FILE NO.:	62.16
DATE:	SEPTEMBER 1, 1995
SUPERSEDES	5060.15
DATE	APRIL 24, 1990

ARMSTRONG

product bulletin

Booster Technical Bulletin

INTRODUCTION - BASIC PUMP CONTROL

Pump Sequencing

In a standard booster system one pump (lead pump), operating alone, handles the low demand requirements. When the system demand increases and exceeds the capacity of the lead pump, the second pump (lag pump) starts up automatically to share the load. In a three pump system the third pump is brought on in the same way when system demand exceeds the combined capacity of the two lead pumps. A similar sequence of events takes place in reverse on decreasing demand.

One of the most important aspects of booster system design is the provision of a reliable method of sequencing the pumps on and off, to match the varying system demand.

Armstrong's standard method uses current relays which sense the motor load current. As flow through the pump increases, so does the motor current, and the relay is set to operate at an ampere value corresponding to the design capacity of the pump.

Having tried all of the sequencing arrangements at one time or another, we recommend the current relay method.
Our reasons are as follows:

a) The relay is comparatively inexpensive, reliable, and easy to calibrate.
b) No hydraulic connections are required, which means that the relay can be located inside the control panel. This is an important point, since we have found that people are less likely to tamper with an internal electrical device than they are with an external pressure switch.
c) Operation of the relay is entirely independent of the shape of the pump curve.
d) The electronic relay includes an adjustable "on delay" to prevent unnecessary operation on momentary surges.

The relay provides inherent motor protection during abnormal voltage conditions. An example of this is the "brown-out" situation where voltage at the generating station is reduced during periods of excessive electrical demand. When voltage variations occur, the current at any particular motor load is increased, as shown by the dotted line in figure 1. The relay, however, will still operate at the same amp setting, which prevents the amp increase being applied to the motor. As far as the system is concerned, all that happens is that sequencing takes place at a lower flow.

Intermittent Systems

a) Certain establishments such as schools and offices require little or no water for long periods of time, and it is often economical to operate the booster system on an intermittent basis. An electrical time clock can be programmed to operate the system continuously when the building is occupied, switching over to intermittent operation at night and on weekends, with an overriding low system pressure switch. A "drawdown" tank must be installed, preferably on the top floor.

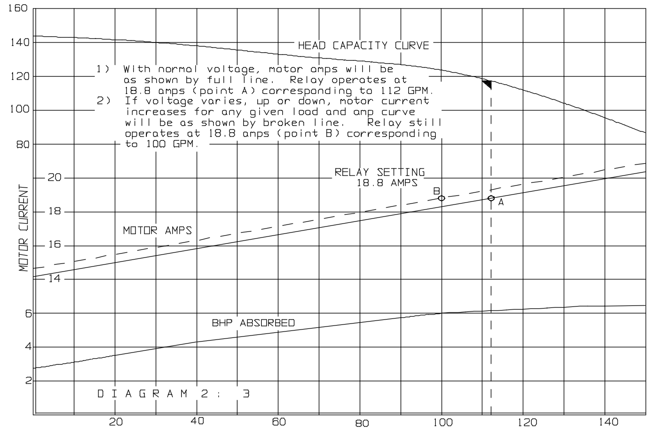


Figure 1. CURRENT SENSING DIAGRAM

Automatic No-Flow Shut-down

When the demand for water decreases to zero, water in the discharge line stops moving. The water soon heats up in the pump casing. An Aquastat (replacing thermal bleed circuit) senses the water temperature and turns off the system, turning on a red indicating light on the panel. The system will remain off until a demand on the system causes the pressure to drop. When the preset pressure is reached a pressure switch connected to the discharge header re-energizes the lead pump. A "drawdown" tank must be installed, preferably on the top floor.

Tank Sizing

Drawdown tanks should be sized to maintain system pressure during periods of pump shutdown. When sizing tank ensure tank pressure rating will withstand the maximum pressure at the tank location. The volume of water stored should be enough to handle very small water requirements and leak loads only. Experience has shown that a realistic tank storage volume is 15 -30 gallons. (See tank sizing example and table below) Remote mounting of tank on top floor or roof of high rise buildings allows for a larger storage of water and lower pressure rated tanks due to the lower tank pre-charge required.

TANK SIZING TABLE

(ACCEPTANCE VALUES)

		Tank Pressure when Pump Stops																				
	psig	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125
TANK PRESSURE WHEN PUMP STARTS	20	0.126	0.224	0.302	0.366	0.419	0.464	0.502	0.535	0.565	0.590	0.613	0.634	0.652								
	25		0.112	0.201	0.274	0.335	0.386	0.430	0.469	0.502	0.531	0.557	0.581	0.602								
	30			0.101	0.183	0.251	0.309	0.359	0.402	0.439	0.472	0.502	0.528	0.552	0.573	0.593						
	35				0.091	0.168	0.232	0.287	0.335	0.376	0.413	0.446	0.475	0.502	0.525	0.547	0.567	0.585	0.601			
	40					0.084	0.155	0.215	0.268	0.314	0.354	0.390	0.422	0.451	0.478	0.501	0.523	0.543	0.561	0.578	0.594	0.608
	45						0.077	0.143	0.201	0.251	0.295	0.334	0.370	0.401	0.430	0.456	0.480	0.501	0.521	0.540	0.557	0.573
	50							0.072	0.134	0.188	0.236	0.279	0.317	0.351	0.382	0.410	0.436	0.459	0.481	0.501	0.520	0.537
	55								0.067	0.125	0.177	0.223	0.264	0.301	0.334	0.365	0.392	0.418	0.441	0.463	0.483	0.501
	60									0.063	0.118	0.167	0.211	0.251	0.287	0.319	0.349	0.376	0.401	0.424	0.445	0.465
	65										0.059	0.111	0.158	0.201	0.239	0.273	0.305	0.334	0.361	0.386	0.408	0.429
	70											0.056	0.106	0.150	0.191	0.228	0.262	0.292	0.321	0.347	0.371	0.394
	75												0.053	0.100	0.143	0.182	0.218	0.251	0.281	0.308	0.334	0.358
	80													0.050	0.096	0.137	0.174	0.209	0.241	0.270	0.297	0.322
	85														0.048	0.091	0.131	0.167	0.200	0.231	0.260	0.286
	90															0.046	0.087	0.125	0.160	0.193	0.223	0.251
	95																0.044	0.084	0.120	0.154	0.186	0.215
	100																	0.042	0.080	0.116	0.148	0.179

Tank Storage Volume = Tank Acceptance X Total Tank VolumeExample: Required Tank Storage Volume (20 Gal.), Minimum Tank Pressure (Pump Start Pressure = 50 PSI), Max. Tank Pressure (Pump Stop Pressure = 65 PSI) From table the tank acceptance = 0.188. Calculate storage for different tank sizes available. Using tank of 106 Gallons. Tank Storage Volume = 0.188 X 106 Gal. = 19.93 Gal.

INTRODUCTION - BASIC BOOSTER SYSTEMS

Piping Arrangement

Armstrong standard booster systems incorporate two or three vertical in-line pumps or close-couples end suction pumps, arranged for parallel operation. Isolating valves are provided on the suction and discharge sides of each individual pump to permit isolation for servicing. Each discharge line is also fitted with a combination pressure reducing and check valve which provides constant system pressure regardless of variations in supply pressure, or with a non-slam check valve.

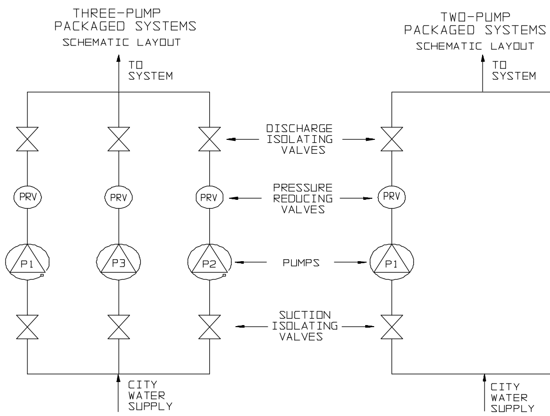
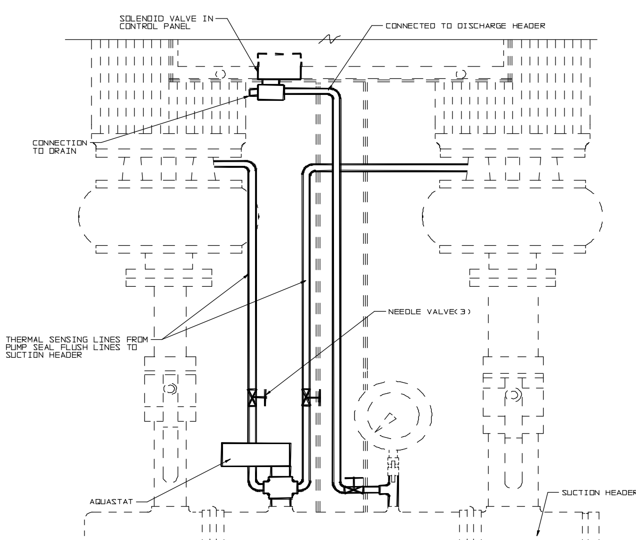


Figure 2. BOOSTER PIPING ARRANGEMENTS

Thermal Bleed Circuit

During periods of low demand the pumps are operating at, or near, shut-off and there is a tendency for the pump to overheat. To prevent this, packaged systems incorporate a thermal bleed circuit (PIPING ARRANGEMENT Figure 3). A small quantity of water from each pump seal chamber is circulated past the bulb on an Aquastat and back to the suction header. Rising water temperature is sensed by an Aquastat which operates a Solenoid Valve and allows a controlled quantity of water to bleed to the drain.

Figure 3. THERMAL BLEED CIRCUIT



Pressure Reducing Valves

In a constant speed pressure booster system the pump discharge pressure will vary according to demand and also in accordance with variations in supply pressure. It is often desirable to maintain a constant output pressure regardless of fluctuations in pumping pressure, and a suitable method of achieving this is to install pressure reducing valves.

These valves are of the hydraulically operated, diaphragm type, with a pilot system which automatically modulates the main valve to maintain a constant outlet pressure over the range of the valve.

The pressure of the system is governed by the setting of the combination pressure reducing valves with built-in non-slam checks. If only check valves are supplied, instead of pressure reducing valves, the pressure will vary according to the inlet city suction pressure and the operation point of the pump on its curve.

In systems incorporating pressure reducing valves, the total pumping head must be increased by an amount corresponding to the pressure loss through the valve.
(See PRV pressure drop chart Figure 5.)

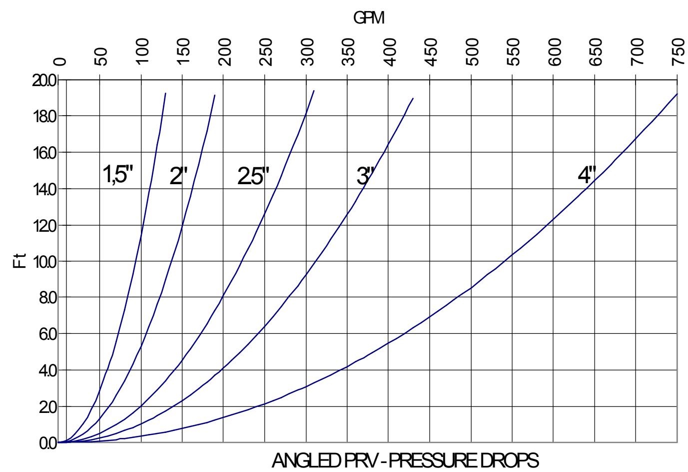


Figure 5. PRV PRESSURE DROP CHART

Control Panel

A standard -pump control panel features the following:

- NEMA 1 General Purpose Enclosure
- Main disconnect interlocked with door
- Motor protection for each motor
- Full voltage magnetic starters
- Thermal overloads
- Current-sensing relay(s)
- Control Circuit Transformer with fused secondary (UL Panels)
- Selector switch for each pump to permit manual or automatic operation
- Time delay relay, which keeps the lag pump operating for a minimum time period to prevent rapid cycling if the demand is fluctuating
- Low suction pressure protection and alarm light
- A selector switch in the control panel, to provide manual alternation of equal lead or lag pumps
- Running lights
- “Power On” indicating light

Safety Features

The following safety features are supplied on standard booster systems:

- Thermal Bleed circuit to prevent the pump from overheating
- Short circuit and Thermal Motor protections
- Pressure switch to protect the system against low suction pressure. If the city supply pressure falls to a dangerously low level, the switch operates and prevents the pumps from running. This condition is indicated by a red light on the control panel
- Should a motor overload and fail to operate, the next pump in sequence starts up automatically

S.A. Armstrong Limited
23 Bertrand Avenue
Toronto, Ontario
Canada, M1L 2P3
Tel: (416) 755-2291
Fax: (416) 759-9101

Armstrong Pumps Limited
Peartree Road, Stanway
Colchester, Essex
United Kingdom, C03 5JX
Tel: 01206-579491
Fax: 01206-760532

Armstrong Pumps Inc.
93 East Avenue
Buffalo, New York
U.S.A. 14120-6594
Tel: (716) 693-8813
Fax: (716) 693-8970
1-800-FLOW-845

Armstrong Darling Inc.
2200 Place Transcanadienne
Montreal, Quebec
Canada, H9P 2X5
Tel: (514) 421-2424
Fax: (514) 421-2436

Printed in Canada