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## Thermal Shocking of Dimple Jackets and Vessels

X-7141-1

The definition of 'thermal shocking' of a dimple jacket or vessel is to cause a sudden temperature change. For dimple jackets, thermal shocking is defined as changing the cooling or heating media (at the inlet) more than 25° F per minute (change in media of 25° F or more). For vessels, thermal shocking is defined when the vessel media (liquid or air) changes by more than 50° F per minute (or a change in media of 50° F or a difference in dimple jacket media and vessel of 50° F more).

Rapid temperature changes causes an unequal rate of thermal expansion between the vessel wall and the dimple jacket resulting in high operating stresses in the dimple jacket and vessel material and welds. Thermal shocking may also cause damage to other dimple jacket or vessel attachments. Thermally shocking dimple jackets and/or vessels will shorten the service life significantly and may cause unscheduled down time and costs.

**Warning: The warranty on DCI vessels does not cover any damages caused by thermally shocking the vessel and/or dimple jackets.** If your process requires thermally shocking, please notify DCI so we can assist you by providing vessel and dimple jacket designs that can significantly prolong the life of the vessel and dimple jacket. DCI recommends no shocking per the above criteria for 304, 304L and 316/316L SS dimple jackets. LDX 2101® (S32101) and Duplex 2205 (S31803/S32205) can be used in "moderate" shock applications (25-35° F per minute per above criteria). Inconel 625® is recommended for "extreme" thermal shock applications (25-50° F per minute per above criteria).

There are ways you can avoid thermal shocking and still meet your process requirements. Tempering is the best way to avoid thermal shocking. The main point to remember is always 'temper' your temperatures whatever the process with the appropriate venting. Following the above temperature parameters and the following procedures will prolong your equipment life. Please contact DCI for any questions on your applications.

Some examples of thermal shocking are:

1. Instantaneously switching dimple jacket media from steam to cooling water.
2. Instantaneously switching dimple jacket media from cooling water to steam.
3. Steaming a vessel interior and introducing cold water into the dimple jacket or vessel (or vice-versa). SIP (Steam-In-Place) or 'Aseptic' procedure used commonly.
4. Cleaning a vessel at high temperatures and rinsing with cold water without tempering the rinse water. A very common but commonly overlooked thermally shocking condition.

Recommendations for the above examples are as follows, keep in mind the temperature recommendations listed above and that these are only recommendations:

1. When switching dimple jacket media from steam to cooling water one of the following procedures should be followed:
  - A. Method A-Forced Tempering
    - a. Vent steam out of jacket and completely drain condensate.
    - b. Let jacket cool down naturally or use a compressed air blow-down from top to bottom of jacket to achieve correct temperature.
    - c. Close vents and slowly introduce hot water at correct temperature to dimple jacket.
    - d. Increase flow rate to process conditions and decrease water temperature at a rate less than 25° F per minute to predetermined process conditions.



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- B. Method B-Natural Tempering
  - a. Vent steam out of jackets and completely drain condensate.
  - b. Let jackets cool down naturally to correct temperature.
  - c. Close vents and introduce cooling water.
2. When switching dimple jacket media from cooling water to steam one of the following procedures should be followed:
  - A. Method A-Forced Tempering
    - a. Raise circulating water temperature in jacket at a rate less than 25° F per minute to desired steam temperature.
    - b. Vent jackets and completely drain out water.
    - c. Close vents and slowly introduce steam into jacket.
  - B. Method B-Natural Tempering
    - a. Vent and drain water out of jackets.
    - b. Let jacket warm up naturally to correct temperature.
    - c. Slowly introduce steam into jackets at a reduced pressure and/or flow rate (temperature) until desired steam temperature is reached.
3. When steaming a vessel interior and introducing cold water into the dimple jacket or vessel the following procedures should be followed:
  - A. Method A-Forced Tempering (Dimple Jacket Side Method)
    - a. Introduce circulating water in the jacket at a temperature no more than 25° F less than the vessel temperature at steaming.
    - b. Lower circulating water temperature in jacket at a rate of less than 25° F per minute to desired cold water temperature.
  - B. Method B-Forced Tempering (Vessel Side Method)
    - a. Cool the vessel by introducing water 50° F or less than steam temperature and then tempering to reach desired low cooling water temperature.
    - b. Slowly introduce circulating cooling water temperature into the jacket.
  - C. Method C-Natural Tempering
    - a. Let the vessel naturally cool down while venting the vessel until the temperature is 50° F or less from the water temperature that will be introduced.
4. When cleaning a vessel at high temperatures, the following procedures should be followed:
  - A. Method A-Forced Tempering
    - a. Temper the rinse water 50° F or less from high temperature to reach desired low temperature while venting the vessel.
  - B. Method B-Natural Tempering
    - a. Let the vessel naturally cool down while venting the vessel.

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