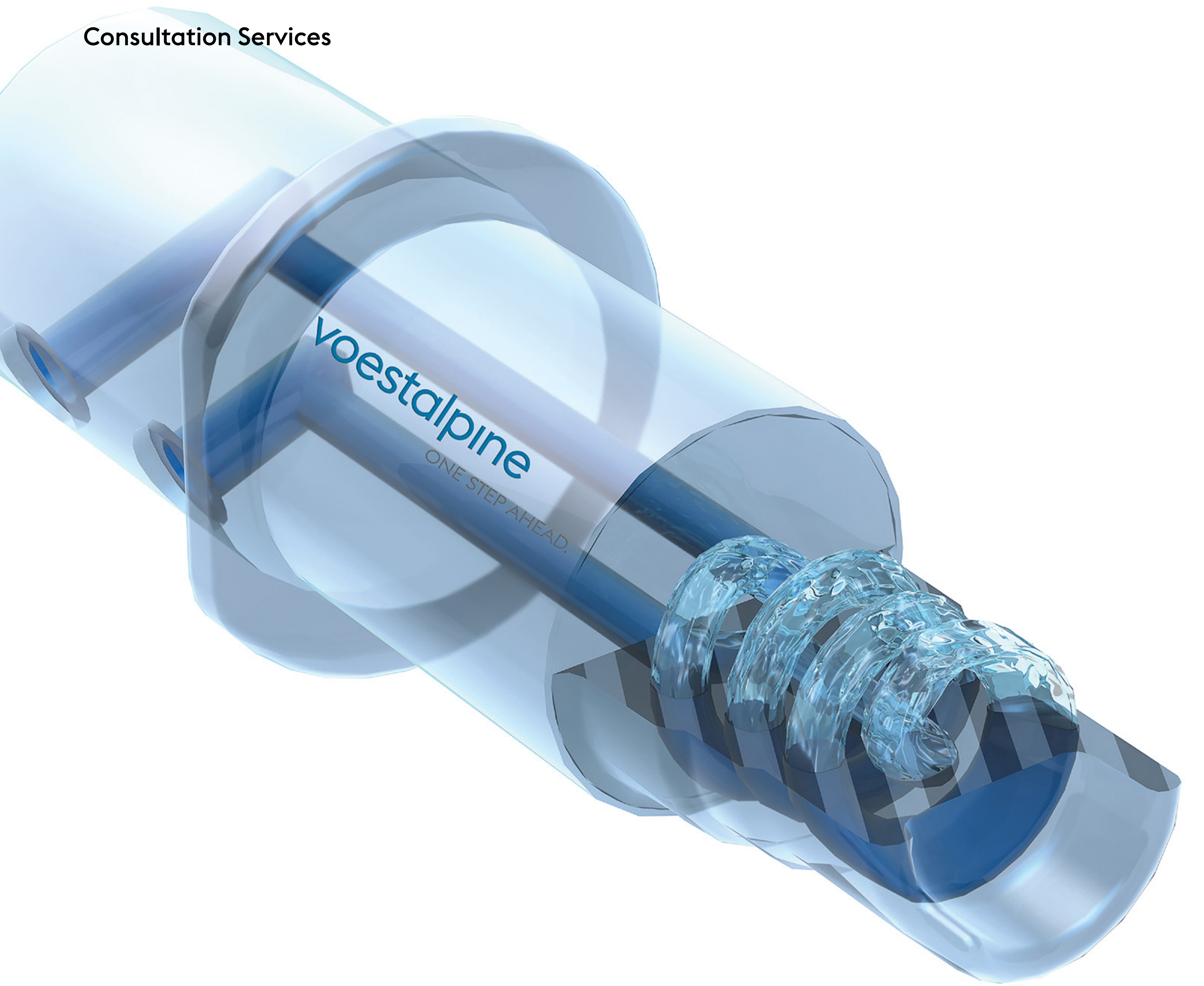
voestalpine

ADDITIVE MANUFACTURING CENTERS
NORTH AMERICA

Consultation Services



voestalpine Additive Manufacturing Centers
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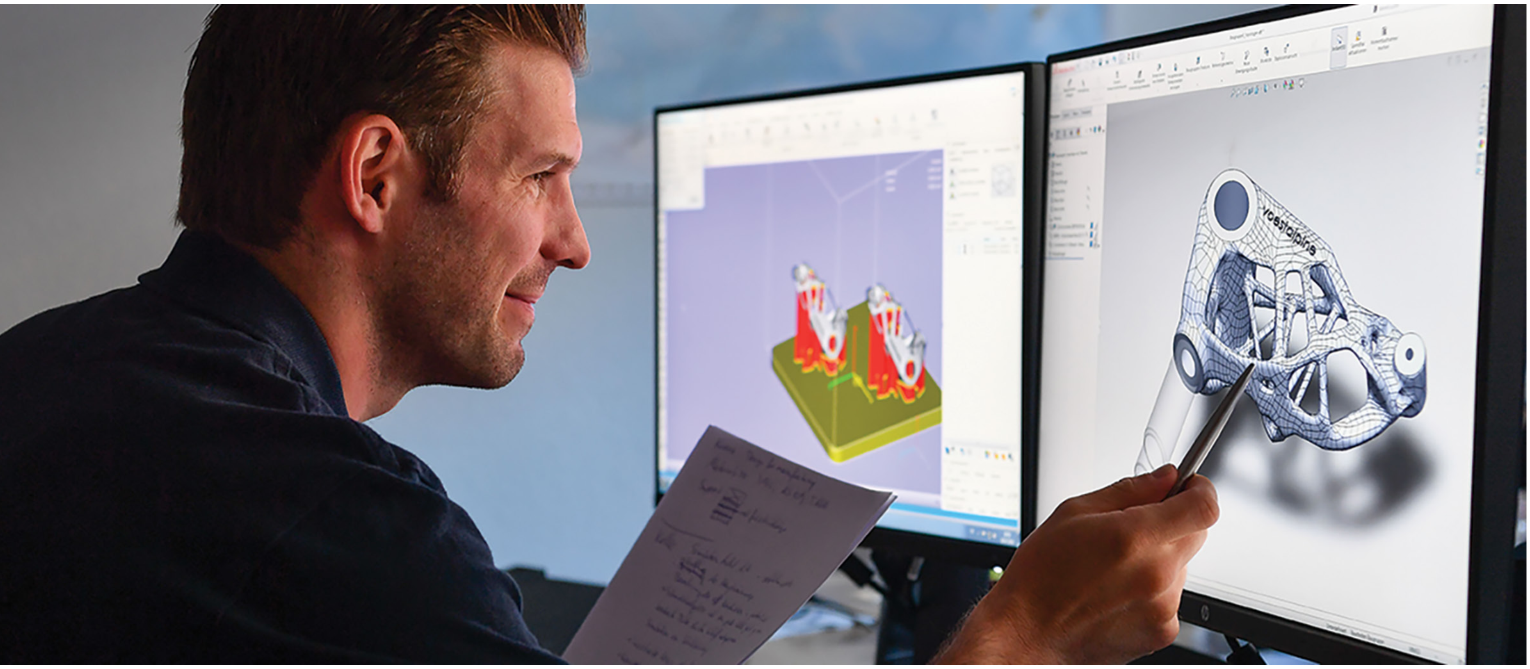
ONE STEP AHEAD.

CONSULTATION SERVICES



Harnessing the power of design and simulation software before utilizing additive manufacturing (AM) offers many advantages that streamline the production process, enhance product quality, and drive cost efficiency.

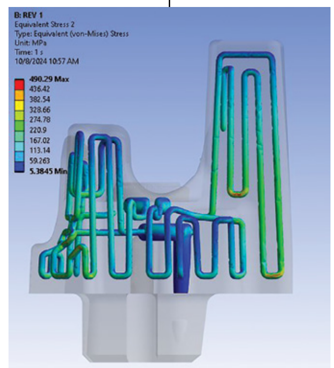
By simulating the end-use environment of AM components and optimizing designs for maximum effectiveness, companies can minimize unnecessary expenditures and significantly reduce risks when implementing AM solutions.

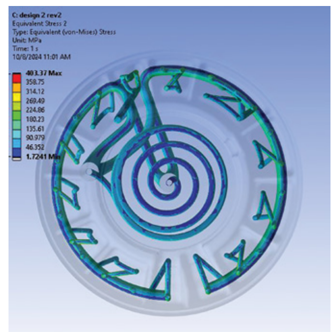
This virtual approach accelerates design iterations, catching potential errors early and ensuring robust design optimization through finite element analysis (FEA) or topology optimization. Enhanced predictive analysis, encompassing structural, thermal, and stress simulations, leads to superior part performance and quality by pre-emptively addressing potential issues.

At voestalpine Additive Manufacturing Centers, we offer a wide range of design consultation services, allowing our customers to bring products to market faster and more efficiently, leading to bottom-line savings. Contact us today to discuss your project.

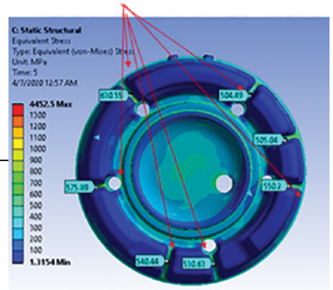
Structure Solver Capabilities

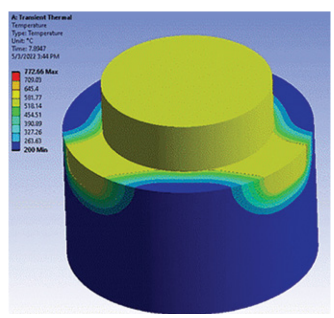
- **Thermo-Mechanical Analysis** - is a comprehensive simulation approach that evaluates the combined effects of thermal and mechanical stresses, particularly in high-stress environments like die casting. This method is essential for accurately predicting how materials behave under operating conditions where temperature fluctuations and mechanical loads are present.
- **Linear Static Analysis** - used to determine the response of structures under static loads, assuming linear relationships between loads and responses and disregarding time-dependent effects.
- **Nonlinear Static** - used in structural engineering to determine the response of structures under static loads, accounting for nonlinear relationships between loads and responses, material nonlinearity, geometric nonlinearity, and large deformations.
- **Nonlinear Geometry** - refers to the consideration of geometric nonlinearity in structural analysis, where deformations are large enough that the linear assumptions of geometry (such as small displacements and rotations) no longer hold, necessitating the inclusion of effects like changing stiffness and load paths.
- **Buckling - Linear Eigenvalue** - is a method used in structural engineering to predict the critical load at which a structure becomes unstable and buckles.
- **Buckling - Nonlinear** - is a method used in structural engineering to predict the buckling behavior of structures under loads, considering both geometric and material nonlinearities.
- **Steady-state Analysis to a Thermal Condition** - is a method used to determine the temperature distribution in a structure under constant thermal loads, assuming that temperatures and heat flow do not change over time.

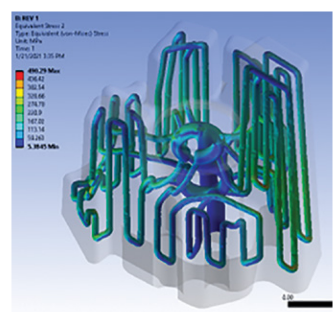


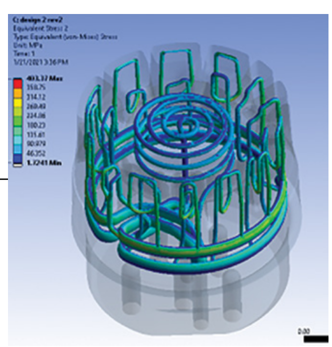


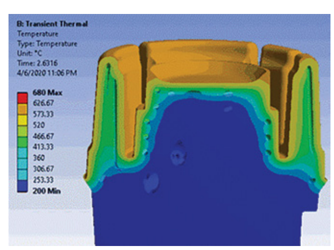
Potential cause of failure in the AM part, geometry change is recommended





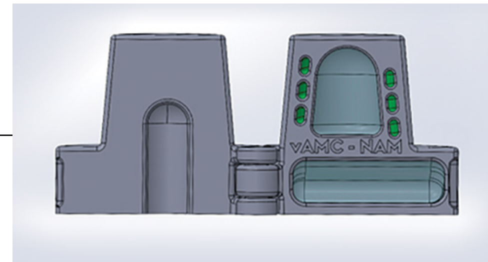


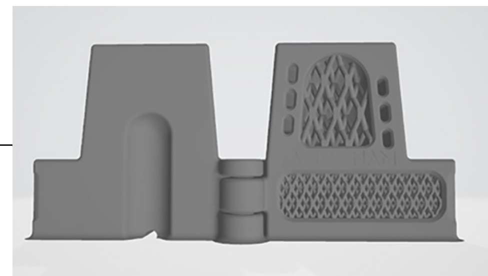




Topology Optimization

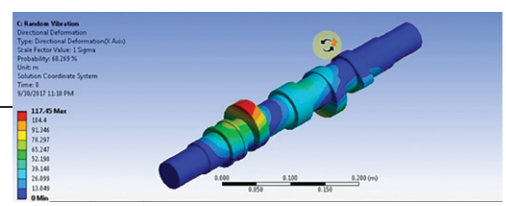
- **Structural Optimization** - Structural topology optimization is a computational technique used to determine the optimal material layout within a given design space.
- **Modal Optimization** - Modal topology optimization is a technique used to determine the optimal distribution of material within a structure to enhance its dynamic properties.
- **Thermal Loads** - Thermal topology optimization is a method used to optimize the distribution of material within a structure to improve its thermal performance, such as maximizing heat dissipation or minimizing thermal stresses.
- **Manufacturing constraints** - Topology optimization with manufacturing constraints refers to the process of optimizing the shape or layout of a structure considering the limitations and capabilities of the manufacturing process.
- **Stress constraints** - Topology optimization with stress constraints involves optimizing the shape or layout of a structure while ensuring that the stresses induced by loads and boundary conditions remain within acceptable limits.
- **Symmetry** - Symmetry topology constraint in optimization refers to the requirement that the optimized design maintains a symmetric layout or pattern.
- **Lattice Optimization** - Lattice optimization topology refers to a specific type of topology optimization where the design is optimized to include lattice structures within the material layout.
- **Overhang/Additive Constraints** - Overhang or additive manufacturing constraints typically include considerations such as the maximum allowable overhang angles that the printer can support without requiring additional support structures.

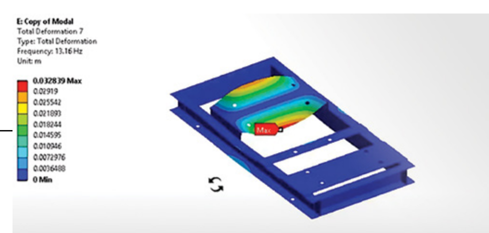




Vibrations

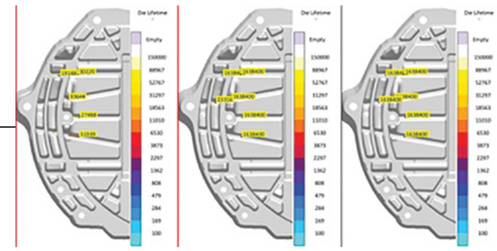
- **Modal Pre-Stressed/Damped Analysis** - refers to a type of dynamic analysis where the structure's natural frequencies and mode shapes are computed considering both pre-stress and damping effects.
- **Transient Mode Superposition** - is a technique used in structural dynamics to analyze the response of a structure subjected to transient (time-varying) loads.
- **Random Vibration Analysis** - deals with the response of structures subjected to stochastic (random) excitation forces or inputs, which can vary unpredictably over time.
- **Harmonic Analysis** - in structural dynamics involves studying the response of a structure to harmonic (sinusoidal) excitation forces or displacements that vary with a constant frequency.
- **Rotodynamic Analysis** - involves the study of the dynamic behavior of rotating machinery and systems.
- **Harmonic Acoustic Analysis** - involves studying the acoustic response of structures or systems to harmonic excitation, typically in the context of sound waves generated by vibrating structures or machinery.





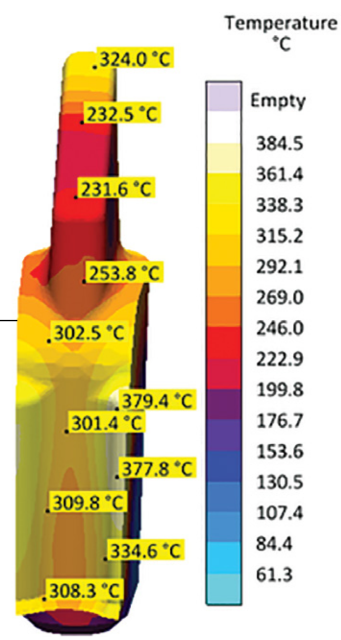
Durability

- **Stress-Life (SN)** - Stress-Life (S-N) analysis, commonly known as fatigue analysis, is a method used to predict the fatigue life of a material or component subjected to cyclic loading.
- **Strain-Life (EN)** - Strain-Life (ε-N) analysis is a method used to predict the fatigue life of a material or component based on the relationship between cyclic strain amplitudes (ε) and the number of cycles to failure (N).
- **Safety Factor** - In durability analysis, the safety factor refers to a margin of safety applied to the predicted fatigue life or durability of a component or structure.
- **Thermo Mechanical Fatigue (TMF)** - refers to the phenomenon of material fatigue failure caused by cyclic mechanical loading combined with cyclic temperature variations.
- **Vibration Fatigue** - refers to the process of material fatigue induced by cyclic mechanical vibrations. It occurs when components or structures are subjected to repeated vibrational forces, leading to progressive damage and eventual failure over time.



Thermal

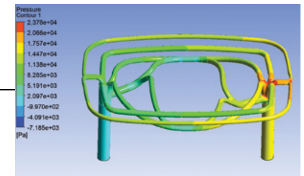
- **Steady State Thermal Analysis** - is a method used to calculate the temperature distribution within a structure when the heat transfer conditions have reached a stable state.
- **Transient Thermal Analysis** - is a method used to predict the temperature distribution within a structure over time when subjected to time-varying thermal loads or boundary conditions.
- **Conduction/Convection** - is the transfer of heat through a material or between materials that are in direct contact, without any bulk movement of the material itself.
- **Convection** - is the transfer of heat between a solid surface and a moving fluid (liquid or gas) through the bulk motion of the fluid.
- **Radiation to Space** - refers to the thermal energy transfer from a surface to its surroundings through electromagnetic waves (radiation), specifically in the form of infrared radiation.
- **Radiation Surface to Surface** - refers to the heat transfer mechanism where thermal energy is exchanged between two surfaces through electromagnetic waves (radiation).
- **Phase Change** - refers to the process in which a substance transitions from one state of matter to another, such as from solid to liquid (melting) due to changes in temperature or pressure.

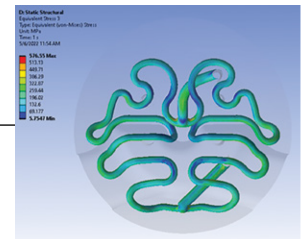


Ansys Fluids:

Single-phase Non-Reacting Flows

- **Incompressible Flow** - refers to fluid flow in which the density of the fluid remains constant throughout the flow field.
- **Compressible Flow** - refers to fluid flow in which the density of the fluid varies significantly throughout the flow field in response to changes in pressure, temperature, or velocity.
- **Porous Media** - refers to materials or substances that contain interconnected voids or pores, which allow fluids (liquids or gases) to flow through them.
- **Non-Newtonian Viscosity** - refers to the viscosity behavior exhibited by fluids that do not follow Newton's law of viscosity.
- **Turbulence** - Turbulence refers to the chaotic and irregular flow of fluids characterized by rapid fluctuations in velocity, pressure, and vorticity





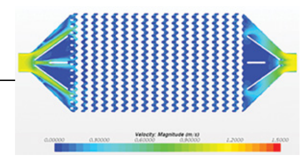
Heat Transfer

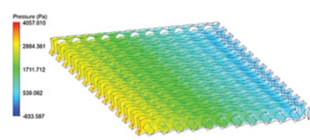
- **Natural Convection** - Natural convection refers to the process of heat transfer in a fluid (liquid or gas) due to density differences that arise from temperature variations.
- **Conduction and Conjugate Heat Transfer** - Conduction is the transfer of heat through a material or between materials that are in direct contact, without any bulk movement of the material itself.

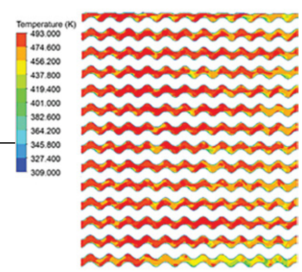
  Conjugate heat transfer refers to the simultaneous heat transfer by conduction within solids and by convection (and possibly radiation) in adjacent fluids or gases.
- **Internal/External Radiation**

  Internal radiation refers to the exchange of thermal energy between surfaces or within a medium that is enclosed or surrounded by other materials.

  External radiation refers to the exchange of thermal energy between surfaces or components that are exposed to surroundings outside of the system.
- **Solar Radiation & Load** - refers to the amount of thermal energy transferred to a surface or system from the Sun through electromagnetic waves (solar radiation).
- **Simplified Heat Exchanger Model** - refers to a theoretical or simplified representation of a heat exchanger system used for analysis, design, or simulation purposes.
- **Porous Media** - refer to materials or substances that contain interconnected voids or pores, allowing fluids (liquids or gases) to flow through them
- **Non-Equilibrium Thermal Load** - refers to a transient or time-dependent thermal condition where the system or component undergoes thermal changes that disrupt or deviate from thermal equilibrium.







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