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An American National Standard

# Standard Specification for Tracking and Traceability Encoding System of Natural Gas Distribution Components (Pipe, Tubing, Fittings, Valves, and Appurtenances)[1]

This standard is issued under the fixed designation F2897; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

## 1. Scope*

1.1 This specification defines requirements for the data used in the tracking and traceability base-62 encoding system and the format of the resultant code to characterize various components used in fuel gas piping systems.

1.2 The final output of this specification is a 16 digit alpha-numeric code that defines a standardized approach or methodology for encoding certain characteristics of components that have been established based on consensus recommendations from the respective stakeholder group members. The means of marking or affixing the code to the components, and the means of reading and/or transferring the data or codes are outside the scope of this specification.

NOTE 1—To facilitate compliance with this specification, a web based application has been developed to manage and maintain unique manufacturer identification numbers. The URL for the website is: http://www.componentid.org.

1.3 The web based application is only intended to serve as a useful resource for managing the respective manufacturer identification numbers, codes, and other identifiers as per this specification. Any changes to the contents of the web based application are contingent upon subsequent changes to this specification. This specification shall have primacy.

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

2.1 *ASTM Standards:*[2]

A53/A53M Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

A106/A106M Specification for Seamless Carbon Steel Pipe for High-Temperature Service

D1600 Terminology for Abbreviated Terms Relating to Plastics

D2513 Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings

F412 Terminology Relating to Plastic Piping Systems

2.2 *API Standards:*[3]

API 5L Specification for Line Pipe

2.3 *ANSI Standards:*[4]

B31.8 Gas Transmission and Distribution Piping System

B1.20.1 1983 Pipe Threads, General Purpose, Inch

B109.1 Diaphragm-Type Gas Displacement Meters (Under 500 Cubic-feet-per-hour Capacity)

B109.2 Diaphragm-Type Gas Displacement Meters (500 Cubic-feet-per-hour Capacity)

B109.3 Rotary Type Gas Displacement Meters

B109.4 Self-Operated Diaphragm Type Natural Gas Service Regulators

2.4 *CFR Standards:*[5]

49 CFR Part 192 Pipeline Safety Requirements

## 3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminology F412, and abbreviations are in accordance with Terminology D1600, unless otherwise specified.

3.2 The gas industry terminology used in this specification is in accordance with ANSI B31.8 or 49 CFR Part 192, unless otherwise indicated.

3.3 *character, n*—an integer from zero (0) to nine (9) or a letter that is upper case and/or lower case from a to z or A to Z.

[1] This specification is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.60 on Gas.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American Petroleum Institute (API), 1220 L. St., NW, Washington, DC 20005-4070, http://www.api.org.

[4] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[5] Available from U.S. Government Publishing Office (GPO), 732 N. Capitol St., NW, Washington, DC 20401, http://www.gpo.gov..

***A Summary of Changes section appears at the end of this standard**

3.4 *component, n*—pipe, tubing, fittings, valves, and appurtenances unless specifically stated otherwise.

3.5 *digit, n*—an integer from zero (0) to nine (9).

3.6 *FPT, n*—internal taper thread as defined under ANSI/ASME B1.20.1, or commonly referred to as "female pipe thread".

3.7 *MPT, n*—external taper thread as defined under ANSI/ASME B1.20.1, or commonly referred to as "male pipe thread".

3.8 *traceability, n*—identify the origin of materials and parts used to manufacturer a given component; and/or the product processing or manufacturing history.

3.9 *tracking, v*—knowing, documenting, and/or collecting information related to the distribution and location of a given component after delivery from the manufacturer or supplier.

## 4. Gas Distribution Component Traceability Identifier

4.1 *General*—The gas distribution component traceability identifier shall be comprised of sixteen (16) alphanumeric characters that specify respective attributes (data set) for a given component.

4.1.1 The specified number of characters and order for each data set shall conform to Table 1.

4.1.2 The specified number of characters shall be developed using the base-62 encoding system per section 4.9 and the initial input data requirements per Section 5.

4.1.3 The gas distribution component traceability identifier shall be in a format suitable for downloading the character codes into database systems owned and maintained by the end user.

NOTE 2—An illustrative example is provided in Appendix X2.

4.2 *Identification of Component Manufacturer*—Each component manufacturer shall be identified by a unique two character code which shall be assigned after completing the required registration and activated by the webmaster of the website http://www.componentid.org. The manufacturer identification code shall be unique to that particular company and can only be used by that respective manufacturer/supplier.

4.3 *Identification of Component Manufacturer's Lot Code*—The component manufacturer's lot code shall be identified by a four character code that is developed using the base-62 encoding system per 4.9. The four character code shall be unique in a manner to help ascertain information related to the origin of materials, product processing history, and other information that is agreed upon between the manufacturer and end user.

4.4 *Identification of Component Production Date*—The production date code shall be identified by a three character code that is developed using the base-62 encoding system per 4.9.

4.5 *Identification of Component Material*—The primary material used to manufacture the pipe or component shall be identified by a single character code per 5.5.

4.6 *Identification of Component Type*—Each component type shall be identified by a two character code per 5.6.

4.7 *Identification of Component Size*—Each component size shall be identified by a three character code that is developed using the sizing calculation outlined in 5.7 and the base-62 encoding system per 4.9.

4.8 *Identification of Base 62 Index*—Each component type shall be identified by a single character code per 5.1.

4.9 *Base-62 Encoding System:*

4.9.1 The base-62 positional encoding system shall utilize integer values between zero and nine and both uppercase and lowercase alphabet characters with the assigned place values as shown in Table 2.

**TABLE 1 Specified Number of Characters and Order for Gas Distribution Component Traceability Identifier**

| Data | Number of Character(s)[A] |
|---|---|
| Component manufacturer | 2 |
| Component manufacturer's lot code | 4 |
| Component production date | 3 |
| Component material | 1 |
| Component type | 2 |
| Component size | 3 |
| Base 62 Index | 1 |

[A] The total number of characters is based on the final resultant after applying the base-62 encoding system in this specification. For different initial input data, the requirements and format are in Section 5 of this specification.

**TABLE 2 Positional Values for Base-62 Encoding System**

| Positional Value | Character | Positional Value | Character |
|---|---|---|---|
| 0 | 0 | 36 | A |
| 1 | 1 | 37 | B |
| 2 | 2 | 38 | C |
| 3 | 3 | 39 | D |
| 4 | 4 | 40 | E |
| 5 | 5 | 41 | F |
| 6 | 6 | 42 | G |
| 7 | 7 | 43 | H |
| 8 | 8 | 44 | I |
| 9 | 9 | 45 | J |
| 10 | a | 46 | K |
| 11 | b | 47 | L |
| 12 | c | 48 | M |
| 13 | d | 49 | N |
| 14 | e | 50 | O |
| 15 | f | 51 | P |
| 16 | g | 52 | Q |
| 17 | h | 53 | R |
| 18 | i | 54 | S |
| 19 | j | 55 | T |
| 20 | k | 56 | U |
| 21 | l | 57 | V |
| 22 | m | 58 | W |
| 23 | n | 59 | X |
| 24 | o | 60 | Y |
| 25 | p | 61 | Z |
| 26 | q | | |
| 27 | r | | |
| 28 | s | | |
| 29 | t | | |
| 30 | u | | |
| 31 | v | | |
| 32 | w | | |
| 33 | x | | |
| 34 | y | | |
| 35 | z | | |

4.9.2 The assigned place values shown in Table 2 shall be used to convert the initial input data into the final alphanumeric code.

NOTE 3—Detailed examples of converting an initial integer string to a corresponding base-62 alphanumeric character string and vice-versa can be found in Appendix X1.

NOTE 4—The positional value is the value corresponding to the respective character. For example, the positional value corresponding to the character "r" is 27. The positional value corresponding to the character "T" is 55.

## 5. Input Data String

5.1 *Base 62 Index*—Each component manufacturer shall determine and establish a single character base 62 index code per Table 3 based on their specific component physical properties.

5.1.1 Unless otherwise specified, the sixteenth character shall be a null value of "0".

NOTE 5—The base 62 index is a reference value that allows for alternative alphanumeric identifiers. The Annex A1 has been added to allow component manufacturers with additional coefficients corresponding to thicker wall sizes that are not listed in the main body of this specification.

5.2 *Component Manufacturer*—Each component manufacturer shall establish a unique two (2) digit identifier by completing the required registration and activated by the webmaster of the website http://www.componentid.org. The manufacturer identification code shall be unique to that particular company and can only be used by that company. In cases where the company undergoes a change in name, acquired, merged with another company, new two (2) digit identifier must be registered and activated if the "acquiring" or "merged with" company does not already have a registered identifier.

5.3 *Component Manufacturer's Lot Code*—Each component manufacturer shall establish a unique seven (7) digit number for their lot code which shall be used as the input into the base-62 encoding system per 4.9. The 7 digit number shall consist of only integer values and cannot contain any other characters such as alphabetic or ASCII characters.

NOTE 6—The 7 digit code can be developed freely by the manufacturer to define individual production lots in a unique way. Elements of the 7 digit code may possibly include production site, extrusion line, injection molding equipment number, operator, shift, etc. The 7 digit code should be capable of providing pertinent traceability information upon request.

5.4 *Component Production Date*—Each component manufacturer shall provide the production date of the respective component consisting of five (5) digits as input into the base-62 encoding system per 4.9.

5.4.1 The first three digits shall correspond to the particular day of the year.

5.4.2 The final two digits shall correspond to the last two digits of the year.

**TABLE 3 List of base 62 Index Values**

| Type | Code |
|---|---|
| Default | 0 |
| Annex A1 | 1 |

NOTE 7—For example, the date input represented by 23410 implies the 234th day of 2010.

5.5 *Component Material*—Each component manufacturer shall assign a single character code for the primary material used to manufacture the respective component from Table 4.

NOTE 8—Additional material code numbers are reserved for future use and will be activated upon revision of this specification.

NOTE 9—The "Grade" designation for steel materials will vary based on the standard to which it is manufactured. The user should verify the chemical and mechanical properties in accordance to the specific standard that they are utilizing before making their final selection.

5.5.1 For pipe and tubing made from a single material, the code shall be assigned from the list shown in Table 4.

5.5.2 For multi-layer pipe and tubing, the inner most layer which is in contact with the natural gas shall be assigned from the list shown in Table 4.

5.5.3 For factory assembled transition fittings and risers and transition tees intended to facilitate a change between metallic and non-metallic piping systems, the non-metallic portion shall be identified.

5.5.4 For all components other than factory assembled transition fittings and risers and transition tees, the material code shall correspond to the outer shell or body of the respective component regardless of the piping system to which it is intended to be installed.

5.5.5 For fittings intended to facilitate a change between PE to another thermoplastic piping systems, the material code

**TABLE 4 List of Material Types**

| Type | Code |
|---|---|
| PE2406 | A |
| PE2708 | B |
| PE2708 PLUS | d |
| PE3408 | C |
| PE3608 | D |
| PE3708 | E |
| PE3710 | F |
| PE4608 | G |
| PE4710 | H |
| PE4710 PLUS | e |
| PE80 | W |
| PE100 | Z |
| Poly (Vinyl Chloride) – PVC | J |
| Polyamide 11 – PA11 | K |
| Polyamide 12 – PA12 | L |
| PEX | Y |
| Steel | M |
| Stainless Steel | N |
| Cast Iron | O |
| Copper | P |
| Brass | Q |
| Malleable Iron | R |
| Ductile Iron | S |
| Reinforced Epoxy Resin | T |
| Nylon | U |
| Glass Filled Nylon | V |
| Other | X |
| Steel – GRADE A | 0 |
| Steel – GRADE B | 1 |
| Steel – GRADE C | 2 |
| Steel – GRADE X42 | 3 |
| Steel – GRADE X46 | 4 |
| Steel – GRADE X52 | 5 |
| Steel – GRADE X56 | 6 |
| Steel – GRADE X60 | 7 |
| Steel – GRADE X65 | 8 |
| Steel – GRADE X70 | 9 |

shall correspond to the outer shell or body of the respective component connecting to the PE pipe.

NOTE 10—In previous editions of Specification D2513 various thermoplastic materials were approved for use under 49 CFR Part 192 requirements. For those other materials which have subsequently deleted but still allowed to be used for repair purposes only, for example. PVC, then PE will take precedence.

5.6 *Component Type*—Each component manufacturer shall assign a two (2) character code for their respective component type from Table 5.

NOTE 11—Additional component type code numbers are reserved for future use and will be activated upon revision of this specification.

5.7 *Component Size*—Each component manufacturer shall develop a unique dimensional code, $D$, corresponding to the size of the respective item. The dimensional code shall be used as input into the base-62 encoding system per 4.9.

5.7.1 The dimensional code shall be calculated using Eq 1 based on the factors from Tables 6-8 corresponding to the dimensions for a given component:

$$D = (C_1 * 378) + C_2 + 1 \quad (1)$$

where:

$C_1$ = factor corresponding to the first dimension, $D_1$, and
$C_2$ = factor corresponding to the second dimension, $D_2$.

5.7.1.1 The second dimension, $D_2$, shall always be the larger dimension for a given component as shown in Eq 2:

$$D_2 > D_1 \quad (2)$$

5.7.2 Only for the case of a pipe, tubing, or other components where either $C_1$ or $C_2$ cannot be ascertained from Table 5-7 corresponding to the dimensions of a given component, then the dimensional code, $D$, shall be set equal to 0 and the resultant base62 dimensional code shall be set equal to 000

5.7.3 For the case of a pipe, tubing, or other in-line components where there is no dimensional change, then $D_1 = D_2$ and $C_1 = C_2$.

5.7.4 For components other than various risers and transition fittings or other using metallic parts, the second dimension, $D_2$, shall be expressed by the connection to the main.

5.7.5 In the case of various types of risers and transition fittings or others using metallic parts, the second dimension, $D_2$, shall be expressed by the metallic size, for example, MPT or FPT.

NOTE 12—For the case of a 2" IPS SDR9.33 pipe, $D_1 = D_2$ and $C_1 = C_2 = 37$. Then from Eq 1, the resulting value for $D = (37*378)+37+1 = 14024$.

NOTE 13—For the case of a 2" IPS SDR9.33 × ½ " CTS 0.090 saddle fitting (electrofusion, molded saddle fusion, mechanical), $D_2$ = 2" IPS with $C_2 = 37$; $D_1$ = ½ " CTS 0.090 with $C_1 = 4$. Then from Eq 1, the resulting value for $D = (4 * 378) + 37 + 1 = 1550$.

## 6. Keywords

6.1 base-62 encoding system; component; gas distribution; marking; pipe; traceability; tracking

**TABLE 5 List of Component Types**

| Category Type-General | Subcategory Type | Character |
|---|---|---|
| Pipe | Other | 10 |
| | Straight | 11 |
| | Coiled | 12 |
| | Casing | 13 |
| | Seamless Line Pipe, API 5L, PSL1, Single Coat | 1A |
| | Seamless Line Pipe, API 5L, PSL1, Dual Coat | 1B |
| | Seamless Line Pipe, API 5L, PSL2, Single Coat | 1C |
| | Seamless Line Pipe, API 5L, PSL2, Dual Coat | 1D |
| | Electric Resistance Weld, API 5L, PSL1, Single Coat | 1E |
| | Electric Resistance Weld, API 5L, PSL1, Dual Coat | 1F |
| | Electric Resistance Weld, API 5L, PSL2, Single Coat | 1G |
| | Electric Resistance Weld, API5L, PSL2, Dual Coat | 1H |
| | Seamless and Welded, ASTM A53/A53M | 1J |
| | Seamless Carbon Steel, ASTM A106/A106M | 1K |
| | High Frequency Weld, API 5L, PSL2, Single Coat | 1L |
| | High Frequency Weld, API 5L, PSL2, Dual Coat | 1M |
| Coupling | Other | 20 |
| | Socket fusion | 21 |
| | Socket fusion with EFV | 22 |
| | Electrofusion | 23 |
| | Electrofusion with EFV | 24 |
| | Mechanical compression or nut follower | 25 |
| | Mechanical compression or nut follower with EFV | 26 |
| | Mechanical stab | 27 |
| | Mechanical stab with EFV | 28 |
| | Mechanical interference fit | 29 |
| | Mechanical interference fit with EFV | 2A |
| | Welded | 2B |
| | Threaded | 2C |
| | Flanged | 2D |
| Adapter Coupling | Other | 30 |
| | Compression by male pipe thread | 31 |
| | Compression by female pipe thread | 32 |
| | Compression by butt fusion | 33 |
| | Compression by butt welded | 34 |
| | Compression by solvent welded | 35 |
| | Compression by stab | 39 |
| | Stab by male pipe thread | 36 |
| | Stab by female pipe thread | 37 |
| | Stab by solvent welded | 38 |
| End caps | Other | 40 |
| | Butt fusion | 41 |
| | Socket fusion | 42 |
| | Electrofusion | 43 |
| | Mechanical compression or nut follower | 44 |
| | Mechanical stab | 45 |
| | Mechanical interference fit | 46 |
| | Welded | 47 |
| | Threaded | 48 |
| | Fabricated | 49 |
| Elbows | Other | 50 |
| | Butt fusion 90 | 51 |
| | Socket fusion 90 | 52 |
| | Electrofusion 90 | 53 |
| | Mechanical compression or nut follower 90 | 54 |
| | Mechanical stab 90 | 55 |
| | Mechanical interference fit 90 | 56 |
| | Welded 90 | 57 |
| | Threaded 90 | 58 |
| | Fabricated 90 | 59 |
| | Butt fusion 45 | 5A |
| | Socket fusion 45 | 5B |
| | Electrofusion 45 | 5C |
| | Mechanical compression or nut follower 45 | 5D |
| | Mechanical stab 45 | 5E |
| | Mechanical interference fit 45 | 5F |
| | Welded 45 | 5G |
| | Threaded 45 | 5H |
| | Fabricated 45 | 5J |
| 3-way tees | Other | 60 |
| | Butt fusion | 61 |
| | Socket fusion | 62 |
| | Electrofusion | 63 |
| | Mechanical compression or nut follower | 64 |
| | Mechanical stab | 65 |

**TABLE 5** *Continued*

| Category Type-General | Subcategory Type | Character |
|---|---|---|
| | Mechanical interference fit | 66 |
| | Welded | 67 |
| | Threaded | 68 |
| | Fabricated | 69 |
| Reducer | Other | 70 |
| | Butt fusion | 71 |
| | Socket fusion | 72 |
| | Electrofusion | 73 |
| | Mechanical compression or nut follower | 74 |
| | Mechanical stab | 75 |
| | Mechanical interference fit | 76 |
| | Butt Fusion with EFV | 7A |
| | Socket Fusion with EFV | 7B |
| | Electrofusion with EFV | 7C |
| | Mechanical compression or nut follower with EFV | 7D |
| | Mechanical Stab with EFV | 7E |
| | Mechanical interference fit with EFV | 7F |
| | Welded | 77 |
| | Threaded | 78 |
| | Fabricated | 79 |
| Tapping tees | Other | 80 |
| | Saddle heat fusion by butt fusion outlet | 81 |
| | Saddle heat fusion by butt fusion outlet with EFV | 82 |
| | Saddle heat fusion by socket outlet | 83 |
| | Saddle heat fusion by socket outlet with EFV | 84 |
| | Saddle heat fusion by mechanical compression outlet | 85 |
| | Saddle heat fusion by mechanical compression outlet with EFV | 86 |
| | Saddle heat fusion by stab outlet | 87 |
| | Saddle heat fusion by stab outlet with EFV | 88 |
| | Electrofusion by butt fusion outlet | 89 |
| | Electrofusion by butt fusion outlet with EFV | 8A |
| | Electrofusion by socket outlet | 8B |
| | Electrofusion by socket outlet with EFV | 8C |
| | Electrofusion by mechanical compression outlet | 8D |
| | Electrofusion by mechanical compression outlet with EFV | 8E |
| | Electrofusion by stab outlet | 8F |
| | Electrofusion by stab outlet with EFV | 8G |
| | Mechanical by butt fusion outlet | 8H |
| | Mechanical by butt fusion outlet with EFV | 8J |
| | Mechanical by socket outlet | 8K |
| | Mechanical by socket outlet with EFV | 8L |
| | Mechanical by mechanical compression outlet | 8M |
| | Mechanical by mechanical compression outlet with EFV | 8N |
| | Mechanical by stab outlet | 8P |
| | Mechanical by stab outlet with EFV | 8Q |
| | Mechanical by mechanical interference fit | 8R |
| | Mechanical by mechanical interference fit with EFV | 8S |
| High Volume Tapping Tees | Other | 90 |
| | Electrofusion by butt fusion | 91 |
| | Saddle heat fusion by butt fusion | 92 |
| | Mechanical by compression outlet | 93 |
| | Electrofusion by socket outlet | 94 |
| | Saddle heat fusion by socket outlet | 95 |
| | Mechanical by stab outlet | 96 |
| | Mechanical by mechanical interference fit | 97 |
| Branch Saddle | Other | B0 |
| | Electrofusion | B1 |
| | Saddle heat fusion | B2 |
| | Mechanical | B3 |
| Mechanical saddle | No outlet | S1 |
| Service tee or Valve tee | Other | D0 |
| | Welded by welded | D1 |
| | Welded by butt fusion | D2 |
| | Welded by thread | D3 |
| | Welded by compression or nut follower | D4 |
| | Welded by mechanical interference fit | D5 |
| | Welded by stab | DD |
| | Thread by welded | D6 |
| | Thread by compression or nut follower | D7 |
| | Thread by mechanical interference fit | DE |
| | Thread by stab | DF |
| | Thread by thread | DG |
| | Thread by butt fusion | DH |
| | Mechanical saddle by welded | D8 |
| | Mechanical saddle by Butt fusion | D9 |

**TABLE 5** *Continued*

| Category Type-General | Subcategory Type | Character |
|---|---|---|
| | Mechanical saddle by thread | DA |
| | Mechanical saddle by compression or nut follower | DB |
| | Mechanical saddle by mechanical interference fit | DC |
| | Mechanical saddle by stab | DJ |
| Service saddles | Other | E0 |
| | Single strap | E1 |
| | Double strap | E2 |
| Flanges | Other | FH |
| | Blind | FB |
| | Lap-Joint | FL |
| | Socket Weld | FX |
| | Slip-On | FS |
| | Threaded | FT |
| | Weld-Neck | FW |
| | PE Flange Adapter Assembly | FP |
| Transition Fitting | Other | T0 |
| | Welded end | T1 |
| | Thread end | T2 |
| | Flanged end | T3 |
| | Socket weld by butt fusion | TX |
| Riser | Other | R0 |
| | Factory Assembled, Anodeless | R1 |
| | Factory Assembled, Anodeless, Flexible | R2 |
| | Factory Assembled, Non-Anodeless | R3 |
| | Field Assembled. Anodeless | R4 |
| | Field Assembled, Anodeless, Flexible | R5 |
| | Field Assembled, Non-Anodeless | R6 |
| Valve | Other | V0 |
| | Ball valve | V1 |
| | Butterfly valve | V2 |
| | Check valve | V3 |
| | Relief valve | V4 |
| | Gate valve | V5 |
| | Needle valve | V6 |
| | Plug valve | V7 |
| Excess Flow Valve | Excess flow valve | EF |
| Meter set assembly and components | Other | M0 |
| | Diaphragm meter | M1 |
| | Rotary meter | M2 |
| | Meter set assembly | M3 |
| | Meter bar | M4 |
| | Meter swivel | M5 |
| | Meter nut | M6 |
| | Ultrasonic meter | M7 |
| | Turbine meter | M8 |
| | Remote shut off meter | M9 |
| Regulator | Other | RX |
| | Pilot | RP |
| | Service | RS |
| | Relief | RR |
| Filter | Other | F0 |
| | Pilot | F1 |
| | Service and mains | F2 |
| | Strainer | F3 |
| Anode | Other | A0 |
| | Cast iron | A1 |
| | Graphite | A2 |
| | Magnesium | A3 |
| | Zinc | A4 |
| Pressure control fitting | Other | P0 |
| | Split repair | P1 |
| | Bottom out | P2 |
| | Top tap | P3 |
| Union | Non-insulated | U1 |
| | Insulated | UX |
| | Other | C0 |
| Repair clamp | Repair clamps | C1 |

**TABLE 6 $C_1$ and $C_2$ Factors Corresponding to Standard Dimensions ($D_1$ or $D_2$) for CTS and IPS Sizes, in. (mm)**

| $D_1$ or $D_2$ | | | Factor $C_1$ or $C_2$ | $D_1$ or $D_2$ | | | Factor $C_1$ or $C_2$ |
|---|---|---|---|---|---|---|---|
| Diameter | SDR | Wall Thickness in. (mm) | | Diameter | SDR | Wall Thickness in. (mm) | |
| ¼ in. CTS | — | 0.062 (1.58) | 1 | 2 in. IPS | 9.33 | 0.255 (6.48) | 37 |
| ⅜ in. CTS | — | 0.062 (1.58) | 2 | 2 in. IPS | 11 | 0.216 (5.49) | 38 |
| ½ in. CTS | — | 0.062 (1.58) | 3 | 2 in. IPS | 13.5 | 0.176 (4.47) | 39 |
| ½ in. CTS | — | 0.090 (2.27) | 4 | 3 in. IPS | 11 | 0.318 (8.08) | 40 |
| ½ in. CTS | — | 0.104 (2.64) | 5 | 3 in. IPS | 11.5 | 0.304 (7.72) | 41 |
| ¾ in. CTS | — | 0.062 (1.58) | 6 | 3 in. IPS | 13.5 | 0.259 (6.58) | 42 |
| ¾ in. CTS | — | 0.077 (1.95) | 7 | 4 in. IPS | 9.33 | 0.482 (12.24) | 43 |
| ¾ in. CTS | — | 0.090 (2.27) | 8 | 4 in. IPS | 11 | 0.409 (10.39) | 44 |
| 1 in. CTS | — | 0.062 (1.58) | 9 | 4 in. IPS | 11.5 | 0.391 (9.93) | 45 |
| 1 in. CTS | — | 0.090 (2.27) | 10 | 4 in. IPS | 13.5 | 0.333 (8.46) | 46 |
| 1 in. CTS | — | 0.099 (2.51) | 11 | 4 in. IPS | 15.5 | 0.290 (7.37) | 47 |
| 1 in. CTS | — | 0.101 (2.56) | 12 | 4 in. IPS | 17 | 0.265 (6.73) | 48 |
| 1 in. CTS | — | 0.121 (3.07) | 13 | 6 in. IPS | 11 | 0.602 (15.29) | 49 |
| 1¼ in. CTS | — | 0.062 (1.58) | 14 | 6 in. IPS | 11.5 | 0.576 (14.63) | 50 |
| 1¼ in. CTS | — | 0.090 (2.27) | 15 | 6 in. IPS | 13.5 | 0.491 (12.47) | 51 |
| 1¼ in. CTS | — | 0.121 (3.07) | 16 | 6 in. IPS | 17 | 0.390 (9.91) | 52 |
| 1¾ in. CTS | — | 0.062 (1.58) | 17 | 6 in. IPS | 21 | 0.315 (8.00) | 53 |
| ½ in. IPS | 9.3 | 0.090 (2.29) | 18 | 8 in. IPS | 11 | 0.784 (19.91) | 54 |
| ½ in. IPS | 11 | 0.076 (1.93) | 19 | 8 in. IPS | 11.5 | 0.750 (19.05) | 55 |
| ¾ in. IPS | 11 | 0.095 (2.41) | 20 | 8 in. IPS | 13.5 | 0.639 (16.23) | 56 |
| ¾ in. IPS | D | 0.090 (2.29) | 21 | 8 in. IPS | 17 | 0.507 (12.90) | 57 |
| 1 in. IPS | 9.33 | 0.140 (3.56) | 22 | 8 in. IPS | 21 | 0.411 (10.44) | 58 |
| 1 in. IPS | 9.9 | 0.133 (3.38) | 23 | 10 in. IPS | 11 | 0.977 (24.82) | 59 |
| 1 in. IPS | 11 | 0.120 (3.05) | 24 | 10 in. IPS | 11.5 | 0.935 (23.75) | 60 |
| 1 in. IPS | 13.5 | 0.097 (2.46) | 25 | 10 in. IPS | 13.5 | 0.796 (20.22) | 61 |
| 1 in. IPS | D | 0.090 (2.29) | 26 | 10 in. IPS | 17 | 0.632 (16.05) | 62 |
| 1¼ in. IPS | 9.33 | 0.178 (4.52) | 27 | 10 in. IPS | 21 | 0.512 (13.00) | 63 |
| 1¼ in. IPS | 10 | 0.166 (4.22) | 28 | 12 in. IPS | 11 | 1.159 (29.44) | 64 |
| 1¼ in. IPS | 11 | 0.151 (3.84) | 29 | 12 in. IPS | 11.5 | 1.109 (28.17) | 65 |
| 1¼ in. IPS | 13.5 | 0.123 (3.12) | 30 | 12 in. IPS | 13.5 | 0.944 (23.98) | 66 |
| 1¼ in. IPS | 17 | 0.098 (2.49) | 31 | 12 in. IPS | 17 | 0.750 (19.05) | 67 |
| 1¼ in. IPS | D | 0.090 (2.29) | 32 | 12 in. IPS | 21 | 0.607 (15.42) | 68 |
| 1½ in. IPS | 11 | 0.173 (4.39) | 33 | 14 in. IPS | 11 | 1.273 (32.33) | 69 |
| 1½ in. IPS | 13.5 | 0.141 (3.58) | 34 | 14 in. IPS | 13.5 | 1.037 (26.34) | 70 |
| 1½ in. IPS | 17 | 0.112 (2.85) | 35 | 14 in. IPS | 17 | 0.824 (20.93) | 71 |
| 1½ in. IPS | D | 0.090 (2.29) | 36 | 14 in. IPS | 21 | 0.667 (16.94) | 72 |
| | | | | 16 in. IPS | 11 | 1.455 (36.96) | 73 |
| | | | | 16 in. IPS | 13.5 | 1.185 (30.10) | 74 |
| | | | | 16 in. IPS | 17 | 0.941 (23.90) | 75 |
| | | | | 16 in. IPS | 21 | 0.762 (19.35) | 76 |
| | | | | 18 in. IPS | 11 | 1.636 (41.55) | 77 |
| | | | | 18 in. IPS | 13.5 | 1.333 (33.86) | 78 |
| | | | | 18 in. IPS | 17 | 1.059 (26.90) | 79 |
| | | | | 18 in. IPS | 21 | 0.857 (21.77) | 80 |
| | | | | 20 in. IPS | 11 | 1.818 (46.18) | 81 |
| | | | | 20 in. IPS | 13.5 | 1.481 (37.62) | 82 |
| | | | | 20 in. IPS | 17 | 1.176 (29.87) | 83 |
| | | | | 20 in. IPS | 21 | 0.952 (24.18) | 84 |
| | | | | 22 in. IPS | 11 | 2.000 (50.8) | 85 |
| | | | | 22 in. IPS | 13.5 | 1.630 (41.40) | 86 |
| | | | | 22 in. IPS | 17 | 1.294 (32.87) | 87 |
| | | | | 22 in. IPS | 21 | 1.048 (26.62) | 88 |
| | | | | 24 in. IPS | 11 | 2.182 (55.43) | 89 |
| | | | | 24 in. IPS | 13.5 | 1.778 (45.16) | 90 |
| | | | | 24 in. IPS | 17 | 1.412 (35.86) | 91 |
| | | | | 24 in. IPS | 21 | 1.143 (29.03) | 92 |

**TABLE 7 $C_1$ and $C_2$ Factors Corresponding to Dimensions ($D_1$ or $D_2$) for MPT and FPT Sizes**

| $D_1$ or $D_2$ | Factor $C_1$ or $C_2$ | $D_1$ or $D_2$ | Factor $C_1$ or $C_2$ |
|---|---|---|---|
| ½ in. MPT | 101 | ½ in. FPT | 121 |
| ¾ in. MPT | 102 | ¾ in. FPT | 122 |
| 1 in. MPT | 103 | 1 in. FPT | 123 |
| 1¼ in. MPT | 104 | 1¼ in. FPT | 124 |
| 1½ in. MPT | 105 | 1½ in. FPT | 125 |
| 2 in. MPT | 106 | 2 in. FPT | 126 |
| 3 in. MPT | 107 | 3 in. FPT | 127 |
| 4 in. MPT | 108 | 4 in. FPT | 128 |
| 6 in. MPT | 109 | 6 in. FPT | 129 |
| 8 in. MPT | 110 | 8 in. FPT | 130 |
| 10 in. MPT | 111 | 10 in. FPT | 131 |
| 12 in. MPT | 112 | 12 in. FPT | 132 |

**TABLE 8 C1 and C2 Factors Corresponding to Dimensions (D1 or D2) for Steel NPS Sizes**

| NPS Designator | Specified Wall Thickness, in. (mm) | Factor $C_1$ or $C_2$ |
|---|---|---|
| ⅛ in. | 0.068 (1.73) | 151 |
| | 0.095 (2.41) | 152 |
| ¼ in. | 0.088 (2.24) | 153 |
| | 0.119 (3.02) | 154 |
| ⅜ in. | 0.091 (2.31) | 155 |
| | 0.126 (3.20) | 156 |
| ½ in. | 0.109 (2.77) | 157 |
| | 0.147 (3.73) | 158 |
| ¾ in. | 0.113 (2.87) | 159 |
| | 0.154 (3.91) | 160 |
| 1 in. | 0.133 (2.87) | 161 |
| | 0.179 (4.55) | 162 |
| 1¼ in. | 0.140 (3.56) | 163 |
| | 0.191 (4.85) | 164 |
| 1½ in. | 0.145 (3.68) | 165 |
| 2 in. | 0.154 (3.91) | 167 |
| | 0.218 (5.54) | 168 |
| 3 | 0.188 (4.78) | 169 |
| | 0.216 (5.49) | 170 |
| 4 | 0.156 (3.91) | 171 |
| | 0.188 (4.78) | 172 |
| | 0.237 (6.02) | 173 |
| 6 | 0.188 (4.78) | 175 |
| | 0.219 (5.56) | 176 |
| | 0.250 (6.35) | 177 |
| | 0.280 (7.11) | 178 |
| 8 | 0.188 (4.78) | 181 |
| | 0.219 (5.56) | 182 |
| | 0.250 (6.35) | 183 |
| | 0.322 (8.18) | 184 |
| 10 | 0.188 (4.78) | 187 |
| | 0.203 (5.16) | 188 |
| | 0.219 (5.56) | 189 |
| | 0.279 (7.09) | 190 |
| | 0.365 (9.27) | 191 |
| 12 | 0.219 (5.56) | 193 |
| | 0.250 (6.35) | 194 |
| | 0.312 (7.92) | 195 |
| | 0.375 (9.52) | 196 |
| 14 | 0.209 (5.30) | 197 |
| | 0.250 (6.35) | 198 |
| | 0.375 (9.53) | 199 |
| | 0.625 (15.88) | 200 |
| | 0.687 (17.45) | 201 |
| | 0.938 (23.83) | 202 |
| 15 | 0.209 (5.30) | 203 |
| | 0.250 (6.35) | 204 |
| 16 | 0.188 (4.78) | 205 |
| | 0.219 (5.56) | 206 |
| | 0.225 (5.72) | 207 |
| | 0.243 (6.17) | 208 |
| | 0.250 (6.35) | 209 |
| | 0.260 (6.60) | 210 |
| | 0.270 (6.86) | 211 |
| | 0.280 (7.11) | 212 |
| | 0.312 (7.93) | 213 |
| | 0.325 (8.26) | 214 |