MATERION

ToughMet®

The World's Best Bearing Material

2012

What is ToughMet®?

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A Copper Nickel Tin Alloy

that provides bearings with:

- Longer life
- More load capacity
- Outstanding lubricity
- Better reliability with fewer unexpected failures…

Cu-15Ni-8Sn

What is ToughMet®?

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A Copper Nickel Tin Alloy with

- High strength and hardness (like titanium),
- A low coefficient of friction (like leaded bronze),
- Great wear resistance (like steel),
- Freedom from galling (like copper beryllium),
- Great corrosion resistance (unlike steel or bronze),
- Excellent machinability (>3x as fast as tool steel)
- No lead (Pb).

Advantages for our customers:

- More Up-Time
- Greater Reliability
- Better Design Flexibility

The Value of ToughMet® Bearings for the Equipment Maker

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ToughMet® bearings can

- Carry heavier loads than bronzes
- Operate with less grease than steel
- Endure impact better than roller bearings
- Tolerate contamination and corrosion better than all 3

ToughMet's durability allows OEMs to

- Eliminate warranty repairs due to bearings
- Guarantee better availability/reliability
- Reduce costs of redesign and testing
- Easily increase load capacity of the vehicle
- Build more competitive equipment

Improvements with ToughMet®?

- Haul Truck Steering: replaced Al bronze to add 80 tons load capacity
- Haul Truck Drives: replaced Mn bronze to eliminate $500,000/year warranty claims
- Continuous Miner: replaced steel to reduce manual greasing time by 18 hours/week
- Longwall Shearer: replaced steel to increase bearing life from 2 weeks to 6 months

The Value for the end users

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Users of ToughMet® are getting

- Longer maintenance cycles (more up time)
- Better reliability (less unplanned down time)
- Longer bearing life

For your customers, that means

- Reduced safety risks
- Better equipment availability and efficiency
- Lower total maintenance costs
- Simpler scheduling and purchasing plans

Longer life / Longer maintenance cycles

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- Takeup tumbler bushings, Bucyrus 495 :
  20,000 hr. = 3x longer than C86300 Mn bronze
- Lower roller bushings, P&H 4100 XPB :
  30,000 hr. = 3x longer than C86300 Mn bronze
- King pin bushings, Hitachi EH5000 :
  30,0000 hr. = 5x longer than C95400 Al bronze
- Bucket bushings Komatsu WA500 :
  15,000 hr. = 5x longer than hardened steel


Materion Wrought Rod, Bar,Tube Official Specs

Specification	AMS 4596 A	AMS 4597	BMS 7-373
Form	rod, bar, tube	rod, bar, tube	rod, bar, tube
Alloy UNS	C72900	C72900	C72900
Temper	AT110	TS160	Class 90
ASTM temper	TX00	TXTS	TX00
UTS minimum MPa	876 - 910	1138 - 1110	793
YS minimum 0.2% Offset	738	1069 - 1007	621
Elong minimum % in 4D	3 - 8	3 - 6	15
Hardness (HRC)	30	34	BHN 269*
Grain Size Control Req'd.	No	No	Reported

Patented EquaCastTM Process

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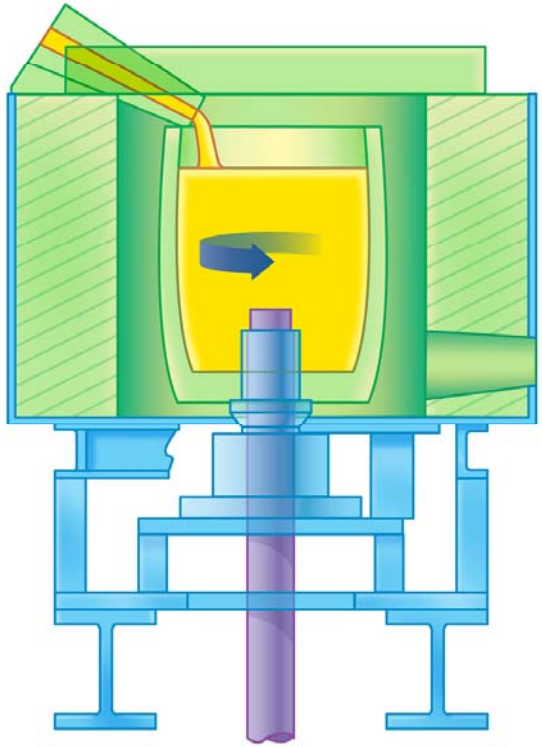
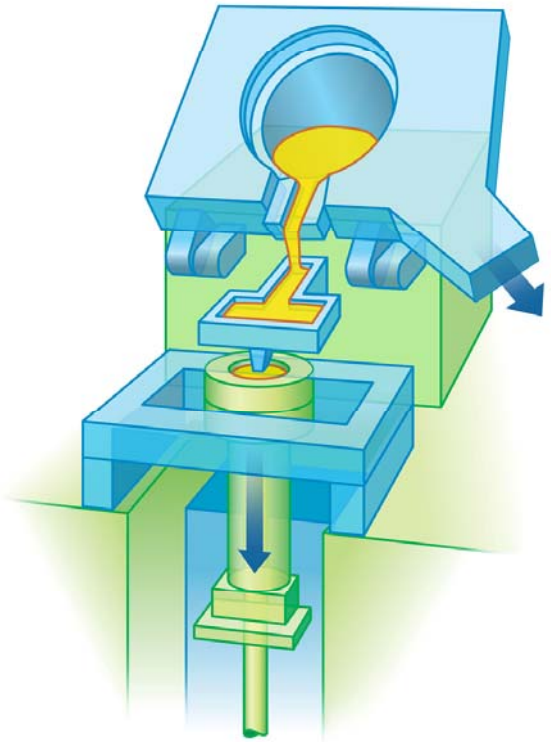


Closed-head EquaCast™ System

Promotes uniformity and purity



Conventional Open-head Cast System

Can lead to segregation, columnar growth and entrapped impurities

Microstructures of ToughMet Tempers

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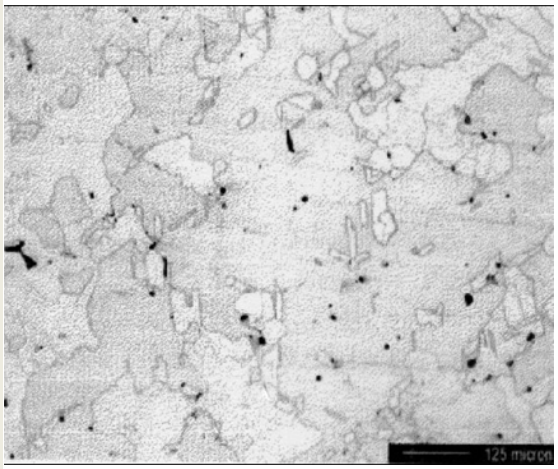
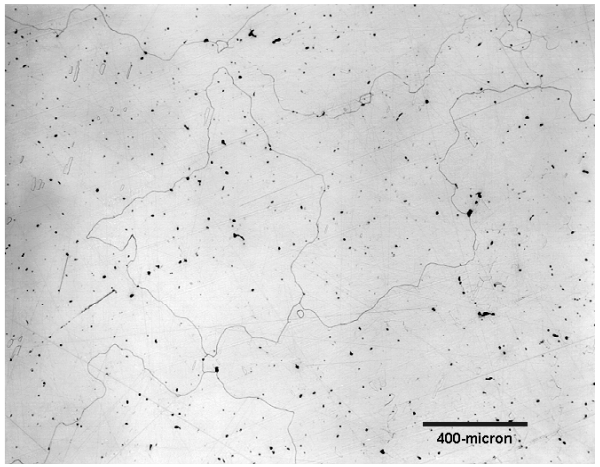
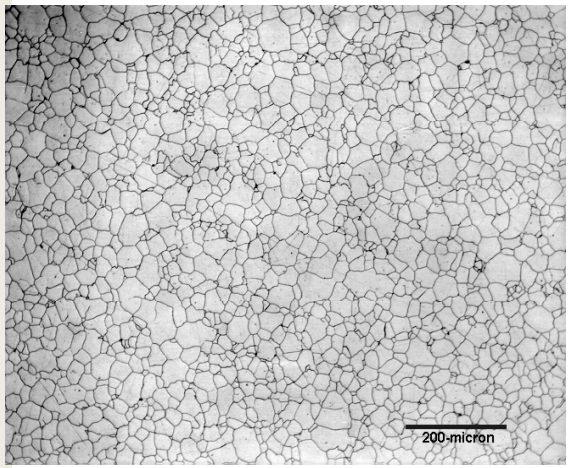


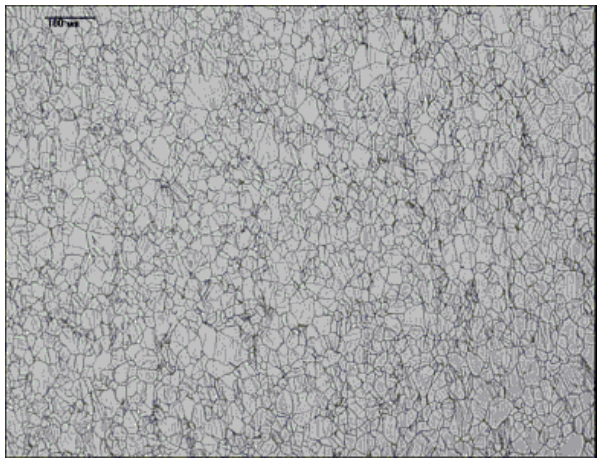
as-cast
UTS 50 ksi
minimum



CX = cast
heat treated
UTS 110 ksi
Minimum
4% elong.



AT = cast
hot worked
heat treated
UTS 135 ksi
Minimum
10% elong.



TS = cast
hot worked
cold worked
heat treated
UTS 165 ksi
Minimum
6% elong.

Minimal microsegregation in casting process combined with mechanical deformation prior to spinodal decomposition significantly increases the alloy strength.

ToughMet's Spinodal Nanostructure lowers friction

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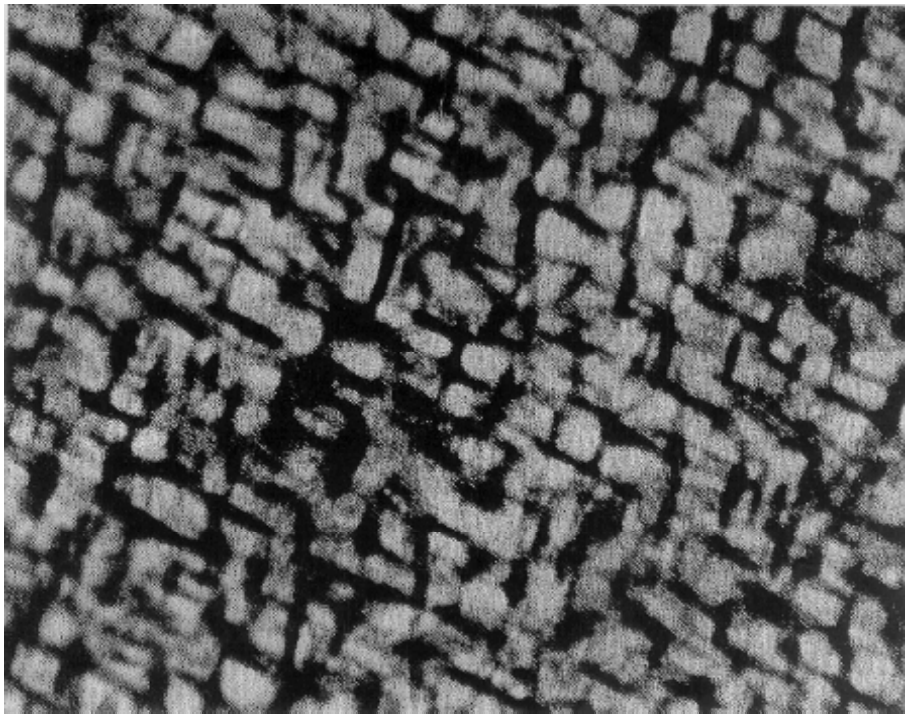
Hard and soft phases still exist:

- Dark = hard Ni_3Sn
- Light = softer Cu - 15% Ni
- Submicroscopic
- Highly uniform distribution

Fine nanostructure reduces creation of wear debris by plowing of hard phases through soft.

Wear debris accumulation = increased friction.



ToughMet 3 CX105 > 300,000 X electron microphotograph of spinodal structure

Casting of ToughMet® Alloys

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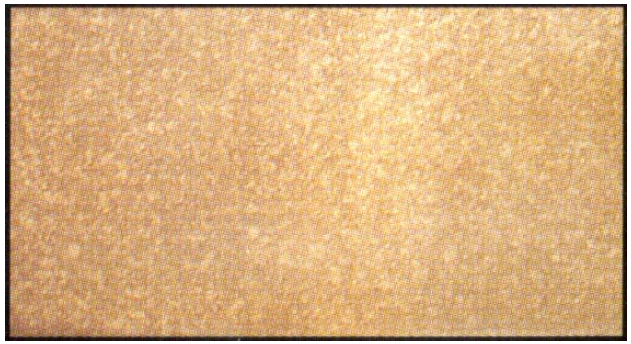

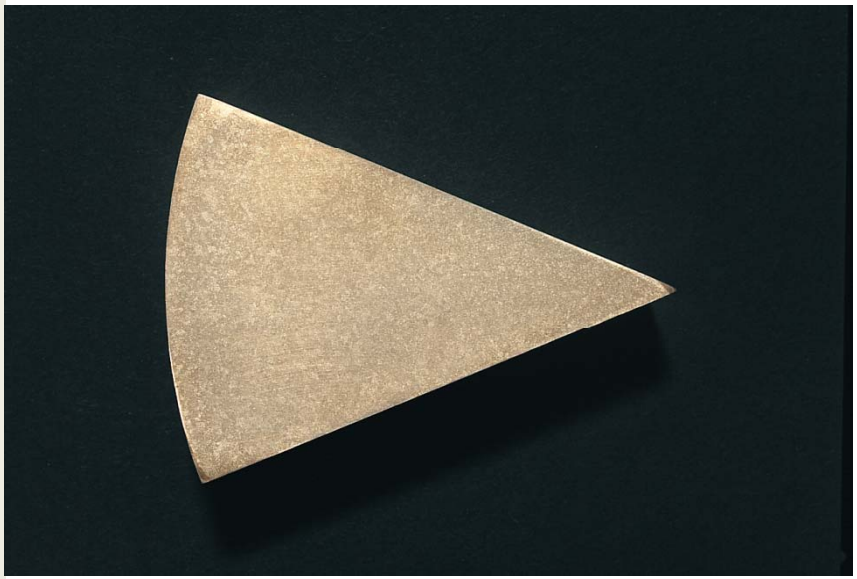

Closed-head Equacast™ system

Promotes uniformity and purity

Conventional Open-Head Cast-System

Causes phase segregation, columnar growth and entrapped impurities.

ToughMet® Nomenclature

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Tempers

- **CX** = Cast and spinodally hardened
  UNS C96900, ASTM B505
- **AT** = Hot worked and spinodally hardened
  UNS C72900, AMS 4596A, ASTM Temper Designation = TX00
- **TS** = Cold worked and spinodally hardened
  UNS C72900, AMS 4597, ASTM Temper Designation = TXTS

=> The number after the temper is the minimum yield strength in ksi. (ksi to Mpa means multiple by factor of 6,8948)

Example: ToughMet® 3 AT110

110 ksi x 6,8948 = 758 MPa

TOUGHMET®

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What Makes ToughMet® So Special?

Strength and Hardness as Titanium

Alloy	Tensile Strength [N/mm²]	Yield Strength [N/mm²]	Elongation [%]	Hardness [HV]
ToughMet® 3	724 - 1100	621 - 1070	15 - 4	280 - 353
ToughMet® 2	690 - 860	630 - 790	15 - 2	270 – 320
C67300 plumbs MnBr	448 - 586	310 - 413	37 -19	115 - 190
C93200 plumbs SnBr	135 - 241	97 - 138	20 - 10	<115
C63000 AlBr	689 - 814	345 - 517	20 - 15	225 - 240
C95400 Ampco 18C	621	248	14	180
Ti-6Al-4V	896	827	10	300
S31600 Steel	517	207	40	220

What makes ToughMet so special?

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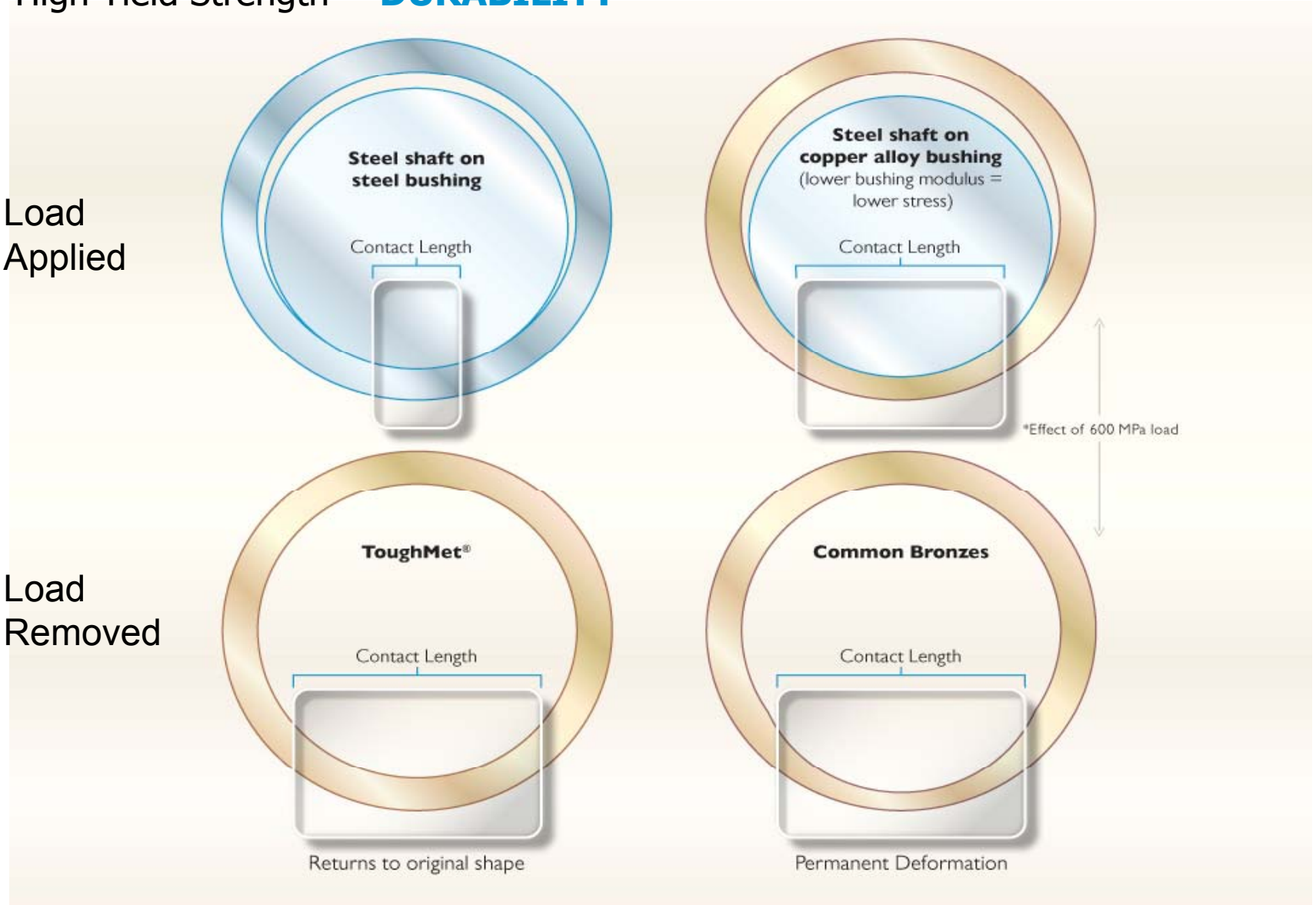
High-Yield Strength = **DURABILITY**



What makes ToughMet so special?

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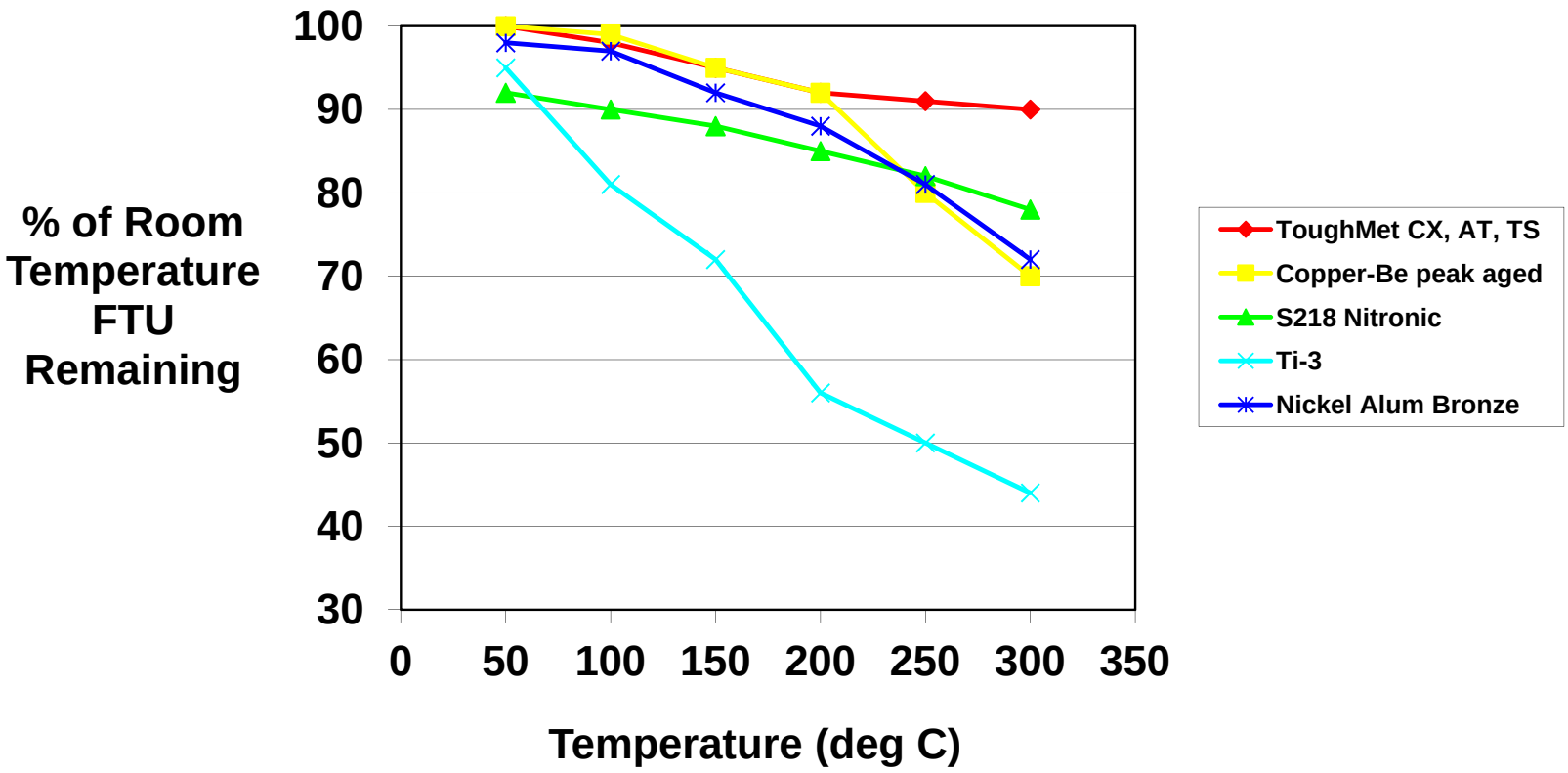
RESILIENCE

Modulus of Resilience: The energy per unit volume that can be absorbed by a material without permanent deformation.

$$U_R = \frac{1}{2} (\sigma_y^2 / E)$$

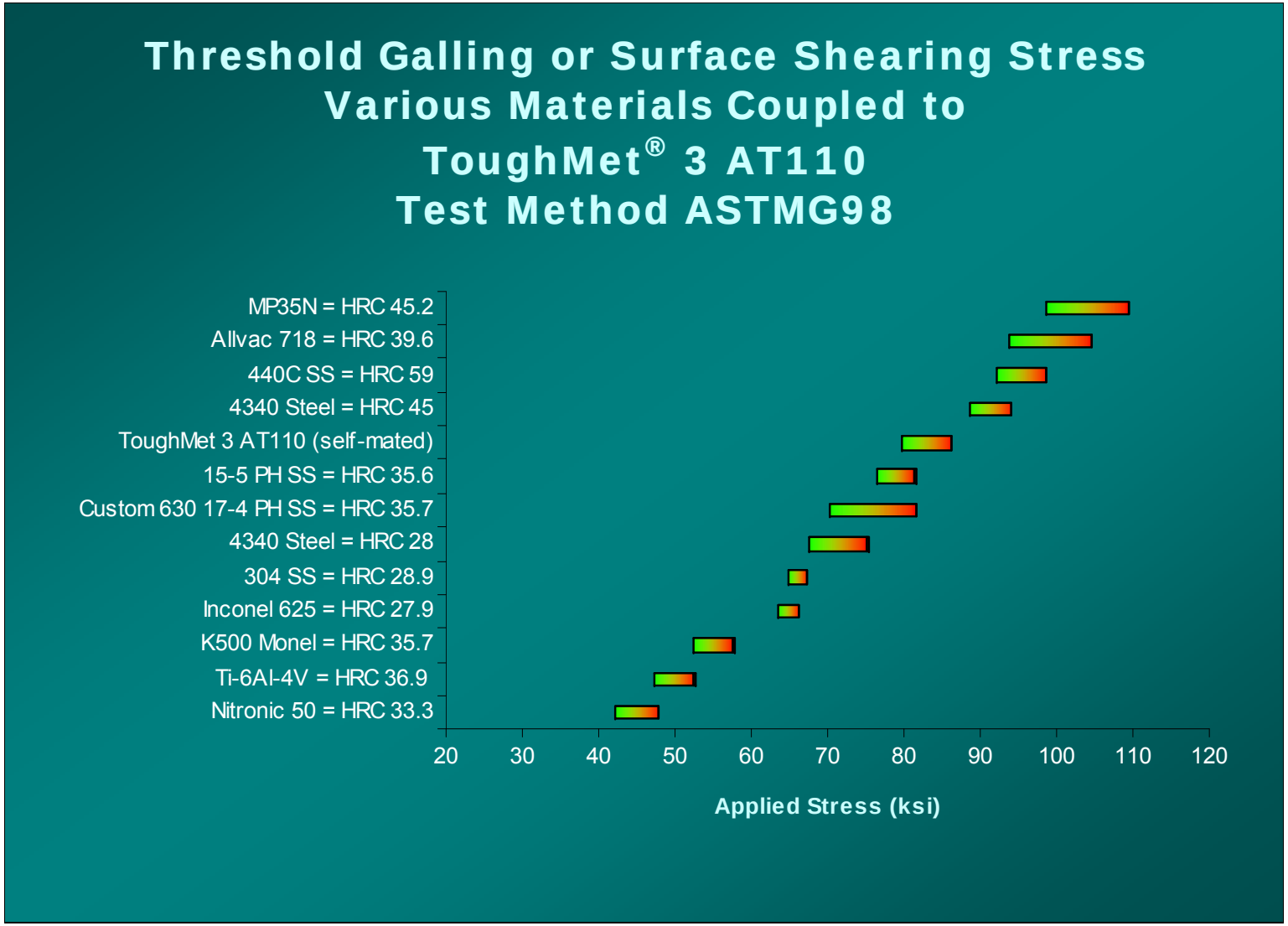
Material	Yield Strength (ksi)	Young's Modulus (10^6 psi)	Modulus of Resilience
Spring steel	140	30	327
Rubber	0.3	0.00015	300
ToughMet 3 CX105	105	19	298
C95510 Al Ni bronze	70	17	144
8620 steel	91	30	138
5052 aluminum	26	10	33
C93200 Pb Sn bronze	18	15	11

Effect of Short Duration Elevated Temperature on Strength of Selected Alloys



Data represent lowest value observed after 30 minutes @ temp. Consult Materion for information describing the effects on our age-hardenable alloys of longer term exposure to temperatures > 175 degrees C .

What makes ToughMet so special?



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MONEL® and INCONEL® are registered tradenames of Special Metals Corporation

What makes ToughMet so special?

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Threshold Galling Stress of Various Metals Running on ToughMet® 3 AT 110 Test Method ASTMG98

Material Run Against ToughMet® 3 AT110	Applied Stress (psi)	Test Remarks
304 SS = HRC 28.9	≤ 64,500	No Galling
	67,500	Galling
Allvac 718 = HRC 39.6	93,900	No Galling
	104,500	Button Deformed, No Galling
Nitronic® 50 = HRC 33.3	42,200	No Galling
	47,900	Galling
MP35N = HRC 45.2	98,700	No Galling
	109,500	Slight Galling
Ti-6Al-4V = HRC 36.9	47,400	No Galling
	52,600	Galling
K500 Monel® = HRC 35.7	52,400	No Galling
	57,700	Galling

Material Run Against ToughMet 3 AT110	Applied Stress (psi)	Test Remarks
Custom 630 17-4 PH SS = HRC 35.7	70,200	No Galling
	81,600	Galling
15-5 PH SS = HRC 35.6	76,400	No Galling
	81,500	Galling
Inconel® 625 = HRC 27.9	63,600	No Galling
	66,200	Slight Galling
	71,300	Galling
440C SS = HRC 59	92,200	No Galling
	98,600	Galling
4340 Steel = HRC 28	67,500	No Galling
	75,300	Galling
4340 Steel = HRC 45	88,600	No Galling
	94,000	Galling
ToughMet® 3 AT110 (self-mated)	79,900	No Galling
	86,200	Galling

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Resistance to Adhesive Wear (Galling)

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GALLING RESISTANCE

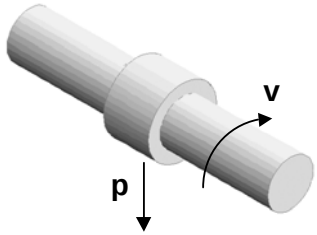
Underground Mining Equipment

- Reciprocating joint
- Lubricated on assembly
- 12 hour function test after assembly
- No external loads applied
- Hardened steel pins

With hardened steel bushings

With bushings made fromToughMet

What makes ToughMet so special?



Low Friction at High Speed

- PV limit is the highest (pressure X speed) at which the sleeve maintains its bearing properties.
- ToughMet has a higher PV limit than any commercial bearing bronze.
- ToughMet dry provides a safety factor in case of lubrication failure.

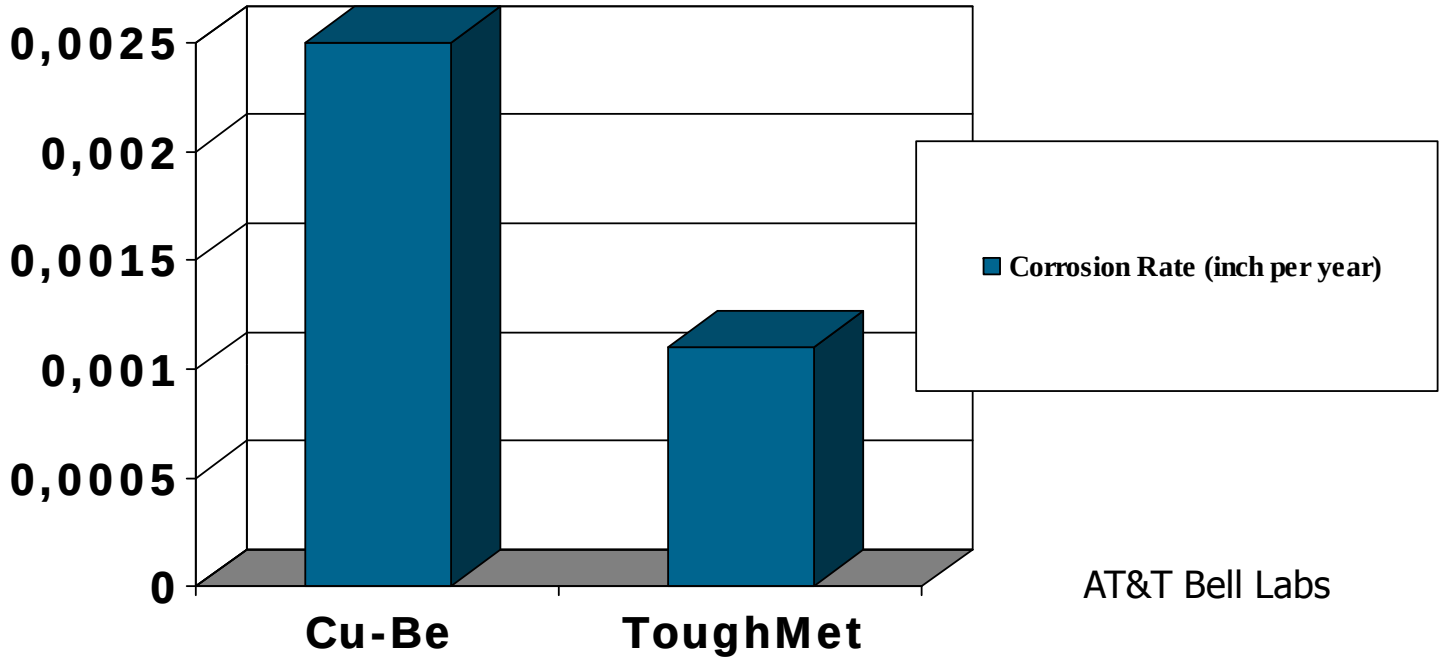
PV Limit Comparisons

Material (Lubricated)	Max .PV (psi-sfpm)
ToughMet® 3	***275,000***
Manganese Bronze	150,000
Aluminum Bronze	125,000
Cast C93200	75,000
SAE 841 Bronze PM	50,000
SAE 863 Fe PM	35,000
60 Cu 40 Fe PM	35,000
SAE 850 Fe	30,000
High Tin Babbitt (89%)	30,000
Low Tin Babbitt (10%)	18,000
ToughMet® 3 Unlubricated	***17,000***
Graphite/Metallized Brgs	15,000
Carbon	15,000
Low Tin Low Pb (6%) Babbitt	12,000

Comparison data from Bunting Bearing Corp.

Seawater Corrosion Rates

389 Days Exposure to Sea Water
(25 ft of water @ St. Croix, US V.I.)



AT&T Bell Labs

ToughMet 3 Sour Environmental Testing

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NACE MRO175/ISO15156 Sour Testing Solutions
Modified NACE Sour Testing Solutions
Solutions are de-aerated

Level	Temperature (C)	H_2S (psi)	CO_2 (psi)	Acetic Acid (%)	NaCl (%)
I	23	-	--	-	5
II	23	Saturated	-	0.5	5
IV	90	0.43	101	--	15
Modified IV	95	5.00	200		25
V	150	101	203	--	15
Modified V	150	5	200		25
VII	205	508	508	--	25

Procedures and Specimens in Accordance with NACE TM0177
Test Time – 720 hours

Method A testing
(Full environmental immersion proof ring) pre-stressed @ 90% of the room temp. Yield Strength Level I pH 2.8 starting/ 3.0 ending Uncoupled to steel

SSC Behavior of ToughMet 3
NACE Standard and Modified Sour Solutions

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Tempers CX , AT (TX00), and TS (TXTS)

- NF=no Failure; no evidence of cracking
- F=Failure
- F1= Evidence of cracking

Temper	Diameter inch (mm)	Hardness, HRC Max. Measured	Level I	Level II	Level IV & Modified IV	Level V Modified	Level V	Level VII
CX	3.0 (76)	33	NF	NF	NF	NF	NF	
TX(AT)	3.3 (83)	32	NF	NF	NF	NF	NF	
TS	1.0 (25)	37	NF	NF	NF	NF	F1	F
TS	2.0 (51)	36	NF	NF	NF	NF		

Procedures and Specimens in Accordance with NACE TM0177

Test time—720 hours

- Method A testing (Full environmental immersion proof ring) pre-stressed @ 90% of the room temp. Yield Strength. 0.250 inch (6.4 mm) gage diameter.
- Level I pH 2.8 starting/3.0 ending
- Uncoupled to steel

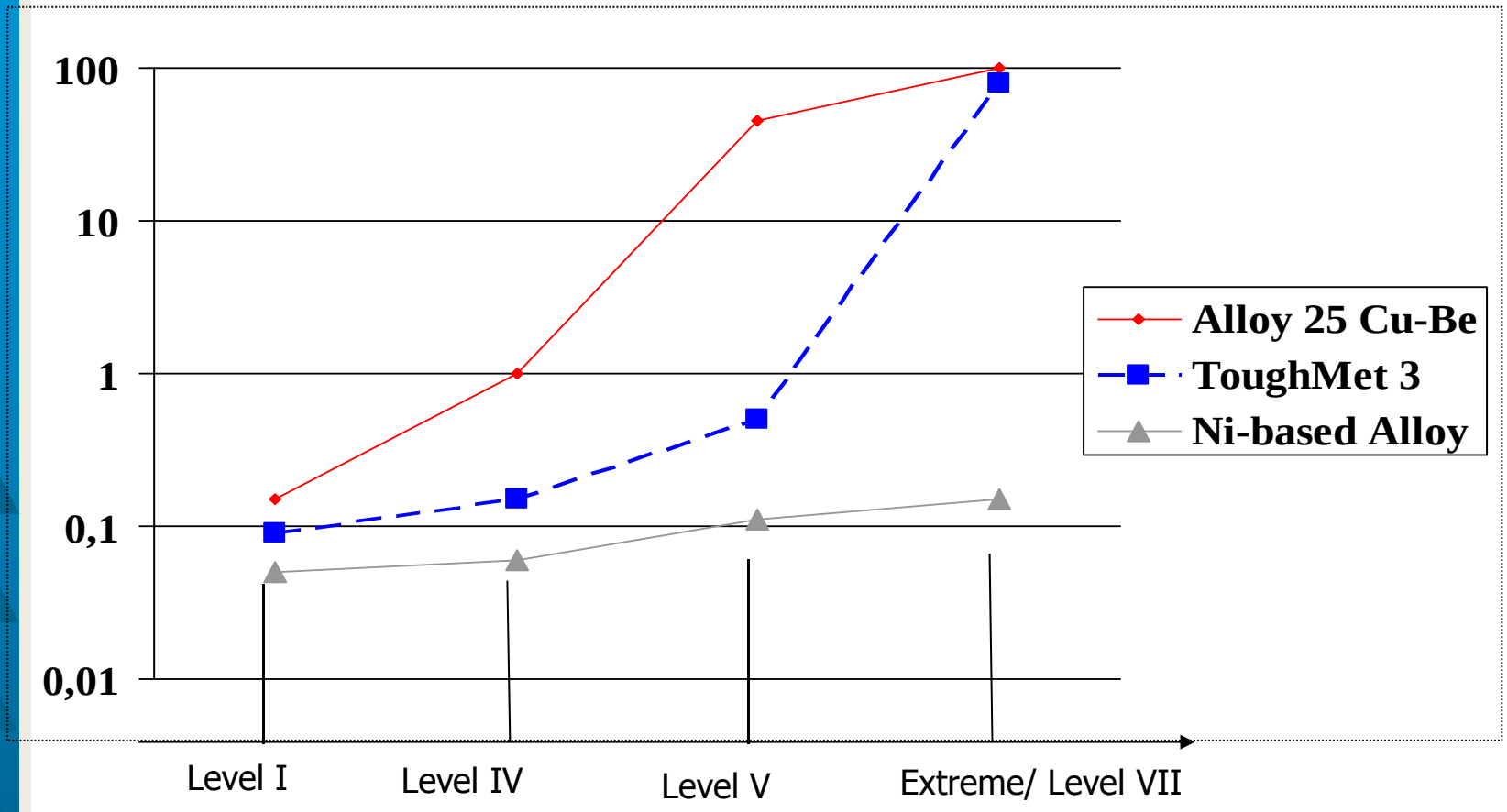
Corrosion Rates of ToughMet 3 Tempers CX, AT(TX00), TS (TXTS)

in NACE & Modified NACE H_2S Solutions

30 day Exposure Weight Loss in mil/yr (µm/yr)

Temper	Level I Room Temp.	Level II Room Temp.	Level IV & Modified IV 90-95 deg C	Level V Modified 150 deg C	Level V 150 deg C	Level VII 205 deg C
CX	<0.5(13)	0.7(18)	1.3(33)		6.9(175)	
TX(AT)	<0.5(13)	0.8(20)	1.3(33)		3.7(94)	
TS	<0.5(13)	1.1(28)	3.0(75)	12(300)	22.0(550)	137(3500)

General Corrosion Rates of Cu-Be, ToughMet 3 and Inconel 718 in Standard Sour Environments



Increasingly Aggressive NACE Standard Sour Testing Environments

y= % of Original Weight Lost after 30 Days' Exposure

The Best Bearing Material in the World

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ToughMet® is an ideal choice in <u>any</u> configuration where:

- Pin or mating part is steel
- Pin hardness > HRC 40
- Bearing pressure > 2,000 psi
- There is edge loading
- Motion is reversing
- Re-lubrication is difficult
- Contamination or corrosion are likely

Switching to ToughMet® is Easy

- Available as rod/tube/plate/shapes or finished parts.
- Replacing Mg bronze or Al bronze (for example, C86300 or C95400)
  - **Drop in replacement**
  - No change to interference fits or clearances
- Replacing hardened steel
  - Small change to interference fit required
  - More fitting options available (ex: liquid N_2)
  - No change to clearances
- Grease grooves may be simplified or eliminated when replacing steel or bronze

Materion Brush Performance Alloys can provide technical assistance with bearing design, testing and manufacture.

The Best Bearing Material in the World

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- Pin hardness > HRC 40
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- Motion is reversing
- Re-lubrication is difficult
- Contamination or corrosion are likely

Thin-section (1 – 5 mm) bearings

- Low cost processes providing ToughMet properties
- Wrapped bushings: 5 mm – 400 mm OD
- Stamped washers
  - Temper: AT (TM04), to 400mm wide
  - 1st production application: Transmissions
- Partner: Bowman International

Thin-section (1 – 5 mm) bearings

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BOWMAN

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Metric bearing data		Imperial bearing data	
Static load	820 N/mm²	Static load	120,000 Lbs/inch²
Dynamic load	340 N/mm²	Dynamic load	50,000 Lbs/inch²
Max sliding speed	1.5 m/s dry 5 m/s oiled	Max sliding speed	5 ft/s dry 17 ft/s oiled
Operating temp	- 250ºC to + 300ºC	Operating temp	- 420ºF to +570ºF
Thermal conductivity	38 W/MK	Thermal conductivity	22 BTU/Ft HRº
Coefficient of friction	0.25 dry 0.04 oiled	Coefficient of friction	0.25 dry 0.04 oiled
Recommended shaft finish	Ra≤ 0.4um (N5)	Recommended shaft finish	16 µinch
Recommended shaft hardness	HB600	Recommended shaft hardness	HRC60
Recommended shaft tolerance	5mm to 75mm f7 80mm to 300mm h8	Recommended shaft tolerance	0.187" to 3.00" f7 3.00" to 12.00" h8
Recommended housing tolerance	7mm to 305mm H7	Recommended housing tolerance	0.25 to 12.00 H6
Pv value	9.6 MPa-m/s	Pv value	275,000 Psi-ft/min

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ToughMet® Case Histories

Better reliability, slow, uniform wear rate

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- No sticking or seizing to steel pins
- No surface treatment or coating to wear away
- High hardness to resist scratching, from silica mines to tar sands
- High strength to resist deformation under edge-loading or sudden impact
- One mining engineer's comment: "ToughMet® has the ability to run wounded, where other materials will fail catastrophically."

Switching to ToughMet is Easy

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- Replacing Mg bronze or Al bronze (for example, C86300 or C95400)
- **Drop in replacement**
- No change to fits and clearances
- Replacing hardened steel
- Small change to interference fit required
- More fitting options available (ex: liquid N2)
- No change to clearances
- Grease grooves may be simplified or eliminated when replacing steel or bronze

Where is ToughMet® used?

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- Track idlers and rollers
- Haul truck steering and transmissions
- Excavator bucket linkages
- Dozer equalizer pins
- Fairleads
- Pump shafts
- Boom lift cylinder ends
- Wrecker hitch pivots
- Cable sheaves
- Clamshell bucket hinge bushings
- Planetary gearbox pins
- Tri-cone drill bits

Where is ToughMet® used?

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Sleeve bearings:

- Crane/loader boom linkages
- Aircraft landing gear
- Haulage truck steering
- Track-type undercarriages
- Racing engines (F1,NASCAR, drag)
- Food can production guides
- Plastic Extruder Lines

Sliding components:

- Pump slippers and rotors
- Press ways
- Hammer piston rings

Thrust bearings:

- Off-road transmissions & drives
- Hydraulic pump port plates
- Tunnel/rock drills

Other applications:

- Petroleum drill string parts
- Furnace guide rollers
- Precision motor shafts
- Marine engine valve guides
- Paper Mill 'whitewater' guides
- Pressure Seals
- Wiper Dies

Case History: King Pin Bushings

King Pin Bushings, Hitachi EH5000

- 30,0000 hours = 5x longer than C95400 Al bronze
- 80 tons additional load capacity

OEM Advantages

- Eliminate warranty repairs due to bearings
- Guarantee better availability/reliability
- Reduce costs of redesign and testing
- Easily increase vehicle load capacity
- Build more competitive equipment

Case History: King Pin Bushings

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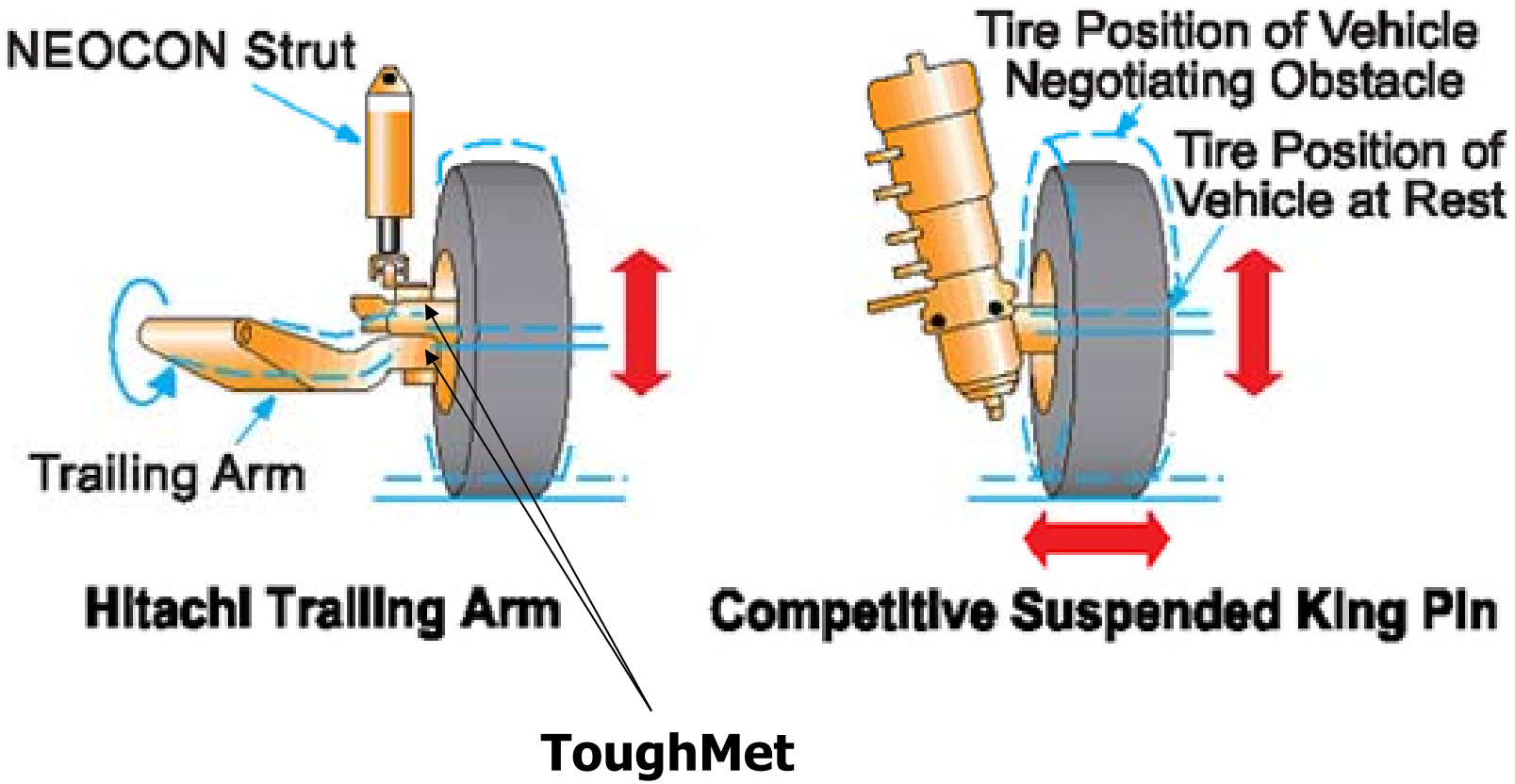
Hitachi Truck Steering Assembly



Case History: King Pin Bushings

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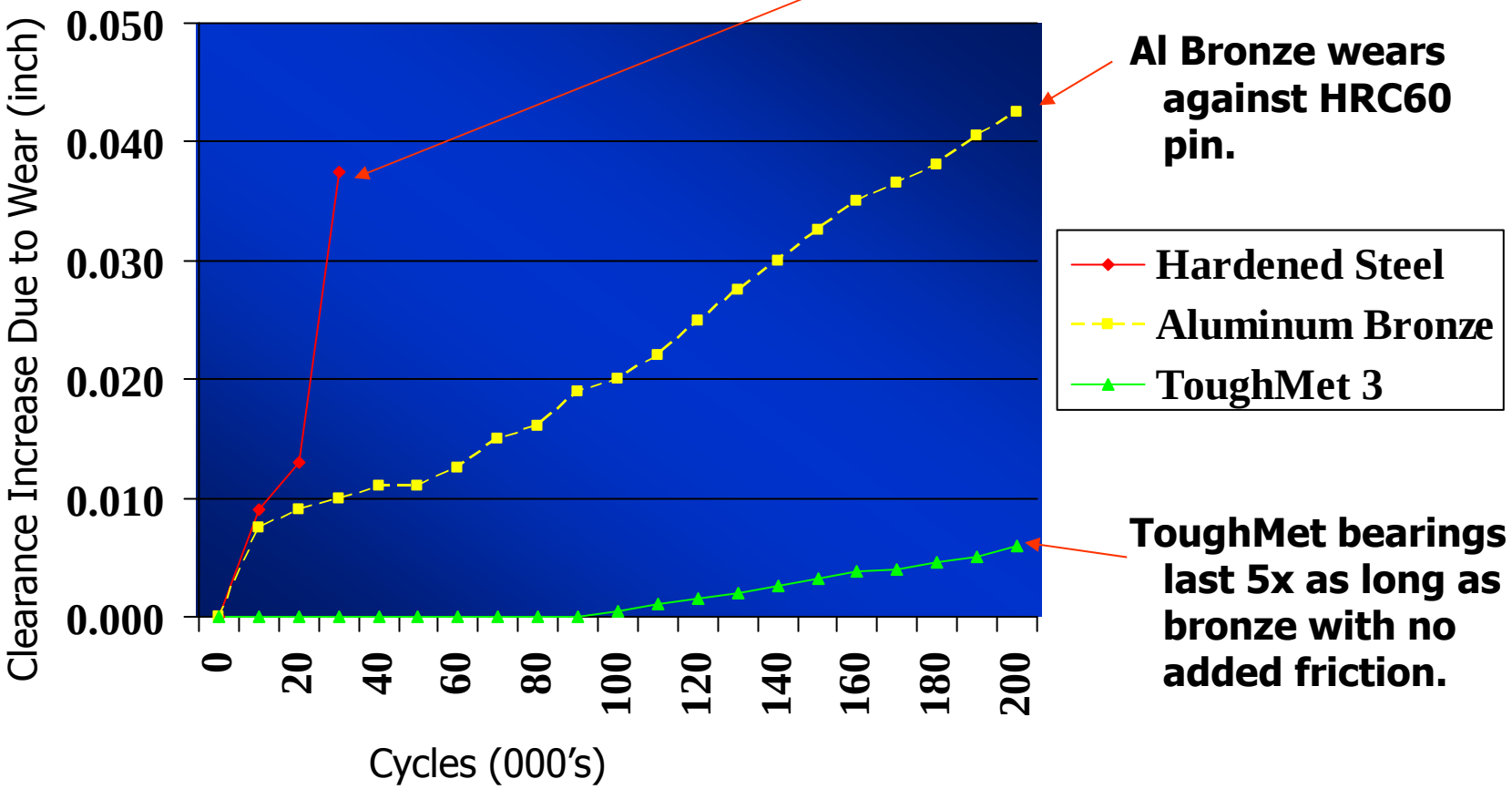
ToughMet® Outlasts Steel and Aluminum Bronze

Oscillating motion over 45 deg.
Theoretical bearing stress 2000 psi. (Actual is higher.)



Steel galls to steel pin: metal removal.

Al Bronze wears against HRC60 pin.

ToughMet bearings last 5x as long as bronze with no added friction.

ToughMet has a slow, predictable wear rate!

Case History: Excavator Bucket Bushing

Bucket bushings, Cat 350L:
3x (and counting) longer than hardened steel

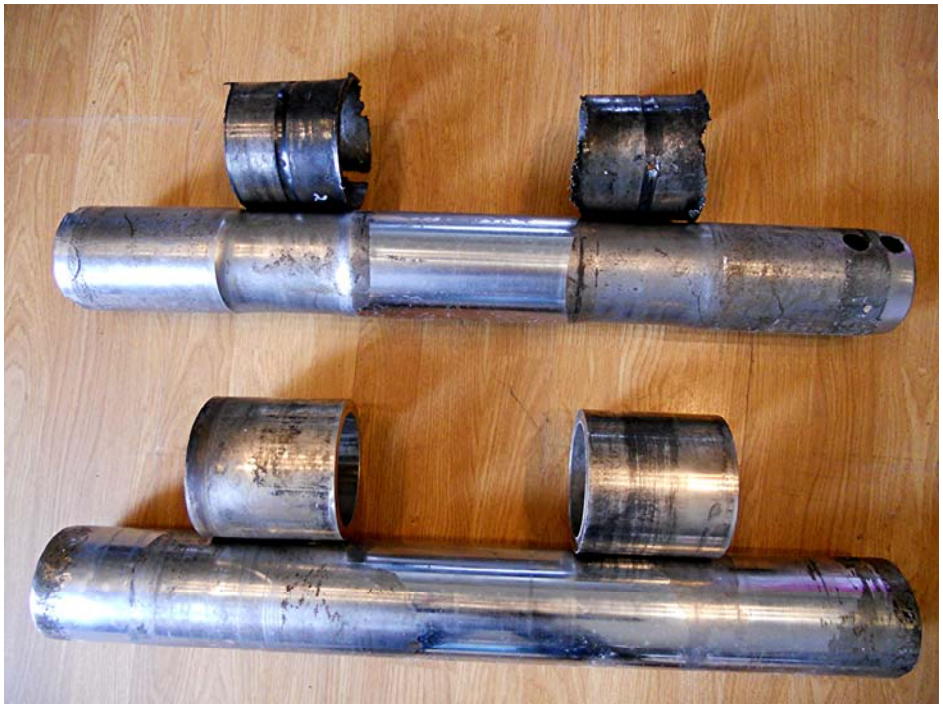
PRODUCTIVITY & RELIABILITY

- Aggregate mining in central Michigan
- Underwater digging with 45 degree swing
- 20-second cycle time
- 4.5 cubic yard bucket =15,000 lb or 6800 kg wet load

Bucket-to-stick joints

Case History: Excavator Bucket Bushing

OEM steel bushing and pin lasted 3600 hours [hardened steel pin with 0.010” (0.254mm) Cr with a 0.005” (0.127mm) clearance]



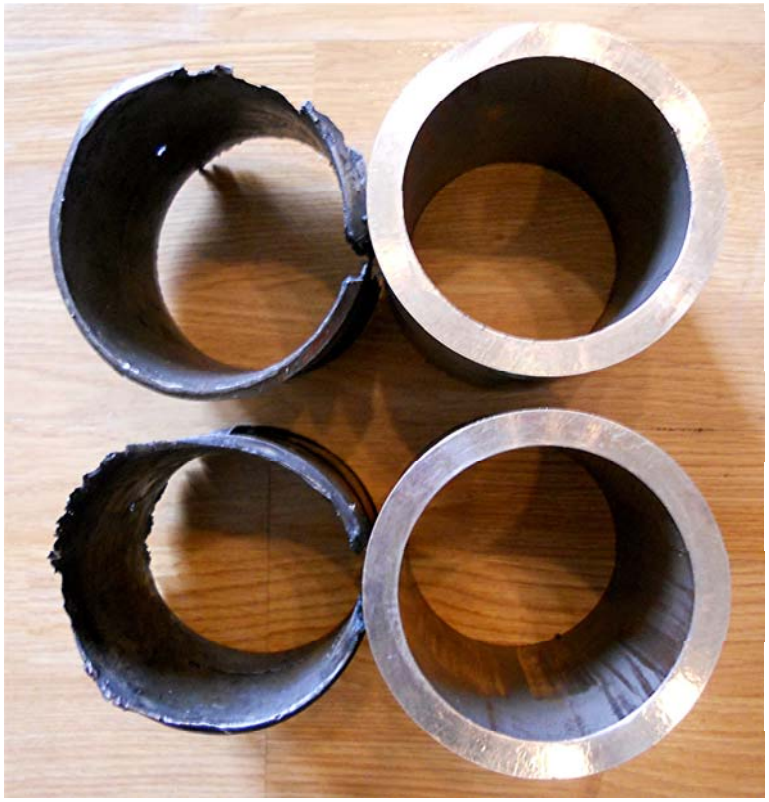
ToughMet® bushings with pin [carbon steel with 0.001” Cr (0.025mm) with a 0.002”(0.051mm) clearance]

- **First maintenance check at 8125 hours**
- **Have been put back in service and are still running**

Case History: Excavator Bucket Bushing

Steel at 3600 hours

ToughMet® at 8125 hours



Intital ID: 4.002”

Wear: 0.372" (9.45mm)

Intital ID: 4.002”

Wear: 0.0085" (0.3mm)

Case History: Wheel Loader Attachment Bushings

Dog bone joints

Bucket-to-side arm joint

PRODUCTIVITY & RELIABILITY

7.3 yd^3 bucket (12,500 lb. or 5680 kg. dry load)

Case History: Wheel Loader Attachment Bushings

MATERION

OEM steel bushings lasted 4800 hours.

Bushings made from ToughMet® pulled for inspection at 6250 hours, including 60 hours without re-greasing. Bushings were reinstalled and continue to run.

Initial ID: 4.002" (101.7 mm)

Wear: 0.030" (0.7 mm)

Initial diameter: 4.000" (101.6 mm)

Wear: 0.010" (0.25 mm)

Case History: Lower Roller Bushings

Lower roller bushings P&H 4100 XP:
30,000 hours =

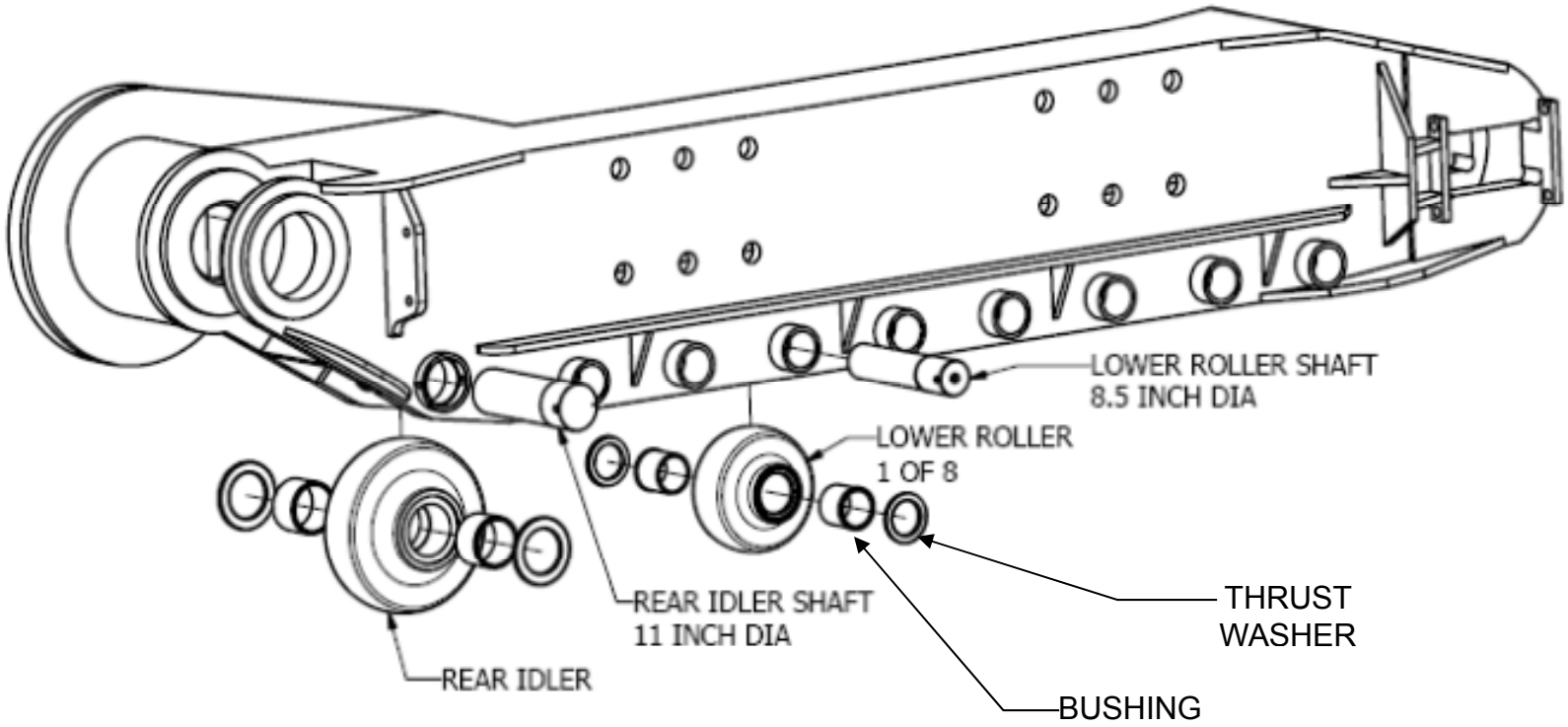
- 3x longer than C86300 Mn bronze
- Extended to match life of roller

PRODUCTIVITY & RELIABILITY

Case History: Lower Roller Bushings

Rollers, Idlers and Crawler Frame Assembly

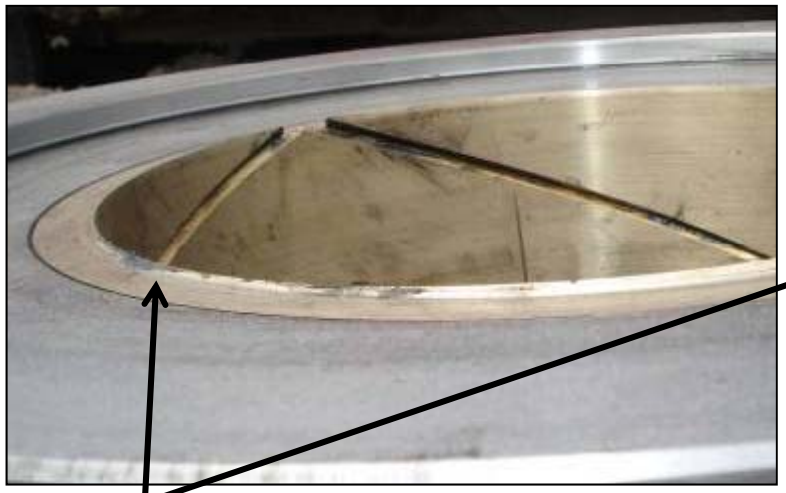
- Lower roller bushings in ToughMet.
- Rear idler bushings and roller thrust washers in C86300.



Loading on rear idler and lower rollers is similar.

Pressure is higher on the smaller load rollers.

Resilience on Edge Loading



C86300 manganese bronze

ToughMet 3 CX105

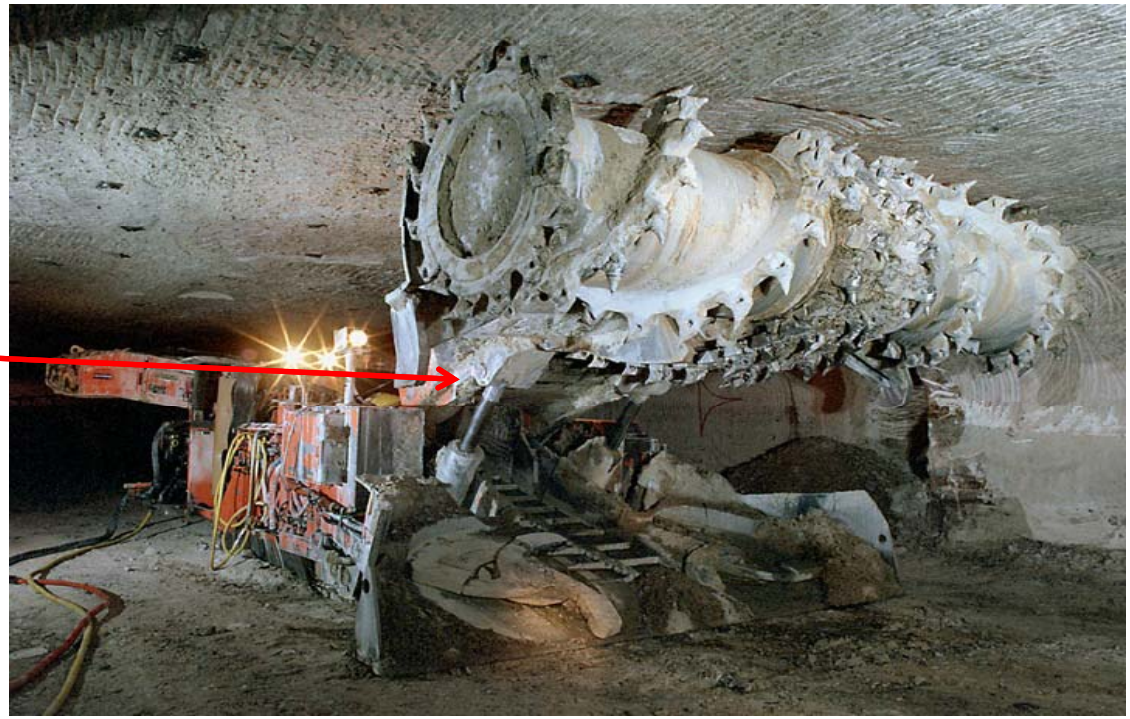
- Rope shovel roller and idler bushings
- C86300 permanently deformed under edge loads
- Diametrical wear at 7,698 hours:
  - Idler bushings in C86300 = 0.200” wear
  - Lower roller bushings in ToughMet = 0.003” – 0.022” wear

$^{1}/_{10}$ to $^{1}/_{75}$ the wear rate of manganese bronze!

Continuous Miner:

Replaced steel to prevent galling

Statement:
"On our miners that run 20 hours a day, we grease the steel bushings daily. The bushings made from ToughMet only have to be greased once a week. Converting to 100% ToughMet gave us a 13% increase in availability and reduced maintenance by 18 man hours per week! "



Longwall Shear Bushings

MATERION

Unlubricated Pivot Bushings

- 2 weeks life in steel
- 6 months in ToughMet

Additional Case Studies - Marine

Ferry boat prop shaft bushings:

2 years = 3x longer than stainless steel

Brass Housing

ToughMet Bushing

Stainless shaft

These Miners Didn't Use ToughMet Alloy Bearings

MATERION

ToughMet® in Oilfields

MATERION

Cu-Be Oilfield applications are mature

ToughMet® Oilfield applications are modern and growing very rapidly

ToughMet is replacing a wide range of materials

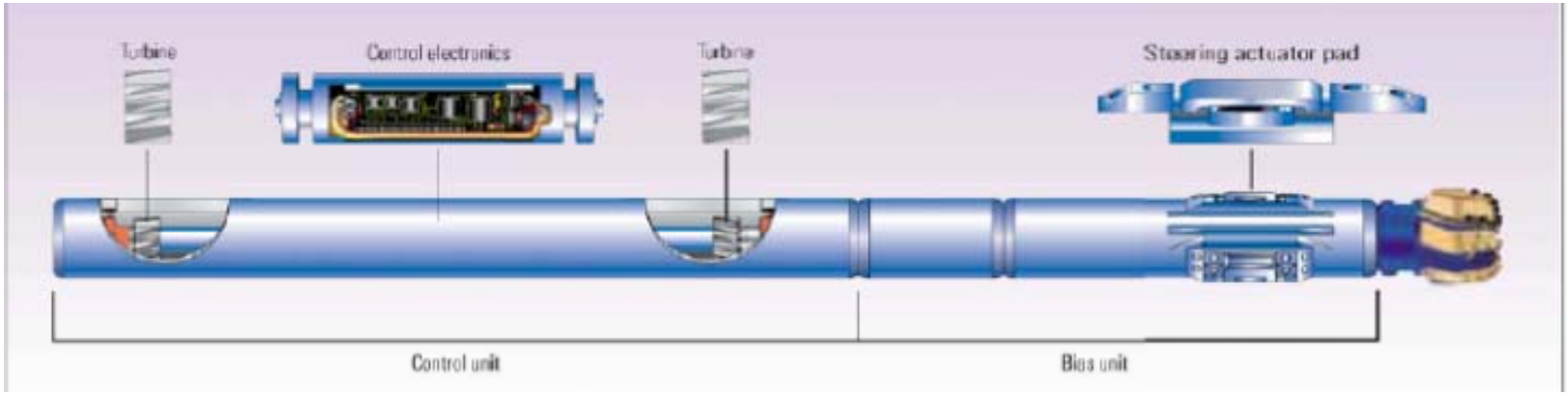
Many customers have definitely improved performance & saved money by using ToughMet instead of these materials in many cases:

- 17-4 PH stainless steel
- 15-5 CRES & 15-15 stainless
- 17Cr-17Mn Nitrogen steel
- AG-17 stainless
- Super-austenitic stainless
- 16 Chrome Mn steel
- P505 & P550 stainless
- Nitronic 50 or 60 (S209,S218)
- Brass or bronze
- Inconel 625, 718, 725
- Monel K500, 400
- NS5 bronze
- Pfinodal
- Nickel aluminum bronze
- Titanium Grade 2
- 2205 duplex stainless steel
- 2507 super-duplex

Successful Application - ToughMet

ToughMet in Oilfield:

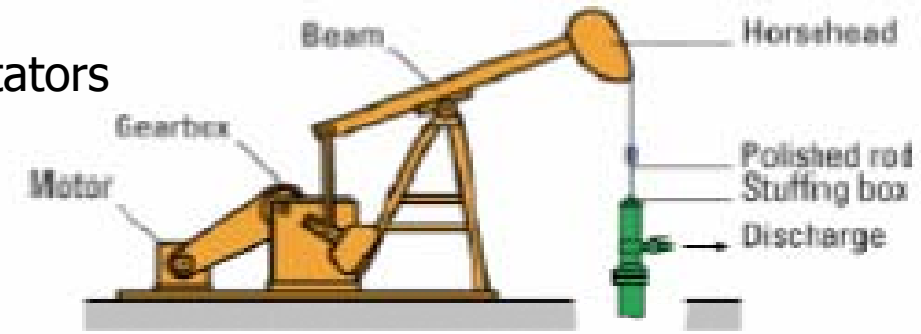
- Well Porforation Gun explosive charge liners
- Drill string centralizers, stabilizers and shock collars
- Rotary steerable drilling tool hardware including housings, actuators, bearings, pistons, power transmisson joints, drive shafts, etc. in control and bias units



Successful Application - ToughMet

ToughMet in Oilfield:

- Sucker rods and polished rods
- Subsea well control manifold hydraulic connectors
- Sour service MWD, LWD pressure housings for electronics and batteries
- Expandable well casing sand screen tool bearings
- Sour service subsea valve actuators, lifting nuts, other mechanical bearings
- Kelly valve seats
- Reservoir completion and formation isolation valve indexers
- Non-magnetic mud motor stators



New TM 3 Temper with high CVN

MATERION

MATERION

ToughMet® 3 TS95 Rod

Materion Brush Performance Alloys' ToughMet® 3 TS 95 Rod is a spinodal copper nickel tin alloy designed for use in applications demanding fracture resistance, resistance to salt water corrosion, resistance to galling, good ductility and good machinability.

CHEMICAL COMPOSITION (weight percent)

Alloy	Nickel	Tin	Copper
ToughMet® 3 TS 95	15	8	Balance

MINIMUM MECHANICAL PROPERTIES

Diameter		0.2% Offset Yield Strength		Ultimate Tensile Strength		Elongation	Hardness		Average CVN Impact Toughness	
inch	mm	ksi	MPa	ksi	N/mm^2	% (in 4d)	HRB	HBW	Ft-lbs	J
0.75 – 3.25	19 - 83	95	655	106	730	18	97	222	30	40

Note: Tensile properties are design limit values (T_{99})

No single CVN value < 24 Ft-lbs, 32 J

Replacing Roller Bearings with Bushings

MATERION

Bushings made from ToughMet replaced needle roller bearings in hand-held torque wrenches:

Increased load capacity

Decreased assembly time and cost.

Replacing Roller Bearings with Bushings

BUCYRUS

Shovel Upgrades

Applies to: All 395BI through 495HF/HR Models
Standard item Lot 109 and later

PIA-EMS-060314

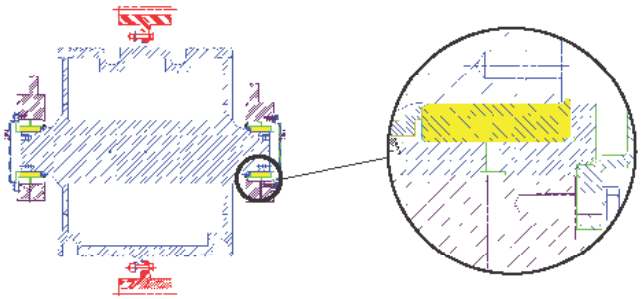
Crowd Drum Shaft Bushing

Challenge

Increase impact resistance of crowd drum bearings.

Response

Replace spherical roller bearings with high-performance ToughMet® hardened "bronze" bushings. No machining is required to install the new bushing components. Bushings run against replaceable sleeves.



BUCYRUS INTERNATIONAL, INC. For more information, contact your local Bucyrus sales representative or our corporate office located at:
1100 Milwaukee Avenue • P.O. Box 500 • South Milwaukee, WI 53172-0500 • 414.768.4000 • FAX 414.768.4474 • An ISO 9001:2000 registered firm.
Visit us on the web at: www.bucyrus.com or e-mail: inquiry@bucyrus.com.

Challenge

Increase impact resistance of crowd drum bearings.

Response

Replace spherical roller bearings with high-performance ToughMet® hardened "bronze" bushings. No machining is required to install the new bushing components. Bushings run against replaceable sleeves.

Manufacturing Case Histories

MATERION

Problem: Machine uptime for citrus juice extractor- juicing season is only 3-4 months/year. C93200 bushing was failing.

ToughMet as a solution:

- ToughMet's lubricity and low coefficient of friction allowed for less lube intervals and less lube overall, reducing possible food contamination.
- Corrosion resistance properties are ideal for acidic environment
- Using ToughMet eliminated the leaded bearing- a plus in food production.

Manufacturing Case Histories

Problem: Uptime in 'white water' area of paper mill. C954 was corroding.

ToughMet as a solution:

- Low coefficient of friction helped compensate for lube loss in the submerged environment
- Corrosion resistant properties ideal for bleaching environment

Manufacturing Case Histories

Problem: Life of roller pin bearing life on hot strip mill entry roll table. C95400 was wearing quickly.

ToughMet as a solution:

- ToughMet's higher yield strength survived high impact of material on each successive roll
- Corrosion resistant properties ideal for strip mill

Manufacturing Case Histories

MATERION

Problem: Large plastic bottle blow mold machine makes 1500 bottles per minute, running 24/7. It is hard to keep joints lubricated- industrial lubrication stains/ contaminates plastic.

ToughMet as a solution:

- The bushings have run 3 years with little change
- ToughMet can run on water as lubrication
- ToughMet can run 'starved' in a joint that is reversing and without full rotation.