

Steam System Best Practices

Document No. 14

Selecting the Optimum Steam Pressure for Process Applications

What is the correct pressure set point for this system?

A common question that every person involved with steam systems must address at some point is “what is the correct steam pressure for the application”. Selecting higher than required steam pressure to a process application will result in a number of negative effects. High steam pressure has a higher steam temperature, but the negative; is a lower usable (latent) energy. This is often an overlooked fact in the “more steam pressure is better” world. A review of the steam tables shows us that as we increase the steam pressure, the latent energy decreases as the sensible energy is increases.

Typical steam process applications utilize only the latent energy in the steam. The sensible energy is removed from the system with the condensate. By contrast, one should select the lowest effective steam pressure and temperature that permits operational process success.

Using the lowest effective steam pressure to achieve the process objective will result in the following:

- Lower steam consumption
- Lower thermal expansion of components
- Lower flash steam volume, particularly at the discharge of the trap.
- Better temperature control, due to the closer proximity to the process heat sink.
- Longer equipment life

Unfortunately, history has shown that the steam process plant accepts the recommendation of the steam equipment manufacturers to designate the required steam pressure. In true practice, the plant should be the designator of the steam pressure to the equipment manufacturer.



Another faulted approach is providing the process equipment manufacturer with the boiler operating steam pressure. At the process application location in the plant; the steam pressure will not be the same as the boiler operating pressure, due to steam line pressure drops and other restrictive devices such as valves in the steam line. A steam control will require a pressure drop to achieve flow. A low pressure drop steam control valve is very large and costly. An oversized steam control valve for will be difficult or impossible to control in a steam application. So selecting valves to overcome a poor operating point selection at the boiler is not a solution.

Choosing a steam pressure set point that is too high will result in the following negative conditions:

- Higher energy cost to produce the steam
- More severe duty operation for all steam components
- Greater thermal expansion
- High flash steam volume
- Temperature control problems
- Shorter operational life of equipment
- Higher surface thermal losses to atmosphere

Manufacturers usually can provide process equipment which can operate at any pressure with one exception, the lower or minimal steam pressure limit. The best “correct” steam pressure limit is the lowest reasonable steam pressure that can be used and meet the specification of the process. Understanding and selecting the correct steam pressure will enhance the steam process application.

Correct Steam Pressure for Low Temperature Applications

Applications that should always use low pressure steam (0.07 bar to 1.03 bar) are the following heating applications:

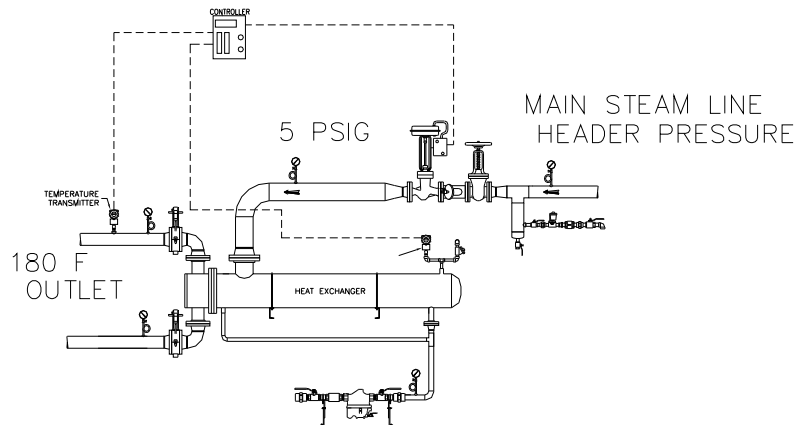
- Heating water
- Unit heaters
- Space heating
- Steam coils for comfort heating

There is no advantage for using high pressure steam for these applications. Therefore always supply general heating loops with steam pressures lower than 0.7 bar.



Example: Water is required to be heated to 82°C; therefore steam pressures from 0.07 bar to 0.7 bar can be used for this application. The steam pressure 0.07 bar is not commonly used for heating water, but

0.07 bar is commonly used in vent condensers. When discussing these applications, we are not including the direct injection of steam for heating water. Steam direct injection for heating water is a different “Best Practice Application Sheet”.



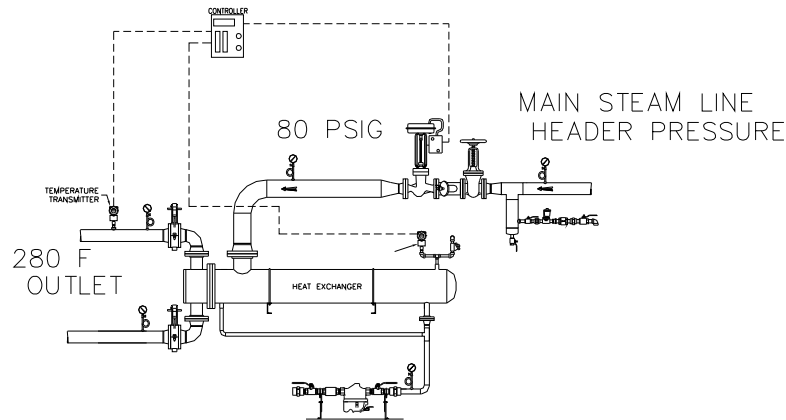
Correct Steam Pressure for High Process Temperature Applications

Process applications typically require high process temperatures, therefore higher steam pressures are needed to meet the process requirements. How does a process person find the correct steam temperature?

An example in the Steps to find the correct steam pressure:

1. Assume a process requires 138°C temperatures
2. Review the steam tables and find 138°C
3. The equivalent “steam” pressure at 138°C is 2.4 bar
4. Add 3.1 bar to the required pressure
5. Add 3.1 bar to 2.4 bar = 5.5 bar steam pressure

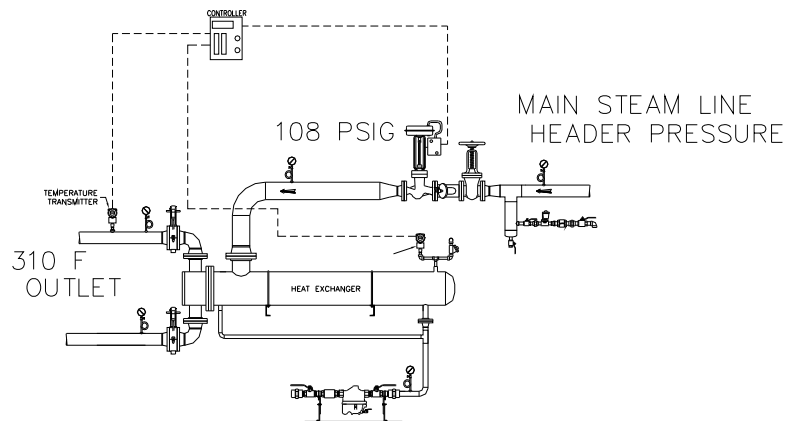
Steam “5.5 bar” pressure that is provided to the equipment manufacturer for design of the process heat transfer. “5.5” bar shall be the pressure after the steam control valve or the steam pressure that can be delivered to the process.



Example:

Process temperature requirements are 154°C; using the steam tables locate the corresponding steam pressure.

1. 154°C = 4.3 bar
2. Add 3.1 bar to 4.3 bar; = 7.4 bar
3. 7.4 bar is provided to the manufacturer for the delivered steam pressure



Conclusion

Always select the correct steam pressure for each application which will result in optimum performance of the process equipment while ensuring system reliability.