TECHNICAL SPECIFICATION
ELECTRICAL INSTRUMENTATION

TCC-TTS-SPEC-E008

Revision History

Revision	Status	Prepared by	Reviewed by	Approved by	Date
0	Issued for Use	D Philipson	L Eastlake	T Laveti	25/09/2025

Contents

1. Introduction

1.1. Purpose

This standard covers electrical instrumentation for Townsville City Council electrotechnical projects.

1.2. Scope

This standard specifies the performance criteria and testing of electrical instrumentation for all sites owned and operated by TCC. General instrumentation requirements and requirements specific to a type of instrument are covered. This standard applies to all new installations and redevelopment of existing installations.

1.3. Electrical Specification Manual

This document forms part of the Electrical Installation section of the TCC Electrical Specification Manual (ESM) and shall be read in conjunction with other documents in the ESM and the Job Specification to determine the requirements for a particular project.

The intention of the ESM is to provide consistency in electrical design and installation requirements that will better enable council to fulfil its duties in the delivery and implementation of their electrical works.

Contractors shall comply with all requirements in this document and the documents referenced in TCC-TTS-SPEC-E001 Introduction to Technical Specifications, unless specified otherwise.

1.4. Exceptions and Feedback

Should the Contractor propose any exceptions, deviations or variations from this specification or referenced documents, such variations shall be submitted in writing to the TCC Nominated Electrical Representative for approval.

If there exists a requirement that is unclear or ambiguous, the Contractor shall contact the TCC Nominated Electrical Representative for clarification and feedback.

2. General

2.1. Sensors

Sensors shall be supplied such that they are compatible for the process installation and the environment in which they are to be installed.

Where sensors are remote from the transmitter, sufficient proprietary cable for connecting the two shall be provided.

Sensors shall be provided with all additional hardware required to facilitate the installation of the unit in the nominated process.

2.2. Transmitters

Preference will be given to transmitters which are capable of performing multiple diagnostic analysis through the application of different software.

Where possible "smart" transmitters shall be offered as an option in addition to the standard models.

Communications shall utilise HART protocol with transmission via high frequency signal superimposed on top of the 4-20 mA output signal.

"Smart" communications to the transmitter shall allow remote interrogation, diagnostics and reconfiguration without interruption of the transmitters signal to the control system.

Configuration shall also possible via wireless (eg: Bluetooth) connections.

Four wire transmitters shall be supplied by 24Vdc where possible.

Transmitters shall have local indication.

2.3. Accuracy

The accuracy of each instrument shall be within +1% of span unless otherwise specified. Accuracy shall be defined as follows:

- For primary elements and their associated signal converters/transmitters: The accuracy shall relate to the analogue signal output to the physical process variable; and,
- For secondary instruments, accuracy shall relate to the output signal, indication or pen record (as appropriate) to the analogue input signal.

All instruments shall be suitable for continuous unattended operation and shall maintain their rated accuracy with a minimum of maintenance or need for calibration and adjustment.

2.4. Output

The analogue output of all electronic signal converters, transmitters, controllers, etc., shall be 4 to 20mA signal.

Each output shall be capable of operating into a load in excess of 600Ω.

Discrete outputs (on/off) of all electromechanical equipment such as flow switches, pressure switches, level switches, valve position switches, relay circuits, etc., and of all electronic switching devices such as electronic level and limit switches, etc., shall be voltage free contacts rated for at least 2A@24Vdc unless otherwise specified.

3. Field Instrumentation Requirements

Field instrumentation shall include the primary measuring elements and associated instrument transmitters for sensing of physical and analytical plant variables, and discrete process devices required for satisfactory monitoring and/or control purposes.

The Contractor shall ensure that the most suitable type of instrument is selected and installed for each application. The Contractor shall submit the proposed Instrument Supply list to the TCC Nominated Electrical Representative for approval prior to purchasing the same.

3.1. Instruments

All wetted components of the instruments, including cabling, isolation valves and connection manifolds as required, shall be constructed of materials where specified or otherwise suitable for the process fluids of the application.

3.1.1. Analytical Instruments

Dissolved Oxygen Measurement:

Dissolved Oxygen measurement system shall comprise (as a minimum):

- Self-cleaning float ball or immersion sensor and transmitter;
- Mounting pole;
- Mounting bracket;
- Connection cable; and,
- Signal Converter.

Dissolved Oxygen analysers shall include the following features:

- Field replaceable sensor cell;
- Sensor membrane damage detection; and,
- Sensor life counter.

Online Suspended Solids / Turbidity Measurement:

The analyser shall be capable of measuring suspended solids in the range specified in the Job Specification with an accuracy of +5%.

Nitrate Measurement:

The nitrate measurement system shall comprise (as a minimum):

- Submersible sensor with wiper cleaning system;
- Mounting hardware;
- Connection cable; and,
- Transmitter.

pH Measurement:

pH measurement equipment shall include either single combination electrodes or discrete measurement and reference electrodes. The reference electrode shall be sealed, gel filled and non-flowing with a ceramic or similar junction that resists fouling.

Automatic temperature compensation shall be provided for each pH measurement.

The pH electrodes shall be equipped with an automatic electrode cleaning as specified in the Job Specification. This device shall reduce routine manual cleaning and the cleaning method utilised shall be suitable for the process fluid monitored.

The pH electrode housing shall be manufactured from glass fibre reinforced polypropylene or similar.

Chlorine Measurement:

See preferred equipment list.

3.1.2. Level Measurement

Ultrasonic Type:

Ultrasonic level transmitters are the preferred measurement technique for large tanks and reservoirs.

Ultrasonic level transmitters shall be loop powered.

Radar:

Radar level transmitters are preferred for difficult applications that can have foam, condensation or buildup (eg: flood gates).

The Job Specification will indicate if guided radar should be used.

Radar level transmitters shall be loop powered.

Hydrostatic Type:

Hydrostatic level transmitters are the preferred type for sewerage wet wells.

Hydrostatic level transmitters shall provide measurement referenced to atmosphere either using a capillary tube connected to the sensor and vented to atmosphere at a connection box, or absolute pressure measurement at the sensor and atmospheric pressure measurement at the transmitter.

Capacitance Type:

Capacitance type probes are generally not preferred by TCC. Permission should be sought from the TCC Nominated Electrical Representative if required.

Each capacitance level measurement system shall consist of an electrode (or probe), an electronic unit in the head of the probe and a signal converter unit.

An earthing reference may also be supplied if necessary.

The electronic unit shall operate at a frequency suitable for the application, shall be mounted in the head of the probe and shall be encapsulated in an inherently noncorrosive, durable material.

Each electronic signal converter unit shall generate a 4-20 mA output signal corresponding to the level and shall incorporate provision for continuous adjustment for both measurement span and zero.

Multiple Point Conductivity:

Capacitance type probes are generally not preferred by TCC. Permission should be sought from the TCC Nominated Electrical Representative if required.

Probes shall be cable suspended PVC tube body with stainless steel sensors located at 150 mm increments along the height of the probe.

Each sensor shall be wired out to allow connection of all or any level to extra low voltage control equipment.

The cable sheath, probe body and sensors shall be suitable for long term operation in the environment in which it shall be installed.

The probe shall be fitted with cable of sufficient length to terminate in the switchboard without joints, suspended from a purpose-built stainless-steel bracket incorporating a flexible probe cleaner.

Where specified, a pump controller shall operate in conjunction with the multipoint conductivity level probe. The controller shall be self-contained to control two pumps and alarms, and shall feature:

- incremental bar graph indication of well/reservoir level;
- selectable levels for each pump start, stop, and alarm;
- selection of pumps to duty, standby or alternating; and,
- Selection of fill or empty modes.

Level Switches (Float Type I):

Type I float switches consist of a free-floating tilt switch.

Type I float switches shall be supplied complete with a sufficient length of heavy-duty flexible cable to provide a generous allowance for adjustment of the operating level.

Type I float switches shall be mounted such as not to foul on any adjacent equipment or structures and shall be protected from turbulence.

All wetted materials shall be inherently noncorrosive material and suitable for the proposed application.

Level Switches (Float Type II):

Type II float switches consist of a bulkhead mounted tilt switch.

Float, stem and other wetted materials shall be constructed from inherently noncorrosive material and suitable for the proposed application.

Each level switch shall be provided with a voltage free, changeover contact.

Level Switches (Capacitive):

Each capacitive level switch shall consist of an electrode (or probe), and an electronic signal converter unit.

An earthing electrode (or probe) shall be provided as necessary for correct operation.

The electronic signal converter shall have a sensitivity suitable for the application.

Each electrode (or probe) and all other wetted materials shall be suitable for the application.

Where the electronic signal converter is mounted in the head of the probe it shall be encapsulated in an inherently noncorrosive, durable material.

Each electronic signal converter shall satisfy enclosure class IP65 or better and shall be provided with a voltage free, changeover contact output.

Level Switches (Vibrating):

Each vibrating level switch shall consist of a sensor and an isolating electronic switching unit.

In addition to a true level alarm condition, the electronic switching unit shall activate the alarm contact upon detection of a damaged sensor and for a short time on power up.

Switching time shall not exceed 1 second.

3.1.3. Flow Measurement

Magnetic Flow Meters:

The sensor shall be suitably lined to resist wear and corrosion.

The signal cables between the sensor and the transmitter shall be supplied as a single length and shall be screened.

The transmitter shall have a digital display to show the flow rate and total flow volume.

A digital output shall be provided to pulse on a configurable accumulated flow (integrator).

Magnetic Flow Meters shall be loop powered where possible and incorporate self-verification functionality for correct operation.

Thermal Mass Flow Meters:

Thermal mass flow meters shall be used for gas flow measurement.

Thermal Mass flow meters shall measure the gas mass flow rate directly without inputs of temperature or pressure from other instruments.

Calibration of thermal mass flow meters shall suit the gas being measured.

Orifice Plate/Differential Pressure Transmitter Mass Flowmeter:

The differential pressure transmitter shall be loop powered and shall provide a 4-20 mA output signal proportional to the calculated flow rate (ie: square root extraction performed within the instrument).

The static pressure range and maximum working pressure of the pressure transmitter shall be as specified or as otherwise suitable for the application.

Positive over range protection shall be provided.

The differential pressure transmitter shall be supplied with a three-valve manifold.

Doppler Effect Flow Sensors:

The flow sensor shall be a nonintrusive dual element Doppler Effect flow sensor clamped to the outside of the pipe work.

A separate transducer/transmitter shall be supplied with the flow sensor. The sensor shall be provided with any proprietary leads and cables for connection between the sensor and transmitter.

Rotameter (Variable Area Flowmeters):

Rotameters shall be of the tapered tube and float type, of straight through construction, with flanged or threaded end connections as required.

The rotameter shall have tempered glass tubes, stainless steel end fittings and stainless steel floats. Plastic may be acceptable with permission from the TCC Nominated Electrical Representative. In the case of plastic tubes, sun protection may be required.

The rotameter shall incorporate a metering tube that can be removed and cleaned without removing the meter body from the line. The rotameter shall be selected to suit the range for each individual application.

The rotameter shall be fitted with a direct reading scale, nominally 250 mm long and scaled in litres/second as appropriate for the flow ranges of each application.

Where switching is required, a magnetically activated switch arrangement providing a voltage free contact shall be provided for 2 wire connection.

Rotameter (Purgemeter):

The rotameter required for monitoring purge air flow shall include an integral inlet needle valve to allow adjustment of the flow of air.

The rotameter shall be fitted with a direct reading scale, nominally 70 mm long and scaled in litre/second or as appropriate for the flow ranges of each application.

All other requirements as per Variable Area Flowmeters shall be met.

3.1.4. Pressure Measurement

Pressure Transmitters:

The range and maximum working pressure of the pressure transmitter shall be as specified or as otherwise suitable for the application.

Positive over range protection shall be provided.

Two valve manifolds shall be supplied with gauge pressure transmitters. Three valve manifolds shall be supplied with differential pressure transmitters.

Pressure Switches:

The adjustable set point range shall be such that the noted set point falls between 30% and 70% of the adjustable range.

The switch shall be of the automatic reset type with an adjustable switching hysteresis.

3.1.5. Temperature Measurement

Resistance Temperature Detector (RTD):

Unless otherwise specified RTD's shall be utilised for temperature measurement.

RTD's shall include a 3 wire platinum resistance temperature detector.

The sensing element shall be sealed in a ceramic former and enclosed in a stainless-steel sheath.

Each RTD shall include a suitable connector head, with enclosure class equivalent to IP65 allowing cable entry via a compression type cable gland.

Where the process cannot be isolated from the RTD, thermowells of suitable material shall be utilised.

A "3 wire" circuit shall be used between each RTD and the associated converter.

The converter shall be located in the RTD connector head. Cabling to current converters shall be of the "two wire" type deriving electrical power from the loop 24Vdc supply. Converters shall include continuously variable span and zero. The output shall be a 4-20 mA signal with respect to temperature.

Thermocouples:

Where specified or as otherwise required for the temperature range, thermocouple type sensors shall be utilised for temperature measurement.

Each thermocouple shall include a type J or Type K, to suit temperature range, single element, ungrounded temperature detector.

The sensing element shall be sealed in a ceramic former and enclosed in a stainless steel sheath.

Each thermocouple shall include a suitable connector head, with enclosure class equivalent to IP65 allowing cable entry via a compression type cable gland.

Where the process cannot be isolated from the thermocouple, thermowells of suitable material shall be utilised.

Thermocouples and signal converters shall be interconnected with wire that will maintain the specified accuracy of the temperature measurement. The converter shall be located in the thermocouple connector head. Signal converters shall be of the "two wire" type deriving electrical power from the loop 24Vdc power supply. The output shall be a 4-20 mA signal with respect to temperature. Converters shall include continuously variable span and zero.

The converter shall include automation reference junction compensation and thermocouple burnout protection.

Temperature Switches (Thermostats):

A calibrated adjustment for the set point shall be provided.

The adjustable set point range shall be such that the noted set point falls between 30% and 70% of the adjustable range.

The switch shall be of the automatic reset type with an switching hysteresis (except where noted).

Wetted materials shall be suitable for the application. Each temperature switch shall satisfy enclosure class IP65 or better and shall be provided with voltage free, changeover contact.

3.1.6. Proximity Sensors

Proximity sensors shall be either 3 wire PNP or two wire make function inductive devices.

Proximity sensors shall withstand reverse polarity connections and shall incorporate short circuit protection.

Where a two-wire proximity sensor is directly interface to a PLC/Telemetry interface, it must be checked to ensure compatibility with the PLC/Telemetry system to ensure minimum off currents and on voltage drops do not interfere with PLC/Telemetry signal states.

3.2. Installation

All instrumentation shall be installed with a means of isolating for removal, repair and maintenance. This may require double, block and bleed for high-risk applications.

All instrumentation shall be mounted conveniently, such that inspection, removal and maintenance does not require specialised equipment such as elevated work platforms and the like.

All instrumentation local displays shall be protected from direct sunlight by way of a stainless steel sunhood.

Refer to TCC-TTS-SPEC-E002 Electrical installation.

3.3. Installation Testing

The Contractor shall carry out a pre-installation test on each instrument as soon as practicable after the receipt of the instrument. The tests shall be carried out in accordance with the manufacturer’s instruction manual.

The Contractor shall ensure during the pre-installation testing that each instrument has been supplied in accordance with specifications, is correctly tagged, factory calibrated and is functioning correctly.

The Contractor shall notify the TCC Nominated Electrical Representative immediately of any defects which cannot be rectified. This notification shall be confirmed in writing.

The Contractor shall obtain the approval of the TCC Nominated Electrical Representative in writing before any non-standard modifications or adjustments are made.

For process instruments the Contractor shall perform tests that will simulate as closely as possible the design process conditions, by the use of manometers, potentiometers, resistance bridges, dead weight testers, test pressure gauges, electric and pneumatic supplies.

For Process switches the Contractor shall check the switching points are set as per the process required settings. For the instruments that have not been factory calibrated, the Contractor shall adjust as required. The Contractor shall check the difference between set and reset values are within specified limits.

Where circumstances prevent the Contractor from carrying out of the prescribed test, a test method shall be agreed with the TCC Nominated Electrical Representative in writing.

Upon completion of tests, the Contractor shall hand the signed Instrument Test Reports, including final instrument scaling to the TCC Nominated Electrical Representative. All evidence and records of abortive tests shall also be handed to the TCC Nominated Representative at this time.

For additional requirements refer to TCC-TTS-SPEC-E002.

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