

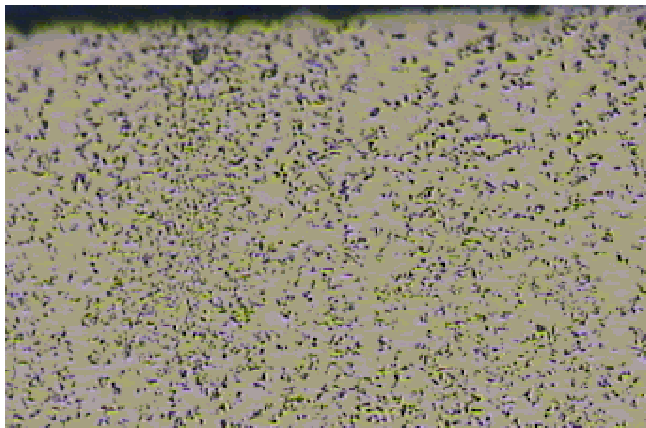


## Technical Data Sheet

### Electrosil Coating Of Engine Blocks

The Electrosil process is carried out in a purpose-built facility dedicated to internal cylinder coating of engine blocks. It has been specifically designed to protect all finish-machined faces and areas from attack by processing chemicals. In addition, the plant has the in-built flexibility to allow parent metal coating of any engine configuration and/or size.

The Electrosil coating developed in Australia is the latest in a line of composite coatings specifically formulated for high performance engine applications. The coating specification is designed to provide optimum wear and oil retention properties based on performance data generated from our comprehensive in-house testing programme.

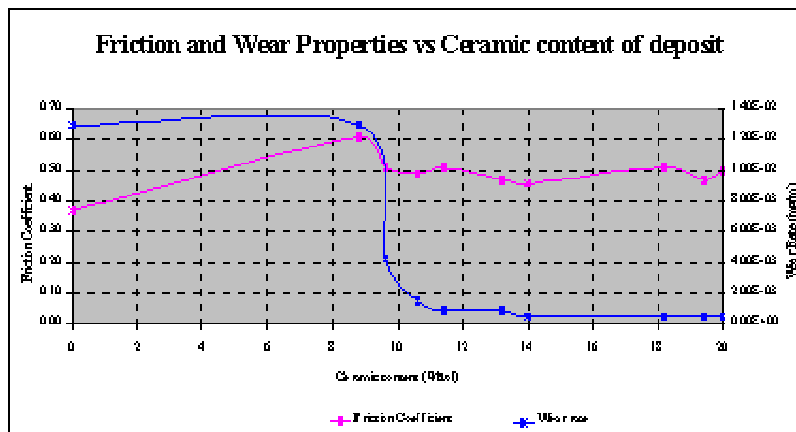


The Electrosil coating has two main constituents, a hardened metal matrix plus extremely hard ceramic particles incorporated in the matrix. A cross section of the coating examined under a high magnification is shown. This is a typical Electrosil production coating containing

approximately 15% by volume hard, ceramic particles.

### Ceramic Content

Our current ceramic content specification for high performance engine applications is 12% - 14% by volume. The graph below shows how ceramic content in the Electrosil coating affects its wear and friction characteristics.



This data has been generated using Electrosil's in-house friction and wear testing equipment.

The tests have been carried out running the Electrosil coating against a nitrided steel counterface, a material commonly used for high performance piston rings.

The Electrosil specification is such that, even when operating in the low end of the tolerance band, the wear performance is optimised. The results generated from our test programme have also shown that coatings with inclusion rates above the Electrosil specification have no added benefits in terms of coating performance.

### **Deposit Hardness**

In addition to Ceramic content, the microhardness of the Electrosil coating has a major influence on its wear properties. Our test programme identified a minimum hardness requirement (560Hv) for the coating below which severe wear can occur. The specification for Electrosil is a deposit microhardness of 580 - 590 Hv. This value was chosen so that even the lower limit provides good wear resistance.

### **Oil Retention**

One of the main reasons for coating an engine bore with this type of coating is its ability to retain oil film, even in sliding speeds encountered in high revving engines. Electrosil have investigated what effect ceramic in the coating has on its ability to retain an oil film. The friction coefficient of Electrosil in an unlubricated cylinder is 0.5 when running against nitrided steel. When oil is applied, this figure drops to 0.05. The results suggest that the coating retains oil better when it has a ceramic content above 10% by volume. Increasing this to 20% gives no performance advantage in regards to oil retention however it increases the apparent hardness of the deposit.

### **Effect of Ring Material**

The test rig at Electrosil also has the ability to generate friction and wear data for Electrosil coatings run against a variety of materials used in piston ring design. The choice of piston ring material can have a major impact on the wear of the coating. When steel rings are used there is little wear of the liner coating but extreme wear of rings. Of the combinations tested to date, titanium nitride coated rings or chrome faced rings offer the best performance when run in against an Electrosil bore.

### **The Electrosil service**

The Electrosil coating has been specifically developed for use on internal cylinder bores for high performance engines. The specification has been established following a lengthy test programme to provide optimum performance in service.

The test facilities at Electrosil's disposal mean that there is an ongoing development programme to investigate new coating compositions that may produce performance benefits and offer other applications for the ceramic composite coating technology. In addition to coating test facilities, there is an extensive range of analysis equipment in the Company's laboratory. This has enabled Electrosil to analyse failures that have occurred in service and provide an accurate diagnosis of the fault to prevent its re-occurrence.

## **KEY BENEFITS OF ELECTROSIL COATING**

- Superior Oil Retention to 25000 rpm
- Improved resistance to scuffing
- Lower friction
- Excellent wear resistance
- High corrosion resistance

## **TECHNICAL PROPERTIES OF ELECTROSIL COATING**

- Typical thickness 60 to 120 micron
- Apparent Hardness Hv 580 to 660
- Ceramic Particle Hardness 2500 to 3000 Hv
- Particle Loading % 10 to 25%
- Ceramic Particle Size 0.4 to 2.0 micron
- Thermal Conductivity 0.22 Cal/Cm 5° C
- Thermal Expansion 0.338 microns/C near 20° C
- Frictional Coefficient(Lubricated) 0.05 to 0.12
- Melting Point 1400° C
- Piston ring Compatibility, Hard Chrome is suited best to two stroke applications. Molybdenum or TiN coated rings are all OK for 4-stroke applications as are cast steel.

## **OPTIMUM SPECIFICATION FOR ELECTROSIL COATING**

- Particle Hardness 2500Hv
- Post Honing coating thickness 75-100 micron
- Average Mean Ceramic particle size 0.8 micron
- Nickel Matrix Hardness 550-600 Hv
- Co-Efficient of Friction 0.09 Dry
- Inclusion Rate 12%

**For further information contact:  
Electrosil  
7 George Crt, Briar Hill, Victoria 3088  
PH: 61 03 9435 7029 FAX: 61 03 9432 1995**