CATEGORY: **ROLL SURFACE INDICATIONS**

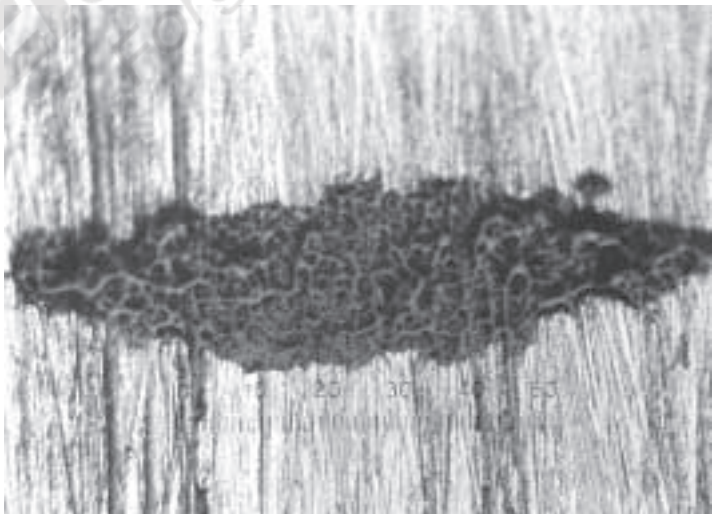
TYPE: **INCLUSION**

## CHARACTERISTICS

Typical inclusions that are visible on the roll surface are irregular in shape with the major axis in the longitudinal direction. Their length can be in the range of 0.05 mm (0.002") to 5 mm (0.020"). The "hole" left in the roll surface after removal of the included material is rough in appearance.

## EXAMPLES

EXAMPLE 1
Exogenous inclusion on the roll surface (50X).



EXAMPLE 2
Close-up of the exogenous inclusion shown in Example 1 (200X).

## MECHANISM

Inclusions that are visually detectable are normally exogenous in nature. The source material can range from refractory, slag or other external materials entrapped during ingot solidification. Indigenous inclusions require the aid of a microscope for detection. This type of inclusion is inherent in the steel making process and can be classified according to its composition (sulfide, aluminate, silicate or oxide).

## PREVENTION

Prevention of inclusions is the responsibility of the roll manufacturer. Inclusions are inherent in all steels, however, their size and multitude can be reduced through identification and control of critical melting variables. The probability for an irregularity to exist in the material after solidification can be reduced by changing from electric arc furnace vacuum degassed material to ESR (Electroslag Remelt) material.