Construction
Blasting Solutions for the Construction Market

August 2011
At Orica, we recognise ‘The Power of Partnership’ and the value of building long-term relationships with our Customers. We are proud of our reputation for superior safety, environmental management, dependability, integrity and expertise, and we aim to maintain and enhance that reputation.

Our Customers can have confidence that we will provide effective products and superior know-how to increase yield, improve productivity and reduce total for completion costs.
Research and Development

Our aim is to develop innovative product and service solutions to improve mining efficiency. We do this by providing the right solution, first time, every time.

Orica Mining Services is dedicated to the development of innovative product and service solutions that deliver safe and efficient blasting solutions to our Customers.

Our Global Technology Team is the driving force behind innovation in products and delivery services and blasting application and measurement. Orica Mining Services has a significant investment in technology which has led to many new and innovative technologies that now are used by our Customers throughout the world.

Orica Mining Services has seven Global Technical Centres around the world in Canada, USA, Australia, Germany, Sweden, South Africa and India. Orica Mining Services conducts R&D in ammonium nitrate, packaged and bulk explosives, explosives hazards, advanced delivery systems for explosives, initiating systems (both non-electric and electronic) and advanced blasting and mining applications.

Orica Mining Services employs approximately 230 scientists and engineers around the world, researching, developing, supporting and maintaining our solutions for Customers.

Construction

In the construction industry there is little or no room for error. Flyrock, excessive vibration and airblast cannot be tolerated. Orica strives to provide blasting solutions specifically designed to overcome the restrictive demands of construction blasting whilst taking into account the requirements of the Customer, regulators and the community.

Building of roads, dams, buildings, harbours, pipelines and tunnels requires excavation of considerable amounts of rock. Orica understands the challenges that face the construction industry, and has developed products, services, systems and techniques to allow safe, fast and cost effective breakage and excavation of rock on most projects. High technology blasting allows more freedom for building designers, contractors and developers to achieve outcomes that will be advantageous to their clients.

Our team provides expert advice aimed at delivering innovative blasting solutions in environments previously thought impossible. We endeavour to deliver results, that provide controlled outcomes and excavation profiles in minimum time. Whether the project involves tunnelling, excavations, pipelines, trenches or road construction, Orica liaises with Customers to manage the risk to enable the provision of operations, that are safe, timely and cost effective.

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Technical Services

Orica’s Technical Service Engineers understand the construction industry and the challenges you face. When you need solutions for better blasting, your Orica Technical Service Engineer is there with the best advice.

They access software such as SHOTPlus®, measurement tools and global network of Orica technology and people to support you in lowering your construction costs. They also offer Safe and Efficient Blasting courses and Shotfiring Courses that can be tailored to meet your needs.

Innovation and responsiveness are the hallmarks of our Technical Services team who offer a range of services such as:

- Blasting in urban environments, community services and residential buildings
- Blasting adjacent to services
- Blasting to break rock cost efficiently adjacent to residential buildings
- Creating permeable channels to direct flow of groundwater
- Trenching
- Tunneling and perimeter control
- Shaft-sinking
- Demolition
- Highway works
- Breaking boulders in commercial/urban environments

Working together with the industry and Customers, they are delivering the real Power of Partnership.

World-class services available for every stage of your construction projects include:

**Risk Assessments**

The purpose of an Orica Risk Assessment is to assess and manage risk and therefore minimise potential hazards before they become incidents. Orica has a safety vision of “no injuries to anyone ever” and this is a core component of how we do business. Orica Quarry and Construction Services has extensive experience in the management of risk.

**Blast Design Services**

Orica has access to a team of blasting engineers around the world. The local team can draw on national and international experience to provide support to your project during the feasibility and design process. It is during this period of the construction cycle that Orica considers significant efficiencies can be achieved for our Customers.

**Environmental Services**

Orica can conduct ground vibration and air overpressure measurements and complete reporting for environmental legislation compliance. Issues of concern raised by these reports can be managed through blast design modifications, and supported by community/regulatory authority consultation.

**Public Relations**

Orica has extensive experience with community consultation. Orica can participate in community meetings, drawing on actual case studies including video footage, to allay public concerns about blasting. This consultation generally provides communities with information on the likely impacts of hard rock excavation in their local environment.

**Blasting Services**

Every project is unique and requires a new mix of services to address its specific project parameters. We provide a range of services that allows these project parameters to be addressed. Our services include engineering to assist with preparing designs and feasibility studies, preparation of quotations, blast management services, shot firing services and day work services which can be varied and modified to match the specific project needs. Our staff members have been trained to the highest safety standards and have access to the most advanced equipment available in the industry today. The range of service levels available is intended to provide maximum support and flexibility for optimising a Customer’s project. We can provide specific expertise that may not be available within your organisation. The potential benefits of these services include excellent safety, health and environmental management and high operational productivity and reliability.

**Blast Management Service**

A Blast Management Service (BMS) is one where Orica co-ordinates all activities associated with providing a full drill and blast operation. Activities can range from a design, drill and blast service, through to complete public relations, risk assessments and environmental management. This service is tailored to specific Customer needs and, by working closely with our Customers, can define and achieve clear milestones on a blast or project basis.
Blast Based Services

Through our vast global experience in construction projects, we understand that every construction project has unique needs and value drivers. For this reason, we have created Blast Based Services.

Blast Based Services is a suite of service based offerings that reinforce our commitment to supporting the productivity, growth, profitability and environmental outcomes of our Customers.

Our Blast Based Services capabilities include:

- a comprehensive range of survey, design, modelling and measurement tools;
- a series of blast improvement, compliance and quality services delivered by our Technical Services team;
- our Advanced Blast Based Services, which offer tailored solutions to deliver immediate results and also maximise downstream value generation in construction projects.

Orica invests heavily in innovation. Over many years our advanced research and development program has allowed us to offer significant technical capabilities to drive greater value for our Customers.

The development of innovative products, systems, applications and services assists our Customers to achieve optimum blasting results cost effectively and safely. The suite of Technology & Tools offered within Blast Based Services is represented in four classes of technical capability:

- Surveying: Orica uses a range of measurement systems for borehole tracking, burden measurement, and laser face surveying. These systems can be interfaced with existing blast management software.
- Design: Orica’s SHOTPlus® suite of software enable optimum blast design and analysis for construction projects.
- Modelling: Orica has developed a wide range of modelling tools for the simulation of the extraction, blast outcomes, cost optimisation and environmental performance.
- Measurement: Orica uses a range of measurement systems for the assessment of blast impacts such as rock movement, fragmentation, blast damage prediction modelling, flyrock, vibration and airblast as well as product performance and cycle time.
Blast Based Services continued

Quality Services

Orica’s Technical Services Engineers understand the demands on construction projects and the challenges you face. When you need technical support and training for better blasting outcomes, an Orica Technical Services Engineer is able to provide you top quality advice and support.

Our Technical Services team enable our Customers to achieve best practice standards by delivering a range of site tailored services:

• Blasting Courses – including Safe and Efficient Blasting, Explosives Awareness, Shotfirer training, Operator training, explosives and product training.
• Quality Blasting Audits and Risk Assessments – targeted at highlighting opportunities for cost efficiencies, safety and environmental improvements and blast optimisation.
• Blast Design & Support – An experienced network of blasting professionals, providing assistance with designs, measurement or on bench support including the introduction of new bulk and initiation products.
• Site Compliance – Risk analysis, compliance monitoring, environmental planning and environmental impact assessments.
• Site Surveys & Industry Benchmarking – Comprehensive site process studies by experienced engineers on site to review construction projects and establish a base line for the identification of the best improvement/efficiency project opportunities. This can include the analysis of comparative blasting scenarios arising from proposed changes in product selection, blasting parameters, or processing equipment selection.

Advanced Solutions

Orica’s Advanced Blast Based Services reinforce our commitment to supporting the growth and profitability of our Customers through the introduction of services that can be tailored and adapted to meet the individual needs of each operation.

Innovation and excellence in unlocking tangible value are the hallmarks of our Advanced Blast Based Services. These advanced services are tailored for every site and are designed to deliver:

• Safely blasting adjacent to services
• Trenching
• Tunnel portal blasting
• Shaft-sinking
• Demolition
• Highway works
• Maximising tunnel advance and delivering perimeter control
• Creating permeable channels in in-situ hard rock to channel the flow or treatment of groundwater
• Reduced unit excavation costs through designs and on-bench standards that maximise the use of every unit of explosives energy
• Minimising the project completion timeline and minimising overall cost by safely delivering blasting in urban environments, near community services and residential buildings
• Breaking boulders in commercial/urban development environments
• Improving performance outcomes within environmental limits
• Reducing Greenhouse Gas intensities through advanced scenario modelling using Orica’s Value and Emissions calculator
• Underwater blasting

Rock 2 Spec™ draws on Orica Mining Services expertise in novel design of blast parameters, leading edge visioning systems and data base management services aimed to deliver significant advanced fragmentation benefits to Customers. It provides Customers with a service that aims to deliver agreed relative improvements in the fragmentation of blasted material (e.g. production of a fragment size that minimises crushing or handling costs for downstream use or additional sales revenue).
The Centra™ Bulk System is a range of high energy, pumped emulsion explosives suitable for dry and wet blasthole applications. The range of fixed and variable density products have been developed to meet the specific needs of the surface construction industry.

<table>
<thead>
<tr>
<th>Product</th>
<th>Application</th>
<th>Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centra™ Gold</td>
<td>High energy pumped emulsion</td>
<td>1.2 g/cc</td>
</tr>
<tr>
<td>Centra™ Gold ES</td>
<td>Environmentally sensitive blasting</td>
<td>1.1 g/cc</td>
</tr>
<tr>
<td>Centra™ Gold GT</td>
<td>High energy product with even greater throw</td>
<td>1.2 g/cc</td>
</tr>
</tbody>
</table>

**Features and Benefits**
- Proven reliability in difficult blasting situations
- Integrated product and delivery systems ensuring accuracy, productivity and dependability of supply
- Less labour intensive than traditional quarrying and construction methods
- High energy and full explosive coupling enables pattern expansion. High speed loading enables high on bench turn around

The Civec™ Bulk System is a range of variable energy, pumped emulsion explosives suitable for dry and wet blasthole applications. The Civec™ range includes products tailored to meet the special challenges of the civil tunnelling and underground construction industry.

<table>
<thead>
<tr>
<th>Product</th>
<th>Application</th>
<th>Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civec™ Drive</td>
<td>Lifter &amp; cut holes</td>
<td>1.2 g/cc</td>
</tr>
<tr>
<td>Civec™ Drive</td>
<td>Face holes</td>
<td>0.8 – 1.1 g/cc</td>
</tr>
<tr>
<td>Civec™ Drive</td>
<td>Retriever &amp; buffer holes</td>
<td>0.7 – 0.9 g/cc</td>
</tr>
</tbody>
</table>

**Features and Benefits**
- Reliability in extreme blasting applications
- Engineered product and delivery systems aiming to ensure safety, accuracy and productivity
- Simplifies site logistics including storage, handling and security
- Reduced environmental impact
- The ground breaking energy of the Civec™ Bulk System can be tailored across the excavation to optimise advance and minimise co- incidental damage

The increased speed of charging and reduced post-blast fumes when using the Civec™ Bulk System, can improve cycle time in tunnelling and construction. The Civec™ Bulk Products are manufactured at the face by Orica’s proprietary delivery systems and pumped into blastholes on demand. The total cost, safety and security issues associated with the storage and handling of packaged explosives can be minimised when using the Civec™ Bulk System.
Electronic Blasting Systems

Electronic Blasting Systems differ from electric and non-electric delay systems in that the delay time is controlled by a programmable integrated circuit, resulting in very precise timing.

The accuracy and programmability of electronic detonators allows for blast timing to be tailored to the geometry, geology and unique requirements of any blasting operation to more effectively use explosives energy.

Key Benefits for Construction blasting
- Vibration control
- Improved blasting efficiency
- Enhanced safety and security
- Reduced and simplified inventory

Our systems are easy to use, easy to program, and very safe. The detonators are identical in size and output to non-electric detonators. Every detonator has a unique, traceable ID number held on the chip, and printed on the attached tag. They are programmable in millisecond increments and have a high level of protection against accidental initiation by stray or induced currents and electrostatic discharges. The tough, all-weather hardware is intuitive and much liked by blasters.

i-kon™ Logger

The Logger is used on the bench as part of the hook-up process, checking the ID number and the status of each detonator. The Logger operates well below the no-fire voltage of the detonator ensuring inherently safe operation on the bench. The delay time for each detonator is stored against the ID number in the memory of the Logger for later programming by the Blaster.

i-kon™ Blaster

The Blaster is used to calibrate, program, arm and fire the i-kon™ detonators via the Loggers. Individual detonators and system integrity are fully verified and displayed to the user before the blast is fired, allowing confident blasting or trouble-shooting to be done.

There are two different Blasters for small and large blasts (Blaster 400 and Blaster 2400S). Two Blaster 2400S units can be synchronised together to fire 4800 detonators.

The i-kon™ Surface Remote Blasting System (SURBS) allow blasts to be fired remotely. The SURBS units can initiate blasts on the surface up to 2000 m away via a secure radio transmission.

Orica’s i-kon™ Digital Energy Control System represents Orica’s most sophisticated blast initiation technology available. The extraordinary accuracy, flexibility and safety delivered by the i-kon™ System will allow you to optimise your blast designs like never before. The i-kon™ System is the result of Orica’s ongoing commitment to provide value-added products and services to our Customers that deliver real productivity improvements.

The i-kon™ System has four key integrated components; detonator, logger, blaster, software:

i-kon™ Detonator

The i-kon™ Standard Detonator is recommended for use in Construction Projects.

Technical Properties
- Delay times: Programmable from 0 ms to 15000 ms in 1 ms increments
- Wire length (m): Standard: 6, 15, 20, 30, 40, 60
- Downline wire: 0.6 mm steel
- Wire tensile strength: 25 kgf (250 N)

The power of the i-kon™ System is SHOTPlus®-i, an in-house tool developed to provide a seamless front end to a construction project’s design and production systems. By integrating directly with the i-kon™ Loggers the blast design process flows into the hook-up design, both speeding up and ensuring the integrity of the process.

SHOTPlus®-i can import survey data detailing blasthole coordinates and identifiers, geological boundaries, pit design information and critical design elements. This allows for more accurate initiation designs to be developed, seamlessly incorporating site based systems with Orica technologies. Data upload completes the process, with the ability to document and report the final blasting outcomes and explosive consumption.
Electronic Blasting Systems continued

**eDev™**

**Electronic Tunneling System**

The eDev™ system is an Electronic Blasting System specifically designed for tunnelling, providing the accuracy and flexibility of electronic timing at a reasonable price with rapid and easy operations at the tunnel face.

The new “time by numbers” feature and SHOTPlus™-T software allows blasters to operate in a familiar and rapid manner making it possible to achieve benefits such as reduction in inventory logistics and costs, reduced vibration, improved advance rate and overbreak control.

The eDev™ system consists of programmable electronic detonators and hardware to test, program and fire the detonators. The eDev™ detonator will directly initiate detonator Servatel™ packaged explosives and Pentex™ boosters.

**eDev™ Detonators**

- eDev™ detonators have the potential to bring wide-ranging benefits over traditional pyrotechnic detonators and other electronic systems.

**Technical Properties**

<table>
<thead>
<tr>
<th>Property</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delay times</td>
<td>Fully programmable from 0 ms to 10000 ms in 1 ms increments</td>
</tr>
<tr>
<td>Wire length (m)</td>
<td>2, 3, 4, 5, 6, 8</td>
</tr>
<tr>
<td>Leg wire</td>
<td>Conductor is copper clad steel</td>
</tr>
<tr>
<td>Wire tensile strength</td>
<td>20 kgf/200 N</td>
</tr>
</tbody>
</table>

**eDev™ Scanner**

The Scanner is used to passively and safely read the detonator ID from the barcode tag. The ID is associated with an assigned delay time in the scanner’s memory and later transferred to the blaster. “Time by numbers” and auto-increment features combine with SHOTPlus™-T software to allow quick operations at the face.

**Network Tester**

The Network Tester is an inherently safe, hand-held testing device used to test for short circuits, leakage and reverse polarity. Most problems can be discovered and corrected by this quick on-pattern testing of the wiring harness.

**eDev™ Blaster**

The eDev™ Blaster tests, programs, arms and fires the detonators with full two-way communications. The dedicated Blaster is the only means of initiating the eDev™ electronic detonator. When the scanner is docked into the Blaster’s docking station, the information held within it is transferred to the Blaster. At the designated time and location, blasting cables are attached to the box and firing sequence initiated. The eDev™ Blaster has capacity to fire even the largest tunnel rounds.

**SHOTPlus™-T**

SHOTPlus™-T is a windows compatible blast design program specifically for tunnelling (which includes mine development). The package contains several standard rounds, but includes powerful routines allowing complex rounds to be designed by applying simple rules to a tunnel face of given geometry. SHOTPlus™-T provides a simple and convenient way to design, analyse and optimise eDev™ blasts.

SHOTPlus™-T is an integral component of the eDev™ System – by interfacing with the eDev™ Scanner the blast design process seamlessly flows into the activities at the face, both speeding up and ensuring the integrity of the process.
Initiating Systems

Featuring the Pentex™ range. Orica offers the widest range of Initiating Products to the market place.

Key Benefits
- High standards of safety
- Reliability of supply
- Consistent product and service performance

Products are produced and distributed throughout the region with world class manufacturing facilities located within Australia, Philippines, China and India.

Pentex™ D is a high explosive composition booster cast into a plastic shell. Pentex™ D has a high density and high velocity of detonation to maximise performance. Designed to be used in conjunction with Hypercharge™ units, the booster fits into a specially designed applicator. The unique design features of the device facilitate ease of loading, placement of the unit at the toe of the blasthole and the secure attachment of a detonator.

Technical Properties
- Shell colour: Orange
- Nominal diameter: 21 mm
- Nominal length: 138 mm
- Nominal mass: 25 g
- Velocity of detonation: 7.2 km/s

Pentex™ H boosters are made of high explosive composition cast into a cardboard shell. Two longitudinal tunnels in the booster accommodate either a detonator or detonating cord. Pentex™ H boosters contain Detlok™. Detlok™ securely holds the detonator in place during loading, while still enabling safe removal of the detonator if required. Pentex™ boosters provide high energy initiating power for booster sensitive explosives.

Technical Properties
- Shell colour: Green
- Nominal diameter: 34 mm
- Nominal length: 120 mm
- Nominal mass: 150 g
- Nominal density: 1.7 g/cm³
- Velocity of detonation: 7.2 km/s
- Nominal detonation pressure: 22.0 GPa

A case contains 150 pieces including an applicator.
Packaged Explosives

Orica Mining Services manufactures a range of packaged products for your construction needs.

**Senatel™ Magnum™**

Senatel™ Magnum™ is a water resistant packaged explosive designed to deliver high energy. It can be used in both priming applications and as a high-density column explosive. Senatel™ Magnum™ cartridges are packaged in film, which readily splits during tamping to maximise coupling and bulk strength within a blasthole.

Both the Senatel™ Magnum™ packaging cases and film are colour-highlighted in red. Standard cartridge sizes are as follows:

<table>
<thead>
<tr>
<th>Diameter (mm)</th>
<th>Nominal length (mm)</th>
<th>Nominal mass (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>200</td>
<td>115</td>
</tr>
<tr>
<td>25</td>
<td>700</td>
<td>460</td>
</tr>
<tr>
<td>32</td>
<td>200</td>
<td>185</td>
</tr>
<tr>
<td>32</td>
<td>700</td>
<td>510</td>
</tr>
</tbody>
</table>

**Performance**

<table>
<thead>
<tr>
<th>Nominal density (g/cc)</th>
<th>1.23</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative effective energy&lt;sup&gt;1&lt;/sup&gt;</td>
<td>132%</td>
</tr>
<tr>
<td>Relative bulk strength&lt;sup&gt;2&lt;/sup&gt;</td>
<td>201%</td>
</tr>
<tr>
<td>– to ANFO @ 0.8 g/cc</td>
<td>153%</td>
</tr>
<tr>
<td>Minimum velocity of detonation&lt;sup&gt;3&lt;/sup&gt; (km/s)</td>
<td>6.4</td>
</tr>
<tr>
<td>CO&lt;sub&gt;2&lt;/sub&gt; (kg/tne)</td>
<td>139</td>
</tr>
</tbody>
</table>

<sup>1</sup> REE is the Effective Energy relative to ANFO at a density of 0.8 g/cc. ANFO has an effective energy of 2.30 MJ/kg. Energies quoted are based on ideal detonation calculations with a 105MPa cut-off pressure. Non-ideal detonation energies are also available on request. These take account of blasthole diameter, rock type and explosive reaction behaviour.

<sup>2</sup> VOD will depend on application including explosive density, blasthole diameter, temperature and degree of confinement. The minimum VOD quoted is based on unconfined test firing data.

<sup>3</sup> Carbon dioxide is the main greenhouse gas produced. The output is calculated assuming ideal detonation.

**Senatel™ Powersplit™**

Senatel™ Powersplit™ is designed for construction projects where a continuous length of decoupled explosive charge is required. Senatel™ Powersplit™ suits perimeter blasting applications such as smooth wall blasting, trimming and pre-splitting.

Senatel™ Powersplit™ is packaged in continuous film and double clipped every 400 mm. Senatel™ Powersplit™ packaging cases and film are colour-highlighted in purple. Standard cartridge sizes are as follows:

<table>
<thead>
<tr>
<th>Diameter (mm)</th>
<th>Length (m)</th>
<th>Case weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>27</td>
<td>17</td>
</tr>
<tr>
<td>32</td>
<td>20</td>
<td>17</td>
</tr>
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**Performance**

<table>
<thead>
<tr>
<th>Nominal density (g/cc)</th>
<th>1.18</th>
</tr>
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<tbody>
<tr>
<td>Relative effective energy&lt;sup&gt;1&lt;/sup&gt;</td>
<td>100%</td>
</tr>
<tr>
<td>Relative bulk strength&lt;sup&gt;2&lt;/sup&gt;</td>
<td>147%</td>
</tr>
<tr>
<td>– to ANFO @ 0.8 g/cc</td>
<td>201%</td>
</tr>
<tr>
<td>Minimum velocity of detonation&lt;sup&gt;3&lt;/sup&gt; (km/s)</td>
<td>6.5</td>
</tr>
<tr>
<td>CO&lt;sub&gt;2&lt;/sub&gt; (kg/tne)</td>
<td>149</td>
</tr>
</tbody>
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** Specialised hot ground blasting products to be used in conjunction with site specific blasting procedures. Donor units may not be compatible with high temperature blasting applications. Contact your local Orica Representative prior to use.

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