FEATURES

The C2 21/28 Series is a family of variable displacement axial piston pumps for use in closed circuits. The displacement is continuously variable by means of a tilting swash plate and the oil flow direction is reversible.

The following range of controls are available:
- Automotive
- Hydraulic proportional without feed-back
- Hydraulic proportional with feed-back
- Manual lever with feed-back
- Manual with zeroing
- Electric two position (ON-OFF)
- Electric impulse
- Electric proportional with feed-back
- Electric proportional without feed-back

Peak operations must not exceed 1% of every minute. A simultaneous maximum pressure and maximum speed are not recommended.

TECHNICAL DATA

<table>
<thead>
<tr>
<th>SERIES</th>
<th>C2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displacement (^{(1)})</td>
<td>21 - 28 (1.28 - 1.71)</td>
</tr>
<tr>
<td>Connection flange</td>
<td>SAE 'B'</td>
</tr>
<tr>
<td>Charge pump displacement</td>
<td>11 (0.671)</td>
</tr>
<tr>
<td>Maximum speed (^{(2)})</td>
<td>3600 rpm</td>
</tr>
<tr>
<td>Minimum speed</td>
<td>700 rpm</td>
</tr>
<tr>
<td>Rated pressure (\text{bar/psi})</td>
<td>250 (3635)</td>
</tr>
<tr>
<td>Peak pressure (\text{bar/psi})</td>
<td>350 (5009)</td>
</tr>
<tr>
<td>Charge pressure (\text{bar/psi})</td>
<td>15-25 (standard 20)</td>
</tr>
<tr>
<td></td>
<td>(218+363) (standard 290)</td>
</tr>
<tr>
<td>Maximum case pressure (\text{bar/psi})</td>
<td>2 (29)</td>
</tr>
<tr>
<td>Suction pressure (\text{bar/psi})</td>
<td>≥ 0.8 (≥ 11.6)</td>
</tr>
<tr>
<td>Moment of inertia rotating parts (\text{kg m}^2/\text{lb ft}^2)</td>
<td>0.0018 (0.042)</td>
</tr>
<tr>
<td>Weight (approx.) (\text{kg/lb})</td>
<td>27 (48.5)</td>
</tr>
</tbody>
</table>

Notes:
(1) The displacements 21/28 use the same external casing.
(2) The values shown are valid for an absolute pressure (pass) of 1 bar (14.5 psi) at the suction inlet port and when operated on mineral oil.
## 1 - SERIES

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C2</td>
<td>Variable displacement axial piston pump for closed circuit “MEDIUM PRESSURE”</td>
</tr>
</tbody>
</table>

## 2 - DISPLACEMENT

<table>
<thead>
<tr>
<th>Code</th>
<th>Displacement</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>21 cm³</td>
</tr>
<tr>
<td>28</td>
<td>28 cm³</td>
</tr>
</tbody>
</table>

## 3 - CONTROLS

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM2</td>
<td>Automotive 12V</td>
</tr>
<tr>
<td>AM4</td>
<td>Automotive 24V</td>
</tr>
<tr>
<td>IND</td>
<td>Hydraulic proportional without feed-back</td>
</tr>
<tr>
<td>INP</td>
<td>Hydraulic proportional without feed-back</td>
</tr>
<tr>
<td>E12</td>
<td>Electric impulse 12V</td>
</tr>
<tr>
<td>E14</td>
<td>Electric impulse 24V</td>
</tr>
<tr>
<td>IRX</td>
<td>Hydraulic proportional with feed-back</td>
</tr>
<tr>
<td>LRX</td>
<td>Manual lever with feed-back</td>
</tr>
<tr>
<td>LNX</td>
<td>Manual with zeroing</td>
</tr>
<tr>
<td>LWX</td>
<td>Manual without zeroing</td>
</tr>
<tr>
<td>E22</td>
<td>Electric two position ON-OFF 12V</td>
</tr>
<tr>
<td>E24</td>
<td>Electric two position ON-OFF 24V</td>
</tr>
<tr>
<td>ER2</td>
<td>Electric proportional with feed-back 12V</td>
</tr>
<tr>
<td>ER4</td>
<td>Electric proportional with feed-back 24V</td>
</tr>
<tr>
<td>EP2</td>
<td>Electric proportional without feed-back 12V</td>
</tr>
<tr>
<td>EP4</td>
<td>Electric proportional without feed-back 24V</td>
</tr>
<tr>
<td>EH2</td>
<td>Electric proportional with feed-back 12V &amp; Hydraulic proportional with feed-back</td>
</tr>
<tr>
<td>EH4</td>
<td>Electric proportional with feed-back 24V &amp; Hydraulic proportional with feed-back</td>
</tr>
</tbody>
</table>
## 4 - THROUGH DRIVE

<table>
<thead>
<tr>
<th></th>
<th>SHAFT END</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Without through drive with charge pump</td>
</tr>
<tr>
<td>2</td>
<td>Without through drive without charge pump</td>
</tr>
<tr>
<td>3</td>
<td>SAE A = Z9 - 16/32 DP with charge pump</td>
</tr>
<tr>
<td>4</td>
<td>SAE B = Z13 - 16/32 DP with charge pump</td>
</tr>
<tr>
<td>5</td>
<td>Pump combination (Short version)</td>
</tr>
<tr>
<td>6</td>
<td>SAE A = Z9 - 16/32 DP without charge pump</td>
</tr>
<tr>
<td>7</td>
<td>SAE B = Z13 - 16/32 DP without charge pump</td>
</tr>
<tr>
<td>8</td>
<td>Pump combination c/w through drive SAE A = 9T - 16/32 DP (C1)</td>
</tr>
<tr>
<td>9</td>
<td>Pump combination c/w through drive SAE B = 13T - 16/32 DP (C2) (C3)</td>
</tr>
<tr>
<td>10</td>
<td>SAE B-B = Z15 - 16/32 DP</td>
</tr>
</tbody>
</table>

Note: (1) With coupling Internal Splined T13 / Internal Splined T15

## 5 - PRESSURE RELIEF VALVE

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>140 bar - (2030 psi)</td>
</tr>
<tr>
<td>17</td>
<td>170 bar - (2465 psi)</td>
</tr>
<tr>
<td>21</td>
<td>210 bar - (3045 psi)</td>
</tr>
<tr>
<td>25</td>
<td>250 bar - (3625 psi) (Standard)</td>
</tr>
<tr>
<td>30</td>
<td>300 bar - (4350 psi)</td>
</tr>
<tr>
<td>35</td>
<td>350 bar - (5075 psi)</td>
</tr>
</tbody>
</table>

## 6 - DIRECTION OF ROTATION

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>CW</td>
</tr>
<tr>
<td>L</td>
<td>CCW</td>
</tr>
</tbody>
</table>
7 - SHAFT END

<table>
<thead>
<tr>
<th></th>
<th>Single</th>
<th>1a Tandem</th>
<th>2a Tandem</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(1)</td>
<td>Splined T9-16/32-DP / Splined T9-16/32-DP (SAE A)</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>2(2)</td>
<td>Splined T9-16/32-DP / Bosch</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>3(3)</td>
<td>Internal splined T9-16/32-DP / Tandem Bosch</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>4(4)</td>
<td>Internal splined T9-16/32-DP / Tandem</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>5(5)</td>
<td>Round shaft Ø15.88 / Splined T9-16/32-DP</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>6(6)</td>
<td>Round shaft Ø24 / Splined T9-16/32-DP</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

Note:
(1) Used for Single pump.
(2) Used for first pump Tandem 21/28 + 14/18 with through drive SAE A.
(3) Used for second pump Tandem 21/28 + 21/28.
(4) Used for second pump Tandem 50/64 + 21/28.
(2) Used for first pump Tandem 21/28 + 21/28 short version.
(3) Used for Single pump with through drive SAE B.
(4) Used for first pump Tandem 21/28 + 21/28 with through drive SAE B.
(5) Used for second pump Tandem 50/64 + 21/28 with through drive SAE B.
(4) Used for second pump Tandem 21/28 + 21/28 short version.
(5) Used for Single pump with through drive SAE A.

8 - PORTS

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>G</td>
<td>Metric (BSPP Threads)</td>
</tr>
<tr>
<td>U</td>
<td>SAE (UNF Threads)</td>
</tr>
</tbody>
</table>

9 - OPTIONS

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>Without options</td>
</tr>
<tr>
<td>AC</td>
<td>C.T. Distribution (Motor swash plate)</td>
</tr>
<tr>
<td>FI</td>
<td>With Filter</td>
</tr>
<tr>
<td>FE</td>
<td>Filter with Electric sensor</td>
</tr>
<tr>
<td>FR</td>
<td>Remote mounted filter</td>
</tr>
<tr>
<td>01</td>
<td>Power Limiter</td>
</tr>
<tr>
<td>P1</td>
<td>Electric Cut-Off Valve 12V</td>
</tr>
<tr>
<td>P2</td>
<td>Electric Cut-Off Valve 24V</td>
</tr>
<tr>
<td>VS</td>
<td>Exchange Valve</td>
</tr>
<tr>
<td>II</td>
<td>Hydraulic inching</td>
</tr>
<tr>
<td>IM</td>
<td>Mechanical inching</td>
</tr>
</tbody>
</table>

10 - SPECIAL VERSIONS
AUTOMOTIVE CONTROL - AM2 / AM4

The automotive control pump has the function of automatically adapting the displacement to the variation in the number of revolutions of the pump (and thus of the diesel engine); set the number of revolutions at which the machine starts up and limit the power absorbed by the transmission to the diesel engine output. The inching valve (variable restrictor) is available as an option, with mechanical or hydraulic control versions.

**HYDRAULIC INCHING**

### Direction of rotation:
Correlation between direction of rotation (shaft view) control and direction of flow.

<table>
<thead>
<tr>
<th>SHAFT ROTATION</th>
<th>PUMP FLOW DIRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Energised Solenoid</td>
</tr>
<tr>
<td>(L)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td>(R)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>
AXIAL PISTON PUMPS
VARIABLE DISPLACEMENT
C2 21/28
SERIES

SECTION 8.264

PUMP AND CONTROL DIMENSION - AM2 / AM4

**METRIC Version**

A – B: Pressure ports – 3/4 G
D1 – D2: Drain port – 1/2 G
S: Suction port – 3/4 G
P: Charge pressure port – ½-16 UNF-2B -> ¼ G
Va: Charge pump valve
V1 – V2: Maximum pressure valves
St: Stroke limiter
Zm: Mechanical zero adjustment screw
p: Charge pressure ports – 1/8 G
Pr: Inching In – 1/8 G
Lp: Power control adjusting screw
Pm: Machine start-up regulation screw
P1r: Minimum charge pressure adjusting screw
P2: Piloting pressure port – ½ "G
P A-B: High pressure port (A-B) – 3/4 "G

**SAE Version**

A – B: Pressure ports – 7/8-14 UNF-2B
D1 – D2: Drain port – 3/4-16 UNF-2B
S: Suction port – 1 1/16 UNF-2B
P: Charge pressure port – ½-16 UNF-2B -> 7/16-20 UNF-2B
Va: Charge pump valve
V1 – V2: Maximum pressure valves
St: Stroke limiter
Zm: Mechanical zero adjustment screw
p: Charge pressure ports – 3/8-24 UNF-2B
Pr: Inching In – 3/8-24 UNF-2B
Lp: Power control adjusting screw
Pm: Machine start-up regulation screw
P1r: Minimum charge pressure adjusting screw
P2: Piloting pressure port – 7/16-20 UNF-2B
P A-B: High pressure port (A-B) – 7/16-20 UNF-2B
The automotive control pump has the function of automatically adapting the displacement to the variation in the number of revolutions of the pump (and thus of the diesel engine); set the number of revolutions at which the machine starts up and limit the power absorbed by the transmission to the diesel engine output. The inching valve (variable restrictor) is available as an option, with mechanical or hydraulic control versions.

**MECHANICAL INCHING**

**Direction of rotation:** Correlation between direction of rotation (shaft view) control and direction of flow.

<table>
<thead>
<tr>
<th>SHAFT ROTATION</th>
<th>Energised Solenoid</th>
<th>Pressure Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>(L)</td>
<td>1</td>
<td>B</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>(R)</td>
<td>1</td>
<td>A</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>B</td>
</tr>
</tbody>
</table>
**AXIAL PISTON PUMPS**

**VARIABLE DISPLACEMENT**

**C2 21/28 SERIES**

**PUMP AND CONTROL DIMENSION - AM2 / AM4**

**METRIC Version**

A – B: Pressure ports – 3/4 G

D1 – D2: Drain port – 1/2 G

S: Suction port – 3/4 G

P: Charge pressure port – 1/16 UNF-2B -> 1/4 G

Va: Charge pump valve

V1 – V2: Maximum pressure valves

Sl: Stroke limiter

Zm: Mechanical zero adjustment screw

p: Charge pressure ports – 1/8 G

p1: a – b piloting ports – 1/4 G

Pi: Inch In – 1/8 G

Pl: Power control adjusting screw

Pm: Machine start-up regulation screw

P1r: Minimum charge pressure adjusting screw

P2: Piloting pressure port – 1/4 "G

P A-B: High pressure port (A-B) – 1/4 "G

**SAE Version**

A – B: Pressure ports – 7/8-14 UNF-2B

D1 – D2: Drain port – 3/4-16 UNF-2B

S: Suction port – 1 1/16 UNF-2B

P: Charge pressure port – 1/16 UNF-2B -> 7/16-20 UNF-2B

Va: Charge pump valve

V1 – V2: Maximum pressure valves

Sl: Stroke limiter

Zm: Mechanical zero adjustment screw

p: Charge pressure ports – 3/8-24 UNF-2B

p1: a – b piloting ports – 7/16-20 UNF-2B

Pi: Inch In – 3/8-24 UNF-2B

Pl: Power control adjusting screw

Pm: Machine start-up regulation screw

P1r: Minimum charge pressure adjusting screw

P2: Piloting pressure port – 7/16-20 UNF-2B

P A-B: High pressure port (A-B) – 7/16-20 UNF-2B
HYDRAULIC PROPORTIONAL WITHOUT FEED-BACK CONTROL - IND

The pump displacement is proportional to the pilot pressure on “a” or “b” piloting ports, which also affect flow direction. Feeding pressure to the control joystick can be provided by charge pressure from p port. The piloting pressure must then be controlled by said joystick or by a pressure reducing valve (not supplied).

Pilot pressure = 4÷16 bar [58÷232 psi]
(at ports a,b)

Start of control = 4 bar [58 psi]
End of control = 16 bar [232 psi]
(Maximum displacement)
Max pressure = 30 bar [435 psi]

Direction of rotation: Correlation between direction of rotation (shaft view) control and direction of flow.

<table>
<thead>
<tr>
<th>SHAFT ROTATION</th>
<th>Piloting Pressure</th>
<th>Pressure Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>(L)</td>
<td>a</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>B</td>
</tr>
<tr>
<td>(R)</td>
<td>a</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>A</td>
</tr>
</tbody>
</table>
PUMP AND CONTROLS DIMENSION - IND

METRIC Version
A – B: Pressure ports – 3/4 G
D1 – D2: Drain port – 1/2 G
S: Suction port – 3/4 G
P: Charge pressure port – ¾-16 UNF-2B -> ¼ G
Va: Charge pump valve
V1 – V2: Maximum pressure valves
Sl: Stroke limiter
Zm: Mechanical zero adjustment screw
a – b: Control piloting pressure port – 1/8 G
P: Ports – 1/4 G
p1: Ports – 1/8 G

SAE Version
A – B: Pressure ports – 7/8-14 UNF-2B
D1 – D2: Drain port – 3/4-16 UNF-2B
S: Suction port – 1 1/16 UNF-2B
P: Charge pressure port – ¾-16 UNF-2B -> 7/16-20 UNF-2B
Va: Charge pump valve
V1 – V2: Maximum pressure valves
Sl: Stroke limiter
Zm: Mechanical zero adjustment screw
a – b: Control piloting pressure port – 3/8-24 UNF-2B
p1: Ports – 7/16-20 UNF-2B
HYDRAULIC PROPORTIONAL WITHOUT FEED-BACK CONTROL - INP

The pump displacement is proportional to the pilot pressure on “a” or “b” piloting ports, which also affect flow direction. Feeding pressure to the control joystick can be provided by charge pressure from p port. The piloting pressure must then be controlled by said joystick or by a pressure reducing valve (not supplied).

Pilot pressure = 4÷16 bar [58÷232 psi]
(at ports a,b)

Start of control = 4 bar [58 psi]

End of control = 16 bar [232 psi]
(Maximum displacement)

Max pressure = 30 bar [435 psi]

Direction of rotation: Correlation between direction of rotation (shaft view) control and direction of flow.

<table>
<thead>
<tr>
<th>SHAFT ROTATION</th>
<th>Piloting Pressure</th>
<th>Pressure Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>(L)</td>
<td>a</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>B</td>
</tr>
<tr>
<td>(R)</td>
<td>a</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>A</td>
</tr>
</tbody>
</table>
METRIC Version
A – B: Pressure ports – ¾ G
D1 – D2: Drain port – 1/2 G
S: Suction port – ¾ G
P: Charge pressure port – ¾-16 UNF-2B -> ¼ G
Va: Charge pump valve
V1 – V2: Maximum pressure valves
Sl: Stroke limiter
Zm: Mechanical zero adjustment screw
a – b: Control piloting pressure port – 1/8 G
p: Ports – 1/8 G
p1: Ports – 1/4 G

SAE Version
A – B: Pressure ports – 7/8-14 UNF-2B
D1 – D2: Drain port – 3/4-16 UNF-2B
S: Suction port – 1 1/16 UNF-2B
P: Charge pressure port – ¾-16 UNF-2B -> 7/16-20 UNF-2B
Va: Charge pump valve
V1 – V2: Maximum pressure valves
Sl: Stroke limiter
Zm: Mechanical zero adjustment screw
a – b: Control piloting pressure port – 3/8-24 UNF-2B
p1: Ports – 7/16-20 UNF-2B
ELECTRIC IMPULSE CONTROL - E12/E14

Impulse control where the displacement of the pump is function of the number of inputs of current to one of the two proportional solenoids. The servo control is without zeroing spring, therefore the piston of the servo control stays in the position until a new input of current is fed to the solenoids. Flow direction depends on which solenoid is energised. Standard solenoids are ON-OFF at 24V DC max. current 1A. (Optional solenoids 12V DC max. current 2A).

Direction of rotation: Correlation between direction of rotation (shaft view) control and direction of flow.

<table>
<thead>
<tr>
<th>SHAFT ROTATION</th>
<th>PUMP FLOW DIRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Energised Solenoid</td>
</tr>
<tr>
<td>(L)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td>(R)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>
PUMP AND CONTROLS DIMENSION - E12/E14

METRIC Version
A – B: Pressure ports – 3/4 G
D1 – D2: Drain port – 1/2 G
S: Suction port – 3/4 G
P: Charge pressure port – ¾-16 UNF-2B -> ¼ G
Va: Charge pump valve
V1 – V2: Maximum pressure valves
Sl: Stroke limiter
Zm: / Mechanical zero adjustment screw
a – b: Control piloting pressure port – 1/8 G
p: Ports – 1/8 G
p1: Ports – 1/4 G

SAE Version
A – B: Pressure ports – 7/8-14 UNF-2B
D1 – D2: Drain port – 3/4-16 UNF-2B
S: Suction port – 1 1/16 UNF-2B
P: Charge pressure port – ¾-16 UNF-2B -> 7/16-20 UNF-2B
Va: Charge pump valve
V1 – V2: Maximum pressure valves
Sl: Stroke limiter
Zm: Mechanical zero adjustment screw
a – b: Control piloting pressure port – 3/8-24 UNF-2B
p1: Ports – 7/16-20 UNF-2B
HYDRAULIC PROPORTIONAL WITH FEED-BACK CONTROL - IRX

The pump displacement is proportional to the pilot pressure on “a” or “b” ports; which also affect flow direction. Piloting can be provided by charge pressure from P port. The piloting pressure will then have to be controlled by a joystick or by a pressure reducing valve (not supplied).

Direction of rotation: Correlation between direction of rotation (shaft view) control and direction of flow.

<table>
<thead>
<tr>
<th>SHAFT ROTATION</th>
<th>PUMP FLOW DIRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>(L)</td>
<td>Pilotina Pressure</td>
</tr>
<tr>
<td>a</td>
<td>B</td>
</tr>
<tr>
<td>b</td>
<td>A</td>
</tr>
<tr>
<td>(R)</td>
<td>Pilotina Pressure</td>
</tr>
<tr>
<td>a</td>
<td>A</td>
</tr>
<tr>
<td>b</td>
<td>B</td>
</tr>
</tbody>
</table>

Pilot pressure = 6÷16 bar [87÷232 psi] (at ports a,b)
Start of control = 6 bar [87 psi]
End of control = 16 bar [232 psi] (Maximum displacement)
Max pressure = 30 bar [435 psi]
### PUMP AND CONTROLS DIMENSION - IRX

**METRIC Version**

- **A – B**: Pressure ports – 3/4 G
- **D1 – D2**: Drain port – 1/2 G
- **S**: Suction port – 3/4 G
- **P**: Charge pressure port – ¼-16 UNF-2B -> ¼ G
- **Va**: Charge pump valve
- **V1 – V2**: Maximum pressure valves
- **Sl**: Stroke limiter
- **Zm**: Mechanical zero adjustment screw
- **a – b**: Control piloting pressure port – 1/8 G
- **p**: Ports – 1/8 G
- **p1**: Ports – 1/4 G

**SAE Version**

- **A – B**: Pressure ports – 7/8-14 UNF-2B
- **D1 – D2**: Drain port – 3/4-16 UNF-2B
- **S**: Suction port – 1 1/16 UNF-2B
- **P**: Charge pressure port – ¾-16 UNF-2B -> 7/16-20 UNF-2B
- **Va**: Charge pump valve
- **V1 – V2**: Maximum pressure valves
- **Sl**: Stroke limiter
- **Zm**: Mechanical zero adjustment screw
- **a – b**: Control piloting pressure port – 3/8-24 UNF-2B
- **p**: Ports – 3/8-24 UNF-2B
- **p1**: Ports – 7/16-20 UNF-2B
MANUAL LEVER WITH FEED-BACK CONTROL - LRX

The displacement of the pump is directly proportional to the angle of the lever. The diagram below shows the relationship between angle and displacement.

Direction of rotation: Correlation between direction of rotation (shaft view) control and direction of flow.

<table>
<thead>
<tr>
<th>SHAFT ROTATION</th>
<th>Control Rotation</th>
<th>Pressure Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>(L)</td>
<td>1</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>B</td>
</tr>
<tr>
<td>(R)</td>
<td>1</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>A</td>
</tr>
</tbody>
</table>
The required torque on the control lever is normally between 0.6÷1.2 Nm (0.44÷0.88 lbf·ft).

The maximum permissible torque on the control lever is 3 Nm (2.17 lbf·ft).

**METRIC Version**
- A – B: Pressure ports – 3/4 G
- D1 – D2: Drain port – 1/2 G
- S: Suction port – 3/4 G
- P: Charge pressure port – ¾-16 UNF-2B -> ¼ G
- Va: Charge pump valve
- V1 – V2: Maximum pressure valves
- Sl: Stroke limiter
- Zm: Mechanical zero adjustment screw
- a – b: Control piloting pressure port – 1/8 G
- p: Ports – 1/8 G
- p1: Ports – 1/4 G

**SAE Version**
- A – B: Pressure ports – 7/8-14 UNF-2B
- D1 – D2: Drain port – 3/4-16 UNF-2B
- S: Suction port – 1 1/16 UNF-2B
- P: Charge pressure port – ¾-16 UNF-2B -> 7/16-20 UNF-2B
- Va: Charge pump valve
- V1 – V2: Maximum pressure valves
- Sl: Stroke limiter
- Zm: Mechanical zero adjustment screw
- a – b: Control piloting pressure port – 3/8-24 UNF-2B
- p1: Ports – 7/16-20 UNF-2B
The pump displacement variation of the pump is achieved by rotating the control pivot (i.e. by the means of a lever - not supplied). The control pivot is built into the swash plate of the pump. The return to zero displacement of the pump is guaranteed by an internal spring.

**Direction of rotation:** Correlation between direction of rotation (shaft view) control and direction of flow.

<table>
<thead>
<tr>
<th>SHAFT ROTATION</th>
<th>PUMP FLOW DIRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control Rotation</td>
</tr>
<tr>
<td>(L)</td>
<td>1</td>
</tr>
<tr>
<td>(R)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>
The torque necessary on the control pivot:
40 bar [580 psi] = Min 6 Nm [4.42 lbf·ft]
Max 15 Nm [11.05 lbf·ft]
200 bar [2900 psi] = Min 12 Nm [8.84 lbf·ft]
Max 25 Nm [18.42 lbf·ft]

**METRIC Version**
- A – B: Pressure ports – 3/4 G
- D1 – D2: Drain port – 1/2 G
- S: Suction port – 3/4 G
- P: Charge pressure port – 3/4-16 UNF-2B -> ¼ G
- Va: Charge pump valve
- V1 – V2: Maximum pressure valves
- Sl: Stroke limiter
- Zm: Mechanical zero adjustment screw
- a – b: Control piloting pressure port – 1/8 G
- p: Ports – 1/8 G
- p1: Ports – 1/4 G

**SAE Version**
- A – B: Pressure ports – 7/8-14 UNF-2B
- D1 – D2: Drain port – 3/4-16 UNF-2B
- S: Suction port – 1 1/16 UNF-2B
- P: Charge pressure port – ¾-16 UNF-2B -> 7/16-20 UNF-2B
- Va: Charge pump valve
- V1 – V2: Maximum pressure valves
- Sl: Stroke limiter
- Zm: Mechanical zero adjustment screw
- a – b: Control piloting pressure port – 3/8-24 UNF-2B
- p1: Ports – 7/16-20 UNF-2B
ELECTRIC TWO POSITION ON-OFF - E22/E24

By switching on one of the ON-OFF solenoids (standard 24V d.c. optional 12V d.c.), the pump swivels to maximum displacement in the corresponding output flow direction. Switching off the stated solenoid will result in swivelling back the pump to zero displacement position.

Direction of rotation: Correlation between direction of rotation (shaft view) control and direction of flow.

<table>
<thead>
<tr>
<th>SHAFT ROTATION</th>
<th>Energised Solenoid</th>
<th>Oil Outlet</th>
</tr>
</thead>
<tbody>
<tr>
<td>(L)</td>
<td>1</td>
<td>B</td>
</tr>
<tr>
<td>(R)</td>
<td>1</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>B</td>
</tr>
</tbody>
</table>
PUMP AND CONTROLS DIMENSION - E22/E24

METRIC Version
A – B: Pressure ports – 3/4 G
D1 – D2: Drain port – 1/2 G
S: Suction port – 3/4 G
P: Charge pressure port – ¾-16 UNF-2B -> ¼ G
Va: Charge pump valve
V1 – V2: Maximum pressure valves
Sl: Stroke limiter
Zm: Mechanical zero adjustment screw
a – b: Control piloting pressure port – 1/8 G
p: Ports – 1/8 G
p1: Ports – 1/4 G

SAE Version
A – B: Pressure ports – 7/8-14 UNF-2B
D1 – D2: Drain port – 3/4-16 UNF-2B
S: Suction port – 1 1/16 UNF-2B
P: Charge pressure port – ¾-16 UNF-2B -> 7/16-20 UNF-2B
Va: Charge pump valve
V1 – V2: Maximum pressure valves
Sl: Stroke limiter
Zm: Mechanical zero adjustment screw
a – b: Control piloting pressure port – 3/8-24 UNF-2B
p1: Ports – 7/16-20 UNF-2B
ELECTRIC PROPORTIONAL WITH FEED-BACK CONTROL - ER2/ER4

The displacement of the pump is directly proportional to the input current of one of the two proportional solenoids. Flow direction depends on which solenoid is energised. Standard solenoids are proportional at 24V d.c. max. current 1A. (Optional solenoids 12V d.c. max. current 2A).

Solenoid 24V:
Current min. 240 mA max. 800 mA

Solenoid 12V:
Current min. 500 mA max. 1500 mA

Direction of rotation: Correlation between direction of rotation (shaft view) control and direction of flow.

<table>
<thead>
<tr>
<th>SHAFT ROTATION</th>
<th>Energised Solenoid</th>
<th>Oil Outlet</th>
</tr>
</thead>
<tbody>
<tr>
<td>(L)</td>
<td>1</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>A</td>
</tr>
<tr>
<td>(R)</td>
<td>1</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>B</td>
</tr>
</tbody>
</table>
PUMP AND CONTROLS DIMENSION - ER2/ER4

METRIC Version
A – B: Pressure ports – 3/4 G
D1 – Drain port – 1/2 G
S: Suction port – 3/4 G
P: Charge pressure port – ¼-16 UNF-2B -> ¼ G
Va: Charge pump valve
V1 – V2: Maximum pressure valves
Sl: Stroke limiter
Zm: Mechanical zero adjustment screw
a – b: Control piloting pressure port – 1/8 G
p: Ports – 1/8 G
p1: Ports – 1/4 G
Zi: Hydraulic zero

SAE Version
A – B: Pressure ports – 7/8-14 UNF-2B
D1 – Drain port – 3/4-16 UNF-2B
S: Suction port – 1 1/16 UNF-2B
P: Charge pressure port – ¾-16 UNF-2B -> 7/16-20 UNF-2B
Va: Charge pump valve
V1 – V2: Maximum pressure valves
Sl: Stroke limiter
Zm: Mechanical zero adjustment screw
a – b: Control piloting pressure port – 3/8-24 UNF-2B
p1: Ports – 7/16-20 UNF-2B
Zi: Hydraulic zero
ELECTRIC PROPORTIONAL WITHOUT FEED-BACK CONTROL - EP2/EP4

The displacement of the pump is directly proportional to the input current of one of the two proportional solenoids. Flow is also influenced by the working pressure. With a given input signal (piloting current) the pump can slightly vary the displacement and the flow when working pressure increases. The input current of the two proportional solenoids must be controlled by an external amplifier card. Flow direction depends on which solenoid is energised. Standard solenoids are proportional 24V d.c. max. current 1A. (Optional solenoids 12V d.c. max. current 2A). For emergency operation only it is however possible to control solenoids directly with 24V d.c. voltage (or 12V d.c.), by-passing the amplifier.

Direction of rotation: Correlation between direction of rotation (shaft view) control and direction of flow.

<table>
<thead>
<tr>
<th>SHAFT ROTATION</th>
<th>Energised Solenoid</th>
<th>Oil Outlet</th>
</tr>
</thead>
<tbody>
<tr>
<td>(L)</td>
<td>1</td>
<td>B</td>
</tr>
<tr>
<td>(R)</td>
<td>1 or 2</td>
<td>A or B</td>
</tr>
</tbody>
</table>

Solenoid 24V:
Current min. 300 mA max. 900 mA

Solenoid 12V:
Current min. 300 mA max. 1300 mA
PUMP AND CONTROLS DIMENSION - EP2/EP4

METRIC Version
A – B: Pressure ports – 3/4 G
D1 – D2: Drain port – 1/2 G
S: Suction port – 3/4 G
P: Charge pressure port – 3/8-16 UNF-2B -> ¼ G
Va: Charge pump valve
V1 – V2: Maximum pressure valves
Sl: Stroke limiter
Zm: Mechanical zero adjustment screw
a – b: Control piloting pressure port – 1/8 G
p: Ports – 1/8 G
p1: Ports – 1/4 G
E: Hand emergency

SAE Version
A – B: Pressure ports – 7/8-14 UNF-2B
D1 – D2: Drain port – 3/4-16 UNF-2B
S: Suction port – 1 1/16 UNF-2B
P: Charge pressure port – ¼-16 UNF-2B -> 7/16-20 UNF-2B
Va: Charge pump valve
V1 – V2: Maximum pressure valves
Sl: Stroke limiter
Zm: Mechanical zero adjustment screw
a – b: Control piloting pressure port – 3/8-24 UNF-2B
p1: Ports – 7/16-20 UNF-2B
E: Hand emergency
SPLINE SHAFT

Type 1 - S T13

Type 2 - S T15

Type 3 - S T13

Type 4 - IS T13

Type 5 - IS T9

Type 6 - S T11
In order to guarantee an optimum stability of the fluid contamination conditions the “C” Series can be equipped with a filter positioned on the delivery outlet of the booster pump. Only the flow necessary to reintegrate the lost oil due to drainage will pass through this filter, all the excess flow, which is drained by the booster pump valve, is therefore not filtered, in this way it will guarantee a longer life of the filter. Upon request it is possible to add an electrical filter clogging sensor. (Connector DIN 43650A).

**Electrical Sensor**

<table>
<thead>
<tr>
<th>SPDT</th>
<th>Max Resistive Load</th>
<th>Max Inductive Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.A.\ A.C. 125-250 V</td>
<td>1 A</td>
<td>1 A</td>
</tr>
<tr>
<td>C.C.\ D.C. 30 V</td>
<td>2 A</td>
<td>2 A</td>
</tr>
<tr>
<td>C.C.\ D.C. 50 V</td>
<td>0.5 A</td>
<td>0.5 A</td>
</tr>
<tr>
<td>C.C.\ D.C. 75 V</td>
<td>0.25 A</td>
<td>0.25 A</td>
</tr>
<tr>
<td>C.C.\ D.C. 125 V</td>
<td>0.2 A</td>
<td>0.2 A</td>
</tr>
</tbody>
</table>
ACCESSORIES AND FILTER DIMENSIONS

Filter FE
ACCESSORIES AND FILTER DIMENSIONS

Filter

[Diagram of Filter Dimensions]
ACCESSORIES

Exchange Valve

The flushing valve allows a cooling action, which is recommended when operating at high speed and power.
ACCESSORIES

Electric Cut-Off Valve

The electric cut-off valve, brings to zero the displacement of the pump when power supply to the ON/OFF solenoid is cut-off. Feed voltage is 12V d.c. or 24V d.c. The cut-off valve cannot be assembled in the Tandem pump short version.

CONNECTOR = DIN43650A
ACCESSORIES

BY-PASS

The By-Pass Valve is a tap inside the pump that allows, if necessary, to connect the pressure port line A and B.

THROUGH DRIVE DIMENSIONS

SAE A Flange
THROUGH DRIVE DIMENSIONS

SAE B Flange

SAE B-B Flange
COMBINATION PUMP DIMENSIONS - SHORT VERSION

<table>
<thead>
<tr>
<th>Configuration</th>
<th>C2 21/28 + C2 21/28</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump</td>
<td>1st</td>
</tr>
<tr>
<td></td>
<td>2nd</td>
</tr>
<tr>
<td>Shafts</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>

With this configuration, only the second pump mount the boost pump.

**Warning:** When ordering a tandem pump it is necessary to indicate for each pump the kind of shaft and the through drive option required.

**Short Version Tandem (TS) Hydraulic Layout**

The hose (1) used to connect the charge pressure ports (P) is supplied with the units. The hoses (2) and (3) connecting the drain ports must be supplied and mounted by the customer.
COMBINATION PUMP DIMENSIONS - SHORT VERSION

**METRIC Version**
- A – B: Pressure ports – 3/4 G
- D1 – D2: Drain port – 1/2 G
- S: Suction port – 3/4 G
- P: Charge pressure port – ¾-16 UNF-2B -> ¼ G
- Va: Charge pump valve
- V1 – V2: Maximum pressure valves
- Sl: Stroke limiter
- Zm: Mechanical zero adjustment screw
- a – b: Control piloting pressure port – 1/8 G
- p: Ports – 1/8 G
- p1: Ports – 1/4 G

**SAE Version**
- A – B: Pressure ports – 7/8-14 UNF-2B
- D1 – D2: Drain port – 3/4-16 UNF-2B
- S: Suction port – 1 1/16 UNF-2B
- P: Charge pressure port – ¾-16 UNF-2B -> 7/16-20 UNF-2B
- Va: Charge pump valve
- V1 – V2: Maximum pressure valves
- Sl: Stroke limiter
- Zm: Mechanical zero adjustment screw
- a – b: Control piloting pressure port – 3/8-24 UNF-2B
- p1: Ports – 7/16-20 UNF-2B

CROSS HYDRAULICS PTY LTD

SECTION 8.294
**COMBINATION PUMP DIMENSIONS - LONG VERSION**

**Tandem C2 21/28 + C2 21/28 SAE-B**

<table>
<thead>
<tr>
<th>Configuration</th>
<th>C2 21/28 + C2 21/28</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump</td>
<td>1st</td>
</tr>
<tr>
<td>Shafts</td>
<td>2nd</td>
</tr>
</tbody>
</table>

With this configuration, both the pumps mount the boost pump.

(1) It is necessary to mount on the first pump the through drive - SAE B

(2) 1 - Spline Shaft 13T - 16/32-DP (C2 21/28)

**Tandem C2 21/28 + C1 14/18**

<table>
<thead>
<tr>
<th>Configuration</th>
<th>C2 21/28 + C1 14/18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump</td>
<td>1st</td>
</tr>
<tr>
<td>Shafts</td>
<td>2nd</td>
</tr>
</tbody>
</table>

With this configuration, both the pumps mount the boost pump.

(1) It is necessary to mount on the first pump the through drive - SAE A

(2) 01 - Spline Shaft 9T - 16/32-DP (C1 14/18)

02 - Spline Shaft 9T - 16/32-DP (Through drive Bosch) (C1 14/18)
COMBINATION PUMP DIMENSIONS - LONG VERSION

First pump with through drive-SAE B

METRIC Version
A – B: Pressure ports – 3/4 G
D1 – D2: Drain port – 1/2 G
S: Suction port – 3/4 G
P: Charge pressure port – ¾-16 UNF-2B -> ¼ G
Va: Charge pump valve
V1 – V2: Maximum pressure valves
Sl: Stroke limiter
Zm: Mechanical zero adjustment screw
a – b: Control piloting pressure port – 1/8 G
p: Ports – 1/8 G
p1: Ports – 1/4 G

SAE Version
A – B: Pressure ports – 7/8-14 UNF-2B
D1 – D2: Drain port – 3/4-16 UNF-2B
S: Suction port – 1 1/16 UNF-2B
P: Charge pressure port – ¾-16 UNF-2B -> 7/16-20 UNF-2B
Va: Charge pump valve
V1 – V2: Maximum pressure valves
Sl: Stroke limiter
Zm: Mechanical zero adjustment screw
a – b: Control piloting pressure port – 3/8-24 UNF-2B
p1: Ports – 7/16-20 UNF-2B