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Technical Requirements Specification for Pressure Transmitters in Protection Relevant Measurements

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1. Performance and Features

1.1	Device Type	<ul style="list-style-type: none"> Digital Pressure Measurement (Gage, absolute, difference) for measurements within and outside of explosion hazardous areas for process measurement, control and protection <p><i>Comment: different devices for Ex version and Non-Ex versions required.</i></p>
1.2	Measurement Description	<ul style="list-style-type: none"> Pressure transmitter for the measurement of process pressures on a heavy duty gasturbine power plant.
1.3	Measurement Input	<ul style="list-style-type: none"> Measurement of air, and media used in gasturbines (e.g., fuel gas, fuel oil, N2, water) Device for gage, absolute and differential pressure Transmitter location: <ul style="list-style-type: none"> Ex-hazard Zone 2 according to IEC 79-10 Non-hazardous area
1.4	Measurement Output	<ul style="list-style-type: none"> Analogue current loop interface: <ul style="list-style-type: none"> Typical: 4 .. 20 mA Extended: 3.8 .. 20.5 mA, according to NAMUR NE43 Fail safe status: ≤ 3.6 mA, according to NAMUR NE43 Potential for bus interface HART Protocol Optional 5 digit LCD meter for local display
1.5	Measurement Ranges	<ul style="list-style-type: none"> Ranges: <ul style="list-style-type: none"> Gage: 0-16 MPa Absolute: 0-0.2 MPa Differential: 0-14 MPa (upper Limit) <p>Smaller ranges can be covered by different versions of device. Turndown: min 50:1</p>
1.6	Accuracy and Stability	<ul style="list-style-type: none"> Reference Accuracy: +/- 0.075% of span Stability: +/-0.15% of URL for 5 years

1.7	Response Behaviour	<ul style="list-style-type: none"> • All times stated below are defined as worst case values instead of any kind of averaged values • Input step response: <ul style="list-style-type: none"> - Dead time: ≤ 45 ms - Total response time: ≤ 150ms - Update time: >20Hz • Re-powering of device: <ul style="list-style-type: none"> - Direct switch from fault indication signal to measurement value. No swinging around actual measurement value
1.8	Power Supply	<ul style="list-style-type: none"> • External or loop sourced (2 wires) • Supply voltage: <ul style="list-style-type: none"> - Range: 20V .. 29 V DC - Nominal: 24 V DC • Power consumption: ≤ 50 mW
1.9	Failure Detection	<ul style="list-style-type: none"> • In any failure case including sensor failure: <ul style="list-style-type: none"> - Output signal shall not be interrupted - Any fuse break must lead to failsafe status - Supply power below low limit must directly lead to fail safe status - Faults of the device's internal power supply shall lead to failsafe status • Fault detection: <ul style="list-style-type: none"> - Out of range according to NAMUR NE43 - Fault status shall be detected after latest 700 ms • Extended fault detection in case of smart device: <ul style="list-style-type: none"> - Main component failures, i.e. of microprocessor(s), A/D coupler(s), multiplexer(s), D/A coupler(s), optocoupler(s), reference voltage(s), shall be detected - Fault status shall be achieved after latest 1.4 s
1.10	Failure Indication and Fail Safe Status	<ul style="list-style-type: none"> • Failure indication with HART device • Fail safe status: <ul style="list-style-type: none"> - Down scale of output ≤ 3.6 mA, according to NAMUR NE43 - Worst case switching time required from full scale to fail safe status: ≤ 150 ms - <i>Comment: the switching time shall be documented by a dynamic measurement</i>
1.11	Lifetime	<ul style="list-style-type: none"> • Design service lifetime: > 10 years
1.12	Safety, Availability and Reliability	<ul style="list-style-type: none"> • FMEDA must be provided by the supplier • Device shall comply with requirements of IEC61508-2, and -3 for software: <ul style="list-style-type: none"> - Assumptions: <ul style="list-style-type: none"> - Application in MC2 at "low demand" - Hardware fault tolerance class "0" - Proof Test Interval: ≥ 24000 hrs - Mean Time To Repair: < 8 hrs - SIL2 - Type-A equipment: 60-90% Safe Failure Fraction - Type-B equipment: $>90\%$ Safe Failure Fraction - Probability of Failure on Demand (average): $< 1.75 \cdot 10^{-3}$ - Total Failure Rate: $< 7 \cdot 10^{-7}$/hr <p><i>Comment: The detailed requirements are intentionally over-determined; each of them must be satisfied.</i></p>
1.13	Servicing and Maintenance	<ul style="list-style-type: none"> • Recalibration shall be possible • Device proof test (off-line) shall be performed not sooner than every 3 years (Proof Test Interval 24000 hrs)

1.14	Explosion Protection	<ul style="list-style-type: none"> • ATEX:EEx d IIC T3 ($t_{amb}=85^{\circ}\text{C}$) • Device location: non-explosion-hazardous area or explosion hazardous area • Sensor location: Explosion-hazardous area Ex-Zone 2 according to IEC 79-10 / Non-hazardous area
1.15	Ambient Operating Conditions (Surrounding air of transmitter, independent from device casing)	<ul style="list-style-type: none"> • Temperature: -40°C to $+85^{\circ}\text{C}$ • Relative humidity: 0-100%

2. General Design

2.1	Casing	<ul style="list-style-type: none"> • Minimum tightness: IP67
2.2	Label	<ul style="list-style-type: none"> • Device shall carry durably over service lifetime one (per channel) tag label: <ul style="list-style-type: none"> - Device Type and version - Manufacturers name and address - Serial number - Production year - Measurement range cell - Safety relevant information and warnings (Ex-protection, pressure equipment)
2.3	Markings	<ul style="list-style-type: none"> • CE ATEX marking according EU directive 94/9/EC • UL,FM or CSA markings • Blue markings at field input terminal and plug
2.4	Mounting	<ul style="list-style-type: none"> • Mounting with brackets on pipe segments
2.5	Connectors	<ul style="list-style-type: none"> • Process Connection: <ul style="list-style-type: none"> • direct connection of pressure tubes • valve manifold • Electrical connection: signal input and output with screw terminal plugs • External bonding (earthing) connection screw • HART terminal connection possibility
2.6	Insulation	<ul style="list-style-type: none"> • According to EN 50178
2.7	Electro Magnetic Compatibility	<ul style="list-style-type: none"> • According to EN 50081, EN 50082, NAMUR NE21
2.8	Surge protection	<ul style="list-style-type: none"> • Device shall allow surge protection without affecting signal quality

3. Certification

3.1	Certifications	<ul style="list-style-type: none"> • CE • ATEX directive 94/9/EC • FM • CSA / UL 508 • EMC Directive 89/336/EEC
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4. Documentation

4.1	General Documentation	<ul style="list-style-type: none"> • CE compliant user manual • Languages: English, Manual also available in other languages on request
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4.2	Standard Documentation	<ul style="list-style-type: none"> • Compliance statement to this document • CE Declaration of conformity to CE (ATEX, LV, EMC) • Calibration certificate • Product description • Product data sheet • Instruction manual: <ul style="list-style-type: none"> - Erection instructions - Commissioning instructions - Troubleshooting instructions - Instructions for safe use (ATEX)
4.3	Technical Documentation	<p><i>Required for product evaluation and validation:</i></p> <ul style="list-style-type: none"> • Technical report (including traces) documenting out-of-serial-production measurements on: <ul style="list-style-type: none"> - Step response - Ramp response - Transmitter failure response - Input-output linearity • Detailed function block diagram • Functional description • Sequence diagram (selftests, output, calibration etc)
4.4	Device Safety and Reliability	<ul style="list-style-type: none"> • SIL parameters according to IEC61508/61511, containing: <ul style="list-style-type: none"> - Device type - SIL number - Type classification - Hardware fault tolerance class - Measuring range - Proof test interval - Overall failure ratio - Safe failure fraction - Average probability of failure on demand • If available: SIL certificate of compliance

5. Implementation

Implementation of a pressure transmitter: only after supplier and product qualification and fulfilment of this requirements specification and successful validation on a front-runner engine.