

# Advanced Ceramic Solutions for Extreme Environments

As modern industry continues to demand stronger, harder, more wear, corrosion and heat resistant materials, which will operate cost effectively in hostile environments, it has become essential to seek alternative engineering materials such as advanced ceramics. International Syalons have nearly 40 years of experience of offering advanced ceramics for extreme environments.



Fig. 1  
Welding rolls for metal forming

## Introduction

International Syalons supplies a range of advanced ceramics such as silicon nitride and sialon, alumina, zirconia and silicon carbide. These materials cover a wide range of wear, corrosion and thermal resistance properties and allow the company to offer cutting-edge solutions to many engineering and industrial problems.

In many cases technical ceramics will replace an existing metal component in a design, where the much greater wear and corrosion resistance of engineering ceramics

## Keywords

metal forming, welding, molten metal handling, oil and gas

can offer significant lifetime improvements over the metal component, often making them very cost effective. Markets and applications utilising these advantageous properties of the company's advanced engineering ceramics include: metal forming, welding, molten metal handling and oil and gas.

## Metal forming

Advanced technical ceramics for use in metal forming applications must possess excellent mechanical strength and toughness, impact, wear and corrosion resistance, thermal shock resistance and thermal stability. The company's range of silicon nitride based materials, Syalon, and its

zirconia ceramics, Zircalon, meet these requirements and are available in a range of products such as wire drawing die inserts, weld location pins and welding rolls (Fig. 1). Syalon 101 wire drawing dies are used extensively for drawing of copper and brass wire. Syalon 101 possesses outstanding mechanical, thermal and chemical properties. It does not contain a metallic phase so die pick-up can be eliminated, which results in improved continuity of the wire drawing process, enhanced surface finish of the product, reduced scrap rates and increased productivity.

A major automotive manufacturer has been using Syalon 101 weld location pins for welding captive nuts on body panels for approaching 30 years. International Syalons offer a comprehensive range of standard pins in both Syalon 101 and Zircalon 10, a super-tough yttria-stabilised zirconia material. These materials are mechanically superior to coated metal pins, chemically stable to the weld spatter and are electrically insulating.

Syalon 101 welding rolls are used in high frequency tube and pipe welding where they apply the pressure to the tube while the metal is being heated, often by high-frequency induction heating, and this combination gives a forged weld.

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This process puts a number of demands on the welding roll material. It requires high strength, thermal shock resistance, wear resistance and high electrical resistance. Also, the pipe temperature can approach the melting point of the metal and so high temperature stability is required. Syalon 101 welding rolls typically last 20 times longer than steel rolls.

### Molten-metal handling

The exceptional heat and corrosion resistant properties of advanced silicon nitride and Syalon ceramics have been utilised in a range of foundry products for non-ferrous molten-metal handling. These include thermocouple protection sheaths, heater and riser tubes, ladles and other foundry products (Fig. 2).

Syalon 101 has excellent thermal shock resistance as a result of its high strength, toughness and thermal conductivity. It is thermally very stable and extremely resistant to corrosion by most non-ferrous metals, particularly aluminium and zinc. There is therefore no contamination of the melt. In addition, Syalon 101 is non-wetting for most non-ferrous metals, making it very resistant to build up of dross and therefore very low maintenance.

Syalon 101 can be used in applications up to 1100 °C. Above this, the company's grade Syalon 050 is preferred. It offers the same outstanding benefits as Syalon 101, but up to 1400 °C. International Syalons offers a vast range of standard thermocouple protection sheaths in lengths up to 2 m.

### Oil and gas

Advanced silicon nitride and Syalon and zirconia ceramics are finding application in the very demanding oil and gas market. As existing supplies of oil and gas are depleted, these industries are being forced to explore ever more severe environments for future supplies.

To help in this exploration, oil and gas companies are utilising the excellent wear, corrosion and thermal resistant characteristics of Syalon and Zircalon.

Their ability to resist corrosion and erosion, their light weight and heat tolerance, are resulting in them replacing traditional metal components in applications such as hydrocyclone desanders, which are used in sub-sea oil extraction to separate sand from the oil.



Fig. 2  
Heater and riser tubes for molten-metal handling

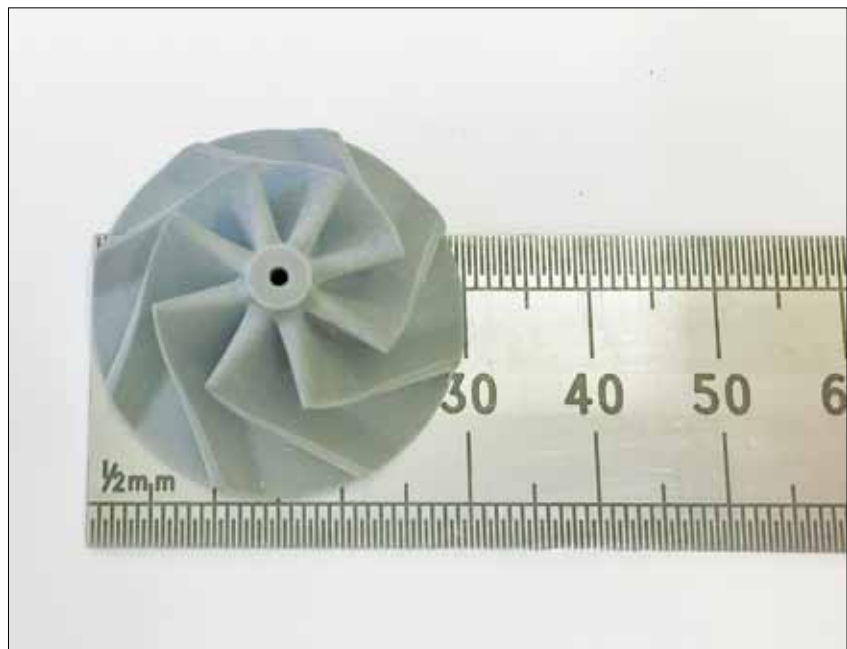


Fig. 3  
Complex-shaped micropart

### Cutting-edge manufacturing and research

The Syalon materials are manufactured using cutting-edge equipment and techniques such as CNC machine tools, gas pres-

sure sintering and additive manufacturing (Fig. 3). International Syalons are actively developing a sensor assembly with a leading aerospace sensor supplier as well as undertaking research into 3D-printing.