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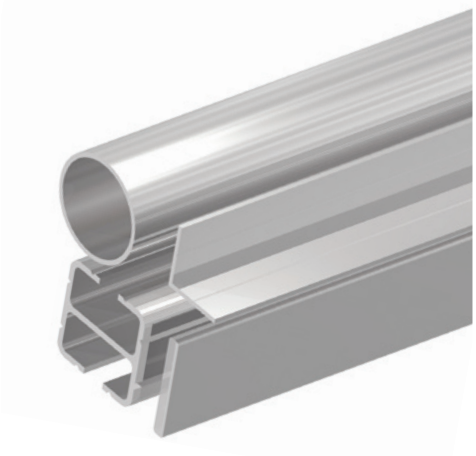
Bus Conductors

Benefits of Aluminum Bus Conductor



- Only 1/3 the weight of copper
- Highly corrosion resistant
- Dissipates heat rapidly and evenly
- Very strong yet lightweight
- Easy to fabricate
- Conducts equivalent loads of electric power with one half as much material weight as copper

Today, aluminum is one of the most widely specified conductive materials used in the manufacture and construction of electrical power distribution components and equipment.

Typical applications presently using aluminum conductors include bus duct, bus bar, panel boards, switchgear, isolated phase bus and a host of other similarly purposed products installed virtually everywhere – from electric utility switchyards to substations construction all over the world.

Alloys and Tempers

The most commonly used alloys are 6063, 6061, and 6101. Alloy 6063 has been widely used for outdoor high voltage substation bus because of its excellent mechanical and electrical properties. Where high strength and lower conductivity is called for, alloy 6061 bus is used. Where high conductivity is required, with a minimum sacrifice in mechanical properties, alloy 6101 is used. AFL aluminum bus conductors are manufactured to meet appropriate ASTM specifications. These include B-241-00 - Aluminum Alloy Seamless Pipe and Tube for Alloys 6063 and 6061; and B-317-00 - Aluminum Alloy Extruded Bar, Rod, Pipe and Structural Shapes for Electrical Purposes for Alloy 6101.

The tempering process is an application that hardens or strengthens the metal by applying heat and/or cooling the metal. The basic temper consists of a letter followed by one or more numbers. The most common tempers are T6, T61, and T63. T6 is solution heat treated, and artifically aged to maximum mechanical property levels. T61 is an overaged temper with higher conductivity, but lower mechanical properties than T6. T63 is an "in-between" temper with higher conductivity than T6, but less than T61.

The most common alloy and temper combinations are 6063-T6, 6061-T6, 6101-T6, 6101-T61, and 6101-T63. For other alloys or tempers, please contact your AFL Sales Representative.

Special Finishes and Packaging

AFL aluminum bus conductor is manufactured with an EHV (Extra-High Voltage) finish and EHV packaged. EHV packaging consists of inter-leafed paper and cardboard boxed.

Factors to Consider When Selecting a Bus Conductor

A variety of factors must be considered in bus design. In all applications, considerations include DC or AC current, ampacity required, frequency, operating voltage, allowable voltage drop, maximum possible short circuit currents, available space, and the taps and connections required. If large currents are involved, factors affecting the economic current density must also be tabulated. And for outdoor substations, weather conditions such as possible maximum icing conditions, wind speeds and similar situations are important. Factors that may affect the design of industrial bus include ampacity for allowable temperature rise, voltage drop and power loss economics.

Conductivity

Pure aluminum has an electrical conductivity of 65 percent of the International Annealed Copper Standard. This is decreased a certain amount for any aluminum alloy, depending on the alloy's composition and temper. Internal heating of the conductor causes a loss of physical strength, which limits the conductor's current carrying capacity. Therefore, not only the temperature at which the alloy begins to anneal, but the time it takes to reach that temperature, must be taken into consideration.

Ampacity

For a given value of continuously flowing current, the temperature of a bus rises until the heat coming from the electrical losses in the bus is equal to the heat given off by radiation and convection.

Bus conductor ampacities are usually based on a continuous operating temperature of 30°C above an ambient temperature of 40°C.

Lengths

Bus Conductor is sold in various lengths ranging from 10 feet to 40 feet. Longer lengths are available in various sizes. Contact your AFL Sales Representative for more information.

Frequently Asked Questions

Do I use seamless pipe or structural pipe for substation construction?
For substation construction, seamless pipe should be used. Extruded structural pipe is produced with a bridge-type die. In the bridge die method of extrusion, the solid ingot is broken up and then rejoined in the weld chamber of the die. Thus, the pipe contains two or more "die welds" along its length. This pipe is intended for use in structural applications such as highway and bridge rails, chain link fence posts, sign structures, lighting brackets, etc. Structural pipe is not intended for applications involving fluid pressure or repeated flexure as there is a possibility of splitting along the die welds. Tubular bus in substations is frequently subjected to aeolian vibration which produces repeated flexure. Seamless pipe is extruded from hollow extrusion ingot by the die and mandrel method. The cross section is continuous; there are no die welds to separate under repeated flexure. For more information about structural pipe look at ASTM standard B-249-00 and for seamless pipe look at ASTM standard B-241-00.

What is the difference between bus pipe and bus tube?
Bus Pipe is manufactured to a "nominal" (not actual) diameter. The wall thickness is described by a "schedule." i.e. 4" Sch40. Bus Tube is a round hollow material manufactured to a specific outside diameter (O.D.) and wall thickness. It is produced to meet the end users requirements.

Does alloy and temper matter?
Yes, the alloy and temper specify the conductivity and mechanical properties.

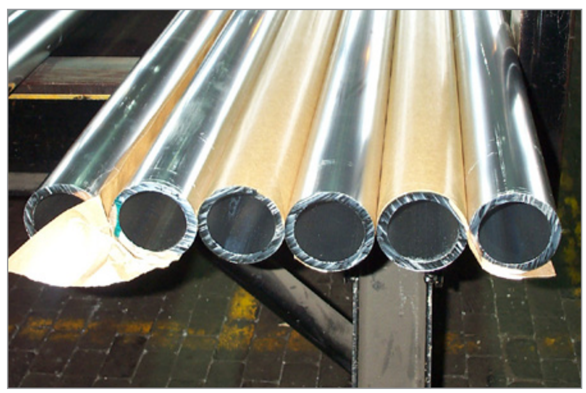
What is the maximum length of bus conductor I can buy?
Most bus conductor is sold in lengths of 10 to 40 feet. Longer lengths are available in various sizes. Contact the AFL Commercial Team for any lengths over 40 feet.

Can I order custom sizes or custom extrusions?
Yes, contact the AFL Commercial Team for custom sizes of bus conductor and custom extrusions.

Bus Packaging Options

Bare - Batten - Bundled (BBB)

EHV Pack - Note interweave paper to protect

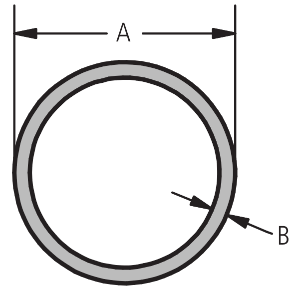


Seamless Bus Pipe

Seamless bus pipe is an extruded tubular product used to convey electricity. It is manufactured to a "nominal," not actual, inside diameter. The wall thickness is described by a "schedule." The schedules are determined by the American Standards Association.

Seamless bus pipe is generally made of 6063-T6 alloy in ANSI Schedule 40 pipe because of its excellent mechanical and electrical properties. 6061-T6 alloy tubular bus is used where high strength and lower conductivity are required.

Specification: B-241 (Seamless Pipe)



Note: For seamless bus tubing over 6 inches, see page 618.

Schedule 40

Nominal Size	Outside Diameter of Tube	Wall Thickness	Area	Weight
in.	in.	in.	sq. in.	lb/ft
SCH 40	A	B		
1	1.315	0.133	0.4939	0.581
1 1/4	1.660	0.140	0.6685	0.786
1 1/2	1.900	0.145	0.7995	0.940
2	2.375	0.154	1.0750	1.264
2 1/2	2.875	0.203	1.7040	2.004
3	3.500	0.216	2.2280	2.621
3 1/2	4.000	0.226	2.6800	3.151
4	4.500	0.237	3.1740	3.733
5	5.563	0.258	4.3000	5.057
6	6.625	0.280	5.5810	6.564
8	8.625	0.322	8.3990	9.879

Schedule 80

Nominal Size	Outside Diameter of Tube	Wall Thickness	Area	Weight
in.	in.	in.	sq. in.	lb/ft
SCH 80	A	B		
1	1.315	0.179	0.6388	0.751
1 1/4	1.660	0.191	0.8815	1.037
1 1/2	1.900	0.200	1.0680	1.256
2	2.375	0.218	1.4770	1.737
2 1/2	2.875	0.276	2.2540	2.650
3	3.500	0.300	3.0160	3.547
3 1/2	4.000	0.318	3.6780	4.326
4	4.500	0.337	4.4070	5.183
5	5.563	0.375	6.1120	7.188
6	6.625	0.432	8.4050	9.884
8	8.625	0.500	12.763	15.009

Ordering Instructions:

Step 1: Choose Nominal Size

Nominal Size	Size Code
1	100
1 1/4	125
1 1/2	150
2	200
2 1/2	250
3	300
3 1/2	350
4	400
5	500
6	600
8	800

Step 2: Choose Schedule

Schedule Number	Schedule Code
SCH 40	S40
SCH 80	S80

Step 3: Choose Alloy

Alloy Number	Alloy Code
6061	X
6063	Y
6101	Z

Step 4: Choose Temper

Temper	Temper Code
T6	T6
T61	T61
T63	T63

Step 5: Choose Packaging

Package Type	Package Code
Bare - Bat - Bundle (BBB)	B
EHV	E

See pictures on page 3

Step 6: Build Catalog Number

Size Code	+	Schedule Code	+	Alloy Code	+	Temper	+	Package Code

Example: To order 2 1/2 inch Schedule 40 6101 T-61 Alloy Bus Pipe with BBB packaging

250	+	S40	+	Z	+	T61	+	B

Completed Catalog Number is 250S40ZT61B.

Physical & Electrical Properties of Aluminum

Standard Pipe-Size Conductors at Typical Conductivities

Nominal Size in	A	B	Area sq in	Weight lbs/ft	Inductive reactance 1 ft spacing 60 Hz microhm/ft	6063-T6				6061-T6			
	Outside Diameter of Tube in	Wall Thickness in				DC Resistance at 20°C microhms/ft	60 Hz Rac/RDC at 70°C	AC Resistance at 70°C 60 Hz microhms/ft	Current Ratings Amp at 60 Hz (1) (2) (3) (4) Outdoor	DC Resistance at 20°C microhms/ft	60 Hz Rac/RDC at 70°C	AC Resistance at 70°C 60 Hz microhms/ft	Current Ratings Amp at 60 Hz (1) (2) (3) (4) Outdoor
Schedule 40 Pipe													
1	1.315	0.133	0.494	0.581	68.24	31.120	1.00039	36.580	681	38.360	1.00032	43.820	622
1 1/4	1.660	0.140	0.669	0.786	62.68	22.990	1.00050	27.030	859	28.340	1.00039	32.370	705
1 1/2	1.900	0.145	0.800	0.940	59.45	19.220	1.00064	22.600	984	23.690	1.00046	27.070	900
2	2.375	0.154	1.075	1.264	54.15	14.300	1.00082	16.820	1234	17.630	1.00055	20.140	1128
2 1/2	2.875	0.203	1.704	2.004	49.85	9.019	1.00220	10.620	1663	11.170	1.00150	12.710	1520
3	3.500	0.216	2.228	2.621	45.19	6.897	1.00300	8.126	2040	8.500	1.00180	9.725	1865
3 1/2	4.000	0.226	2.680	3.151	42.05	5.736	1.00380	6.761	2347	7.070	1.00220	8.091	2145
4	4.500	0.237	3.174	3.733	39.28	4.842	1.00470	5.712	2664	5.968	1.00270	6.834	2436
5	5.563	0.258	4.300	5.057	34.31	3.574	1.00680	4.224	3348	4.406	1.00400	5.051	3063
6	6.625	0.280	5.581	6.564	30.23	2.754	1.00950	3.263	4064	3.394	1.00540	3.897	3719
8	8.625	0.322	8.399	9.879	24.39	1.830	1.0162	2.167	5434	2.257	1.0086	2.590	5047
Schedule 80 Pipe													
1	1.315	0.179	0.639	0.751	68.81	24.060	1.00100	28.300	774	29.650	1.00075	33.840	707
1 1/4	1.660	0.191	0.882	1.037	63.14	17.440	1.00140	20.520	985	21.490	1.00105	24.570	901
1 1/2	1.900	0.200	1.068	1.256	59.89	14.390	1.00200	16.940	1137	17.730	1.00150	20.280	1039
2	2.375	0.218	1.477	1.737	54.56	10.400	1.00280	12.260	1446	12.820	1.00210	14.670	1322
2 1/2	2.875	0.276	2.254	2.650	50.23	6.820	1.00720	8.071	1907	8.406	1.00390	9.647	1746
3	3.500	0.300	3.016	3.547	45.55	5.096	1.01030	6.050	2363	6.281	1.00490	7.225	2199
3 1/2	4.000	0.318	3.678	4.326	42.39	4.178	1.01380	4.972	2735	5.150	1.00750	5.935	2507
4	4.500	0.337	4.407	5.183	39.61	3.487	1.01710	4.168	3118	4.298	1.00950	4.965	2862
5	5.563	0.375	6.112	7.188	34.63	2.515	1.02600	3.032	3949	3.099	1.01650	3.604	3631
6	6.625	0.432	8.405	9.884	30.58	1.829	1.04570	2.247	4891	2.254	1.02120	2.656	4532
8	8.625	0.500	12.763	15.009	24.12	1.204	1.095	1.467	6651	1.484	1.0388	1.739	6152

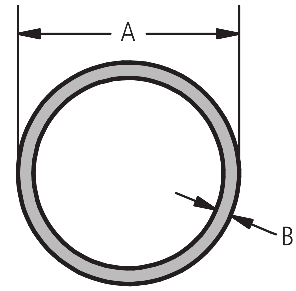
Notes:

1. Current ratings listed in the Tables are based on 30°C temperature rise over 40°C ambient horizontally mounted conductors, with spacing sufficient to eliminate proximity effects, generally assumed not to be significant if spacing is 18 in. or over. Conduction of heat by supporting structures and taps can appreciably affect the ratings.
2. Conductors with a 2ft/sec crosswind. Nominal oxidized surface (e=0.50)
3. Current Ratings for direct current are close to those of alternating current for all except the larger sizes; and for them, the increase for dc bus is about 1.5 percent.
4. NEMA Standard SG1-3.02 (7/13/60) lists current rating for tubes of 57%-61% IACS conductivity, but without stated emissivity factors. However, even after adjustment for the 53% IACS conductivity of 6063-T6 alloy (and 43% for 6061-T6 alloy), the ratings differ somewhat from those of this table.

Seamless Bus Tube

Seamless bus tube is a round, hollow material manufactured to a specific outside diameter (O.D.) and wall thickness. It is produced to meet specific end user requirements. Tubing is described by the actual outside diameter and wall thickness, i.e. 8″ O.D. x 0.500″ Wall aluminum tubing.

Outdoor tubular bus is generally made of 6063-T6 alloy because of its excellent mechanical and electrical properties and is readily available. 6061-T6 tubular conductor is used where very high strength and lower conductivity is required.



Note: For seamless bus tube sizes not listed, contact the AFL Commercial Team.

Outside Diameter of Tube	Wall Thickness	Area	Weight
in	in	sq in	lb/ft
A	B		
8	0.250	6.09	7.16
8	0.375	8.98	10.56
8	0.500	11.78	13.85
8	0.625	14.48	17.03
9	0.250	6.87	8.08
9	0.375	10.16	11.95
9	0.500	13.35	15.70
9	0.625	16.44	19.34

Outside Diameter of Tube	Wall Thickness	Area	Weight
in	in	sq in	lb/ft
A	B		
10	0.312	9.50	11.17
10	0.375	11.34	13.33
10	0.500	14.92	17.55
10	0.625	18.41	21.65
12	0.312	11.46	13.47
12	0.375	13.70	16.11
12	0.500	18.06	21.24
12	0.625	22.33	26.27

Ordering Instructions:

Step 1: Choose Outside Diameter

Outside Diameter	Diameter Code
8	8OD
9	9OD
10	10OD
12	12OD

Step 2: Choose Wall Thickness

Wall Thickness	Thickness Code
1/4″	250W
5/16″	312W
3/8″	375W
1/2″	500W
5/8″	625W

Step 3: Choose Alloy

Alloy Number	Alloy Code
6061	X
6063	Y
6101	Z

Step 4: Choose Temper

Temper	Temper Code
T6	T6
T61	T61
T63	T63

Step 5: Choose Packaging

Package Type	Package Code
Bare - Bat - Bundle (BBB)	B
EHV	E

See pictures on page 3

Step 6: Build Catalog Number

Outside Diameter	+	Wall Thickness	+	Alloy Code	+	Temper	+	Package Code

Example: To order 8 inch OD 1/2″ wall 6101-T61 Alloy Bus Pipe with BBB packaging

8OD	+	500W	+	Z	+	T61	+	B

Completed Catalog Number is 8OD500WZT61B.

Physical & Electrical Properties of Large Diameter Round Tube

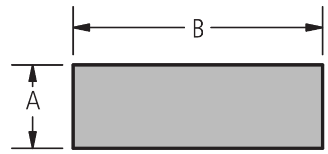
Amperes for 6101-T61 Alloy 57% IACS Conductivity

A	B	Area Sq In	Weight lb/ft	Moment of Inertia 1 in^4	Inductive Reactance 1 ft spacing 60 Hz-Xa microhms/ft	DC Resistance at 20°C microhms/ft	Rac/Rda at 70°C	AC Resistance at 70°C 60 Hz microhms/ft	Current Rating 60 Hz Amp	
Outside diameter in	Wall thickness in								Indoor	Outdoor
8	0.250	6.09	7.16	45.70	25.80	2.348	1.006	2.8070	3805	4720
8	0.375	8.98	10.56	65.44	26.00	1.591	1.030	1.9470	4555	5645
8	0.500	11.78	13.85	83.20	26.20	1.213	1.091	1.5730	5045	6250
8	0.625	14.48	17.03	99.20	26.50	0.987	1.206	1.4140	5190	6435
9	0.250	6.87	8.08	65.80	23.20	2.079	1.006	2.4860	4255	5245
9	0.375	10.16	11.95	94.70	23.30	1.406	1.030	1.7220	5100	6285
9	0.500	13.35	15.70	121.00	23.40	1.070	1.092	1.3890	5650	6965
9	0.625	16.44	19.34	145.00	23.60	0.869	1.308	1.2480	5980	7370
10	0.312	9.50	11.17	111.50	20.60	1.505	1.015	1.8140	5185	6355
10	0.375	11.34	13.33	131.50	20.70	1.260	1.031	1.5430	5635	6910
10	0.500	14.92	17.55	168.80	20.90	0.958	1.092	1.2430	6255	7670
10	0.625	18.41	21.65	203.10	21.00	0.776	1.210	1.1160	6640	8140
12	0.312	11.46	13.47	195.80	16.30	1.247	1.015	1.5040	6155	7480
12	0.375	13.70	16.11	231.60	16.40	1.043	1.031	1.2780	6685	8125
12	0.500	18.06	21.24	299.20	16.60	0.791	1.093	1.0280	7415	9015
12	0.625	22.33	26.27	362.30	16.70	0.640	1.213	0.9219	7850	9545

Notes:

1. Current ratings listed in the Tables are based on 30°C temperature rise over 40°C ambient horizontally mounted conductors, with spacing sufficient to eliminate proximity effects, generally assumed not to be significant if spacing is 18 in. or over. Conduction of heat by supporting structures and taps can appreciably affect the ratings.
2. Conductors with a 2ft/sec crosswind. Nominal oxidized surface (e=0.50)
3. Current Ratings for direct current are close to those of alternating current for all except the larger sizes; and for them, the increase for dc bus is about 1.5 percent.

Rectangular Bar - Sharp Corners (Standard)



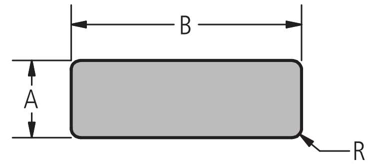
Rectangular shapes are the all-purpose rigid conductor for switchgear, control apparatus and busways. The use of multiple bar bus can provide a large surface area for heat dissipation. Joints and taps are easily made by bolting or welding; it is also easy to make off-sets and 90-degree bends.

For direct current, the capacity of a rectangular bar bus conductor can be controlled by varying the size or number of bars in parallel. The same is true of alternating current up to certain limits. Special arrangements of laminations are used for high-amperage alternating current.

Thickness A	Width B	Estimated Weight per lb/ft
in	in	
1/8 0.125	0.375	0.055
1/8 0.125	0.500	0.074
1/8 0.125	0.500	0.074
1/8 0.125	0.625	0.090
1/8 0.125	0.750	0.110
1/8 0.125	0.875	0.127
1/8 0.125	1.000	0.149
1/8 0.125	1.000	0.145
1/8 0.125	1.250	0.184
1/8 0.125	2.000	0.299
1/8 0.125	2.500	0.371
1/8 0.125	4.000	0.599
3/16 0.188	0.375	0.084
3/16 0.188	0.500	0.112
3/16 0.188	0.625	0.140
3/16 0.188	0.750	0.169
3/16 0.188	0.750	0.168
3/16 0.188	0.875	0.187
3/16 0.188	1.000	0.222
3/16 0.188	2.000	0.442
1/4 0.250	0.500	0.149
1/4 0.250	0.750	0.209
1/4 0.250	1.000	0.284
1/4 0.250	1.250	0.359
1/4 0.250	1.500	0.434
1/4 0.250	2.000	0.584
1/4 0.250	2.500	0.734
1/4 0.250	3.000	0.884
1/4 0.250	3.250	0.959
1/4 0.250	4.000	1.184

Thickness A	Width B	Estimated Weight per lb/ft
in	in	
1/4 0.250	4.500	1.334
1/4 0.250	5.000	1.484
1/4 0.250	6.000	1.784
1/4 0.250	7.000	2.084
1/4 0.250	8.000	2.384
3/8 0.375	0.625	0.277
3/8 0.375	1.25	0.527
3/8 0.375	2	0.895
3/8 0.375	2	0.864
3/8 0.375	2.5	1.120
3/8 0.375	3	1.314
3/8 0.375	4	1.764
3/8 0.375	5	2.214
3/8 0.375	6	2.664
3/8 0.375	8	3.596
1/2 0.5	0.75	0.385
1/2 0.5	1.5	0.896
1/2 0.5	2	1.196
1/2 0.5	3	1.796
1/2 0.5	4	2.396
1/2 0.5	5	2.996
1/2 0.5	6	3.596
1/2 0.5	8	4.796
1/2 0.5	10	5.996
3/4 0.75	1	0.884
3/4 0.75	4	3.455
3/4 0.75	5	4.495
1	1.25	1.498
1	8	9.535
1	10	11.996
1	12	14.364

Rectangular Bar - Rounded Corners (Special Order)



Rectangular shapes are the all-purpose rigid conductor for switchgear, control apparatus and busways. The use of multiple bar bus can provide a large surface area for heat dissipation. Joints and taps are easily made by bolting or welding; it is also easy to make off-sets and 90-degree bends.

For direct current, the capacity of a rectangular bar bus conductor can be controlled by varying the size or number of bars in parallel. The same is true of alternating current up to certain limits. Special arrangements of laminations are used for high-amperage alternating current.

Thickness A	Width B	Radius R	Estimated Weight per lb/ft
in	in	in	
1/8 0.125	0.375	0.031	0.055
1/8 0.125	0.500	0.016	0.074
1/8 0.125	0.500	0.031	0.074
1/8 0.125	0.625	0.062	0.090
1/8 0.125	0.750	0.031	0.110
1/8 0.125	0.875	0.062	0.127
1/8 0.125	1.000	0.031	0.149
1/8 0.125	1.000	0.062	0.145
1/8 0.125	1.250	0.062	0.184
1/8 0.125	2.000	0.031	0.299
1/8 0.125	2.500	0.031	0.371
1/8 0.125	4.000	0.031	0.599
3/16 0.188	0.375	0.031	0.084
3/16 0.188	0.500	0.031	0.112
3/16 0.188	0.625	0.031	0.140
3/16 0.188	0.750	0.016	0.169
3/16 0.188	0.750	0.031	0.168
3/16 0.188	0.875	0.094	0.187
3/16 0.188	1.000	0.062	0.222
3/16 0.188	2.000	0.094	0.442
1/4 0.250	0.500	0.031	0.149
1/4 0.250	0.750	0.125	0.209
1/4 0.250	1.000	0.125	0.284
1/4 0.250	1.250	0.125	0.359
1/4 0.250	1.500	0.125	0.434
1/4 0.250	2.000	0.125	0.584
1/4 0.250	2.500	0.125	0.734
1/4 0.250	3.000	0.125	0.884
1/4 0.250	3.250	0.125	0.959
1/4 0.250	4.000	0.125	1.184

Thickness A	Width B	Radius R	Estimated Weight per lb/ft
in	in	in	
1/4 0.250	4.500	0.125	1.334
1/4 0.250	5.000	0.125	1.484
1/4 0.250	6.000	0.125	1.784
1/4 0.250	7.000	0.125	2.084
1/4 0.250	8.000	0.125	2.384
3/8 0.375	0.625	0.062	0.277
3/8 0.375	1.25	0.188	0.527
3/8 0.375	2	0.062	0.895
3/8 0.375	2	0.187	0.864
3/8 0.375	2.5	0.062	1.120
3/8 0.375	3	0.187	1.314
3/8 0.375	4	0.187	1.764
3/8 0.375	5	0.187	2.214
3/8 0.375	6	0.187	2.664
3/8 0.375	8	0.062	3.596
1/2 0.5	0.75	0.250	0.385
1/2 0.5	1.5	0.062	0.896
1/2 0.5	2	0.062	1.196
1/2 0.5	3	0.062	1.796
1/2 0.5	4	0.062	2.396
1/2 0.5	5	0.062	2.996
1/2 0.5	6	0.062	3.596
1/2 0.5	8	0.062	4.796
1/2 0.5	10	0.062	5.996
3/4 0.75	1	0.125	0.884
3/4 0.75	4	0.375	3.455
3/4 0.75	5	0.062	4.495
1	1.25	0.031	1.498
1	8	0.250	9.535
1	10	0.062	11.996
1	12	0.188	14.364

Bus Conductors

Ordering Instructions

Step 1: Width of Bar

Width of Bar	Width Code
3/8	R375
1/2	R500
5/8	R625
3/4	R750
7/8	R875
1	R1i
1 1/4	R125i
1 1/2	R15i
2	R2i
2 1/2	R25i
3	R3i
3 1/4	R325i
4	R4i
4 1/2	R45i
5	R5i
6	R6i
7	R7i
8	R8i
10	R10i
12	R12i

Step 2: Thickness of Bar

Thickness of Bar	Thickness Code
1/8	125W
3/16	188W
1/4	250W
3/8	375W
1/2	500W
3/4	750W
1	100W

Step 3: Standard Alloy

Alloy Number	Alloy Code
6101	Z

Step 4: Choose Temper

Temper	Temper Code
T6	T6
T61	T61
T63	T63

Step 5: Choose Edge Finish

Type	Radius
Square	(blank)
Rounded	R

See pictures on page 3

Step 6: Build Catalog Number

Width Code + Thickness Code + Alloy Code + Temper + Radius

Example: To order 1 1/4" "wide x 1/8" wall thickness 6101-T6 Bus Bar

R125i + 125W + Z + T6 + R

Completed Catalog Number is R125i125WZT6R.

Current Rating of Rectangular Aluminum Bus Bar Arrangements

Amperes for 6101-T61 Alloy 57% IACS Conductivity

Sizes (Inches)	1 BAR		2 BARS		3 BARS		4 BARS	
	DC	60 HZ AC	DC	60 HZ AC	DC	60 HZ AC	DC	60 HZ AC
1/4 x 1	308	308	607	601	605	887	1203	1168
1 1/2	430	429	833	817	1235	1194	1637	1561
2	549	545	1051	1021	1552	1480	2053	1915
3	780	768	1472	1410	2162	2000	2851	2530
4	1005	980	1878	1760	2749	2462	3619	3081
5	1225	1184	2275	2092	3321	2905	4365	3625
6	1443	1381	2665	2413	3881	3338	5095	4146
7	1870	1760	3427	3034	4974	4183	6517	5152
3/8 x 2	691	678	1340	1278	1989	1831	2638	2332
3	974	941	1857	1709	2739	2384	3620	2946
4	1249	1191	2356	2099	3460	2893	4563	3574
5	1519	1429	2842	2483	4162	3387	5479	4178
6	1785	1657	3320	2847	4848	3857	6375	4765
8	2308	2098	4253	3569	6188	4774	8119	5875
10	2822	2534	5165	4289	7493	5632	9817	6941
1/2 x 3	1145	1074	2205	1991	3265	2742	4324	3297
4	1462	1369	2782	2416	4100	3264	5417	3940
5	1774	1634	3345	2828	4912	3778	6477	4580
6	2081	1892	3897	3230	5706	4284	7514	5210
8	2685	2393	4975	4014	7255	5276	9531	6246
10	3278	2880	6209	4779	8763	6256	1149	7579

Sizes (Inches)	1 BAR		2 BARS		3 BARS		4 BARS	
	DC	60 HZ AC	DC	60 HZ AC	DC	60 HZ AC	DC	60 HZ AC
1/4 x 1	300	300	585	580	775	765	905	880
1 1/2	420	415	800	785	1060	1020	1240	1180
2	535	530	1010	980	1340	1280	1560	1460
3	750	735	1380	1310	1850	1700	2180	1940
4	955	930	1720	1600	2300	2050	2740	2330
5	1160	1120	2000	1830	2670	2330	3160	2610
6	1320	1270	2220	2010	2970	2540	3440	2800
8	1620	1520	2640	2320	3410	2840	3900	3080
3/8 x 2	670	660	1230	1170	1620	1490	1920	1700
3	935	905	1680	1550	2250	1960	2730	2220
4	1190	1130	2080	1860	2800	2340	3360	2630
5	1420	1340	2420	2110	3250	2650	3850	2940
6	1630	1520	2710	2330	3680	2940	4280	3200
8	2000	1820	3240	2700	4210	3270	4820	3490
1/2 x 3	1100	1050	1870	1650	2560	2080	3070	2340
4	1390	1300	2290	1960	3150	2470	3800	2750
5	1650	1520	2680	2240	3630	2780	4370	3090
6	1890	1710	3050	2490	4060	3050	4800	3330
8	2310	2050	3640	2900	4790	3490	5510	3720

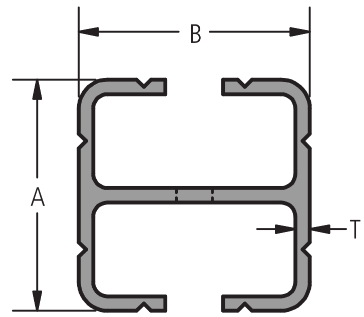
Notes:

1. Ratings based on 30°C rise over 40°C ambient in still but confined air (e=0.35), corresponding to usual indoor temperature. Vertical bar ampacity based on work by House and Tuttle. Horizontal bar ampacity from industry sources.
2. Space between bars is assumed equal bar thickness.
3. For ac phase spacings less than 18 inches an allowance for proximity effect must be made.
4. Ratings are based on horizontal mounting, in air with no attachments. For dc ratings of other alloys, multiply by: For 6101-T61, 0.982; 6101-T63, 0.992; 6101-T64, 1.02; 6101-T65, 0.996. For 60Hz, the use of these multipliers is conservative.

Integral Web (IWBC)

Bus Conductor

This shape is used for station bus, open or enclosed and for the high-current bus of outdoor substations for distribution voltages, as well as for 600-volt bus for industrial plants. AFL offers the integral web bus conductor in both ventilated and non-ventilated conditions. The use of this shape makes it unnecessary to use the spacer clamps or welded tie-bars normally needed across the channels between insulator supports. Although convection airflow is less than that of a face-to-face channel arrangement, transverse strength is greater. The shallow grooves extruded on the surface facilitate location of the centers of drilled or punched holes for attaching base plates and taps.



Size		Wall Thickness	Area	Weight
Height A	Width B	T		
in.	in.	in.	sq. in.	lb/ft
4	4	0.156	2.439	2.87
4	4	0.250	3.781	4.45
4	4	0.312	4.460	5.25
6	4	0.250	4.780	5.62
6	4	0.375	6.020	7.10
6	4	0.375	6.950	8.17
6	5	0.375	7.600	8.94
6	6	0.375	8.600	10.15
6	6	0.550	11.220	13.19
7	7	0.500	12.840	15.10
8	5	0.375	9.080	10.68
8	5	0.500	11.750	13.82
8	8	0.500	16.120	18.96
9	9	0.625	20.040	23.57
10	10	0.625	23.500	27.64

Physical & Electrical Properties of Integral-Web Channel Bus Conductors – 6101-T6 Alloy 55.0% IACS Conductivity (minimum)

Size A in.	Size B in.	Wall Thickness T in.	Area sq. in.	Weight lb/ft	Moment of Inertia, in.⁴ I_{x-x}	Moment of Inertia, in.⁴ I_{y-y}	DC Resistance Rdc-20°C microhms per ft	Current Rating DC 70°C e=0.35 Indoors	Inductive Reactance Xa-60Hz 1 ft spacing microhms per ft	Rac/ RDC70°C 60HZ	AC 60 Hz Resistance Rac-70°C microhms per ft	Current Rating AC-60Hz Indoor e=0.35	Current Rating AC-60Hz Outdoor e= 0.50
4	4	0.156	2.439	2.87	3.876	6.213	6.88	2260	39.02	1.020	7.017	2240	2520
4	4	0.250	3.781	4.45	5.788	9.213	4.42	2810	39.76	1.035	4.579	2276	3115
4	4	0.312	4.460	5.25	6.892	10.94	3.75	3050	40.80	1.050	3.940	2980	3360
6	4	0.250	4.780	5.62	16.35	12.74	3.50	3480	34.80	1.050	3.670	3400	3780
6	4	0.375	6.020	7.10	14.50	14.00	2.78	3900	36.60	1.080	3.000	3760	4180
6	4	0.375	6.950	8.17	22.91	17.45	2.41	4200	----	1.090	2.630	4020	4470
6	5	0.375	7.600	8.94	25.19	29.78	2.20	4500	32.50	1.110	2.440	4320	4800
6	6	0.375	8.600	10.15	29.73	45.98	1.95	5020	27.60	1.110	2.160	4760	5270
6	6	0.550	11.22	13.19	40.05	60.86	1.49	5730	31.40	1.220	1.820	5190	5740
7	7	0.500	12.84	15.10	64.83	95.67	1.30	6530	27.60	1.210	1.570	5940	6540
8	5	0.375	9.080	10.68	52.88	37.59	1.84	5350	29.10	1.120	2.064	5060	5560
8	5	0.500	11.75	13.82	66.84	46.67	1.42	6090	30.00	1.280	1.820	5380	5910
8	8	0.500	16.12	18.96	103.5	152.3	1.04	7740	24.70	1.260	1.310	6890	7550
9	9	0.625	20.04	23.57	162.3	240.1	0.83	9060	21.60	1.370	1.140	7740	8450
10	10	0.625	23.50	27.64	255.6	362.4	0.71	10260	19.10	1.420	1.010	8610	9350

Notes:

1. Current ratings are based on 6101-T61 alloy with standard vent-holes in web. For 6101-T6 reduce the rating by 2 percent. Indoor ratings are based on 30°C rise over 40°C ambient in still but unconfined air, normally oxidized surface (e=0.35) and similarly for outdoor ratings, except 2 ft/sec cross wind (e=0.50). Horizontal mounting is assumed with spacing sufficient to eliminate proximity effects, generally assumed to be 18-in. or over. For temperature rise of 50°C above 40°C ambient, the indoor ratings for 30°C may be increased about 30 percent. Indoor ratings (D-C and A-C) calculated by computer and verified by test rounded. Outdoor ratings are calculations only.
2. For vent and notch arrangements, consult your AFL Sales Representative. The interior perimeter varies according to the washer diameters that are to be accommodated, and as to their location per NEMA spacing. The 12 in. x 12 in. size is a opposite of two symmetric extrusions bolted together.

Ordering Instructions:

Step 1: Choose Size of IWBC

Size of IWBC	Size Code
4″ x 4″	I44
6″ x 4″	I64
6″ x 5″	I65
6″ x 6″	I66
7″ x 7″	I77
8″ x 5″	I85
8″ x 8″	I88
9″ x 9″	I99
10″ x 10″	I101

Step 2: Choose Wall Thickness

Wall Thickness	Thickness Code
5/32	156W
1/4	250W
5/16	312W
3/8	375W
0.550	550W
1/2	500W

Step 3: Standard Alloy

Alloy Number	Alloy Code
6101	Z

Step 4: Choose Temper

Temper	Temper Code
T6	T6
T61	T61
T63	T63

Step 5: Choose Piece Length
Piece Length is a whole number between 10 feet and 40 feet.

Step 6: Build Catalog Number

Size Code + Thickness Code + Alloy Code + Temper + Vented

Example: To order 8″ x 8″ IWBC with 1/2″ wall thickness 6101 T-6 Alloy

I88 + 500W + Z + T6 + V

Completed Catalog Number is I88500WZT6V.

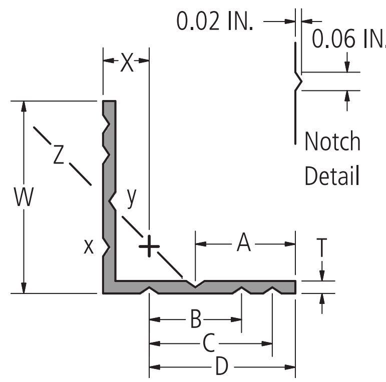
Example: To order 4″ x 4″ IWBC with 1/4″ wall thickness 6063 T-6 Alloy Non-vented

I44 + 250W + Y + T6 +

Completed Catalog Number is I44250WYT6

Universal Angle Bus Conductor (UABC)

The universal angle bus conductor is used for moderate-size outdoor substations at distribution voltages. Centerline grooves make it easy to locate bolt holes. The bus can be mounted directly on insulator caps, since both legs are of uniform thickness. In contrast to the large number of fittings sometimes required for bus installation, angle can be easily installed using bolts. Terminal connectors are used to make taps or flexible connections. Angle shapes are usually made of 6101-T6 alloy.



Same Notching on Other Leg

Standard - Non-Vented

Size W	Size T	Notching Dimensions A	B	C	D	Area sq. in.	Weight lb/ft
in.	in.	A	B	C	D		lb/ft
3 1/4	1/4	1.500	1.750	---	2.375	1.57	1.83
4	1/4	1.875	1.750	2.00	2.813	1.93	2.27
4	3/8	1.875	1.750	2.00	2.813	2.85	3.36
4 1/2	3/8	2.187	1.750	2.00	3.006	3.23	3.80
5	3/8	2.313	1.750	2.00	3.256	3.60	4.24

Ordering Instructions:

Step 1: Choose Size

Size of UABC	Size Code
3 1/4″	A325
4″	A400
4 1/2″	A450
5″	A500

Step 2: Choose Wall Thickness

Wall Thickness	Thickness Code
1/4	250W
3/8	375W

Step 3: Standard Alloy

Alloy Number	Alloy Code
6101	Z

Step 4: Choose Temper

Temper	Temper Code
T6	T6
T61	T61
T63	T63

Step 5: Build Catalog Number

Size Code	+	Thickness Code	+	Alloy Code	+	Temper

Example: To order 5″ 3/8″ Wall Thickness 6106-T6 Alloy UABC

A500	+	375W	+	Z	+	T6

Completed Catalog Number is A500375WZT6.

Physical & Electrical Properties of Uniform-Thickness Angle Bus Conductors – 6101-T6 alloy 55.0% IACS Conductivity (minimum) (4)

Size (3)		Area sq. in.	Weight lb/ft	Moment of Inertia in.^{4}		Minimum Distance to Neutral Axis		Xa - 60 Hz Inductive Reactance 1-ft Spacing microhms/ft	DC Resistance at 20°C microhms/ft	Rac/Rdc at 70°C 60 Hz	AC Resistance at 70°C 60Hz microhms/ft	AC Current Rating 60 Hz Amp (1)	
W in.	T in.			Ix or y	Iz	x or y	z					Indoor e=0.35	Outdoor e=0.50
3 1/4	1/4	1.57	1.83	1.60	0.65	0.91	1.30	51.41	11.20	1.024	11.49	1300	1902
4	1/4	1.93	2.27	3.02	1.18	1.09	1.51	46.60	9.07	1.045	9.46	1550	2236
4	3/8	2.85	3.36	4.35	1.75	1.14	1.60	46.62	6.14	1.115	6.85	1850	2654
4 1/2	3/8	3.23	3.80	6.31	2.61	1.26	1.77	43.93	5.42	1.145	6.20	2050	2885
5	3/8	3.60	4.24	8.75	3.50	1.39	1.96	41.52	4.86	1.175	5.71	2250	3130

Notes:

1. Indoor current ratings are based on 30°C rise over 40°C ambient in still but unconfined air, normally oxidized surface (e=0.35). Outdoor ratings are based similarly, but with 2 ft/sec crosswind (e=0.50). Horizontal mounting is assumed with spacing sufficient to eliminate proximity effects, generally assumed to be 18-in. or over. Indoor ratings based on work by House and Tuttle. Outdoor ratings from IEEE paper by Prager, Pemberton, Craig and Bleshman.
2. Back-to-back angles are to be considered as separate members; not as a composite.
3. Alignment grooves are extruded to facilitate centering of holes according to NEMA standard spacings.
4. A modification of this design has a lug at top that does not interfere with bolting, yet it strengthens the shape against tendency to roll-over to the z-z axis in long spans subjected to large lateral short circuit forces. For equal weight of shape, the z-z radius of gyration is increased by 20 percent. The stress that causes roll-over is thereby increased about 40 percent.

Mechanical Properties of Aluminum Bus Conductors

The Table below shows the mechanical properties of the aluminum alloys and tempers generally used for bus conductor. From this information, the best combination of properties can be selected for a particular application. For example, where the cost of power is important, high electrical conductivity is a key factor. In outdoor applications, mechanical properties are a prime consideration. Other factors, such as yield strength and tensile strength may are taken into consideration.

Mechanical Properties of Aluminum Bus Conductor & Related Alloys

Product	Alloy and Temper	Thickness in.	Tensile Strength (ksi) at 20°C (68oF)		Typical Ultimate (b)	Typical Yield (b)	Typical (a) Elongation (Percent - in 2 in. or 4 Dia.)
			Minimum Ultimate (b)	Minimum Yield (b)			
Extruded rod, bar tube, pipe	6101-T6	0.125-0.500	29.0	25.0	32.0	28.0	15.0
	6101-T61	0.125-0.749	20.0	15.0			
		0.750-1.499	18.0	11.0			
		1.500-2.000	15.0	8.0			
	6101-T63	0.125-0.500	27.0	22.0			
	6101-T64	0.125-1.000	15.0	8.0			
	6101-T65	0.125-0.749	25.0	20.0			
Extruded Pipe (c)	6061-T6	Pipe size 1.0 and over	38.0	35.0	45.0	40.0	10.0 min
	6063-T6	Pipe size, all	30.0	25.0	35.0	31.0	8.0 min

(a) Elongation values apply to specimens of sizes related to product uses.
(b) Values apply to ANSI net stress area of regular or semi-finished bolts.
(c) Values apply to ASTM B241 seamless pipe.

Bending and Forming Bus Conductor

Aluminum bus conductors can be formed by the same procedures and practices that are used for other metals. The most important factors governing to consider when bending bus conductor are:

1. The ductility of the conductor
2. The size and shape of the conductor
3. The method of bending
4. The bending equipment used

A metal must be ductile enough to allow stretching and compression to take place. Elongation alone is not a complete criterion for ductility. The ration of yield strength to tensile strength must also be taken into account. A combination of a high elongation value and a low ratio of yield strength to tensile strength provides the most satisfactory ductility.

The size and the shape of the bus conductor is another factor that must be taken into consideration. For example, in case of a tube, the sharpness of a bend depends not only on the diameter of the tube, but also on the ratio of wall thickness to the diameter. When making edgewise bends of rectangular bar, tests have shown that the radius (in terms of width of the bar) around which a bar can be bent satisfactorily depends not only on the ductility of the car but also on its ratio of width to thickness.

Extruded, rolled, and sawed-plated bus bars can be bent flatwise at room temperature through an angle of 90 degrees to minimum inside radii.

Tubular conductors made alloys 6063-T6 and 6061-T6 are often bent to form turns and offsets In these cases, specifications should require seamless pipe made by holow ingot process (ASTM B241). Ideally, the ratio of tensile yield to tensile ultimate should not exceed 0.85. It is vital to specify that severe forming will be encountered and optimum heat treatments are required.

For substations, inside radii of five to seven times the nominal pipe size for ASA schedules 40 and 80 pipe of 6063-T6 and 6061-T6 alloys should produce satisfactory results with conventional bending tools.

Flatwise Bends for Rectangular Bus

Type of Bar	Alloy and Temper	Thickness in.	Radius min.[1]
Extruded	6101-T6	0.125-0.375	2 x thickness
Extruded	6101-T6	0.376-0.500	2 1/2 x thickness
Extruded	6101-T61	0.125-0.500	1 x thickness
Extruded	6101-T61	0.501-0.749	2 x thickness
Extruded	6101-T61	0.750-1.000	3 x thickness
Extruded	6101-T61	1.001-1.625	4 x thickness
Extruded	6101-T63	0.125-0.375	1 x thickness
Extruded	6101-T63	0.376-0.500	1 1/2 x thickness
Extruded	6101-T63	0.501-1.000	2 1/2 x thickness
Extruded	6101-T64	0.125-0.750	1 x thickness
Extruded	6101-T64	0.751-1.00	2 1/2 x thickness
Extruded	6101-T65	0.125-0.500	1 x thickness
Extruded	6101-T65	0.501-0.749	2 x thickness

1. Applicable to widths up through 6 inches in the T6, T61, T63 and T65 tempers and to widths up through 12 inches for all other listed tempers. Blend radii for greater widths are subject to inquiry.

Deflection Values of Schedule 40 Aluminum Pipe

Conditions	Nominal Pipe Size - in.	10	15	20	25	30	35	40	45	50
Bare	1	0.15	0.76	2.39						
	1 1/4	0.09	0.46	1.45	3.55					
	1 1/2	0.07	0.35	1.09	2.67					
	2	0.04	0.21	0.68	1.65	3.46				
	2 1/2	0.03	0.15	0.47	1.15	2.38	4.22			
	3	0.02	0.10	0.31	0.76	1.58	2.93	5.00		
	3 1/2	0.02	0.08	0.24	0.58	1.20	2.21	3.78	6.07	
	4	0.01	0.06	0.19	0.45	0.94	1.74	2.96	4.76	7.26
	5	0.01	0.04	0.12	0.29	0.61	1.12	1.91	3.08	4.69
	6	0.01	0.03	0.08	0.20	0.42	0.79	1.34	2.15	3.28
1/2 in. ice	1	0.43	2.20	6.96						
	1 1/4	0.24	1.23	3.89	9.62					
	1 1/2	0.17	0.88	2.80	6.83					
	2	0.10	0.52	1.63	4.00	8.36				
	2 1/2	0.06	0.30	0.96	2.30	4.89	9.05			
	3	0.04	0.19	0.60	1.47	3.06	5.72	9.75		
	3 1/2	0.03	0.14	0.44	1.08	2.24	4.16	7.16	11.46	
	4	0.02	0.11	0.34	0.83	1.71	3.17	5.42	8.73	13.31
	5	0.01	0.07	0.21	0.51	1.05	1.95	3.34	5.37	8.19
	6	0.01	0.04	0.14	0.34	0.71	1.32	2.25	3.60	5.49
1/2 in. ice 4 lb Wind Plus Constant	1	0.56	2.85	9.02						
	1 1/4	0.30	1.53	4.84	11.81					
	1 1/2	0.21	1.08	3.40	8.30					
	2	0.12	0.61	1.93	4.70	9.75				
	2 1/2	0.07	0.34	1.09	2.65	5.49	10.17			
	3	0.04	0.21	0.67	1.64	3.40	6.30	10.76		
	3 1/2	0.03	0.15	0.49	1.19	2.47	4.58	7.81	12.51	
	4	0.02	0.12	0.37	0.90	1.86	3.45	5.89	9.43	14.38
	5	0.01	0.07	0.22	0.55	1.13	2.10	3.57	5.72	8.72
	6	0.01	0.05	0.15	0.36	0.75	1.39	2.37	3.80	5.79
1 in. ice	1	0.88	4.44	14.03						
	1 1/4	0.47	2.37	7.47	18.49					
	1 1/2	0.34	1.69	5.35	13.07					
	2	0.18	0.92	2.91	7.09	14.95				
	2 1/2	0.10	0.50	1.59	3.87	8.03	15.06			
	3	0.06	0.31	0.97	2.37	4.91	9.20	15.69		
	3 1/2	0.04	0.22	0.70	1.70	3.53	6.53	11.14	18.06	
	4	0.03	0.16	0.52	1.27	2.63	4.88	8.32	13.49	20.56
	5	0.02	0.10	0.31	0.76	1.57	2.91	4.97	8.05	11.74
	6	0.01	0.06	0.21	0.50	1.04	1.92	3.28	5.26	8.02

Notes:

1. These are maximum deflection values in inches for a simple beam with uniformly distributed load. For beams fixed at both ends, the deflection will be one-fifth of the values given.
2. Deflection d1 for any other span L1 may be obtained from the relation: $d1=d\ L1^4/L^4$

Deflection Values of Schedule 80 Aluminum Pipe

Conditions	Nominal Pipe Size - In.	10	15	20	25	30	35	40	45	50
Bare	1	0.16	0.81	2.56						
	1 1/4	0.10	0.49	1.54	3.77					
	1 1/2	0.07	0.36	1.15	2.82					
	2	0.04	0.23	0.72	1.76	3.65	6.76			
	2 1/2	0.03	0.16	0.49	1.21	2.50	4.64	7.92		
	3	0.02	0.10	0.33	0.80	1.66	3.08	5.25	8.40	
	3 1/2	0.01	0.08	0.25	0.60	1.25	2.32	3.97	6.36	9.69
	4	0.01	0.06	0.19	0.47	0.98	1.82	3.11	4.98	7.58
	5	0.01	0.04	0.12	0.31	0.63	1.17	2.01	3.21	4.89
	6	0.01	0.03	0.09	0.21	0.44	0.82	1.40	2.25	3.43
1/2 in. ice	1	0.40	2.01	6.34						
	1 1/4	0.22	1.11	3.51	8.65					
	1 1/2	0.16	0.79	2.51	6.12					
	2	0.09	0.46	1.45	3.54	7.40	13.72			
	2 1/2	0.05	0.28	0.88	2.15	4.46	8.33	14.20		
	3	0.03	0.17	0.55	1.35	2.80	5.23	8.93	14.30	
	3 1/2	0.02	0.13	0.40	0.99	2.05	3.80	6.50	10.47	15.96
	4	0.02	0.10	0.31	0.75	1.56	2.89	4.95	7.96	12.14
	5	0.01	0.06	0.20	0.49	1.01	1.88	3.20	5.13	7.81
	6	0.01	0.04	0.13	0.32	0.67	1.24	2.11	3.38	5.15
1/2 in. ice 4 lb Wind Plus Constant	1	0.50	2.53	7.99						
	1 1/4	0.27	1.34	4.24	10.36					
	1 1/2	0.94	2.97	7.24						
	2	0.10	0.53	1.66	4.06	8.42	15.60			
	2 1/2	0.06	0.31	0.98	2.39	4.95	9.17	15.65		
	3	0.04	0.19	0.60	1.47	3.06	5.66			
	3 1/2	0.03	0.14	0.44	1.07	2.21	4.10	7.00	11.21	17.08
	4	0.02	0.10	0.33	0.81	1.67	3.09	5.28	8.45	12.88
	5	0.01	0.06	0.20	0.49	1.01	1.88	3.20	5.13	7.81
	6	0.01	0.04	0.13	0.32	0.67	1.24	2.11	3.38	5.15
1 in. ice	1	0.76	3.86	12.21						
	1 1/4	0.40	2.02	6.39	15.80					
	1 1/2	0.28	1.40	4.42	10.79					
	2	0.15	0.77	2.43	5.94	12.46	23.09			
	2 1/2	0.09	0.44	1.38	3.37	6.99	13.10	22.34		
	3	0.05	0.26	0.84	2.04	4.24	7.93	13.53	21.67	
	3 1/2	0.04	0.19	0.60	1.46	3.03	5.61	9.60	15.52	23.65
	4	0.03	0.14	0.45	1.09	2.26	4.19	7.16	11.54	17.59
	5	0.02	0.08	0.26	0.65	1.34	2.48	4.25	6.85	10.44
	6	0.01	0.05	0.17	0.42	0.87	1.61	2.75	4.41	6.72

Notes:
1. These are maximum deflection values in inches for a simple beam with uniformly distributed load. For beams fixed at both ends, the deflection will be one-fifth of the values given.
2. Deflection d1 for any other span L1 may be obtained from the relation: $d1=d\ L1^4/L^4$

Welding Aluminum Bus to Aluminum Connectors

Welding of aluminum in electrical construction offers a superior and economical means of joining conductors. Electric arc welding using an inert gas shield produces mechanically and electrically sound joints requiring no flux or special surface preparation other than the cleaning of the surface to be welded.

A welded connection that is mechanically satisfactory is also electrically satisfactory. With welded connections, there is an essentially homogeneous union that gives a permanent stable connection. It is not necessary to try to produce a connection with the same resistance as bus itself in order to have a stable permanent joint.

There are bus connectors where it is important to insure a resistance ratio of unity with the conductor itself. Small differences in resistance can affect the current distribution in some bus systems. Some bus systems require equalization bars. Welded connections are an ideal solution to both problems. Such connections can be made by following procedures outlined in The American Welding Society Handbook "Welding Aluminum."

General Welding Specifications for Tubular Aluminum Bus Conductor

The following items cover key points that should be included in specifications for welding aluminum bus conductors. It is recommended that the references be reviewed in the preparation of proprietary welding specifications.

1. The welding process and all welding operators should be qualified in accordance with the Aluminum Association, "Aluminum Construction Manual" Section 7.2.4 "Qualification of Welding Procedure and Welding."
2. All Joints to be welded should be free of moisture and hydrocarbon. Moisture can be removed thermally, but the temperature applied should not exceed 250°F (121°C). Degreasing should be done with a non-toxic solvent so as to leave a minimum of residual on the parts. Sufficient time must be allowed for evaporation of the solvent prior to welding. Wire brushing with a stainless steel wire brush should be employed after solvent cleaning to remove thick heat-treat oxide films, water stains, etc., to permit optimum fusion and soundness of the weld.
3. All welds should be made by the gas metal-arc (MIG) or the gas tungsten-arc (TIG) welding process. Reversed polarity direct current should be used for MIG welding, whereas alternating current should be used for TIG welding. The shielding gas should be welding grade Argon, Helium, or a mixture of the two. Filler alloy 4043 should be used.
4. The working area should be substantially draft free and should be protected from atmospheric contamination.
5. All connections should be checked before, during and after the weld is made. Before the weld is begun, visually inspect the connection to determine proper edge preparation and alignment. During the weld, maintain a smooth and continuous flow of metal into the joint and maintain a constant current setting on the welding station. When several passes are to be made, check the previous pass before laying down the next one to enable detection of poor fusion or cracks. Defective areas should be removed with a dry chisel prior to application of subsequent weld passes. After the weld has been complete, it should be visually inspected again for quality and to insure the weld bead is of the correct size. The cross sectional area of the weld should not be less than that of the smallest member being joined.
6. Members being joined should be tack welded in place to prevent misalignment during the welding process.