



# APEX

## Enhanced Carbide Work Roll

**M**ove up to a higher level of performance with APEX and

achieve maximum efficiency for your mills. APEX is our enhanced niobium (Nb) carbide ICDP/AIC grade and provides an extended campaign life up to 25% compared to standard AIC rolls.

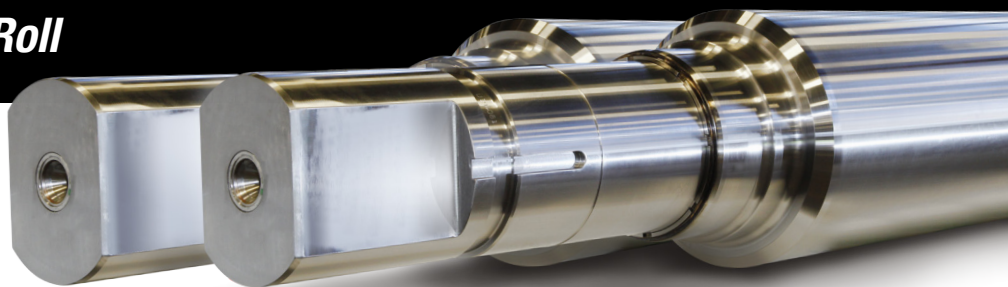
### The Union Electric Åkers Difference

Superior wear resistance and uniform surface finish of APEX are achieved through a controlled microstructure and harder carbide reinforcement throughout the roll life. These very hard, small alloy carbides are well distributed throughout the matrix. The result is a microstructure that is unique to Union Electric Åkers and a finish during rolling that is free from non-uniform wear effects.

*See reverse side for chemistry, properties and microstructure details.*

### Features and Benefits

- **Superior wear resistance** in hot strip mill applications
- **Extended campaign life** up to 25% more than standard ICDP/AIC materials
- **Excellent resistance to mill-induced mechanical damage** such as pinches, tail slap, etc.
- **Superior surface finish** with no differential wear effects—such as orange peel—through the life of the roll
- **Maximizes mill efficiency and strip surface quality**
- **Consistent hardness and performance properties** through the entire life of roll
- **Controlled casting** and Union Electric Åkers proprietary heat treatment provides superior resistance to interface related spalling, neck and core fracturing

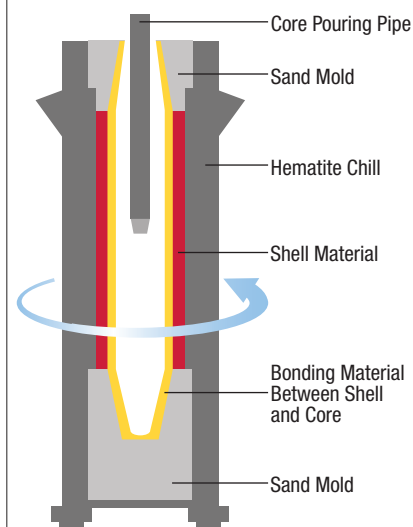


### Mill Applications

- Hot Strip Mills
- Steckel Mills
- Plate Mills

### Manufacturing Method

Manufactured by **duplex spin casting**—a vertical centrifugal casting method – and double tempered. It's a specialized process that enhances the microstructure, produces a stable interface and delivers advanced performance characteristics.



# APEX Specifications



## Aim Chemistry (Wt%)

C	Si	Mn	Ni	Cr	Mo	Nb
3.0/3.4	0.5/1.0	0.5/1.0	4.0/5.0	1.0/2.0	0.2/1.0	1.0/2.0

## Microstructure

The basic microstructure of APEX is a careful balance of primary  $M_3C$  carbide and graphite within a matrix of fine-tempered martensite and bainite. However, APEX's enhancements are in the presence of small, very hard niobium carbides throughout the structure. Additionally, the graphite morphology has been controlled so that it is spherical in shape and evenly distributed. These features prevent differential wear and improve resistance to crack propagation.

## Typical Carbide Analysis

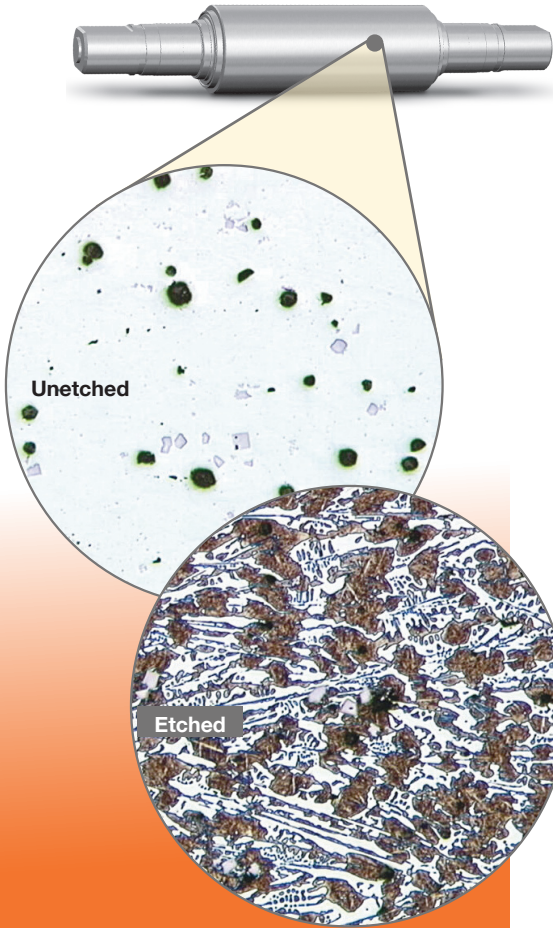
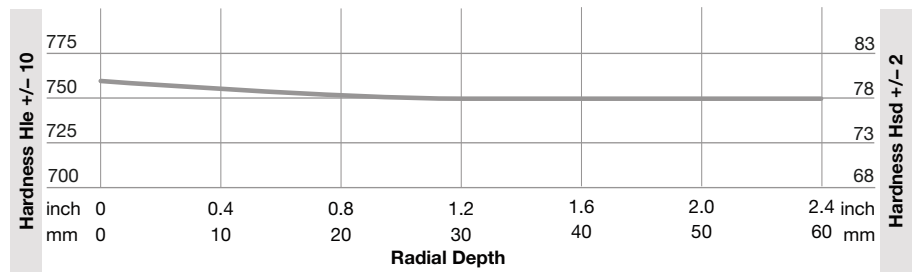
Carbide Type	Carbide Hardness (HV)	Surface Area (%)
$M_3C$	850 - 1100	35 - 40
NbC	2400	1-1.5

The hardness of the enhanced niobium carbides is more than twice that of the primary carbides, providing extra stability to the structure to resist breakdown due to wear.

## Mechanical/Physical Properties

	Barrel	Journal
<b>Tensile Strength</b>	420 MPa	425 MPa
<b>Yield Strength</b>	380 MPa	400 MPa
<b>Modulus of Elasticity</b>	183,000 MPa	170,000 MPa
<b>Thermal Conductivity</b>	17.3 (50°C) W/M°C 22.5 (400°C) W/M°C	22 (50°C) W/M°C 30 (400°C) W/M°C
<b>Coefficient of Thermal Expansion</b>	14.84 x 10 <sup>-6</sup>	14.2 x 10 <sup>-6</sup>
<b>Specific Heat</b>	525 (50°C) J/Kg°C 633 (400°C) J/Kg°C	460 (50°C) J/Kg°C 603 (400°C) J/Kg°C

## Typical Depth of Hardness



We engineer every product to meet your specific needs. Working closely with you, our highly trained sales team and technical support staff assess your rolling operations and recommend the most appropriate product for your application.