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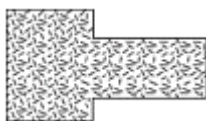
The Forging Advantage

Component Integrity

1. Directional Strength

When metallic materials are ‘worked’ these individual crystals or grains align themselves in the principal direction of ‘work’; a characteristic grain flow is developed, promoting directional strength in the product.

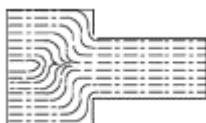
- **Cast Bar** – no grain flow or directional strength



- **Machined Bar** – the unidirectional grain flow has been cut when changing contour, exposing the grain ends. The material is more liable to fatigue failure and sensitivity to stress corrosion cracking.



- **Forged Bar** – directional alignment through the forging process; deliberately orientated in the direction which requires maximum strength. This also improves ductility, impact and fatigue properties.

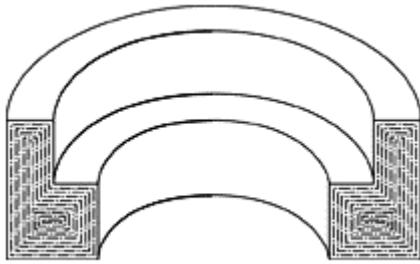


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- Custom Forging – forging stock is typically ‘pre-worked’ to refine and consolidate the as cast structure, removing defects and porosity. Mechanically deforming the heated metal under controlled conditions produces a predictable grain flow and uniform grain size.



- These qualities translate into
 - Superior metallurgical properties
 - Superior mechanical qualities
 - Increased directional strength within the part

2. Structural Strength

- Forging provides a degree of structural integrity that is un-matched by other metal working processes.
- Forging eliminates internal voids and gas pockets, which can weaken metallic parts and structures; dispersing alloy segregation and providing superior chemical uniformity.
- Predictable structural integrity reduces part inspection requirements, simplifies heat treatment and machining requirements.
- Ensures optimum part performance under field conditions.

3. Impact Strength and Fatigue Resistance

- Components can be forged to meet any stress, load or impact requirement.
- Orientation of grain flow assures maximum impact strength and fatigue resistance.

4. Strength to Weight Ratio

- The high strength properties of the forging process can be used to reduce section thickness and overall weight without compromising component integrity.

5. Compatibility

- Forged components have superior response to all forms of heat treatment.
- Absence of structural defects means forgings offer the best opportunity for strong, efficient welds.
- Lack of internal discontinuities and surface inclusions means that forgings provide a dependable machining micro-structure for metal-cutting processes.
- Forged parts can be fabricated by welding, bolting or riveting and are suited for most surface condition treatments.
- A forging can be designed to eliminate multiple assembly components.

Component Flexibility

1. Component sizes

- Limited only by the size of ingot which can be cast, forgings can range from 0.5kgs to 500 tonnes.
- Forgings are often specified for their soundness instead of rolled bars, plates and castings.
- Components which are too large to produce by any other method.

2. Versatility of component shapes

- Bar, shaft and ring configurations
- Hollow forgings
- Flange, single and double boss forgings
- Limited only by the creative skills and imagination of the forge-master

3. Metallurgical range / spectrum

- Forgings can be manufactured from all ferrous and non-ferrous metals.
- The forging process can be adjusted through; selection of alloys, temperatures, methods of work and post forging techniques to deliver virtually any desired metallurgical property.

4. Quantity and prototype options

- Forgings are custom made, purchase options from one to thousands, as required.
- Forgings can offer low volume prototypes, to test component designs of similar grain flow, deformation and other beneficial characteristics.

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Economic Advantages

1. Material savings

- Forging can measurably reduce material costs since less starting metal is required to produce many component shapes.
 - Example, a forged ring versus a torch cut ring from plate material

2. Machining economies

- Forging can yield machining, lead time and tool life advantages.
- Savings by forging to net or near net shape, closer to finish size than is capable by plate or bar rolling.
- Less machining is required to complete the component with benefits on shorter lead time plus reduced wear and tear on equipment.

3. Reduced rejection rates

- Providing weld free components, produced with cleaner forging quality material;
 - Improved structural integrity
 - Forging can virtually eliminate rejections

4. Production efficiencies, using forging processes

- The same component can be produced from different sizes of starting stock, allowing a wider variety of inventoried grades.
- This flexibility means that any forged component of any grade can be manufactured quickly and economically.

Comparative Analysis

1. When compared to machined bar – forgings deliver

- Contoured grain flow – which delivers; directional strength, greater impact and fatigue resistance.
- Material cost savings
- Reductions in waste
- Less machining and better tool life
- Material and size range options

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2. When compared to weldments / fabrications – forging deliver

- Superior and more consistent metallurgical properties
- Reduced labour, rework and rejection / replacement costs
- Stronger components due to the elimination of welds
- Single piece design and inspection efficiencies
- Simplified production requirements

3. When compared to castings – forgings deliver

- Directional grain flow and superior final component strength
- Continuous grain flow for the optimum combination of fatigue strength and toughness
- Structural integrity and product reliability
- Reduced process control and inspection requirements
- More predictable response in heat treatment

4. When compared to torch cut plate – forgings deliver

- Controlled directional grain flow for the optimum combination of strength, toughness and fatigue strength
- Significantly greater size and grade flexibility
- Elimination of porosity and laminations
- Reductions in material cost
- Reductions in waste

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