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Liquid Thermal Sizing Information Sheet

Contact Name: _____

Phone #: (____) _____

Customer Company: _____

Fax #: (____) _____

Location: _____

Tag/PSV Numbers: _____

Quantity: _____

1. Operating Data

- What is the Relief Valve Protecting: _____
- Operating Pressure, (P_o): _____ psig
- Operating Temperature, (T_o): _____ °F
- Set Pressure, (P_{set}): _____ psig
- Back Pressure:
 - Superimposed _____ psig
 - Is the Superimposed Back Pressure Variable or Constant?
 - Built-up _____ psig

2. Fluid Data

- Liquid Name: _____
- Specific Gravity, (SG): _____
- Viscosity, (μ): _____ cP
- Cubical Expansion Coefficient, (B): _____ 1/°F
- Total Heat Transfer Rate, (H): _____ BTU/h
- Specific Heat of the fluid, (C): _____ BTU/lb/°F

The Formulas used in these calculations are from API RP 521, API RP 520, *Relief Systems Handbook*, and ASME BPVC, Section VII, Division I.

Generated Thermal Capacity

$$Q_{GPM} = \frac{B \times H}{500 \times SG \times C}$$

Initial Required Orifice Area

$$A_o = \frac{Q_{GPM}}{38 \times K} \times \sqrt{\frac{SG}{P_1 - P_2}}$$

Reynold's Number

$$Re = \frac{2800 \times Q_{GPM} \times SG}{m \times \sqrt{A_o}}$$

Viscosity Correction Factor

$$K_v = \left(0.9935 + \frac{2.878}{Re^{0.5}} + \frac{342.75}{Re^{1.5}} \right)^{-1.0}$$

Required Orifice Area

$$A_o = \frac{Q_{GPM}}{38 \times K \times K_v} \times \sqrt{\frac{SG}{P_1 - P_2}}$$

Variables

B=Cubical Expansion Coefficient, (1/°F)
 H=Total Heat Transfer Rate, (BTU/h)
 Q_{GPM}=Thermal Capacity, (GPM)
 SG=Specific Gravity Relative to 60°F Water
 C=Specific Heat of the Fluid, (BTU/lb/°F)
 A_o=Initial Required Orifice Area, (in²)
 A=Required Orifice Area, (in²)
 K=Discharge Coefficient
 P₁=Flowing Pressure, P_{set} + Overpressure + P_{atm}, (psia)
 P₂=Total Back Pressure, (psia)
 Re=Reynold's Number
 m=viscosity, cP
 K_v=Viscosity Correction Factor

Typical Cubical Expansion Coefficients for Hydrocarbon Liquids and Water at 60°F

Gravity of Liquid (°API)	Value (1/°F)
3 - 34.9	0.0004
35 - 50.9	0.0005
51 - 63.9	0.0006
64 - 78.9	0.0007
79 - 88.9	0.0008
89 - 93.9	0.00085
94 - 100 and lighter	0.0009
Water @ 60°F	0.0001

Table was taken from API RP 521