
OPERATION MANUAL

TITLE : Rodless Cylinder
CYV Series

- Read this manual thoroughly before mounting and operation.
- Especially, carefully read the description concerning safety.
- Keep this manual where accessible when necessary.



Safety Instructions

These safety instructions are intended to prevent hazardous situations and/or equipment damage. These instructions indicate the level of potential hazard with the labels of "Caution," "Warning" or "Danger." They are all important notes for safety and must be followed in addition to International Standards (ISO/IEC)*1), and other safety regulations.

*1) ISO 4414: Pneumatic fluid power -- General rules relating to systems.

ISO 4413: Hydraulic fluid power -- General rules relating to systems.

IEC 60204-1: Safety of machinery -- Electrical equipment of machines .(Part 1: General requirements)

ISO 10218: Manipulating industrial robots -Safety.

etc.



Caution

Caution indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.



Warning

Warning indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.



Danger

Danger indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.

Warning

1. The compatibility of the product is the responsibility of the person who designs the equipment or decides its specifications.

Since the product specified here is used under various operating conditions, its compatibility with specific equipment must be decided by the person who designs the equipment or decides its specifications based on necessary analysis and test results.

The expected performance and safety assurance of the equipment will be the responsibility of the person who has determined its compatibility with the product.

This person should also continuously review all specifications of the product referring to its latest catalog information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

2. Only personnel with appropriate training should operate machinery and equipment.

The product specified here may become unsafe if handled incorrectly.

The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.

3. Do not service or attempt to remove product and machinery/equipment until safety is confirmed.

1. The inspection and maintenance of machinery/equipment should only be performed after measures to prevent falling or runaway of the driven objects have been confirmed.

2. When the product is to be removed, confirm that the safety measures as mentioned above are implemented and the power from any appropriate source is cut, and read and understand the specific product precautions of all relevant products carefully.

3. Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.

4. Contact SMC beforehand and take special consideration of safety measures if the product is to be used in any of the following conditions.

1. Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.

2. Installation on equipment in conjunction with atomic energy, railways, air navigation, space, shipping, vehicles, military, medical treatment, combustion and recreation, or equipment in contact with food and beverages, emergency stop circuits, clutch and brake circuits in press applications, safety equipment or other applications unsuitable for the standard specifications described in the product catalog.

3. An application which could have negative effects on people, property, or animals requiring special safety analysis.

4. Use in an interlock circuit, which requires the provision of double interlock for possible failure by using a mechanical protective function, and periodical checks to confirm proper operation.



Safety Instructions

Caution

1. The product is provided for use in manufacturing industries.

The product herein described is basically provided for peaceful use in manufacturing industries.

If considering using the product in other industries, consult SMC beforehand and exchange specifications or a contract if necessary.

If anything is unclear, contact your nearest sales branch.

Limited warranty and Disclaimer/Compliance Requirements

The product used is subject to the following "Limited warranty and Disclaimer" and "Compliance Requirements".

Read and accept them before using the product.

Limited warranty and Disclaimer

1. The warranty period of the product is 1 year in service or 1.5 years after the product is delivered, whichever is first.*2)

Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.

2. For any failure or damage reported within the warranty period which is clearly our responsibility, a replacement product or necessary parts will be provided.

This limited warranty applies only to our product independently, and not to any other damage incurred due to the failure of the product.

3. Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalog for the particular products.

*2) Vacuum pads are excluded from this 1 year warranty.

A vacuum pad is a consumable part, so it is warranted for a year after it is delivered.

Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty.

Compliance Requirements

1. The use of SMC products with production equipment for the manufacture of weapons of mass destruction(WMD) or any other weapon is strictly prohibited.

2. The exports of SMC products or technology from one country to another are governed by the relevant security laws and regulation of the countries involved in the transaction. Prior to the shipment of a SMC product to another country, assure that all local rules governing that export are known and followed.

Caution

SMC products are not intended for use as instruments for legal metrology.

Measurement instruments that SMC manufactures or sells have not been qualified by type approval tests relevant to the metrology (measurement) laws of each country.

Therefore, SMC products cannot be used for business or certification ordained by the metrology (measurement) laws of each country.

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1. Handling

1. Cylinder is supplied in a double clean package. When opening the internal package, be sure to open it in a clean room or clean atmosphere.
2. Do not touch the cylinder with bare hands when installing a cylinder to an application. It may affect the discharge gas characteristics.
3. Replacement and disassembly of parts in a chamber shall be done after compressed air left in piping is exhausted out of the clean room completely.
4. As aluminum alloy is use for cylinder's outer material, be sure to handle it carefully to secure no scratches or dent are caused due to metal components (such as tool).
5. Put off a wrist watch before handling the cylinder. As a magnet is installed in the slider, the watch may break due to leaked magnetic flux.

2. Installation to equipment

When the cylinder is installed on the equipment, use a set of special gloves for clean room not to touch the cylinder with bare hands directly.

1. Do not place works directly or apply force on the top cover of the cylinder. The top cover might be deformed and may come in contact with the surface of the slide table (external moving part).
2. Be sure to fix both sides of the plates with bolts before using the cylinder (Both ends fixing). Do not use the cylinder in that state that only the slide table or one side of the plate is fixed. Excessive moment may break the cylinder. (See figure 1)

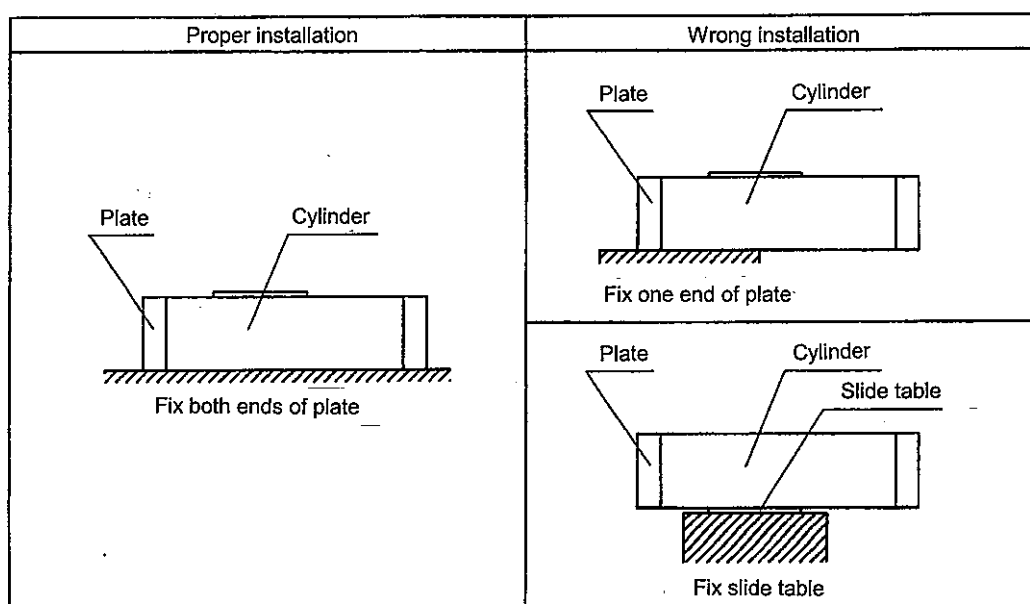


Figure 1. Example of cylinder installation

3. Two optional ways of mounting are available when mounting the cylinder with bolts. Select the one which is applicable to the equipment specifications. (See figure 2)

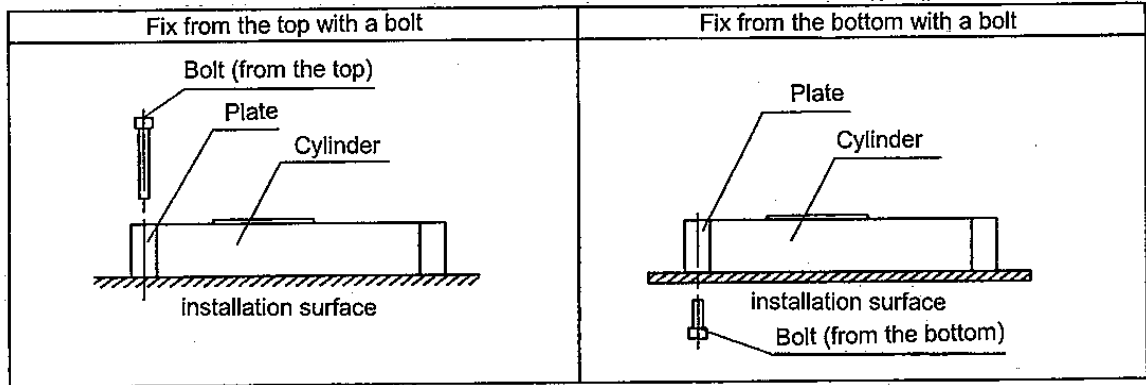


Figure 2. Bolt mounting

4. As the slide table is fixed with a precision bearing, do not apply a strong impact or excessive moment on the slide table when mounting works. It may deteriorate accuracy.
5. Do not remove the top cover for the purposes other than maintenance. When the cover is removed, do not hit the cylinder tube with an object or cause deformation on the cylinder due to an improper handling.

With this construction, the outside surface of the cylinder tube doesn't come in contact with the internal surface of the slide table. Therefore, a slight deformation and misalignment may cause malfunction or resistance deterioration, or lower the feature to prevent particle generation.

6. Although it is possible to mount a work directly within the allowable range, pay great attention to the centering of the cylinder and the external guide in the case that the external guide will be used together. If the external guide is used additionally, the longer the stroke extends, the larger the axis center will change. Therefore, the cylinder should be connected in a way to absorb the displacement, and a proper setting should be maintained to prevent deflection due to excessive force wherever the stroke is placed. At the same time, take measures to lower particle generation (friction of the materials).
7. Mount the cylinder on the equipment and be sure to perform tests to check if the cylinder operates properly when the cylinder comes in contact with the work. Supply compressed air or electricity after installation or maintenance to perform a proper function and leakage inspections, and check that the cylinder is properly connected.
8. A positioning sensor is not mounted on the cylinder body. Use an optical sensor, etc. from outside the chamber for sensing.

3. Piping

1. The compressed air supply inlet of the cylinder has a unified thread. For this vacuum rodless cylinder, use fitting for vacuum (with O-ring) commercially available.(Table 1)

Table 1 Example of applicable fitting: Male connector
(O-ring parallel thread) (Made by Swegelok)

Cylinder model	Fitting thread size for piping	Example of applicable fitting	Piping tube OD (inch)
CYV15	5/16-24 UNF	SS-200-1-OR	1/8
CYV32	7/16-20 UNF	SS-400-1-OR	1/4

2. Before piping, the used fitting and piping tube shall be cleaned and air-blown by clean air carefully to remove oil and hazardous particles.

4. Precautions on handling

1. The max. operating pressure of the cylinder is 0.3MPa. If the pressure exceeds the max. operating pressure 0.3MPa, a magnet coupling will come off and it may deteriorate the proper operation and the feature to prevent particle generation.
2. In case of a vertical installation, the magnet coupling may come off, and the slide table may drop. When the cylinder is mounted vertically, be sure to use it within the allowable rate. If load (pressure) exceeds the allowable level, the magnet coupling may come off and the slide table may drop. Pay great attention to the load and pressure control.
3. Do not use the cylinder when the magnet coupling is displaced. If an external stopper is mounted outside of the cylinder at the time of displacement, remove the stopper and push the slide table at the end of stroke (or push the piston moving component pneumatically) to return it to the right position. (When pushing the slide table, do not use a bare hand.)
4. As this cylinder is non-lube type, no lubrication needs to be supplied to the operating fluid. The internal surface of the cylinder tube is initially lubricated, so once the turbine oil or other type of oil is supplied, the product specification might not be satisfied.
5. Do not supply the grease different from the one that has initially been applied to the guide's sliding part. It may deteriorate the feature to prevent particle generation.
6. Be sure to use the cylinder in the place filled with inactive gas. If corrosive gas is present, the cylinder may corrode and its resistance might be deteriorated.

7. Be sure to operate the cylinder in a pressure environment between atmospheric pressure and 1.3×10^{-4} Pa (ABS). If it is operated in a lower pressure environment, the grease applied to the guide will evaporate too much, which may affect the endurance and contaminate the chamber.
8. The temperature for baking before operation must be set to 150 deg.C or less. If it is operated in a lower pressure environment, the grease applied to the guide will evaporate too much, which may affect the endurance and contaminate the chamber. (The cylinder should not be operated during baking.)

5. Air source

1. Use clean compressed air or inactive gas. If synthetic oil, salt or corrosive gas containing chemicals or organic solution is contained in the compressed air, do not use it to prevent the cylinder from the damage due to malfunction.
2. Mount an air filter. Mount the air filter upstream and in the vicinity of the valve. Select 5 μ m or less of filtration.
3. Install an air-cooler, air dryer and drain catch as a countermeasure to vent out drain.

6. Operation check and speed adjustment

- (1) Once the cylinder installation is completed, do not check the operation with operating pressure first but to increase the regulator pressure slowly.
The max. operating pressure of the vacuum rod less cylinder is 0.3MPa.
- (2) Clean restrictor is recommended for speed control.
(Contact SMC representative for the operating equipment and the method.)
Although meter-in, meter-out type clean speed controller are capable of controlling the speed, it might not be able to provide smooth start and stop motion.
- (3) In case of the vertical mounting, the system that has a regulated pressure supply circuit should be installed on the lower side.
(Effective for start-delay on the rising motion and energy-saving.)

< Stroke adjustment and cushion effect >

Stroke adjustment is a mechanism that can mate the stroke end position of the slide table with the mechanical stopper of the equipment. Adjusting range is from - 4 to 0mm on the both ends (from - 2 to 0mm on one side).

(Remove all the operating air, and take measures to deal with the residual pressure and cylinder-drop for a safety measure before the adjustment.)

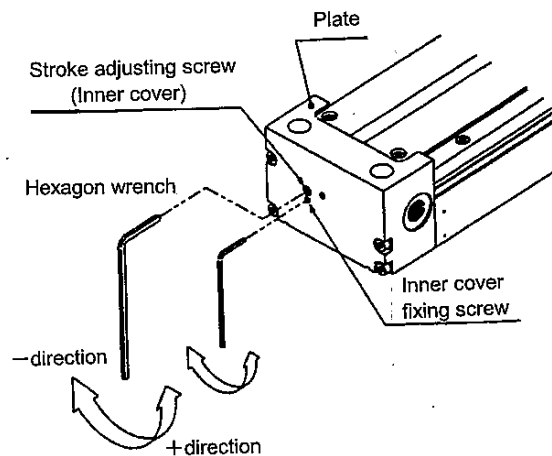
【Procedure】

- 1) Loosen the inner cover fixing screw with a hexagon wrench.
- 2) Turn the stroke adjusting screw (inner cover) with the hexagon wrench clockwise and counterclockwise, move the inner cover to back and front, and mate the position with the mechanical stopper.
- 3) Max. adjusting amount on one side is from -2 to 0 mm and from -4 to 0 mm on the both sides. Then tighten the inner cover fixing screw with the hexagon wrench once the stroke adjustment is completed.

Table 4 Inner cover fixing screw tightening torque[Nm]

Model	Screw size	Tightening torque
CYV15	M3 x 0.5	0.3
CYV32	M6 x 1	2.45

Sine suction mechanism is installed as a standard specification. However, cushion effect adjustment is not available.



7. Maintenance

- (1) Do not disassemble the cylinder tube, linear guide, slide table and other components. Once they are disassembled, the slide table is attracted to the external cylinder tube due to the installed-magnet force, and the friction may cause particle generation.
- (2) When replacing the packing or wearing, contact SMC representatives.
- (3) If a corrosive gas is applied to the cylinder by mistake, consult SMC, clearly specifying the name of the corrosive gas.

8. Feature to prevent particle generation

To maintain the grade of particle generation, restrict the operating cycle up to 1,000,000 cycles, and running distance up to 200km as a standard. If it exceeds the recommended rate, the linear guide doesn't move smoothly, and deteriorates the feature to prevent particle generation. Replace the cylinder in a proper timing depending on the cylinder condition.

If the operation continues in excess of recommended value, confirm the operating condition to maintain the cylinder life, and directly apply a decent amount of grease on the sliding part of the linear guide in a regular period. Contact SMC representative for the applicable grease.

9-1. Model Selection 1

Design Parameters 1

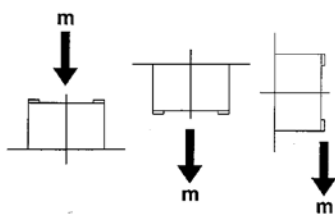
The allowable load mass moment differs depending on the work piece mounting method, cylinder mounting orientation and piston speed.
To determine whether or not the cylinder can be operated, do not allow the sum ($\Sigma \alpha_n$) of the load factors (α_n) for each mass and moment to exceed "1".

$$\Sigma \alpha_n = \frac{\text{Load mass (m)}}{\text{Max. load mass (m max)}} + \frac{\text{Static moment (M)}}{\text{Allowable static moment (M max)}} + \frac{\text{Dynamic moment (Me)}}{\text{Allowable dynamic moment (Me max)}} \leq 1$$

Load mass

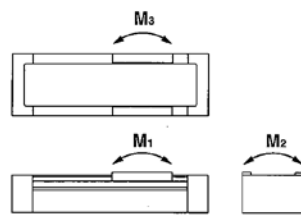
Max. load mass (kg)

Model	m max
CYV15	1
CYV32	5



Moment

Allowable moment
(Static moment/Dynamic moment)



Model	M1	M2	M3
CYV15	0.3	0.6	0.3
CYV32	3	4	3

(N·m)

Static Moment

Moment generated by the work piece weight even when the cylinder is stopped

■ Pitch moment

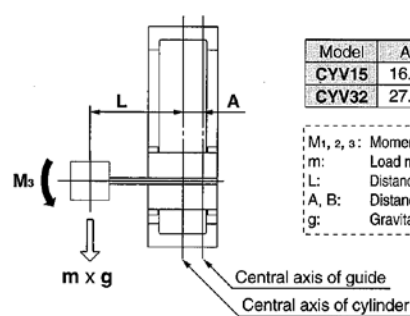
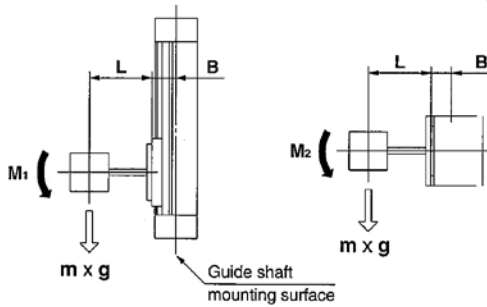
$$M_1 = m \times g \times (L + B) \times 10^{-3}$$

■ Roll moment

$$M_2 = m \times g \times (L + B) \times 10^{-3}$$

■ Yaw moment

$$M_3 = m \times g \times (L + A) \times 10^{-3}$$



Model	A	B
CYV15	16.5	25.5
CYV32	27.0	48.0

(mm)

M1, 2, 3: Moment [N·m]
m: Load mass [kg]
L: Distance to load center of gravity [mm]
A, B: Distance to guide shaft [mm]
g: Gravitational acceleration [9.8m/s²]

Dynamic Moment

Moment generated by the load equivalent to impact at the stroke end

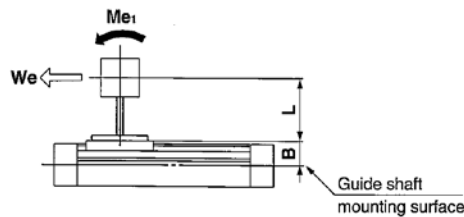
$$We = 5 \times 10^{-3} \times m \times g \times U$$

We: Load equivalent to impact [N] U: Max. speed [mm/s]
m: Load mass [kg] g: Gravitational acceleration [9.8m/s²]

■ Pitch moment

$$Me_1 = 1/3 \cdot We(L + B) \cdot 10^{-3} *$$

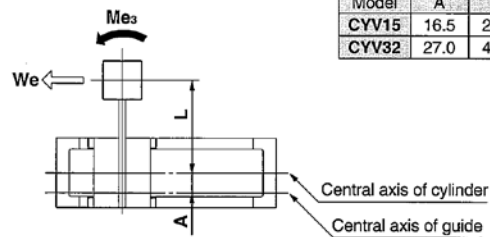
* Average load coefficient



■ Yaw moment

$$Me_3 = 1/3 \cdot We(L + A) \cdot 10^{-3} *$$

* Average load coefficient



Model	A	B
CYV15	16.5	25.5
CYV32	27.0	48.0

(mm)

9-2. Model Selection 2

Selection Calculation

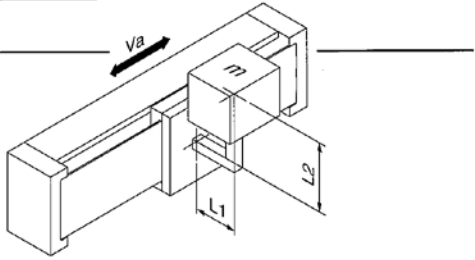
The selection calculation finds the load factors (α_n) of the items below, where the total ($\Sigma\alpha_n$) does not exceed "1".

$$\Sigma\alpha_n = \alpha_1 + \alpha_2 + \alpha_3 \leq 1$$

Item	Load factor α_n	Note
1. Max. load mass	$\alpha_1 = m/m \text{ max}$	Review m . m max is the maximum load mass.
2. Static moment	$\alpha_2 = M/M \text{ max}$	Review M_1, M_2, M_3 . M max is the allowable moment.
3. Dynamic moment	$\alpha_3 = Me/Me \text{ max}$	Review Me_1, Me_3 . Me max is the allowable moment.

Calculation Example

Operating conditions
 Cylinder: CYV32
 Mounting: Horizontal wall mounting
 Maximum speed: $U = 300$ [mm/s]
 Load mass: $m = 1$ [kg] (excluding mass of the arm section)
 $L_1 = 50$ [mm]
 $L_2 = 50$ [mm]



Item	Load factor α_n	Note
1. Maximum load mass 	$\alpha_1 = m/m \text{ max}$ $= 1/5$ $= 0.20$	Review m .
2. Static moment 	$M_2 = m \cdot g \cdot (L_1 + B) \cdot 10^{-3}$ $= 1 \cdot 9.8 \cdot (50 + 48) \cdot 10^{-3}$ $= 0.96$ [N-m] $\alpha_2 = M_2/M_2 \text{ max}$ $= 0.96/4$ $= 0.24$	Review M_2 . Since M_1 and M_3 are not generated, review is unnecessary.
3. Dynamic moment 	$We = 5 \times 10^{-3} \cdot m \cdot g \cdot U$ $= 5 \times 10^{-3} \cdot 1 \cdot 9.8 \cdot 300$ $= 14.7$ [N] $Me_3 = 1/3 \cdot We(L_2 + A) \cdot 10^{-3}$ $= 1/3 \cdot 14.7 \cdot (50 + 27) \cdot 10^{-3}$ $= 0.38$ [N-m] $\alpha_{3a} = Me_3/Me_3 \text{ max}$ $= 0.38/3$ $= 0.13$	Review Me_3 .
	$Me_1 = 1/3 \cdot We \cdot (L_1 + B) \cdot 10^{-3}$ $= 1/3 \cdot 14.7 \cdot (50 + 48) \cdot 10^{-3}$ $= 0.48$ [N-m] $\alpha_{3b} = Me_1/Me_1 \text{ max}$ $= 0.48/3$ $= 0.16$	Review Me_1 .

$$\Sigma\alpha_n = \alpha_1 + \alpha_2 + (\alpha_{3a} + \alpha_{3b})$$

$$= 0.20 + 0.24 + (0.13 + 0.16)$$

$$= 0.73$$

The result $\Sigma\alpha_n = 0.73 \leq 1$ allows operation.

Revision

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Note: Specifications are subject to change without prior notice and any obligation on the part of the manufacturer.
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