



## ELEKTRON® WE54

ELEKTRON WE54 is a high strength fully heat treatable magnesium based casting alloy for use at temperatures up to 300°C. The alloy develops high strength properties at elevated temperatures, without containing either silver or thorium.

### APPLICATIONS

The excellent retention of properties at elevated temperatures and improved corrosion resistance will be of interest to designers of power systems, transmissions, missiles, high performance cars and other high technology applications.

Prolonged use of this alloy (ie in excess of 1000 hours) at temperatures in the range 100°C–250°C may result in the loss of ductility. An alternative alloy is ELEKTRON WE43.

### SPECIFICATIONS

AECMA MG-C96001

AMS 4426

ASTM B80 WE54A-T6

BS2970 MAG14-TF

UNS M18410

ISO 16220:MC95310

### CHEMICAL COMPOSITION

|                    |           |
|--------------------|-----------|
| Yttrium            | 4.75–5.5% |
| Heavy rare earths* | 1.0–2.0%  |
| Neodymium          | 1.5–2.0%  |
| Zirconium          | 0.4% min  |
| Magnesium          | Balance   |

\*Heavy rare earth fraction contains mainly Yb, Er, Dy, and Gd.

### HEAT TREATMENT

The alloy develops its properties in the fully heat treated (T6) condition ie: 8 hours at 525°C,

Hot water or polymer quench or air cool,

Age for 16 hours at 250°C, Air cool.

### PHYSICAL PROPERTIES

|                                  |                                      |
|----------------------------------|--------------------------------------|
| Specific gravity                 | 1.85                                 |
| Coefficient of thermal expansion | $27.0 \times 10^{-6} \text{K}^{-1}$  |
| Thermal conductivity             | $52 \text{ Wm}^{-1} \text{K}^{-1}$   |
| Specific heat                    | $960 \text{ Jkg}^{-1} \text{K}^{-1}$ |
| Electrical resistivity           | 173 nΩm                              |
| Modulus of elasticity            | 44.1 GPa                             |
| Poissons ratio                   | 0.3                                  |
| Melting range                    | 545–640°C                            |
| Damping index                    | 0.17                                 |
| Brinell hardness                 | 85                                   |

### DESIGN DATA

Minimum specification tensile properties

ISO 16220

0.2% Proof stress 170 MPa

Tensile strength 250 MPa

Elongation 2%

## OTHER PROPERTIES

### CASTABILITY

Fine grained and pressure tight with good casting characteristics.

### PATTERN MAKERS SHRINKAGE FACTOR

1.5%

### WELDABILITY

Weldable by the tungsten arc inert gas process (TIG) with a filler rod of the parent alloy composition. Castings should be heat treated after welding: 1 hour at 510°C, quenched or air cooled and 16 hours at 250°C.

### MACHINING

ELEKTRONWE54 castings, like all magnesium alloys, machine faster than any other metal. Providing the geometry of the part allows, the limiting factor is the power and speed of the machine rather than the quality of the tool material.

The power required per cubic centimetre of metal removed varies from 9 to 14 watts per minute depending on the operation.

### SURFACE TREATMENT

Yttrium containing magnesium alloys do not respond to certain chemical treatments, notably some of the chromate conversion coating baths. The precautions and alternative treatments are identified in the Magnesium Elektron Design Guide.

## CORROSION RESISTANCE

Additions of yttrium contribute to the excellent corrosion resistance characteristics of ELEKTRON WE54 to the extent that it is of a similar order to aluminium casting alloys under salt spray conditions.

|                         |                         |
|-------------------------|-------------------------|
| Corrosion rate          | mg/cm <sup>2</sup> /day |
| Intermittent salt spray | 0.023                   |
| ASTM B117 salt fog      | 0.1–0.2                 |
| Sea water immersion     | 0.1                     |

## AMBIENT TEMPERATURE MECHANICAL PROPERTIES

### TYPICAL TENSILE PROPERTIES

|                   |         |
|-------------------|---------|
| 0.2% Proof stress | 205 MPa |
| Tensile strength  | 280 MPa |
| Elongation        | 4%      |

### TYPICAL COMPRESSIVE PROPERTIES

|                   |             |
|-------------------|-------------|
| 0.2% Proof stress | 165–175 MPa |
| Ultimate strength | 410 MPa     |

### TYPICAL SHEAR PROPERTIES

|                 |         |
|-----------------|---------|
| Ultimate stress | 150 MPa |
|-----------------|---------|

### FRACTURE TOUGHNESS

|                 |                           |
|-----------------|---------------------------|
| K <sub>IC</sub> | 14.3 MPa m <sup>1/2</sup> |
|-----------------|---------------------------|

### FATIGUE PROPERTIES

Rotating bend test

| Endurance Limit MPa | Stress Reversals |                     |                 |                     |
|---------------------|------------------|---------------------|-----------------|---------------------|
|                     | 10 <sup>6</sup>  | 5 × 10 <sup>6</sup> | 10 <sup>7</sup> | 5 × 10 <sup>7</sup> |
| Unnotched           | 102              | 100                 | 99              | 97                  |

# ELEKTRON<sup>®</sup> WE54

## AMBIENT TEMPERATURE MECHANICAL PROPERTIES

### TYPICAL TENSILE PROPERTIES

|       | 0.2% Proof stress (MPa) | Tensile strength (MPa) | Elongation (%) |
|-------|-------------------------|------------------------|----------------|
| 20°C  | 205                     | 280                    | 4.0            |
| 100°C | 197                     | 260                    | 4.5            |
| 150°C | 195                     | 255                    | 5.0            |
| 200°C | 183                     | 241                    | 6.5            |
| 250°C | 175                     | 230                    | 9.0            |

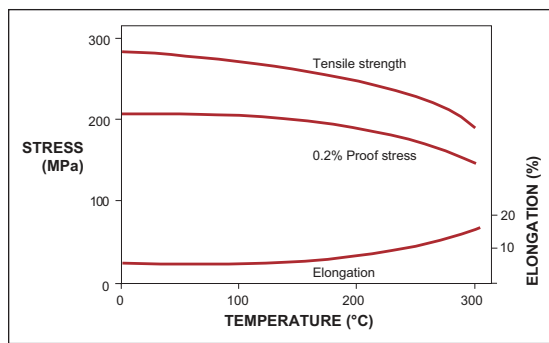


FIG. 1 Effect of temperature on tensile properties

## CREEP PROPERTIES

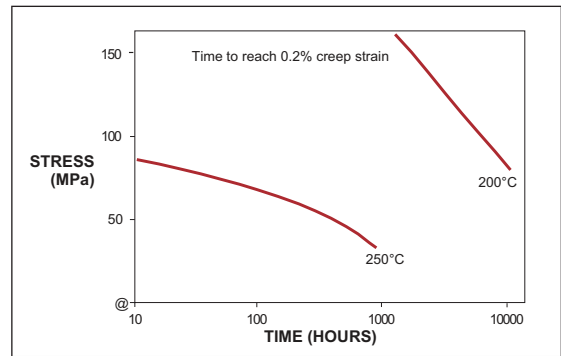


FIG. 2 Stress / time relationship at 200°C and 250°C

## FATIGUE PROPERTIES

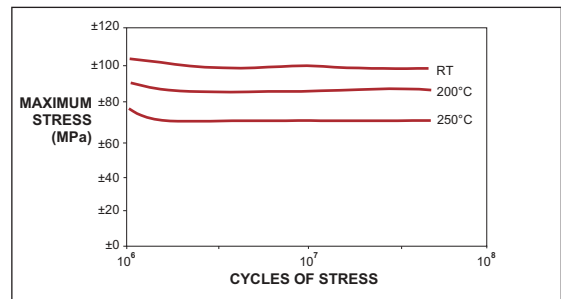


FIG. 3 Rotating bend fatigue tests

## CUT UP PROPERTIES ON SAMPLES TAKEN FROM ACTUAL CASTINGS

| Source  | Section Thickness (mm) | Number of Tests |         | 0.2% Proof Stress (MPa) | Tensile Strength (MPa) | Elongation |
|---------|------------------------|-----------------|---------|-------------------------|------------------------|------------|
| U.K.    | 5–20                   | 27              | Maximum | 219                     | 300                    | 11         |
|         |                        |                 | Average | 195                     | 274                    | 5          |
|         |                        |                 | Minimum | 177                     | 250                    | 1          |
| Canada  | 8–20                   | 58              | Maximum | 238                     | 297                    | 7          |
|         |                        |                 | Average | 203                     | 275                    | 3          |
|         |                        |                 | Minimum | 183                     | 240                    | 1          |
| France  | 10–20                  | 34              | Maximum | 222                     | 303                    | 8          |
|         |                        |                 | Average | 204                     | 276                    | 5          |
|         |                        |                 | Minimum | 190                     | 237                    | 1          |
| Germany | 8–20                   | 59              | Maximum | 254                     | 304                    | 7          |
|         |                        |                 | Average | 212                     | 277                    | 4          |
|         |                        |                 | Minimum | 187                     | 230                    | 1          |
| USA     | 10–20                  | 41              | Maximum | 222                     | 281                    | 7          |
|         |                        |                 | Average | 202                     | 263                    | 3          |
|         |                        |                 | Minimum | 168                     | 214                    | 1          |

† The information contained within is meant as a guideline only

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