

CERAMIC WEAR PANELS



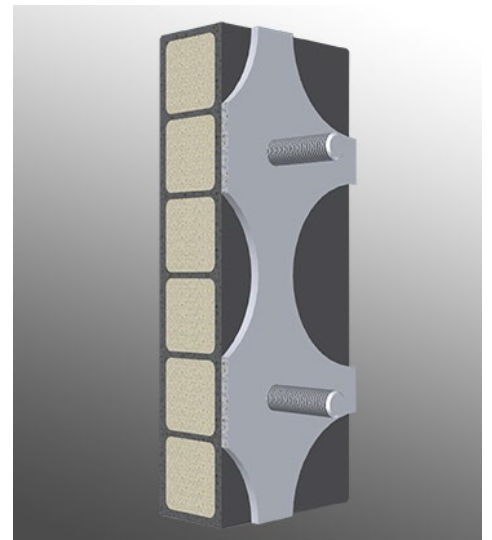
Elastotec has developed a range of high performance ceramic wear panels for use in the mining industry. Based on composites of state of the art ceramics, high strength, high resilience elastomer and S/S and engineering polymer backing plates the Elastotec wear panels are precision vacuum moulded. This ensures a rubber tear bond is obtained between the rubber and the ceramic tiles and the rubber and the polymer backing plates. The 100% rubber tear bonding ensures that the ceramic tiles are retained in the panel even under the most arduous operating conditions.

Ceramics

Elastotec has formulated a range of wear resistant ceramics. In house ability to test key ceramic properties including Vickers Hardness, Flex Crack Toughness and Wear Resistance has enabled Elastotec to optimise the ceramic performance and confirm these properties on each production batch.

Elastotec wear panels can be made in a range of ceramic materials to suit a variety of end use applications. These include:

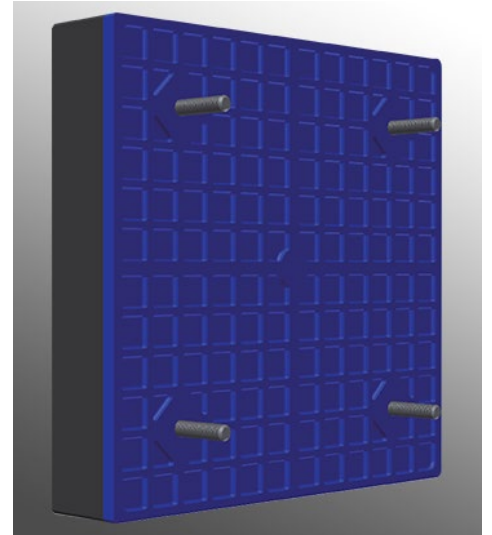
Aluminium Oxide Al ₂ O ₃	92%	Economic cost with reasonable wear resistance
Aluminium Oxide Al ₂ O ₃	96%	Improved wear resistance
Aluminium Oxide Al ₂ O ₃	99%	Highest hardness, highest wear resistance grade of Aluminium Oxide.
Toughened Aluminium Oxide	ZTA	Aluminium oxide with improved flexural crack resistance - used in applications that require some impact resistance and exceptional wear resistance.
Zirconium Oxide Ceramic	YTZ	Combines very good wear resistance with exceptional flex crack toughness



CERAMIC WEAR PANELS

Ceramic Oxide Properties

MATERIAL		Al2O3	Al2O3	Al2O3	ZTA	YTZ
		92%	95-97%	99%	Toughened Alumina Oxide	
Density	(g/cc3)	3.7	3.7	3.9	4.1	6.05
Flexural Strength	(Mpa)	315	325	340	480	1300
Compressive Strength	(Mpa)	1960	3400	3600	3300	3000
Modulus of Elasticity	(Gpa)	270	350	380	320	205
Impact Resistance	(Mpa m1/2)	4.7	4.8	3.9	8.1	4.4
Vickers Hardness	(Hv 10)	1050	1200	1400	1100	1460

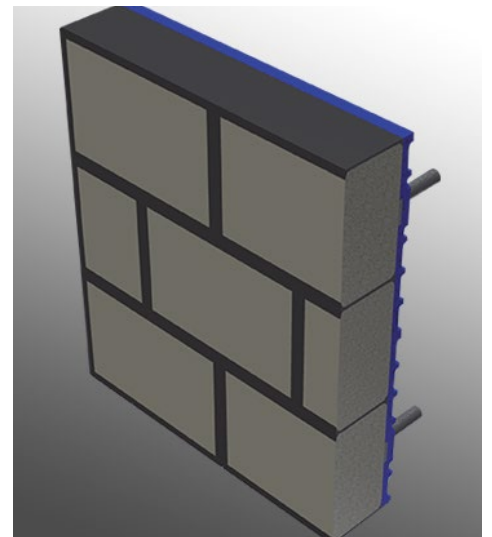


Rubber

Elastotec has a strong background and knowledge of elastomers. The elastomer is the lowest cost raw material in a ceramic wear panel but provides critical functions of retention of the ceramic tiles and cushioning from impact. Elastotec has developed a high strength (>30 Mpa Tensile Strength), high resilience (>60% resilience) elastomer with in built adhesion promoters. As with the ceramics Elastotec has in house testing capability for all these elastomer physical properties and can guarantee 100 % rubber tear bonds between the ceramic and the polymer backing plate for each and every panel.

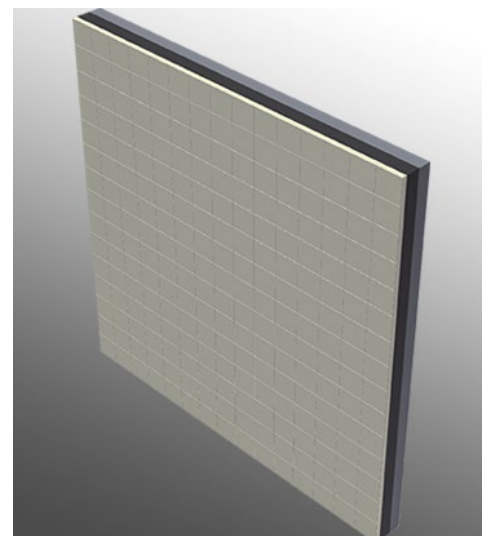
Typical elastomer properties are:

- Tensile Strength > 30 Mpa
- % Elongation > 600%
- Hardness 55+/-5
- Resilience > 60%
- Abrasion Resistance DIN 53516 < 100 mm3 Volume Loss



Backing Plates

Elastotec has backing plates available in S/S and also engineering thermoplastic(ETP).The ETP offers a number of unique features - reduced weight, provide - corrosion resistance, increased impact resistance and reduced cost. For many years the automotive and appliance industries. For many years the automotive and appliance industries have been using engineering thermoplastics as metal replacements to reduce cost and increase performance for many years. Elastotec is applying this technology to the wear panels it manufactures.



CERAMIC WEAR PANELS

Adhesion

Elastotec has carried out extensive testing to ensure that the ceramic wear panels it makes have:

- Increased adhesion strength
- Increased environmental resistance of bonds

Ceramic Tile Bond Failure

There are a number of causes of ceramic tile bond failure, including the following:

- The primer and adhesive systems that are used by some manufacturers of ceramic panels provide a good initial bond when applied at the specified coating weight, but field experience attests to bond failure as service time extends. Laboratory testing by Elastotec has also identified that some widely used ceramic bonding systems deteriorate with exposure to moisture (refer to Table #1).
- An effective bond between ceramic tiles and rubber requires a minimum coating weight of primer and adhesive. A number of ceramic lagging manufacturers apply primer and adhesive using a spray application, making it difficult to ensure that the required minimum primer/adhesive coating weight is obtained on all tile surfaces and leading to tile/rubber bond failures.

Tile Adhesion Testing

Elastotec has undertaken extensive outdoor testing of ceramic/rubber bond performance and has found that a number of primer/adhesive systems recommended by adhesive suppliers, provide a bond that initially offers rubber tear adhesion but, after prolonged exposure to moisture and UV, rapidly deteriorates.

Elastotec checks the integrity of the bonds through an outdoor testing process, where the tile/rubber bond is under constant stress. The testing is done by bending a strip of ceramic into a tight circle, with the ceramic tiles on the outside of the circle. The strip is then held in this position during the outdoor exposure period. The results are recorded at regular intervals and have been used to identify the optimum primer/adhesive system for long-term adhesion performance (Photo #2).

Additional testing has been carried out to increase the adhesion strength between the rubber backing and the aluminium oxide tiles, as well as the steel for the backing plate. This testing was undertaken using the tension pull method – (see Photo #1 and Table #1).

Table #1

PRIMER (MPa)	ADHESIVE	TENSION PULL	FAILURE MODE
A3	B1	4.31	90% R
A3	B2	6.87	100% R
A4	B1	6.42	100% R
A4	B2	3.26	50% R

100% R = 100% Rubber Tear Bond Failure

Adhesive / primer system used for the Elastotec Ceramic Wear Panels



PHOTO #1

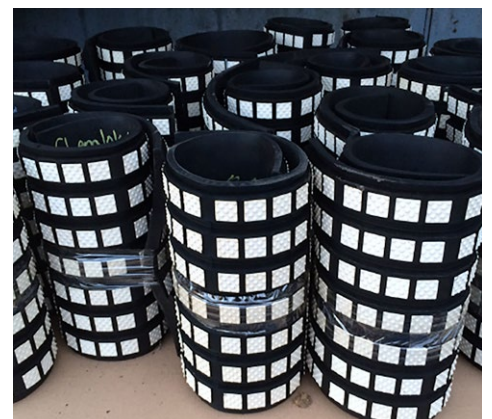


PHOTO #2

CERAMIC WEAR PANELS

Based on the results of the Outdoor Ageing Tile Bond Testing (Table #2), the Tension Pull Adhesion Testing and production considerations the adhesive system of Primer A3 and Adhesive B2 was selected for Elastotec Ceramic Wear Panels, as this provided the best performance.

Importantly, the testing program has identified improvements in the ceramic/rubber bond strength, as well as eliminating the deterioration in bond strength due to moisture and UV exposure. This technology is an important and unique component of the wear panels manufactured by Elastotec.

Tile Coating – Primer & Adhesive

Elastotec uses a proprietary dipping process for the coating of the ceramic tiles with primer and adhesive, which ensures that all tile surfaces receive the necessary minimum coating weight of primer and adhesive. To date, more than 5,000,000 tiles have been coated using this method and there have been no reported bond failures.

Table #2

Primer	Adhesive	Initial Bond as Manufactured	Loss of Bond Strength After Ageing						
			1 Mth	2 Mth	3 Mth	4 Mth	5 Mth	6 Mth	12 Mth
A1	B1	0%	25%	27%	27%	29%	29%	29%	>50%
A1	B2	0%	33%	39%	42%	43%	43%	45%	>70%
A2	B1	0%	0%	1%	1%	1%	1%	1%	6%
A2	B2	0%	10%	19%	26%	30%	33%	36%	>40%
A3	B1	0%	0%	0%	0%	0%	0%	0%	1%
A3	B2	0%	0%	0%	0%	0%	0%	0%	0%
-	B2	1%	6%	9%	11%	14%	16%	17%	>40%
A4	B1	0%	0%	0%	0%	0%	0%	0%	0%
A4	B2	0%	0%	0%	0%	0%	0%	0%	0%

*Each test lagging sample contained 168 tiles. Bond failures are reported as a percentage of the total number of bonds that have failed.

Adhesive / primer system used for the Elastotec Ceramic Wear Panels

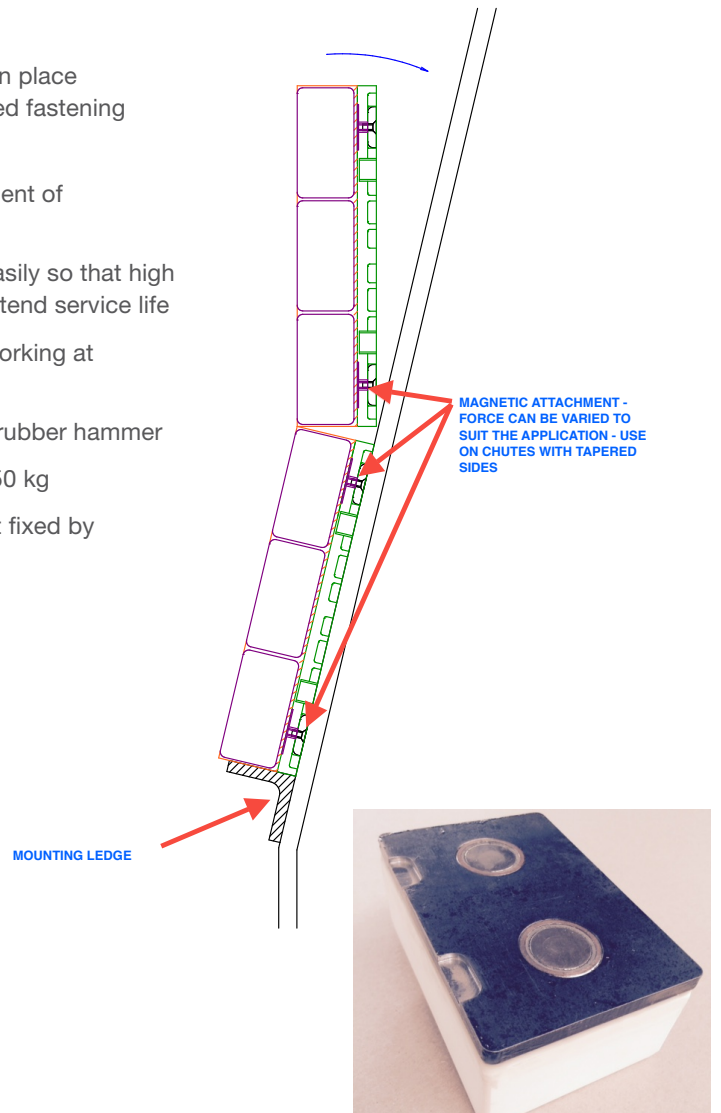
CERAMIC WEAR PANELS

Single Sided Attachment

In addition to the traditional method of fixing ceramic wear panels in place using threaded studs, Elastotec has developed a unique single sided fastening arrangement that has a number of benefits.

- 1.) Single sided attachment reduces time for removal and replacement of ceramic wear panels
- 2.) Single sided attachment allows rotation of panels quickly and easily so that high wear areas can be quickly swapped with lower wear areas to extend service life
- 3.) No need to access outside of the transfer chute with possible working at height and OH&S issues
- 4.) Simple tools for removal and replacement of panels - lever and rubber hammer
- 5.) Panels available in a range of clamping forces from 160 kg to 650 kg
- 6.) Panel position can be adjusted with a rubber hammer and is not fixed by hole location

PANEL SIZE (mm)	CLAMPING FORCE (kg)
300 x 300	160
300 x 300	270
300 x 300	320
300 x 300	450
300 x 300	650
300 x 150	160
300 x 150	270
300 x 150	320
300 x 150	450
300 x 150	650



Contact

ROKEBY TECHNOLOGIES PTY LTD

Suite 15, 336 Churchill Avenue,
Subiaco WA 6008

M: +61 418 882 215

E: jdebenham@rokebytechnologies.com.au

rokebytechnologies.com.au