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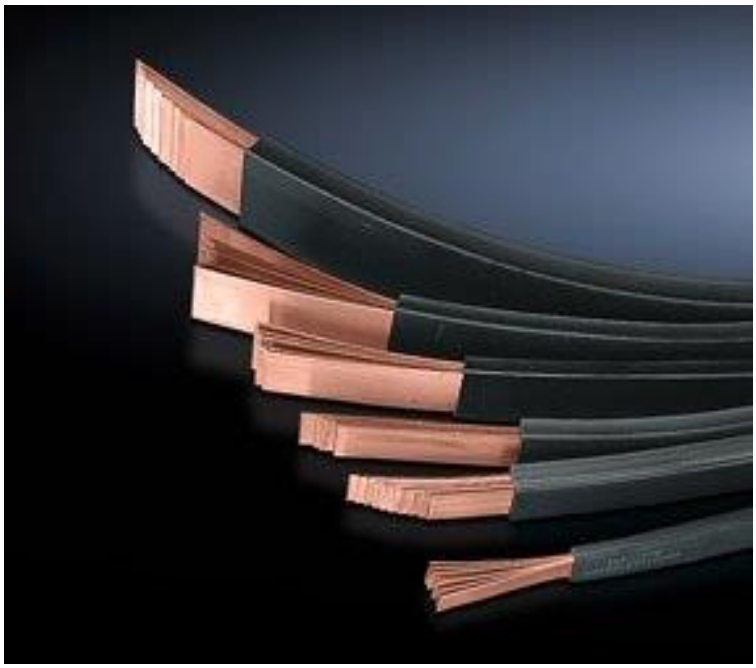
TECH PAPER: The Flexible Busbar Advantage

ENCLOSURES | POWER DISTRIBUTION | CLIMATE CONTROL | IT INFRASTRUCTURE | SOFTWARE & SERVICES

FRIEDHELM LOH GROUP

Executive Summary

What is Flexible Busbar?



Flexible busbar consists of pure electrolytic copper laminates within a protective PVC jacket. The individual laminates slide smoothly against one another allowing the flexible busbar to be easily shaped, twisted and bent to fit a wide range of panel layouts. When compared to standard round cable, flexible busbar offers space saving advantages due to a tighter bend radius and the ability to replace multiple round conductors with a single piece of flexible busbar. Modification of fewer conductors and the elimination of ring terminals can result in significant cost reduction.

The Flexible Busbar Advantage

- **Space Advantage**
  - Requires less wire bending space than cable.
  - With greater ampacities, a single piece of flexible busbar can replace multiple runs of cable.
  - Protective PVC jacket allows the flexible busbar to be mounted in tight areas where rigid busbar could not be used.
- **Time Advantage**
  - Eliminates the need for lugs which reduces installation time and cost.
  - Can replace rigid busbar designs eliminating the time spent engineering and fabricating rigid busbar.
  - Easier to bend and shape than large cables, so installation is quicker.
- **Operating Advantage**
  - Greater surface area is utilized when making connections with flexible busbar, so the connection points are at a lower operating temperature.
  - Ring terminals are no longer needed. Simply punch or drill through the exposed end of the flexible busbar to bolt to rigid bus or electrical components.
- **Aesthetic Advantage**
  - Increases design flexibility.
  - Neatly organizes hard-to-make connections.

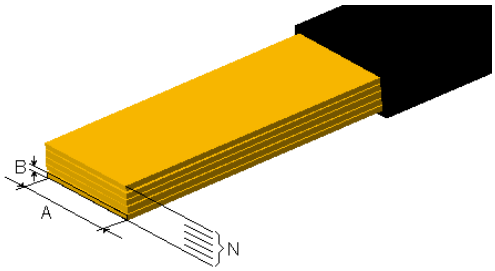
Applications

- Low Voltage Power Distribution and Control Applications
- Busbar Systems
- Motor Control Centers
- Drive Systems
- Switchboards
- Transformers
- Panelboards
- Control Panels
- Power Supplies
- Electrical Machinery
- UPS Systems

Technical Specifications

- **Agency Approvals**
  - cURus
  - CSA Certified
- **Conductor**
  - 99.9 % pure copper (tinned copper available on request)
  - Conductivity: 57 S x m/mm^2
  - Resistivity: 0.01758 Ω mm^2/m
- **Insulator**
  - Special high-quality PVC
  - Self-extinguishing per UL 94 VO
  - Thickness of ≥ 1.6 mm
  - Dielectric strength of 20 kV/mm
  - Elongation 370%
  - Temperature range: -20 to 105° C dry
  - UL operating voltage 600 VAC and 750 VDC
  - IEC operating voltage 1000 VAC and 1500 VDC

- **Ampacities**

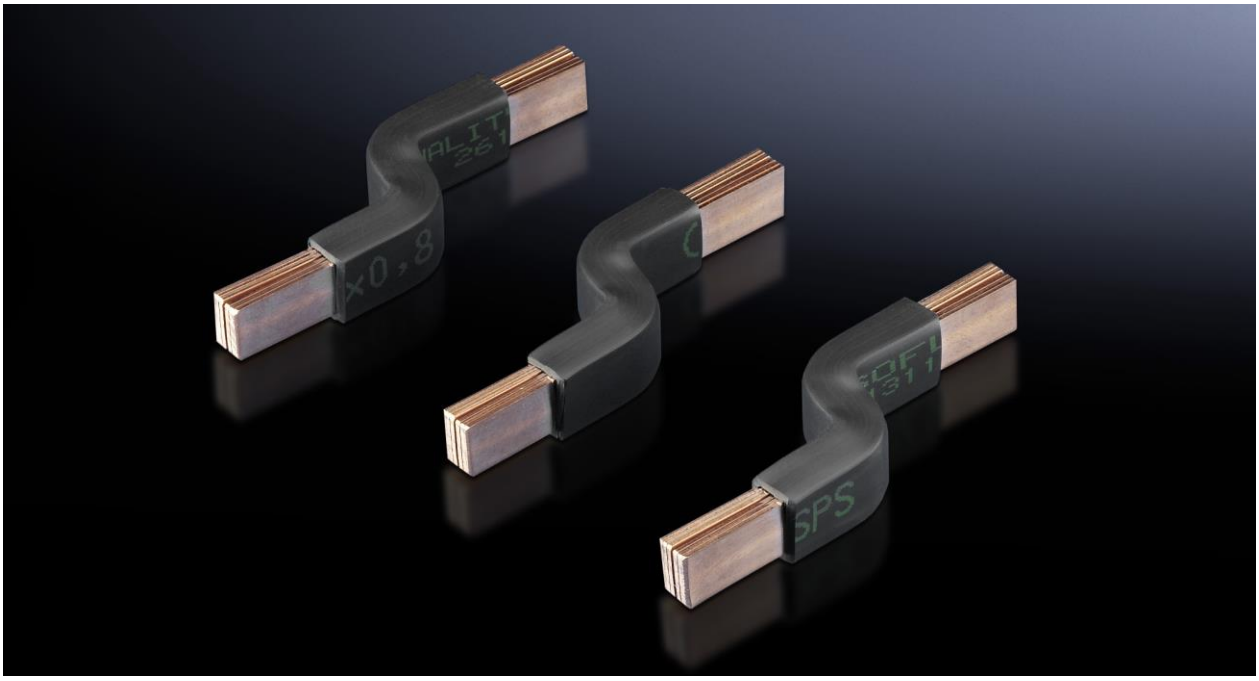


N	A (mm)	B (mm)	Length (mm)	Rated Ampacity Temp. Rise of [1]			Part No.
				70°C	50°C	30°C	
8	6	0.5	2000	195	165	125	3565015
6	9	0.8	2000	285	250	180	3565005
4	15.5	0.8	2000	330	275	210	3567005
6	15.5	0.8	2000	415	350	265	3568005
10	15.5	0.8	2000	575	480	365	3569005
5	20	1	2000	525	435	330	3570005
5	24	1	2000	605	510	385	3571005
10	24	1	2000	920	770	585	3572005
5	32	1	2000	770	645	485	3573005
10	32	1	2000	1155	965	730	3574005
5	40	1	2000	930	780	590	3575005
10	40	1	2000	1370	1145	865	3576005
5	50	1	2000	1125	940	710	3577005
10	50	1	2000	1635	1365	1030	3578005
10	63	1	2000	1950	1610	1230	3579005

[1] The conductor temperature of the laminated copper busbar is derived from the sum total of the ambient temperature and the temperature increase.

Cable Comparison

Ampacity (at 50°C rise)	Part No.	Configuration (NxAxB)	Substitute For These Comparable Cable Sizes
165	3565015	8x6x0.5	#1 AWG
250	3565005	6x9x0.8	1 x 3/0 or 2 x #3 AWG
275	3567005	4x15.5x0.8	1 x 4/0 or 2 x #2 AWG
350	3568005	6x15.5x0.8	1 x 350 kcmil or 2 x 1/0 or 3 x #3 AWG
480	3569005	10x15.5x0.8	1 x 600 kcmil or 2 x 3/0 or 3 x #1 AWG
435	3570005	5x20x1	1 x 400 kcmil or 2 x 2/0 or 3 x #2 AWG
510	3571005	5x24x1	1 x 600 kcmil or 2 x 3/0 or 3 x 1/0 AWG
770	3572005	10x24x1	1 x 2000 or 2 x 400 kcmil or 3 x 3/0 AWG
645	3573005	5x32x1	1 x 1000 or 2 x 300 kcmil or 3 x 2/0 AWG
965	3574005	10x32x1	2 x600 or 3 x 300 or 4 x 250 kcmil
780	3575005	5x40x1	1 x 2000 or 2 x 400 kcmil or 3 x 4/0 AWG
1145	3576005	10x40x1	2 x 800 or 3 x 400 kcmil
940	3577005	5x50x1	2 x 500 or 3 x 250 kcmil
1365	3578005	10x50x1	2 x 1250 or 3 x 500 or 4 x 400 kcmil
1610	3579005	10x63x1	3 x 800 or 4 x 600 or 5 x 400 kcmil



Electrical Connections

- Flexible busbar surface conditions – The surface of the flexible busbar should be flat but not polished. Clean the surface of the flexible busbar so that it is free of oxide and grease.
- Connection overlap – The recommended overlap is at least 5 times the thickness of all of the laminates.

Recommended Bolt Sizes

Ampacity (at 50°C rise)	Part No.	Configuration (NxAxB)	Min. Overlap mm	Bolt	
				Qty	Size
165	3565015	8x6x0.5	20	1	clamp
250	3565005	6x9x0.8	24	1	clamp
275	3567005	4x15.5x0.8	16	1	clamp
350	3568005	6x15.5x0.8	24	1	clamp
480	3569005	10x15.5x0.8	40	1	clamp
435	3570005	5x20x1	25	1	5/16-18
510	3571005	5x24x1	25	1	7/16-14
770	3572005	10x24x1	50	1	7/16-14
645	3573005	5x32x1	25	2	7/16-14
965	3574005	10x32x1	50	2	7/16-14
780	3575005	5x40x1	25	2	1/2-13
1145	3576005	10x40x1	50	2	1/2-13
940	3577005	5x50x1	25	2	1/2-13
1365	3578005	10x50x1	50	2	1/2-13
1610	3579005	10x63x1	50	3	1/2-13

- Clamping torque values – Using an SAE Grade 5 bolt along with flat and contact washers on both sides of the connection:

Recommended Torque Specs

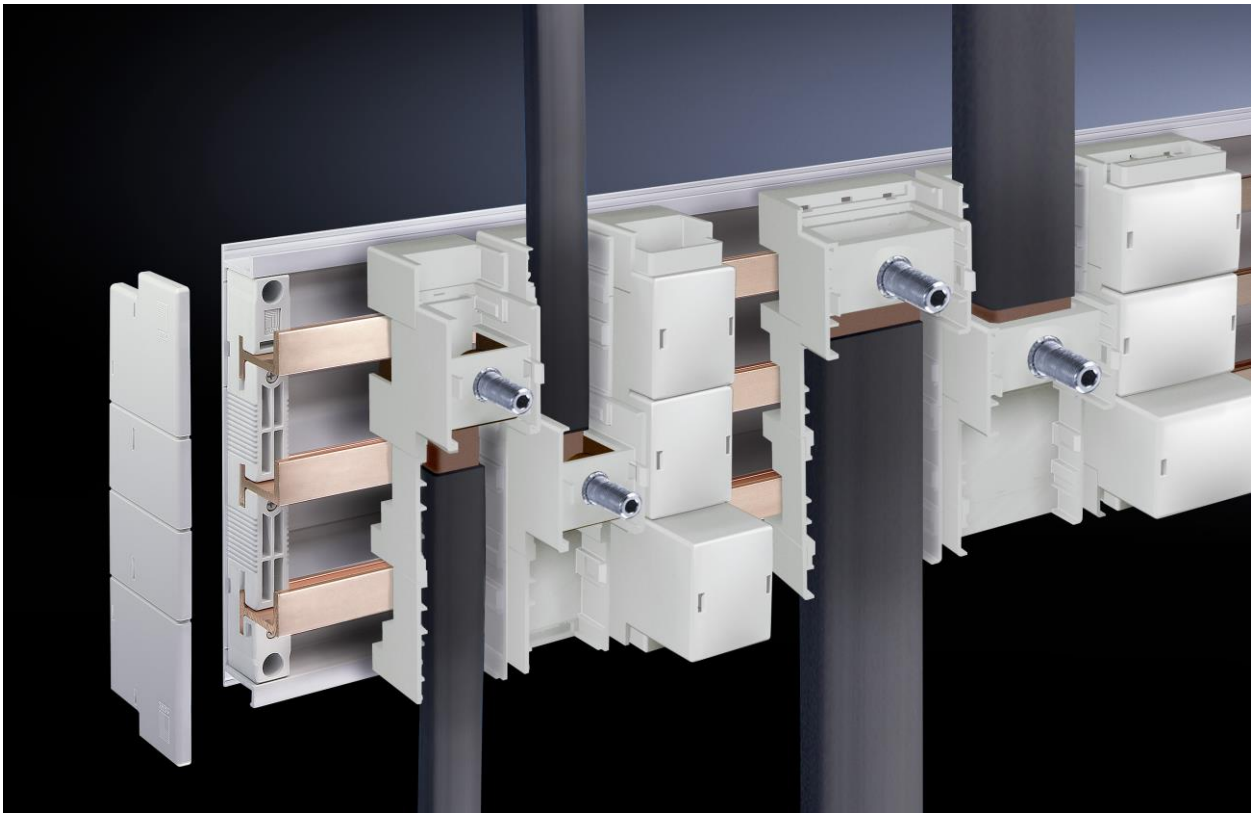
	Bolt Size					
	1/4-20	5/16-18	7/16-14	1/2-13	9/16-12	5/8-11
Torque (lb-ft)	9	18	50	75	110	150

Additional Recommended Fabrication Procedures

- Holes **-** The minimum distance of the flexibar edge to nearest edge of hole is 3/16 in.
    - Tip: When drilling through the flexible busbar, clamp the laminates together so that they do not ride up the drill bit.
- Bending Radii – The bend radius should be greater than or equal to 1/2 in. or the radius should equal 1/8 in. x the number of laminates.
    - Tip: Since the copper laminates will slide freely within the insulating jacket, follow the below procedure when shaping a piece of flexible busbar.
        - Strip the insulating jacket on one end of the flexible busbar.
        - Clamp the copper laminates and drill the bolt hole(s) in the exposed end of the flexible busbar. Only drill holes in one end of the part.
        - Insert a temporary “holding” bolt into the hole, that has been drilled, then form the flexible busbar into the desired shape.
        - Cut the flexible busbar at the unexposed end to the desired length then strip that same end to reveal the copper laminates. Clamp the laminates together and drill the required bolt-holes.
- Twisting – When twisting flexible busbar along its length, it is recommended that the part is not twisted greater than 90 degrees. The length allowance for a 90-degree twist should be at least three times the width of the flexible busbar (including the insulating jacket).

The “Flexible” solution…

This reliable alternative to cable or rigid bus will allow more “flexibility” in panel designs as well as save space and build-up time.



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