NHP

100 percent Australian Owned

TECHNICAL NEWS

Issue 37 NOV 2002

Please circulate to

Quarterly Technical Newsletter of Australia's leading supplier of low-voltage motor control and switchgear.

IS YOUR COPPER FLEXIBLE?

Written by William Mairs
Technical Manager, NHP Electrical Engineering Products Pty Ltd

Slicing a copper bar into thin strips allows it to become flexible. Wrapping the strips with an insulating material keeps it all together. While flexible busbars have been available for some time their use is still expanding as the potential cost savings become more apparent. Anything that can reduce labour inputs into a switchboard assembly can potentially reduce costs.

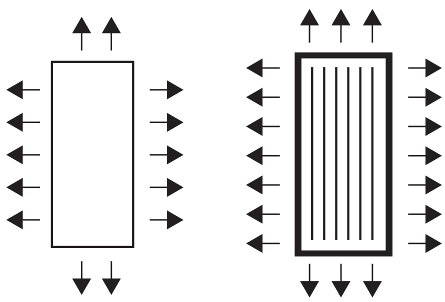
The flexible busbar fits between a cable and solid bars. It has a mixture of the advantages of both conductor styles. The application of flexible busbars still causes a lot of confusion as most data available only relates to cables or solid bars. This article is intended to improve the general understanding of flexible busbars.

Flexible busbars can reduce assembly cost

1. Rating

For most electrical equipment it is the temperature rise caused by the passage of current that determines the current rating. For cables and the flexible busbar the allowable temperature of the insulating sheath provides the limit. For a solid busbar it is the long term annealing temperature that has been used to set the limit. The long term annealing temperature is taken to be 105 ˚C and therefore bare bars have much the same temperature limit as a bar insulated with PVC. In switchboards it is important to maintain the rigidity of the bars so they can withstand the forces during a possible short circuit.

While the temperature limit may be much the same for the three types of conductors other factors must be considered.
The effective cooling of the conductor surface is influenced by the available cooling area. For a round cable configuration the surface area is at a minimum and this gives the poorest cooling effect. As the surface area of a cable increases in proportion to the diameter and the cross sectional area



The emissitivity of isolated flexible busbars is high than bare copper. Higher current ratings are possible.

IN THIS ISSUE

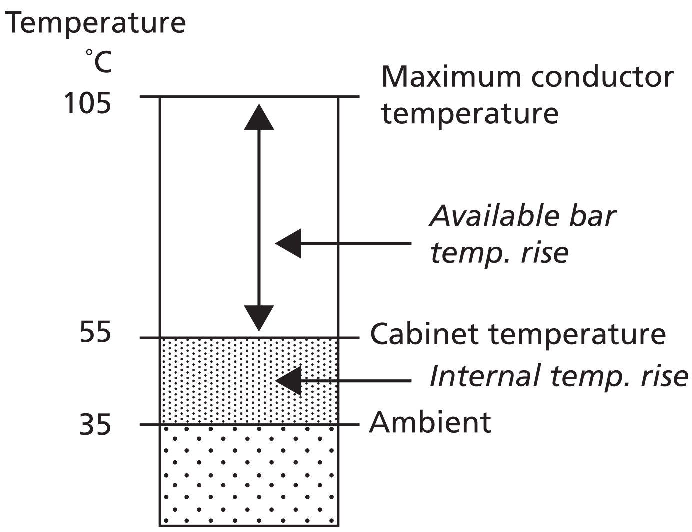
increases in proportion to the square of the diameter, the larger the cable the poorer the cooling. With busbars, if the width is say doubled then the current rating is doubled. Therefore flat bars can carry the same current as a cable with less copper. This can be in the order of a 25% copper reduction.

The emissivity or the ability of the surface of the conductor to radiate heat also comes into play. The surface of bright copper is not as efficient as the surface of the PVC used on flexible busbars in radiating heat. The flexible busbars can have a small rating advantage over the bare bar because of this.

2. Current derating

As the main factor that determines the current rating of electrical equipment is the maximum allowable temperature, any external factors that will increase the operating temperature must be compensated for. For cables the standard AS/NZS3008.1 provides extensive tables for cable ratings when applied in different installations. These tables have been derived from tests and calculation. In the case of busbars the information is presented in a different manner but the aim is the same. That is to limit the maximum temperatures.

Given that the temperature of the flexible busbar is limited to 105 ˚C then the current it can carry will depend on the maximum cabinet temperature it is required to work in. If the maximum temperature of the cabinet is say 55 ˚C then the temperature rise of the bar due to the passage of current is limited to 50 ˚C. Using this temperature rise a suitable bar size can be selected to suit the required current. Unfortunately this approach requires a calculation of the cabinet temperature. Australian standard AS4388 provides a guide on how to perform this calculation or the NHP Temperformance programme can be used. This programme is based on AS4388. A method of temperature-rise assessment by extrapolation for partially type-tested assemblies (PTTA) of low-voltage switchgear and control gear. A typical switchboard will have an internal temperature rise of 20 ˚C and when this is added to a maximum room ambient of 35 ˚C the busbars need to be rated to operate in 55 ˚C.



Total cabinet temperature determines the available temperature rises on conductors.

3. Connection to switchgear

As electrical switchgear is rated on the basis of 'standard test conductors' care must be taken when selecting conductors that will connect directly to the device terminals. Overheating of the device may result if the connecting copper work is not of adequate size. To allow for this, reduce the temperature rise of the busbar by 20˚C. If the cabinet temperature is 75 ˚C then the permissible temperature rise of the bar becomes 30 ˚C and not 50˚C as in the above example.

Conductors connecting directly to switchgear should have a lower temperature rise

4. Short circuit strength

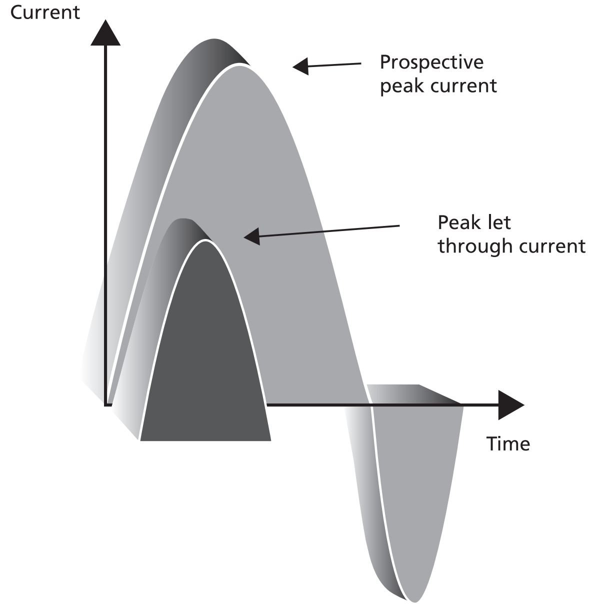
Short circuit current levels will cause displacement of flexible busbars in much the same way as cables. The insulation prevents any dielectric problems but if the short circuit is of comparatively long duration then the flexing may damage the conductors or loosen the joints. Supports should be provided to restrain the movement.

5.

Special supports are available for flexible busbars

Short circuit thermal withstand

During a short circuit the conductors are heated rapidly. It is usually the insulation materials that set a limit to how high the temperature will go without damage. A typical limit is 170 ˚C. This can cause significant softening of the insulation but as it is only for a very brief period it does not cause long term damage. For heavy current busbar systems the rigidity of the bars is important to the ability to withstand the mechanical forces. Temperatures must be kept below a level that may cause annealing of the copper and again 170 ˚C is a typical figure for a short term peak.



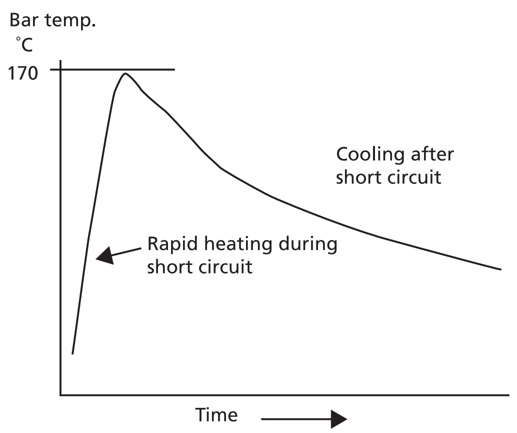
Moulded case circuit breakers reduce both the peak current and duration of a short circuit

6. Short circuit protection

Relays for short circuit protection are usually time graded so that only the device near the fault trips. It is common for trip times on the main busbar systems to reach one second. This means the main conductors must withstand both the thermal and mechanical forces created by the fault current for a comparatively long time. While the flexible busbar is basically equivalent to the solid bar in respect to thermal performance it does not have the rigidity and is best suited to applications where the protective device will limit the peak currents and fault duration to low levels. This includes all applications below a moulded case circuit breaker or fuse and any tee off's from the main bars to these devices.

7. Insulation strength

The insulation on most flexible busbars is intended for use on low voltage systems (below 1000 V) within a protective enclosure. The withstand voltage may be quoted in the order of 20 kV but it is not suitable for system voltage as high as this. This does not stop flexible busbars being used at voltages above 1000 V



Copper and insulating materials can withstand short term peak temperature.

but the bar coating should not be relied upon to meet the insulation requirements of the system.

8. Bending

Flexible busbars flex easily in one plane but not the other. It is easy to overcome this problem by folding the bar to change direction but a neater installation will be achieved if equipment is laid out in a manner that keeps the bends in one plane.

9. Conclusion

Flexible busbars can offer cost reductions in switchboard manufacture. They are quick to terminate as no lug is required and can take on awkward shapes by simple hand bending. They best suit the mid range of currents (100 – 1500 A).

If you would like previous copies of Technical News, please complete the following form and **fax to NHP on (03) 9429 1075** marked to the attention of the **Marketing Services Department.**

Name:..Title:...

Company: ....

Address: ....

Telephone: ( ) ....Fax: ( )...

☐ **CPB**

Other titles currently available. Please tick those you would like to receive.

- ☐ Controlling high short circuit currents with current limiting circuit breakers (short circuit co-ordination KT 7)
- ☐ EMC - what's all the noise about (understanding EMC)
- ☐ How does electrical equipment rate (Understanding ratings of electrical equipment)
- ☐ The quality Switchboard (Switchgear and protection devices for Switchboards)
- ☐ RCDs are saving lives (Earth leakage protection; RCDs)
- ☐ Terminations, good or bad? (Terminals)
- ☐ Power factor what is it?(Power factor and correction equipment)
- ☐ Set the protection (MCCB breakers and application)
- ☐ IP ratings what do they mean? (IP Ratings, use and meaning)
- ☐ Utilisation categories (Electrical life of switches)
- ☐ Don't forget the motor protection (Motor protection devices and application)
- ☐ Electrical life of contactors (How and why contactors are tested)
- ☐ Taking the 'hiss' out of DC switching (DC switching principles)
- ☐ Start in the correct gear (Application of different motor starters)
- ☐ Application guide to lamp selection (Industrial pushbutton controls)
- ☐ Electrical surges can be expensive (Electrical surges)
- ☐ The thinking contactor (The development of the contactor)
- ☐ Some don't like it hot (Temperature rise in electrical switchgear)
- ☐ Pollution of the airwaves (Unwanted signals and their effects on motor protection devices)
- ☐ What's the difference about safety (Safety devices and their application)
- ☐ Talk about torque (Motors and torque)
- ☐ Keep Cool (Derating)
- ☐ Does your CT measure up?

Editorial content: - Please address all enquiries to 'The Editor - 'NHP Technical News'
PO Box 199, Richmond, Victoria, 3121.

NHP Electrical Engineering Products Pty Ltd A.B.N. 84 004 304 812
www.nhp.com.au
AUSTRALIA
VICTORIA
MELBOURNE
43-67 River Street
Richmond VIC 3121
Phone (03) 9429 2999
Fax (03) 9429 1075
NEW SOUTH WALES
SYDNEY
30-34 Day Street North,
Silverwater NSW 2128
Phone (02) 9748 3444
Fax (02) 9648 4353
NEWCASTLE
575 Maitland Road
Mayfield West NSW 2304
Phone (02) 4960 2220
Fax (02) 4960 2203
QUEENSLAND
BRISBANE
25 Turbo Drive
Coorparoo QLD 4151
Phone (07) 3891 6008
Fax (07) 3891 6139
TOWNSVILLE
62 Leyland Street
Garbutt QLD 4814
Phone (07) 4779 0700
Fax (07) 4775 1457
ROCKHAMPTON
14 Robison Street
Rockhampton QLD 4701
Phone (07) 4927 2277
Fax (07) 4922 2947
TOOWOOMBA
Cnr Carroll St & Struan Crt
Toowoomba QLD 4350
Phone (07) 4634 4799
Fax (07) 4633 1796
CAIRNS
14/128 Lyons Street
Bungalow QLD 4870
Phone (07) 4035 6888
Fax (07) 4035 6999
SOUTH AUSTRALIA
ADELAIDE
36-38 Croydon Road
Keswick SA 5035
Phone (08) 8297 9055
Fax (08) 8371 0962
WESTERN AUSTRALIA
PERTH
38 Belmont Ave
Rivervale WA 6103
Phone (08) 9277 1777
Fax (08) 9277 1700
NORTHERN TERRITORY
DARWIN
3 Steele Street
Winnellie NT 0820
Phone (08) 8947 2666
Fax (08) 8947 2049
TASMANIA
HOBART
2/65 Albert Road
Moonah Tasmania 7009
Phone (03) 6228 9575
Fax (03) 6228 9757
NEW ZEALAND
NHP Electrical Engineering Products (NZ) Limited
7 Lockhart Place
Mt Wellington Auckland NZ
Phone 64 9 276 1967
Fax 64 9 276 1992
476 St Asaph Street
Linwood, Christchurch NZ
Phone 64 3 389 7604
Fax 64 3 389 7605

Version 6