

## 4. OPERATIONAL PARAMETERS

### 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)	2 1/4	2 7/8 <sup>2</sup>	2 7/8 <sup>3</sup>	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): <sup>1</sup>	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): <sup>1</sup>	TBD	150	150	150	250	600	600	850	850	850	850	1,500	1,500	1,500	2,000	1,500

<sup>1</sup> Max Flow Rate Calculated using Sea Water

<sup>2</sup> 2 Ports

<sup>3</sup> 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 bigger tool sizes (12" down to 6 3/4") we supply white vinyl activation balls which have a service temperature up to 340°F (171°C), at operating depth. Upon request higher temperature balls could be supplied for these tool sizes. Smaller tool sizes (5 1/4" 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 could be adjusted, thus they could be used at temperatures higher than 450°F (232°C), for further information please contact a DSI representative.

For example: 6 3/4" 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 we are mentioning in our operational instruction that 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).