

OIL & GAS

*Oil & Gas Capabilities*

# COMPETITIVE ADVANTAGE THROUGH INNOVATION

——— *Element Six works in partnership with customers to develop cutting-edge synthetic diamond and carbide solutions that deliver a step change in productivity across multiple explorations and production applications.*



# A STEP CHANGE IN PRODUCTIVITY ACROSS MULTIPLE OIL & GAS APPLICATIONS

Element Six works in partnership with Oil & Gas customers to deliver a broad portfolio of solutions that harness the extreme properties of synthetic diamond and tungsten carbide to:

- Improve Rates of Penetration (ROP) and cut the cost per foot drilled
- Reduce rig downtime and shorten drilling project duration
- Improve competitiveness throughout the Oil & Gas value chain

## DRILLING

Our drilling range maximises efficiency, across multiple drilling techniques and environments.

### PDC BITS

PDC PREMIUM, ASSURED AND GAGE CUTTERS



SHAPED DIAMOND CUTTERS



### ROLLER CONE BITS

CARBIDE INSERTS



DIAMOND INSERTS



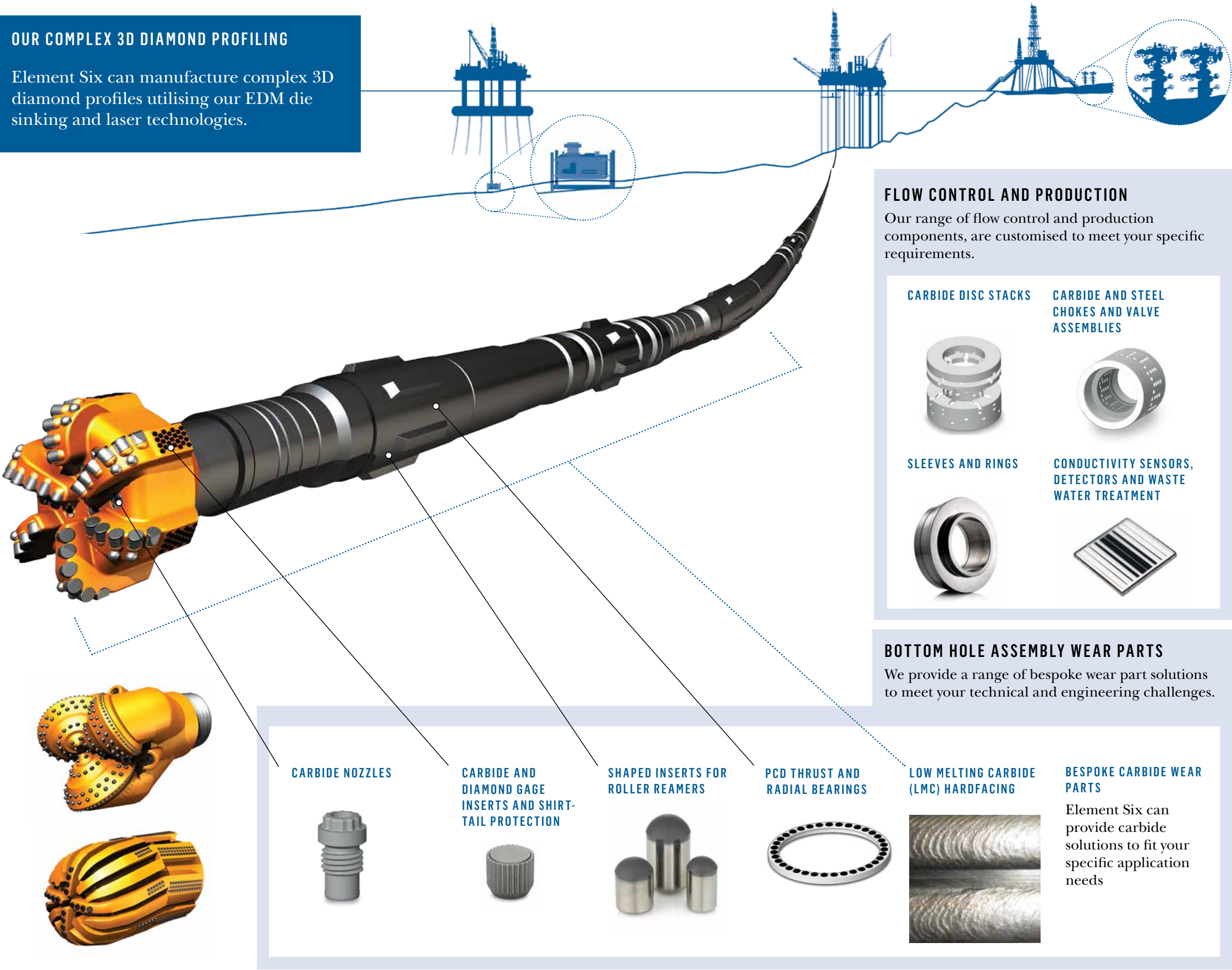
### DIAMOND IMPREGNATED BITS

PREMIUM COATED AND UNCOATED SYNTHETIC DIAMOND GRIT



## OUR COMPLEX 3D DIAMOND PROFILING

Element Six can manufacture complex 3D diamond profiles utilising our EDM die sinking and laser technologies.



## FLOW CONTROL AND PRODUCTION

Our range of flow control and production components, are customised to meet your specific requirements.

CARBIDE DISC STACKS



CARBIDE AND STEEL CHOKES AND VALVE ASSEMBLIES



SLEEVES AND RINGS



CONDUCTIVITY SENSORS, DETECTORS AND WASTE WATER TREATMENT



## BOTTOM HOLE ASSEMBLY WEAR PARTS

We provide a range of bespoke wear part solutions to meet your technical and engineering challenges.



# RAPID INNOVATIVE MATERIALS SOLUTIONS

## UNDERSTANDING THE OIL & GAS INDUSTRY

Element Six has been working in partnership with Oil & Gas customers for 30 years. We have developed a broad capability and provide advanced material solutions for every stage in Oil & Gas production.

Our dedicated Oil & Gas team work closely with customers to understand how our products behave in the field. Extensive laboratory application tests and in-field performance analysis give our team an industry leading understanding of the relationship between tool performance, materials microstructure and design.

This dedicated application engineering expertise enables our customers to be first to market with successful new products.

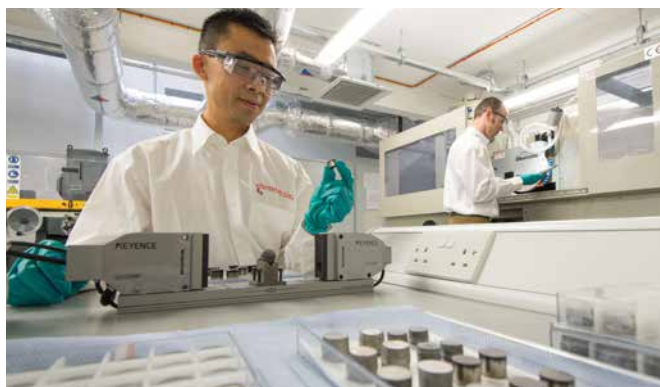
## A HUB FOR MARKET READY INNOVATIONS

Working with customers, our Global Innovation Centre can take a product concept and quickly turn it into a tested market-ready product.

Our GIC has more than 140 experienced engineers, materials scientists, physicists and technologists wholly dedicated to developing diverse, application-ready diamond and carbide based solutions specific to our customers' needs.

Our unrivalled end-to-end innovation capabilities include;

- Material characterisation
- Synthesis and sintering
- Tool assembly
- Prototyping
- Application testing



*Over 140 engineers, material scientists and technologists work in partnership with customers at our Global Innovation Centre.*

## OVER 2500 CUSTOMERS WORLDWIDE USE ELEMENT SIX SOLUTIONS

With over 50 years in synthetic diamond manufacturing, our supermaterials are in demand for cutting, grinding, drilling, shearing and polishing and we are developing applications for industries as diverse as optics, power transmission, water treatment, semiconductors and sensors.

## BACKED BY WORLD-CLASS MANUFACTURING CAPABILITIES

Element Six is an ISO9001 2008 Registered Company. Continuous investment in both R&D and production technology ensures that Element Six continues to push the boundaries of materials performance.

- Our world class manufacturing sites can quickly scale up innovations into production ready products
- Our global manufacturing facilities exploit the benefits of the latest press technologies including both belt and cubic presses
- Consistently high performance can be delivered every time thanks to our unequalled diamond synthesis capabilities and unrelenting focus on quality



*Element Six's unequalled synthesis capability includes the very latest belt and cubic press technology to continuously push the boundaries of materials performance.*

# SYNTHETIC DIAMOND TO INCREASE ROP, TOOL LIFE AND PROFITABILITY

## FASTER DRILLING

Within the Oil & Gas industry, the challenge of improving productivity in diverse environments calls for innovative ways to drill further, faster and for longer. Element Six synthetic diamond supermaterials can help meet that challenge.

## POLYCRYSTALLINE DIAMOND CUTTERS

Our range of high performance Premium and Assured PDC cutters are designed to meet your application requirements:

- Cutters for high impact, abrasion or general purpose applications
- Engineered to enable better durability, faster drilling and higher rates of penetration (ROP) throughout the drilling cycle
- Longer tool life and exceptionally low wear rates protect the drill bit, maximise interval lengths and reduce bit trips



## THE TOUGHEST DRILLING CONDITIONS DEMAND THE HARDEST MATERIAL

In addition to PDC cutters, Element Six can provide an extensive range of synthetic diamond solutions such as shaped diamond cutters, chisel and gage inserts and synthetic diamond grit.

Synthetic diamond's exceptional hardness and stiffness translates into exceptional durability and reliability for various drilling techniques and applications;

- PDC bits and Borehole enlargement solutions
- Roller cone bits
- Diamond Impregnated bits
- Stabilizers and Roller Reamers
- Bespoke solutions



# DELIVERING HIGH PERFORMANCE AND LOWER MAINTENANCE COSTS

## WEAR RESISTANCE

A range of carbide and synthetic diamond materials and components for wear parts such as valves, bearings and turbine parts are available from Element Six, delivering extended component life and reduced maintenance costs throughout the drilling, flow control and production processes.



*Element Six wear part solutions improve efficiency in topside and subsea valves in the oil and gas industry.*

## LOW MELTING CARBIDE (LMC) HARD-FACING

Element Six has developed a novel hard-facing material, LMC, that can be applied to steel substrates using a patented Plasma Transferred Arc Welding technology.

LMC provides enhanced surface protection and life improvements throughout the drill string.



*LMC hard facing on pipe surface.*

## TUNGSTEN CARBIDE WEAR PARTS

Element Six offers a wide range of bespoke Tungsten Carbide products developed from 60 years of experience and market-leading expertise. Characterised by extreme strength, toughness and hardness, Tungsten Carbide is highly resistant to wear and high temperatures.



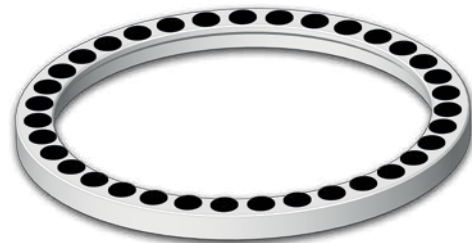
*Tungsten carbide chokes and valves can be made to any customer specification.*

## PCD BEARINGS

The extreme properties of polycrystalline diamond (PCD) include:

- Very low friction
- Extreme durability
- Efficient operation in hazardous environments

These properties make it an ideal material for bearings, delivering high performance, extended life and reduced maintenance costs.



*Representative example of thrust bearing made of PCD braised to steel.*

# SYNTHETIC DIAMOND ENABLES NEW TECHNOLOGIES

## SENSING AND DETECTING

In addition to synthetic diamond's exceptional hardness and chemical stability, it also has a high thermal conductivity and, when doped with boron, high electrical conductivity, making it an ideal material for sensing and detecting in hostile environments.

## WHERE ONLY SYNTHETIC DIAMOND CAN SURVIVE

Very few diagnostic tools can be sent down an oil well and survive. However, synthetic diamond is chemically inert and robust enough to withstand the extreme temperatures, aggressive chemicals and physical stresses encountered down hole – providing consistent and reliable sensing.

## ELECTROCHEMICAL SENSORS

Our electrochemical sensor technology uses boron doped diamond electrodes encapsulated in insulating diamond, enabling Oil and Gas engineers to probe the properties of formation waters. The potential advantages of these sensors include:

- Robust and stable pH measurements
- High accuracy conductivity measurements for analysis of water salinity
- Physical/chemical robustness
- Suitability for long term deployment and in-situ cleaning
- Compatibility with off-the-shelf drivers



*Element Six's conductivity sensor combines conducting and insulating diamond for reliable and continuous sensing in hostile environments.*

## NEUTRON DETECTORS

Neutron particle detectors (as supplied to CERN by Element Six) offer many advantages over materials in use today, such as Helium and scintillators, to improve well-logging efficiency, reliability and productivity.

These advantages include:

- Compact solid state device
- High speed response
- Intrinsic sensitivity to fast neutrons
- Wide band gap, low leakage current even at high temperatures
- Chemical and abrasion resistance

## ELEMENT SIX

Element Six, part of the De Beers Group of Companies, designs, develops and produces synthetic diamond and other supermaterials, and operates worldwide with primary manufacturing facilities in China, Germany, Ireland, South Africa, the UK and US.

Element Six supermaterial solutions are used in applications such as cutting, grinding, drilling, shearing and polishing, while the extreme properties of synthetic diamond beyond hardness are opening up new applications in a wide array of industries such as optics, power transmission, water treatment, semiconductors and sensors.

If you would like to know more about Element Six please visit our website [www.e6.com](http://www.e6.com) or contact us at the address below.

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