

BESHIELDING

BUSBAR | ENGINEERING | SHIELDING

**The BESHIELDING shielded busbar
trunking system**



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Introduction

Often, the need for extremely low magnetic flux density in the environment, as in laboratories where high-sensitivity devices are installed (e.g., electron microscopes), requires careful design of magnetic shielding systems capable of achieving high attenuation factors.

In particular, when laboratories are located near ELF (Extremely Low Frequency) sources (typically 50 or 60 Hz), magnetic shielding must ensure a global reduction of the magnetic field from several μT down to 0.1 or 0.2 μT ^[1].

Beyond the limits imposed near sensitive equipment, several countries, especially in Europe, have also established mandatory limits for the long-term protection of the population ^[2].

A recent example is the restriction on low-frequency magnetic fields introduced in France in 2013. The “Ministère de l’Écologie, du Développement Durable et de l’Énergie” published guidelines on the maximum allowable magnetic flux density in sensitive areas such as hospitals, maternity wards, nurseries, kindergartens, primary schools, etc.

This value is set at 0.4 μT as a 24-hour average. To comply with this limit, a safety distance (“bordure de zone de prudence”) corresponding to 1 μT must be ensured for new installations such as overhead and underground cables, transformer stations, and similar infrastructure.

Active and/or passive shielding solutions can sometimes be used separately or in combination to better meet magnetic field reduction requirements ^[3] ^[4].

Furthermore, for passive solutions, it is possible to simultaneously shield both the cleanroom and the various sources to achieve greater magnetic attenuation.



The most effective solution, however, is to minimize the magnetic fields generated by the sources themselves.

For this reason, BESHielding has developed a compact busbar trunking system that is inherently shielded, capable of reducing the magnetic flux density by about 20 times compared to an equivalent compact unshielded system.

Even for larger sizes, BESHielding’s busbar trunking systems provide extremely low magnetic field levels at relatively short distances.

Therefore, BESHielding products are suitable for power transmission and distribution in critical environments such as laboratories and cleanrooms, where extreme levels of electromagnetic immunity are required.

BIBLIOGRAPHY

- ^[1] D. A. Muller and John Grazul, “Optimizing the environment for sub-0.2nm scanning transmission electron microscopy”, *Journal of Electron Microscopy*, vol. 50(3), pp. 219-226, 2001.
- ^[2] S. Kandel, ELF policies worldwide – protection of general public, in: WHO Workshop, 2007 June.
- ^[3] D. Bavastro, A. Canova, F. Freschi, L. Giaccone, and M. Manca, “Magnetic field mitigation at power frequency: design principles and case studies,” *IEEE Trans. Ind. Appl.*, vol. 51, pp. 2009–2016, May 2015.
- ^[4] J. C. del-Pino-López, L. Giaccone, A. Canova, P. Cruz-Romero, Design of active loops for magnetic field mitigation in MV/LV substation surroundings, *Electric Power Syst. Res.* 119, 337–344, 2015.

Laboratory tests

The comparison between the performance of a traditional compact busbar trunking system and a shielded compact version is carried out through accurate laboratory testing.

The test setup consists of two sections connected in series, one shielded and one unshielded, powered by a controlled current source, as shown in Fig. 1.

The unshielded section is positioned closer to the power supply source.

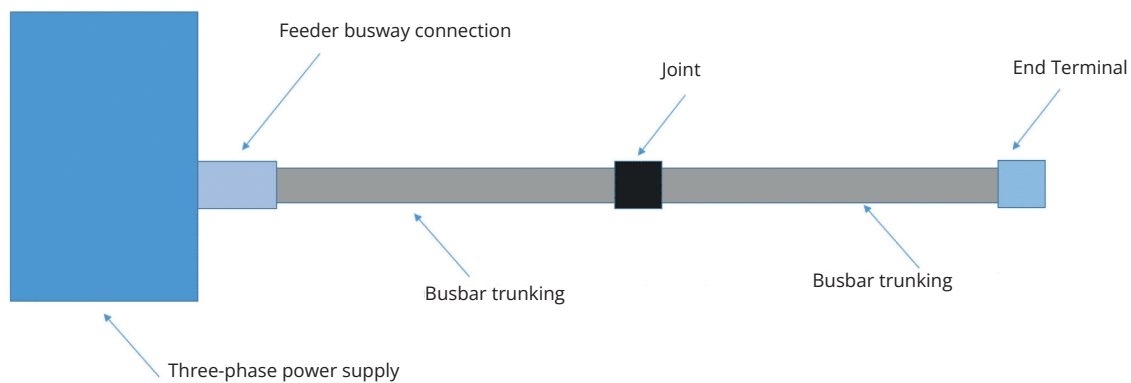


Fig. 1 Basic schematic of the system for busbar trunking test

Measurements were carried out at various distances from the busbar trunking system, along the axes referred to as “lateral” and “top”, as shown in Fig. 2.

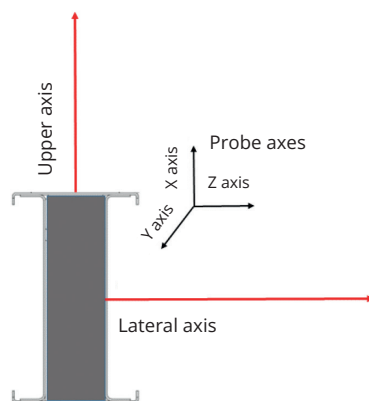


Fig. 2 Magnetic flux density measurement axes

The measurements were repeated at multiple sections along the y-axis, i.e., parallel to the axis of the busbar trunking system (as shown in Fig. 3).



Fig. 3 Position of the probe for measuring magnetic flux density along the busbar trunking system

To highlight the high performance of BEShielding solutions, a performance comparison between a shielded and an unshielded busbar trunking system is presented.

Fig. 4 shows the trend of the magnetic flux density measured along a 2000 A busbar trunking system composed of two sections: the first unshielded and the second shielded. It is clearly observable that in the shielded section, the magnetic flux density drops significantly compared to the unshielded section.

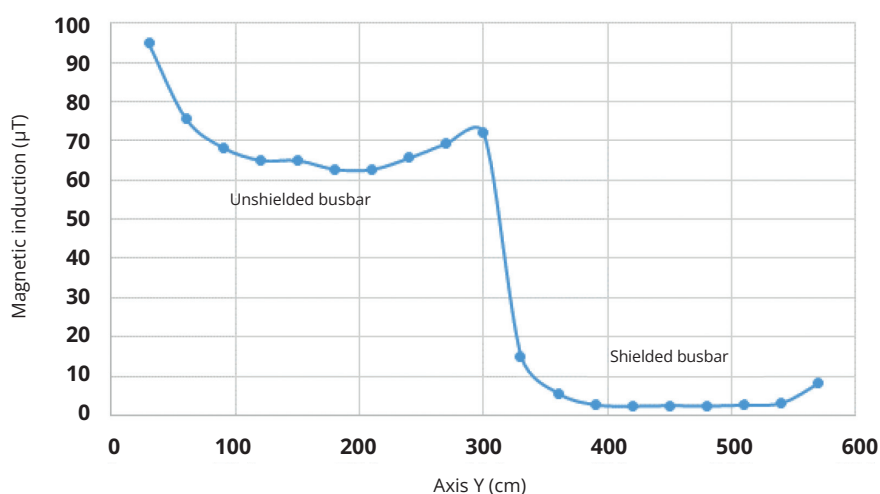


Fig. 4 Magnetic flux density trend along the axis of the busbar trunking system: comparison between unshielded and shielded section

Performances

The main objective of the shielded busbar trunking system is to reduce the magnetic flux density generated at a given distance and to a specified value.

The key parameter that defines its performance is, therefore, the distance from the busbar trunking system at which the magnetic flux density falls below the susceptibility threshold of the “victim”.

For example, when referring to people, where compliance with Italian legislation on long-term exposure must be ensured, the target is the so-called quality objective, set at 3 μT .

In the case of sensitive electronic equipment, such as electron microscopes, the required magnetic field level must not exceed 0.1 μT .

It is therefore crucial, during the design phase of electrical routing layouts, to take these factors into consideration.

Accordingly, in defining the performance of BESHielding’s shielded busbar trunking systems, particular emphasis has been placed on these operational aspects.

A table is provided specifying, based on the busbar’s current rating and the desired magnetic field level, the distance from the busbar that ensures compliance with non-interference requirements.

The following section defines the required distances corresponding to three magnetic flux density thresholds: 3 μT , 1 μT , and 0.1 μT .

For the 3 μT level, it is also noted that the required distances vary depending on whether the measurement is taken near a joint—where busbars spread apart and produce a stronger field—or near a straight section of the busbar.

Due to the geometry of the system, different distances are also specified depending on the axis considered (horizontal or vertical), as illustrated in Fig. 5.

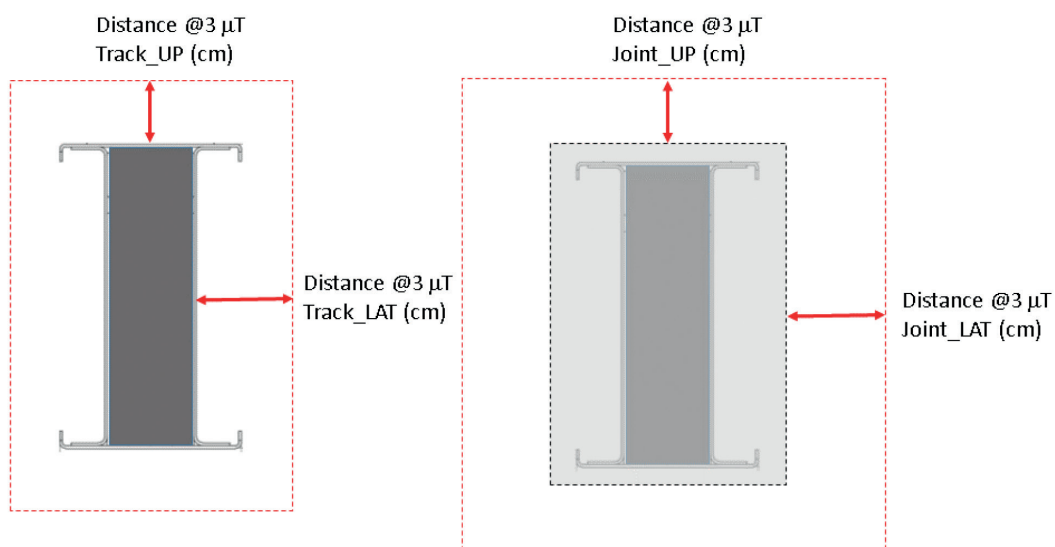


Fig. 5 Distances from the busbar trunking system and joint corresponding to the 3 μT limit

For the 1 μT and 0.1 μT thresholds, since the magnetic flux density exhibits a “circular” distribution, it is preferable to define a radius measured from the center of the busbar trunking system.

At these distances, the effect of the joint, being localized, can be considered negligible. Therefore, this “radius” can be assumed to correspond to that of the busbar trunking system itself (Figure 6).

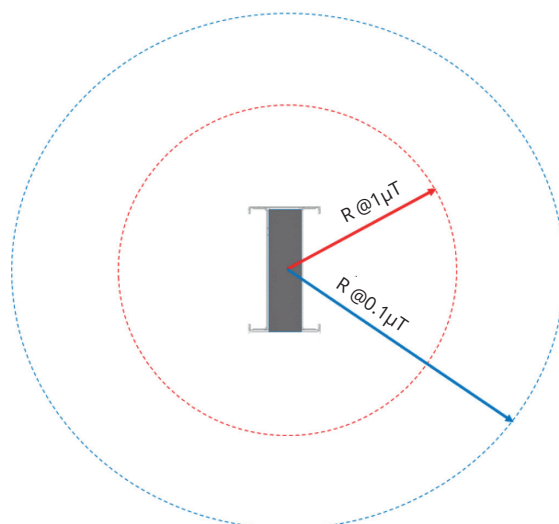


Fig. 6 Distance from the center of the busbar trunking system corresponding to the 1 μT and 0.1 μT limits

In Table 1 reports the distances, expressed in cm, for the different sizes.

Busbar Size (A)	B (μT) - Joint_UP	B (μT) - Joint_LAT	Distance @3 μT - Joint_UP (cm)	Distance @3 μT - Joint_LAT (cm)	Distance @3 μT - Track_UP (cm)	Distance @3 μT - Track_LAT (cm)	R@1 μT (cm)	R@0.1 μT (cm)
800	<15	<7	<25	<15	<5	<10	14	40
1000	<15	<7	<25	<15	<5	<10	16	48
1250	<15	<7	<25	<15	<5	<10	18	56
1600	<15	<7	<25	<15	<5	<10	22	70
2000	15	7	25	15	<5	<10	25	80
2500	15	7	25	15	5	12	28	95
3200	15	7	25	15	5	13	40	120
4000	15	7	25	15	5	15	50	150
5000	20	10	30	18	10	20	58	165
6300	20	10	30	18	10	20	65	170

Table 1: Distances associated with different magnetic field limits for each busbar size

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