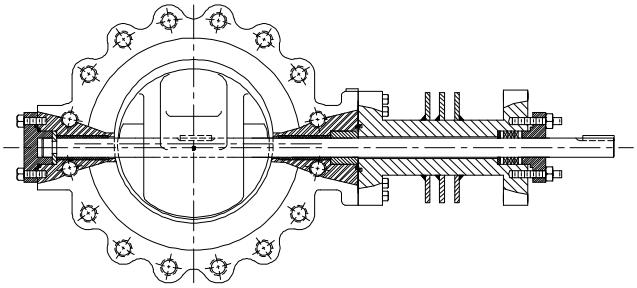
SCORE VALVES TRICENTRIC®



TECHNICAL BULLETIN 102

HIGH TEMPERATURE SERVICE

General: TRICENTRIC® high performance butterfly valves are designed for temperatures to 1500 °F and higher. The valve s all metal robust construction and metal-to-metal, unique geometry design provides tight shut-off without any jamming - even at high temperature differential. The selection of materials and design options is determined according to temperature, media and pressure conditions. Each of the following components must be evaluated in determining an appropriate design.

Valve Design: TRICENTRIC® valve components for high temperature are generally selected from a common material type to make allowance for dimensional changes caused by thermal gradients, differences in co-efficient of thermal expansion and creep. That is the body, disc, clamp ring and seal are all stainless, all inconel, etc. *[see Score-TRICENTRIC® High Performance Butterfly Valve General Catalogue for body and disc pressure/temperature ratings].*

Seat and Seal Overlay: In order to resist both wear and galling (which are a function of temperature, material couples, hardness of the mating materials and loading) at higher temperatures, it is required to select seat and seal materials and/or overlays to resist these effects.

Temp (°F.)	Media (Note 1)	Seat	Seal Material	Seal/Disc Overlay
to 975	oxidizing	316 SST	laminated 316 SST/grafoil	none
to 1200	non-oxidizing	316 SST	laminated 316 SST/grafoil	none
975 to 1200	oxidizing	316 SST	solid 316 SST/grafoil spiral gasket	none
1200 to	oxidizing & non-oxidizing	stellite #6 overlay	solid 316 SST/grafoil spiral gasket	Stellite #6
above 1500	oxidizing & non-oxidizing	stellite #6 overlay	solid 316 SST disc	Stellite #6

The above guidelines are based on low cycle, low differential pressure (20 PSIG above 1000 °F.) clean service. Conditions other than these generally require moving down the chart to the next upgrade. Applications where the media requires material upgrades from 316 SST must be evaluated on an application specific basis.

Solid Disc: TRICENTRIC® recommends the use of a solid disc for high thermal cycling applications. Thermal cycling can cause warpage and dimensional changes to components that can be enhanced by the process media and cycle rates. This can cause threaded parts to loosen in service and may result in thermal cracking at the thinner sections. High thermal cycling applications must be evaluated on an application specific basis.

Bearing Material: In general, the higher the temperature, the greater the tendency to gall and the lower the pressure required to initiate galling. The following table indicates recommended general bearing material temperature limits.

Temp (°F.)	Media	Bearing
-400 to 1700 °F.	non-oxidizing	Graphite
-400 to 600 °F.	oxidizing	Graphite
-325 to 1500 °F.	oxidizing & non-oxidizing	Nitronic 60
-425 to 1700 °F.	oxidizing & non-	Stellite 6
-20 to 2500 °F.	oxidizing & non-	Ceramic

(Note 1) The chart below gives general guidelines on the oxidizing nature of various media

Media	General Nature
Air	oxidizing
Amines	non-oxidizing
Ammonia	non-oxidizing
Aromatics/Solvent	non-oxidizing
Asphalts & Tars	non-oxidizing
Butane & Propane	non-oxidizing
Caustics	oxidizing
Chlorine	oxidizing
Dye	oxidizing
Hydrogen	non-oxidizing
Hydrocarbons	non-oxidizing
Inhibitor	non-oxidizing
Mercaptans	non-oxidizing
Phenol	non-oxidizing

SCORE VALVES TRICENTRIC®

Score Energy Products Inc.
9821 - 41 Avenue
Edmonton, Alberta
Canada T6E 0A2

Phone: [780] 466-6782
Fax: [780] 465-6979
Email: technical@scorevalves.com

Shaft Material: Material selection is based on temperature, differential pressure and media. *[see Score-TRICENTRIC® High Performance Butterfly Valve General Catalogue for general corrosion data and temperature and differential pressure limits].* Selection of shaft material with a reduced differential pressure rating will result in a reduced maximum seating torque at temperature (see table below).

Shaft Material	TEMPERATURE °F															
	- 423 to 100	- 423 to - 20	- 19 to 100	101 to 200	201 to 300	301 to 400	401 to 500	501 to 600	601 to 650	651 to 700	701 to 750	751 to 800	801 to 850	851 to 900	901 to 950	951 to 1000
	% of Max. Full Rated Differential Pressure	PERCENT OF MAXIMUM ALLOWABLE TORQUE														
17.4 ph DH1150 Stainless steel	100	100	100	100	100	97	95	94	93	92*	90*	87*	84*	80*	74*	66*
316 Stainless steel (annealed)	56	56	56	56	54	53	53	53	53	53	53	52	52	51	49	-
Alloy K-500	100	100	100	100	100	100	100	100	100	100	100	100	100	76	76	-
Alloy C	74	74	74	74	73	71	69	68	67	66	66	66	65	65	64	63
Alloy 20 (annealed)	59	59	59	59	59	58	57	57	57	57	57	57	-	-	-	-
Alloy XM-19	74	74	74	74	70	67	66	65	65	64	63	63	62	61	60	59
Stellite 6B	100	-	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Inconel 718	100	-	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Inconel 625	89	89	89	89	89	89	85	84	83	82	82	81	80	79	78	76
Inconel 600	59	59	59	59	59	59	59	59	59	59	59	59	58	56	-	-

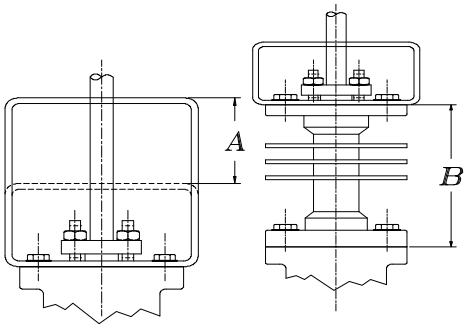
*** Prolonged exposure above 600 °F may cause embrittlement** Contact Score-TRICENTRIC® Engineering for all temperatures & materials not listed.

Packing Material: The compatibility of packing material with the process media at high temperature will determine the requirement for an extended bonnet. The purpose of an extended bonnet is to reduce the temperature of the packing to a temperature threshold where the material is compatible with the process media. The table to the right outlines the maximum allowable service temperature based on media.

Temp (°F.)	Media (Note 1)	
to 850 °F.	oxidizing	standard grade grafoil
to 975 °F.	oxidizing	corrosion inhibited grade grafoil
to 1200 °F.	non-oxidizing	NOTE: packing exposed to air as well as process thus limiting upper temperature

Bracket Extension & Bonnet Extension: In order to reduce thermal transfer through the valve stem and bracket to the actuator under high temperature conditions an increase in bracket height from standard may be required (*standard height is as per gear operator bracket height > see Technical Bulletin 106*). Along with this, consideration must be given to the packing material temperature as previously discussed. The following chart indicates recommended application of bracket and bonnet extension.

Temp (°F.)	Media (Note 1)	Option Required	Dimension A/B - Bracket/Extension Height	
600 to 975	oxidizing	Extended bracket for actuator	3 to 8" | A = 4" min.	10" and larger | A = 8" min
975 to 1200	non-oxidizing	Extended bracket for actuator	3 to 8" | A = 4" min.	10" and larger | A = 8" min
above 975	oxidizing	Bonnet extension - finned	3 to 8" | B = 8" min.	10" and larger | B = 12" min
above 1200	non-oxidizing	Bonnet extension - finned	3 to 8" | B = 8" min.	10" and larger | B = 12" min



STANDARD RECOMMENDED HIGH TEMPERATURE VALVE CONSTRUCTION DETAILS

Temp (°F.)	Components and Materials of Assembly						
	Body	Seat	Seal	Disc	Shaft	Bearing	Extension
600 to 850	Standard	Standard	Standard	Standard	Standard	Standard	Extended Bracket
851 to 975	Standard	Standard	Standard	Standard	Inconel 625	Standard	Extended Bracket
976 to 1200 (non-oxidizing)	Standard	Standard	Standard	Standard	Inconel 718	Standard	Extended Bracket
976 to 1200 (oxidizing)	Standard	Standard	Solid 316 w/spiral gasket	Standard	Inconel 718	Nitronic 60	Extended Bonnet
1201 to 1500	Standard	Stellite #6	Solid 316 w/stellite #6 overlay & spiral gasket	Standard	Inconel 718	Nitronic 60/ Stellite/Ceramic	Extended Bonnet
above 1500	Standard	Stellite #6	Seal integral w/Solid disc & stellite #6 overlay	Solid Disc	Inconel 718	Stellite/Ceramic	Extended Bonnet

Bulletin contents may change at anytime without notice

Score Energy Products Inc.
9821 - 41 Avenue
Edmonton, Alberta
Canada T6E 0A2

Phone: [780] 466-6782
Fax: [780] 465-6979
Email: technical@scorevalves.com