Tech Sheet #SPD 202

Stall: Definition, Causes, and Effects

Steam is an excellent heat transfer medium, used as the primary process heating source in a wide range of industries from refining, chemicals, paper, pharmaceutical, food & beverage, and even for comfort heating in commercial and institutional buildings. The heat energy content of steam, typically measured in British Thermal Units (BTUs), is transferred from steam to the process fluid or product through some type of heat exchanger or heat transfer equipment. In some cases, it can be difficult to maintain process heating temperatures or the heat transfer equipment may experience water hammer and reliability problems as result of condensate back-up where the movement of condensate ceases or *stalls*. Such a phenomenon, when condensate is unable to be drained from heat transfer equipment, is known as a stall condition, or more simply, "Stall".

Misunderstanding regarding the cause and effects of Stall leads some users to inadequate or ineffective attempts to resolve the no-flow condition. For example, some flooding of the equipment might actually be caused by mechanical failure of the steam trap or level pot/control valve combination), but this type of failure is not considered Stall. So then, what is Stall, and better yet, what should be done to overcome such an occurrence? A thorough understanding of Stall, its causes, and the problems that arise as a result of it will help users take proper corrective and preventive action.

- **Cause**
  Stall occurs when the modulated or condensed steam pressure exiting the heat transfer equipment falls below the back pressure after the steam trap (or level pot/control valve). A positive differential pressure ($P_{in} > P_{out}$) across the steam trap is necessary for proper condensate drainage, whereas a negative pressure differential across the steam trap results in Stall. When there is no pressure differential or a negative pressure differential ($P_{in} \leq P_{out}$) across the steam trap, condensate will backup and flood the equipment. This occurs most often in systems in which the inlet steam supply pressure is modulated to obtain a desired output (e.g., product temperature).

- **Effects**
  Stalled condensate can cause a variety of problems, including the following:
  - Reduction of heat or poor heat quality from inadequate condensate drainage
    - Off spec product, variance from process set temperature
  - Water hammer on tubes or plate and frame exchangers, damaged channel head gaskets
  - Frozen coils
  - Corrosion due to cool condensate and the formation of carbonic acid
  - Short equipment life
  - Control valve hunting (system cycling)

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- **Factors contributing to Stall**

  There is one cause of Stall: pressure differential at or across the condensate drainage device that is inadequate to drain condensate. The cause of the insufficient pressure differential, however, can vary. Some possible reasons for insufficient pressure differential follow:

  - Oversized heat transfer equipment (excessive heat transfer surface area)
  - Overly conservative fouling factors
  - High back pressure at equipment & drainage device due to elevation (lifting of condensate to the return line), obstruction in the return line or increase in static pressure in the return line (many times caused by open bypass valves and leaking steam traps)
  - Modulation of the steam supply control valve
  - Equipment operating at lower pressures due to reduced load demands
  - Vacuum in the steam heat transfer space

- **Possible solutions to Stall**

  A Secondary Pressure Drainer (SPD) is a vessel that uses high pressure steam or compressed air as a motive to provide positive pressure differential for complete condensate drainage. A Type 2 SPD must use only high pressure steam as its motive source, and is utilized as a solution for Stall to drain heat transfer equipment. Following is a chart showing when an SPD is needed for typical SPD applications. For further information about SPDs, see Tech Sheet #SPD 201.

Drainage Device Selection Guide Chart

Application		Device Type	Motive Source
Condensate Recovery		Type 1 SPD	Secondary Steam or Air
Equipment Drainage			
	Stall	Type 2 SPD	Secondary Steam
	No Stall	Steam Trap	Primary Steam