MINING & GEOTECHNICAL CATALOGUE

February 2016
Introduction

IPI is a world leader in equipment for in-situ characterization of permeability and rock stress (hydraulic fracturing and jacking), and provides a wide range of custom and standard packer-based products for the mining and geotechnical industries. IPI provides technical support and training with our qualified staff of engineers and technicians to assist our customers. IPI technology has been applied at diverse sites around the globe, including: mine site hydrogeological characterization for major and minor projects; ice drilling in Antarctica; CBM (Coal permeability) projects; CO₂ sequestration; nuclear waste site characterization; dam monitoring and numerous other projects.
From the early days of IPI, established in 1999, we have been privileged to have supplied our equipment to some of the world’s most prestigious mining and geotechnical projects and have continued our association with many of these to this day. We’re also privileged to work with some of the world’s leading mining and geotechnical consultants including Golder Associates, Klohn Crippen Berger, Knight Piesold, Schlumberger Water Services and SRK.

Various Major Tunnel and Dam Projects, worldwide

Clients use a range of IPI products from OEM or standard inflatable packers for their own tools to IPI’s own wireline permeability testing tools, including versions with balanced piston setting tools and optional impression packers, for a wide range of geotechnical tests.

Oyo Tolgoi Copper Mine
Gobi Desert, Mongolia

One of the early users of SWiPS®, IPI has gone on to develop market leading permeability testing tools that now dominate the hard rock mining and coal bed methane industries, as well as used for such as CO₂ sequestration and salt dome testing. All the world’s major mining companies use IPI equipment.

El Teniente, Chile
World’s largest underground copper mine.

The Andean hard rock mining industry are advanced users of inflatable packer technology for wireline permeability testing, hydraulic fracturing for rock burst mitigation and block caving pre-conditioning as well as for In Situ Recovery.

Several nuclear waste disposal sites, worldwide

Work is either undertaken by specialist consultancies or government sector agencies. For the sensitivity of data required, IPI has provided specialist tools with advanced Data Acquisition Systems and high pressure specialist testing rods.
**IPI – our vision is to be the world’s first choice inflatable packer company.**

Founded in 1999 in Perth, Western Australia, by Clem Rowe to design and manufacture inflatable packer based down-hole tools for the international marketplace, IPI has since developed a world-wide presence. IPI delivers world-class service in striving to achieve its vision with which many clients, most of whom are service companies or consulting engineers, would confirm. IPI is primarily a manufacturer but can provide on-site services if required, especially for training purposes. In May 2015 the IPI Perth facility achieved third party accreditation of its Quality Management System as complying with ISO 9001:2008.
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The IPI SWiPS® is designed for permeability testing in NQ, HQ and PQ wireline core holes. The packers are hydraulically inflated through the drill string, eliminating the need for high-pressure gas bottles and inflation lines. This system is potentially adaptable to suit other core systems.

APPLICATIONS:
Permeability testing for:
- Mine design and dewatering
- Coal bed methane exploration
- In situ mining

FEATURES:
- Completely hydraulic - needs no nitrogen gas or inflation lines
- Water inflation enables a higher sealing pressure
- Effective to depths over 1,000m in angle and vertical holes
- Works with standard Boart Longyear™ or equivalent systems
- Compatible with orientation devices
- Configurable as single or straddle packer system
- Deflate and retrieve with wireline and standard overshot
- Rental systems available
- Flow meter skids available
- Pump-down versions for shallow angle and horizontal use
- Stainless steel option for brine and other aggressive borehole conditions
- Sizes to suit NQ, HQ and PQ size core barrels.
- Types of Testing
  - Permeability
  - Lugeon Tests
  - Falling Head
  - Air Lift
OPERATION: EASY AS 1-2-3

STEP 1
Remove inner barrel, then run SWiPS® in and latch into core barrel.

STEP 2
Inflate SWiPS® by filling and pressurizing the drill string and conduct permeability test

STEP 3
Latch on to tool using a standard overshot, deflate packers by pulling up slightly. Once deflated, retrieve SWiPS® to surface, replace inner barrel, and resume drilling.

ACCESSORIES:
- Non-rotating C-Plate and hauling sub for tool assembly over rods
- Flow meter assembly with pressure gauge and optional data logger
- Extension subs for 3m/10’, 6m/20’ and 12m/40’ core barrels
- PQ 70 adaptation kit to enable HQ SWiPS® to be run in PQ size Core Barrel using 70mm Packer Elements
- Downhole memory gauge carriers

SWIPS® technical specifications:

<table>
<thead>
<tr>
<th>Nominal Size</th>
<th>NQ [75.7mm]</th>
<th>HQ [96.0mm]</th>
<th>PQ70 [122.6mm]</th>
<th>PQ [122.6mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centre Tube ID</td>
<td>13.9mm [0.55&quot;]</td>
<td>18.9mm [0.74&quot;]</td>
<td>18.9mm [0.74&quot;]</td>
<td>32.5mm [1.3&quot;]</td>
</tr>
<tr>
<td>Maximum Working Pressure</td>
<td>100 bar [1450 psi]</td>
<td>100 bar [1450 psi]</td>
<td>100 bar [1450 psi]</td>
<td>100 bar [1450 psi]</td>
</tr>
<tr>
<td>Packter Element Length</td>
<td>1000mm [39.4&quot;]</td>
<td>1000mm [39.4&quot;]</td>
<td>1000mm [39.4&quot;]</td>
<td>1000mm [39.4&quot;]</td>
</tr>
<tr>
<td>OD - Deflated</td>
<td>42 mm [1.65&quot;]</td>
<td>60 mm [2.36&quot;]</td>
<td>70mm [2.76&quot;]</td>
<td>80 mm [3.15&quot;]</td>
</tr>
</tbody>
</table>
The STX-60 is the smallest diameter version of IPI's ST range. It employs a multi-cycle, four stage valving mechanism that allows fluid communication to either the packers, annulus, test interval or provides complete shut in. What makes the STX unique is that it can be run:

■ As a wireline tool in conjunction with a 3m or longer mineral wireline coring system;
■ Or, on rods/tubing – including coiled tubing.

As with all other setting tools in IPI’s range, shifting between different stages is accomplished by axial movement only – no rotation is required. The multi-stage functionality enables multiple tests in a single run without pulling out of hole.

APPLICATIONS:
■ Permeability testing
■ Hydrojacking
■ Hydraulic fracturing
■ Rock stress testing
■ Selective stimulation
■ Casing integrity testing
■ Caprock integrity testing

FEATURES:
■ Run in on either wireline or on rods/tubing
■ Ease of use - no control lines, no rod rotation, no down hole pumps required
■ Inflation bypass design - no ‘squeeze’ pressure while inflating the straddle packers
■ Zero displacement valve design - maintains accurate shut-in pressures after the tool is shifted from injection/inflow to shut-in. Prevents spiking the formation when shifting from shut-in to test zone, which can cause jacking/fracking.
■ Balanced valve piston - the tool is in equilibrium
■ Ability to circulate while shut-in
■ Ability to blow down the fluid in the drill pipe/tubing whilst in circulating stage by using compressed air/nitrogen, to facilitate DST or slug withdrawal testing
■ All inlet/outlet ports are protected by filter screens to prevent ingress of solids
■ Emergency deflation - can be activated by over-pull in the event that the packers will not deflate by normal means
■ Cased and open hole application
COMPATIBLE PACKER SYSTEMS

<table>
<thead>
<tr>
<th>PACKER SIZE</th>
<th>WIRELINE</th>
<th>TUBING</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm</td>
<td>inch</td>
<td>Hole Size</td>
</tr>
<tr>
<td>Ø57</td>
<td>Ø2 ¼</td>
<td>HQ (Ø96mm)</td>
</tr>
<tr>
<td>Ø60</td>
<td>Ø2 ¾</td>
<td>HQ (Ø96mm)</td>
</tr>
<tr>
<td>Ø67</td>
<td>Ø2 ¾</td>
<td>PQ (Ø122mm)</td>
</tr>
<tr>
<td>Ø70</td>
<td>Ø2 ¾</td>
<td>PQ (Ø122mm)</td>
</tr>
<tr>
<td>Ø86</td>
<td>Ø3 ¾</td>
<td>N/A</td>
</tr>
</tbody>
</table>

SPECIFICATIONS

- Minimum Tool Diameter: 60mm
- Run in Mineral Wireline Coring System: HQ or PQ Size
- Run in on Tubing/Pipe: NQ, HQ & PQ
- Max. Pressure Rating: 5000 psi (34.5 MPa)
- Max. Temperature Rating**: 70° C (158° F)
- Max. Pull (Emergency Deflate): 4.4 T (9700 lb)
- Max. Axial load (1.6 safety factor): 13.5 T (29,762 lb)

**Maximum temperature rating on a standard tool. Tools requiring higher temperatures can be supplied, as well as change over kits to existing tools to a maximum temperature of 130°C/266°F.

PRESSURE vs. FLOW

![Pressure vs. Flow Graph]
IPI’s ST range of multi-cycle inflatable packer systems features a four-stage operational mechanism that enables packer inflation, annular circulation, interval testing, and complete shut-in isolation. The ST range can be configured as a single packer or a dual packer straddle assembly; its multi-cycle functionality allows for multiple formation evaluation tests or stimulation cycles to be performed on different zones within a single trip.

Its design features a volume-compensated balanced piston that prevents inner-component movement from inducing pressure fluctuations within isolated test zones and allows to accurately record initial shut-in pressure while preventing unintentional formation fractures. This innovation makes the ST range the optimal inflatable packer solution for formation evaluation and well stimulation in open hole or cased hole applications.

APPLICATIONS:
- Coalbed methane DST, IFO and DFIT testing
- Formation evaluation in oil & gas, geotechnical, or water wells
- Casing patch leak-off testing
- Well stimulation (acid treatment)
- Caprock integrity analysis

FEATURES:
- Simple and reliable operation only requires axial movement and hydraulic pressure (control lines, rotation, or downhole pumps are not required)
- Innovative design eliminates squeeze pressure during packer inflation
- Improved shut-in pressure accuracy due to zero-displacement valve design
- Low-pressure-loss tool chassis
- Ability to circulate while in the shut-in stage enables air/nitrogen induced hydrostatic head reduction for DST or swabbing applications
- Filter screen protected flow path prevents solid/debris clogging
- Backup pull-release emergency deflation mechanism available
- Ideal for cased and open hole applications
- Available upgrades for real-time downhole measurement systems
- Adaptor sub extensions available for longer straddle intervals
- Three different chassis sizes available for adaptability with an extensive range of packer types and sizes
### COMPATIBLE PACKER SYSTEMS

<table>
<thead>
<tr>
<th>Packer Size</th>
<th>Compatible ST Tool</th>
<th>Hole Size</th>
<th>Max. Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ø57 Ø2 ¼</td>
<td>ST60</td>
<td>76 3.0</td>
<td>5000 psi</td>
</tr>
<tr>
<td>Ø67 Ø2 ¾</td>
<td>ST60</td>
<td>96 3.8</td>
<td>2500 psi</td>
</tr>
<tr>
<td>Ø86 Ø3 ¾</td>
<td>ST66</td>
<td>140 5.5</td>
<td>1700 psi</td>
</tr>
<tr>
<td>Ø114 Ø4 ¼</td>
<td>ST66 &amp; ST114</td>
<td>115 4.5</td>
<td>5000 psi</td>
</tr>
<tr>
<td>Ø127 Ø5</td>
<td>ST66 &amp; ST114</td>
<td>152 6</td>
<td>2000 psi</td>
</tr>
<tr>
<td>Ø140 Ø5 ½</td>
<td>ST66 &amp; ST114</td>
<td>170 6.7</td>
<td>5000 psi</td>
</tr>
<tr>
<td>Ø178 Ø7</td>
<td>ST114</td>
<td>250 9.8</td>
<td>1600 psi</td>
</tr>
<tr>
<td>Ø190 Ø7 ½</td>
<td>ST114</td>
<td>260 10.2</td>
<td>2800 psi</td>
</tr>
<tr>
<td>Ø280 Ø11</td>
<td>ST114</td>
<td>210 8.3</td>
<td>5000 psi</td>
</tr>
</tbody>
</table>

### SPECIFICATIONS

<table>
<thead>
<tr>
<th>Tool Type</th>
<th>ST60</th>
<th>ST86</th>
<th>ST114 *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Tool Diameter</td>
<td>60 mm</td>
<td>86 mm</td>
<td>114 mm</td>
</tr>
<tr>
<td>Run on API Drill Pipe/Tubing</td>
<td>2 ¾ inch</td>
<td>2 ¾ inch</td>
<td>4 ½ inch</td>
</tr>
<tr>
<td>Max. Pressure Rating</td>
<td>5000 psi (34.5 MPa)</td>
<td>5000 psi (34.5 MPa)</td>
<td>5000 psi (34.5 MPa)</td>
</tr>
<tr>
<td>Max. Temperature Rating **</td>
<td>80° C (176° F)</td>
<td>80° C (176° F)</td>
<td>80° C (176° F)</td>
</tr>
<tr>
<td>Max. Pull (Emergency Deflate)</td>
<td>4.4 T (9,700 lb)</td>
<td>13.2 T (29,100 lb)</td>
<td>26.4 T (58,202 lb)</td>
</tr>
<tr>
<td>Max. Axial Load (1.6 safety factor)</td>
<td>13.5 T (29,762 lb)</td>
<td>48 T (105,821 lb)</td>
<td>87 T (191,802 lb)</td>
</tr>
</tbody>
</table>

* ST114 High pressure version available (up to 10,000 psi)
** Maximum temperature rating on a standard tool

Tools requiring higher temperatures can be supplied, as well as change over kits to existing tools to a maximum temperature of 150° C / 302° F.

### PRESSURE vs. FLOW

![Pressure Drop vs Flow Diagram]

- **ST114**
- **ST86**
- **ST60**

Flowrate, gpm vs. Pressure Drop, psi graph showing different tool performances.
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Portable Flow Meter Skids

IPI manufactures a range of portable flow meter skids for use with high-pressure IPI downhole tools, eg. SWiPS® STX 60, ST Range, etc.

APPLICATIONS:
- Permeability tests
- Injection test
- Withdrawal tests
- Hydrojacking
- Minifrac to 5000 psi

FEATURES:
- Built-in strainer to protect flowmeter
- 1” JIC male connections
- Easy-to-use flow control globe valve
- All stainless steel construction
- Waterproof “Pelican” storage & shipping case
- Robust high & low pressure analog gauges with optional electronic transducer on data logging models
- User friendly logging software (data logging models only)
- Twin meter boards also available, custom skids available

<table>
<thead>
<tr>
<th>Model</th>
<th>Max. Pressure rating</th>
<th>Flow meter type</th>
<th>Pressure measurement</th>
<th>Flow rate measurement range</th>
<th>Data logging capability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>psi</td>
<td>bar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FM-800 Manual</td>
<td>800</td>
<td>55</td>
<td>Turbine</td>
<td>Dual direct drive gauges</td>
<td>0.5 - 83</td>
</tr>
<tr>
<td>FM-5000 Electronic</td>
<td>5000</td>
<td>345</td>
<td>Ultrasonic</td>
<td>Dual direct drive gauges + Strain bridge transducer</td>
<td>0.26 - 661.7</td>
</tr>
</tbody>
</table>
The IPI Slim Hole Formation Tester produces detailed evaluation of formations in boreholes as small as 3" [76mm]. The straddle section has a flush outside diameter to minimize running risk. Real time data acquisition enables quality assurance and evaluation on site, and yields high-quality data necessary for modern well test evaluation methods.

APPLICATIONS:
- Nuclear waste site characterization
- Oil shale exploration
- Aquifer testing
- Tight formation evaluation

FEATURES:
- Robust straddle packer system with flush OD straddle section
- Zero-displacement downhole shut-in valve
- Real-time Data Acquisition System (DAS for downhole and surface instruments)
- Can be run with IPI O-Rod with O-ring seal and easy-mate threads
- Standard diameters of 60mm [2 3/8"] and 70mm [2 3/4”]; other diameters available upon request

SYSTEM OPTIONS:
- In-line submersible pump
- Safety joint
- Encapsulated flatpack control line
- Motorised spooling unit
- Pulse generator
- Piezoelectric or quartz pressure transducers
DuraFRAC® HP Straddle

Designed specifically to suit pre-conditioning for rock burst mitigation and for block caving via very high pressure hydraulic fracturing. IPI packers deflate faster and recover to their original diameter better than any packers on the market, enabling them to be run with lower annular clearances.

APPLICATIONS:
- Hydraulic pre-conditioning for block caving
- Rock burst mitigation
- Other Hydraulic fracturing

FEATURES:
- Exceptional packer durability
- Use in any hole orientation (i.e. down-hole, up-hole or horizontally)
- Injection zones as short as 350mm
- Standard diameters for NQ (76mm) and HQ (96mm) size holes.
- Pressure rating up to 12,000 psi (850 bar)
- Option of “XHP” packer elements
- Available in both carbon steel and stainless steel
- Lead-in wiper to minimize rock particle puncture when used up-hole
- Bypass feature to equalise pressure below and above the injection zone
- BQ rod connection and 1/4” tube inflation connection as standard.

AUXILIARY EQUIPMENT:
- Setting tools available to avoid use of external inflation lines
- Deflation dump valve
- Use in conjunction with impression packers to analyze formation fractures
- Downhole pressure sensors and housings
- Single or dual wall push rods
### PRODUCT SPECIFICATIONS:

#### STANDARD SYSTEM CONFIGURATIONS

<table>
<thead>
<tr>
<th>Hole size</th>
<th>Packer diameter</th>
<th>Packer effective length</th>
<th>Frac interval</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>mm</td>
<td>inch</td>
<td>mm</td>
</tr>
<tr>
<td>NQ</td>
<td>70</td>
<td>2.75</td>
<td>400</td>
</tr>
<tr>
<td>NQ</td>
<td>70</td>
<td>2.75</td>
<td>400</td>
</tr>
<tr>
<td>NQ</td>
<td>70</td>
<td>2.75</td>
<td>900</td>
</tr>
<tr>
<td>HQ</td>
<td>89</td>
<td>3.50</td>
<td>900</td>
</tr>
</tbody>
</table>

#### PACKER PRESSURE vs. INFLATED DIAMETER

![Graph showing relationship between inflated diameter and allowable inflatable pressure]
DuraFRAC® Mini

Designed for hydraulic fracturing determination of in-situ rock stresses using IPI DuraFRAC® inflatable packer elements. IPI packers deflate faster and recover to their original diameter better than any packers on the market, enabling them to be run with smaller radial clearances.

APPLICATIONS:
- Rock stress testing
- Other geotechnical applications

FEATURES:
- Exceptional packer durability
- Single or Straddle packer system options
- Use in any hole orientation (i.e. up-hole or horizontally)
- Standard 1m injection (test) zone - can be designed shorter, if shorter intervals are required
- Standard diameters from: 33 mm (1 ⅓") up
- Pressures up to 12,000 psi (850 bar)

OPTIONAL EQUIPMENT
- Deflation dump valve
- Use in conjunction with impression packers to analyze formation fractures.
- Downhole pressure sensors and housings available for larger sizes.
- Dual wall push rods (see over for more details)
- Air vent valve for up-hole use.
- H.P. inflation & test pump
- Data acquisition system
- Flow control board
PRODUCT SPECIFICATIONS:

STANDARD SYSTEM CONFIGURATIONS

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packer diameters</td>
<td>33mm, 43mm, 53mm</td>
</tr>
<tr>
<td>Packer effective lengths</td>
<td>175mm, 500mm</td>
</tr>
<tr>
<td>Test zone length</td>
<td>100mm, 500mm</td>
</tr>
<tr>
<td>Rubber options</td>
<td>Natural (NR)</td>
</tr>
<tr>
<td></td>
<td>Nitrile (NBR)</td>
</tr>
<tr>
<td></td>
<td>Hydrogenated Nitrile (HNBR)</td>
</tr>
</tbody>
</table>

(Other sizes available on request)

PACKER PRESSURE RATING vs. INFLATED DIAMETER

Dual Wall Push Rods

Designed specifically for DuraFRAC® Mini packer system, Push rods are lightweight and enable manual deployment of the packers without the complication of separate injection pipe & inflation tube. Being O-ring sealed to guarantee pressure integrity, they simply screw together by hand as the system is installed in the Borehole.
DuraFRAC® with Dual Wall Frac Pipe

Dual wall frac pipe is designed for use with IPI DuraFRAC® packer system and eliminates the use of control line for packer inflation to the surface. It is also suitable for high flow, high pressure and abrasive/corrosive injection treatments.

APPLICATIONS:
- Open or cased hole hydraulic fracturing
- Hydraulic pre-conditioning for block caving
- Rock burst mitigation
- In-situ stress testing

FEATURES:
- Multi set with exceptional packer durability
- Use in any hole orientation
- Injection zones as short as 350mm
- Pressure rating up to 12,000 psi (850 bar)
- Available in both carbon steel and stainless steel
- Lead-in wiper to minimize rock particle puncture when used up-hole
- Bypass feature to equalise pressure below and above the injection zone (optional).
- No moving parts, no exposed seals, no control line
- Suitable for use with proppant

AUXILIARY EQUIPMENT:
- Deflation dump valve for low static fluid levels
- Priming valves for up-hole use
- Downhole pressure sensors and housings
Impression Packers

The IPI impression packer is an inflatable packer element that can be run in on tubing or drill pipe, that after being inflated into open hole or casing imprints the details of the sidewall with its unique memory retention rubber. Fine details of the sidewall are permanently imprinted on the packer element for examination at surface. Directional tools can be run in conjunction with the Impression Packer to determine the orientation of the imprint.

APPLICATIONS:
- Formation fractures
- Rock characterization
- Casing damage or splits in casing
- Corrosion or erosion pitting

FEATURES:
- Customizable packer diameter and impression lengths
- Redressable packer element
- Directional tools for impression orientation
- Impression rubber is reformable to remove previously imprinted impressions
IPI offers a range of simple, lower pressure inflatable packers that typically find application for grouting works and simple hydrogeological investigations. These packers have long been the standard in the foundations and construction industries for reliable use in lower pressure grouting and similar applications.

**FEATURES:**
- Available as either single or straddle (double) packer assemblies
- Single packers are easily converted to double packers
- Suitable for Tube à Manchette grouting
- Double packer test zone lengths easily adjusted
- Field replaceable packer elements
- Inflated by small diameter control tube run to surface

The length of the rubber sealing element depends on the application requirements with the standard lengths being:
- 300mm for Ø 28, 30 and 42mm packers
- 500mm and 1000mm for Ø 28, 30, 42, 56, 72, 85, 102, 130 & 170mm packers

**STANDARD SIZES AND WORKING PRESSURES:**

<table>
<thead>
<tr>
<th>Nominal diameter, mm</th>
<th>Connection upper</th>
<th>Central tube Inner diameter, mm</th>
<th>Expansion Max. diameter, mm</th>
<th>Inflation Inlet(s)</th>
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</thead>
<tbody>
<tr>
<td>28</td>
<td>1/8&quot; BSP</td>
<td>8</td>
<td>55</td>
<td>1 x 1/8&quot; BSP</td>
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<tr>
<td>30</td>
<td>1/8&quot; BSP</td>
<td>8</td>
<td>55</td>
<td>1 x 1/8&quot; BSP</td>
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<tr>
<td>42</td>
<td>1/4&quot; BSP</td>
<td>17</td>
<td>98</td>
<td>2 x 1/4&quot; BSP</td>
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<tr>
<td>56</td>
<td>1/4&quot; BSP</td>
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<td>125</td>
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<td>72</td>
<td>1 1/4&quot; BSP</td>
<td>35</td>
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<td>2 x 1/4&quot; BSP</td>
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<tr>
<td>85</td>
<td>1 1/4&quot; BSP</td>
<td>35</td>
<td>185</td>
<td>2 x 1/4&quot; BSP</td>
</tr>
<tr>
<td>102</td>
<td>2&quot; BSP</td>
<td>53</td>
<td>200</td>
<td>2 x 3/8&quot; BSP</td>
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<tr>
<td>130</td>
<td>3&quot; BSP</td>
<td>83</td>
<td>270</td>
<td>2 x 3/8&quot; BSP</td>
</tr>
<tr>
<td>170</td>
<td>3&quot; BSP</td>
<td>83</td>
<td>350</td>
<td>2 x 3/8&quot; BSP</td>
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</tbody>
</table>
Mining and Geotechnical Equipment

ASR Flow Control Valve

The IPI ASR (Aquifer Storage & Recovery) Flow Control Valve is an innovative and cost-effective tool for minimizing the introduction of air into injection and recovery wells. The flow control element with tapered, inflated shape in conjunction with PLC control provides a single-point choke that controls high volume flow without causing fluttering, and eliminates the need to create a variable tortuous flow path. This simple approach means that the IPI ASR Valve is lighter and more economical than other similar valves. IPI can tailor the FCV design to suit your operational requirements.

APPLICATIONS:
- Aquifer storage and recovery (requires submersible pump)
- Produced water reinjection

FEATURES:
- Provision for down hole sensors
- Inflatable element expands in a tapered shape to control annular area during injection phase
- Flow rate controlled by packer inflation pressure via a PLC (Programable Logic controller) control system which monitors injection pressure at surface and adjusts the inflation pressure to maintain the injection pressure set points (max/min)
- Packer expands full-length in closed position. Normally closed to prevent cavitation
- Integrated downhole air-over-water inflation reservoir for rapid valve response
- Economical construction
- Scalable to fit a wide range of flow rates

7 inch Casing ASR Valve Performance

Inflation Pressure vs Flow Rate

![Graph showing Inflation Pressure vs Flow Rate for 7 inch Casing ASR Valve Performance](image-url)
The IPI Down-hole Shut-in Valve (DHSIV) is designed to be run in-line above a single or straddle packer assembly and is used to isolate a test section in communication with the running pipe ID for the purpose of hydrological testing of a well. A typical test regime requiring such down-hole pressure isolation is an Injection Fall-Off (IFO) Test.

In brief, the DHSIV comprises a ball valve maintained in position by a spring and actuated to a second position via hydraulic pressure supplied by a pressure control line run to the surface. It is usually setup in the “normally-open” condition and hydraulically actuated to the closed position although it may also be set up as “normally-closed” and actuated to “open”.

**APPLICATIONS:**
- Down-hole pressure shut-in
- Injection Fall-Off (IFO) Testing
- Drill Stem Testing (DST)
- Slug Test (Falling head test)

**FEATURES:**
- Zero-volume displacement shut-in
- 100% sealing ball valve
- Pressure ratings up to 10,000 psi (700 bar)
- Full stainless steel construction
- Available vented to annulus or non-vented
- High strength, long life disk springs
- Standard O.D. & I.D. sizes are:
  - 60 mm (2.362”) O.D. x 10 mm (0.394”) I.D.
  - 70 mm (2.756”) O.D. x 12.7 mm (0.5”) I.D.
  - 89 mm (3.5”) O.D. x 19.05 mm (0.75”) I.D.
  - 114 mm (4.5”) O.D. x 25.4 mm (1.0”) I.D.
IPI O-Rods were specifically developed to provide a 100% leak tight rod string for hydrogeological investigations. Typically mineral mining rods such as the Q-series are used for these applications but such rods, even new, are not guaranteed to offer leak tight connections. By incorporating an O-ring seal in the threaded connection, IPI O-Rods can offer this guarantee. Furthermore, these rods offer a tapered round thread connection for robustness, ease of stabbing, quick and secure make-up for a leak-free, high pressure rated rod string. The couplings have an external upset and are internally flush with the matching pipe ID to facilitate handling and deployment of tools internally.

APPLICATONS:
Leak free, high pressure rods for:
- Hydraulic fracturing
- Other Straddle Packer applications, eg:
  - Testing of low permeability rock

FEATURES:
- High pressure rating (up to 10,000 psi)
- Robust O-ring seal
- Tapered round thread for easy make-up
- Couplings threaded and chemically bonded (Loctite®) to pipe
- Damaged couplings can be replaced
- External upset couplings for ease of running and flush internal diameter
- Standard length is 6m (20ft)
- Custom lengths, diameters and higher pressure ratings available on request
- Each rod is pressure tested at the factory for quality assurance
- Flush ID
- Carbon or Stainless steel available

<table>
<thead>
<tr>
<th>NOMINAL SIZE</th>
<th>ID [mm]</th>
<th>OD [mm]</th>
<th>COUPLING OD [mm]</th>
<th>INTERNAL PRESSURE RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1”</td>
<td>24.1</td>
<td>33.4</td>
<td>44</td>
<td>10,000 psi</td>
</tr>
<tr>
<td>1,5”</td>
<td>38.1</td>
<td>48.3</td>
<td>60</td>
<td>8,000 psi</td>
</tr>
<tr>
<td>2”</td>
<td>49.3</td>
<td>60.3</td>
<td>73</td>
<td>6,000 psi</td>
</tr>
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</table>
IPI inflatable packers are based on an Australian developed technology that has been in use since the early 1980’s. Its wire reinforcing is different to more traditional cable, braided wire or slat reinforcement and offers distinctly superior multi set performance compared to other types of inflatable packer element. IPI has taken the basic design and improved both the strength and temperature characteristics to offer market leading performance in water, mining, oil and gas applications. A significant characteristic of this type of packer is its full diameter recovery on deflation – enabling high pressure multi set capability that is beyond that of more traditional designs in either cased or open hole. For an IPI packer to achieve several hundred inflate/deflate cycles in open hole is quite common – although packer life has many variables affecting it.

APPLICATIONS:
Replacement and OEM elements on service tools, including:
- Well Testing Tools
- Hydraulic Fracturing Equipment

FEATURES:
- Predicted performance from sophisticated computer modelling
- Individually factory pressure tested and supplied with test certificates
- Full diameter recovery on deflation

OPTIONS:

<table>
<thead>
<tr>
<th>Min. packer element Ø</th>
<th>28mm</th>
<th>1.1in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. packer element Ø</td>
<td>≥ 2800mm</td>
<td>≥ 110in</td>
</tr>
<tr>
<td>Max. inflation Ø</td>
<td>200% Standard</td>
<td></td>
</tr>
<tr>
<td>Temperature range</td>
<td>-40 °C (Min.)</td>
<td>150 °C (Max.)</td>
</tr>
<tr>
<td>Effective length range</td>
<td>100mm - 6000mm</td>
<td>4in - 236in</td>
</tr>
<tr>
<td>Max. pressure</td>
<td>15000 psi</td>
<td></td>
</tr>
<tr>
<td>Hydraulic inflation</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Standard elastomer options</td>
<td>Natural (NR)</td>
<td>Nitrile (NBR)</td>
</tr>
</tbody>
</table>

**Alternative materials available on request**
Listed below is IPI's stocked range of oilfield standard replacement packer elements.

Custom packer elements can be built on request.

### Table of Packer Elements

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>J</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outer Diameter</td>
<td>Inner Diameter</td>
<td>Overall Length</td>
<td>Rubber Effective Length</td>
<td>Thread Connection *</td>
<td>Thread Length</td>
<td>Maximum Inflation Diameter</td>
<td>Maximum Pressure at Max Diameter</td>
<td>Optimum Inflation Diameter</td>
<td>Max Pressure at Optimum Inflation</td>
</tr>
<tr>
<td>3.15 in 80 mm</td>
<td>2.00 in 50.8 mm</td>
<td>65.75 in 1670 mm</td>
<td>51.57 in 1310 mm</td>
<td>2.81 x 8 SA 71.4 x 8 SA</td>
<td>1.93 in 49 mm</td>
<td>6.25 in 159 mm</td>
<td>750 psi 3.50 in 89 mm</td>
<td>5000 psi</td>
<td></td>
</tr>
<tr>
<td>4.33 in 110 mm</td>
<td>2.44 in 62 mm</td>
<td>65.75 in 1670 mm</td>
<td>49.61 in 1260 mm</td>
<td>3.87 x 6 SA 98.25 x 6 SA</td>
<td>2.41 in 61.2 mm</td>
<td>8.27 in 210 mm</td>
<td>1000 psi 5.00 in 127 mm</td>
<td>5000 psi</td>
<td></td>
</tr>
<tr>
<td>5.00 in 127 mm</td>
<td>2.00 in 51 mm</td>
<td>65.75 in 1670 mm</td>
<td>50.00 in 1270 mm</td>
<td>2.81 x 8 SA 71.4 x 8 SA</td>
<td>1.97 in 50 mm</td>
<td>8.50 in 216 mm</td>
<td>3000 psi 6.25 in 159 mm</td>
<td>5000 psi</td>
<td></td>
</tr>
<tr>
<td>5.50 in 140 mm</td>
<td>3.19 in 81 mm</td>
<td>66.02 in 1677 mm</td>
<td>47.91 in 1217 mm</td>
<td>4.87 x 6 SA 123.8 x 6 SA</td>
<td>3.03 in 77 mm</td>
<td>10.25 in 260 mm</td>
<td>1350 psi 6.50 in 165 mm</td>
<td>5000 psi</td>
<td></td>
</tr>
<tr>
<td>6.75 in 171 mm</td>
<td>3.39 in 86 mm</td>
<td>66.02 in 1677 mm</td>
<td>47.91 in 1217 mm</td>
<td>4.87 x 6 SA 123.8 x 6 SA</td>
<td>3.03 in 77 mm</td>
<td>12.50 in 317 mm</td>
<td>2200 psi 8.00 in 203 mm</td>
<td>5000 psi</td>
<td></td>
</tr>
<tr>
<td>7.50 in 190 mm</td>
<td>4.45 in 113 mm</td>
<td>66.02 in 1677 mm</td>
<td>47.91 in 1217 mm</td>
<td>6.25 x 6 SA 158.7 x 6 SA</td>
<td>2.78 in 70 mm</td>
<td>13.25 in 337 mm</td>
<td>1800 psi 8.00 in 203 mm</td>
<td>5000 psi</td>
<td></td>
</tr>
<tr>
<td>10.50 in 267 mm</td>
<td>4.06 in 103 mm</td>
<td>66.14 in 1680 mm</td>
<td>37.80 in 960 mm</td>
<td>6.25 x 6 SA 158.7 x 6 SA</td>
<td>3.00 in 76 mm</td>
<td>16.50 in 419 mm</td>
<td>1400 psi 11.50 in 292 mm</td>
<td>5000 psi</td>
<td></td>
</tr>
</tbody>
</table>

* 'SA' - Abbreviated Stub Acme
Custom Made Packers

IPI packer technology is probably the most versatile of inflatable packer technologies and has many potential non-standard formats and applications. IPI’s business started from custom design and manufacture to order and IPI still develops specific products for clients, completely customized or a customization of the growing list of our standard inflatable packer products. This may be as simple as stainless steel versions, higher temp versions (requiring different seals and elastomers) and chemically resistant versions, to IPI rising to the challenge of something totally new. This covers the application of our core packer technology as well as the developing tools the elements are run on. If needed to put together a complete system, IPI will also buy in equipment from third parties – delivery of which often defines the critical path on the delivery schedule. A high level of inventory, SolidWorks CAD software, years of experience and a strong client service ethic result in a high level of client service and satisfaction. We cannot always reveal details of our custom designs, or certain details, owing to confidentiality restraints, but the following are some examples of customized and custom designed products and detail that we can feature.

For an underground mining project in an Andean mountain location in 2015, comprising of both standard products and custom made equipment, including customized water flow diverter systems, plug and abandonment packers and monitoring packers, together with stainless steel versions of SWiPS®.

A high temperature blow out preventer to use with mineral drilling equipment in SE Asia shipped at 3 weeks notice in 2015. The BOP uses inward inflating IPI packer technology.

130mm stainless steel packers for solution mining (In Situ Leaching/ In Situ Recovery) in South Western USA. ISR is expected to be a significant mining technique in the future.
A series of PVC tube mounted pipe packers for a copper mine’s tailing dam.

A shipment of customised 70mm Hydraulic Fracture Straddles with special 400mm long elements for a major South American mine in 2013. Now a standard product.

A 355mm dilatometer sleeve – an example of IPI providing an OEM component solution for a European client who has made the rest of this advanced tool for rock elasticity measurement. Now a regular order from this client, covering various sizes.

Special purpose inflatable packers deployed as part of a subglacial geological drilling operation performed for an Antarctic research project. This is another IPI supplied project funded by the United States Government. IPI has clients on every continent, including those operating in Antarctica’s extreme conditions.