


# Schedule of Accreditation

issued by

## United Kingdom Accreditation Service

2 Pine Trees, Chertsey Lane, Staines-upon-Thames, TW18 3HR, UK

|  |  |   |
|--|--|---|
|  <p>Accredited to<br/><b>ISO/IEC 17025:2005</b></p> | <b>Westmoreland Mechanical Testing &amp; Research Ltd</b>                          |   |
|  | <b>Issue No: 025    Issue date: 27 January 2017</b>                                |   |
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| <b>Testing performed at the above address only</b>   |  |   |

### DETAIL OF ACCREDITATION

| Materials/Products tested                         | Type of test/Properties measured/Range of measurement  | Standard specifications/ Equipment/Techniques used                               |
|---|--|--|
| METALS, ALLOYS and METAL PRODUCTS                 | <u>Chemical Tests</u>  |  |
| Aluminium and aluminium alloys                    | Elemental analysis<br>Si, Fe, Cu, Mn, Mg, Zn, Ni, Cr, Pb, Sn, Ti, Be, Bi, Ca, Cd, Ga, Na, P, Sb, Sr, Li, V, Zr | Documented in-house method WMTR/QTP/OES001 using OES                             |
| Carbon steels, low alloy steels, stainless steels | C, Si, Mn, P, S, Cr, Mo, Ni, Al, Co, Cu, Nb, Ti, V, W, Pb, Sn, As, Zr, Ca, Sb, B                               |  |
| Nickel alloys                                     | Al, B, C, Co, Cr, Cu, Fe, Mg, Mn, Mo, Nb, P, S, Si, Sn, Ti, V, W, Zr   |  |
|   | <u>Corrosion Tests</u>   |  |
| Aluminium alloys                                  | Intergranular corrosion  | BS EN ISO 7866:2012 Annex A<br>ASTM G110-92(2015)                                |
|   | Alternate Immersion Stress Corrosion (Including preparation of samples)  | ASTM G44-99(2013)<br>ASTM G47-98(2001)<br>ASTM G38-01(2013)<br>ASTM G49-85(2011) |
|   | Salt Spray (Fog)   | ASTM B117-11   |



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| METALS, ALLOYS and METAL PRODUCTS (cont'd) | <u>Mechanical Tests</u>  |  |
| Aluminium foil                             | Tensile  | ASTM E345-93(2013)e1   |
|  | Tensile<br>(forces up to 100 kN, temperatures - ambient to 1000°C) | ASTM E8/E8M-15a<br>ASTM A370-15<br>ASTM B557-15<br>ASTM B557M-15<br>BS EN ISO 6892-1:2009<br>BS 4A4-1:Section 1:1966 (withdrawn)<br>BS EN 2002-1:2005<br>BS EN ISO 6892-2:2011<br>ASTM E21-09<br>BS EN 2002-2:2005 |
|  | Youngs Modulus, Tangent Modulus and Chord Modulus                  | ASTM E111-04(2010)   |
|  | Plastic strain ratio (r)   | ASTM E517-00(2010)   |
|  | Strain hardening exponent (n)                                      | ASTM E646-15   |
|  | Compression  | ASTM E9-09   |
|  | Bend Testing   | Documented in-house method WMTR/QTP/EM007  |
|  | Pin - Type Bearing test  | ASTM E238-12   |
|  | Double shear   | ASTM B769-11   |
|  | Shear  | ASTM B831-14   |
|  | <u>Hardness</u>  |  |
|  | Brinell hardness<br>(10/3000 HBW)                                  | ASTM E10-15a   |
|  | Rockwell hardness<br>(HRB & HRC)                                   | ASTM E18-15  |
|  | Vickers hardness<br>(HV5, HV10, HV30)                              | ASTM E384-11e1   |
|  | Micro-hardness<br>(HV 0.2, 0.3, 0.5, 1 & HK 0.5, 1)                | ASTM E384-11e1   |



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| <p>METALS, ALLOYS and METAL PRODUCTS (cont'd)</p> | <p><u>Mechanical Tests</u> (cont'd)<br/><u>Impact</u></p> <p>Charpy V - notch<br/>(temperatures -196 °C to 100 °C)</p> <p>Izod</p> <p><u>Fracture toughness</u></p> <p>Fracture toughness (KIC)</p> <p>R Curve</p> <p>K<sub>1C</sub>, CTOD, J</p> <p>CTOD</p> <p><u>Fatigue testing</u></p> <p>Constant amplitude fatigue</p> <p>High cycle &amp; low cycle fatigue under force control<br/>(forces up to 500 kN)<br/>(temperature ambient to 1000°C)</p> <p>High cycle fatigue<br/>(temperature - ambient to 1000°C )</p> <p>Low cycle fatigue under force control<br/>(temperature - ambient to 800°C )</p> <p>Low cycle fatigue under strain control (ambient temperature)</p> <p>Low cycle fatigue under strain control<br/>(temperature ambient to 1000°C)</p> <p>Fatigue crack growth<br/>(forces up to 250 kN &amp; temperatures - ambient to 1000°C)</p> | <p>ASTM E23-12c<br/>ASTM A370-15</p> <p>BS 131-1:1961</p> <p>ASTM E399-09</p> <p>ASTM E561-15a</p> <p>BS 7448-1:1991</p> <p>ASTM E1290-08e1 (Withdrawn)</p> <p>BS EN 6072:2010</p> <p>BS 3518-3:1963<br/>ASTM E466-15</p> <p>BS EN 3987:2009</p> <p>prEN 3874:Edition P1, April 1998</p> <p>BS 7270: 2006</p> <p>ASTM E606-12</p> <p>ASTM E647-11</p> |



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| METALS, ALLOYS and METAL PRODUCTS (cont'd) | <u>Physical test</u><br><br>Surface roughness (R <sub>a</sub> )<br><br><u>Metallurgical Tests</u><br><br>Depth of decarburisation<br><br>Average grain size<br><br>Largest grain<br><br>Hydrogen embrittlement<br><br>Inclusion content<br><br>Microstructure of graphite in iron castings<br><br>Alpha Case in Titanium<br>Microscopic and bend test methods | Documented In-house Method<br>WMTR/QTP/EM003<br><br>ASTM E1077-14<br><br>ASTM E1382-97(2015)<br>automatic & semi-automatic methods<br>ASTM E112-13<br><br>ASTM E930-09(2014)<br><br>ASTM F519-13<br><br>ASTM E45-13 (Method D)<br><br>ASTM A247-10<br><br>Documented In-house Method<br>WMTR/QTP/MOG024 |
| PLASTICS & REINFORCED PLASTIC COMPOSITES   | <u>Mechanical Tests</u><br><br>Compressive properties<br><br>Compressive residual strength properties<br><br>In-plane shear<br><br>Tensile<br><br>Apparent interlaminar shear strength<br><br>Flexural  | ASTM D695-15<br>prEN 6036:1995<br><br>ASTM D7137/D7137M-12<br>prEN 6038:1995<br><br>BS EN ISO 14129:1998<br>ASTM D3518/D3518M-13<br><br>BS EN 2561:1995<br>ASTM D3039/D3039M-14<br>prEN 6035:1995<br><br>BS EN 2563:1997<br><br>ASTM D790-15e2  |



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| PLASTICS & REINFORCED PLASTIC COMPOSITES (cont'd) | <u>Mechanical Tests</u> (cont'd)<br><br>Tension fatigue<br><br>Tensile | ASTM D3479/D3479M-12<br><br>BS EN ISO 527-1:2012<br>BS EN ISO 527-2:2012<br>BS EN ISO 527-4:1997<br>BS EN ISO 527-5:2009<br>BS 2782-3 Method 326F:1997<br>ASTM D638-14 |
| END   |  |  |