

TITUS



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ENDURA vs HARDOX 500

MANUFACTURING

- **ENDURA ... OIL QUENCHED** resulting in a “fine homogenous micro structure” for improved hardness and easier processing.

Small and even dispersion of Carbides provides hardness and abrasion resistance Less brittleness and less cracking

Homogenous micro structure provides elasticity effect which limits gouging, tearing and shearing.

Limited amount of “Unstable or Retained Austenite” reduces chipping and cracking

- **HARDOX ... WATER QUENCHED** resulting in a “course non homogenous microstructure”.

Large and uneven dispersion of carbides provides embrittling effect prone to cracking

Pockets of “Unstable or Retained Austenite” causes chipping and cracking

CHEMISTRY

	<u>C</u>	<u>Mn</u>	<u>Ni</u>	<u>Cr</u>	<u>Mo</u>	<u>P</u>	<u>S</u>
ENDURA	.28	1.6	.4	1.6	.2	.005	.015
HARDOX	.27	1.6	.3	1.0	.3	.025	.010

- **ENDURA ... 60% more Chrome** for hardness and corrosion resistance.
Limited Phosphorous for easier processing and weldability.

HARDNESS

- **ENDURA ... Initial hardness 470 BHN ... Work-hardens to 540-560 BHN with impact**
- **Hardox ... Typical 490 BHN ... no work-hardening properties**

Endura's work-hardening properties ... Lower initial hardness for easier processing ... but increases 50 -70 brinell points with impact.

MECHANICAL PROPERTIES

1. CHARPY/IMPACT

- **ENDURA ... 32 ft. lbs. @ -20c**
- **HARDOX ... 20 ft. lbs. @ -20c**

Endura is 1/3 more resistant to impact and cracking

2. TENSILE STRENGTH

- **ENDURA ... 235,000 p.s.i**
- **HARDOX ... not published. Based on similar AR 500 products estimated at 220,000 p.s.i.**

Endura is 7 % tougher before ultimate failure of the steel.

3. YIELD

- **ENDURA ... 180,000 p.s.i.**
- **HARDOX ... not published. Based on similar AR 500 products estimated at 170,000 p.s.i.**

Endura has 5-6 % more resistance before deformation of the steel begins.

4. ELONGATION

- **ENDURA ... 12%**
- **HARDOX ... not published. Based on similar AR 500 products estimated at 8% p.s.i.**

Endura is 50% more elastic thereby reducing cracking and breaking

PROCESSING

1. BENDING

- *ENDURA* ... Radius = 5 times thickness
- *HARDOX* ... Radius = 7 times thickness

Endura is easier to bend and less prone to cracking

Bending radius can be reduced by bending at right angles to the grain or direction of rolling.

2. WELDING

- *ENDURA* ... No pre or Post heating required up to 2 “
- *HARDOX* ... Pre and Post heating required on ALL thicknesses

3. MACHINING

- *ENDURA* ... Possible with High Speed tools
- *HARDOX* ... Tungsten carbide tools only

IN SERVICE

A) REBUILD BUCKET

Actual Field Test ... Terra Mining... Rebuild Bucket

	<u>ENDURA</u>	<u>AR 500</u>
# Rebuilds/year	3	6.5
Material Cost	\$ 45,000	\$ 65,000
Labor	23,100	50,050
Lost Production	<u>11,355</u>	<u>24,602</u>
Total Cost	\$ 79,455	\$ 139,652

SAVINGS \$ 61,197 (44%)

B) BUCKET LIP

Actual Field Test ... BARRICK GOLD CORP ... Bucket LIP

	<u>ENDURA</u>	<u>AR 500</u>
PLATE SIZE	1”	1 ¼ “
TONS OF PRODUCTION	48,500	30,000

C) MINE TRIPPER CAR

Actual Field Test ... IRON ORE COMPANY ... Liners Tripper car

	<u>ENDURA</u>	<u>AR 500</u>
Months of Service	40 months	3 months
Cost of Liners	\$ 2,466	\$ 19, 248

D) REBUILD BUCKET BOWL

Actual Field Test ... IRON ORE COMPANY... Rebuild Bucket

	<u>ENDURA</u>	<u>AR 500</u>
Months of Service	16 months	6 months
Production	3 million cu yards	½ million yards