Hydraulic and Hydro-pneumatic Clamping Elements for Production Tooling
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Use Servo 68 grade or equivalent oil for better performance
A. About the Catalogue

This catalogue will guide the designer and end-users
* To find out solutions for clamping automation
* To select various elements used in automated clamping system

It gives the details of various hydraulic and hydropneumatic elements. It also highlights advantages and limitations of these elements.

Please contact us in case of doubt regarding these elements or regarding any design problems which could not be solved with the standard elements in this catalogue.

B. Why Automation for Clamping

C-1 Saves Time — Manual clamping and declamping requires 15 to 20 seconds per clamp. For a fixture with multiple clamping points, the total time for clamping will be more than one minute. For uniform clamping, this time will be still more. This time can be saved by automatic clamping. The pay back period for the cost of automation can be estimated considering the net saving per job (Time saved x Machine hour rate).

Advantage of time saving is increase in production capacity of bottle neck machines.

C-2 Reduces operator fatigue — In manual clamping, the efficiency of the operator decreases due to fatigue. This may result in less clamping torque at the end of the shift, specifically for the elderly operators, causing reduction in safety. A human approach is more important than the clamping efficiency. By introducing automatic clamping system, one operator can handle two or more machines simultaneously.

C-3 Improves quality of clamping — Only one point can be clamped at a time during manual clamping. To achieve uniform clamping, initially all the bolts are clamped with a light clamping force and then with a heavy clamping force. Clamping force at each bolt may vary. However with automation -
- All clamps can be operated at the same time.
- There is no need of a light and heavy clamping force.
- Clamping force can be controlled as per the requirement, to control dimensional accuracy.
- Clamping force is consistent.

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D. Types of automation in clamping

Pneumatic Automation is used only for small aluminum components, due to force and space constraints. In majority of the applications, hydraulic or hydropneumatic clamping is preferred.

Hydraulic Automation is used in SPMs, where it need long stroke, speed, sequencing or high volumes.

Hydropneumatic Automation has two types

A) Hydropneumatic Intensifier is widely used on conventional machines and SPMs, where a hydraulic power unit is not available on the machine. Low cost, simpler circuit and no oil heating as compared to hydraulic power unit, are some of its advantages.

B) Hydropneumatic Pump combines advantages of hydraulic & hydropneumatic automation. Longer stroke & sequencing is possible without oil heating problem. Another consideration is the production volume.

Manual clamping is used in prototype production or batch production where production volumes are low. As the production increases, even conventional machines are dedicated for specific operation.

Hydropneumatic clamping is generally used at this production level (50 to 200 jobs per shift). SPM with hydraulic clamping is preferred when the production level goes near 1 job per min.

E. Selection of clamping cylinders

E-1 Type of cylinder

<table>
<thead>
<tr>
<th>Stud size</th>
<th>M 6</th>
<th>M 8</th>
<th>M 12</th>
<th>M 16</th>
<th>M 20</th>
<th>M 24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clamping Force</td>
<td>2.5kN</td>
<td>5 kN</td>
<td>10 kN</td>
<td>20 kN</td>
<td>30 kN</td>
<td>50 kN</td>
</tr>
</tbody>
</table>

E-2 Clamping force of cylinder

Stud-bolt size used in the existing fixture with manual clamping is the best clue for selecting the clamping force.

Selection criteria for the type of automation

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Pneumatic</th>
<th>Hydraulic</th>
<th>Hydropneumatic*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>Low (Running Cost highest)</td>
<td>High (Running Cost Lowest)</td>
<td>Low (Running Cost high)</td>
</tr>
<tr>
<td>Clamping force</td>
<td>Light - 2 to 3 kN max. Higher forces if no space constraints</td>
<td>Medium and heavy - above 5 kN</td>
<td>Medium and heavy - from 5 kN to 100 kN</td>
</tr>
<tr>
<td>Clamping Cylinder Size</td>
<td>Bulky for even medium clamping force (Op.Pr. 5 bar)</td>
<td>Compact (For SPM Op.Pr. 30 to 70 bar)</td>
<td>Most Compact for heavy forces (Op.Pr. 150 to 200 bar)</td>
</tr>
<tr>
<td>Clamping Stroke</td>
<td>Wide range - from short to very long</td>
<td>Wide range - from short to very long</td>
<td>Short stroke - 50 mm max.</td>
</tr>
<tr>
<td>Clamping Speed</td>
<td>Very fast</td>
<td>Fast</td>
<td>Fast</td>
</tr>
<tr>
<td>Impact while clamping</td>
<td>Present</td>
<td>Not Present</td>
<td>Not Present</td>
</tr>
<tr>
<td>Reliability</td>
<td>Low - as can be overpowered due to the compressibility of air</td>
<td>Most safe - due to the check valve and incompressibility of oil</td>
<td>Safe - as factor of safety for force selection can be more</td>
</tr>
<tr>
<td>Sequencing</td>
<td>Possible</td>
<td>Possible</td>
<td>Difficult</td>
</tr>
<tr>
<td>Piping &amp; Circuit</td>
<td>Complicated</td>
<td>Complicated</td>
<td>Simple</td>
</tr>
<tr>
<td>Oil heating problem</td>
<td>Not Present</td>
<td>Present</td>
<td>Not Present</td>
</tr>
<tr>
<td>Return stroke speed and power</td>
<td>Fast due to double acting cylinder, but with low power</td>
<td>Fast, with power and positive due to double acting cylinder</td>
<td>Sluggish due to spring return cylinders</td>
</tr>
<tr>
<td>No. of clamping points</td>
<td>No limit</td>
<td>No limit</td>
<td>Limited, 3 to 5 per intensifier</td>
</tr>
<tr>
<td>Other applications</td>
<td>Material handling, Valve actuation, Door movement</td>
<td>Feed cylinders, Earth moving equip., Cutting, Hole punching, Deep drawing</td>
<td>Pressing assembly, Riveting, Crimping, Cutting</td>
</tr>
</tbody>
</table>

* Hydropneumatic automation referred above is with hydropneumatic intensifier. Hydropneumatic pump is not considered.
Air Driven Pump is self-reciprocating hydropneumatic intensifier. Hydropneumatic intensifier is suitable only for single acting elements. Air Driven Pump is more suitable for double acting elements.

**Principle**

Oil pressure is intensified due to the area ratio of air piston & oil piston. As the air piston moves towards the end position, pressurized air input is diverted & is used for pilot operated pneumatic direction control valve. Due to this arrangement, air piston is reversed at both ends. Hence this system is self-reciprocating & acts as pump. Two check valves are used in suction & delivery line.

**Operation**

Clean & lubricated air is connected to "Hy-Power" air driven pump. Pump reciprocates to give oil output till full pressure is reached. By changing hydraulic direction control valve position, pump reciprocates to operate cylinder till full pressure is reached. In case of oil leakage & pressure drop, pump operates to compensate the pressure drop.

**Advantages**

Pressure holding without consuming power.
No heat builds up.
Adjustable oil output flow & pressure.
Can be driven by any inert gas.
Built in tank & Optional CETOP 3 interface.

**Applications**

Air driven pump is a good replacement to electric power unit. It is more suitable for clamping / holding application.
E.g. Job clamping by double acting elements in fixtures. Die clamping cylinders & die lifters.

**Specifications**

- Intensification: 1:32
- Oil output flow: 2.2 lpm Max. @ 6 bar Air Pressure
- Tank capacity: 2 lit.
- Input ports: 1/4" BSP. (Pneumatic)
- Output ports: 3/8" BSP, P/T lines (Hydraulic)
- Manifold (Optional)
- Interface : CETOP 3
- Output ports : 1/4" BSP.

Note

Inlet air has to be lubricated.

- This pump is more suitable for double acting element or single acting load return element & should not be used for single acting spring return elements.
- Manifold has to be ordered separately.

Subject to change for improvement
All dimensions are in mm
Overall dimension tolerance ± 0.5 mm

Shevanta Enterprise
Hydraulic Power Unit

Description
This hydraulic power unit is specially designed for clamping application only. Special care is taken to avoid oil heating problem. This hydraulic power unit is suitable to operate double acting clamping cylinders in parallel.

Operation
In clamping & declamping mode, after reaching the set pressure, which is sensed by a pressure switch, direction control valve shifts to the centre-position, unloading pump delivery to the tank. In case of pressure drop, the direction control valve operates to increase pressure, to the set pressure.

The system includes all relevant electrical and mechanical accessories. Pendent with clamp unclamp push buttons is provided along with the system.

Specifications
- Motor - 3 phase, 1 hp, 1440 RPM.
- Direction Control Valve - Cetop-3 mounting, 3 position, solenoid operated.
- Tank capacity - 30 liters approximately
- Working pressure - 150 bar
- Maximum oil pressure - 175 bar
- Pump - Gear pump 1.8 lpm at 1500 rpm.
- Pressure switches- 2 Nos.
- Pilot operated check valve.
- Useful oil volume - 25 liters approximately
- Pendent cable length Maximum - 5 meters.
- Control panel.
  - Length - 730 mm
  - Width - 580 mm
  - Total Height - 850 mm

Note
- Clamping time in seconds = total oil volume at clamping side of all the cylinders in cc divided by pump output (28 cc per second)
- Declamping time in seconds = total oil volume at declamping side of all the cylinders in cc divided by pump output (28 cc per second)
- While using single acting cylinder on Hydraulic power unit make sure that return line have minimum resistance to the flow.
- Special care has taken to avoid electric shocks while designing control panel
Hydropneumatic intensifiers are widely used on conventional machines, where hydraulic power unit is not available with the machine. Single acting elements are generally used with hydropneumatic intensifiers.

**Principle**
In the static condition, (Pressure x Area) at air side is equal to (Pressure x Area) at oil side.

**Description**
Hydropneumatic intensifier has one oil cylinder and one air cylinder. The pistons of both these cylinders are connected to each other. In single acting intensifier, the air cylinder is single acting, spring return. The air piston is the driving piston and the oil piston is the driven piston.

**Operation**
When air is allowed in the intensifier by a D.C. valve, oil on the hydraulic side gets pressurised and is forced out. The oil output operates the clamping cylinders and the job gets clamped. After releasing the air pressure, due to the spring in the intensifier, the air piston returns back and the job gets declamped. Oil is pushed back into the intensifier due the spring in the cylinder.

**Leakage Compensation**
(Make up oil system)
This is an important feature of hydropneumatic intensifier. The oil-side of the hydropneumatic intensifier, hydraulic hoses and cylinders form a close loop system. Oil in this loop is a confined fluid. There must be a leakage compensation for the confined oil, if there is any leakage (across piston of cylinder and through connectors). The make-up oil system, compensates for leakage by adding small volume of oil at every stroke. In the unpressurised mode, make-up oil is always connected to the oil side. In the pressurisation stroke, as the piston moves up and crosses the high pressure seal, the make-up oil gets disconnected from the oil side. In case of leakage, when the system pressure is released after operation, the hydraulic piston moves down to the bottom. When it crosses the high pressure seal, the make-up oil gets connected to the oil side. Any leaked-out volume causes vacuum on the oil side and is automatically compensated due to the atmospheric pressure.

### Selection of intensifier

1. **Intensification Ratio:**
   - For 5 to 7 bar air pressure, select an intensification ratio of 28 so as to get about 150 bar hydraulic output. For 3.5 to 4 bar air pressure, select an intensification ratio of 40 to get about 150 bar hydraulic output.

2. **Oil Output:**
   - Oil volume for every cylinder is given in the catalogue. Sum up all the oil volumes of the cylinders to get the total oil requirement. Intensifier output must be more than the total oil volume required.

   e.g. To use 2 cylinders of part no. 1510200 and 2 cylinders of part no. 1540100 for clamping a job,
   - Oil required = (oil vol of 1510200) x 2 + (oil vol of 1540100) x 2
   - = (22 x 2) + (34 x 2) = 112 cc
   - Select the part no. 1128200 with 200 cc oil output.
Hydropneumatic Intensifier
double acting

Hydropneumatic intensifiers are widely used on conventional machines, where hydraulic power unit is not available with the machine. Single acting elements are generally used with hydropneumatic intensifiers.

**Principle**

In the static condition, \((\text{Pressure} \times \text{Area})\) at air side is equal to \((\text{Pressure} \times \text{Area})\) at oil side.

**Description**

Hydropneumatic intensifier has one oil cylinder and one air cylinder. The pistons of both these cylinders are connected to each other. In double acting intensifier, the air cylinder is double acting. The air piston is the driving piston and the oil piston is the driven piston.

**Operation**

When air is allowed in the intensifier by a D.C. valve, oil on the hydraulic side gets pressurised and is forced out. The oil output operates the clamping cylinders and the job gets clamped. After changing position of D.C. Valve, due to the return air pressure, the air piston returns back and the job gets declamped. Oil is pushed back into the intensifier due the spring in the cylinder.

**Leakage Compensation**

(Make up oil system)

This is an important feature of hydropneumatic intensifier. The oil side of the hydropneumatic intensifier, hydraulic hoses and cylinders form a close loop system. Oil in this loop is a confined fluid. There must be a leakage compensation for the confined oil, if there is any leakage (across piston of cylinder and through connectors). The make-up oil system, compensates for leakage by adding small volume of oil at every stroke.

In the unpressurised mode, make-up oil is always connected to the oil side. In the pressurisation stroke, as the piston moves up and crosses the high pressure seal, the make-up oil gets disconnected from the oil side. After changing the flow of air with the help of D.C. Valve to opposite direction, piston moves down to bottom connecting oil bottle to oil side.

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>INTENSIFICATION RATIO</th>
<th>A</th>
<th>OIL OUTPUT</th>
<th>AIR VOLUME PER STROKE</th>
<th>WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:32</td>
<td>340</td>
<td></td>
<td>25 cc</td>
<td>1.8 lit.</td>
<td>6 kg.</td>
</tr>
<tr>
<td>1:32</td>
<td>493</td>
<td></td>
<td>40 cc</td>
<td>2.8 lit.</td>
<td>6.5 kg.</td>
</tr>
</tbody>
</table>

Maximum air inlet pressure 7 bar

**Selection of intensifier**

1. Oil Output: Oil volume for every cylinder is given in the catalogue. Sum up all the oil volumes of the cylinders to get the total oil requirement. Intensifier output must be more than the total oil volume required.

   e.g. To use 2 cylinders of part no. 1510100 and 1 cylinders of part no. 1510200 for clamping a job,

   Oil required = (oil vol of 1510100) x 2 + (oil vol of 1510200) x 1
   = (7.5 x 2) + (22 x 1) = 37 cc
A-2 Accessories
1. FRL - Filter, Regulator and Lubricator Unit.
   - Filter to separate water from compressed air,
   - Regulator to regulate air pressure to 5 bar,
   - Lubricator for lubrication of valves and the pneumatic seal of the intensifier.
2. D.C.Valve - Direction Control valve - (3/2 way valve)
   - On position - Job gets clamped.
   - Off position - Job gets declamped.
3. Q.E.Valve - Quick Exhaust valve -
   - To increase declamping speed.
4. Pneumatic line
   - The hoses which should withstand an air pressure up to 10 bar
5. Hydraulic line
   - The hoses of R2 grade or metallic piping which should withstand an oil pressure up to 200 bar
   - Copper washers or bonded seals must be used for connectors.
6. Pressure gauge- Use glycerine filled gauges of 400 bar capacity.

A-3 Safety elements
- Hydraulic Pressure Switch - The clamping force is directly proportional to the air pressure in the intensifier. Precaution must be taken to maintain this air pressure, and shut down the machine if the pressure is not sufficient.
- The pressure switch will shut down the machine, if the oil pressure drops below the preset value.

A-4 Points to remember while designing the system
1. Keep the system as simple as possible.
2. Keep minimum no. of connections in the circuit to avoid possibility of leakage.
3. Try to minimize the hose length and use a quick exhaust valve to get a quick returnstroke.
4. Use bonded seals for leak proof connections.
5. Keep the intensifier preferably at the highest points for easy bleeding.
6. In case of a rigid piping, use a slant piping going towards intensifier for easy bleeding.
7. For easier bleeding, avoid loops in hoses or rigid piping.
8. In a hydropneumatic system, a flow control valve with a check valve can be used to achieve a delay in butting and clamping cylinders as shown in the figure. Do not use more than one such valve in the circuit. Adjust the cracking pressure of the check valve to less than 0.3 bar.
9. A single-acting swing clamp should not be used after a sequence valve. Two separate intensifier circuits can be used for better sequencing.
10. For hole punching, an external spring force should be applied in the hydropneumatic system as stripping out force is not available.

A-1 Selection of compressor
Compressed air requirement can be calculated as follows:
Compressed air volume required per cycle = Intensification ratio x oil output.
e.g. For the intensifier of ratio 28 and oil output 100 cc, air required per cycle
= 28 x 100 = 2800 cc = 3 lit. approx.
If number of jobs per hour = 20 then air required per hour
= 2800 cc x 20 = 56000 cc = 56 lit. approx.
Oil intensifier is used to boost the low pressure output of a hydraulic power unit. The high pressure output of the intensifier is used for clamping cylinders and work supports.

**Principle**

Oil intensifier works on the same principle as that of a hydropneumatic double acting intensifier. The power source is low pressure oil instead of pneumatic power.

**Advantages**

Oil intensifier gives a high pressure output without the oil heating problem. It uses low pressure oil as the power source and achieves intensification by static pressure conversion.

**Versions**

Two models are available with intensification ratios 4 and 6.

If the oil output of an intensifier is sufficient for clamping elements, the circuit as shown in fig. 1 can be used. If the oil requirement of clamping elements is more than the output of an intensifier, then the prefill circuit can be used as shown in fig. 2. By removing the make-up oil bottle, the same port is used for prefilling.

**Leakage Compensation**

For fig. no. 1, make-up oil bottle works in the same way as in hydropneumatic intensifier. For fig. no. 2, prefilling circuit takes care of the leakage compensation, and hence the make-up oil bottle is not required.

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>INTENSIFICATION RATIO</th>
<th>OIL OUTPUT</th>
<th>WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:4</td>
<td>100 cc</td>
<td>14 kg</td>
<td></td>
</tr>
<tr>
<td>1:6</td>
<td>60 cc</td>
<td>13.5 kg</td>
<td></td>
</tr>
</tbody>
</table>

Maximum oil inlet pressure 40 bar.
A-1 Bleeding
Bleeding means removing air, trapped in the hydraulic circuit, i.e. oil side of the intensifier, hydraulic hoses or piping and cylinders. Bleeding is necessary, first at the time of installation and later when air gets trapped in the system. If air is not bled properly, full pressure may not be achieved. Also a jerky motion of the cylinders may be observed. It is recommended to bleed the system from the highest point. It is always better to have this highest point as an intensifier.

A-2 Trouble shooting
The intensifier will continue to work without any problem unless there is any leakage in the system or there is air in the system. Leakage in the system can be detected from the oil level in the make-up oil bottle. This level should remain constant.

1. **Symptom** — No oil pressure from intensifier.
   **Cause** — There is air in the system.
   **Remedy** — Bleed the system to remove air.
   See bleeding procedure.

2. **Symptom** — Oil level always decreases.
   **Cause** — Oil is sucked into the system through the make-up oil system, indicating leakages in the high pressure line. Leakages may be in the connections or through seals of cylinders.
   **Remedy** — Stop leakages, change cylinder seals, if necessary.

3. **Symptom** — Oil level increases in pressurized mode.
   **Cause** — In pressurized mode, make-up oil system is cut-off from the high pressure side. A rise in the oil level in the pressurized mode indicates that the high pressure seal of the intensifier is leaking.
   **Remedy** — Change the high pressure seal of the intensifier.

4. **Symptom** — Oil level increases in unpressurised mode.
   **Cause** — There is air in the system. Due to the compressibility of air, the trapped air gets compressed in pressurized mode. In unpressurised mode, it expands and pushes the oil to the make-up oil system. Hence the oil level rises in the unpressurised mode.
   **Remedy** — Bleed the system to remove air. See bleeding procedure. Replace the oil if necessary.
Threaded Body Cylinder
single acting (spring return), push type

Description
Solid piston threaded body cylinder is single acting, spring return cylinder, suitable to use with hydropneumatic intensifier.

Advantages
The cylinder is most simple in construction and very easy for maintenance. The piston force can be directly used for clamping. The piston force can be increased by using a clamping strap leverage.

Specifications
- Maximum oil pressure 200 bar.
- Return spring back pressure @ 1 bar.

Note
- As the cylinder is single acting spring return, a breather is provided. It should be protected from cutting fluid and coolant.
- Heavy extensions to piston rod can influence return stroke of the cylinder.
- Lock nut has to be ordered separately.
- For ordering the seal kit, add the prefix "S" to the part number.

<table>
<thead>
<tr>
<th>FORCE</th>
<th>3 kN</th>
<th>5 kN</th>
<th>10 kN</th>
<th>18 kN</th>
<th>30 kN</th>
<th>50 kN</th>
</tr>
</thead>
<tbody>
<tr>
<td>ØBORE</td>
<td>16</td>
<td>20</td>
<td>30</td>
<td>40</td>
<td>50</td>
<td>65</td>
</tr>
<tr>
<td>D</td>
<td>21.8</td>
<td>27.5</td>
<td>43.5</td>
<td>54.5</td>
<td>57.5</td>
<td>67.5</td>
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<tr>
<td>Ø</td>
<td>52</td>
<td>11.05</td>
<td>15.85</td>
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<tr>
<td>G</td>
<td>3/8&quot;</td>
<td>3/8&quot;</td>
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<td>SW</td>
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<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

Note:
LOCK NUT (ACCESSORY) TO BE ORDERED SEPARATELY

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>D2</th>
<th>M6 hex</th>
<th>M6 hex</th>
<th>M5 hex</th>
<th>M5 hex</th>
<th>M10</th>
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<td>75</td>
<td>90</td>
<td>90</td>
<td>110</td>
<td></td>
</tr>
<tr>
<td>D</td>
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<td>10</td>
<td>10</td>
<td>12</td>
<td>12</td>
<td>15</td>
</tr>
</tbody>
</table>
Description
These clamping cylinders are single acting spring return cylinders. These cylinders are fitted either in tapped hole in fixture, or in manifold. Sealing ‘O’ Ring is provided on the face of the cylinder.

Advantages
These cylinders are suitable to clamp smaller work pieces & when two or more jobs are clamped with short distance in between. The advantage of these cylinders is piping gets eliminated.

Installation
Sealing ring is provided on the face of cylinder, for proper sealing resting face should be flat & square to thread axis.

Notes
- Manifold mounting cylinders must not be subjected to a load in retracted position.
- These cylinders must not be loaded in unpressurised mode. Minimum wall thickness 3 mm for manifold. Aggressive cutting fluids & coolant can damage elastomer of the seal. Sealing may not be effective in this case. Hence breather must be protected from these fluids.
- For ordering the seal kit, add the prefix “S” to the part number.

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>FORCE $F$ (kN)</th>
<th>Ø Bore</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
<th>f</th>
<th>SW1</th>
<th>SW2</th>
<th>Max. seating torque (Nm)</th>
<th>Min Spring Force (N)</th>
<th>Weight (gm)</th>
<th>OIL VOLUME (cc)</th>
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<tr>
<td>Min Spring Force</td>
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<tr>
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</table>
Hollow Piston Cylinder

Description
Hollow piston cylinders are single acting, spring return cylinders, suitable to use with hydropneumatic intensifiers. The piston is provided with a through hole.

Advantages
Hollow piston cylinders can be easily adapted on existing fixtures. The cylinder can be mounted on the stud, by increasing the stud length. Automation can be achieved very fast.

Specifications
- Maximum oil pressure - 150 bar.

Notes
- As the cylinder is single acting, spring return, a breather is provided. It should be protected from cutting liquids and coolants.
- For ordering the seal kit, add the prefix “S” to the part number.

<table>
<thead>
<tr>
<th>FORCE</th>
<th>22 kN</th>
<th>22 kN</th>
<th>33 kN</th>
<th>33 kN</th>
<th>50 kN</th>
<th>50 kN</th>
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<th>78 kN</th>
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<table>
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<tr>
<th>MIN SPRING FORCE</th>
<th>232 N</th>
<th>173 N</th>
<th>381.1 N</th>
<th>244 N</th>
<th>432.9 N</th>
<th>422 N</th>
<th>756.5 N</th>
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<tr>
<td>OIL VOL.</td>
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<td>15 cc</td>
<td>37 cc</td>
<td>22 cc</td>
<td>55 cc</td>
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<td>110</td>
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<td>1.5 kg</td>
<td>2 kg</td>
<td>2.5 kg</td>
<td>2.5 kg</td>
<td>-</td>
<td>3.6 kg</td>
<td>5 kg</td>
</tr>
</tbody>
</table>

§ Force is specified at 150 bar.
Pull Cylinder
single acting (spring return), pull type, front flange mounting

Description
Pull cylinders are single acting, spring return cylinders, suitable for use with a hydropneumatic Intensifier.

Specifications
- Maximum operating pressure - 150

Note
- As the cylinder is single acting, spring return, a breather is provided. It should be protected from the cutting liquid and coolant.
- Heavy extensions to the piston rod can influence the return stroke of the cylinder.
- For ordering the seal kit, add the prefix "S" to the part number.

### PART NO.

<table>
<thead>
<tr>
<th>Force $§$</th>
<th>11 kN</th>
<th>22 kN</th>
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<tr>
<td>ØBORE</td>
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<td>STROKE</td>
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<td>32</td>
</tr>
<tr>
<td>E</td>
<td>M 12</td>
<td>M 16</td>
<td>M 20</td>
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<td>G</td>
<td>1/4&quot;</td>
<td>1/4&quot;</td>
<td>3/8&quot;</td>
</tr>
<tr>
<td>L</td>
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<td>50</td>
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<tr>
<td>SW</td>
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<tr>
<td>MIN SPRING FORCE</td>
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</tr>
<tr>
<td>WEIGHT</td>
<td>1.5 kg</td>
<td>2.5 kg</td>
<td>3.5 kg</td>
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</table>

$§$ Force is specified at 150 bar.
Swing Cylinder

Description
Swing cylinders are pull type cylinders. The piston rotates by 90° during the swing stroke, followed by straight clamping stroke due to the internal cam.

Application
Loading and unloading of the job is very easy due to swing action. In the unclamped position, the workpiece area is free from the strap.

Overload Protection
The built-in slip mechanism prevents the damage of the swing mechanism in case of overload.

Versions
TM — Top mounting
BM — Bottom mounting

Swing direction (While clamping & looking from rod side)
CW — Clockwise
CCW — Counter clockwise

Specifications
- Maximum oil pressure - 150 bar.
- Minimum oil pressure - 30 bar.

Important notes
- These cylinders can be used as single acting cylinders by using air breather at port 'B'.
- These cylinders can be used as double acting cylinders by removing air breather and connecting return line to port 'B'.
- Adjust the oil flow rate in such a way that the total clamping time will be between one to three seconds.
- Use only meter in circuit.
- Clamp the job in the straight clamping stroke only.
- For height adjustment, either use a spacer or an adjusting bolt on the strap.
- For horizontal mounting of single acting cylinders, weight of the strap should assist the declamping swing stroke.
- Do not exceed the standard strap length.
- Breather should be protected from cutting liquids and coolants.
- Angular tolerance ± 3°
- Strap has to be ordered separately.
- For ordering the seal kit, add the prefix "S" to the part number.

<table>
<thead>
<tr>
<th>Ø BORE</th>
<th>3.5 kN</th>
<th>8.9 kN</th>
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<tr>
<td>d</td>
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| TM CW | -- |
| TM CCW| -- |
| BM CW | -- |
| BM CCW| -- |

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<th>R2</th>
<th>C</th>
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<th>V</th>
<th>E</th>
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$^\text{§ Force is specified at 150 bar.}$
Swing Cylinder
without overload protection flange mounting single acting /

Description
Swing cylinders are pull type cylinders. The piston rotates by 90° during the swing stroke, followed by straight stroke due to the cam.

Application
The clamping strap rotates by 90° while clamping and declamping. Due to the swing action, loading and unloading of the job is very easy. In the un-clamped position, the workpiece area is free from the strap.

Versions
Following versions are available.
Type of cylinder
SW — Single acting (spring return)
DSW — Double acting
Swing direction
(While clamping & looking from rod side)
CW — Clockwise
CCW — Counter clockwise

Specifications
- Bore diameter - 30 mm.
- Maximum oil pressure - 150 bar.
- Minimum oil pressure - 20 bar
- Oil volume clamp - 9.2 cc.
- Oil volume declamp - 19.8 cc.
- Force at 150 bar - 5.0 kN.
- Weight of the cylinder - 2.8 kg.

Important notes
- To avoid damage to the swing mechanism -
  - Hold the clamping strap in a vice or spanner, while tightening and loosening the cap screw (M 10).
  - Clamp the job in the straight clamping stroke only.
- Double acting cylinders are suitable with the hydraulic power unit.
- Single acting cylinders are suitable with the hydropneumatic intensifier.
- Do not exceed the standard strap length.
- Adjust the oil flow rate in such a way so that the total clamping time will be more than one second.
- For height adjustment, either use a spacer at the mounting plate or adjust the clamping bolt on the strap.
- For horizontal mounting of single acting cylinders, weight of the strap should assist the decamping swing stroke.
- Breather should be protected from cutting liquids and coolants.
- For ordering the seal kit, add the prefix "S" to the part number.
Swing Cylinder
without overload protection, threaded body, flange mounting,single acting /

**Description**
Swing cylinders are pull type cylinders. The piston rotates by 90º during the swing stroke, followed by straight stroke due to the cam.

**Application**
The clamping strap rotates by 90º while clamping and declamping. Due to the swing action, loading and unloading of the job is very easy. In the unclamped position, the workpiece area is free from the strap.

**Versions**
Following versions are available.
Type of cylinder
- SW — Single acting (spring return)
- DSW — Double acting

Swing direction
- While clamping & looking from rod side
  - CW — Clockwise
  - CCW — Counter clockwise

**Specifications**
- Bore diameter - 30 mm.
- Maximum oil pressure - 150 bar.
- Minimum oil pressure - 20 bar.
- Oil volume clamp - 9.2 cc.
- Oil volume declamp - 19.8 cc.
- Force at 150 bar - 5.0 kN.
- Weight of the cylinder - 2.8 kg.

**Important notes**
- To avoid damage to the swing mechanism -
  - Hold the clamping strap in a vice or spanner, while tightening and loosening the cap screw (M 10).
  - Clamp the job in the straight clamping stroke only.
- Double acting cylinders are suitable with the hydraulic power unit.
- Single acting cylinders are suitable with the hydropneumatic intensifier.
- Do not exceed the standard strap length.
- Adjust the oil flow rate in such a way so that the total clamping time will be more than one second.
- For height adjustment, either use a spacer at the mounting plate or adjust the clamping bolt on the strap.
- For horizontal mounting of single acting cylinders, weight of the strap should assist the decamping swing stroke.
- Breather should be protected from cutting liquids and coolants.
- For ordering the seal kit, add the prefix "S" to the part number.
Compact Cylinder

Description
Compact cylinders are solid piston, double acting. Cylinders are very compact in the axial direction.

Advantages
These cylinders are used where height is a constraint. Mounting of the cylinder is very easy.

Specifications
- Maximum operating pressure - 150 bar.
- Double rod end cylinders can be available on request.

Note
- Due to compact design, port thread depth is short.
- Reduce the standard connector thread length to suit the port depth.
- For ordering the seal kit, add the prefix “S” to the part number.

All dimensions are in mm

Subject to change for improvement

§ Force is specified at 150 bar.
**Block Cylinder**

Block cylinders are widely used in workholding fixtures and other short stroke applications.

**Advantages**
As compared to the tie rod construction cylinders, these cylinders are very compact, due to the integral construction.
These cylinders are versatile, i.e. they can be mounted in many different ways.

**Versions**
Two versions are available in all models
- Double acting
- Single acting push type, with spring return.

**Specification**
- Maximum operating pressure - 150 bar

**Note**
- For side mounting, positive stopper should be provided to reduce the load on the clamping bolts.
- For the single acting, spring return cylinder, a breather is provided. It should be protected from cutting liquids and coolants.
- For ordering the seal kit, add the prefix "S" to the part number.

### Double Acting Cylinder

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>STROKE ±2</th>
<th>20</th>
<th>50</th>
<th>20</th>
<th>50</th>
<th>20</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>68</td>
<td>98</td>
<td>81</td>
<td>111</td>
<td>105</td>
<td>135</td>
<td></td>
</tr>
<tr>
<td>OIL VOL push</td>
<td>10 cc</td>
<td>25 cc</td>
<td>25 cc</td>
<td>63 cc</td>
<td>63 cc</td>
<td>156 cc</td>
<td></td>
</tr>
<tr>
<td>OIL VOL pull</td>
<td>6 cc</td>
<td>15 cc</td>
<td>15 cc</td>
<td>38 cc</td>
<td>37 cc</td>
<td>93 cc</td>
<td></td>
</tr>
<tr>
<td>WEIGHT</td>
<td>1.5 kg</td>
<td>2.3 kg</td>
<td>2.5 kg</td>
<td>3.5 kg</td>
<td>9.6 kg</td>
<td>12.3 kg</td>
<td></td>
</tr>
</tbody>
</table>

### Single Acting Push Type Spring Return Cylinder

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>STROKE</th>
<th>15</th>
<th>30</th>
<th>15</th>
<th>30</th>
<th>15</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>68</td>
<td>98</td>
<td>81</td>
<td>111</td>
<td>105</td>
<td>135</td>
<td></td>
</tr>
<tr>
<td>OIL VOL push</td>
<td>8 cc</td>
<td>15 cc</td>
<td>19 cc</td>
<td>38 cc</td>
<td>48 cc</td>
<td>95 cc</td>
<td></td>
</tr>
<tr>
<td>SPRING FORCE</td>
<td>110 N</td>
<td>100 N</td>
<td>300 N</td>
<td>280 N</td>
<td>425 N</td>
<td>460 N</td>
<td></td>
</tr>
<tr>
<td>WEIGHT</td>
<td>1.5 kg</td>
<td>2.3 kg</td>
<td>2.5 kg</td>
<td>3.5 kg</td>
<td>9.6 kg</td>
<td>12.3 kg</td>
<td></td>
</tr>
</tbody>
</table>
Vertical Swing Cylinder

Description

It is a double acting cylinder. The job gets clamped in the piston push direction. The clamping strap is connected to the piston by a linkage mechanism.

Installation and advantages

Installation of the cylinder is very simple with 4 cap screws on the top flange. Clamp and declamp ports are provided on face of the mounting flange as shown in figure.

Top of the cylinder body is angled to allow coolant and chips to flow away from wiper section.

Notes

- Standard strap has to be ordered separately. In case, a longer strap is required, it should be designed for increased bending moment.
- The adjusting screw on the strap should be adjusted for a 3 mm reserve stroke.
- For xxxxxxx, two ports are at rear side only.
- Bore Ø80 details will be available on request.
- Manifold mounting and single acting versions will be available on request.
- For ordering the seal kit, add the prefix “S” to the part number.

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>U</th>
<th>V</th>
<th>AB</th>
<th>DB</th>
<th>R</th>
<th>W</th>
<th>SP</th>
<th>ST</th>
<th>Z</th>
<th>CT</th>
<th>CA</th>
<th>WA</th>
<th>TP</th>
<th>X</th>
<th>Y</th>
<th>C</th>
<th>H</th>
<th>Wt</th>
</tr>
</thead>
<tbody>
<tr>
<td>24.3</td>
<td>16.5</td>
<td>6.5</td>
<td>10</td>
<td>16</td>
<td>8</td>
<td>12</td>
<td>6</td>
<td>18.5</td>
<td>23.5</td>
<td>6</td>
<td>11.8</td>
<td>M6</td>
<td>6</td>
<td>6</td>
<td>4</td>
<td>0.15 kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>13</td>
<td>13</td>
<td>18</td>
<td>26</td>
<td>18</td>
<td>11</td>
<td>10.1</td>
<td>24</td>
<td>28</td>
<td>14</td>
<td>22</td>
<td>M6</td>
<td>8</td>
<td>12</td>
<td>5</td>
<td>0.2 kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>15</td>
<td>16</td>
<td>22</td>
<td>32</td>
<td>24</td>
<td>12.5</td>
<td>12.5</td>
<td>30</td>
<td>38</td>
<td>12</td>
<td>26</td>
<td>M10</td>
<td>10</td>
<td>15</td>
<td>2</td>
<td>0.4 kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>64</td>
<td>20</td>
<td>24</td>
<td>32</td>
<td>48</td>
<td>38</td>
<td>20.5</td>
<td>20.1</td>
<td>48</td>
<td>65</td>
<td>13</td>
<td>38</td>
<td>M16</td>
<td>16</td>
<td>22</td>
<td>10</td>
<td>1 kg</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Vertical swing cylinders are used in applications similar to that of swing cylinders and can replace swing cylinders in many places. In the unclamped position, the work piece area is free from the strap, to facilitate easy loading / unloading.

<table>
<thead>
<tr>
<th>STROKE</th>
<th>ØBore</th>
<th>ØBore</th>
<th>ØBore</th>
</tr>
</thead>
<tbody>
<tr>
<td>push</td>
<td>12cc</td>
<td>24cc</td>
<td>45cc</td>
</tr>
<tr>
<td>pull</td>
<td>8cc</td>
<td>16cc</td>
<td>31cc</td>
</tr>
</tbody>
</table>

| WEIGHT  | 1.5 kg | 2.5 kg | 4 kg  | 11 kg |

All dimensions are in mm

Overall dimension tolerance ± 0.5 mm

Subject to change for improvement

§ Force is specified at 150 bar.

A - Clamp Port
B - Declamp Port
Die Clamping Cylinder

Shevanta Enterprise

Die clamping cylinder is a pull type, spring return cylinder. An integral ‘T’, suitable to 28mm ‘T’ slot, is provided to the piston rod of the cylinder.

Application
These cylinders are widely used for the quick change of dies & tools on presses.

Operation
For changing the tool, first the cylinder pressure is released and the cylinders are moved away from the tool, either manually or by a pneumatic cylinder. After changing the tool, cylinders are placed back at the clamping points and are pressurized.

Important Notes
- Two separate circuits should be used for two diagonals of the tool (Tandem Clamping). This feature is a must for the safety purpose.
- Cylinder stroke is only 8 mm. Clamping height of different tools must be the same with the tolerance of ±1 mm. Specify dimension ‘H’ (clamping height of the tool), while ordering the cylinder.
- For ordering the seal kit, add the prefix “S” to the part number.

Specifications
Maximum operating pressure - 200 bar.

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>FORCE</th>
<th>ØBORE</th>
<th>d</th>
<th>g</th>
<th>f</th>
<th>j</th>
<th>H</th>
<th>OIL VOL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50 kN</td>
<td>70</td>
<td>40</td>
<td>87</td>
<td>95</td>
<td>60</td>
<td></td>
<td>20.73 cc</td>
</tr>
<tr>
<td></td>
<td>75 kN</td>
<td>80</td>
<td>40</td>
<td>87</td>
<td>105</td>
<td>74</td>
<td></td>
<td>30.16 cc</td>
</tr>
<tr>
<td></td>
<td>105 kN</td>
<td>94</td>
<td>45</td>
<td>92</td>
<td>125</td>
<td>78</td>
<td></td>
<td>42.99 cc</td>
</tr>
</tbody>
</table>

§ Force is specified at 200 bar.

Subject to change for improvement
Description
Die Lifers are used in pairs or sets as per the 'T' slot length in the bolster. Hydraulic piston fitted with needle roller bearing lift the dieset allowing the die to be easily rolled in and out during die change process. Dielifter is of rectangular cross section & can be fitted in 'T' Slot of bolster. In 250 mm & 200 mm length die lifters, four & three single acting, load return cylinders are fitted respectively. Various lengths can be assembled by using combinations of 250 & 200 length die lifters.

Application
Die-lifters are used for quick change of dies & tools on presses. Die can be pushed & pulled only in the direction of T slot.

Specifications
- Operating pressure - 85 kg/cm²
- Force per unit length :- 5 kg/mm at 85 bar
- Stroke :- 3 mm
- Max. operating pressure 100 kg/cm²
- Lengths Available- 200, 250, 400, 450, 500, 600, and any length in step of 50 above 600 mm

Installation
Die-lifters are fixed in T slot. Die-lifters must be 1 mm below bolster top in un pressurized mode. Proper packing should be used to achieve this specific height. Connector tubes are used to connect two units of die-lifter in the row as shown in figure. Minimum two rows of die-lifter are required to balance die weight. At one end hydraulic connection has to be give & other end has to be plugged.

Operation
For changing die, first unclamp the die-set. (Keep all cylinders in Parking stand, if die is clamped by die clamping cylinders) Move ram up. Pressurize die-lifter, so that die is lifted by 2mm above bolster top. Push die-set on trolley. Push new die set on bolster. Release die-lifter pressure so that die will rest on bolster.

Note
- There should not be pockets on the bottom of die-sets. It is preferred to have hardened strip at bottom area which is in contract with die-lifters.
- Do not pressurize die-lifters when either dies are in clamped condition on Ram is at bottom dead center.
- Die-lifter circuit must have counter balance valve relief valve so that maximum pressure is controlled.
- For ordering the seal kit, add prefix "S" to the part number (Specify total length and number of rollers).
- Tslot dimensions should be 28mm as per DIN 650 standard
- Specify dimension ‘L’(Length of die lifter), while ordering the die lifter.

Subject to change for improvement
All dimensions are in mm
Hydraulic Power Unit

Salient features
- Modular construction - There are four separate manifolds, two for the top die and two for the bottom die. A separate manifold is provided for the die lifters. All these manifolds are mounted on the base manifold, which includes pressure switches, accumulator, pressure relief valve and check valves. The tandem clamping ensures positive clamping.
- The pump is put ‘ON’ and ‘OFF’ by the differential pressure switch, to avoid oil heating. Extra pressure switches give the feedback and stop the press.
- Accumulator is fitted to compensate leakage in case of power failure.
- Direction control valve allows the operation of either die clamps or die lifters.

Specifications
- Tank Capacity - 12 liters approximately
- Useful oil volume - 8 liters approximately
- Pump - Radial piston pump, 1.5 lpm @ 1440 rpm.
- Motor - 1.5 hp, 3-phase
- Accumulator - 0.32 liters.
- Solenoid valves with pilot operated check valve
- Operating pressure - 200 bar.
- Maximum oil pressure - 300 bar.

Quick Die Change System

Description
HPCPL manufactures die clamping cylinders, die lifters & die clamping powerpack. HPCPL also offers die handling & loading - unloading trolley to change dies less than 10 minutes. Specific care is taken to locate die on bolster, so that cylinders can be inserted without losing time. Dies weighing less than 5 ton can be pushed or pulled manually. Interlocks are provided for safety of operator, machine & die sets.
Ball Latch

**Description**
Ball latch does two functions:

I) Locating
II) Clamping

Locating is achieved by two precision bushes & one locating pin. Screw & balls in tapered seat achieve positive clamping.

**Application**
Ball latch is useful to locate & clamp fixture plate to base plate in a minute. This system is suitable for CNC machine where small batches of different jobs are machined. Diagonally opposite two ‘Ball-Latches’ are sufficient to locate plate. Additional ball latch may create redundant location. Additional ball latch can be used for clamping purpose without fixing liner bushes.

A. For accurate repeatability (±0.013mm), use two primary liner & center distance tolerance for hole machining is ± 0.005mm. (Fig.A)
B. For slightly less accurate repeatability (±0.04 mm) use one primary & one secondary liner with center distance Tolerance for hole machining ±0.025mm (Fig. B)

**Versions**
Ball latch has three parts:

Shank - Shank are available in 16mm, 20mm & 25mm sizes
Liner - Liner bushes have two types.

Primary Liners are with close tolerance, while secondary liners are slight loose.
Bottom Bush - Bottom bushes are of two types.

- Bolt in bushes are fixed from front side, while reverse fit bushes are pressed from bottom side.

Subject to change for improvement

All dimensions are in mm
**IMPORTANT NOTES**

I) Never use more than two liners in the fixture plate. Additional clamping holes must be without liners.

II) While pressing reverse mount bush interference should not be more than 0.013mm.

III) Bolt in bushes should be below the surface.

* Do not exceed maximum screw torque

---

**Primary Liner I.D. Is Nominal +0.005/+0.018**

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Max. Working Load (KN)</th>
<th>Max. Screw Torque (N-M)</th>
<th>Fixture Plate Thick. ± 0.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-16 x 20</td>
<td>5.3</td>
<td>1.38</td>
<td>20</td>
<td>8</td>
</tr>
<tr>
<td>5-20 x 20</td>
<td>12.7</td>
<td>5.40</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>5-25 x 25</td>
<td>30.4</td>
<td>12.16</td>
<td>25</td>
<td>10</td>
</tr>
</tbody>
</table>

---

**Part No.**

**Primary Liner**

**Description**

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Part No.</th>
<th>Secondary Liner</th>
</tr>
</thead>
<tbody>
<tr>
<td>PL 16 x 20</td>
<td>46 00 479</td>
<td>SL 16 x 20</td>
<td></td>
</tr>
<tr>
<td>PL 20 x 20</td>
<td>46 00 449</td>
<td>SL 20 x 20</td>
<td></td>
</tr>
<tr>
<td>PL 25 x 25</td>
<td>46 00 484</td>
<td>SL 25 x 25</td>
<td></td>
</tr>
</tbody>
</table>

**Hole Size For Liner**

<table>
<thead>
<tr>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>25.016</td>
<td>25.026</td>
</tr>
<tr>
<td>35.018</td>
<td>35.028</td>
</tr>
<tr>
<td>35.018</td>
<td>35.028</td>
</tr>
</tbody>
</table>

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**Part No.**

**Description**

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>P</th>
<th>Q</th>
<th>R</th>
<th>S</th>
<th>T</th>
<th>BORE -0.01</th>
<th>BORE -0.00</th>
<th>Min. Subplate Thickness</th>
<th>Counter Bore AB</th>
<th>DEPTH ±0.02</th>
</tr>
</thead>
<tbody>
<tr>
<td>RB 16</td>
<td>6.81</td>
<td>26.6</td>
<td>22</td>
<td>16</td>
<td>12.1</td>
<td>22</td>
<td>20</td>
<td>20</td>
<td>29</td>
<td>7.24</td>
<td></td>
</tr>
<tr>
<td>RB 20</td>
<td>6.81</td>
<td>32.2</td>
<td>28</td>
<td>20</td>
<td>17.1</td>
<td>28</td>
<td>20</td>
<td>33</td>
<td>8.74</td>
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<td></td>
</tr>
<tr>
<td>RB 25</td>
<td>10.27</td>
<td>40.2</td>
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<td>25</td>
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<td>35</td>
<td>25</td>
<td>41</td>
<td>10.54</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Subject to change for improvement**

All dimensions are in mm.
Specifications
- Max. pressure - 160 bar.
- Max reciprocating speed - 12 m/min.
- Break-away pressure - 3 to 5 bar.
- Standard cushioning length - 20 mm.
- Minimum cushioning speed - 400 mm/min or less adjustable.
- Cushioning is available from 63 mm bore onwards only.

All dimensions are in mm
Subject to change for improvement

All dimensions are in mm
Shevanta Enterprise

MX2- Cap Mounting Tie Rods Extended

<table>
<thead>
<tr>
<th>BORE</th>
<th>A</th>
<th>B</th>
<th>B</th>
<th>D</th>
<th>E</th>
<th>T</th>
<th>Z</th>
<th>J</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>40</td>
<td>19</td>
<td>19</td>
<td>M5 x 0.8</td>
<td>40</td>
<td>28.3</td>
<td>114</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>59</td>
<td>36</td>
<td>36</td>
<td>M8 x 1</td>
<td>63</td>
<td>41.7</td>
<td>153</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>74</td>
<td>46</td>
<td>46</td>
<td>M12 x 1.25</td>
<td>75</td>
<td>52.3</td>
<td>159</td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>91</td>
<td>46</td>
<td>46</td>
<td>M12 x 1.25</td>
<td>90</td>
<td>64.3</td>
<td>168</td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>117</td>
<td>59</td>
<td>59</td>
<td>M16 x 1.5</td>
<td>115</td>
<td>82.7</td>
<td>190</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>137</td>
<td>59</td>
<td>59</td>
<td>M16 x 1.5</td>
<td>130</td>
<td>96.9</td>
<td>203</td>
<td></td>
</tr>
</tbody>
</table>

MX3- Head Mounting Tie Rods Extended

<table>
<thead>
<tr>
<th>BORE</th>
<th>A</th>
<th>B</th>
<th>B</th>
<th>D</th>
<th>E</th>
<th>T</th>
<th>Z</th>
<th>J</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>40</td>
<td>19</td>
<td>19</td>
<td>M5 x 0.8</td>
<td>40</td>
<td>28.3</td>
<td>114</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>59</td>
<td>35</td>
<td>35</td>
<td>M8 x 1</td>
<td>63</td>
<td>41.7</td>
<td>153</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>74</td>
<td>46</td>
<td>46</td>
<td>M12 x 1.25</td>
<td>75</td>
<td>52.3</td>
<td>159</td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>91</td>
<td>46</td>
<td>46</td>
<td>M12 x 1.25</td>
<td>90</td>
<td>64.3</td>
<td>168</td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>117</td>
<td>59</td>
<td>59</td>
<td>M16 x 1.5</td>
<td>115</td>
<td>82.7</td>
<td>190</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>137</td>
<td>59</td>
<td>59</td>
<td>M16 x 1.5</td>
<td>130</td>
<td>96.9</td>
<td>203</td>
<td></td>
</tr>
</tbody>
</table>

MP1- Cap Mounting Fixed Clevis

<table>
<thead>
<tr>
<th>BORE</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>L</th>
<th>R</th>
<th>X</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>14</td>
<td>12</td>
<td>10</td>
<td>8</td>
<td>10</td>
<td>13</td>
<td>12</td>
<td>127</td>
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</tr>
<tr>
<td>40</td>
<td>18</td>
<td>20</td>
<td>14</td>
<td>10</td>
<td>63</td>
<td>19</td>
<td>17</td>
<td>172</td>
<td></td>
</tr>
<tr>
<td>50</td>
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<td>15</td>
<td>75</td>
<td>32</td>
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<td>191</td>
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<td></td>
</tr>
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<td>115</td>
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<tr>
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MP3- Cap Mounting Fixed Eye

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MS2 - Mounting with Side Lugs

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Subject to change for improvement

All dimensions are in mm
Features and Benefits

- The Piston Rod is hardened, ground, hard chrome plated and polished to ensure a smooth, dent & rust resistant surface for best sealing and long life.
- The Cylinder Tube is to meet close standards of straightness, roundness and surface finish for longer seal life and performance.
- Floating Cushion Bush and Sleeve.
- The floating cushion bush and sleeve are self centering, allowing close tolerances and therefore more effective cushioning.
- For the return stroke, a ball check valve at the head end and the lifting bush at the cap end allow free flow for fast cycle time.
- Seals - Bronze filled teflon seals

HOW TO ORDER

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<th>CYLINDER BORE</th>
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BT for bronze filled teflon seals

CB : Cushioned at Both ends
NC : Non-Cushioned
CE : Cap End Cushioned
CH : Head End Cushioned
(Cushioning is available from 63 mm bore onwards only)

CUSHIONING DETAILS

ME5, ME6, MT1, MT2, MT4, MX2, MX3, MP1, MP3, MS2
MOUNTING STYLE

Subject to change for improvement

All dimensions are in mm