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EQUIPMENT GUIDE / PIPING & FITTINGS

Piping & Fittings Material Selection Guide

Which pipe, tubing, fitting, and containment architecture holds up against your actual chemical, concentration, and installed cost — not the generic "chemical resistant pipe" answer.

THE PROBLEM THIS GUIDE SOLVES

Installed cost, not just material compatibility, decides the winner

> A pipe rated for "chemical service" is not a specification. Real project data in this dataset shows engineers comparing PTFE-lined steel, 316L stainless, and thermoplastic piping on the same job — and choosing the thermoplastic option on installed cost, "not even close," even when all three materials passed compatibility.

This guide organizes real, vendor-documented selection data by piping/fittings category, not by brand. Every material and installation call-out is sourced to a named vendor document, a real installed-project case, or the chemical-compatibility chart.

ARCHITECTURE SELECTION, AT A GLANCE

Piping & fittings categories, by what they're actually built to carry

Architecture family	Built for	Watch for
Pipe (thermoplastic, Advanced PE)	General chemical transfer piping across acids, caustics, and oxidizers	Fuming/concentrated sulfuric acid can require a different material than dilute service on the same line
Tubing	Smaller-bore chemical transfer, vacuum-drawn service, instrumentation lines	PVDF fails at fuming-acid concentrations where FEP/PFA/PTFE/ECTFE remain resistant — the exception, not the rule
Fitting (manways, bulkhead fittings, gaskets)	Tank/vessel penetrations, off-gas venting, leak-critical connections	A fume-tight or hinged-weighted design is often required by the chemistry, not just by the pipe material
Fluoropolymer Tubing, Lined Pipe & Chemical Hose	Hydrocarbon and fuel transfer, dry-break fuel connections	PP is a weak material choice for hydrocarbons despite being common elsewhere — PTFE/PFA are the safe defaults
Compressed Air / Gas & Hydrogen-Rated Piping	Compressed air distribution, hydrogen and natural gas service	Hydrogen SERVICE certification is a separate, harder credential than material compatibility alone
Double Containment Piping	Plating-bath waste, cyanide-bearing streams, spent-solvent drains	Simultaneous butt fusion is required for double-wall pipe — primary and secondary fused in one operation
Thermoplastic Piping System	Full-system replacement for corroding metal piping runs	Threaded joints should not be allowed on double-wall systems per vendor installation rules
Commercial Pipe Reducer (Concentric/Eccentric)	Line-size transitions in lined piping systems	Liner continuity through the reducer, not just the reducer body, is the real compatibility question
NSF-61 Potable Water Hose & Bypass Reel System	Municipal potable-water and sewer-bypass service	NSF-61 approval is the entire selection criterion for potable-contact hose — not a general chemical-resistance question

PIPE — EVIDENCE: STRONG

26 real installed projects, not a generic resistance table

Asahi/America Advanced PE / Chem Proline / Ultra Proline

Also: Netafim FlexNet HP (heap leach)

Sulfuric Acid (93%) | Hydrochloric Acid | Hydrofluosilicic Acid

Asahi's own reference list includes 26 real named installed projects with field concentrations, several exceeding what a general resistance table would predict — 93% sulfuric acid appears twice. Advanced PE is NSF/ANSI/CAN 61-G certified; in one RO plant installation, ECTFE/Halar was chosen over Advanced PE specifically for the sulfuric acid service on that line, a real material-substitution decision worth carrying forward.

> **Oxidizer hardware requirement:** sodium hypochlorite and hydrochloric acid service mandates vented ball valves on this piping system, while hydrogen peroxide service requires diaphragm valves — this is a hardware-class requirement beyond simple elastomer or pipe-material selection.

Caustics/bases — evidence: moderate. Sodium hydroxide and aqueous ammonia are named among the 26 real installed-project case chemistries, using Advanced PE or PVC. **Salts/brines — evidence: moderate.** Ferric chloride, cadmium oxide, and sodium cyanide are named among the same real project chemistries, with glass-fiber reinforced polymer as an alternate material. **Solvents/organics — evidence: moderate.** BTEX (benzene, toluene, xylene) is named among groundwater remediation and hydrofracturing water-treatment applications for this pipe.

TUBING — EVIDENCE: STRONG

Fuming acid is the exception that breaks the PVDF default

Altaflo/Pexco ALTAFLUOR 200/350/400/480

`Sulfuric Acid 98% (fuming/oleum)`

> **Material flag:** fluoropolymer tubing (FEP/PFA/PTFE/ECTFE) remains resistant at fuming-acid concentrations where PVDF fails — per this dataset's own engineering-rules cross-reference. PVDF is the general-purpose default elsewhere in this project, which is exactly why this exception matters: don't default to PVDF on fuming or oleum-grade sulfuric acid without checking concentration first.

Oxidizers/disinfectants — evidence: moderate. Altaflo 550 PVDF Flex Tubing is explicitly marketed as "preferred for water disinfecting processes involving ozone" — a chemistry not otherwise covered by the chlorine-centric rules elsewhere in this dataset. Altaflo 480 UHP PFA is separately rated for fluorosurfactant resistance.

Solvents/organics — evidence: light. JCS Tool's PTFE/PP/PVDF-lined tubing and fittings name vacuum-drawn chemical transfer and vacuum distillation service as their vendor-stated application.

FITTING — EVIDENCE: STRONG

Fume-tight and pressure-relief designs, not just material choice

Poly Processing Fume-Tight Manway Cover · Hinged-Weighted Manway

Also: GORE Gasket Tape Series 1000 · GORE Universal Pipe Gasket (Style 800)

Hydrochloric Acid (fume-tight) | Hydrogen Peroxide (decomposition venting) | Chlorine (wet/dry gas, liquid)

The Fume-Tight Manway Cover is explicitly required for HCl applications — a direct parallel to this project's broader HCl-vapor-no-metal rule established for valves and pumps elsewhere. Bulkhead fittings for this service are available in PVC, CPVC, PP, PVDF, 316SS, Titanium, and Hastelloy C-276.

> **Pressure-relief by design:** the Hinged-Weighted Manway opens at 0.25 psi specifically to vent hydrogen peroxide decomposition — a passive mechanical safety feature, not a material property. GORE's Universal Pipe Gasket (Style 800) carries real third-party chlorine-service certification from Eurochlor and the Chlorine Institute, using ePTFE construction with indefinite shelf life.

Caustics/bases — evidence: moderate. X-Link/XLPE gaskets are flagged as leak-prone on reinstall — a real material-selection caveat for caustic tank fittings, since the gasket lacks form memory once compressed and released. Sodium hydroxide service on bulkhead fittings is specifically noted as creep-prone over time.

FLUOROPOLYMER TUBING, LINED PIPE & CHEMICAL HOSE — EVIDENCE: STRONG

The installed-cost story: thermoplastic beat stainless "not even close"

Continental Chemical Transfer Hose · PT Coupling Maxi Dry · Saint-Gobain/Acutech ETFE, FEP, PFA, PTFE, PVDF

Gasoline | Diesel Fuel | Crude Oil | Benzene / Toluene / Xylene (BTEX)

Two real installed proof points anchor this category. Asahi's reference list includes an oil-field fracking water-treatment installation handling BTEX in water and a BAE Dry Dock San Francisco natural gas line, both in Chem Proline. The hydrofracturing chemical-blend plant story is a genuine competitive datapoint: the plant engineer compared PTFE-lined steel, 316L stainless steel, and Chem Proline for HCl blended with benzene/xylene solvents — and Chem Proline won on installed cost, "not even close," even with all three materials chemically compatible.

> **Material flag:** the compatibility chart rates PTFE and PFA "Excellent" across essentially the entire hydrocarbon set, and PVDF "Excellent" almost everywhere except "Good" on naphtha at 80°C. Polypropylene is comparatively weak — "Fair" on turpentine oil at 40°C and "Corroded" on cyclohexane. PT Coupling's Maxi Dry dry-break fittings are the safety-relevant fitting class for fuel transfer and appear nowhere else in this dataset.

COMPRESSED AIR / GAS & HYDROGEN-RATED PIPING — EVIDENCE: STRONG

H2ready certification — a harder credential than compatibility alone

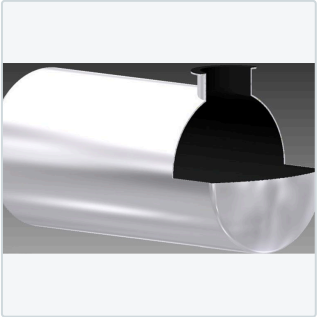
Asahi/America Chem Proline Advanced PE PE445584C · Air-Pro · Pro-Vent

Hydrogen | Natural Gas | Chlorine Dioxide

Hydrogen is benign across nearly every material in the compatibility chart, but hydrogen *service* certification is a separate, harder credential to hold — and Asahi's Advanced PE resin holds it (H2ready certified). Two real gas-service installations exist in this dataset: natural gas at BAE Dry Dock San Francisco (2012) and chlorine dioxide test spools at the City of Akron OH water treatment plant (2013). Full Notch Creep Test data backs the material science: Advanced PE's minimum standard FNCT is 8,760 hours (1 year) versus 300 hours for standard PE 100 — a real average test result of 14,648 hours, roughly 27× the PE100 minimum. The vendor's explicit installation rule: threaded joints should not be allowed on this piping system.

DOUBLE CONTAINMENT PIPING — EVIDENCE: STRONG

The strongest plating-bath field data in this dataset



Asahi/America Chem Prolok Double Wall · Duo-Pro · Poly-Flo

`Chromic Acid 30–37%` `Sodium Cyanide 7–9%` `Nickel Sulfate 25%`

Four real UTC Goodrich Cleveland installations from 2013 document this category directly — not a compatibility table, real field data: 30–37% chromic acid combined with 35% sulfuric acid; a 7–9% sodium cyanide plus 2% sodium hydroxide plus 3% cadmium oxide plus 6% sodium carbonate mixture; 25% nickel sulfate; and contaminated groundwater remediation. That cyanide/cadmium/caustic/carbonate mixture is an actual plating-bath waste stream, confirming Chem Prolok double-wall containment for the cyanide-bearing waste itself, not merely for treatment instrumentation nearby.

> **Broader pattern worth publishing:** of the 26 documented installations across this dataset, at least 9 explicitly replaced failed or leaking PVC or CPVC piping — a real, quantified failure-replacement rate, not a hypothetical risk. Simultaneous butt fusion is required for double-wall pipe: primary and secondary walls fused in one operation, and threaded joints should not be allowed.

Duo-Pro (PP, PVDF, or ECTFE) is designed so the outer pipe meets the EPA standard of at least 30 days of containment. PAL-AT cable-based and LiquidWatch II electronic leak detection round out the monitoring side of this category.

NSF-61 POTABLE WATER HOSE & BYPASS REEL SYSTEM — EVIDENCE: STRONG

NSF-61 approval is the entire selection criterion for potable-contact hose — not a general chemical-resistance question. North American Fire Hose Corp's NSF-61 approved potable water and sewer bypass hose, paired with Hydro Engineering emergency bypass reel systems, targets water/wastewater departments specifically, a distinct product class from industrial chemical hose covered elsewhere in this guide. Allied Fluid Products also offers free expansion-joint surveys for new construction or MRO on existing plants.

NEXT STEP

Send LibertyCES the process data, not a part number.

Nine piping and fittings architectures, real vendor selection data, one guide — but your actual line still has a specific chemical, concentration, temperature, and installed-cost tradeoff that determines which material is correct. A spec review checks the exact conditions against the exact material, before equipment gets ordered.

Fluid, chemistry, concentration, temperature, line size, and current infrastructure — that's what a real spec review needs to start.

Request a spec review

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