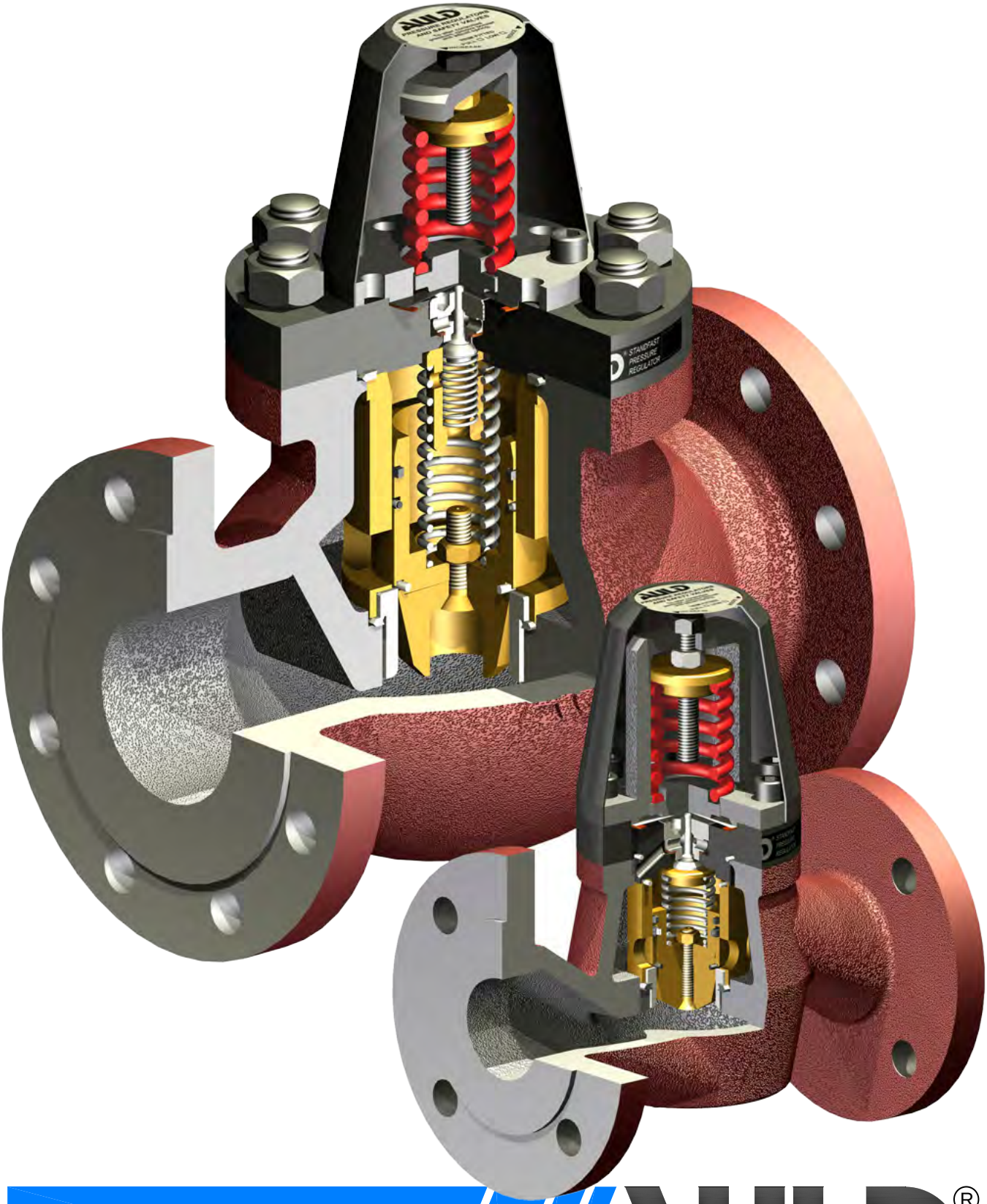
Standfast® Pressure Regulator Technical Brochure



AULD®

PRESSURE CONTROL AND SAFETY VALVES

Standfast pressure regulator

- Accurate self operated pressure control ±1% in appropriate installations.
- Cartridge design for easy maintenance.
- Control valve rangeability from dead tight to full bore.
- Suitable for steam, air, gas, water, oils etc.
- High lift main piston valve with soft face for dead tight shut off.
- Valve flow trims easily changed.
- Remote sensing option for difficult conditions.
- 14 sizes and 7 material options.
- Range of pilot controllers, pressure, temperature, flow and remote electronic and pneumatic.
- Unaffected by varying inlet pressure.

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Application

The Standfast will regulate pressure, temperature, or flow, depending on the pilot controller, over a wide range of fluids, from saturated steam at 20 bar, to cold water, oil, or compressed air at a maximum of 38 bar. The normal maximum outlet pressure is 12.5 bar but this can be extended to 25 bar. The maximum temperature is 220°C. Fluids with entrained solids or of a highly viscous nature may not be suitable. The Company should be consulted.

Design features

The Standfast accuracy comes from a pilot valve complete with an option facility for remote sensing, and the stability from placing the piston valve downstream of the main valve seat. This feature also permits the cylinder guide and piston valve to be only slightly larger than the valve seat. The resulting design is compact, with all the internals manufactured to close tolerances, held in place by the top cover, for ease of access, replacement and maintenance.

Special seals, 'O' ring and valve face, have been designed and developed, to withstand conditions from hot, like saturated steam, to cold, like water, be unaffected by chemical attack, have low coefficient of friction, and still produce "drop tight" shut off. The complete design has been thoroughly developed, and evaluated on Auld's own computer controlled test rig, for accuracy and stability, from full flow to tight shut off and in many varied onsite applications.

Principle of operation

The Standfast regulator is a self-contained valve, obtaining the necessary operating energy from the fluid flowing through it. Referring to drawings on pages 12 and 13, the fluid enters the valve in the direction of arrow and flows up through the MV seat (3) to the underside of the piston cap (6). A restricted flow passes up through the orifice hole, in the hollow screw (7) and enters the cavity above the piston body.

Under "Dead End" (no-flow) conditions, the pilot valve remains closed, resulting in equal pressure above and below the piston assembly (4-8). As the piston body area is greater than the seat bore area, a downward force, assisted by the MV spring (10) will move the piston assembly down, closing the main valve tight.

When the valve is on flow demand, the downstream pressure will tend to fall slightly. This change will alter the force balance between the PV piston (22) and PV spring (23) -i.e. lower the pressure under the diaphragm (20) thus allowing the spring (23) to push the internals down and open the pilot valve (17). Fluid then escapes from piston cavity to the low pressure main via internal ports. This escaping fluid lowers the pressure above the piston body, allowing the high pressure below the piston cap to open the main valve piston assembly sufficiently to maintain the required reduced pressure. Any increase in the reduced pressure will increase the pressure in the cavity above the piston body tending to close the main valve piston assembly, hence regulating the flow and pressure on the low pressure side of the valve.

Establishing the duty

The only correct way to apply a valve to the duty is to establish the specific details of the application. It is also useful to have a general knowledge of the system demands and plant process. The minimum requirements are as follows:

- The type of fluids, gas or liquid, steam, water etc., with either the molecular weight or specific gravity.
- Temperature and viscosity if appropriate.
- The inlet pressure with either the outlet pressure or the pressure drop across the valve.
- The maximum and minimum required flow rate and or, the pipe size.

When only a part specification is available, that is when a flow rate is not stated then it may be assumed from the typical pipeline capacities given here for the inlet pressure. This method is adequate in many cases but not foolproof. The assumed duty flow rate should be stated to the customer.

Valve size selection

The valve size selection can be made in one of three ways:

- Give the duty specification to Auld who will size by return.
- For the more common fluids, by using the various valve capacity charts supplied for air, steam and water.
- By the Cv method, convert the duty into a duty Cv and from the valve Cv table select a valve rated Cv which matches the duty Cv.

Take care to ensure that the capacity is sufficient for the minimum pressure drop which is likely to occur. Avoid over sizing the valve.

Rated Cv - BS EN 60534

Valve Bore (mm)	15	20	25	32	40	50	65	80	100	150
Full flow Cv	2.7	5.5	9.5	12.2	19	34	55	68	125	255
Low flow Cv	1.4	2.6	4.8	6.1	9.4	17	27.5	33	62.5	127
Micro trim Cv	0.7	1.3	2.4	3	4.7	8.5	13.8	16.9	31.3	63.8
Ultra low flow Cv	0.3	0.6	1.2	1.5	2.3	4.3	6.9	8.4	15.6	31.9

For larger sizes consult Auld for Cv values.

Alternative trims

The **full flow** Cv is used when the Standfast is fitted with full flow internals for maximum capacity. It this Cv or sizing table results in the bore size of the regulating valve being more than two sizes smaller than the pipe line, then select, a larger valve with **low flow** Cv. This situation is most likely to occur when sizing a PRV for liquid with a substantial pressure drop. The **low flow** Cv approximately halves the capacity.

The **low flow** Cv internals may be selected to optimise the pressure control, when fitting the regulating valve to a pipeline of the same nominal bore size. This also permits the economical selection of a smaller safety valve.

In addition to the full and low flow trims, we have two further trims, **micro trim** and **ultra low flow**, allowing even more scope in selecting the ideal trim to cater for a variety of differing systems.

Range of pilot controllers

The Standfast Pressure Regulator is shown throughout this brochure in its principal role as a pressure reducing valve. However its control function can be altered or enhanced in the following ways. For further details consult Auld.

Remote balance pipe	when greater accuracy is required for pressure reducing a balance pipe may be fitted from the valve to a point downstream as shown in the typical installation drawing.
Surplus valve	controlling the inlet upstream pressure. When the upstream pressure reaches set point the pilot valve is opened and thus pressure is reduced. When the upstream pressure falls below set point the pilot valve closes enough to regulate the fluid flowing through it. This is a modified valve and the remote balance pipe must be used and connected to the upstream pipeline.
Temperature control	for calorifiers, feed water heaters etc. can be achieved by an alternative pilot valve.
Temp/pressure control	under normal conditions the valve is operated by temperature but once the set point is reached control is taken over by the pressure unit.
Electric solenoid control	for pressure, and temperature control with "off/on" remote electrical override.
Electric proportional control	accepting a 3-15 psig or a 4-20 mA control signal from a remote external control system.

System safety

The Standfast is part of a range of safety and control valves. If the downstream system cannot safely withstand the upstream pressure then a safety valve should be fitted after the regulator in case it should fail open. If in doubt the Insurance Authority should be consulted. When a safety valve is required Auld recommend that its capacity matches the maximum capacity of the installed regulator unless the system cannot deliver that amount of fluid to the regulator.

Limiting factors

Fig No	Limiting Factors		Valve size (mm)						
			15 20 25 32	40	50	65	80	100	150
All	Maximum temperature		220°C 428°F						
All	Max outlet - Std top		12.5 bar 180 psi						
M5	Max outlet - HP top		25.0 bar 360 psi						
All	Minimum outlet		0.3 bar 5 psi						
All	Min pressure drop		See paragraph below						
All	Max inlet pressure		See below in bar only						
M1	Iron standard	Hot	13	13	13	13	13	13	13
		Cold	13	13	13	13	13	13	13
M2	Steel standard	Hot	20	20	20	20	20	20	20
		Cold	25	25	25	20	20	20	20
M3	Bronze standard	Hot	17	17	17	17	17	17	17
		Cold	25	25	25	20	20	20	17
M5	Steel HP CF	Cold	35	35	35	-	-	-	-
M6/7	Stainless Steel	Cold	35	35	35	25	25	25	25
M4	Bronze N Sea	Cold	25	25	25	20	20	20	20

Dimensions (mm)		15 20 25 32	40	50	65	80	100	150
Height C/L to top	A	165	187	187	241	241	267	330
Face to Face	B	171	190	229	292	292	356	445
C/L to bottom	C	64	79	83	95	95	127	159
Finished weight approx. (kg)		8	11	13	35	42	57	130

Adjusting spring for controlled pressure

Reduced pressure (bar g)	Spring colour
0.3 - 4.0	Black
3.5 - 9.0	Red
8.0 - 12.5	Green
12.5 - 17.0	Yellow - not in Iron yoke
17.0 - 25.0	Blue - only in HP top

Stock & flanges

Many sizes are carried in stock in standard flanges and materials both drilled and undrilled. Special flanges can be catered for quickly with our own Lloyds approved in-house foundry.

Minimum pressure drop

The Standfast needs a pressure drop across the valve to operate it. To achieve **full** capacity the pressure drop should be at least 2 bar g for valves of 32mm or smaller and 1.5 bar g for valves of 50mm or larger. A remote sensing pipe should also be fitted. At lower pressure drops the capacity will be curtailed and the advice of Auld should be sought for such applications.

Short material specification

Reference	M1	M2	M3	M4	M5	M6	M7
Short title	Iron standard	Steel standard	Bronze standard	Bronze N.Sea special	Steel HP copper free	Stainless steel wetted	Stainless steel all
Some applications	Steam, air, water & seawater and many fluids			Seawater & heavy saline	Ammonia Chemical attack HP air	NACE sour, demin water	Clean rooms & food industry
Body	Iron	Steel	Bronze	Bronze	Steel	Stainless	Stainless
Other wetted parts	Bronze steel stainless	Bronze steel stainless	Bronze steel stainless	Bronze	Stainless	Stainless	Stainless
External parts	Steel	Steel	Steel CP	Bronze	Steel	Steel	Stainless

Material and fluid selection

The three standard specifications M1, M2, & M3 will cover the majority of conditions. Auld will advise on the application of materials and the suitability of the valves for special fluids. The wetted parts are taken as those in contact with the fluid flow during normal operation. When the valve is sited in a particularly aggressive or demanding external environment then external parts are also up rated.

Spares

Routine service pack	**Item**
Includes:	
Soft face	5
Cover gasket	11
Seat gasket	12
Piston seal	13
Piston ring	14
Guide / port seal	16
PV plug	17
PV diaphragm	20
Diaphragm gasket	21

Complete repair pack	**Item**
Includes:	
Routine service pack	
Seat	3
Piston body	4
Piston cap	6
Hollow screw	7
Locknut	8
Guide tube	9
MV spring	10
MV spring cap	15
PV seat	18
PV seat sealing ring	19
PV piston	22
Decoupling spring	34

Items individually available	
Alternative flow piston cap	6
Guide tube	9
Diaphragm and gasket	20
PV spring	23

Installation

For best performance, long life, and safety it is recommended that the Standfast should be installed in a horizontal pipeline as part of a *regulating station* as shown in the diagram on page 11, complete with high and low pressure stop valves, strainer, and safety valve, sized to the maximum capacity of the Standfast.

On **Steam** duties the regulating valve needs to be kept free of condensate by installing the Standfast at a *high point* in the main and fitting adequately sized steam traps in the adjacent high and low pressure lines. Excessive flooding of the regulating valve will lead to erratic control and shortened working life.

On **Water** or similar liquid duties, the Standfast should installed at a *low point* in the main, with appropriate air vents at a *high point*. Trapped air in the regulator may cause erratic control and possible water hammer.

When a large pressure drop occurs across the Standfast on steam, air or gas duties, then the change in fluid density may require a low pressure main with a larger bore than the HP main. Under this condition it is recommended to connect the remote sensing point (29) of the pilot to the LP main at a point at least 10 pipe diameters downstream.

Commissioning

Check that the main pipeline is clear of all foreign matter. If using steam, temperature cycle several times to remove any scale or loose welding slag. It is recommended that a strainer be fitted.

First open the downstream stop valve then slowly open the high pressure stop valve allowing low pressure to build up to the desired value. There will be a slight tendency for the low pressure to overshoot as the high pressure is increased to its full value - this effect can be controlled by careful use of the high pressure stop valve.

Once the system has stabilised the desired reduced pressure may be obtained by removing the bonnet and adjusting the spring. Increased compression will increase the controlled low pressure.

Dirt causes most initial problems. Strip and clean all parts and piston cylinder. Otherwise consult problem solving guide.

Maintenance - general

For prolonged accurate operation the valve should be stripped, cleaned and examined at yearly internals and any worn or damaged parts replaced. Spare parts may be ordered individually or as routine service packs and complete repair packs. All sub-assemblies are designed for direct installation with no fitting required for quick in-line service.

Maintenance - main valve

Dismantling the Standfast is a simple procedure. First make sure that all the pressure has been released from the system then remove the cover (2) from the chest (1). The guide (9), seat (3), piston assembly (4-8), MV spring (10) and spring cap (15) can now be lifted out, examined, cleaned and where necessary replaced.

Ensure that the chest is free from any dirt or pipe debris and then re-assembly is a simple reversal of the above. Pull down the cover evenly with nuts (32) or bolts (33) until face to face with chest flange. We recommend that all gaskets, seals, piston rings and face (11,12,13,14,16 & 5) are renewed at the annual inspection.

Maintenance - piston valve assembly

Carefully remove piston ring (14) if fitted from top groove. Clean and replace if worn. Remove piston seal (13), clean groove, taking care not to damage bottom or sides and check that there are no sharp edges. Warm new seal to 25/30°C and gently stretch over piston body and into bottom groove. Insert piston assembly into guide tube and after allowing ring to return to size, check interference between seal and guide (between 0.254/0.31mm). Piston assembly should move smoothly and easily in guide.

To renew soft face (5) remove locknut (8) and hollow screw (7), prise out face and check there are no sharp edges on body (4) and cap (6). Clean groove and insert new soft face. Check that the orifice hole in the hollow screw is clear and free from obstructions and then assemble cap on piston body. Re-tighten locknut (8) and replace assembly in guide.

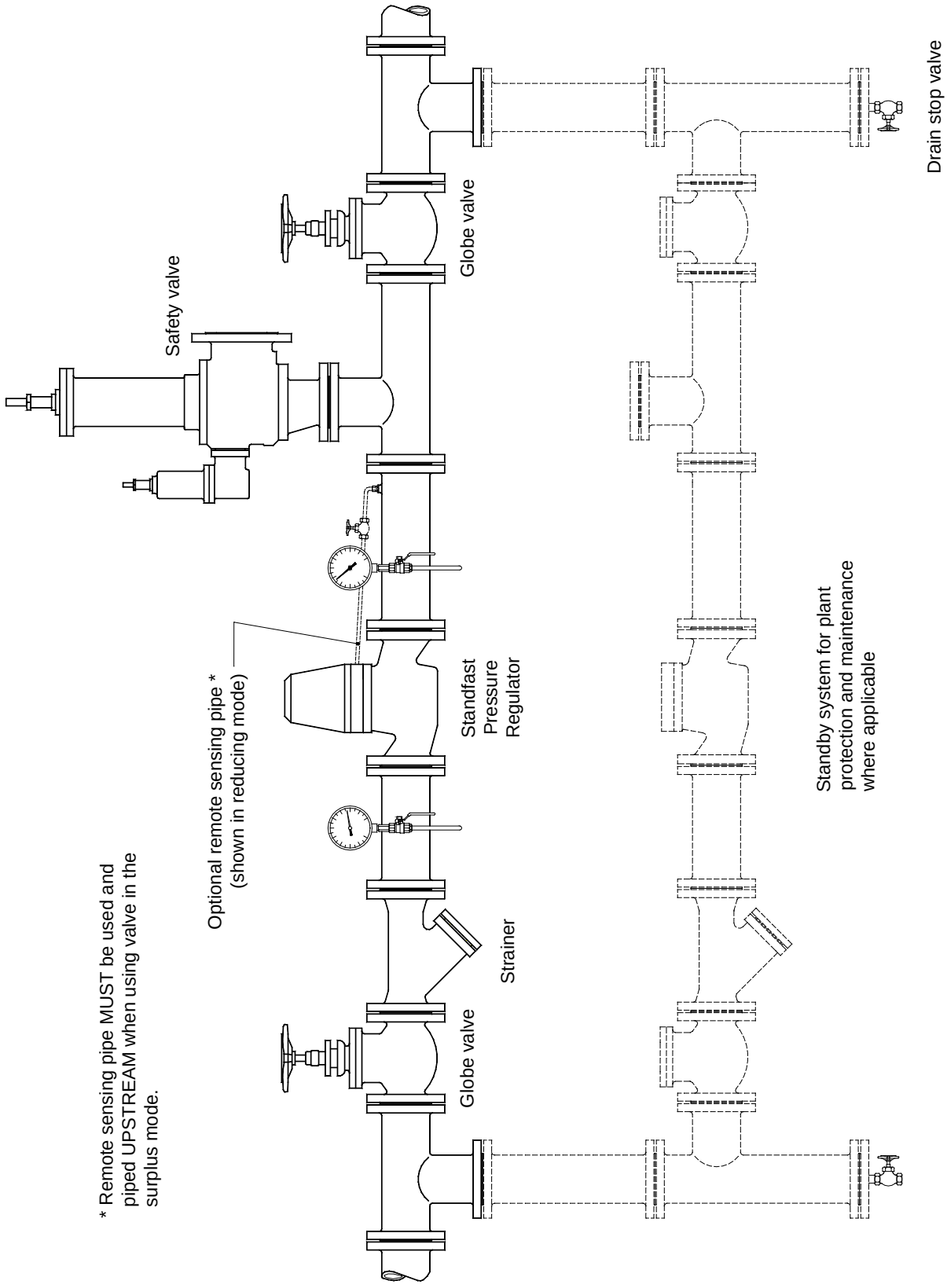
Maintenance - pilot valve

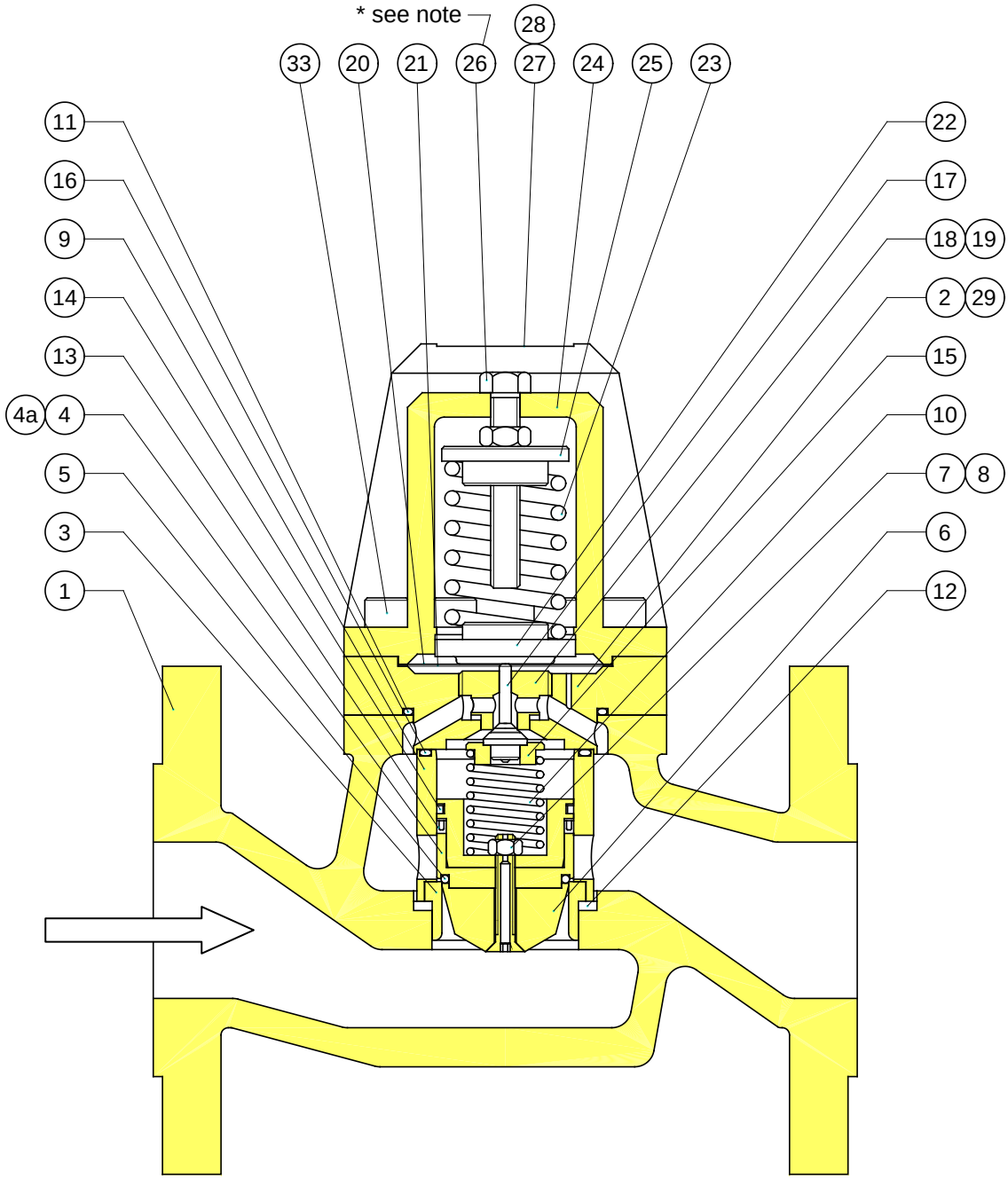
Remove bonnet (27) and relax PV spring (23). Remove cover (2) from chest (1). On 65mm valves and above remove yoke bolts and lift yoke (24) clear. Remove PV plug (17) from MV spring cap (15). Remove diaphragm (20) break out PV seat (18) by unscrewing anti-clockwise with special tool and remove seat sealing ring (19). Check seat and plug for signs of wear and replace if necessary. Also check diaphragm for cracks or signs of hardening.

Place sealing ring (19) over seat spigot and screw firmly into cover (2) using some "Loctite A650" on thread. Place new diaphragm gasket (21) in recess and insert a straight edge across it. Insert PV plug (17) through guide in seat and check that the gap between plug and straight edge is 0.381mm/0.457mm.

Place PV plug in MV spring cap (15) and carefully lower cover over plug - making sure PV plug comes up through guide hole. On 15mm - 50mm valves hold cover on chest flange and place diaphragm (20) on gasket (21). Place PV piston (22). PV spring (23) and spring cap (25) on top of diaphragm and lower yoke over spring. Insert yoke bolts (33) and tighten. On 65mm valves and above tighten cover with cover nuts (32) then repeat above procedure for assembling of yoke.

Regulating station

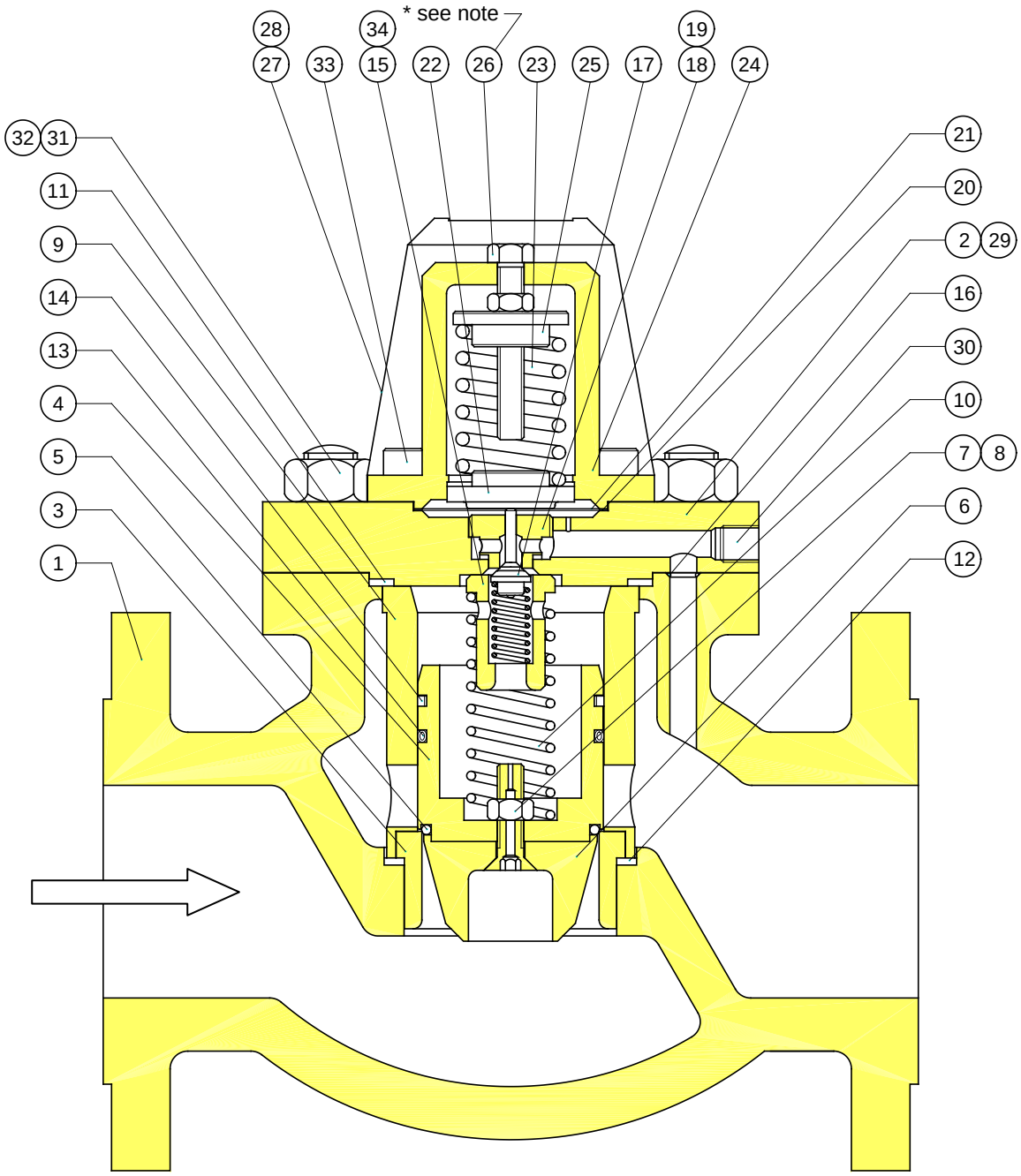




Standfast pressure regulator - up to 50mm

1	Chest	11	Cover seal	22	PV piston
2	Cover	12	Seat gasket	23	PV spring
3	Seat	13	Piston seal	24	Yoke
4	Piston body	14	Piston ring	25	PV spring cap
4a	Piston insert	15	MV spring cap (40 - 50mm only)	26	Adjusting screw
5	Soft face	16	Guide tube seal	27	Bonnet
6	Piston cap	17	PV plug	28	Locking screw
7	Hollow screw	18	PV seat	29	Remote plug
8	Locknut	19	Seat sealing ring	33	Yoke bolt
9	Guide tube	20	Diaphragm		
10	MV spring	21	Diaphragm gasket		

** Adjust the nut on top of spring cap – not the adjusting screw head.*



Standfast pressure regulator - 65mm and above

1	Chest	12	Seat gasket	24	Yoke
2	Cover	13	Piston seal	25	PV spring cap
3	Seat	14	Piston ring	26	Adjusting screw
4	Piston body	15	MV spring cap	27	Bonnet
5	Soft face	16	Guide tube seal	28	Locking screw
6	Piston cap	17	PV plug	29	Remote plug
7	Hollow screw	18	PV seat	30	Blanking plug
8	Locknut	19	Seat sealing ring	31	Cover stud
9	Guide tube	20	Diaphragm	32	Cover nut
10	MV spring	21	Diaphragm gasket	33	Yoke bolt
11	Cover gasket	22	PV piston	34	Decoupling spring

** Adjust the nut on top of spring cap – not the adjusting screw head.*

Saturated steam capacity - full flow (kg/h)

Pressure (bar g)		Valve Size (mm)									
In	Out	15	20	25	32	40	50	65	80	100	150
2.0	0.6	74	152	263	337	526	941	1523	1883	3461	7061
2.5	1.0	86	176	305	391	610	1091	1766	2183	4013	8188
	0.5	93	190	329	422	658	1178	1906	2357	4333	8840
3.0	1.5	97	198	342	439	685	1225	1983	2451	4506	9194
	1.0	100	203	352	452	704	1260	2038	2520	4632	9451
	0.5	111	227	393	505	787	1408	2279	2817	5179	10566
4.0	2.5	116	236	408	524	817	1462	2365	2924	5376	10968
	2.0	122	250	432	555	864	1547	2502	3094	5688	11604
	1.5*	125	254	440	565	880	1575	2548	3150	5791	11814
5.0	3.5	132	270	466	598	932	1669	2700	3338	6136	12519
	3.0	142	290	502	645	1004	1798	2908	3596	6611	13486
	2.5	148	301	521	669	1042	1866	3018	3732	6860	13995
	2.0*	150	305	528	678	1056	1890	3057	3780	6949	14176
6.0	4.5	147	300	518	665	1036	1854	3000	3709	6818	13910
	4.0	160	327	564	725	1129	2022	3271	4044	7434	15165
	3.5	168	344	594	763	1188	2127	3440	4254	7819	15952
	3.0	173	353	610	783	1220	2183	3532	4367	8027	16376
	2.5*	175	356	616	791	1232	2205	3567	4410	8107	16539
7.0	5.5	160	327	565	726	1131	2024	3274	4048	7442	15182
	5.0	176	360	621	798	1243	2225	3600	4451	8182	16692
	4.0	194	396	685	789	1370	2451	3966	4903	9013	18388
	3.0*	200	407	704	904	1408	2520	4077	5040	9265	18902
8.5	7.0	179	364	630	809	1260	2256	3649	4512	8294	16920
	6.0	213	433	749	962	1499	2682	4339	5365	9863	20121
	5.0	230	469	811	1041	1622	2902	4695	5805	10671	21770
	4.0	236	482	833	1070	1667	2983	4826	5966	10968	22375
	3.5*	243	496	857	1101	1715	3070	4967	6141	11289	23029

* Outlet pressures below this value have the same capacity.

Saturated steam capacity - full flow (kg/h)

Pressure (bar g)		Valve Size (mm)									
In	Out	15	20	25	32	40	50	65	80	100	150
10	8.5	195	299	689	885	1378	2466	3990	4933	9068	18500
	7.5	235	480	830	1066	1660	2971	4806	5942	10923	22283
	6.5	259	527	911	1170	1823	3263	5278	6526	11996	24473
	5.5	271	552	953	1224	1907	3413	5522	6827	12550	25602
	4.5*	275	560	968	1243	1936	3465	5605	6930	12740	25990
14	12.5	234	478	826	1061	1652	2957	4784	5915	10874	22183
	11.5	288	588	1015	1304	2031	3635	5881	7271	13366	27267
	10.5	324	660	1141	1466	2283	4085	6609	8171	15020	30642
	9.5	348	709	1225	1574	2451	4387	7097	8774	16130	32906
	8.5	363	740	1279	1643	2559	4579	7408	9159	16836	34346
	7.5	371	757	1308	1680	2617	4683	7576	9367	17220	35128
	6.5*	375	764	1320	1695	2640	4725	7644	9451	17373	35442
17	15.5	260	530	916	1176	1832	3278	5303	6557	12054	24591
	13.0	383	780	1348	1731	2697	4826	7808	9653	17745	36200
	11.5	419	855	1477	1897	2955	5288	8555	10577	19444	39665
	10.0	440	897	1550	1990	3100	5547	8974	11095	20396	41609
	8.5*	448	914	1579	2028	3158	5652	9143	11304	20779	42390
20	18.5	283	577	997	1281	1995	3571	5777	7142	13130	26785
	17.5	353	720	1245	1599	2490	4456	7208	8912	16383	33421
	16.5	404	823	1422	1826	2844	5089	8233	10179	18713	38174
	15.0	457	931	1608	2065	3216	5756	9311	11512	21162	43170
	13.5	491	1001	1729	2220	3458	6189	10012	12378	22755	46420
	10.0	523	1067	1843	2366	3686	6596	10670	13192	24250	49470
	9.0*	537	1095	1892	2429	3784	6771	10953	13543	24895	50786

* Outlet pressures below this value have the same capacity.

Other products

Auld have a range of products complementary to the Standfast, all conforming to the requirements of the European Pressure Equipment Directive. A range catalogue is available from the company.

Briefly the products are:

- DA series safety valve
- Vigilant safety valve
- SuperVigilant safety valve
- A100 control valve
- A100 desuperheater valve

Further information is freely available for download on our web site at www.auldvalves.com

Saturated steam pipe capacities (kg/h)

Working Pressure (bar g)	Pipe Size - mm									
	15	20	25	32	40	50	65	80	100	150
0.3	8	17	35	55	89	174	273	392	814	1884
0.6	10	21	43	67	109	215	335	483	1002	2317
1.3	13	30	60	93	151	298	466	671	1391	3220
2.0	16	37	75	117	191	377	588	846	1756	4064
3.3	24	53	107	167	271	536	837	1205	2499	5784
5.0	32	71	145	226	367	724	1132	1630	3381	7823
6.0	37	84	170	265	429	848	1325	1908	3957	9156
6.6	40	90	183	286	464	916	1431	2061	4274	9891
8.0	47	105	213	333	589	1066	1665	2397	4972	11506
10.0	57	128	259	405	635	1294	2022	2912	6039	13976
12.0	67	150	305	477	772	1526	2384	3433	7120	16478
13.3	73	165	334	523	846	1671	2612	3762	7802	18055
14.6	80	180	366	572	926	1829	2858	4115	8535	19751
16.6	89	201	409	639	1035	2044	3194	4599	9539	22074
20.0	106	239	485	758	1229	2427	3792	5460	11325	26209

Steam Velocity (m/s)	21.3	21.3	24.4	24.4	27.4	30.5	30.5	30.5	30.5	36.6

British Standard sizing

The steam and air capacity tables have been calculated using the 'full bore' Cv shown for the Standfast on page 5 of this brochure and the formula given for capacity in:
BS EN 60534-2-2:1993. **Sizing equations for compressible fluid flow under installed conditions**.

The water capacities have been calculated using the 'low flow' Cv and the formula in:
BS EN 60534-2-1:1993. **Sizing equations for incompressible fluid flow under installed conditions**.

Both these Standards may be used with any appropriate fluid to calculate the duty Cv and then to match the duty Cv with the Standfast rated Cv.

Air pipe capacities (normal m^3/min)

Working Pressure (bar g)	Pipe Size (mm)									
	15	20	25	32	40	50	65	80	100	150
0.3	0.31	0.68	1.19	1.89	2.69	4.76	7.4	10.7	19.1	42.9
0.6	0.37	0.85	1.5	2.35	3.37	6.00	9.3	13.5	23.9	53.9
1.3	0.54	1.19	2.12	3.28	4.76	8.44	13.1	18.9	33.7	73.8
2.0	0.68	1.53	2.72	4.25	6.12	10.87	16.9	24.4	43.4	97.8
3.3	1.19	2.21	3.94	6.17	8.86	15.77	24.6	35.4	63.0	141.8
5.0	1.36	3.09	5.47	8.52	12.29	21.86	34.1	49.1	57.3	196.6
6.0	1.59	3.60	6.37	9.98	14.36	25.51	39.9	57.4	102.1	229.7
6.6	1.78	3.94	6.99	10.93	15.72	27.95	43.6	62.8	111.8	251.6
8.0	2.04	4.62	8.21	12.83	18.49	32.85	51.3	73.9	131.3	295.6
10.0	2.52	5.64	9.77	15.69	22.60	40.15	62.7	90.3	160.5	361.3
12.0	2.97	6.68	11.86	18.55	26.70	47.46	74.1	106.7	189.7	427.0
13.3	3.28	7.36	13.11	20.47	29.48	52.41	81.9	117.9	209.7	471.8
14.6	3.57	8.07	14.33	22.37	32.22	57.28	89.5	128.9	229.1	515.5
16.6	4.05	9.09	16.14	25.23	36.33	64.62	100.9	145.4	258.5	581.5
20.0	4.81	10.82	19.23	30.02	43.24	76.88	120.1	172.9	307.5	681.9

Air capacity - full flow (normal m^3/min)

Pressure (bar g)		Valve Size (mm)									
In	Out	15	20	25	32	40	50	65	80	100	150
2.0	0.6	1	3	5	7	11	20	32	40	74	151
2.5	1.0	1	3	6	8	13	23	37	46	85	174
	0.5	1	3	6	8	13	24	38	48	88	180
3.0	1.5	2	4	7	9	14	25	41	51	95	194
	1.0	2	4	7	9	15	27	44	54	100	204
	0.5	2	4	7	10	15	28	46	56	104	213
4.0	2.5	2	4	8	10	17	30	49	61	112	229
	2.0	2	5	9	11	18	32	53	65	120	246
	1.5*	2	5	9	12	19	34	55	68	125	255
5.0	3.5	2	5	9	12	19	34	56	69	127	260
	3.0	3	6	10	13	21	37	61	75	139	283
	2.5	3	6	11	14	22	39	64	79	146	298
	2.0*	3	6	11	14	22	40	66	81	150	306
6.0	4.5	3	6	10	13	21	38	62	76	141	287
	4.0	3	6	11	15	23	42	68	84	155	316
	3.5	3	7	12	16	25	44	72	89	165	336
	3.0	3	7	13	16	26	46	75	93	171	349
	2.5*	3	7	13	17	26	47	77	95	175	357
7.0	5.5	3	6	11	14	23	41	67	83	153	313
	5.0	3	7	12	16	25	46	74	92	170	347
	4.0	4	8	14	18	29	51	83	103	190	389
	3.0*	4	8	15	19	30	54	88	108	200	408
8.5	7.0	3	7	12	16	25	46	75	92	170	347
	6.0	4	9	15	20	31	55	90	111	205	419
	5.0	4	9	17	22	34	61	99	122	225	460
	4.0	5	10	17	23	35	64	103	128	236	482
	3.5*	5	10	18	23	36	64	105	129	238	487

* Outlet pressures below this value have the same capacity.

Air capacity - full flow (normal m^3/min)

Pressure (bar g)		Valve Size (mm)									
In	Out	15	20	25	32	40	50	65	80	100	150
10	8.5	4	8	14	18	28	50	81	101	185	379
	7.5	4	9	17	22	34	61	99	123	226	461
	6.5	5	11	19	24	38	68	110	136	251	513
	5.5	5	11	20	26	40	72	117	145	267	545
	4.5*	5	12	20	26	41	74	121	149	275	561
14	12.5	4	9	16	21	33	60	97	120	222	452
	11.5	5	12	20	26	41	74	120	149	274	560
	10.5	6	13	23	30	47	84	137	169	311	635
	9.5	7	14	25	32	51	91	148	183	337	688
	8.5	7	15	27	34	54	96	156	193	356	726
	7.5	7	16	27	35	55	100	162	200	368	751
	6.5*	8	16	28	36	57	102	165	204	375	765
17	15.5	5	10	18	23	37	66	108	133	245	501
	13.0	7	16	27	35	55	99	161	199	367	749
	11.5	8	17	30	39	61	110	179	221	407	831
	10.0	9	19	32	42	65	117	190	235	432	883
	8.5*	9	19	34	43	68	121	196	243	447	913
20	18.5	5	11	20	26	40	72	117	145	267	545
	17.5	7	14	25	32	50	91	147	182	335	683
	16.5	8	16	29	37	58	104	169	209	384	785
	15.0	9	19	33	42	66	119	193	238	439	896
	13.5	10	20	36	46	72	129	209	259	477	973
	10.0	11	23	39	51	79	142	230	284	522	1066
	9.0*	11	23	40	51	80	143	232	287	527	1076
25	23.5	6	13	22	29	45					
	21.0	9	20	35	45	70					
	19.0	11	23	40	52	81					
	16.0	13	26	46	59	92					
	13.0	13	28	48	62	97					
	10*	14	28	49	63	99					

* Outlet pressures below this value have the same capacity.

Water capacity - low flow (m^3/h)

The water capacities given here are based on using the low flow trim. In certain applications the full bore trim can be applied after consultation with the company.

The pressure difference between inlet and outlet should be calculated as minimum and maximum and the appropriate capacities read off the table below.

When the flow rate is not known a typical flow can be assumed from the pipeline capacity table below. The assumed capacity must be stated to the customer.

Pressure Drop (bar)	Valve Size (mm)									
	15	20	25	32	40	50	65	80	100	150
1.3	1.4	2.8	5.0	6.3	9.5	17.0	28.0	35.0	63.5	129.5
2.0	1.6	3.5	6.0	7.6	11.7	21.3	34.0	42.0	77.7	158.8
3.0	2.2	4.0	7.4	9.3	14.5	26.0	42.0	51.8	95.2	194.2
4.0	2.5	5.0	8.5	11.0	16.6	30.0	48.3	59.7	110.0	224.2
5.0	2.7	5.5	9.3	12.0	18.8	33.5	54.0	66.8	123.0	251.0
6.0	3.0	6.0	10.4	13.0	20.5	36.5	59.0	73.0	135.0	275.0
7.0	3.3	6.3	11.2	14.2	22.0	39.6	64.0	79.0	145.0	296.8
8.0	3.3	6.8	11.7	15.3	23.7	42.3	68.5	84.6	155.5	317.0

Water pipe capacities - (m^3/h)

Bore(mm)	15	20	25	32	40	50	65	80	100	150
Capacity	0.835	1.88	3.34	5.21	7.50	13.3	24.3	35.0	71.18	180.2
Water Velocity (m/s)	1.8	1.8	1.8	1.8	1.8	1.8	2.1	2.1	2.4	2.7

Useful conversions

Multiply	By	To obtain
Pa (N/m^2)	0.00001	bar
kgf/cm	20.9807	bar
lb/in	20.069	bar
atm	1.013	bar
inH_2O	0.0025	bar
ftH_2O	0.03	bar
mH_2O	0.098	bar
mmHg	0.0013	bar
in Hg	0.0339	bar
lb/s	1633	kg/h
lb/min	27.216	kg/h
lb/h	0.4536	kg/h
UK ton/h	1016	kg/h
t/h	1000	kg/h
l/s	3.6	m^3/h
l/min	0.06	m^3/h
l/h	0.001	m^3/h
UK gal/s	16.364	m^3/h
UK gal/min	0.2728	m^3/h
UK gal/h	0.004546	m^3/h
US gal/min	0.2271	m^3/h
ft^3/min	1.699	m^3/h
ft^3/h	0.0283	m^3/h
To obtain	**By**	**Divide**

Fault finding

Problem	Possible cause	Action
Leakage from under bonnet. (see action sheet 7).	Broken diaphragm.	Replace diaphragm and joint.
Regulated pressure not maintained as flow varies, safety valve blows when flow stops. (see action sheet 2).	Excessive solid deposits from steam.	Clean out and re-assemble. Check condensate and modify water treatment.
	Torn or scored piston seal.	Replace and check fit.
	Scored guide tube.	If lightly scored smooth down with fine emery cloth or scotchbrite.
	Damaged soft face.	Replace and check main valve seat for signs of wear.
	Relay port between diaphragm chamber and valve outlet blocked.	Clear blockage.
Regulated pressure not maintained when flow reaches maximum but is OK at low & no flow conditions. (see action sheet 6).	Regulator undersized.	Replace with larger valve or consider fitting another regulator in parallel. (Assuming pipework is suitable for larger capacities).
	Pressure drop across regulator too small.	No remedy - unless inlet or regulated pressure can be adjusted to give an increased drop.
	Downstream pipework and fittings undersized.	Try fitting remote sensing pipe at least 10 pipe diameters downstream.
	Upstream pressure not being maintained.	No remedy - this is a basic system fault.
Regulated pressure correct on full flow conditions but erratic on small flows. (see action sheet 5).	Regulator oversized.	Fit smaller regulator. If full flow internals fitted - change to low flow. Check main and pilot valves for erosion.
Regulated pressure builds up on no flow conditions. (see action sheet 2).	Main valve seat wire drawn.	Machine or replace.
	Inlet steam leaking past pilot valve seat.	Tighten down pilot valve seat. Renew sealing ring if necessary
	Condensate accumulating in the regulator.	Fit steam traps.
Violent regulated pressure fluctuations under all flows. (see action sheet 5).	Inlet pipe and or strainer and fittings undersized.	If badly undersized replace pipework and fittings.
	Inlet flange joint restricting flow to the regulator.	Rectify joint.
	Regulator oversized.	Fit smaller regulator or replace piston with lower flow internals.
	Relay port from valve outlet to pilot valve diaphragm chamber partially blocked.	Clear blockage. Replace 'O' ring if necessary.

Problem	Possible cause	Action
Regulated pressure erratic under all conditions.	Main valve spring weak or broken.	Replace spring.
	Condensate accumulating in the valve.	Fit steam traps to inlet and outlet pipes. Make sure valve is mounted at a high point in the system.
Regulated pressure oscillates slowly.	Relay port from valve outlet to pilot valve diaphragm chamber partially blocked	Clear blockage. Replace 'O' ring if necessary.
Regulated pressure oscillates for a short period when starting up after a system shutdown.	Condensate accumulating in the valve.	Fit steam traps to inlet and outlet pipes. Make sure valve is mounted at a high point in the system.
Relief valve subject to periodic discharge without apparent change in operation. (see action sheet 3).	Condensate accumulating in the valve.	Fit steam traps to inlet and outlet pipes. Make sure valve is mounted at a high point in the system.
A regulated pressure not obtainable (regulator will not open when adjusted). (see action sheet 9).	Relay port from valve outlet to pilot valve diaphragm chamber blocked.	Clear blockage.
	Main piston stuck in the closed position.	Check and service as necessary.
Full inlet pressure measured at regulator outlet (valve stuck open). (see action sheet 1).	Orifice hole in hollow screw blocked.	Clean out and re-assemble. Check inlet strainer and clean if necessary
Water or steam leaking through joints.	Joints not properly tightened.	Adjust or renew as required.
	Condensate accumulating in the valve.	Fit steam traps to inlet and outlet pipes. Make sure valve is mounted at a high point in the system.
Joints decomposing.	Maximum recommended working temperature of the regulator exceeded.	Replace with appropriate type of regulator.

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