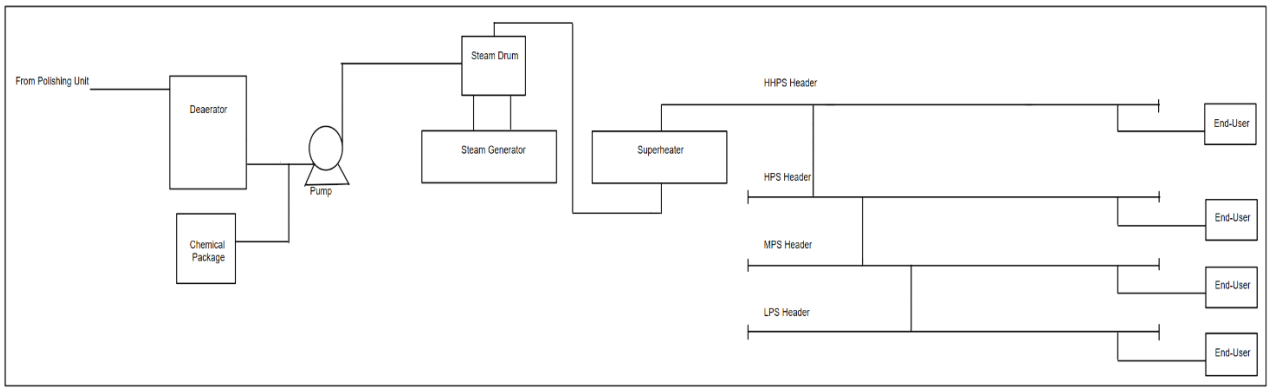
Steam System

Description

Purpose of steam systems: to provide end-users with demanded steam condition.

Components of a steam system

- Deaerator: DMW produced in polishing unit now should be converted to boiler feed water (BFW) and then the BFW will go through steam drums and shell and tube heat exchangers and as a result steam is produced. In order to convert DMW to BFW, water quality should be improved. Oxygen should be removed, which is done by means of deaerator.
- Chemical Packages: In order to make sure that all oxygen is removed we are supposed to use oxygen scavengers. Also, in order to maintain PH, we use Amines. Lastly, we use scale inhibitors to prevent scale agglomeration in the steam drum and heat exchangers.
- BFW Pumps: They are the most important pumps in each process plant which supply BFW to steam drums. It is a normal practice to use turbine-driven pumps alongside motor-driven pump to manage energy in the unit.
- Steam Drum: Steam drum is used to distribute BFW to shell and tube heat exchangers to produce steam and then the saturated steam is freed from water droplet. It all happens in the steam drum.
- Heat Exchanger: The hot stream passes through tube And the BFW, through downcomers, comes down from steam drum to shell side. BFW receives the heat from tube side and becomes vapor and moves upward to steam drum.
- Superheaters: They are just shell and tube heat exchangers which are located after steam generators to simply superheat the steam by 50 to 100 C.
- HHP Header: It is simply a distributor of HHPS to end-users such as turbines.
- HPS Header: It is simply a distributor of HPS to end-users such as turbines and heat exchangers.
- MPS Header: It is simply a distributor of MPS to end-users such as heat exchangers.
- LPS Header: It is simply a distributor of LPS to end-users such as reboilers and deaerator.



Now let's detail the first version of PFD.

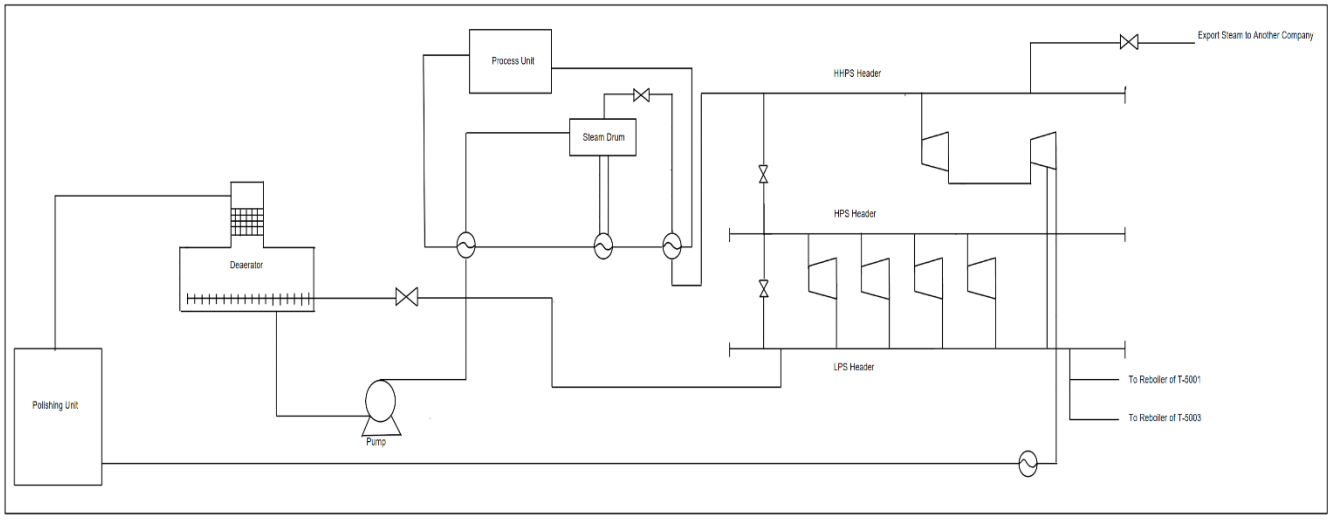
1.Deaerator
- In deaerators, it is normal practice to use LPS to warm-up DMW and eliminate oxygen from DMW. To inject LPS in deaerators, we need spargers inside deaerator to distribute the steam.
- We also use packings to enhance the surface area between DMW and LPS.
- Since we aim to remove most of the oxygen in the deaerator, then the Deaerators should have good spacing, so that oxygen trapped in DMW can easily move and exit.
- We use Dome type deaerator to accommodate the packing.

2.Chemical Package
- Oxygen scavenger is injected to both the deaerator and exit line to protect the deaerator and downstream equipment against any corrosion.

3.Steam Generation
- Before entering the steam drum, the BFW should be preheated to maximize energy efficiency. So, we use a BFW preheater.
- Shell and tube heat exchangers are shown like the icon in Aspen Hysys regardless of the fact that it is the heat exchanger or superheater.
- Steam drum and the heat exchanger are connected via risers and downcomers. To show them on PFD, we use just simple line.
- Steam drums have two controlling parameters which should be checked by process engineers regularly. The pressure of steam drum which is controlled via a PV and the level which is controlled by means of LV.

4.Headers

- We can convert HHPS to HPS by a PV, which means by means of a PV we can reduce the pressure from 98 barg to 42 barg. The same happens to HPS to MPS and MPS to LPS.
- End-users are small turbines which consume HPS and give back LPS. The turbines of BFW pumps, cooling water pumps, ID and FD fans for furnaces are examples of end users for HPS. In additions, reboilers from distillation columns or shell and tube heat exchangers are examples of that. So, we have to show them. Notice that like other processes in methanol plants we have large turbine which drives a large compressor. The turbine consumes HHPS and gives back HPS and LPS and Atmospheric pressure steam which is cooled down via a large condenser to be send to polishing unit.
- Plant capacity is normally 100%. Based on actual data when you go above 75% of the capacity, the HHPS produced becomes surplus. As a result, we export the HHPS to outside of the plant.



Let's add a little more detail:

1.Heat exchangers

- When we say that we give LPS to Reboiler of T-5001 or T-5002, then We should expect some low-pressure condensate from these heat exchangers. Where should they go? Deaerator is the best choice.
- A little process-based: In methanol plants, we have an oxygen preheater and the hot medium is HPS. So, we should expect a high pressure condensate. The high-pressure condensate goes to a drum and finally its pressure is controlled by a LV. Remember the pressure at the same time reduces from 44 barg to 3 barg to be

suitable for deaerator condition.

2. Operating Condition

Based on Process Design Criteria, here are the conditions of utilities:

Steam

HHP superheated steam

Parameter	Units	Min.	Norm.	Max.	Mech. design
Pressure	bar g	-	98	-	112
Temperature	°C	-	454	-	490

Min fouling factor for heat exchanger design, m²°C/W 0.00020

Battery limit conditions:

Parameter	Units	Min.	Norm.	Max.	Mech. design
Pressure	bar g	38	43	47	52
Temperature	°C	400	410	430	470

Min fouling factor for heat exchanger design, m²°C/W 0.00025

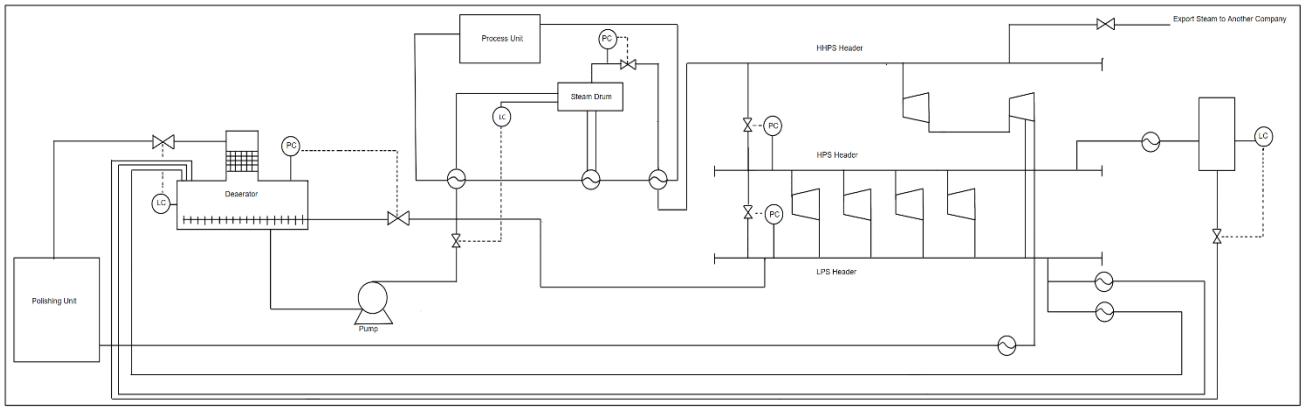
LP steam

Parameter	Units	Min.	Norm.	Max.	Mech. design
Pressure	bar g	6.5	7	8	9.5
Temperature	°C	-	217[3]		340

- The temperature of BFW out of the deaerator should be 120C because of the chemicals deterioration limit. Also, the DMW temperature to the deaerator should be around 70C to prepare the process to remove the oxygen. So, it needs DMW preheater.
- Operating pressure of deaerator in all process plants is around 1 barg to keep it low enough to be able to deaerate all oxygen.

3.Simple Control System

- Add LIC loop [LIC + LV] when it concerns separators. Add PIC loop [PIC + PV] when it comes to pressure change.
- Examples:
  - LIC loop for HPC drum or deaerator
  - PIC loop for steam let-down or deaerator



Now Let’s check the last existing version: