









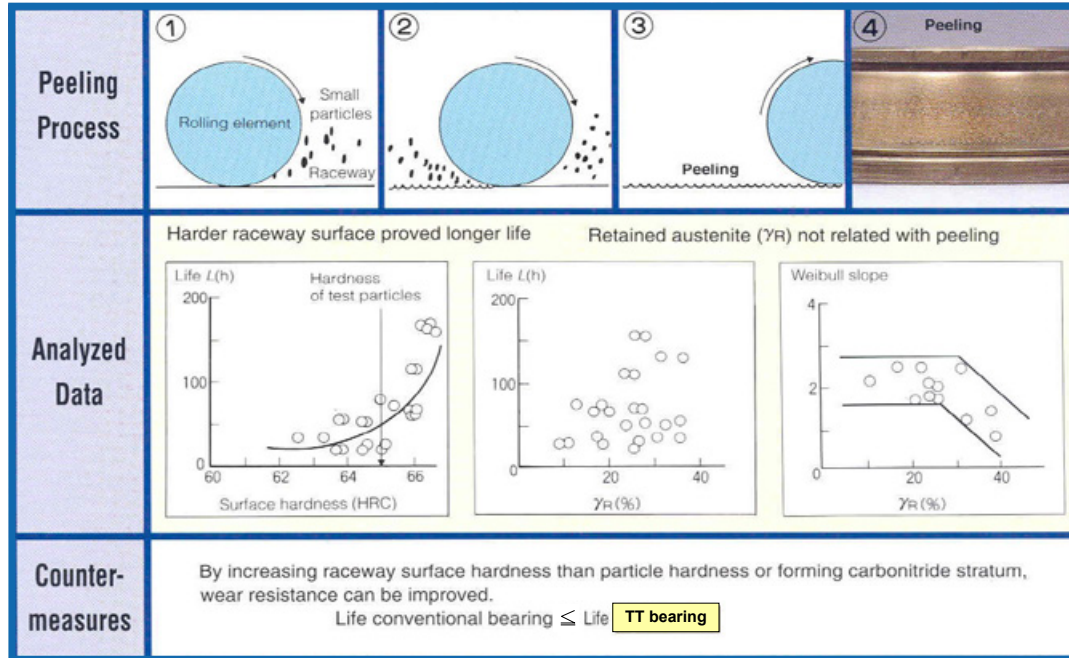
TERRAIN TAMER **HEAVY DUTY** **BEARINGS SERIES**



1: Flaking Mechanism and Countermeasures

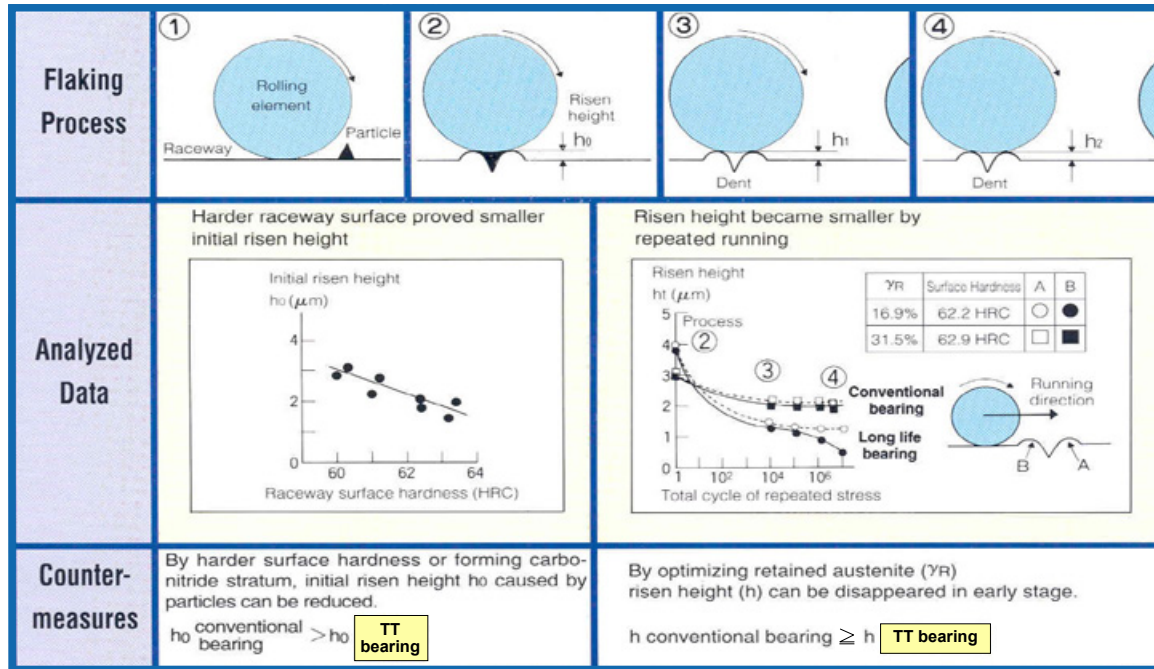
Modes	FLAKING IN CONTAMINATED OIL			FLAKING IN CLEAN OIL
	FLAKING INITIATED FROM SURFACE			FLAKING INITIATED FROM SUB - SURFACE
	PEELING	MIXED FLAKING	FLAKING FROM DENT	
Appearance				
Mechanism	 <p>Abrasive wear by small and hard particles</p>	 <p>Abrasive wear by small hard particles, and plastic deformation by large hard particles</p>	 <p>Plastic deformation caused by outside force or large and hard particles</p>	 <p>Material defect at maximum shear stress</p>
Measures	<p>Harder Surface Hardness for</p> <ul style="list-style-type: none"> • Improve Wear Resistance • Reduce Plastic Deformation <p>↓</p> <p>TT Bearing ←</p> <p>Optimized Retained Austenite</p> <ul style="list-style-type: none"> • Early Disappearance of Plastic Deformation 			<p>Optimized matrix C %</p> <p>Optimized surface hardness of rolling element</p> <p>Stabilized structure for high temperature</p> <p>Formed high residual compressive stress on surface</p>

2: Peeling and How to get Long Life

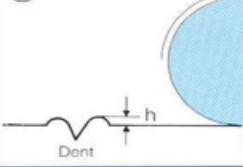


3: Flaking from Dent and How to get Long Life

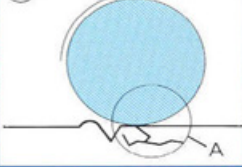
Flaking In Contaminated Oil & Countermeasures



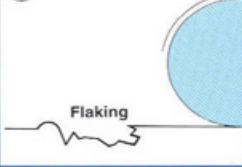
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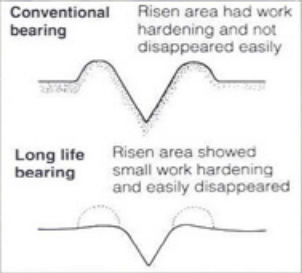


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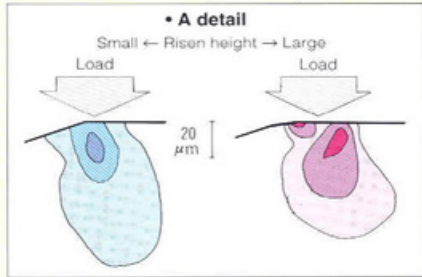


Flaking from dent

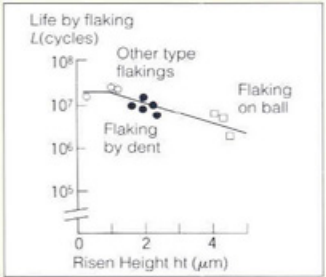
By optimizing retained austenite (γ_R), work hardening of risen area could be repressed



Smaller risen height showed smaller shear stress



Smaller risen height showed longer life



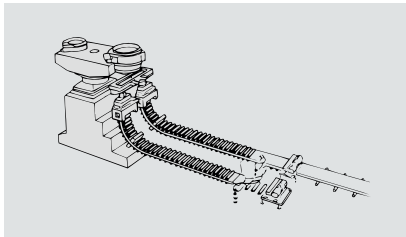
Risen height (h)
 $h_{\text{conventional bearing}} \geq h_{\text{TT bearing}}$
 Therefore, shear stress (τ)
 $\tau_{\text{conventional bearing}} \geq \tau_{\text{TT bearing}}$

By increasing surface hardness and optimizing retained austenite.
 $\text{Life}_{\text{conventional bearing}} \geq \text{Life}_{\text{TT bearing}}$

4: Bearing Types and Performance

LONG LIFE BEARINGS	MATERIAL	CHARACTERISTICS AND EFFECTS	PERFORMANCE (Compared with Conventional Bearings)		APPLICABLE BEARINGS					APPLICATIONS	
			Life in clean lubricant	Life in contaminated lubricant	Ball Brg.	Cylindrical Roller Brg.	Tapered Roller Brg.	Spherical Roller Brg.	Needle Roller Brg.		
TERRAIN TAMER	Carburized Steel	<ul style="list-style-type: none"> • High surface hardness • Controlled retained austenite 	2 times or longer	10 times or longer				●			<ul style="list-style-type: none"> • In contaminated lubricant such as differential and transmission

Applications



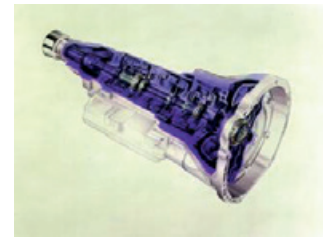
• Continuously casting equipment



• Steel rolling mill



• Turbocharger



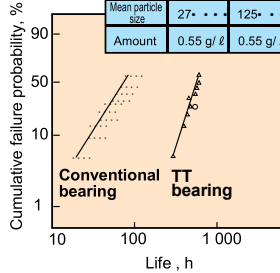
• Transmission

5: Bearing Life Evaluation Results Against Flaking

Life in contaminated lubricant

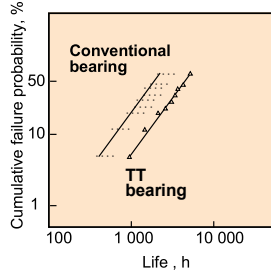
TT bearing:
10 times or longer

Hardness	630HV	700HV
Mean particle size	27•••	125•••
Amount	0.55 g/ℓ	0.55 g/ℓ



Life in clean lubricant

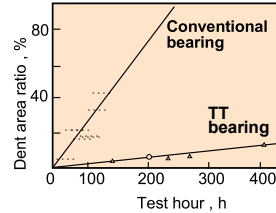
TT bearing:
2 times or longer



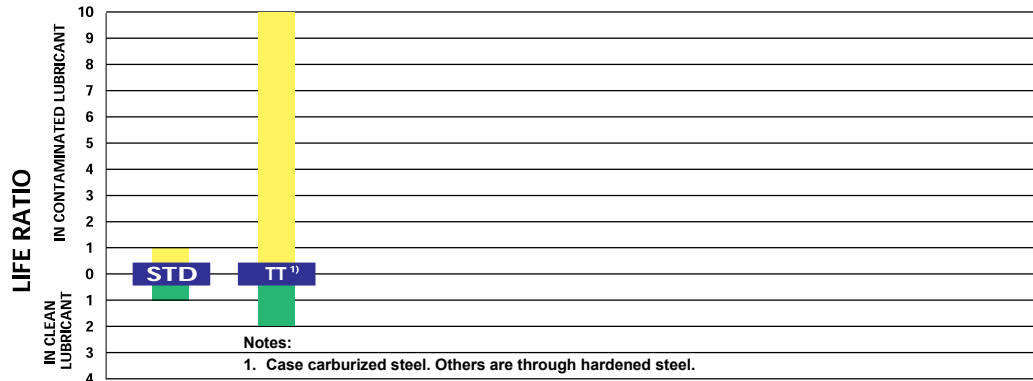
Dent resistance

TT bearing:
10 times or more

Dent area ratio measured at 20 points of inner ring raceway center and analyzed by computer



6: Life Comparison





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