

ENDURA Dual - The New Standard for Fixed Plant Liners used in Ore Processing

Paul Kobelke, Sandvik Materials Technology,

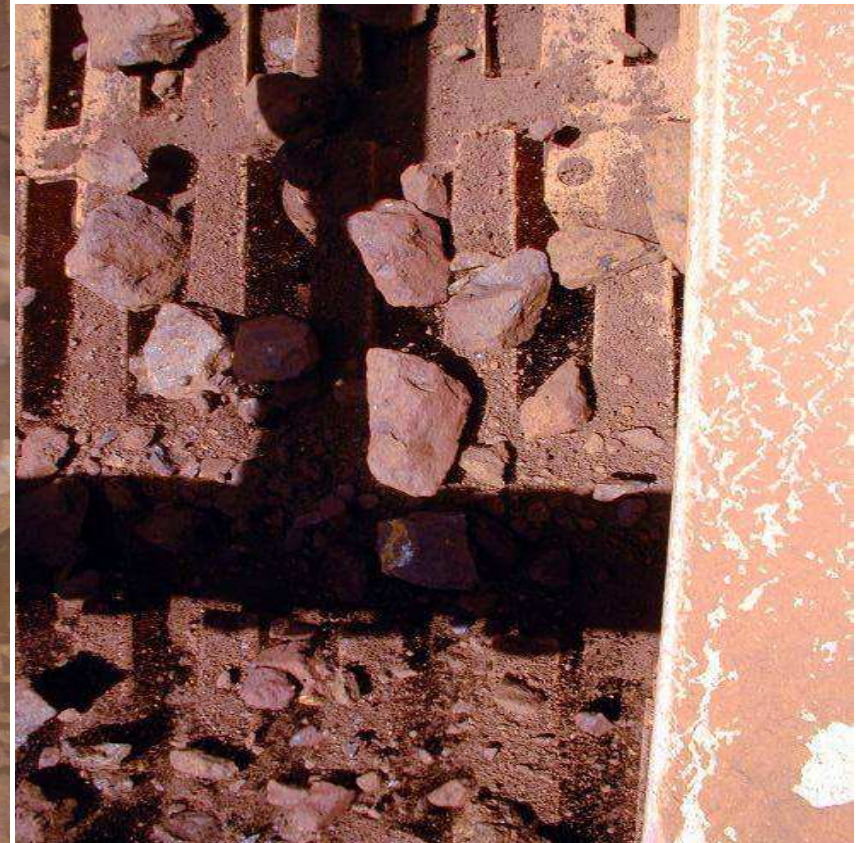


ENDURA Dual fixed Plant Liners Presentation TOPICS



- 1 The GRIZZLE Intro – impact abrasion the perfect start for ENDURA Dual
- 2 Pilbara Iron Scalping Screen – 2010 Case Study
- 3 The Unique combination of properties behind ENDURA Dual success .
- 4 ENDURA Dual the perfect choice for most fixed plant application .
- 5 Weld overlay replacement a focus market
- 6 Processing ENDURA Dual – The Key to ongoing success .
- 7 Summary - Selecting the right target to start is important

First Stage Processing of ROM Ore typically requires both Impact and Slide Abrasion resistance .



The Grizzle Deck is used to separate lump ore from the fines prior to the primary crusher circuit –
Demanding Service Application



ENDURA Dual 40 & 50 mm Grizzle Decks

Replacing ENDURA as the previous Iron Ore Grizzle Deck standard over the Past Decade



2003 -Traditional approach utilised 500 HB Water Quenched Wear Plate delivering average 3 months service



2013 Service Update

ENDURA Dual Delivers min 50%

Extended Service Life over ENDURA

ENDURA – Grizzle Finger after 3 months service – June 2003

2006 Service Update

ENDURA Grizzle Deck Fingers are now used extensively throughout the Pilbara, delivering significant service life improvement across the iron ore industry.
100% plus service life improvement

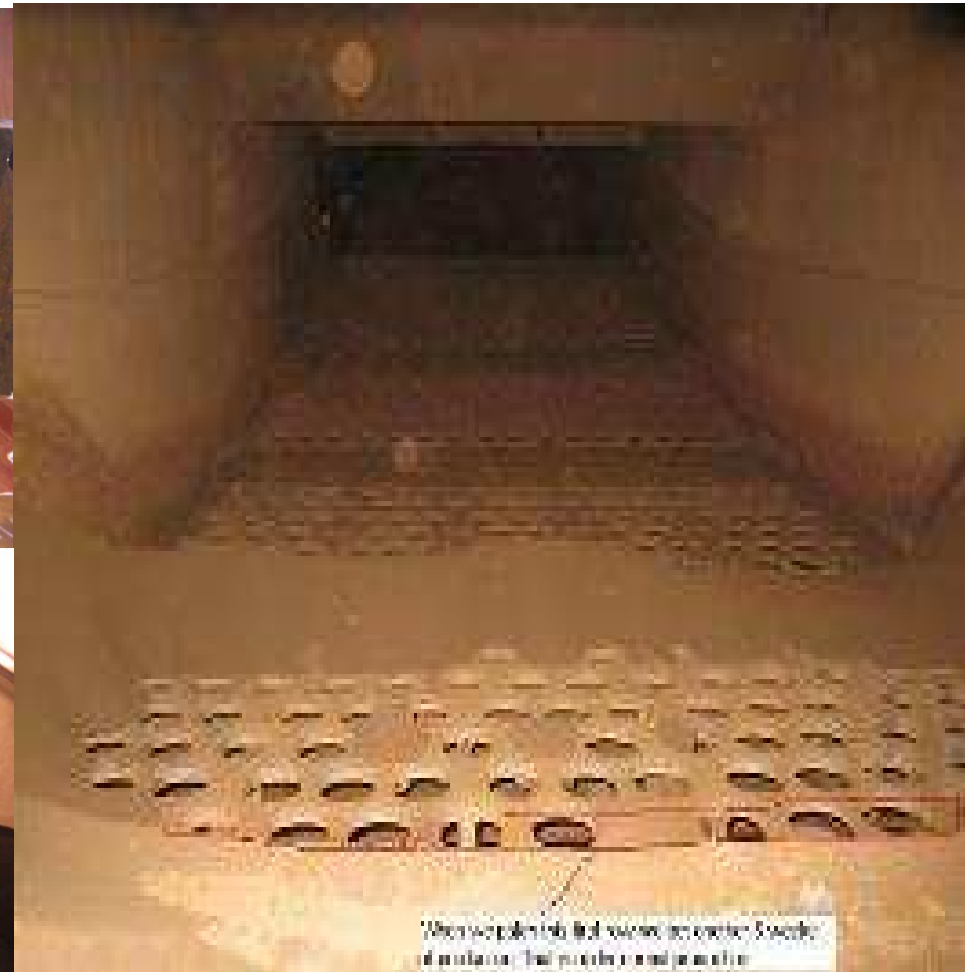


Rio Tinto - Pilbara Iron – Tom Price High Grade Iron Ore Stock Pile



- **SERVICE** -Primary Screen Decks handling high grade hematite ore
- Wear Mechanism – medium Impact / high slide abrasion
- Large tonnage through put 20 MT / annum –
- Ore feed subject to variation in Lump / Fines ration

PI -Tom Price **ENDURA** 30 mm thick –
High Grade Scalping Screen Deck
after 12 weeks Service .



PI -Tom Price **ENDURA Dual** 30 mm thick –
Grade Scalping Screen Deck
after 18 weeks Service – 50 % Increase Service Life



ENDURA Dual



**ENDURA Dual
LINERS
INCREASE
SERVICE LIFE
BY min 50% over
ENDURA And Typically
100% Plus
Over Std Q & T
Wear Plate**



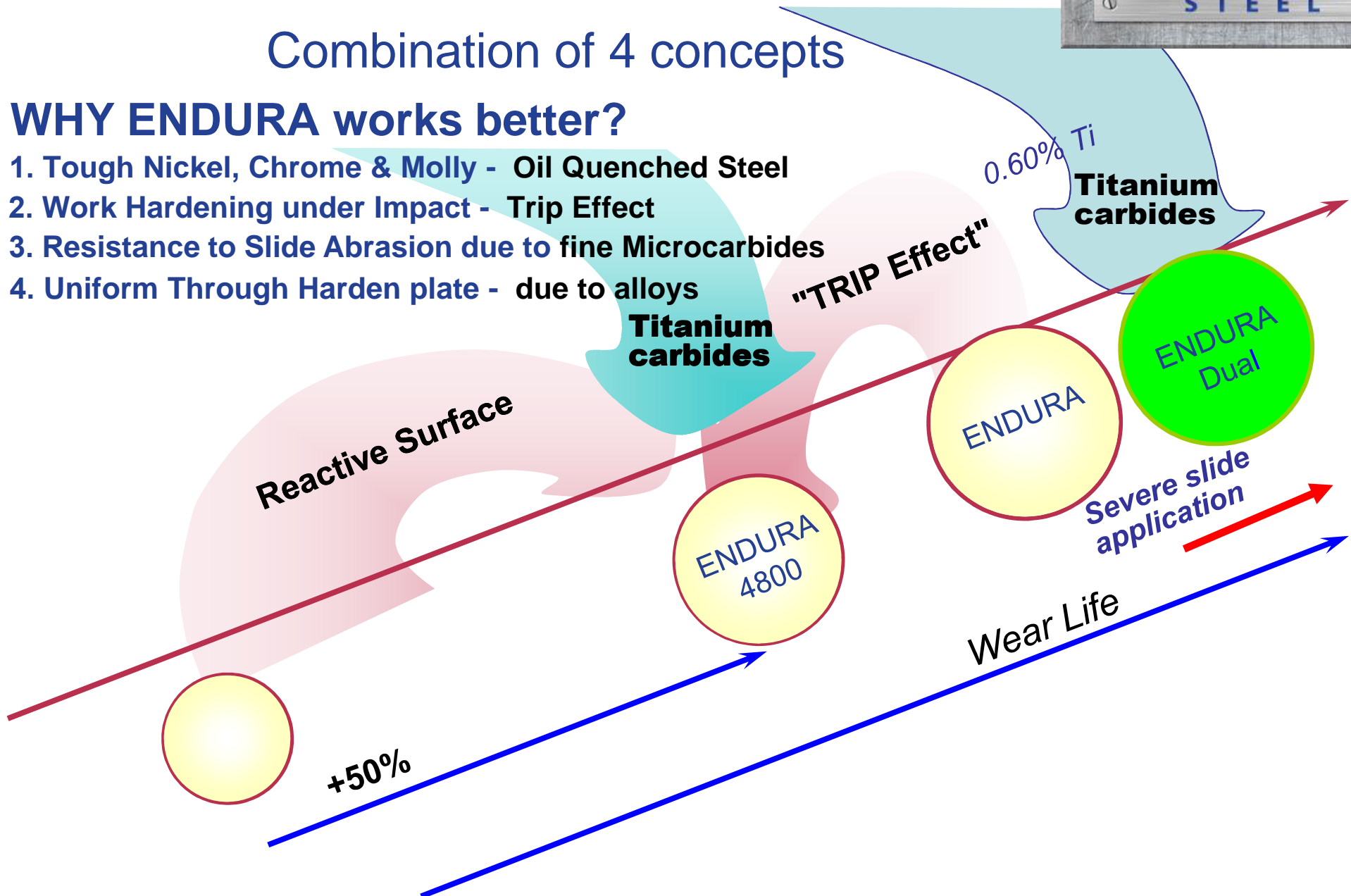
ENDURAFAMILY

Combination of 4 concepts



WHY ENDURA works better?

1. Tough Nickel, Chrome & Molly - Oil Quenched Steel
2. Work Hardening under Impact - Trip Effect
3. Resistance to Slide Abrasion due to fine Microcarbides
4. Uniform Through Harden plate - due to alloys

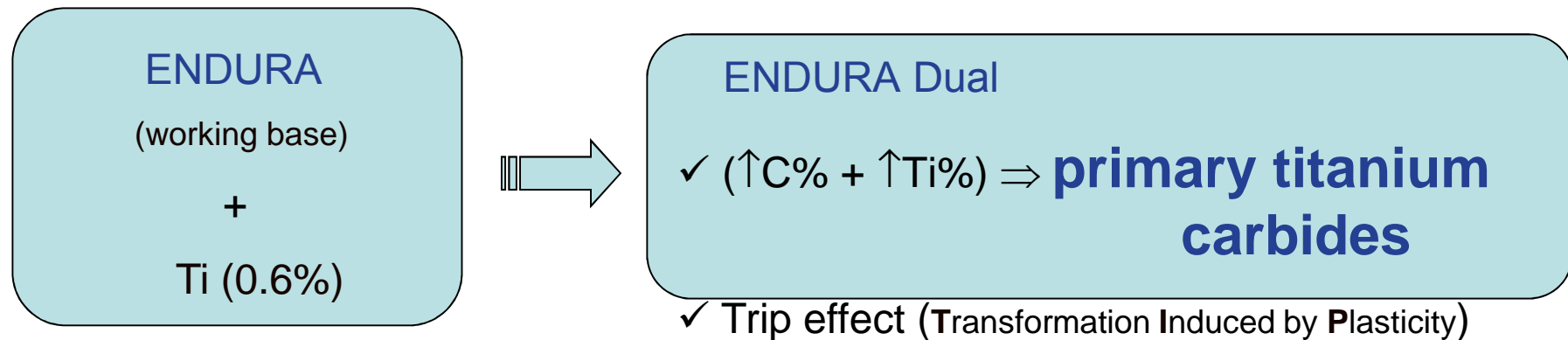


ENDURA Dual



WHY IS ENDURA Dual UNIQUE

The answer is given by a sophisticated grade, which is built around the metallurgy of ENDURA combined to a high titanium content

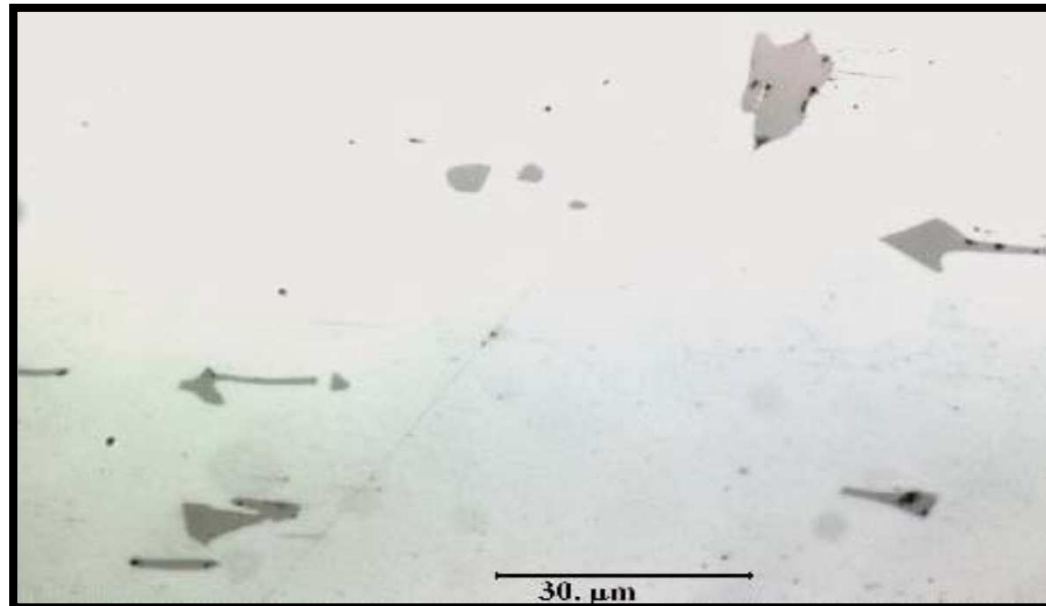


ENDURA Dual



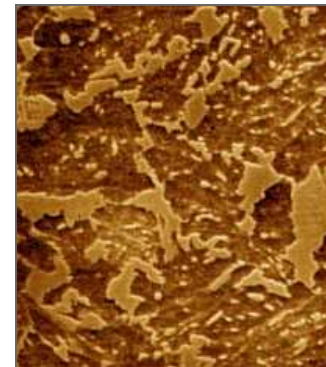
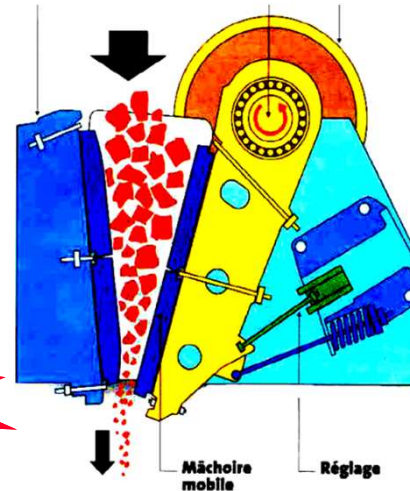
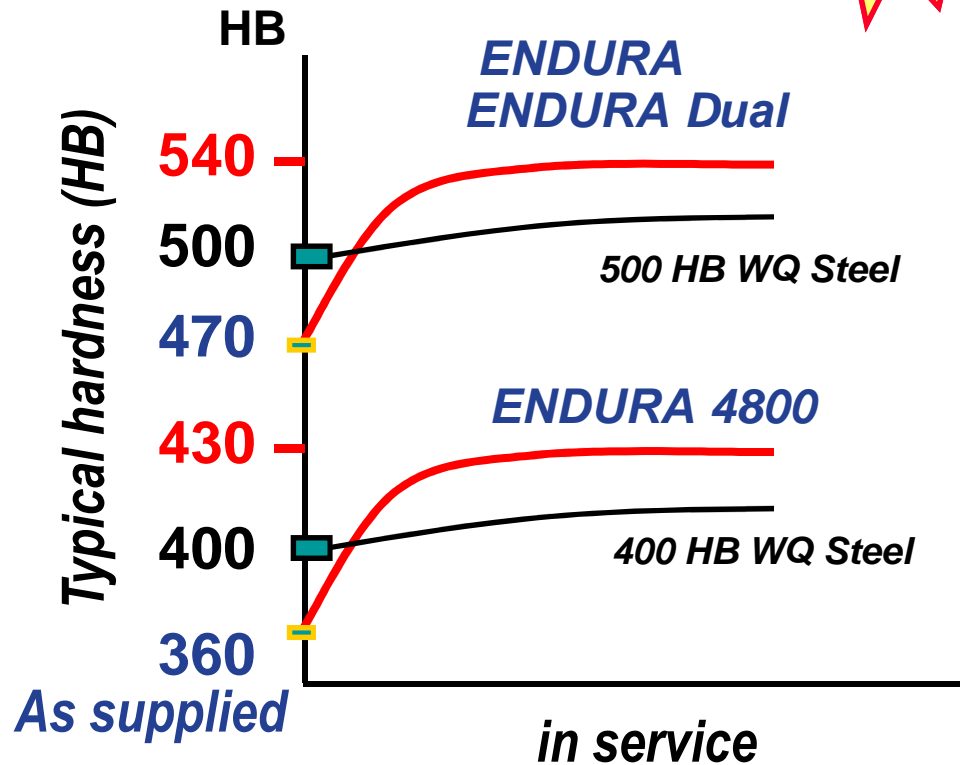
ENDURA Dual

- C Mn Ni Cr Mo S Ti
- ≈ 0.40 ≈ 1.30 ≈ 0.45 ≈ 0.70 ≤ 0.34 ≤ 0.002 ≈ 0.60
- Maintains all the properties of **ENDURA**
- Delivers significantly improved slide abrasion resistance over **ENDURA**
- Target market replacing WELD OVERLAY– high abrasion +impact load



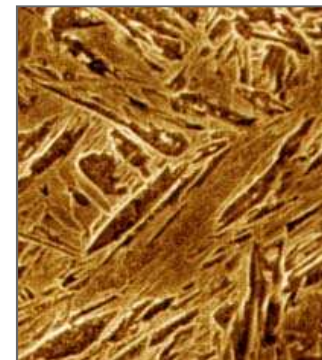
ENDURA - WorkHardening similar to 18% manganese crusher components

+70 HB



ENDURA

- ✓ Hardness (martensite + bainite)
- ✓ Hardening by TRIP effect
- ✓ Micro Carbides (Cr, Mo, Ti)



Water Quench

- ✓ Hardness (martensite)

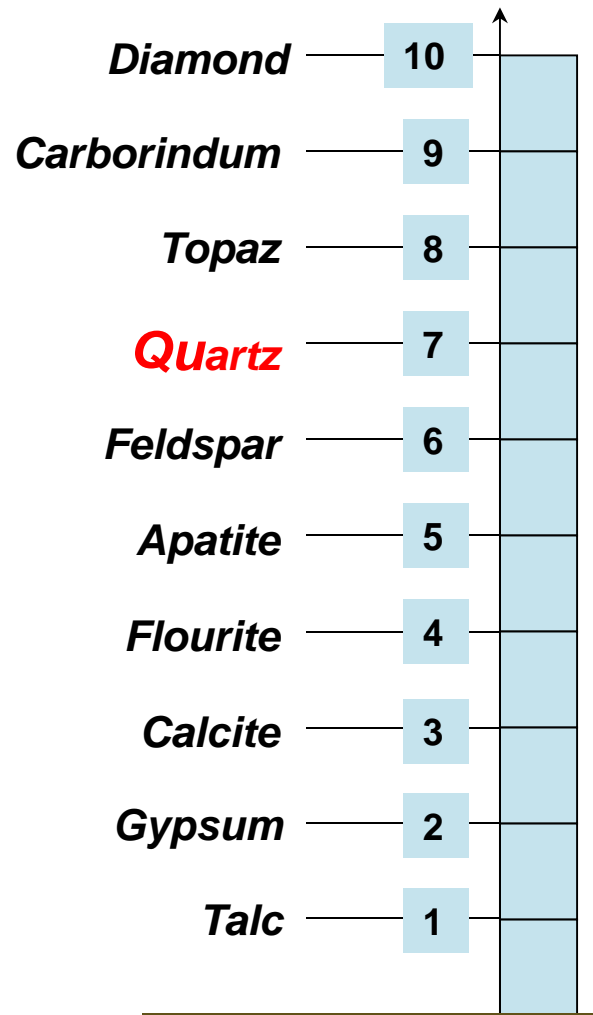
Typical Mines Rock Ore Hardness

Mohs hardness

ENDURA Micro Carbides



Reference
Material



Titanium Carbide (3000 HV)

2000 HV

Molybdenum Carbides (1800 HV)

1620 HV

Chromium Carbides (1500 HV)

1280 HV

720 HV

Typical 500 HB

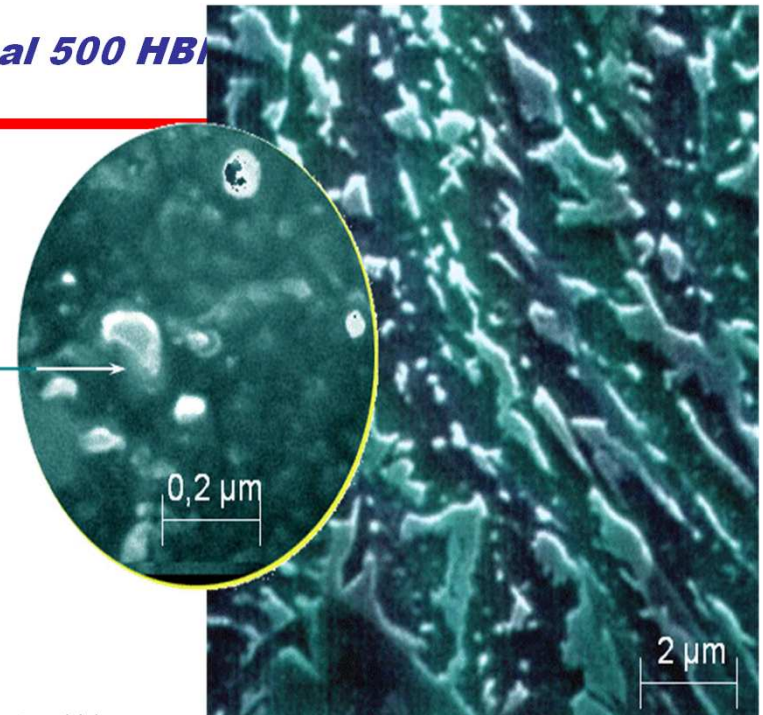
500 HV

180 HV

110 HV

70 HV

20 HV



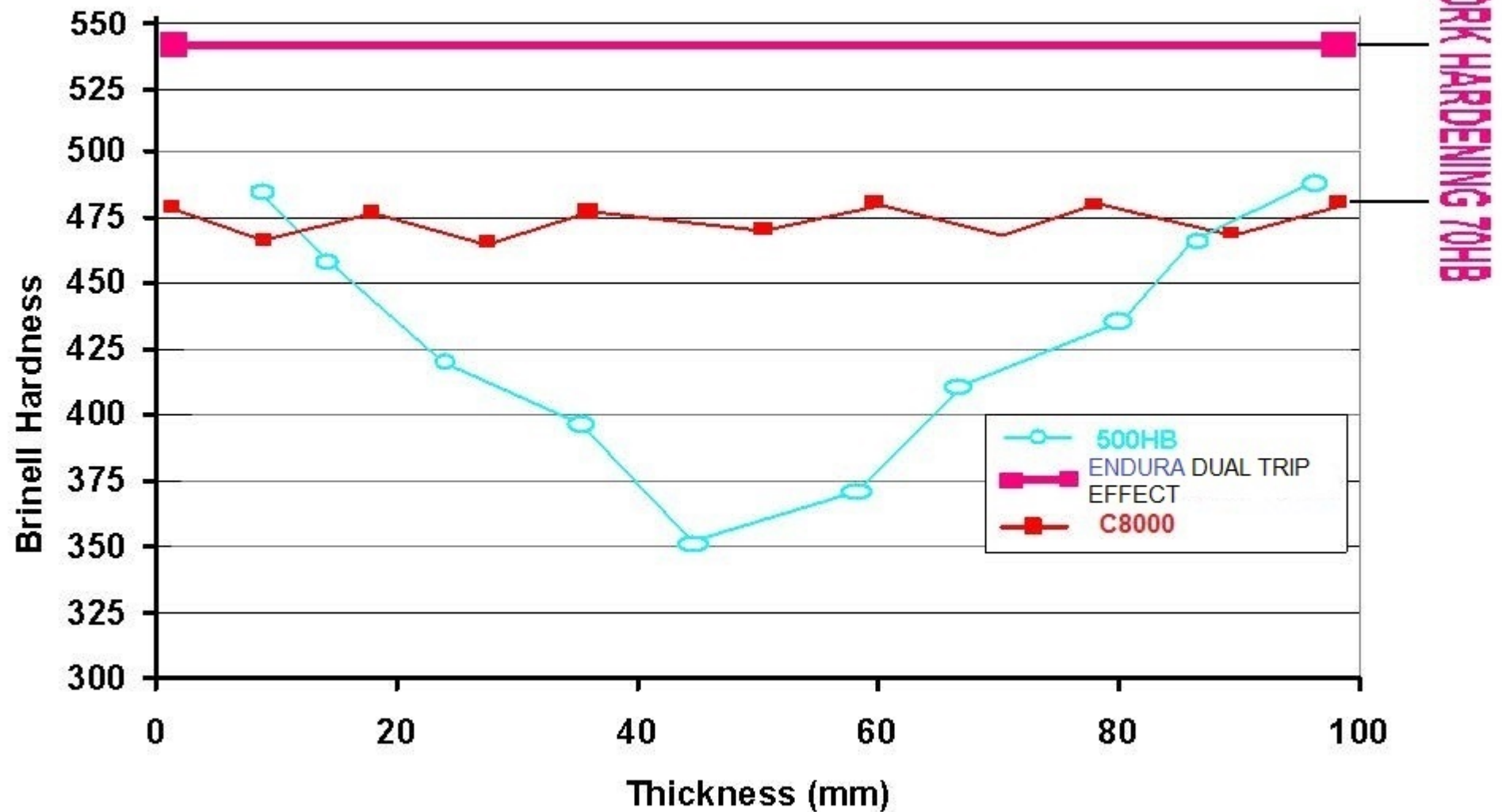
(**) dependent on thickness

ENDURA Dual and the Carbide ROAD - Concept

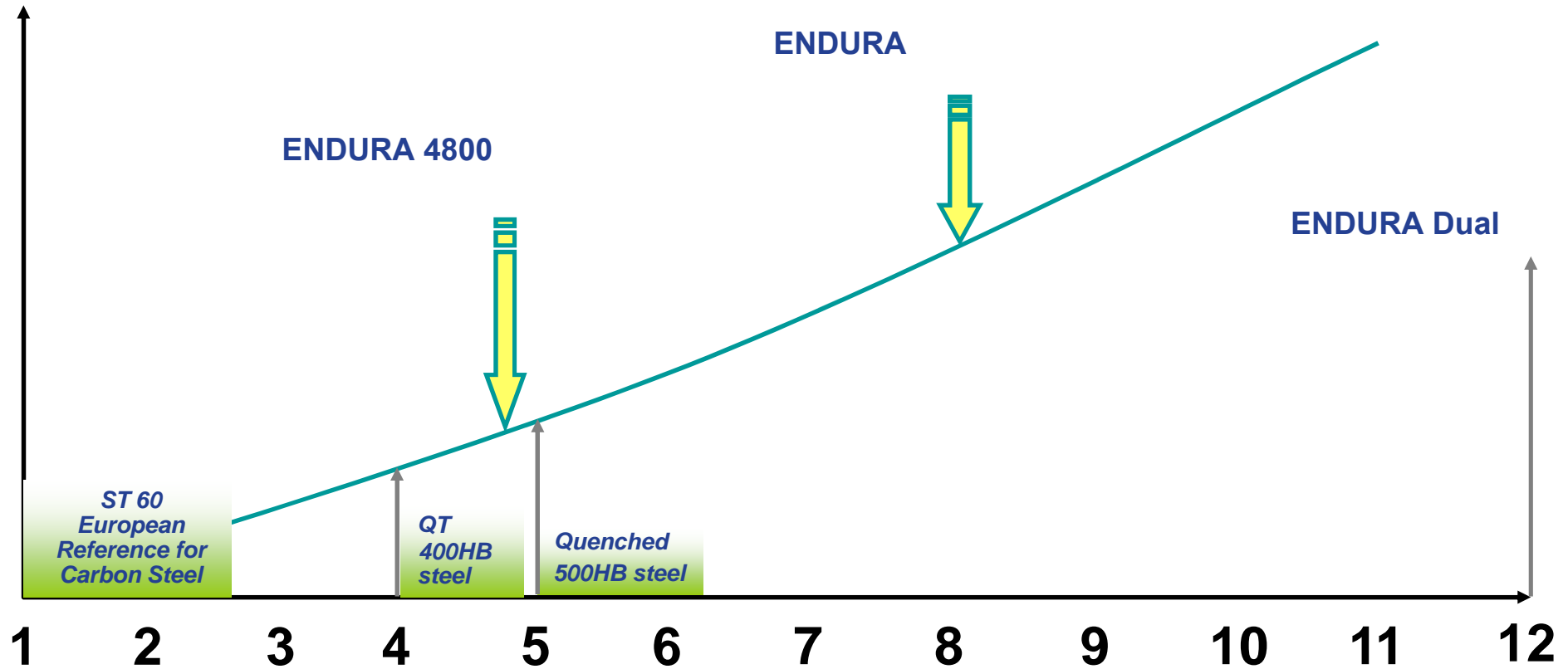


ENDURA Dual *Hardness Consistency*

Hardness through the thickness - 100mm thick plate



Comparison of service life



ENDURA - Iron Ore Mine - Pilbara

Replacing 500HB wear plate

min 100% Service Life

Improvement



ENDURA Dual



Coal -25 mm Roller Feeder Screen.

**ENDURA Dual FLOWERS Double the Service
Life Replacing 500HB Material with hard faced
teeth**



ENDURA WEAR SERVICE Update – 2013 CADIA Valley MINE - FIXED PLANT Application



Cadia High Grade Stock Pile Bath
Liners supplied in

ENDURA

Replaced Ni Hard – 2008

Replaced in 2012 after 4 years in
service .

ENDURA Dual 50 mm upgrade liner
material Proposed for this application
at Cadia Mine .



ENDURA Dual



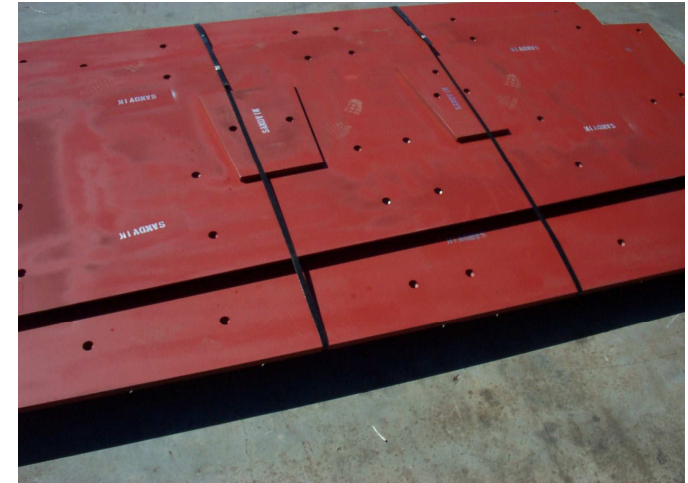
ENDURA Dual Lined Coal chutes –Replacing 450 HB Q & T wear plate Weld overlay has edge wear issues

ENDURA Dual

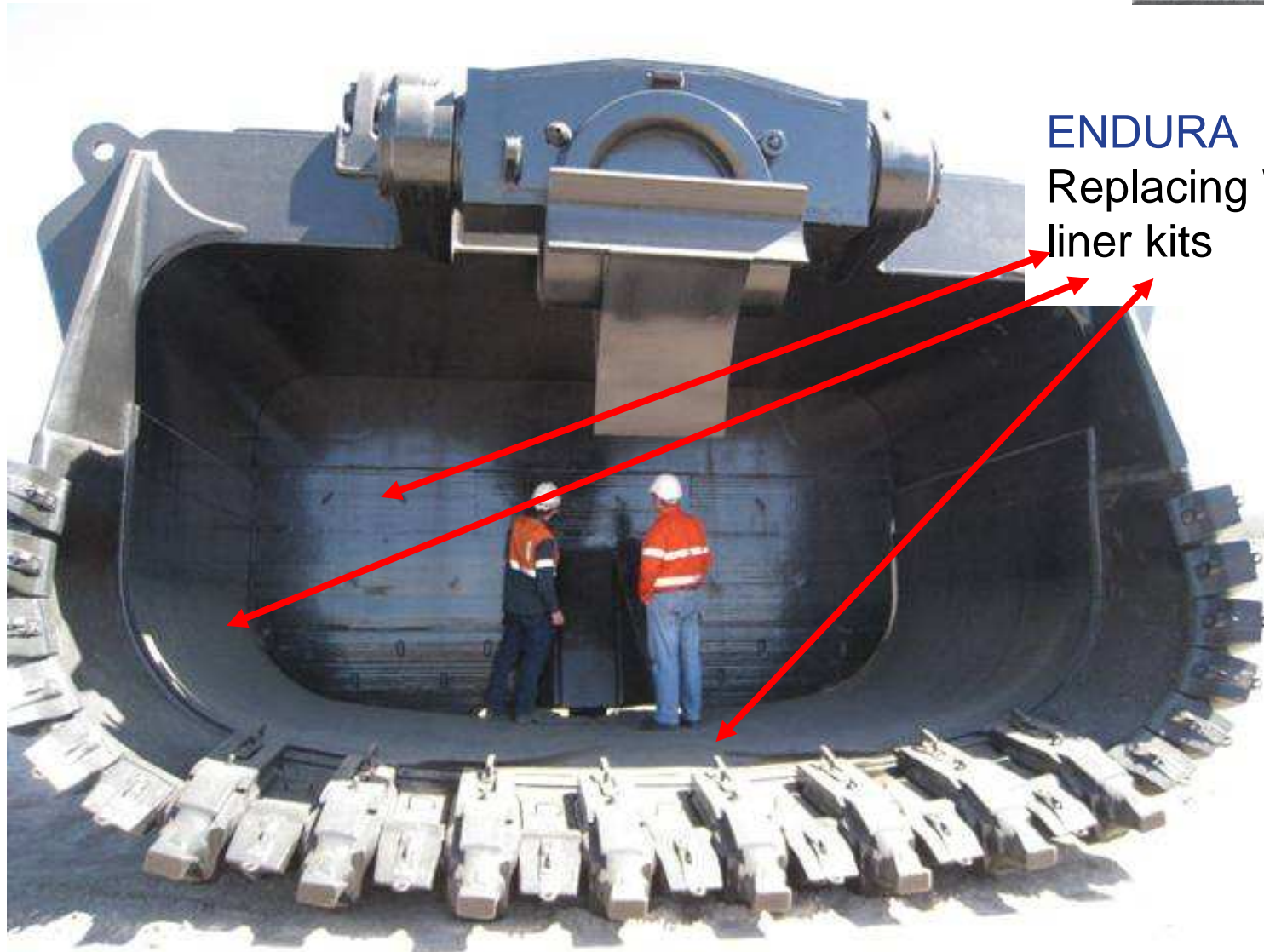
ENDURA Diverging Feeder Liner Sets - PI-STD

ENDURA Dual replacement increase service life by 50%

Replacing Weld Overlay extending service life 30%



ENDURA Dual



ENDURA Dual 20 mm
Replacing Weld Overlay
liner kits

ENDURA Dual 20 mm - Train Load Out Vault Liners

- Iron Ore Mine
- Pilbara replacing weld overlay
- Fabrication includes safety approved lifting lugs



ENDURA Dual WELDING – Good Practice Critical





ENDURA DUAL WELD PROCEDURE SPECIFICATION -[WPS]

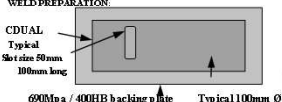

Essential this is reviewed and followed at all times

- 1> Flux Cored Wire FCAW

- 2> Solid Wire GMAW

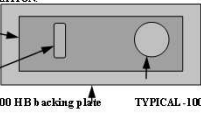

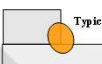


WELD PROCEDURE SPECIFICATION (WPS)

WELDING CODE	AS. 1554.4	CLIENT	TYPICAL Creusabro CDUAL FCW wire Welding Procedure	
WELDING PROCESS	FCAW	PROJECT	N/A	
EDGE PREPARATION	PLASMA CUT AND GROUND	DRAWING NO.	N/A	
JOINT TYPE	8 – 9 mm FILLET	WPS NO.	Sandvik Creusabro (1)	
JOINT POSITION	2F Downhand	WPS No.	Sandvik Creusabro (1)	
JOINT TOLERANCE		MATERIAL DETAILS		CONSUMABLE DETAILS
Root gap (G)	N/A	Grade / type - 1	Creusabro CDUAL	Brand Name - 1
Root Face (F)	N/A	Material Group	N/A	Electrode Class - 1
Included Angle (A)	N/A	Grade / type - 2	690Mpa and 400 HB	Brand Name - 2
Fillet Joint Angle	90°	Material Group	N/A	Electrode Class - 2
Prequalified Joint	N/A	Carbon Eqv.	N/A	Electrode Conditioning
Prequalified Consumables	N/A	Backing Strip	N/A	Shielding gas
Max Gap Tolerance	N/A	Range Qual.	50 mm	
WELD PREPARATION:				
				
690Mpa / 400HB backing plate			Typical 100mm Ø	
CDUAL			Backstep plug welds permitted	
Typical Slot size 50mm 100mm long			Note: 150mm max Backstep weld	
Typical 100mm Ø			Typical 6 – 8 mm fillet	
Ensure moisture free before welding				
!!!				
MATERIAL PREPARATION			THERMAL TREATMENT	
Cutting Method	Oxy Flame or Plasma	PREHEAT - °C	PWHT - °C	
Class cut req'd	1	Preheat method	Oxy / Acet	PWHT - Type
Chemical Clean	N/A	Preheat Temp.	150° C	Soak Temp.
Interpass Clean	Wire brush	Preheat Retention	N/A	Dwell Time
Back Gauge	N/A	Adm. Temp. Start	20 Deg C	Heating Rate
Gauge Mth	N/A	Preheat Check	N/A	Cooling Rate
Finish req'd	As Welded	Max Interpass	280 Deg C	Withdrawal Temp.
PASS DETAILS		CONSUMABLE DESCRIPTION		SHIELD GAS
No.	SIDE	POS.	TYPE	WELDING PARAMETERS
1	1	2F	BEAD	HEAT INPUT
			SIZE 6mm	
			SHIELD	
			EXPOS	
			FLOW	
			UNIT	
			AMPS	
			VOLTS	
			SPEED	
			UNIT	
			POL.	
			AC	
			ID/mm MAX.	
			1.65 Kj/mm	
WELDER DETAILS				
Name	Push / Drag	Push & Pull	Normal Size	GTAW DETAILS
ID Number	Transfer Type	Global	Tungsten Size	
Dated			Tungsten Type	
Stringer/Weave				
STICKOUT: 22 mm				
RECOMMENDED GOOD WELDING PRACTICE				
TEST REQUIRED				
DT				
No.				
NDT				
Macro				
Hardness				
Bend S/R/R				
Tensile				
Impact				
UT				
WPS - STATUS				
APPROVED BY				
PREPARED BY				
INSPECTED BY				
DATE				



WELD PROCEDURE SPECIFICATION (WPS)

WELDING CODE	AS. 1554.4	CLIENT	TYPICAL Creusabro CDUAL Solid Wire MIG PROCEDURE	
WELDING PROCESS	GMA W	PROJECT		
EDGE PREPARATION	PLASMA CUT AND GROUND	DRAWING NO.	N/A	
JOINT TYPE	8-9 mm FILLET	WPS NO.	Sandvik Creusabro (1)	
JOINT POSITION	2F Downhand	WPS No.	Sandvik Creusabro (1)	
JOINT TOLERANCE		MATERIAL DETAILS		CONSUMABLE DETAILS
Root gap (G)	N/A	Grade / type - 1	Creusabro Dual	Brand Name - 1
Root Face (F)	N/A	Material Group	N/A	Electrode Class - 1
Included Angle (A)	N/A	Grade / type - 2	690Mpa or 400HB	ER 70S-4
Fillet Joint Angle	90°	Material Group	N/A	Electrode Class - 2
Prequalified Joint	N/A	Carbon Eqv.	N/A	Electrode Conditioning
Prequalified Consumables	N/A	Backing Strip	N/A	Shielding gas
Max Gap Tolerance	N/A	Range Qual.	50 mm	Clean 20-25 % CO ₂ - Bal Argon
WELD PREPARATION				
CDUAL TYPICAL Slot size 50mm 100mm long 690 Mpa / 400 HB backing plate TYPICAL -100mm Ø			Back step fillet weld permitted  Note: 150mm max Backstep weld  Typical 6-8mm fillet	
Ensure moisture free before welding!!!				
MATERIAL PREPARATION				
Cutting Method	Oxy Flame or Plasma	PREHEAT - °C		PWHT - °C
Class cut req'd	1	Preheat method	Oxy/ Acet	N/A
Chemical Clean	N/A	Preheat Temp.	150° C	N/A
Interpass Clean	Wire brush	Preheat Retention	N/A	N/A
Back Gauge	N/A	Adm. Temp. Start	20 Deg C	N/A
Gauge Mth	N/A	Preheat Check	N/A	N/A
Finish req'd	As Welded	Max Interpass	280 Deg C	N/A
PASS DETAILS		WELDING PARAMETERS		HEAT INPUT
No.	SIDE	POS.	TYPE	BEAD
1	1	2F	BEAD	SIZE 6mm
			SHIELD	SHIELD
			EXPOS	EXPOS
			FLOW	FLOW
			UNIT	UNIT
			AMPS	AMPS
			VOLTS	VOLTS
			SPEED	SPEED
			UNIT	UNIT
			POL.	POL.
			AC	AC
			KJ/mm MAX.	KJ/mm MAX.
			1.6 Kj/mm	1.6 Kj/mm
WELDER DETAILS				
Name	Push / Drag	Push & Pull	Normal Size	N/A
ID Number	Transfer Type	Global	Transfer Type	N/A
Dated			Tungsten Size	N/A
Stringer/Weave			Tungsten Type	N/A
STICKOUT: 22 mm				
RECOMMENDED GOOD WELDING PRACTICE				
Radius all plate edges and remove rust scale and contaminants prior to welding.		DT		
Ensure plates are dry and apply a soaking pre heat. NO MOISTURE is critical		No.		
Use Back step welding at max 150 mm plus do not weld around sharp corners		NDT		
Ensure close joint fit and apply appropriate tactics to reduce weld joint stress		Macro		
Develop a weld sequence plan to control weld restraint stress levels		Hardness		
Poor quality welds NOT permitted the root run is critical avoid welding defects		Bend S/R/R		
DO NOT fill plugs with weld metal. Use a 6-8 mm fillet as standard		Tensile		
WPS - STATUS		Impact		
APPROVED BY		UT		
PREPARED BY		Other		
INSPECTED BY		DATE		



RECOMMENDED GOOD WELDING PRACTICE

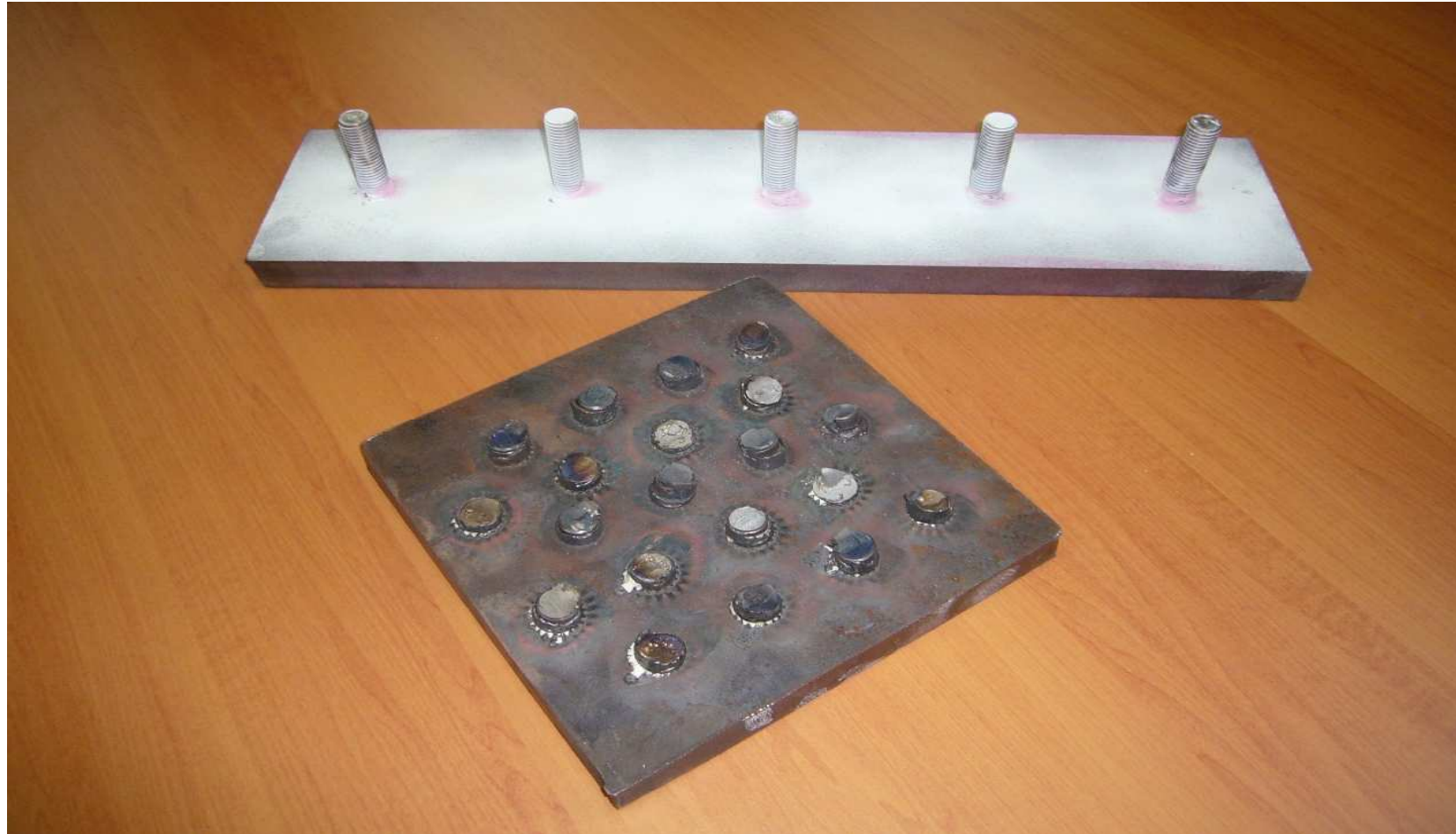
ENDURA Dual -Requires **Good Control** for a Successfully Welded Joint

- 1> Radius all plate edges , remove scale and contamination prior to welding .
- 2> Ensure a close joint fit up and apply appropriate tacks to reduce weld stress .
- 3 > Develop a weld sequence plan to control weld restraint stress levels .
- 4> Ensure plates are dry and apply a soaking **150 Deg C pre heat** - NO Moisture
- 5> Use Back Step welding at max **150 mm** plus do not weld around sharp corners
- 6> Poor quality welding is NOT Permitted , the root run is critical avoid weld defects
- 7> DO NOT fill plug with weld metal . Use a 6- 8 mm fillet as standard on most joints.



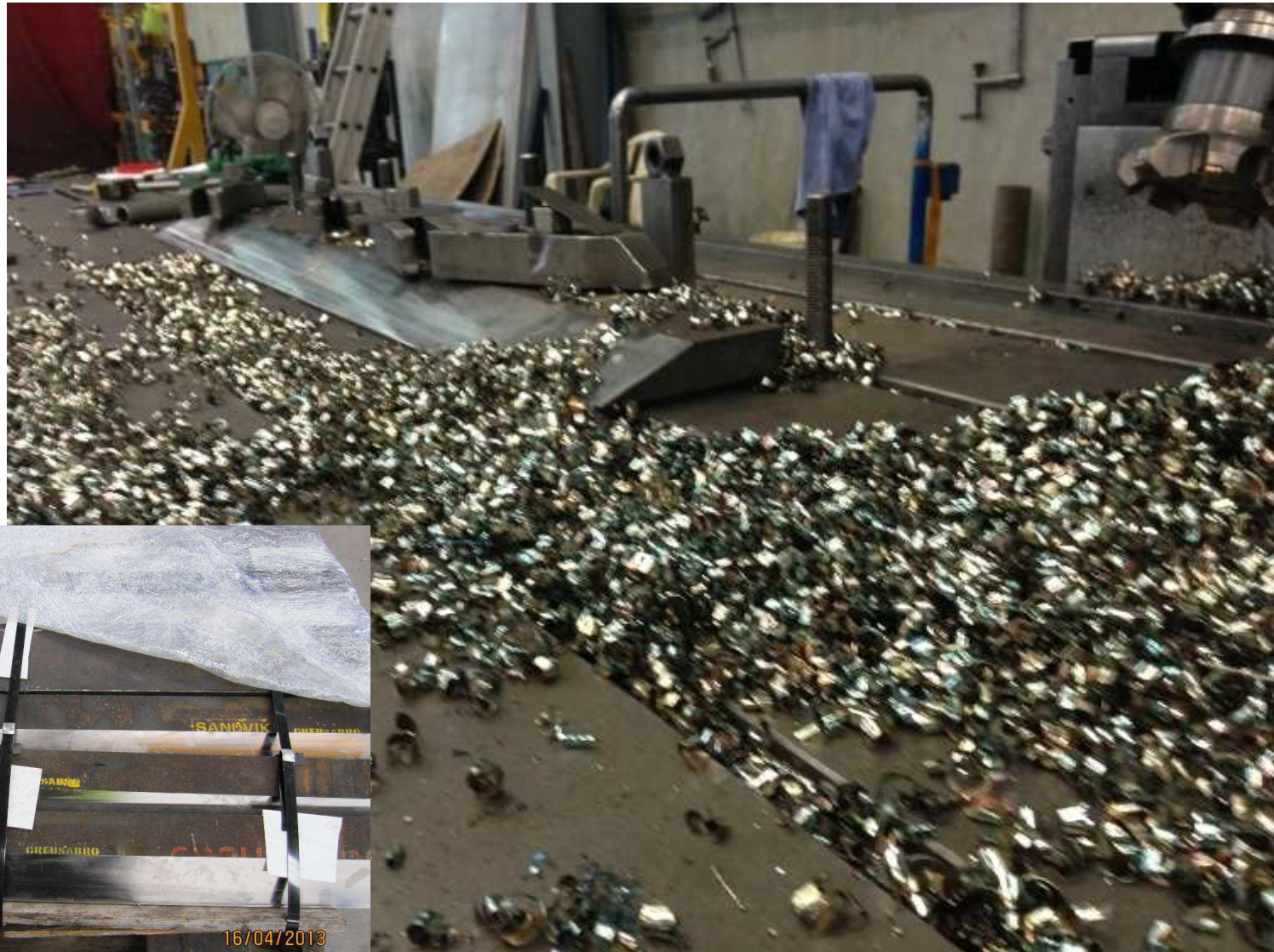
ENDURA Dual Stud Welding – Well Proven

No Problems – provided control procedures maintained



ABCCement - ENDURA Dual 50 mm Push Blades

Machined using heavy cuts on large milling machine . ENDURA Dual machine requires similar settings to ENDURA – improved chip breaking



ENDURA 30 mm plate drilled and tapped
Offers significant advantages in fixed plant
applications **ENDURA Dual** has similar M/c
characteristics



ENDURA Dual Forming - the REAL Challenge with this grade



ENDURA Dual 20 mm Pressing Failure – Handle with care – notch



- **ENDURA DUAL** is far more notch sensitive than **ENDURA** due to the primary Titanium carbides –
Min 150 deg C preheat required and use large former and dye openings - NO tight radius .
- Roll forming when possible preferred .
- Form with care as only the best will be successful in pressing **ENDURA DUAL**

ENDURA Dual 20 mm Formed Bucket Liner Kit



Worlds BIGGEST Loader Bucket
liner formed in **ENDURA Dual 20**
mm 1700 x 6600 mtrs .
Supply to Cape Preston - 2009
Replacing Weld Overlay



Summary -

Selecting the right target to start is important



- **ENDURA Dual** is a UNIQUE Steel perfect for all high impact abrasion application
- **ENDURA Dual** delivered min 50 % extra service over **ENDURA** and over twice the life of all other wear plates .
- A key **ENDURA Dual** target market is replacement of weld overlay where it not only last longer but provides significant cost savings .
- **ENDURA Dual** requires close welding control and forming needs to be undertaken by the best in the game – not for everyone.
- **ENDURA Dual** should be used as the standard Creusabro liner material across all fixed plants – stand out performer which will promote itself once in service .

ENDURA Dual - The FUTURE for all TITUS STEEL Fixed Plant Application



- The NEW Standard Approved and Ready To GO **ENDURA Dual** 16 & 20 mm Liners ready for November 2013 Pilbara mine Fixed Plant Shut down.