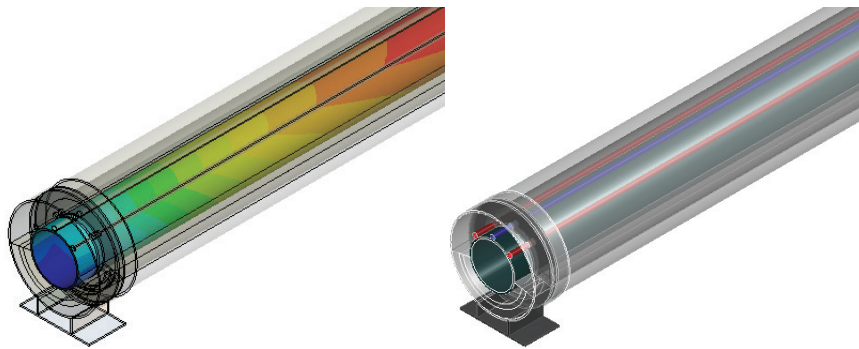


# THERMAL FINITE ELEMENT ANALYSIS

nVent offers sophisticated engineering analysis tools such as Finite Element Analysis (FEA) and Computational Fluid Dynamics (CFD) for providing valuable insights into the details and complexity of heat-tracing applications. FEA and CFD techniques take into account the system's geometry, specifications, material properties and environmental conditions. Such modelings consider all these aspects to optimize a heat-tracing design, provide cost effective design options, and deliver confident solutions to problems not solvable with conventional techniques.

Our extensive heat-tracing knowledge, in conjunction with years of FEA and CFD experience, provides a valuable capability to develop, analyze, and optimize any heat-tracing design. nVent can also experimentally test heating cables under different scenarios to help verify and calibrate FEA models.

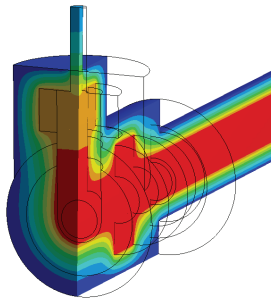


Typical insulated pipe model with one pass of heat tracing

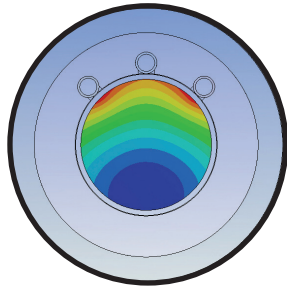
Through the use of cutting-edge tools such as FEA and CFD, nVent is able to provide unmatched understanding and competency to design and predict the performance of heat management systems by:

- Identification of non-uniform thermal characteristics, including localized hot or cold spots for critical services.
- Cost savings associated with optimization of the heat-tracing design relative to cable length, heat output, insulation requirements, and heater placement.
- Simulation of heat tracing with complex structures or equipment, which cannot otherwise be evaluated with sufficient accuracy.
- Prediction of thermal profiles for various heating scenarios, to assist with locating temperature sensors and temperature sensitive devices.
- Evaluation of transient heat-up or cool-down thermal profiles as environmental conditions change, or heat tracing is energized or de-energized.

**nVent is able to provide Finite Element Analysis (FEA) modeling expertise for heat-tracing design development and optimization**



Heat-Traced Valve Body



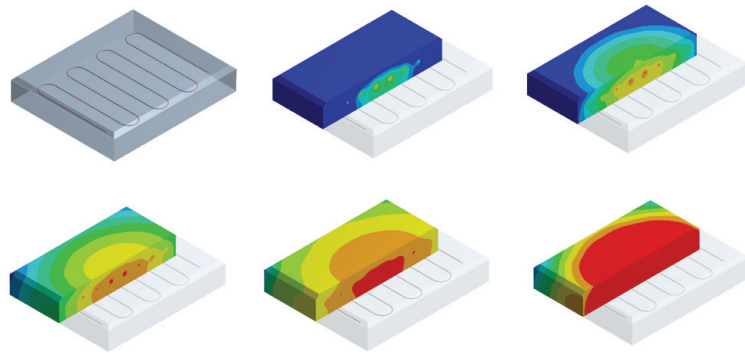
Melting of Solidified Sulphur using two STS heaters (left and right) and independently monitored by fiber optics in a tube at the 12 o'clock position

nVent also has the experience to build and simulate FEA and CFD models for special heat-tracing applications which cannot be solved accurately through conventional methods, such as sulphur pipelines. nVent can evaluate and refine the thermal performance of complex geometries or operating conditions, reducing high costs required to cover otherwise unknown variables.

Listed below is a sampling of special heat-tracing applications completed by nVent with critical FEA and CFD modeling contributions.

- Transit Running Surface Freeze Protection
- Deployable Remediation Probes
- Unconventional Piping Equipment
- Vessels and Tanks (Surface and Base Slab Heating)
- Transient Sulphur Remelt
- Sheath Temperature Prediction of Heaters
- Duty Cycle Performance of Heaters
- Oil Well Flow Assurance & Reservoir Heating

A heat-traced system's heat-up and cool-down characteristics can be evaluated by performing a transient FEA/CFD. A transient thermal FEA/CFD model is used to evaluate the changing temperature gradient over time, and calculate real world heating/cooling scenarios. Results can be associated with phase change, thermal stresses, flow rates, and other useful parameters for defining a system or process.



Transient heat-up of a concrete slab with embedded heat tracing

**nVent uses FEA to enhance project designs and deliverables by modeling typical heat-tracing components such as piping, flanges, supports, valves, and concrete slabs. Simulating these components helps optimize cable and thermal insulation selections, power requirements, and heater configuration or adds; all of which improve cost savings.**

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