Designation: A 587 – 96 (Reapproved 2005)

Standard Specification for Electric-Resistance-Welded Low-Carbon Steel Pipe for the Chemical Industry[1]

This standard is issued under the fixed designation A 587; 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[2] covers electric-resistance-welded low-carbon steel pipe intended for use as process lines.

1.2 Pipe ordered under this specification shall be suitable for severe forming operations involving flanging in all sizes and bending to close radii up to and including NPS 4.

1.3 This specification covers NPS ½ through 10, plus additional sizes. The corresponding outside diameters and wall thicknesses for NPS ½ through 10 are listed in Table 1, as are the dimensions for the additional sizes.

NOTE 1—The dimensionless designator NPS (nominal pipe size) has been substituted in this standard for such traditional terms as "nominal diameter," "size," and "nominal size."

1.4 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.5 The following precautionary caveat pertains only to the test method portion, Sections 6, 12, and 13, of this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:* [3]

A 53/A 53M Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products

A 530/A 530M Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe

A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

E 213 Practice for Ultrasonic Examination of Metal Pipe and Tubing

E 273 Practice for Ultrasonic Examination of the Weld Zone of Welded Pipe and Tubing

E 309 Practice for Eddy-Current Examination of Steel Tubular Products Using Magnetic Saturation

E 570 Practice for Flux Leakage Examination of Ferromagnetic Steel Tubular Products

3. Ordering Information

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

3.1.1 Quantity (feet or number of pieces),

3.1.2 Name of material (electric-resistance-welded steel pipe),

3.1.3 Size (NPS or outside diameter and wall thickness),

3.1.4 Length (definite cut length or random),

3.1.5 Test report required (see 14.2),

3.1.6 Specification number, and

3.1.7 Special requirements.

4. Materials and Manufacture

4.1 *Process*—The steel shall be aluminum killed steel made by one or more of the following processes: open-hearth, basic-oxygen, or electric-furnace.

4.2 Steel may be cast in ingots or may be strand cast. When steels of different grades are sequentially strand cast, identification of the resultant transition material is required. The producer shall remove the transition material by any established procedure that positively separates the grades.

[1] This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel, and Related Alloys, and is the direct responsibility of Subcommittee A01.09 on Carbon Steel Tubular Products.

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[2] For ASME Boiler and Pressure Vessel Code applications see related Specification SA-587 in Section II of that Code.

[3] 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.

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TABLE 1 Tolerance for Outside Diameter and Wall Thickness

NPS Designator	Outside Diameter	Wall Thickness					
		Min	Nom	Max	Min	Nom	Max
		Inches					
—	0.8125 ± 0.004	0.095	0.103	0.111	0.129	0.140	0.151
½	0.840 ± 0.006	0.095	0.103	0.111	0.125	0.140	0.151
¾	1.050 ±0.006	0.099	0.108	0.117	0.135	0.147	0.159
—	1.0625 ± 0.006	0.099	0.108	0.117	0.135	0.147	0.159
—	1.3125 ± 0.006	0.116	0.126	0.136	0.157	0.171	0.185
1	1.315 ± 0.006	0.116	0.126	0.136	0.157	0.171	0.185
1¼	1.660 ± 0.007	0.121	0.132	0.143	0.167	0.182	0.197
—	1.875 ± 0.008	0.127	0.138	0.149	0.175	0.190	0.205
1½	1.900 ± 0.008	0.127	0.158	0.149	0.175	0.190	0.205
2	2.375 ± 0.010	0.135	0.147	0.159	0.191	0.208	0.225
3	3.500 ± 0.015	0.189	0.206	0.223	0.262	0.286	0.310
4	4.500 ± 0.017	0.207	0.226	0.245	0.295	0.322	0.349
6	6.625 ± .030	0.245	0.267	0.289	0.378	0.412	0.446
8	8.625 ± .040	0.282	0.308	0.334	0.438	0.478	0.518
10	10.750 ± .050	0.319	0.348	0.377	0.520	0.567	0.614
		Millimetres					
—	20.64 ± 0.10	2.41	2.62	2.82	3.28	3.56	3.84
½	21.30 ± 0.15	2.41	2.62	2.82	3.28	3.56	3.84
¾	26.70 ± 0.15	2.51	2.74	2.97	3.43	3.73	4.04
—	26.99 ± 0.15	2.51	2.74	2.97	3.43	3.73	4.04
—	33.34 ± 0.15	2.95	3.20	3.45	3.99	4.34	4.70
1	33.40 ± 0.15	2.95	3.20	3.45	3.99	4.34	4.70
1¼	42.16 ± 0.18	3.07	3.35	3.63	4.24	4.62	5.00
—	47.63 ± 0.20	3.22	3.51	3.78	4.45	4.83	5.21
1½	48.30 ± 0.020	3.22	3.51	3.78	4.45	4.83	5.21
2	60.33 ± 0.25	3.43	3.73	4.04	4.85	5.28	5.72
3	88.90 ± 0.38	4.80	5.23	5.66	6.66	7.26	7.87
4	114.30 ± 0.43	5.26	5.74	6.22	7.49	8.18	8.87
6	168.28 ± 0.76	6.22	9.32	7.34	9.60	10.47	11.33
8	219.08 ± 1.02	7.16	7.82	8.48	11.13	12.14	13.16
10	273.05 ± 1.27	8.10	8.84	9.58	13.21	14.40	15.60

4.3 *Manufacture*—The pipe shall be made by electric resistance welding.

4.4 *Heat Treatment*—Pipe furnished in the as-welded condition shall be normalized at a temperature above the upper critical temperature. Cold-drawn pipe shall be normalized after the final cold-draw pass.

5. Chemical Composition

5.1 *Heat Analysis*—An analysis of each heat of steel shall be made to determine the percentages of the elements specified. The chemical composition thus determined shall conform to the requirements specified in Table 2 and the chemical analysis shall be in accordance with Test Methods, Practices, and Terminology A 751.

5.2 *Product Analysis*—When requested on the purchase order, a product analysis shall be made by the supplier from one pipe or coil of steel per heat. The chemical composition thus determined shall be reported to the purchaser or the purchaser's representative and shall conform to the requirements specified in Table 2.

TABLE 2 Chemical Composition Requirements

Element	Composition, %
Carbon, max	0.15
Manganese	0.27–0.63
Phosphorus, max	0.035
Sulfur, max	0.035
Aluminum	0.02–0.100

5.3 *Retests*—If the original test for product analysis fails, retests of two additional lengths of flat-rolled stock or pipe shall be made. Both retests for the elements in question shall meet the requirements of the specification; otherwise, all remaining material in the heat shall be rejected or, at the option of the producer, each length of flat-rolled stock or pipe may be individually tested for acceptance. Lengths of flat-rolled stock or pipe which do not meet the requirements of the specification shall be rejected.

5.4 Supplying an alloy grade of steel that specifically requires the addition of any element other than those listed in Table 2 is not permitted.

6. Mechanical Requirements

6.1 *Tensile Properties*:

6.1.1 The material shall conform to the requirements as to tensile properties prescribed in Table 3.

6.1.2 The yield strength shall be determined by the drop of the beam, by the halt in the gauge of the testing machine, by the use of dividers, or by other approved methods. When a definite yield point is not exhibited, the yield strength corresponding to a permanent offset of 0.2 % of the gauge length of the

TABLE 3 Tensile Requirements

Tensile strength, min, psi (MPa)	48 000 (331)
Yield strength, min, psi (MPa)	30 000 (207)
Elongation in 2 in. or 50 mm, min, %	40

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specimen, or to a total extension of 0.5 % of the gauge length under load, shall be determined.

6.1.3 If the percentage of elongation of any test specimen is less than that specified and any part of the fracture is more than ¾ in. (19 mm) from the center of the gauge length, as indicated by scribe marks on the specimen before testing, a retest shall be allowed.

6.2 *Flattening Test*:

6.2.1 A section of pipe not less than 4 in. (102 mm) in length shall be flattened cold between parallel plates in two steps. The weld shall be placed 90° from the direction of the applied force. During the first step, which is a test for ductility, no cracks or breaks, except as provided for in 6.2.5, shall occur on the inside or outside surfaces until the distance between the plates is less than the value of H, calculated by the following equation:

$$H = [(1 + e)t] / [e + t/D] \quad (1)$$

where:

H = distance between flattening plates, in.,
t = specified wall thickness of the pipe, in.,
D = specified outside diameter of the pipe, in., and
e = deformation per unit length (0.09 for low-carbon steel).

6.2.2 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, or of incomplete weld that is revealed during the entire flattening test shall be cause for rejection.

6.2.3 Surface imperfections in the test specimens before flattening, but revealed during the first step of the flattening test, shall be judged in accordance with the finish requirements.

6.2.4 Superficial ruptures resulting from surface imperfections shall not be cause for rejection.

6.2.5 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.

6.3 *Reverse Flattening Test*—A section 4 in. (102 mm) in length of pipe in sizes down to and including 13⁄16 in. (20.6 mm) in outside diameter shall be split longitudinally 90° on each side of the weld and the sample opened and flattened with the weld at the point of maximum bend. There shall be no evidence of cracks or lack of penetration or overlaps resulting from flash removal in the weld.

6.4 *Flange Test*—A section of pipe not less than 4 in. (102 mm) in length shall be capable of having a flange turned over at a right angle to the body of the pipe without cracking or showing flaws. This flange, as measured from the outside of the pipe, shall be not less than ⅛ in. (3.2 mm) nor more than ½ in. (12.7 mm). Within these limits, the width of the flange shall be not less than the percentages specified in Table 4.

7. Dimensions and Permissible Variations

7.1 *Permissible Variations in Outside Diameter and Wall Thickness*—The outside diameter and wall thickness variations shall not exceed the limits prescribed in Table 1.

TABLE 4 Flange Requirements

Outside Diameter of Pipe, in.	Width of Flange, % of OD
Over ¾ to 2½ , incl	15
Over 2½ to 3¾ , incl	12½
Over 3¾ to 4½ , incl	10
Over 4½ to 6⅝ , incl	7½
Over 6⅝	5

7.2 *Permissible Variations in Straightness*—Each pipe shall be straight within 0.030 in. (0.76 mm) maximum deflection in any 3 ft (0.91 m) length to 8 NPS. For 8 NPS and above, pipe shall be straight within 0.060 in. (1.52 mm) maximum deflection in any 3 ft (0.91 m) length. Galvanized pipe shall be reasonably straight.

7.3 *Lengths*:

7.3.1 Pipe may be ordered in definite cut lengths or in random lengths as provided herein.

7.3.2 When ordered in definite cut lengths, the variation in length shall not exceed the amounts prescribed in Table 5.

7.3.3 If definite lengths are not required, pipe may be ordered in single random lengths of 16 to 22 ft (4.9 to 6.7 m) with 5 % 12 to 16 ft (3.7 to 4.9 m), or in double random lengths with a minimum average of 35 ft (10.7 m) and a minimum length of 22 ft (6.7 m) with 5 % 16 to 22 ft (4.9 to 6.7 m).

8. Workmanship, Finish, and Appearance

8.1 The finished pipe shall be free of injurious defects and shall have a workman-like finish. Minor defects may be removed by grinding, provided the wall thickness is not reduced to less than the minimum thickness permitted for the ordered nominal wall thickness.

8.2 The pipe shall have smooth ends free of burrs and free of scale except that the pipe may have a superficial "blue" oxide film on the surfaces.

8.3 For NPS ½ to 1½ inclusive, the inside diameter welding flash shall be removed so that the remaining flash does not exceed 0.006 in. (0.15 mm). For NPS over 1½ , the remaining inside diameter welding flash shall not exceed 0.010 in. (0.25 mm).

8.4 For all nominal sizes, the outside diameter welding flash shall be removed flush with the outside diameter contour.

8.5 Undercut flash must be smoothly blended into the pipe wall.

8.6 The intent of the flash conditions as prescribed in 8.3, 8.4, and 8.5 is to obtain a surface contour suitable for flanging.

9. Number of Tests

9.1 Two tensile tests as specified in 6.1 shall be made from each heat.

TABLE 5 Permissible Variations in Length[A]

Outside Diameter, in.	Cut Length, in. (mm)	
	Over	Under
Under 2	⅛ (3.2)	0
2 and over	3⁄16 (4.8)	0

[A] These permissible variations in length apply to pipe before bending. They apply to cut lengths up to and including 24 ft (7.3 m). For lengths over 24 ft, an additional over-tolerance of ⅛ in. for each 10 ft (3.0 m) or fraction thereof shall be permissible, up to a maximum of ½ in. (12.7 mm).

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9.2 The flattening test as specified in 6.2 shall be made on two lengths of pipe from each lot of 250 lengths or fraction thereof.

9.3 The reverse flattening test specified in 6.3 shall be made on 1 length of pipe from each lot of 250 lengths or fraction thereof.

9.4 The flange test as specified in 6.4 shall be made on specimens from 2 lengths of pipe from each lot of 250 lengths or fraction thereof.

10. Retests

10.1 If the results of the mechanical tests of any heat or lot do not conform to the requirements specified, retests may be made on additional pipe of double the original number from the same heat or lot, each of which shall conform to the requirements specified.

11. Retreatment

11.1 If a heat or lot fails to conform to the test requirements, that heat or lot may be reheat treated and resubmitted for tests. Not more than one reheat treatment shall be permitted.

12. Test Specimens and Methods of Testing

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

12.2 Test specimens shall be taken from the ends of finished pipe prior to upsetting, swaging, expanding, or other forming operations, or being cut to length. They shall be smooth on the ends and free from burrs and flaws.

12.3 If any test specimen shows flaws or defective machining, it may be discarded and another specimen substituted.

13. Nondestructive Test

13.1 The nondestructive test shall be made instead of the hydrostatic test.

13.1.1 The test shall provide a 360° inspection for sizes up to and including 3½ in. (88.9 mm) outside diameter.

13.1.2 For pipe larger than 3½ in. (88.9 mm) outside diameter, nondestructive inspection of the weld and heat affected zone is required.

13.2 Each pipe shall be tested with a nondestructive test in accordance with Practices E 213, E 273, E 309, or E 570. Except as provided in 13.6.2, it is the intent of this test to reject pipe with imperfections that produce test signals equal to or greater than that of the calibration standard. In order to accommodate the various types of nondestructive testing equipment and techniques in use, and manufacturing practices employed, any one of the following calibration standards may be used, at the option of the producer, to establish a minimum sensitivity level for rejection:

13.3 For eddy-current testing, the calibration pipe shall contain, at the option of the producer, any one of the following discontinuities to establish a minimum sensitivity level for rejection. For welded pipe, they shall be placed in the weld if visible.

13.3.1 *Drilled Hole*—A hole not larger than 0.031 in. (0.79 mm) in diameter shall be drilled radially and completely through the pipe wall, taking care to avoid distortion of the pipe while drilling.

13.3.2 *Transverse Tangential Notch*—Using a round tool or file with a ¼-in. 6.4 mm diameter, a notch shall be filed or milled tangential to the surface and transverse to the longitudinal axis of the pipe, preferably in the weld area. Said notch shall have a depth not exceeding 12½ % of the specified wall thickness of the pipe or 0.004 in. (0.10 mm), whichever is greater.

13.3.3 *Longitudinal Notch*—A notch 0.031 in. (0.79 mm) or less in width shall be machined in a radial plane parallel to the pipe axis on the outside surface of the pipe, to a depth not exceeding 12½ % of the specified wall thickness of the pipe or 0.004 in. (0.102 mm), whichever is greater. The length of the notch shall be compatible with the testing method.

13.4 For ultrasonic testing, the longitudinal calibration reference notches shall be at the option of the producer, any one of the three common notch shapes shown in Practices E 213 or E 273. The depth of the notch shall not exceed 12½ % of the specified wall thickness of the pipe or 0.004 in. (0.102 mm), whichever is greater. For welded pipe, the notch shall be placed in the weld, if visible.

13.5 For flux leakage testing, each of the longitudinal calibration notches shall be a straight-sided notch not over 12½ % of the wall thickness in depth and not over 1.0 in. (25 mm) in length. Both outside diameter and inside diameter notches shall be placed in the tube located sufficiently apart to enable separation and identification of the signals.

13.6 Pipe producing a signal equal to or greater than the calibration defect shall be subject to rejection. The area producing the signal may be examined.

13.6.1 Test signals produced by imperfections that cannot be identified, or produced by cracks or crack-like defects shall result in rejection of the pipe subject to rework and retest.

13.6.2 Test signals produced by imperfections such as those listed below may be judged as injurious or noninjurious depending on visual observation or their severity or the type of signal they produce on the testing equipment used, or both:

13.6.2.1 Dinges,

13.6.2.2 Straightener marks,

13.6.2.3 Loose inside diameter bead and cutting chips,

13.6.2.4 Scratches,

13.6.2.5 Steel die stamps,

13.6.2.6 Chattered flash trim,

13.6.2.7 Stop marks, or

13.6.2.8 Tube reducer ripple.

13.6.3 Any imperfection of the above type exceeding 0.004 in. (0.102 mm) or 12½ % of the specified wall thickness (whichever is greater) in depth shall be considered injurious.

13.6.3.1 If the imperfection is judged as injurious, the pipe shall be rejected but may be reconditioned and retested providing the dimensional requirements are met.

13.6.3.2 If the imperfection is explored to the extent that it can be identified as noninjurious, the pipe may be accepted without further test providing the imperfection does not encroach on the minimum wall thickness.

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14. Inspection

14.1 The inspector shall have entry at all times while work on an order is being done to all parts of the manufacturer's works that concern the manufacture of the pipe ordered. The manufacturer shall afford the inspector, without charge, all reasonable facilities to satisfy the inspector that the material is being furnished in accordance with this specification. All tests and inspection shall be made prior to shipment.

14.2 When inspection at the place of manufacture has been waived by customer, the manufacturer shall furnish a statement that the material has been tested and has met all the requirements of this specification. A certificate or report shall be made available to customer when all the requirements of this specification have been met. When Supplementary Requirement S1 is furnished, certificates or reports furnished shall bear the notation "S-1."

15. Rejection

15.1 Each length of pipe received from the manufacturer may be inspected by the purchaser and, if it does not meet the requirements of this specification based on the inspection and test method as outlined in the specification, the length may be rejected and the manufacturer shall be notified. Disposition of rejected pipe shall be a matter of agreement between the manufacturer and the purchaser.

15.2 Pipe found in fabrication or in installation to be unsuitable for the intended use, under the scope and requirements of this specification, may be set aside and the manufacturer notified. Such pipe shall be subject to mutual investigation as to the nature and severity of the deficiency and the forming or installation, or both, conditions involved. Disposition shall be a matter for agreement.

16. Product Marking

16.1 Each length of pipe NPS 1½ and larger shall be legibly marked by either stenciling or stenciling and light die marking. The die marking shall include the manufacturer's logo or symbol and the stenciling shall include the name or brand of the manufacturer, size, heat number, and the specification number. Such marking shall be applied starting within 8 in. (203 mm) of the end of each length.

16.2 For NPS under 1½ the markings prescribed in 16.1 may be applied to tags and securely attached to the bundle, bale, or other unit, prepared for shipment.

16.3 A tag shall be securely attached to each bundle of pipe shipped indicating the name of the manufacturer, size, wall thickness, length, and specification.

16.4 *Bar Coding*—In addition to the requirements in 16.1, 16.2, and 16.3, bar coding is acceptable as a supplemental identification method. The purchaser may specify in the order a specific bar coding system to be used.

17. Packaging

17.1 The manufacturer, at his option, will box, crate, carton, or package in secured lifts, or bundle to ensure safe delivery. Special packaging requiring extra operations other than those normally used by the manufacturer must be specified on the order.

SUPPLEMENTARY REQUIREMENTS

One or more of the supplementary requirements described below may be included in the purchaser's order or contract. When so included, a supplementary requirement shall have the same force as if it were in the body of the specification. Supplementary requirements details not fully described shall be agreed upon between the purchaser and the supplier, but shall not negate any of the requirements in the body of the specification.

S1. Hydrostatic Testing

S1.1 Hydrostatic testing shall be in accordance with Specification A 530/A 530M. When this supplement is furnished the pipe shall be marked "S-1."

S2. Galvanizing

S2.1 Galvanizing shall be in accordance with Specification A 53/A 53M, except that the rate of application shall be 1.3 minimum to 1.7 maximum oz per f^2.

S3. Surface Coatings

S3.1 All surfaces shall be coated, the exterior with a hard drying lacquer, and the interior with a suitable rust inhibitor.

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