Precision Cylinder

Series MTS

ø8, ø12, ø16, ø20, ø25, ø32, ø40

Cylinder with ball spline

<table>
<thead>
<tr>
<th>Model</th>
<th>Standard stroke (mm)</th>
<th>Rod end configuration</th>
<th>Cushion</th>
<th>End lock</th>
<th>Made to Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTS8</td>
<td>5 10 15 20 25 30 50 75 100 125 150 175 200</td>
<td>Female thread (Standard)</td>
<td>Rubber bumper</td>
<td>Rod through-hole</td>
<td>Variable stroke/Adjustable extend</td>
</tr>
<tr>
<td>MTS12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MTS16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MTS20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MTS25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MTS32</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MTS40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Precision Cylinder with Internal Guide Function.**

**Series MTS**

**MTS8**

- **Non-rotating accuracy:** 0.1 ° or less (0.2 ° or less for ø8, within allowable torque values)
- **Deflection:** 0.1 mm or less (For MTS12-25, within allowable lateral load values)

- **Small size ø8 introduced to series**
- **Rod through-hole allows vacuum piping (Made-to-order).** Lifting and transfer of small electronic parts is possible with short mounting pitch.
- **Piping is possible from two directions.**

- **Short mounting pitch: 15 mm**

- **Uses new type compact auto switches (ø8 only).** Two auto switches can be mounted even with the minimum 5 stroke (mm).

- **Air cushion standardized** (ø8 equipped with rubber bumper)

- **Rear end lock type added to series (ø12 to ø40)**

- **Sealing and durability equivalent to conventional round rod models have been achieved with a specially configured rod seal.**

- **Application Example**
  - Picking & placing
  - Transferring of workpieces
  - Positioning of pins

- **Mounting space reduced**

- **Two types of rod end configuration**
  - Standard: Rod end female threads
  - Option: Rod end male thread (Using stud bolt)

- **Three types of mounting are possible**
  - Bottom mounting
  - Front mounting
  - Both sides mounting

- **Auto switch capable on four sides** (Two sides for ø8)

- **Stroke adjustment mechanism/ Made to Order Specifications**
  - Stroke adjustment is possible on the rod extension side.
  - Stroke adjustment range: 0 to 10 mm (ø8)
  - 0 to 25 mm (ø12 to ø40)

- **Parallelism of mounting surfaces (side, bottom) to rod: 0.1 mm or less**
- **Squareness of mounting surface (front) to rod: 0.1 mm or less**
- **Deflection:** 0.1 mm or less (For MTS12-25, within allowable lateral load values)

- **Mounting is possible in high accuracy.**

- **Reduced labor for design and assembly**
Series **MTS**

**Model Selection**

⚠️ **Caution** Confirmation of theoretical output is required separately. Refer to “Theoretical Output” on page 239.

**Selection Conditions**

Follow the tables below in order to determine selection conditions and choose one selection graph.

**Vertical Mounting**

<table>
<thead>
<tr>
<th>Mounting orientation</th>
<th>Selection graph</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ø8</td>
</tr>
</tbody>
</table>

**Maximum speed (mm/s)**

- Up to 100
- Up to 200
- Up to 300
- Up to 400
- Up to 500
- Up to 600
- Up to 800

**Stroke (mm)**

- All strokes

**Selection graph**

- (1) — (2) — (3) — (4) — (5) — (6) — (7)

**Horizontal Mounting**

<table>
<thead>
<tr>
<th>Mounting orientation</th>
<th>Selection graph</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ø12 to ø40</td>
</tr>
</tbody>
</table>

**Maximum speed (mm/s)**

- Up to 100
- Up to 150
- Up to 200
- Up to 250
- Up to 300
- Up to 350
- Up to 400
- Up to 450
- Up to 500
- Up to 550
- Up to 600
- Up to 650
- Up to 700
- Up to 750
- Up to 800

**Stroke (mm)**

- All strokes

**Selection graph**

- (1) — (2) — (3) — (4) — (5) — (6) — (7) — (8) — (9) — (10) — (11) — (12) — (13) — (14) — (15) — (16) — (17) — (18) — (19) — (20) — (21)

*Direction for L can be up, down, left, right, or diagonal.*

**Caution**

- In the case of horizontal mounting, when the load center of gravity is beyond the rod end, add that distance to the stroke to select a graph.

**Selection Example**

1. **Selection conditions**

   - Mounting: Vertical
   - Maximum speed: 800 mm/s
   - Overhang: 50 mm
   - Load mass: 2 kg

   Refer to graph (7) based on vertical mounting and the maximum speed of 800 mm/s. On graph (7), find the intersecting point for the overhang of 50 mm and the load mass of 2 kg to determine ø32.

2. **Selection conditions**

   - Mounting: Horizontal
   - Maximum speed: 600 mm/s
   - Stroke: 125 mm
   - Overhang: 80 mm
   - Load mass: 0.7 kg

   Refer to graph (16) based on horizontal mounting, the maximum speed of 600 mm/s, and 125 mm stroke. On graph (16), find the intersecting point for the overhang of 80 mm and the load mass of 0.7 kg to determine ø25.
**Vertical Mounting**

**Ø8**

**Graph (1) Maximum Speed: Up to 100 (mm/s)**

```
Mass W (kg) vs Overhang L (mm)
```

**Graph (2) Maximum Speed: Up to 300 (mm/s)**

```
Mass W (kg) vs Overhang L (mm)
```

**Graph (3) Maximum Speed: Up to 500 (mm/s)**

```
Mass W (kg) vs Overhang L (mm)
```

**Ø12 to Ø40**

**Graph (4) Maximum Speed: Up to 200 (mm/s)**

```
Mass W (kg) vs Overhang L (mm)
```

**Graph (5) Maximum Speed: Up to 400 (mm/s)**

```
Mass W (kg) vs Overhang L (mm)
```

**Graph (6) Maximum Speed: Up to 600 (mm/s)**

```
Mass W (kg) vs Overhang L (mm)
```

**Graph (7) Maximum Speed: Up to 800 (mm/s)**

```
Mass W (kg) vs Overhang L (mm)
```
Series MTS

Horizontal Mounting

Maximum speed: Up to 300 mm/s

Graph (8) Stroke: Up to 10 stroke

Graph (9) Stroke: Up to 20 stroke

Graph (10) Stroke: Up to 30 stroke

Maximum speed: Up to 500 mm/s

Graph (11) Stroke: Up to 10 stroke

Graph (12) Stroke: Up to 20 stroke

Graph (13) Stroke: Up to 30 stroke
Precision Cylinder Series MTS

Ø12 to Ø40

Maximum speed: Up to 600 mm/s

Graph (14) Stroke: Up to 50 stroke

Graph (18) Stroke: Up to 50 stroke

Maximum speed: Up to 800 mm/s

Graph (15) Stroke: Up to 100 stroke

Graph (19) Stroke: Up to 100 stroke

Graph (16) Stroke: Up to 150 stroke

Graph (20) Stroke: Up to 150 stroke

Graph (17) Stroke: Up to 200 stroke

Graph (21) Stroke: Up to 200 stroke

MXH
MXU
MXS
MXQ
MXF
MXW
MXJ
MXP
MXY
MTS

Overhang L (mm)
Mass W (kg)

Graph (14)  Stroke: Up to 50 stroke
Graph (18)  Stroke: Up to 50 stroke
Graph (15)  Stroke: Up to 100 stroke
Graph (19)  Stroke: Up to 100 stroke
Graph (16)  Stroke: Up to 150 stroke
Graph (20)  Stroke: Up to 150 stroke
Graph (17)  Stroke: Up to 200 stroke
Graph (21)  Stroke: Up to 200 stroke

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Courtesy of Steven Engineering, Inc.-230 Ryan Way, South San Francisco, CA 94080-6370-Main Office: (650) 588-9200-Outside Local Area: (800) 258-9200-www.stevenengineering.com
Series MTS
Spline Rod Displacement

Warp Angle
Displacement angle of spline rod due to torque load
The displacement angle when a static load is applied in the direction of the arrow, with the spline rod retracted.

Torque load (N·m)  Angle (°)

ø8

Torque load (N·m)  Angle (°)

ø12

Torque load (N·m)  Angle (°)

ø16

Torque load (N·m)  Angle (°)

ø20

Torque load (N·m)  Angle (°)

ø25

Torque load (N·m)  Angle (°)

ø32

Torque load (N·m)  Angle (°)

ø40
**Deflection Amount**

Displacement of spline rod due to pitch moment load
Displacement of the rod end when a static load is applied in the direction of the arrow, with the spline rod fully extended.

1. **Caution on Design**
   1. Displacement may increase after an impact load has been applied.
      If an impact load is applied to the spline rod, the guide unit may be permanently deformed and displacement may increase.
Precision Cylinder
Series MTS
ø8, ø12, ø16, ø20, ø25, ø32, ø40

How to Order

<table>
<thead>
<tr>
<th>Bore size</th>
<th>MTS 8</th>
<th>-</th>
<th>20</th>
<th>-</th>
<th>M9BW</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>ø8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bore size</th>
<th>MTS 20</th>
<th>-</th>
<th>100</th>
<th>-</th>
<th>M9BW</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>ø12 to ø40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Piping direction
- Standard piping type
- Axial piping type

Made to Order
- Without auto switch (Built-in magnet)
- Refer to page 239 for the made-to-order types.

Number of auto switches
- Nil
- 2 pcs.
- S
- 1 pc.
- n
- "n" pcs.

Auto switch
- For the applicable auto switch model, refer to the table below.
- For ø8 cylinders with auto switch, some auto switches cannot be mounted depending on piping direction and stroke size. Refer to "Auto Switch Mounting Stroke for ø8" on page 248.

End lock
- Nil
- None (Standard)
- R
- With head end lock

Rod end configuration
- Nil
- Rod end female thread (Standard)
- M
- Rod end male thread

Cylinder stroke (mm)
Refer to "Standard Stroke" on page 239.

Port thread type
- Nil
- M thread ø8 to ø24
- Rc
- ø32, ø40
- TN
- NPT
- TF
- G

Applicable Auto Switch
Refer to pages 1719 to 1827 for further information on auto switches.

<table>
<thead>
<tr>
<th>Type</th>
<th>Special function</th>
<th>Electrical entry</th>
<th>Wiring (Output)</th>
<th>Load voltage</th>
<th>Auto switch model</th>
<th>Lead wire length (m)</th>
<th>Pre-wired connector</th>
<th>Applicable load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid state switch</td>
<td>Diagnostic indication (2-color indication)</td>
<td>Grommet</td>
<td>3-wire (NPN), 3-wire (PNP), 2-wire, 3-wire (NPN), 3-wire (PNP), 2-wire</td>
<td>5 V, 12 V</td>
<td>M9NV, M9P</td>
<td>0.5, 1, 3, 5</td>
<td>-</td>
<td>IC circuit</td>
</tr>
<tr>
<td>Rod switch</td>
<td></td>
<td>Grommet</td>
<td>3-wire (PNP equivalent)</td>
<td>-</td>
<td>A96V</td>
<td>0, 100 V</td>
<td>-</td>
<td>IC circuit</td>
</tr>
</tbody>
</table>

- Lead wire length symbols: 0.5 m - Nil (Example) M9NW
- 1 m - M (Example) M9NWM
- 3 m - L (Example) M9NWL
- 5 m - Z (Example) M9WZ

- Solid state auto switches marked with " " are produced upon receipt of order.

- Since there are other applicable auto switches than listed, refer to page 249 for details.
- For details about auto switches with pre-wired connector, refer to pages 1784 and 1785.
- Auto switches are shipped together (not assembled).
## Specifications

**Bore size (mm)** | 8  | 12  | 16  | 20  | 25  | 32  | 40
--- | --- | --- | --- | --- | --- | --- | ---
**Fluid** | 4  | 6  | 8  | 10 | 13 | 16 | 20

<table>
<thead>
<tr>
<th>Without end lock</th>
<th>With end lock</th>
<th>Without end lock</th>
<th>With end lock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. operating pressure</td>
<td>0.15 MPa</td>
<td>—</td>
<td>0.12 MPa</td>
</tr>
</tbody>
</table>

**Maximum operating pressure** | 0.7 MPa | — | 1.0 MPa | — |

**Proof pressure** | — |

**Ambient and fluid temperature** | — | 10 to 60°C (No freeze/rost) |

**Bearing type** | Ball spline |

**Cushion** | Rubber or | Air cushion |

**Effective cushion length (mm)** | — | 9 | 10 | 11 | 12 | 17 | 17 |

**Lubrication** | Not required (Non-lube) |

**Piston speed (mm/s)** | 50 to 500 | 50 to 800 |

**Allowable kinetic energy (J)** | 0.02 | 0.19 | 0.32 | 0.55 | 0.78 | 1.6 | 2.8 |

**Stroke tolerance** | ±0.5 mm |

**Non-rotating accuracy** | 0.2° or less (Non-lube) |

**Piping port size** | M3 x 0.5 |

**Vacuum (Rod through-hole)** | — |

**Symbol Specifications**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>-XC8</td>
<td>Adjustable stroke cylinder/Adjustable extension type</td>
</tr>
<tr>
<td>-XC90</td>
<td>Vacuum (Rod through-hole)</td>
</tr>
</tbody>
</table>

### Standard Stroke

**Bore size (mm)** | 8, 12, 16, 20, 25, 30, 32, 40
**Standard stroke (mm)** | 25, 50, 75, 100, 125, 150, 175, 200

* Strokes other than the above are produced upon receipt of order.

### Stud Bolt Part No.

<table>
<thead>
<tr>
<th>Bore size (mm)</th>
<th>Part no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>MT-S8</td>
</tr>
<tr>
<td>12</td>
<td>MT-S12</td>
</tr>
<tr>
<td>16</td>
<td>MT-S16</td>
</tr>
<tr>
<td>20</td>
<td>MT-S20</td>
</tr>
<tr>
<td>25</td>
<td>MT-S25</td>
</tr>
<tr>
<td>32</td>
<td>MT-S32</td>
</tr>
<tr>
<td>40</td>
<td>MT-S40</td>
</tr>
</tbody>
</table>

* Replacement parts for rod end male thread. * Rod end nut is attached.

### End Lock Specifications

<table>
<thead>
<tr>
<th>Bore size (mm)</th>
<th>12</th>
<th>16</th>
<th>20</th>
<th>25</th>
<th>32</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lock position</strong></td>
<td>Head end only</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Holding force (Max.) (N)</strong></td>
<td>29</td>
<td>53</td>
<td>82</td>
<td>125</td>
<td>211</td>
<td>329</td>
</tr>
<tr>
<td><strong>Backlash</strong></td>
<td>1 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Theoretical Output

<table>
<thead>
<tr>
<th>Bore size (mm)</th>
<th>Operating direction</th>
<th>Operating pressure (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>OUT</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>IN</td>
<td>37</td>
</tr>
<tr>
<td>12</td>
<td>OUT</td>
<td>113</td>
</tr>
<tr>
<td></td>
<td>IN</td>
<td>84</td>
</tr>
<tr>
<td>16</td>
<td>OUT</td>
<td>201</td>
</tr>
<tr>
<td></td>
<td>IN</td>
<td>150</td>
</tr>
<tr>
<td>20</td>
<td>OUT</td>
<td>235</td>
</tr>
<tr>
<td></td>
<td>IN</td>
<td>224</td>
</tr>
<tr>
<td>25</td>
<td>OUT</td>
<td>490</td>
</tr>
<tr>
<td></td>
<td>IN</td>
<td>358</td>
</tr>
<tr>
<td>32</td>
<td>OUT</td>
<td>804</td>
</tr>
<tr>
<td></td>
<td>IN</td>
<td>603</td>
</tr>
<tr>
<td>40</td>
<td>OUT</td>
<td>1256</td>
</tr>
<tr>
<td></td>
<td>IN</td>
<td>942</td>
</tr>
</tbody>
</table>

### Mass

<table>
<thead>
<tr>
<th>Model</th>
<th>Standard stroke (mm)</th>
<th>End lock</th>
<th>(g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTS6</td>
<td>36 40 44 48 52 56</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>MTS12</td>
<td>— — — — —</td>
<td>138</td>
<td>157</td>
</tr>
<tr>
<td>MTS16</td>
<td>— — — — —</td>
<td>186</td>
<td>222</td>
</tr>
<tr>
<td>MTS20</td>
<td>— — — — —</td>
<td>350</td>
<td>500</td>
</tr>
<tr>
<td>MTS25</td>
<td>— — — — —</td>
<td>487</td>
<td>547</td>
</tr>
<tr>
<td>MTS32</td>
<td>— — — — —</td>
<td>918</td>
<td>1,083</td>
</tr>
<tr>
<td>MTS40</td>
<td>— — — — —</td>
<td>1,420</td>
<td>1,533</td>
</tr>
</tbody>
</table>

* Do not apply a load that is 50% or more of the theoretical output.

---

**Caution**

- When attaching or removing loads, be sure to do so while securing the spline rod’s width across flats and not to apply a rotating torque on the spline nut.
- If rotational torque must be applied due to unavoidable circumstances, use the table below to make sure the allowable rotational torque is not exceeded.

<table>
<thead>
<tr>
<th>Bore size (mm)</th>
<th>8</th>
<th>12</th>
<th>16</th>
<th>20</th>
<th>25</th>
<th>32</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allowable rotational torque (N·m)</td>
<td>0.02</td>
<td>0.18</td>
<td>0.36</td>
<td>0.65</td>
<td>1.06</td>
<td>1.57</td>
<td>10.4</td>
</tr>
</tbody>
</table>

---

**Caution**

- Do not apply a load that is 50% or more of the theoretical output.

---

**Symbol Specifications**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>-XC8</td>
<td>Adjustable stroke cylinder/Adjustable extension type</td>
</tr>
<tr>
<td>-XC90</td>
<td>Vacuum (Rod through-hole)</td>
</tr>
</tbody>
</table>

---

**Made to Order Specifications**

For details, refer to pages 1886 and 1933.

---

**Symbol Specifications**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>-XC8</td>
<td>Adjustable stroke cylinder/Adjustable extension type</td>
</tr>
<tr>
<td>-XC90</td>
<td>Vacuum (Rod through-hole)</td>
</tr>
</tbody>
</table>
**Series MTS**

**Construction**

**Basic style**

- ø8

**ø12 to ø40**

**Rod cross section for ø12, ø16, ø20, and ø25**

**Rod cross section for ø32 and ø40**

**With end lock**

- ø12 to ø40

**Caution**

**Disassembly/Replacement**

A special tool is required when reassembling the cylinder after disassembled. Contact SMC when replacing component parts.

### Component Parts

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Material</th>
<th>Qty</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rod cover</td>
<td>Aluminum alloy</td>
<td>1</td>
<td>Clear anodized</td>
</tr>
<tr>
<td>2</td>
<td>Head cover</td>
<td>Aluminum alloy</td>
<td>1</td>
<td>Clear anodized</td>
</tr>
<tr>
<td>3</td>
<td>Cylinder tube</td>
<td>Aluminum alloy</td>
<td>1</td>
<td>Hard anodized</td>
</tr>
<tr>
<td>4</td>
<td>Piston</td>
<td>Aluminum alloy</td>
<td>1</td>
<td>Chromated</td>
</tr>
<tr>
<td>5</td>
<td>Spacer for switch type</td>
<td>Stainless steel</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Spline rod</td>
<td>Stainless steel</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Cushion bolt</td>
<td>Stainless steel</td>
<td>1</td>
<td>ø8: 800-2400 zinc chromated</td>
</tr>
<tr>
<td>8</td>
<td>End lock bolt</td>
<td>Carbon steel</td>
<td>1</td>
<td>ø8: Quenched/Zinc chromated</td>
</tr>
<tr>
<td>9</td>
<td>Collar</td>
<td>Aluminum alloy</td>
<td>1</td>
<td>Chromated</td>
</tr>
<tr>
<td>10</td>
<td>Spline nut</td>
<td>Carbon steel</td>
<td>1</td>
<td>ø12 to ø16</td>
</tr>
<tr>
<td>11</td>
<td>Cushion needle</td>
<td>Carbon steel</td>
<td>2</td>
<td>Nickel plated</td>
</tr>
<tr>
<td>12</td>
<td>Cap</td>
<td>Copper alloy</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Lock piston</td>
<td>Carbon steel</td>
<td>1</td>
<td>ø8: Quenched/Zinc chromated</td>
</tr>
<tr>
<td>14</td>
<td>Lock spring</td>
<td>Steel wire</td>
<td>1</td>
<td>Zinc chromated</td>
</tr>
<tr>
<td>15</td>
<td>Bumper</td>
<td>Urethane</td>
<td>2</td>
<td>ø8</td>
</tr>
<tr>
<td>16</td>
<td>Key</td>
<td>Carbon steel</td>
<td>1</td>
<td>ø12 to ø40</td>
</tr>
<tr>
<td>17</td>
<td>Type C retaining ring for hole</td>
<td>Carbon tool steel</td>
<td>2</td>
<td>ø8: Phosphate coated</td>
</tr>
<tr>
<td>18</td>
<td>Magnet</td>
<td>—</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Plug</td>
<td>Alloy steel</td>
<td>3</td>
<td>Nickel plated</td>
</tr>
<tr>
<td>20</td>
<td>Hexagon socket head set screw</td>
<td>Alloy steel</td>
<td>1</td>
<td>Black zinc chromated</td>
</tr>
<tr>
<td>21</td>
<td>Piston seal</td>
<td>NBR</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Spline seal</td>
<td>NBR</td>
<td>1</td>
<td>Rod seal for ø8</td>
</tr>
<tr>
<td>23</td>
<td>Collar gasket</td>
<td>NBR</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Tube gasket</td>
<td>NBR</td>
<td>2</td>
<td>ø12 to ø40</td>
</tr>
<tr>
<td>25</td>
<td>Piston gasket</td>
<td>NBR</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Cushion seal</td>
<td>Urethane</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Needle gasket</td>
<td>NBR</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Piston seal for lock</td>
<td>NBR</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Cap gasket</td>
<td>NBR</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
Precision Cylinder Series MTS

Dimensions: ø8

MTS8
Basic style

Note: Spline rod’s width across flats have nothing to do with the position of the body mounting face.

Stud bolt part no.: MT-S8
Material: Chromium molybdenum steel (Nickel plated)

Rod end nut part no.: NTJ-006A
Material: Carbon steel (Nickel plated)

Width across flats 3.5

2 x M3 x 0.5, effective length 5

Port size for axial piping type MTS8-□P

Width across flats 3.5

2 x M3 x 0.5, effective length 5

Port size for axial piping type MTS8-□P

Width across flats 3.5

4 x M3 x 0.5, effective length 5

Stud bolt part no.: MT-S8
Material: Chromium molybdenum steel (Nickel plated)

Rod end nut part no.: NTJ-006A
Material: Carbon steel (Nickel plated)
Series MTS

Dimensions: ø12

MTS12

Basic style

Note) Spline rod's width across flats have nothing to do with the position of the body mounting face.

Rod cross section

Width across flats 5

Rod end male thread

Width across flats 5

Stud bolt part no.: MT-S12
Material: Chromium molybdenum steel (Nickel plated)

Rod end nut part no.: NTP-010
Material: Carbon steel (Nickel plated)

With end lock

Width across flats 12

Material: Chromium molybdenum steel (Nickel plated)

Material: Carbon steel (Nickel plated)
Precision Cylinder Series MTS

Dimensions: ø16

MTS16
Basic style

Note: Spline rod's width across flats have nothing to do with the position of the body mounting face.

Rod cross section

4 x M4 x 0.7, effective length 7

Width across flats 6

Rod end male thread

M5 x 0.8

Width across flats 6

Stud bolt part no.: MT-S16
Material: Chromium molybdenum steel
(Nickel plated)

With end lock

Rod end nut part no.: NTJ-015A
Material: Carbon steel
(Nickel plated)

Width across flats 12

Materials:
- Stud bolt: Chromium molybdenum steel (Nickel plated)
- Rod end nut: Carbon steel (Nickel plated)
**Series MTS**

**Dimensions: ø20**

**MTS20**

**Basic style**

Note) Spline rod's width across flats have nothing to do with the position of the body mounting face.

**Rod cross section**

4 x M5 x 0.8, effective length 8

2 x M5 x 0.8, (Port size)

2 x cushion needle

2 x 4 x Ø7.5, counterbore depth 4.5 (Opposite side also)

**Rod end male thread**

Width across flats 8

M5 x 0.8

M6 x 1.0

Stud bolt part no.: MT-S20

Material: Chromium molybdenum steel
(Nickel plated)

Rod end nut part no.: NT-015A

Material: Carbon steel
(Nickel plated)

**With end lock**

Width across flats 14

11.5

119.5 + Stroke

137.5 + Stroke

**Material:**
- Stud bolt: Chromium molybdenum steel (Nickel plated)
- Rod end nut: Carbon steel (Nickel plated)
Precision Cylinder Series MTS

Dimensions: \( \phi 25 \)

**MTS25**

Basic style

Note: Spline rod's width across flats have nothing to do with the position of the body mounting face.

**Rod cross section**

- \( 4 \times M5 \times 0.8, \) effective length 8
- \( M6 \times 1.0 \)
- \( 4 \times M4.5 \) through
- \( 2 \times 4 \times \phi 7.5, \) counterbore depth 4.5 (Opposite side also)

**Rod end male thread**

- \( M8 \times 1.25 \)
- \( \phi 10.7 \)
- \( \phi 12.8 \)
- \( 12 \)
- \( 14.5 \)
- \( 41.5 \)

Stud bolt part no.: MT-S25
Material: Chromium molybdenum steel (Nickel plated)

Rod end nut part no.: NT-02
Material: Carbon steel (Nickel plated)

**With end lock**

- \( \phi 12.8 \)
- \( 14.5 \)
- \( 41.5 \)
- \( 12 \)
- \( 124.5 + \) Stroke
- \( 145.5 + \) Stroke

Stud bolt part no.: MT-S25
Material: Chromium molybdenum steel (Nickel plated)

Rod end nut part no.: NT-02
Material: Carbon steel (Nickel plated)
**Series MTS**

**Dimensions: ø32**

Note) Spline rod's width across flats have nothing to do with the position of the body mounting face.

**MTS32**

**Basic style**

Rod cross section

Width across flats 14

4 x M6 x 1.0, effective length 9

M8 x 1.25

26 ± 0.01

20 ± 0.01

4 x ø5.5 through

2 x 4 x ø9, counterbore depth 5.5 (Opposite side also)

4 x M6 x 1.0, effective length 9

**Rod end male thread**

Width across flats 14

M10 x 1.25

15

17.5

7.5

Stud bolt part no.: MT-S32

Material: Chromium molybdenum steel (Nickel plated)

**With end lock**

Width across flats 14

13

153.5 + Stroke

177.5 + Stroke

Material: Carbon steel (Nickel plated)

Stud bolt part no.: MT-S32

Material: Chromium molybdenum steel (Nickel plated)
**Precision Cylinder Series MTS**

**Dimensions: 40**

**MTS40**

**Basic style**

Note: Spline rod’s width across flats have nothing to do with the position of the body mounting face.

**Rod cross section**

- Width across flats 17
- 4 x M6 x 1.0, effective length 9
- M10 x 1.5
- 2 x cushion needle
- 2 x (Rc, NPT, G) 1/8 (Port size)
- 2 x X (Rc, NPT, G) 1/8 (Port size)
- 4 x ø5.5 through
- 2 x ø9, counterbore depth 5.5 (Opposite side also)

**Rod end male thread**

- Width across flats 17
- M12 x 1.25
- ø 9.9
- 18
- 20.5
- 8.5
- 55
- Stud bolt part no.: MT-S40
  Material: Chromium molybdenum steel (Nickel plated)

**With end lock**

- Width across flats 16
- M12 x 1.25
- ø 9.9
- 18
- 20.5
- 8.5
- 55
- Rod end nut part no.: MCN-NT-04
  Material: Carbon steel (Nickel plated)

**Series MTSPrecision Cylinder**

MXH  MXU  MXS  MXQ  MXF  MXW  MXJ  MXP  MXY

D-X

 Courtesy of Steven Engineering, Inc.-230 Ryan Way, South San Francisco, CA 94080-6370 - Main Office: (650) 588-9200 - Outside Local Area: (800) 258-9200 - www.stevenengineering.com
Series MTS

Auto Switch Proper Mounting Position (Detection at Stroke End) and Its Mounting Height

ø8

Auto Switch Proper Mounting Position

<table>
<thead>
<tr>
<th>Bore size (mm)</th>
<th>Reed auto switch</th>
<th>Solid state auto switch</th>
<th>2-color indication solid state auto switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>D-A9□</td>
<td>D-A9□</td>
<td>D-A9□</td>
</tr>
<tr>
<td></td>
<td>D-M9□</td>
<td>D-M9□</td>
<td>D-M9□</td>
</tr>
<tr>
<td></td>
<td>D-M9□W</td>
<td>D-M9□W</td>
<td>D-M9□W</td>
</tr>
</tbody>
</table>

Operating Range

<table>
<thead>
<tr>
<th>Auto switch model</th>
<th>Bore size (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-A9□</td>
<td>5 6 7.5 7.5 8 7 8</td>
</tr>
<tr>
<td>D-M9□W</td>
<td>3.0 4.5 4 4.5 5 4.5 5.5</td>
</tr>
<tr>
<td>D-M9□WV</td>
<td>2.5 4 4.5 4.5 4.5 4.5 5</td>
</tr>
</tbody>
</table>

* Since this is a guideline including hysteresis, not meant to be guaranteed. (Assuming approximately 30% dispersion.) There may be the case it will vary substantially depending on an ambient environment.

Auto Switch Mounting Stroke for ø8

<table>
<thead>
<tr>
<th>Piping direction</th>
<th>Mounting condition</th>
<th>Applicable auto switch</th>
<th>Stroke (mm)</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard piping type</td>
<td>2 pcs. on same side</td>
<td>D-A9□, D-M9□, D-M9□W</td>
<td>5 10 15 20 25 30</td>
<td>(2)</td>
</tr>
<tr>
<td></td>
<td>1 pc. each on 2 sides</td>
<td>D-A9□, D-M9□, D-M9□W</td>
<td>x x x</td>
<td>(2)</td>
</tr>
<tr>
<td>Axial piping type</td>
<td>2 pcs. on same side</td>
<td>D-A9□, D-M9□, D-M9□, D-M9□W</td>
<td>x x x</td>
<td>(2)</td>
</tr>
<tr>
<td></td>
<td>1 pc. each on 2 sides</td>
<td>D-A9□, D-M9□, D-M9□, D-M9□W</td>
<td>x x x</td>
<td>(2)</td>
</tr>
</tbody>
</table>

Note 1) With the standard piping type, solid state auto switches D-F8□, D-M9□, and D-M9□WV with perpendicular electrical entry cannot be mounted due to the interference of the fitting and speed controller.
Note 2) When mounting auto switches with in-line electrical entry, allow a space of 10 mm or more at the rear end to prevent lead wire interference.

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Precision Cylinder **Series MTS**

Auto Switch Proper Mounting Position (Detection at Stroke End) and Its Mounting Height

<table>
<thead>
<tr>
<th>ø12 to ø40</th>
</tr>
</thead>
</table>

![Diagram](image)

**D-A9**
**D-M9**
**D-M9□W**

**D-A9□V**
**D-M9□V**

**D-M9□WV**

<table>
<thead>
<tr>
<th>ø12/16/20</th>
</tr>
</thead>
</table>

![Diagram](image)

<table>
<thead>
<tr>
<th>ø25/32/40</th>
</tr>
</thead>
</table>

![Diagram](image)

### Table: Auto Switch Proper Mounting Position

<table>
<thead>
<tr>
<th>Bore size (mm)</th>
<th>ø12</th>
<th>ø16</th>
<th>ø20</th>
<th>ø25</th>
<th>ø32</th>
<th>ø40</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>42</td>
<td>43.5</td>
<td>59.5</td>
<td>63</td>
<td>84.5</td>
<td>98.5</td>
</tr>
<tr>
<td>B</td>
<td>15.5</td>
<td>17</td>
<td>23</td>
<td>26</td>
<td>32</td>
<td>32.5</td>
</tr>
<tr>
<td>C</td>
<td>35.5</td>
<td>37</td>
<td>43.5</td>
<td>46</td>
<td>52</td>
<td>52.5</td>
</tr>
<tr>
<td>A</td>
<td>13</td>
<td>15</td>
<td>19</td>
<td>20</td>
<td>23</td>
<td>30</td>
</tr>
<tr>
<td>B</td>
<td>18</td>
<td>20</td>
<td>22.5</td>
<td>23.5</td>
<td>26</td>
<td>28</td>
</tr>
<tr>
<td>C</td>
<td>18</td>
<td>20</td>
<td>22.5</td>
<td>23.5</td>
<td>26</td>
<td>28</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reel auto switch</th>
<th>Solid state auto switch</th>
<th>2-color indication solid state auto switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-A9□</td>
<td>D-M9□</td>
<td>D-M9□WV</td>
</tr>
<tr>
<td>D-M9□</td>
<td>D-M9□W</td>
<td>D-M9□WV</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ø12/16/20</th>
</tr>
</thead>
</table>

![Diagram](image)

<table>
<thead>
<tr>
<th>ø25/32/40</th>
</tr>
</thead>
</table>

![Diagram](image)

### Note:
Adjust the auto switch after confirming the operating conditions in the actual setting.

### Other than the applicable auto switches listed in “How to Order”, the following auto switches can be mounted. For detailed specifications, refer to pages 1719 to 1827.

<table>
<thead>
<tr>
<th>Auto switch type</th>
<th>Model</th>
<th>Electrical entry (Fetching direction)</th>
<th>Features</th>
<th>Applicable bore size (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid state</td>
<td>D-F8N</td>
<td>Grommet (Perpendicular)</td>
<td>With indicator light</td>
<td>ø8 to ø40</td>
</tr>
<tr>
<td></td>
<td>D-F8P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>D-F8B</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Normally closed (NC = b contact), solid state auto switch (D-F9G/F9H type) are also available. For details, refer to page 1746.
### Series MTS

#### Caution on Installing in Close Proximity to Each Other

1. When cylinders are used in close proximity to one another as in mounting patterns (1) through (4), the magnetic force of the auto switch magnets in cylinder B may have an effect on the operation of the auto switches on cylinder A. The mounting pitch of cylinders should be at least the values given in the table below:

<table>
<thead>
<tr>
<th>Bore size (mm)</th>
<th>Auto switch model</th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-A9, D-A9:V</td>
<td>27 (37)</td>
<td>5 (15)</td>
<td>15</td>
</tr>
<tr>
<td>D-M9, D-M9:V</td>
<td>27 (39)</td>
<td>5 (17)</td>
<td>15</td>
</tr>
<tr>
<td>D-F8</td>
<td>47</td>
<td>25</td>
<td>15</td>
</tr>
<tr>
<td>D-M9:W, D-M9:WV</td>
<td>27 (39)</td>
<td>5 (17)</td>
<td>15</td>
</tr>
</tbody>
</table>


2. Avoid wiring patterns in which bending stress and pulling force are repeatedly applied to the lead wires. When a bending stress is repeatedly applied to the lead wires, be sure to secure the lead wire close to the switch and to maintain a bending radius of R40 to R80 or more as a guideline. Applying a stress or pulling force to the connection part of a lead wire and an auto switch may cause broken wires, or a sheath to be dropped outs. Be sure that no force of any kind is applied to the connection part.
Series MTS
Specific Product Precautions
Be sure to read before handling.
Refer to front matters 42 and 43 for Safety Instructions and pages 3 to 11 for Actuator and Auto Switch Precautions.

Caution on Using End Lock Type

Operating Precautions

- **Caution**
  1. **Do not use 3 position solenoid valves.**
     Avoid use in combination with 3 position solenoid valves (especially closed center metal seal types). If pressure is trapped in the port on the lock mechanism side, the cylinder cannot be locked.
     Furthermore, even after being locked, the lock may be released after some time, due to air leaking from the solenoid valve and entering the cylinder.
  2. **Back pressure is required when releasing the lock.**
     Before starting operation, be sure to control the system so that air is supplied to the side without the lock mechanism. There is a possibility that the lock may not be released. (Refer to the section on releasing the lock.)
  3. **Release the lock when mounting or adjusting the cylinder.**
     If mounting or other work is performed when the cylinder is locked, the lock unit may be damaged.
  4. **Operate with a load ratio of 50% or less.**
     If the load ratio exceeds 50%, this may cause problems such as failure of the lock to release, or damage to the lock unit.
  5. **Do not operate multiple cylinders in synchronization.**
     Avoid applications in which two or more end lock cylinders are synchronized to move one workpiece, as one of the cylinder locks may not be able to release when required.
  6. **Use a speed controller with meter-out control.**
     It may not be possible to release the lock with meter-in control.
  7. **Be sure to operate completely to the cylinder stroke end on the side with the lock.**
     If the cylinder piston does not reach the end of the stroke, locking and unlocking may not be possible.

Relation to Cushion

- **Warning**
  1. Before releasing the lock, be sure to supply air to the side without the lock mechanism, so that there is no load applied to the lock mechanism when it is released. If the lock is released when the port on the other side is in an exhaust state, and with a load applied to the lock unit, the lock unit may be subjected to an excessive force and may be damaged.
     Furthermore, sudden movement of the spline rod is very dangerous.

Releasing the Lock

- **Caution**
  1. Insert the bolt, screw it into the lock piston, and then pull it to release the lock. If you stop pulling the bolt, the lock will return to an operational state. Thread sizes, pulling forces and strokes are as shown below.

<table>
<thead>
<tr>
<th>Bore size (mm)</th>
<th>Thread size</th>
<th>Pulling force (N)</th>
<th>Stroke (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12, 16</td>
<td>M2 x 0.4 x 15 or more</td>
<td>2</td>
<td>1.5</td>
</tr>
<tr>
<td>20, 25, 32</td>
<td>M3 x 0.5 x 30 or more</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>40</td>
<td>M3 x 0.5 x 30 or more</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

* Remove the bolt for normal operation. It can cause lock malfunction or faulty release.

Operating Pressure

- **Caution**
  1. **Apply air pressure of at least that shown in the table below to the port on the lock mechanism side. This is necessary to release the lock.**

<table>
<thead>
<tr>
<th>Bore size (mm)</th>
<th>Operating pressure (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12, 16</td>
<td>0.17</td>
</tr>
<tr>
<td>20, 25, 32, 40</td>
<td>0.15</td>
</tr>
</tbody>
</table>

Exhaust Speed

- **Caution**
  1. **Locking will occur automatically if the pressure applied to the port on the lock mechanism side falls to 0.05 MPa or less.**
     In the cases where the piping on the lock mechanism side is long and thin, or the speed controller is separated at some distance from the cylinder port, the exhaust speed will be reduced. Take note that some time may be required for the lock to engage.
     In addition, clogging of a silencer mounted on the solenoid valve exhaust port can produce the same effect.