

TIN 036 Tower Crane Electrical Supplies, Earthing Arrangements, Emergency Escape Lighting and Lightning Protection

1.0 Introduction

This Technical Information Note provides guidance to tower crane hirers (users) about the provision of tower crane electrical supplies, emergency escape lighting and lightning protection. It includes guidance on inspection and testing following installation and whilst in service.

This guidance is not intended to extend to the electrical equipment and circuits on the crane that were provided by the crane manufacturer at time of first supply.

NOTE: European Standard **BS EN 14439** includes requirements for electrical equipment and circuits on tower cranes.

2.0 Regulatory Requirements, Guidance, and Information

The **Electricity at Work Regulations 1989** (EAWR) impose duties on employers to ensure that electrical equipment and systems are safe and without risk of injury to persons when purchased, installed, and put into use. Within the regulations, the term 'injury' means death or injury to any person from:

- a) Electric shock;
- b) Electric burn;
- c) Fires of electrical origin;
- d) Electric arcing;
- e) Explosions initiated or caused by electricity.

Guidance on the application of EAWR is provided in HSE publication **HSR25 - The Electricity at Work Regulations 1989 – Guidance on Regulations**.

Guidance on the safe working practices for people who carry out on or near electrical equipment is provided in HSE publication **HSG85 - Electricity at Work – Safe working practices**.

British Standard **BS 7671:2018 - Requirements for Electrical Installations** (also known as the IET Wiring Regulations) are non-statutory regulations which provide guidance on the design, selection, erection, inspection and testing of electrical installations providing electrical power to the crane and emergency lighting systems.

Additional information is provided in:

- British Standard **BS 7121-5:2019** *Code of practice for safe use of cranes Part 5: Tower cranes*;
- British Standard **BS 7375:2010** *Distribution of electricity on construction and demolition sites - Code of practice*;
- British Standard **BS 7430:2011+A1:2015** *Code of practice for protective earthing of electrical installations*;
- British Standard **BS EN14439:2006+A2:2009** - *Cranes – Safety – Tower cranes*;
- British Standard **BS EN IEC 62305-1:2011** *Protection against lightning - Part 1: General principles*;
- British Standard **BS EN IEC 62305-2:2012** *Protection against lightning - Part 2: Risk management*;
- British Standard **BS EN 62305-3:2011** *Protection against lightning - Part 3: Physical damage to structures and life hazard*;

- British Standard **BS EN IEC 62305-4:2011** *Protection against lightning - Part 4: Electrical and electronic systems within structures*;
- British Standard **BS 5266-1:2016** *Emergency lighting. Code of practice for the emergency lighting of premises*;
- Construction Plant-hire Association Tower Crane Interest Group Technical Information Notes:
 - **TIN 011:** *Attachment of Floodlights, Illuminated signs and Christmas Decorations*;
 - **TIN 021:** *Maintenance Principles for Tower Cranes*;
 - **TIN 039:** *Guidance to Crane Users – Notification of Erection, Obstacle Lighting and Marking of Cranes*.

3.0 Electrical Supplies and Earthing

The tower crane hirer (user) should ensure that the electrical circuits to the crane are assessed, designed and installed in accordance with **BS 7671**, **BS 7375** and **BS 7340** by competent electrical persons.

3.1 Electrical Supplies

The tower crane hirer (user) should obtain from the tower crane supplier, details of the supply required by the crane. Most tower cranes require a 400V a.c. 3-phase supply (3-phase, neutral and earth). The current requirements of the crane will depend on the type, size and number of motors and control systems installed on the crane.

NOTE: *The use of variable-frequency drive-controlled motors on newer designs of crane reduces starting currents and, consequently, the required capacity of the power supply.*

3.1.1 Electrical Generators

If a suitable mains supply is not available on site, the alternative is to use an engine-driven generator, which must be adequately sized to cope with peak starting-current demands of the crane. The generator should be supplied with an appropriately sized circuit protection device.

If the generator and circuit protection devices provided are inappropriately selected to cope with peak current demands of the crane, nuisance trips may occur. These trips may cause damage to sensitive electronic items within the electrical control systems of the crane, shock loading on the crane and load swings as brakes are applied with loss of power.

3.1.2. Essential Supplies

A smaller power supply will be required for any obstacle lights that may be required on the crane. This power supply will be continuously required whilst the crane remains erected. The supply should be separate from the standard supply to the crane as power will be required when the main electrical supply to the crane is isolated, or the generator is switched off, when the crane is not in use. Guidance on fitment of obstacle lights is provided in **TIN 039: Guidance to Crane Users – Notification of Erection, Obstacle Lighting and Marking of Cranes**.

This smaller power supply can also be used to feed the control panel heaters, which should be left on continuously to ensure that a stable temperature and humidity is maintained in the control panel. This will prevent damage to sensitive expensive electronic equipment due to condensation.

3.2 Mechanical Protection

All cables supplying the crane should be protected from mechanical damage by one or more means, such as running in conduit, trunking or on trays, being clipped to a structure in a position where they are protected from mechanical damage and/or be of steel wire armour construction.

Cable connectors should be a suitably rated industrial type, with ingress protection.

3.3 Isolator Switches

The electrical installation should include suitable weatherproof isolator switches that can be locked in the off position for the main supply to the crane and any secondary supplies. The switches should be clearly marked to indicate both where supply originates from and the equipment it isolates. The switches should be positioned at or near to the base of the crane.

NOTE: Care should be taken to ensure that the tower crane power supply is not switched off without giving the crane team plenty of warning, as this may lead to uncontrolled movements of the crane.

3.4 Electrical Protection

The electrical supply circuits supplying the crane should be provided with appropriate electrical protection against overload, short-circuit and earth fault current.

The protective devices should be capable of interrupting, without damage, any overcurrent that might occur. The characteristics of fuses and circuit-breakers used for protection of circuits should be coordinated to afford selectivity (discrimination) in operation to avoid dangers resulting from disconnection of other circuits.

If earth fault protection is provided by Residual Current Devices (RCDs), these may need to be set with an appropriate trip current and delay setting to ensure that there is discrimination between RCDs on the site distribution system and the crane, to prevent nuisance tripping.

Any RCD and miniature circuit breaker (MCB) protecting the tower crane supply will need to be selected, configured and tested to avoid potential nuisance tripping. RCD's and MCB's used on systems which contain variable-frequency drives must be a type suitable for the service.

NOTE: Nuisance tripping of a tower crane supply may also lead to uncontrolled movements of the crane.

NOTE: RCDs with a 30mA rated tripping current and 'instantaneous' operation are only required on final sub circuits, such as socket outlets, to protect users of portable appliances.

3.5 Earth Bonding

The crane structure, motor frames and conducting cases of all electrical equipment, including metal conduit and cable guards, should be effectively and directly connected to earth.

4.0 Lightning Protection

4.1 Lightning Protection arrangements

Lightning protection should be designed, installed, tested and maintained by competent persons in accordance with both the **BS EN IEC 62305** series of standards and **BS 7430**.

The connection to the tower crane base should be carried out using the manufacturer's approved earthing points (see **Figure 1**). Earthing points should not be created by drilling or welding to structural elements of the crane, (see **Figure 2**).



Figure 1: Earthing point marked by manufacturer



Figure 2: Earth incorrectly connected to a non-manufacturer approved point. The structural member should not have been drilled and tapped as this could weaken the member.

Reliance should not be placed on the earth conductor of any mains power supply. In most instances, the earth bonding can be connected to the lowest metallic part of the crane structure as the metal structure of a tower crane provides good continuity. Following installation of lightning protection, an earth continuity check should be made to ensure that the resistance path between the bottom of the tower and earth is less than 10 ohms.

If the resistance to earth exceeds 10 ohms, the tower crane base should be bonded to a suitable earth network via a single core cable of not less than 70 mm² cross sectional area, and the earth resistance measured again to ensure that it has been reduced to an acceptable value.

4.3 Action to be taken in the event of a thunderstorm

Lightning can induce significant voltages in the tower crane structure, which may lead to the electrocution of personnel in direct or indirect contact with the crane or load. In the event of a thunderstorm warning, the operator should put the crane out of service and leave the crane. Where the operator does not have time to leave the crane, as in the event of a sudden thunderstorm, he/she should stay in the operating cab and avoid touching any controls until the storm has passed.

It is important that personnel on the ground do not touch any part of the load, lifting accessories or the crane structure during a thunderstorm.

4.4 Action to be taken if there is a lightning strike

In the event of a lightning strike, the crane supplier should be notified and the crane should be thoroughly examined by a competent person before being returned to service. This is to ensure that damage has not occurred to the crane or any of its components, including the slew ring, safety and control systems. It is recommended that the slew ring is re-inspected after the crane is dismantled at the end of the hire period.

5.0 Emergency Escape Routes and Lighting

The organisation in charge of the site where the crane is erected, the principal contractor on a construction site, should prepare an emergency plan that considers emergency escape routes and lighting from the crane for the crane operator and maintenance personnel. This is especially important if the escape route is via a basement or enclosed area. Tower cranes are not in general supplied with emergency and escape lighting and they should be provided and installed by the tower crane hirer (user) after consultation with the tower crane supplier.

It is essential that emergency and escape lighting and supply circuits are appropriately and securely fastened to the crane structure and do not interfere with the safe access and operation of the crane. The emergency lighting system should be designed and installed in accordance with **BS 7671** and **BS 5266-1**.

The emergency and escape lighting should be inspected after first installation and thereafter at a maximum interval of three months. A record of inspections should be retained on site.

6.0 Floodlights, Illuminated Signs and Christmas Decorations on the crane

The tower crane hirer (user) should consult with the tower crane supplier in advance of installing any floodlights, illuminated signs and Christmas decorations on the crane. It is essential that the lighting fixtures and cables are securely attached to the crane and do not interfere with access to, and operation of, the crane. Guidance on the installation of floodlights, illuminated signs and Christmas decorations to cranes is provided in **TIN 011: Attachment of Floodlights, Illuminated signs and Christmas Decorations**.

7.0 Responsibility for supply, installation, testing and in-service maintenance

Clear lines of responsibility for supply, installation, testing and in-service maintenance should be established, ensuring that those appointed and responsible have sufficient knowledge and experience to carry out their duties in a way which will ensure that risks are properly controlled

NOTE: *Once a tower crane has been erected on a site, the user of the crane has a duty to ensure that it is adequately inspected and maintained. The actual undertaking of the maintenance and inspection is often delegated to the crane owner by the user. The user however retains the responsibility for ensuring that the maintenance and inspection is carried out. Further Guidance is provided in **TIN 021: Maintenance Principles for Tower Cranes**.*

The tower crane hirer (user) is normally responsible for supply, installation and testing of:

- The electrical switched isolator at or near to the base of the crane;
- The electrical supply circuits from the site distribution board or generator to the switched isolator;
- The lightning protection arrangements;
- Emergency escape lighting and any site lighting placed on the crane.

The tower crane supplier is normally responsible for supply, installation, and testing of:

- The electrical circuits from the electrical switched isolator to the control cabinets on the crane;
- The connection of electrical components and circuits on the crane during installation;
- Any obstacle navigation lights.

Records of inspections and tests should be retained by the tower crane Hirer (user). Guidance on test reports is provided in **BS 7671**.