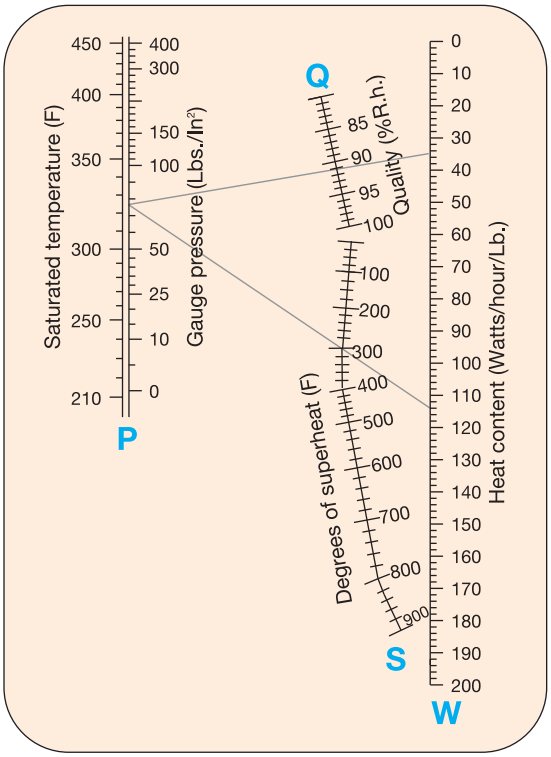
Calculating KW Requirements to Superheat Steam



Superheated Steam Graph

Problem: ***Heat 420 lbs/hr of 90% quality steam to 620°F @ 75PSIG***

1. Plot the pressure on graph **P** and the steam quality on graph **Q**. Draw a straight line from **P** through **Q** and read **W1**.

2. Plot the degrees of superheat on graph **S**. The degrees of superheat equals operating temperature minus saturated temperature. Saturated temperature is read beside gauge pressure on graph **P**.

   620°F – 320°F = 300°F

   Draw a straight line from **P** through **S** and read **W2**.

3. Determine the required KW using the following equation:

   KW = LBS/HR × (W2 – W1) / 1000 × Safety factor
   = 420 × (114 – 36) / 1000 × 1.2 = 39.3 KW

CAUTION ***Note:*** Element watt density is critical in choosing the correct circulation heater and is dependent upon maximum operating temperature and steam velocity.

Standard Pipe Data

Nominal Pipe Size	Threads Per Inch	Inside Diameter (inches)	Outside Diameter (inches)	Weight Pipe (lbs/ft)	Length in Feet Containing One Cubic Foot	Gallons in One Linear Foot	Weight Water (lbs/ft of Pipe)
⅛	27	0.269	0.405	0.244	2526.000	0.0030	0.025
¼	18	0.364	0.540	0.424	1383.800	0.0054	0.045
⅜	18	0.493	0.675	0.567	754.360	0.0099	0.083
½	14	0.622	0.840	0.850	473.910	0.0158	0.132
¾	14	0.824	1.050	1.130	270.030	0.0277	0.231
1	11½	1.049	1.315	1.678	166.620	0.0449	0.374
1¼	11½	1.380	1.660	2.272	96.275	0.0777	0.648
1½	11½	1.610	1.900	2.717	70.733	0.1058	0.882
2	11½	2.067	2.375	3.652	49.913	0.1743	1.453
2½	8	2.469	2.875	5.793	30.077	0.2487	2.073
3	8	3.068	3.500	7.575	19.479	0.3840	3.200
3½	8	3.548	4.000	9.109	14.565	0.5136	4.280
4	8	4.026	4.500	10.790	11.312	0.6613	5.510
5	8	5.047	5.563	14.617	7.198	1.0393	8.660
6	8	6.065	6.625	18.974	4.984	1.5008	12.510
8	8	7.981	8.625	28.551	2.878	2.5988	21.680
10	8	10.020	10.750	40.483	1.826	4.0963	34.100
12	8	12.000	12.750	49.560	1.274	5.9036	49.000
14	8	13.250	14.000	54.570	1.046	7.1928	59.700
16	8	15.250	16.000	62.580	0.789	9.5301	79.100
18	8	17.250	18.000	70.590	0.617	12.1928	101.200

Barlow's Formula

Pressure ratings of fluid vessels depend mainly on the tensile strength of the material being used at the process temperature, and the wall thickness of the vessel. Normally, the safety factor ratio should be at least 4 to 1 in determining the maximum pressure a vessel may see.

$$\text{Minimum wall thickness (in)} = \frac{\text{Maximum Pressure (PSI)} \times \text{OD of vessel (in)}}{2 \times \text{Tensile Strength (PSI) at process temperature}}$$