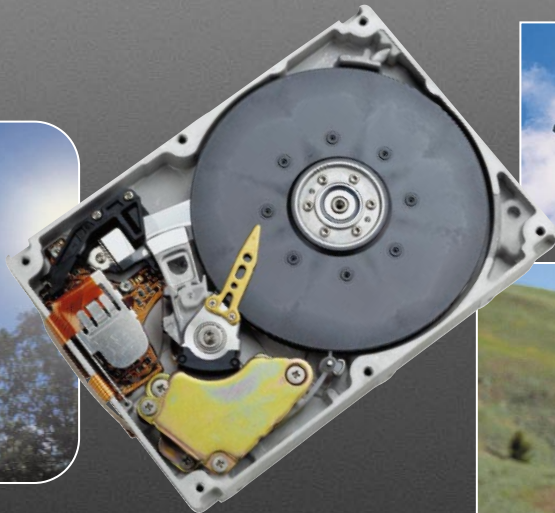
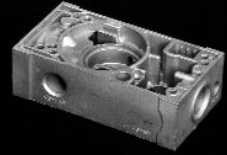




Viscous Forged Semi Solid Materials

A New **Material** Advantage

- Near Net Shape Precision
- Peak Mechanical Performance
- Lower Manufacturing Costs
- High Integrity and Pressure-Tight



Product Applications

- Complex, near net/net shape parts
- Pressure-tight, gas or fluid containing to 5,000 + psi
- High precision/repeatability
- Structural parts requiring strength & ductility
- Wear parts requiring high through hardness
- Weldable, heat-treatable, plateable, clean, smooth surfaces



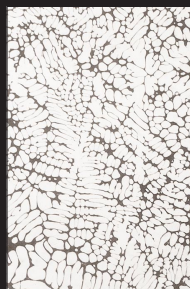
Technical Approach

- Optimize for end-product manufacturability
- Anticipate & implement machining/finishing/assembly steps
- Innovative tooling to minimize cost and accelerate product delivery
- Engineering from shape/ProE/CAD to drafted, complex 3-D tool model

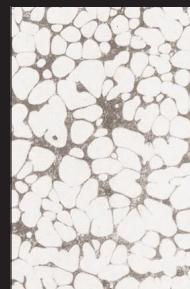
Semi Solid Material (SSM)

Vforge SSM components exhibit superior mechanical performance and integrity derived in part from a transformation in the alloy microstructure. High-grade, conventional ingot which normally exhibits a dendritic, branch-like microstructure is continuously cast into bar. During SSM bar casting, electromagnetic stirring or other means refines the microstructure, generating fine crystals. During the Vforge heating process, this structure transforms, resulting in a “ball-bearings in honey” microstructure that significantly improves material flow and achieves **Higher Mechanical Performance**.

Microstructure
– Conventional



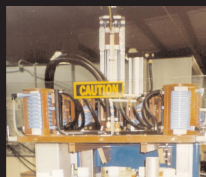
Microstructure
– Vforge SSM



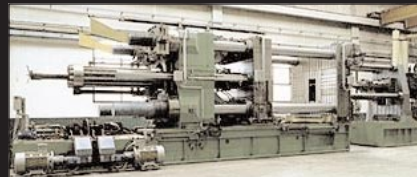
Manufacturing

The unique viscous material retains its shape until a shear force is applied as in the knife-cut photo above. Using simple pick and place devices, operators load the slug directly into the shot sleeve. The semi solid slug is injected into the die cavity based on an optimum pressure/velocity curve, yielding complex parts that are **Pressure Tight and Net/Near Net Shape**.

Finishing steps may include assembly operations, coatings/painting/ anodizing, **Full T5/T6 Heat Treatment or CNC Machining**.



Vforge Heating System

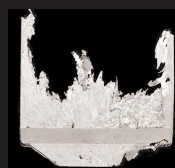


Vforge Hydraulic Forming Press

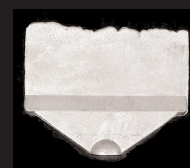
Systems Excellence

SSM material is received at Vforge and subjected to a full metallurgical inspection. One month inventory is maintained for a variety of alloys. High-speed band saws cut multiple bars to the desired shot weight, ensuring repeatability and efficiency. Slugs are then induction heated on a carousel indexing table, maintaining strict control within the alloy melting range. This process control provides for a consistent liquid/solid fraction, maintaining the ideal viscosity to fill the die cavity with a predictable, non-turbulent front thereby **Eliminating Porosity**.

ISO 9002 Quality Compliant

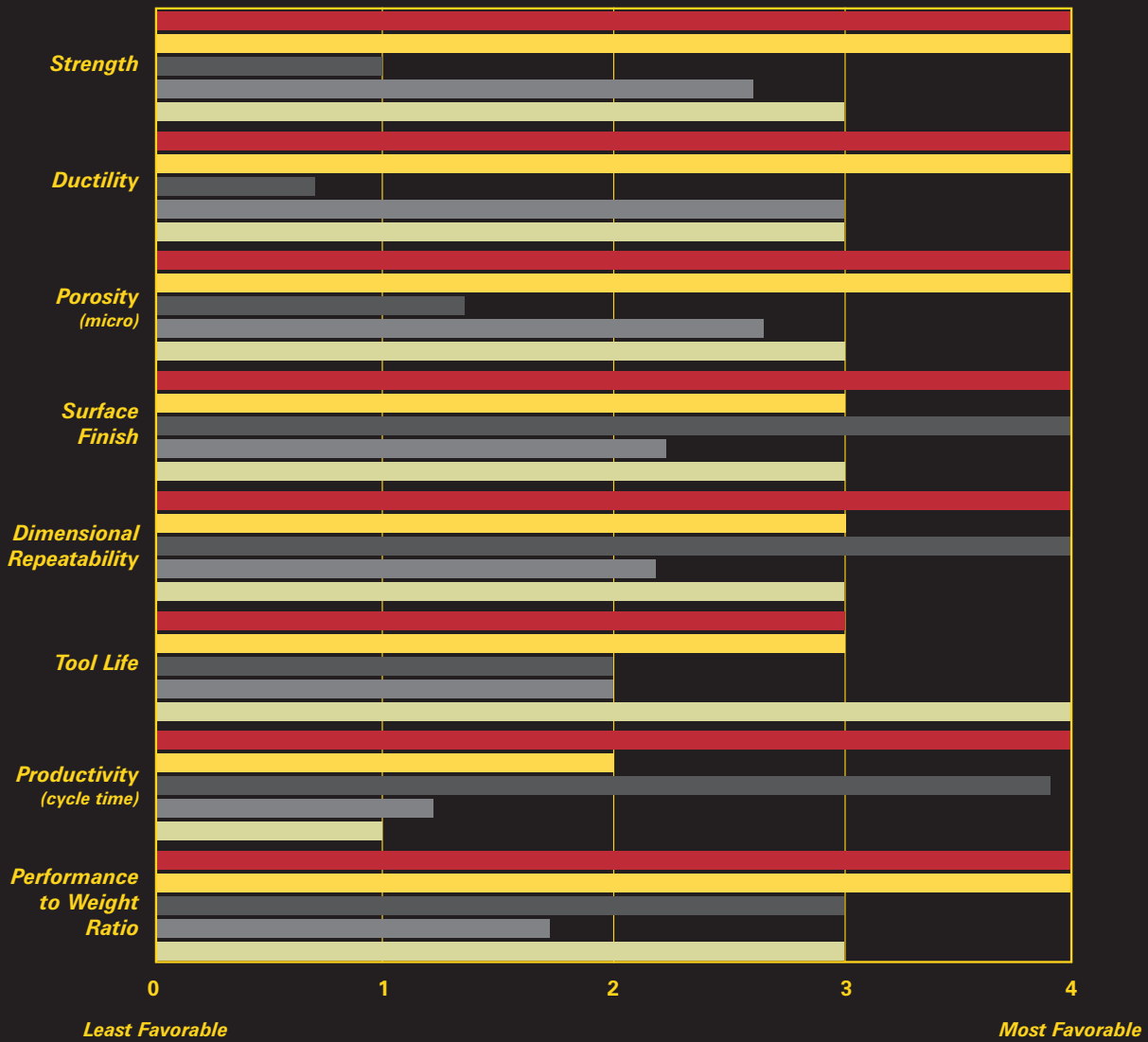


Conventional Liquid



Vforge SSM

Process Comparison



Superior Metal - Forming Technology

Diecasting
 Permanent Mold
 Investment
 Forging
 Vforge

Production Timeline

Week	Vforge	Client
1	Manufacturing review Drawing file finalized	Part specifications
2-4	Tool design Final part 3-D model for tool	Final part / 3-D model approval
5-10	Tool build	
11-12	Process optimization	
13-14	Sample submission	Sample review
15		Sample approval
16	Production ready	Order production

