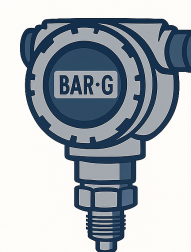


INTERNATIONAL STANDARDS - INSTRUMENTATION LIST

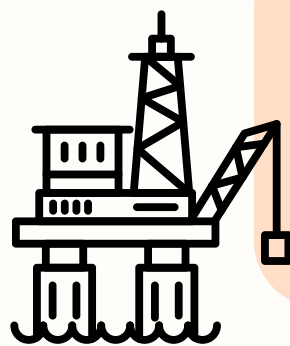
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1) Cross-cutting “core” standards (use on every project)

- **Functional safety**
 - IEC 61511 (SIS for the process industry) — lifecycle, SRS, SIL, proof tests
 - IEC 61508 (generic functional safety) — hardware/software SIL metrics, FMEDA
- **Alarm management**
 - ISA-18.2 / IEC 62682 (alarm lifecycle, KPIs, rationalization)
- **FAT/SAT for automation systems**
 - IEC 62381 (FAT/FIT/SAT/SIT procedures & checklists)
- **PLC/SCADA software & networks**
 - IEC 61131-3 (PLC programming languages)
 - IEC 61158 / IEC 61784 (fieldbus & industrial Ethernet profiles; PROFIBUS/PA, FF, HART, PROFINET, etc.)
- **Materials in sour service**
 - NACE MR0175 / ISO 15156 (H₂S environments, material selection)



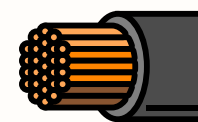
2) Documentation & drawing deliverables

Symbols, tags, identification (P&IDs, hook-ups, loops, I/O lists)

- ISA-5.1 (Instrumentation Symbols & Identification; tagging rules)
- ISA-5.4 (Instrument Loop Diagrams) — mandatory structure for loop sheets
- ISA-20 (Instrument specification forms / data sheets)
- Batch processes (where relevant)
- ISA-88 / IEC 61512 (models & terminology for batch control)



4) Electrical & earthing for instruments



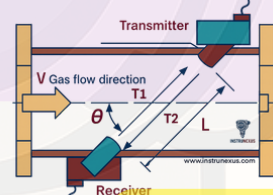
Low-voltage installations / bonding

- IEC 60364 (incl. earthing 60364-5-54) — complement IEC 60079-14 in Zones
- EMC for industrial equipment
- IEC 61326-1 (EMC requirements for instrumentation & control equipment)

5) Instrument air & pneumatics

Compressed instrument air quality

- ISO 8573-1 (air purity classes for particulate/water/oil)
- ISA-7.0.01 (Quality standard for instrument air; dew point, oil, solids)

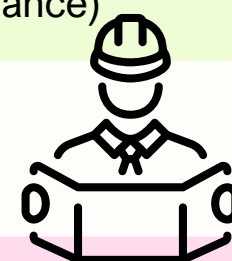


3) Hazardous areas, equipment protection & installation



Area classification (define Zones/Divisions for layouts & cable routing)

- IEC 60079-10-1/-10-2 (classification of gas/vapor & dust hazardous areas)
- API RP 500 (Class/Division) & API RP 505 (Zone 0/1/2) for petroleum facilities. Latest editions in 2023 & 2025, respectively.
- Equipment protection concepts (Ex) & installation / inspection
- IEC 60079 series (general reqs, Ex d/e/i/p/n/t; installation -14, inspection -17)
- Gas detection
- IEC 60079-29-1/-29-2 (performance + selection/installation/maintenance)



8) Flow measurement

- **Differential pressure primary elements — ISO 5167 series**
 - -1 (general), -2 (orifice plates), -3 (nozzles/Venturi), -4 (Venturi tubes), -5 (cone meters)
- **Ultrasonic (liquid & gas)**
 - API MPMS Ch. 5.8 (liquid hydrocarbons by ultrasonic flowmeters)
 - ISO 12242 (transit-time meters for liquids)
 - ISO 17089-1 (ultrasonic meters for gas — custody transfer)
- **Coriolis**
 - ISO 10790 (selection/installation/use guidance for Coriolis mass meters) (widely applied for liquids & gases; custody per API/AGA where applicable)
- **Turbine (gas)**
 - AGA Report No. 7 (turbine meters for natural gas) (with API MPMS Ch. 14 references)
- **Ultrasonic (gas)**
 - AGA Report No. 9 (gas ultrasonic meters) — custody transfer (align with ISO 17089-1)
- **Orifice metering (gas)**
 - AGA Report No. 3 / API MPMS 14.3 (orifice measurement of natural gas)
 - Sampling, proving & property data (custody transfer context)
 - API MPMS Chapters 4 (proving), 7 (temp), 8 (sampling), 9 (density), 11 (PFV/corrections), 12 (calculation of petroleum quantities)
 - Tip: For custody transfer, align the meter's type standard (ISO/AGA) with API MPMS requirements for installation, proving and uncertainty.

6) Pressure, level, temperature

- **Transmitters — performance test methods**
 - IEC 60770 (industrial transmitters; performance) and IEC 61298 (evaluation methods, test setups)
- **Temperature sensors**
 - IEC 60584-1 (thermocouple EMF tables & tolerances) & IEC 60751 (Pt RTDs)
- **Level measurement**
 - Follow device-family standards (e.g., radar/ultrasonic manufacturer standards) + IEC 61326-1 (EMC) and IEC 60079 if Ex; use ISO 5167 when DP level via head.

7) Control valves, actuators & accessories

Control valve family (global baseline) — IEC 60534 series

- 60534-1 (terminology, general), 60534-2-1 (sizing equations), 60534-3-1 (face-to-face), 60534-4 (inspection, routine & seat-leakage classes), 60534-8-x (noise & cavitation prediction)

Seat leakage (acceptance class)

- ANSI/FCI 70-2 (Classes I–VI, test media & pressures)
- Fire-safe type tests (specify for hydrocarbon service where required)
- API 607 (quarter-turn soft-seated valves), API 6FA (valves fire test), ISO 10497 (fire type-testing of valves)

Fugitive emissions (environmental compliance)

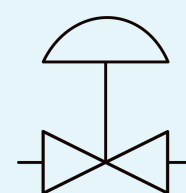
- ISO 15848-1/-2 (FE type test & endurance), API 624 (rising-stem) & API 641 (quarter-turn)

Positioners / digital valve controllers

- IEC 61514-2 (tests for intelligent valve positioners)

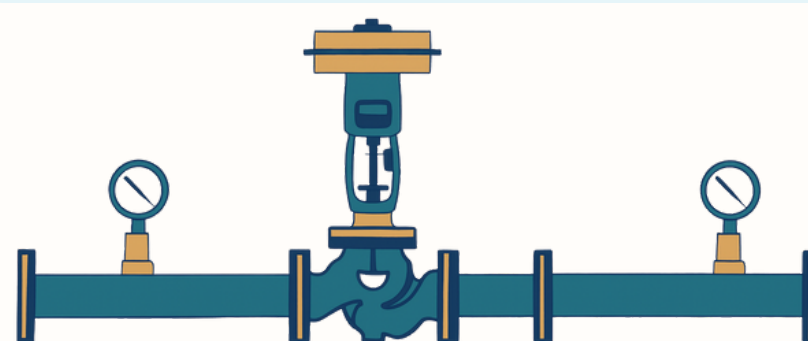
Actuator interfaces

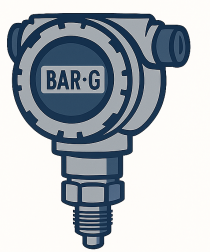
- ISO 5211 (part-turn actuator mounting), ISO 5210 (multi-turn/linear interfaces) — define flange/drive dimensions across vendors



9) Typical mapping to I&C deliverables

- Hook-up drawings: ISA-5.1 for symbols/tags; ISO 8573-1 & ISA-7.0.01 for air; IEC 60079-14 for Ex installation; IEC 61326-1 (EMC); materials per ISO 15156 in sour service.
- Loop drawings / I/O allocations: ISA-5.4 format; wiring to IEC 60364; Ex loops to IEC 60079-14/-11 (IS).
- Instrument datasheets & indices: ISA-20; device-family standards (e.g., ISO 5167, ISO 12242, ISO 17089-1).
- Control narratives / cause & effect / alarm database: IEC 61511 lifecycle alignment; ISA-18.2/IEC 62682 for alarm design.
- FAT/SAT procedures & checklists: IEC 62381.
- HAZOP/SIL: IEC 61511/61508; device SIL data per vendor FMEDA.





10) Process Analysers

1) Process Analysers

- General analyzer system design
 - ISA-76 (Modular component interfaces for analyzers)
 - ASTM D3764 / D7045 (performance validation of online analyzers)
- CEMS / gas analyzers
 - US EPA 40 CFR Part 60 & 75 (CEMS requirements for emissions)
 - ISO 12039 (CO, CO₂, O₂ measurement)
 - ISO 10723 (performance evaluation of analyzers for natural gas)
- Shelters & sample systems
 - IEC 60079 series (hazardous area analyzers)
 - ASTM D8147 (validation of online water content analyzers)



11) Cybersecurity for I&C

- IEC 62443 (Industrial Automation & Control Systems Cybersecurity) — zones/conduits, system security requirements, technical policies.
- NIST SP 800-82 (Guide to ICS security) — often referenced in oil & gas alongside IEC 62443.
- IEC 61511 Ed.2 Clause 8 (explicit cybersecurity requirement for SIS).



12) NEMA & Enclosures

- NEMA 250 (enclosures for electrical equipment: Types 1–13; weatherproof, dust-tight, corrosion-resistant).
- IEC 60529 (IP Code) — ingress protection, global equivalent to NEMA.
- NEMA ICS standards (ICS 6 for enclosures; ICS 2 for control devices).

13) Fire & Gas Standards

- NFPA 72 (National Fire Alarm & Signaling Code) — detector placement, alarm logic.
- NFPA 70 (NEC) (wiring for F&G devices).
- NFPA 497 (flammable gas/vapor classification).
- API RP 14C (F&G detection & protection for offshore production).
- ISA TR84.00.07 (Guidance on fire & gas mapping and performance design).
- EN 54 series (fire detection/alarm systems — common in Europe).



14) Instrument & Control Cables

- Design & type
 - IEC 60228 (conductor classes)
 - IEC 60502-1/-2 (power/control cables up to 30 kV)
 - IEC 60092-376 (marine/offshore instrumentation cables)
 - ICEA S-95-658 / S-73-532 (North America, control cables)
- Fire performance
 - IEC 60332 (flame retardancy tests)
 - IEC 60754 (halogen acid gas emission)
 - IEC 61034 (smoke density).



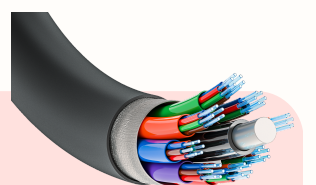
16) Fire & Gas Mapping

- ISA TR84.00.07 (detection coverage, mapping methodology).
- FM 6320 (approval standard for gas detection).
- EN 60079-29-2 (selection, installation & maintenance of gas detectors).
- UK HSE EI guidance (often used for practical layout of detectors).



15) Cable Sizing & Wiring Practices

- IEC 60287 (current rating of cables, thermal sizing).
- IEC 60364-5-52 (cable selection & installation).
- NEC NFPA 70 Articles 310 & 725 (conductor ampacity, control wiring).
- IEEE 399 (Brown Book) (power distribution design; useful for sizing cross-checks).



19) Instrumentation Networking

- IEC 61158 / IEC 61784 (Fieldbus & Ethernet industrial comms).
- IEC 61850 (substation comms, sometimes applied in oil & gas).
- IEEE 802.3 / 802.11 (Ethernet & wireless LAN in industrial networks).
- ODVA / PI / FieldComm group specs (PROFIBUS, PROFINET, HART-IP, FOUNDATION Fieldbus).

17) Bulk Material Standards (Installation Materials)

- ASTM A106 / A53 (pipe for impulse lines).
- ASTM A312 (SS pipes/tubing for instruments).
- ASTM A479 / A276 (SS bar for fittings & brackets).
- ASTM A269 (SS tubing).
- ASTM A105 / A182 (flanges & forgings).
- SAE / ASTM fastener standards (A193, A194 for bolts/nuts).

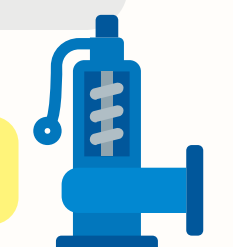


21) Material Certification & Traceability

- EN 10204 – Metallic products – inspection documents (3.1, 3.2 certificates).
- ASTM A105 / A182 / A350 / A694 – Forged carbon & alloy steel materials for flanges and fittings.
- ASTM A216 / A217 / A351 / A352 – Cast steels for valves and fittings.
- NACE MR0175 / ISO 15156 – Material selection for H₂S service.
- PED 2014/68/EU – Pressure Equipment Directive (Europe) – material conformity.
- ISO 9001 – Quality management and traceability system.

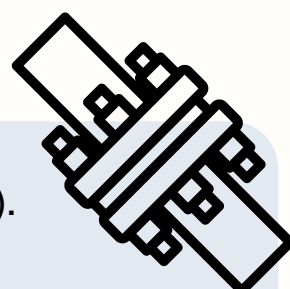
18) Safety Relief Valves (PSVs/PRVs)

- API 520 Part I & II (sizing, selection & installation of PRVs).
- API 521 (pressure-relieving & depressuring systems).
- API 526 (flanged steel safety valves — dimensional standard).
- API 527 (seat tightness test of PRVs).
- ASME VIII Div.1 UG-125 to UG-137 (device requirements in pressure vessels).
- ISO 4126 series (safety devices for protection against overpressure).



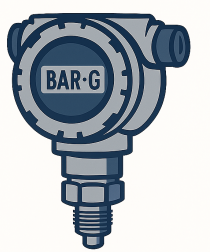
24) Flanges & End Connection

- ASME B16.5 – Pipe flanges and flanged fittings (NPS ½ – 24).
- ASME B16.47 – Large-diameter steel flanges (Series A & B).
- ASME B16.10 – Face-to-face and end-to-end dimensions of valves.
- ASME B16.25 – Buttwelding ends preparation.
- EN 1092-1 – Flanges and their joints (metric series).
- API 6A – Flanged, studded, and clamp connections for wellhead and Xmas-tree equipment.



20) Telecoms, DCS/PLC networking & cybersecurity

- Industrial comms — IEC 61158 / 61784 (fieldbus & Real-Time Ethernet profiles)
- Cybersecurity for IACS — IEC 62443 (policies, zones/conduits, technical controls) (apply across ESD/SIS, DCS, PLC, analyzers)



22) Level Sketches / Installation Drawings

- ISA RP3.1 (drawings for level instruments, dip tubes, displacers).
- ISO 5167 (if DP head-type level).
- IEC 60079-14 (for Ex installations).
- Common EPC practice: vendor GA + ISA hook-up drawings cross-referenced.

26) Ball Valves

- API 608 – Metal ball valves for refinery and general industrial service.
- API 6D – Pipeline and piping valves (ball, gate, plug, check).
- API 607 / ISO 10497 – Fire test for soft-seated quarter-turn valves.
- ISO 17292 – Metal ball valves for petroleum, petrochemical, and allied industries.
- ISO 5208 / API 598 – Pressure testing of valves (hydrostatic and seat tests).
- MSS SP-72 – Ball valves with flanged or butt-welding ends.
- API 6FA – Fire test for valves with bolted or welded bonnets (complementary).

28) Instrument air & pneumatics

- Compressed instrument air quality
- ISO 8573-1 (air purity classes for particulate/water/oil)
- ISA-7.0.01 (Quality standard for instrument air; dew point, oil, solids)

30) Offshore Process Design – Best Practices

- ISO 19900 Series – Offshore structures (general requirements).
- API RP 14C – Analysis, design, installation, and testing of safety systems for offshore production.
- API RP 14E – Design and installation of offshore production platform piping systems.
- API RP 14F / 14FZ – Electrical systems for fixed and floating offshore installations.
- IEC 61892 Series – Mobile and fixed offshore electrical installations.
- NORSOK Standards (e.g., P-001, P-002, I-001) – Design principles for offshore process, utilities, and instrumentation.
- DNV-ST-F101 – Submarine pipeline systems.
- DNV-ST-N001 – Marine operations and lifting.
- IEC 61511 / IEC 61508 – Safety instrumented systems lifecycle.
- IEC 60092-376 – Marine/offshore instrumentation cables.
- IMO MODU Code – Fire and explosion protection, evacuation, and life-saving systems.

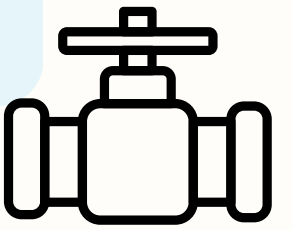


34) Onshore Process Design – Best Practices

- API RP 500 / 505 – Area classification for petroleum facilities (Class/Zone).
- API RP 521 – Pressure-relief and depressurizing systems.
- API 14C (applicable to onshore terminals) – Safety systems design philosophy.
- NFPA 30 / 70 / 72 – Flammable liquids, electrical, and fire alarm codes.
- IEC 60079 series – Electrical apparatus for explosive atmospheres.
- ASME B31.3 – Process piping design and fabrication.
- ISO 13703 – Piping and pipeline systems for petroleum and natural gas industries.
- API 610 / 614 / 682 – Centrifugal pumps, lubrication, and sealing systems.
- API 2350 – Overfill protection for petroleum storage tanks.
- API 2000 – Venting for atmospheric and low-pressure storage tanks.
- API 5000 Series – Mechanical integrity & risk-based inspection guidelines.
- IEC 61511 & IEC 62443 – Functional safety and cybersecurity integration.

25) Other Commonly Missed Standards

- IEC 61514 (function blocks & positioners for control loops).
- IEC 62682 / ISA-18.2 (alarm management).
- IEC 62381 (FAT/SAT for automation systems).
- API 2000 (venting for tanks; often tied with level/pressure).



27) Butterfly Valves

- API 609 – Butterfly valves: double-flanged, lug-type, and wafer-type designs.
- ISO 5752 – Face-to-face and center-to-face dimensions of flanged valves.
- MSS SP-67 – Rubber-seated and high-performance butterfly valves.
- API 607 / ISO 10497 – Fire test for quarter-turn valves.
- ASME B16.34 – Pressure-temperature ratings and dimensions.

29) Globe, Gate & Check Valves

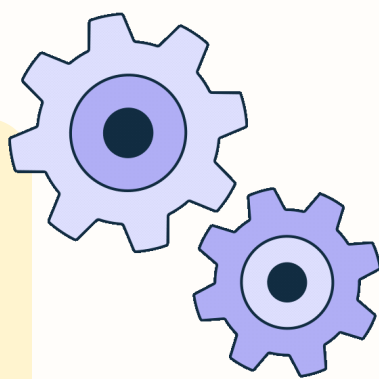
- API 602 – Compact steel gate, globe, and check valves ($\leq$ DN 100).
- API 603 – Corrosion-resistant, bolted bonnet gate valves.
- API 623 – Steel globe valves for refinery and petrochemical service.
- API 594 – Check valves: wafer, dual-plate, and lug-type.
- API 598 / ISO 5208 – Inspection and pressure testing.
- BS 1873 / BS 1868 – Globe and check valves for process service.
- API 624 / ISO 15848-1 – Fugitive emission qualification.
- ASME B16.34 – Design and dimensional requirements.

31) Flanges & End Connections

- ASME B16.5 – Pipe flanges and flanged fittings (NPS ½ – 24).
- ASME B16.47 – Large diameter steel flanges (Series A & B).
- ASME B16.10 – Face-to-face and end-to-end dimensions.
- ASME B16.25 – Buttwelding ends preparation.
- EN 1092-1 – Flanges and joints (metric series).
- API 6A – Flanges, studded and clamp connections (wellhead and Christmas tree).
- MSS SP-44 – Steel pipeline flanges (complementary to ASME).

32) Valve Testing & Inspection

- API 598 / ISO 5208 – Pressure testing for all valve types.
- API 6D Annex E – Additional testing for pipeline valves.
- API 624 / ISO 15848-1 – Fugitive emission tests.
- MSS SP-55 – Visual inspection of castings.
- API 607 / 6FA – Fire tests for valves.



33) General Design Integrity (Cross-Discipline)

- ISO 9001 – Quality management systems.
- ISO 14001 – Environmental management systems.
- ISO 45001 – Occupational health & safety management.
- ISO 31000 – Risk management principles and guidelines.
- ISO 14224 – Reliability and maintenance data for equipment.
- ISO 55000 – Asset management framework.
- IEC 60092 / 60364 – Electrical installations – onshore/offshore interface.
- API 17 / ISO 13628 – Subsea production systems.
- Shell DEP / BP GP / TOTAL GS – Company-specific engineering practices (adopted in EPC projects).

