NSK

# THE TOUGH STEEL FAMILY OF MATERIALS: PREMIUM TECHNOLOGY FOR WIND


Outstanding toughness, performance and economy - NSK technology sets a new standard for long service life

# NSK Tough Steels

## Why Tough Steels

- Resistant to white structure failures
- Excellent resistance to damage from debris
- Superior wear and smear resistance

NSK Tough Steels are a family of exclusive materials with patented heat treatment processes, developed by NSK, to provide the longest bearing life for the wind turbine industry.

Wind Turbines experience bearing failures as a result of subsurface formation of white structure. Tough Steels resist the microstructural changes that cause white structure flakes and axial cracks.

## Product Features

- NSK optimized alloys resist hydrogen migration
- Resistant to microstructural changes
- Reduces maintenance costs and down time
- Improves wind farm ROI
- Increases turbine up time
- Higher load capacity
- Improves life for low Lamda conditions

## Wind Turbine Gear Box Positions

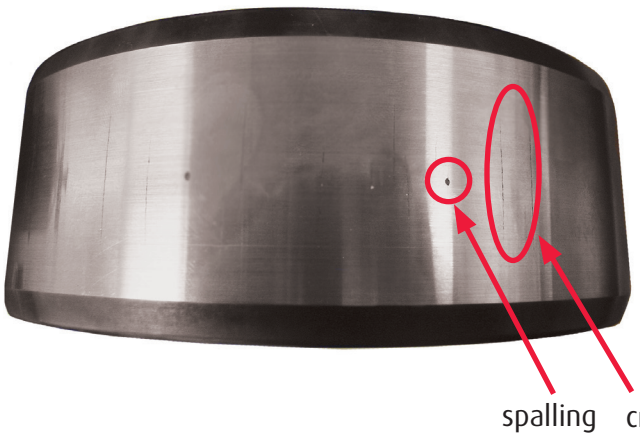
- Planet Gear
- High Speed Shaft
- Intermediate Shaft
- Planetary Carrier

## Product Size Range

AWS-TF: Component Ring Outside Diameter 180mm to 400mm
STF: Outer Ring Diameter Up to 2000mm

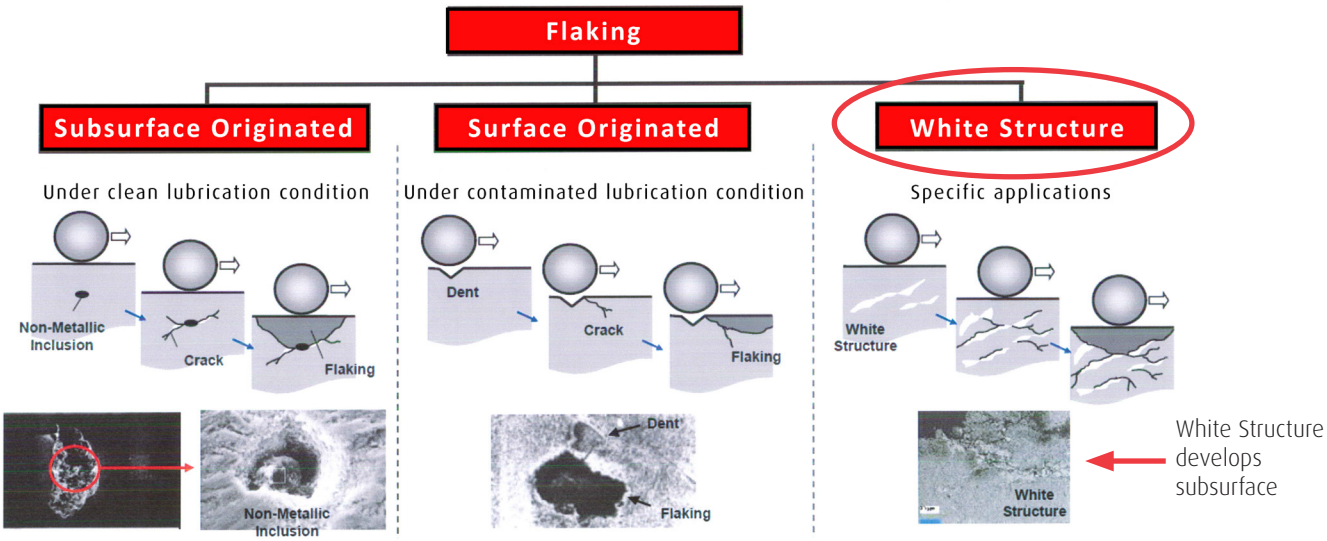
The STF and AWS-TF materials contain increased percentages of alloy to slow the microstructural change of steel that leads to the formation of white structure. NSK's patented processing of Tough Steels results in increased compressive residual stress to resist crack initiation. Specially developed heat treatments create higher surface hardness for debris, wear and smearing resistance.

## Combat Bearing Damage with NSK Tough Steel




Avoid white structure failures and significantly extend service life by utilizing NSK's Tough Steel technology.

## Flaking Generation




## NSK Bearing Life Improvement

NSK is leading the way with research and development specific to wind industry solutions. NSK Tough Steels address multiple failure modes including:

- Subsurface originated flaking
- Surface originated flaking
- White structure flaking/axial cracks
- Boundary lubrication conditions
- Resistance to wear, smear and seizure

## Bearing Upgrade Comparison

STF: Super Tough
AWS-TF: Anti White Structure Tough

| | NSK | | Competition |
|---|---|---|---|
| | AWS-TF | STF | |
| Material | NSK Specific Alloy for White Structure Resistance | NSK Specific Alloy for Debris Resistance | AISI 3310 |
| Heat Treatment | Carbonitride | Carbonitride | Carburize |
| Compressive Residual Stress | Yes | Yes | Yes |
| Coating | BOC Available | BOC Available | DLC |
| **Life Improvement over AISI 52100 for White Structure** | **+7x** | 4x | 2x |
| Life Improvement over AISI 3310 for Debris Conditions | 1.5x | 2.5x | 2x |

+ Denotes test stopped with no white structure failure.

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