

ITS specification
**General electrical
requirements**
(ITS-01-03)

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Private Bag 6995
Wellington 6141

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Document management plan

1) Purpose

The purpose of this document is to specify the general electrical requirements for ITS equipment and systems design and installation.

2) Document information

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Document author	Jamie French	(09) 300 9000
	Tom Harris	Tom.Harris@opus.co.nz (09) 355 9542
	Bruce Walton	Bruce.Walton@beca.com (09) 336 9465
	Paul Addy	Paul.Addy@beca.com (09) 308 0833
	James Shi	James.Shi@nzta.govt.nz
Document owner	Russell Pinchen/Kevan Fleckney	

3) Key words

ITS Supply and Installation General Electrical Requirements

Record of amendment

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Draft R1	All	AMA Specifications Review	JF & TLH	25/1/2011
Final R2	All	Update following consultation	PTA & BW	09/01/2012
Final R3	All	Provisional	BW & JS	14/02/2012

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1.0 Electrical requirements

1.1 Scope

The scope of work required by this section of the specification is the provision of a complete working installation.

Following are the general requirements relating to electrical works across all sites.

Provision means the supply, delivery, installation, putting to work, testing and commissioning of electrical works (or its components), together with auxiliary hardware and all other work required to form a safe system working according to the design intent.

1.1.1 Electrical Works

The Electrical works shall include:

- a. Supply and installation of suitable outdoor cabinets to house all necessary equipment.
- b. Supply and installation of a power distribution network and local distribution equipment with filtering, surge protection and Uninterruptible Power Supply (UPS) equipment.

1.1.2 General

The Electrical works shall include:

- a. The work performed shall provide a fully integrated and working system with high availability and reliability.
- b. All work shall be performed with personnel and equipment safety in mind. Consideration must be given to the use of any necessary safety visibility equipment and traffic management plans.

The Contractor shall be responsible for:

- a. Supply and installation of all cable support mechanisms.
- b. Provision of equipment and cable labelling.
- c. All other associated hardware and equipment required to form a complete working electrical and communications system.
- d. Testing, commissioning and certification by a registered electrical inspector, that the work has been completed and inspected in accordance with the requirements of the relevant Regulations.

1.2 Design criteria

1.2.1 General

The equipment and systems supplied and installed must be compatible with existing ITS systems.

All work that is installed shall be to the best finish and positioning of all electrical services items.

All materials and installation work shall comply with the relevant standards and regulations.

1.2.2 Regulations

The installation shall comply with:

- a. New Zealand electricity regulations current at the time of installation.
- b. Relevant Statutory Acts, Building Code, Local Health and Safety regulations, Local Authority Regulations, District Plans and Bylaws.

1.2.3 Standards

The following standards and requirements shall apply:

- a. Local Electricity Supply Authority requirements
- b. Wiring Rules: AS/NZS 3000
- c. Lighting Protection: AS/NZS 1768
- d. EMC standards: AS/NZS 61000, AS/NZS 4251.2, AS/NZS 4252.1.
- e. IEC 60721-3-3 Environmental parameters

1.2.4 Materials and Components

All materials and components used shall:

- a. Be new and of the best quality and class
- b. Be fully suitable for the duty that it will be required to perform – 24 hours per day, every day.
- c. Be able to operate in the wide ranging environmental conditions experienced detailed in ITS-01-02 Environmental Requirements, without any loss or degradation in performance.
- d. Comply with the latest issue and amendments of the relevant IEC, NZS, AS or BS standards.

Equipment to be installed along the motorway network will be subject to the effects of high sided vehicles passing at high speeds and in close proximity. These effects include:

- a. Vibration;
- b. Wind buffeting;
- c. Spray drenching;
- d. Dust and grit intrusion;
- e. Oil, bitumen and vehicular emissions.

The above factors shall be considered in the selection of all equipment, enclosures and structures.

During installation, no repairs of damaged or defective parts will be permitted without the approval, in writing, of the Principal and the Engineer.

1.2.5 Reliability and Availability

Electronic subsystems supplied are required to operate 24 hours per day, every day, and shall be supplied and installed in accordance with the NZ Transport Agency's (NZTA) *ITS specification: General requirements* (ITS-01-01) for reliability and availability.

1.2.6 Workmanship

Only skilled, competent personnel appropriately qualified and registered or licensed at the time of carrying out the work shall carry out the work.

1.2.7 Surge/Lightning Protection

A surge/lightning protection system shall be provided at each CCTV/IP Camera, VMS and VDS installation in accordance with NZS/AS 1768.

A point of entry protection shall be provided at the Distribution Board in each control cabinet. Minimum 10mm² green copper conductors shall be used for the connections. Leads shall be as short as possible to prevent L di/dt voltage differentials.

Multi-stage surge diversion shall also be provided on the incoming power circuits and communication circuits.

Surge diverters shall be field replaceable without the need to disconnect wiring and they shall have integral indicators to show when they have blown.

1.3 Electrical installation requirements

1.3.1 General

All electrical/electronic components shall be of modular design, interchangeable, and electronic circuits shall be conformal coated.

The design life of all individual components shall not be less than 10 years, operating 24 hours a day, every day.

All component power and heat dissipation ratings shall be de-rated by 20% to minimise ageing effects.

1.3.2 Socket outlets

Socket outlet requirements at each cabinet are:

- a. Fed from a Residual Current Device (RCD)/ Miniature Circuit Breaker (MCB) combination protection device. The earth leakage setting shall be 30 mA.
- b. A minimum of 2 socket outlets to provide power for maintenance or testing equipment.
- c. Socket outlets shall be flat three-pin socket type incorporating a suitably rated switch for single-phase applications.
- d. Switched socket outlets shall be located in relation to the equipment or appliance such that the isolation point is readily accessible.
- e. Switched socket outlets shall be labelled to identify the equipment connected.

1.3.3 Electrical terminations

All field terminals shall be made from self-extinguishing materials, be rail mounted, and of the self-locking screwed pressure plate type. They shall be adequately sized to take the conductor(s) which they connect and shall have a current rating of not less than 20A, with the smallest terminals being capable of taking stranded conductors up to 2.5mm² CSA.

Earth terminals shall be green or green/yellow. No other terminals shall be the same colour. Terminals carrying power shall be appropriately labelled, shielded and segregated from control signal terminals.

Where power is fed to other cabinets from a particular cabinet, the Incoming Neutral shall be cadwelded to the Outgoing Neutral with a three way cadweld. The third connection, a pigtail shall be connected to the particular cabinet Neutral Bus. (This is to eliminate dangerous touch voltages if a neutral path would be interrupted).

All cables shall be glanded at the point of entry into equipment. Glands shall be selected to match the type of cable correctly.

1.3.4 Electrical wiring

All wiring shall comply with the version of the NZ Electricity Regulations current at time of installation. Wiring shall be stranded copper conductors with minimum 30/0.25 PVC 600/1000 volt grade size on 400/230 volt circuits and of minimum 24/0.2 PVC 250 volt grade on extra low voltage circuits in accordance with AS/NZS 3147-1992.

All control wiring shall be run in proprietary PVC open slotted cable trunking that shall be sized to provide 50% spare space within, once all conductors are installed. All trunking shall be fitted complete with lid.

Wiring panel doors, if not run in PVC trunking, shall be neatly loomed and supported with nylon cable ties at spacings no greater than 100 mm.

Hinged doors shall have an earth bonding conductor

Wiring between panel(s) and hinged doors shall be of sufficient length to enable the door to swing fully open. Flexible mechanical protection around each wiring loom and anchor both ends shall be provided. Glue-on supports shall not be used.

Connections and wiring within each panel shall be arranged with special care to prevent overheating resulting from bunched conductors and to give a tidy appearance.

All wires shall be number ferruled at each end. Wires shall not be joined or connected between terminals.

All wiring shall use stranded conductors.

1.3.5 Marking and labelling

All cables and cable cores installed shall be labelled. Write-on or "Dyno" (impression stamped plastic type) labels shall not be used. Cables and cores shall be marked at both ends of the cable or core.

All markers shall be correctly sized for each conductor, thus ensuring no movement through gravity or vibration and be left clearly visible and neatly lined up. The text of all labels shall be black lettering on a white background.

The numbering/lettering of each cable/core shall correspond with the As-Built drawings.

1.3.6 Bonding of other services and metal work

All metallic enclosures, ducts, pipe work, other exposed metal members etc, shall be bonded to the electrical earth at the MSB using a green PVC insulated copper conductor.

Minimum cross sectional area of bonding conductors shall be 4.0mm².

1.3.7 Field installation cabling arrangements

Independently of the type of support structure used, the cabling from the field installation shall be run inside existing UV stabilised PVC conduits, unless specified to the contrary elsewhere in this specification.

Unprotected cables affixed to the outside of support structures shall not be permitted. Cables and conduits enclosing cables shall be enclosed within the support structures.

From the base of support structure, cables shall be run underground within conduits to the Roadside Control Cabinet.

Cables, ducts and fixings are not permitted to be attached to W section guard rails or guard rail posts

Saddles shall be used to support conduit or ducting not enclosed in concrete, at intervals not exceeding 1000mm. Saddles shall be screw fixed with corrosion resistant screws.

1.3.8 Cable ducts and glands

Ducts shall be installed as per ITS-02-01 Duct supply and installation.

Ducts shall be extra high impact in accordance with AS/NZS 2053.

All unused ducts shall be plugged with removable plugs to prevent ingress of water and soil and shall be sealed with a waterproof expanding foam.

Ducts shall terminate 1m past the edge of the concrete pad or any associated paved maintenance area. All ducts and conduits used or unused shall be left with a draw-wire in place.

Proprietary cable glands shall be used for "making off" all metal sheathed, armoured, and neutral screened cables entering or exiting any enclosure.

Cable entries/exits for external cables shall be provided as follows:

TPS - bushed holes (sealed).

MICC - MICC glands

MIMS/PVC - MIMS glands with plastic sleeves.

NS - compression type glands

PLYSS - sealing box and brass wiping gland.

PLSWAS - sealing box and armour clamping gland.

XLPE/HT-PVC - compression type glands.

XLPE/SWA/PVC and PVC/PVC/SWA/PVC - compression type glands with armour clamp.

Cable glands used shall be sealed appropriately so as not to compromise the IP rating of its enclosure.

Cable bends shall be followed by a minimum of 50mm of straight cable before the cable enters a gland where practical.

Earthing rings shall be used in conjunction with armour clamps.

1.3.9 Electrical noise

In order to minimise the effects of generated or radiated electrical noise the following installation practices shall be followed:

- a. The DC power and electronic signal cables shall not run parallel or in close proximity to AC power cables;
- b. Proper grounding techniques shall be utilised;
- c. Proper cable shielding shall be utilised;
- d. Suitable power filters shall be installed to mitigate the effects of noise occurring on AC power supplies.

1.3.10 Certificate of compliance

All electrical works undertaken shall be issued with a Certificate of Compliance as per the Electrical (Safety) Regulations 2010.

Certification shall be undertaken by registered and qualified person(s).

The certificate must be completed within 1 day of completion of each electrical installation or termination of the contract for the work, whichever is sooner.

1.3.11 Declaration of conformity

Where required, a declaration of conformity shall issued with equipment.

The equipment shall be installed as per the conditions of the declaration of conformity.

2.0 Power supply and earthing

2.1 Scope

The scope of work covered by this section of the specification is the provision of the power supply and earthing as set out in this specification.

2.2 Design criteria

For all ITS installations, mains supply shall be single phase, 230 V ($\pm 5\%$), 15 -20 A, 50 Hz AC

All electrical work shall comply with the requirements of the New Zealand Electricity Regulations and AS/NZS 3000: Wiring Rules.

All exposed ducting within 2.0m of ground level shall be galvanised steel conduit.

All exposed ducting above 2.0m of ground level shall be UV stabilised PE

2.3 Existing supply

The LV main supply is in general provided from an existing NZTA roadside Montrose Box. Their locations are detailed in the system layout drawings.

Underground power cable to site is installed in ducts on route detailed in the scheme drawings.

Requirements for duct installation are specified in the NZTA's *ITS specification: Duct supply and installation* (ITS-02-01).

2.3.1 Electricity supplier metering

The Contractor shall be responsible for arranging for installations to be metered if required, on the Electricity Network Operators tariff and forward details for approval by the Engineer.

Where a new connection is made the Contractor shall supply full account details including location, supplier, power draw etc.

2.3.2 Service connections

The Contractor shall arrange for the provision of the service main cable from the existing distribution system, of the size or rating detailed in the equipment supply schedule and scheme drawings.

Installation of the cable is to be underground in existing power cable ducts on route detailed in the scheme drawings or an alternate confirmed route.

Foundation penetrations for underground service cables are detailed on the scheme drawings.

2.4 Distribution pillars

A power distribution pillar shall be used to terminate mains power supply at any provisional equipments sites that are situated between a local power supply point (e.g.: Montrose Box) and any confirmed equipment sites.

Minimum specifications for the pillar shall be as follows:

- a. The pillar shall be made of impact proof, UV resistant, self extinguishing, non-flammable, and medium density polyethylene (MDPE).
- b. The pillar shall be rated at IP54.
- c. The installation shall comply with the Manufacturer's installation instructions.
- d. The pillar shall be able to be mounted on a purpose designed concrete pad.
- e. Access to the interior of the pillar shall be through a removable top cover. The cover shall be secured through standard stainless steel M8 cap screws.
- f. Shall utilise industry standard fittings (IEC269)
- g. The pillar shall be ventilated to prevent condensation and build up of moisture internally.
- h. Contractor shall provide and install a permanent sign on the front of the box stating "DANGER LIVE CABLES" in red and white colouring.
- i. All labelling shall be Traffolyte and screw mounted by a minimum of 2 screws.
- j. Fuses shall be HRC cartridge type providing excess current protection.
- k. Cable entries for external cables shall be provided as specified in the NZTA's *ITS specification: Duct supply and installation (ITS-02-01)*.
- l. The method used to install the Neutral connection shall prevent accidental disconnection, breakage, loosening, corrosion and increased electrical resistance. Preferred method is CADWELD welded connection.

2.5 Earthing

2.5.1 Earth continuity conductors

Earthing shall be in accordance with AS/NZS 3000.

All metalwork not normally expected to carry current must be bonded to earth. This includes equipment panels, screens, glands, conduits, sheath structural members, access doors, access platforms, etc.

Conductors shall be installed with the wiring to all lighting, switch, power or other connection points.

2.5.2 Main earth

Main earthing rods shall be supplied and installed as indicated on the drawings.

2.5.3 Earthing test results

Allow to measure the earth resistance of the main earth using approved instruments and methods, and to repeat the test in the presence of a nominated witness.

All results shall be submitted for review as required under the NZTA's *ITS specification: Commissioning and Handover process (ITS-10-01)*.