

# Signal Training Bulletin

## COMMITTEE G: Education & Training Communication & Signal Division, AAR

### B-11 Wire Lines

Approved November 1981

**Definition:** A conductor used to transmit electrical energy from one point to another.

Symbol:



**Description:** A wire line can be composed of various types of metals or a combination of metals. It can be bare or insulated, soft or hard drawn.

**Purpose and Application:** Wire lines are used to transmit electrical energy from one point to another. Energy may be alternating current, direct current or a combination of both. By various methods electrical energy can be controlled to transmit various means of intelligence over wire lines.

**General Information:** The selection of communication and signal conductors for open wire should take into consideration the electrical, physical requirements and importance of the lines. Hard drawn copper wires have the best electrical conductance. Copper-covered steel (Copperweld) wires have superior physical strength.

**Table 1** — Physical properties of bare wires of Hard Drawn Copper, 40% Copperweld and Alumoweld.

Wire Size AWG	Wire Diameter Inches	Breaking Load Pounds	Weight (Lbs. per 1000 Feet)	Maximum Resistance (Ohms per 1000 Feet)
<b>Bare Hard Drawn Copper</b>				
6	0.1620	1280	79.46	0.4108
8	0.1285	826	49.97	0.6533
9	0.1144	661	39.63	0.8238
10	0.1019	529	31.43	1.039
<b>Bare 40% Copperweld</b>				
6	0.1620	2433	72.85	1.008
8	0.1285	1660	45.81	1.602
9	0.1144	1368	36.33	2.020
10	0.1040	1177	30.01	2.445
<b>Bare Alumoweld</b>				
6	0.1620	3608	58.88	1.943
8	0.1285	2529	37.03	3.089
10	0.1019	1590	23.29	4.912

The strength of conductor used will depend on the assumed storm loading information. This information is available in the National Safety Code. These areas expressed in simple terms are:

Heavy loading: 1/2 inch of radial ice plus 57 miles per hour wind.

Medium loading: 1/4 inch of radial ice plus 57 miles per hour wind.

Light loading: No ice; 70 miles per hour wind.

The type of conductors used in various loading areas will also depend on the length of spans and type of reliability required.

The loading map of Canada and the United States shows the variations of loading in the geographic sections of the two countries.

#### Electrical Properties

Electrical consideration will be determined by length of line and type of communication or signal circuits that will be transmitted over the conductors.

Attenuation in db per mile of open wire pairs with wire spaced 8 inches and 40 pairs of double petticoat or "CS" insulators per miles is shown in Table 2.

**Table 2** — Attenuation in db per mile for Hard Drawn Copper, 40% Copperweld and Alumoweld wires.

Hard Drawn Copper Wire		Frequency									
Wire Size	AWG	1kHz	5kHz	50kHz	100kHz	150kHz					
		Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
6		.025	.030	.044	.052	.127	.162	.178	.237	.218	.299
8		.034	.040	.059	.068	.158	.195	.220	.283	.268	.353
10		.042	.050	.080	.089	.189	.227	.262	.326	.317	.405
<b>40% Copperweld Wire</b>											
6		.078	.084	.088	.097	.119	.153	.168	.227	.214	.295
8		.120	.126	.138	.148	.163	.199	.203	.265	.251	.336
10		.162	.169	.195	.205	.221	.261	.252	.317	.293	.382
<b>Alumoweld Wire</b>											
6		.119	.125	.166	.175	.198	.232	.213	.272	.228	.309
8		.190	.196	.266	.276	.317	.354	.341	.404	.365	.450
10		.240	.248	.342	.352	.427	.467	.463	.528	.493	.582

Resistance of conductors in ohms per loop mile at 20C (68F) degrees with wire spacing of 8 inches and 40 pairs of double petticoat or "CS" insulators is shown in Table 3.

**Table 3** — Resistance in ohms per loop mile for Hard Drawn Copper, 40% Copperweld and Alumoweld Wires. Hard Drawn Copper

Frequency	1kHz	5kHz	50kHz	100kHz	150kHz
Wire Size					
AWG					
6	4.10	5.61	15.50	21.45	26.03
8	6.82	7.92	20.41	28.09	33.96
10	10.33	11.11	25.67	35.10	42.42
40% Copperweld					
6	10.0	10.6	14.5	20.8	25.9
8	16.3	17.4	20.4	26.5	32.5
10	24.6	26.0	28.7	33.3	39.6
Alumoweld					
6	6.94	7.60	19.36	26.69	32.37
8	11.02	11.45	24.87	34.20	41.19

Wire line circuits must have good quality construction and proper maintenance. Following is a list of practices which will help provide high quality and reliable wire line circuits.

- Proper insulation by using double petticoat insulators.
- Sag difference between two conductors should not exceed three inches in any span.
- 2 Pin spacing should remain the same through entire section of line.
- 2 Proper cleaning of conductors before applying Nicopress sleeves.
- 2 Proper crimping of Nicopress sleeves.
- 2 Conductors must be kept free of brush and trees.
- 2 Appropriate transposition pattern.

**Note:** This Bulletin is for general information only. For specific applications consult the rules, standards and instructions published by your railroad.

