*~~
~~*r_i = average inside pipe radius, mm*~~

b) for MRS rating method:
p = (2000 MRS) ÷ [(DR – 1) C_{min}]
or
p = (2000 HDS_{MRS}) ÷ (DR – 1)
where
p = pressure rating, kPa
MRS = minimum required strength, MPa
HDS_{MRS} = MRS ÷ C_{min}
C_{min} = minimum service (design) coefficient
Note: *In the application of gas distribution, the recommended value for and guidance on the use of C_{min} for gas applications are provided in Clause 12 of CSA Z662.*
DR = dimension ration
C_{min} = shall be used only to determine the pressure rating for MRS-rated compounds, and the service (design) factor (f) shall be used only to determine the pressure rating for HDB-rated compounds. C_{min} and f are not simply reciprocals of each other. They shall be used only with their respective rating method (i.e., C_{min} with the MRS rating and f with the HDB rating).

Section 6.6.4, Determination and validation of HDB:
6.6.4.1 Procedure for testing HDB-rated compounds (LTHS determination)
~~*Note: See Clause A.2 for further guidance on the method of least squares regression analysis.*~~
6.6.4.1.1
The HDB shall be established in accordance with ASTM D2837. The inside test medium for the pipe test specimens shall be water. The outside environment shall be either water or air. Other test media may be used, but the environment shall be maintained within ± 2 °C of the test temperature.
Note: *Weeping-type failures are difficult to detect when the outside environment is water. When oxidation can be involved or weeping-type failures are expected, the external environment should be air.*

~~***6.6.4.1.2***~~
~~*Testing shall be conducted at 23 °C, 60 °C, or 82 °C, as specified in the applicable product Standard of the CSA B137 Series. Where additional test temperatures are used, they should be selected from the recommended test temperatures in ASTM D618.*~~
~~***6.6.4.1.3*** *The average outside diameter and minimum wall thickness of each specimen shall be measured.*~~
~~***6.6.4.1.4***~~
~~*A minimum of 18 stress failure/time points shall be obtained for each selected temperature. The stress values for testing shall be selected to give data points as follows:*~~

~~*Time range, h*~~	~~*Failure points*~~
~~*10 ≤ h < 1000≥*~~	~~*≥ 4*~~
~~*1000 ≤h < 6000*~~	~~*≥ 3*~~

~~h ≥ 6000~~	~~≥ 3~~
~~h ≥ 10 000~~	~~≥ 1~~

~~Note: Useful information can be obtained for some plastics when failure times below 10 h are used. In such circumstances, however, the relative accuracy of the time-to-failure measurements should be maintained.~~

~~**6.6.4.1.5**~~

~~The internal test pressure in each specimen corresponding to the selected stress and time-to-failure shall be measured with sufficient accuracy so that when added together, the tolerance for the timing device and the tolerance for the pressure gauge shall not exceed ± 2%. For each specimen, the test results shall be analyzed by using the logarithm of the stress in MPa and the logarithm of the time-to-failure in hours. The strength at 100 000 h shall be calculated by using the method of least squares. Specimens that have not failed after being under test for more than 10 000 h shall be included as failures at the conclusion of the test only if they increase the value of the extrapolated strength.~~

~~**6.6.4.1.6**~~

~~The suitability of the data for use in calculating the long-term hydrostatic strength of plastic pipe shall be determined as follows:~~

~~(a) The data shall be extrapolated to a log time value of 5.0 and the extrapolated stress value shall be rounded to the nearest 0.07 MPa.~~

~~(b) The lower confidence value of stress at this point shall be calculated. The data shall be considered unsuitable if~~

~~(i) the lower confidence value of stress differs from the extrapolated stress value by more than 15%;~~

~~(ii) the lower confidence value of stress is zero or negative; or~~

~~(iii) b in the equation h = a + bf is positive.~~

~~**6.6.4.1.7**~~

~~The long-term hydrostatic design basis, S, shall be based on the extrapolated stress at 100 000 h as follows:~~

~~Extrapolated 100 000 h stress value ranges, MPa~~	~~Hydrostatic design basis, S, MPa~~
~~5.25–6.55~~	~~5.50~~
~~6.60–8.20~~	~~7.00~~
~~8.25–10.50~~	~~8.60~~
~~10.55–13.15~~	~~11.00~~
~~13.20–16.50~~	~~13.70~~
~~16.55–20.75~~	~~17.20~~
~~20.80–26.35~~	~~22.00~~
~~26.40–33.00~~	~~27.50~~
~~46.95–48.95~~	~~58.75~~

~~**6.6.4.1.8**~~

~~The hydrostatic design basis of PE compounds shall be validated in accordance with Clause 6.6.4.1.9 or 6.6.4.1.10 based on the occurrence of brittle failures during testing as detailed in those clauses.~~

~~**6.6.4.1.9**~~

~~*If no brittle failure occurs before the completion of 10 000 h of testing at 23 °C as specified in Clauses 6.6.4.1.1 through 6.6.4.1.7, the hydrostatic design basis of PE compound determined at 23 °C shall be validated as follows:*~~

~~*(a) a minimum of six specimens shall be tested at the stress level determined by the following table:*~~

~~HDB at 23°C to be validated, MPa~~	~~90 °C test temperature~~		~~80 °C test temperature~~	
	~~Stress, MPa~~	~~Time, h~~	~~Stress, MPa~~	~~Time, h~~
~~3.40~~	~~1.795~~	~~200~~	~~1.585~~	~~70~~
~~4.30~~	~~2.240~~	~~200~~	~~2.000~~	~~70~~
~~5.50~~	~~2.860~~	~~200~~	~~2.515~~	~~70~~
~~7.00~~	~~3.550~~	~~200~~	~~3.170~~	~~70~~
~~8.60~~	~~4.445~~	~~200~~	~~3.965~~	~~70~~
~~11.00~~	~~5.690~~	~~200~~	~~5.070~~	~~70~~

~~*(b) the six specimens shall have a minimum log average time that exceeds the value specified in order to validate the hydrostatic design basis (e.g., in order to validate an hydrostatic design basis of 7.00 MPa at 23 °C, the required time shall be 70 h at 3.17 MPa and 90 °C, or 200 h at 3.55 MPa and 80 °C); and*~~

~~*(c) where a temperature and stress condition in the above table result in the premature ductile failure of a particular PE compound, the stress at that temperature may be lowered by 15%. The corresponding required time for this lowered stress shall be increased to six times the value specified in the table (e.g., when validating a hydrostatic design basis of 11.00 MPa at 23 °C, if testing at 5.69 MPa and 80 °C results in ductile failure, the stress may be lowered to 4.835 MPa and the specimen retested. The required time to validate using this new condition shall be 1200 h. If ductile failures still occur, the stress may be lowered to 4.11 MPa and the corresponding time increased to 7200 h).*~~

~~***6.6.4.1.10***~~

~~*If a brittle failure occurs before the completion of 10 000 h of testing at 23 °C as specified in Clauses 6.6.4.1.1 though 6.6.4.1.7, the method of validation of the hydrostatic design basis in Clause 6.6.4.1.9 shall not be applicable, and a different method shall be used (see Section F.4.2 in PPI TR-3, or Alternate Method, Procedure I of ASTM D2837).*~~

Section 6.7, Impact resistance test for pipe: Revised the impact resistance test for pipe as follows:

6.7.1 Apparatus

The following apparatus, or an equivalent, shall be used:

a) a tup (falling mass) having geometry and mass in accordance with the applicable tup from Figure 5;

~~*b) a flat, level, solid bed with a V groove to support the specimen; and*~~

b) a flat-plate holder consisting of a plate approximately 200 × 300 × 25 mm with a 120° groove to position the pipe specimen. The groove shall be approximately 3 mm in depth for testing pipe up to NPS-12, and approximately 15 mm in depth for testing pipe larger than NPS-12. The edges of the groove shall be rounded to a radius of approximately 1.5 mm

c) a rigid base fastened to a concrete slab, onto which the holder shall be mounted. Means shall be provided to centre the specimen under the guide rail; and

***Note:** A bar or rod placed inside the specimen and retained by a light spring may be employed if difficulty is encountered in holding the specimen in position.*

d) *a guide tube or guide rails, to ensure that the tup impacts the specimen at the top of the vertical diameter.*

Note: *Auxiliary equipment may also be used (e.g., for the tup release or tup elevation).*

6.7.2 Specimens

Each specimen shall be cut from the pipe and numbered in sequence. The cut shall be square and free of large chips or other imperfections. For pipes in sizes NPS-2 and smaller, the length shall be a minimum of 150 mm. For pipes in sizes NPS-~~2-1/2~~ 3 to NPS-6, the length shall be a minimum of 270 mm. For pipes in sizes larger than NPS-6, the length shall be a minimum of 300 mm.

6.7.3 Procedure

6.7.3.1

Specimens shall be tested on a "GO" or "NO GO" basis in accordance with ASTM D2444. ~~The mean impact and standard deviation may be determined in accordance with ASTM D2444.~~ The impact ~~tup mass and the height from which the tup is dropped~~ energy and temperature shall be as specified in the applicable product Standard of the CSA B137 Series. Each specimen shall be struck only once. Within each series of specimens for each particular pipe type and size, the impacts shall be evenly spaced around the circumference of the pipe being tested.

Section 6.11, Resistance to rapid crack propagation (RCP): Added a resistance to rapid crack propagation test as follows:

6.11 Resistance to rapid crack propagation (RCP)

6.11.1

When required by the individual product standard, RCP testing shall be conducted to determine the RCP critical pressure for each compound with a particular pipe wall thickness.

6.11.2

RCP testing shall be conducted using the ISO 13477 (the small-scale steady-state or "S4" test), or the ISO 13478 (the full-scale or "FS" test) test method, at 0 °C to determine the critical pressure, pc, as specified in the applicable product Standard of the CSA B137 Series. Where there is a discrepancy, the results of the ISO 13478 (FS) test method shall take precedence.

Note: For "S4" testing of some materials or products, it may be necessary to demonstrate that there is no "false arrest" in RCP testing at test pressures less than the critical pressure required. Clause 4.2.4.6.3 of CSA B137.4 contains an example of such a consideration.

6.11.3

A compound's resistance to RCP shall be tested using pipe of the heaviest wall thickness for which the compound is intended to be used. Further testing of pipe shall be required only when the wall thickness of the pipe is greater than the wall thickness of the pipe used in the RCP test to determine the RCP critical pressure for the compound that is used to make the pipe. In such cases, the pipe supplier shall provide test data generated in accordance with Clause 6.11.2 for their products.

CSA B137.1 “Polyethylene (PE) pipe, tubing, and fittings for cold-water pressure services”

Section 4.2, Materials: Expanded the materials covered to include a new compound and added additional crack growth testing specific to the new compound PE 4710 PLUS as follows:

4.2.1 Compounds

PE compound used in a single production run shall be from one manufacturer and shall have a pipe material designation code of PE 1404, PE 1704, PE 2606, PE 2708, PE 3608, PE 3708, PE 3710, PE 4608, PE 4708, or PE 4710, or PE 4710 PLUS.

PE 4710 PLUS compounds shall also comply with the requirements of Clause 4.2.6 of this Standard.

4.2.6 Requirements for PE 4710 PLUS compounds

4.2.6.1 Slow crack growth

Resistance to slow crack growth (SCG) for PE 4710 PLUS compounds shall be determined using the PENT test method in accordance with ASTM F1473. The PENT value shall be at least 2000 h.

Section 5.1.3, Pressure rating: Added a 230 Series classification of PE pipe as follows:

5.1.3.1

PE pipe and tubing shall be classified according to a series number that denotes its pressure rating for water at 23 °C, expressed in pounds per square inch, as follows:

Product	Rating
Pipe	Series 50
	Series 60
	Series 75
	Series 80
	Series 100
	Series 125
	Series 160
	Series 200
	Series 230
Tubing	Series 160
	Series 200

Table 1, Hydrostatic design stress for PE compounds: Added a hydrostatic design stress requirement for PE 4710 PLUS used in the manufacture of PE pipe as follows:

Table 1

Hydrostatic design stress for PE compounds

(See Clause 4.2.3.)

Compound	***Design stress, MPa***
PE XX04	*2.76*
PE XX06	*4.34*
PE XX08	*5.52*
PE XX10	*6.89*
PE 4710 PLUS	*7.83*

Table 7, Pressure ratings for PE pipe (with water at 23 °C): Added the pressure rating requirements for 230 Series PE pipe as follows:

Table 7

Pressure ratings for PE pipe (with water at 23 °C)

Series	***Pressure rating, kPa***
50	*345*
60	*415*
75	*515*
80	*550*
100	*690*
125	*860*
160	*1105*
200	*1380*
230	*1587*

Table 8, Minimum required extrapolated 100 000 h stress values for PE compounds: Added hydrostatic design basis requirements for PE 4710 PLUS as follows:

Table 8

Minimum required extrapolated 100 000 h stress values for PE compounds

Material designation codes	**Hydrostatic design basis, MPa (psi)**	**Minimum required extrapolated 100 000 h stress, MPa (psi)**
PE 1404, PE 1704	5.52 (800)	5.24 (760)
PE 2606, PE 2708	8.62 (1250)	8.28 (1200)
PE 3608, PE 3708, PE 3710, PE 4608, PE 4708, PE 4710, *PE 4710 PLUS*	11.03 (1600)	10.55 (1530)

CSA B137.5 “Crosslinked polyethylene (PEX) tubing systems for pressure applications”

Section 4.2, Materials:

Section 4.2.1, Tubing: Removed the allowance to use reworked material for PEX tubing as follows.

4.2.1.2

~~*Clean reworked compound from the tubing manufacturer’s own tubing production may be used by the same manufacturer if blended with the virgin compound from which it originated. In addition to the requirements specified in Clause 6.10, tubing manufactured using reworked compound shall comply with the requirements of this Standard.*~~ *Use of reworked material for PEX tubing is not permitted.*

Section 4.2.2, PEX Material designation code: Added requirements to apply a PEX material designation code as follows:

4.2.2 PEX Material designation code

In accordance with ASTM F876, the PEX tubing material designation code shall consist of the abbreviation for the type of plastic (PEX) followed by four Arabic digits that describe short-term properties in accordance with applicable ASTM standards and as shown in Table 4.

4.2.2.1

The first digit following the abbreviation for the type of plastic is for chlorine resistance tested in accordance with ASTM Test Method F2023.

a) A “0” indicates that the PEX tubing either has not been tested for chlorine resistance or that the PEX tubing does not meet the minimum requirement for chlorine resistance.
b) A “1” indicates the PEX tubing has been tested and meets the ASTM F876 requirement for minimum chlorine resistance at the end use condition of 25% at 60°C and 75% at 23 °C.
c) A “2” is reserved for future application.
d) A “3” indicates that the PEX tubing has been tested and meets the ASTM F876 requirement for minimum chlorine resistance at end use condition of 50% at 60°C and 50% at 23 °C.
e) A “4” is reserved for future application.
f) A “5” indicates that the PEX tubing has been tested and meets the ASTM F876 requirement for minimum chlorine resistance at end use conditions of 100% of the time at 60 °C.

4.2.2.2

The second digit following the abbreviation for the type of plastic is for demonstrated UV resistance of PEX material when tested in accordance with ASTM Test Method F2657 and evaluated in accordance with ASTM F876.

a) A “0” indicates that the PEX tubing either has not been tested for UV resistance or that the PEX tubing does not meet the minimum requirement for UV resistance.
b) A “1” indicates the PEX tubing has been tested and meets the ASTM F876 requirement for minimum UV resistance of 1 month.
c) A “2” indicates the PEX tubing has been tested and meets the ASTM F876 requirement for minimum UV resistance of 3 months.

d) A "3" indicates the PEX tubing has been tested and meets the ASTM F876 requirement for minimum UV resistance of 6 months.

Note: PEX tubing is not intended for use or storage in direct sunlight. UV resistance is intended to protect PEX tubing during installation time. See ASTM F876 Appendix X2 for more information.

4.2.2.3

The last two digits following the abbreviation for the type of plastic are the hydrostatic design stress for water at 23 °C in units of 100 psi with any decimal figures dropped. Where the hydrostatic design stress code contains less than two digits, a zero is used before the number.

Section 4.2.3, Metal components of fittings: Revised the requirements for mechanical fittings to include those made of materials compliant with applicable nationally recognized standards as follows:

~~***4.2.2***~~ ***4.2.3 Metal components of*** ~~***mechanical***~~ ***fittings***

~~***4.2.2.1***~~

Metal components of transition fittings, compression-type fittings, insert-type or ASTM B75M fittings, and other mechanical fittings shall be made of materials as specified in the applicable nationally recognized standard specification.

~~*(a) wrought copper complying with the requirements of ASTM B75, alloys UNS C10200, C10300, C10800, or C12200;*~~

~~*(b) cast copper alloy complying with the requirements of ASTM B584, alloys UNS C84400, C83800, or C89844, or ASTM B62, alloy UNS C83600;*~~

~~*(c) machined brass complying with the requirements of ASTM B16/B16M, alloys UNS C36000, or ASTM B140/B140M, alloy UNS C31400;*~~

~~*(d) forged brass complying with the requirements of ASTM B283, alloy UNS C37700; or*~~

~~*(e) other metals that, when tested as part of an assembly, comply with the corrosion-resistance requirements of Clause 6.1.1 of CAN/CSA-B125.*~~

~~***4.2.2.2***~~

~~*Crimping rings for use with insert-type fittings shall be made of wrought copper alloy, UNS C10200 or C12200, with an allowable hardness of 35 to 45 on the Rockwell 15T scale.*~~

~~***4.2.2.3***~~

~~*Stepless one-ear clamps for use with insert-type fittings shall be made of Type 304 stainless steel. Hardness of such clamps shall be as specified in ASTM A240/A240M.*~~

~~***4.2.4 Toxicity***~~

~~*Components of transition fittings, compression-type fittings, insert-type fittings, and other plastic mechanical fittings shall comply with the applicable toxicity requirements of Clause 4.2.1 of CSA B137.0.*~~

~~*4.2.5 Push-fit fittings*~~

Section 4.2.5, Push-fit fittings: Included requirements for push fit fittings as follows:

4.2.5.1

Connections achieved by push-fit fittings shall comply with ASSE 1061.

4.2.5.2

A tube support liner shall be used with PEX tubing systems, when required by the fitting manufacturer.

4.2.5.3

Push-fit fittings shall not be used with tubing that includes an ethylene vinyl alcohol (EVOH) layer or barrier unless specified by the manufacturer.

Section 5, Detailed requirements: Expanded the requirements for multiple fitting types as follows:

Section 5.1.1, Tubing: Revised the tubing coiling diameter requirement as follows:

5.1.1.5

PEX tubing may be supplied in either straight lengths or coils with a minimum coiling diameter ~~that complies with Table 4~~ based on a tubing bend radius of 10 times the average outside diameter.

Section 5.1.2, Fittings: Expanded the requirements to incorporate additional fittings as follows:

5.1.2 ~~Mechanical and compression type~~ Fittings

5.1.2.1

~~Mechanical and compression type~~ Fittings for use with PEX tubing shall be compatible with tubing complying with the requirements of Tables 2 and 3.

5.1.2.2

Fittings shall comply with the requirements of the applicable reference fitting standard, this Standard and the applicable requirements of CSA B137.0. Reference fitting standards include ASTM F1807, F1865, F1960, F2080, F2098, F2159, and F2735.

5.1.2.3

Fittings without an applicable reference fitting standard and intended for use with PEX tubing shall be tested in accordance with Clause 5.1.7 for qualification with PEX tubing.

~~5.1.2.2~~ 5.1.2.4

Fittings made of plastic shall comply with both the requirements of this Standard and the applicable requirements of CSA B137.0.

Section 5.1.3, Insert-type fittings: Added requirements for insert-type fittings utilizing a reinforcing insert as follows:

5.1.3.1

Insert-type fittings utilize a reinforcing insert which is inserted into the tubing and a ring or clamp which compresses the tubing over the insert. Examples of insert-type fitting reference fitting standards are ASTM F1807, F2159, and F2735.

~~5.1.3.1~~ 5.1.3.2

The dimensions and tolerances of insert-type fittings shall be in compliance with the values of the reference standard when measured in accordance with Clause 6.9 of CSA B137.0.

Section 5.1.4, Transition fittings:

5.1.4.1

Transition fittings to adapt PEX tubing to other materials may utilize threaded, soldered, mechanical compression, or press-connect type joints.

~~5.1.4.1~~ 5.1.4.2

Pipe thread connections shall be in compliance with Clause 5.2 of CSA B137.0.

Section 5.1.5, Crimping rings and clamps: Added requirements for crimp rings and clamps as follows:

5.1.5.1

Crimping rings and clamps are utilized with insert fittings to compress the tubing over the insert. Examples of crimping ring and clamp reference fitting standards are ASTM F1807, F2159, and F2098.

~~5.1.5.1~~5.1.5.2
The dimensions and tolerances of copper crimping rings shall be in compliance with the values specified in ~~*Tables 6 & 7*~~ *ASTM F1807* when measured in accordance with Clause 6.9 of CSA B137.0.

~~5.1.5.1~~5.1.5.3
The dimensions and tolerances of stepless one-ear clamps shall be in compliance with the values specified in ~~*Table 8*~~ *ASTM F2098* when measured in accordance with Clause 6.9 of CSA B137.0.

Section 5.1.6, Cold-expansion fittings: Added requirements for cold-expansion fittings as follows:
5.1.6 Cold-expansion fittings
5.1.6.1
Cold expansion fittings require the expansion of the pipe or tube prior to insertion of the fitting. Examples of cold expansion fitting standards are ASTM F1865, F1960, and F2080.
5.1.6.2
The dimensions and tolerances of cold-expansion fittings shall be in compliance with the values of the reference Standard when measured in accordance with Clause 6.9 of CSA B137.0.
5.1.6.3
Each insert end of a fitting shall have a tubing stop that limits the depth of insertion of the fitting into the tubing.

Section 5.1.7, Fitting qualification: Added fitting qualification requirements as follows:
5.1.7 Fitting qualification
Fittings shall meet the system performance requirements of this Standard (Clauses 5.2.2, 5.3, and 5.9) and the applicable fitting standard, if any, when tested with each specific PEX tubing with which it is intended to be used.

Section 5.3, Thermocycling test: The note referencing Clause A.2.2 was removed as follows:
5.3 Thermocycling test
Tubing and fitting assemblies shall not separate or leak when tested in accordance with Clause 6.6.7 of CSA B137.0.
~~*Note: See Clause A.2.2 for further guidance on the assembly of tubing and fittings.*~~

Section 5.9, Excessive temperature and pressure capability: The note referencing Clause A.2.2 was removed as follows:
5.9 Excessive temperature and pressure capability
Tubing and fitting assemblies shall not separate or leak in less than 48 h when tested in accordance with Clause 6.8.
Note: ~~*(1)*~~ *In the event of a heating system malfunction, PEX tubing should have adequate strength to accommodate short-term conditions of high temperature and pressure (e.g., up to 48 h of 99 °C at 1035 kPa) until repairs can be made.*
~~*(2) See Clause A.2.2 for further guidance on the assembly of tubing and fittings.*~~

Section 6.5, Degree of crosslinking:

6.5.1

Note: *This Clause provides a test method for measuring the average degree of crosslinking over the tubing wall thickness.*

The degree of crosslinking shall be determined as follows:

A piece of PEX tubing shall be placed in a lathe with automatic feeding. A strip consisting of the full wall thickness shall be shaved and shall constitute a test specimen. The strip thickness shall be ~~0.1 mm~~ 0.10 +/– 0.05 mm and shall be obtained by setting the lathe feeding accordingly.

The specimens shall be tested in accordance with ASTM D2765, Method B; however, those requirements relating to test specimen preparation shall not be mandatory.

For the purposes of this Standard, the degree of crosslinking, V, shall be calculated as follows:

V = (100 percent – extract percent)

where

extract percent = the solvent extraction, %, as calculated in accordance with Section 13 of ASTM D2765

6.5.2

The degree of crosslinking shall not vary outside the limits at any part of the tubing. In case of disagreement, strips of the same thickness, ~~0.1 mm~~ 0.10 +/– 0.05 mm, shall be taken in a tangential, axial, or radial direction at any angle section, wall thickness depth, or both.

Former Section 6.10, Additional tests for tubing manufactured using reworked compound: Allowance for use of reworked material was removed from section 4.2.1 as well as the associated additional requirements as follows:

~~*6.10 Additional tests for tubing manufactured using reworked compound*~~

~~*6.10.1 General*~~

~~*PEX tubing manufactured using reworked compound shall be tested at the highest concentration for which it is listed, in accordance with Clauses 6.10.2 to 6.10.4, and shall comply with the same requirements as tubing manufactured from virgin compound containing no reworked compound.*~~

~~*6.10.2 Long-term hydrostatic strength*~~

~~*The long-term hydrostatic strength of tubing manufactured using reworked compound shall be determined at 82 °C, in accordance with 6.6.4 of CSA B137.0, for a minimum of 8760 h.*~~

~~*6.10.3 Temperature and pressure capability*~~

~~*Tubing manufactured using reworked compound shall comply with the excessive temperature and pressure capability requirements specified in Clause 5.9.*~~

~~*6.10.4 Environmental stress cracking*~~

~~*Tubing manufactured using reworked compound shall comply with the environmental stress cracking requirements specified in Clause 5.5.*~~

~~*7 Additional requirements of tubing manufactured using reworked compound*~~

~~*7.1*~~

~~*Tubing manufactured using reworked compound shall be*~~

~~*(a) identified with a mark; and*~~

~~*(b) limited to a single extrusion pass.*~~

~~*7.2*~~

~~*The degree of crosslinking of the reworked compound at the time of incorporation into the tubing shall not exceed that degree of crosslinking for which the tubing was evaluated.*~~

~~*7.3*~~

~~*The maximum concentration of reworked compound shall not exceed that maximum concentration for which the reworked tubing was evaluated.*~~

Section 7, Markings: Added requirements to mark tubing with the PEX designation code and the standard designation of the associated fitting as follows:

~~*8*~~ *7 **Markings***

~~*8*~~ *7.1 **Tubing***

PEX tubing shall be marked in accordance with Clause 7.1 of CSA B137.0, with the following additional requirements:

a) Pipe and tubing for reclaimed water distribution shall be marked as specified in CSA B128.1.

b) Pipe and tubing for ground source geothermal systems shall be marked as specified in the CAN/CSA-C448 Series.

c) PEX tubing material designation code as per Clause 4.2.2.

d) Where applicable, the standard designation(s) of the fitting system(s) for which the tubing is recommended by the tubing manufacturer and that is specifically qualified for use with PEX in accordance with Clause 5.1.7.

~~*8*~~ *7.2 **Fittings***

Fittings, rings, and stepless one-ear clamps shall be permanently and indelibly marked on the exterior surface with at least the following:

a) Marking on fittings shall include manufacturer's name or trademark, or some other identifying mark; and

b) ~~the CSA Standard designation, "CSA B137.5", or the letters "PEX"~~. if size permits, PEX or the standard number, or a combination thereof.

~~*Table 4 Coil dimensions for PEX tubing (See Clause 5.1.1.5).*~~

Table 4 Material designation code cells (See Clause 4.2.2.)

~~*Table 5 Fitting insert dimensions and tolerances (See Clause 5.1.3.1.)*~~

Table 5 Minimum hydrostatic sustained pressure requirements for PEX tubing and fitting assemblies (See Clauses 6.4, 6.7.1, 6.7.2, and 6.9.)

~~*Table 6 Crimping ring dimensions* before crimping (See Clause 5.1.5.1.)*~~

~~*Table 7 Crimping ring dimensions after crimping (See Clauses 5.1.5.1 and A.2.2.4 and Table 6.)*~~

~~*Table 8 Stepless one-ear clamp dimensions (See Clause 5.1.5.2.)*~~

~~*Table 9 Minimum hydrostatic sustained pressure requirements for PEX tubing and fitting assemblies (See Clauses 6.4, 6.7, and 6.9.)*~~

CSA B137.6 “Chlorinated polyvinylchloride (CPVC) pipe, tubing, and fittings for hot- and cold-water distribution systems”

Section 5.3, Fittings: Added requirements for push-fit fittings compliance with ASSE 1061 as follows:
5.3.4 Push-fit fittings
Connections achieved by push-fit fittings shall comply with ASSE 1061.

CSA B137.9 “Polyethylene/aluminum/polyethylene (PE- AL-PE) composite pressure-pipe systems”

There are no changes between the 2013 edition including Updates No. 1, No. 2 and No. 3 dated March 2015, October 2015 and November 2015 and 2017.