Compression Sleeves - A Pragmatic Approach to Managing Design Variables and Constraints

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This paper provides a parametric overview of the design parameters that influence the installation and performance of Type A compression sleeves on pipelines. When designed and installed correctly, Type A compression sleeves can be effective in reducing the net hoop stress in the carrier pipe. At the functional level, the interaction between a compression sleeve and the carrier pipe manifests as an interference fit where the installation is achieved by way of thermal expansion of the sleeve rather than by the use of mechanical force (without the interference fit aspect, the functionality degrades to a traditional Type A sleeve).

On account of the nature of the initial stresses imparted on the sleeve (tensile) and the carrier pipe (compressive) during installation, some level of optimization of installation parameters is necessary to achieve the desired final stress levels in the carrier pipe as well as the sleeves. This requires careful consideration of the temperature difference between the carrier pipe and the sleeve, material properties of both the pipe and the sleeve, sleeve thickness, and operation and hydrostatic testing pressures. By way of examples, the paper demonstrates the influence of such parameters on the performance of compression sleeves and the resulting state of stress in the carrier pipes. The paper will also address the effect of installation pressure on the performance of the sleeves.

The paper follows an analytical approach that utilizes spreadsheet-based mathematical modeling of the system parameters as well as finite element analysis (FEA). FEA results also provide additional insight into the circumferential and axial distribution of stresses along the sleeve as well as the carrier pipe. A more rigorous understanding of the performance of the compression sleeves will allow wider application opportunities for such sleeves and allow better control of the performance.

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