


TIMKEN[®]

MicroTec[®]

Timken[®] Microalloy Steel 



THE TIMKEN COMPANY

A high-magnification micrograph of a steel microstructure. The image shows a complex, interlocking pattern of light and dark regions, characteristic of a ferrite-pearlite structure. Numerous small, bright, dot-like precipitates are scattered throughout the matrix, representing vanadium carbonitride particles. The overall appearance is a dense, textured network of fine-scale features.

MicroTec® steels are designed to produce ferrite-pearlite microstructures that achieve added strength over the matrix microstructure through fine carbonitride particle dispersions. The rows of dots you see in this photograph show vanadium carbonitride precipitates in ferrite at a magnification of approximately 50,000x. They give the microalloy steels their added strength. Through extensive research, we have discovered that by carefully changing the proportions of various elements in the chemical formula of our MicroTec steels, we can enhance specific characteristics of the steel.

Timken – A Leader in Microalloy Steel Technology



The Timken Company has assembled a team of experts and become a leader in microalloy steel research and application over the last decade.

In the early 1970s, researchers found that by adding small amounts of carbonitride-forming elements, they could improve the strength of medium-carbon steel in the as-rolled or as-forged condition.

This discovery suggested a low-cost alternative to heat-treated steels and paved the way for rapid developments in microalloy steel technology.

Today, the family of Timken® products offers a wide array of medium-carbon

microalloy steels, which allow manufacturers to reduce costs, increase productivity and improve performance. Our MicroTec® microalloy steels can be used in applications where moderate levels of strength and ductility are required.

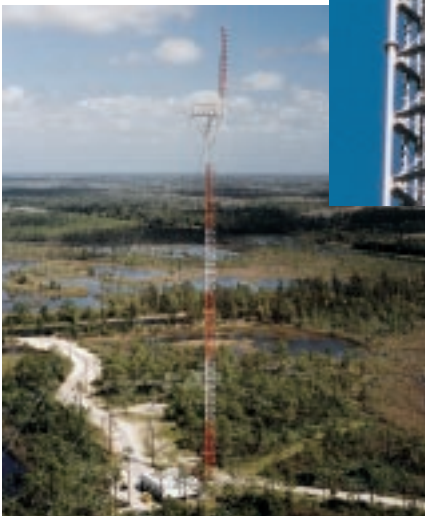
Microalloy Steel Technology – The Savings Add Up

Microalloy steels attain higher strength in the as-rolled, as-pierced or as-forged condition than standard carbon and many low-alloy steels. MicroTec steels allow you to achieve significant cost savings and improvements in productivity by elimi-

nating the conventional quench-and-temper heat treatment operation.

The forging industry estimates that the savings realized by the use of microalloy steels can be as high as 10 percent. MicroTec steels can help you realize even greater savings by:

- Reducing cycle or lead times (especially important for just-in-time operations)
- Reducing floor usage
- Lowering in-process inventory costs
- Eliminating inspection operations needed for detecting quench cracks
- Increasing productivity through improved machinability.



The Application: Main support leg members for use in constructing analog, HDTV, television and FM radio broadcast towers.

The Challenge: Reduce costs by replacing a quenched-and-tempered ASTM A588 steel with a microalloy steel. Material must provide equal strength in a hot-rolled condition with adequate ductility and toughness.

The Solution: MicroTec 2W65 weldable microalloy bar provides the required tensile and ductility properties in an as-rolled condition. The nominal 0.18 percent carbon and low alloy content enhances weldability.

Photo courtesy of Kline Iron & Steel, Inc.

Reduce Costs



The Application: Outer race for one-way roller clutches produced by Timken for Ford Motor Company for use in passenger cars.

The Challenge: Reduce costs and cut lead times by eliminating heat-treat operations. Meet specifications for chemistry restrictions, core hardness of 26 to 36 HRC and surface hardness of 90 HR15-N min. (60 HRC min.) by induction hardening. Ensure adequate machinability to facilitate band saw cutting, turning, drilling, grinding and broaching operations.

The Solution: MicroTec 5H95A tubing, a nominal 0.55 percent carbon microalloy steel with necessary induction hardening and core hardness properties. Timken supplies steel parts machined from Timken tubing, which are ready for assembly.

Reduce Lead Time

MicroTec Advantage – Critical Properties Add Value

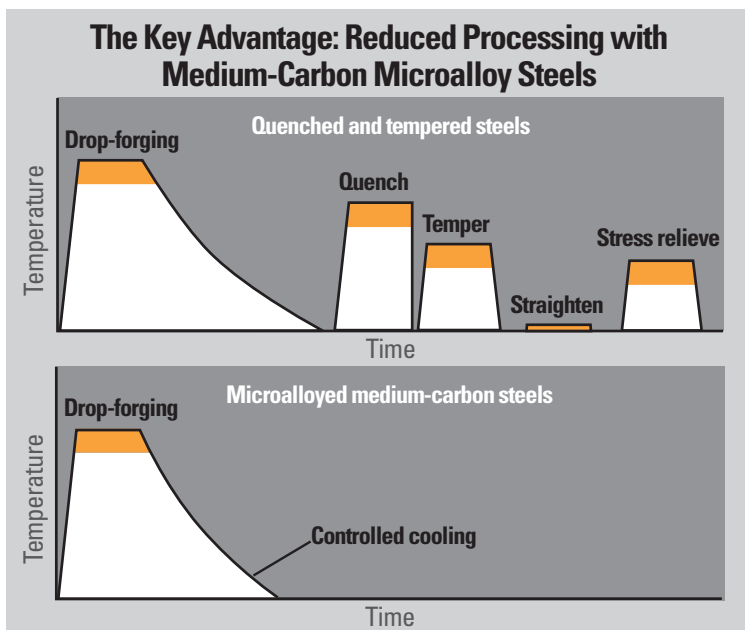
The properties of MicroTec steels often offer many other advantages over quenched-and-tempered steels. For example, you can:

- **Save money.** There are no quenching distortions, so you can

eliminate costly fixtures used to prevent warpage and reduce requirements for inspection, testing and reporting.

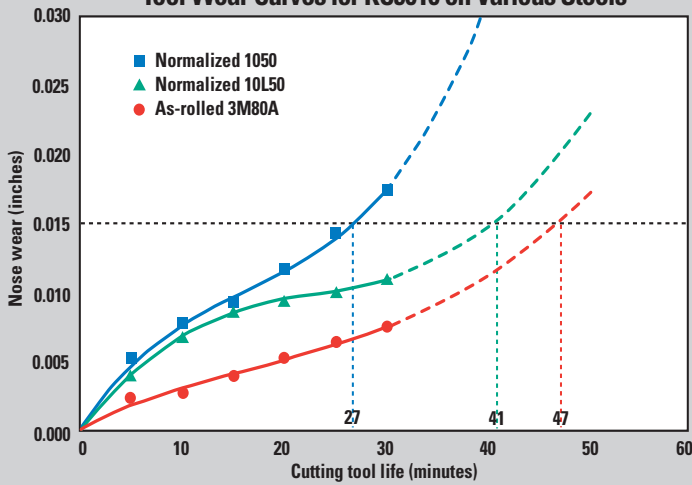
- **Achieve hardness uniformity** throughout a cross-section of larger parts surpassing that of heat-treated carbon steel parts.

- **Improve machinability** over that of quenched-and-tempered steels with comparable hardness levels.
- **Increase weldability** over non-heat-treated steels by lowering the carbon equivalent while maintaining the strength of the base steel through microalloy precipitation hardening.
- **Comparable fatigue resistance** to quenched-and-tempered steels of equivalent hardness levels.



MicroTec steels also provide several advantages for use in parts traditionally produced as castings. Researchers have documented the improved reliability of these steels for structural components like crankshafts. The higher strength-to-weight ratio and stiffness of MicroTec steels permit lighter, smaller parts to be used in place of heavier, bulkier castings.

Machinability – Turning Tool Wear Curves for KC9010 on Various Steels



At equivalent hardness levels, machinability of MicroTec steels is improved over plain carbon steels. Here, MicroTec 3M80A exhibits reduced tool wear versus normalized 1050 and 10L50 steels at a hardness of approximately 222 BHN. The horizontal line shows that cutting tool life can be significantly increased.

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MicroTec Chemistry – The Right Steel for the Job

MicroTec steels are designed to produce ferrite-pearlite microstructures that achieve added strength over the matrix microstructure through fine carbonitride particle dispersions.

Through extensive research, we have discovered that by carefully changing the proportions of various elements in the chemical formula of our MicroTec steels, we can enhance specific characteristics of the steel.

Due to a number of factors, including simplicity of processing for the forger, The Timken Company chose vana-

dium as the microalloying element for its MicroTec steels. Continuous research combined with our superior chemistry control has led to the availability of more than 20 grades of high-quality vanadium microalloyed steels. MicroTec steels can be supplied as machining bar, forging bar, seamless tubing and parts.



Improve Weldability

The Application: Hydraulic cylinder barrels and cylinder rods produced for use in mobile hydraulic cranes. 1026 Tubing and bar for the barrels and solid rods and 4140 tubing for the hollow rods, cold finished for improved strength and tolerances were previously used.

The Challenge: Reduce costs and improve weldability and mechanical properties with microalloy cold finished tubing and bars.

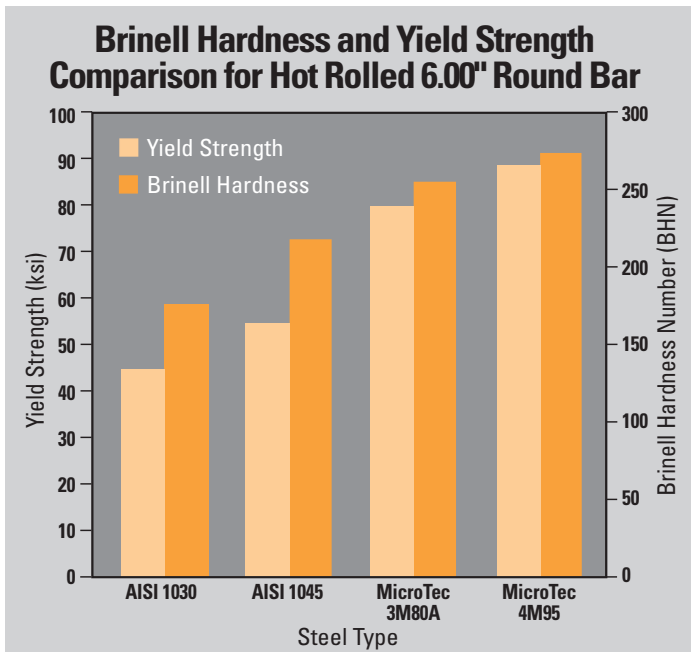
The Solution: For the barrels and hollow rods, MicroTec 2W60 cold drawn tubing with a nominal 0.14 percent carbon and MicroTec 2W65 with a nominal 0.18 percent carbon were chosen. For the solid rods, MicroTec 3W75 bars with a nominal 0.28 percent carbon content were chosen and are shipped turned, ground and polished, ready for chrome plating. The low carbon and alloy contents provided improved weldability, while concurrently improving the mechanical properties of the cylinder parts.

Photo courtesy of Grove Worldwide

Timken Expertise — An Engineering Partnership

Working in partnership with manufacturers, Timken engineers determine precise requirements for all the essential product characteristics, including strength, hardness, ductility, toughness, weldability, machinability and overall processability. Based on these and other requirements, our experts recommend the MicroTec steel that will consistently produce the desired characteristics. *Timken engineers work in partnership with you to meet your individual requirements by customizing one of our microalloy grades.*

Since variables during the forging process are also critical to achieving the desired properties, we extend the partnership to include assistance at your forging plant. Timken engineers help you choose the most effective methods of processing MicroTec steel.



The Application: Crankshafts produced for use in turbo-charged engines for light trucks. Crankshafts are heavily machined and must exhibit good machinability characteristics.

The Challenge: Reduce costs by replacing 15B28 quenched-and-tempered steel with a microalloy steel. Eliminate the quenched-and-tempered process, ensure equal or better strength, improve machinability and fatigue characteristics, allow for adequate induction hardening and minimize distortion during forging.

The Solution: A customized version of MicroTec 3M80A for forging bars. A nominal carbon content of 0.30 percent with elevated manganese and vanadium additions meet specifications for strength, ductility, induction hardening and fatigue characteristics. Moderately elevated sulfur content and uniform ferrite/pearlite microstructure facilitates excellent deep hole drilling and turning. Timken expertise aided in the development of a consistent forging and controlled cooling practice for uniform forgings.

Minimize Distortion

About The Timken Company

The Timken Company is a leading international manufacturer of highly engineered bearings, alloy and specialty steels and components, as well as a provider of related products and services. Making steel since 1916, the company produces 1.5 million tons of premium alloy steels each year, including approximately 100,000 tons of microalloy steel bar, tubing and components. With \$1 billion annual steel sales, Timken serves virtually every major manufacturing industry from operating plants and offices around the world.

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