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Pumps ▪ Valves ▪ Service

MIL

MIL 90000 - Automatic Recirculation Control Valves

Introduction

Operation of Centrifugal pumps below their minimum flow requirements is the primary cause of premature pump failure. Recirculation systems are employed for protection of Boiler feed pumps

When the Boiler Feed water (BFW) is circulated through the Boiler Feed Pump (BFP), the heat generated during the process is transferred to the BFW and to the BFP. When the BFP operates close to the rated design values of Discharge Pressure and Flow Rate, the increase in fluid temperature is not significant. As the pump requires a minimum liquid flow through it to avoid overheating, when the downstream demand of BFW flow reduces, there is an increase in temperature. This temperature increase can be drastic when the demand drops typically below 50%. Vapour pockets can form which can lead to severe cavitation damage to the pump internals.
To ensure that this damage does not happen, Centrifugal Pumps always have a design value of Minimum Flow, which should be necessarily circulated through the pump as a minimum to avoid increase in fluid temperature to the cavitation regime. The minimum flow is decided based on the pump design and plant safety considerations and normally varies between 20% to 50% of the design flow. For pump and plant safety, this set value of minimum flow has to be circulated through the pump regardless of the downstream demand.
For ensuring this, a recirculation system is employed along with Centrifugal Pumps, bypassing the discharge line back to the deaerator. The recirculation system design will be based on the design criteria / operating philosophy of the plant.

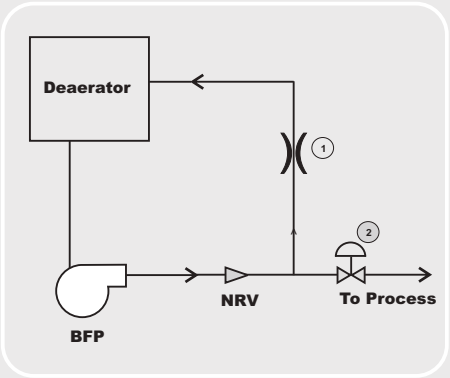
Typical systems / devices to ensure minimum flow through a Boiler Feed Pump

- Continuous Recirculation System
- Automatic Recirculation System
- On-Off Recirculation System
- Modulating Recirculation System

Automatic Recirculation Valve

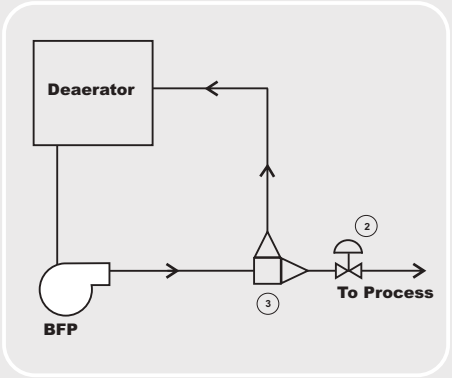
An automatic recirculation valve (ARC) is a multifunctional valve whose primary function is to ensure a pre-determined minimum flow through the centrifugal pump at all times. An ARC valve has one inlet and two outlet ports. The main discharge port connects to the process and bypass port connects back to the deaerator. When the flow is high, the main discharge port of the ARC is kept fully open and bypass port closes. When the flow reduces, the main port starts closing under gravitational pull or spring assistance. Simultaneously, the bypass port starts opening. At transient flow rates, the main port and bypass port are both partially open. When the flow falls below the set minimum flow limit, the main port closes fully and at this condition, the bypass port will be fully open. The bypass port is sized for minimum flow and thus the minimum flow required of BFP is met. ARC being a combination of NRV and RC Control Valve, does not require any external control system.

Continuous Recirculation system



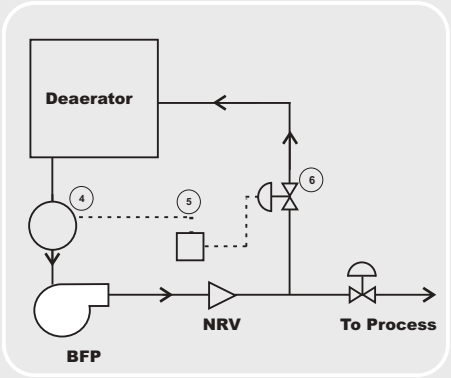
1- Fixed Pressure Reduction Device
2 - Feedwater Regulating Control Valve

Recirculation system with ARC



3 - Automatic Recirculation Valve
4 - Flow/Temp/Pressure Measurement

Recirculation system with Control Valves



5 - For ON-OFF: Flow/Temp/Pressure Switch of On/Off Controller
For Modulating: Flow/Temp/Pressure Modulating Controller
6 - BFP Min.RC Valve

Technical Information

Model Decodification

1st	2nd	3rd	4th	5th	Suffix			
9	0	-	-	-	-	-	-	-

Series	Model	Size	Pressure Class	Connection	Configuration	Bypass option	Body Material
90. Automatic Recirculation Control Valve	**1**. Single stage **2**. Double stage **3**. Multi stage	**1**. 1″ **2**. 1½″ **3**. 2″ **4**. 2½″ **5**. 3″ **6**. 4″ **7**. 5″ **8**. 6″ **9**. 8″ **A**. 10″ **B**. 12″	**1**. 150 **2**. 300 **3**. 600 **4**. 900 **5**. 1500 **6**. 2500 **A**. PN 10 **B**. PN 16 **C**. PN 25 **D**. PN 63 **E**. PN 100 **F**. PN 160 **G**. PN 250 **H**. PN 320 **J**. PN 400	**F**. Flanged **W**. Weld End	**V**. Vertical Mounting **H**. Horizontal Mounting	**S**. Standard **O**. Oversized	**C**. Carbon Steel **S**. Stainless Steel **A**. Alloy Steel **D**. Duplex Steel

Design Features

Regulatory duty

The valve performs not only On/Off function, but modulating function also. It can also work in various load conditions without loss of energy

Stable operation

Sturdy spring loaded check valve design eliminates instability during operation. Hardfaced seat surface (check valve side) ensures long service life

Rugged bypass design

The bypass port employs the globally field proven MIL 78000 series technology which is based on based on the principle of multi-step high resistance axial-flow. Pressure reduction occurs along the length of the plug through a series of throttling stages, designed to divide the total drop equally between the trim elements or steps. No individual stage is ever exposed to the full pressure differential and as a result, trim life is greatly extended. In addition, the fluid takes a tortuous path. This adds resistance and therefore velocity head loss. The valve trim is designed to reduce pressure recovery to lessen chances of vaporization at the orifice and consequently, eliminates cavitation. Because of their

relatively large flow passages and shearing action provided by the multiple stage plug & cage designs, these valves are particularly well suited for applications involving fluids with entrained particles. This is of more relevance in older power plants when pipe scales can pass through the feed water.

General Data

Flow direction	Flow To Open (Check Valve) Flow To Close (Bypass Valve)
Leakage Class	Main Check Valve: FCI 70.2 Class IV (all models) Bypass: FCI 70.2 Class IV (for 903 model)

Operating Temperature range	Up to 260°C
O-Ring Materials	
▪ EPDM	≤ 120°C
▪ FEPM	≤ 150°C
▪ Viton	≤ 190°C
▪ Kalrez / Chemrez	≤ 260°C

Installation requirements

- Standard Orientation - Vertical
- Filter mesh having mesh size 0.3 to 0.5mm should be used at pump suction side

Sizing and Selection

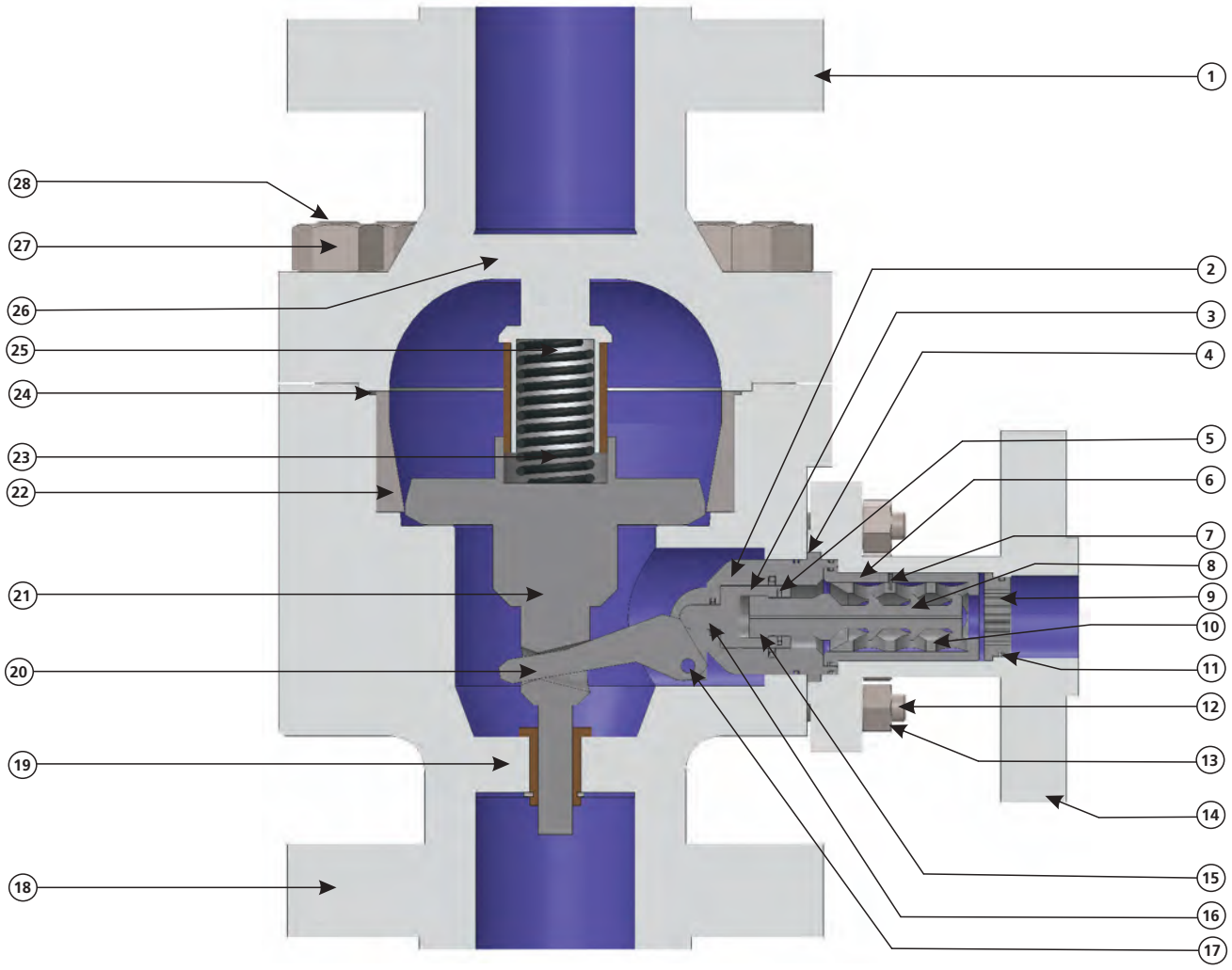
Size code	1	2	3	4	5	6	7	8	9
Valve size (inch)	1	1 ½	2	2 ½	3	4	5	6	8
Main Flow(m^3/hr)	6 - 20	9 - 47	14 - 80	20 -115	33 - 178	52 - 282	77 - 425	108 - 555	138-791
Bypass Size (inch)	1	1	1	1 ½	1 ½	2	2	2 ½	3
Max Bypass flow(m^3/hr)	16	16	16	42	42	62	62	125	175

Valve size / Rating / Approx. Weight

KSB MIL Model	Main Size (inch)	Rating	Bypass Size (inch)	Approx. Weight (kg)
90322	1.5	300	1	36
90323	1.5	600	1	36
90324	1.5	900	1	36
90325	1.5	1500	1	49
90332	2	300	1	50
90333	2	600	1	57
90334	2	900	1	59
90335	2	1500	1	59
90342	2.5	300	1 ½	60
90343	2.5	600	1 ½	87
90344	2.5	900	1 ½	88
90345	2.5	1500	1 ½	91
90352	3	300	1 ½	71
90353	3	600	1 ½	87
90354	3	900	1 ½	88
90355	3	1500	1 ½	127

KSB MIL Model	Main Size (inch)	Rating	Bypass Size (inch)	Approx. Weight (kg)
90362	4	300	2	107
90363	4	600	2	153
90364	4	900	2	155
90365	4	1500	2	205
90372	5	300	2	185
90373	5	600	2	225
90374	5	900	2	227
90375	5	1500	2	348
90382	6	300	2 ½	257
90383	6	600	2 ½	273
90384	6	900	2 ½	280
90385	6	1500	2 ½	485
90392	8	300	3	470
90393	8	600	3	555
90394	8	900	3	558
90395	8	1500	3	928

Construction



Material of Construction

Drawing ref. No.	Part name	Standard material
1	Top Flange	A 105
2	Bypass housing	AISI 420
3	Guide bush	AISI 420
4	Pin	SS316
5	Rod Seal	PTFE + Carbon / Graphite
6	Spacer tube / seat	AISI 420
7	Roll Pin	AISI 420
8	Bypass Plug	AISI 420
9	Flow Straightner	AISI 420
10	Liner	AISI 420
11, 24	O-Ring	EPDM
12	Bypass Body Stud	ASTM A193 Gr B7
13	Bypass Body Nut	ASTM A194 Gr 2H

Drawing ref. No.	Part name	Standard material
14	Bypass Body	A 105
15	Bypass Plug cap	AISI 420
16	Contact button	AISI 420
17	Pivot Pin	AISI 420
18	Main Body	A 105
19, 26	Plug Guide	SS 316
20	Bypass Connector	17-4 PH (H900)
21	Main Plug	SS 316L
22	Seat Liner	SS 304
23	Spring	SS 304
25	Spring Guide	AISI 420
27	Main Body Nut	ASTM A194 Gr 2H
28	Main Body Stud	ASTM A193 Gr B7

Technology that **makes its mark**

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