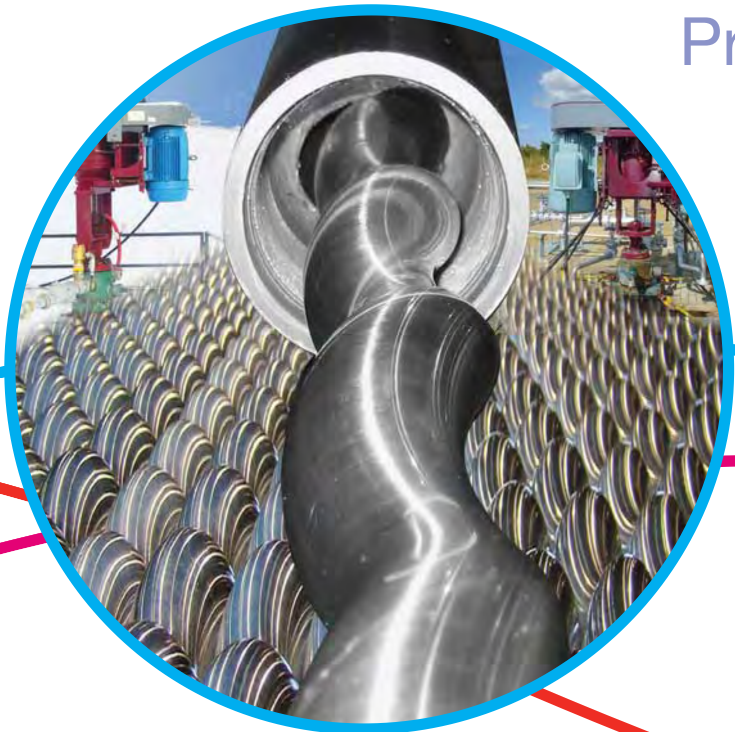
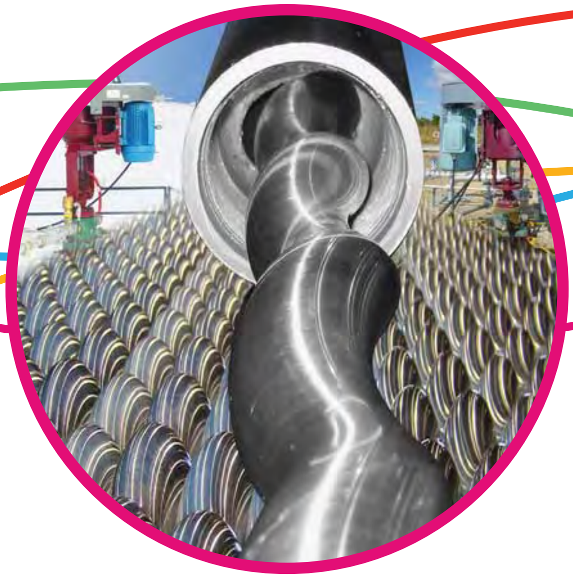
# Artificial Lift

## Progressing Cavity Pumps



NOV Monoflo®

One Company, Unlimited Solutions



NOV Monoflo is a leading name in the design, manufacture and supply of progressing cavity pumps, grinders, screens and packaged solutions worldwide. We have 8 international sites and a global distribution network, as well as over 70 years experience in providing a range of products for multiple application requirements of today's industries.

Our strong heritage and global success is recognised and supported by our parent company National Oilwell Varco (NOV), who are world leaders in the oil and gas industry.

The NOV Monoflo line of downhole progressing cavity pumps (PC Pumps) are designed for use in both oil and coal bed methane recovery applications where the economics of oil and gas production demand efficiency, reliability and low life cycle cost from the pumping equipment.

## Production Solutions

Our state of the art production facility is equipped with pump test benches, lathes and welding facilities to ensure fast turnaround times. Monoflo offers several types of state of the art progressing cavity pumping systems designed for specific applications:

- Heavy crude (aggressive geometry)
- Coal bed methane (specialised elastomers)
- Patented insert progressing cavity pumping system
- Patented multi-intake pumps (for increased intake area)
- Charge pumps (for high gas applications)
- Exclusive distributorship of the perforated stator
- Exclusive distributorship of the hollow rotor

## Performance by Design

Rotors are available in alloy steel (4140) with hard chrome plating which provides resistance to abrasion and wear. Through the use of advanced manufacturing technology and modern production techniques, finite machining and plating of the rotor profile is maintained, ensuring that the design performance is always achieved.

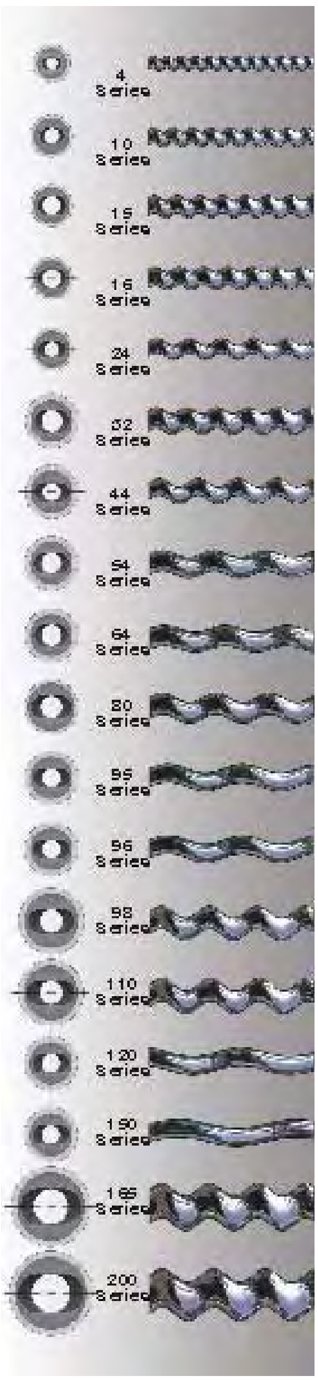
### A range of stator elastomers are available allowing the pump to be selected for many downhole fluid conditions:

| ELASTOMER | ELASTOMER TYPE | GENERAL DESCRIPTION AND APPLICATION | TEMPERATURE LIMIT (°C) | WEAR RESISTANCE | H2S RESISTANCE | CO2 RESISTANCE | AROMATICS RESISTANCE | WATER RESISTANCE | HARDNESS (SHORE A) |
|---|---|---|---|---|---|---|---|---|---|
| **Buna "L" (OD)** | Medium Nitrile | The Buna "L" (OD has a lower durometer rating than Buna Nitrile (RR) with a medium acrylonitrile content with good soil and solvent resistance. It has excellent abrasion resistance and mechanical properties and is typically used in abrasive and high water cut applications with lower aromatic content. | 90 | Excellent | Fair | Fair | Poor | Excellent | 60-65 |
| **Buna Nitrile (RR)** | Buna Nitrile | Buna Nitrile (RR) has a medium acrylonitrile content with good oil and solvent resistance. It has excellent abrasion resistance and mechanical properties. It is typically used in abrasive and high water cut applications with lower aromatic content. | 100 | Excellent | Good | Good | Good | Excellent | 68-72 |
| **High Nitrile (OB)** | High Nitrile | High Nitrile (OB) has a high acrylonitrile content with improved oil and solvent resistance and good mechanical properties. It tends to be used for higher aromatic content applications. | 100 | Good | Good | Good | Excellent | Excellent | 70-75 |
| **Hydrogenated Nitrile (OC)** | Hydrogenated Nitrile | Hydrogenated Nitrile (OC) has a high acrylonitrile content with similar properties to High Nitrile (OB), but with improved resistance to hydrogen sulphide ($H_2S$) | 100 | Good | Excellent | Excellent | Excellent | Good | 68-72 |

Please see below a table outlining our progressing cavity pump specifications. For further details please contact your local NOV Monoflo representative.

## Progressing Cavity Pump Specifications

| PUMP | | | | | STATOR | | | | | ROTOR | | | | APPLICATION | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PC Pump Series | | Displacement | Lift Capacities | | Top Connection EUE | Max O.D. | Tag Bar Distance | Length | Weight | Top Connection API Pin | Max O.D. | Length | Weight | Can Run In | Can Run In | Coil Past |
| *Metric* | *Imperial* | *Bbl/Day/100 RPM* | *psi* | *ft* | *in* | *in* | *in* | *in* | *lbs* | *in* | *in* | *in* | *lbs* | 2⅞" Tbg | 3½" Tbg | 3½" Tbg |
| 4-1200 | 25-4100 | 25 | 1800 | 4100 | 2⅞ Pin | 3.1 | 6 | 95 | 80 | ¾ Pin | 1.28 | 103 | 24 | x | x | x |
| 4-1800 | 25-6000 | 25 | 2600 | 6000 | | | | 142 | 120 | | | 150 | 33 | | | |
| 10-1200 | 60-4100 | 60 | 1800 | 4100 | 2⅞ Box | | | 131 | 139 | | | 146 | 53 | | | |
| 10-1500 | 60-5000 | 60 | 2150 | 5000 | Or | 3.5 | 17 | 163 | 174 | ⅞ Pin | 1.68 | 178 | 66 | x | x | x |
| 10-1800 | 60-6000 | 60 | 2600 | 6000 | 3½ Box | | | 197 | 209 | | | 212 | 77 | | | |
| 10-2400 | 60-8000 | 60 | 3400 | 8000 | | | | 262 | 278 | | | 277 | 106 | | | |
| 15-1400 | 95-4600 | 95 | 2000 | 4600 | 2⅞ Box | | | 172 | 190 | | | 187 | 68 | x | | |
| 15-1800 | 95-6000 | 95 | 2600 | 6000 | Or | 3.5 | 17 | 215 | 245 | ⅞ Pin | 1.92 | 231 | 88 | If 3½" handling | x | x |
| 15-2000 | 95-6600 | 95 | 2900 | 6600 | 3½ Box | | | 237 | 270 | | | 253 | 98 | pump is used | | |
| 16-1200 | 100-4100 | 100 | 1800 | 4100 | 2⅞ Box | | | 158 | 167 | | | 174 | 62 | | | |
| 16-1500 | 100-5000 | 100 | 2150 | 5000 | Or | 3.5 | 17 | 197 | 208 | ⅞ Pin | 1.95 | 211 | 78 | x | x | x |
| 16-1800 | 100-6000 | 100 | 2600 | 6000 | 3½ Box | | | 137 | 250 | | | 252 | 90 | | | |
| 16-2400 | 100-8000 | 100 | 3400 | 8000 | | | | 316 | 334 | | | 332 | 124 | | | |
| 24-1200 | 150-4100 | 150 | 1800 | 4100 | 2⅞ Box | | | 211 | 222 | | | 225 | 83 | | | |
| 24-1500 | 150-5000 | 150 | 2150 | 5000 | Or | 3.5 | 17 | 263 | 278 | ⅞ Pin | 1.79 | 277 | 78 | x | x | x |
| 24-1800 | 150-6000 | 150 | 2600 | 6000 | 3½ Box | | | 316 | 334 | | | 330 | 90 | | | |
| 32-900 | 200-3100 | 200 | 1350 | 3100 | | | | 161 | 260 | | | 177 | 108 | | | |
| 32-1200 | 200-4100 | 200 | 1800 | 4100 | 3½ Box | 4.5 | 17 | 214 | 347 | 1" Pin | 2.27 | 230 | 141 | x | x | |
| 32-1500 | 200-5000 | 200 | 2150 | 5000 | | | | 269 | 433 | | | 284 | 180 | | | |
| 32-1800 | 200-6000 | 200 | 2600 | 6000 | | | | 322 | 520 | | | 338 | 207 | | | |
| 44-1400 | 280-4600 | 280 | 2000 | 4600 | 3½ Box | | | 252 | 520 | | | 265 | 207 | | | |
| 44-1800 | 280-6000 | 280 | 2600 | 6000 | w/2' Weld Ext. | 4.5 | 17 | 303 | 650 | 1" Pin | 2.2 | 317 | 266 | x | x | |
| 44-2100 | 280-6900 | 280 | 3000 | 6900 | | | | 279 | 780 | | | 394 | 326 | | | |
| 54-900 | 340-3100 | 340 | 1350 | 3100 | | | | 242 | 260 | | | 257 | 108 | | | |
| 54-1200 | 340-4100 | 340 | 1800 | 4100 | 3½ Box | 4.5 | 17 | 322 | 520 | 1" Pin | 2.3 | 338 | 213 | x | x | |
| 54-1500 | 340-5000 | 340 | 2150 | 5000 | | | | 403 | 650 | | | 418 | 266 | | | |
| 54-1800 | 340-6000 | 340 | 2600 | 6000 | | | | 484 | 780 | | | 499 | 326 | | | |
| 64-800 | 400-2700 | 400 | 1150 | 2700 | | | | 242 | 488 | | | 257 | 160 | | | |
| 64-1040 | 400-3500 | 400 | 1500 | 3500 | 3½ Box | 4.5 | 17 | 322 | 650 | 1" Pin | 2.26 | 338 | 213 | x | x | |
| 64-1300 | 400-4400 | 400 | 1900 | 1100 | | | | 403 | 813 | | | 418 | 266 | | | |
| 64-1560 | 400-5350 | 400 | 2200 | 5100 | | | | 484 | 975 | | | 499 | 320 | | | |
| 80-800 | 500-2700 | 500 | 800 | 2700 | | | | 225 | 357 | | | 193 | 117 | | | |
| 80-1200 | 500-4100 | 500 | 1200 | 4100 | 3½ Box | 4.5 | 17 | 314 | 610 | 1⅛" Pin | 2.58 | 282 | 175 | | x | |
| 80-1600 | 500-5300 | 500 | 1600 | 5300 | | | | 426 | 714 | | | 372 | 235 | | | |
| 80-1800 | 500-6000 | 500 | 1800 | 6000 | | | | 470 | 714 | | | 416 | 235 | | | |
| 96-800 | 600-2700 | 600 | 1150 | 2700 | 3½ Box | | | 289 | 535 | | | 278 | 176 | | | |
| 96-1040 | 600-3500 | 600 | 1500 | 3500 | x 2' Weld Ext. | 4.5 | 17 | 378 | 713 | 1" Pin | 2.29 | 367 | 235 | x | x | |
| 96-1300 | 600-4400 | 600 | 1900 | 4400 | | | | 466 | 891 | | | 455 | 294 | | | |
| 120-800 | 755-2700 | 755 | 1150 | 2700 | 3½ Box | | | 354 | 713 | | | 367 | 235 | | | |
| 120-1000 | 755-3400 | 755 | 1500 | 3400 | x 2' Weld Ext. | 4.5 | 17 | 442 | 891 | 1" Pin | 2.27 | 455 | 293 | x | x | |
| 120-1200 | 755-4100 | 755 | 1800 | 4100 | | | | 531 | 1070 | | | 544 | 353 | | | |
| 150-600 | 940-2000 | 940 | 850 | 2000 | 3½ Box | | | 378 | 713 | | | 367 | 235 | | | |
| 150-750 | 940-2500 | 940 | 1100 | 2500 | x 2' Weld Ext. | 4.5 | 17 | 466 | 891 | 1" Pin | 2.26 | 455 | 293 | x | x | |
| 150-900 | 940-3100 | 940 | 1350 | 3100 | | | | 555 | 1070 | | | 544 | 353 | | | |




## The Pumping Principle

The progressing cavity pump is ideally suited to the demands of pumping downhole fluids. At the heart of the downhole PC pump lies the pumping elements, consisting of a hard steel rotor, usually in the form of a single external helix of circular section, and a stator with the internal form of a two-start helix.

The stator is manufactured from a resilient, abrasion-resistant elastomer, bonded inside an alloy steel tube and is selected to be compatible with the specified well fluids. When the rotor is placed inside the stator a series of sealed cavities are formed.

As the rotor turns, these cavities progress from the suction end of the progressing pump up to the discharge end, positively transporting the well fluid through the pump and up the tubing string to the surface, without pulsation.

The fluid flow rate is directly proportional to speed of rotation. Therefore the pump can be closely matched to the well inflow rate for optimum productions.

The constantly sweeping seal line between the stator and rotor prevents a build up of solids within the pump. Entrained gas or suspended solids can also pass through the pump without causing gas locking or pump blockage.

## Features & Benefits

When compared to alternative artificial lift methods, PC pumps have many benefits for the operator:

### Lower Capital Cost

The lack of expensive foundations, the simple construction and the compact surface drive unit minimizes start-up costs. Alternatively, for the same capital outlay more pumps can be installed and more oil recovered.

### Lower Running Cost

Typically a PC pump has an overall efficiency rating of 70% or more, which is significantly higher than alternative lift methods such as electric submersible pumps or beam pumps. The cost per barrel of fluid recovered is reduced.

### Reliability

The simple construction has no standing or travelling valves to block, and only one moving part downhole. The pump handles gas and solids without blocking and is more resistant to abrasive wear.

### More Environmentally Acceptable Profile

The low, unobtrusive profile of the quiet running surface drivehead makes the PC pump more acceptable in environmentally sensitive areas.

**Europe**

Mono Pumps Ltd, Martin Street, Audenshaw
Manchester, M34 5JA, England
T. +44 (0)161 339 9000
E. info@mono-pumps.com

D.M.I EST, 56 rue du Pont
88300 Rebeuville, France
T. +33 (0)3 29 94 26 88
E. dmi-est@dmi-est.fr

**Americas**

NOV Monoflo, 9606 Kirkton
Houston, Texas 77095, USA
T. +1 281 200 1200
E. inquire@monoflo.com

Monoflo S.A., Ing Huergo 2239
(1842) Monte Grande
Pcia. de Buenos Aires, Argentina
T. +54 11 4290 9940/50
E. info@monoflo.com.ar

Monoflo Canada., 5702 63rd Ave
Alberta, Lloydminster
Canada, T9V0Y4
T. +1 (780) 8755504
F. +1 (780) 8758584
E. info.monoflo@nov.com

**Australasia**

Mono Pumps (Australia) Pty Ltd
Mono House, 338-348 Lower Dandenong Road
Mordialloc, Victoria 3195, Australia
T. +1800 333 138
E. ozsales@mono-pumps.com

Mono Pumps (New Zealand) Ltd
PO Box 71-021, Fremlin Place, Avondale
Auckland 7, New Zealand
T. +64 (0)9 829 0333
E. info@mono-pumps.co.nz

**Asia**

Mono Pumps Ltd, No. 500 YaGang Road
Lujia Village, Malu, Jiading District
Shanghai 201801, P.R. China
T. +86 (0)21 5915 7168
E. monoshanghai@nov.com

**www.mono-pumps.com**



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