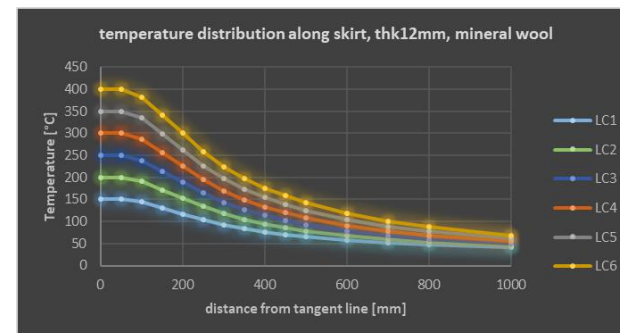


# Equipment Skirts Thermal Profile

## An Introduction



# Equipment Skirts Thermal Profile

## Why Determining Equipment Skirts Thermal Profile?

It is useful to know the temperature distribution along the axial direction of an equipment skirt to determine the extent of appropriate coatings and insulation...



# Equipment Skirts Thermal Profile

## Why Determining Equipment Skirts Thermal Profile?

... and to estimate skirt thermal expansion, used within piping stress analysis calculations.



# Equipment Skirts Thermal Profile

## The Kellogg's Method...

The well-known *Kellogg's Design Manual* provides an empirical tool for determining the average skirt temperature from process fluid temperature, presence or absence of insulation, skirt thickness and height.

DATE	THE M. W. KELLOGG COMPANY	SUBJECT
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VERTICAL VESSELS

2311 GENERAL STATEMENT

This manual subject provides design information concerning the supporting and guiding of all piping connected to vertical vessel nozzles.

The structural design of supports and guides, and the structures, are provided by the Vessel Design Group. However, the location on the vessel and the design criteria is calculated by Piping Mechanical and indicated on the Piping Planning Drawings to achieve the proper pipe stress analysis, pipe flexibility and vessel nozzle loading.

2312 VESSEL EXPANSION (FOR UNLINED VESSELS)

The thermal expansion movements of vessel nozzles due to process temperatures must be calculated in order to accurately analyze the connecting piping. The thermal expansion movement of any elevation on a vertical vessel is the skirt axial thermal expansion, plus, the summation of the axial thermal expansion of all of the constant temperature vessel shell zones below the subject elevation. The radial thermal expansion movement is based on the vessel radius at the desired elevation and the local zone temperature.

2312A Vertical Skirt Expansion

The axial or vertical movement of the lower vessel tangent line due to the skirt thermal expansion is calculated by using the average temperature of the skirt (see example below) and the skirt height.

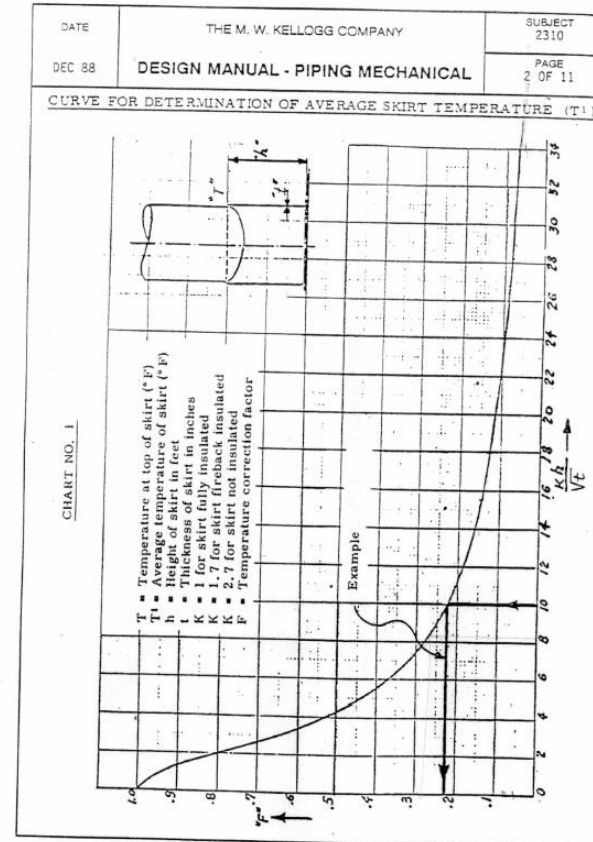
Example: calculate the average temperature of the skirt

Give the following conditions:

$T = 600^{\circ}\text{F}$   
 $h = 10'-0"$   
 $t = 1"$   
 $K = 1$  (skirt is fully insulated)

Step 1. Calculate  $\frac{K \cdot h}{\sqrt{t}} = \frac{1 \cdot 10}{1} = 10$

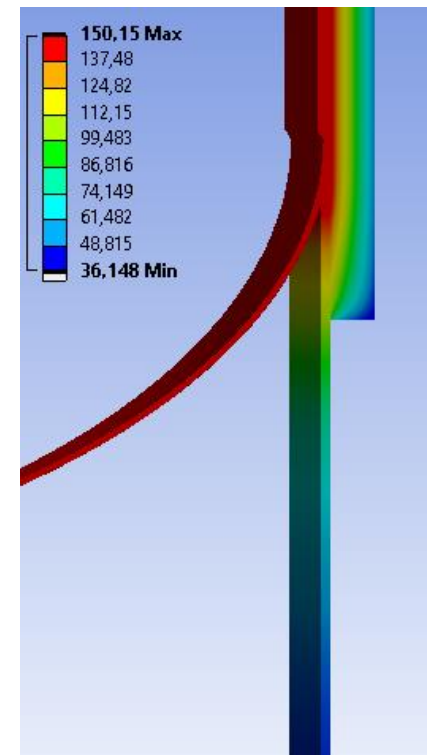
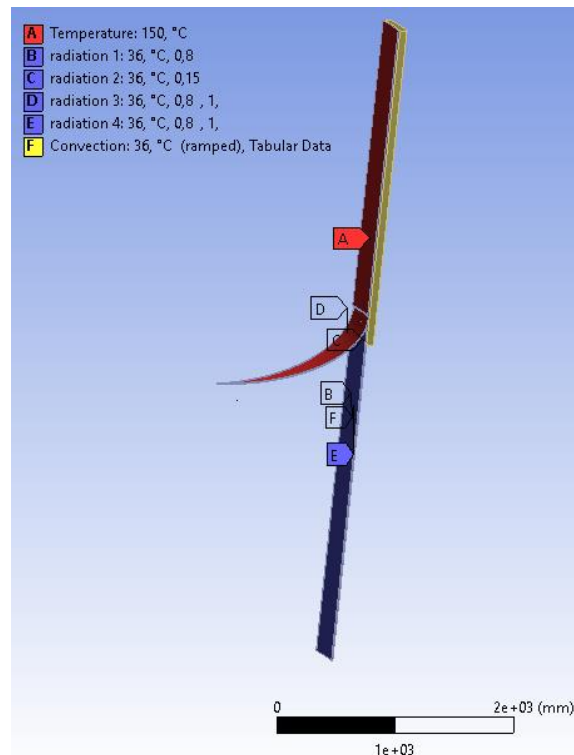
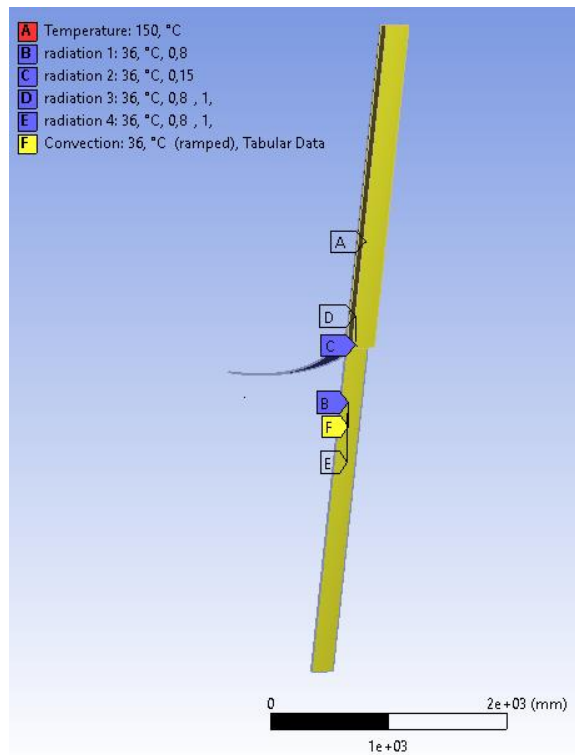
Step 2. Enter the Chart no. 1 at the point along the bottom line where  $K \cdot h / \sqrt{t} = 10$ . Then move vertically to the point where the curve is intersected. Then move horizontally to the left to find the temperature correction factor  $F$ , which in this example is equal to 0.22.



# Equipment Skirts Thermal Profile

## ... and the Numerical Simulation Approach

Unfortunately, Kellogg's method does not provide further insight into temperature profile along skirt axis, which, however, can be described by numerical thermal simulations.

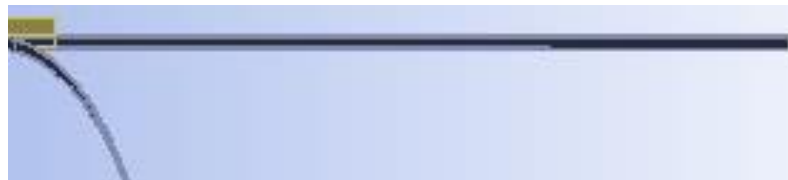
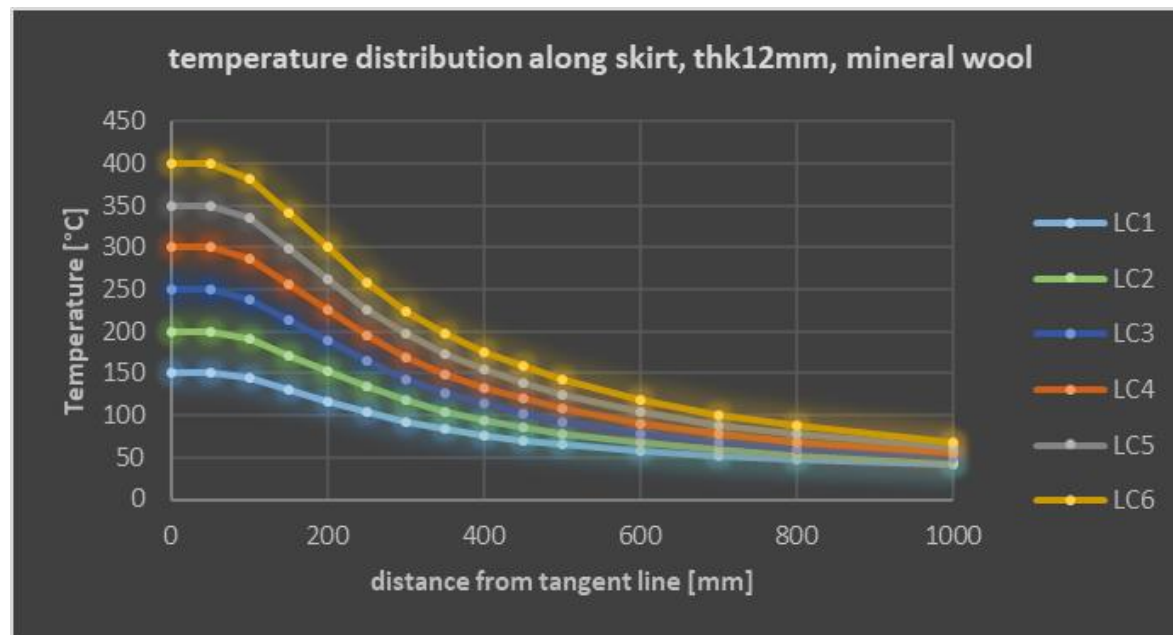




# Equipment Skirts Thermal Profile

## Axial Temperature Profiles

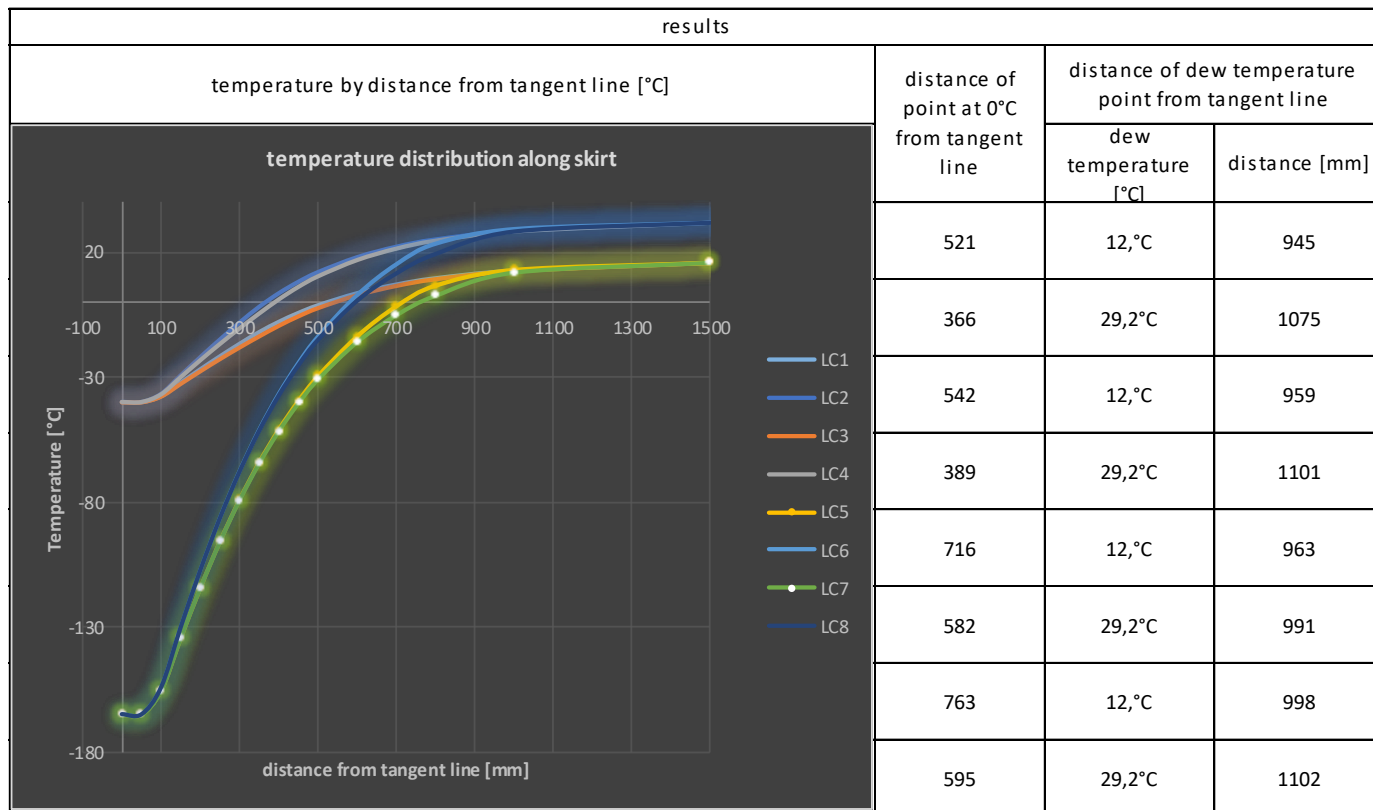
An adequate virtual experimental campaign in line with to Design Of Experiments good practices can identify the axial temperature distribution for most Oil&Gas typical cases.



# Equipment Skirts Thermal Profile

## Critical Temperature Areas Identification

Areas where temperatures reach critical values for paints or dew/frost points can also be identified in this way.



# Equipment Skirts Thermal Profile

## Methods Validity

Lastly, the calculated axial thermal expansion values are essentially like those obtained by the Kellogg's method.

