



Bonneagar Iompair Éireann
Transport Infrastructure Ireland

TII492 Intelligent Transport Systems (ITS) - Equipment Supply and Installation Framework - Generation 2 - Lot 1

Volume A: Works Requirements

**Part 3: Technical Specification
Section 13: Power Supplies**

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1. Electrical Requirements

1.1 General

All electrical systems and equipment shall be designed, manufactured, installed, tested and commissioned in accordance with the latest versions and amendments of all relevant Irish, British, European and International Standards, Regulations, Rules, Codes of Practice, Guides, Legislation and Directives. In all cases, the safety of installers, maintainers, users and the general public shall be the prime consideration during the design, installation and operation of the equipment. This document may be applied to a wide range of Equipment, and the application of specific directives and standards will vary with the type of equipment.

As a guide, manufactured equipment will generally comply with one or more of the following:

- Low Voltage Directive (LVD) 2014/35/EU
- Ireland's National Rules for Electrical Installations I.S. 10101:2020
- Electromagnetic Compatibility Directive 2014/30/EU
- Construction Products Regulation 305/2011
- Regulation 2023/1230/EU
- Radio Equipment Directive (RED)2014/53/EU
- CE marked

The above list of directives and regulations may not be exhaustive for all electrical equipment supplied under the contract as this will depend on the nature of the equipment.

Electrical equipment and components not required to comply with any of these directives and regulations shall comply with the requirements of the IS 10101 National Rules for Electrical Installation current at date of Tender (i.e. I.S. 10101:2020 and subsequent amendments) and be considered an 'Installation'. It shall satisfy the requirements of I.S. 10101:2020 and shall be noted in the Contractor's technical file.

Equipment shall have a power factor as near unity as practicable but in any case, not less than 0.85 lagging nor less than 0.95 leading under all operating conditions.

When the mains supply is outside the limits necessary to ensure correct operation of the equipment, the equipment shall shut down in an orderly manner without any unexpected or detrimental effect to the equipment or hazard to personnel (including road users). When the mains supply returns to within these limits, the equipment shall reset and be allowed to start up without delay, in an orderly manner and without hazard or any external intervention.

1.2 Energy Usage and Efficiency

The energy usage and power factor of the equipment shall be determined by measurement in load states appropriate to its intended use. These load states and their methods of measurement shall be as stated in the Specification. Measured values shall be documented in the equipment handbooks. The measured values shall also be recorded with the method of measurement in the Contractor's site records.

Equipment shall use the minimum amount of energy required to conform to the functional and performance requirements of the Specification. This is both from the point of view of operational cost and environmental responsibility.

Heaters or fans shall only be used within equipment when explicitly required by the Specification and their operational use shall be kept to the minimum required to maintain correct operation of the equipment.

1.3 Terminations for Incoming Supply

The equipment shall be provided with a suitable connector for the type of supply and location.

The terminals for the incoming mains supply connections shall be clearly identified in accordance with I.S. EN 60445.

There shall be no connection between the neutral conductor and the Protective Bonding Circuit inside the electrical equipment nor shall a combined Protective Earth Neutral (PEN) terminal be used inside the enclosure.

1.4 Electrical Service Outlets

Electrical service outlet (sockets) for accessory equipment such as hand-held power tools and test equipment shall be provided as described on the 1500 series SCD drawings and shall be of the form described in I.S. EN 60309-1.

1.5 Equipment Protection and Interfaces

Electronic equipment shall be protected against lightning damage and shall comply with the requirements I.S. EN 62305.

Equipment utilising TIA-485 or TIA-232 line interfaces shall comply with the requirements of:

- ITU-T series K: Protection against interference
- K.20 Table 2a tests 2.1.2

Ethernet/IP connection shall comply with the requirements of:

- ITU-T K - Protection against interference
- K.44/K.45 Table 2a tests 2.1.2

1.6 Identification and Warnings

All cables, conductors, terminals and outlets shall be clearly identified, and all multi-pair cables shall additionally be identified by colours or number code (and this shall conform to the relevant international standard) and terminated in accordance with that colour code.

Electrical equipment shall carry an identification label marked with the rated supply voltage and maximum power consumption (at the rated supply voltage).

All devices and components shall be identified in the equipment with the same circuit designation or reference as that adopted in the technical documentation.

Durable safety signs complying with I.S. EN ISO 7010 shall be secured to all enclosures, housings, etc. where there is any voltage that can cause a hazard, any laser source, or any other hazard, as appropriate. They shall be of sufficient size and fixed so that they shall be plainly visible to operating and maintenance personnel.

1.7 Safety and Reliability

1.7.1 Safety Requirements

The Contractor shall provide safety information in the Safety File.

The information shall be prepared by the Contractor or sub-contractors concerned and detail all design and production process controls and the extent of inspection and testing to be carried out by the sub-contractor. They shall cover all elements of the equipment being supplied including software.

1.7.2 Reliability Requirements

All electronic and optical equipment shall be subjected to a continuous reliability test on-load ("burn in") for at least 96 hours unless otherwise stated. The equipment shall remain fully functional throughout this test. The Contractor shall provide details of his/her test methodology to demonstrate this with the Tender response.

Equipment shall be designed to operate continuously for a service life of 15 years, unless otherwise specified, when used in a motorway environment and operated in accordance with the manufacturer's instructions.

The Contractor shall carry out a Failure Mode and Effects Analysis (FMEA) based on the techniques, principles and procedures defined in I.S. EN 60812. This shall be carried out as early as possible in order to derive countermeasures for any potential failure modes identified in the design resulting in non-operational malfunction of the equipment, as well as eliminating dormant failures as far as practicable. An FMEA report shall be submitted with the Technical File. Overall predicted Mean Time Between Failure (MTBF) and module MTBF's shall be clearly stated in the report and justified for each equipment type.

The information from the FMEA shall be used to establish a rationalised whole-life spares procurement policy which shall include an assessment of the quantities of spares to be carried and where repairs should be carried out e.g. back-to-base. Those components having a limited life expectation, whether in service or as the shelf-life of spares (e.g. batteries), shall be detailed in the Safety File.

2. Electrical Cables and Hardware

2.1 Power Supplies

Electricity Supply Company Interface (EI) equipment will be housed in electrical pillars and/or metering cabinets which are typically installed on the motorway boundary line.

Power to roadside equipment cabinets will be distributed from the EI pillars. The power supply cable should be routed to the equipment cabinets via a mini-pillar adjacent to the roadside equipment cabinet.

The Contractor is responsible for the provision of power to be distributed from the EI cabinets to the roadside equipment cabinets and then onto the equipment on the motorway.

The power supply system shall comply with EN 61558 'Safety of power transformers, power supplies, reactors and similar products'.

The Contractor is responsible for procuring and installing equipment that when operating simultaneously does not exceed the cumulative specific noise levels under the Environmental Noise Directive.

2.2 Power Cables

Armoured cables are to be used for all power supply installations associated with the Motorway Communication systems and typically be of type XLPE/SWA/PVC and comply with BS 5467.

The Contractor shall confirm the integrity of the cable by testing in accordance with the most recent version of I.S. 10101 the 'National Rules for Electrical Installations by the Electro-Technical Council of Ireland (ETCI).

Armoured power cable cores are to be terminated with compression lugs or bootlace ferrules, as appropriate.

All conductors for power supply cables shall be stranded copper regardless of the conductor size and have PVC bedding and sheaths, unless agreed otherwise with the Employer's Representative.

Cable sheaths shall be flame retardant.

All power cables shall have their conductors tested for insulation resistance immediately prior to terminating the cable end.

The system of colour coding of conductors throughout the installation shall be as per the European harmonised core colour code. Conductors of each type (phase, neutral and protective) shall not be converted (e.g. by sleeving) for use as any other type of conductor than that specified.

Glands for armoured cables shall be I.S. EN 62444 and sized to suit the cable being terminated. Where SWA cables are glanded to clearance holes, the gland shall be secured using a brass lockout and brass earth tag. All glands shall be fitted with shrouds.

The routing of main power cables shall be arranged to obtain the maximum separation of such cables from equipment which may be sensitive to mains borne interference and switching transients.

The Contractor shall be responsible for the safe and secure storage of all cable. The Contractor shall keep and maintain a register of all cable drums; the register shall for each cable drum include the

cable drum number, cable size and length(s) of cable removed. Both ends of each cable are to be sealed as protection from the ingress of moisture.

2.3 Local Power Supplies

Local supplies to equipment housed in roadside equipment cabinets, a gantry or cantilever, shall require a local power isolation mini-pillar.

2.4 Operational and Design Requirements

Electrical installations should conform, where applicable, to the following regulations:

- Electro-Technical Council of Ireland (ETCI)
 - I.S. 10101 'National Rules for Electrical Installations, Fourth Edition' and
 - ET101:2008+A1+A2+A3:2018
- Current ESB and ESN Regulations, Codes of Practice and Guidelines including ESB National Code of Practice for Customer Interface version 6.1.
- BS 7430 'Code of practice for protective earthing of electrical installations

2.5 Design

I.S. 10101:2020 shall be adhered to for all of the Contract's electrical installations.

2.6 Voltage Considerations

In accordance with I.S. 10101:2020, for installations rated not greater than 80A, the voltage drop should be restricted to a maximum of 4%.

2.7 Safety Considerations

The automatic disconnection of supply time should be provided in accordance with Chapter 4 of I.S. 10101:2020.

Where a gantry spans both carriageways an electrical cabinet should be provided in both verges and the switching arrangement should be such that the gantry can be isolated from either cabinet.

Power isolation locations are required on the electrical network to 'switch off' power.

Whilst maintenance or alterations are carried out power isolation locations should be lockable in the 'off' position.

2.8 Earthing and Bonding

The entire installation shall be properly and effectively earthed and bonded, with protective earthing and main supplementary equipotential bonding provided, as required, throughout.

The earthing and bonding of the whole installation shall comply with the most recent version of I.S. 10101:2020, 'National Rules for Electrical Installations' by the Electro-Technical Council of Ireland. It shall also be in compliance with CC-SPW-01400 - Specification for Road Works Series 1400 - Electrical Work for Road Lighting and Traffic Signs.

The area of gland plates or boxes which will come in contact with a cable gland shall be cleaned of all paint and corrosion before a cable gland is fitted. Once the gland is fitted, exposed metalwork of gland plates or boxes shall be suitably treated to protect against corrosion.

All connections to bolted fixtures shall be made through crimped type lugs.

Adjacent cabinets less than 2m distant shall be effectively earth-bonded together.

Tests on the earthing system shall be made and recorded in accordance with the ETCI Regulations.

Resistance tests shall be carried out on each section of the earthing system and on the complete system at the completion of the works.

2.9 Uninterruptible Power Supplies

Where an Uninterruptible Power Supply (UPS) is required to provide a continuous power supply to an item of roadside equipment in the event of a mains power failure, the UPS shall be located in the roadside equipment cabinet and should be suitably rated for use in an outdoor environment.

The UPS system shall provide continuous, transient free power to critical loads regardless of voltage and frequency deviations and outages of the normal and/or generator backed supply.

Where located in a roadside equipment cabinet, the UPS shall be rack mountable. All components shall be contained in a single enclosure, and it shall provide continuous, transient free power to critical loads regardless of voltage and frequency deviations and outages of the normal mains supply.

The UPS shall provide an autonomous power supply for a length of time to be agreed with Transport Infrastructure Ireland on a project specific basis but typically should be no longer than 30 minutes.

The UPS EMC category shall be C1/C2/C3/C4 in accordance with EN 62020-2.

The UPS shall be equipped with a network connection to allow for remote monitoring of the UPS operational status.

3. Power Cable Testing

As soon as is practicable after completion of the installation, the Contractor shall undertake tests on cables as detailed within this Specification.

The Employer's Representative shall arrange for the tests to be witnessed by a specialist if they so require.

Three copies of all cable test results shall be supplied to the Employer's Representative on the completion of each test.

The Contractor shall, after testing, locate and expose any damaged outer sheath whether caused by him- or herself or not and shall report all such damage to the Employer's Representative. The Employer's Representative shall be informed prior to the commencement of any operation to expose damaged cable and shall be allowed to be in attendance during the operation.

The Contractor shall provide and display warning notices, barriers etc. when testing cables.

All test instruments requiring calibration shall have a current calibration certificate. The Contractor shall provide the Employer's Representative with copies of all such certificates prior to the commencement of testing.

The Contractor shall give at least two weeks' notice, in writing, to the Employer's Representative of their intention to test any power cable.

No tests shall be carried out until the cable trench has been backfilled and the ground above the cable reinstated, and the cable ends have been installed (terminated) in the respective termination cabinets.

The Contractor shall carry out the tests described below on power cables, together with such other tests and measurements to prove compliance with this specification, relevant standards and with the requirements of the most recent version of I.S. 10101:2020:

- An insulation resistance test to measure the insulation resistance between each conductor and the remaining conductors and between each conductor and the metallic sheath (if any) and armouring.
- An earth continuity test to verify that the cable armouring and metal sheath, if any, have been properly bonded to earth.
- Phase-rotation and phase-correspondence tests to prove that the cables have been correctly connected.