

**TWEED SHIRE COUNCIL**

**ELECTRICAL  
DESIGN  
SPECIFICATION**

**EL12**

**PROCESS CONTROL INSTRUMENTS**

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# PROCESS CONTROL INSTRUMENTS

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## 1 CITATION

This document is named “Tweed Shire Council, Electrical Design Specification EL12 - Process Control Instruments”

## 2 ORIGIN OF DOCUMENT, COPYRIGHT

This document was originally produced for Tweed Shire Council. This document is copyright to Tweed Shire Council.

## 3 VERSIONS

VERSION	AMENDMENT DETAILS	CLAUSES AMENDED	DATE ISSUED (The new version takes effect from this date)	Authorised by the Director of Engineering Services
1.1	Original version		1 November 2005	

## 4 STANDARDS

The equipment and materials supplied under this Specification must comply with the latest relevant Australian Standards, or, in their absence, with the latest relevant IEC Standards, together with the requirements of competent Authorities having jurisdiction over all or part of their manufacture, installation and operation.

In particular, all equipment and materials supplied must comply with the relevant requirements of the following Regulations, Standards and Reference Specifications.

BS 1042 - Orifice Plate Design

EL03 - Standard Specification – Preferred Electrical Equipment

## 5 GENERAL

Instrumentation systems must be built up from standard products supplied by recognised instrument hardware suppliers. All process monitoring and control system instruments must be electronic types. The Council reserves the right to approve the selection of makes, types and applications of instrumentation systems and field equipment.

Analogue current signals are preferred with a 4-20 mA D.C. range.

### 6 FIELD MOUNTED DEVICES, TRANSDUCERS AND TRANSMITTERS

#### 6.1 General

##### 6.1.1 Environmental Tolerance

All pipes, valves, fittings and instrument parts in contact with the process must be suitable for the operating conditions of pressure, temperature, abrasion and corrosion which are likely to be encountered in the process. Parts subject to wear, tear and corrosion are to be designed for a minimum operating period of ten years without adjustment, repair or replacement.

Where equipment is subject to adverse effects by the process, convenient means of cleaning them must be provided.

##### 6.1.2 Transducers and Transmitters

Each field mounted transducer or transmitter with analogue output must be either an indicating type or be provided with an output indicator. The indicator or indicating transmitter must be mounted such that the measurement can be easily read from the nearest access platform.

Enclosures for all field mounted devices must be dust, weather and hoseproof to IP65.

##### 6.1.3 Loop Loading

Instrument loops and circuits must be designed in such a manner that the burden on any transmitter or transducer is sufficiently low to permit the addition of a recorder for testing and calibration purposes without overloading the transmitter or loss of calibration.

#### 6.2 Field Control Devices

- 1) Position and Limit Switches:- non contact type, induction actuated.
- 2) Under speed switch: non contact, induction actuated and pulse output. Pulse count and all logic to be handled by the P.L.C. or remote evaluation unit in M.C.C..
- 3) High Level Switches: Timing and evaluation function in the P.L.C.

#### 6.3 Level Measurement

The Contractor must select the appropriate level measurement system and must supply details and a control description for the Council's approval.

The following applications have preferred methods of measurement:

- Dense Medium – ultrasonic type;

#### 6.4 Flow Measurement

Orifice plates must not be used on lines less than 50mm and must be designed in accordance with British Standard B.S. 1042.

Magnetic flowmeters must be the preferred method of measuring flow in liquid. Area, target, turbine and vortex flow measurement techniques, may be acceptable, with Council approval, dependant upon application.

#### 6.5 Pressure Measurement

Electronic D.P. cells must be the preferred method of measurement. For corrosive or slurry application, diaphragm seals must be provided. For pulsating service adjustable dampeners must be provided.

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Minimum size for local pressure gauges must be 100 mm diameter.

### 6.6 Temperature Measurement

Control room indication/control measurement elements must be type K (Cromel-alumel) thermocouples.

Resistance Bulbs must be used for all differential measurement and can be used where high accuracies are required. A three lead platinum element of 100 ohm resistance must be standard.

Dial type indicators (bimetallic type) must have 100mm diameter heads and be supplied with a suitable thermowell. Indicators must be supplied with demountable bezel and accuracy must be within 1% of the range of scale.

### 6.7 Control Valves

Control valve sizing calculations must be provided. Sizing must be based on the estimated variable range of flow rate, and the pressure drop must be 33% of the total system friction head at design flow. Minimum body size must be 25 mm. Sizing calculations must be submitted for review prior to final detail design.

Control valve design must be such that the valve action may be reversed in the field without additional parts.

Air operated actuators must be used in all applications and designed to "fail safe" on air failure.

Noise level must not exceed 85 dbm at one metre from the source.

All control valves 50 mm and larger must be provided with a positioner. Positioners must be fitted with filter, regulator, air supply gauge, air output gauge, control air gauge and bypass switch.

Conversion of the controller output signals to the valve must be effected by field mounted current to pneumatic converters. If the output signal operates a pneumatic actuator incorporating a positioner, conversion is preferably carried out in the positioner instead of a separate device.

## 7 PANEL MOUNTED DISPLAY INSTRUMENTS

### 7.1 Scales

Instruments must be calibrated and scaled such that under normal operating conditions the pen, pointer, or indicator is between 30% and 70% of full scale deflection. In addition the scale must cover the full range of operating conditions.

All scales and charts must have linear characteristics, that is, linearisers, square root extractors, and the like, must be included as necessary.

### 7.2 Digital Indicators

Displays must be a minimum of 3½ digits with 12 mm characters either LED or LCD. Each instrument must be provided with an adjustment for display update time with a minimum setting of

one second. Power supplies for these instruments must be fully regulated and there must be no significant roll in the last digit.

### 7.3 Analogue Controllers

All controllers must utilise 4-20 mA input and output signals or Devicenet where nominated.. On-off controllers used for electric actuators, motorised valves, and the like, must be provided with feedback signals from position indicating potentiometers.

Unless stated otherwise, controllers must be a minimum of two term (proportion plus integral) and must be capable of conversion to three term using additional or replacement plug in modules without the necessity to disconnect cabling or remove the controller from its mounting. The controllers must be PC or micro processor based.

Each controller must display the measured variable, the set point and the controller output. A manual-auto switch capable of operation without the necessity for balancing and without disturbing the process must also be provided.

The manipulation of the instrument loop characteristics and the structure of the instrument loop hardware must be in simple terms. The development of instrument loops by means of lengthy and involved software manipulation is not acceptable.

### 7.4 Chart Recorders

Continuous trace line or pen recorders must utilise charts with linear scales, minimum 100mm wide with an electric drive operating at no less than 20 mm per hour. Generally recorders must not exceed two pens per recorder.

Chart drives must be 110 V AC and each instrument must be provided with a flexible lead and three pin polarised socket and plug outlet.

## 8 CONTROL PANELS

Mounting shelves, racks, power supplies and terminals must be logically arranged on the panels.

At least 20% spare space must be left for future expansion of the system.

All instruments must be arranged in a configuration compatible with the process.

## 9 POWER SUPPLIES

Required voltages are 240 V AC for chart drives and actuators and 24 V DC for analogue loops and alarms.

The AC power supply voltage to the system may vary on a long term basis between + 10% and on a short term basis (3 seconds) between + 20%. All necessary voltage regulating equipment must be provided to compensate for this supply voltage fluctuation to the instrument system.

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The 24 V DC regulated power supplies for the analogue loops must be adequately rated with at least 25% spare capacity being provided on each supply system. The power supply systems must be provided with short circuit protection on their outputs.

A separate pair of rail mounted control fuses must be provided for each loop.

### 10 SIGNAL ISOLATORS

Signal isolators must be provided where equipment power supplies and signal connections are common. They must also be provided where earth faults on field mounted analogue equipment can cause damage to the controller output. These isolators must be high quality equivalent to Rochester.

### 11 INSTRUMENT WIRING AND CABLING

Wiring and cabling associated with circuits operating at extra low voltage and carrying instrument signals must be PVC insulated and screened in twisted pairs or triads and PVC sheath. Multicore cables must use individually screened and twisted pairs or triads with PVC sheath. All screens must have tinned stranded copper drain wires, unless they are braided copper.

This cabling must be segregated and separated from low and medium voltage cabling as follows:

- within control panels and racks - by a distance of 50mm and a continuous insulating barrier;

Conducting screens and drain wires in instrument signal cables must be earthed at the control panel or P.L.C. end only. The screens must be maintained over conducting pairs as close as possible to the connection point to provide maximum shielding.

All wiring must be identified by means of embossed cable ferrules and terminated using insulated crimp pins or cable lugs.

All cables must be provided with cable markers at each end in accordance with the cable schedule.

## 12 INSTRUMENTATION AND INSTALLATION REQUIREMENTS

### 12.1 Instrumentation Packing and Documentation

Unless otherwise authorised, all items of equipment must not be removed from their packing until ready for installation or pre-installation testing. At all times it must be the Contractor's responsibility to ensure the safety and protection of the instrumentation equipment.

Keys, packing slips, guarantees, warranty documents, instrument manuals and tools supplied with the equipment must be handed over to the Council by the Contractor.

### 12.2 Device Location

Instrumentation control valves and systems must be installed in the manner and general location as shown on the installation drawings. The final location on site must be agreed by the Council.

The instrumentation location must be as close as possible and visible from the controlled unit, with due regard to the following:

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- be accessible for personnel and maintenance. All equipment must be located 1500mm above the operating level. Any platforms or stairs to access the equipment must be installed under this Contract;
- method of support must not vibrate sufficiently to affect equipment operation and performance;
- avoid corrosive atmospheres and process fluid;
- weatherproof;
- keep process impulse lines as short as possible;
- be visible from the manually operated by-pass system.

### 12.3 Instrument Installation

Each instrument must be installed complete with mounting brackets, valves, pipework, dash pots, liquid or vapour seal pots, drains, manifolds and the like to enable the instrument to:

- be safely removed from service without disconnecting the process connections;
- be calibrated (both zero and span) without disconnecting the process connections;
- operate satisfactorily and without errors induced by trapped vapours, condensed liquids, trapped or settling solids, coating of electrodes, sensors, probes, diaphragms, and the like, by the process material.

Instruments, control systems, piping, wiring, support frames and structures must be installed plumb, level and securely bolted into position.

Equipment having a single direction flow characteristic must be installed in the correct direction. If no direction marking arrow exists, the Contractor must install one, in a permanent manner.

The Contractor must disconnect instrument connections to control valves and other inline instrument items designated by the Council to enable removal of these items from the lines for piping system pressure tests, draining, blowing and flushing operations. After reinstatement of the items in the lines the Contractor must reconnect the instrument connections.

## 13 INSTRUMENT AIR SUPPLY PIPING AND TUBING

Tubing and pipes must be installed in the locations, generally as shown on the Drawings. Runs must be in a straight line with right angle bends. Tubing must not be strapped to or supported by process pipework or equipment. It must be installed in tray or other approved means.

Tubing and pipe runs must be protected from falling objects, metal cutting, grinding or welding splatter. Negligence by the Contractor must be cause for the Council to reject the damaged tubing or lines and the Contractor must be responsible for replacement costs associated therein.

Piping and tubing must be kept internally free from moisture, dirt and contaminants and must be blown free and clear with oil free compressed air prior to connecting to instrumentation.

Instruments connected to vessels or piping subject to expansion or contraction must have sufficient flexibility in the connecting pipes or tubing to avoid strain on the instruments and connections.



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Piping and tubing must be worked with the proper tools and equipment. Joints in tubing must be kept to a minimum and occur only at instruments or junction boxes.

Impulse lines must normally be 15 mm 316 ss seamless tubing. All fittings on impulse lines must be 316 ss compression fitting from an approved manufacturer. Sample or impulse lines must, in general, be run with a slope equal to or greater than 1 in 12, unless otherwise specified.

The direction of slope must be down from the tapping point for liquids, steam and vapour that must condense at ambient temperature, and upwards from the tapping point for gas service unless special provisions are made in the drawings for venting and draining.

Instrument air supply and distribution must be provided at a single termination point. Instrument air supply and signal tubing must be fully bonded polyethylene/aluminium tubing.

Tube terminations must be carried out using brass compression fitting from an approved manufacturer.

Air supply lines must be 10 mm diameter and instrument signal lines must be 6mm diameter.

An isolating valve must be installed at the point of entry to each device requiring an instrument air supply.