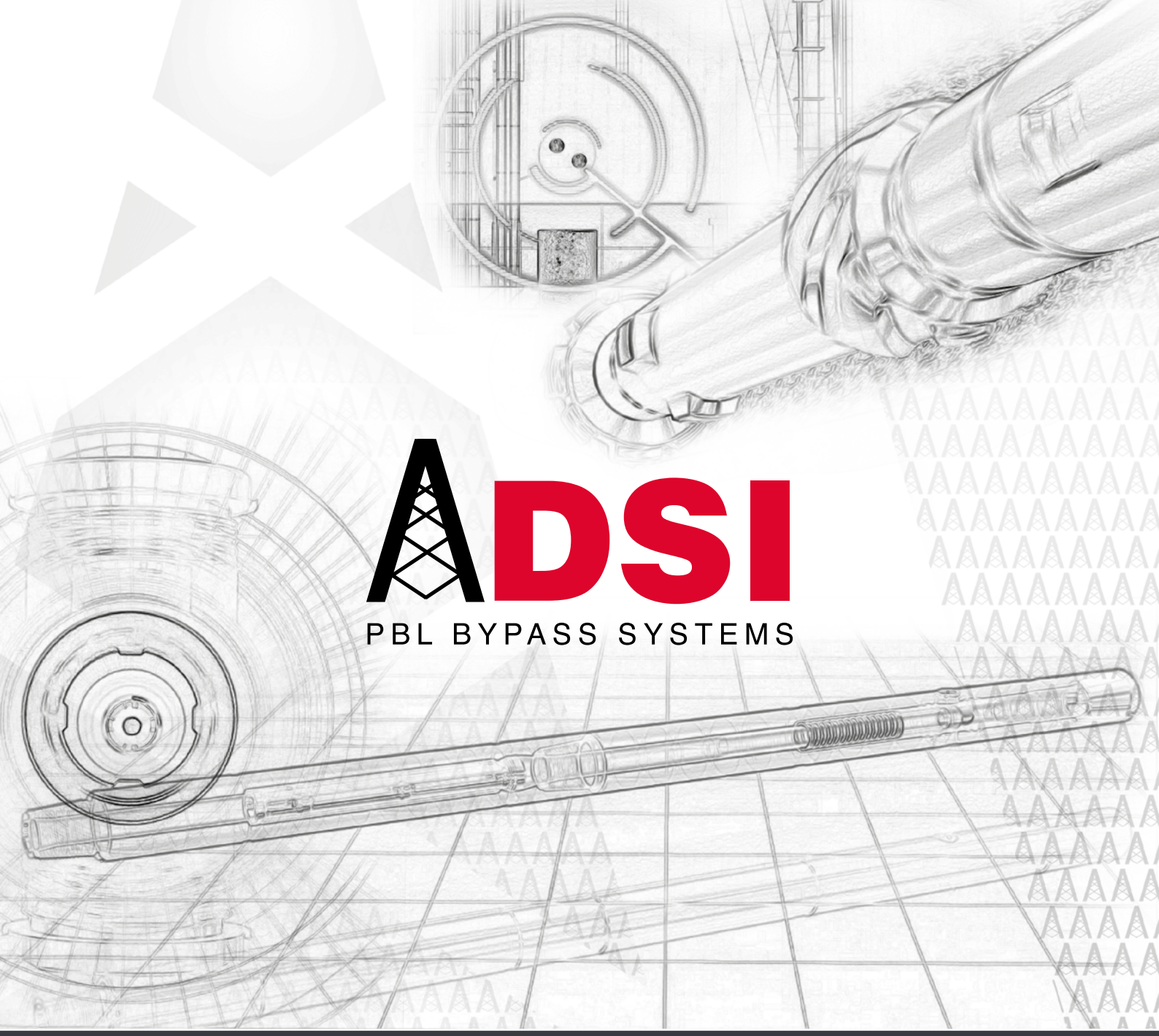

# ADSI

PBL BYPASS SYSTEMS

## Leader in downhole circulation technology

PBL Multiple Activation Bypass Systems for drilling, completion, workover and thru-tubing operations.

PBL®

www.dsi-pbl.com

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EFFECTIVE HOLE CLEANING
FULL WELL CONTROL
REDUCING DRILLING COSTS
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# 1. INTRODUCTION

DSI FZE is pleased to offer the PBL Multiple Activation Bypass System for drilling, completion and work-over operations. The PBL Bypass System is a simple reliable tool which diverts 100% of the flow through side ports into the annulus enabling increased circulation rates and TFA (Total Flow Area).

*„Pumping LCM pills and increase circulation rates for effective hole cleaning.“*

Primarily the PBL Multiple Activation Bypass System was developed to enable the pumping of aggressive LCM pills and increase circulating rates during drilling operations. Alternatively the PBL Bypass System has found a niche in completion and workover applications, proving most effective when it is imperative to have a clean well bore.

It is a simple ball activated tool which does not necessitate DSI personnel on-site.

*„Reliable tool which does not require DSI personal on rig site.“*

**The PBL Multiple Activation Bypass System has numerous applications to enhance & aid:**

- Lost circulation during all drilling techniques
- Well bore cleanout
- Displacement during work-over and completions
- Slim hole and Thru Tubing Drilling
- Stuck pipe scenarios
- Acidising & stimulation
- Under balanced drilling
- Open hole jetting (e.g. remove paraffine accumulation when it effects 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
  - Reverse circulation
  - Filling Drill strings while running in hole
  - Shocking Pipe to remove scale and debris

**The PBL Bypass Tool can be cycled a number of times**

The unique PBL Multiple Activation Bypass System has the flexibility to assist you in substantially reducing drilling costs associated with lost circulation and limited flow rate problems. The tool has effectively supported operators throughout numerous campaigns worldwide.

This is a general overview of the services provided by DSI FZE and we hope the information furnished is helpful. If you require further information or assistance please do not hesitate to contact us, or our appointed authorised distributors allocated to various regions worldwide.

# 2. PBL APPLICATIONS

### Lost circulation

The PBL Multi-Activation Bypass System is an effective tool to combat lost circulation problems. With the tool run as low in the BHA as possible it can be opened (activated) by simply dropping and pumping down a vinyl activation ball. When the tool opens operators are not limited in the size or concentration of LCM they can pump. The limitations rest with the surface equipment. Once circulation is regained the tool can now be closed. Simply drop and pump down two steel closing balls to close the tool and drill ahead. If the problem should be encountered again the PBL tool can be activated and deactivated again up to 5 times (standard setup). Extended ball catcher cages to accommodate up to 10 cycles and more are available on request.

*„High concentration of LCM could be pumped through the PBL tool (incl. thixotropic cement).“*

Based on the robust design and the large port sizes the PBL sub offers a significant increase of the TFA and allows various concentrations of LCM (incl. thixotropic cement) to be pumped thru. The PBL tool combines the ability to pump high concentrations of LCM while maintaining full well control integrity. The special safety feature of the tool is, that whenever pumps are turned off, the sleeve shifts to the closed position and isolates the ports, which eliminates the u-tube effect and assures full well integrity.
In addition to lost circulation control the PBL Multi-Activation Bypass System can deal with numerous other down-hole applications including horizontal drilling hole cleaning, workovers and completions. The tool offers other apparent cost/time saving advantages and enhancements.

*„Full well control at any time.“*

### Increasing flow rates beyond critical limits

All directional drilling tools have critical limits that operators must not exceed. The limits set on directional tools by manufacturers often restrict operators from achieving preferred circulating rates for effective hole cleaning. The PBL Multi-Activation Bypass system is useful in increasing circulation rates above the rates allowed through directional tools (for maximum circulation rates through the PBL please see page 21).

### Workovers & Completions

PBL circulation subs have proven to be effective in increasing circulating rates and pressure loss application when in wells with liners on bottom. The PBL Tool is utilized to bypass small work strings inside liners and avoid premature pressure setting. With the tool positioned directly above the slim hole string in the liner it can be run in an open position, with the autolock feature, to bypass the friction loss associated with the slim hole work string.

When increased flow rates are required, activating the PBL Circulation sub can increase as much as five times that of the rate achieved with circulating through the slim hole string.

The bypass system also allows operators to rotate and reciprocate during the displacement operation greatly helping to reduce casing erosion and/or washing. When activated, the PBL isolates the work string and running tools during displacement operations.

## Stuck Pipe

The PBL sub is an effective tool to assist in stuck pipe situations in conjunction with other BHA tools and techniques. When getting indications that the well is starting to lose circulation due to pack off or bridging, the PBL sub can be rapidly activated either by standard activation ball or by using the Hollow Dart or Fast Ball. It can then be used to assist in spotting fluids, hole conditioning and changing the hydrostatic pressure in the well. Once circulation is re-established, the drill string can be worked with different techniques depending on the sticking mechanism.

- Differential Sticking
  - Auto-lock permits reverse circulation to lower the hydrostatic pressure in the well
  - As pressure reduces the sticking formation rebalances and releases the pipe
  - Once the string is freed, the PBL can be de-activated and normal circulation resumed
- Mechanical Sticking
  - No circulation possible (pack off below the PBL tool)
  - Deploy Hollow Dart or Fast Ball by gravity
  - Re-establish circulation
  - Venturi effect pulls the cuttings from the pack off

Having a PBL in the BHA is also critical once string becomes free in order to increase flow rate and circulate clean the wellbore at maximum allowable flow rates. Flow rate must be more than cutting slip velocity in order to transport cuttings effectively. Using the PBL sub will allow to pump sweeps more effectively to assist in hole cleaning. Reciprocating and rotating while circulating through the PBL will improve hole cleaning ability.

## Horizontal acidising & stimulation

In multilateral horizontal wells it is necessary to find the lateral leg which requires stimulation. For this reason it is necessary to run expensive MWD tools. With the PBL tool run directly above the MWD tool, stimulation can be achieved with no adverse effects on the MWD tool and motors thus reducing unnecessary high repaircosts. All acid can be pumped through the PBL tool and the PBL tool can be opened and closed so that the operator can regain signals from the MWD tool.

## Horizontal drilling

With increased activity and demand for horizontal drilling it became apparent that there were yet more applications for the tool in this specialised area. In addition to improving hole cleaning, one of the more interesting applications is using the tool to break circulation while running in the hole with down-hole motors. This application allows operators to break circulation through the PBL Bypass System when running in the hole. This is an advantage when running motors with bent housings and PDC bits. This application eliminates motor and bit rotation preventing bit wear and tear as well as casing wear. With the BHA on bottom the Bypass System can be closed to commence with drilling. This is very effective for Thru Tubing Rotary Drilling (TTRD) operations.

# 2. PBL APPLICATIONS

### Managed Pressure Drilling

- Fractured carbonates and limestone formations often encounter significant or total fluid losses to the formation associated with hydrocarbon influx into the wellbore.
- Drilling to TD or casing point in such a situation may be very difficult, time consuming and maybe not possible.
- The ability to drill these wells using Pressurized Mud Cap Drilling (PMCD) Managed Pressure Drilling techniques with a PBL Sub in the BHA has been proven to be highly successful.
- Curing the losses with LCM, gunk squeezes or cement with a PBL can be successful
- PBL placement in the drill string is critical avoid any issues and conflicts with the float subs and or drop in dart subs when used.

### Fixed cutter/bi-centre bits or Ream While Drilling Tool (RWD) Applications

When these above mentioned tools are run in conjunction with down hole motors some operational problems can be eliminated with the use of the PBL Multi-Activation Bypass System. Pumping through drilling motors with the above mentioned tools is not recommend while inside casing or tubing. In most cases it is not recommended to turn these bits inside the casing/tubing with the drilling motors as this can damage the bit, the casing or the tubing. The PBL Multiple Activation Bypass System can solve this problem as follows:
With one of the above mentioned assemblies, put the vinyl activation ball, preferably with a dart combination into the PBL Multiple Activation Bypass System. With the ball in place in the tool circulation can be achieved when desired with the flow going out of the PBL Bypass System and not through the motor or MWD. When the drill string enters the open hole the PBL Multiple Activation Bypass System can be deactivated to allow for circulation through the MWD and motor.

### Sub Sea Riser/BOP Jetting

The PBL Multiple Activation Bypass System can be utilised to jet BOP‘s and risers during drilling and completion operations. The jetting application can be performed by opening and closing the PBL Bypass System without the need for tripping jetting tools in and out of the hole.

Jetting your subsea BOP’s will clean shale and debris out of the cavities in the subsea BOP stack greatly enhancing safety. Jetting the riser will effectively clean the riser during drilling and completion operations.

Utilising the PBL Multiple Activation Bypass System for jetting subsea BOP‘s and risers will greatly reduce rig time. By having the tool as a component of the BHA, this jetting operation can be performed during each trip as and when required.

## Thru Tubing

DSI FZE introduced the Thru Tubing Line of PBL Multiple Activation Circulating Tools designed to work on coil tubing and pipe for completion, workover, and production operations.

Drilling operations Benefits

- Hole Cleaning
- Elimination of debris previously left in the well
- Reducing circulating times up to 300 %
- Reducing coil tubing running charges
- Reducing short trips
- Reducing chemical cost
- Reducing Days

Complete Isolation of the BHA Eliminating cost associated with damages to the BHA while displacing

- Acid
- Foam
- Nitrogen
- Fluid displacements
- Performing Acidizing and stimulation treatments

Multiple activation feature of the Thru Tubing PBL permits increased total and annular flow rates for hole cleaning at desired intervals to assist with:

- No sticking or hole problems due to reduction of cuttings in wellbore
- Fewer and Less Lengthy Coil Short Trips required thus reducing the overall Coil Footage Costs
- Incremental savings by the reduction and elimination of high cost Chemical additives
- Permits the blowing coil dry with nitrogen through PBL while POOH eliminating dedicated trip.
- Capability of pumping acid, nitrogen or foam through PBL to clean out fractures and stimulate the well
- The PBL used to isolate the motor and remaining BHA from damages often associated with pumping acid.
- Mulitple activation feature of the PBL permitted both the spotting of acid without damage to the BHA, subsequent chemical slurry was able to be pumped in order to neutralize potential damage to the string of coil tubing.

# 3. OPERATIONAL INFORMATION

## a. PBL Tool Specification

| TOOL SIZE (INCHES) | 1 11/16 | 2 1/8 | 2 7/8 | 2 7/8 | 3 1/8 | 3 1/2 | 4 3/4 [7] | 5 1/4 | 6 1/4 | 6 1/2 | 6 3/4 [8] | 7 1/4 | 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 |
| Drift ID (when no balls are in tool):[1] | 0.31 | 0.34 | 0.562 | 0.562 | 0.562 | 0.94 | 1.27 up to 1.40 | 1.27 up to 1.40 | 1.27 up to 1.80 | 1.27 up to 1.80 | 1.27 up to 1.80 | 1.27 up to 1.80 | 1.50 up to 2.27 | 1.50 up to 2.27 | 1.50 up to 2.27 | 1.50 up to 2.65 | 1.50 up to 2.27 |
| Drift ID (when balls are in tool): | 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 | 6.75 | 8.0 | 8.25 | 9.5 | 9.5 | 12 |
| PBL tool end connections (Box x Pin): [2] | 1.00 AMMT | 1 1/2 AMMT | 2 3/8 PAC | 2 3/8 PAC | 2 3/8 REG | 2 3/8 IF | 3 1/2 IF | XT 39 | 4 1/2 XH | 4 1/2 IF/ 4 1/2 XH | 4 1/2 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 1/4 AMMT | 1.750-8 STUB ACME-2G | 2 3/8 PAC | 2 3/8 PAC | 2 3/8 SLH90 | 2 1/2 VAM FJL | 3 1/2 IF | XT 43 | 4 1/2 XH | 4 1/2 IF | 4 1/2 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 1/4 | 1 1/2 | 1 1/2 | 2 | 2 | 2 | 2 | 2 1/2 | 2 1/2 | 2 1/2 | 2 3/4 | 2 1/2 |
| 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 | 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 Nee-ded 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 w / Fast Dart in Tool: | NA | NA | 2 | 5 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 |
| Flow Area (sq/in) Through Tool: | 0.13 | 0.28 | 0.78 | 0.78 | 0.78 | 1.13 | 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 (sq/in) when Tool is Open | 0.22 | 0.31 | 0.72 | 1.02 | 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 | 125 | 125 | 300 | 350 | 800 | 800 | 800 | 800 | 1,000 | 1,000 | 1,600 | 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 | 565,000 | 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] | 400 | 880 | 2,200 | 2,200 | 5,600 | 2,750 | 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
[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 3/4 tool with smaller activation ball size (1 1/4") and with larger activation ball size (1 5/8") available on request
[8] 6 3/4 tool with smaller activation ball size (1 7/16") available on request
[9] 8 1/4 HF tool with larger ID (2.65") available on request

## b. The Tool & Accessoires

Each PBL sub will be sent to the rig site with a complete operational ball kit.

### Content of the operational ball kit:

- Vinyl activation balls (equivalent density of 11.2 PPG drilling fluid)
- Steel deactivation balls
- Fast Dart combination (for further information please see page 19)
- Smaller vinyl locking balls (for further information please see page 24)
- Operational instructions
- Service cycle guideline (for further information please see page 23)
- Inspection report and material certificate
- Service support contact details (for further information please see page 35)

### After receiving the PBL tool on rig site, the tool should be checked for the following:

- PBL Serial Numbers located on ID band below Ports on the Main Body.
- Confirm rig end connections are as required.
- Confirm Drop Ball Kit matches tool size and number.
- Shearing pressures for Ball Seat (Deactivation Pressure) and Ports (Unlocking Pressure) are marked on tool and on Tech Sheet included in tool packet.
- Confirm PBL Activation Ball will drift through entire drill string above PBL Tool.
- Confirm PBL No-Go will allow passage of any required third party Activation Balls.
- Drift the drop ball thru PBL prior to connecting BHA.
- Remove tape covering PBL Ports prior to RIH.

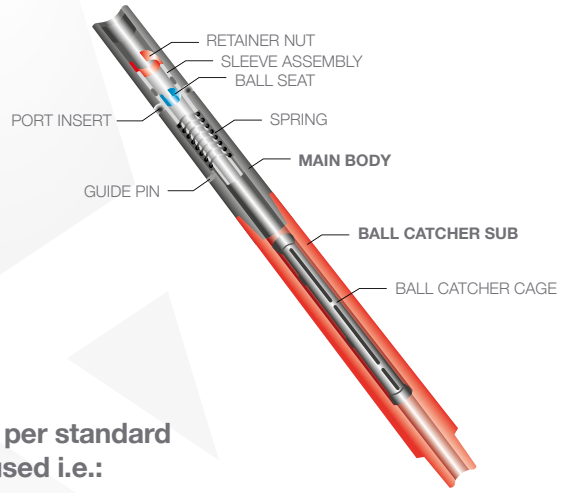
| Common PBL tool sizes [1] | 2 7/8 [2] | 3 1/2 | 4 3/4 | 6 3/4 | 8 1/4 | 9 1/2 |
|---|---|---|---|---|---|---|
| Number of cycles (standard) [3] | 4 | 3 | 5 | 5 | 5 | 5 |
| Vinyl activation balls (amount of balls and size) | 4 x 1” | 3 x 1 1/4” | 5 x 1 1/2” | 5 x 2” | 5 x 2 1/2” | 5 x 2 1/2” |
| Steel deactivation balls (amount of balls and size) | 8 x 7/8” | 6 x 1 1/16” | 10 x 1 3/8” | 10 x 1 3/8” | 10 x 1 3/4” | 10 x 1 3/4” |
| Smaller vinyl locking balls (amount of balls and size) | 2 x 0.70” | 2 x 0.70” | 2 x 1 1/8” | 2 x 1 1/8” | 2 x 1 3/8” | 2 x 1 3/8” |
| Fast Dart (amount of darts and size) | 1 x 1” | 1 x 1 1/4 “ | 1 x 1 1/2” | 1 x 2” | 1 x 2 1/2” | 1 x 2 1/2” |

[1] addional tool sizes are available on request
[2] two ports
[3] tools with more cycles are available on request

# 3. OPERATIONAL INFORMATION

## c. Make up Procedure

The PBL circulating sub with port nozzles on the side is made up on top of the Ball Catcher Sub (for further details please check PBL operation instructions).




### Make up Torque is as per standard connections on tool used i.e.:

| TOOL SIZE (INCHES) | PBL TOOL END CONNECTIONS* |
|---|---|
| 1 11/16 OD | 1.00 AMMT |
| 2 1/8 OD | 1 1/2 AMMT |
| 2 7/8 OD | 2 3/8 PAC |
| 3 1/8 OD | 2 3/8 REG |
| 3 1/2 OD | 2 3/8 IF |
| 4 3/4 OD | 3 1/2 IF |
| 5 1/4 OD | XT 39 |
| 6 1/4 OD | 4 1/2 XH |
| 6 1/2 OD | 4 1/2 IF/XH |
| 6 3/4 OD | 4 1/2 IF |
| 7 1/4 OD | XT 57 |
| 8 OD | 6 5/8 REG |
| 8 1/4 OD | 6 5/8 REG |
| 9 1/2 OD | 7 5/8 REG |
| 12 OD | 8 5/8 REG |

*Special thread connections are available on request.

### Make-up torque (FT-LBS)

| TOOL SIZE (INCHES) | 1 11/16 | 2 1/8 | 2 7/8 | 2 7/8 | 3 1/8 | 3 1/2 | 4 3/4 | 5 1/4 | 6 1/4 | 6 1/2 | 6 3/4 | 7 1/4 | 8 | 8 1/4 | 9 1/2 | 9 1/2 HF | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PBL tool end connections | 1.00 AMMT | 1 1/2 AMMT | 2 3/8 PAC | 2 3/8 PAC | 2 3/8 REG | 2 3/8 IF | 3 1/2 IF | XT 39 | 4 1/2 XH | 4 1/2 IF/ XH | 4 1/2 IF | XT57/ XTM57 | 6 5/8 REG | 6 5/8 REG | 7 5/8 REG | 7 5/8 REG | 8 5/8 REG |
| Make-Up Torque end connections (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 |
| PBL tool mid connection: [1] | 1 1/4 AMMT | 1.750-8 STUB ACME-2G | 2 3/8 PAC | 2 3/8 PAC | 2 3/8 SLH90 | 2 1/2 VAM FJL | 3 1/2 IF | XT 43 | 4 1/2 XH | 4 1/2 IF | 4 1/2 IF | XT 57 | 6 5/8 REG | 6 5/8 REG | 7 5/8 REG | 7 5/8 REG | 8 5/8 REG |
| Make-Up Torque mid connection (ft-lbs): [1] | 400 | 880 | 2,200 | 2,200 | 5,600 | 2,750 | 11,500 | 19,200 | 26,710 | 34,190 | 34,840 | 56,900 | 41,800 | 46,450 | 81,290 | 81,290 | 135,500 |

[1] Between main body and ball catcher sub

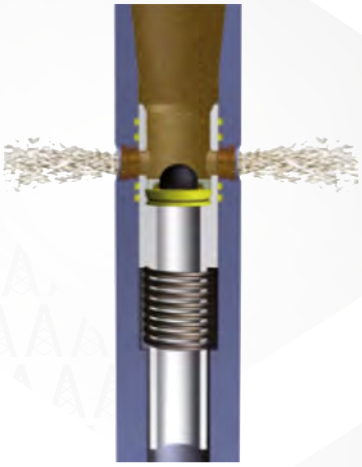
## d. Activation Procedure

| TOOL SIZES (INCHES) | ACTIVATION BALL SIZES (VINYL BALL) (“) |
|---|---|
| 1 11/16 PBL | 13/32 |
| 2 1/8 PBL | 5/8 |
| 2 7/8 PBL | 7/8 or 1.00 (dark vinyl) |
| 3 1/8 PBL | 1.00 (dark vinyl) |
| 3 1/2 PBL | 1 1/4 (dark vinyl) |
| 4 3/4, 5 1/4 PBL | 1 1/2 (dark vinyl) |
| 6 1/4, 6 1/2, 6 3/4, 7 1/4 PBL | 2.00 (white or dark vinyl) |
| 8, 8 1/4, 9 1/2, 12 PBL | 2 1/2 (white or dark vinyl) |
| 9 1/2 HF | 2 3/4 (white or dark vinyl) |

### PBL ACTIVATION Procedure:

Drilling Mode
FLOW to BIT

Vinyl Activation Ball
Seated



Open Position
FLOW THRU PORTS

Prior to activating the tool, Record Pump Pressure/Pump Strokes. This will be used as a reference to confirm de-activation of the tool.

Calculate the fluid displacement volume and time in the drill string to estimate when the Activation Ball will reach the PBL Bypass Tool.

- Break drill string at rig floor and drop one Activation Ball.
- It is recommended to fill the drill string with fluid prior to dropping the Activation Ball.

# 3. OPERATIONAL INFORMATION

Displace approximately 50% of the drill string volume at normal drilling pump rates then reduce the pump rate that the string pressure is 1,000 psi below the ball shearing pressure until the ball lands on the Seat.

- In addition please consider: Flow rate should be maximum 400 gpm (200 gpm for Fast Ball) when ball lands on Seat.
- **NOTE:** Care should be taken when pumping the Activation Ball down as pumping the Activation Ball on Seat at high flow rates and/or high pressures may cause the Activation Ball to blow through the Seat.
- The Activation Ball will often seat sooner than the calculated pump strokes.
- The Activation Ball has an equivalent density of 11.2 PPG (20.9 PPG for Fast Ball) drilling fluid.
- In the event the ball does get blown through the Seat, as indicated by no change in pump pressure/ strokes as recorded in first step, drop two (2) De-activation Balls to ensure the Activation Ball has gone through the Seat. **This step must be done prior to dropping another vinyl ball.**
- Repeat the normal tool activation process to re-open the tool.

When the Activation Ball lands on Seat, the Sliding Sleeve will shift to its open position against the Spring.

- **NOTE: IT TAKES 100-200 PSI TO ACTIVATE /OPEN THE TOOL.**
- Fluid will now be diverted through the side Ports. As long as pumping is continuous, fluid will be diverted through the Ports. If pumping is halted, the Sliding Sleeve will shift to the closed position. When pumping resumes, the Sleeve will shift open.
- A constant, high pump rate should be maintained while the tool is in the open position. **If low flow rates, low differential pressures between drill pipe and annulus, bull heading, squeezing or similar low flow operations are required, it is recommended to de-activate the PBL Tool prior to commencing such operations.**

*„A pressure drop is the indication that the PBL tools has been opened.“*

### ACTIVATION DURING ‘TOTAL LOSS’

In case of a vertical well, drop the Activation Ball and wait until the ball reaches the Seat by way of gravity (chasing the Activation Ball by pumping may cause the Activation Ball to blow through the Seat due to a combination of the suction caused by the loss zone and pumping).

In case of a horizontal well or highly deviated well, chase the Activation Ball with as low pumping as possible until it lands on the ball Seat.

**“Well Control”** - a special safety feature of the tool is, that whenever pumps are turned off, the sleeve shifts to the closed position and isolates the ports, which eliminates the u-tube effect and assures full well integrity.

*„A special safety feature of the PBL tool is full “Well Control” at any time.“*

## e. De-Activation Procedure

| TOOL SIZES (INCHES) | DEACTIVATION BALL SIZES (STEEL) (“) |
|---|---|
| 1 11/16 PBL | 3/8 (steel) |
| 2 1/8 PBL | 7/16 (steel) |
| 2 7/8 PBL | 13/16 (steel) |
| 3 1/8 PBL | 7/8 (steel) |
| 3 ½ PBL | 1 1/16 (steel) |
| 4 ¾, 5 ¼ PBL | 1 3/8 (steel) |
| 6 ¼, 6 ½, 6 ¾, 7 ¼ PBL | 1 3/8 (steel) |
| 8, 8 ¼, 9 ½, 9 ½ HF, 12 PBL | 1 ¾ (steel) |

### PBL DE-ACTIVATION Procedure:

Steel De-Activation Balls Dropped And Pumped Down PRESSURE UP

Balls Sheared Thru Seat Tool Reset

Drilling Mode FLOW to BIT

Break the drill string at rig floor and drop 2 x steel De-activation Balls (It is a good practice to drop the second steel ball 5-10 seconds after dropping the first one)

After dropping the steel De-activation Balls, pump at 50% of the normal drilling flow rates and watch for a stand pipe pressure increase. When the steel balls reach the PBL Bypass Tool, they will cut off flow through the Ports creating an immediate pressure increase.

- Bring the pressure up while continuing pumping at high constant pump rates until a pressure decrease is seen.
- A pressure decrease is an indication the Activation Ball has blown through the Seat into the Ball Catcher. The steel balls will follow into the Ball Catcher.
- The Activation Ball will blow through the Seat at +/- 10% of stated shear pressure depending upon downhole conditions.
- After the Activation Ball shears through the Seat, the Sleeve will move to the closed position. Circulation will now be through the BHA.

When pumping is resumed, check that the pressure and strokes are the same as they were prior to activating the PBL Tool (See data recorded in first step, above).

**NOTE:** After tripping out of the hole, the balls must be removed from the Ball Catcher Sub before RIH again.

**The used Activation Balls should be immediately discarded and NEVER RE-RUN.**

**If the PBL Sub is to be rerun after being activated, it is strongly recommended to de-activate the tool prior to tripping out of the hole to minimize the wear within the tool.**

### f. Re-Run Procedure

- **After POOH** clean the tool with a power washer (fresh water) to remove debris and visual inspect the tool for any damages.
- Clean rotary connection and visually inspect threads for damage.
- Balls must be removed from the ball catcher sub before RIH again.
- Never re-run used vinyl activation balls or Fast Dart.
- **Before re-run** please check the hours below rotary table and total circulation hours (PBL activated). If the PBL has been in hole for greater than 240 hours it is advisable not to re-run the tool – use the back-up tool and send used tool back for servicing.
- Surface function test is necessary before re-run (please see operational instruction for further details of the surface function test).

## g. Number of cycles (activation/deactivation)

The PBL tool is a multiple activation circulation sub which could be activated and deactivate (cycle) 5 times in the standard setup of the tool (please see table below). However, if more cycles would be required extended catcher cages to accommodate up to 10 sets of balls (10 cycles) and more are available on request.

*„Extended ball catcher cages to accommodate up to 10 cycles and more are available on request.“*

| TOOL SIZE (INCHES) | 1 11/16 | 2 1/8 | 2 7/8 [1] | 2 7/8 [2] | 3 1/8 | 3 1/2 | 4 3/4 | 5 1/4 | 6 1/4 | 6 1/2 | 6 3/4 | 7 1/4 | 8 | 8 1/4 | 9 1/2 | 9 1/2 HF | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of Cycles: | 2 | 7 | 4 | 7 | 4 | 3 | 5 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |

[1] two ports
[2] three ports

## h. Downhole Survey Systems (GYRO) recommendations

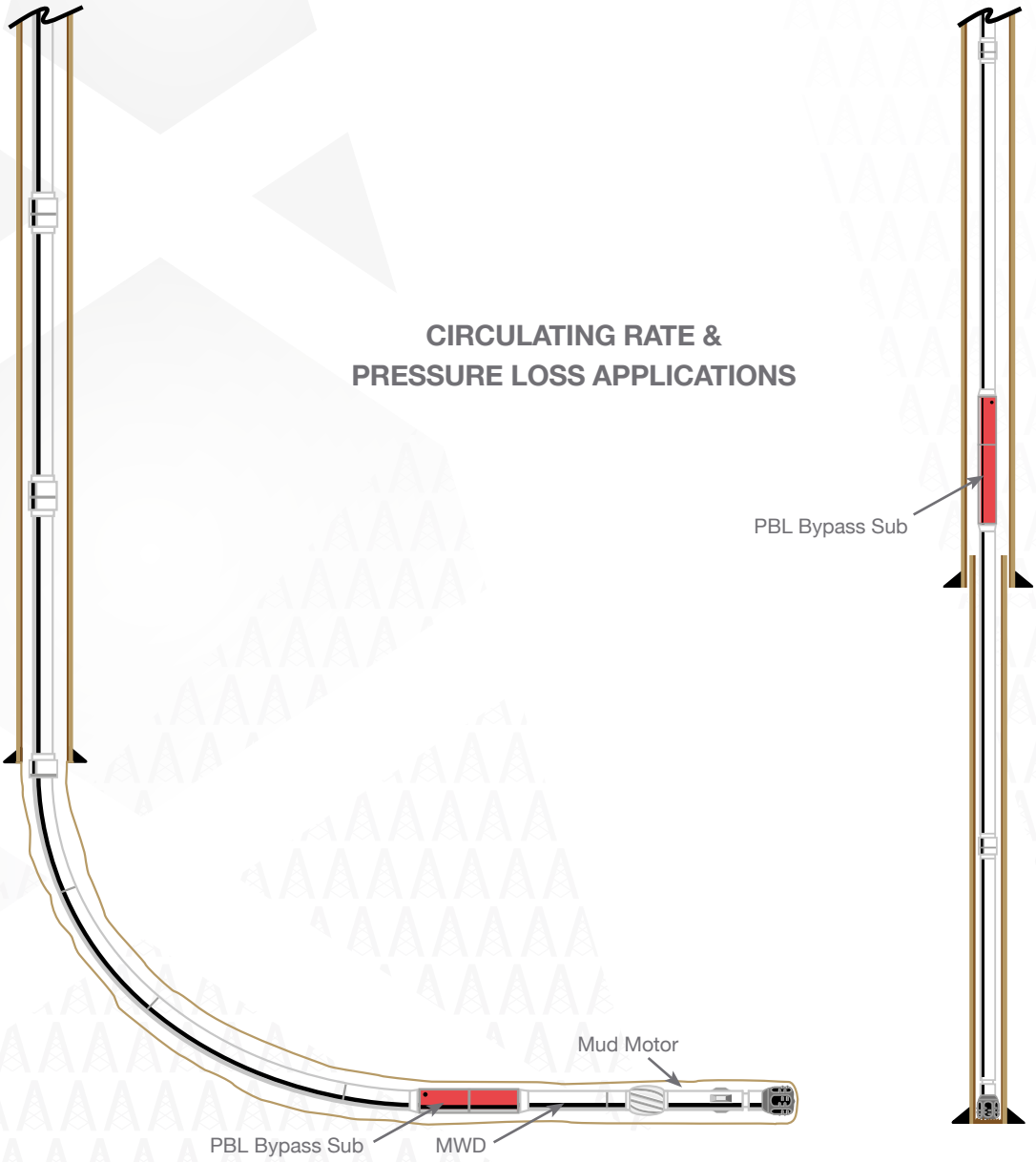
The PBL Multiple Activation Bypass System is compatible with Survey Tools. It is recommended to land the Survey Tool on the Ball Catcher Sleeve in the 6 ¼” tool and larger and on the Top Sub ID in the 4 ¾” tools and smaller. On the larger tools if there are balls in the Ball Catcher Sleeve the Survey Barrel will land on top of the Balls. It is recommended to check the Survey Tool in PBL Bypass tool to confirm compatibility.

With regards to Directional Surveys some modification can be made to make the PBL Bypass tool compatible with mule shoe / orienting sub systems. To make 4 ¾” PBL tools compatible, the orienting sub can be run above the PBL Bypass tool.
The ID of the orienting Sub Sleeve will have to be modified up so a 1.500” Ball can pass. This has proven effective in the past. With regard to 6 ¼” - 6 ¾” PBL Bypass Tools, DSI can provide a larger mule shoe and orienting Sub Sleeve to fit in the top of the PBL Bypass tool. This will allow the 2“ Vinyl Balls to pass through the orienting Sub Sleeve in the top of the PBL Bypass Tool. The OD of the mule shoe provided by PBL is 2 ⅜”.

# 3. OPERATIONAL INFORMATION

## i. Drill String placement

For drilling, it is recommended to run the PBL Multiple Activation Bypass System as low in the hole as possible i.e. Just above non-magnetic components in directional situations and just above the Bit Sub in conventional vertical drilling. This will allow operators to free point and back off as well as Survey as low in the hole as possible.



## j. Completions Applications

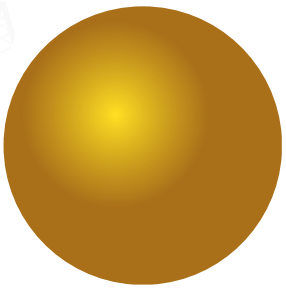
Run the PBL Multiple Activation Bypass tool at the crossover of the tapered working string. During completions, operators are working in cased hole so free point and back off is not necessary as the likelihood of becoming stuck in the hole is very remote.

## k. Fast Ball or Fast Dart

The use of the Fast Ball/Fast Dart is recommended for the following situations.

1. In situations where **high mud weights** are used the Fast Ball or Fast Dart will help to speed up the activation process.
2. If the **drill string or annulus becomes plugged or packed off** it will be hard to get the standard activation ball to the tool to activate (open) it. The Fast Ball and Fast Dart have a much higher unit weight than the standard activation ball. This feature allows for a quicker activation of the PBL tool which is especially helpful in situations where there is limited or no circulation. It is not recommended to utilize the Fast Dart in well bores with angles greater than 55º (this restriction of the angle only applies if you are not able to pump the Fast Dart down – in this case it sinks down by gravity only). With the tool activated it may be possible to break circulation through the tool and clean up the annulus. With the annulus clean the tool can be deactivated to allow the operator to continue drilling ahead. If the bit is plugged it will allow the operator to circulate.

Fast Ball



Fast Dart


**Note:** Must be inserted dart end down

# 4. OPERATIONAL PARAMETERS

## a. Pumping aggressive LCM thru the PBL tool

The PBL sub is the leading circulation sub on the global drilling market and based on the robust design it accepts the highest amounts of LCM material to be pumped thru.

**Guideline for pumping LCM thru the PBL tool (depending on the LCM material and dispersion)***

Rule of thumb – max. LCM particle size: ⅓ of port diameter

- **4 ¾, 5 ¼, 6 ¼, 6 ½, 6 ¾, 7 ¼ - PBL tool:**
  **Customers pump 220 lbs per barrel thru these tool size on daily basis.**

- **8, 8 ¼, 9 ½ - PBL tool:**
  **Customers pump 270 lbs per barrel thru these tool size on daily basis.**

**Comment from a Superintendent - Offshore Drilling Department (Saudi Arabia)**

*"We have successfully mixed and pumped 270 pound per barrels LCM thru the 12" and 9.5 PBL deployed in ARBI/HSBH with no problems plugging or closing PBL after use and continue drilling ahead. This is a best practice established by Offshore Drilling group. The smaller size PBL subs 6.75 are used to pump 200 to 220 pound per barrels LCM at depths of 11,000 to 13.500 ft. (3,353 to 4,115 m) on daily bases when drilling Khuff formation in Karn. We have yet to have plugged string or unable to open and close when required. Overall we have been very successful with DSI PBL subs to date. Note we have been using for the last 2.5 years on every well drilled in Karn, HSBH and ARBI. With Zero failure rates."*

Furthermore, customers are successfully pumping thixotropic cement through the PBL tool to set cement plugs (last resort LCM).

*„Thixotropic cement to set cement plugs could be pumped through the PBL tools - last resort LCM."*

## b. Maximum circulation rates

Based on the robust tool design the PBL tool offers the highest TFA per port on the multiple activation circulation sub market. This enables our customers to pump aggressive LCM pills (incl. thixotropic cement) and the highest circulation rates for effective hole cleaning thru the PBL tool.

*„The PBL tool offers the highest TFA per port on the multiple activation circulation sub market.“*

The maximum circulation rates differ depending on whether the tool is in the open or closed position. The chart below should give an overview about the recommended maximum circulation rates (USgpm) per tool size.

### DSI recommends following maximum circulation rates (Usgpm):

| TOOL SIZE (INCHES) | 1 11/16 | 2 1/8 | 2 7/8 [2] | 2 7/8 [3] | 3 1/8 | 3 1/2 | 4 3/4 | 5 1/4 | 6 1/4 | 6 1/2 | 6 3/4 | 7 1/4 | 8 | 8 1/4 | 9 1/2 | 9 1/2 HF | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Max Flow when Tool is Open (Autolock, GPM): [1] | TBD | TBD | 175 | 275 | 175 | 500 | 1,000 | 1,000 | 1,200 | 1,200 | 1,200 | 1,200 | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 |
| Max Flow when Tool is closed (Autolock, GPM): [1] | TBD | TBD | 150 | 150 | 150 | 250 | 600 | 600 | 850 | 850 | 850 | 850 | 1,500 | 1,500 | 1,500 | 2,000 | 1,500 |

[1] Max Flow Rate Calculated using Sea Water
[2] 2 Ports
[3] 3 Ports

If higher circulation rates would be required please contact your DSI representative.

## c. PBL temperature rating

All PBL tools will be supplied with HPHT seals (420°F/216°C). As a standard for our larger tool sizes (12” down to 6 ¾”) we supply white vinyl activation balls which have a service temperature up to 266°F (130°C), at operating depth. Upon request higher temperature balls could be supplied for these tool sizes.
Smaller tool sizes (5 ¼” and smaller) will be supplied with dark vinyl activation balls which have a service temperature up to 500°F (260°C).

All PBL tool sizes can be adjusted, thus they can be used at temperatures higher than 450°F (232°C), for further information please contact a DSI representative.
For example: 6 ¾ PBL tool was successfully used at 470°F (243°C), 19.2 PPG (2.3 SG) drilling fluids, ~28,000 ft (~ 8,534 m) - onshore US.

With continuous operation of PBL’s worldwide, our experience has shown that in high temperatures and high pressures the density of the vinyl balls is slightly affected causing ball shearing pressure to be decreased by around 200 - 300 psi. Therefore the activation ball will blow through the seat at +/- 10% of stated shear pressure depending upon down hole conditions (shearing pressure is marked on the tool body).

# 4. OPERATIONAL PARAMETERS

### d. Maximum operating pressure

The PBL Multiple Activation Bypass System gets pressure tested at 5,000 PSI but the tool is capable to be run at higher differential pressure ratings if HPHT seals are used. If you would like to run the PBL at higher differential pressure ratings than 5,000 PSI please contact a DSI representative to get further information.

*„All PBL tools will be supplied with HPHT seals (420°F/216°C).“*

### e. PBL usage in harshest environments

With over 25 years of experience, operating in 60+ countries in every major petroleum region of the world the PBL's have been successfully run in many areas of the world including the harshest environments including CO2 and H2S. In the Middle East, Canada and the Caspian Region the PBL's have been run with H2S concentrations, as high as 50%. In these cases fluid inhibitors were used to neutralize the H2S and the PBL's functioned as required. The PBL has a proven historical operating efficiency of 99% worldwide.

*„PBL tools have been successfully run in the harshest environments including CO2 and H2S.“*

The PBL Multiple Activations Bypass Systems similar to most bottom hole assemble components are manufactured to the highest standards with premium grade materials and sealing elastomers. PBL's can be manufactured out of special alloys if required to address specific requirements of a critical well.

The PBL tool will work on 100% nitrogen or with any combination of fluids and nitrogen, i.e., acid treatments, cement, drilling fluids, KCL water, production fluids, completion fluids, foam, water, or compressed air, please contact a DSI representative for further information.

### f. Internal drift

The drift is the smallest inside diameter of the tool (for further details please see page 10). Larger drifts are available to accommodate coring and reamer balls or wireline accessories. When the PBL tool has been activated and deactivated and balls are in the ball catcher cage the drift is eliminated.

*„The PBL has a proven historical operating efficiency of 99% worldwide.“*

## g. PBL utilization in combination with ball activated third party tools

The PBL Tool can be used in conjunction with ball activated reamers, adjustable stabilizers and coring assemblies below the PBL Tool. This combination has been successfully utilized for many years (e.g. deep water GOM). For this application, a special tool setup which incorporates a larger drift (No-Go) in the ball catcher cage to accommodate the third party activation balls was designed. The third party activation ball must be pumped down prior to PBL activation.

Prior to assembling the PBL Tool in the BHA, it is recommended to pass the third party activation ball through the PBL to confirm proper drift

**Activation/Deactivation Procedure:**

1. When third party tool activation is required, pump down their activation ball as per third party instructions. The PBL Tool will remain closed during this operation

2. The PBL Tool can now be activated as per standard procedures. When activated, there will be no flow to the BHA below the PBL Tool. Thus the reamer or stabilizer will not open due to elimination of flow

3. The PBL Tool can also be deactivated as per standard procedures. Once deactivated, 100% of flow is resumed to BHA and reamer or stabilizer is again activated

4. The normal number of PBL cycles are available for use

**Note:** After activating/deactivating the PBL tool there is no pass thru for any third party balls. By activating the PBL Tool, the third party tools are effectively deactivated as there is no flow through the BHA

## h. PBL service cycle guide line

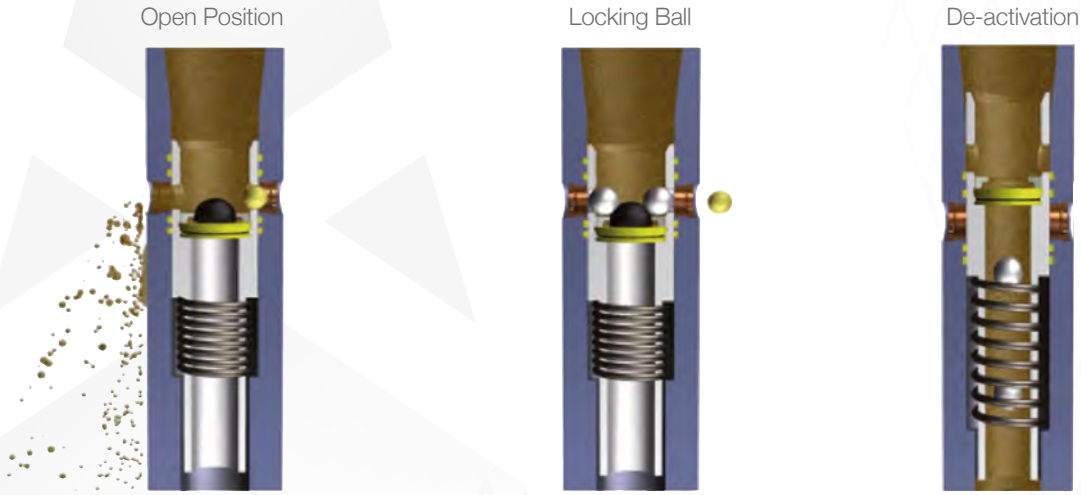
| Guide line for the PBL Service Cycle | |
|---|---|
| Total time in hole (Hours maximum) | **300 hours**<br>(If the PBL has been in hole for greater than 240 hours it is advisable not to re-run this tool - use the back-up tool and send this tool back to be serviced).<br>It is not recommended to make a special pipe trip to remove the PBL from the BHA if maximums limit is met. |
| Total time open (Circulating hours) | **100 hours**<br>It is not recommended to make a special pipe trip to remove the PBL from the BHA if maximums limit is met. |
| Total No. of cycles | 4-¾" = 5, 6-¾" = 5, 8-¼" = 5, 9-½" = 5 |
| Re run after wait | Within 7 days provided the tool is flushed out with fresh water after POOH & a successful function test has been conducted prior to RIH. |
| Maximum time if not used | **6 Months**<br>(If it is stored in a protected place - NOT on the rig site) |

# 5. ADDITIONAL FEATURES OF THE PBL MULTIPLE ACTIVATION BYPASS SYSTEM

## a. Auto-lock feature

### Introduction

The Auto-lock feature of the PBL tool was developed at the request of the operators to allow for safer and timelier tripping. By locking the tool in the open position, the drill string can easily drain and fill during tripping operations. This feature allows operators the ability to open and close the tool down hole up to 5 times to assist in dealing with hole conditions. This feature is safe, reliable and effective.




### Applications details

1. **Trip Dry Pipe:** When the PBL tool is in the activated position (activation ball on seat, flow through the PBL ports) and by dropping and pumping down the locking ball the tool will lock open. This is confirmed on surface, as the “Plastic Locking Ball” will cut the TFA in half, so surface indication is clear. With the Locking Ball Seated there is 1 x 1 ⅛”or 1 ⅜”full opening port to drain the pipe. Pulling dry pipe with Lighter Weighted pills will be realized.
2. **Fill pipe:** Running in the hole with the PBL Auto-lock Bypass System will eliminate costly time filling the pipe. When it is desired to close the tool, drop two Steel Deactivation Balls and close the tool.
3. **Equalize & Reverse Circulate:** If differential sticking occurs the PBL Auto-lock Bypass tool can be opened to allow lighter fluid to be pumped down the annulus until the pipe comes free. With the pipe coming free conventional circulation can be resumed to displace the lighter fluid out of the hole and out of the system.
4. **Equalize & Reverse Circulation for effective completions:** Utilize the PBL Auto-lock tool to reverse fluids during displacement operations to achieve maximum annular velocities to clean the well bore. Resume conventional circulation at any time as well as open and close the tool 5 times while in hole.
5. **To Shock the Pipe:** By locking the PBL Auto-lock tool open and dropping one Steel Deactivation Ball, the system will pressure up and shear the plastic locking Ball. This has the effect of shocking the pipe. The debris falling off of the ID of the pipe will exit out the Port in the PBL Auto-lock Bypass System, this will eliminate debris from contaminating the BHA. Drop the second Steel Deactivation Ball to reset tool and resume drilling.

### Locking tool for hydraulic reset

For locking tool open, a Plastic Locking Ball is used. Using this procedure, will allow the operators to lock the tool open and to open or close the tool down hole anytime.

Drop Vinyl Activation Ball/Dart pump 50% to 70% of pipe volume ports will open, pressure will drop indicating the tool is open. To lock the tool open, drop Plastic Locking Ball. Pump the locking Ball to the tool @ 50% of drilling rate when the pressure decreases, the Activation Ball has opened the tool. When the pressure increases the "Locking Ball" has seated in the nozzle, the tool is now locked open. When the circulation stops the tool will remain locked open with the Plastic Locking Ball holding the sleeve open. To close the tool drop two Steel Deactivation Balls, the Locking Ball will shear through the nozzle and the two Steel Balls will restrict the flow out of the ports. The system will pressure up and the Vinyl Activation Ball will shear and the tool will close. The Steel Balls will end up in the Ball Catcher Sleeve with the activation Ball. With the ports closed drilling can resume. This procedure can be performed on below the rotary table or in the hole at any time. This procedure is also used to surface reset tool after tripping in locked open position.

### Well control consideration

When the PBL Auto-lock Bypass tool is locked open there is communication between the annulus and the ID of the drill string. Flapper valves can be run above the PBL Auto-lock tool to eliminate influx through the port and into the drill string. Standard flappers can be provided that will drift up to 2" vinyl activation balls. Modified flappers can be provided to drift 2 ½" vinyl activation balls. If flappers are not used above the PBL Auto-lock tool, drill crews should be briefed on stabbing value and well control procedures. We recommend to use the Auto-lock feature only in cased hole.

## b. PBL Split Flow Dart

DSI FZE is pleased to introduce an additional option for the PBL Multiple Activation Bypass System for drilling, completion and workover operations. The Split Flow Dart (patented) will allow a pre-calculated amount of drilling or completion fluid to pass through the PBL Tool and on to the BHA below and the remaining fluid to be by-passed out of the PBL Tool ports. By splitting the flow, the operator is able to have more control over available hydraulics and hole cleaning parameters.

The Split Flow Dart is not included in the standard operational ball kit which will be sent to the rig site as a special setup of the PBL tool is required. Please contact your DSI Representative for more information on the Split Flow Dart.

The Split Flow Dart incorporates a jet nozzle mounted in a cone shaped dart. The ports of the PBL Tool are also equipped with jet nozzles. By pre-determining the sizes of the dart and port nozzles, a calculated portion of drilling fluid can be by-passed at the PBL Tool. This dart activates the PBL Tool in a similar manner as the ball utilized in standard PBL operations. The Split Flow Dart contains a shear ring manufactured from the same material as the PBL activation balls and utilizes the same, proven technology to land, activate and shear through the seat.

# 5. ADDITIONAL FEATURES OF THE PBL MULTIPLE ACTIVATION BYPASS SYSTEM

At the time split flow is required, the Split Flow Dart is inserted into the drill string at the surface and pumped to the PBL Tool. Once landing, the PBL Tool will open once a pre-determined minimum flow rate is established. After opening, the flow will be divided between the BHA and the ports to the annulus. It is important to maintain flow above the minimum rates to keep the PBL Tool completely open. Whenever pumping ceases, the PBL Tool will close and there will be no fluid communication to the annulus through the PBL Tool ports.
To discontinue the split flow option, one steel deactivation ball is dropped. This ball will land in the top of the dart and shut off flow to the BHA below. At this time the flow will be exiting through the nozzled ports of the PBL Tool. These ports have a limited TFA due to the split flow option, and caution needs to taken to not develop excessive differential pressure and cause the dart to shear through the seat. When de-activation (100% of flow to BHA) is required, a total of three steel de-activation balls are dropped. (Drop only two additional balls if one was dropped as above to discontinue split flow) One will land in the top of the dart (as above), while the other two will cut off flow through the ports creating a pressure increase to the pre-set shear pressure. This will cause the dart to shear through the seat and the dart and balls will be caught in the ball catcher cage.

The Split Flow Dart option for the PBL Tool will greatly enhance hole cleaning ability while not pumping excessive fluid through the MWD/LWD, rotary steerable system, drilling motor or drill bit causing possible washouts and difficulty steering. This simple and reliable system will save the operator large amount of rig time and thus money.

Please contact your DSI Representative for more information on the Split Flow Dart.

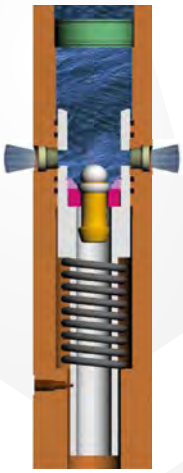
1. Drilling Mode Flow to Bit

2. Split Flow Dart Seated

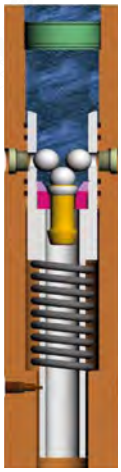
3. Open Position Flow thru Dart & Ports

4. Pumps Off Ports Closed

5. Split Flow Discontinued One Ball on Seat



6. Open Position Flow thru Ports Only



7. Steel De-Activation Ball Droped

8. Dart Sheared thru Seat & Dart Falling in to Ball Catcher Cage

9. Drilling Mode Flow to Bit

# 6. THE PBL SLIDING SLEEVE BIG BORE SYSTEM

To answer the drilling industry's need for an efficient circulating sub that can be used in conjunction with retrievable MWD probes, DSI FZE introduces the Sliding Sleeve Big Bore (SSBB) system. This tool provides the same reliability associated with DSI's PBL® multiactivation Bypass System as well as the same industry proven functionality.

**New features:**

- Unlimited number of cycles
- Large ID provides the operator with the ability to deploy or retrieve probe style MWD sensors, drilling tools, or core barrels while still maintaining the ability to activate the SSBB tool
- Remove Ball Catcher Cage

**The SSBB has the same applications as the standard PBL:**

- Increasing circulation rates for improved hole cleaning resulting in reduced torque and drag, thereby increasing ROP
- Increasing annular velocity in highly deviated and horizontal wellbores where removal of cutting beds and hole cleaning are problematic
- Pumping all types of LCM materials, including aggressive materials and cement squeezes
- Fluid displacements
- Sub-sea riser/BOP jetting
- Acidizing and stimulation treatments
- Coring applications

DSI will supply the SSBB system with the necessary over shot for retrieving the SSBB dart.

1. Flow and Access Through to Bit

2. Open Position Flow through Ports

3. Dart Picked up by Wireline, Ports Closed

**Technical Specifications for SBSS System**

| Tool OD | ID Drift (in)[1] | Port TFA (in2)[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

# 7. THE PBL MULTIPLE ACTIVATION JETTING TOOL

The PBL® Multiple Activation Jetting Tools utilize the same industry proven components used in the PBL Multiple Activation Bypass System. Enhanced cleanout operations are conducted through an array of jet nozzles positioned throughout the sleeve:

A Major US Deepwater Operator was searching for a way **to clean out the subsea wellhead and liner hangers thoroughly after drilling 26" hole section without rotating entire drill string which could damage the casing due to running a huge bit on a bent housing motor during batch casing drilling program.**

## Objective:

To run the Multiple Activating PBL Multi Jet with 30 jet nozzles above the HWDP for subsea cleanout while POOH, therefore getting a thorough cleanout on multiple wells for batch casing setting without making dedicated cleanout trips or removing tool from BHA.

## BHA Details:

- PBL Multi Jet with 16 ¼" Housing
- Directional MWD
- Bent Housing Drilling Motor
- 26" Bit

## Results:

- PBL Multi Jet Activated as designed
- Subsea Wellhead & Liner Hangers were cleaned thoroughly
- PBL Deactivated
- BHA hung off for next well
- Same PBL cycled for next well cleanout
- Repeated results
- No Dedicated Cleanout Trips Required

**Benefits:** Thorough Cleanout without BHA rotation on multiple wells without dedicate cleanout trips.

**Savings: ½ day per well @ $ 500,000 per day**

**The PBL Multiactivated Jetting Tool has many uses in the drilling and completion environment:**

- Cleanout of BOP, risers, liner hangers and liner tops without additional pipe trips
- Increased flow rates to aid in hole cleaning during displacements
- Can be utilized in conjunction with various brush and cleanout tools for maximum riser cleanup
- When included as part of the drilling BHA, cleanouts can be conducted while tripping out of hole without rotation of drillpipe

## Technical Specifications for PBL Multi Jet Tool

| Tool OD | Connection | Sleeve OD | Number of Ports[3] | PBL Cycles | Drift ID |
|---|---|---|---|---|---|
| 6 ¾" | 4 ½ IF | 11" | 12 | 5 | 1.50" |
| | | 16" | 18 | 5 | 1.50" |
| 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

# 8. FAQ

**What is the Pressure Drop thru PBL?**

No significant Pressure Drop, even when cage is full.

Pressure drop = $PQ^2/10858A^2$ psi (p-Mud weight lb/gal, Q-circulation rate gpm, A-Area in2).

**When deactivated, do the balls in the cage create a flow restriction?**

The balls in the cage do not create a flow restriction.

**Where do you install the PBL?**

Normally just above the Mud motor & MWD, LWD collars but can be placed in string wherever required. Insure all ID's above the PBL will drift activation ball.

**How many cycles are possible during one run?**

4 for 4 ¾" & 5 for 6 ¾", 8 ¼", 9 ½" (See the Spec table for more details).

Extended catcher cages to accommodate up to 10 sets of balls (cycles) are available on request.

**What is the drift of the PBL?**

4 ¾"- 1.25/1.40, 6 ¾"-1.27/1.75, 8 ¼"-1.50/2.27, 9 ½"-1.50/2.27 (See the Spec table for more details).

If other ball drop tools are placed below the PBL we would recommend to Drift the PBL on site to make sure required balls will pass thru' the PBL.

**Can you pump cement thru the PBL?**

Yes, you can pump thixotropic cement thru the PBL tool.

**How much LCM can be displaced thru the PBL once opened?**

No limitations to the amount of LCM that can be pumped.

**Can other ball activated tools be run below the PBL?**

Yes, but the NO-GO must be sized for the other tools.

**What length does the PBL have?**

Depending on the PBL tool size the tool length is between 3 and 10 ft (please see page 10). Furthermore the length could vary slightly according to any connection rework.

**Are high torque connections available on PBL's?**

Yes but please allow lead-time for special connections.

**What is the TFA thru the ports on the PBL?**

4 ¾"- 1.901sq/in, 6 ¾"-2.454sq/in, 8 ¼"-3.534sq/in. (See the Spec table for more details)

**Can multiple PBL's be run at the same time?**

Yes they can, please refer to DSI Rep for advice.

## What kind of material are the activation balls?

Vinyl (Black) for 5 ¼" OD and smaller (rated to 500 F or 260 C).
Vinyl (White) for 6 ¾" OD above size (rated to 270 F or 130 C).
Torlon can be supplied for larger tool sizes on request for HTHP applications.

## What connections does the PBL have?

| TOOL SIZE (INCHES) | PBL TOOL END CONNECTIONS* |
|---|---|
| 1 11/16 OD | 1.00 AMMT |
| 2 1/8 OD | 1 1/2 AMMT |
| 2 7/8 OD | 2 3/8 PAC |
| 3 1/8 OD | 2 3/8 REG |
| 3 1/2 OD | 2 3/8 IF |
| 4 3/4 OD | 3 1/2 IF |
| 5 1/4 OD | XT 39 |
| 6 1/4 OD | 4 1/2 XH |
| 6 1/2 OD | 4 1/2 IF/XH |
| 6 3/4 OD | 4 1/2 IF |
| 7 1/4 OD | XT 57 |
| 8 OD | 6 5/8 REG |
| 8 1/4 OD | 6 5/8 REG |
| 9 1/2 OD | 7 5/8 REG |
| 12 OD | 8 5/8 REG |

*Special thread connections available on request.

## What is the shear value/De-activation Pressure of the PBL's?

Varies from 1,600 psi - 4,500 psi (on customer request). All tools are dressed with specific PSI seats, typically 2,000 to 3,000 psi. Lower psi seats can be supplied for land rigs or where requested.

## What limits the quantity of cycles on the PBL?

Length of the catcher cage.

## Can the PBL be cycled more than the recommended amount of times?

Not during one run but after empty the balls from the cage you can run the tool again.
(Please see service cycle guideline on page 23).

- **When using Darted Activation Balls, how many times can the PBL be Cycled?**
  One cycle is lost for each darted activation ball utilised.
  3 for 4 ¾" & 4 for 6 ¾", 8 ¼", 9 ½" (See the Spec table for more details).
  With extended catcher cages more cycles are possible.

- **What is the highest angle that an activation ball can be dropped with circulation thru the bit?**
  The activation ball can be dropped at an hole angle of 90° and above. DE-activation has been achieved in holes of +90 Degrees. The Fast Dart is recommended with a hole angle up to 55° (if no circulation is possible – free fall).

- **What are the procedures for Activating/Deactivating the PBL?**
  Please see page 13.

- **What is the max operating temperature that the PBL can be used?**
  Up to 450 F or 232 C (Please see page 21).

- **Is there any flow to the bit once the PBL is activated?**
  No, there is no flow to the bit anymore. If some flow would be required, we would recommend to use the split flow dart (Please contact a DSI representative for further information).

- **How many hours downhole can the tool be used?**
  Total time in hole (Hours maximum): 300 hours
  Total time open (Circulating hours through PBL ports): 100 hours
  For further details please see page 23.

# 9. PBL SUB - DO's & DON'Ts

- All ID's of the drill string components should be larger than the diameter of the activation ball otherwise the ball could get stuck during the pumping process.
- If other ball-activated tools are used in the drill string (e.g. ball-activated reamer) please consider the "drift" of the PBL tool.
- Remove any "mud cleaning filters" before dropping the activation or de-activation balls.
- Be careful that no other objects (cement chunk, glove, part of a drill pipe screen, thread protector, etc.) get inside the drill pipe and land on the seat. These objects could act like an activation ball and improperly open the tool. It is highly recommended to place a filter in the standpipe and drill string to prevent unintended activation of the tool due to junk/debris.
- If the optional surface test is done, always ensure the PBL tool is fully within drilling fluids to avoid potential ball shattering during de-activation.
- Large diameter LCM materials can be pumped through the PBL ports. LCM size should not normally exceed 1/3 of port diameter (if in any doubt please call a DSI representative).
- It is recommended to pump the activation ball with a fluid spacer (normal drilling mud, no LCM included) otherwise LCM may pass the ball during the pumping process before the activation ball lands on the seat and LCM gets access to the sensitive BHA.
- When LCM has been pumped, it is recommended to clean the drill string (with normal drilling mud, no LCM included) from LCM before dropping the de-activation balls.
- Never re-use a previously dropped activation ball (vinyl).

## 9. PBL SUB - DO's & DON'Ts

- If the BHA is "packed-off" and therefore unable to circulate, the PBL tool kit contains a Fast Dart. This can be dropped to reach the seat without pumping (up to 55 degrees) and it may be possible to regain circulation through the PBL by starting the pumps and opening the PBL ports.

- Once the PBL has been activated, high flow rates can be used with pressures that are much higher than the PBL de-activation pressure. DSI recommends the use of high flow rates to fully make use of the extra cleaning power of the PBL sub or high flow to pump LCM (the de-activation pressure ONLY applies when the steel balls have been dropped to de-activate the tool & cannot be exceeded by high flow rates when the tool is open).

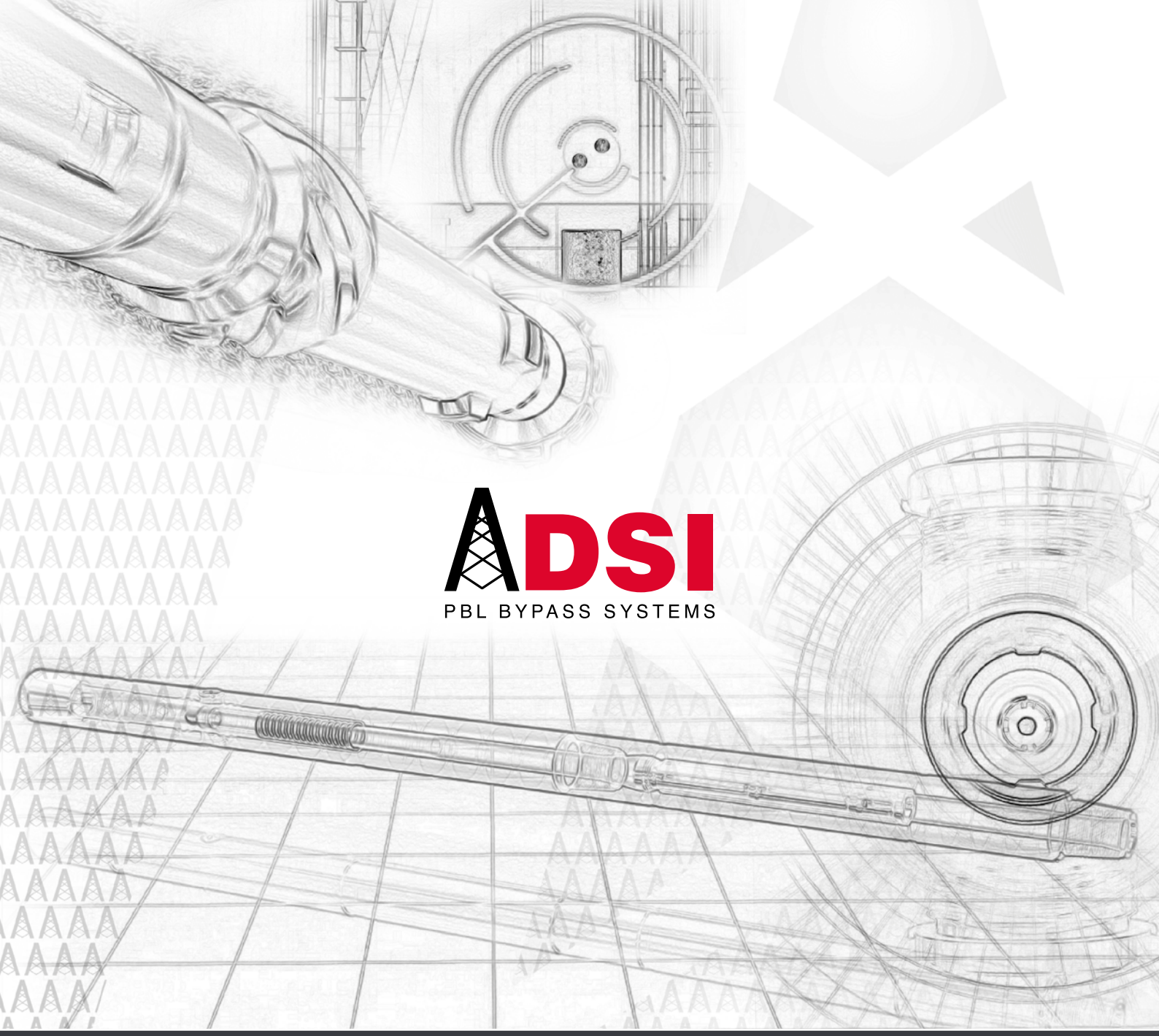
- If low flow rates, low differential pressure between drill pipe and annulus, bull heading, squeezing or similar low flow operations are required, it is recommended to deactivate the PBL tool before commencing such operations.

- If the PBL sub is laid down and is planned to be re-run in hole, please jet-wash fully with clean water when first POOH.

**Please fully use the running procedures and the tool service guidelines which are sent with each PBL tool (if in any doubt please call a DSI representative)**

DSI
PBL BYPASS SYSTEMS

DSI FZE provides worldwide service and support in more then 55 countries. To find out more about our services and products, please contact an authorized DSI representative or visit **www.dsi-pbl.com**.



# ADSI

PBL BYPASS SYSTEMS

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