Balancing Valve for Heating & Chilled Circuits

1. Design Features.

The primary purpose of Balancing Valve is to over come the frictional resistance of the water and effectively balance the distribution to each of the multicircuits in the system. Balancing Valve is a double regulating valve. The valve can also be used for tight shut-off or for regulating flow. The Balancing Valve is designed for constant trouble free service and easy operation for controling typical hydronic system for heating or cooling in Air-conditioning central plant in a multi storey complex.

The valve can be rendered temperproof with stem locking system in pre-regulated flow conditions. Tight closure of the valve is assured by use of teflon seat insert. Balancing Valve incorporting two pressure test valve cocks which can be connected to a suitable manometer or through computersied Hydronic Balancing System to measure the headloss across the valve. The Balancing Valve are extensively used in Heating or Chilled water circuits & other process applications to over come the balancing problems.

The valves are avilable in PN-16 rating from 15mm to 500mm NB.

2. Construction Features.

The valve with complete balancing system. Available in Gun-metal / Bronze from sizes (15mm) 1/2" NB to (80mm) 3" NB screwed end connection in 'Y' pattern Globe Valve body with or without pressure test valve cocks. The pressure test valves cocks are provided to permit flow measurement, regulation & isolation. Their primary application is in injection or other circuits requiring a double regulating valve for system balancing. Also available in Cast Iron / Steel construction from (50mm) 2" NB to (500mm) 20" NB. Flanged end connection in standard 'H' pattern having a characterised throttling disc with sufficient authority to regulate flow in circuits in-corporating a flow measurement valve. These valves have a unique device which enable the disc to be locked in position with a stem locking system provided to control flow at a pre-determined rate.

The Linkage with positioner indicator embraces a Vernier Scale for accurate setting while opening or closing of a valve position at a pre-detarmined rate.

3. System Balancing

In the system balancing a Balancing Valve with a pressure test connection to each side of the valve seat. The pressure drop or headloss across the valve could be measured and when related to a graph of the valve characteristics (head loss-Vs-flowrate) enabled the flowrate to be detarmined. This method of determining mass flowrate of water could be undertaken by using the pump to circulate the water around the circuits without a need to opearte the boiler / chiller.

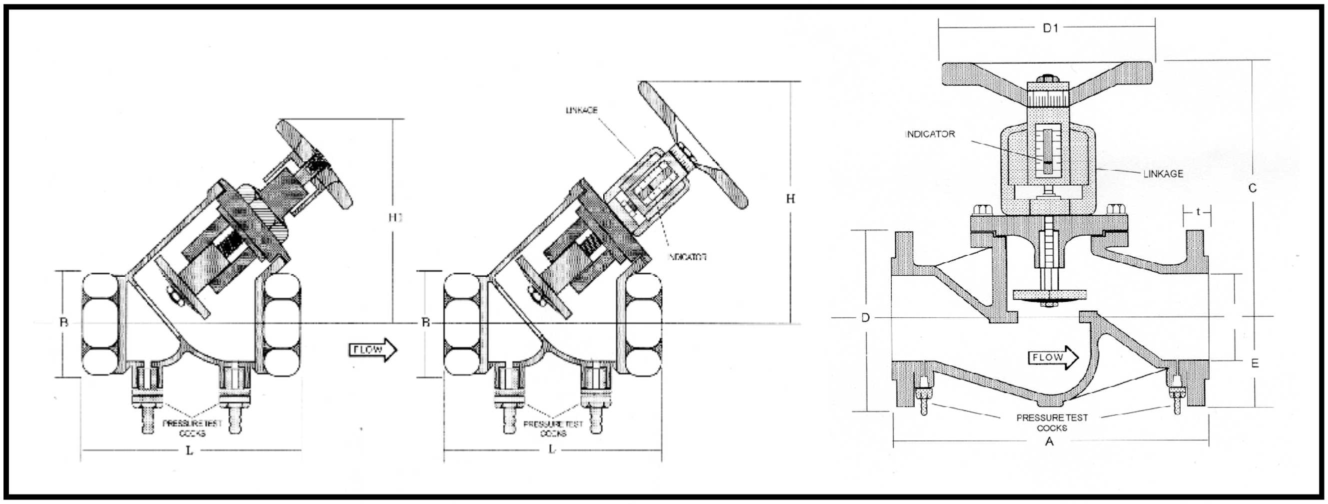
Balancing Valve for Heating & Chilled Circuits

5. Installation Practice.

10 Up & 5 Down

When water passes through an 'orifice' there will be a drop in pressure which can be measured by taking pressure readings upstream & downstream of the 'orifice'. To ensure steady, acceptable and reliable readings on the manometer connected to the upstream & downstream terminals of the orifice it is essential that the flow is smooth without undue turbulence either side of the 'orifice'. Upstream of the orifice this smooth flow should be maintained over a distance equivalent to not less than ten diameters of pipe, & downstream for a distance equivalent to not less than five diameters of pipe.

6. Installation Dimension & Material Of Construction.



SIZES In MM	15	20	25	32	40	50	65	80	50	65	80	100	125	150	200	250	300	350	400	500
A									230	290	310	350	400	480	600	730	850	980	1100	1350
C									160	240	255	275	300	340	375	510	565	695	850	965
D									165	185	200	220	250	285	340	405	460	520	580	715
E									83	93	100	110	125	143	170	203	230	260	290	358
D1									100	140	165	190	210	240	300	350	400	520	520	520
t									18	18	20	20	22	22	24	26	28	30	33	34
L	57	75	82	100	108	130	180	225												
H	70	92	100	108	115	125	133	150												
B	27	32	40	50	57	72	93	107												
Number Of Turns	2	2.5	2.5	3	3	4	6	8	4	6	8	10	11	12	12	13	13.1	14	14	16

BALANCING INSTRUCTIONS

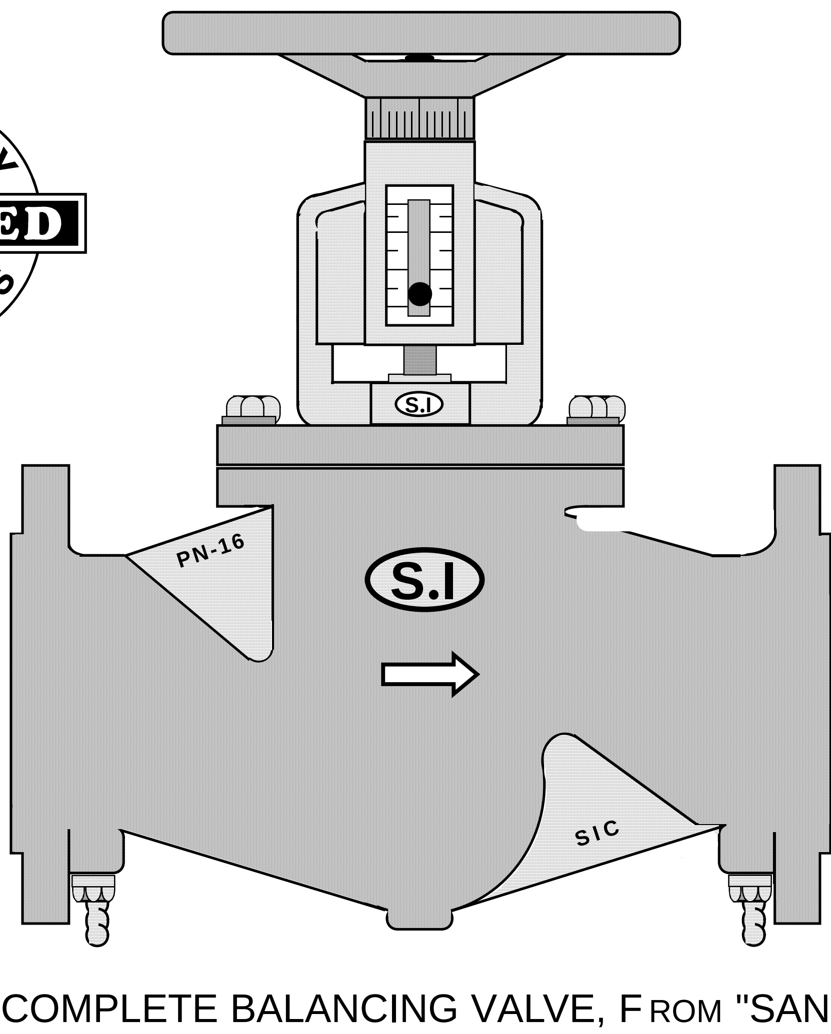
FOR

SYSTEM BALANCING

OF

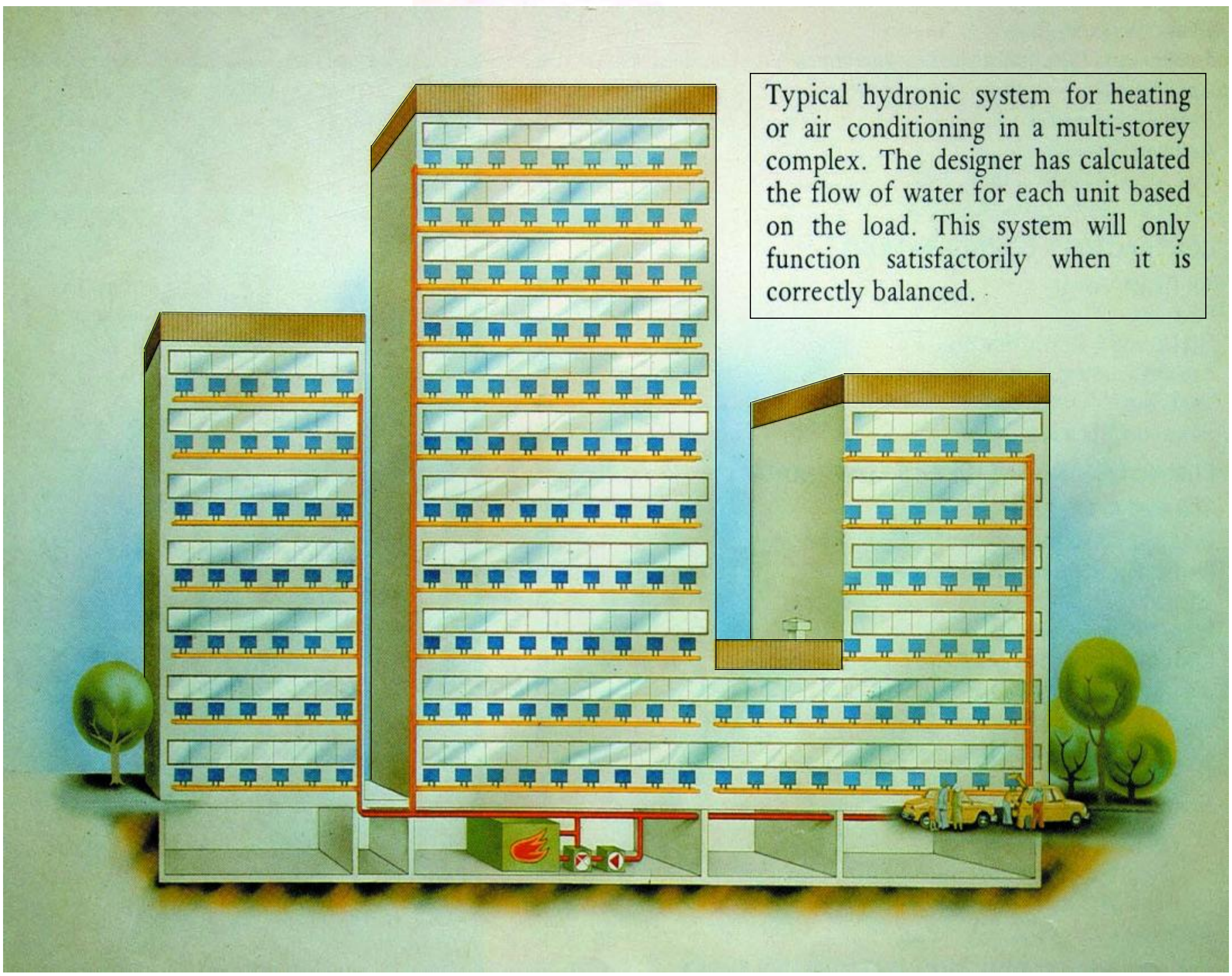
HEATING & CHILLED WATER CIRCUITS

Typical Hydronic System for Heating or Cooling in Air-Conditioning Central Plant in a multi-storey complex. The designer has calculated the flow of water for each unit based on the load. The system will only function satisfactorily when it is correctly Balanced.



A COMPLETE BALANCING VALVE, FROM "SANT"

BALANCING VALVE



Typical hydronic system for heating or air conditioning in a multi-storey complex. The designer has calculated the flow of water for each unit based on the load. This system will only function satisfactorily when it is correctly balanced.

Valve Instruction Sheets

When valves for flow measurement and regulation are delivered to site or store, they will have appropriate installation and operation instruction sheets. As these give full details of valve setting & locking, it is important that they are retained for use by the commissioning engineer.

Valve Indentification Lables

When the system is completed and all valves installed, each valve should have an indestructible tag lable giving valve number (corresponding with that shown on design sheet), and sufficient space for the commissioning engineer to insert the flowrate or headloss.

COMMISSIONING ENGINEER'S COMPENDIUM

The need to Balance a system

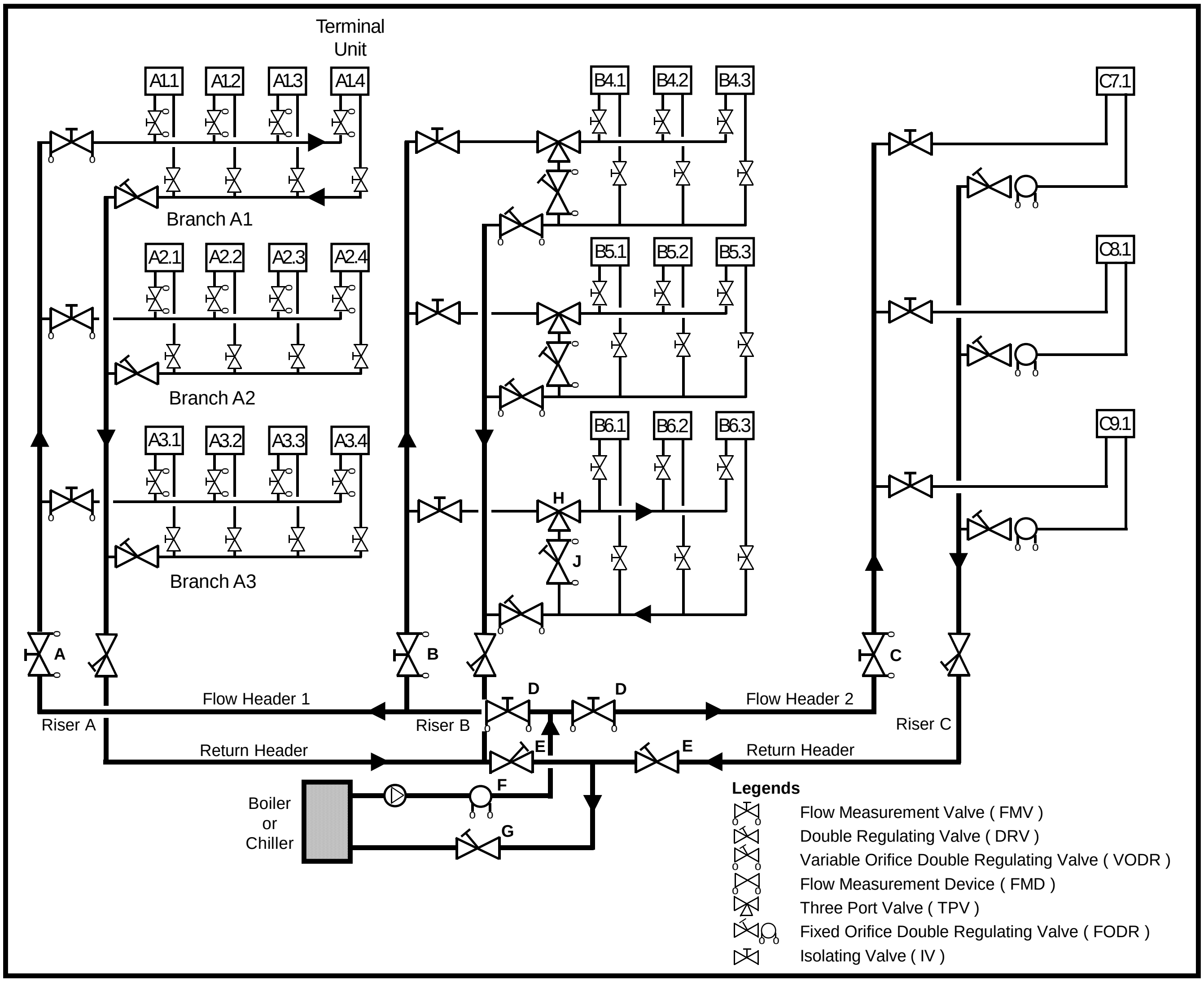


Fig : SIC 1.1 Schematic of Typical System

Consider the design of a multi-circuit system (Fig SIC-1.1).

The designer has determined and totalled the flowrates for eash terminal, the friction & headloss of pipes, valves, fittings, etc., and the headloss for each branch and riser. These calculations will indicate the 'least favoured' (index) circuit enabling correct sizing of the pump.

This pump will circulate water through the total system but, unless the system is correctly 'balanced', the flows in the 'most favoured' circuits will be much higher than the designed flow in the index circuit.

The objective of the commissioning engineer is to 'squeeze' excess of flow from the 'most favoured' circuits to the 'least favoured' circuits sequentially in mains, risers, branches & terminals, keeping within the permitted tolerances for each section and so balance the system.

From system design to completion of installation there often are modification made to the system as well as adjustments to pipe runs in order that circuits are complete. Different manufacture of terminal units, valves, pipe fittings, strainers, etc., will have different resistance. Until all these components are installed their actual headloss will not be known and it may not be possible to precisely maintain the headlosses calculated at design stage.

Data & Equipment needed for Commissioning

1. Schematic of complete system together with any pertinent observations by the contractor.

2. Appropriate manometer test sets.

3. Headloss / Flowrate graphs for each size & type of valve and flow measurement device installed in the system.

4. Pad of Commissioning Summary Sheets for recording reading & settings (Appendix B). These will simplify & quicken the commissioning procedure and so to reduce costs.

5. Pocket Digital Calculator for calculating Flow Rate Proportion Factors.

On very large systems two-way radios for comminication between commissioning engineers will prove invaluable.

Preparation for System Balancing

- From the schematic of the system identify header, risers, branches & terminal units.

- Check that the flowrates for each branch and terminal unit are specified.

- Open all isolating, automatic control, flow measurement & regulating valves. Set three-port valves on by-pass circuits to 'main flow' position.

- Partially close the discharge or regulating valves of the pump. Should a flow measurement device be installed in the primary header check the flowrate at that point is within -0% to + 10% of the design flow, and that pump motor current is correct for that flowrate.

- Ensure that the water in the system has been de-aerated and, should the system be pressurised, that the pressure is just sufficient to permit filling & venting.

Tolerances

Working tolerances as % proportional flow.

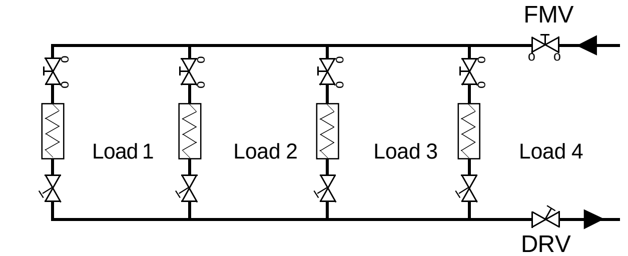
Terminal Units	:	- 0% + 15%
Branches	:	- 0% + 10%
Risers & Headers	:	- 0% + 10%

The above table shows the tolerance permissiable for different sections of the system.

Proportional Balancing

A simple branch circuit (Fig SIC - 1.2) has four terminals. The total flow as measured by the branch flow measurement valve (FMV) will split into percentage proportions for each of the four terminals depending upon their required load. This percentage split will be constant notwithstanding any changes of flowrate. This law of hydraulics enables proportional balancing to be reliably based on flowrate.

Proportional balancing of flowrate frees the system designer from the need to accurately specify pressure drop, and allows modifications to be made during system installation without changing design flowrate calculations.



Flowrate	FMV	Load 1	Load 2	Load 3	Load 4
kg/s	0.4	0.8	0.10	0.11	0.11
%of Total	100	20	25	27.5	27.5
kg/s	0.8	0.16	0.20	0.22	0.22
%of Total	100	20	25	27.5	27.5

Fig : SIC 1.2 Percentage proportional of terminals.

The only information required by the commissioning engineer is design flowrate and measured flowrate.

Identifying 'most favoured' Riser & Branch

Having identified from the schematic the risers, check the flowrate in each and calculate their flow proportion factors, ie. the proportion between actual flowrate & design flowrate.

Example

$$\frac{\text{Actual Flow (e.g. 0.62 l/s)}}{\text{Design Flow (e.g. 0.5 l/s)}} = \text{Proportion Factor (e.g. 1.24 : ie. 24\% HIGH)}$$

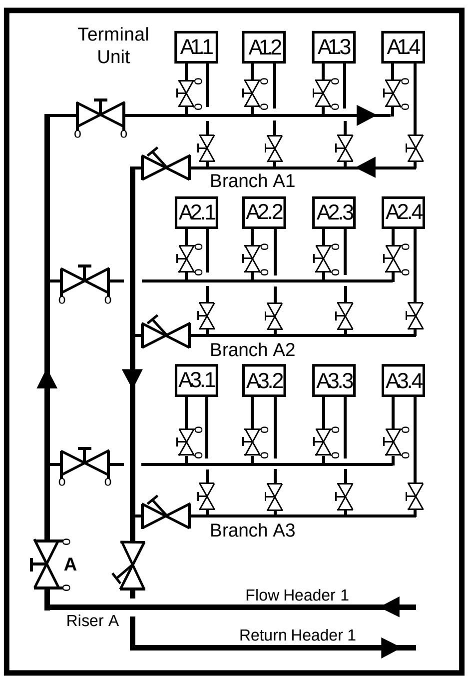
The 'most favoured' risers can be identified in order of flow precedence by their proportion factors. On the 'most favoured' riser measure the flow at the FMV or FMD of each main branch and place these in order of flow precedence by their proportion factors.

On the 'most favoured' branch measure the flow at each of the terminal units and place these in order of the flow precedence by their proportion factors.

Identifying 'least favoured' terminal unit

With few exceptions the terminal unit with the LEAST proportion of flow (lowest proportion factor) will be the one on the branch furthest from pump (hydraulically). It is not the furthest, then the valves on the other terminals on the branch must be regulated so that the furthest terminal has the least LEAST proportion of the flow. This terminal will be the INDEX for the branch and the reference unit. The tolerance for the proportion factor of the terminal units is - 0% to + 15%. Should this factor for the INDEX exceed 15%, gradually close the valve until the factor is within tolerance.

Fig : SIC 1.3 Schematic of Typical Scheme (Flow Header/ Riser A, Branches & Terminal Units).



Systems Balancing Procedure

The sequence of balancing begins with the INDEX terminal of the 'most favoured' branch and ends at the pump. The first task is to achieve a percentage flow identical to that of the INDEX terminal, for all other ternimal units on the 'most favoured' branch.

This action is then repeated branch by branch. Similarly the 'LEAST favoured' branch will dictate the percentage flow to be achieved in the other branches of the same riser, then the 'least favoured' riser for the other risers on the same header, and then the headers, finally back to the pump.

Terminal Units on Branches

Connect a manometer to the valve of the INDEX terminal (A3.4). Measure flow, calculate and record proportion factor. With the manometer still connected to the INDEX, connect another manometer to the next 'least favoured' terminal unit (A3.3) and adjust the flow to the same proportion as that of INDEX. Deal with the other terminal units in a similar matter sequentially (A3.2 then A3.1) until all the terminal units on the branch have the same proportion as the INDEX. Should during this procedure the flow if INDEX, indicated by the manometer, be seen to increase slightly, recalculate the proportion factor then return to the previous terminal unit and adjust its flowrate to achieve the new proportion factor of the INDEX. At this stage do not adjust the branch valve.

Apply the same procedure to the terminal units of all other branches of the same riser in order of branch flow proportion precedence, (highest proportion factor, next highest proportion factor and so on) ensuring that the stated tolerance is maintained.

Branches on Risers

With each terminal proportionally balanced with its index in the branch, the proportion factor of the branch valve should equal the index terminal of that branch.

This should be confirmed by measurement and calculation.

Balancing procedure for branches now follows the sequence as detailed for balancing terminals.

Identify branches in descending order of 'MOST favoured' to 'LEAST favoured'. The 'LEAST favoured' branch will be the one furthest from the pump (hydraulically). If it is not it must be made so by regulating its valve to induce a proportion factor equal to, or lower than, the other branches, keeping within stated tolerances.

Deal with each branch in a similar manner.

Risers on Headers

Should there be more than one header, they should be balanced in a similar manner to that described for risers, the tolerance for headers being dictated by the final proportion factor of the riser.

Headers

Should there be more than one header, they should be balanced in a similar manner to that described for risers, the tolerance for headers being dictated by the final proportion factor of the risers.

Adjusting Total Flow

The actual flow from the pump will be in accordance with the proportion factor of the headers

By adjusting the pump discharge valve (G), the dynamic balancing of the total system will respond in proportion throughout the whole system. The tolerance at the pump should not exceed - 0% to + 10%.

Final Check

Any three-port valve (H) used in by-pass or balance pipes should be operated to permit flow through the VODR valve (J) which is now in the balancing mode. Regulate the VODR valve to give flowrate across the valve identical to flowrate across the balanced circuit (B.6), then return the three-port valve to main setting.

All regulating valves in the system should be locked at their 'set' positions. They should be correctly numbered and flowrate or 'set' positions value recorded.

Recording of all the commissioning procedures is essential.

Remember

Whereever possible commission circuits with the water at ambient temperature.

Air must be eliminated from all circuits, and strainers must be free of sediment.

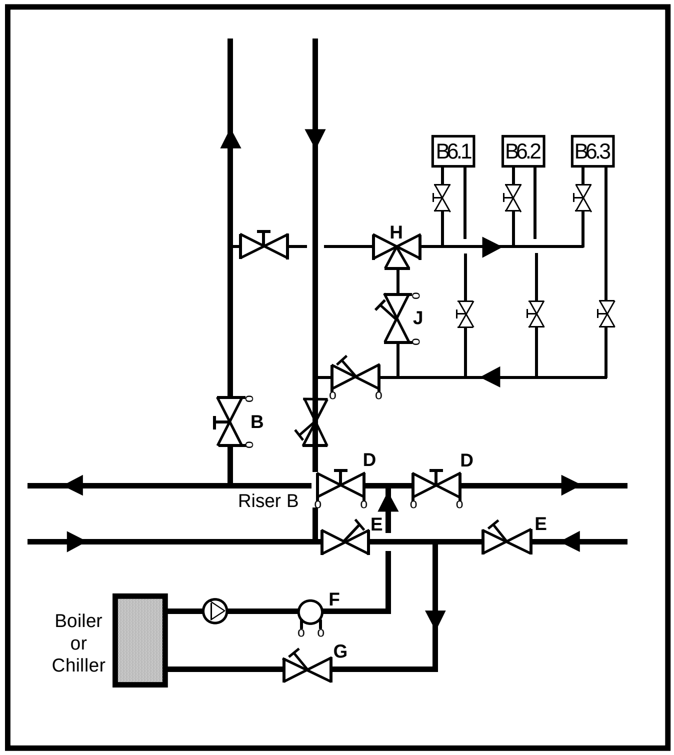


Fig : SIC 1.4 Schematic of Typical Scheme (By-pass circuits & balance pipes).

H.T.H.W. is potentially dangerous and, should such a system need be commissioned when 'live', never use conventional pressure test valves. Manometer readings should be carried out with copper bleed tubes connected to the pressure tappings and terminated with needle valves. Ensure that the manometer is suitable for H.T.H.W. particularly with regard to static pressure and temperature.

Installation Practice

10 Up & 5 Down

When water passes through an 'orifice' there will be a drop in pressure which can be measured by taking pressure readings upstream & downstream of the 'orifice'. To ensure steady, acceptable and reliable readings on the manometer connected to the upstream & downstream terminals of the orifice it is essential that the flow is smooth without undue turbulence either side of the 'orifice'. Upstream of the orifice this smooth flow should be maintained over a distance equivalent to not less than ten diameters of pipe, & downstream for a distance equivalent to not less than five diameters of pipe. Therefore at design stage and during installation the positioning of a flow measuring device must be such that there are no other pipeline components, eg. fittings, closer than the distance stated, as these will give rise to turbulence.

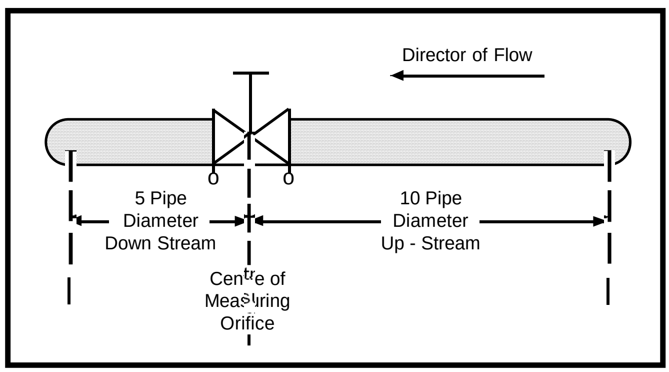


Fig : SIC 1.5 "10 up & 5 down"

FMV	:	Flow Measurement Valve.
FMD	:	Flow Measurement Device.
VODR	:	Variable Oriffice Double Regulating Valve.
FODR	:	Fixed Orifice Double Regulating Valve.
HTHW	:	High Temperature Hot Water.

BALANCING VALVE