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1. INTRODUCTION

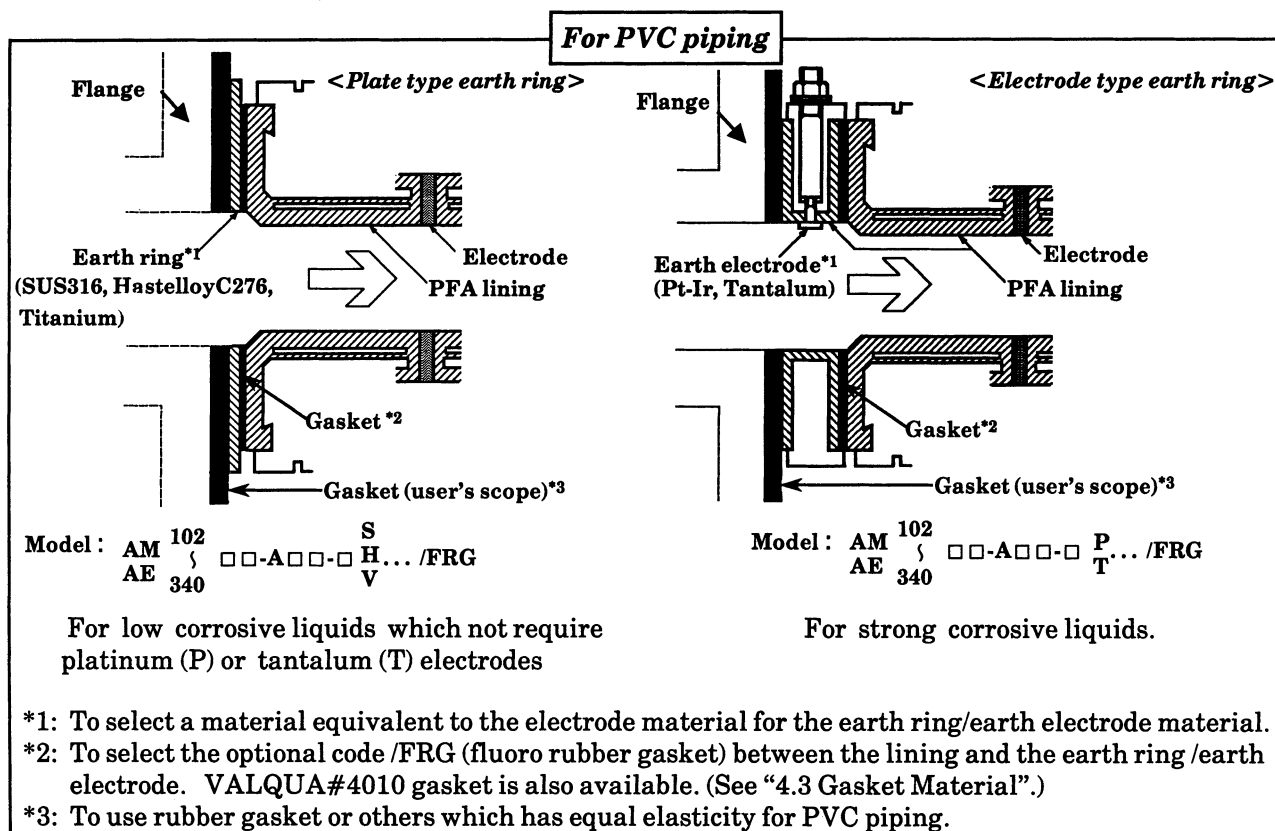
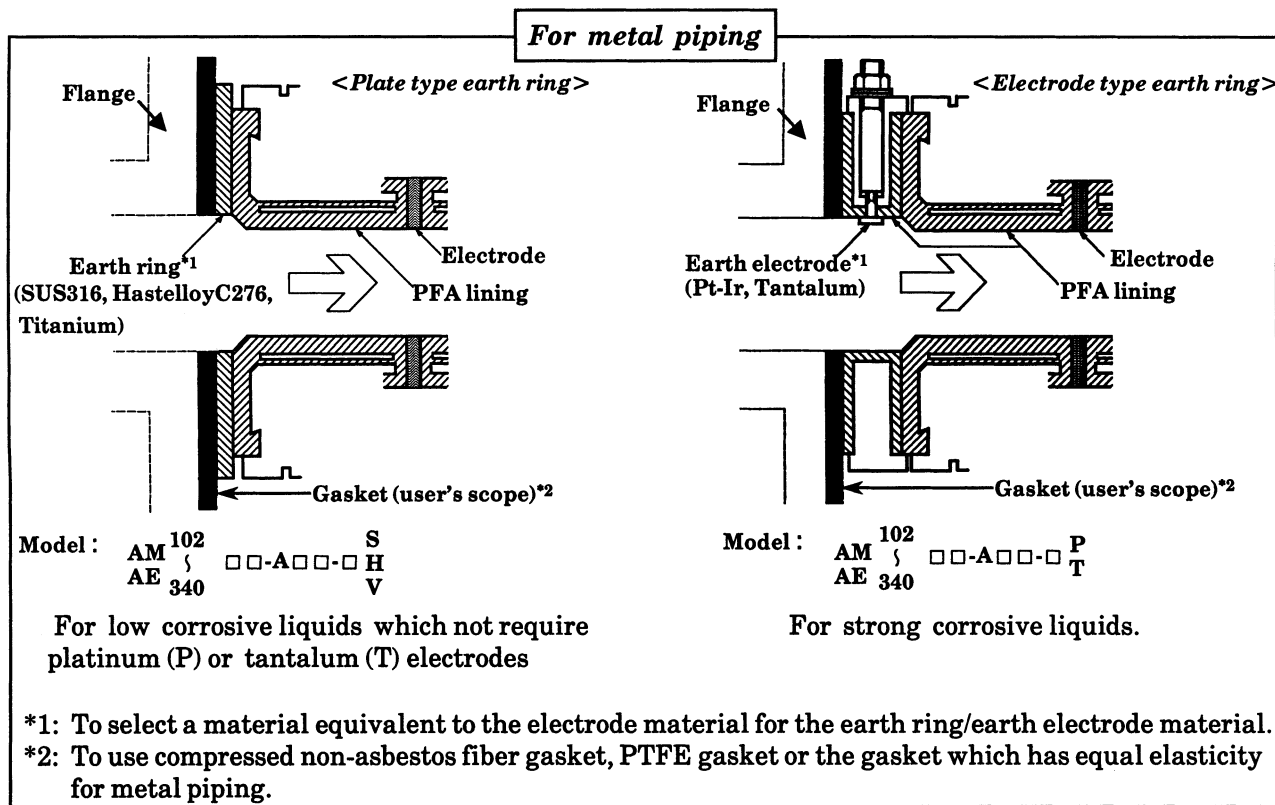
This is the selection guide of the wetted part materials of ADMAG series magnetic flowmeters. This selection guide is composed of data based on field experience and published data. However, the data doesn't always apply the actual process conditions. For suitable selection of the materials, careful consideration of the process fluid is required; conditions such as temperature, pressure, consistency, corrosiveness, abrasiveness and/or adhesiveness are possible to affect the corrosion rate.

2. DISCLAIMER

Final responsibility for material selection remains with the customer (end-user) who knows the actual process conditions best. Yokogawa does not guarantee any data shown in this guide.

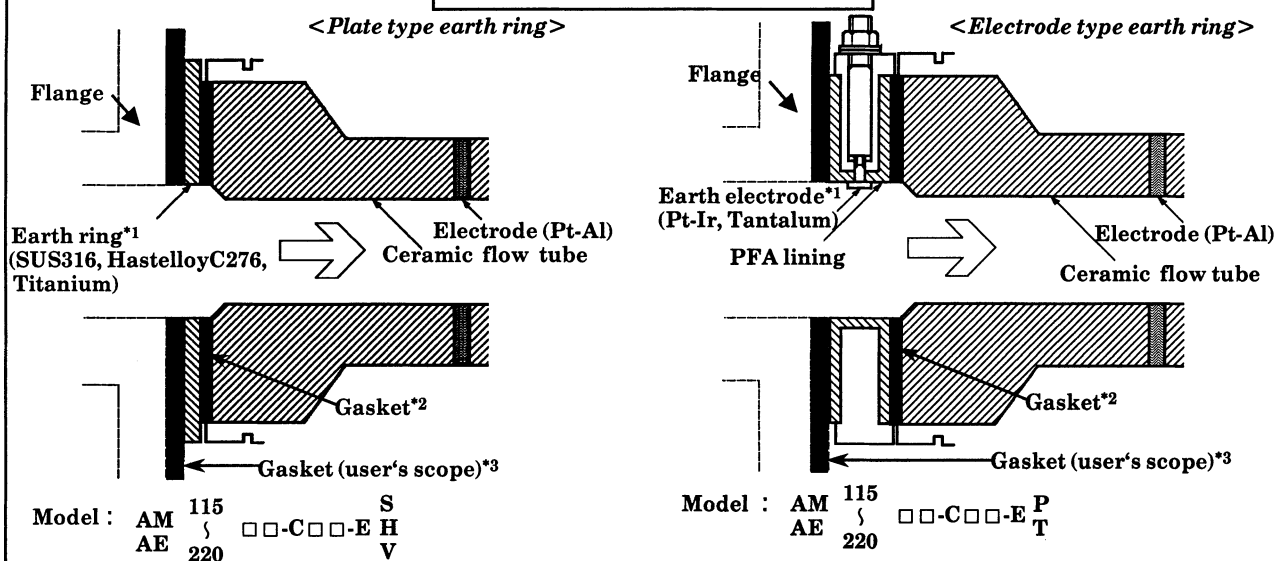
3. MAGNETIC FLOWMETER WETTED PARTS

■ Fluorocarbon PFA Lining



■ Ceramic Lining

For metal piping / PVC piping



For low corrosive liquids which not require platinum (P) or tantalum (T) electrodes

For strong corrosive liquids.

*1: To select a material equivalent to the electrode material for the earth ring/earth electrode material.

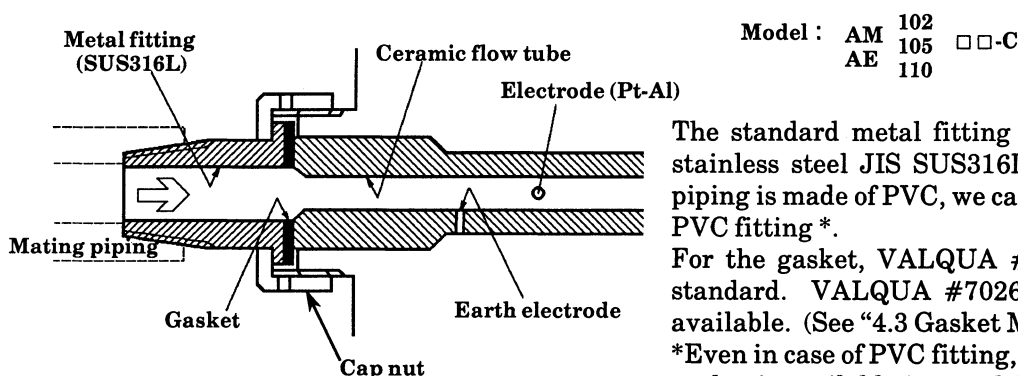
*2: For metal piping, VALQUA#7020 gasket is supplied as standard for insertion between the ceramic tube and the earth ring. VALQUA#7026 gasket is also available. (See "4.3 Gasket Material".)

For PVC piping, to select the optional code /FRG (fluoro rubber gasket) between the lining and the earth ring/earth electrode. VALQUA#4010 gasket is also available. (See "4.3 Gasket Material".)

*3: For metal piping, to use compressed non-asbestos fiber gasket, PTFE gasket or the gasket which has equal elasticity.

For PVC piping, to use rubber gasket or others which has equal elasticity.

Union joint



The standard metal fitting material is stainless steel JIS SUS316L. If the mating piping is made of PVC, we can also provide PVC fitting*.

For the gasket, VALQUA #7020 is used as standard. VALQUA #7026 is also available. (See "4.3 Gasket Material".)

*Even in case of PVC fitting, the standard gasket is available (no need /FRG) because the cap nut is made of metal.

4. MATERIAL FEATURES

4.1 Lining Material

	Abrasion resistance	Heat resistance	Pressure tightness ^{Note 4)}	Corrosion resistance	Adhesion resistance
Fluorocarbon PFA	Not applicable	160°C max.	4MPa max.	Suitable Note 1)	Normally
Ceramic	Suitable	180°C max.	4MPa max.	Suitable Note 2)	Suitable Note 3)
Polyurethane	Normally applicable	40°C max.	2MPa max.	Not applicable	Normally

Note 1) This cannot be used for potassium hydroxide and is also vulnerable to nitric acid, hydrofluoric acid, and fluorides.

Note 2) This is vulnerable to hydrofluoric acid, phosphoric acid, and strong alkalis.

Note 3) The inner surface must be mirror-finished.

Note 4) Maximum pressure depends on sizes and models.

4.2 Electrode Material

	Applications
Stainless Steel JIS SUS316L	Suitable for filtrated water and sewage Cannot be used for organic and inorganic acids and chlorides
Hastelloy C-276	Meets the abrasive liquid requirements Vulnerable to chlorides and sulfuric acids
Titanium	Usable for chlorides, sulfides, sulfuric acid compounds, and alkali solutions Unusable for hydrochloric acids, sulfuric acids, nitric acids, etc.
Platinum-iridium	Not chemically attacked by almost any chemical. Not applicable to aqua regia, ammonium salt, etc.
Tantalum	Not chemically attacked by almost any chemical Vulnerable to HF, strong NaOH, and fuming nitric acid

4.3 Gasket Material

	Product name	Applications
Standard gasket for ceramic lining	VALQUA #7020 (ceramic particles are filled in PTFE)	Applicable to high concentration sulfuric acid or nitric acid
Alkali-resistant gasket for ceramic lining*	VALQUA #7026 (carbon particles are filled in PTFE)	Applicable to high concentration alkalis such as potassium hydroxide and sodium hydroxide, and acids such as hydrochloric acid and hydrofluoric acid
Gasket for PVC piping	Rubber containing fluorine (Viton) Optional code /FRG	For PVC piping to which sufficient axial fastening force cannot be applied.
Acid-resisting gasket for PVC piping*	Rubber containing fluorine (VALQUA #4010) Mixing No.: RCD470	For PVC piping to which sufficient axial fastening force cannot be applied. Applicable to strong acidic liquids.
Alkali-resisting gasket for PVC piping*	Rubber containing fluorine (VALQUA #4010) Mixing No.: RCD970	For PVC piping to which sufficient axial fastening force cannot be applied. Applicable to strong alkaline liquids.

* Special spec. ; Contact Yokogawa.

5. MATERIAL CORROSION RESISTANCE

Wetted material Liquid name (Liquid temperature is assumed as max. 100degC when it is not specified.)	Lining		Electrode/Earth ring					Gasket				
	PFA	Cera mic	SUS 316	Pt-Ir	Haste loy C	Tanta lum	Titani um	For metal piping		For PVC piping		
								Stan dard	Alkali- resistant	/FRG	Acid- resistant	Alkali- resistant
Acetaldehyde CH_3CHO (100%)	A	A	A	A	A	A	A	A	A	N	N	N
Acetic acid CH_3COOH (50%)	A	A	B	A	A	A	A	A	A	N	N	N
Acetic acid (75%)	A	A	N	A	A	A	A	A	A	N	N	N
Alum (100%)	A	A	N	A	N	A		B	A	A	A	A
Aluminum chloride AlCl_3 (100%)	A	A	N	A	A	B	A	A	A	A	A	A
Aluminum fluoride (100%)	A	A	N	A	N	N	B	B	A	A	A	A
Aluminum hydroxide $\text{Al}(\text{OH})_3$ (100%)	A	A	B	A	N	A		B	A			
Aluminum nitrate (100%)	A	A	N	A	N	N	B	N	N			
Aluminum sulfate $\text{Al}_2(\text{SO}_4)_3$ (100%)	A	A	N	A	B	A	B	A	A	A	A	A
Aluminum potassium sulfate (100%)	A	A	N	A	B	A	A	B	A			
Amidosulfonic acid (100%)	A	A	N	A	N	A		A	A			
Ammonium carbonate $(\text{NH}_4)_2\text{CO}_3 \cdot \text{H}_2\text{O}$ (50%)	A	A	B	A	B	A	B	B	A	A	A	
Ammonium chloride NH_4Cl (30%)	A	A	N	A	A	A	B	A	A			
Ammonium fluoride NH_4F (100%)	A	A	N	A	B	N	A	B	A			
Ammonium hydrogencarbonate (50%)	A	A	N	A	N	A		B	A			A
Ammonium hydrogenfluoride (50%)	A	A	N	A	B	N	N	N	A			N
Ammonium hydroxide (100%)	A	A	A	A	A	A	A	B	A		B	B
Ammonium nitrate (100%)	A	A	B (120°C)	B	N	B	B	A	N			
Ammonium persulfate (100%)	A	A	B	A	B	A	N	A	N			A
Ammonium phosphate $(\text{NH}_4)_3\text{PO}_4$ (100%)	A	A	A	A	A	A		B	A			
Ammonium sulfate $(\text{NH}_4)_2\text{SO}_4$ (20%)	A	B	B	A	B	A	B	A	A	N	N	N

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Note 3) Corrosion-resistance assessment for ceramics lining is that containing electrodes (platinum-alumina cermet)

Note 4) Shaded parts show the products handled as semi-standard.

A	Usable
B	Usable term may be short.
N	Unusable due to permeation, corrosion,
No symbol	No data

Wetted material Liquid name (Liquid temperature is assumed as max. 100degC when it is not specified.)	Lining		Electrode/Earth ring					Gasket				
	PFA	Cera mic	SUS 316	Pt-Ir	Haste lloy C	Tanta lum	Titani um	For metal piping		For PVC piping		
								Stan dard	Alkali- resistant	/FRG	Acid- resistant	Alkali- resistant
Ammonium sulfide (NH ₄) ₂ S(100%)	A	A		B		B		A	A	N		
Antimony pentachloride (100%)	A	A	N	A	B	A		A	A			
Antimony trichloride (100%)	A	A	N	A	N	A		A	A			
Aqua regia (100%)		N	N	N	N	A	B	B	N		A	B
Arsenic acid (100%)	A	A	N	A	N	A		B		A	A	A
Arsenous acid (100%)	A	A	N	A	N	A		A	A			
Barium carbonate (100%)	A	A	N	A	N	A		A	A			A
Barium chloride BaCl ₂ (30%)	A	A	N	A	A	A	B	A	A	A	A	A
Barium hydroxide Ba(OH) ₂ (50%)	A	A	B	A	B	B	B	B	A	A	A	A
Barium sulfate BaSO ₄ (100%)	A	A	N	A	N	A	B	A	A	A	A	A
Barium sulfide BaS(100%)	A	A	N	A	A	A	A	B	A	A	A	A
Benzenesulfonic acid (100%)		A	N	A	B	A	N	A	A		A	N
Boron Fluoride (100%)	B		A	A	B	A	N	N	A			
Cadmium chloride CdCl ₂ (100%)	A	A	N	B	N	A		A	A			
Calcium carbonate CaCO ₃ (100%)	A	A	B	A	B	A	A	A	A	A	A	A
Calcium chlorate CaClO ₃ (30%)	A	A	N	A	B	A	B	B	N			A
Calcium chloride CaCl ₂ (40%)	A	A	N	A	B	A	B	A	A	A	A	A
Calcium hydroxide Ca(OH) ₂ (50%)	A	A	B	A	A	A	A	B	A	A	A	A
Calcium hypochlorite Ca(ClO) ₂ (100%)	A	A	N	A	B	A	A	A	N	A	A	A
Calcium nitrate Ca(NO ₃) ₂ (10%)	A	A	N	A	N	A	A	A	N	A	A	A
Calcium sulfate CaSO ₄ (100%)	A	A	N	A	B	A		A	A	A	A	A
Chloroacetic acid (100%)	A	A	N	A	B	A		B	B			B
Chlorosulfuric acid ClSO ₃ H(100%)	B	A	N	A	B	A		B				
Chromic acid H ₂ CrO ₄ (100%)	A	A	N	A	N	A		A	N			

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	PFA	Ceramic	SUS 316	Pt-Ir	Hastelloy C	Tantalum	Titanium	For metal piping		For PVC piping		
								Standard	Alkali-resistant	/FRG	Acid-resistant	Alkali-resistant
Chrome fluoride (100%)	A	A						B	A			
Chromic acid H ₂ CrO ₄ (50%)	A	A	N	A	N	A	A	A	N	A	A	A
Chromium sulfate (100%)	A	A	N	A	B	A		A	A			
Copper(II) chloride CuCl ₂ (50%)	A	A	N	N	N	A	N	A	A	A	A	A
Copper(II) cyanide (100%)	A	A	B	A	B	A		A	A		A	
Copper fluoride CuF ₂ (100%)	A		N	A	N	N		N	A			
Copper(II) nitrate (50%)	A	A	N	A	B	A	B	A	N			
Copper oxychloride (100%)	A	A	N	A	N	N	N	A	N			B
Copper sulfate (40%)		A	N		B	A	B	A	A	A	A	A
Copper sulfide (100%)	A	A	B	A	B	A		B	A			
Fluorosilicic acid (35%)	A	A	N	A	B	N		B	A			
Fluorosilicic acid (40%)	B		N	A	B	N	N	N	A			
Fluorosilicic acid (100%)	B (35°C)	A	N	A	B	N		B	A			
Formaldehyde HCHO(100%)	A	A	N	A	B	A		A				N
Formic acid HCOOH(80%)	A	A	N	A	B	A	B	N	B	N	N	B
Glycerin (100%)	A	A	A	A	A	A	A	A	B	A	A	A
Hydrobromic acid (50%)	A	A	N	N	N	A		A	A	A	A	A
Hydrochloric acid HCl(10%, 180°C)	A	B	N	B	N	A	N	N	A		A	A
Hydrochloric acid HCl(100%, 20°C)	A	B	N	B	N	A	N	B	A			B
Hydrochloric acid HCl(10%, 60°C)	A	A	N	B	N	A	B	A	A	A	A	A
Hydrochloric acid HCl(38%, 60°C)	A	A	N	B	N	A	N	A	A	A	A	A
Hydrofluoric acid HF·H ₂ O(98%, 20°C)	B	A	N	A	B	N	B	N	A		A	
Hydrogen cyanide HCN(100%)	A	A	B	A	B	A		A	A			

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<div>Wetted material</div> <div>Liquid name (Liquid temperature is assumed as max. 100degC when it is not specified.)</div>	Lining		Electrode/Earth ring					Gasket				
	PFA	Cera mic	SUS 316	Pt-Ir	Haste loy C	Tanta lum	Titani um	For metal piping		For PVC piping		
								Stan dard	Alkali- resistant	/FRG	Acid- resistant	Alkali- resistant
Hydrogen peroxide H_2O_2 (50%)	A		A	B	B	B	B	N	N		A	B
Hydroxy acetic acid (35%)	B	A	B	A	B	A		B	A			
Hydroxy acetic acid (70%)	B		B	A	B	A		B	A			
Hypochlorous acid (20%)	A	A	N	N	B	A	N	A	N	A	A	A
Iron(II) chloride FeCl_2 (100%)	A	A	N	A	B	A	A	A	A		A	A
Iron(III) chloride FeCl_3 (100%)	A	A	N	A	B	A	A	A	A	A	A	A
Iron(II) nitrate (100%)	A	A	N	A	B	A		A	N	A	A	A
Iron(III) nitrate (100%)	A	A	N	A	B	A		A	N			
Iron nitrate (100%)	A	A	N	A	B	A		A	N	A	A	A
Iron(II) sulfate FeSO_4 (100%)	A	A	N	A	B	A		A	A			
Lead acetate $\text{Pb}(\text{CH}_3\text{COO})_2 \cdot 3\text{H}_2\text{O}$ (100%)	A	A	N	N	N	A		A	A	N	N	N
Lithium chloride LiCl (100%)	A	A	N	A	A	A	A	A	A			A
Magnesium carbonate MgCO_3 (10%)	A	A	B	A	B	A		A	A			A
Magnesium chloride MgCl_2 (40%)	A	A	N	A	A	A	B	A	A	A	A	A
Magnesium hydrogensulfate (100%)	A		B		B			N	A			
Magnesium hydroxide (100%)	A	A	N	A	N	N		B	A	A	A	A
Magnesium nitrate (100%)	A	A	N	A	N	A	B	A	N			
Magnesium sulfate MgSO_4 (100%)	A	A	B	A	B	A	B	A	A	A	A	A
Mercury(II) chloride Hg_2Cl_2 (60%)	A	A	N	A	B	A	B	A	A	A	A	A
Nickel chloride NiCl_2 (20%)	A	A	N	A	B	A	A	A	A	A	A	A
Nickel nitrate (10%)	A	A		A	B	A		A	N			
Nickel sulfate NiSO_4 (100%)	A	A	N	A	B	A		A	A	A	A	A
Nitric acid HNO_3 (10%, 100°C)	B	A	B	A	B	A	A	A	N	B	A	A
Nitric acid HNO_3 (60%, 100°C)	B	A	N	A	B	A	A	B	N	N	N	N

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Wetted material Liquid name (Liquid temperature is assumed as max. 100degC when it is not specified.)	Lining		Electrode/Earth ring					Gasket				
	PFA	Ceramic	SUS 316	Pt-Ir	Hastelloy C	Tantalum	Titanium	For metal piping		For PVC piping		
								Standard	Alkali-resistant	/FRG	Acid-resistant	Alkali-resistant
Nitric acid (70%, 70°C)	B	A	N	A	N	A	A	B	N		A	
Nitric acid (98%, 30°C)	B	A	N	A	N	A	N	B	N		A	
Oxalic acid C ₂ H ₂ SO ₄ (100%)	A	A	N	A	N	A	N	A	A			
Perchloric acid HClO ₄ (50%)	A	A	N	A	N	A	B	A	B		A	B
Phenol (carbolic acid) (10%)		A	B	A	B	A		A	A	A	A	A
Phosphoric acid H ₃ PO ₄ (100%, 20°C)	A	A	N	A	B	A	N	A				
Phosphoric acid (25%, 180°C)	A	A	B	A	B	A	B	A		A	A	A
Phosphoric acid (50%, 180°C)	A	B	N	A	B	A	N	B				
Phosphoric acid (50%, 60°C)	A	A	B	A	B	A	B	A	A	A	A	A
Phosphoric acid (80%, 180°C)	A	B	N	A	B	A	N	B				
Phosphoric acid (80%, 60°C)	A	A	N	A	B	A	N	A				
Potassium carbonate CaCO ₃ (100%)	A	A	B	A	B	A	B	A				A
Potassium chloride KCl(50%)	A	A	B	A	A	A	A	A	A	A	A	A
Potassium dichromate (100%)	A	A	A	A	N	A		A	N			
Potassium ferricyanide (100%)	A	A	N	N	N	A		A	N			
Potassium ferrocyanide (100%)	A	A	N	N	N	A		A	N			
Potassium hydroxide KOH(25%, 180°C)	A	N	N	A	B	A	B	N	A		B	B
Potassium hydroxide (50%, 180°C)	A	N	N	A	B	B	N	N	A			
Potassium nitrate (80%)	A	A	N	A	B	B	A	A	N	A	A	A
Potassium permanganate KMnO ₄ (10%)	B	A	N	A	N	B	B	A	N			
Potassium persulfate (10%)	A	A	B	A	B	A	A	A	N			A
Potassium sulfate KNO ₃ (100%)	A	A	B	A	A	A	B	A	A	A	A	A
Sea water	A	A	N	A	B	A	A	A		A	A	A

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	PFA	Cera mic	SUS 316	Pt-Ir	Haste lloy C	Tanta lum	Titani um	For metal piping		For PVC piping		
								Stan dard	Alkali-resistant	/FRG	Acid-resistant	Alkali-resistant
Silver nitrate (50%)	A	A	N	A	B	B	B	A	N	A	A	A
Sodium acetate CH ₃ COONa(100%)	A	A	N	A	N	A	A	A	A	N	N	N
Sodium borate (100%)	A	A	N	A	N	A		A				
Sodium bromide (100%)	A	A	N	A	N	A		A	A			A
Sodium carbonate Na ₂ CO ₃ (100%)	A	A	B	A	B	B	A	A	A	A	A	A
Sodium chlorate (40%)	A	A	N	A	B	A	A	B	N			A
Sodium chloride (30%)	A	A	N	A	A	A	A	A	A	A	A	A
Sodium chlorite NaClO ₂ (40%)	A		N	B	N	A	A	N	N			A
Sodium chromate Na ₂ CrO ₄ (100%)	A	A	N	A	N	A	A	B	N			A
Sodium cyanide (100%)	A	A	N	N	B	A	A	A	A			
Sodium ferricyanide (100%)	A	A	N	N		A		A	N			
Sodium fluoride NaF(100%)	A		N	A	N	N		N	A			
Sodium hydrogencarbonate (30%)	A	A	B	A	B	A	A	B	A	A	A	A
Sodium hydrogensulfate (100%)	A	A	N	A	N	A	A	N	A	A	A	A
Sodium hydrogensulfide (100%)	A		B	A	N	A		N	A			
Sodium hydrogensulfite (100%)	A	A	N	A	B	A		A	A	A	A	A
Sodium hydrosulfite (100%)	A		B	A	B	A		N	A			
Sodium hydroxide (30%, 180°C)	A	B	N	A	B	N	B	B	B			A
Sodium hydroxide (40%, 70°C)	A	B	B	A	A	N	B	B	A		B	A
Sodium hydroxide (40%, 90°C)	A	B	B	A	A	N	B	B	B		N	A
Sodium hydroxide (50%, 180°C)	A	B	N	A	B	N	B	B	B			A
Sodium hypochlorite Na(ClO) ₂ (15%)	A	A	N	A	A	A	A	A	N	A	A	A
Sodium hypochlorite Na(ClO) ₂ (25%)	B (90°C)	A	N	A	B	B	B	A	N			

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Wetted material Liquid name (Liquid temperature is assumed as max. 100degC when it is not specified.)	Lining		Electrode/Earth ring					Gasket				
	PFA	Ceramic	SUS 316	Pt-Ir	Hastelloy C	Tantalum	Titanium	For metal piping		For PVC piping		
								Standard	Alkali-resistant	/FRG	Acid-resistant	Alkali-resistant
Sodium metaphosphate (100%)	A	A						A	A			
Sodium nitrate (40%)	A	A	B	A	B	A	B	A	N	A	A	
Sodium nitrite NaNO ₂ (40%)	A	A	B	A	N	A	A	A	A			
Sodium silicate Na ₂ O.xSiO ₂ (100%)	A	A	A	A	B	A	A	B	A	A	A	A
Sodium sulfate Na ₂ SO ₄ (100%)	A	A	N	A	B	A		A	A	A	A	A
Sodium sulfide (100%)	A	A	N	A	B	A	B	B	A			
Sodium sulfite NaSO ₃ (30%)	A	A	B	A	A	A	A	A	A	A	A	A
Sodium tetraborate (100%)	A	A	B	A	B	A		A	B			
Sodium thiosulfate Na ₂ S ₂ O ₃ (100%)	A	A	N	A	B	N	B	A	A	A	A	A
Sulfuric acid H ₂ SO ₄ (100%, 60°C)	A	A	N	A	B	A	N	N			A	B
Sulfuric acid (30%, 180°C)	A	B	N	A	N	A	N	N			A	A
Sulfuric acid (30%, 60°C)	A	A	N	A	B	A	N	A			A	A
Sulfuric acid (70%, 100°C)	A	N	N	A	N	A	N	N			A	A
Sulfuric acid (70%, 60°C)	A	A	N	A	B	A	N	N			A	A
Sulfurous acid (10%)	A	A	B	A	A	A	B	A	A	A	A	A
Tin(II) chloride SnCl ₂ (100%)	A	A	N	A	N	A	B	A	A	A	A	A
Tin(IV) chloride SnCl ₄ (100%)	A	A	N	A	N	A	N	A	A	A	A	A
Trisodium phosphate (NH ₄) ₃ PO ₄ (100%)	A	A	B	A	B	A		B	A			
Zinc chloride ZnCl ₂ (50%)	A	A	N	A	A	A	A	A	A			

Yokogawa does not guarantee the data of this guide. See the disclaimer on the top page.

Note 1) Assessment at a parenthesized concentration or temperature is shown.

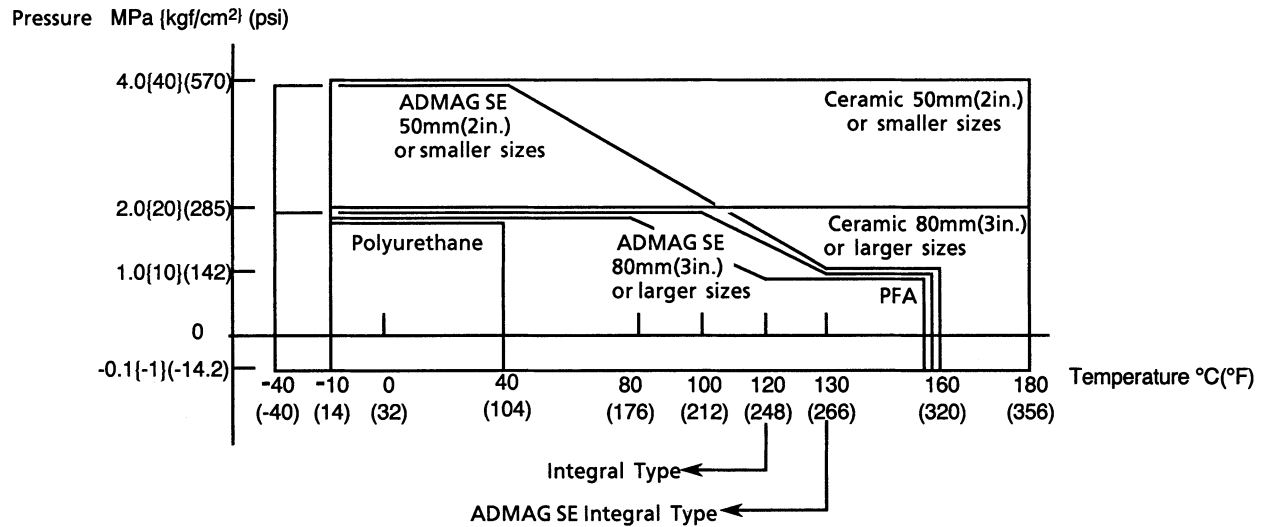
Note 2) Assessment is shown in the case of containing no mixture in the liquids.

Note 3) Corrosion-resistance assessment for ceramics lining is that containing electrodes (platinum-alumina cermet)

Note 4) Shaded parts show the products handled as semi-standard.

A	Usable
B	Usable term may be short.
N	Unusable due to permeation, corrosion,
No symbol	No data

6. FLUID TEMPERATURE AND PRESSURE



7. THERMAL SHOCK LIMITS OF CERAMIC FLOW TUBE

