



# Cross currents

OCTOBER, 2008

FOR PRIVATE CIRCULATION ONLY



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Happy Diwali & Prosperous New Year...



## WIRING OF TERMINAL BLOCKS WITH ALUMINIUM CONDUCTORS

### Introduction

Switchgear and control panel manufacturers and panel-builders are generally aware that the terminal blocks conforming to IEC 60947-7-1 are meant for copper wiring only. This awareness however may not exist with site staff, who may sometimes connect aluminium wires to these terminal blocks, resulting in conditions harmful for installations.

The fact is that the terminal blocks as per above IEC Standard can also be used for wiring aluminium conductors, if technical differences in use of copper and aluminium wires are properly understood, and certain procedure is followed for connecting aluminium wires.

Ignoring these technical differences in wiring up aluminium conductors to terminal blocks can lead to harmful consequences. The present article discusses these technicalities and recommends ratings of **elmex** terminal blocks for connecting aluminium wires.

### Considerations in using aluminium wires

Over the years, copper bus bars, jumpers, cables and wires have been stage wise replaced by aluminium by the switchgear and control panel manufacturers and site engineers, after careful technical considerations as regards selecting proper size of aluminium conductors. In addition, procedure for using aluminium conductors is also followed. If both of these technicalities are taken into account while wiring up terminal blocks, then the installation with aluminium wiring can give trouble free service.

However sometimes unforeseen situations come up at site, as summarised below, resulting into harmful consequences.

**1.** For site-wiring, aluminium-wires of required current rating are naturally used. The sq mm size of such aluminium wires is considerably higher than of that copper - wire of same current rating, simply because aluminium has a considerably lower conductivity which is 60% of copper conductivity.

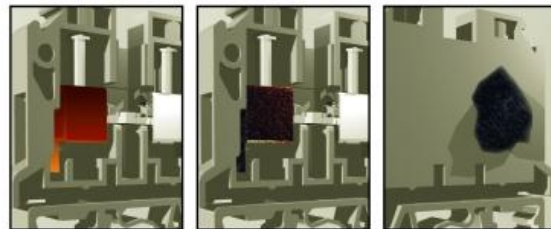
As a result the site wireman will find that AL-wire does not go into conductor clamping space meant for copper wire. If the AL-wire is stranded, some strands are therefore cut-off in order to accommodate it in the terminal block.

Aluminium-wire with less number of stands as above can carry less than its own rated current. Therefore joint with terminal block overheats when carrying load current.

**2.** AL-conductors have to be applied conducting grease, immediately after cleaning to prevent oxidation, every time they are connected. This is true for bus bar, jumper and cabling applications as well as for wiring applications. If this is not done, the joint fails slowly but steadily, as the aluminium gets coated with non-conducting oxide over a period of time, and as a result, the terminal block starts getting over heated.

**3.** Aluminium as a metal exhibits cold-flow characteristics. It means that under clamping pressure, aluminium flows outward from under the joint, resulting in reduction of contact pressure. The joint fails steadily as above, unless aluminium wires are provided with proper cable lugs, and treated with oxidation-preventive conducting grease.

The accompanying graphic displays failure of terminals, due to reasons such as above, even through the terminal blocks conform to the IEC specifications and are accorded various international approvals.



Contact becomes red hot

Contact charres

Insulation burns

In all investigated complaints, it was found that the Cu-wire side of the terminal was intact, while the Al-wire side damaged the terminal due to the above reasons.

### Procedure for using aluminium wires:

Using aluminium conductors at site is a natural consequence of replacing copper with aluminium in various applications.

The procedure for using aluminium wires, as described below, should be followed for trouble free operation.

**1. It is advisable** to use crimping lugs with Al-conductor before connecting it to terminal block for the sake of better and more uniform contact pressure.

Following should be observed:

- a. Use proper size lug for crimping.
- b. Use ring type, Al-lugs, for stud type terminals and pin type tubular lugs for screw-clamp type terminals.

## WIRING OF TERMINAL BLOCKS WITH ALUMINIUM CONDUCTORS

c. Clean the wire / conductor (stripped portion) and then apply conducting anti-corrosion compound before crimping as per the procedure in Step - 2 below.

d. Insert all the strands fully into lug-tube, without any insulation entering the tube. Only then crimping should be done. (see the box : "Crimping Workmanship")

e. The crimped cable as above should be clamped in terminal by using torque screw drivers / torque wrenches, upto recommended torque values for tightening screws / nuts.

f. Ensure that proper crimping tool is used as recommended by lug-manufacturer.

2. To overcome oxidation problem of Al-conductors, remove oxide film from the stripped conductor strands using fine emery paper, and wipe off the dust from the strands thoroughly and immediately apply conducting anti-corrosion compound on all the strands, fixing the crimping lug immediately. The anti-corrosion compound should also

be applied to the lug after crimping, followed by clamping the cable in the terminal block.

3. Every time cable is disconnected and reconnected to the terminal block, anti-oxidation conducting grease must be applied as above.

4. Termination should be periodically attended for physical check-up and tightening of screws.

### Recommended **elmex** Terminal blocks for Al-wiring:

The selection of terminal blocks for desired rating needs careful consideration, since for the same current rating, aluminium-wire size is considerably larger than the copper wire size. To accommodate aluminium wire of such larger size, a higher connection-capacity terminal block has to be used. Alternatively the terminal block selected for copper wiring has to be derated, as evident in the accompanying tabulation, which recommends **elmex** terminal blocks for various conductor sizes of AL & Cu conductors, with rated current of terminal blocks.

### "K" SERIES FEED THROUGH TERMINALS (with pin type lugs) \*

Terminal Type	Conductor cross section (mm <sup>2</sup> )	Recommended Current Rating (Amp)	
		with Copper conductor	with Aluminium conductor
KUT 6	6	41	20
KUT 10	10	57	35
KUT 16	16	76	42
KUT 25	25	101	55
KUT 35	35	125	75
KUT 50	50	150	90
KUT 95	95	232	140

### STUD TYPE TERMINALS (with ring type lugs) \*

Terminal Type	Conductor cross section (mm <sup>2</sup> )	Recommended Current Rating (Amp)	
		with Copper conductor	with Aluminium conductor
KAT M5C	16	76	53
KBT M5C	16	76	50
KBT M6C	25	101	50
DPBB 50	50	150	75
DPBB 70	70	192	95
DPBB 120	120	269	155
SPT 35	35	140	70
SPT 70	70	192	108

\*Ratings are valid with specified wire sizes, lug-sizes and properly crimped wires only.

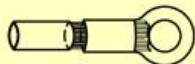
### CRIMPING WORKMANSHIP



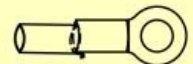
**CORRECT CRIMPING**



**FAULTY CRIMPING**  
All strands not inserted in lug



**FAULTY CRIMPING**  
Strands projecting and obstructing nut fitting



**FAULTY CRIMPING**  
Insulation inserted in lug

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ELECTRICAL & INDUSTRIAL ELECTRONICS.

## SAFE PRACTICES FOR CONDUCTOR CLAMPING

### UNSAFE WORKING

1. Inserting wires without stripping the insulation to required length.
2. Using Aluminium wires instead of Copper wires.
3. Cutting off strands from stranded / flexible wires for making connections.
4. 'Connector' type small screw drivers OR over size screwdrivers are used for all sizes of terminals.
5. Connecting very small size wires in large size terminals.

### TECHNICALITY

Along with conductor, the insulation also gets clamped, reducing contact area and causing overheating.

For same cross-section Aluminium wires have lower current rating. Bare Aluminium builds up non conducting film in normal atmosphere. Both these factors cause overheating.

At the clamping face of conductor, number of strands are reduced, hence joint cannot carry rated current, causing overheating.

The strands are cut off usually by ignorance, neglect or by using aluminium stranded conductor of same current rating, which cannot be accommodated in terminal block without cutting off strands.

Connector type screw drivers cannot provide required torque as terminal size increases, causing overheating. Oversize screw drivers can damage threads.

Smaller wire sizes cannot be clamped properly in larger size terminal blocks, causing overheating.

### SAFE PRACTICES

Always strip the conductor to required length so that only the conductor and its full contact area is clamped.

- a) Use only Copper wires as per rated connection capacity of terminal block.
- b) If Aluminium wires are to be used consult manufacturer. The terminal for copper wire has to be de-rated and Aluminium wires need to be prepared first to prevent oxide film.

Connect up all the strands of stranded & flexible wires, to the terminal block.

It is best to use torque measuring screw drivers. Atleast select proper size of screwdriver to match slot size of terminal screw for tightening fully.

For each terminal size, minimum and maximum conductor sizes are specified, which are permitted for connection to the terminal in manufacturers' catalogues.

## elmex & econix AT AUTOMATION 2008





**SP elmex PRODUCTS APPROVED AS PER CANADIAN NATIONAL STANDARDS SP**

elmex Terminal Blocks conforming to IEC-60947-1-7 are already approved as per UL 1059, for use both in USA and Canada. They are now additionally approved as per Canadian Standard C 22.2 No. 158-1987 (as ammended to date). The terminals approved as per these standards are : "K" Series Feed Through Terminals, Earth Terminals, Multilevel Terminals, Spring-loaded Terminals, Fuse Terminals, Disconnecting Terminals, Power Terminals, Component Housing Terminals, Copper Alloy Terminals, Micro Terminals and many other terminals.

**econix PICO INTERFACE RELAY MODULES**

econix now offers PICO Interface Relay Modules which are miniaturized versions of traditional relay interface modules with better performance parameters.

These modules are 50% less in weight and occupy 60% less space on a 16 channel board, as compared to traditional relay interface modules. Performance wise, they have a much lower burden of 360 mW, faster operating time of 10 m Sec., and release time of 5 m Sec. They are more cost effective as well, without sacrificing contact ratings of 7A at 250 V AC / 24 V DC.

econix PICO Interface Relay Modules find application where faster operating and release timings are important, with space and cost economy, such as for drive synchronizing panels in Paper Mills.



**OUR PRODUCT RANGE**

♥ Insulation Housings in Melamine, Polyamide (Nylon) 6.6, FRPP ♥ Conductor Clamping with Screw Clamps (MS & Brass), Spring Clamps, Bolted Connection, Anti-Vibration Spring-loaded Clamps ♥ Mounting on Standard DIN-rails TS 35, TS 32 and TS 15

<b>Feed-through Terminals</b> 	<b>Micro Terminals</b> 	<b>Power (Bus Bar) Terminals</b> 	<b>High Current Terminals</b> 	<b>Fully Enclosed High Current Terminals</b> 
<b>Double Deck Terminals</b> 	<b>Triple Deck Terminals</b> 	<b>Disconnecting Type Terminals</b> 	<b>Fuse Disconnection Terminal</b> 	<b>Fuse Feed Through Terminals</b> 
<b>Spring Clamp Terminals</b> 	<b>All Brass Terminals</b> 	<b>Plug &amp; Socket type Terminals</b> 	<b>Special Application Terminals (C.T.-Sec.)</b> 	<b>Distribution Blocks</b> 
<b>Stud type Terminals</b> 	<b>Spring Loaded Terminals</b> 	<b>Lighting Pole Terminals</b> 	<b>Earth Terminals</b> 	<b>Special Application Switches</b> 
<b>Plug-in type PCB Connectors</b> 	<b>Low Consumption Relay Modules</b> 	<b>Switching Mode Power Supplies (SMPS)</b> 	<b>Termitronix with Control Elements</b> 	<b>Surge Protecting Devices</b> 

We welcome your suggestions and queries regarding our products and feedback about CROSS CURRENTS. Write to us at [ask@elmex.net](mailto:ask@elmex.net)

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TECHNICAL SPECIFICATIONS MAY CHANGE IN LINE WITH TECHNICAL ADVANCES AND INDUSTRY STANDARDS.