

BULLETIN 309 Revised 4 79

wire

FOR WIREBOUND BOXES & CRATES



PACKAGE RESEARCH LABORATORY/ROCKAWAY, NEW JERSEY

Introduction

Wire used in making wirebound containers is technically described as LOW CARBON STEEL WIRE.

The *hardness, stiffness, strength,* and other properties are controlled by the manufacturer to meet definite specifications.

The tensile strength varies from 45,000 to 125,000 pounds per square inch for different grades and purposes.

The wire is divided into two general types, - (a) stapling wire and (b) binding wire. Binding wire is divided into different grades according to the use intended.

STAPLING WIRE

Standard Sizes - 14, 15, 16, 17, 18, 19 and 20 gage.

Finish - Bright and galvanized.

High tensile wire may be used for special purposes on GROUP IV woods.

BINDING WIRE

Standard Sizes - 17, 16, 15, 14, 13, 12 and 11 gage.

Grades - Soft, Medium, and Hard.

Finish - Uncoated and Galvanized.

Stapling Wire

Stapling wire is formed into the staples that secure the binding wire to the box blank. The wire is fed by knurled feed wheels to the stapling mechanism which cuts off the wire, forms the staples, and drives them into the blank. Stapling wire is stiff enough to drive satisfactorily, yet is soft enough to minimize wear in the stapling mechanism.

The required qualities for stapling wire are:

Smooth surface to prevent wear in machine.

Accurate gage, to fit mechanism.

Correct stiffness, to form and drive properly.

FINISH

Stapling wire shall be either bright finish, galvanized or copper coated finish. The finish of *bright stapling wire* is that obtained by dry drawing cleaned and lubricated hot rolled rods or annealed wire so that the resulting wire surface is smooth and free from excessive lubricant which would tend to come off the wire and cause clogging of the stitchers.

Galvanized stapling wire shall be "Regular Galvanized Wire" as described in the American Iron & Steel Institute *Steel Products Manual*, "Wire and Rods, Carbon Steel." "Regular Galvanized Wire" is the finish generally used on wire for wirebound boxes when galvanized wire is specified.

Galvanized stapling wire shall be dull-finished, also referred to as "air cooled."

Binding Wire

Binding wire is fastened to the box blank by the staples driven over it.

The required qualities for binding wire are:

Smooth surface - Rough or dirty surface may cause trouble at the Rock Fastener machine.

Correct stiffness - Wire that is too hard will break in service and cause machine trouble. Wire that is too soft cannot be used for Rock Fasteners.

GRADES

Twist Binding Wire is used only for the manufacture of boxes with twisted closures. Normally it will not give satisfactory results when used for Rock Fasteners.

Medium Binding Wire is used for wirebound containers on all woods except the very hardest.

Hard Binding Wire is used only on the hardest woods and is not recommended for general use. The Rock Fasteners will be stiff when being closed, and will break in 2 to 4 reclosings. It will not give satisfactory results when used for closure by twisting.

Intermittent Binding Wire is used in the manufacture of Durabox containers and DU-ALL boxes. The intermediate wire or wires are bent around the edge slats of these containers.

FINISH

The surface coating on binding wire is either uncoated, galvanized or copper coated.

Galvanized binding wire may be either bright or dull finish. Bright-finished wire improves the appearance of the box. Bright finish is referred to as "water-cooled," dull finish is referred to as "air-cooled."

Galvanized Binding Wire shall be "Regular Galvanized Wire" as described in the Ameri-

can Iron & Steel Institute *Steel Products Manual*, "Wire and Rods, Carbon Steel." "Regular Galvanized Wire" is the finish generally used on wire for wirebound boxes. The zinc coating shall be smooth and shall not flake or peel when the wire is wound around a mandrel 3/16" in diameter.

TYPES

Types of galvanized wire having heavier weights of zinc coating are Type 1, Type 2, and Type 3. When specified by type number, the galvanized wire is commonly made to a minimum weight of coating as given under the respective types shown in the table below.

MINIMUM OUNCES OF ZINC
PER SQUARE FOOT OF SURFACE

Gage	Decimal Equivalent	Regular Coating	Type 1 Coating	Type 2 Coating	Type 3 Coating
11	0.121	No specified minimum weight of coating.	0.30	0.50	0.80
12	0.106		0.30	0.50	0.80
13	0.092		0.30	0.50	0.70
14	0.080		0.25	0.45	0.65
15	0.072		0.15	0.35	0.50
16	0.063		0.15	0.35	0.50
17	0.054		0.15	0.30	0.40

Coatings with minimum weights heavier than those listed in Type 3 are produced.

Physical Properties

STIFFNESS

The required stiffness of stapling wire and of binding wire is specified in terms of readings on the Rockaway Wire Tester.

The stiffness of wire is a more dependable measure of its suitability than is the tensile strength, although, in general, these two factors are usually in agreement.

Readings on the Rockaway Wire Tester covering the range for stapling wire and for binding wire are shown in the Table on page 4.

Nearly every mill manufacturing wire that is used on All-Bound, Rock Fastener, and Twist Wire Boxes uses the Rockaway Wire Tester to test their wire.

It is recommended that manufacturers of wirebound boxes use the Rockaway Wire Tester to check the wire as received from the wire mill. Any coils that fail to meet the specifications should be rejected, although a tolerance of one pound over or under the specifications should be permitted on not more than 10% of the coils in the shipment.

GAGE OF WIRE (W & M)	DIAMETER OF WIRE, INCH	DIAMETER OF WIRE, MILLIMETER	READINGS ON ROCKAWAY WIRE TESTER						MINIMUM ELONGATION IN 10 INCHES, PERCENT	
			STAPLING WIRE		BINDING WIRE				BINDING WIRE	
			Group I, II, III, Woods	Group IV Woods	Twist Closure (Soft)	Rock Fastener (Medium) Gr. I, II, III, Woods	Closure (Hard) Gr. IV Woods	Intermittent Wire (Soft)	Soft	Medium and Hard
20	0.0348	0.884	6-10 (A2)	6-10 (A2)						
19	0.0410	1.041	14-17 (A2)	14-17 (A2)						
18	0.0475	1.207	11-15 (A)	11-15 (A)				9-12 (A)		
17	0.0540	1.372	26-32 (A)	26-32 (A)	13-20 (A)	18-22 (A)	20-23 (A)			
16	0.0625	1.588	13-17 (B)	17-21 (B)*	15-22 (A)	23-29 (A)	28-32 (A)	18-20 (A)	15	10
15	0.0720	1.829	28-32 (B)	30-34 (B)*	7-11 (B)	13-17 (B)	15-18 (B)	9-13 (B)	15	10
14	0.0800	2.032	40-44 (B)	32-37 (C)*	12-17 (B)	20-25 (B)	24-29 (B)		15	10
13	0.0915	2.324			22-40 (B)	20-26 (C)	25-30 (C)		15	10
12	0.1055	2.680			27-38 (C)	28-38 (C)	38-48 (C)		15	10
11**	0.1205	3.061			50-65 (C)	60-75 (C)	70-85 (C)			

* Special grade steel. Specifications furnished on request.

**11-gage wire can be tested on the new Rockaway Wire Tester scale which has readings from 0 to 100 lbs.

- 1) These standards apply to wire in original coils.
- 2) (A) (B) (C) indicates tester pins to be used. (A2) indicates two lengths of wire.
- 3) Certain conditions may require wire having lower or higher readings than the above.
- 4) When boxes with Rock Fasteners are to be made for multiple reuse, the binding wire should test in the lower half of the range.
- 5) Minimum elongation of binding wire - 10%.
- 6) Southern Yellow Pine should be considered as a GROUP IV wood in the above table.
- 7) Intermittent wire is the center wire on Duraboxes and DU-ALLS.

TENSILE STRENGTH

If a Rockaway Wire Tester is not available, the tensile strength may be used as indicating the grades of wire as follows:

- twist binding wire - 45,000 to 70,000 lbs. per sq. in.
- medium binding wire - 60,000 to 75,000 lbs. per sq. in.
- hard binding wire - 70,000 to 85,000 lbs. per sq. in.
- stapling wire* - 95,000 to 125,000 lbs. per sq. in.

*special grade - to 180,000 lbs. per sq. in.

ELONGATION

Occasionally, binding wire meeting the requirements of stiffness, as determined on the Rockaway Wire Tester, and of tensile strength, does not give satisfactory performance. Such wire is usually brittle and lacks ductility. Experience has shown that binding wire having a minimum elongation of 10%, based on 10" original length of wire, will give satisfactory performance. Staple wire of 18 gage and heavier should have an elongation between 5 and 10%. Twenty gage staple wire can be run with elongation as low as .5%.

WIRE SIZES & WEIGHTS

GAGE (Washburn & Moen)	AREA		DIAMETER		WEIGHT/LENGTH		Feet to 1 Pound	Meters to 1 Kilogram
	in ²	mm ²	In	mm	lb/ft	kg/m		
11	0.0114	7.355	0.1205	3.061	0.0387	0.058	25.84	17.37
12	0.0087	5.613	0.1055	2.680	0.0296	0.044	33.78	22.70
13	0.0066	4.258	0.0915	2.324	0.0223	0.033	44.84	30.14
14	0.0050	3.226	0.0800	2.032	0.0170	0.025	58.82	39.53
15	0.0041	2.645	0.0720	1.829	0.0138	0.021	72.46	48.72
16	0.0031	2.000	0.0625	1.588	0.0104	0.015	95.15	64.62
17	0.0023	1.484	0.0540	1.372	0.0077	0.011	129.87	87.28
18	0.0018	1.161	0.0475	1.207	0.0060	0.009	166.67	112.01
19	0.0013	0.839	0.0410	1.041	0.0044	0.007	227.27	152.74
20	0.0010	0.645	0.0348	0.884	0.0032	0.005	312.50	210.01

NUMBER OF STAPLES PER POUND/KILOGRAM

Length of Staple		Staple Width Inside ¼ in. or 6.34 mm Gage (Washburn & Moen)													
		14		15		16		17		18		19		20	
		per lb	per kg	per lb	per kg	per lb	per kg	per lb	per kg	per lb	per kg	per lb	per kg	per lb	per kg
1/4	6.4											3244	7153	4953	10921
5/16	7.9											3058	6743	4246	9362
3/8	9.5									1994	4397	2676	5901	3715	8192
7/16	11.1									1773	3909	2378	5243	3300	7277
1/2	12.7									1596	3519			2973	6555
9/16	14.3					837	1846	1121	2472	1450	3197			2729	6017
5/8	15.9					767	1691	1028	2267	1328	2928				
11/16	17.5					708	1561	949	2093	1227	2706				
3/4	19.1					658	1451	882	1945	1140	2514				
13/16	20.6					614	1354	823	1815	1063	2344				
7/8	22.2					576	1270	771	1700	997	2198				
15/16	23.8					542	1195	726	1601	933	2057				
1	25.4			385	849	512	1129	685	1510	886	1954				
1-1/16	27.0					485	1089								
1-1/8	28.6	281	620	347	765	461	1017								
1-1/4	31.8	255	562	325	717	419	924								
1-3/8	34.9	234	516	290	639	387	853								
1-1/2	38.1	214	472	261	576	354	781								
1-5/8	41.3	199	439	248	547										
1-3/4	44.5	185	408	226	498										
1-7/8	47.6	174	384												

Rockaway Wire Tester

In the manufacture of wirebound containers, it is essential

First, *to determine the correct grade of wire to be used, and*

Second, *to maintain uniformity of wire quality during manufacturing operations.*

Correct grades of wire have been determined through the cooperation of wire mill metallurgists, box manufacturers, and engineers of Stapling Machines Co., Rockaway, N. J.

The problem is to provide an *inexpensive* method of securing, within commercially acceptable limits, uniformity of wire quality as specified.

The Rockaway Wire Tester is designed to meet this need. Briefly, it is a device for measuring the pull in pounds required to bend a wire beam past its yield point. The beam is a short length of wire supported freely at two points at an accurately determined distance apart, while a determinable load is concentrated mid-way between the two supporting points.

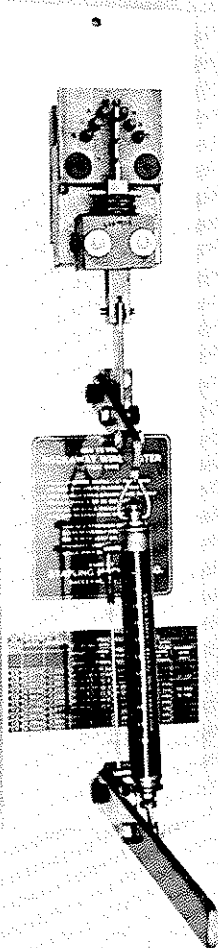
HOW TO USE THE ROCKAWAY WIRE TESTER

1. Select a straight sample of wire from the original coil, 2" or 3" long, and place on proper pins under plunger hook.
2. Pull down handle steadily and slowly—should take 5 to 10 seconds.
3. Pointer on scale indicates maximum reading when wire bends.

Reading of a single wire is designated "A", "B", or "C" on the table. Reading for 2 pieces tested together is designated "A2." This applies only to 19 and 20 gage wire.

Note: A new scale reading 0-100 lbs. may be obtained from Stapling Machines Co. and substituted for the older 0-50 lbs. scale. The new scale is necessary to test 11 gage wire, but can also be used to test other gages of wire. All new Rockaway Wire Testers are equipped with 100 lb. scales.

If a new scale is to be installed, it is recommended that your Wire Tester be returned to Rockaway so that the new scale can be installed and recalibrated.



Purchase Specifications

A general purchase specification for wire is given below. We recommend that it accompany each purchase order. The purchase order should specify the sizes and grades of wire required in compliance with P.R.L. *Bulletin No. 309*, latest revision. If coils of 22" average diameter are wanted instead of 16" average diameter, the specifications should be changed accordingly.

60 to 80 pounds for stapling wire, and 75 to 100 pounds for binding wire.

Coils shall average 16" in diameter, with a minimum 12" inside diameter. If 22" coils are specified, they shall average 22" in diameter, with a minimum 18" inside diameter.

SIZE

Wire must be true to size within the following limits:

GAGE (Washburn & Moen)	DIAMETER	TOLERANCE
20	.0348"	plus or minus .002"
19	.0410"	
18	.0475"	
17	.0540"	
16	.0625"	
15	.0720"	plus or minus .003"
14	.0800"	
13	.0915"	
12	.1055"	
11	.1205"	

STIFFNESS

Wire as received must pass the stiffness tests specified for each particular size. The Rockaway Wire Tester will be used to check the grade and uniformity of the wire as received. Each coil must test within the readings specified on the purchase order. A tolerance of one pound over or under the specifications on not more than 10% of the coils is acceptable.

RUST AND SCALE

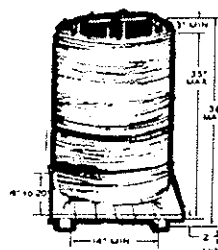
Wire must be free from rust or scale.

CATCH WEIGHT COILS

Wire must be smoothly coiled and free from sharp bends or kinks.

Coils shall be catch-weight, weighing from

HEAVY COILS



Box plants that have adequate floor space for mechanical handling may order binding and stapling wire according to the following specifications:

1. In continuous length coils of approximately 600 lbs.
2. Inside diameter of coil 13" \pm 1/4".
3. Maximum overall height of coil above base: 35".
4. Coil to be mounted on skid or platform base which should measure 19" to 20" square. This base to have two skids (runners or risers) spaced not less than 14" apart (clear distance between), and provide at least 2-3/8" clearance above floor for fork lift handling.
5. The core or inner support of the coil should extend a minimum of 3" above the top of the coil, and be 38" maximum above the floor (including the base).
6. The construction of base and core should permit safe stacking of two tiers of these single unit coils.

IDENTIFICATION MARKS

Each coil must carry a tag showing gage, grade, and mill.

The free end of each coil must be tagged: "Start Here."

Repairing Defective Boxes

We recommend the use of magazine loaded, pneumatically operated staplers or tackers in repairing defective wirebound boxes and crates. Staples of approximately the same length and gauge as recommended in Bulletin 318, **Quality Control Recommendations**, should be used.

