Designation: A 586 – 98

AMERICAN SOCIETY FOR TESTING AND MATERIALS
100 Barr Harbor Dr., West Conshohocken, PA 19428
Reprinted from the Annual Book of ASTM Standards. Copyright ASTM

Standard Specification for Zinc-Coated Parallel and Helical Steel Wire Structural Strand and Zinc-Coated Wire for Spun-In-Place Structural Strand[1]

This standard is issued under the fixed designation A 586; 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 zinc-coated parallel and helical steel wire structural strand, prestretched or nonprestretched, for use where a high-strength, high-modulus prefabricated zinc-coated steel multiple-wire tension member is desired as a component part of a structure.

1.2 The strand is furnished with Class A weight zinc-coated wires throughout. It can be furnished with Class B weight or Class C weight zinc-coated outer wires where additional corrosion protection is required.

1.3 The sections of this specification describing wire (that is, Sections 4, 5, 6, and 10) also cover zinc-coated steel wire used for spun-in-place strands for structural application.

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

2. Referenced Documents

2.1 *ASTM Standards:*

A 90/A 90M Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles[2]

B 6 Specification for Zinc (Slab Zinc)[3]

3. Ordering Information

3.1 Orders for material under this specification shall include the following information:

3.1.1 Length of strand,

3.1.2 Nominal diameter of strand (Table 1 and Table 2),

3.1.3 Prestretched (see 7.3) or nonprestretched,

3.1.4 Coating weight class on outer wires if other than Class A (Table 3),

3.1.5 Mechanical tests if required (see 7.5 and 9.1),

3.1.6 Special packaging requirements (11.1), and

3.1.7 Inspection (10.1).

NOTE 1—A typical ordering description is as follows: 2500 ft, 1 in., 1 × 19 galvanized helical strand, class A coating, on wooden reels, to ASTM Specification A 586 – ____.

TABLE 1 Properties of Zinc-Coated Steel Structural Strand

Nominal Diameter, in.	Minimum Breaking Strength in Tons of 2000 lb: Class A Coating Throughout	Minimum Breaking Strength in Tons of 2000 lb: Class A Coating Inner Wires. Class B Coating Outer Wires	Minimum Breaking Strength in Tons of 2000 lb: Class A Coating Inner Wires. Class C Coating Outer Wires	Approx Gross Metallic Area, in.^{2}	Approx Weight, lb/ft
1/2	15.0	14.5	14.2	0.150	0.52
9/16	19.0	18.4	18.0	0.190	0.66
5/8	24.0	23.3	22.8	0.234	0.82
11/16	29.0	28.1	27.5	0.284	0.99
3/4	34.0	33.0	32.3	0.338	1.18
13/16	40.0	38.8	38.0	0.396	1.39
7/8	46.0	44.6	43.7	0.459	1.61
15/16	54.0	52.4	51.3	0.527	1.85
1	61.0	59.2	57.9	0.600	2.10
1 1/16	69.0	66.9	65.5	0.677	2.37
1 1/8	78.0	75.7	74.1	0.759	2.66
1 3/16	86.0	83.4	81.7	0.846	2.96
1 1/4	96.0	94.1	92.2	0.938	3.28
1 5/16	106.0	104.0	102.0	1.03	3.62
1 3/8	116.0	114.0	111.0	1.13	3.97
1 7/16	126.0	123.0	121.0	1.24	4.34
1 1/2	138.0	135.0	132.0	1.35	4.73
1 9/16	150.0	147.0	144.0	1.47	5.13
1 5/8	162.0	159.0	155.0	1.59	5.55
1 11/16	176.0	172.0	169.0	1.71	5.98
1 3/4	188.0	184.0	180.0	1.84	6.43
1 13/16	202.0	198.0	194.0	1.97	6.90
1 7/8	216.0	212.0	207.0	2.11	7.39
1 15/16	230.0	226.0	221.0	2.25	7.89
2	245.0	241.0	238.0	2.40	8.40
2 1/16	261.0	257.0	253.0	2.55	8.94
2 1/8	277.0	273.0	269.0	2.71	9.49
2 3/16	293.0	289.0	284.0	2.87	10.05
2 1/4	310.0	305.0	301.0	3.04	10.64
2 5/16	327.0	322.0	317.0	3.21	11.24
2 3/8	344.0	339.0	334.0	3.38	11.85
2 7/16	360.0	355.0	349.0	3.57	12.48
2 1/2	376.0	370.0	365.0	3.75	13.13
2 9/16	392.0	386.0	380.0	3.94	13.80
2 5/8	417.0	411.0	404.0	4.13	14.47
2 11/16	432.0	425.0	419.0	4.33	15.16
2 3/4	452.0	445.0	438.0	4.54	15.88
2 7/8	494.0	486.0	479.0	4.96	17.36
3	538.0	530.0	522.0	5.40	18.90
3 1/8	584.0	575.0	566.0	5.86	20.51
3 1/4	625.0	616.0	606.0	6.34	22.18
3 3/8	673.0	663.0	653.0	6.83	23.92
3 1/2	724.0	714.0	702.0	7.35	25.73
3 5/8	768.0	757.0	745.0	7.88	27.60
3 3/4	822.0	810.0	797.0	8.43	29.50
3 7/8	878.0	865.0	852.0	9.00	31.50
4	925.0	911.0	897.0	9.60	33.60

[1] This specification is under the jurisdiction of ASTM Committee A-5 on Metallic-Coated Iron and Steel Products, and is the direct responsibility of Subcommittee A05.12 on Wire Specifications.

Current edition approved April 10, 1998. Published November 1998. Originally published as A 586 – 68. Last previous edition A 586 – 97.

[2] *Annual Book of ASTM Standards*, Vol 01.06.

[3] *Annual Book of ASTM Standards*, Vol 02.04.

TABLE 2 Properties of Zinc-Coated Steel Structural Strand

Approx Nominal Diameter, mm	Approximate Minimum Breaking Strength in Metric Tons			Approx Metallic Area, mm²	Approx Weight, kg/m
	Class A Coating Through-out	Class A Coating Inner Wires Class B Coating Outer Wires	Class A Coating Inner Wires Class C Coating Outer Wires		
12.7	13.6	13.2	12.9	96.8	0.77
14.3	17.2	16.7	16.3	122.6	0.98
15.9	21.8	21.1	20.7	151.0	1.2
17.5	26.3	25.5	25.0	183.2	1.5
19.1	30.8	29.9	29.3	218.1	1.8
20.6	36.3	35.2	34.5	255.5	2.1
22.2	41.7	40.5	39.6	296.1	2.4
23.8	49.0	47.5	46.5	340.0	2.8
25.4	55.3	53.7	52.5	387.1	3.1
27.0	62.6	60.7	59.4	436.8	3.5
28.6	70.8	68.7	67.2	489.7	4.0
30.2	78.0	75.7	74.1	545.8	4.4
31.8	87.1	85.4	83.6	605.6	4.9
33.3	96.2	94.4	92.5	664.5	5.4
34.9	105.2	103.4	100.7	729.0	5.9
36.5	114.3	111.6	109.8	800.0	6.5
38.1	125.2	122.5	119.8	871.0	7.0
39.7	136.1	133.4	130.6	948.4	7.6
41.3	147.0	144.2	140.6	1025.8	8.3
42.9	159.7	156.0	153.3	1103.2	8.9
44.5	170.6	166.9	163.3	1187.1	9.6
46.0	183.3	179.6	176.0	1271.0	10.3
47.6	196.9	192.3	187.8	1361.3	11.0
49.2	208.7	205.0	200.5	1451.6	11.7
50.8	222.3	218.6	215.9	1548.4	12.5
51.1	236.8	233.2	229.5	1645.2	13.3
54.0	251.3	247.7	244.0	1748.4	14.1
55.6	265.8	262.2	257.6	1851.6	15.0
57.2	281.2	276.7	273.1	1961.3	15.8
58.7	296.7	292.0	287.6	2071.0	16.7
60.3	312.1	307.5	302.0	2180.7	17.6
61.9	326.6	322.1	316.6	2303.2	18.6
63.5	341.1	335.7	331.1	2419.4	19.5
65.1	355.6	350.2	344.7	2541.9	20.5
66.7	378.3	372.9	366.5	2664.5	21.5
68.3	391.9	385.6	380.1	2793.6	22.6
69.9	410.1	403.7	397.4	2929.0	23.6
73.0	448.2	440.9	434.5	3200.0	25.8
76.2	488.1	480.8	473.6	3483.9	28.1
79.4	529.8	521.6	513.5	3780.7	30.5
82.6	567.0	558.8	549.8	4090.3	33.0
85.7	610.5	601.5	592.4	4406.5	35.6
88.9	656.8	647.7	636.8	4742.0	38.3
92.01	696.7	686.7	675.9	5083.9	41.1
95.3	745.7	734.8	723.0	5438.7	43.9
98.4	796.5	784.7	772.9	5806.5	46.9
101.6	839.2	826.5	813.7	6193.6	50.0

4. Material

4.1 *Base Metal*—The base metal shall be carbon steel made by the open-hearth, basic-oxygen, or electric-furnace process and of such quality that the finished strand and the hard-drawn individual zinc-coated wires coated by the hot-dip or electrolytic process shall have the properties and characteristics as prescribed in this specification.

4.2 *Zinc*—The slab zinc when used shall conform to Specification B 6.

5. Physical Requirements

5.1 *Tensile Properties*:

5.1.1 The zinc-coated wire used in the parallel wire strand shall, prior to fabrication, conform to the mechanical properties in Table 4. In this case the prestretching provision of the test sample of 5.1.2 is not permitted.

5.1.2 The zinc-coated wire used in the helical wire strand shall conform to the mechanical properties in Table 4 prior to fabrication, but the wire test sample may be prestretched to 55 % of the minimum tensile strength specified in Table 4 prior to conducting the tests.

5.1.3 The tensile strength and the stress at 0.7 % extension shall be based on the actual cross-sectional area of the finished wire, including the zinc coating.

5.1.4 *Test Specimens*—The test specimens shall be free of bends or kinks other than the curvature resulting from the usual coiling operation. The hand straightening necessary to permit insertion of the specimen in the jaws of the testing machine shall be performed by drawing between wood blocks or by some other equally satisfactory means.

5.2 *Stress at 0.7 % Extension Under Load*—The value of stress at 0.7 % extension under load shall be determined by one of the following procedures, depending on the type of extensometer used:

5.2.1 *Non-Autographic Extensometer*—When a non-autographic extensometer is used to measure the 0.7 % extension, it shall have a gage length of 10 in. (254 mm), and it shall be so graduated that the smallest division corresponds to a strain not larger than 0.0001 in./in. (0.0001 mm/mm) of gage length. Apply a load corresponding to the tensile stress indicated in Table 5, using the nominal diameter of the specimen. Maintain this load while a 10-in. extensometer is attached and adjusted to the initial setting shown in Table 5. Then increase the load uniformly until the extensometer indicates an extension of 0.07 in. (1.78 mm) or 0.7 % extension. Record the load for this extension. The stress corresponding to this load shall meet the requirements for the stress of 0.7 % extension specified in Table 4, depending on the class of coating under consideration. Hold the specimen at 0.7 % extension under load and remove the extensometer used to measure the stress at 0.7 % extension; then replace it with an elongation extensometer. Continue the application of load until fracture occurs. Record the elongation attained from the elongation extensometer and add to it 0.7 % obtained from the stress at 0.7 % extensometer to get the total elongation.

5.2.2 *Autographic Extensometer*—When an autographic extensometer is used, it shall have a gage length of at least 2 in. (50.8 mm) and the magnification of strain shall not be less than 250. Apply a load, corresponding to the tensile stress indicated in Table 5, using the nominal diameter of the specimen. Maintain this load and attach the extensometer. Then increase the load uniformly until the extension recorded by the extensometer is at least 0.7 %. Determine the load at 0.7 % extension from the load-strain curve. The stress corresponding to this load shall meet the requirements for stress at 0.7 % extension prescribed in Table 4, depending on the class of coating under consideration. Hold the specimen at 0.7 % extension under load and remove the extensometer used to measure the stress at 0.7 % extension; then replace it with an elongation extensometer. Continue the application of load until fracture occurs. Record the elongation attained from the elongation extensometer and add to it 0.7 % obtained from the

TABLE 3 Minimum Weight of Coating

Nominal Diameter of Coated Wire		Weight of Zinc Coating, min					
		oz/ft^2 of Uncoated Wire Surface			g/m^2 of Uncoated Wire Surface		
in.	mm	Class A Coating	Class B Coating	Class C Coating	Class A Coating	Class B Coating	Class C Coating
0.040 to 0.061, incl	1.016 to 1.549, incl	0.40	0.80	1.20	122	244	366
0.062 to 0.079, incl	1.575 to 2.007, incl	0.50	1.00	1.50	153	305	458
0.080 to 0.092, incl	2.032 to 2.337, incl	0.60	1.20	1.80	183	366	549
0.093 to 0.103, incl	2.362 to 2.616, incl	0.70	1.40	2.10	214	427	641
0.104 to 0.119, incl	2.642 to 3.023, incl	0.80	1.60	2.40	244	488	732
0.120 to 0.142, incl	3.048 to 3.607, incl	0.85	1.70	2.55	259	519	778
0.143 to 0.187, incl	3.632 to 4.750, incl	0.90	1.80	2.70	275	549	824
0.188 and larger^A	4.775 and larger^A	1.00	2.00	3.00	305	610	915

^{A}This is not to imply that larger wire will be manufactured to any unlimited diameter. It only implies that the wire sizes chosen by the strand manufacturer must meet the requirements of this specification.

TABLE 4 Mechanical Requirements

Zinc Coating Class	Nominal Diameter		Stress at 0.7 % Extension Under Load, min		Tensile Strength, min		Total Elongation in 10 in. or 250 mm, min, %
	in.	mm	psi	MPa	psi	MPa	
A	0.040 to 0.110	1.016 to 2.794	150 000	1030	220 000	1520	2.0
	0.111 and larger^A	2.820 and larger^A	160 000	1100	220 000	1520	4.0
B	0.090 and larger^A	2.286 and larger^A	150 000	1030	210 000	1450	4.0
C	0.090 and larger^A	2.286 and larger^A	140 000	970	200 000	1380	4.0

^{A}This is not to imply that larger wire will be manufactured to any unlimited diameter. It only implies that the wire sizes chosen by the strand manufacturer must meet the requirements of this specification.

TABLE 5 Initial Settings for Determining Stress at 0.7 % Extension

Nominal Diameter		Initial Stress		Initial Setting of Extensometer, in./in. or mm/mm
in.	mm	ksi	MPa	
0.040 to 0.089, incl	1.070 to 2.26, incl	14	100	0.0005 (0.05 % extension)
0.090 to 0.119, incl	2.29 to 3.02, incl	28	190	0.0010 (0.10 % extension)
0.120 and larger	3.05 and larger^A	42	290	0.0015 (0.15 % extension)

^{A}This is not to imply that larger wire will be manufactured to any unlimited diameter. It only implies that the wire sizes chosen by the strand manufacturer must meet the requirements of this specification.

stress at 0.7 % extensometer to get the total elongation.

NOTE 2—The extensometer used for the stress at 0.7 % extension and the elongation extensometer may be the same instrument. Two separate instruments are advisable since the more sensitive stress at 0.7 % extensometer that could be damaged when the wire fractures may be removed following the determination of the 0.7 % extension. The elongation extensometer may be constructed with less sensitive parts or be constructed in such a way that little damage would result if fracture occurs while the extensometer is attached to the specimen.

5.3 *Elongation*—In determining total elongation (elastic plus plastic extension) autographic or extensometer methods may be employed. If fracture takes place outside the middle third of the gage length, the elongation value obtained may not be representative of the material.

5.4 *Tensile Strength*—The tensile strength is determined from the maximum load during the total elongation test.

5.5 *Ductility of Steel*—The zinc-coated wire, prior to fabrication into strand, shall be capable of being wrapped two turns in a close helix at a rate not exceeding 15 turns per minute around a cylindrical steel mandrel equal to three times the nominal diameter of the wire under test without fracture of the wire.

5.6 *Weight of Zinc Coating*—The weight of zinc coating on the individual wires prior to fabrication of strand shall be not less than that specified in Table 3.

5.7 *Adherence of Coating*—The zinc-coated wire, prior to fabrication into strand, shall be capable of being wrapped two turns in a close helix at a rate not exceeding 15 turns per minute around a cylindrical steel mandrel equal to five times the nominal diameter of the wire under test without cracking or flaking the zinc coating to such an extent that any zinc can be removed by rubbing with the bare fingers. Loosening or detachment during the adherence test of superficial small particles of zinc formed by mechanical polishing of the surface of zinc-coated wire shall not be considered cause for rejection.

5.8 If any sample breaking within the grips or the jaws of the testing machine results in values below the specified limits for tensile strength, stress at 0.7 % extension or elongation, the results shall be considered invalid and retesting shall be required.

5.8.1 If any test fails to meet the minimum value required, two additional tests shall be made on samples of wire from the same coil or reel and if failure occurs in either of these tests, the coil or reel shall be rejected. If both of these tests pass, the coil or reel shall be accepted.

5.9 *Finish*—The zinc-coated wire surface shall be free of imperfections not consistent with good commercial practice. The coating shall be continuous and reasonably uniform.

NOTE 3—It is recognized that the surface of heavy zinc coatings, particularly those produced by the hot-dip galvanizing process, are not perfectly smooth and not devoid of irregularities.

6. Test for Coating Weight

6.1 The weight of the zinc coating shall be determined by a stripping test made on the individual wires prior to fabrication of strand, in accordance with Test Method A 90/A 90M.

7. Strand

7.1 The zinc-coated strand shall consist of layers of wire about a center wire. The number of layers and number and size of wires in each layer shall be determined by the manufacturer.

7.2 The minimum breaking strength of helical strand properties are shown in Table 1 and Table 2. Specifically dimensioned strand bigger than 4 in. (101.6 mm) may be employed provided that the breaking strength, gross metallic area, and weight per unit length are defined. The properties of parallel wire strand shall be as agreed upon between the purchaser and the manufacturer.

7.3 When specified, the helical strand shall be prestretched under tension of not more than 55 % of the breaking strength listed in Table 1 and Table 2.

7.4 The modulus of elasticity shall be as shown in Table 6.

7.5 If specified, a test for modulus of elasticity shall be made on each manufactured length of strand. The modulus of elasticity shall be determined from gage length of not less than 100 in. (2.54 m) and shall be computed on the sum of the gross metallic cross-sectional areas of the wire making up the strand, including the zinc coating. Throughout the range from 10 % to 50 % of the breaking strength listed in Table 1 and Table 2, the modulus of elasticity shall not be less than the value shown in Table 6.

8. Joints and Splices

8.1 The wires shall be made in such lengths that the helical strands can be manufactured with no splices or joints in the finished outer wires. Welds made in the outer wires prior to drawing are permitted. Splicing of the inner wires during the stranding operation is permissible. Joints in the wires of strand shall be dispersed sufficiently so as to maintain the minimum breaking strength as listed in Table 1 and Table 2. When joints are necessary in any wires, they shall be made in accordance with best known acceptable practices and shall be recoated in a workmanlike manner with zinc or a lead-zinc compound containing a minimum of 50 % zinc.

TABLE 6 Minimum Moduli of Elasticity of Prestretched Structural Strand

Nominal Diameter Strand		Minimum Modulus—Class A Coating[A]	
in.	mm	ksi	MPa
½ to 2$\frac{9}{16}$	12.70 to 65.09	24 000	165 500
2⅝ and larger	66.67 and larger	23 000	158 600

[A] For Class B or Class C weight of zinc-coated outer wires, reduce minimum modulus 1000 ksi or 6900 MPa.

9. Sampling and Testing

9.1 If specified, a test sample shall be taken from each manufactured length of strand and tested to the minimum breaking strength. If it fails to meet the minimum breaking strength requirement, and has not broken in the cone or grips, two additional samples shall be cut from the same manufactured length and tested. If either additional sample fails the retest for breaking strength, the manufactured length in question shall be rejected. If both of these two samples pass the retest for breaking strength, the manufactured length in question shall be accepted. Any test, however, which fails due to faulty attaching of the sockets shall be disregarded.

10. Inspection

10.1 All tests and inspection shall be made at the place of manufacture unless otherwise specified and shall be so conducted as not to interfere unnecessarily with the operations of the works. The manufacturer shall afford the inspector representing the purchaser all reasonable facilities to satisfy him that the material is being furnished in accordance with this specification. When specified, inspection may be waived, and certified copies of test reports furnished.

11. Packaging

11.1 Structural strand shall be packaged in coils or on reels at the discretion of the manufacturer unless otherwise specified. Strand shall be packaged in such a manner so that no permanent deformation of wires in the strand will occur.

12. Keywords

12.1 structural strand; zinc-coated strand; zinc-coated wire for spun-in-place structural strand