



## STEAM – ITS EFFECT ON HOSE

*“The hose must be faulty.”* This is the usual reaction when steam hose fails in service, especially when, on the same application, the same type of hose has given satisfactory service.

Explaining why can be very difficult, but experience has shown that such examples of sudden failure are rarely due to defective hose. In most cases, failure is the result of changing conditions of steam. A temporary condition of super-heated steam in a saturated steam line can quickly deteriorate the lining of a steam hose, hardening or softening, resulting in failure.

To understand the problem let us start at the beginning. Steam is an invisible gas and cannot be seen. What is seen issuing from the spout of a boiling kettle is not steam, but water vapour. The temperature at which water boils depends upon the vessel containing the water. At normal atmospheric pressure, water boils at 100 degrees Celsius. As more heat is added steam is generated but the water remains at the same temperature. Under these conditions moisture can be present in the steam which is known as **“wet saturated steam”** or simply **wet steam**.

As more heat is added all the water will be converted into steam which is known as **dry saturated steam** – still at atmospheric pressure and with a temperature of 100 degrees Celsius.

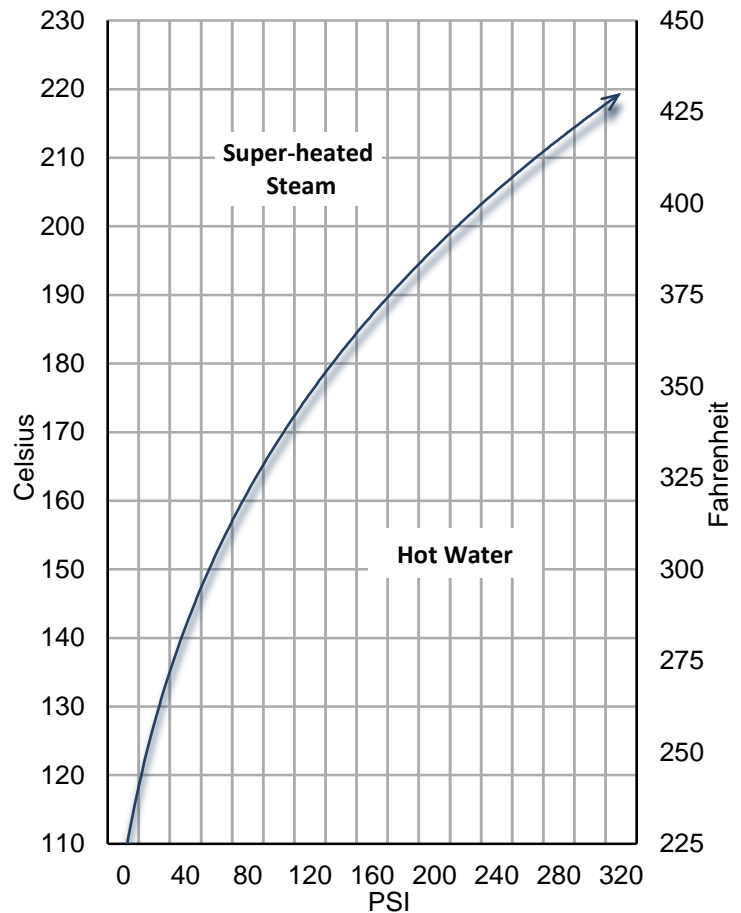
If even more heat is added the temperature of the dry saturated steam will be increased further. This is known as **“super-heated steam”** or **dry steam**. The word “super-heated” is used because its temperature is higher than that at which the water boils. This process does not conform to an invariable pressure/temperature relationship, as applies in the generation of saturated steam. It is possible for super-heated steam to exist at a wide range of temperatures in relation to a particular pressure. But steam is almost always generated, and carried, at higher than atmospheric pressures and we know that the effect of increasing the pressure on the water is to increase its boiling point. For example, at a gauge pressure of 70 PSI is 158 degrees Celsius and at 150 PSI, 185 degrees Celsius.

In the chart below, the black line represents the temperature at which water boils, or at which steam is generated.

Consequently any point on this line represents **saturated steam** – which may be completely free of un-vapourized particles of water, known as ‘dry’ or carry such particles as ‘wet’.

Any point in the zone below the line represents hot water.

Any point in the zone above the line represents **super-heated steam**.



Although most steam hose applications involve **Saturated Steam, two quite different conditions can cause the steam to turn into super-heated steam.** They are:



## Temperature of Saturated Steam

1. *An increase in temperature*
  - a. This can result from faulty operation of the steam generating equipment which could cause a temperature increase without a corresponding increase in pressure.
2. *A decrease in pressure*
  - a. In an open-end steam line operating at a gauge pressure of 60 PSI, the temperature at the boiler end of the line will be 153 degrees Celsius and at the open end the gauge pressure will be zero and the temperature 100 degrees Celsius. For the steam in this line to remain saturated, the temperature drop along the line should be from 152 degrees Celsius to 100 degrees Celsius. If the steam line is not installed correctly, the pressure/temperature relationship could be such that the **saturated steam** has been changed to **super-heated steam**.
  - b. The sudden opening of a valve in a steam line, or steam passing into a larger diameter pipe can result in pressure drop which, unless accompanied by a corresponding temperature drop can result in **saturated steam** changing into **super-heated steam**.

PSI	Gauge Pressure			Temperature	
	KG CM <sup>2</sup>	ATM	BAR	°C	°F
25	1.76	1.70	1.73	130	267
30	2.11	2.04	2.07	134	274
35	2.46	2.38	2.42	138	281
40	2.81	2.72	2.76	141	287
45	3.16	3.06	3.11	144	292
50	3.52	3.40	3.45	148	298
60	4.22	4.08	4.14	153	307
70	4.92	4.76	4.83	158	316
80	5.62	5.44	5.52	162	324
90	6.32	6.12	6.21	166	330
100	7.03	6.80	6.90	170	338
120	8.44	8.44	8.28	177	350
140	9.84	9.84	9.66	182	361
160	11.25	11.25	11.04	188	371
180	12.65	12.65	12.42	193	379
200	14.06	14.06	13.80	198	388
225	15.82	15.82	15.53	203	397
250	17.58	17.58	17.25	208	406
275	19.33	19.33	18.98	212	414
300	21.09	21.09	20.70	216	422
325	22.85	22.85	22.43	221	429
350	24.61	24.61	24.15	225	437

***Make sure that you have all the facts, and don't hesitate to ask if you are in doubt. Steam is dangerous; it is much better to spend a little more time at the enquiry stage than to have a hose fail prematurely in service because something was left to chance.***