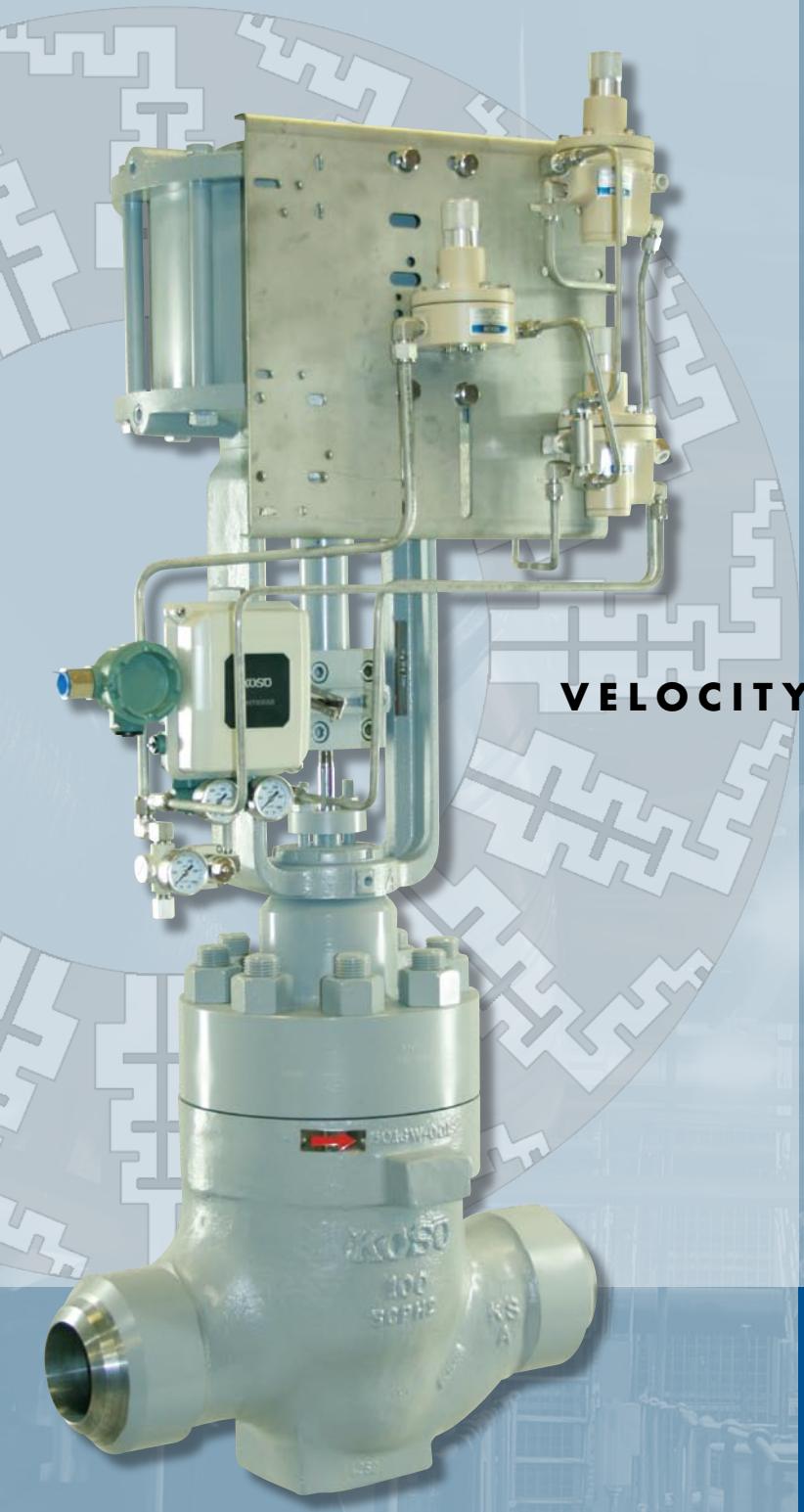

VECTOR™
VELOCITY CONTROL TECHNOLOGY

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VECTOR™ RECIRCULATION (VR) FOR BOILER FEEDPUMPS

KOSO

In a power plant, the water is circulated through the boiler by a feedpump driven by either a steam turbine or an electrical motor. In supercritical power plants, the feedpump takes the water from the deaerator or low-pressure heat exchangers and increases the water pressure as high as 380 bar (5500 psi). To prevent cavitation and overheating, a certain minimum amount of flow must pass through these pumps. If the boiler is not ready to accept the high pressure water from the feedpump, a recirculation system is used to return the minimum required flow back to the condenser or deaerator and from there to the pump inlet. Most of the time, the high pressure water is sent to the boiler and the recirculation system shut, but ready to open if required. See Figure 1 for a typical plant schematic.

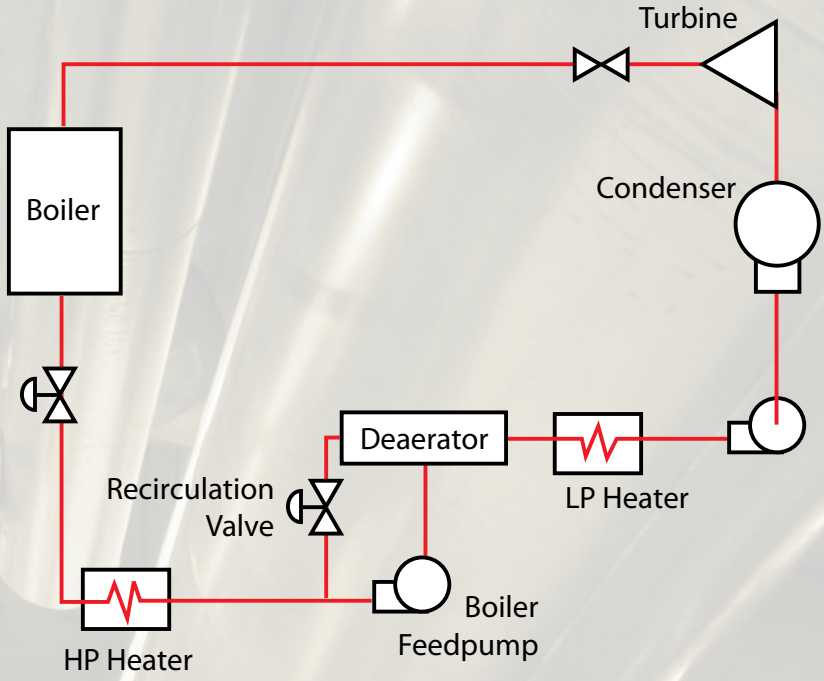


Figure 1: Schematic of typical once-thru, universal pressure, steam-generating plant, showing the location of the boiler feedpump recirculation valve

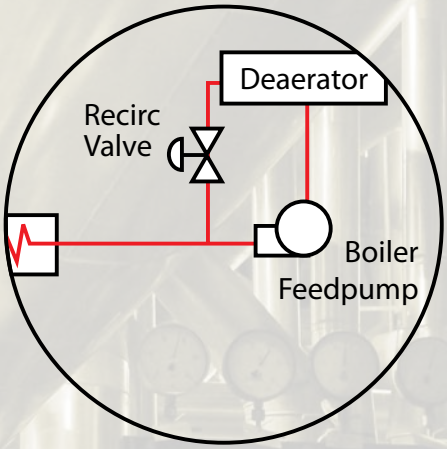


Figure 2: A KOSO Vector globe valve is shown located near the pump discharge with flow to deaerator. A KOSO Vector angle valve is also available, should piping configuration dictate. Systems discharging to the condenser normally use angle valves.

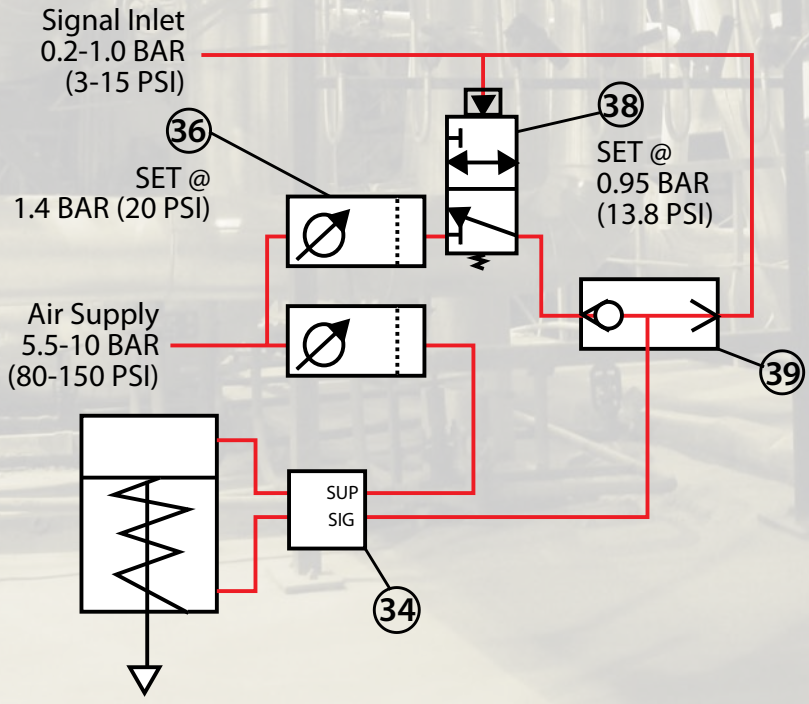
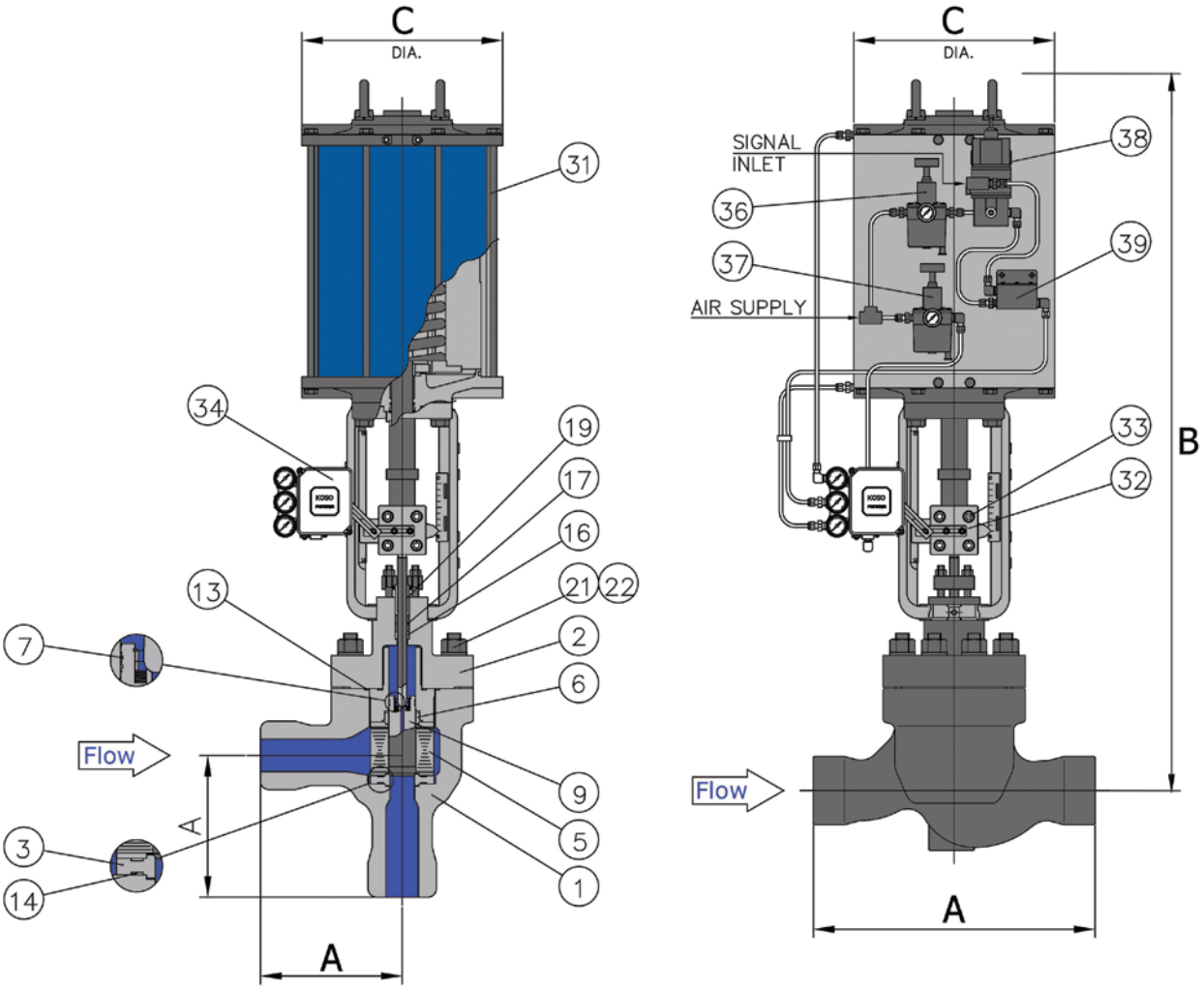


Figure 3: An actuator control schematic is shown for 3-15 psi modulation signal, with decreasing signal tending to open the valve. The actuator is fitted with a spring for fail open on loss of air signal. A snap-acting relay is provided to ensure the valve is fully seated when requested by the demand signal. The snap-acting relay is set as shown so the valve modulates between 10% and 100% open.



Nominal Valve Size	Valve Dimensions, mm (in.)								
	Nominal Trim Size		Angle			Globe			Actuator Diameter, C DIM
			Face-to-CL, A DIM		CL-to-Top, B DIM	Face-to-Face, A DIM		CL-to-Top, B DIM	
	Size	Stroke	1500#	2500#		1500#	2500#		
2 in. (50 mm)	38 (1.5)	90 (3.5)	235 (9.25)	286 (11.25)	1260 (49.6)	464 (18.25)	565 (22.25)	1320 (52.0)	382 (15.0)
3 in. (75 mm)	50 (2)	90 (3.5)	270 (10.62)	333 (13.13)	1260 (49.6)	533 (21.00)	660 (26.00)	1330 (52.4)	382 (15.0)
4 in. (100 mm)	62 (2.5)	115 (4.5)	352 (13.88)	457 (18.00)	1670 (65.7)	699 (27.50)	908 (35.75)	1750 (68.9)	382 (15.0)
	62 (2.5)	150 (6)			1770 (67.7)			1850 (72.8)	382 (15.0)
	75 (3)	150 (6)			1770 (67.7)			1850 (72.8)	382 (15.0)
6 in. (150 mm)	100 (4)	150 (6)	416 (16.38)	508 (20.00)	1750 (68.9)	826 (32.50)	1016 (40.00)	1850 (72.8)	382 (15.0)

Nominal Valve Size	Nominal Trim Size, mm (in.)		Valve Capacity, Kv (Cv)			
			Angle		Globe	
	Size	Stroke	18 Turn	24 Turn	18 Turn	24 Turn
2 in. (50 mm)	38 (1.5)	90 (3.5)	9.9 (11.5)	6.6 (7.6)	9.7 (11.2)	6.5 (7.5)
3 in. (75 mm)	50 (2)	90 (3.5)	14.9 (17.2)	10.5 (12.1)	14.5 (16.8)	10.4 (12.0)
4 in. (100 mm)	62 (2.5)	115 (4.5)	26.5 (30.6)	18.5 (21.4)	25.8 (29.8)	18.3 (21.1)
	62 (2.5)	150 (6)	34.8 (40.2)	24.7 (28.5)	33.2 (38.4)	24.0 (27.8)
	75 (3)	150 (6)	43.5 (50.3)	28.6 (33.1)	42.0 (48.6)	28.2 (32.6)
6 in. (150 mm)	100 (4)	150 (6)	71.9 (81.3)	49.0 (56.6)	69.9 (80.8)	48.4 (55.9)

KOSO VECTOR™ Recirculation valve for boiler feedpumps

			Modulating		On-Off	
Item	Description	Material/Component	Standard	Optional	Standard	Optional
1	Body	Angle:ASTM-A216 Gr WCB	X		X	
		Globe:ASTM-A217 Gr C5				
2	Bonnet	ASTM-A 105	X		X	
3	Seat Ring	300 Series SS	X		X	
5	Disk Stack	400 Series SS	X		X	
6	Guide Bushing	400 Series SS	X		X	
7	Piston Ring	Inconel 718	X		X	
9	Plug Assembly	400 Series SS/17-4 PH	X		X	
13	Bonnet Gasket	Graphite/300 Series SS	X		X	
14	Seat Ring Gasket	Graphite/300 Series SS	X		X	
16	Packing Spacer	300 Series SS	X		X	
17	Packing	TFE	X		X	
19	Packing Follower	300 Series SS	X		X	
21	Bonnet Stud	A193 Gr B7	X		X	
22	Bonnet Nut	A194 Gr 2H	X		X	
31	Actuator	Aluminum & Carbon Steel	X		X	
32	Stem Connector	Ductile Iron	X		X	
33	Stem Connector Bolting	Alloy Steel	X		X	
34	Positioner, Pneumatic	KOSO PPC-805	X			
35	Limit Switches(not shown)	YAMATAKE		X		X
36	Filter Regulator	KOSO PRF-302		X		
37	Filter Regulator	KOSO PRF-308	X		X	
38	Snap Acting Relay	FAIRCHILD MODEL 24		X		
39	High Pressure Select Relay	FAIRCHILD MODEL 91		X		
40	Solenoid Valve	ASCO			X	
41	I/P Transducer	YOKOGAWA	X			
42	Actuator Fittings/Tubing	300 Series SS	X		X	

ASME B16.25 Dimensions (mm)						
Nominal Pipe Size	**Outside Diameter**		**Schedule**	**Figure 4**	**Figures 5 & 6**	**Figures 4, 5 & 6**
NPS	**A** DIA		Schd	**B** DIA ±.8	**C** DIA +.25/-0	**D** ±.8
50	62	+2.3 -.8	80, XS	49		9.7
			160	43		14.2
			XXS	38		17.3
80	91	+2.3 -.8	40, STD	78	78.25	9.7
			80, XS	74	74.50	12.7
			160	67	68.40	17.3
			XXS	58	61.20	23.6
100	117	+2.3 -.8	40, STD	102	102.70	9.7
			80, XS	97	98.25	14.2
			120	92	93.80	17.3
			160	87	89.65	20.6
			XXS	80	83.30	26.4
150	172	+4.1 -.8	40, STD	154	154.80	11.2
			80, XS	146	148.06	17.3
			120	140	142.25	22.4
			160	132	135.30	28.4
			XXS	124	128.85	33.3

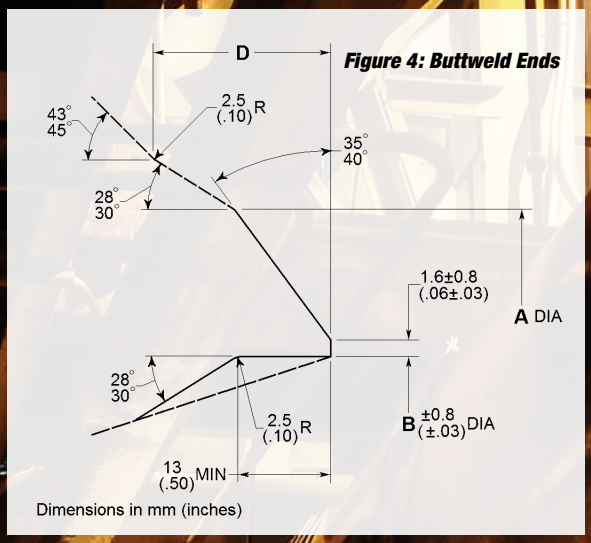


Figure 4: Buttweld Ends

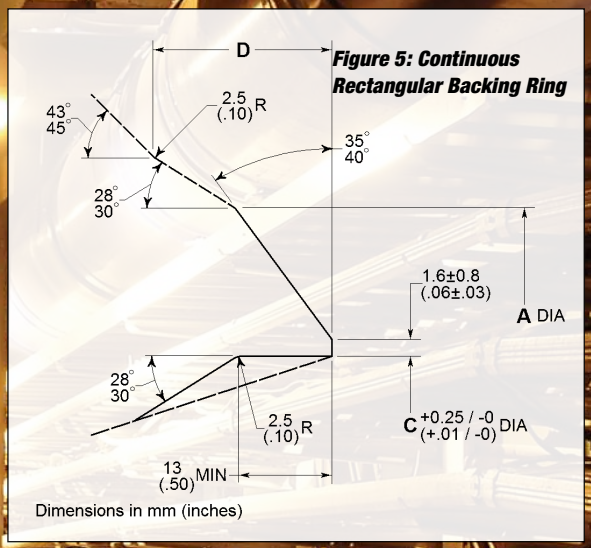


Figure 5: Continuous Rectangular Backing Ring

ASME B16.25 Dimensions (inches)						
Nominal Pipe Size	**Outside Diameter**		**Schedule**	**Figure 4**	**Figures 5 & 6**	**Figures 4, 5 & 6**
NPS	**A** DIA		Schd	**B** DIA	**C** DIA	**D**
				±.03	+.01/-0	±.03
2	2.44	+.09 -.03	80, XS	1.939		0.38
			160	1.687		0.56
			XXS	1.503		0.68
3	3.59	+.09 -.03	40, STD	3.068	3.081	0.38
			80, XS	2.900	2.934	0.50
			160	2.624	2.692	0.68
			XXS	2.300	2.409	0.93
4	4.62	+.09 -.03	40, STD	4.026	4.044	0.38
			80, XS	3.826	3.869	0.56
			120	3.624	3.692	0.68
			160	3.438	3.530	0.81
			XXS	3.152	3.279	1.04
6	6.78	+.16 -.03	40, STD	6.065	6.094	0.44
			80, XS	5.761	5.828	0.68
			120	5.501	5.600	0.88
			160	5.187	5.326	1.12
			XXS	4.897	5.072	1.31

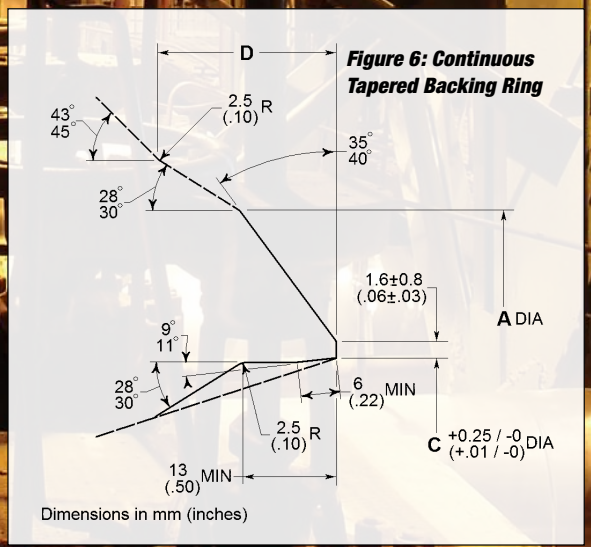


Figure 6: Continuous Tapered Backing Ring

Operation

The recirculation system controls the flow in response to the pump's requirements. This may be done by either an on-off or modulating control valve, which would normally be closed, but opens automatically if the boiler's need for water comes to an end. The water conditions at the inlet of the recirculation valve would be pressures of 170 bar to 380 bar (2500 psi to 5500 psi) and temperatures of 140 °C to 245 °C (300 °F to 500 °F). At the outlet, the water pressure will be 0.3 bar A to 10 bar (4 psi A to 150 psi) depending on where the water is dumped. The outlet temperature will range from 41 °C to 109 °C (105 °F to 240 °F). During operation, the high pressure drop will push the water through the recirculation valve releasing a lot of fluid energy. The valve trim must be able to handle the high pressure drop and flashing water, and minimize erosion, cavitation, and noise problems.

The pressure drop across the closed recirculation valve could build as high as 380 bar (5500 psi) and the valve is expected to be leak free. Even the smallest amount of leaking water and flashing steam mixture would wire cut the seating surface and in a short time the seating surfaces of the trim would be destroyed and the shutoff function of the valve would be lost. Excessive leakage of the high pressure water lowers the efficiency of the plant through direct energy loss and because full flow rate cannot be fed to the boiler. In the worst case, the wire cutting across the seating surfaces by the water

and steam mixture could cut into the pressure boundary of the valve body and the entire power plant may be shut down.

A Feedpump Recirculation valve should be able to:

1. Control the pressure letdown of the water from 380 bar (5500 psi) to near or below atmospheric pressure while preventing:
   a. trim erosion due to flashing
   b. cavitation
   c. mechanical vibration and noise
2. Remain leak tight for long periods of time
3. Open automatically to protect the pump, modulate on demand and open in case of failure of power to the valve operator

The KOSO VECTOR™ Recirculation (VR) valve has been designed to meet these stringent requirements.

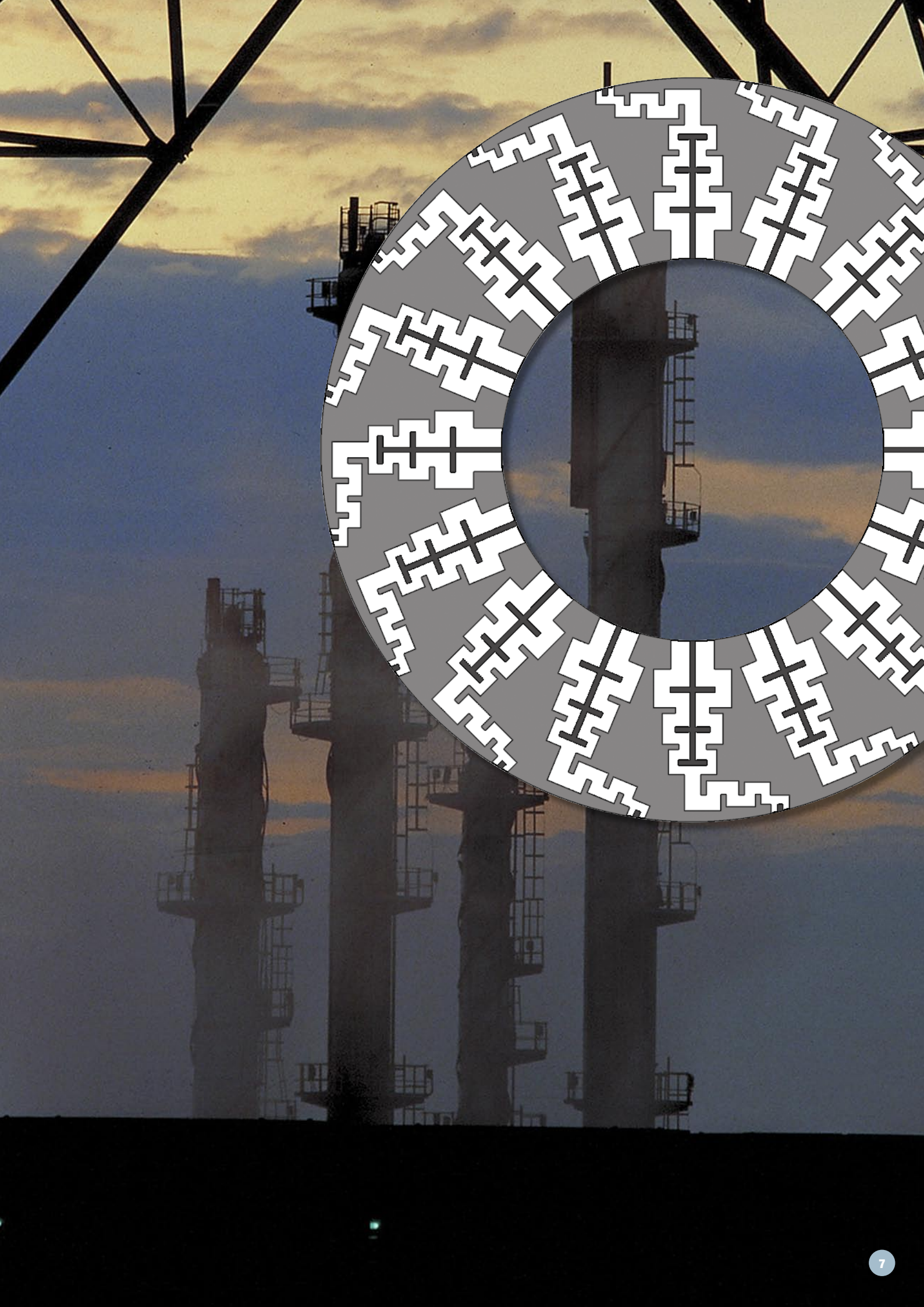
The KOSO VECTOR™ disk stack has a special, complex pattern disk specifically designed for this service. The only considerations required for selecting the valve is to determine the body type (A for angle, G for globe), the required flow coefficient, Cv, or required flow rate in gallons per minute, GPM and the maximum pressure drop in psi. Select the valve from Table 1 which meets or exceeds the required flow coefficient, Cv or flow. The dimensions for buttwelded end connections will be per ASME B16.25. Special weld ends can also be provided.

Pressurized Seat Plug

The pressurized seat plug design is a special plug that is balanced during modulation, but when shut, allows full operating pressure to assist in closing the plug on to the seat. When the valve is completely closed, the balance hole between the top and bottom of the plug is closed by the valve stem. When the valve is shut, a small leakage across the piston rings on the outside diameter of the plug lets pressure build up on top of the valve plug, creating very high seating load for improved shutoff with a metal-seated valve. This operating pressure assisted loading is in addition to the actuator loading applied to the seat. Once the stem is lifted to uncover the balancing hole, the main valve plug can be opened as easily as any other balanced plug configuration. This feature provides superior, block valve type, shutoff (MSS-SP-61).

The following information is needed to select and size the proper valve and trim:

- Piping configuration (globe or angle body type)
- Operating Conditions
  -Flow rate
  -Inlet pressure
  -Outlet pressure
  -Inlet temperature
- Design Conditions
  -Pressure
  -Temperature
  -Shutoff pressure drop
- Actuator Requirements
  -Supply power
  -Control signal



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