

PENBERTHY

application report

Section 2000
Application Report 2783.1
Issued 05/06
Replaces 05/05

For: HYDROFLUORIC ACID INCLUDING UOP SPEC 6-20

Hydrogen fluoride is a colorless, extremely corrosive gas known as hydrofluoric acid (HF) when in aqueous solution. Like most inorganic acids, HF vigorously attacks common metals; but, unlike most acids, HF will attack glass and other silica-containing materials. Heavily fluorinated polymers provide the best protection against HF attack.

HF is employed as a catalyst in the "HF Alkylation Process" used extensively by the oil industry to produce a high octane gasoline blended component as well as a general fluorinating agent.

Gage glasses and gagecocks specified for HF service are commonly subject to a specification developed by UOP.

UOP Standard Specification 6-20 Section 5

ARMORED GAGE GLASSES FOR HF ACID SERVICE:

- A. transparent gages with 1/16" [1.6 mm] PCTFE (Kel-F[®]) shields **AND** gaskets to protect the glass are specified
- B. cushions are specified to be either PCTFE (Kel-F[®]) or flexible graphite
- C. bolting material is ASTM A193 Gr B7M
- D. nut material is ASTM A194 Gr 2HM

GAGECOCKS

Penberthy Model 730R Gagecock

- A. 3/4" RF flanged vessel connection
- B. 1/2" female socketweld gage, vent and drain Connections
- C. Monel[®] Trim
- D. flexible graphite stem packing and PTFE seat inserts
- E. yoke gaskets are spiral wound Monel[®] with flexible graphite filler
- F. bolting material is ASTM A193 Gr B7M
- G. nut material is ASTM A194 Gr 2HM

PCTFE (Kel-F[®]) Ratings

<u>Pressure</u>		<u>Temp</u>
psi [kPa]		°F [°C]
300 [2070]	@	100 [38]
225 [1550]	@	250 [121]
210 [1450]	@	300 [149]
180 [1240]	@	400 [204]

Specifying equipment for HF service should be done carefully. All specifications should be followed in detail.

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Since the UOP specification knowingly allows base metal corrosion to occur at a rate of >50 mils/year [1250 μ] for any dilution of HF (100% HF (largely unionized) will attack the base metal at a slower rate of 20-50 mils/year [500 - 1250 μ] if the temperature is maintained below 160°F [70°C]).

Penberthy suggests the following for optimum service life:

- A. all construction to be welded
- B. all connections to be flanged with flange gasketing to be either PCTFE (Kel-F[®]) or flexible graphite
- C. bolting to be ASTM A193 Gr B7M
- D. nuts to be ASTM A194 Gr 2HM
- E. armored gages
 - 1. transparent gages with 63 mil [1.6 mm] PCTFE (Kel-F[®]) shields **AND** gaskets.
6 mil [0.15 mm] PCTFE (Kel-F[®]) shields are available for general glass protection against chemical attack such as hot concentrated hydroxides. Exercise extreme caution since HF will actively diffuse through these thin shields except at very low HF concentrations.
 - 2. cushions to be PCTFE or stainless steel insert graphite
 - 3. metal protection
 - a) optimum protection of metallic components to 270°F [132°C] is Tefzel[®] (PETFE) or Halar[®] (PECTFE) lined steel per NACE MR0103/MR0175
 - b) better – Monel[®] wetted parts
Monel[®] demonstrates corrosion rates <2 mils/year [51 μ] at temperatures up to 400°F [204°C] for dilution of HF (slightly worse with 100% concentration – better at lower dilutions)
 - c) good – Hastelloy C[®] wetted parts
Hastelloy C[®] demonstrates corrosion rates of <2 mils/year [51 μ] at temperatures up to 210°F [99°C]
- F. armored OS&Y gagecock (example Penberthy Assembly #9AD60-023)
 - 1. flexible graphite stem packing and PTFE seat inserts
 - 2. yoke gasket – spiral wound Monel[®] with flexible graphite filler
 - 3. trim - Monel[®]
 - 4. other wetted parts to be carbon steel, Monel[®] or Hastelloy C[®] (refer to E3 (b) and (c) above for discussion)

PCTFE (formerly known as Kel-F[®] - a registered trademark of 3M) is manufactured by Daikin
Kel-F[®] is included due to historical tradename usage