SPECIFICATION PREFACE SHEET

DEPARTMENT: Engineering / Electrical	SHEET 1 OF 13	
AREA: Norðurál Grundartangi Reduction Plant	SPEC No: 00/07/TS004	REV: C2

STANDARD TECHNICAL SPECIFICATION FOR INSTRUMENTATION

MEASUREMENT OF PROCESS VARIABLES

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NORÐURÁL - ENGINEERING

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TECHNICAL SPECIFICATION

1.0 INTRODUCTION

In this Document the following words and expressions shall have the meaning hereby assigned to them except where the context otherwise requires:

Engineer: The Owner or any person or organization employed or engaged at any time by the Owner and authorized by the Owner, in writing, from time to time to act on behalf of the Owner in the execution of the items covered by this Document, in whole or in any part, for any or all purposes provided in this Technical Specification.

Owner: Norðurál hf (Nordic Aluminum Corporation Ltd.), an independent legal entity owned by Century Aluminum.

2.0 GENERAL

Equipment used for the measurement of process variables shall in all cases be “fit for purpose” and shall be suitably selected for use under the process and environmental conditions of the plant.

Smart type transmitters/instrumentation can be used but must have prior approval of the Engineer and the necessary equipment to re-configure their settings and calibrations provided with them.

Where smart type transmitters are used they shall be supplied configured in accordance with the specified parameters.

Clear and concise configuration data shall be provided with the appropriate configuration device.

2.0 TEMPERATURE MEASUREMENT

Thermocouples shall be used for measurement of fluid and metal temperatures in which case the thermocouple shall conform to EN 60584

For temperatures of 425°C and above chromel/alumel thermocouples shall be used.

Thermocouple and thermowell assemblies shall be provided with weatherproof terminal heads and shall be installed so as to totally prevent the ingress of foreign matter. Extension leads shall have conductor materials compatible to that of the thermocouple in order to eliminate the effects of cold junction variations.

Where a greater accuracy is required or temperature conditions dictate resistance thermometers to EN 60751 shall be used.

Resistance thermometers shall be fully compensated for resistance changes due to variations in ambient temperatures along the extension leads.

Suitable protection sheaths or pockets shall be supplied for all temperature sensing devices. Drawings of sheaths and pockets showing dimensions, method of attachment to plant and the materials used shall be submitted to the Engineer in order that the suitability of the design and materials to the application may be determined.

High speed response pockets shall be provided for all applications involving control of critical process temperatures.

In all cases a length of flexible cable of 1,5 m shall be connected between the head of the temperature sensor and a local junction box located on the tray supporting the fixed cable to allow for withdrawal of the sensor from its sheath without electrical disconnection.

Whenever practicable extension leads shall be terminated locally to the plant in groups.

Extension leads for all thermocouple devices shall be run in compensating cable appropriate to the thermocouple right up to the point of cold junction compensation.

Filled system and bi-metallic type dial thermometers shall be used as appropriate for local indications in the field. Unless otherwise specified the respective dial sizes shall be 150 mm diameter for filled system type and 100 mm for bi-metallic type.

Generally temperature transmitters will be used only when instruments or control loop requires signal conversion.

Radiation pyrometers may be considered for use on applications where:

(a) Temperatures are above practical operating range of thermocouples.

(b) The environment will contaminate operating range of thermocouples.

(c) The target is not easily accessible.

(d) An average temperature of a large area is required.

Radiation pyrometers shall respond to 98% of target temperature change within two seconds.

3.0 PRESSURE MEASUREMENT

All pressure instruments shall be capable of continuous operation at the maximum pressure indicated on the chart or scale. All pressure instruments shall have suitable overrange protection.

A pressure instrument installed for measurement of steady pressure shall normally operate at 75% of its maximum range. When used for measurement of varying pressure it shall operate in a band centred on 60% of its maximum range.

All local mounted pressure gauges shall comply with EN 837.1/2/3 as a minimum requirement and shall have a dial size of 150 mm diameter.

3.4 PROCESS CONNECTIONS AND INSTALLATIONS

Instruments used in high-pressure process applications shall be provided with a double isolating valve at the pressure source and this valve shall not be smaller than 12 millimetres nominal bore.

Approved ball valves shall be used where temperatures and conditions permit. The valves shall be rated for not less than the line pressure of the main pipeline.

When an instrument is located at a distance of 2,5 metres or more from its pressure connection an additional block valve and a vent valve shall be provided adjacent to the instrument. If the pressure piping is of such length that the isolating valve is inaccessible from the instrument location, a suitable valve shall also be fitted at the instrument itself.

All pressure instruments shall be installed vertically and means shall be provided for venting pressure from the line and instrument so that it may be removed safely.

Vent valves shall be arranged if necessary, with drain lines to ensure that operation of these valves does not create a hazard.

Recorders, transmitters, controllers, pressure switches and the like shall be supported independently of the pressure connection. The type of support shall depend upon the make of instrument and location. When installing pressure instruments care must be taken to avoid the possibility of imposing stresses from the pressure piping conduit etc., which may cause malfunction.

Transmitters which have no mechanical indication (blind type) shall be supplemented with process connected direct pressure gauges to facilitate local measurement/ control in the event of transmitter failure.

When the pressure impulse line is liquid filled the measuring unit shall be compensated for static head. The head correction shall be stated on the unit.

All process connections, pressure impulse lines and instrument arrangements shall be fully detailed with the approval of the Engineer.

4.0. INSTRUMENT PROTECTION

Chemical protectors (diaphragm seals) shall be used with the pressure instruments for the following services:

a) Fluids that will clog the pressure element.

b) Corrosive fluids requiring special materials available for diaphragms but not satisfactory for use as pressure measuring element.

All pressure gauges shall be fitted with a suitable blow-out disc at the back of the gauge.

Where pressure measurements are subject to pulsation, snubbers (dampers) shall be fitted.

Installation of pressure instruments at locations subject to excessive vibration shall be avoided.

5.0 FLOW MEASUREMENT

Flow measurement shall be provided to measure :

a) The flow of all raw materials and final product streams associated with the plant.

b) All plant internal material flows required for efficiency and proving calculations.

c) Major internal and external services flows (e.g. steam, water, air etc.).

d) Other internal and external services flows (e.g. steam to ejector, fuel gas to burner and minor internal material flows (e.g. hydrogen to catalyst regeneration) where the reduction on cost can be effected by better control arising from such measurement.

(e) Special cases whereby Custody Transfer/Fiscal flow measurement of dutiable materials bonded or otherwise involving taxable revenue (i.e. Customs and Excise).

Flow shall be measured in mass or volume rate.

For duties mainly under (d) flow measurement shall be to general "Process Standards" in which the permissible overall tolerance can amount to $\pm$ 4% over 25% - 100% of metering full scale range. The accuracy of other measurements shall be appropriate to the duty concerned and shall be to the approval of the Engineer.

6.0 PRIMARY ELEMENTS

Differential pressure meters in conjunction with square edged concentric orifice plates shall normally be used for the measurement of fluid flow in pipes except in the following cases :-

(a) Where requirements of accuracy cannot be met.
(b) Where wide range of flow rate exist.
(c) Where there are limitations of system pressure drop.
(d) For high viscosity liquids and slurries.
(e) Where piping configurations are restrictive, eg fully welded construction.
(f) Lines subject to pulsation.

Flow nozzles may be considered under the above headings (a) to (f).

Rectangular venturi tubes may be considered where other measuring devices are impossible or impractical (eg in large rectangular air duct of boilers).

Orifice plates and flow nozzles shall be manufactured of AISI 316 Stainless Steel unless specified otherwise.

Positive displacement type or turbine type meters shall be used as an alternative providing their use for such purposes is within the acceptable limits of the measurement requirements.

Magnetic and ultrasonic flow meters may be used under special circumstances but prior to their use agreement must be obtained from the Engineer.

Concentric or eccentric orifice plates shall be sized for a d/D ratio not less than 0,20 and not greater than 0,70. Higher rather than lower d/D ratios are preferred to minimise line restrictions.

Flow straighteners and minimum upstream and downstream straight piping lengths shall comply with requirements of BS 1042.
Metering runs shall be kept to a minimum and shall conform to the current edition of British Standard 1042; or equivalent.

Meter run piping and isolation valves shall conform to not less than the main pipeline rating they are connected to.

Tags on orifice plates shall be stamped with the basic design information (i.e. flow rate, pressure and temperature of the passing fluid the orifice diameter and the pressure differential generated).

In general, orifice plates shall be designed for flange taps. However, approved taps may be substituted when applicable for good engineering practice.

In general, the concentric type orifice shall be used. Eccentric or segmental types shall be used for measurement of dirty gases or fluids carrying suspended matter which might tend to cause buildup.

Venturi tubes shall only be considered when operating economy requires low permanent pressure losses.

7.0 LEVEL MEASUREMENT

Level measurement shall generally be made by either displacement or differential pressure measurement. However, for special application techniques such as ultrasonic capacitance probes etc. may be considered subject to the approval by the Engineer for each application.

Where detection of discrete levels is required the simple float operated switch should be used. However each switch shall have snap action with limited hysteresis to prevent contact bounce caused by small fluctuations in level.

Switches used for level detection shall provide facilities for testing the mechanical and electrical operation of the switch without its removal from the process. Isolation by means of shut-off valve will be allowable during testing.

It shall be possible with both the displacer type and differential pressure type of transmitter to isolate the transmitter from the process by suitable tight shut-off valves conforming to the pressure rating of the vessel to which they are connected and allow removal of the transmitter for maintenance without causing shutdown of the process.

Double isolation shall be provided for instruments on duties with pressures equivalent to ANSI Class 600 and above.

For measurement of large storage tanks, the load indication and transmitting mechanism shall be located at the base of the tank.

On differential pressure types of measurement where a reference leg of process fluid is used, the design of the system shall ensure that the reference leg is fully maintained at is prescribed height during all conditions of process level change and changes in process conditions and that the density of the reference leg does not vary from that of the process fluid due to temperature changes or other reasons.

For local indication of level, gauge glasses may be used providing they conform to the rated design criteria for the vessel, are equipped with quick closing isolation valves, lever handles and replaceable sets. Isolating valves for gauge glasses shall be fitted with ball checks.

Transparent or reflex type gauge glasses shall be used as and where service conditions allow.

All tubular glass type gauges shall be furnished with safety protective shields.

Connections shall be provided at the top and bottom of the gauge glass for draining and flushing purposes.

On all forms of measurement all parts of the switch, transmitter, etc. in contact with the process fluid shall be made of material compatible with the process fluid. Stainless steel shall normally be used on all corrosive duties.

8.0 VIBRATION MEASUREMENT (ROTATING MACHINERY)

Measurement of vibration is to be made on all large rotating or reciprocating machinery for protection and predictive maintenance.

The vibration level of all equipment shall be in the category "good" or better as defined by VDI 2056.

For the protection and predictive maintenance of major rotating machinery a vibration monitoring system shall be provided in accordance with VDI 2056.

The vibration monitoring system shall be reliable, accurate, easy to maintain, and suitable for use in such environmental conditions appertaining to the intended Plant installation.

Wherever feasible, Standardization and interchangeability of components shall be implemented.

The following criteria shall be used as a guideline for rotating machinery, in order to ascertain the monitoring points, principles of what signal shall be measured, what is displayed, and what mechanical conditions entail alarm and/or trip status.

(a) Non-contacting proximity probes shall be provided unless otherwise specified for measuring rotor shaft vibration and axial position. They will also be used to determine phase angle of primary rotor imbalance.

(b) Vibration measurements shall be in displacement micrometers peak to peak.

(c) Systems and equipment shall meet the requirements of API 670 or equivalent International Standard.

(d) In cases where, because of process conditions, accessibility or non-critical service, may entail the use of machine casing mounted vibration transducers, the transducers shall be of the "acceleration" type incorporating a filter network, if necessary, along with integration in the monitor unit for vibration read out in velocity mm/sec. RMS. For alarm only, one transducer may be used. For alarm and trip conditions, 3 transducers shall be used with a voting system (i.e one high reading out of three = alarm, two out of three = trip). Contacting type transducer systems and equipment shall meet the requirements of ISO 2954.

(e) Velocity type transducers shall be used as an alternative to accelerometers when machine rotational speed and generated vibration frequency conditions dictate.

(f) Individual read out of all channels shall be provided. Display shall be by means of a multipoint indicator and digital selector.

(g) Facility for trend monitoring using control room mounted chart recorders shall be provided on the turbo- generator bearings as an aid for predictive maintenance purposes.

(h) Buffered signals at the monitor shall be a requirement to enable external recordings to be obtained, if such are deemed necessary.

(i) Facilities shall be provided for the calibration of the instrumentation system.

ISO 10816 shall form the basis for evaluating standards of measurement required and all measurement systems shall comply with ISO 2954. Particular attention shall be paid to individual plant manufacturer's requirement for vibration measurement to protect the safety of each major item of plant.

Generally seismic type devices shall be used for this form of measurement. However non-contact proximity probes may be used especially for lower frequency detection.

The contractor shall ensure that each sensing device is suitable for the range of frequencies and amplitudes that may be encountered on any particular application and the device shall not be damaged or calibration altered by inputs three times the normal measurement range.

The sensing head shall be fully suitable for the environment in which it is mounted and shall be fully protected from any process fluids.

Facilities for off line calibration of each type of sensing device shall be included in the contract.

9.0 ANALYSERS - PROCESS STREAM

The tenderer shall provide technical data relating to each type of analyser in his offer, including but not limited to:

(a) Specifications of physical and chemical conditioning of sample streams.
(b) System requirements of accuracy, reliability and servicing frequency.
(c) Details of analysis instrument.
(d) Display and output signal level information.

Single stream analysers shall be used, except in cases where the Engineer has specified or has given written agreement to multi-stream types.

Wherever possible analysers shall utilise an in-stream analysis probe.

The use of individual or multiple prefabricated analyser installations shall be used to reduce Site installation work. This prefabrication shall include sample conditioners, analysers, air and electrical distribution, cooling water distribution or coolant circulating system all piped and wired on a common frame. The arrangement shall permit testing of the entire assembly before despatch to site and shall be arranged for convenient removal from on-line operation to facilitate routine maintenance and calibration.

Generally analysers shall be suitable for mounting in ambient plant conditions, however when this is not feasible, i.e spectrographic or chromatographic analysers, they shall be mounted in an air conditioned room.

A schedule of recurring maintenance and adjustment operations shall be prepared and the necessary environment for these operations specified.

Flammable vapour effluents, including sample discharge lines shall be disposed to an atmospheric vent that is independent of any process vent. The vent shall be taken to a safe height and its location agreed with the Engineer.

The sampling system shall include but not be limited to all probes, valves, filters, coolers, pressure regulators, coalescers, flow-meters, piping and pumps as necessary, to give the analyser a representative and suitably conditioned sample.

The delay time between a sample being withdrawn from the process and being available to the analyser shall be consistent with the measurement and control requirements of the particular process. The preferred method of keeping sampling lags to acceptable limits shall be by locating the analyser close to its sample take-off point. When this is not practicable, the distance-velocity lag of the sampling system shall be reduced by increasing the velocity of the sample, e.g. by fast loop. The sample shall be returned to the process or disposed of in an economic and safe manner.

10.0 INSTALLATION

All instrument installations shall be carried out in accordance with recognised and approved standards and shall comply with the manufacturers recognised and approved standards and shall comply with the manufacturers instructions.

All instruments shall have isolation (for high pressure application double isolation) and, where appropriate, venting facilities to permit removal of all instruments whilst the plant is in operation.

Adequate test points for portable instruments shall be provided for the testing and maintenance of all remote and local measurement loops.

Instruments shall be easily accessible either from grade or from a permanent platform for process observation and operation and for maintenance.

Instruments mounted in the field shall not be supported from pipework, stairways or railings.

Drip trays or effective barriers shall be provided to prevent damage to electrical equipment due to fluid leakage.

Instruments shall be adequately protected to ensure long-term service in the operating environment and shall be mounted in such a manner as to avoid the effects of vibration, extremes of temperature, dust, humidity and salt spray etc. Instruments shall not be located beneath tanks and vessels and other areas where spillage or overflow will cause the fluid to come into contact with the instrument.

The instrument installation shall make due allowance for thermal cladding. The length of temperature sheaths, impulse piping etc. shall be selected to prevent disturbing the cladding during instrument removal.

The supplier shall include with his offer typical hook up drawings for each type of measurement.