Electrical Fire Safety – Revisiting Indian Standards & Regulations

Amol Kalsekar
About ICA India

The International Copper Association India (ICA India) is a member of the Copper Alliance™ and the Indian arm of the International Copper Association Limited (ICA), the leading not for profit organization for promotion of copper worldwide set up in 1959, with its presence in more than 60 countries.

Our current initiatives:

- Promote Electrical Safety in Buildings
- Increase awareness of Power Quality through Asia Power Quality Initiative (APQI) Platform
- Conduct Sustainability Campaign through use of high EE Motors
- Address reliability and distribution loss reduction by promotion of low loss DT to power sector
- Promote Copper driven technologies for AC to improve air quality and reduce carbon footprint

ICA India drives its program through

- Capacity building
- Technology upgradation
- Publications
- Collaboration, etc.
Electrical accidents Trend

Electrical Accidents in India

<table>
<thead>
<tr>
<th>Year</th>
<th>Electrical Accidents in India</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012-13</td>
<td>8869</td>
</tr>
<tr>
<td>2013-14</td>
<td>14290</td>
</tr>
<tr>
<td>2014-15</td>
<td>14729</td>
</tr>
<tr>
<td>2015-16</td>
<td>14513</td>
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<tr>
<td>2016-17</td>
<td>11444</td>
</tr>
<tr>
<td>2017-18</td>
<td>14135</td>
</tr>
<tr>
<td>2018-19</td>
<td>12754</td>
</tr>
</tbody>
</table>
Statistics of Electrical Accidents
Human & Animal [Fatal/Non-Fatal]

Year | Total | Human Fatal | Human Non-Fatal | Animal Fatal | Animal Non-Fatal
--- | --- | --- | --- | --- | ---
2012-13 | 8869 | 3925 | 2336 | 2597 | 11
2013-14 | 14290 | 5517 | 3534 | 5182 | 57
2014-15 | 14729 | 5828 | 3427 | 5382 | 92
2015-16 | 14513 | 5808 | 3244 | 5244 | 1217
2016-17 | 14135 | 4799 | 2399 | 4296 | 40
2017-18 | 11444 | 4799 | 2399 | 4296 | 40
2018-19 | 12754 | 5445 | 2596 | 2596 | 48

0 | 2000 | 4000 | 6000 | 8000 | 10000 | 12000 | 14000 | 16000 | 18000
State wise Electrical Accidents (Major Contributors)

<table>
<thead>
<tr>
<th>State</th>
<th>2016-17</th>
<th>2017-18</th>
<th>2018-19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maharashtra</td>
<td>3032</td>
<td>3116</td>
<td>2969</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>3130</td>
<td>2548</td>
<td></td>
</tr>
<tr>
<td>Gujarat</td>
<td>1341</td>
<td>1267</td>
<td>1164</td>
</tr>
<tr>
<td>Karnataka</td>
<td>1133</td>
<td>1145</td>
<td>1514</td>
</tr>
<tr>
<td>Andra...</td>
<td>603</td>
<td>1095</td>
<td>1255</td>
</tr>
</tbody>
</table>
Safety Challenges in India

Inadequate and substandard quality use of Personal Protective Equipments (PPEs)

Substandard quality of wire, no heed towards hazards and taking it casually.

Lack of proper earthing system

Short Circuiting in building due to lack of maintenance schedule

Electrocution in houses are frequent due to lack of proper safety devices like Residual Current Device, wiring/switches having poor IR
Voltage level and % of electrical accidents

- **440 V**: 26%
- **11 kV**: 43%
- **230 V**: 29%
- **33 kV**: 2%
India Public safety

- 5445 people died in 2018-19 due to electrocution and fire due to Electrical Short Circuits i.e. 15 people die every day
- 13% of fires occur due to electrical system faults / defects / non-standard products leading to Short Circuits
- 8% of deaths that occur in factories are due to electricity.

Source: National Crime Records Bureau report 2015
Why does this Happen?
**Electrical Safety  Core issues**

**Old Installations**
1. Addition of loads – Modification
2. Degradation of insulation & Components Ageing
3. Poor Maintenance practices
4. Technology up gradation

**Design Issues**
1. Code violations
2. Competent designer
3. Adequate wire sizing
4. Selection of reputed make cost reduction
5. Active & Passive fire systems
6. Protective device coordination

**Workmanship**
1. Training & Skill level
2. Non competence person
3. Outsourcing
4. Maintenance Man Power Vs Cost reduction

**Maintenance Issues**
1. Work force Availability
2. Outage based maintenance practices
3. Predictive maintenance (thermographic Survey)
4. Obsolescence of components
Code violations

- Oil filled transformer indoor without fixed extinguishing system
- Panel located in an accessible location below the stair case
- Electrical distribution board in front of LPG header
- Switch boards installed above cooking area within a meter distance
Some major fires caused by short circuits

Feb’2017: Hyderabad, Attapur; Deaths: 6
Pic: The Hindu

Mar’2017: Kolkata, Hi Chi Min Sarani; Deaths: 2
Pic: The Indian Express

Apr’2018: Delhi, Kohat Enclave; Deaths: 4
Pic: TimesNow

Jan’2017: Pune, Kondhwa; Deaths: 6
Pic: The Indian Express
Some major fires caused by short circuits

May’2018: Chennai, Vadapalani; Deaths: 4
Pic: ANI

Jan’2018: Mumbai, Marol; Deaths: 4
Pic: The Times of India

Jun’2017: Bengaluru, Jayanagar Hospital
Pic: The Hindu

Aug’2018: Ahmedabad, Law Garden Area
Pic: The Times of India
Property loss in Mumbai

Mumbai (2016-2018):

1. Total INR 12,818,052 has been paid out in insurance claims for total 44 commercial building fires caused by electrical problems.

2. Total INR 232,546,266 has been paid out in insurance claims for total 143 industrial building fires caused by electrical problems.
Statutory Provisions for Electrical Safety

- Indian Electricity Act 2003

- Central Electricity Authority (Measures related to Safety and Electric Supply) Regulations 2010 and further amendments 2015 and 2018
  - Reg. 5 Electrical Safety Officer
  - Reg. 5A Chartered Electrical Safety Engineer
  - Reg. 30 Periodical Inspection
  - Reg. 31 Testing of Consumer’s Installation
  - Reg. 32 Testing of Generating Units
  - Reg. 36 Provisions for multistoried buildings
  - Reg. 43 Prior Approval before commissioning
Electrical Safety: Standards, Codes and Guidelines

• BIS publications
  • National Electrical Code 2011
  • National Building Code 2016
  • IS 732 2019

• Other International references
  • International Electro-technical Commission (IEC)
  • National Fire Protection Association (NFPA 70, 70A, 70B, 70E)
  • Institution of Electric and Electronics Engineers (IEEE)
  • Occupational Safety and Health Administration (OSHA)
Highlights IS 732

- Regulation 12 of CEA safety Regulations 2010, refer Indian Standards and mention to follow them in accordance hence becomes mandatory.
- Heat / spark gets generated due to over-current or fault current which may occur due incorrectly designed size of conductor and its protection. IS 732 gives guidelines in this regard.
- Electrical hazards can mainly be classified as Electrical Shock and Fire initiated due to electrical installation. if selection of cables is not proper, gases generated due to burning of insulation are toxic endangering human life
- current carrying capacity as claimed by manufacturer under normal condition my reduce to 50% depending on situation and method of installation, which further requires increase in size of conductor proportionately
- Adequate and correctly designed protective equipment is a gate way to prevent any mishap. Any possible cause of mishap, over current, short-circuit, earth leakage, earth fault, voltage variation can be prevented by following guidelines mentioned under IS 732.
- Electrical installation needs verification. This verification shall be done before connecting the installation to electric supply, after connecting to supply and then further periodically, once in a year or at least once in five years
Aluminum conductor cables in sizes less than 16 mm sq cause termination problems leading to heating at the terminals and enhance the possibility of a fire. For conductor sizes less than or equal 16 mm\(^2\), only copper conductor cables should be used.

Use of **Circuit Integrity Cable** for all Emergency applications like emergency lights, Lifts, fire fighting System etc.

It is advisable to replace wiring, which is more than **30 years old** as the insulation also would have deteriorated, and will be in a state to cause failure on the slightest of mechanical or electrical disturbance.

The **periodical inspection and testing** of installations of voltage equal to or below the notified voltage belonging to the supplier or consumer, shall be carried out by the supplier or owner or consumer and shall be self-certified.

<table>
<thead>
<tr>
<th>Type of Circuit</th>
<th>Minimum Wire Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting</td>
<td>1.5 mm sq</td>
</tr>
<tr>
<td>Socket-outlets, 6 A</td>
<td>2.5 mm sq</td>
</tr>
<tr>
<td>Socket-outlets, 16 A</td>
<td>2.5 mm sq</td>
</tr>
<tr>
<td>Water heater &lt; 3 kW</td>
<td>2.5 mm sq</td>
</tr>
<tr>
<td>Heaters or electric equipment more than or equal to 3 kW</td>
<td>4 mm sq</td>
</tr>
<tr>
<td>Free standing electric range Separate oven and/or cook top</td>
<td>4 mm sq</td>
</tr>
<tr>
<td>Air conditioner &gt;= 1.5 t</td>
<td>4 mm sq</td>
</tr>
<tr>
<td>Appliances like dishwashers, heaters, etc.</td>
<td>2.5 mm sq</td>
</tr>
<tr>
<td>Appliance rated &gt;3 kW&lt;6 kW</td>
<td>6.00 m sq</td>
</tr>
</tbody>
</table>
Where are the missing links??

• Need of qualified Electrical Designers / Consultants?
• Lack of awareness with the consumer?
• Lack of knowledge level / experience of the persons carrying out job
• Adherence of electrical safety regulations
• Poor implementation of standards and codes
• Collective efforts by electrical safety advocates and stakeholders?
• Legal Enforcement
Attitude towards Fire Safety in India

- Fire Safety Specification get diluted during project stage to reduce the project cost
- Compromise on selection of quality cables & associated equipment’s
- Poor performance of the equipment's due to poor installation practices
- Lack of physical verification at regular inspection
- Customer vulnerability due to ignorance & invisible electrical infrastructure
Thank you

For more information please contact

Copper Alliance