Wire Fabric and Reinforcement

Under the state specification for 709.08 for concrete reinforcement, ASTM A 82 is called out.

Under the state specification 709.10 for concrete reinforcement, ASTM A 185 is called out. This specification uses welded steel wire under A 82.

Under the state specification 709.11 for concrete reinforcement, ASTM A 496 is called out.

Under the state specification 709.12 for concrete reinforcement, ASTM A 497 is called out. This specification uses deformed steel wire under A 496.

Under the state specification 709.14 for concrete reinforcement, ASTM A 884 is called out. This specifications connects the epoxy-coated steel wire to the other types of steel wire.

Under the state specification 709.09 for concrete reinforcement, ASTM A 184 is a specification that basically makes wire mat out of the reinforcing steel bars. Go to the reinforcing steel bar certification test for more information.

Dimension Requirements

Dimensions should be verified to assure the delivered product meets what your ordered.

When plain wire for concrete reinforcement is ordered by size number, the relation between size number, diameter, and area for A 82 should follow these requirements. If the order is in metric check A 82 for the dimensions.

Dimensional Requirements for Plain Wire - SI Units, Wire Sizes

Size Number[A]	Nominal Diameter mm (in.)	Nominal Area mm^2 ($in.^2$)
MW 5	2.50 (0.100)	5 (0.008)
MW 10	3.60 (0.142)	10 (0.016)
MW 15	4.40 (0.173)	15 (0.024)
MW 20	5.00 (0.197)	20 (0.030)
MW 25	5.60 (0.220)	25 (0.039)
MW 30	6.20 (0.244)	30 (0.046)
MW 35	6.70 (0.264)	35 (0.054)
MW 40	7.10 (0.280)	40 (0.062)
MW 45	7.60 (0.299)	45 (0.070)
MW 50	8.00 (0.315)	50 (0.077)
MW 55	8.40 (0.331)	55 (0.085)
MW 60	8.70 (0.343)	60 (0.093)
MW 65	9.10 (0.358)	65 (0.101)
MW 70	9.40 (0.370)	70 (0.108)
MW 80	10.10 (0.397)	80 (0.124)
MW 90	10.70 (0.421)	90 (0.139)
MW 100	11.30 (0.445)	100 (0.155)
MW 120	12.40 (0.488)	120 (0.186)
MW 130	12.90 (0.508)	130 (0.201)
MW 200	15.95 (0.628)	200 (0.310)
MW 290	19.22 (0.757)	290 (0.450)

[A]This table represents a hard metrication of the most readily available sizes in the welded wire reinforcement industry. This table should be used on projects designed using inch-pound units. Areas of wire should be checked with the most efficient and readily available material from producers. Other wire sizes are available and many manufacturers can produce them in 2-mm^2 (0.0015-in^2) increments.

As a example the size number W 2, has a nominal area of .02 $inches^2$.

The permissible variation in the diameter should be checked to see if they meet the tolerances for A 82.

When deformed wire for concrete reinforcement is ordered by size number, the relation between size number, diameter, and area for A 496 should follow these requirements. If the order is in metric check A 496 for the dimensions.

Dimensional Requirements for Deformed Steel Wire for Concrete Reinforcement - US Customary Units

Wire Sizes

	Nominal Dimensions			Deformation Requirements			
Deformed Wire Size Number[A,B]	Unit Weight, lb/ft (kg/m)	Diameter, in. (mm)[C]	Cross-sectional Area, in^2 (mm^2)[D]	Perimeter, in. (mm)	Maximum, in. (mm)	Minimum, in. (mm)	Minimum Average Height of Deformations in (mm)[E,F]
D-1	0.034 (0.0510)	0.113 (2.87)	0.01 (6.45)	0.355 (9.02)	0.285 (7.24)	0.182 (4.62)	0.0045 (0.114)
D-2	0.068 (0.1013)	0.159 (4.04)	0.02 (12.90)	0.499 (12.67)	0.285 (7.24)	0.182 (4.62)	0.0063 (0.160)
D-3	0.102 (0.1523)	0.195 (4.95)	0.03 (19.35)	0.162 (15.54)	0.285 (7.24)	0.182 (4.62)	0.0078 (0.198)
D-4	0.136 (0.2025)	0.225 (5.72)	0.04 (25.81)	0.706 (17.93)	0.285 (7.24)	0.182 (4.62)	0.0101 (0.257)
D-5	0.170 (0.2532)	0.252 (6.40)	0.05 (32.26)	0.791 (20.09)	0.285 (7.24)	0.182 (4.62)	0.0113 (0.287)
D-6	0.204 (0.3038)	0.276 (7.01)	0.06 (38.71)	0.867 (22.02)	0.285 (7.24)	0.182 (4.62)	0.0124 (0.315)
D-7	0.238 (0.3548)	0.299 (7.57)	0.07 (45.16)	0.936 (23.77)	0.285 (7.24)	0.182 (4.62)	0.0134 (0.304)
D-8	0.272 (0.4051)	0.319 (8.10)	0.08 (51.61)	1.002 (25.45)	0.285 (7.24)	0.182 (4.62)	0.0143 (0.363)
D-9	0.306 (0.4561)	0.338 (8.59)	0.09 (58.96)	1.061 (26.95)	0.285 (7.24)	0.182 (4.62)	0.0152 (0.386)
D-10	0.340 (0.5063)	0.356 (9.04)	0.10 (64.52)	1.118 (28.40)	0.285 (7.24)	0.182 (4.62)	0.0160 (0.406)
D-11	0.374 (0.5574)	0.374 (9.50)	0.11 (70.97)	1.174 (29.82)	0.285 (7.24)	0.182 (4.62)	0.0187 (0.475)
D-12	0.408 (0.6076)	0.390 (9.91)	0.12 (77.42)	1.225 (31.13)	0.285 (7.24)	0.182 (4.62)	0.0195 (0.495)
D-13	0.442 (0.6586)	0.406 (10.31)	0.13 (83.87)	1.275 (32.39)	0.285 (7.24)	0.182 (4.62)	0.0203 (0.516)
D-14	0.476 (0.7089)	0.422 (10.72)	0.14 (90.32)	1.325 (33.66)	0.285 (7.24)	0.182 (4.62)	0.0211 (0.536)
D-15	0.510 (0.7599)	0.437 (11.10)	0.15 (96.77)	1.372 (34.85)	0.285 (7.24)	0.182 (4.62)	0.0218 (0.554)
D-16	0.544 (0.8101)	0.451 (11.46)	0.16 (103.23)	1.416 (35.97)	0.285 (7.24)	0.182 (4.62)	0.0225 (0.572)
D-17	0.578 (0.8611)	0.465 (11.81)	0.17 (109.68)	1.460 (37.08)	0.285 (7.24)	0.182 (4.62)	0.0232 (0.589)
D-18	0.612 (0.9114)	0.478 (12.14)	0.18 (116.13)	1.501 (38.13)	0.285 (7.24)	0.182 (4.62)	0.0239 (0.607)
D-19	0.646 (0.9624)	0.491 (12.47)	0.19 (122.58)	1.542 (37.17)	0.285 (7.24)	0.182 (4.62)	0.0245 (0.622)
D-20	0.680 (1.0127)	0.504 (12.80)	0.20 (129.03)	1.583 (40.21)	0.285 (7.24)	0.182 (4.62)	0.0252 (0.6
D-21	0.714 (1.0637)	0.517 (13.13)	0.21 (135.48)	1.624 (41.25)	0.285 (7.24)	0.182 (4.62)	0.0259 (0.658)
D-22	0.748 (1.1139)	0.529 (13.44)	0.22 (141.94)	1.662 (42.21)	0.285 (7.24)	0.182 (4.62)	0.0265 (0.673)
D-23	0.782 (1.1649)	0.541 (13.74)	0.23 (148.39)	1.700 (43.18)	0.285 (7.24)	0.182 (4.62)	0.0271 (0.688)
D-24	0.816 (1.2152)	0.553 (14.05)	0.24 (154.84)	1.737 (44.12)	0.285 (7.24)	0.182 (4.62)	0.0277 (0.704)
D-25	0.850 (1.2662)	0.564 (14.33)	0.25 (161.29)	1.772 (45.01)	0.285 (7.24)	0.182 (4.62)	0.0282 (0.716)
D-26	0.884 (1.3164)	0.575 (14.61)	0.26 (167.74)	1.806 (45.87)	0.285 (7.24)	0.182 (4.62)	0.0288 (0.732)
D-27	0.918 (1.3675)	0.586 (14.88)	0.27 (174.19)	1.841 (48.76)	0.285 (7.24)	0.182 (4.62)	0.0293 (0.732)
D-28	0.952 (1.4177)	0.597 (15.16)	0.28 (180.64)	1.876 (47.65)	0.285 (7.24)	0.182 (4.62)	0.0299 (0.759)
D-29	0.986 (1.4687)	0.608 (15.44)	0.29 (187.10)	1.910 (48.51)	0.285 (7.24)	0.182 (4.62)	0.0304 (0.772)
D-30	1.020 (1.5190)	0.618 (15.70)	0.30 (193.55)	1.942 (49.33)	0.285 (7.24)	0.182 (4.62)	0.0309 (0.785)
D-31	1.054 (1.5700)	0.628 (15.95)	0.31 (200.00)	1.973 (50.11)	0.285 (7.24)	0.182 (4.62)	0.0314 (0.798)
D-45	1.530 (2.276)	0.757 (19.23	0.45 (290.32)	2.378 (60.40)	0.285 (7.24)	0.182 (4.62)	0.0379 (0.961)

[A] The number following the prefix indicates the nominal cross-sectional area of the deformed wire in square inches (square millimeters)

[B] For sizes other than those shown above, the Size Number shall be the number of one hundredths of a square inch in the nominal area of the deformed wire cross section, prefixed by the letter D

[C] The nominal diameter of a deformed wire is equivalent to the diameter of a plain wire having the same weight per foot as the deformed wire

[D] The cross-sectional area is based on the nominal diameter. The area in square inches may be calculated by dividing the unit weight in pounds by 0.2833 (weight of 1 in.3 of steel), or by dividing the unit weight per linear foot of specimen in pounds by 3.4 (weight of steel 1 in. square and 1 foot long)

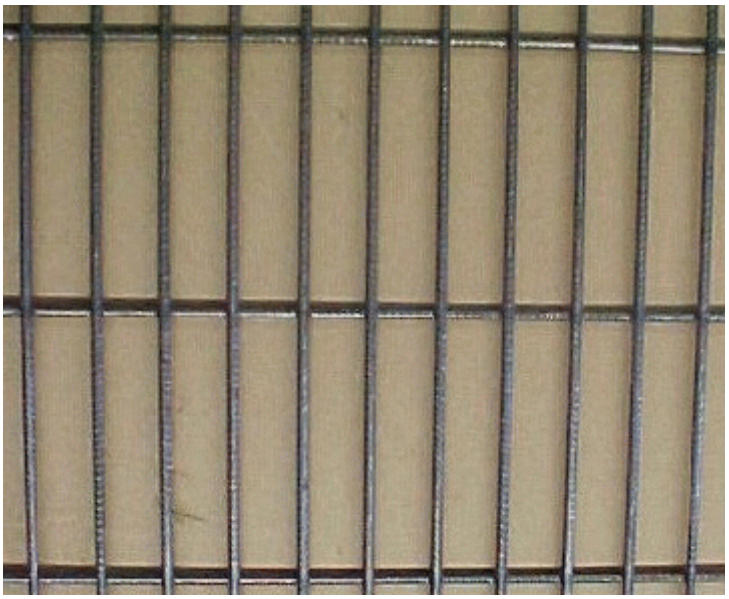
[E] The minimum average height of the deformations shall be determined from measurements made on not less than two typical deformations from each line of deformations on the wire. Measurements shall be made at the center of indentation as described in 6.2.

[F] These sizes represent the most readily available sizes in the welded wire reinforcement industry. Other wire sizes are available and many manufacturers can produce them in 0.0015 in 2 (mm 2) increments.

As a example the size number D12, has a nominal area of .12 inches^2.

The minimum average height of the center of a typical deformation based on the nominal wire diameters shown in the last tables should be as follow:

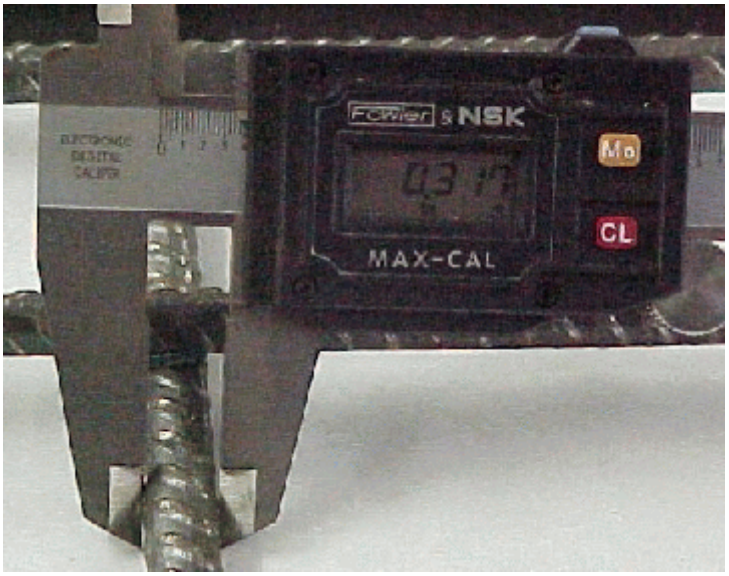
Wire Sizes	Minimum Average Height of Deformation, Percent of Nominal Wire Diameter
D-3 and finer	4
Coarser than D-3 through D-10	4 ½
Coarser than D-10	5



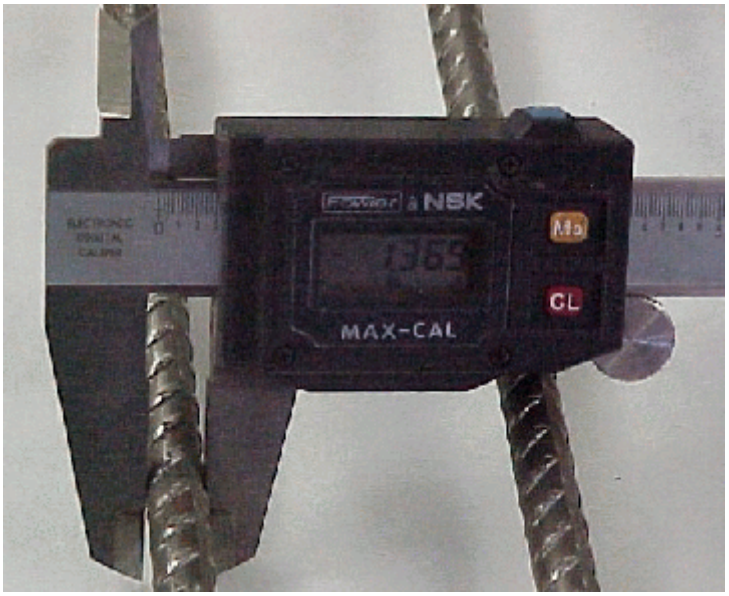
For deformed steel wire, deformations should be spaced along the wire at a uniform distance and should be symmetrical around the perimeter of the section. The deformed wire should have two or more lines of deformations. The average longitudinal spacing of deformations should be 3.5 to 5.5 deformations per inch in each line of deformation on the wire.

The minimum average height of deformations should be determined by making at least two measurements on a typical deformation on a wire. Measurements should be made at the center of the indentation.

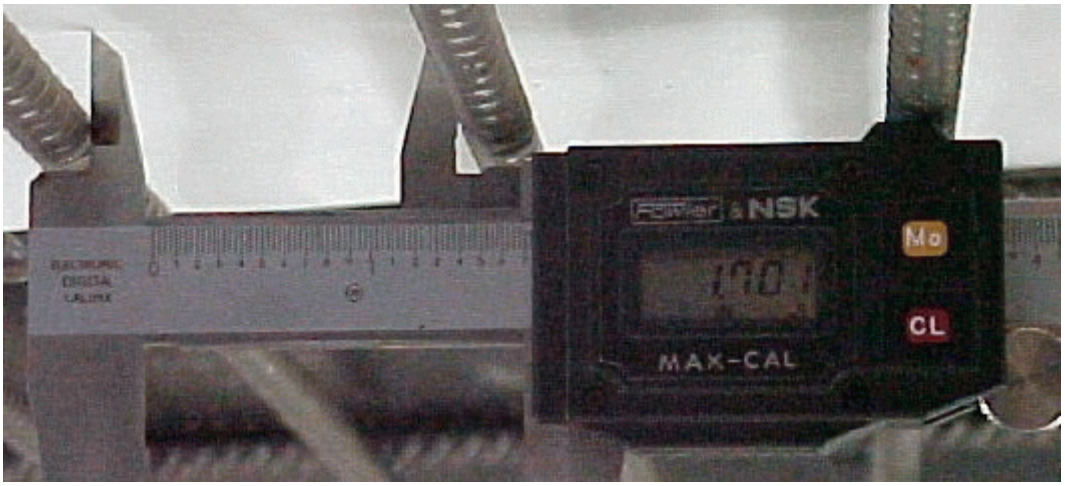
Measure the diameter of the vertical wire with a calibers



Now measure the horizontal diameter of the wire.

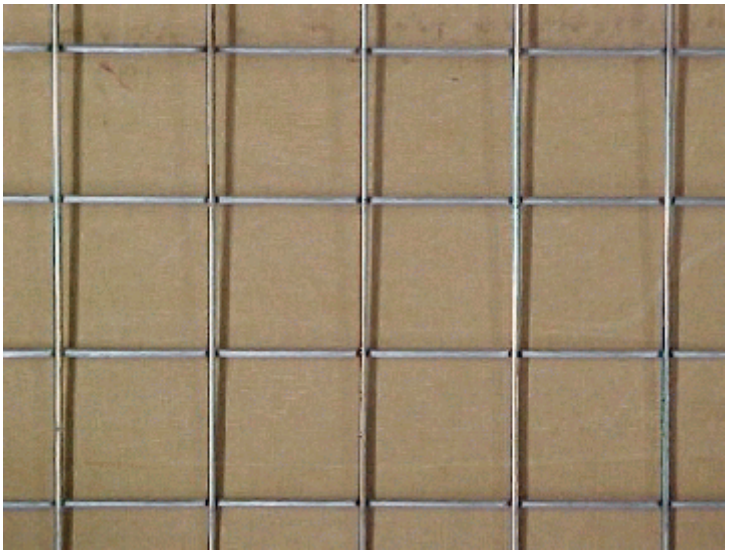


Measure the spacing between the horizontal and vertical wires.



Calculate the area of the wire by using the information you received from your measurements. As example: if the diameter D is 0.126 inch: then the area is D x D x 3.1416/4 = .126 x .126 x .7854 = .012 sq inch.

When the plain wire fabric is used, the permissible variation on spacing of wires should be within ± 1/4 inch of the specified width.



A example for a diameter of a wire could be 4 x 12 - W 2 x W 4, which means the wire W2 wire is spaced every 4 inches and the W4 wire is spaced every 12 inches.

The overall length of the flat sheets may vary ± 1 inch, or 1%, whichever is greater. This is true whether deformed welded steel wire fabric or plain welded steel wire.

Marking

For steel wire the size of the wire, ASTM A 82 and A 496 specifications, and name or mark of manufacturer should be marked on a tag securely attached to each coil of wire. For the wire fabric the description of the material, ASTM A 185 and A 497, and the name of the manufacturer should be marked on a tag for each bundle of flat sheets.

Mechanical Requirements

Along with Dimensional requirements another key issue is the mechanical properties of the material. Listed below is the information that can be found in the applicable specification for steel wire.

For specifications A 82 and A 496 one tension and bend test should be used for each 10 tons or seven samples of each size of wire.

The Mechanical Requirements for A 82 should meet these requirements based on the nominal area of the wire.

Tension Test Requirements

Tensile strength, min, ksi (Mpa)	80 (550)
Yield strength, min, ksi (MPa)	70 (485)
Reduction of area, min, %	30[A]

[A]For material testing over 100 ksi (690 MPa) tensile strength, the reduction of area shall be not less than 25 %

Tension Test Requirements (Material for Welded Fabric)

	Size W 1.2 and Larger	Smaller than Size W 1.2
Tensile Strength, min, ksi (MPa)	75 (515)	70 (485)
Yield Strength, min, ksi (MPa)	65 (450)	56 (385)
Reduction of area, min, %	30[A]	30[A]

[A]For material testing over 100 ksi (690 MPa) tensile strength, the reduction of area shall be not less than 25 %

The Mechanical requirements for A 496 should meet these requirements based on the nominal area of the wire.

Tension Test Requirements

	psi (MPa) min
Tensile Strength	85,000 (585)
Yield Strength	75,000 (515)

Tension Test Requirements (Material for Welded Fabric)

	psi (MPa) min
Tensile Strength	80,000 (550)
Yield Strength	70,000 (485)

The bend test is used to determine how much the plain or deformed steel wire will bend. The requirements for degree of bending for A 82 should meet the following table

Bend Test Requirements

Size Number of Wire	Bend Test
W7 and smaller	Bend around a pin the diameter that is equal to the diameter of the specimen
Coarser than W7	Bend around a pin the diameter that is equal to twice the diameter of the specimen

The requirements for degree of bending for A 496 should meet these requirements.

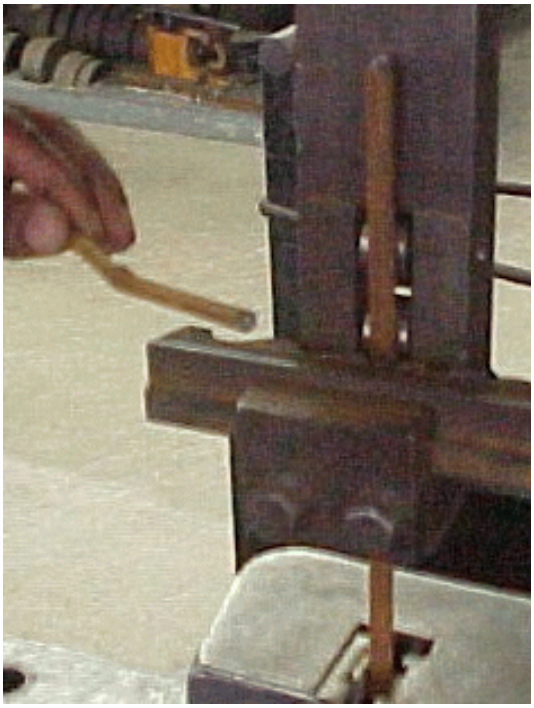
Bend Test Requirements

Size Number of Wire	Bend Test
D-6 and smaller	Bend around a pin the diameter that is equal to twice the diameter of the specimen
Coarser than D-6	Bend around a pin the diameter that is equal to four times the diameter of the specimen

Shear Strength Test

The weld shear strength test is required to be used to test the strength of the weld at the intersections of the longitudinal and transverse wires in plain and deformed wires..

To test for weld shear strength you will select four welds at random to use. The minimum average shear value in pounds-force is 35,000 multiplied by the nominal area of the larger wire in square inches. Example for the load would be a wire fabric where the larger wire is W4. The area, by specification is .04 sq inches and the required force would be .04 x 35,000 = 1400 lbs



Epoxy Coating Thickness

If the steel wire or welded wire fabric is epoxy coated they should meet the specifications for 709.14 and A 884.

The surface of the steel wire or welded wire fabric to be coated should be cleaned by abrasive blast cleaning to near-white metal color. After blast cleaning it may be possible to use a chemical wash or conversion of the blast-cleaned steel reinforcement surface, or both, to enhance coating adhesion.

The powder coating should be applied to the cleaned and pretreated (if used) surface as soon as possible after surface treatments have been completed.

A Class A minimum coating thickness is mandated by the state specification 709.14 for coating on a wire but the Class A coating minimum thickness is ≥ 5 mils and less than 12 mils. Finding more than 5% of the coating thickness measurements below 5 mils is cause for rejection.

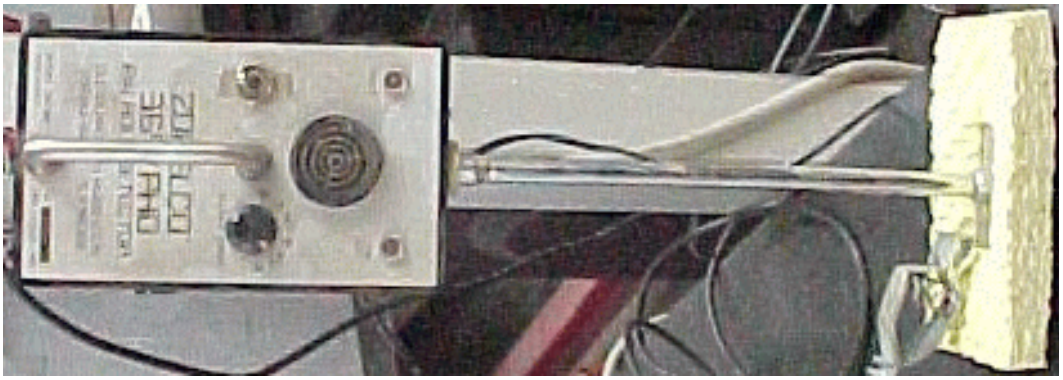
A 884 allows different types of coating that can be used on the wire and the welded wire fabric.

A. A Type 1 coating is a designation of fusion-bonded epoxy coating that has been designed to be sufficiently flexible to allow fabrication of the coated wire or welded wire fabric.
B. A Type 2 coating is a designation of fusion-bonded epoxy coating that has not been designed to be sufficiently flexible to allow fabrication of the coated ire or welded wire fabric.

For testing at least fifteen coated wire or welded wire fabric thickness measurements are required for each test wire. Tests for coating thickness and continuity shall be made on a minimum of 1 ft of each size wire or welded wire fabric coated during each production hour.

Determine the thickness of the epoxy coating by using the elcometer.

Holiday checks are used to determine the porous contents in the wire.



Bend test for coating flexibility should be used for only Type 1 coating. Bend tests for Type 1 coating flexibility shall be conducted on at least one wire of each size or style of fabric from each 2 hour production.

The requirements for degree of bending for A 884 should meet these requirements.

Test Requirements

Wire Size No. MW or MD, mm	Wire Size No. W or D, in.	Mandrel Diameter, mm [in.]	Time to Complete, s (maximum)
6.5 to 39	1 to 6	twice the diameter of the wire being tested.	15
>39	>6	four times the diameter of the wire being tested.	45

If required, a 8 oz sample of the powder coating should be supplied to the purchaser from each batch. The sample shall be packaged in an airtight container and identified by batch number.

For certification the manufacturer should furnish written certification that the coated steel wire and welded wire fabric meets the requirements for this specification. A copy of the manufacturer's quality control tests, the epoxy powder certifications and the wire mill certifications should be submitted.

A report of the test results for yield strength, tensile strength, and bend tests is required for certification for all wire or wire fabric.

Sample Certification

ENGINEERED WIRE PRODUCTS

Date 11-4-99

CERTIFIED STEEL REPORT

Customer ODOT Sample Customer Order No. 75,000 s.f.

Style of Material 6x12 W8.5 &W 4 ASTM A-185

Description	Diam.	Breaking Strength LBS	Tensile Strength PSI	Weld Shear Strength Actual	Weld Shear Strength Req'd	Test	Heat Number	C A	Mn	Ph.	So A
Long Wire	.326	8830	105960	3680	2975	OK	12411C	.06	.36	.008	.016
	.327	8000	95200	5710	"	"	"	"	"	"	"
	.327	7960	94724	4080	"	"	"	"	"	"	"
	.326	8070	96840	5180	"	"	"	"	"	"	"
			①			②					
Cross Wire	.224	3980	101092			OK	11659C	.09	.41	.005	.007
	.224	3920	99568			"	"	"	"	"	"
	.226	3860	99114			"	"	"	"	"	"
	.227	3600	88920			"	"	"	"	"	"
			①			②					

1. The results from the tensile test showed that the tensile strength was 105,960 psi. The wire passed the test because the minimum was 85,000 psi.
2. The results from the Weld Shear Strength test showed that the actual Weld Shear Strength was 3680 pounds. The wire passed the test because the minimum to pass the test was 2975 pounds.

If the wire had epoxy coating a report for the epoxy thickness would contain the thickness of the coating and if the coating passed the bend test.