

# Telescopic Cylinder

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## 1 What is a Telescopic Cylinder?

A telescopic cylinder, also called a multi-stage cylinder, is a cylinder with a multi-tube piston rod. This type of cylinder can provide a long output stroke from a compact retracted length and is generally used to raise and lower the load-carrying deck of a dump truck or in other similar applications.

## 2 Structure of Telescopic Cylinders

### 2.1 Structure

The telescopic cylinder has the same structure (structure type and support system) as the general single-acting cylinder except that the former has a multi-stage tube piston rod as described above.

An example of a structure of a telescopic cylinder is shown in Fig. 1. Structurally, this cylinder is a single-acting<sup>Note 1)</sup> ram cylinder<sup>Note 2)</sup>. The support system is of the clevis type on both ends. The number of stages is three.

Note 1) The single-acting telescopic cylinder is designed to operate under pressure only in one direction, i.e., extension or retraction. In the other direction, the cylinder operates using its own weight and/or the weight of the load. A telescopic cylinder designed to be extended and retracted under pressure in both directions is called a “double-acting type”.

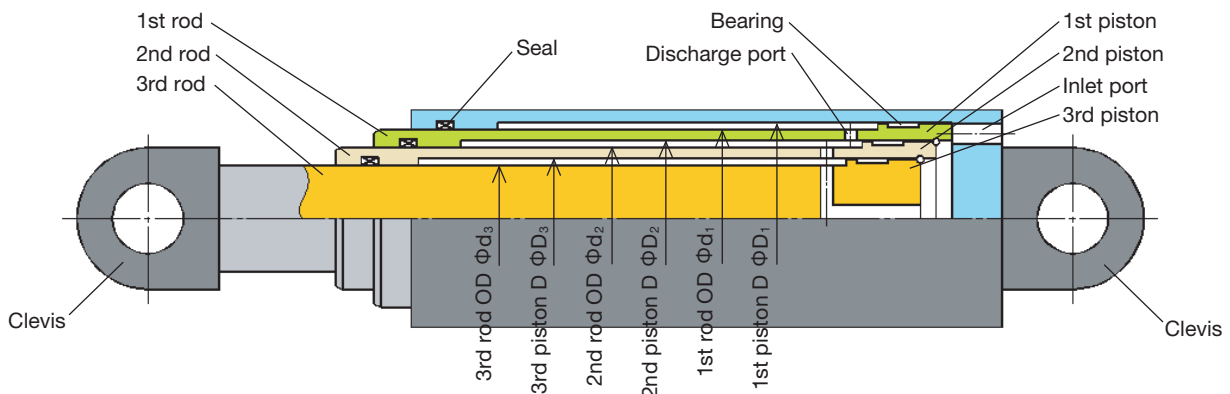
Note 2) The ram cylinder has no hydraulic seal in its piston section. In this type of cylinder, the pressure sensing area matches the outside diameter of the rod. On the other hand, a cylinder with a seal in its piston section is called a “piston type”. In this type of cylinder, the pressure sensing area for extension is different from that for retraction (except for double-rod cylinders).

### 2.2 Cylinder Thrust and Stroke Speed

For the cylinder shown in Fig. 1, the pressure sensing area of each stage matches the outside diameter of the rod of the stage because it is the ram type.

For the piston type cylinder, the pressure sensing area for extension of each stage matches the diameter of the piston while the pressure sensing area for retraction matches the difference between the diameter of the piston and the outside diameter of the rod.

With these differences in pressure sensing area among stages, the ram cylinder provides the extension thrust and



**Fig. 1** Structure of telescopic cylinder (example)  
(Single-acting, 3-stage ram cylinder with clevis support on both ends)

extension stroke speed progressively changing by stage as long as the pressure and flow rate to the cylinder are constant. The changes in thrust and speed can be expressed as follows:

- Cylinder thrust: 1st stage > 2nd stage > 3rd stage
- Stroke speed: 1st stage < 2nd stage < 3rd stage

### 3 Operating Principle

The operating sequence of the telescopic cylinder is shown in Fig. 2.

#### 3.1 Extension Stroke

When a pressure is applied to the cylinder from the port, the 1st rod, which has the largest pressure sensing area, first operates. In this instance, the oil in the 1st rod chamber is discharged to the 2nd rod chamber via the discharge port.

When the 1st rod reaches the stroke end, the 2nd rod, which has the next larger pressure sensing area, operates. Thereafter, the remaining rods progressively operate in the same manner until the last rod reaches the stroke end. The total combined stroke length is the sum of the strokes of all the stages.

#### 3.2 Retraction Stroke

The cylinder in this example retracts with its own weight and/or the load applied to the rods in reverse order to the case of extension stroke because it is the single-acting type.

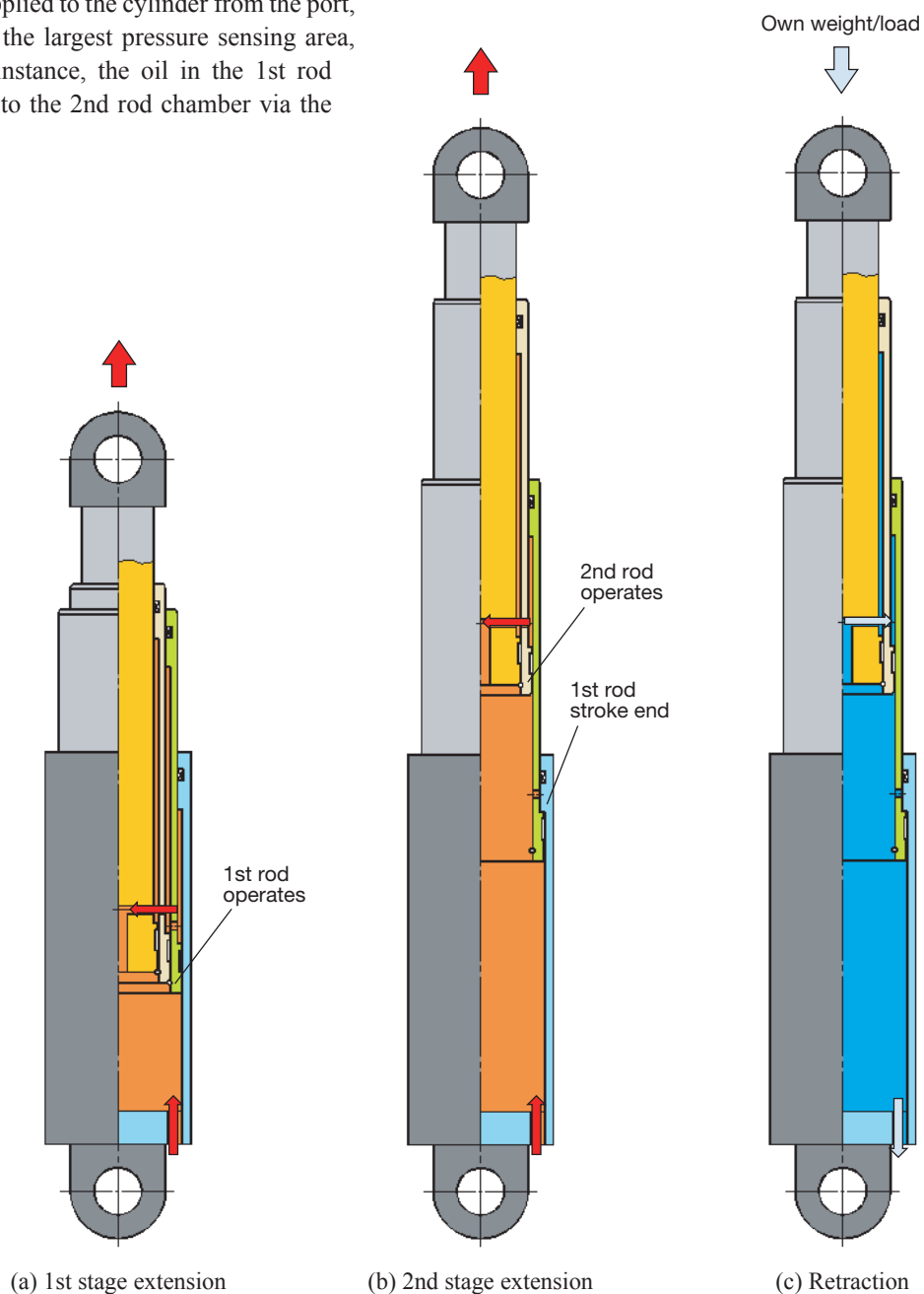


Fig. 2 Operating sequence of telescopic cylinder