IMI FLOW DESIGN

FlowSet
Balancing Procedure

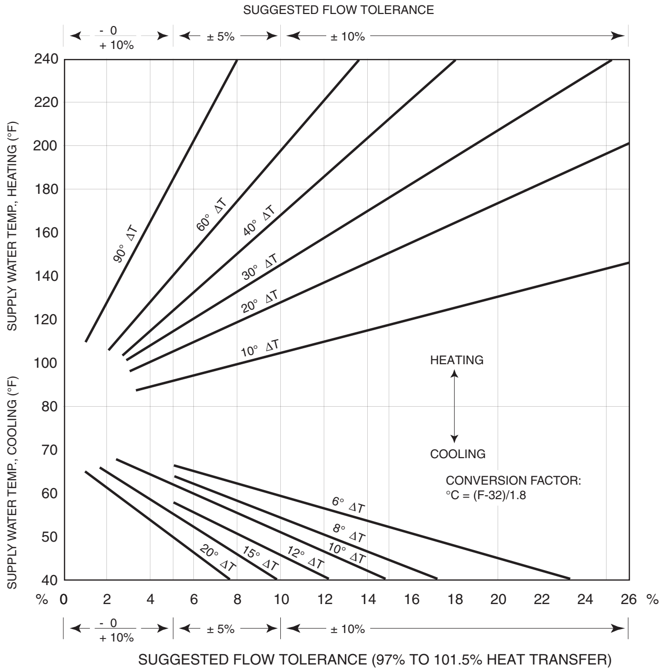
Engineering
GREAT Solutions

IMI Hydronic Engineering

FlowSet Balancing Procedure

Select the flow tolerance required

As per the attached chart (ASHRAE Systems Guide, 1984), ± 10% is generally accepted as a reasonably cost effective flow tolerance, but special systems may require more accurate balance. System tolerance is composed of three parts: the flow element (in our case ± 2%), the flow reading device (in our case ± 1/2% giving Flowset an installed and readable field accuracy of better than ± 3%). The third part, the field reading and adjusting, must be of a high degree of accuracy to produce overall results in the ± 10% range or better. It is important to specify both the accuracy and the reporting method to obtain best field results.



FLOW TOLERANCE PLOT

Pre-balanced procedure

1. Analyze the job drawings and develop a flow diagram listing design GPM at each designated location. Be sure all flow paths have at least flow readout and temperature readout capability.

2. System must be flushed, strainers cleaned and re-installed. All manual valves are to be in open position, all automatic temperature control valves in open position, expansion tank charged to at least 15 PSI and all air eliminated from the system.

3. With three way valve systems, the bypass valve should be closed at this point and reset later while reading the terminal units to provide the same pressure drop as the terminal. In primary/secondary systems, secondary pumps must be running and balancing valves open.

4. Equipment required: One (preferably two) flow meter kits. pressure gauge, temperature measurement equipment, radio communications systems for balancing team, and balancing forms (see installation/balancing tab for sample) for recording all data.

FlowSet Balancing Procedure

Typical System Layout

Step 1 - Read Pumps

Step 2 - Read Risers

Step 3 - Read Branches on Selected Riser

Step 4 - Read Units on Selected Branch

Step 5 - Adjust Units to Proportion of Lowest

Step 6 - Adjust Units on All Branches Lowest to Highest

Step 7 - Adjust Branches to Proportion of Lowest Riser Now Proportionally Balanced Repeat 4 thru 7 For All Risers

Step 8 - Adjust Risers to Proportion of Lowest

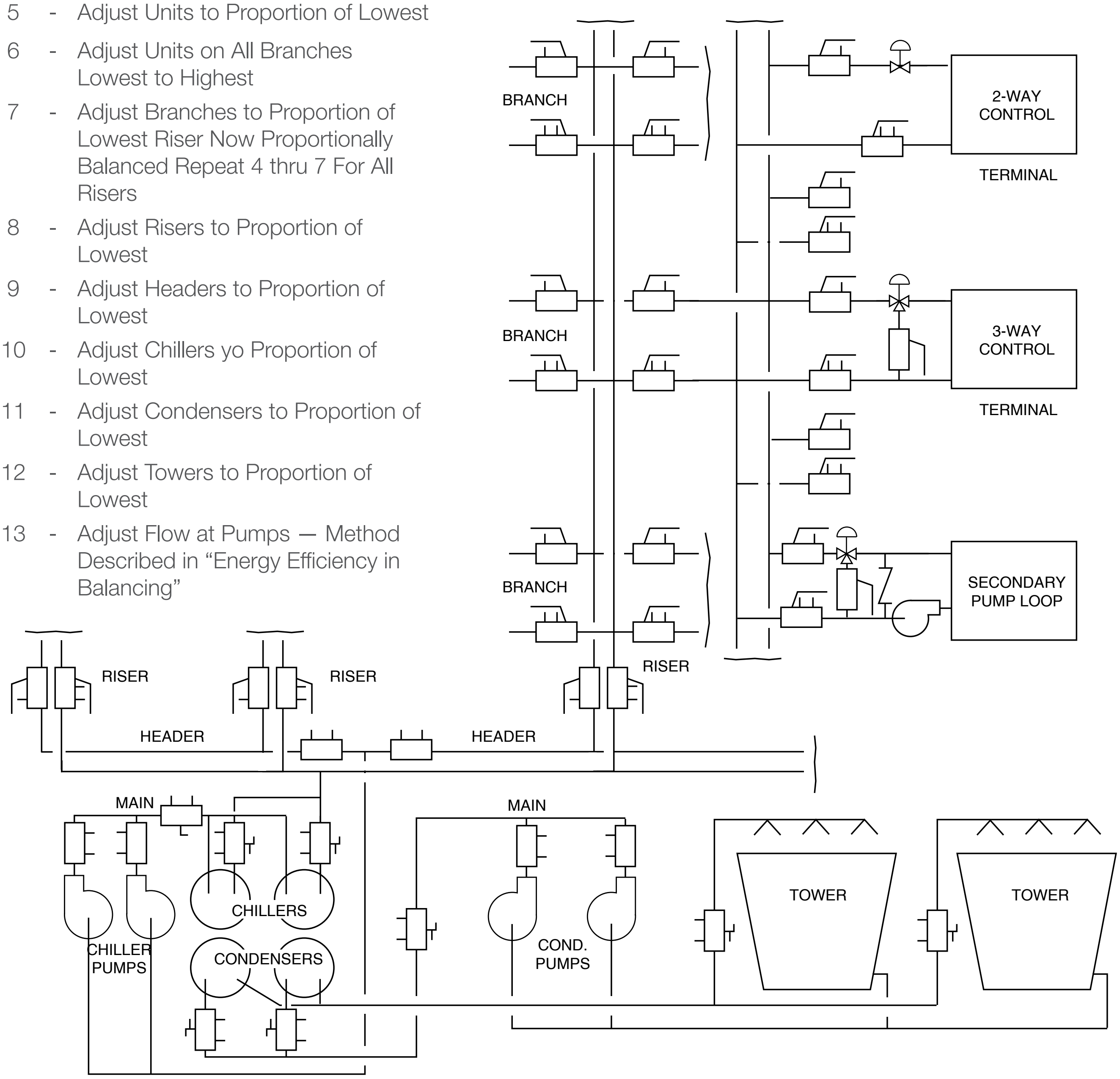
Step 9 - Adjust Headers to Proportion of Lowest

Step 10 - Adjust Chillers yo Proportion of Lowest

Step 11 - Adjust Condensers to Proportion of Lowest

Step 12 - Adjust Towers to Proportion of Lowest

Step 13 - Adjust Flow at Pumps — Method Described in “Energy Efficiency in Balancing”



FlowSet Balancing Procedure

Select the flow tolerance required

The most efficient and lowest pressure drop balancing method is known as proportional balancing. This procedure develops one complete flow path with no balancing valves throttled. Rather than attempting to set design flows one at a time, the entire system is balanced to the same proportion or ratio of actual flow to design flow. The final adjustment of flow is accomplished at the pump and all previously proportionally balanced devices are brought to design flow simultaneously.

Step One
With all valves open, read system flow at pump(s) and compare to the total design flow of all connected devices. If the flow is less, verify that it is within the range of the intended diversity. If flow is more than 20% above design, adjust discharge of pump to + 20% maximum.

Step Two
Read the flows of all risers and/or secondary pump loops to identify the riser/loop having the highest proportion of actual to design flow. This is the riser with the lowest installed pressure drop and will be the first balanced. Any risers or secondary pump loops that are more than 20% above design flow should be adjusted to + 20% maximum.

Step Three
Read the flows of all branches on the selected riser to identify the branch having the highest proportion of flow. This is the branch with the lowest installed pressure drop and will be the first balanced. Any branches that are more than 20% above design flow should be adjusted to + 20% maximum.

Step Four
Read the flow of all the units on the selected branch and select the unit having the lowest proportion of actual to design. This is the unit with the highest installed pressure drop and will remain open.

Step Five
Adjust the unit with the next lowest proportion of actual to design to match the proportion of the lowest unit. You should check back on the lowest unit (which becomes the reference unit) as it will increase when the next unit is adjusted. Adjust all other units on this branch to the same proportion as the reference unit with appropriate check-backs as required. Balance from the lowest pro-portion to highest proportion until all units on branch are proportionally balanced. Readout all units to verify they are set at the same proportion.

Step Six
The next set of units balanced will be on the branch with the next lowest proportion of flow. Continue from lowest to highest, balancing all units on each of selected riser using procedure in STEP FIVE.

Step Seven
Find the branch with the lowest proportion (this branch will remain open), and then balance all other branches to the reference branch. The riser is now proportionally balanced. Repeat STEPS FOUR thru SEVEN for all risers until the units and branches on each are proportionally balanced.

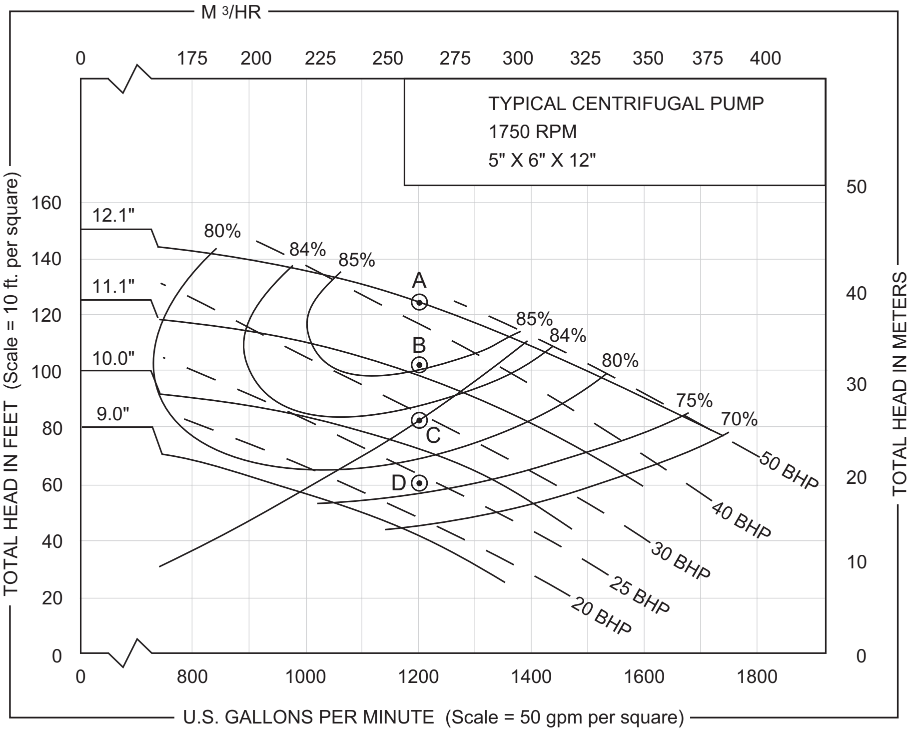
Step Eight
Select the riser with the lowest proportion (this riser will remain open). Set the next lowest riser to the same proportion as the reference riser and proceed until all risers are proportionally balanced.

Step Nine
If system has multiple headers, identify the one having the lowest proportion (leave open) and set the next lowest proportional header to match. Adjust each header accordingly. System is now proportionally balanced and contains one open flow path from headers to risers to branches to terminals having the lowest pressure drop possible. Readout all terminals and fine tune any out of range devices, set memory stops, and record final readings. The final flow adjustment takes place at the pump and the method of achieving design flow is the subject of the section titled “Energy Efficiency in Balancing.”

FlowSet Balancing Procedure

Balancing the system

Using the following actual pump curve as an example, it is easy to tabulate the effects of various methods of obtaining design flow at the pump. Point E represents the proportionally balanced system before any adjustment at the pump to achieve design flow condition. The design flow may be obtained by throttling the pump, trimming the impeller, changing the pump or reducing the pump speed. The simplest and least costly of these options is to throttle the pump, (system goes to Point A) producing balanced design condition and saving three horsepower in our example. It is also possible to operate the system at Point C (design flow rate with actual system pressure drop). Operation at Point C can be obtained by trimming the pump impeller to approximately 10.5" or reducing the pump speed using a variable speed device. Trimming the pump impeller is the lowest cost method of obtaining this operating point but, once trimmed, the impeller offers no capability of producing additional flow should conditions warrant. A variable speed pump can match future load conditions, but imposes an additional penalty of the inefficiency of the drive on the system, thus making it a poor choice if this is all the drive is designed to accomplish. Systems having variable flow characteristics (modulating valves) can utilize variable speed drives to a substantial cost advantage taking into account the building's diversity, etc. The pump/system curve analysis also shows the effect of using the **FlowSet** low-loss design and **FlowSet Venturi/Pitot** design for all flow measuring and setting stations (System B). A system designed (per the attached schematic) using conventional flow measurement and setting devices on the pump discharge, chillers, headers, risers, branches, and units and selected per the manufacturers recommendations contrasted to FlowSet devices picked for the same line diameters and flow conditions would result in a net pressure drop approximately 21 feet higher than the **FlowSet system**. The effect of this 21 feet pressure drop savings produces a substantial reduction in pump horsepower. **FlowSet** valves, when matched with impeller trimming, produces a system offering the most efficient and cost effective design possible (System D).



Typical System Analysis							
System	**Description**	**GPM**	**HEAD**	**PUMP BHP**	**System Comparison**	**$ Saved** Per Year**	**$Saved Per** 25 Years**
A	Designed w/conventional variable orfice balancing valves at pumps, chillers, headers, risers, branches, and terminals	1200	125'	44	A vs E	1844	247,000
B	Same system w/ FlowSet devices in same position, same line size	1200	104'	36.3	B vs E	4124	553,000
C	Trim Impeller/Variable Speed Pump - System A (Conventional)	1200	83'	30.2	C vs E	6494	870,000
D	Trim Impeller/Variable Speed Pump - System B (FlowSet)	1200	60'	24.2	D vs E	8788	1,179,000
E	Unbalanced System	1200	112'	47			