Designation: F 492 – 95

An American National Standard

Standard Specification for Propylene and Polypropylene (PP) Plastic-Lined Ferrous Metal Pipe and Fittings[1]

This standard is issued under the fixed designation F 492; 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 covers factory-made propylene and polypropylene (PP) plastic-lined ferrous metal pipe and fittings, primarily intended for conveying corrosive liquids and gases. Requirements for materials, workmanship, dimensions, design, construction, working pressures and temperatures, test methods, and markings are included.

NOTE 1—In this specification, propylene plastics cover those materials defined as both polypropylene plastics and propylene plastics in Definitions D 883. Both materials are identified as "PP" on the product. Note that this is at variance with Abbreviations D 1600, where PP is the abbreviation for polypropylene.

NOTE 2—This specification does not include products *coated* with PP nor does it define the suitability of PP-lined components in chemical environments.

1.2 The ferrous piping products shall meet the requirements of the relevant specifications listed in 1.2.1. Nominal sizes from ½ through 12 in. in Class 125, 150, and 300-psi are covered.

NOTE 3—The PP sealing faces may prevent achievement of the full pressure rating of the ferrous housings. For pressure limitations, the manufacturer should be consulted.

NOTE 4—Flanged fittings are not available in sizes ½ and ¾.

1.2.1 *For Ferrous Pipe*:

Title of Specification	ASTM Designation
Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless (Types E and S)	A 53
Seamless Carbon Steel Pipe for High-Temperature Service	A 106
Electric-Resistance Welded Steel Pipe	A 135
Electric-Welded Low-Carbon Steel Pipe for the Chemical Industry	A 587
Seamless and Welded Austenitic Stainless Steel Pipe	A 312
Electric-Resistance Welded Carbon and Alloy Steel Mechanical Tubing	A 513

1.2.2 *For Ferrous Flanges*:

Title of Specification	ASTM Designation
Gray Iron Castings	A 48
Forgings, Carbon Steel, for Piping Components	A 105
Gray Iron Castings for Valves, Flanges, and Pipe Fittings	A 126

Title of Specification	ASTM Designation
Forgings, Carbon Steel, for General-Purpose Piping	A 181
Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service	A 182
Carbon-Steel Castings Suitable for Fusion Welding for High-Temperature Service (Grade WCB).	A 216
Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650°F (345°C)	A 278
Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures (60-40-18)	A 395
Ductile Iron Castings (60-40-18, 65-45-12, 80-55-06)	A 536

1.2.3 *For Ferrous Fittings*:

Title of Specification	ASTM Designation
Gray Iron Castings	A 48
Forgings, Carbon Steel, for Piping Components	A 105
Gray Iron Castings for Valves, Flanges, and Pipe Fittings	A 126
Forgings, Carbon Steel, for General-Purpose Piping	A 181
Carbon Steel Castings Suitable for Fusion Welding for High-Temperature Service (Grade WCB)	A 216
Piping Fittings of Wrought Carbon Steel and Alloy for Moderate and Elevated Temperatures Steel Welding Fittings	A 234
Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650°F (345°C)	A 278
Austenitic Steel Castings for High-Temperature Service	A 351
Alloy Steel Castings Specially Heat-Treated for Pressure-Containing Parts Suitable for High-Temperature Service	A 389
Ductile Iron Castings (60-40-18, 64-45-12, 80-55-06)	A 536
Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures (60-40-18)	A 395
Wrought Austenitic Stainless Steel Piping Fittings	A 403

1.3 The PP-lined flanged pipe and fitting assemblies are limited to use from −18 to 107°C (0 to 225°F). For use below −18°C (0°F) consult the manufacturer. Use in specific aggressive environments may alter the above temperature range. The operating temperature limits shall be established by mutual agreement between the purchaser and the seller.

1.4 The values stated in inch-pound units are to be regarded as the standard.

2. Referenced Documents

2.1 *ASTM Standards:*

D 1238 Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer[2]

[1] This specification is under the jurisdiction of ASTM Committee F-17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.11 on Composite.

Current edition approved Sept. 10, 1995. Published November 1995. Originally published as F 492 – 77. Last previous edition F 492 – 93a.

[2] *Annual Book of ASTM Standards*, Vol 08.01.

D 1600 Terminology for Abbreviated Terms Relating to Plastics[2]
D 2146 Specification for Propylene Plastic Molding and Extrusion Materials[3]
F 412 Terminology Relating to Plastic Piping Systems[4]
2.2 *ANSI Standards:*
B 16.1 Cast Iron Pipe Flanges and Flanged Fittings[5]
B 16.5 Steel Pipe Flanges and Flanged Fittings[5]
B 16.42 Fittings, Flanges and Valves[5]
2.3 *Federal Standard:*
Fed. Std. No. 123 Marking for Shipment (Civil Agencies)[6]
2.4 *Military Standard:*
MIL-STD-129 Marking for Shipment and Storage[6]

3. Terminology

3.1 Definitions—Definitions are in accordance with Terminology F 412, and abbreviations are in accordance with Terminology D 1600, unless otherwise indicated.

4. Materials

4.1 *Lining*:

4.1.1 *Material*—The lining shall be made from PP resins conforming to the requirements of Specification D 2146, except that (*1*) a maximum of 1 % by weight of colorants is permissible for identification, and (*2*) up to 30 % by weight glass fiber filler is permissible to modify physical properties. Organic colorants, if used, shall be identified in the manufacturer's specification.

4.1.2 The PP lining shall be made from virgin resin or clean reworked resin which is not thermally degraded.

4.1.3 Two types of PP resins are covered in this specification. Type I materials are polypropylene homopolymer resins; Type II are propylene copolymer resins.

4.1.4 *Mechanical Properties*—The following table lists minimum tensile strength and minimum elongation at yield for each PP type when tested in accordance with the requirements of Specification D 2146, except that the test specimens shall be obtained from extruded or molded PP liner. The minimum values for tensile strength and elongation shall apply to both the longitudinal and circumferential directions.

Mechanical Properties of PP

PP Type	Minimum Tensile Properties at Yield	
	Strength, psi (MPa)	Elongation, %
Type I (Homopolymer)	4000 (28)	10
Type II (Copolymer)	3000 (21)	10
30 % Glass Fiber Filled	2500 (17)	2

4.1.5 *Flow Rate*—PP resins used to manufacture the PP liner and molded fittings shall have the following flow rate when tested in accordance with Condition L of Test Method D 1238.

Type I—0.2 to 0.6 g/10 min
Type II—0.3 to 0.8 g/10 min
30 % Glass Fiber Filled—3.0 to 6.0 g/10 min

The flow rate of PP linings made from Type I and Type II resins shall not exceed 1.7 g/10 min, or 1.7 times the flow rate of the original resin, whichever is smaller. The melt flow rate of PP linings made from 30 % glass filled materials shall not exceed 7.5 g/10 min, or 1.25 times the melt flow rate of the original resin, whichever is smaller.

4.2 *Ferrous Pipe and Fittings*:

4.2.1 The mechanical properties of the pipes and fittings shall conform to the requirements of the appropriate specification of 1.2 except as they are influenced by accepted methods of processing in the industry, for example, Van Stone flaring, bending, swagging, and welding. The carbon steel pipe and wrought fittings shall be welded or seamless steel, Schedule 40 or Schedule 80, except that Schedule 30 pipe may be used in 8, 10, and 12-in. nominal size. Schedule 20 may also be used for 12-in. nominal size with the agreement of the purchaser.

4.2.2 *Finish*—The interior surfaces of all housings shall be clean and free of mold burrs, rust, scale, or other protrusions that may adversely affect the integrity or performance of the lining.

4.3 *Back-Up Gaskets*:

4.3.1 *General*—Back-up gaskets shall be used to cover the pipe end and gasket face of threaded or slip-on flanges unless a full radius or chamfer is provided at the end of the pipe and flange. Gaskets may also be required on fittings to provide accommodation or elimination, or both, of sharp corners that could damage the lining.

4.3.2 *Material*—Plain gaskets meeting the temperature requirements, or perforated metallic gaskets, may be used.

5. Requirements

5.1 *Dimensions*:

5.1.1 *Housings*—Housing installation dimensions are as required in the applicable material specification listed in 1.2.

5.1.2 *Wall Thickness*—Fitting linings shall have a minimum wall thickness of 3⁄32 in. (24 mm), and shall have a uniform face thickness of not less than 3⁄32 in. (24 mm). Pipe linings shall have a minimum wall thickness of 0.050 in. (13 mm), and the flared radius and gasket faces shall have a uniform thickness not less than 80 % of the wall thickness. Molded faces shall not be less than 3⁄32 in. thick.

5.1.3 *PP Face Diameter*—The outside diameter of the PP covering the gasket face of the flange or the full face of the lap-joint stub end shall not be less than the diameter specified in the following table. They shall be concentric within 1⁄16in.

Face Diameter

Nominal pipe size, in.	Minimum PP face diameter, in. (mm)
1	1 7⁄8 (48)
1 1⁄2	2 11⁄16 (68)
2	3 7⁄16(87)
2 1⁄2	3 15⁄16 (100)
3	4 5⁄8(119)
4	5 15⁄16(151)
6	8 (203)
8	10 1⁄16(256)
10	12 1⁄4(311)
12	14 3⁄8 (365)

[3] *Discontinued*—See *1984 Annual Book of ASTM Standards*, Vol 08.02.
[4] *Annual Book of ASTM Standards*, Vol 08.04.
[5] Available from American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036.
[6] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

5.1.4 *Tolerances*—Tolerances for pipe, flanges, and fittings shall be as specified in the following table. Bolt holes in both flanges on a fixed flange spool shall straddle the same center line to facilitate alignment. Finished lined (plastic face to plastic face) fabricated fittings shall conform to the nominal face-to-face, etc., as specified in ANSI B 16.1, B 16.5, or B 16.42 with the applicable tolerances.

Tolerances for Pipe, Flanges, and Fittings, in.

Pipe	Tolerance
Length	± ⅛ (32 mm)
Fixed flange bolt hole alignment	± 1/16 (16 mm)
Flange perpendicularity (with pipe centerline)	3/32 in./ft (80 mm/m) of diameter
Flanges and Fittings	
All dimensions	in accordance with ANSI B16.1, B16.5, or B16.42

5.2 *Flange Construction*:

5.2.1 Screw-type flanges shall be secured in position to prevent inadvertent turning of the flange.

5.2.2 Socket-type flanges shall be fully back-welded to the pipe housing and the inside surfaces of the socket flanges shall be welded and ground smooth.

5.2.3 Slip-on flanges shall be fully back-welded.

NOTE 5—No welding shall be done on lined components.

5.2.4 Lap-joint (or Van Stone) flanged ends may be manufactured by standard forming techniques or by using fully welded stub ends or collars. Lap-joints shall not contain any cracks or buckles.

NOTE 6—The use of lap-joint flanges in a piping system may simplify alignment.

5.3 *Workmanship*:

5.3.1 Pipe and fitting linings shall show no evidence of pinholes, porosity, or cracks when inspected in accordance with 5.4.2. The linings shall fit snugly inside the pipe and fitting housings. Any bulges or other obvious indication of poor contact with the housing shall be cause for rejection.

5.3.2 The gasket face portion of the linings shall be free of surface defects that could impair sealing effectiveness. Scratches, dents, nicks, or tool marks on the gasket surface shall not be deeper than 10 % of the wall thickness.

5.4 *Performance*:

5.4.1 *Qualification*—The lined pipes and fittings must be capable of meeting the requirements specified in Section 6.

5.4.2 *Inspection*:

5.4.2.1 Each lined pipe and fitting, prior to shipment, shall be subjected to a hydrostatic test or electrostatic test, or both, as specified in 8.1 or 8.2. The test or tests to be used shall be at the option of the manufacturer, unless otherwise specified by the purchaser.

5.4.2.2 Each lined pipe and fitting shall subsequently be visually inspected prior to shipment to verify conformance to the design and dimensional requirements of 5.3.

5.4.2.3 Each lined pipe and fitting shall bear an inspection verification impression stamp on the housing to indicate compliance with the requirements of this specification.

6. Qualification Tests

6.1 *Temperature Test*:

6.1.1 Cycle representative production samples of the lined pipes and fittings in an oven from room temperature to 225 ± 5°F (107 ± 3°C) to determine the ability of the lined components to withstand heat aging and temperature cycling. Test a minimum of two pipe spools, tees, and 90-deg elbows in each size.

6.1.2 Install companion flanges at the manufacturer's recommended torque value, and affix a thermocouple to the ferrous housing to measure the temperature. Pipe spools shall be at least 3 ft (1 m) long. After 3 h in an oven at 225 ± 5°F (107 ± 3°C) as indicated by the thermocouple, air cool the lined components to 85°F (29°C) maximum. Repeat this test for a total of three cycles.

6.1.3 Inspect the lined pipe and fittings after each cycle for distortion or cracks in the lining. At the completion of the third cycle, subject specimens to either the hydrostatic or electrostatic test described in 8.1 or 8.2.

6.2 *Steam-Cold Water Cycling Test*:

6.2.1 Subject representative production samples of the lined pipe and fittings to steam-cold water cycling to determine the ability of the lined components to withstand rapid temperature changes. Test a minimum of two pipe spools, tees, and 90-deg elbows in each size.

6.2.2 Assemble the lined pipe and fittings with suitable blind flanges having provision for the introduction of steam, air, or cold water, and for drainage. Install the flanges using the manufacturer's recommended torque value. Pipe spool length shall be 10 ft (3 m) minimum. Mount the test specimens in such a manner as to permit complete drainage and then subject them to 100 steam-cold water cycles, each of which shall consist of the following in the sequence given:

6.2.2.1 Circulate 4 ± 1-psig (28 ± 7-kPa) saturated steam through the specimens until the ferrous housing skin temperature adjacent to the flange at the outlet end of the test specimen has been maintained at the maximum stabilized temperature for 30 min.

6.2.2.2 Close off steam.

6.2.2.3 Vent and introduce air to purge the specimens for a minimum of 1 min.

6.2.2.4 Circulate water at a maximum temperature of 77°F (25°C). Circulate the cooling water until the ferrous housing skin temperature adjacent to the flange at the outlet end of the test specimen measures 100°F (38°C) maximum.

6.2.2.5 Drain and introduce air to purge the specimens for a minimum of 1 min, making certain that specimens are completely drained.

6.2.3 There shall be no evidence of leakage from the venting system or the flanges during the 100 cycles. At the completion of the test, the liner shall show no evidence of buckling, cracking, or crazing.

6.2.4 At the conclusion of the testing specified in 6.2.2, subject the lined pipe or fitting to the hydrostatic test specified in 8.1 or, after drying, to the electrostatic test specified in 8.2.

6.3 *Vacuum Test*:

6.3.1 Test representative production samples of the lined pipe and fittings to determine the vacuum ratings of the lined components. Test a minimum of two pipe spools, tees, and 90-deg elbows in each size. Conduct tests at room temperature and at the manufacturer's maximum recommended service temperature.

NOTE 7—Vacuum-temperature ratings should be published in the manufacturer's literature.

6.3.2 For pipe spools, specimen length shall be at least 10 pipe diameters. Install a flange incorporating a sight glass at one end and a blind flange suitable for drawing a vacuum at the other end. Make provisions for measuring the ferrous housing temperature. Heat the specimens uniformly externally with the sight glass end visible, and after the desired ferrous housing temperature is reached, begin the test. Hold a selected initial vacuum level for 24 h and if no failure occurs, increase the vacuum by 2 in. Hg (6.7 kPa). Repeat every 24 h until failure or full vacuum is reached. Failure is defined as any buckling or collapse of the liner. Full vacuum is defined as 29.6 in. Hg (100 kPa) corrected. If failure occurs at the initial vacuum level selected, test a new test specimen at a lower vacuum level to determine the failure threshold. The vacuum failure threshold is defined as 1 in. Hg (3.4 kPa) below that at which failure occurs.

NOTE 8—The external pressure method to simulate higher than full vacuum can be used to establish the failure threshold when full vacuum is achievable. With the use of pressure taps, an external pressure is applied between the liner outside diameter and the pipe inside diameter.

6.3.3 The vacuum rating shall be 80 % of the failure threshold value.

6.3.4 At the test completion and after the vacuum rating is established, heat a duplicate specimen to the test temperature. Apply the rated vacuum to the specimen after the desired skin temperature has been reached. Achieve the rated vacuum within 2 min and apply continuously for 48 h. If no liner buckling or collapse occurs, the vacuum rating shall be considered acceptable.

6.4 *Retest*—When a test specimen fails to meet the requirements of 6.1, 6.2, or 6.3, the cause of failure shall be sought and corrected. Repeat the temperature test specified in 6.1, the steam-cold water cycling test specified in 6.2, and the vacuum test specified in 6.3, using double the number of test specimens.

7. Finish

7.1 The outside surface of all lined pipe and fittings, other than stainless steel, shall be coated with a corrosion-resistant coating over a properly prepared surface.

NOTE 9—Industry practice is to use a paint primer (generally either zinc-rich or epoxy bonded) which permits the user to apply a second layer of paint consistent with his color scheme or identification code, if he so desires.

8. Inspection Tests

8.1 *Hydrostatic Pressure Test*—The internal test pressure shall be 250 psi (1.7 MPa) minimum for 125-psi (0.9-MPa) components and 425 psi (2.9 MPa) minimum for 150-psi (0.1-MPa) and 300-psi (2.1-MPa) components. Conduct the test at ambient temperature. Completely fill the pipe and fitting with clean water and bleed the system free of all air prior to the application of pressure. Reach full test pressure within 1 min and maintain for a further 3 min. Observe the pressure gage throughout the test for any evidence of leakage, which shall be cause for rejection.

8.2 *Electrostatic Test*—Conduct the test with a nondestructive high voltage tester at an output voltage of 10 kV. A visible or audible spark, or one that is both, that occurs at the probe when electrical contact is made with the housing because of a defect in the liner shall be cause for rejection.

9. Marking

9.1 Marking on the pipe and fitting shall include the following:

9.1.1 Nominal pipe size,

9.1.2 Liner material identification "PP,"

9.1.3 Manufacturer's name (or trademark),

9.1.4 This ASTM specification "ASTM F 492,"

9.1.5 Length (on pipe only), and

9.1.6 Other information such as order numbers, part numbers, item numbers, etc. shall be provided at the purchaser's request.

9.2 Pipe liner identification shall be provided on a band containing the raised letters "PP." One band is required on fittings and on pipe lengths up to 6 ft; two bands are required for pipe lengths over 6 ft. The band will typically be located near the flange.

10. Packaging

10.1 The gasket face of each lined pipe and each fitting shall be protected by end plates or other suitable protective means, such as individual boxing.

11. Quality Assurance

11.1 When the product is marked with this designation, F 492, the manufacturer affirms that the product was manufactured, inspected, sampled, and tested in accordance with this specification and has been found to meet the requirements of this specification.

SUPPLEMENTARY REQUIREMENTS

GOVERNMENT/MILITARY PROCUREMENT

These requirements apply *only* to federal/military procurement, not domestic sales or transfers.

S1. *Responsibility for Inspection*—Unless otherwise specified in the contract or purchase order, the producer is responsible for the performance of all inspection and test requirements specified herein. The producer may use his own or any other suitable facilities for the performance of the inspection and test requirements specified herein, unless the purchaser disapproves. The purchaser shall have the right to perform any of the inspections and tests set forth in this specification where such inspections are deemed necessary to ensure that material conforms to prescribed requirements.

NOTE S1.1— In U.S. federal contracts, the contractor is responsible for inspection.

S2. *Packaging and Marking for U.S. Government Procurement:*

S2.1 *Packaging*—Unless otherwise specified in the contract, the materials shall be packaged in accordance with the supplier's standard practice in a manner ensuring arrival at destination in satisfactory condition and which will be acceptable to the carrier at lowest rates. Containers and packing shall comply with Uniform Freight Classification rules or National Motor Freight Classification rules.

S2.2 *Marking*—Marking for shipment shall be in accordance with Fed. Std. No. 123 for civil agencies and MIL-STD-129 for military agencies. S2.1

NOTE S2.1— The inclusion of U.S. Government procurement requirements should not be construed as an indication that the U.S. Government uses or endorses the products described in this specification.