BYPASS SYSTEMS BY DSI

dsi-pbl.com

REDUCING DRILLING COSTS

DSI is the specialised leader in downhole circulation technology. Our core solution is the PBL Bypass System for drilling, completion and workover operations. Together with our new products it helps to save money and reduce drilling costs – over and over.

FULL WELL CONTROL

REDUCING DRILLING COSTS

10 CYCLES AND MORE

HPHT SEALS (420°F/216°C)

PUMPING LCM
(INCL. THIXOTROPIC CEMENT)

SIMPLICITY

RELIABILITY

SPLIT FLOW

PBL: PATENTED TECHNOLOGY

Innovations like the Booster Tool offer new features and solutions that make us stand out technologically and provide superior service.

The Multiple Activation Bypass System is the leading circulating sub in the market. This simple and reliable tool, diverting 100 % of the flow through side ports into the annulus enabling increased circulation rates and TFA (Total Flow Area).

The patented technology helps to maximise efficiency in drilling, completion, workover, through-tubing and decommissioning operations. The PBL tool can be run in many applications to solve occurring drilling problems, including:

— pumping high concentrations of LCM in order to prevent drilling fluid loss to the formation and increased hole cleaning capacity, especially when drilling fluid circulation rates are limited and/or where annular velocities are very low.

PBL: MAIN FEATURES

— The PBL technology is designed for use in extreme onshore and offshore environments, including high temperature and high pressure applications.
— The tool has been successfully run in the harshest environments including CO2 and H2S.
— It is a simple ball-activated tool which does not require DSI personnel on rig site.
— All PBL tools are supplied with HPHT seals (420 °F / 216 ° C).
— As a safety feature, the ports are closed when the pumps are turned off.
— Our experience enables us to offer superior service.
— PBL has a proven historical operating efficiency of 99 % worldwide.

INNOVATIONS & APPLICATIONS

Burst Disc Technology

Since the high pressure/high temperature Burst Disc is incorporated into the lower section of the Multiple Activation Bypass System, BHA and bit pack-off issues can be easily remediated, as it allows an alternate flow path to re-establish circulation and regain well control through activation of the PBL tool.

Booster Tool

The new Booster Tool offers a 3-port configuration for split-flow applications – where drilling fluid is directed through both the BHA and the side-ports to the annulus. Field-interchangeable jetting nozzles are directed up-hole allowing for increased annular fluid velocity while minimising wellbore erosion and maximising hole cleaning. The fluted main body has wear reduction coating applied to the exterior contact areas for increased durability, wellbore interaction and reduced vibration. These features combined contribute to increased tool reliability.

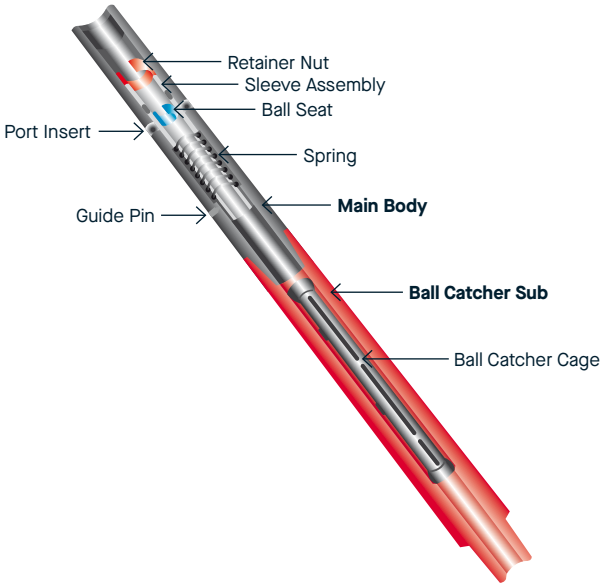
Applications

The Multiple Activation Bypass System has numerous applications to enhance and aid:

- Loss of circulation during all drilling techniques
- Wellbore cleanout
- Increased flow rates beyond critical limits
- Displacement during workover and completions
- Slim hole and thru-tubing drilling
- Stuck pipe scenarios
- Acidising and stimulation
- Horizontal drilling
- Under-balanced drilling
- Open hole jetting (e.g. remove paraffine accumulation when it affects production)
- Special application coring techniques
- Managed Pressure Drilling (MPD)
- Fixed cutter/bi-centre bits or hole enlargement applications (under-reaming)
- Sub sea riser/BOP jetting
- Horizontal and extended reach drilling
- PBL autolock function
- Tripping dry pipe
- Filling drillstrings while running in hole
- Reverse circulation
- Shocking pipe to remove scale and debris

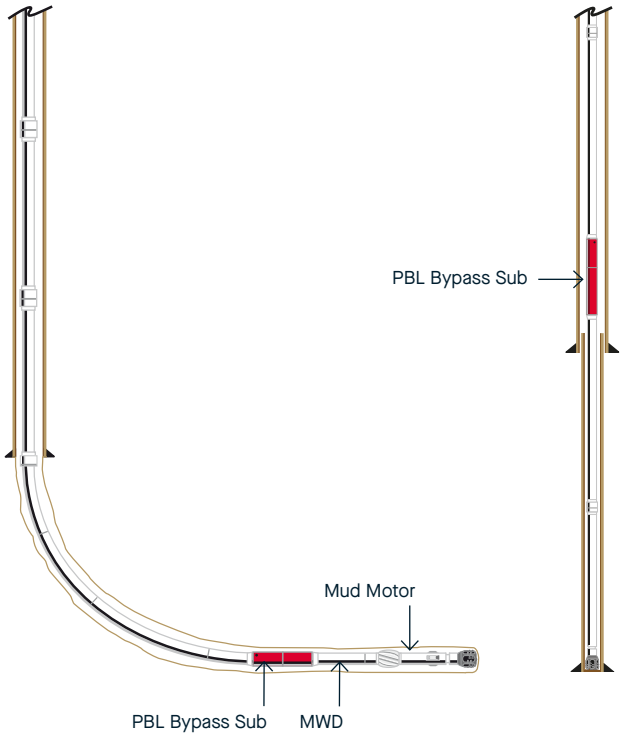
Tool design

The tool is normally placed just above the MWD/LWD/motor or at a point just within the casing shoe. Simple and robust, it consists of a main body, which houses the ball seat, spring, sliding sleeve and inner ports, plus two outer side ports. A ball catcher sub below the main body contains the ball catcher cage.



Drill string placement

For drilling, running the PBL Multiple Activation Bypass System as low in the hole as possible is recommended, i.e. just above non-magnetic components in directional situations and just above the bit sub in conventional vertical drilling. This allows operators to free point and back off as well as survey as low in the hole as possible.



CIRCULATING RATE & PRESSURE LOSS APPLICATIONS

PRODUCTS

PBL Multiple Activation Bypass System

This tool has proven itself for decades and offers the perfect solution for many drilling problems.

With its robust and proven design, the PBL Multiple Activation Bypass System offers a simple, cost-effective technical solution to common drilling problems, such as lost circulation and limited circulating rates. As it helps to reduce the number of trips and limit non-productive time when circulating, the PBL Tool has a positive financial impact to lowering drilling costs.

ACTIVATION AND DEACTIVATION SEQUENCE

- A vinyl ball (or heavy dart) is pumped down to the ball seat.
- Once the ball (or dart) is seated, a slight backpressure is created, which forces the sliding sleeve to move to the open, or activated, position.
- At this point the inner and outer ports are aligned and 100 % of the drilling fluid exits the tool through the ports to the annulus.
- Whenever the pumps are turned off, the pressure from the spring mechanism within the main body forces the sliding sleeve to return to the original closed position. This is critical for maintaining well control and to prevent any U-tube effect.
- To deactivate the tool, drop and pump two steel de-activation balls. On reaching the tool the two deactivation balls create a restriction on the inner ports, which allows the pressure inside the PBL Tool to build up quickly.
- Once the pressure has built up to the pre-determined "shear pressure", the vinyl ball or dart shears through the ball seat followed by the deactivation balls. All of the balls are captured in the ball catcher cage below.
- 100 % of flow is now re-established to the BHA and drill bit.
- The ball catcher cage is designed to hold up to 5 or 10 sets of balls and has a large flow area through and around the cage so that no pressure drop occurs, even if the cage is full.

ACTIVATION OPTIONS

- ○ Standard Ball
- ● Fast Ball
- ⬡ Fast Dart
- ⬡ Split Flow Dart

COMPATIBLE WITH

- Multi Activation Jetting Tools
- Booster Tool

Booster Tool

This innovation is the most powerful option for splitting the flow during drilling, completion and workover operations.

The Booster Bypass Tool, developed to maintain flow through the BHA while achieving higher annular flow rates than our standard split flow tool, features a 3-nozzle configuration to increase the port TFA. Activated by a single vinyl ball, a pre-calculated percentage of drilling fluid passes through the tool to the BHA and drill bit below. At the same time, three field-interchangeable jetting nozzles on the side of the tool are directed up-hole to give increased annular fluid velocity, maximised hole cleaning and minimal well bore erosion. The tool can be cycled to provide split flow up to 10 times.

ACTIVATION AND DEACTIVATION SEQUENCE

- A single vinyl ball is pumped down to the ball seat.
- As the ball seats, pressure builds which forces the sleeve downward and aligns the inner and outer ports.
- A clutch and index mechanism locks the inner and outer ports into position once pressure is built and the vinyl ball shears through the ball seat into the catcher cage below.
- The tool now remains in the open (split flow) position until another vinyl ball is pumped down.
- To deactivate and close the tool, another single vinyl ball is pumped down to rotate the index mechanism, slide the sleeve upward and close the tool.
- Simply apply the shear pressure in order to shear the vinyl ball through the ball seat and 100% of flow is now re-established through the BHA.

ACTIVATION OPTIONS

- ○ Standard Ball
- ● Fast Ball
- ⬡ Fast Dart

COMPATIBLE WITH

- PBL Multiple Activation Bypass System

Multi Activation Jetting Tool

This product was developed for special applications, for example cleaning inside the BOP.

If included as part of the standard BHA, the Multi Activation Jetting Tool can be used to minimise rig time by cleaning inside the BOP, riser, liner hanger and liner tops without the need for an additional trip. The Jetting Tool is a specialised solution for various cleanout operations. The design features an outer spiral sleeve containing up to 30 nozzles, allowing high velocity jetting operations to be carried out without rotating the drillpipe.

ACTIVATION AND DEACTIVATION SEQUENCE

- A vinyl activation ball or heavy dart is pumped down to the ball seat within the tool.
- Once seated, a low backpressure compresses the internal spring mechanism, allowing the sliding sleeve to move to the activated position and align the inner ports with the outer nozzle flow channels.
- At this point 100% of flow is directed out through each of the nozzles.
- Due to the spiral design of the outer sleeve, jetting is possible without rotating the drill string.
- To deactivate/unlock the tool two steel deactivation balls are pumped down. The two deactivation balls create a restriction on the inner ports allowing the pressure to build.
- Once the pre-determined shear pressure is achieved, the vinyl activation ball or dart shears through the ball seat into the ball catcher cage below.
- The internal spring mechanism now expands, forcing the sliding sleeve to return to the original position and closes the tool off. 100% of flow now passes through the BHA below.

ACTIVATION OPTIONS

- ○ Standard Ball
- ● Fast Ball
- ⬡ Fast Dart

COMPATIBLE WITH

- PBL Multiple Activation Bypass System

Sliding Sleeve Big Bore System

The SSBB tool has no ball catcher cage. This allows for an unlimited number of cycles.

The Sliding Sleeve Big Bore (SSBB) System was developed for drilling operations where the retrievability of MWD sources in the BHA below the SSBB tool is required. Used in exactly the same applications as the standard PBL Tool, the SSBB tool features a much larger internal ID without any ball catcher cage. This not only allows retrieval from below the SSBB tool, but also gives an unlimited number of cycles when opening or closing the tool.

ACTIVATION AND DEACTIVATION SEQUENCE

- A dart which contains a fishneck to allow an overshot for retrieving the dart is pumped down to the internal seat.
- Once landed on the seat, the dart seals off any fluid flow to the BHA below and thus creates a low back-pressure.
- The backpressure forces the internal spring mech-anism to compress, allowing the internal sleeve to slide downward, aligning the inner sleeve ports and the outer ports on the main body of the tool.
- At this point 100% of the drilling fluid is diverted out of the tool into the annulus.
- To deactivate the tool an overshot on a wireline is low-ered to the tool and attaches to the activation dart. Once attached, the overshot and dart are retrieved by wireline from the hole.
- By then the internal spring has forced the sliding sleeve back to its original closed position and 100% of drilling fluid now passes through the BHA below.
- Once the activation dart is removed, a fishing tool may be passed through the large ID of the SSBB tool to retrieve any material from below.
- With the help of the SSBB tool, unlimited activation and deactivation cycles can be repeated.

ACTIVATION OPTION

- Wireline Retrievable Dart

COMPATIBLE WITH

- PBL Multiple Activation Bypass System

ACTIVATION OPTIONS

Depending on the requirements we offer different activation mechanisms/ procedures. For most applications, the patented ball activation is the simplest and most reliable solution.

Activation

DRILLING MODE
FLOW TO BIT

VINYL ACTIVATION BALL
SEATED

OPEN POSITION
FLOW THRU PORTS

Standard Ball

A vinyl ball which is used in most applications Temperature: up to 260°C (500°F) and depends on the PBL tool size, for further information please contact a DSI representative.
Density: 1.34sg or 11.2 ppg

ALLOWS ACTIVATION OF THE FOLLOWING PRODUCTS:

— PBL Multiple Activation Bypass System
— Booster Tool
— Multiple Activation Jetting Tool

Fast Ball

A much denser activation ball – in comparison to the standard ball – and used in applications where high mud weights and high temperatures occur.
Temperature: up to 260°C or 500°F
Density: 2.50sg or 20.9 ppg

ALLOWS ACTIVATION OF THE FOLLOWING PRODUCTS:

— PBL Multiple Activation Bypass System
— Booster Tool
— Multiple Activation Jetting Tool

Fast Dart

A heavy dart which can be used in the highest mud weights or where mud cannot be circulated – i.e. packed-off situation. Allows activation by gravity drop. Much faster than a standard ball, which reduces activation time significantly. Descent by gravity only: can be used in wells with a maximum inclination up to 55°. Descent by being pumped down: can be used in wells with a maximum inclination up to 90°.

ALLOWS ACTIVATION OF THE FOLLOWING PRODUCTS:

— PBL Multiple Activation Bypass System
— Multiple Activation Jetting Tool
— Booster Tool

Split Flow Dart

Allows drilling fluid to be split partially through the BHA and partially to the annulus. The percentage split to BHA and annulus is variable and can be calculated based on the hole cleaning or cooling MWD tools and motor requirements. Three steel balls are used to deactivate the tool.

ALLOWS ACTIVATION OF THE FOLLOWING PRODUCT:

— PBL Multiple Activation Bypass System

Wireline Retrievable Dart

This activation option does not require a ball catcher cage and can be activated and deactivated an unlimited number of times. Allows retrievability of nuclear sources or probes from the BHA below the tool.

ALLOWS ACTIVATION OF THE FOLLOWING PRODUCT:

— Sliding Sleeve Big Bore System

TECHNICAL SPECIFICATIONS

BOOSTER TOOL

Tool Size Inches	**5**	**6 ¾**
Maximum O.D. (")	5.875	8.375
Minimum I.D. (")	1.400	1.800
Standard rig ends	NC 38	NC 50
Fishing neck I.D. (")	5.000	6.750
No. of stabilization pads	4	3
Number of nozzles	4	3
Nozzle size range (")	$^{7}/_{32}$–$^{16}/_{32}$	$^{7}/_{32}$–$^{16}/_{32}$
Activation/De-Activation ball size	1.5	2"
Number of cycles	10	10
Flow area through tool (in^2)	1.67	2.92
TFA through nozzles when tool is activated (min / max in^2)	0.148/0.784	0.111/0.589
Weight (lbs)	460	1198
Shoulder to shoulder length (")	120	150.0
Make-Up Torque (ft-lbs)	11,500	34,840

MULTI ACTIVATION JETTING TOOL

Tool OD	Connection	Sleeve OD	Number of Ports[3]	PBL Cycles	Drift ID[4]
6 ¾"	4 ½ IF	11" 16"	12 18	5	1.27" (1.80")
8 ¼"	6 ⅝ REG	16.25"[1,2]	30	5	1.50" (2.27")
9 ½"	7 ⅝ REG	16.25"[1,2]	30	5	1.50" (2.27")

[1] Sleeve blades coated with "casing friendly" material
[2] Alternate diameters may be available
[3] All port nozzles are field changeable
[4] Minimum tool ID could vary if Activation Ball or Dart is used

SLIDING SLEEVE BIG BORE SYSTEM

Tool OD	ID Drift (in)[1]	Port TFA (in^2)[2]	Connections[3]	Number of Cycles
9 ½	2.63	3.53	7 ⅝ REG	Unlimited
8 ¼	2.63	3.53	6 ⅝ REG	Unlimited
8	2.63	3.53	6 ⅝ REG	Unlimited
6 ¾	2.24	2.45	4 ½ IF	Unlimited
6 ½	2.24	2.45	4 ½ IF	Unlimited

[1] Alternative Drift ID's available to accommodate drill pipe restrictions
[2] Fullbore Port TFA listed
[3] Alternative connection may be available

Tool Sizes Inches	**1 11/16**	**2 1/8**	**2 7/8**	**2 7/8**	**3 1/8** [10]	**3 1/2**	**4 3/4** [7]	**5 1/4**	**6 1/4**	**6 1/2**	**6 3/4** [8]	**7**	**8**	**8 1/4** [9]	**9 1/2**	**9 1/2 HF**	**12**
Number of Ports	3	3	2	3	2	2	2	2	2	2	2	2	2	2	2	2	2
Minimum Tool ID when no balls are in tool [1]	0.31	0.34	0.562	0.562	0.562	1.00	1.27–1.40	1.27–1.40	1.27–1.80	1.27–1.80	1.27–1.80	1.27–1.80	1.50–2.27	1.50–2.27	1.50–2.27	1.50–2.65	1.50–2.27
Drift ID when balls are in tool	NO DRIFT							NO DRIFT					NO DRIFT				
Maximum O.D.	1.69	2.13	2.88	2.88	3.125	3.5	4.75	5.25	6.25	6.5	6.75	7.0	8.0	8.25	9.5	9.5	12
PBL tool end connections (Box x Pin) [2]	1.00 AMMT	1 ½ AMMT	2 3/8 PAC	2 3/8 PAC	2 7/8 HT PAC	2 3/8 IF	3 ½ IF	XT 39	4 ½ XH	4 ½ IF/ 4 ½ XH	4 ½ IF	XT57/ XTM57	6 5/8 REG	6 5/8 REG	7 5/8 REG	7 5/8 REG	8 5/8 REG
PBL tool mid connection [3]	1 ¼ AMMT	1.750-8 STUB ACME-2G	2 3/8 PAC	2 3/8 PAC	2 3/8 SLH90	3 ½ VAM FJL	3 ½ IF	XT 43	4 ½ XH	4 ½ IF	4 ½ IF	XT 57	6 5/8 REG	6 5/8 REG	7 5/8 REG	7 5/8 REG	8 5/8 REG
Activation Ball Size (")	13/32	5/8	7/8 or 1	7/8 or 1	1	1 ¼	1 ½	1 ½	2	2	2	2	2 ½	2 ½	2 ½	2 ¾	2 ½
Locking Ball Size (")	5/16	3/8	0.700	0.700	0.700	0.700	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8
Steel De-Activation Ball Size (")	3/8	7/16	13/16 or 7/8	13/16	7/8	1 1/16	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4
No. of Balls Needed to Activate Tool	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
No. of Balls Needed to De-Activate Tool	3	3	2	3	2	2	2	2	2	2	2	2	2	2	2	2	2
Number of Cycles [4]	6	7	4	7	5	3	5	4	5	5	5	5	5	5	5	5	5
Number of Cycles remaining w / Fast Dart in Tool	NA	NA	2	5	3	2	3	2	3	3	3	3	3	3	3	3	4
Flow Area Through Tool (sq/in)	0.13	0.28	0.78	0.78	0.78	1.07	1.67	1.67	2.92	2.92	2.92	2.92	4.6	4.6	4.6	5.85	4.6
Port Diameter (in) [5]	0.31	0.36	0.68	0.68	0.68	0.68	1.10	1.10	1.10	1.10	1.10	1.10	1.35	1.35	1.35	1.35	1.35
TFA when Tool is Open (sq/in)	0.22	0.31	0.72	1.08	0.72	0.72	1.901	1.901	1.901	1.901	1.901	1.901	2.863	2.863	2.863	2.863	2.863
Weight (lbs)	20	27	125	125	132	132	380	380	800	880	880	900	1,000	1,525	1,800	1,800	2,750
Length (ft) [6]	3	3	6	6	6	6	10	9	10	10	10	10	10	10	10	10	10
Tensile Strength Main Body (lbs)	100,000	120,000	415,000	415,000	490,000	490,000	1,000,000	667,600	1,900,000	2,500,000	3,100,100	1,208,700	3,500,000	3,700,000	6,000,000	6,000,000	10,450,000
Torsional Strength Main Body (ft-lbs)	3,425	5,025	12,000	12,000	16,500	19,000	49,500	37,300	130,000	166,000	190,000	94,800	295,000	335,000	565,00	565,000	1,550,000
Make-Up Torque Rig Ends (ft-lbs)	400	960	2,200	2,200	3,000	3,700	11,500	22,400	26,710	34,190	34,840	56,900	41,800	46,450	81,290	81,290	135,500
Make-Up Torque mid connection (ft-lbs) [3]	625	880	2,200	2,200	5,600	2,400	11,500	19,200	26,710	34,190	34,840	56,900	41,800	46,450	81,290	81,290	135,500

[1] Standard ID listed, larger ID's are available to accommodate coring balls, reamer balls and wireline accessories. Minimum tool ID could vary if Activation Ball or Dart is used

[2] Alternative PBL tool end connections may be available on request

[3] Between main body and ball catcher sub

[4] Extended length cages may be available on request

[5] Larger port diameter available on request

[6] The length could vary slightly according to any connection rework

[7] 4 ¾ tool with smaller activation ball size (1 ¼") available on request

[8] 6 ¾ tool with smaller activation ball size (1 7/16") available on request

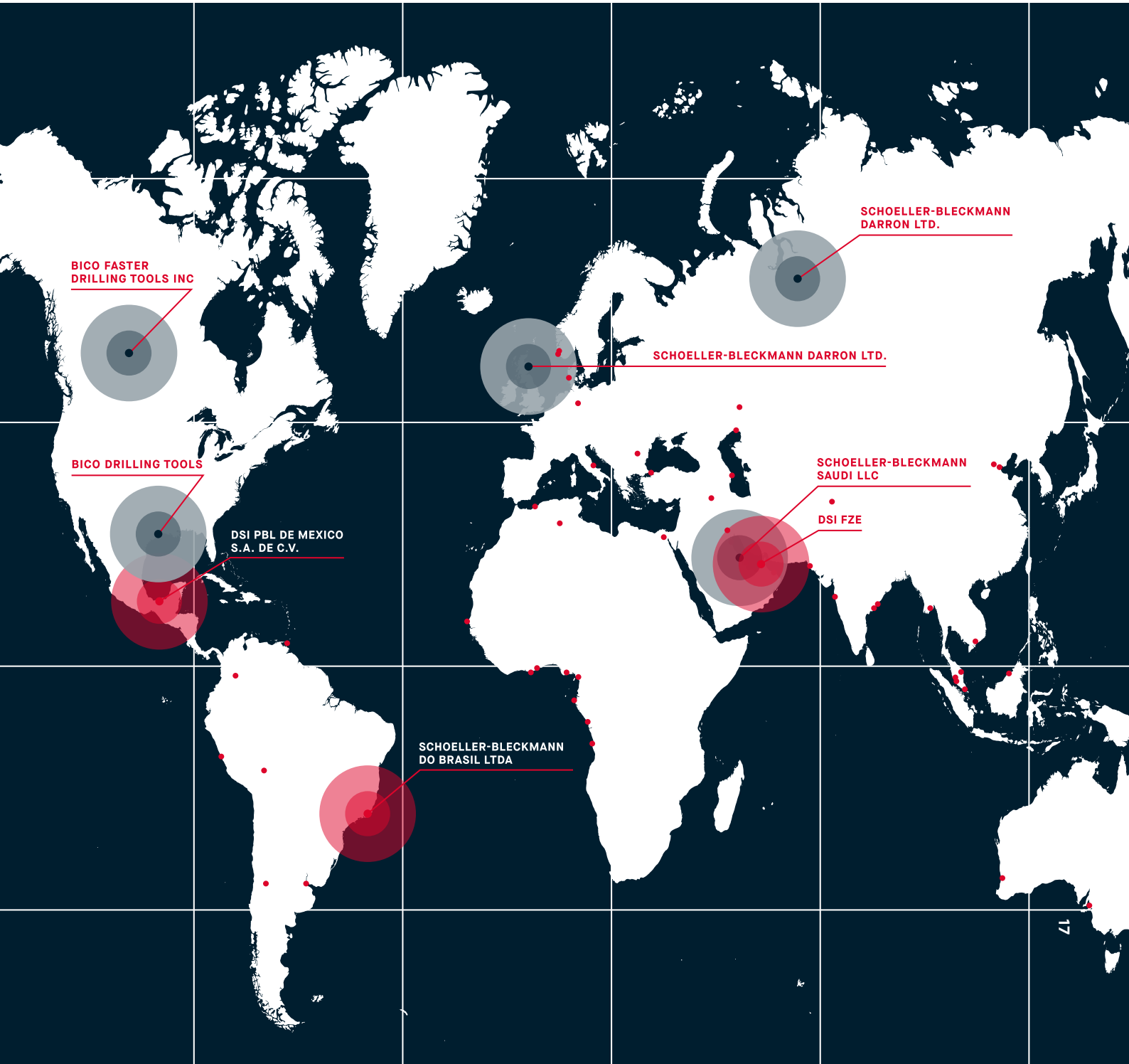
[9] 8 ¼ HF tool with larger ID (2.65") available on request

[10] 3 ⅛" HF [3] port tool available on request

WORLDWIDE SERVICE

DSI is able to cater to service customers' needs worldwide. We are available to meet at any time in order to discuss your applications and drilling problems, providing you with custom solutions. DSI has offices in Europe, Africa, the Middle East, Asia and the Americas. In addition, we can access the global network of Schoeller-Bleckmann Oilfield Equipment AG.

- **DSI FZE**
- **SCHOELLER-BLECKMANN OILFIELD EQUIPMENT AG**
- **DSI BUSINESS PARTNERS**



THE COMPANY

DSI is the specialised leader in downhole bypass tool technology.

We have a very clear focus – the PBL Bypass System is our core solution. It is not just one product among many in the portfolio.

Our product specialisation combined with our experience, gained over 20 years of supplying the PBL Multiple Activation Bypass System, provides DSI with unprecedented technical knowledge and expertise. For our customers, this means increased security and reliability when it comes to applying our products and service.

The patented PBL technology is simple yet ingenious. As the original fluid bypass solution, it offers significant technical and safety advantages, especially in terms of functionality, flexibility and reliability.

DSI is a wholly-owned subsidiary of Schoeller-Bleckmann.

Schoeller-Bleckman Oilfield Equipment AG is one of the leading suppliers of downhole tools and equipment. The umbrella of SBO provides a strong strategic and financial basis.

DSI FZE
10 ROUND ABOUT ROAD 911
JEBEL ALI FREE ZONE
P.O. BOX 30576 DUBAI
UNITED ARAB EMIRATES

TEL.: +9714 8808228
FAX: +9714 8808218
E-MAIL: ENQUIRIES@DSI-PBL.COM
DSI-PBL.COM

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