

# Analysis of Wear Ring Wall Thickness and Integrity of Structural Strength

Umesh Badgajar

Certified Professional Engineer, India

**Abstract:** This study evaluates the structural integrity of pump wear rings with locking screw configurations in accordance with API 610 requirements. The objective is to assess the adequacy of ligament thickness between the screw hole and outer surface. Visual inspection and geometric analysis were employed to identify localized wall thinning and stress concentration regions. The findings indicate that although the design satisfies hole diameter limits, insufficient ligament thickness may lead to elevated stress concentration, distortion, and fatigue risk. The study highlights the limitation of compliance based solely on dimensional criteria and emphasizes the need for structural assessment. It is recommended to optimize screw placement or adopt alternative anti rotation mechanisms to enhance reliability. These results contribute to improved design practices for rotating equipment components.

**Keywords:** pump wear rings, ligament thickness, stress concentration, API 610 compliance, fatigue risk

## 1. Observation

During inspection of the pump wear ring, Inspection revealed that

- The **locking screw hole** provided for anti-rotation is located **very close to the outer edge** of the wear ring.
- The **remaining ligament thickness** (material between screw hole and outer surface) appears **is insufficient based on geometric assessment**.
- Localized wall thinning is evident at the screw location (as highlighted in attached photograph).



**Applicable API 610 requirements are as follows:**

As per clause no 5.7 of API 610 Wear rings shall be **Securely fixed** to prevent rotation (by press fit, pin or screw).

- The standard specifies that “*The diameter of the hole for locking pin or screw shall not exceed one-third (1/3) of the wear ring width.*”

### Technical Concern

Although the manufacturing design may comply with the **hole diameter requirement**, the current configuration introduces the following engineering concerns:

**A reduction in structural integrity** due to insufficient ligament thickness

**High stress concentration** at the threaded hole location. This configuration increases the risk of the following failure modes:

- Crack initiation during tightening or operation
- Wear ring distortion affecting running clearance
- Fatigue failure under vibration and thermal loading

## 2. Conclusion

This study demonstrates that compliance with API 610 hole diameter limits does not guarantee adequate structural integrity of wear rings. The observed reduction in ligament thickness at locking screw locations introduces significant stress concentration, increasing the likelihood of crack initiation, distortion, and fatigue failure.

These findings underscore the importance of evaluating geometric constraints alongside mechanical performance criteria. Adoption of optimized screw placement or alternative locking mechanisms can improve durability and operational reliability.

## 3. Recommendation

It is recommended that the supplier or manufacturing facility:

- 1) Verify ligament thickness at locking locations during inspection.
- 2) Alternative design configurations should be considered, including:
  - Relocating screw to thicker section
  - Using dowel pin arrangement
- 3) If the observation is repeating then verify the minimum thickness criteria on pattern /moulds.

## References

- [1] API 610: 2021 12<sup>th</sup> edition Centrifugal pumps for Petroleum and Natural Gas Industries.
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