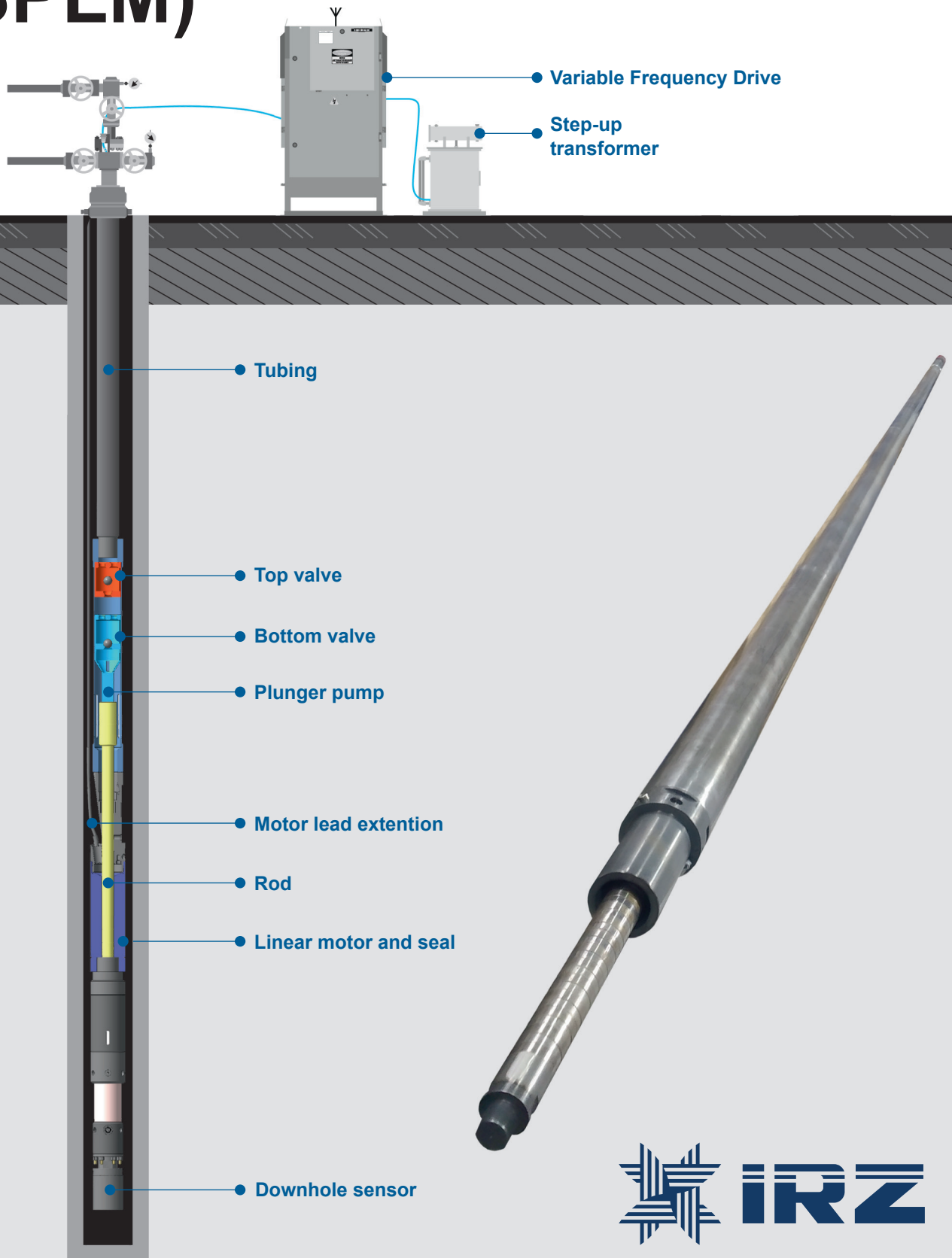


Submersible reciprocating pump unit with linear permanent magnet motor (SPLM)



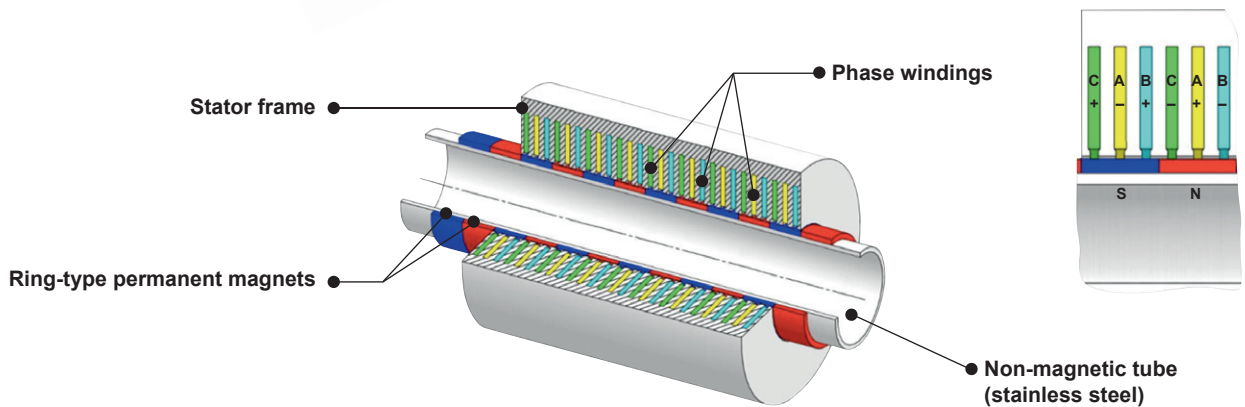


SPLM

**innovative solution
for low production rate wells**

Application

Oil production, monitoring of equipment and well parameters in horizontal, vertical, and deviated wells with 3-652 bpd (0.5 - 103 m³/day) production rate and up to 13700 ft (4190 m) depth.



Operation principle

The pump plunger is driven by a downhole linear permanent magnet motor installed below the pump. The linear motor comprises a fixed round stator and rod with permanent magnets. The stator consists of three-phase winding cylindrical coils that are connected in series and powered by a variable frequency drive. The stator coils generate a travelling magnetic field that induces an electromotive force to move the magnetic slider which pushes the plunger pump rod.

SPLM advantages

- no failures caused by rod twisting, breakout, corrosion, and wear of rods and tubing
- suitable for operation in severe environment with low permeability, and in marginal wells
- easy onsite assembling
- lower maintenance costs
- smooth adjustment of length and number of strokes per minute
- average efficiency is 60-90% higher compared with other pumping systems
- energy consumption is 30-80% lower compared with other pumping systems
- suitable for high pressure wells – up to 30-60 MPa
- high withstanding voltage – tested at 3000 V, 50 Hz, 200 °C within 1 minute
- high insulation resistance – 100 MOhm at 2500 V
- option for remote control

Technical specification

| Parameter | Value | |
|---|---|---|
| Power | 35 kW | |
| Traction force | 2.4 ton | |
| Voltage | 900 V | |
| Maximum output current | 35-50 A | |
| Pump flowrate range | 3-652 bpd (0.5-103 m ³ /day) | |
| Overall dimensions (motor +pump +dh sensor) | Ø 4.6" * 55.7 ft (Ø 117 mm * 17 m) | Ø 4.6" * 60.4 ft (Ø 117 mm * 18.4 m) |
| Slider stroke | 4.03 ft (1230 mm) | |
| Operating temperature | 0...+ 150 °C (0 ... 300 °F) | |

Comparative characteristics of SPLM, ESP, SRP and PCP systems

SPLM is an economically viable, power efficient, and environmentally friendly version of a sucker-rod pumping system. Unlike PCP and SRP, SPLM can be used at depths over 6400 ft (2000 m), as well as in deviated and horizontal wells. Moreover, SPLM can effectively substitute ESP in low production rate wells without replacement of the infrastructure.

| | PCP | Rod Pumps | ESP | SPLM |
|---|---------------------------------------|---|---------------------------------------|--|
| Structure | Rod (Abrasion) | Rod (Abrasion) | Motor Rotary | Rodless (no Abrasion) |
| Suitable for deviated or horizontal wells | no | no | yes | yes |
| Wellhead infrastructure installations | required | required | not required | not required |
| Production | <400 bpd (<60 m ³ /day) | <1200 bpd (<200 m ³ /day) | >190 bpd (>30 m ³ /day) | <652 bpd (<103 m ³ /day) |
| Operating mode | continuous | continuous | periodic | continuous |
| Running depth | < 4900 ft (<1500 m) | <6400 ft (<2000 m) | <10000 ft (<3000 m) | <4190 ft (<4190 m) |
| Specific energy consumption (kW/ton) | 2.56 kWh/barrel (16 kWh/ton) | 3.2 kWh/barrel (20 kWh/ton) | 1.6 kWh/barrel (10 kWh/ton) | 1.28 kWh/barrel (8 kWh/ton) |

Criteria for selecting SPLM systems

- flow rate 3-315 bpd (0.5 - 50 m³/day), marginal wells
- pump installation depth up to 13000 ft (4000 m)
- directional and deviated wells and wells with periodic injection programs requiring intermittent flow rate adjustment
- limited electric power

SPLM system includes

- VFD with a step-up transformer
- power cable
- reciprocating (plunger) pump
- linear motor
- downhole sensor
- Universal digital downhole sensor installed below the motor allows for real-time reading of:
 - pump intake pressure
 - pump intake temperature
 - motor temperature
 - motor vibrations
 - motor and power cable insulation resistance

The system is arranged with variable frequency drive which, along with the digital downhole sensor, helps to increase oil production and protect the motor thanks to:

- **smart control modes**
- **building up load curves, evaluation of pump fill and flow rates**
- **continuous analysis of loads to determine optimal SPM**
- **medium monitoring (asphalt, resin and paraffin deposits, gas, viscosity, etc.) and prompt response to emergency situations**

The variable frequency drive ensures easy and convenient adjustment of well operating parameters, as well as remote monitoring and control of oil production process.

The combination of motor, pump and VFD is selected according to the depth, production rate, viscosity, and other parameters of a well.



SPLM Application Matrix

| | | PLUNGER DIAMETER. STROKE LENGTH 4 FT (1260 MM). 12/16 STROKES PER MINUTE | | | | | |
|--|----------------------------|--|---|---|---|---|--|
| | | 1 1/16" (27 mm) | 1 1/4" (31.8 mm) | 1 1/2" (38.1 mm) | 1 3/4" (44.5 mm) | 2 1/4" (57.2 mm) | 2 3/4" (69.9 mm) |
| Pump setting depth at maximum tractive effort | $\rho = 1 \text{ t/m}^3$ | 4190 m (13700 ft) | 3020 m (9900 ft) | 2100 m (6880 ft) | 1540 m (5050 ft) | 930 m (3050 ft) | 625 m (2050 ft) |
| | $\rho = 1.5 \text{ t/m}^3$ | 2790 m (9150 ft) | 2015 m (6600 ft) | 1400 m (4590 ft) | 1030 m (3370 ft) | 620 m (2030 ft) | 410 m (1240 ft) |
| Production rate at filling factor 1 (ideal conditions) | 12 spm | 12.1 m ³ /day (72.6 bpd) | 17 m ³ /day (102 bpd) | 24 m ³ /day (144 bpd) | 32.3 m ³ /day (193.8 bpd) | 54.6 m ³ /day (327.6 bpd) | 81.5 m ³ /day (489 bpd) |
| | 16 spm | 16.2 m ³ /day (97.2 bpd) | 22.8 m ³ /day (136.8 bpd) | 32.1 m ³ /day (192.6 bpd) | 43 m ³ /day (258 bpd) | 72.8 m ³ /day (436.8 bpd) | 108.7 m ³ /day (652.2 bpd) |

Contacts

Julia DETKOVA

Head of International Sales Department

Tel: +7 3412 662 660

Email: detkova@irz.ru

Sergey MKRTCHYAN

Business Development Manager

Tel: +7 3412 501 189

Email: ss.mkrтчyan@irz.ru

IRZ

19 Bazisnaya street

Izhevsk, Russia

426034

Tel / fax: + 7 3412 501 501 / 686 555

Email: sales@irz.ru

Web: oil.irz.ru