

CATEGORY: JOURNAL BREAKAGE
TYPE: CORROSION CRACKING
AFFECTS: WORK AND BACK UP ROLLS

CHARACTERISTICS

The journal surface at the area of the barrel end face to journal radius displays cracking with a circumferential orientation. Within the area of the radius surface oxidation and corrosion pitting will also be present. This phenomenon is predominantly seen on 2- high work and back up rolls fitted with oil film bearings.

EXAMPLE



Figure 1

Cracking observed within the barrel end face radius of a back up roll after applying dye penetrant inspection.

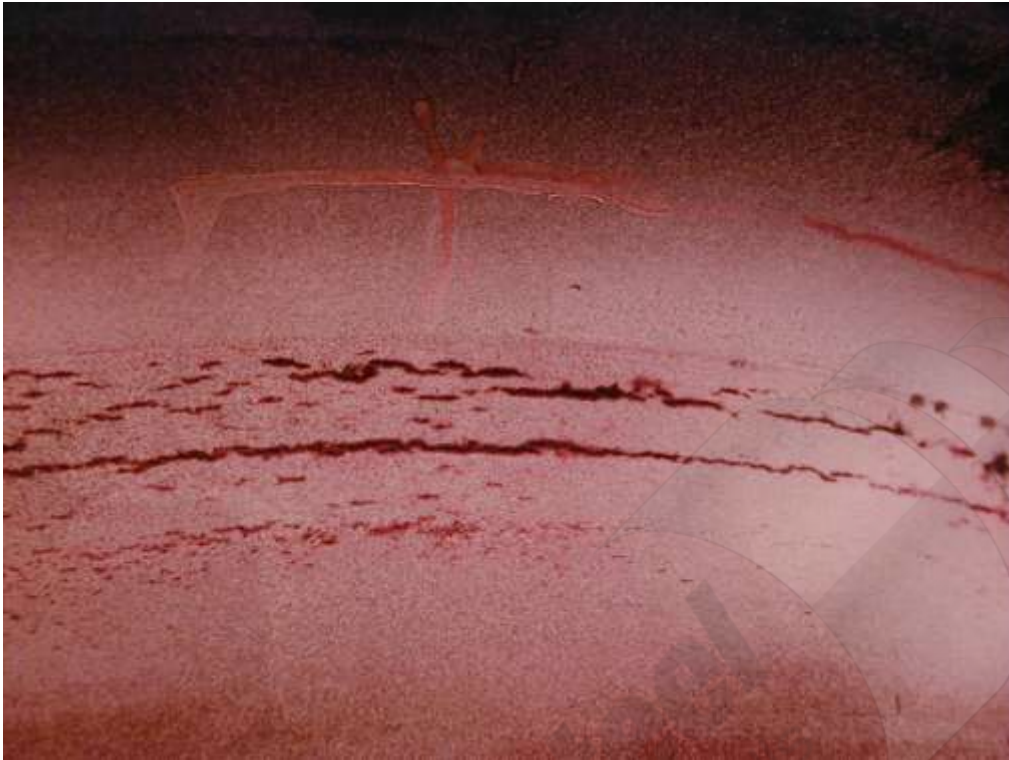


Figure 2

Close up view showing a series of small cracks that interconnect between individual corrosion pits and form larger circumferential cracks.



Figure 3

Corrosion pitting and cracking at the barrel end face radius of a back up roll



Figure 4
Extensive corrosion pitting of a back up roll barrel face radius.



Figure 5
Multiple small cracks at an early stage of formation within the corroded barrel face radius of a back up roll.



Figure 6

Cracking present at the barrel end face radius of a back up roll after applying magnetic particle inspection. Note the irregular nature of the crack as it is formed from many smaller interconnecting cracks.



Figure 7

Cracking and corrosion pitting visible at the barrel face radius of a 2-high work roll. Surface has been lightly ground to remove oxidation.



Figure 8

Cracks initiating at the barrel face radius propagated inward and ultimately resulted in a journal fracture.



Figure 9

Area of cracking/fatiguing (blackened) can be seen on the outside edge of the fracture surface.

MECHANISM

The oxidation and corrosion observed at the barrel end face to journal radius results from the ingress and intermixing of mill cooling water, particulates and oil from the bearing. This intermixed corrosive fluid becomes entrapped in the space between the outer water seal and inner oil seal assemblies in contact with the journal surface. The heating that occurs to this entrapped fluid during rolling further accelerates the oxidation and corrosion processes resulting in the formation of surface pitting.

The presence of corrosion pitting at the surface of the barrel face radius will result in an elevated stress concentration at that location. This localized stress concentration at a location which already experiences high bending stress concentration will allow for cracks to be initiated with an applied stress and a total number of stress cycles lower than expected for a non-corroded and pitted equivalent material.

PREVENTION

Surface corrosion and pitting of the barrel end face to journal radius cannot be totally avoided when using oil film type bearings. Good seal maintenance and routine cleaning to remove surface oxidation from the radius area is recommended. It is also prudent to routinely inspect this area of a roll for cracks especially in the latter part of a rolls life. If cracking is found then an assessment of rolls suitability for further service will need to be made dependent upon the depth and extent of the cracks present.

The roll maker can aid in restricting the formation of cracks within this area of a roll by carrying out the following during manufacture.

- Surface hardening of the barrel face to journal radius. This hardening will induce compressive stress within the area of the radius, pre-stressing the area and offsetting the effect of the corrosion pitting.
- Cross polishing or grinding the surface of the radius in an axial direction. This will restrict any circumferential growth of cracks that may form.