

Optimising Cost, Maximising value



Gas Lift Systems Catalogue

Side Pocket Mandrels | Gas Lift Valves | Conventional Mandrels | Waterflood Mandrels

Contents

• About Penguin Petroleum Services (P) Limited	3
• Gas Lift Mandrels	4
• Side Pocket Mandrels	5
• SPMO Series Side-Pocket Mandrels—Oval-Body	7
• SPMR Series Side-Pocket Mandrels— Round-Body	9
• Water flood-Injection System	11
• Conventional Gas Lift Mandrels	13
• Gas Lift Valves	14

ABOUT PENGUIN PETROLEUM SERVICES (P) LIMITED

Penguin Petroleum Services (P) Limited - PPSL - brings a suite of solutions to upstream hydrocarbon business segment encompassing activities from engineering to product realization, timely delivery performance and tangible value addition to its customers.

PPSL has a world class manufacturing and service facility located on a 90,000 sq ft plot, off Mumbai-Pune Expressway, India, where design & development, manufacturing as well as validation/functional testing of products are carried out.

The facility is equipped with state-of-the-art machinery, inspection/quality control devices & tooling including well-equipped mechanical and metrology labs, NDE equipment, comprehensive range of Sucker Rod Pump tooling, CNC turning centres, VMCs, Turn Mills, makeup-breakout machine (100,000 ft/lbs torque), honing and deep hole drilling machines etc. Extensive range of these equipment & tooling coupled with highly skilled work force enable Penguin to deliver end-to-end solutions relating to its spectrum of business expertise.

PPSL's design validation/functional test facility for completion tools & accessories is capable of testing downhole tools up to 1,200,000 lbf of bi-directional load, four separate or simultaneous channels each of liquid (ISO V3) and nitrogen gas pressure testing (ISO V0) up to 20,000 psi to 500 deg. F ambient temperature range.

In essence, PPSL's global delivery centre in India is poised to deliver world class solutions relating to bespoke engineering, precision machining, products manufacturing and testing/assembly of products.

Gas Lift Mandrels

Penguin Petroleum Services Pvt. Ltd. (PPSL) designs and manufactures Gas lift Mandrels which are installed on production tubing during well completion for gas lift, water flood, chemical injection and other special applications. These Side Pocket Mandrels can be installed with 1" & 1-1/2" OD wire line retrievable flow-control devices.

PPSL mandrels are available for tubing sizes ranging from 2- 3/8" to 5- 1/2", suitable for both 1" and 1-1/2" flow control devices, in variety of thread configurations manufactured out of fully traceable material heat treated in conformity with NACE specifications MR0175 for sour services as well standard services with highest strength levels. These mandrels are designed for straight as well deviated wellbores and also suitable for dual completions.



Side Pocket Mandrels:

Penguin's Side Pocket Mandrel is designed with an oval cross section which provides a full opening tubing drift and an offset bore parallel to the tubing bore in which 1" & 1-1/2" OD flow control device can be installed. This offset bore contains a machined pocket with sealing surfaces and latching profiles for the flow control device to be installed. The ports in the pocket allow communication between the casing annulus and tubing through the flow control device.

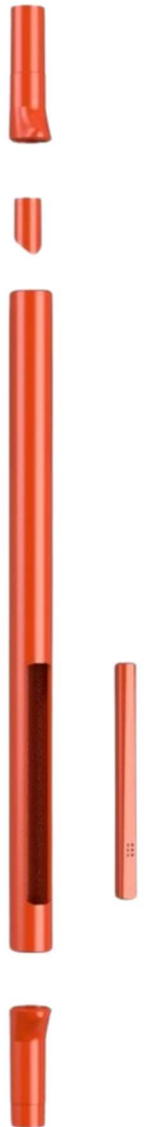
The design includes an eccentric swage at both ends of the oval tube, an orienting sleeve in the upper swage, a tool deflector cum anchor and a machined pocket. The orienting sleeve guides the kickover tool in the right orientation while running or retrieving 1" & 1-1/2" O.D. valves thru wireline. The tool deflector cum anchor allows only the appropriate running and pulling tools to approach the pocket and deflects all other tools into the tubing bore of the mandrel.

Penguin's facility at Khopoli, near Mumbai, India, is fully equipped to manufacture side pocket mandrels as per API specifications

19G1. Penguin manufactures mandrels with product grades V1, F1, Q1 and all environmental service classes from E4-E1. The quality management system of Penguin is in compliance with the requirements of API Q1 and ISO 9001 standards.

Testing & Inspection:

- Magnetic Particle Inspection
- Hydrostatic pressure test, Internal and external.
- Radiographic test for welded parts
- I.D. /O.D. Drift test
- Hardness Value test
- Flow control device running and pulling inspection using Slickline tools.



SIDE POCKET MANDREL SPECIFICATION GUIDE

SIDE POCKET MANDREL SPECIFICATION GUIDE											Rated Test Pressures										
											Standard Service				Sour Service						
Tubing Size		Mandrel Pocket I.D.		Mandrel Body Design	Mandrel Type	Major O.D.		Minor O.D.		Drift		Internal Test		External Test		Internal Test		External Test		Latch Type	Kickover tool
in.	mm	in.	mm			in.	mm	in.	mm	in.	mm	psi	bars	psi	bars	psi	bars	psi	bars		
2.375	60.3	1.000	25.4	Oval	SPMOI-01-1X-XX-XX	4.250	108	2.910	73.9	1.901	48.3	7,500	517.1	6,000	413.7	6,000	413.7	5000	344.7	BK-2 BEK-2 Integral	OK-1 Merla KOT-1
					SPMOI-01-1X-XX-XX													5000	344.7		
					SPMOI-01-1X-XX-XX													5000	344.7		
		1.500	38.1	Round	SPMR01-1X-XX-XX	4.500	114.3	N/A	N/A			7,500	517.1	6,000	413.7	6,000	413.7	5000	344.7		
					Oval	SPMO-02-1X-XX	4.750	120.7	4.000			101.6	7,500	517.1	6,000	413.7	6,000	413.7	5000	344.7	
						SPMO-02-1X-XX															
2.875	73.0	1.000	25.4	Oval	SPMOI-01-2X-XX-XX	4.750	120.7	4.000	101.6	2.347	59.6	7,500	517.1	6,000	413.7	6,000	413.7	5000	344.7	BK-2 BEK-2 Integral	OK-1 Merla KOT-1
					SPMOI-01-2X-XX-XX													5000	344.7		
					SPMOI-01-2X-XX-XX													5000	344.7		
					SPMOI-01-2X-XX-XX													5000	344.7		
					SPMOI-01-2X-XX-XX													5000	344.7		
				Round	SPMR-01-2X-XX-XX	5.250	133.4	N/A	N/A			7,500	517.1	6,000	413.7	6,000	413.7	5000	344.7		
		1.500	38.1		Oval	SPMO-02-2X-XX	5.500	139.7	4.593			116.7	7,500	517.1	6,000	413.7	6,000	413.7	5000	344.7	RK RKP
				SPMO-02-2X-XX																	
				SPMO-02-2X-XX																	
				SPMO-02-2X-XX																	
				SPMO-02-2X-XX																	
		Round	SPMR-02-2X-XX-XX	5.500	139.7	N/A	N/A	7,500	517.1			6,000	413.7	6,000	413.7	5000	344.7				
3.500	88.9	1.000	25.4	Oval	SPMOI-01-3X-XX-XX	5.313	135.0	4.125	104.8	2.867	72.7	7,500	517.1	6,000	413.7	6,000	413.7	5000	344.7	BK-2 BEK-2 Integral	OK-1 Merla KOT-1
					SPMOI-01-3X-XX-XX													5000	344.7		
					SPMOI-01-3X-XX-XX													5000	344.7		
					SPMOI-01-3X-XX-XX													5000	344.7		
					SPMOI-01-3X-XX-XX													5000	344.7		
				Round	SPMR-01-3X-XX-XX	5.750	146.1	N/A	N/A			7,500	517.1	6,000	413.7	6,000	413.7	5000	344.7		
		1.500	38.1		Oval	SPMO-02-3X-XX-XX	5.968	151.6	5.000			127	7,500	517.1	6,000	413.7	6,000	413.7	5000	344.7	RK RKP
				SPMO-02-3X-XX-XX																	
				SPMO-02-3X-XX-XX																	
				SPMO-02-3X-XX-XX																	
				Round	SPMR-02-3X-XX-XX	6.468	164.3	N/A	N/A			7,500	517.1	6,000	413.7	6,000	413.7	5000	344.7		
		4.500	114.3	1.000	25.4	Oval	SPMOI-01-4X-XX-XX	6.437	163.5			5.500	139.7	3.833	97.4	7,500	517.1	6,000	413.7	6,000	413.7
SPMR-01-4X-XX-XX	6.625						168.3	N/A	N/A	7,500	517.1	6,000	413.7			6,000	413.7	5000	344.7		
1.500	38.1					Oval	SPMO-02-4X-XX-XX	7.031	178.6	6.080	154.4	7,500	517.1			6,000	413.7	6,000	413.7	5000	344.7
				SPMO-02-4X-XX-XX																	
				Round	SPMR-02-4X-XX-XX	7.531	191.3	N/A	7,500	517.1	6,000	413.7	6,000			413.7	5000	344.7			
					SPMR-02-4X-XX-XX																
5.500	139.7	1.500	38.1	Oval	SPMO-02-5X-XX-XX	7.938	201.6	6.812	173	4.653	118.2	7,500	517.1	6,000	413.7	6,000	413.7	5000	344.7	RK RKP	OM-1 KOT-2
					SPMO-02-5X-XX-XX							7,500	517.1	6,000	413.7	6,000	413.7	5000	344.7		
		Round	SPMR-02-5X-XX-XX	8.375	212.3	N/A	N/A	7,500	517.1			6,000	413.7	6,000	413.7	5000	344.7				
			SPMR-02-5X-XX-XX																		

Notes: Exact pressure ratings of an individual specification to confirmed by Penguin's representatives during RFQ stage

Slim hole type SPMs and other dimensions are available upon request

SPMO Series Side-Pocket Mandrels—Oval-Body

Penguin's SPMO Side Pocket Mandrel series comprises of forged pockets and with machined pockets, based on application requirement, boast an oval-body design and threaded connections for installation in the tubing string. These mandrels feature an offset side pocket from the bore of the tubing, which enables unrestricted full tubing drift during well-servicing operations. The side pocket includes profiles and seal bores that facilitate the installation of gas-lift and other flow-control devices, using a kickover tool that is run into the well through standard wireline techniques.

In addition, the SPMO series mandrels are equipped with an integral orienting sleeve, which aligns the kickover tool and flow control devices with the pocket for accurate installation in both straight and deviated wellbores. The SPMO series mandrels are further enhanced with a one-piece forged and machined pocket/deflector, based on well application, which guides the flow-control device into the pocket and deflects any tools larger than the pulling/running tool back into the tubing bore of the mandrel.



Application, Features, Advantages and Benefits

- Based on application these mandrels are designed for use in both straight and deviated wellbores, featuring machined as well as forged pockets and tool guards, 1- and 1 1/2-inch ID pockets, and integral orienting sleeves.
- The side-pocket design obviates the need to pull or rerun the tubing string for gas-lift valve installation or replacement, making the process much more efficient.
- By offsetting the side pocket from the tubing bore, the flow area is maximized, and full tubing drift is allowed for unrestricted well servicing operations through the mandrel.
- The oval-body mandrel design is particularly advantageous for dual-completion applications and helps to reduce overall running clearances.
- A tool guard is incorporated into the design to prevent damage to the gas-lift equipment by deflecting larger tools away from the flow-control device.
- Recessed opposing ports in the forged pocket prevent flow erosion and port blockage in the event that the mandrel pocket is positioned against the casing wall.
- The mandrel material is fully heat-treated to ensure optimal strength and corrosion resistance for its intended application.

- The one-piece forged pocket/deflector found in the SPMO series creates a smooth internal profile, which promotes the passage of wireline tools and minimizes flow turbulence in the pocket section.

SPMR Series Side-Pocket Mandrels— Round-Body

Penguin's SPMR series side-pocket mandrels are characterized by their round cross-sectional profile with machined swages, pockets, and tool guards, all of which are designed with threaded connections to enable installation in the tubing string. These mandrels possess a robust design that makes them suitable for use in applications where special dimensional requirements, premium alloy, and increased pressure and tensile-strength capabilities are necessary.

The side pocket's strategic location away from the tubing bore allows for unrestricted full tubing drift during well-servicing operations through the mandrel. This side pocket contains profiles and sealed bores that enable the installation of appropriate flow-control devices, such as gas-lift valves, through the use of a kickover tool that is run into the well using standard wireline techniques.

The SPMR series mandrels boast an integral orienting sleeve that aligns the kickover tool and flow-control device above the pocket for precise installation in both straight and deviated wellbores. Conversely, the SPMR series mandrels lack orienting sleeves and should only be installed in straight wellbores. These mandrels come with tool guards at the top of the pocket that deflect tools larger than the pulling/running tool back into the tubing bore to prevent damage to the valve latch.



The SPMR series mandrels feature 1-in. and 1 1/2-in. inside diameter (ID) pockets and are designed for installation in straight wellbores and also features integral orienting sleeves and tool guards that allow for installation in both straight and deviated wellbores.

Applications, Features, Advantages, and Benefits

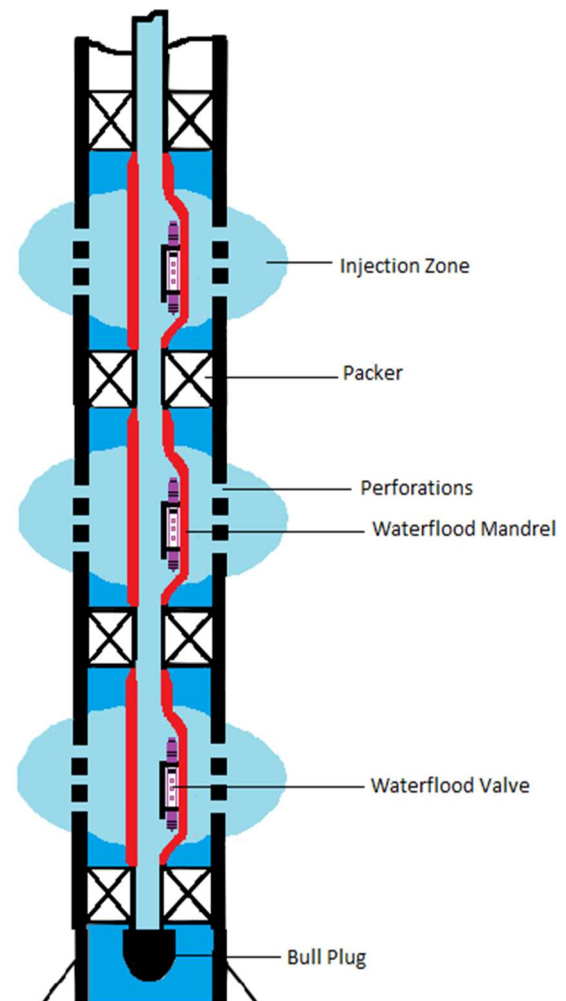
- SPMR series mandrels are utilized as internal receivers for gas-lift valves and other flow-control devices.
- These mandrels are typically used in single completions and can be used in standard, high-pressure, and corrosive service applications.

- The high-pressure design of SPMR series mandrels allows for their use in deep applications with high pressure and tensile ratings, making them suitable for demanding environments.
- The side pocket is strategically offset from the tubing bore to maximize the flow area and enable full tubing drift during well-servicing operations through the mandrel, without any restriction.
- By eliminating the need to pull or rerun the tubing string to install or replace gas-lift equipment, the side pocket design of these mandrels reduces operating costs.
- Machined pockets and tool guards prevent larger tools from damaging the valve latch and protect gas-lift equipment from potential damage.
- The slotted orienting sleeve ensures reliable installation and retrieval of gas-lift equipment in deviated wellbores by providing positive alignment of the kickover tool.
- Fully heat-treated mandrel materials provide the best combination of strength and corrosion resistance for the intended use.
- SPMR series mandrels are available with special-clearance outside diameters (OD), which makes them suitable for smaller-diameter casing where standard-diameter mandrels may not be practical, providing operational flexibility.

Waterflood-Injection System

Penguin's waterflood-injection systems are designed to provide operators with reliable and efficient injection rates for managing waterflood-injection performance. Our versatile systems consist of regulator valves and side-pocket mandrels, which work together to achieve an even and efficient sweep. For high-injection rate applications, our unique dual systems enable maximum rates with minimal casing wear. Conversely, for lower-rate applications, standardized system components can be interchanged with other products to provide increased operational convenience and dependability.

Our waterflood-injection systems are used worldwide for both single-zone and multiple-zone applications, and can accommodate tubing sizes ranging from 2-3/8 to 4-1/2 inches. In numerous field locations, hundreds of multiple-zone completions have been installed, with single-well injection rates of up to 10,000 barrels of water per day (bwpd).



Features, Advantages and Benefits

Penguin's waterflood systems offer a simple, reliable, and cost-effective solution that reduces operational complexity and expenses in several ways. These include the reduction of the number of injector wells and tubing strings, as well as the wellbore diameter. Additionally, our systems minimize the need for surface and completion equipment, stabilize surface injection pressure, and ensure consistent flow-rate at the injection zone.

Simple Design, Maximum Dependability

Penguin offers a comprehensive range of waterflood-injection systems, featuring a full spectrum of reverse-flow regulators for standard tubing-ported mandrels, standard-flow regulators for waterflood-ported mandrels, and exclusive dual regulators for specially ported waterflood mandrels. With injection rates spanning from 60 to 5,550 bwpd, our systems provide operators with a wide range of options to ensure successful waterflood management. Penguin also provides Annular/casing flow Side Pocket Mandrels for Casing through Tubing gas injection. Penguin's Waterflood Mandrels when equipped with special Rotate to Release Packers, provides perfect Injection Well completions. Penguin is also an API 11D1 licensed supplier of Packers.

Regulators and Valves (Under development):

- Dual and Standard Regulators
- Specialized Waterflood Valve
- Casing (annular) flow



Conventional Gas Lift Mandrels

PPSL manufactures tubing retrievable conventional gas lift mandrels. These mandrels are installed as an integral component of the tubing. The external ported lug of the mandrels is used to carry tubing retrievable gas lift and orifice valves.



Tubing Size	Mandrel Lug ID	Mandrel OD	Drift ID	Mandrel Length
2-3/8"	1.00	3.782	1.901	51
2-3/8"	1.50	4.282	1.901	51
2-7/8"	1.00	4.335	2.347	51
2-7/8"	1.50	4.835	2.347	51
3-1/2"	1.50	5.570	2.867	51

Gas Lift Valves

PPSL manufactures 1" and 1.5" Wireline-retrievable and Tubing-retrievable gas-lift valves for different well applications. We offer all 5 categories of gas lift valves including:

- Injection Pressure Operated Valves
- Production Pressure Operated Valves
- Orifice gas lift valves
- Dummy Valves
- Conventional Valves

All Gas Lift Valves leaving Penguin's facility are tested and validated as per API 19G2 Standards.

