API Specification
16C
1st Edition, January 1993
Choke and Kill Systems

Sections 10.2 and 3

Purchasing Guidelines and Design Requirements

10.2
Purchasing Guidelines
This appendix provides recommended guidelines for inquiry and purchase of API Choke and Kill Systems Equipment. The purchaser should provide rated working pressure, temperature ratings and size designation, when placing an order or making an inquiry.

10.2.1
Size Designation
The size designation consists of the nominal through bore dimension. A list of standard sizes is found in Section 3 of this specification.

10.2.2
Rated Working Pressure
The rated working pressure is determined by the lowest rated working pressure of the component or assembly, including integral end or outlet connections. Standard rated working pressures are listed in Section 3.

10.2.3
Temperature Rating
The minimum temperature rating is based on the lowest ambient temperature to which the equipment may be subjected during operation. The maximum temperature rating is the highest temperature of the fluid which may flow through the equipment.

10.2.3.1
Metallic Materials
Metallic equipment should be designed to operate in one of the temperature ratings listed in Section 3.

10.2.3.2
Non-Metallic Materials
Non-metallic equipment and components, including seals, should be designed to operate in one of the temperature ranges listed in Section 3.

Section 3
Design Requirements

3.1
Design Method
Design method shall be in accordance with one or more of the following criteria.

3.1.1
ASME Method
The design methodology as described in the ASME Boiler and Pressure Vessel Code, Section VIII, Division 2, Appendix 4, shall be used for design calculations. Design allowable stresses shall be limited by the following criteria:

$S_m = 2/3\ S_y$ and $S_t = 0.9\ S_y$

where

S_m = design stress intensity at rated working pressure

S_y = material minimum specified yield strength

S_t = maximum allowable primary membrane stress intensity at hydrostatic test pressure.

3.1.2
Distortion Energy Theory Method
The Distortion Energy method shall be used for design calculations for unions. The minimum pressure design thickness shall be calculated by combining triaxial stresses based on the distortion energy method, using either one of the limits below. Secondary stresses and stress concentrations are beyond the scope of this method.

1. The rated working pressure

   $S_e = 2/3\ S_y$

   S_e = von Mises equivalent stress

2. The hydrostatic test pressure limited by the following criterion:

   $S_e = S_y$

3.1.3
Experimental Stress Analysis
Experimental Stress Analysis as described in ASME Boiler and Pressure Vessel Code, Section VIII, Division 2, Appendix 6, shall be used.

3.1.4
Proof Test Analysis
Proof testing as described in ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, Part UG-101, shall be used.

3.2
Performance Requirements
Performance requirements are specific and unique to the product in the as-shipped condition. Products shall be designed to perform according to the requirements of this section and in the pressure, temperature ranges, test fluids, and in accordance with Section 4.

(Continued to next column)

3.2.1
Pressure Integrity
Products shall be capable of withstanding rated working pressure at rated temperature without deformation to the extent that any other performance requirement is not met.

3.2.2
Thermal Integrity
Products and/or systems shall be capable of functioning throughout the temperature range of which they are rated.

3.2.3
Leakage
No visible leakage is allowed.

3.2.4
Load Capability
Products shall be capable of sustaining rated loads without deformation to the extent that any other performance requirement is not met.

3.2.5
Cycles
Products shall be capable of performing and operating as intended for the number of operating cycles specified in Section 9 for applicable products.

3.2.6
Operating Force or Torque
The force or torque required to operate products shall be within the manufacturer's written specification, which includes acceptance criteria.

3.3
Performance Verification
The performance verification procedures are imposed on designs of new products and on designs resulting from changes. Verification testing specified in this section is intended to be performed on line samples representative of production models.

3.3.1
Performance Verification Requirements
Performance verification requirements are set forth in Section 9.

3.3.2
Product Changes
A design that undergoes a substantive change becomes a new design requiring performance verification. A substantive change is a change identified by the manufacturer which affects the performance of the product in the intended service condition. This includes changes in fit, form, function or material.

3.4
Bore sizes and Rated Working Pressure
The bore size and rated working pressure designation of a choke and kill system and the components shall consist of the values delineated in Table 3.4.1, Equipment Bore Sizes and Rated Working Pressure, Table 3.4.2 and Table 3.4.3.

Table 3.4.1 – Equipment Bore Sizes and Rated Working Pressure

Size (minimum through bore) in. (mm)	Rated Working Pressure psi (MPa)
2 1/16 (52) 2 9/16 (65) 3 1/8 (78) 4 1/16 (103)	2000 (13.8)
2 1/16 (52) 2 9/16 (65) 3 1/8 (78) 4 1/16 (103)	3000 (20.7)
2 1/16 (52) 2 9/16 (65) 3 1/8 (78) 4 1/16 (103)	5000 (34.5)
1 13/16 (46) 2 1/16 (52) 2 9/16 (65) 3 1/16 (78) 4 1/16 (103)	10,000 (69.0)
1 13/16 (46) 2 1/16 (52) 2 9/16 (65) 3 1/16 (78) 4 1/16 (103)	15,000 (103.5)
1 13/16 (46) 2 1/16 (52) 2 9/16 (65) 3 1/16 (78) 4 1/16 (103)	20,000 (138)

Note: *Specific size and pressure rating combinations are not necessarily available for each type of end or outlet connection (e.g., flange, hub and threaded).*

Table 3.4.2 – Union, Swivel Joint and Articulated Line Sizes and Rated Working Pressures

Nominal Size in. (mm)	Rated Working Pressure psi (MPa)
2 (50.8) 3 (76.2) 4 (101.6)	3,000 (20.7)
1 (25.4) 1 ½ (38.1) 2 (50.8) 3 (76.2) 4 (101.6)	5,000 (34.5)
1 (25.4) 2 (50.8) 3 (76.2) 4 (101.6)	10,000 (69.0)
2 (50.8) 2 ½ (63.5) 3 (76.2)	15,000 (103.5)
2 (50.8) 2 ½ (63.5) 3 (76.2)	20,000 (138)

Table 3.4.3 – Flexible Line Sizes and Rated Working Pressures

ID in. (mm)	Rated Working Pressure psi (MPa)
2 (50.8) 3 (76.2) 3 ½ (88.9) 4 (101.6)	5,000 (34.5)
2 (50.8) 2 ½ (63.5) 3 (76.2) 4 (101.6)	10,000 (69.0)
2 (50.8) 2 ½ (63.5) 3 (76.2)	15,000 (103.5)
2 (50.8) 2 ½(63.5) 3 (76.2)	20,000 (138)

3.5
Service Conditions

3.5.1
Rated Working Pressure
Equipment within the scope of this specification shall be rated in only the following working pressures, psi (MPa): 2000 (13.8), 3000 (20.7), 5000 (34.5), 10,000 (69.0), 15,000 (103.5), and 20,000 (138.0) psi (MPa), as delineated in Section 3.4.

3.5.2
Temperature Ratings
Minimum temperature is the lowest ambient temperature to which the equipment may be subjected, while in service. Maximum temperature is the highest fluid temperature which may flow through the equipment, while in service. Equipment shall be designed to operate within the temperature ranges shown in Table 3.5.2.1.

Table 3.5.2.1 – Temperature Rating for Metallic and Nonmetallic Materials and Flexible Lines

Rating	Operating Range °F (°C)	
A	−4 to 180	(−20 to 82)
B	−4 to 212	(−20 to 100)
K	−75 to 180	(−60 to 82)
P	−20 to 180	(−29 to 82)
U	0 to 250	(−18 to 121)

3.5.3
Fluid Service Conditions
Choke and Kill Systems are generally mobile and may be expected to be used in areas wher sour service conditions may be encountered. Metallic materials which come in contact with the well fluid shall meet the requirements of NACE Standard MR0175-91.

3.5.4
Flange and Hub End and Outlet Connections
Flanges and hubs are designed in accordance with design criteria and methods developed by the API Committee on Standardization of Valves and Well-head Equipment and the API Committee for Drill-Through Equipment. End and outlet connections are described in this specification. Design is not within the scope of this specification. Manufacturers shall make the end and outlet connections as per the applicable sections of API Specifications 6A and 16A.

3.6
Closure Bolting
The maximum allowable tensile stress for closure bolting shall be determined considering initial bolt up rated working pressure, and hydrostatic test pressure conditions. Bolting stresses, based on the root area of the thread, shall not exceed the following limits:

$S_a = 0.83S_y$

where

S_a = maximum allowable tensile stress

S_y = bolting material specified minimum yield strength

Bolting Stresses shall be determined considering all loading on the closure including pressure acting over the seal area, gasket loads and any additive mechanical and thermal loads.

3.7
Clamps
Clamps for API 16BX Hubs are not included in this specification edition or the current API Spec 16A. Clamps will be addressed in a future edition of these specifications.

3.9
Test, Vent, Pipe Plugs and Gauge Connections
Test, Vent, Pipe Plugs and Gauge Connections for use on 2000 (13.8), 3000 (20.7), 5000 (34.5), 10,000 (69.0), 15,000 (103.5), and 20,000 (138.0) psi (MPa) equipment shall be as per API Spec 6A, Section 911. Vent connections shall be in accordance with manufacturers written specifications.

3.10
Design Documentation
Documentation of designs shall include methods, assumptions, calculations, and design requirements. Design documentation media shall be clear, legible, reproducible and retrievable.

3.10.1
Design Review
Design documentation shall be reviewed and verified by qualified personnel other then those who created the original design.

3.10.2
Design Verification
Manufacturer's shall document their verification procedures and the results of performance verification of designs. Design verification is not required on API flanges, hubs and ring gaskets.

3.10.3
Documentation Retention
Design documentation shall be retained for ten years after the last unit of that model, size and rated working pressure is manufactured.

Table 3.8 – Fraction to Decimal Conversion

8th	16th	32nd	64th	0.000	0.00
			1/64	0.016	0.02
		1/32		0.031	0.03
			3/64	0.047	0.05
	1/16			0.062	0.06
			5/64	0.078	0.08
		3/32		0.094	0.09
			7/64	0.109	0.11
1/8				0.125	0.12
			9/64	0.141	0.14
		5/32		0.156	0.16
			11/64	0.172	0.17
	3/16			0.188	0.19
			13/64	0.203	0.20
		7/32		0.219	0.22
			15/64	0.234	0.23
1/4				0.250	0.25
			17/64	0.266	0.27
		9/32		0.281	0.28
			19/64	0.297	0.30
	5/16			0.312	0.31
			21/64	0.328	0.33
		11/32		0.344	0.34
			23/64	0.359	0.36
3/8				0.375	0.38
			25/64	0.391	0.39
		13/32		0.406	0.41
			27/64	0.422	0.42
	7/16			0.438	0.44
			29/64	0.453	0.45
		15/32		0.469	0.47
			31/64	0.484	0.48
1/2				0.500	0.50

(Continued to next column)

Table 3.8 – Fraction to Decimal Conversion *(continued)*

8th	16th	32nd	64th	0.000	0.00
			33/64	0.516	0.52
		17/32		0.531	0.53
			35/64	0.547	0.55
	9/16			0.562	0.56
			37/64	0.578	0.58
		19/32		0.594	0.59
			39/64	0.609	0.61
5/8				0.625	0.62
			41/64	0.641	0.64
		21/32		0.656	0.66
			43/64	0.672	0.67
	11/16			0.688	0.69
			45/64	0.703	0.70
		23/32		0.719	0.72
			47/64	0.734	0.73
3/4				0.750	0.75
			49/64	0.766	0.77
		25/32		0.781	0.78
			51/64	0.797	0.80
	13/16			0.812	0.81
			53/64	0.828	0.83
		27/32		0.844	0.84
			55/64	0.859	0.86
7/8				0.875	0.88
			57/64	0.891	0.89
		29/32		0.906	0.91
			59/64	0.922	0.92
	15/16			0.938	0.94
			61/64	0.953	0.95
		31/32		0.969	0.97
			63/64	0.984	0.98
1				1.000	0.100