English version

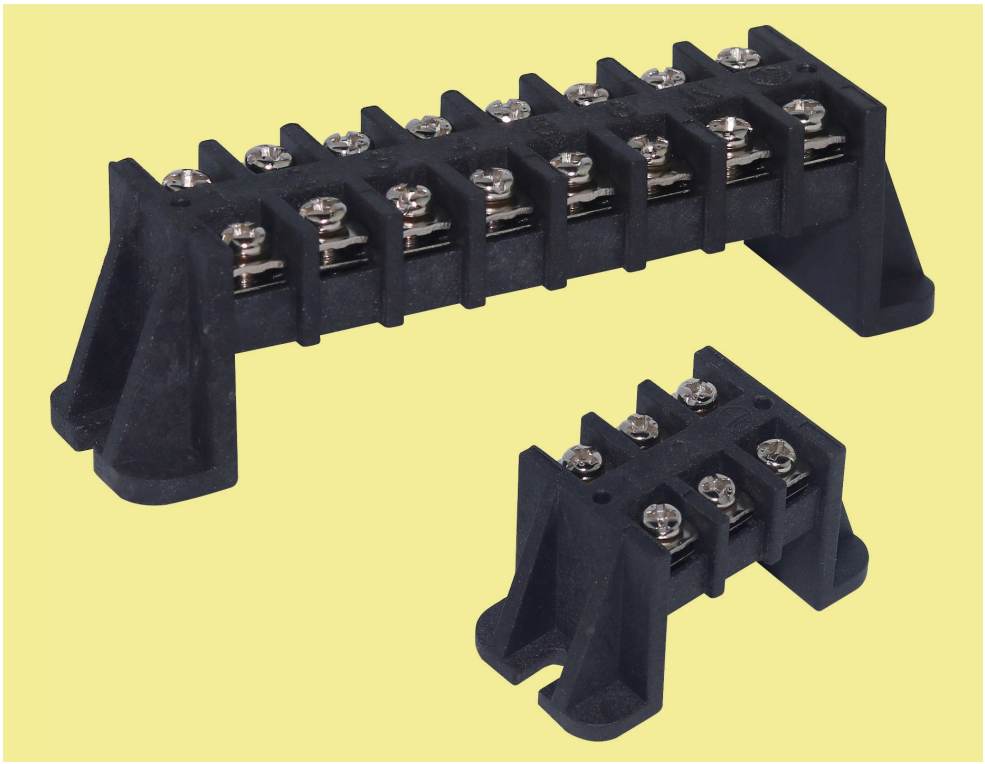
ULTIMHEAT® MUSEUM

Jacques Jumeau

Technology of components used in heating.

Chapter 4

Connection blocks in immersion heaters enclosures



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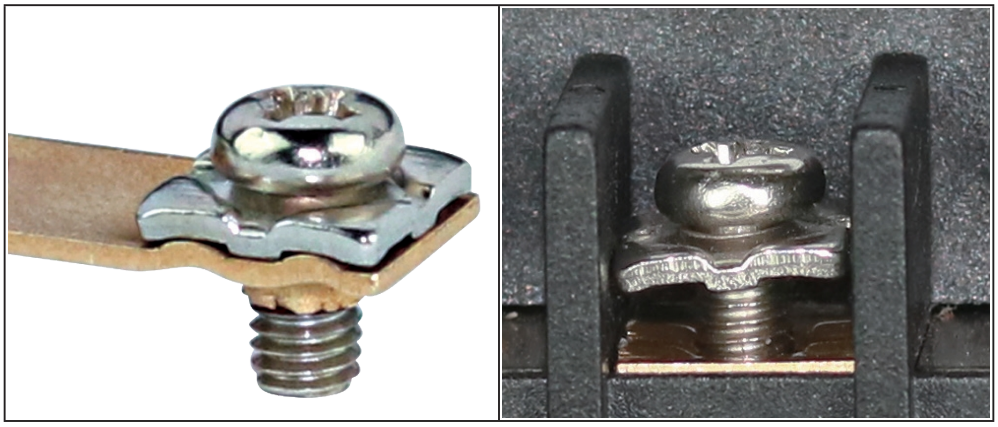
1st edition 2017/12/16

Connection blocks



Some enclosures can be supplied with a molded terminal block, standard or optional. These terminal blocks must meet specific specifications because of their application.
However, it is still possible to use ceramic terminal blocks if the ambient temperatures are too high.

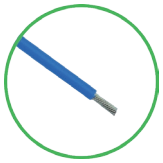
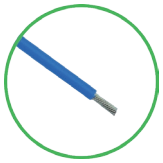
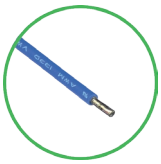
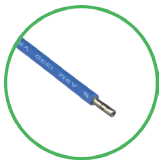
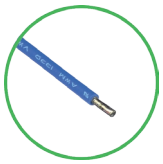
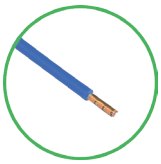
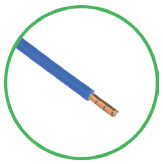
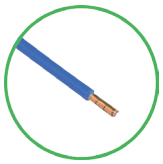
Plastic material

The plastic material of this terminal block, a particular high-end PA66, is different from that of the enclosures, and has been selected to meet the specific constraints of its use.
The most critical constraint that a terminal block can undergo, is a poor tightening of a conductor, the high contact resistance of which causes the terminal to overheat and to melt the plastic material of the support. The class providing the highest resistance to overheating and that of plastics with a GWFI (Glow Wire Ignition Rating) greater than 850°C. This class is mandatory for applications with unattended use, according to the specifications of EN60335-1 § 30-2-3-1. The material we use for these terminal blocks has a GWFI of 960°C, well above the minimum specifications of this standard. This plastic also offers the best resistance to tracking currents with a CTI> 600 (Class 1, the highest).
Another critical parameter, for these housings intended for immersion heaters or temperature sensors, is the temperature of deflection under load. Measured according to ISO 75, this plastic material has a particularly high deflection temperature of 282°C under a 1.8 MPa load.

Terminals

Depending on the size of the boxes, the terminals include M3, M3.5 or M4 screws. These terminals have the following advantages:
- Introduction of 2 wires inside each terminal:
The use of screws with a captive and enveloping square washer, allows to put 2 conductors, even with slightly different size without affecting the quality of tightening.
- No accidental loosening:
The elastic effect of the washer also provides good resistance to loosening by vibration.
- Accept all wires terminations:
This type of terminal also allows the introduction of single stranded or stranded bare conductors, tinned conductors, fork or eye lugs and conductors with cable shoe.
- Allows to visualize the good introduction of the wires:
The end of the terminal, not hidden by a plastic, makes possible to clearly visualize the correct introduction of the wire, frequent source of problems in the terminal boxes with cage, where often it is introduced by mistake under the cage and is not tightened.
- Recommended tightening torques: M3: 50 N.cm; M3.5 N.cm: 80; M4: 120 N.cm

Comparative table of connection types accepted by the different terminal styles

Wires termination styles	Terminal style			
	Direct screw	Screw with plate	Cage terminal	Screw with notched square washer
Bare wire (solid or stranded)				
Bare tinned wire				
Cable shoe				
Spade terminal				
Eyelet terminal				
Cosse ronde				

Wire pull-out force and vibration loosening resistance

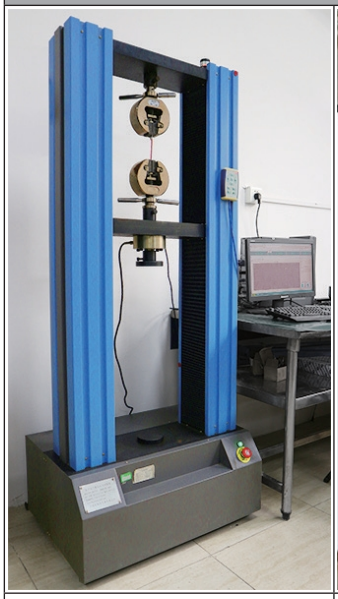
(Tests made in the worst case: a multi-stranded conductor with crimped cable shoe)

Vibration resistance is an important parameter for enclosures terminal blocks, especially if they are installed on trucks, trains or near an engine. In order to verify the effectiveness of the accidental loosening resistance of the terminals, these were subjected to cycles of 10 minutes of variable sinusoidal vibrational sequences covering the range of 1.7 Hz to 5 Hz with variable accelerations from 0.3 to 2.6 G for 48 hours, and the pull-out forces were again measured.

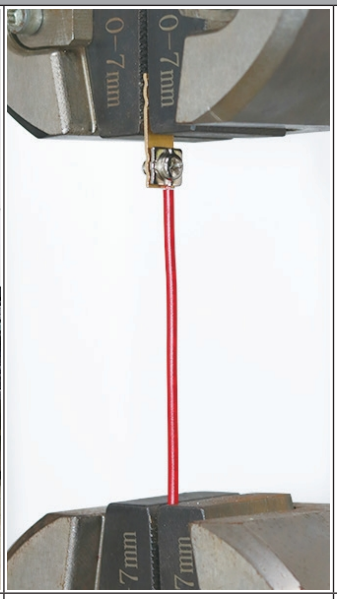
Type	Tightening torque (DaN)	0.5mm²	0.75mm²	1mm²	1.5mm²	2mm²	2.5mm²	4mm²
M3 screw (before vibrations)	50 N.cm	65	105	134	151	160	211	
M3 screw (after vibrations)	50 N.cm	62	102	131	147	155	202	
M3.5 screw (before vibrations)	80 N.cm	68	105	142	165	171	220	
M3.5 screw (after vibrations)	80 N.cm	65	102	132	162	170	218	

Type	Tightening torque (DaN)	0.5mm²	0.75mm²	1mm²	1.5mm²	2mm²	2.5mm²	4mm²
M4 screw (before vibrations)	120 N.cm	86	110	145	157	190	235	260
M4 screw (after vibrations)	120 N.cm	84	107	138	153	185	231	248
Minimum values requested by EN61210		60	85	108	150	200	230	310

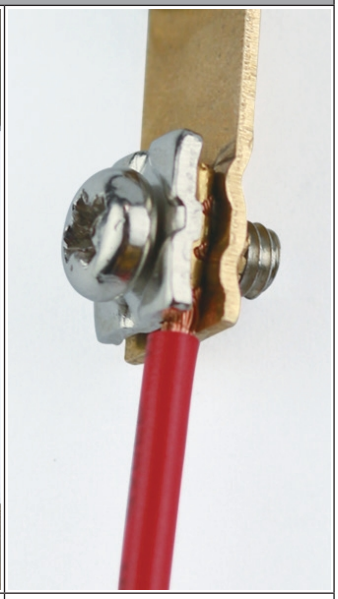
Pull tests, made in our laboratory



Pull test bench



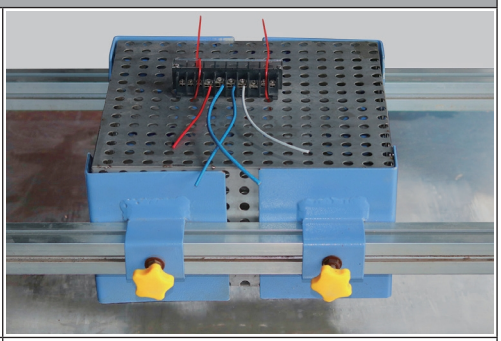
Jaws detail



Terminal detail

Vibration resistance tests, made in our laboratory

Vibration test equipment



Connection block during test