



ANSI/ASTM A 53 – 79

Standard Specification for PIPE, STEEL, BLACK AND HOT-DIPPED, ZINC-COATED WELDED AND SEAMLESS¹

This standard is issued under the fixed designation A 53; 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.

This specification has been approved for use by agencies of the Department of Defense to replace WW-P-404D and for listing in the DoD Index of Specifications and Standards.

1. Scope

1.1 This specification² covers seamless and welded black and hot-dipped galvanized steel pipe in nominal sizes $\frac{1}{8}$ to 26 in., incl, with nominal (average) wall thickness as given in Tables X2 and X3. Pipe having other dimensions (Note 1) may be furnished provided such pipe complies with all other requirements of this specification.

NOTE 1—A comprehensive listing of standardized pipe dimensions is contained in American National Standard ANSI B36.10.

1.2 Pipe may be furnished in the following types and grades:

1.2.1 *Type F*—Furnace-butt welded, continuous welded,

1.2.2 *Type E*—Electric-resistance welded, Grades A and B, and

1.2.3 *Type S*—Seamless, Grades A and B.

NOTE 2—See the Appendix for definition of types of pipe.

1.3 Pipe ordered under this specification is suitable for welding, and suitable for forming operations involving coiling, bending, and flanging, subject to the following qualifications:

1.3.1 Type F is not intended for flanging.

1.3.2 When Types S and E are required for close coiling or cold bending, Grade A should be specified. This provision is not intended to prohibit the cold bending of Grade B pipe.

1.3.3 When pipe is required for close coiling, this should be specified on the order.

1.3.4 Type E may be furnished either nonexpanded or cold expanded at the option of the manufacturer. When pipe is cold ex-

panded, the amount of expansion shall not exceed $1\frac{1}{2}$ % of the outside diameter pipe size.

NOTE 3—The values stated in inch-pound units are to be regarded as the standard. The metric equivalents may be approximate.

2. Applicable Documents

2.1 *ASTM Standards:*

A 90 Tests for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles³

A 370 Methods and Definitions for Mechanical Testing of Steel Products⁴

A 700 Recommended Practices for Packing, Marking, and Loading Methods for Steel Products for Domestic Shipment⁵

B 6 Specification for Zinc (Slab Zinc)⁶

E 29 Recommended Practice for Indicating Which Places of Figures Are to Be Considered Significant in Specified Limiting Values⁷

E 59 Sampling Steel and Iron for Determination of Chemical Composition⁸

¹ This specification is under the jurisdiction of ASTM Committee A-1 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.09 on Pipe.

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² For ASME Boiler and Pressure Vessel Code applications, see related Specification SA-53 in Section II of that Code.

³ *Annual Book of ASTM Standards*, Part 3.

⁴ *Annual Book of ASTM Standards*, Part 1.

⁵ *Annual Book of ASTM Standards*, Parts 1, 3, 4, and 5.

⁶ *Annual Book of ASTM Standards*, Part 7.

⁷ *Annual Book of ASTM Standards*, Part 41.

⁸ *Annual Book of ASTM Standards*, Part 31.

2.2 American National Standards Institute Standards:⁹

B2.1 Pipe Threads

B36.10 Welded and Seamless Wrought Steel Pipe

2.3 Military Standards:¹⁰

MIL-STD-129 Marking for Shipment and Storage

MIL-STD-163 Steel Mill Products Preparation for Shipment and Storage

2.4 Federal Standard:¹¹

Fed. Std. No. 123 Marking for Domestic Shipment (Civil Agencies)

2.5 American Petroleum Institute Standard:¹²

Specification 5L

3. Ordering Information

3.1 Orders for material under this specification shall include the following, as required, to describe the desired material adequately:

3.1.1 Specification number,

3.1.2 Quantity (feet, metres, or number of lengths),

3.1.3 Method of manufacture (seamless, electric-resistance welded or furnace welded),

3.1.4 Type (see 1.2 and Table 2),

3.1.5 Grade (see Table 2),

3.1.6 Finish (black or galvanized),

3.1.7 Size (either nominal and weight class or schedule number, or both; or outside diameter, and nominal wall thickness, Tables X2 and X3),

3.1.8 Length (specific or random, Section 17),

3.1.9 End finish (plain or threaded, Section 18),

3.1.10 Close coiling, if required (see 1.3.3),

3.1.11 Skelp for tension tests, if permitted (see 12.2),

3.1.12 Couplings, if threaded (see 18.3); no couplings, if not desired, or power-tight, if so desired,

3.1.13 Certification (see 23.3),

3.1.14 End use of material,

3.1.15 Special requirements, and

3.1.16 Selection of applicable level of preservation and packaging and level of packing required, if other than as specified or if MIL-STD-163 applies (see 22.2).

4. Materials and Manufacture

4.1 The steel for both seamless and welded pipe shall be made by one or more of the following processes: open-hearth, electric-furnace, or basic-oxygen.

4.2 The weld seam of electric-resistance-welded pipe in Grade B shall be heat treated after welding to a minimum temperature of 1000°F (540°C) or processed in such a manner that no untempered martensite remains.

5. Chemical Requirements

5.1 The steel shall conform to the requirements as to chemical composition specific in Table 1.

6. Product Analysis

6.1 An analysis of two pipes from each lot of 500 lengths, or fraction thereof, may be made by the purchaser. Samples for chemical analysis, except for spectrographic analysis, shall be taken in accordance with Method E 59. The chemical composition thus determined shall conform to the requirements specified in Table 1.

6.2 If the analysis of either pipe does not conform to the requirements specified in Table 1, analyses shall be made on additional pipes of double the original number from the same lot, each of which shall conform to the requirements specified.

7. Tensile Requirements

7.1 The material shall conform to the requirements as to tensile properties prescribed in Table 2.

7.2 The yield strength corresponding to a permanent offset of 0.2 % of the gage length of the specimen or to a total extension of 0.5 % of the gage length under load shall be determined.

7.3 The test specimen taken across the weld shall show a tensile strength not less than

⁹ Available from American National Standards Institute, 1430 Broadway, New York, N. Y. 10018; and American Society of Mechanical Engineers, 345 E. 47th St., New York, N. Y. 10017.

¹⁰ Available from Naval Publications and Forms Center, 5801 Tabor Ave., Philadelphia, Pa. 19120.

¹¹ Available from General Services Administration, Washington, D. C. 20405.

¹² Available from American Petroleum Institute, Division of Production, 300 Corrigan Tower Building, Dallas, Tex. 75201.

the minimum tensile strength specified for the grade of pipe ordered. This test will not be required for pipe under 8 in. (203.3 mm) in outside diameter.

7.4 Transverse tension test specimens for electric-welded pipe 8 ⁵/₈ in. (219.1 mm) in outside diameter and larger shall be taken opposite the weld. All transverse test specimens shall be approximately 1 ¹/₂ in. (38.1 mm) wide in the gage length, and shall represent the full wall thickness of the pipe from which the specimen was cut.

8. Bending Requirements

8.1 For pipe 2 in. and under in nominal diameter, a sufficient length of pipe shall be capable of being bent cold through 90 deg around a cylindrical mandrel, the diameter of which is twelve times the nominal diameter of the pipe, without developing cracks at any portion and without opening the weld. When ordered for close coiling, the pipe shall stand being bent cold through 180 deg around a cylindrical mandrel, the diameter of which is eight times the nominal diameter of the pipe, without failure. Double-extra-strong pipe over 1 ¹/₄ in. in diameter need not be subjected to the bend test.

9. Flattening Test

9.1 The flattening test shall be made on pipe over 2 in. in nominal diameter with wall thicknesses extra strong and lighter.

9.2 Seamless Pipe:

9.2.1 For seamless pipe, a section not less than 2 ¹/₂ in. (63.5 mm) in length shall be flattened cold between parallel plates in two steps. During the first step, which is a test for ductility, no cracks or breaks on the inside, outside, or end surfaces, except as provided for in 9.7, shall occur until the distance between the plates (Table 3) is less than the value of H calculated as follows:

$$H = (1 + e)t/(e + t/D)$$

where:

H = distance between flattening plates, in. (Note 4),

e = deformation per unit length (constant for a given grade of steel, 0.09 for Grade A, and 0.07 for Grade B),

t = specified wall thickness, in., and

D = specified outside diameter, in.

9.2.2 During the second step, which is a test for soundness, the flattening shall be continued until the specimen breaks or the opposite walls of the pipe meet. Evidence of laminated or unsound material that is revealed during the entire flattening test shall be cause for rejection.

NOTE 4—The H values have been calculated for standard and extra-heavy weight sizes from 2 ¹/₂ to 24 in., inclusive, and are shown in Table X1.

9.3 *Electric-Resistance-Welded Pipe*—A specimen at least 4 in. (101.6 mm) in length shall be flattened cold between parallel plates in three steps with the weld located either 0 or 90 deg from the line of direction of force as required in 9.3.1. During the first step, which is a test for ductility of the weld, no cracks or breaks on the inside or outside surfaces shall occur until the distance between the plates is less than two thirds of the original outside diameter of the pipe. As a second step, the flattening shall be continued. During the second step, which is a test for ductility exclusive of the weld, no cracks or breaks on the inside or outside surfaces, except as provided for in 9.7, shall occur until the distance between the plates is less than one third of the original outside diameter of the pipe but is not less than five times the wall thickness of the pipe. During the third step, which is a test for soundness, the flattening shall be continued until the specimen breaks or the opposite walls of the pipe meet. Evidence of laminated or unsound material or of incomplete weld that is revealed during the entire flattening test shall be cause for rejection.

9.3.1 For pipe produced in single lengths, the flattening test specified in 9.3 shall be made on both crop ends cut from each length of pipe. The tests from each end shall be made alternately with the weld at 0 deg and at 90 deg from the line of direction of force. For pipe produced in multiple lengths, the flattening test shall be made on crop ends representing the front and back of each coil with the weld at 90 deg from the line of direction of force, and on two intermediate rings representing each coil with the weld 0 deg from the line of direction of force.

9.4 *Butt Welded Pipe*—For butt-welded pipe, a specimen not less than 4 in. in length shall be flattened cold between parallel plates in three steps. The weld shall be located 90

deg from the line of direction of force. During the first step, which is a test for quality of the weld, no cracks or breaks on the inside, outside, or end surfaces shall occur until the distance between the plates is less than three fourths of the original outside diameter for butt-welded pipe. As a second step, the flattening shall be continued. During the second step, which is a test for ductility exclusive of the weld, no cracks or breaks on the inside, outside, or end surfaces, except as provided for in 9.7, shall occur until the distance between the plates is less than 60 % of the original outside diameter for butt-welded pipe. During the third step, which is a test for soundness, the flattening shall be continued until the specimen breaks or the opposite walls of the pipe meet. Evidence of laminated or unsound material or of incomplete weld that is revealed during the entire flattening test shall be cause for rejection.

9.5 Surface imperfections in the test specimen before flattening, but revealed during the first step of the flattening test, shall be judged in accordance with the finish requirements in Section 20.

9.6 Superficial ruptures as a result of surface imperfections shall not be cause for rejection.

9.7 When low D -to- t ratio tubulars are tested, because the strain imposed due to geometry is unreasonably high on the inside surface at the 6 and 12 o'clock locations, cracks at these locations shall not be cause for rejection if the D -to- t ratio is less than 10.

10. Hydrostatic Test

10.1 Each length of plain-end pipe shall be tested at the mill to the hydrostatic pressures prescribed in Table X2, and each threaded-and-coupled length shall be hydrostatically tested to pressures prescribed in Table X3. The hydrostatic test may be applied, at the discretion of the manufacturer, on pipe with plain ends, with threads only, or with threads and couplings and may be applied to pipe in single lengths or multiple lengths. Welded pipe 2 in. and larger shall be jarred near one end while under test pressure.

10.2 The maximum specified hydrostatic test pressure shall not exceed 2500 psi (17.2 MPa) for normal sizes 3 in. and under, or

2800 psi (19.3 MPa) for all nominal sizes over 3 in. The hydrostatic pressure shall be maintained for not less than 5 s for all sizes of seamless and electric-welded pipe.

11. Nondestructive Electric Test

11.1 The weld seam of each length of ERW pipe 2 in. nominal size and larger shall be tested with a nondestructive electric test as follows:

11.1.1 *Ultrasonic and Electromagnetic Inspection*—Any equipment utilizing the ultrasonic or electromagnetic principles and capable of continuous and uninterrupted inspection of the weld seam shall be used. The equipment shall be checked with an applicable reference standard as described in 11.1.2 at least once every working turn or not more than 8 h to demonstrate its effectiveness and the inspection procedures. The equipment shall be adjusted to produce well-defined indications when the reference standard is scanned by the inspection unit in a manner simulating the inspection of the product.

11.1.2 *Reference Standards*—Reference standards shall have the same specified diameter and thickness as the product being inspected, and may be of any convenient length as determined by the pipe manufacturer. Reference standards shall contain machined notches, one on the inside surface and one on the outside surface, or a drilled hole, as shown in Fig. 1, at the option of the pipe manufacturer. The notches shall be parallel to the weld seam, and shall be separated by a distance sufficient to produce two separate and distinguishable signals. The $1/8$ -in. (3.2-mm) hole shall be drilled through the wall and perpendicular to the surface of the reference standard as shown in Fig. 1. Care shall be taken in the preparation of the reference standard to ensure freedom from fins or other edge roughness, or distortion of the pipe.

NOTE 5—The reference standards defined in 11.1.2 are convenient standards for calibration of nondestructive testing equipment. The dimensions of these standards should not be construed as the minimum size imperfection detectable by such equipment.

11.1.3 *Acceptance Limits*—Table 4 gives the height of acceptance limit signals in percent of the height of signals produced by reference standards. Imperfections in the weld

seam that produce a signal greater than the acceptance limit signal given in Table 4 shall be considered an injurious defect unless the pipe manufacturer can demonstrate that the imperfection does not reduce the effective wall thickness beyond 12½ % of the specified wall thickness.

12. Test Methods

12.1 The test specimens and the tests required by this specification shall conform to those described in the latest issue of Methods and Definitions A 370.

12.2 The longitudinal tension test specimens shall be taken from the end of the pipe or for continuous welded pipe, may be taken from the skelp, at a point approximately 90 deg from the weld, and shall not be flattened between gage marks. The sides of each specimen shall be parallel between gage marks. If desired, the tension tests may be made on the full section of pipe. When impracticable to pull a test specimen in full thickness, the standard 2-in. (50.8-mm) gage length tension test specimen shown in Fig. 6 of Methods A 370 may be used.

12.3 Transverse weld test specimens from electric-welded pipe shall be taken with the weld at the center of the specimen. All transverse test specimens shall be approximately 1½ in. (38.1 mm) wide in the gage length and shall represent the full wall thickness of the pipe from which the specimen was cut.

12.4 Test specimens for the bend and flattening tests shall consist of sections cut from a pipe. Specimens for flattening tests shall be smooth on the ends and free from burrs, except when made on erop ends taken with welded pipe.

12.5 All specimens shall be tested at room temperature.

13. Number of Tests

13.1 For seamless and electric-resistance-welded pipe, one of each of the tests specified in Sections 7, 8, and 9 shall be made on one length of pipe from each lot of 500 lengths, or fraction thereof, of each size. A length is defined as the length as ordered, except that in the case of orders for cut lengths shorter than single random, the term lot shall apply to the lengths as rolled, prior to cutting to the required short lengths.

13.2 For furnace butt-welded pipe, one of each of the tests specified in Sections 7, 8, and 9 shall be made on one length of pipe from each lot of 25 tons, or fraction thereof, of pipe 1½ in. and smaller, and from each lot of 50 tons, or fraction thereof, of pipe 2 in. and larger.

13.3 The number of flattening tests for electric-resistance-welded pipe shall be in accordance with 9.3.1.

13.4 Each length of pipe shall be subjected to the hydrostatic test specified in Section 10.

14. Retests

14.1 If the results of the mechanical tests of any lot do not conform to the requirements specified in Sections 7, 8, and 9, retests may be made on additional pipe of double the original number from the same lot, each of which shall conform to the requirements specified.

14.2 If any section of the pipe fails to comply with the requirements of 9.3 for pipe produced in single lengths, other sections may be cut from the same end of the same length until satisfactory tests are obtained, except that the finished pipe shall not be shorter than 80 % of its length after the original cropping; otherwise the length shall be rejected. For pipe produced in multiple lengths, retests may be cut from each end of each individual length in the multiple. Such tests shall be made with the weld alternately 0 deg and 90 deg from the line of direction of force.

15. Dimensions and Weights

15.1 The dimensions and weights of plain-end pipe included in this specification are listed in Table X2. Dimensions and weights of threaded-and-coupled pipe are listed in Table X3.

15.2 The dimensions and weights furnished under this specification are included in ANSI B36.10.

16. Permissible Variations in Weight and Dimensions

16.1 *Weight*—The weight of the pipe as specified in Table X2 and X3 shall not vary by more than ±10%.

NOTE 6—The weight tolerance is determined from the weights of the customary lifts of pipe as produced for shipment by the mill divided by the

number of feet of pipe in the lift. On pipe sizes over 4 in., where individual lengths may be weighed, the weight tolerance is applicable to the individual length.

16.2 Diameter—For pipe 1½ in. and under in nominal diameter, the outside diameter at any point shall not vary more than 1/64 in. (0.40 mm) over nor more than 1/32 in. (0.79 mm) under the standard specified. For pipe 2 in. and over in nominal diameter, the outside diameter shall not vary more than ±1 % from the standard specified.

16.3 Thickness—The minimum wall thickness at any point shall be not more than 12.5 % under the nominal wall thickness specified. The minimum wall thickness on inspection shall conform to the requirements in Table X4.

17. Lengths

17.1 Unless otherwise specified, pipe lengths shall be in accordance with the following regular practice:

17.1.1 Pipe of weights lighter than extra-strong shall be in single-random lengths of 16 to 22 ft (4.88 to 6.71 m), but not more than 5 % of the total number of threaded lengths may be jointers, which are two pieces coupled together. When ordered with plain ends, 5 % may be in lengths of 12 to 16 ft (3.66 to 4.88 m).

17.1.2 Pipe of extra-strong and heavier weights shall be in random lengths of 12 to 22 ft. Five percent may be in lengths of 6 to 12 ft (1.83 to 3.66 m).

17.1.3 When extra-strong or lighter pipe is ordered in double-random lengths, the minimum lengths shall be not less than 22 ft, with a minimum average for the order of 35 ft (10.67 m).

17.1.4 When lengths longer than single random are required for wall thicknesses heavier than extra-strong, the length shall be subject to negotiation.

17.1.5 When pipe is furnished with threads and couplings, the length shall be measured to the outer face of the coupling.

18. End Finish

18.1 Plain End—Pipe sizes and weights shown in Table X2 ordered with plain end shall be furnished to the following regular

practices, unless otherwise specified:

18.1.1 Pipe of standard or extra-strong weights, or in wall thicknesses less than 0.500 in. (12.7 mm), other than double-extra-strong pipe, shall be plain end beveled.

18.1.2. Pipe with wall thicknesses over 0.500 in. (12.7 mm), and all double-extra-strong pipe, shall be plain end cut square.

18.2 Threaded End—The sizes and weights shown in Table X3 may be ordered with threads and couplings, and when so ordered, the ends shall be provided with threads in accordance with the gaging practice and tolerances of ANSI B2.1. For standard-weight pipe in sizes 6 in. and smaller, refer to Table X5 for basic threading data, and Fig. X1 for an illustration of the joint. For standard-weight pipe in sizes 8 in. and larger and for all sizes of extra-strong-weight and double-extra-strong-weight pipe, refer to Table X6 for basic threading data and Fig. X2 for an illustration of the joint. Threaded pipe sizes 4½ in. OD and larger shall have thread protectors on the ends not protected by the coupling.

18.3 Couplings—Each length of threaded pipe shall be provided with one coupling, unless otherwise specified. The coupling threads shall be in accordance with the gaging practice of ANSI B2.1. The coupling shall be applied handling-tight, unless power-tight is specified on the order. Couplings may be wrought-iron or steel. Taper-tapped couplings shall be furnished on all weights of threaded pipe 2½ in. and larger. For sizes 2 in. and smaller, it is regular practice to furnish straight-tapped couplings for standard-weight pipe and taper-tapped couplings for extra-strong and double-extra-strong pipe, and standard-weight pipe 8 in. and larger. If taper-tapped couplings are required for sizes 2 in. and under on standard-weight pipe, line pipe in accordance with API Specification 5L should be ordered. The taper-tapped couplings provided on line pipe in these sizes may be used on mill-threaded standard-weight pipe of the same size.

19. Galvanized Pipe

19.1 Galvanized pipe ordered under this specification shall be coated with zinc inside and outside by the hot-dip process. The zinc used for the coating shall be any grade of zinc conforming to Specification B 6.

19.2 *Weight of Coating*—The weight of zinc coating shall be not less than 1.8 oz/ft² (0.55 kg/m²) as determined from the average results of the two specimens taken for test in the manner prescribed in 19.5 and not less than 1.6 oz/ft² (0.49 kg/m²) for either of these specimens. The weight of coating expressed in ounces per square foot shall be calculated by dividing the total weight of zinc, inside plus outside, by the total area, inside plus outside, of the surface coated.

19.3 *Weight of Coating Test*—The weight of zinc coating shall be determined by a stripping test in accordance with Methods A 90. The total zinc on each specimen shall be determined in a single stripping operation.

19.4 *Test Specimens*—Test specimens for determination of weight of coating shall be cut approximately 4 in. (101.6 mm) in length.

19.5 *Number of Tests*—Two test specimens for the determination of weight of coating shall be taken, one from each end of one length of galvanized pipe selected at random from each lot of 500 lengths or fraction thereof, of each size.

19.6 *Retests*—If the weight of coating of any lot does not conform to the requirements specified in 19.2, retests of two additional pipes from the same lot shall be made, each of which shall conform to the requirements specified.

19.7 When pipe ordered under this specification is to be galvanized, the tension, flattening, and bend tests shall be made on the base material before galvanizing. When specified, results of the mechanical tests on the base material before galvanizing. When specified, results of the mechanical tests on the base material shall be reported to the purchaser. If impracticable to make the mechanical tests on the base material before galvanizing, such tests may be made on galvanized samples, and any flaking or cracking of the zinc coating shall not be considered cause for rejection. When galvanized pipe is bent or otherwise fabricated to a degree which causes the zinc coating to stretch or compress beyond the limit of elasticity, some flaking of the coating may occur.

20. Finish

20.1 The finished pipe shall be reasonably

straight and free of injurious defects. All burrs at the ends of the pipe shall be removed.

21. Marking

21.1 Each length of pipe shall be legibly marked by rolling, stamping, or stenciling to show: the name or brand of the manufacturer; the kind of pipe, that is, furnace-butt-welded, electric-resistance-welded A, electric-resistance-welded B, seamless; or seamless B; XS for extra strong, XXS for double extra strong; the specification number; and the length. Length shall be marked in feet and tenths of a foot, unless otherwise specified on the purchase order.

21.2 For pipe sizes 1½ in. and smaller which is bundled, this information may be marked on a tag securely attached to each bundle.

21.3 When pipe sections are cut into shorter lengths by a subsequent processor for resale as material, the processor shall transfer complete identifying information to each unmarked cut length, or to metal tags securely attached to bundles of unmarked small diameter pipe. The same material designation shall be included with the information transferred, and the processor's name, trademark, or brand shall be added.

22. Packaging, Marking, and Loading

22.1 When specified on the purchase order, packaging, marking, and loading or shipment shall be in accordance with those procedures recommended by Recommended Practice A 700.

22.2 *For Government Procurement*—When specified in the contract or purchase order, material shall be preserved, packaged, and packed in accordance with the requirements of MIL-STD-163. The applicable levels shall be as specified in the contract or order. Marking for shipment of such material shall be in accordance with Fed. Std. No. 123 for civil agencies and MIL-STD-129 for military agencies.

23. Inspection and Certification

23.1 *Inspection*—The inspector representing the purchaser shall have entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works that concern the manufacture of