TECHNICAL GUIDE

How to correctly select a functional replacement for a pressure transmitter and flow meter?

A practical guide to repairing measurement instrumentation, measuring-range calibration, and safety exclusions: the IFM efector, WIKA S-20, and Endress+Hauser Cerabar series.

Downtime cost and the functional-replacement strategy

A critical production line failure caused by a damaged pressure transmitter or flow meter generates a cost measured in thousands of PLN for every hour of downtime. The delivery time for an original part from the manufacturer (OEM) — especially for special models, factory-calibrated units, or those with a long lead time — often far exceeds the time a plant can afford to lose. In such a situation, the maintenance (UR) team faces a decision: wait for an exact 1:1 part, or use a **functional replacement for the pressure transmitter** that's available off the shelf.

A functional replacement is a device that performs the same measuring function as the damaged component, but is not necessarily identical in terms of range, output signal, material, or connection. Using one is justified only when the maintenance engineer can fully verify — and, if needed, reparametrize — three layers of compatibility: mechanical, electrical/signal, and regulatory. This guide walks through all three layers using the three series most commonly found in Polish plants: **IFM efector**, **WIKA S-20**, and **Endress+Hauser Cerabar**.

Mechanical and material compatibility: process connections and wetted materials

Before a transmitter goes onto an installation, two mechanical parameters must be verified: the type of process connection and the material of the wetted parts. An error at this stage results in a leak, corrosion, or — in a worse scenario — damage to the installation.

Process connections fall into several families that aren't interchangeable with each other without an adapter:

- G threads (metric, EN 837) – G 1/4, G 1/2, G 1 – the European standard.
- NPT (ANSI/ASME) – tapered thread, e.g. 1/4" NPT, 1/2" NPT – the US and Asian standard.
- Tri-Clamp (hygienic) – a clamp connection used in the food and pharmaceutical industries, where quick disassembly and surface cleanliness matter.
- SAE / DIN flanges – typical for hydraulic and high-pressure systems.

The wetted material must be matched to the aggressiveness of the medium, not just to its chemical name — the same 316L stainless steel behaves differently in demineralized water than in a chloride solution. The most common choices are 316/316L SS (universal corrosion resistance), Hastelloy (highly aggressive media – acids, bases, chlorides), and materials approved for food contact in food and pharmaceutical applications.

Table 3. Connection and wetted-material selection by application

| Application type | Recommended connection/thread | Recommended wetted material | Recommended seal material |

|---|---|---|---|

| Hydraulic oil | G 1/2, SAE, 7/16-20 UNF | 316 SS stainless steel | FKM |

| Demineralized water | G 1/4–G 1/2, NPT | 316L SS stainless steel | EPDM |

| Food & Beverage | Tri-Clamp (hygienic), DIN 11851 | 316L SS, polished surface | EPDM or food-grade FFKM |

| Corrosive / chemical media | NPT, flange | Hastelloy C276 | FFKM (e.g. Kalrez) |

For each of the combinations above, the exact variant should be verified in the current datasheet — manufacturers regularly expand or restrict the availability of material variants depending on the series.

Electrical and signal integration: from 4-20 mA to IO-Link and HART

Mechanical compatibility isn't enough — the replacement also has to "speak" the same signal language as the automation system, or the engineer has to plan a conversion.

Analog signals remain the most common denominator in older installations:

- 4…20 mA (2-wire) – current-based, resistant to voltage drops over long cable runs, the industrial standard.
- 0…10 V (3-wire) – voltage-based, still found in older control cabinets, more susceptible to interference.

Digital protocols are gaining importance as installations are modernized:

- IO-Link (IEC 61131-9) – bidirectional digital communication that transmits diagnostics and configuration parameters in addition to the measured value. The standard defines three transmission speeds: COM1 (4.8 kbit/s), COM2 (38.4 kbit/s), and COM3 (230.4 kbit/s). Switching from an analog sensor to IO-Link requires an IO-Link master, an IODD file, and full reparametrization in the PLC/HMI — this is a change to the integration architecture, not just a sensor swap.
- HART – layers digital diagnostics on top of the traditional 4-20 mA signal, without disrupting the main measurement. Integration requires a HART communicator or gateway and a

minimum line load of 250 Ω.

The riskiest scenario is changing the signal type without proper conversion — e.g. the old setup expects 0-10 V, but the functional replacement only provides 4-20 mA. This then requires either a signal converter or a change to the PLC's input card.

Table 2. Output signal compatibility and required actions when replacing

| Original signal | Direct replacement possible | Required PLC/hardware modification | Required calibration/scaling correction |

|---|---|---|---|

| 4-20 mA | High | Usually none – same analog input terminals | Verify zero and span |

| 0-10 V | Medium, depends on PLC input | May require a signal converter or a different input card | Full range rescaling |

| IO-Link | Low without an adapter | Requires an IO-Link master and an IODD file | Digital parametrization instead of analog |

| HART | High (base 4-20 mA layer preserved) | Usually none, optionally a HART modem for diagnostics | Verify Device Type/DD revision, rescale for a different range |

| PROFIBUS PA | Low | Requires a compatible PA segment and a GSD file | Full reparametrization in the DCS system |

Measuring-range calibration and scaling (turndown ratio)

Even when the connection and signal match, a functional replacement almost always has a different physical measuring range than the original — and this is where a measuring-range calibration error is most often made.

The key concept is the **turndown ratio** — the ratio of the sensor's maximum measuring range to the actually configured working range (span). Example: the installation was factory-calibrated so that 4 mA corresponds to 0 bar and 20 mA corresponds to 6 bar. The off-the-shelf replacement has a physical range of 0–10 bar. Installing it "as-is" and leaving the factory 0–10 bar configuration will mean that at an actual pressure of 6 bar, the automation system will read a signal corresponding to only about 60% of the range — i.e. an incorrect process value, even though the sensor itself is working correctly.

Correct procedure:

1. Determine the installation's actual working range (e.g. 0–6 bar), not the sensor's maximum range.

2. Reparametrize the zero and span of the new transmitter (or the corresponding scaling block in the PLC) so that 4 mA and 20 mA correspond to exactly the same physical values as in the original.

3. Check the allowable turndown ratio for the chosen model – with too large a range reduction (e.g. using a 0–100 bar sensor to measure 0–2 bar), measurement accuracy drops drastically, even though the signal formally "works."

4. Document the new configuration in the installation's operating records to avoid an error at the next replacement.

Safety and regulatory exclusions: when a functional replacement is prohibited

Time pressure during a failure doesn't exempt anyone from regulatory responsibility. There are limits where a quick switch to a functional replacement is outright prohibited without formal recertification.

Explosion-hazard zones (ATEX/IECEx) require the replacement to carry its own Ex marking matching the installation's zone — a "similar" industrial sensor isn't enough. **SIL safety loops** (Safety Instrumented System) require a device with its own SIL declaration at the same or higher level, backed by an FMEDA report — a replacement without such a declaration invalidates the safety function of the entire loop, even if it physically measures correctly. **FDA/EHEDG compliance** in food and pharmaceutical applications isn't just about the wetted material, but also surface roughness and crevice-free construction — here, compliance documentation decides, not the seller's commercial claim.

Table 4. Safety and regulatory exclusion checklist

| Standard / environment | Replacement restriction | Mandatory verification | Consequences of non-compliance |

|---|---|---|---|

| ATEX Zone 0/1 (explosion hazard) | Prohibited to install a device without its own Ex certificate for that zone | Check the Ex marking and validity of the ATEX/IECEx certificate | Risk of explosion, loss of insurance coverage, criminal liability |

| SIL 2/3 safety loop | The replacement must have its own SIL declaration at the same level | Verify the manufacturer's FMEDA report and SIL certificate | Loss of the safety function, risk of accident during a process failure |

| FDA/EHEDG compliance (hygienic) | Requires materials and finish approved for food contact | Check the FDA/EHEDG compliance declaration and surface roughness | Product contamination, batch recall, sanitary sanctions |

| Marine approval (e.g. DNV, Lloyd's Register) | Requires a classification certificate from the relevant society | Check the validity of the classification certificate | Loss of vessel class, denial of insurance payout |

Series analysis: IFM efector, WIKA S-20, and Endress+Hauser Cerabar in maintenance practice

Each of the three series represents a different design philosophy, which translates into a typical replacement scenario.

IFM efector is a sensor family oriented toward factory automation and digital integration – a strong focus on IO-Link, a compact housing, and an LED display that makes readings easy without connecting a communicator. Typical replacement scenario: modernizing an older analog input during a failure, using the parallel 4-20 mA and IO-Link channel on the same device – this allows the sensor to be swapped off the shelf on the analog signal, with a later transition to IO-Link without another hardware swap.

WIKA S-20 is the classic industrial "workhorse" – a huge number of connection variants (G threads, NPT, SAE, DIN) and signal types (4-20 mA, 0-10 V, 1-5 V) makes it the most universal candidate for a quick functional replacement in installations without certification requirements. Typical scenario: emergency replacement of a general-industrial transmitter with a high working pressure, where off-the-shelf availability across a wide configuration range matters most.

Endress+Hauser Cerabar represents the segment of modular, precision transmitters with full HART and PROFINET over Ethernet-APL support, available in versions with ATEX, IECEx, CSA C/US, NEPSI, and optionally SIL certificates. Typical scenario: a process installation or Ex zone, where the replacement must preserve not only the measuring function but also full regulatory compliance – here, the decision to make a "quick swap" must be preceded by verification against the safety exclusion table above.

Table 1. Technical comparison of the analyzed series

| Parameter / feature | IFM efector | WIKA S-20 | Endress+Hauser Cerabar (PMC51B) |

|---|---|---|---|

| Measuring range | depends on variant, typically up to ca. 600 bar | 0…0.4–1600 bar | 100 mbar – 40 bar (depending on version) |

| Output signal | 4-20 mA, IO-Link, selected models 0-10 V | 4-20 mA, 0-10 V, 1-5 V | 4-20 mA, 4-20 mA HART, PROFINET over Ethernet-APL |

| Process connection | G 1/4, G 1/8, 1/4" NPT, R 1/4 | G threads, NPT, SAE, DIN – over 20 variants | G 1/2–G 2 thread, NPT, DN25–DN80 flange |

| Power supply | ca. 18–30 VDC | ca. 8–36 VDC (depending on variant) | depends on version (Ex/non-Ex) |

| Ingress protection | IP65/IP67 | depends on enclosure variant | depends on version |

| Certifications | depends on variant | to be confirmed with the distributor for a specific configuration | ATEX, IECEx, CSA C/US, NEPSI, optionally SIL |

| Typical replacement scenario | upgrade to IO-Link during a failure | universal general-industrial replacement | process installations and Ex zones requiring full compliance |

Enetiv – a trusted partner in critical failure situations

When a line is down and the decision has to be made within hours, what matters isn't just engineering know-how, but also the availability of the right part. **Enetiv** operates as a supplier of automation equipment and process instrumentation, offering a broad range of solutions from the industry's most popular manufacturers, including **IFM electronic, WIKA, Endress+Hauser, Emerson, JUMO, KROHNE, VEGA, and ABB**. The offering includes both new parts and verified used and refurbished units, which in a critical failure situation often means real delivery times counted in days rather than the weeks it takes for OEM production. If needed, Enetiv can also arrange an automation technician on site, supporting the maintenance team not just in selecting parts, but also with the replacement and parametrization itself. It's this combination of equipment availability with real engineering support that makes Enetiv a partner worth reaching out to before a failure turns into a downtime counted in production days.

Sources / Bibliography

- WIKA S-20 – datasheet (EN): https://www.wika.com/en-co/s_20.WIKA
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