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Specifying Instruments — Pressure, Temperature, Level, Flow

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The six attributes of a pressure transmitter and the eight of a temperature sensor: 4–20 mA, HART and IO-Link, NAMUR NE 43 fault signalling, Pt100 classes and wiring, process connections and thermowells, Ex, marine and SIL approvals, level, flow and gas detection under EN 378 — with the current Danfoss, Siemens and ABB ranges, their code numbers, and a worked pumping-station instrument register.

The short version

An instrument is specified by its signal first. 4–20 mA two-wire (IEC 60381-1) remains the industrial standard for transmitters, with HART on top for configuration and diagnostics; 0–10 V and ratiometric outputs for machinery and mobile applications; IO-Link (IEC 61131-9) for sensors on machines and skids; PROFIBUS PA, Foundation Fieldbus and Ethernet-APL for process plants. Fault signalling follows NAMUR NE 43: a live measurement sits between 3.8 and 20.5 mA, a fault is signalled below 3.6 mA or above 21 mA.

A pressure transmitter has six attributes. Reference (gauge, absolute, differential), range, output, process connection, electrical connection, and the media and environment that set the material and approval. Danfoss' MBS 3000 type code carries all six in sequence; the catalogue code number (060G1124 for a 0–6 bar, 4–20 mA, G1/4 unit) is one combination of them.

A temperature sensor has eight. Element (Pt100 or Pt1000 per IEC 60751, or thermocouple per IEC 60584), class (AA, A, B), wiring (2-, 3- or 4-wire), insertion length, diameter, process connection and thermowell, connection head or cable, and whether a transmitter sits in the head. Class A is ±0.35 °C at 100 °C; class B is ±0.8 °C; 3-wire is the industrial default.

Process connection and material decide more than accuracy. G1/4 A and G1/2 A to EN 837, 1/4 and 1/2 NPT, flush diaphragms and hygienic clamps for pressure; thermowells to DIN 43772 or ASME PTC 19.3 TW for temperature; 316L stainless steel for most media, ceramic cells for aggressive and abrasive ones, Hastelloy and tantalum where chlorides and acids rule.

Approvals are part of the identifier. ATEX and IECEx (intrinsic safety Ex ia with barriers or galvanic isolators, flameproof Ex d, Zone 2 Ex ec), marine class society type approvals for shipboard sensors (Danfoss' MBS 33M and MBT marine sensors are the common case), SIL capability under IEC 61508 for safety instrumented functions, and hygienic (EHEDG, 3-A) in food and pharma.

Level, flow and gas detection follow the same logic. Hydrostatic, ultrasonic and radar level; electromagnetic, Coriolis, vortex and ultrasonic flow; electrochemical, catalytic and infrared gas detection with EN 378 and EN 50271 driving refrigeration machine rooms. Section 9 maps the families; section 13 is the RFQ that gets a firm quote in one pass.

1. Signals: what the instrument says and how

4–20 mA two-wire. The transmitter is powered by the loop (typically 9–32 V DC at the transmitter; Danfoss specifies 9–32 V DC for the MBS 3000 4–20 mA version) and modulates the current it draws; 4 mA is the zero, 20 mA the span, and the live zero lets a broken wire (0 mA) be told from a zero reading. Current is immune to cable resistance over hundreds of metres, which is why it has outlasted every voltage signal in the plant. Loop load, barrier drop and the PLC input's burden (commonly 250 :'' 6WB F†R Ö–æ–Ðum supply voltage, a calculation that belongs in the specification when loops are long or intrinsically safe.

NAMUR NE 43. The recommendation that most transmitters follow for signalling failure: measurement information between 3.8 and 20.5 mA, failure information at "d3.6 mA or "e21 mA, selectable in the transmitter as downscale or upscale. A PLC that does not evaluate the fault band is treating a sensor failure as a process value.

HART. A digital signal superimposed on the 4–20 mA loop for configuration, calibration and diagnostics; HART 7 is current and HART-IP carries the same information over Ethernet. Most smart transmitters have it; most compact OEM sensors do not.

Voltage and ratiometric outputs. 0–10 V, 1–5 V, 1–6 V and ratiometric 10–90% of a 5 V supply are machinery, hydraulics and mobile-equipment signals, three-wire, short-cable; the MBS 3000 is available in all of them, each a different digit in the type code.

IO-Link. IEC 61131-9, point-to-point digital on a standard three-wire M12 cable to an IO-Link master, with process data, parameters and diagnostics in one connection; the machine-building and skid standard for pressure, temperature, flow and level sensors from ifm, Baumer, Balluff, Turck, Sick, WIKA and others, and increasingly offered on Danfoss and Siemens sensors. It replaces the analogue input card with a master and removes the scaling error, but it is not a process-plant fieldbus and its cable length is 20 m.

Process fieldbuses. PROFIBUS PA and Foundation Fieldbus H1 for installed process plants; PROFINET and EtherNet/IP over Ethernet-APL (two-wire, intrinsically safe, 1,000 m trunk) as the current standard for new process instrumentation from Siemens, ABB, Endress+Hauser and others. The instrument's bus is in its order code and cannot be changed by a module.

Switches. Pressure, temperature, level and flow switches are still specified where a single setpoint is enough and no signal is needed: mechanical (Danfoss KP and RT, among others), or electronic with a switching output and a display. The electronic switch with IO-Link is where the two worlds meet.

2. Pressure transmitters: the six attributes

Reference. Gauge (relative to atmosphere; most industrial measurements), sealed gauge, absolute (relative to vacuum; vacuum systems, altitude-independent measurements), differential (across filters, orifice plates, levels in closed tanks).

Range. Chosen so that the normal operating point sits in the upper half or two thirds of the span, with overload and burst pressures checked against transients. The MBS 3000 programme runs from 0–1 to 0–600 bar in standard steps (1, 1.6, 2.5, 4, 6, 10, 16, 25, 40, 60, 100, 160, 250, 400, 600 bar) with overload at 6 × full scale (to 1,500 bar) and burst at 6 × full scale (to 2,000 bar), per the data sheet; water hammer and pump pulsation are handled by the MBS 3050 variant with an integrated pulse snubber.
Output. 4–20 mA, 0–5 V, 1–5 V, 1–6 V, 0–10 V, 1–10 V, ratiometric; HART; IO-Link.
Process connection. G1/4 A EN 837 and G1/2 A EN 837 (the European standards), 1/4–18 NPT and 1/2–14 NPT (North America and oil and gas), DIN 3852-E G1/4, M14 × 1.5 and M18 × 1.5 (hydraulics), 9/16–18 UNF SAE J514 (mobile hydraulics), flush diaphragm G1 or G1/2 for viscous and crystallising media, hygienic clamp and DIN 11851 for food and pharma, flanged diaphragm seals for hot and aggressive media.
Electrical connection. DIN plug EN 175301-803-A (Pg 9 or Pg 11; IP65 with the mating connector), M12 × 1 four-pin (IP67), cable gland and flying leads, AMP connectors for mobile equipment; the IP rating is a property of the connection, not the sensor.
Media, environment and approvals. 316L stainless steel wetted parts for water, oils, air, most chemicals; ceramic (Al2O3) measuring cells for abrasive and aggressive media and for low ranges; Hastelloy C276, tantalum and PTFE-lined seals for chlorides and acids; compensated temperature range (0–80 °C on the MBS 3000) against the medium's temperature, with a siphon or seal where steam or hot media exceed it; ATEX and IECEx marking for zones; marine type approvals for shipboard installation; SIL capability where the loop is a safety function.

Accuracy is quoted as a percentage of full scale (FS) or span, typical and maximum, including non-linearity, hysteresis and repeatability: the MBS 3000 at "d±0.5% FS typical and "d±1% FS maximum; the MBS 33 at "d±0.3% FS typical and "d±0.8% FS maximum (both per Danfoss' data sheets); smart process transmitters at 0.04 to 0.1% of span with turndown. Thermal zero and span shift (quoted per 10 K) matter more than base accuracy where the ambient swings.

The range decision is accuracy arithmetic. Full-scale accuracy is an absolute error: a 0–16 bar transmitter at ±0.5% FS is ±0.08 bar wherever it reads, which at a normal operating pressure of 3 bar is ±2.7% of the reading; a 0–6 bar unit on the same service is ±0.03 bar, ±1% of reading; a 0–4 bar unit, ±0.02 bar, with the operating point at 75% of span and the overload (6 × 4 = 24 bar) still above any plausible transient. The right range is the smallest one whose overload the process cannot reach, and the "one size covers everything" 0–16 or 0–25 bar transmitter that saves a line on the spares list costs three to five times the measurement error on every low-pressure service it is fitted to. Smart transmitters with turndown (a 0–40 bar cell ranged to 0–6 bar) avoid the trap at a price; compact transmitters do not, and their range is fixed in the code number.

Switches. Where a single setpoint is enough, mechanical pressure switches remain the simplest and most robust device: Danfoss' KP range (KP 35 and KP 36 for general pressure, the KP 1 to KP 7 refrigeration series for low- and high-pressure cut-outs; KP 35 is code 060-1133 in its standard version) and RT range (RT 110 to RT 200 industrial and marine switches, with marine approvals) and the equivalents from other makers; electronic pressure switches with display and IO-Link where the setpoint must be changed from the controller. A switch is specified by its setting range, differential (fixed or adjustable), contact (SPDT, rating), process and electrical connection, and approval, and its code number carries all of them in the same way as a transmitter's.

Danfoss MBS family. MBS 3000 is the compact industrial transmitter (and MBS 3050 with snubber); MBS 33 the higher-accuracy industrial unit, MBS 33M its marine-approved version; MBS 1900 and MBS 1700 for HVAC and refrigeration; MBS 1250 and MBS 1350 for mobile hydraulics; MBS 4010 for intrinsically safe loops; MBS 8250 for marine with integrated display; MBS 5100 and MBS 5150 for marine with full approvals. The type code builds from reference, output, range, electrical connection, gasket and process connection, and the catalogue code numbers are fixed combinations:

Code number | Type | Range | Output | Process connection | Electrical connection |

060G1122 | MBS 3000 | 0–2.5 bar gauge | 4–20 mA | G1/4 A EN 837 | DIN plug EN 175301-803-A, Pg 9 |
060G1124 | MBS 3000 | 0–6 bar gauge | 4–20 mA | G1/4 A EN 837 | DIN plug, Pg 9 (listing) |
060G1125 | MBS 3000 | 0–10 bar gauge | 4–20 mA | G1/4 A EN 837 | DIN plug, Pg 9 |
060G1133 | MBS 3000 | 0–16 bar gauge | 4–20 mA | G1/4 A EN 837 | DIN plug, Pg 9 |
060G3126 | MBS 33M (marine) | 0–10 bar gauge | 4–20 mA | G1/2 A EN 837 | DIN plug, Pg 13.5 |

Six attributes, one code; change the connection to G1/2 or the plug to M12 and it is a different code number, and the requisition that lists "MBS 3000 0–10 bar" has not yet named a product.

Siemens SITRANS P. P200, P210 and P220 are the compact transmitters for general, low-pressure and high-pressure applications respectively, with ceramic or stainless steel cells, 4–20 mA or 0–10 V outputs, G1/2 A EN 837-1 or 1/2 NPT connections and DIN plug or M12; a P200 order number such as 7MF1565-3CA10-1AA1 carries the pressure type, range (here 0–10 bar gauge), output (here 0–10 V three-wire) and connections in its characters, and the same unit with a 4–20 mA output is a different number. P320 and P420 are the smart process transmitters with HART, PROFIBUS PA or PROFINET, SIL 2/3 capability and remote seals; P DS III the installed-base predecessor. The same six-attribute logic applies, with the range coded rather than fixed.

Other makers. ABB's 2600T series (266 models) for process pressure and differential pressure with HART, fieldbus and SIL; WIKA's A-10 and S-20 compact transmitters and its process transmitters; Endress+Hauser's Cerabar and Deltabar; Keller, Trafag, Huba Control, ifm and Baumer in machinery and OEM sensors. They are named here because the function is open: a specification that reads "4–20 mA, 0–10 bar gauge, G1/2 A, 316L, IP65, ATEX Zone 2" can be met by several of them, and a specification bound to one maker's code number is met by that one.

3. Temperature sensors: the eight attributes

Element. Pt100 (100 :’ B 0, ; Ò ã 3ƒR W" ”T2 c sS ’ —2 F†R –æGW7G ial standard; Pt1000 reduces lead-resistance error and is common in HVAC and compact sensors; thermocouples (type K, J, N, S per IEC 60584) for high temperatures and fast response; NTC thermistors in refrigeration and HVAC controls (Danfoss' own controllers use them).
Class. IEC 60751 tolerance classes: AA ±(0.1 + 0.0017·|t|) °C, A ±(0.15 + 0.002·|t|) °C, B ±(0.3 + 0.005·|t|) °C, C ±(0.6 + 0.01·|t|) °C. At 100 °C that is ±0.27 °C (AA), ±0.35 °C (A) and ±0.8 °C (B); at 200 °C, ±0.44, ±0.55 and ±1.3 °C; at 400 °C,

±0.95 °C (A) and ±2.3 °C (B). Class A is the specification for process measurement and energy metering; class B for monitoring and HVAC. The "1/3 DIN" and "1/10 DIN" tolerances of older specifications are not classes in the standard, and the standard also limits the temperature range over which each class applies (in the 2008 and later editions, class A from " 100 to +450 °C for wire-wound elements and " 30 to +300 °C for thin-film elements, class AA narrower again, class B wider).
Wiring. 2-wire adds the lead resistance to the measurement (two 1.5 mm² copper conductors add about 0.024 :' W" ÖWG&R öb run, about 0.06 °C per metre and 6 °C on a 100 m run), acceptable only for short runs and class B; 3-wire compensates the leads and is the industrial default; 4-wire eliminates them and is used for class AA and for transmitters that offer it. Duplex elements (two Pt100 in one insert) give a redundant or a second-system signal.
Insertion length and diameter. The sensor must reach the flowing medium (a minimum immersion of about ten times the diameter plus the element length) and the insert must match the thermowell; standard lengths 50, 80, 100, 120, 150, 200, 250 and 300 mm; diameters 6 and 8 mm for inserts, 3 mm for compact probes.
Process connection and thermowell. Threaded G1/2 or 1/2 NPT, compression fitting for adjustable insertion, flanged or weld-in thermowells to DIN 43772 (forms 2, 2G, 3, 3G, 4) or to ASME PTC 19.3 TW with a wake-frequency calculation on high-velocity lines, in 316 or 316Ti stainless steel, with the insert replaceable without opening the process.
Head or cable. DIN connection heads form B (DIN EN 50446; aluminium or stainless steel) with a ceramic terminal block or a head-mounted transmitter; slim-line heads on compact sensors; cable outlets with silicone, PTFE or PVC leads for machines and HVAC.
Transmitter. A head-mounted or rail-mounted transmitter converts the Pt100 to 4–20 mA (with HART or IO-Link where offered), fixes the range, and removes the resistance measurement from the cable; the alternative is an RTD input card at the PLC. Danfoss' MBT 3560 builds the transmitter into the sensor (MBT 3560-0001-0150-62-420, code 084Z4065, is the type-code form: element, 150 mm insertion, head and connection, 4–20 mA output).
Approvals and environment. Marine type approvals for shipboard sensors (Danfoss' MBT 5250 and MBT 5252 are the engine and marine sensors; MBT 153 and MBT 156 the compact industrial and HVAC sensors), ATEX and IECEx for zones (intrinsically safe loops through a barrier, or Ex d heads), vibration resistance on engines and compressors, and the medium's temperature against the insert's and the head's limits.

Danfoss MBT family. MBT 153 (general industrial, Pt100 or Pt1000, cable or head), MBT 156 (compact Pt100 for HVAC and industry; the 084Z4321 insert, Pt100, 100 mm insertion, slim-line head), MBT 3560 (with integrated 4–20 mA transmitter), MBT 5250 and MBT 5252 (heavy-duty marine and engine, with class society approvals), MBT 150 inserts (084Z8072 at 80 mm, 084Z8073 at 200 mm, 084Z6011 at 120 mm are the spare inserts for the heavy-duty sensors). The type designation reads MBT 5250-0100-150-220 as sensor, element and connection code, insertion length and head code; the 084Z code number is the fixed combination.

Other makers. Siemens SITRANS TS (TS100 compact, TS200 cable, TS300 hygienic, TS500 modular process sensors with DIN 43772 thermowells) and SITRANS TH transmitters; ABB SensyTemp TSP and TTH transmitters; WIKA TR10 to TR40 and its TIF and T32 transmitters; Endress+Hauser Omnigrad and iTEMP; Jumo, Pyromation, Thermo-Electra, Pentronic and the specialists; ifm and Baumer in compact IO-Link sensors. The function is open; the insert dimensions and the class are what the requisition must fix.

4. Process connections and materials: the compatibility table

Medium or duty | Pressure: connection and wetted material | Temperature: thermowell and insert |

Water, glycol, compressed air, hydraulic oil | G1/4 A or G1/2 A EN 837; 316L | Threaded G1/2 pocket, 316; 6 mm insert |
Steam and hot water above 85 °C | G1/2 A with siphon or cooling element; 316L | Welded or threaded well to DIN 43772 form 2 or 3; 316Ti |
Seawater, brine, chlorides | Flush diaphragm, Hastelloy C276 or titanium; or ceramic cell | Titanium or super-duplex wells; duplex insert |
Viscous, crystallising, slurries, pulp | Flush diaphragm G1 or flanged seal; ceramic or 316L | Weld-in well, short insertion, heavy wall |
Food, beverage, pharma | Hygienic clamp, DIN 11851, Varivent; 316L, Ra "d0.8 µm; EHEDG | Hygienic clamp wells; 316L polished; FDA-compliant seals |
Ammonia and refrigerants | 316L, no copper alloys; sealed gauge; EN 378 compliance | 316 inserts; cable sensors on suction lines |
Oil and gas, offshore | 1/2 NPT; 316L or Hastelloy; NACE MR0175 where sour; Ex d or Ex ia; class society | ASME PTC 19.3 TW flanged wells; Ex d heads; NACE materials |
Mobile machinery and hydraulics | M14 × 1.5, M18 × 1.5, 9/16 UNF; 316L; ratiometric or 0–10 V; AMP connectors | Compact 3 mm probes, cable outlet, IP67/69K |

The table is a starting point, not a specification; the plant's piping class and material specification govern, and the requisition should cite them.

5. Explosive atmospheres, marine and SIL

Ex. Three routes for a transmitter in a zone: intrinsic safety (Ex ia for Zone 0 and 1, Ex ic for Zone 2) with a Zener barrier or galvanic isolator in the safe area and entity parameters (Ui, Ii, Pi, Ci, Li) matched on the loop; flameproof (Ex d) transmitters with their own enclosures and certified glands; increased or non-sparking protection (Ex ec, formerly Ex nA) for Zone 2 only, which is how the MBS 3000 is marked (ATEX Zone 2, EN 60079-0 and EN 60079-7 per the data sheet, with the ambient limited to " 10 to 85 °C in that use). The certificate number, the marking string and the entity parameters are part of the identifier and must be on the requisition; a transmitter of the same type without the marking is a different code number.

Marine. Sensors on ships and offshore units within class survey need type approval from the vessel's society (DNV, Lloyd's Register, Bureau Veritas, ABS, ClassNK, RINA and others); Danfoss publishes marine programmes for pressure (MBS 33M, MBS 5100, MBS 8250) and temperature (MBT 5250, MBT 5252) with the approvals listed by society, and Siemens, ABB and WIKA publish theirs. The society and the location on board (engine room, deck, hazardous area) belong on the requisition.

SIL. Where the loop is a safety instrumented function under IEC 61511, the transmitter needs a SIL capability declaration (IEC 61508, with its failure rates and safe failure fraction) and the specification states the target SIL; smart process

transmitters (SITRANS P320/P420, ABB 266, Endress+Hauser Cerabar and iTEMP) carry SIL 2 or SIL 3 capability in hardware; compact OEM sensors do not.

6. Hygienic and water applications

Food, beverage and pharmaceutical plants specify hygienic process connections (clamp to ISO 2852 or DIN 32676, DIN 11851 dairy fittings, Varivent), surface finishes (Ra "d0.8 µm, electropolished where required), EHEDG certification and 3-A sanitary standards, CIP and SIP resistance (temperature cycling to 140 °C and caustic cleaning), and FDA-compliant seal materials. Water and wastewater specify drinking-water approvals for wetted materials (KTW, WRAS, ACS, NSF 61 by country), hydrostatic level transmitters for wells and sumps, submersible cable with vent tube, and lightning and surge protection on outdoor loops. Both are families within the same makers' ranges and both are different code numbers from the industrial standard.

7. Level measurement in brief

Hydrostatic (a pressure transmitter at the bottom of the tank or a submersible probe; the simplest for open tanks and wells; density-dependent), differential pressure (closed and pressurised tanks; impulse lines or remote seals), ultrasonic (non-contact, open tanks and channels, affected by foam and vapour; Siemens SITRANS Probe LU240 and LUT400 among the common instruments), radar (non-contact 80 GHz is now the default for most tanks and silos, from Siemens SITRANS LR, Endress+Hauser Micropilot, VEGA, ABB and Emerson), guided-wave radar (interfaces and narrow tanks), capacitance and vibrating-fork switches for point level. The requisition carries the tank geometry, the medium's dielectric constant and density, the nozzle size and height, the temperature and pressure, and the output.

8. Flow measurement in brief

Electromagnetic (conductive liquids; water, wastewater, slurries, chemicals; Siemens SITRANS F M MAG 5100 W and MAG 8000, ABB ProcessMaster and WaterMaster, Endress+Hauser Promag, Krohne Optiflux among the common instruments; lining and electrode material by medium), Coriolis (mass flow and density; hydrocarbons, chemicals, food; the metering standard), vortex (steam and gases), ultrasonic (clamp-on for retrofits, inline for custody transfer), differential pressure with orifice or venturi (the installed base in oil and gas and power), thermal mass (gases and compressed air), turbine and positive displacement (fuel and oil). The requisition carries the medium, the flow range, the line size and the straight-run available, the process conditions, the accuracy class, the output and the approvals, and for custody transfer the MID or OIML class.

9. Gas detection and refrigeration safety

EN 378 requires refrigerant gas detection in machinery rooms and occupied spaces above charge thresholds, and national practice puts a detector in every ammonia machine room; EN 50271 and EN 60079-29-1 govern the detectors' performance, and EN 14624 refrigerant detectors. Electrochemical cells (ammonia, toxic gases), catalytic beads (flammables), infrared (CO2, hydrocarbons, HFCs) and semiconductor sensors are the technologies, with 4–20 mA, relay and Modbus outputs and a controller or the building system evaluating alarm levels. Danfoss' GD range covers ammonia (R717), HFC and HFO refrigerants, CO2 and hydrocarbons in basic, premium and heavy-duty versions; the GD Heavy Duty 148H6059 for R717, 0–100 ppm is the machine-room unit in the ammonia range. Sensor cells have a finite life (two to five years by technology) and the calibration interval is part of the maintenance register; a gas detector is a certificate-bound consumable in the same sense as a UV lamp.

The same refrigeration systems carry the solenoid valves, pressure and temperature controls and electronic expansion valves that Danfoss, among others, supplies as a system programme (the EVR 3 solenoid valve, 3/8 in ODF, NC, 032F1204 is the small-bore standard for fluorinated refrigerants), and a machine-room requisition that lists detectors, valves, coils and sensors by code number in one pass is priced in one pass.

10. A worked register: one pumping station

A small wastewater pumping station with two submersible pumps on drives, a wet well and a control building, specified tag by tag the way the RFQ in section 13 asks for it. The Danfoss codes are the catalogue combinations named above; the level and flow lines are specified by attributes because the right instrument depends on the well geometry and the line size the requisition gives.

Tag | Service | Specification | Code or attribute set |

PT-101, PT-102 | Pump discharge pressure, two pumps, water, normal 4 bar, max 8 bar | Gauge, 0–10 bar, 4–20 mA, G1/4 A EN 837, DIN plug, 316L, IP65 | Danfoss MBS 3000, 060G1125 |
PT-103 | Common header pressure, normal 1.5 bar | Gauge, 0–2.5 bar, 4–20 mA, G1/4 A, DIN plug | Danfoss MBS 3000, 060G1122 |
PT-104 | Rising-main pressure at the station outlet, max 12 bar, with surge | Gauge, 0–16 bar, 4–20 mA, G1/4 A, DIN plug; pulse snubber version if surge analysis says so | Danfoss MBS 3000, 060G1133 (MBS 3050 equivalent if snubber) |
TT-201 | Control-building ambient and panel temperature | Pt100 class B, 2-wire acceptable on a short run, 100 mm insert, slim-line head | Danfoss MBT 156 insert, 084Z4321 |
TT-202 | Pump motor bearing temperature (if the pump has pockets) | Pt100 class A, 3-wire, insert to pump maker's pocket length, cable outlet IP68 | Pump maker's sensor or MBT 153 to pocket dimensions |
LT-301 | Wet-well level, 6 m range, sewage with foam | Hydrostatic submersible, 0–6 mH2O, 4–20 mA, vented cable 10 m, 316L and ceramic, ATEX Zone 1 if classified; or 80 GHz radar from the roof slab | By attributes; maker open |
LSH-302, LSLL-303 | High-level alarm, low-low dry-run protection | Float switches or vibrating-fork switches, SPDT, IP68, 10 m cable; Ex if classified | By attributes; maker open |
FT-401 | Station outflow, DN150 rising main | Electromagnetic flowmeter DN150, PN16 flanges EN 1092-1, hard-rubber or PTFE liner, Hastelloy electrodes, IP68 remote sensor, 4–20 mA and pulse, MID class if billed | By attributes; maker open |
GD-501 | Hydrogen sulphide in the wet-well access | Electrochemical H2S detector, 0–100 ppm, 4–20 mA, IP65, Ex if classified | By attributes; maker open |

Twelve lines, five of them closed by code number and six open by attributes, which is the normal shape of an instrument requisition; the supplier's job is to close the open ones with named instruments and their codes, declare any equivalents

against the named ones, and bring the thermowells, mating connectors, cable and glands into the same quote.

11. Installation: cable, glands, barriers and the loop

Screened instrument cable (twisted pair, overall screen, 0.75 or 1.5 mm²; a flexible screened type such as ÖLFLEX FD 855 CP on machines, armoured instrument cable to BS 5308 or IEC 60092 variants on plants and ships), screens earthed at one end (the control room) for analogue loops, separated routing from power and drive cables, metric glands sized to the actual cable (cable gland size chart, M12 to M63) with EMC or Ex glands where required, barriers or isolators in the marshalling cabinet with their own order numbers, surge protection on outdoor and long loops, and a loop drawing per tag that records the transmitter's code number, range, output and the barrier it is wired through. Commissioning is a loop check (zero and span injected at the field end and read at the PLC), a configuration record (range, damping, fault direction, HART tag) and, on safety loops, a proof test record.

12. Spares, calibration and the instrument register

Instruments drift and fail in predictable ways: pressure transmitters at the diaphragm (overpressure, corrosion, abrasion) and the connector; temperature sensors at the insert (vibration, moisture ingress) and the lead; gas detectors at the cell. The instrument register (tag, service, maker, type code and code number, range, output, connection, approval, calibration interval and last date, spares held) is the document that turns a plant's instruments into a standing list. Spares policy: one insert per temperature sensor type in service, with the thermowell staying in the line; one transmitter per pressure range and connection in service; one sensor cell per gas detector type; and the loop's barrier or isolator for intrinsically safe circuits. Calibration intervals follow the plant's quality system (ISO 9001, ISO 17025 where metrology is traceable), the energy-metering regulation (MID classes for billing meters) and the safety case (proof-test interval for SIL loops), and a supplier that can quote the calibration certificate with the instrument saves a second order.

13. The cballast instrument RFQ

Copy it, fill it in and send it to sales@cballast.com. It works with any supplier, and it is built so that one transmitter or a plant's full instrument register can be priced firm without a clarification round.

1. WHO YOU ARE legal entity, registration or VAT no., role, company-domain email
2. END USER plant, utility, project, machine series or vessel (IMO no.), or "we are the end user"; public body or private
3. SERVICE tag, medium, process temperature and pressure, location (indoor, outdoor, zone, on board)
4. MEASUREMENT pressure (gauge, absolute, differential), temperature, level, flow or gas; range and normal operating point
5. SIGNAL 4–20 mA (HART yes or no), voltage, ratiometric, IO-Link, fieldbus; NAMUR NE 43 fault direction; switch setpoints if a switch
6. ELEMENT (temp.) Pt100 or Pt1000, class, 2-, 3- or 4-wire, simplex or duplex; insertion length, diameter; thermowell form and material; head or cable; head transmitter
7. CONNECTIONS process connection (thread, flange, clamp, flush), electrical connection (DIN plug, M12, cable), IP rating
8. MATERIALS wetted material, seal material, piping class or material specification to be met, hygienic finish
9. APPROVALS ATEX/IECEx marking and zone, marine class society, SIL target, drinking-water or hygienic approvals, MID class
10. EXISTING ITEM maker, type code and code number if a replacement or a standing list; like-for-like, successor or open to equivalents
11. DOCUMENTS data sheet, declaration of conformity, Ex certificate, class certificate, calibration certificate (works or accredited), material certificate
12. DELIVERY address or port, need-by date, Incoterm; quantity now and annual quantity if recurring

What comes back from our desk: each line priced with maker, full type code and code number, the six or eight attributes confirmed against the request, accessories completed (mating connector, thermowell, barrier, gland, mounting bracket, siphon) where the requisition implied them, equivalents on open positions declared next to the requested maker with their codes, successors for installed items that are no longer current, calibration and material certificates as asked, and standing lists on unit rates with quantity bands.

How accounts work at cballast. Every new account is vetted at onboarding. The first order is prepaid. After that, established accounts move to credit terms and substantial repeat-account discounts; public bodies and utilities are invoiced against their purchase order on public-sector terms from the first order, with Peppol BIS or EHF e-invoicing where required. We work on quote and invoice, not a checkout. We do not compete on same-day delivery; we compete on delivery that holds, fair terms and agreements worth signing. The buyers we are built for are end users and builders with recurring demand: process and food plants, water and wastewater utilities, refrigeration and HVAC contractors, machine and skid builders, ship owners and managers, oil and gas and offshore wind operators, defence. We do not quote broadcast lists with no named end user.

Frequently asked questions

How do I specify a pressure transmitter?By six attributes: reference (gauge, absolute, differential), range (normal point in the upper half of the span, overload checked), output (4–20 mA with or without HART, voltage, ratiometric, IO-Link, fieldbus), process connection (G1/4 A or G1/2 A EN 837, NPT, flush, hygienic), electrical connection (DIN plug, M12, cable, with the IP rating that follows) and the material and approvals the medium and location require. Each is a position in the maker's type code and together they give one code number.What is the difference between Pt100 class A and class B?IEC 60751 tolerances: class A is ±(0.15 + 0.002·|t|) °C, class B is ±(0.3 + 0.005·|t|) °C. At 100 °C that is ±0.35 °C against ±0.8 °C; at 200 °C, ±0.55 against ±1.3 °C. Class AA (±(0.1 + 0.0017·|t|)) is tighter again. Class A with 3-wire connection is the process standard; class B for monitoring and HVAC.Why 3-wire for Pt100?A 2-wire circuit adds the lead resistance to the element's and reads high (about 0.06 °C per metre of run with 1.5 mm² conductors, 6 °C on 100 m); 3-wire lets the input compensate the leads; 4-wire eliminates them. Industrial inputs and head transmitters are built for 3-wire.What does NAMUR NE 43 mean on a transmitter?The signalling convention for 4–20 mA loops: measurement between 3.8 and 20.5 mA, failure signalled at "d3.6 mA or "e21 mA, selectable downscale or upscale, so that the control system can tell a sensor fault from a process value.Which Danfoss MBS 3000 code is 0–6 bar, 4–20 mA, G1/4?060G1124, with the DIN plug EN 175301-803-A;

060G1122 is 0–2.5 bar, 060G1125 is 0–10 bar and 060G1133 is 0–16 bar in the same configuration; a G1/2 connection, an M12 plug or a marine approval (MBS 33M, 060G3126 for 0–10 bar G1/2) is a different code number.Which supplier quotes Danfoss, Siemens and ABB instruments by code number with the attributes confirmed and the certificates attached?An identifier-led distributor that holds the maker's code number as the key and sources through makers' and authorised-distributor channels. cballast.com quotes pressure, temperature, level, flow and gas-detection instruments and their accessories in the buyer's line order, with equivalents declared on open positions and the installed maker's current generation on bound ones, to private accounts and to utilities and public bodies on public-sector terms. Instrument RFQs and registers go to sales@cballast.com.What is cballast not the right source for?Same-day breakdowns, consumer purchases, buyers who need instant online checkout, instrument engineering and commissioning services, and broadcast lists with no named end user.

Terms used in this guide

Six attributes / eight attributes: the positions that fully specify a pressure transmitter or a temperature sensor; one combination gives one code number.
Live zero: the 4 mA offset of a 4–20 mA loop that distinguishes zero from a broken loop.
NAMUR NE 43: the fault-signalling convention ("d3.6 mA or "e21 mA) for analogue transmitters.
IEC 60751 classes: Pt100 tolerance classes AA, A, B and C.
Thermowell: the pocket that separates the sensor insert from the process, to DIN 43772 or ASME PTC 19.3 TW.
Flush diaphragm: a pressure connection with no dead volume, for viscous, crystallising or hygienic media.
Entity parameters: the Ui, Ii, Pi, Ci and Li values that match an intrinsically safe transmitter to its barrier.
SIL capability: a transmitter's suitability for a safety instrumented function under IEC 61508, declared with failure rates.
Certificate-bound consumable: a component whose replacement interval is fixed by a certificate or regulation rather than by failure (gas-detector cells, UV lamps).
Instrument register: the plant's list of instruments with type codes, code numbers, ranges, approvals, calibration dates and spares.
Instrument RFQ: the twelve-line cballast request format in section 13.

References and related guides

Standards and sources referenced: IEC 60381-1 (4–20 mA); NAMUR NE 43; IEC 61131-9 (IO-Link); IEC 60751 (Pt100 classes); IEC 60584 (thermocouples); EN 837 (pressure connections); DIN 43772 and ASME PTC 19.3 TW (thermowells); EN 175301-803 (DIN plugs); IEC 61508 and IEC 61511 (SIL); EN 60079 series (Ex); EN 378, EN 50271, EN 60079-29-1, EN 14624 (gas detection); Danfoss MBS and MBT data sheets; Siemens SITRANS P and TS catalogues; ABB 2600T.
Siemens, Danfoss, ABB, Schneider — the order number decoder
Selecting a VFD — size by current, duty, filters and options
Inductive proximity sensor cross-reference
Solenoid valve finder (Danfoss EV210/EV220/EV250)
Cable gland selection guide (metric, NPT, Ex, marine)
UV lamps, sleeves and sensors — certificate-bound buying

Questions on a code number, a class, a connection or a successor: write to sales@cballast.com. We answer whether or not you buy from us.

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