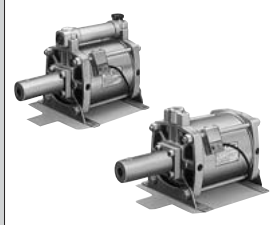




High Power Systems

Outline of Models/For Safe Use.....ED2

Pneumerlocks.....ED24



Clamping Elements...ED52



Toggle PressesED58

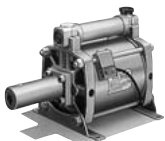


Oil Pack Cylinders...ED66



Pneumlock

Direct pressure type booster



Pre-pressure type booster



PBH

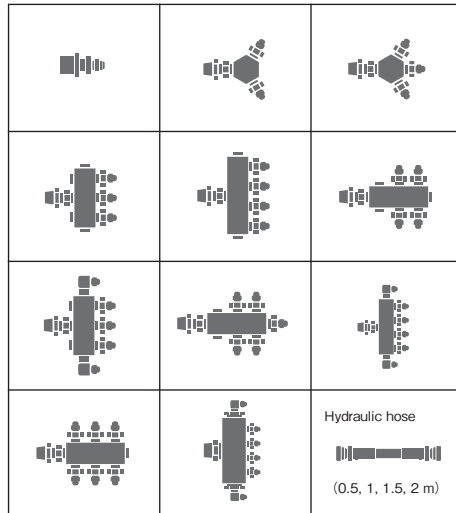
Clamp head



Clamp head for pre-pressure type booster



Fittings and hydraulic hoses



System for converting easy-to-handle pneumatic pressure to high hydraulic pressure through booster to actuate small-size clamp head with high power

Model number	Working pneumatic pressure range MPa	Boosting ratio	Theoretical output oil pressure at max. working pneumatic pressure MPa	Discharge oil capacity cm ³
NBH3-40	0.2 to 1	11	11	77
NBH3-60	0.2 to 0.7	25	17.5	77
NBH3-60-130	0.2 to 0.7	25	17.5	130
*NBH-80	0.2 to 0.7	25	17.5	176
*NBH-100	0.2 to 0.7	25	17.5	304

The *-marked models cannot be provided with sensors.

Model number	Working pneumatic pressure range MPa	Boosting ratio	Theoretical output oil pressure at max. working pneumatic pressure MPa	Discharge oil capacity cm ³
PBH3-40, PBE3-40	0.2 to 1	11	11	77
PBH3-60, PBE3-60	0.2 to 0.7	25	17.5	77
*PBH-80, *PBE-80	0.2 to 0.7	25	17.5	176

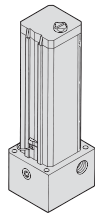
The *-marked models cannot be provided with sensors.

Model number	Effective stroke mm	Piston pressure receiving area mm ²	Max. stroke volume cm ³
LHD	6	570	4
LHC	7	1340	10.7
LHA	12	1460	19
LHA-25	24	1460	36.5
LHA-40	38	1460	58.4
LHAS-2	20	2640	60.7

Model number	Max. stroke mm	Piston area on extension side mm ²	Max. working hydraulic pressure on extension side MPa	Max. stroke oil capacity on extension side cm ³	Piston area on retraction side mm ²	Max. working pneumatic pressure on retraction side MPa	Max. stroke volume on retraction side cm ³
LHF-28-60	62 ⁰ _{-1.5}	610	17.5	38	410	1	25.7
LHF-40-80	82 ⁰ _{-1.5}	1250	17.5	103	540	1	45.1
LHF-50-100	103 ⁰ _{-2.0}	1950	17.5	201	700	1	72.1

Air-oil converters for pre-pressure type booster

Model number	Oil capacity ℓ
AHU2-063-001	0.16
AHU2-063-002	0.25
AHU2-063-004	0.4
AHU2-063-006	0.63
AHU2-063-010	1
AHU2-063-016	1.6



Pressure sensors (for high pressure)

Model number	Port size	Set pressure range
0882100	G1/4	0.5 to 7 MPa
0882200		1 to 16 MPa
0882300		2.5 to 25 MPa
0882400		4 to 40 MPa

Pressure gauges

Model number	Port size	Remarks
PG150Q-2	R1/4	For 15 MPa
PG250Q-2		For 25 MPa
PG150Q-2G		For 15 MPa (containing glycerine)
PG250Q-2G		For 25 MPa (containing glycerine)

Clamping Element

Clamp heads integral with booster, which can operate with pneumatic pressure and are easy to use because of its reduced size and weight



Pneumatic Toggle Press

Space-saving pneumatic press. Its volume is 1/10 compared to conventional presses. You can use it with sufficient space around it.



Oil Pack Cylinder

High output of 5 to 30 ton can be obtained only by pneumatic pressure. High output can be maintained for a long time.



Item Model number	Nominal stroke mm	Boosting ratio	Port size G	Theoretical clamping force at max. working pneumatic pressure kN	Working pneumatic pressure range MPa
LE2-3603-03	3	7.84	1/8	3.7	0.15 to 0.9
LE2-3606-03	6		1/8		
LE2-3609-03	9		1/8		
LE2-4803-08	3	8.16	1/8	8.3	0.15 to 0.9
LE2-4806-08	6		1/8		
LE2-4809-08	9		1/8		
LE2-4812-08	12	16	1/8	2.3	0.15 to 0.7
LE2-4803-12	3		1/8		
LE2-6006-18	6		1/4	18.0	0.15 to 0.9
LE2-6009-18	9	17.36	1/4		
LE2-6012-18	12		1/4		
LE2-6003-21	3	17.36	1/4	20.8	0.15 to 0.7
LE2-6006-21	6		1/4		

● Use the value obtained by subtracting 1 mm from the nominal stroke as an effective stroke.

Model number	Nominal output kN	Stroke mm	Max. use frequency C.P.M.
TPH-010040	9.8	40	60
TPH-015040	14.7	40	60
TPH-020040	19.6	40	60

● Working fluid: Air Working pressure range: 0.15 to 0.7 MPa

Item Model number	Pneumatic cylinder bore mm	Hydraulic cylinder bore mm	Full stroke mm	Boosting stroke mm	Boosting ratio	Working pressure range MPa
HSP3F -100- *-10	φ100	φ55	100 · 200	10	44.4	0.5 to 0.8
HSP3F -150- *-10	φ150	φ90			28.7	0.3 to 0.8
HSP3F -200- *-10	φ200	φ110			44.4	

The safety precautions stated below are to be followed to use the product safely and correctly and to safeguard both you and other persons and avoid property damage. The precautions are classified into three categories, DANGER, WARNING and CAUTION, to indicate the degree of hazard, damage and imminence. Strictly observe these important safety precautions in addition to the safety requirements specified in ISO 4414*¹⁾ and JIS B 8370*²⁾ and other standards.

⚠ DANGER : An imminent hazard which, if not avoided, will result in death or serious injury

⚠ WARNING : A potentially hazardous situation which can result in death or serious injury if the product is improperly handled

⚠ CAUTION : A potentially hazardous situation which may result in personal injury or only property damage if the product is improperly handled

* 1) ISO 4414: Pneumatic fluid power Recommendations for the application of equipment to transmission control systems

* 2) JIS B 8370: General rules of pneumatic system

⚠ WARNING

- The suitability of pneumatic equipment shall be judged by the person who designs the pneumatic system or determines the specifications.
- The equipment shall be handled by persons with sufficient knowledge and experience. Incorrect handling of compressed air can cause hazardous situations. Any machine or device using pneumatic equipment shall be assembled, operated and maintained by persons with sufficient knowledge and experience.
- Never handle any machine or device or remove the equipment without ensuring the safety.
 - 1) Before inspecting or servicing any machine or device, make sure that the object to be driven is provided with drop or runaway preventing means.
 - 2) Before removing the equipment, make sure that the above safeguard has been provided, and discharge the compressed air in the system.
 - 3) Before restarting any machine or device, make sure that jumping-out preventing measures have been taken.
- Use the product in an environment appropriate to the specifications.
If the product is used in any equipment which may considerably affect persons or properties, such as nuclear, railroad, aircraft, vehicle and medical equipment, equipment in contact with drink or food, entertainment equipment, emergency shutoff devices, safeguards for press, brake circuits and safety equipment, particularly for a purpose requiring safety or in an outdoor area, contact us.

Common Conditions

⚠ WARNING

- The system shall be handled by persons with sufficient knowledge and experience. Any machine or device using hydraulic and/or pneumatic equipment shall be assembled, operated and maintained by persons with sufficient knowledge and experience.
- Do not put the fire close to the equipment. The hydraulic equipment uses flammable hydraulic fluids. Therefore, doing so may cause fire.
- Never handle or remove the equipment without ensuring the safety.
 - Before removing the equipment, make sure that safeguard has been provided, disconnect power from the air pressure source, and make sure that pressure in the hydraulic and pneumatic circuits has been discharged.
 - Before inspecting or servicing any machine or device, make sure that the object to be driven is provided with drop preventing means.
 - When restarting any machine or device, increase the air pressure source pressure gradually from a low pressure to the set pressure while checking for abnormalities of bolts and other parts.
- If any machine or device may cause personal injury, put a protective cover on it. If the object to be driven or actuator moving parts may cause personal injury, design the machine or device so that human bodies cannot touch directly such a unit.
- Surely tighten the fixing and connecting parts of the equipment.
 - For securing the equipment, use bolts of the specified size and strength class, and tighten the bolts to the specified torque. For rocking mounting accessories, use pins of the specified size. If the bolts are tightened improperly or bolts of improper size are used, the bolts may be loosened or damaged by the cylinder thrust force or its reaction force.
 - Use rigid mounting materials.
- When adjusting the air vent, take care not to excessively loosen the air plug. If the air vent plug is excessively loosened, it may come off the cylinder and jump out, and oil may spout out, thereby causing personal injury or malfunction of the actuator.
- Examine the action to be taken upon occurrence of emergency stop. If the equipment will be stopped by a safety device when an operator presses the emergency stop button or system trouble is caused by power failure, design the equipment so that the action of the actuator will not cause personal injury or damage the equipment or device.
- Check the specifications.
 - The products shown in the catalog have been designed and manufactured as parts for general industrial machines or iron making machines. The use of any of the products at a pressure or temperature out of the specified range or in an improper operating environment can cause damage to the machine or operation failure. Do not use them under improper conditions.
 - For electric parts, such as sensors, sufficiently check the specifications for load current, temperature and impact. The use of the parts under improper conditions can cause operation failure, damage and burnout.
- Never modify the products. Doing so can cause abnormal operation, resulting in personal injury, electric shock and fire.
- If the equipment is used under the following conditions, give a sufficient consideration to safety measures, and contact us.
 - Use under conditions or in an environment not conforming to the indicated specifications or in an outdoor place
 - Use related to public safety (e.g., nuclear, railroad, aircraft, vehicle and medical equipment, entertainment equipment, emergency shutoff devices, brake circuits and equipment in contact with drink or food)
 - Use for safety equipment
 - Use for purposes specially requiring safety

Notes on Use of Pneumerlock

Notes on air pressure source

⚠CAUTION

- Use clean compressed air. Compressed air containing chemicals or corrosive gas may damage the equipment or cause operation failure.
- To remove foreign particles in compressed air, install an air filter.
- To remove drain in compressed air, install an after-cooler, air dryer and/or air filter.

Notes on use environment

⚠WARNING

- Do not use the equipment in a corrosive environment. For the cylinder material, see the text.

⚠CAUTION

- Take care that the hydraulic hoses will not be splashed with cutting oil or lubricant so frequently.

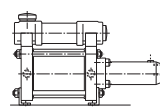
Notes on installation

⚠CAUTION

- Lateral load (eccentric load) must not be applied to the clamp head rod. When manufacturing the mounting jigs, take this into consideration.
- The clamp head can be installed in any direction. However, install it in a place with less vibration. (Otherwise, oil leakage may be caused.)
- Avoid using the full stroke of the clamp head. Never hit the rod against the lower cover.
- If the frequency of use of the booster is high, install a stop valve in the middle of the pressure gauge piping to protect the pressure gauge.
- Install the booster a little higher than the clamp head. If the booster is installed at an excessively higher position, hydraulic pressure will be increased due to drop, and the fluid may not be returned completely due to the force of the return spring of the clamp head.
- Use the clamp head within the effective stroke. Do not excessively bend the hydraulic hose. Keep a bending radius of 300 mm or more.
- When setting the clamp head, give consideration to ensure that the load is applied to the clamp head piston surface in the vertical direction and the load is applied to the whole piston surface. If eccentric load is applied to the surface, failure may be caused.

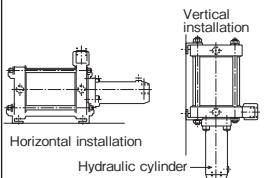
- Procedures for installing Pneumerlock
 - Install the booster in the following direction.

Direct pressure type booster



Horizontal installation
(Direct pressure type boosters cannot be installed vertically.)

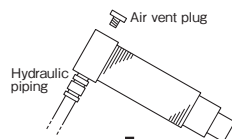
Pre-pressure type booster (PBH/PBE)



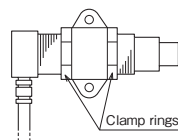
Horizontal installation
Hydraulic cylinder
(Do not install the hydraulic cylinder upward.)

Vertical installation

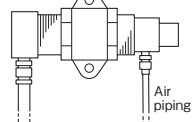
- Procedures for piping and installing clamp head for pre-pressure type booster



- Discharge air with the clamp head connected to the booster.

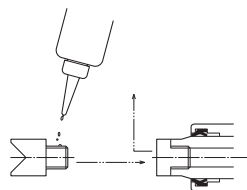


- Fit the clamp head from which air has been discharged to the mounting bracket, position it based on the jig and work positions, and secure it with the clamp rings.



- Connect the air piping for return to the clamp head.

- Prevention of looseness of rod end attachment
It is possible to remove the rod end attachment and fit another jig. In this case, use a commercially available looseness preventing agent.



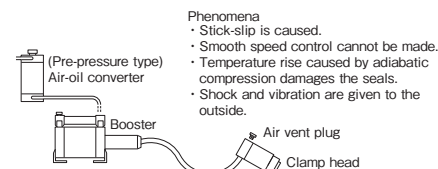
Notes on piping

⚠CAUTION

- Clean the pipes before piping.
- Take care that sealing tape and sealing materials will not enter the pipes.
- Take care that chips caused by pipe threading and dust will not enter the pipes.
- Select a piping material which can withstand the operating conditions.
- Before using, discharge air from the hydraulic piping system.

- Air discharging procedures

If air is contained in the hydraulic fluid, the air will function as an air cushion when pressure is applied, and the specified clamping force cannot be obtained. In addition, operation failures as shown below will be caused.



Phenomena
 • Stick-slip is caused.
 • Smooth speed control cannot be made.
 • Temperature rise caused by adiabatic compression damages the seals.
 • Shock and vibration are given to the outside.

- ① Set the clamp head a little higher than the booster so that the hydraulic fluid can easily enter the clamp head.
 - ② Set the piston in the booster at the most backward position.
 - ③ Loosen the air vent plug of each connected clamp head as much as possible to facilitate discharge of air.
 - ④ Pour the supplied hydraulic fluid through the oil hole. Continue to pour the fluid until it flows out of the air vent plug mounting hole.
 - ⑤ When air bubbles are not discharged from the air vent plug mounting hole, fully tighten (turn clockwise) the air vent plug, and make sure that the fluid does not leak from the plug.
 - ⑥ After discharging air as stated above, adjust the amount of hydraulic fluid so that the fluid level is between the red circles on the level gauge in the case of the direct pressure type booster or the level is above the lower limit of the air-oil converter level gauge after the clamp head makes a pre-pressure stroke in the case of the pre-pressure type booster.
 - ⑦ Tightly fit the oil hole cap.
 - ⑧ If the booster does not give output during operation, set the booster to the state ②, discharge residual pressure, and stop the supply of pneumatic pressure. Then, check for inclusion of air (discharge air) in accordance with ③ to ⑦.
- * Discharge air not only from the booster and clamp head, but also from the piping.

Note) If residual pressure is left in the circuit when air is discharged, the fluid may spout out, thereby causing serious accidents. Before discharging air, make sure that residual pressure is not in the circuit.

Notes on hydraulic fluid

⚠CAUTION

- As the hydraulic fluid, use Cosmo New Mighty Super 10 (COSMO OIL).

Notes on adjustment

⚠CAUTION

- When starting the machine, gradually increase the supply pressure from a low pressure, and make sure that the machine operates smoothly.

Notes on maintenance

⚠WARNING

- Before removing or disassembling the equipment, take measures for prevention of drop and runaway, discharge compressed air from the system, and ensure the safety.

⚠CAUTION

- Periodically discharge drain from the pneumatic system.
 - Periodically inspect the equipment. If any abnormality is found, do not use it until measures are taken.
 - Check that the mounting bolts and nuts are not loose.
 - Check that the equipment operates normally.
 - Check that the fluid does not leak to the outside.
 - Check that the parts (tie rod, flange, etc.) of the body do not show any abnormality.
 - Determine the frequency of periodic inspection depending on the operating conditions and necessity. It is recommended to conduct the periodic inspection at least once a year.
- Notes) Replace the seals and gaskets with new ones in the periodic inspection. Do not use seals which have been stored for more than one year.

Notes on Use of Clamping Element

Notes on air pressure source

⚠CAUTION

- Use clean compressed air. Compressed air containing chemicals or corrosive gas may damage the equipment or cause operation failure.
- To remove foreign particles in compressed air, install an air filter.
- To remove drain in compressed air, install an after-cooler, air dryer and/or air filter.

Notes on use environment

⚠WARNING

- Do not use the equipment in a corrosive environment. For the cylinder material, see the text.

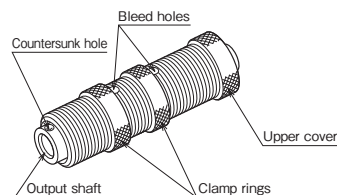
⚠CAUTION

- Take care that the output shaft is not splashed with liquids, such as cutting oil.

Notes on installation

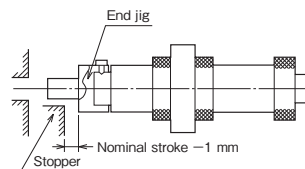
⚠CAUTION

- When mounting the clamping element, take care not to block the bleed holes. Take care that dust and foreign particles do not enter the bleed holes. When using the element in the horizontal direction, turn the body to face the bleed holes toward the ground, and tighten the clamp rings. (Fig. 1)



(Fig. 1)

- Use the countersunk hole to fit an end jig.
- The working stroke must be shorter than the nominal stroke by 1 mm. When using the clamping element for punching, provide an external stopper, so that the output shaft gets into contact with the stopper 1 mm before the nominal stroke end. (Fig. 2)



(Fig. 2)

- Take care that any force other than the force in the returning direction is not applied to the output shaft when the output shaft returns. (If any external force is applied to the returning output shaft, fit a speed control valve at the port to set the output shaft returning speed to 1 to 2 seconds.)

Notes on piping

⚠CAUTION

- Clean the pipes before piping.
- Take care that sealing tape and sealing materials will not enter the pipes.
- Take care that chips caused by pipe threading and dust will not enter the pipes.

Notes on lubrication

⚠CAUTION

- To lubricate the clamping element, use turbine oil Class 1 (non-additive) ISO VG32. Do not use machine oil or spindle oil.
- If once you lubricate the clamping element, do not discontinue to lubricate it. The grease in the element may have been washed away by the lubricant, and the clamping element may malfunction.

Notes on adjustment

⚠CAUTION

- When starting the machine, gradually increase the supply pressure from a low pressure, and make sure that the machine operates smoothly.

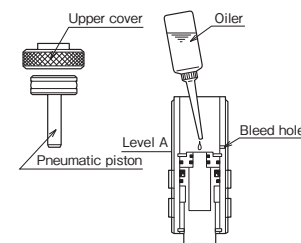
Notes on maintenance

⚠WARNING

- Before removing or disassembling the equipment, take measures for prevention of drop and runaway, discharge compressed air from the system, and ensure the safety.

⚠CAUTION

- Periodically discharge drain from the pneumatic system.
- Periodically inspect the pneumatic equipment, and, if any abnormality is found, do not use it until measures are taken.
- Periodically check the working stroke to ensure that the specified stroke is maintained.
- Procedures for pouring hydraulic fluid (Fig. 3)
(If the stroke has reduced, pour the hydraulic fluid as stated below.)
 - If the amount of hydraulic fluid is insufficient, stand the body with the output shaft vertically downward, remove the upper cover, and draw out the pneumatic piston.
 - The pneumatic piston can be loosened by blowing a small quantity of air at a low pressure through the bleed hole.
 - Slowly pour the hydraulic fluid with an oiler, and fill the element to the level A, taking care that air bubbles do not enter.
 - Apply a small quantity of hydraulic fluid to the pneumatic piston sliding surface.
 - After air bubbles on the level A disappear, carefully reassemble the pneumatic piston assembly.



(Fig. 3)

- As the hydraulic oil, use Cosmo Pure Safety 830 made by Cosmo Oil Lubricants.

Notes on Use of Toggle Press

Notes on design

⚠CAUTION

- Note that the use of toggle press under a load higher than the nominal output may reduce its durability.
- Take care not to apply lateral load or eccentric load to the ram.
- If the load is removed in the middle of ram stroke, for example, in the case of punching or cutting, use the press with the following load rate for each working pneumatic pressure. If a load rate with too large allowance is selected, the internal piston will give an excessive shock to the body after the completion of working, thereby damaging the bolts or body.
0.5 MPa...90% 0.6 MPa...80% 0.7 MPa...75%
- The load must be within 4 mm from the bottom dead center.
- If backlash caused by rotation of the ram is unfavorable for the purpose of use, contact us.

Notes on air pressure source

⚠CAUTION

- Use clean compressed air. Compressed air containing chemicals or corrosive gas may damage the equipment or cause operation failure.
- To remove foreign particles in compressed air, install an air filter.
- To remove drain in compressed air, install an after-cooler, air dryer and/or air filter.

Notes on use environment

⚠WARNING

- Do not use the equipment in a corrosive environment. For the cylinder material, see the text.

⚠CAUTION

- If the press is used in a place with much dust or exposed to water drops or oil drops, cover the piston rod.

Notes on installation

⚠CAUTION

- When connecting, align the ram shaft center with the moving direction.

Notes on piping

⚠CAUTION

- Clean the pipes before piping.
- Take care that sealing tape and sealing materials will not enter the pipes.
- Take care that chips caused by pipe threading and dust will not enter the pipes.

Notes on lubrication

⚠CAUTION

- For lubrication, use turbine oil Class 1 (non-additive) ISO VG32. Do not use machine oil or spindle oil.

Notes on adjustment

⚠CAUTION

- When starting the machine, gradually increase the supply pressure from a low pressure, and make sure that the machine operates smoothly.

Notes on maintenance

⚠WARNING

- Before removing or disassembling the equipment, take measures for prevention of drop and runaway, discharge compressed air from the system, and ensure the safety.

⚠CAUTION

- Periodically discharge drain from the pneumatic system.
- Periodically inspect the pneumatic equipment, and, if any abnormality is found, do not use it until measures are taken.

Notes on Use of Oil Pack Cylinder

Notes on design

⚠CAUTION

- If the cylinder is operated to the stroke end for boosting, the output is zero at the stroke end. Use the cylinder within the range of (stroke-1) mm. If the load is removed in the middle of stroke, for example, in the case of punching, provide an external stopper without fail.
- If a jig or a heavy article is fitted to the end of the piston rod, the returning force is reduced. Therefore, in such a case, return the rod with external force of a spring, etc.

Notes on air pressure source

⚠CAUTION

- Use clean compressed air. Compressed air containing chemicals or corrosive gas may damage the equipment or cause operation failure.
- To remove foreign particles in compressed air, install an air filter.
- To remove drain in compressed air, install an after-cooler, air dryer and/or air filter.

Notes on use environment

⚠WARNING

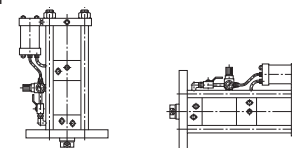
- Do not use the equipment in a corrosive environment. For the cylinder material, see the text.

Notes on installation

⚠CAUTION

- Connect the cylinder aligning the rod shaft center with the moving direction.
- Be sure to use the cylinder with the piston rod downward or horizontal. (Fig. 1)

Fig. 1

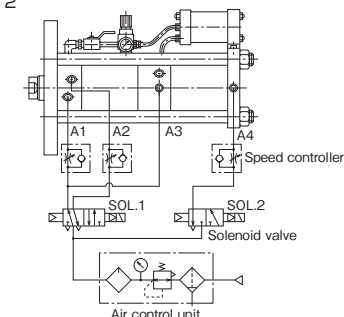


Notes on piping

⚠CAUTION

- Clean the pipes before piping.
- Take care that sealing tape and sealing materials will not enter the pipes.
- Take care that chips caused by pipe threading and dust will not enter the pipes.
- Connect the oil pack cylinder and the directional control valves as shown in Fig. 2.

Fig. 2



- Set the directional control valves to feed air to the following ports
Pre-pressure process : A2
Boosting process : A2 and A4
Stopping and returning: A1 and A3
- Install the speed controllers for controlling the piston rod advancing speed to set the port A1 to the meter-out control and the port A2 to the meter-in control. For controlling the piston rod returning speed, install the speed controller to set the port A4 to the meter-out control.

Notes on lubrication

⚠CAUTION

- For lubrication, use turbine oil Class 1 (non-additive) ISO VG32. Do not use machine oil or spindle oil.

Notes on adjustment

⚠CAUTION

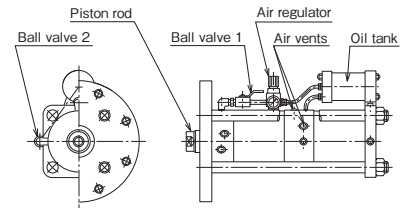
- When starting the machine, gradually increase the supply pressure from a low pressure, and make sure that the machine operates smoothly.
- Provide the cylinder with speed controllers without fail, and increase the speed gradually from a low speed to the set speed.
- Operating procedures
Operate the cylinder in accordance with the following procedures, referring to Figs. 2 and 3.

- ①Air vent
1. Close the ball valves 1 and 2.
 2. Set the pneumatic pressure for obtaining the required output, referring to the theoretical output table. Then, supply air.
 3. Turn the air regulator handle fully to the left. (The pressure is 0.)
 4. Open the ball valve 1.
 5. Gradually turn the air regulator handle to the right to set the pressure to 0.08 MPa.
 6. Open the ball valve 2.
 7. Loosen the screws of the air vents (2 places) with a screwdriver, and discharge air slowly until air bubbles does not flow out. (It is unnecessary to discharge air in this way every time the cylinder is used.)

- ②Checking the amount of fluid in the oil tank
- If the amount of fluid is insufficient, reduce the pressure of the air regulator to 0, remove the oil tank lubricating plug, and pour the fluid. Fill the oil tank to (H) on the level gauge.
 - As the hydraulic fluid, use Cosmo New Mighty Super 10 (COSMO OIL).

- ③Starting the operation
- Close the ball valves 1 and 2, and start the operation. Periodically open the ball valves 1 and 2, and replenish the cylinder with the fluid. In this case, restart the operation after closing the ball valves 1 and 2.
 - To operate the cylinder, connect the pipes correctly as shown in Fig. 2, turn on SOL.1, and turn on SOL.2 after the pre-pressure process. Then, conduct the boosting process. After the completion of these steps, turn off SOL.1 and SOL.2, and return the piston rod. Thus, one cycle is complete.

Fig. 3



Notes on maintenance

⚠WARNING

- Before removing or disassembling the equipment, take measures for prevention of drop and runaway, discharge compressed air from the system, and ensure the safety.

⚠CAUTION

- Periodically discharge drain from the pneumatic system.
- Periodically inspect the pneumatic equipment, and, if any abnormality is found, do not use it until measures are taken.

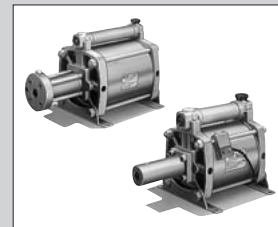
Troubleshooting

Trouble or phenomenon	Cause	Measures
No stroke	• Incorrect piping • Hydraulic fluid containing oil • Hydraulic fluid leakage • Inclusion of dust in sliding parts • Piston rod bent	• Connect the pipes correctly. • Discharge air (in accordance with the procedures). • Replace the seals. • Check the piston, piston rod and cylinder tube for scratches and wear, and replace them if they are defective.
No output	• Insufficient supply air pressure • Hydraulic fluid containing oil • Hydraulic fluid leakage • Seals worn out	• Check that the supply air pressure is appropriate. • Discharge air (in accordance with the procedures). • Replace the seals.
Piston rod does not return.	• Hydraulic fluid containing oil • Heavy work	• Discharge air (in accordance with the procedures). • Check that the weight does not exceed the specified value shown in the output table.

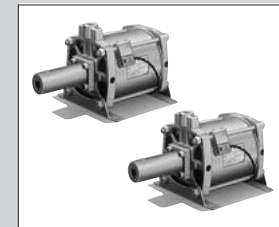


Pneumerlock®

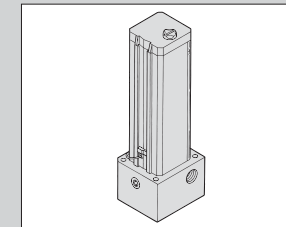
Direct Pressure Type Boosters ..ED24



Pre-pressure Type Boosters ..ED32



Oil-Air Converters for
Pre-pressure Type Booster ..ED39



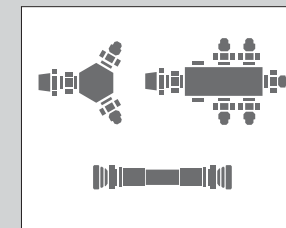
Clamp Heads.....ED40



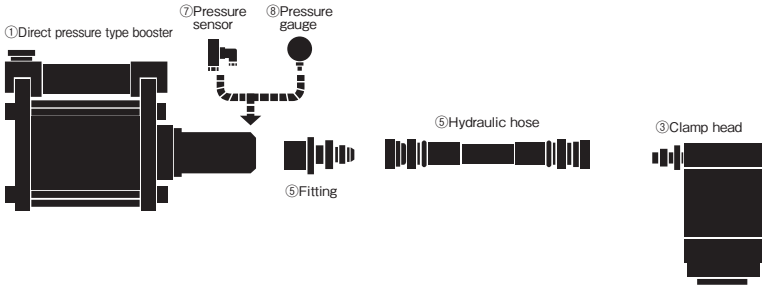
Clamp Heads for
Pre-pressure Type Booster ..ED42



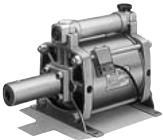
Fittings and Hydraulic Hoses ..ED46



Direct pressure type booster configuration



① Direct pressure type booster



② Pre-pressure type booster



③ Clamp heads



④ Clamp heads for pre-pressure type booster



Model number	Working pneumatic pressure range MPa	Boosting ratio	Theoretical output oil pressure at max. working pneumatic pressure MPa	Discharge oil capacity cm ³
NBH3-40	0.2 to 1	11	11	77
NBH3-60	0.2 to 0.7	25	17.5	77
NBH3-60-130	0.2 to 0.7	25	17.5	130
*NBH-80	0.2 to 0.7	25	17.5	176
*NBH-100	0.2 to 0.7	25	17.5	304

The *-marked models cannot be provided with sensors.

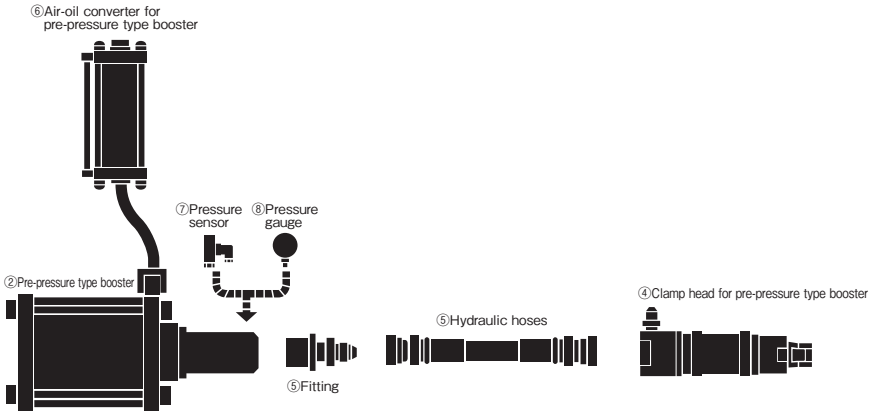
Model number	Working pneumatic pressure range MPa	Boosting ratio	Theoretical output oil pressure at max. working pneumatic pressure MPa	Discharge oil capacity cm ³
PBH3-40, PBE3-40	0.2 to 1	11	11	77
PBH3-60, PBE3-60	0.2 to 0.7	25	17.5	77
*PBH-80, *PBE-80	0.2 to 0.7	25	17.5	176

The *-marked models cannot be provided with sensors.

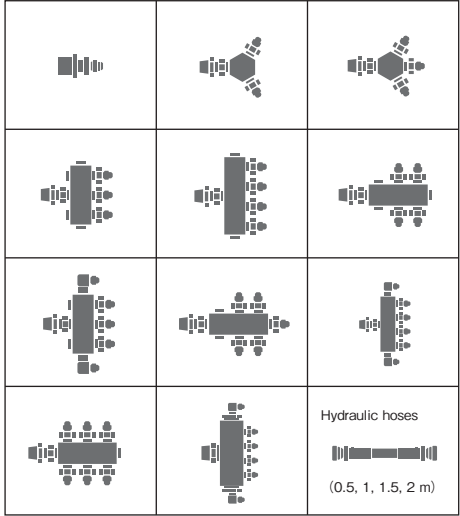
Model number	Effective stroke mm	Piston pressure receiving area mm ²	Max. stroke volume cm ³
LHD	6	570	4
LHC	7	1340	10.7
LHA	12	1460	19
LHA-25	24	1460	36.5
LHA-40	38	1460	58.4
LHAS-2	20	2640	60.7

Model number	Max. stroke mm	Piston area on retraction side mm ²	Max. working hydraulic pressure on extension side MPa	Max. stroke oil capacity on extension side cm ³	Piston area on retraction side mm ²	Max. working pneumatic pressure on retraction side MPa	Max. stroke volume on retraction side cm ³
LHF-28-60	62 ₋₀ ^{1.5}	610	17.5	38	410	1	25.7
LHF-40-80	82 ₋₀ ^{1.5}	1250	17.5	103	540	1	45.1
LHF-50-100	103 _{-2.0} ⁰	1950	17.5	201	700	1	72.1

Pre-pressure type booster configuration

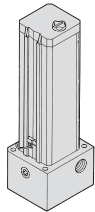


⑤ Fittings and hydraulic hoses



⑥ Air-oil converters for pre-pressure type booster

Model number	Oil capacity ℓ
AHU2-063-001	0.16
AHU2-063-002	0.25
AHU2-063-004	0.4
AHU2-063-006	0.63
AHU2-063-010	1
AHU2-063-016	1.6



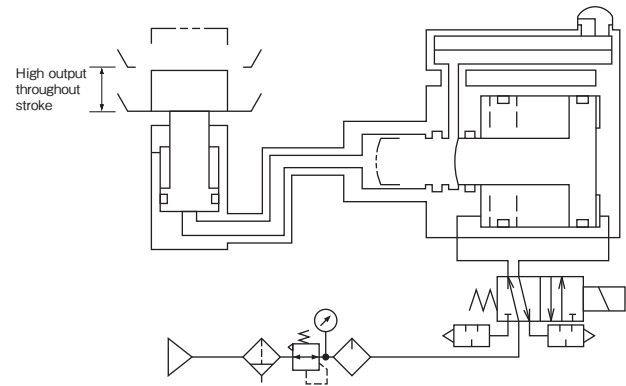
⑦ Pressure sensors (for high pressure) ⑧ Pressure gauges

Model number	Port size	Set pressure range	Model number	Port size	Remarks
0882100	G ¹ / ₄	0.5 to 7 MPa	PG150Q-2	R ¹ / ₄	For 15 MPa
0882200		1 to 16 MPa	PG250Q-2		For 25 MPa
0882300		2.5 to 25 MPa	PG150Q-2G		For 15 MPa (containing glycerine)
0882400		4 to 40 MPa	PG250Q-2G		For 25 MPa (containing glycerine)

As related products, compact design hydraulic cylinders are applicable.
See the general catalog of hydraulic equipment.

Direct pressure type

This type is suitable for operations requiring high output throughout the stroke, for example, lifting of work on a table as shown below.



Pre-pressure type

System designed to be suitable for operations for moving work with a long-stroke clamp head or hydraulic cylinder and then applying pressure to the work

① Moving process (pre-pressure process)

The air-oil converter converts low pneumatic pressure to hydraulic pressure on a one-to-one basis, and the hydraulic cylinder is pushed only a certain stroke.

SOL1	OFF
SOL2	ON

② Pressing process

High hydraulic pressure generated by the booster is lead to the hydraulic cylinder to press the work.

SOL1	ON
SOL2	ON

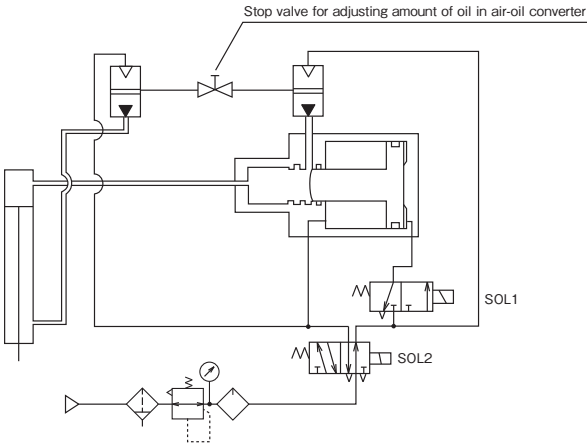
③ Returning process

After the completion of operation, the valves are switched to return the hydraulic cylinder and booster by pneumatic pressure to their original positions.

SOL1	OFF
SOL2	OFF

Note) When a long-stroke clamp head or a hydraulic cylinder is used, it is recommended to use an air-oil converter for return at the position A. (AHU2 Series)

Example of circuit for reference



Note) When inspecting, adjust the amount of oil in the air-oil converter which has been reduced by internal leak.

Example of use of direct pressure type booster and clamp head

Drilling

Clamping

Milling

Clamping

Milling

Clamping

Press-fitting

Pipe straightening

Unpinning

Bending

Example of use of pre-pressure type booster and clamp head for pre-pressure type booster

Bending

Press-fitting into deep hole

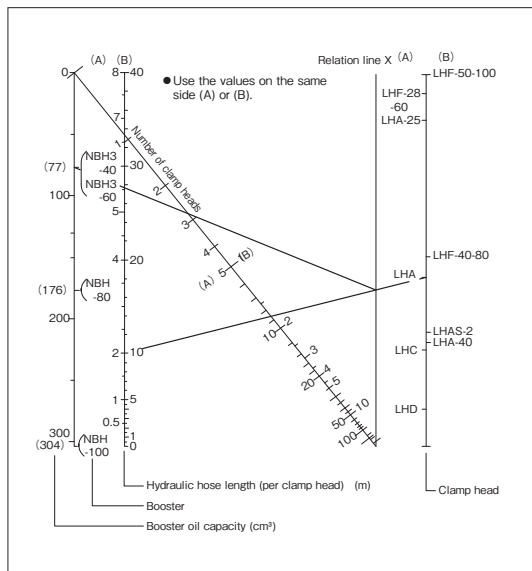
Caulking

Straightening of round bar

Fixing of workpieces differing in size

Fixing of workpieces differing in size

How to select clamp head for direct pressure type booster

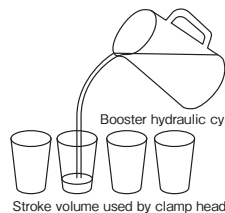


〈Example〉 How many clamp heads LHA can be used for NBH3-60 with a 2m long hydraulic hose?

〈Answer〉 LHA is shown on the side A. Connect the point of 2 m indicated on the side A and the point of LHA. Connect the intersection of this line with the relation line X with the booster oil capacity (77 cm³ for NBH3-60), and find the number of clamp heads indicated on the side A, approx. 2.8 pcs. In this case, be sure to use a lower number, 2 pcs.

How to select clamp head

The number of clamp heads which can be used for one booster is determined by the booster oil capacity and the volume used by the clamp heads.



• When one model of clamp heads is used

$$\text{Number of usable clamp heads} = \frac{\text{booster oil capacity}}{\text{stroke volume used by one clamp head} + \text{hydraulic hose expansion loss}} \times 0.85$$

Notes) The hydraulic hose expansion loss is 5 cm³ per meter.
In the case of connection with pipes, the expansion loss is not taken into account.

• When more than one model of clamp heads is used

$$0.85 > \frac{\text{total stroke volume used by all clamp heads} + \text{total expansion loss}}{\text{booster oil capacity}}$$

Note) If the result of the above calculation is less than 0.85, the clamp heads can be used.

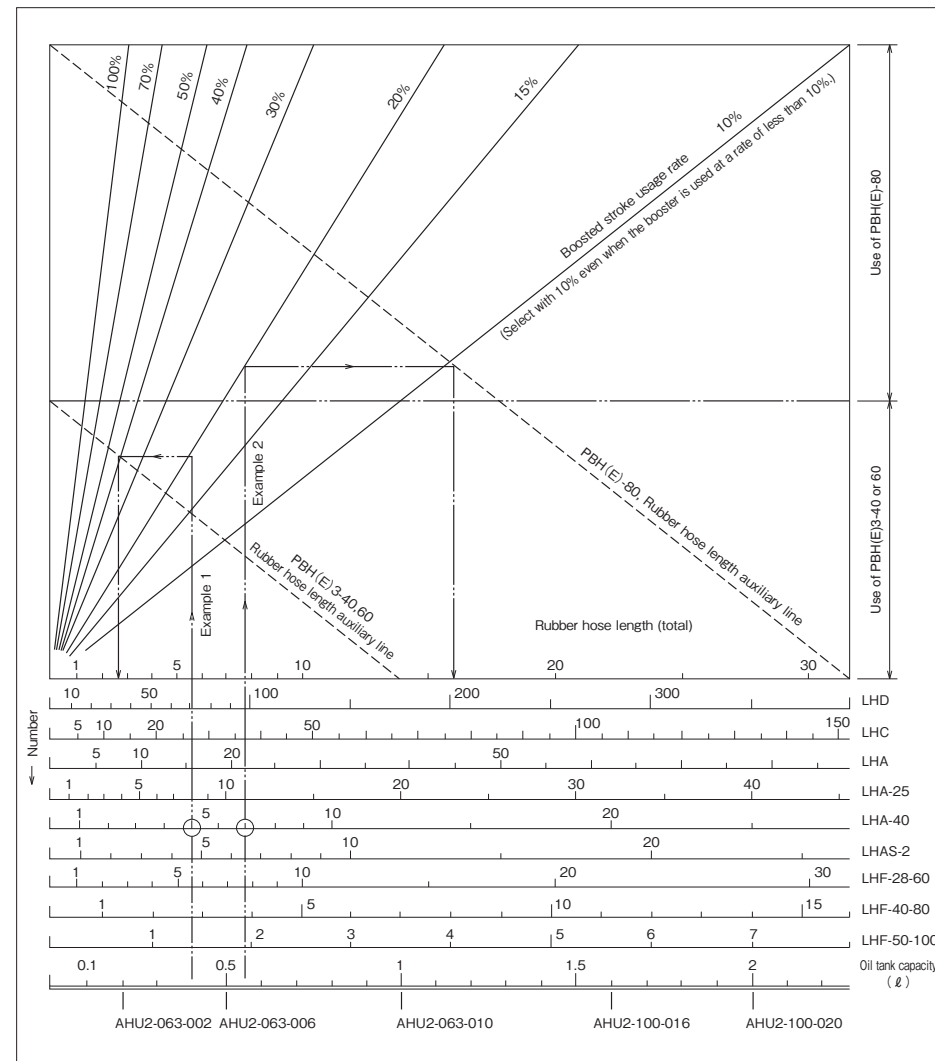
〈Example〉 How many LHA clamp heads can be used for NBH3-60 with an effective stroke of 12 mm?
The hydraulic hose is 1 m long.

〈Answer〉 Stroke volume used by one LHA clamp head = piston pressure receiving area × working stroke = 14.6 × 1.2 = 17.52 cm³

$$\text{Number of usable clamp heads} = \frac{77}{17.52 + 5} \times 0.85 = 2.906 \dots$$

Up to two clamp heads can be used.

How to select clamp head for pre-pressure type booster and air-oil converter

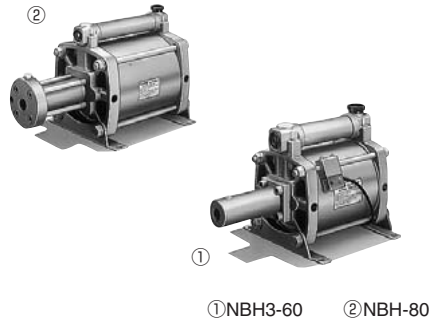


〈Example 1〉 When 5 pcs. of LHA-40 (max. stroke of 40 mm) are used at a boosted stroke of 8 mm, the boosted stroke rate is $\frac{8}{40} \times 100 = 20\%$. Therefore, PBH(E)3-40 or PBH(E)3-60 should be used, and a rubber hose up to 2.6 m long can be connected. The oil tank AHU2-063-006 should be used.

〈Example 2〉 When 7 pcs. of the clamp heads are used under the same conditions as stated in Example 1, PBH(E)-80 should be used, and a rubber hose up to 16 m long can be connected. The oil tank AHU2-063-010 with a capacity of more than 0.56 ℓ should be used.

System which converts pneumatic pressure to hydraulic pressure with a booster and generates hydraulic pressure of up to 17.5 MPa to powerfully actuate small-size clamp head

- Suitable for lifting work or operations requiring high output for clamp head throughout the stroke
- The use of hydraulic pressure ensures constant, uniform and reliable force.



Specifications

Model number	NBH3-40	NBH3-60	NBH3-60-130	NBH-80	NBH-100
Item					
Boosting ratio	11	25	25	25	25
Discharge oil capacity cm ³	77	77	130	176	304
Theoretical output oil pressure at max. working pneumatic pressure	11 MPa	17.5 MPa			
Adaptable fluid	Cosmo New Mighty Super 10 (COSMO OIL)				
Working temperature range	+5 to +60°C				
Pneumatic block	Working fluid	Air			
	Lubrication	Unnecessary (but possible)		Required	
	Working pressure range	0.2 to 1 MPa	0.2 to 0.7 MPa		
	Recommended lubricant	JIS K2213 Class 1 (non-additive turbine oil ISO VG32) or its equivalent			
Weight kg	9.5	15	17	41	92
With sensor	Provided			None	
Related equipment	Pressure sensor, pressure gauge (For the part numbers, see pages ED16 and 48.)				

Actual Output Table

Booster	Clamp head	Working pneumatic pressure MPa									
		0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	
NBH3-40	LHA · LHA-25 · LHA-40	2.7	4.1	5.5	6.9	8.2	9.6	11.0	12.4	13.5	
	LHAS-2	5.1	7.8	10.4	12.9	15.5	18.1	20.7	23.3	25.6	
	LHC	2.5	3.8	5.1	6.4	7.7	8.9	10.2	11.5	12.6	
	LHD	1.1	1.7	2.3	2.8	3.3	3.9	4.5	5.0	5.5	
NBH3-60	LHA · LHA-25 · LHA-40	6.2	9.3	12.3	15.5	18.5	21.7	—	—	—	
NBH3-60-130	LHAS-2	11.7	17.5	23.3	29.1	35.0	40.8	—	—	—	
NBH-80	LHC	5.7	8.6	11.5	14.3	17.3	20.1	—	—	—	
NBH-100	LHD	2.5	3.8	5.0	6.3	7.6	8.8	—	—	—	

Air Consumption

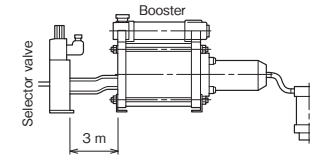
Booster	Working pneumatic pressure MPa									
	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	
NBH3-40	6	8	10	12	14	16	18	20	21.8	
NBH3-60	13.5	18	22.5	27	31.5	36	—	—	—	
NBH3-60-130	21.5	29	36	43	50	57	—	—	—	
NBH-80	31.5	42	52.5	63	73.5	84	—	—	—	
NBH-100	60	80	100	120	140	160	—	—	—	

Note) The air consumption is obtained by converting the amount of air used by one reciprocation of booster at each pneumatic pressure to its equivalent atmospheric pressure.

Clamp Head Working Speed

Unit: s

Booster	Common to all clamp heads	
	Extending stroke time	Retracting stroke time
NBH3-40	1	1
NBH3-60	1.5	1.5
NBH3-60-130	1.8	1.8
NBH-80	2	2
NBH-100	3.5	3.5



The clamp head working speed varies depending on the booster used. The left table shows the extending stroke time and retracting stroke time when the piping between booster and switching valve is approx. 3 m. Determine the cycle time, etc. based on these times. Also when using a direct pressure type booster set (order made), determine the parameters based on these times.

Note) If the booster is used at a speed exceeding the speed shown left, the seals will wear earlier and drop, output may be reduced due to entry of air, and oil may enter the pneumatic circuit. Particularly, if the clamp head returns the pneumatic piston of the booster faster than the returning time, negative hydraulic pressure may be caused in the circuit, resulting in entry of air.

How to Order

Direct pressure type booster **NBH** **3-60** **FA** **2**
Model Type Sensor symbol Sensor quantity

Direct pressure type booster set (order made)

With solenoid valve **NBH** **3-60** **-S-** **1** **FA** **2**

With manual valve **NBH** **3-60** **-H** **FA** **2**
Model Type Solenoid valve voltage
1 100 V AC (50/60 Hz)
2 200 V AC (50/60 Hz)
8 24 V DC

Assembly number of sensor and bracket **SZZ** Sensor only Bracket only
R **34** B **L3-105** **L3-105** **L3-105** B
Booster type **34** NBH3-40 **35** NBH3-60 · NBH3-60-130
Sensor type See the sensor list.
The booster will be delivered without the sensor mounted.
Booster type **34** NBH3-40 **35** NBH3-60 · NBH3-60-130

L3 type sensor



Delivery conditions

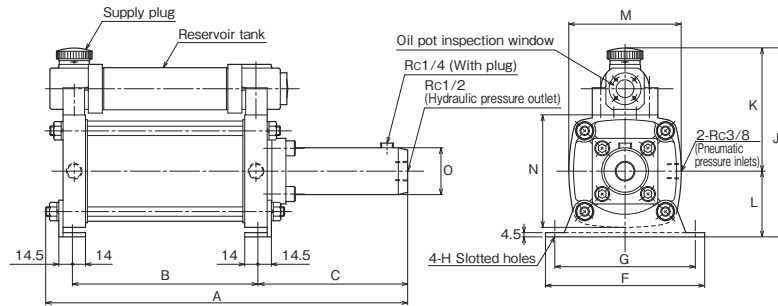
- NBH3-40, NBH3-60 and NBH3-60-130 come with 1 ℓ of adaptable fluid (Cosmo New Mighty Super 10), and NBH-80 and NBH-100 come with 2 ℓ and 3 ℓ of the fluid, respectively.
- NBH-80 and NBH-100 provided with sensor are not available.

Sensor List/Iron proximity type

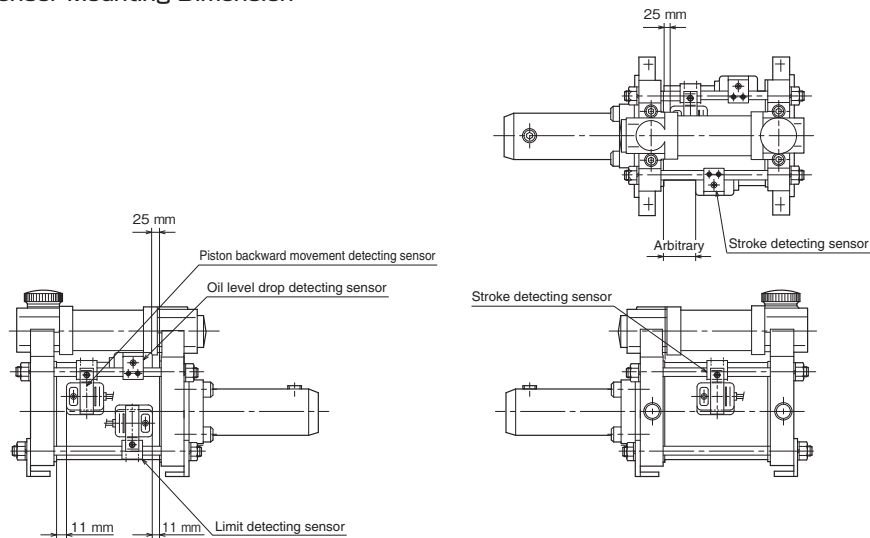
Type	Sensor symbol	Load voltage range	Load current range	Max. switching capacity	Protective circuit	Indicating lamp	Wiring method	Cord length	Applicable load
Reed sensor	 L3-101	AC: 80 to 220 V	2 to 20 mA	2 VA	Provided	Neon lamp (Lights when not sensing)	0.3 mm ² , 2-core, outer dia. ø5.3 mm, rear wiring	1 m	Small relay, programmable controller
	 L3-105							5 m	
	 L3-241	DC: 20 to 28 V	3 to 50 mA	1.5 W	Provided	LED (Lights when sensing)		1 m	
	 L3-245							5 m	

Note) • For handling of sensors, be sure to see the sensor specifications at the end of this catalog.

NBH3-40
NBH3-60
NBH3-60-130



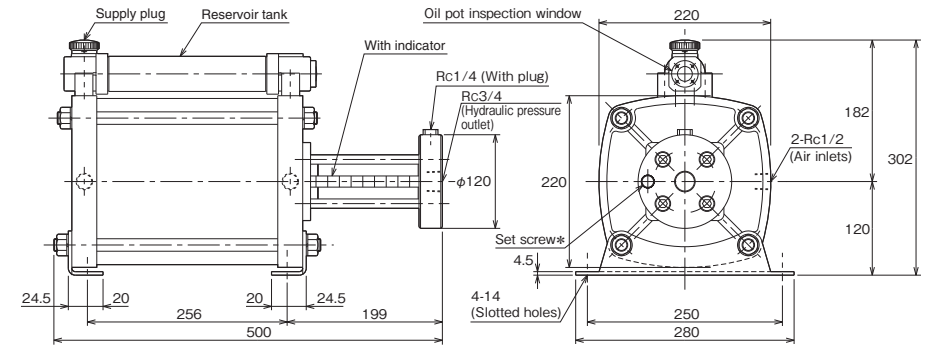
Sensor Mounting Dimension



Dimensional Table

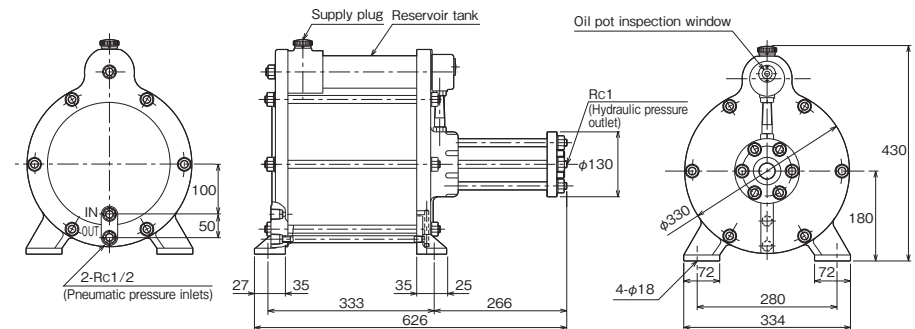
Symbol Model number	A	B	C	F	G	H	J	K	L	M	N	O
NBH3-40	389	198	160	170	150	9	202	132	70	120	120	$\phi 50$
NBH3-60	387	198	160	250	220	11	252	157	95	170	170	$\phi 50$
NBH3-60-130	537	273	235	250	220	11	252	157	95	170	170	$\phi 50$

NBH-80



Note) Never remove the *-marked set screw at the end of the indicator. (The indicator may jump out.)

NBH-100

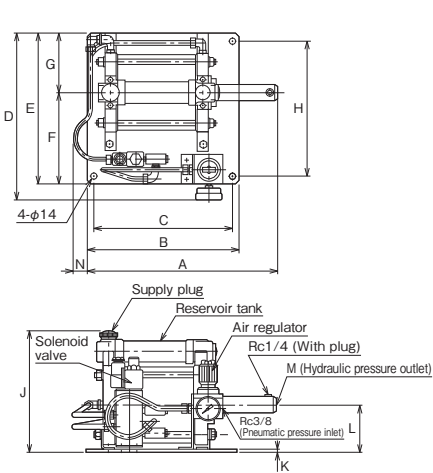


The booster, regulator and solenoid valve or manual valve located on one bed as an integral unit can be made to order.

Specifications

Model number	NBH3-40-S	NBH3-60-S	NBH3-60-130-S	NBH-80-S	NBH3-40-H	NBH3-60-H	NBH3-60-130-H	
Item								
Boosting ratio	11	25	25	25	11	25	25	
Discharge oil capacity cm ³	77	77	130	176	77	77	130	
Theoretical output oil pressure at max. working pneumatic pressure	11 MPa	17.5 MPa			11 MPa	17.5 MPa		
Addaptable fluid	Cosmo New Mighty Super 10 (COSMO OIL)							
Working temperature range	+5 to +60℃							
Pneumatic block	Air							
	Unnecessary (but possible)			Required	Unnecessary (but possible)			
	Lubrication							
	Working pressure range	0.2 to 1 MPa	0.2 to 0.7 MPa			0.2 to 1 MPa	0.2 to 0.7 MPa	
Recommended lubricant	JIS K2213 Class 1 (non-additive turbine oil ISO VG32) or its equivalent							
Weight kg	15	22	25	54	15	22	25	
With sensor	Provided			None	Provided			
Applicable valve	Solenoid valve (5-port 2-position air return type) 5ER-08E	Rated power : supply type	5ER-8E-10S4(100 V AC/DC · 50/60 Hz) 5ER-8E-20S4(200 V AC · 50/60 Hz) 5ER-8E-24S4(24 V DC)		Manual valve type: 4PN-20			
Related equipment	Pressure sensor, pressure gauge (For the part numbers, see pages ED16 and 48.)							

With Solenoid Valve
NBH3-40-S NBH3-60-130-S
NBH3-60-S NBH-80-S



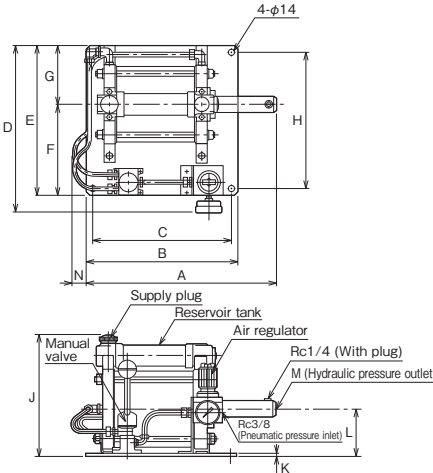
- NBH3-40-S, NBH3-60-S, NBH3-60-130-S and NBH-80-S are the model numbers of sets assembled on the bed shown above.
- NBH-80-S uses a booster having a different appearance.

Dimensional Table

Symbol	A	B	C	D	E	F	G	H	J	K	L	M	N
Model number													
NBH3-40-S	404	300	270	286	250	165	85	220	208	6	76	Rc ¹ / ₂	35
NBH3-60-S	404	320	290	356	320	195	125	290	261	6	101	Rc ¹ / ₂	30
NBH3-60-130-S	553	400	370	356	320	195	125	290	261	6	101	Rc ¹ / ₂	—
NBH-80-S	520	400	370	430	440	275	165	410	313	8	128	Rc ³ / ₄	—
NBH3-40-H	404	300	270	286	250	165	85	220	221	6	76	Rc ¹ / ₂	35
NBH3-60-H	404	320	290	356	320	195	125	290	261	6	101	Rc ¹ / ₂	30
NBH3-60-130-H	553	400	370	356	320	195	125	290	261	6	101	Rc ¹ / ₂	—

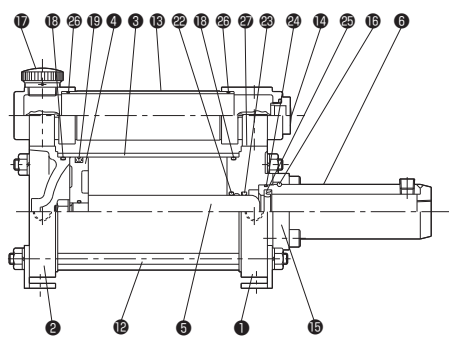
Unit: mm

With Manual Valve
NBH3-40-H NBH3-60-130-H
NBH3-60-H

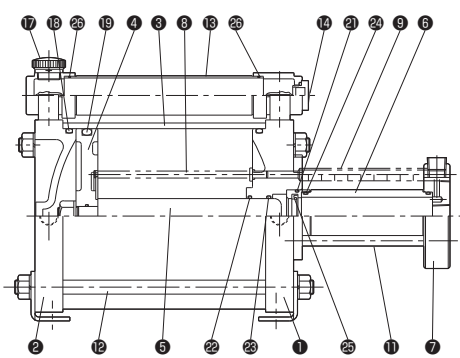


- NBH3-40-H, NBH3-60-H and NBH3-60-130H are the model numbers of sets assembled on the bed shown above.

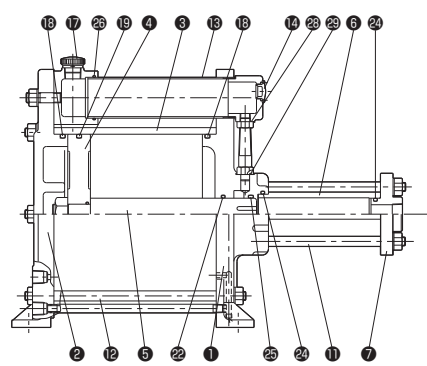
●NBH3-40/NBH3-60/NBH3-60-130



●NBH-80



●NBH-100



Parts List

No.	Name	Material	Qty.
①	Hydraulic cylinder mounting cover	Grey cast iron	1
②	Pneumatic cylinder cover	Grey cast iron	1
③	Pneumatic cylinder tube	Aluminum alloy (NBH3-40·60) Carbon steel for machine structural use (NBH-80·100)	1
④	Pneumatic piston	Grey cast iron	1
⑤	Hydraulic piston	Carbon steel for machine structural use	1
⑥	Hydraulic cylinder tube	Carbon steel for machine structural use	1
⑦	Hydraulic cap cover	Rolled steel for general structure	1
⑧	Indicator rod	Carbon steel for machine structural use	1
⑨	Indicator pipe	Resin	1
⑩	Hydraulic tie rod	Chromium-molybdenum steel	4
⑪	Pneumatic tie rod	Rolled steel for general structure	4
⑫	Reservoir tube	Aluminum alloy (NBH3-40·60·NBH-80) Carbon steel for machine structural use (NBH-100)	1
⑬	Oil pot	Resin	1
⑭	Flange	Rolled steel for general structure	1
⑮	Ring	Hard steel wire	1
⑯	Supply plug	Resin	1

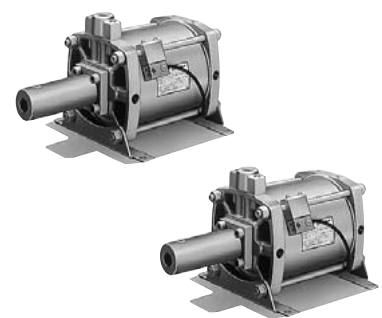
Seal List

Name	⑮	⑯	⑰	⑱	⑲	⑳	㉑	㉒	㉓	㉔	㉕
	Cylinder tube gasket	Pneumatic piston seal	Gland gasket	Rod seal	Rod seal	Hydraulic cylinder tube gasket	Hydraulic seal	Reservoir tube gasket	Reservoir tube gasket	Lubricating pipe nut gasket	Lubricating pipe gasket
Material	Nitrile rubber	Nitrile rubber	Nitrile rubber	Nitrile rubber	Nitrile rubber	Nitrile rubber	Nitrile rubber	Nitrile rubber	Nitrile rubber	Nitrile rubber	Nitrile rubber
Qty.	2	1	1	1	1	1(2)*1	1	2(1)*2	2	1	1
Model number	2	1	1	1	1	1(2)*1	1	2(1)*2	2	1	1
NBH3-40	G95	DXP100	—	P30	PS-30	S46	IDU-30	AS568 030	P15	—	—
NBH3-60 · NBH3-60-130	G145	DXP150	—	P30	PS-30	S46	IDU-30	AS568 030	P15	—	—
NBH-80	G190	P185	G55	P40	PS-40	G50	IDU-40	AS568 030	P15	—	—
NBH-100	AS568 448	AS568 448	—	AS568 329	—	AS568 326/333	AS568 329	G65	—	P14	P14

- The parenthesized values marked with *1 apply to NBH-80.
- The parenthesized values marked with *2 apply to NBH-100.

System which converts pneumatic pressure to hydraulic pressure with a booster and generates hydraulic pressure of up to 17.5 MPa to powerfully actuate small-size clamp head

- Suitable for operations for moving work with a long-stroke clamp head or hydraulic cylinder and applying pressure to the work
- Any high output can be obtained steplessly only by adjusting the pneumatic pressure with the pressure reducing valve.
- A wide range of movement, from a small stroke to a large stroke, can be obtained.
- The use of hydraulic pressure ensures constant, uniform and reliable force.



Specifications

Model number		PBH3-40·PBE3-40	PBH3-60·PBE3-60	PBH-80·PBE-80
Item				
Boosting ratio		11	25	25
Discharge oil capacity cm ³		77	77	176
Theoretical output oil pressure at max. working pneumatic pressure		11 MPa	17.5 MPa	
Addaptable fluid		Cosmo New Mighty Super 10 (COSMO OIL)		
Working temperature range		+5 to +60°C		
Pneumatic block	Working fluid	Air		
	Lubrication	Unnecessary (but possible)		Required
	Working pressure range	0.2 to 1 MPa	0.2 to 0.7 MPa	
	Recommended lubricant	JIS K2213 Class 1 (non-additive turbine oil ISO VG32) or its equivalent		
Weight	PBH (foot type)	9	14.5	40
	kg PBE (cap flange)	10.5	19	48
With sensor		Provided		None
Related equipment		Pressure sensor, pressure gauge (For the part numbers, see pages ED16 and 48.)		

Actual Output Table (efficiency of 90%)

Unit: kN

Booster	Clamp head	Working pneumatic pressure MPa								
		0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
PBH3-40 PBE3-40	LHA · LHA-25 · LHA-40	2.7	4.1	5.5	6.9	8.2	9.6	11.0	12.4	13.5
	LHAS-2	5.1	7.8	10.4	12.9	15.5	18.1	20.7	23.3	25.6
	LHC	2.5	3.8	5.1	6.4	7.7	8.9	10.2	11.5	12.6
	LHD	1.1	1.7	2.3	2.8	3.3	3.9	4.5	5.0	5.5
	LHF-28-60	1.2	1.8	2.4	3.0	3.6	4.2	4.8	5.4	5.9
	LHF-40-80	2.4	3.7	4.9	6.2	7.4	8.6	9.8	11.0	12.2
	LHF-50-100	3.7	5.8	7.7	9.6	11.5	13.4	15.3	17.3	18.9
PBH3-60 · PBE3-60 PBH-80 · PBE-80	LHA · LHA-25 · LHA-40	6.2	9.3	12.5	15.5	18.5	21.7	—	—	—
	LHAS-2	11.7	17.5	23.3	29.1	35.0	40.8	—	—	—
	LHC	5.7	8.6	11.5	14.3	17.3	20.1	—	—	—
	LHD	2.5	3.8	5.0	6.3	7.6	8.8	—	—	—
	LHF-28-60	2.7	4.0	5.4	6.8	8.0	9.4	—	—	—
	LHF-40-80	5.5	8.2	11.1	13.8	16.6	19.3	—	—	—
	LHF-50-100	8.6	12.9	17.3	21.6	25.9	30.1	—	—	—

Air Consumption

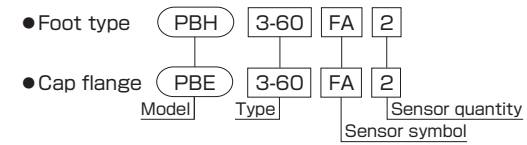
Unit: ℓ /reciprocation

Booster	Working pneumatic pressure MPa								
	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
PBH3-40 · PBE3-40	6	8	10	12	14	16	18	20	21.8
PBH3-60 · PBE3-60	13.5	18	22.5	27	31.5	36	—	—	—
PBH-80 · PBE-80	31.5	42	52.5	63	73.5	84	—	—	—

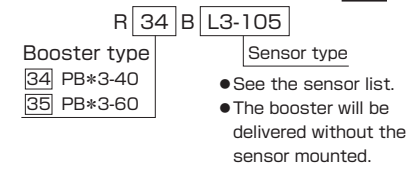
Note) The air consumption is obtained by converting the amount of air used by one reciprocation of booster at each pneumatic pressure to its equivalent atmospheric pressure.

How to Order

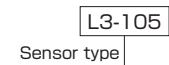
Pre-pressure type booster



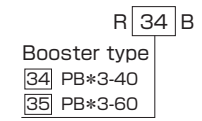
Assembly number of sensor and bracket SZZ



Sensor only



Bracket only



Delivery conditions

- PBH(E)3-40(60) comes with 1 ℓ of addaptable fluid (Cosmo New Mighty Super 10), and PBH(E)-80 comes with 2 ℓ of the fluid.
- PBH-80 and PBE-80 provided with sensor are not available.

Sensor List/Iron proximity type

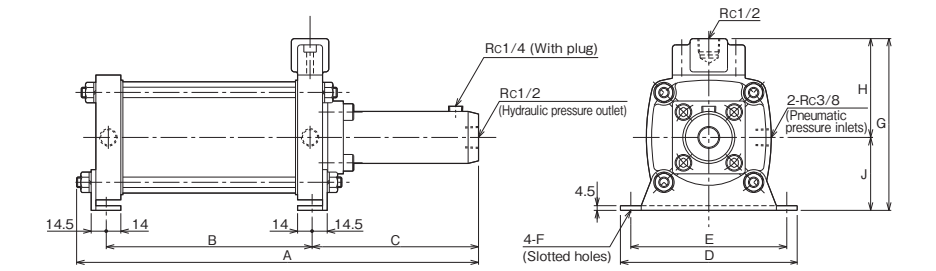
Type	Sensor symbol	Load voltage range	Load current range	Max. switching capacity	Protective circuit	Indicating lamp	Wiring method	Cord length	Applicable load
Reed sensor	 L3-101	AC: 80 to 220 V	2 to 20 mA	2 VA	Provided	Neon lamp (Lights when not sensing)	0.3 mm ² , 2-core, outer dia. φ5.3 mm, rear wiring	1 m	Small relay, programmable controller
	 L3-105							5 m	
	 L3-241	DC: 20 to 28 V	3 to 50 mA	1.5 W	Provided	LED (Lights when sensing)		1 m	
	 L3-245							5 m	

Note) ● For handling of sensors, be sure to see the sensor specifications at the end of this catalog.

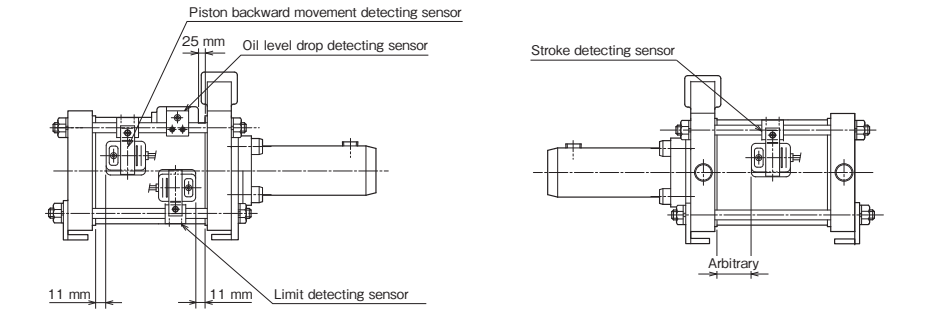
L3 type sensor



PBH3-40 PBH3-60

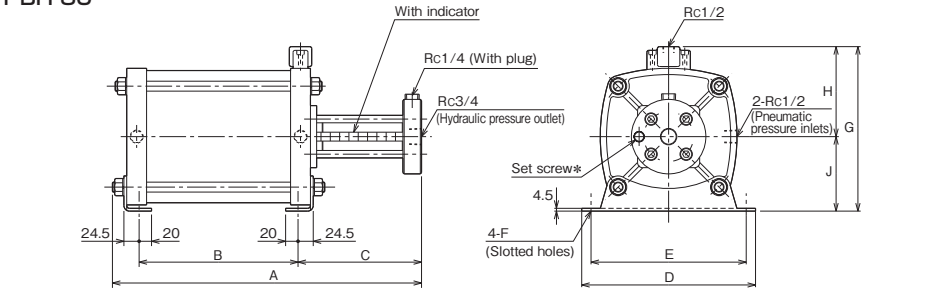


Sensor Mounting Dimension



•For the procedures for fitting the sensors, see "Sensor fitting procedures".

PBH-80

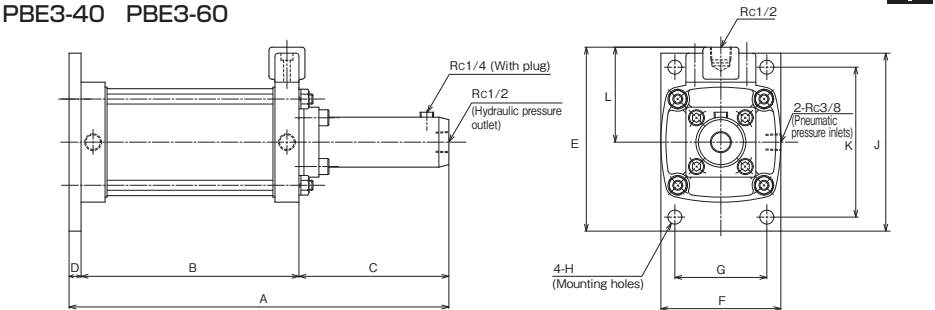


Note) Never remove the *-marked set screw at the end of the indicator. (The indicator may jump out.)

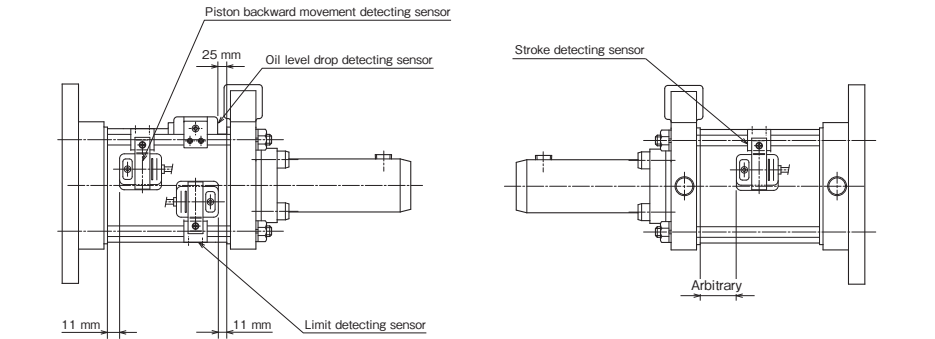
Dimensional Table

Symbol Model number	A	B	C	D	E	F	G	H	J
PBH3-40	384	198	160	170	150	9	165	95	70
PBH3-60	387	198	160	250	220	11	215	120	95
PBH-80	498	256	199	280	250	14	265	145	120

PBE3-40 PBE3-60

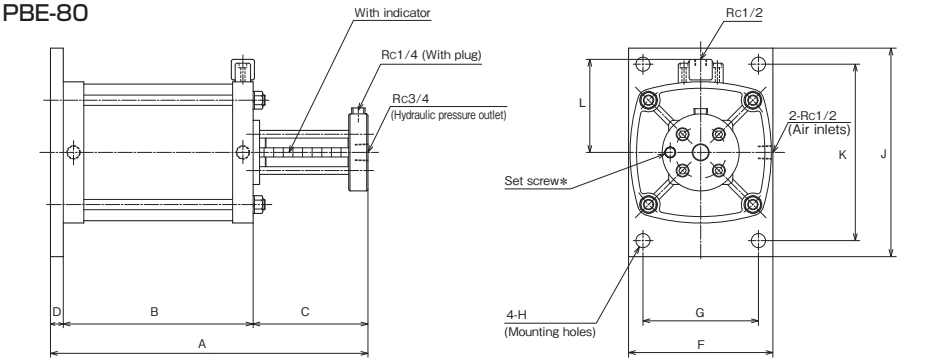


Sensor Mounting Dimension



•For the procedures for fitting the sensors, see "Sensor fitting procedures".

PBE-80

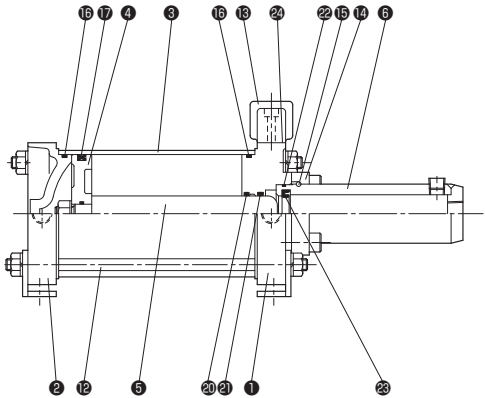


Note) Never remove the *-marked set screw at the end of the indicator. (The indicator may jump out.)

Dimensional Table

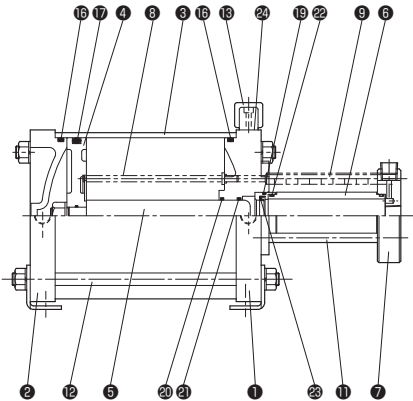
Symbol Model number	A	B	C	D	E	F	G	H	J	K	L
PBE3-40	380	218	150	12	184	120	92	φ14	178	150	95
PBE3-60	382	218	150	14	254	175	134	φ18	270	220	120
PBE-80	495	296	179	20	—	225	180	φ22	325	275	145

- PBH3-40・PBE3-40
- PBH3-60・PBE3-60



●This drawing shows the sectional view of PBH model (foot type).

- PBH-80・PBE-80



●This drawing shows the sectional view of PBH model (foot type).

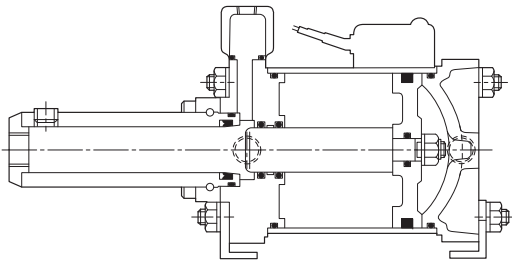
Parts List

No.	Name	Material	Qty.
①	Hydraulic cylinder mounting cover	Grey cast iron	1
②	Pneumatic cylinder cover	Grey cast iron	1
③	Pneumatic cylinder tube	Aluminum alloy (PB * -40・60) Carbon steel for machine structural use (PB * -80)	1
④	Pneumatic piston	Grey cast iron	1
⑤	Hydraulic piston	Carbon steel for machine structural use	1
⑥	Hydraulic cylinder tube	Carbon steel for machine structural use	1
⑦	Hydraulic cap cover	Rolled steel for general structure	1
⑧	Indicator rod	Carbon steel for machine structural use	1
⑨	Indicator pipe	Resin	1
⑩	Hydraulic tie rod	Chromium-molybdenum steel (PB * -80)	4
⑪	Pneumatic tie rod	Rolled steel for general structure	4
⑫	Pre-pressure chamber joint	Aluminum alloy casting	1
⑬	Flange	Rolled steel for general structure	1
⑭	Ring	Hard steel wire	1

Seal List

Name	⑫	⑬	⑭	⑮	⑯	⑰	⑱	⑲
	Cylinder tube gasket	Pneumatic piston seal	Gland gasket	Rod seal	Rod seal	Hydraulic cylinder tube gasket	Hydraulic seal	Pre-pressure chamber joint gasket
Material	Nitrile rubber	Nitrile rubber	Nitrile rubber	Nitrile rubber	Nitrile rubber	Nitrile rubber	Nitrile rubber	Nitrile rubber
Qty.	2	1	1	1	1	1	1	2
Model number	2	1	1	1	1	1	1	2
PBH3-40・PBE3-40	G95	DXP100	—	P30	PS-30	S46	IDU-30	P15
PBH3-60・PBE3-60	G145	DXP150	—	P30	PS-30	S46	IDU-30	P15
PBH-80・PBE-80	G190	P185	G55	P40	PS-40	G50	IDU-40	P15

Explanation of operation of Switch Set



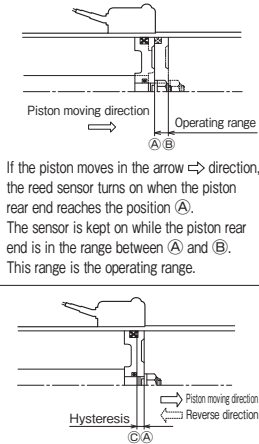
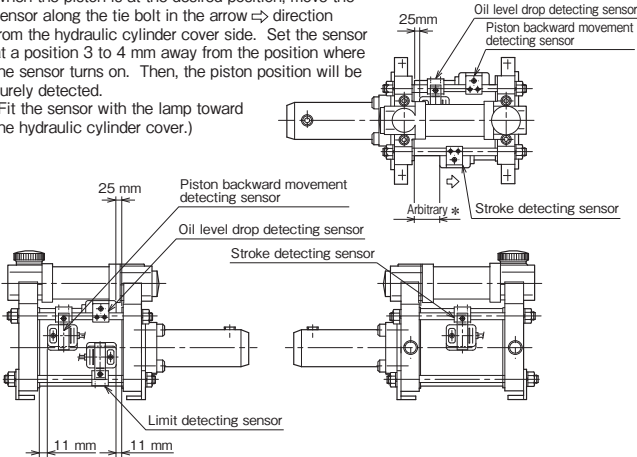
Explanation of operation

The reed sensor, permanent magnet, protective circuit and operation check lamp are contained in the case, and an iron proximity type sensor integral with a plastic structure is mounted on the periphery of the aluminum tube. When the iron piston comes under the sensor, the reed sensor is operated, and the cylinder stroke position can be detected without contact from the outside.

Usage of sensor and detection position setting

- Stroke detection For checking normal pressing operation
(When the clamp head does not make a stroke for any cause, the sensor does not detect a stroke—Error detection)
- Piston backward movement detection ... For checking normal returning operation
- Fluid level drop detection If the fluid leaks from the clamp head or hydraulic hose while pressure is held for a long time, the piston moves forward. If the discharge rate is approx. 90% of the max. discharge rate, the error is detected. Add the fluid, and check for defective parts.
- Detection of limit of use Output zero signal or stop of peripheral equipment
(When the booster piston moves to the stroke end, the output is reduced to zero. Therefore, the limit is detected just before it reaches the end.)

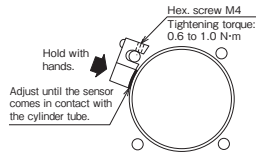
*When the piston is at the desired position, move the sensor along the tie bolt in the arrow ⇨ direction from the hydraulic cylinder cover side. Set the sensor at a position 3 to 4 mm away from the position where the sensor turns on. Then, the piston position will be surely detected.
(Fit the sensor with the lamp toward the hydraulic cylinder cover.)



If the piston moves in the arrow ⇨ direction, the reed sensor turns on when the piston rear end reaches the position (A). The sensor is kept on while the piston rear end is in the range between (A) and (B). This range is the operating range.

When the piston reaches the position (A), the sensor turns on. When the piston moves in the reverse direction ⇐ from the position, the sensor is kept on until the piston reaches the position (C). The distance between (A) and (C) is called hysteresis.

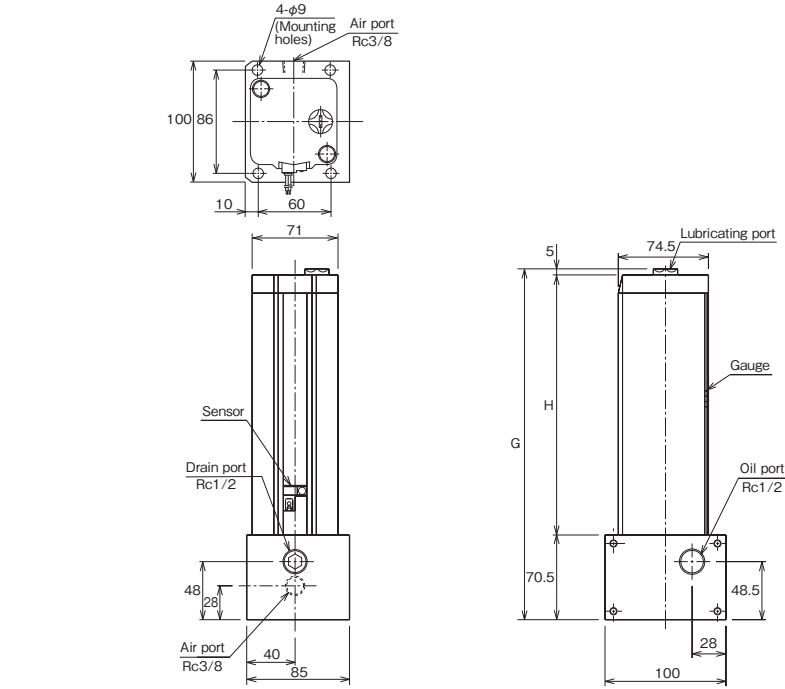
Sensor fitting procedures



- Loosen the two hex. screws M4 with a hex. wrench (2 mm), and fit the sensor to the tie rod.
- Gently hold the top of the sensor at a desired position so that the cylinder tube contacts the detecting face of the sensor, and clamp the hex. screws.
- The indicating lamp will go out when the sensor for AC turns on and light up when the sensor for DC turns on.

Note) Tighten the hex. screws to a proper tightening torque. Inappropriate tightening torque may cause the off-center of the sensor position.

● Converter



Dimensional Table

Symbol Model number	G						H					
	0.16 ℓ	0.25 ℓ	0.4 ℓ	0.63 ℓ	1 ℓ	1.6 ℓ	0.16 ℓ	0.25 ℓ	0.4 ℓ	0.63 ℓ	1 ℓ	1.6 ℓ
φ63	218	245	290	358	468	648	142.5	169.5	214.5	282.5	392.5	572.5

How to Order The item enclosed by broken line needs not to be entered, if unnecessary.

AHU2 - 063 - 001 - C 1

Model Converter capacity Sensor quantity Sensor symbol

001 0.16 ℓ 002 0.25 ℓ 004 0.4 ℓ 006 0.63 ℓ 010 1 ℓ 016 1.6 ℓ

C ZR3 (with lamp) 1.5 m

●For the details of model numbers and specifications, see “Air-Oil System”.

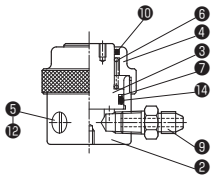
- Spring return type single acting cylinders
- A suitable type of clamp head can be selected from six types



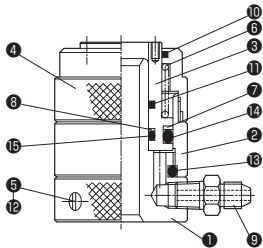
Specifications

Item	Model number	LHD	LHC	LHA	LHA-25	LHA-40	LHAS-2
Max. working pressure		17.5 MPa					
Proof test pressure		26.2 MPa					
Working temperature range		+5 to +60°C					
Structure of cushioning		None					
Addaptable fluid		Cosmo New Mighty Super 10 (COSMO OIL)					
Effective stroke mm		6	7	12	24	38	20
Piston pressure receiving area mm ²		570	1340	1460	1460	1460	2640
Max. stroke volume cm ³		4	10.7	19	36.5	58.4	60.7
Spring mounting load N		31.4	56.9	113	134	101	127
Max. spring load N		72.6	90.2	196	226	274	255
Weight kg		0.5	1	2	2.2	2.5	5.2

• LHD • LHC



• LHA • LHA-40
• LHA-25 • LHAS-2



Parts List

No.	Name	Material	Qty.
①	Upper cover	Rolled steel for general structure	1
②	Cylinder	Rolled steel for general structure	1
③	Piston	Carbon steel for machine structural use	1
④	Lower cover	Rolled steel for general structure	1
⑤	Air vent plug	Rolled steel for general structure	1(2)

• The parenthesized value applies to LHAS-2.

No.	Name	Material	Qty.
⑥	Return spring	Piano wire	1
⑦	Backup ring for piston shield	Fluororesin	1
⑧	Backup ring for piston	Fluororesin	1
⑨	Hydraulic joint	Rolled steel for general structure	1

Seal List

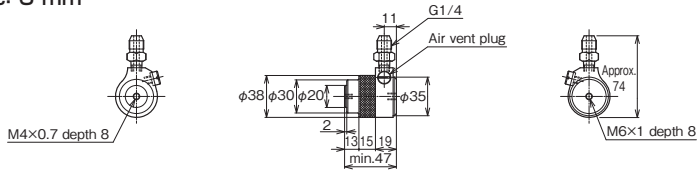
Name	⑩	⑪	⑫	⑬	⑭	⑮
	Lower cover wiper	Piston wiper	O-ring for air vent plug	O-ring for upper cover	O-ring for piston shield	O-ring for piston
	Leather	Leather	Nitrile rubber	Nitrile rubber	Nitrile rubber	Nitrile rubber
Model number	Qty.	Qty.	Qty.	Qty.	Qty.	Qty.
LHD	26×20×2.5	—	P-7	—	AS568 211	—
LHC	35×30×2.5	—	P-7	—	AS568 220	—
LHA	45×40×2.5	32×26×3	P-7	AS568 327	AS568 326	AS568 215
LHA-25	45×40×2.5	32×26×3	P-7	AS568 327	AS568 326	AS568 215
LHA-40	45×40×2.5	32×26×3	P-7	AS568 327	AS568 326	AS568 215
LHAS-2	55×61×2.5	44.2×52×2.5	P-7	AS568 335	AS568 333	AS568 327

(Note) The O-rings for piston shield and O-rings for piston are provided with backup rings designed for their sizes.

Unit: mm

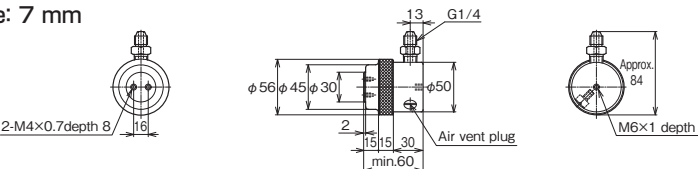
LHD

Effective stroke: 6 mm



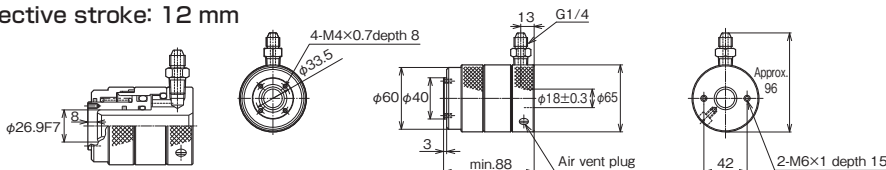
LHC

Effective stroke: 7 mm



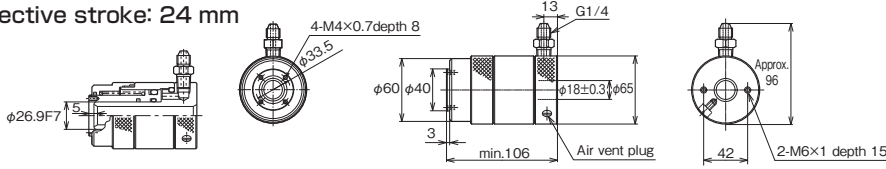
LHA

Effective stroke: 12 mm



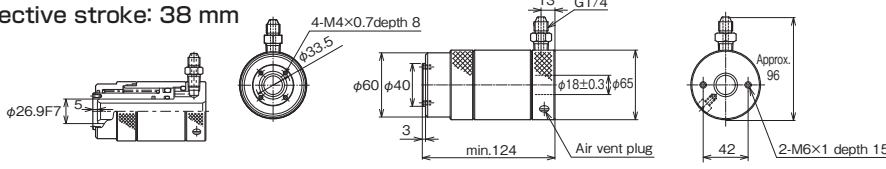
LHA-25

Effective stroke: 24 mm



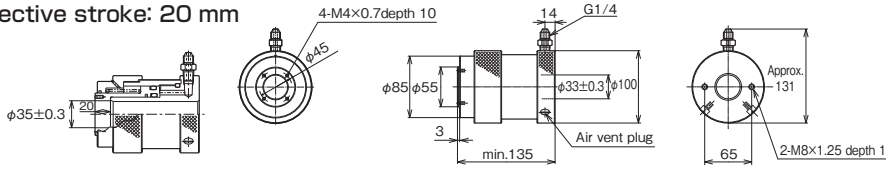
LHA-40

Effective stroke: 38 mm

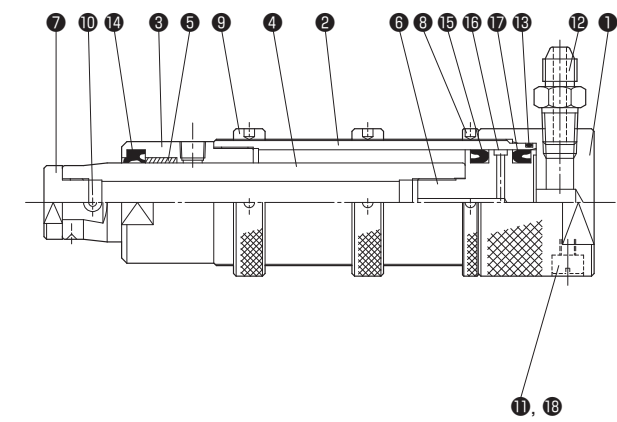


LHAS-2

Effective stroke: 20 mm



- LHF-28-60
- LHF-40-80
- LHF-50-100



Parts List

No.	Name	Material	Qty.
①	Upper cover	Carbon steel for machine structural use	1
②	Tube	Carbon steel for machine structural use	1
③	Lower cover	Carbon steel for machine structural use	1
④	Rod	Carbon steel for machine structural use	1
⑤	Bush	Oil-impregnated sintered bearing	1
⑥	Piston	Carbon steel for machine structural use	1

No.	Name	Material	Qty.
⑦	Rod end attachment	Carbon steel for machine structural use	1
⑧	Positioning ring	Carbon steel for machine structural use	1
⑨	Clamp ring	Carbon steel for machine structural use	2
⑩	Disk	Sintered metal	1
⑪	Air vent plug	Rolled steel for general structure	1
⑫	Hydraulic joint	Rolled steel for general structure	1

Seal List

Name	⑬	⑭	⑮	⑯	⑰	⑱
	Tube gasket	Rod seal	Piston seal (on pneumatic side)	Wear ring	Piston seal (on hydraulic side)	O-ring for air vent plug
Material	Nitrile rubber	Nitrile rubber	Nitrile rubber	Synthetic resin	Nitrile rubber	Nitrile rubber
Qty.	1	1	1	1	1	1
Model number	S-30	DRP-16	DOL-20	28x2.5x2	ODU-28	P-7
LHF-28-60	S-30	DRP-16	DOL-20	28x2.5x2	ODU-28	P-7
LHF-40-80	S-42	DRP-30	DOL-30	SWA-40	ODU-40	P-7
LHF-50-100	S-53	DRP-40	DOL-40	SWA-50	ODU-50	P-7

Clamp heads for pre-pressure type booster

- Air return type hydraulic cylinders
- A suitable clamp head for pre-pressure type booster can be selected from three types according to the purpose of use.



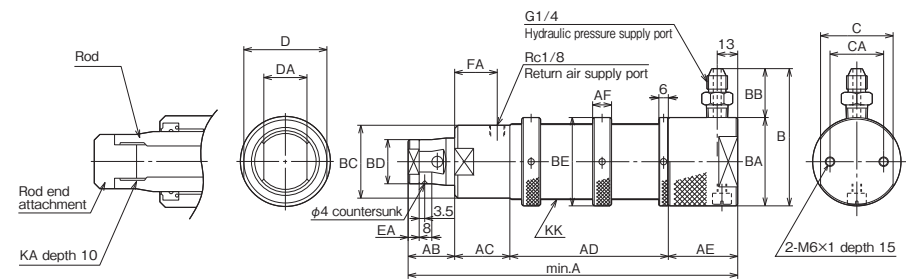
① LHF-28-60 ② LHF-40-80 ③ LHF-50-100

Specifications

Model number	LHF-28-60	LHF-40-80	LHF-50-100
Item			
Proof test pressure on extension side	26.2 MPa		
Working temperature range	+5 to +60°C		
Structure of cushioning	None		
Addaptable fluid	Cosmo New Mighty Super 10 (COSMO OIL)		
Max. stroke	62 ⁰ / _{-1.5}	82 ⁰ / _{-1.5}	103 ⁰ / _{-2.0}
Piston area on extension side mm ²	610	1250	1950
Max. working hydraulic pressure on extension side MPa	17.5	17.5	17.5
Max. stroke oil capacity on extension side cm ³	38	103	201
Piston area on retraction side mm ²	410	540	700
Max. working pneumatic pressure on retraction side MPa	1	1	1
Max. stroke volume on retraction side cm ³	25.7	45.1	72.1
Weight kg	1.1	2.3	4.3
Applicable brackets	D3600	D4800	D6000
	V3600	V4800	V6000
	H3600	H4800	H6000

- To calculate the air consumption on the retraction side, multiply the max. stroke volume on retraction side shown above by (gauge pressure + 1).
 - These clamp heads cannot be used by the cylinder stopping method. Use them within the maximum stroke.
- Note) At the maximum stroke, the output is 0. The lower cover is not resistant to impact caused by collision. Therefore, it may be damaged.
- These clamp heads are designed specially for pre-pressure type boosters. They are a kind of air return hydraulic cylinders. To return the clamp head mounted with a jig, use a return spring or another mechanism.
 - The hydraulic pressure generated in a cylinder due to the inertia of load must be lower than the proof test pressure.

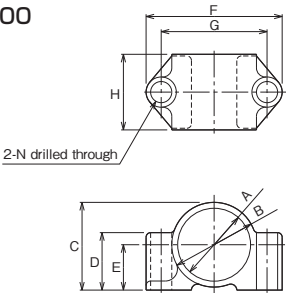
LHF



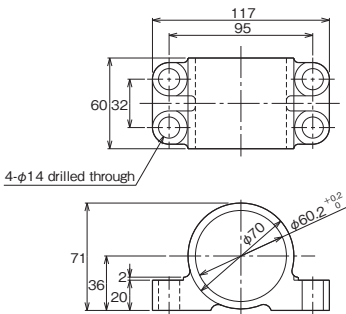
● As a rod end screw, another jig can be fitted.
See the Notes on Use of Pneumerlock.

Mounting bracket SZZ

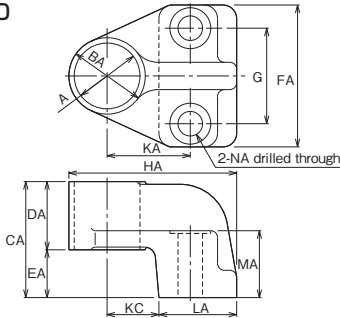
H3600
H4800



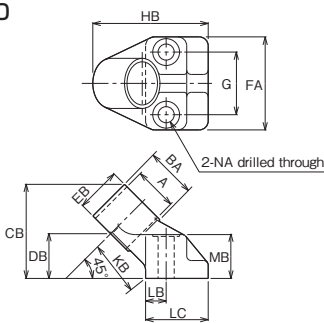
H6000



V3600
V4800
V6000



D3600
D4800
D6000



Dimensional Table/LHF

Symbol	A	AB	AC	AD	AE	AF	B	BA	BB	BC
Model number										
LHF-28-60	178±0.5	27.5	28	78.5 ^{+1.5} ₀	44	12	73	φ42	30	34.2
LHF-40-80	209±0.5	29.5	35	100.5 ^{+1.5} ₀	44	12	87	φ56	30	46.2
LHF-50-100	231±0.5	29.5	35	120.5 ⁺² ₀	46	14	101	φ70	30	57

Symbol	BD	BE	C	CA	D	DA	EA	FA	KA	KK
Model number										
LHF-28-60	15f8	42	38	26	32	12	5	20	M10×1	M36×1.5
LHF-40-80	28f8	56	46	34	43	27	7	27	M18×1.5	M48×1.5
LHF-50-100	38f8	70	62	48	53	35	7	27	M22×1.5	M60×2

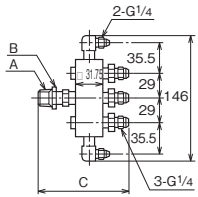
Dimensional Table/Mounting bracket

Symbol	A	B	BA	C	CA	CB	D	DA	DB	E	EA	EB	F
Model number													
* 3600	φ 36.2 ^{+0.1} ₀	φ42	φ44	45	65	85	34	35	44.5	24	30	35	72
* 4800	φ 48.2 ^{+0.1} ₀	φ56	φ56	58	85	105	38	50	50	30	35	50	90
* 6000	φ 60.2 ^{+0.1} ₀	φ70	φ70	71	105	146	—	70	71.5	36	35	70	117

Symbol	FA	G	H	HA	HB	MA	MB	N	NA	KA	KB	KC	LA	LB	LC
Model number															
* 3600	81	54	40	102	99	38	38	φ11	φ14	48	55	32	48	18	50
* 4800	104	70	50	123	129	49	49	φ14	φ18	61	63	38	57	23	70
* 6000	135	90	60	169	173	59	52	φ14	φ22	82	88	52	82	27	95

● To fit the bracket, use hex. socket head cap screws.

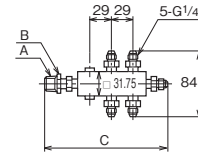
LT Series



Dimensional Table

Symbol Model number	A	B	C	Applicable boosters
1-1-40	R1/2	23	101	NBH3-40 · PBH(E)3-40 NBH3-60 · PBH(E)3-60 NBH3-60-130
1-1-80	R3/4	29	103	NBH-80 · PBH(E)-80
1-1-100	R1	35	105	NBH-100

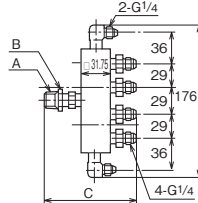
LT Series



Dimensional Table

Symbol Model number	A	B	C	Applicable boosters
2-1-40	R1/2	23	159	NBH3-40 · PBH(E)3-40 NBH3-60 · PBH(E)3-60 NBH3-60-130
2-1-80	R3/4	29	161	NBH-80 · PBH(E)-80
2-1-100	R1	35	163	NBH-100

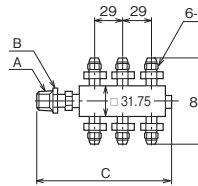
LT Series



Dimensional Table

Symbol Model number	A	B	C	Applicable boosters
3-1-40	R1/2	23	101	NBH3-40 · PBH(E)3-40 NBH3-60 · PBH(E)3-60 NBH3-60-130
3-1-80	R3/4	29	103	NBH-80 · PBH(E)-80
3-1-100	R1	35	105	NBH-100

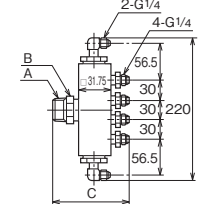
LT Series



Dimensional Table

Symbol Model number	A	B	C	Applicable boosters
3-2-40	R1/2	23	138	NBH3-40 · PBH(E)3-40 NBH3-60 · PBH(E)3-60 NBH3-60-130
3-2-80	R3/4	29	140	NBH-80 · PBH(E)-80
3-2-100	R1	35	142	NBH-100

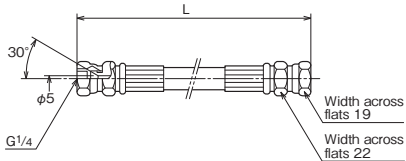
LT Series



Dimensional Table

Symbol Model number	A	B	C	Applicable boosters
4-1-40	R1/2	23	101	NBH3-40 · PBH(E)3-40 NBH3-60 · PBH(E)3-60 NBH3-60-130
4-1-80	R3/4	29	103	NBH-80 · PBH(E)-80
4-1-100	R1	35	105	NBH-100

OH Series

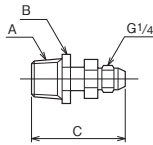


Dimensional Table

Symbol Model number	L(m)
OH-05	0.5
OH-10	1
OH-15	1.5
OH-20	2

Hose inner diameter: φ9.5

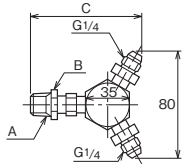
LT Series



Dimensional Table

Symbol Model number	A	B	C	Applicable boosters
1-1-40	R1/2	23	47	NBH3-40 · PBH(E)3-40 NBH3-60 · PBH(E)3-60 NBH3-60-130
1-1-80	R3/4	29	49	NBH-80 · PBH(E)-80
1-1-100	R1	35	51	NBH-100

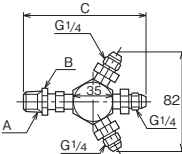
LT Series



Dimensional Table

Symbol Model number	A	B	C	Applicable boosters
2-1-40	R1/2	23	87	NBH3-40 · PBH(E)3-40 NBH3-60 · PBH(E)3-60 NBH3-60-130
2-1-80	R3/4	29	89	NBH-80 · PBH(E)-80
2-1-100	R1	35	91	NBH-100

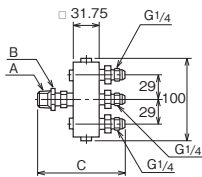
LT Series



Dimensional Table

Symbol Model number	A	B	C	Applicable boosters
3-1-40	R1/2	23	104	NBH3-40 · PBH(E)3-40 NBH3-60 · PBH(E)3-60 NBH3-60-130
3-1-80	R3/4	29	106	NBH-80 · PBH(E)-80
3-1-100	R1	35	108	NBH-100

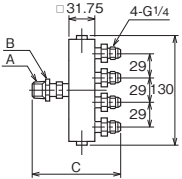
LT Series



Dimensional Table

Symbol Model number	A	B	C	Applicable boosters
3-2-40	R1/2	23	101	NBH3-40 · PBH(E)3-40 NBH3-60 · PBH(E)3-60 NBH3-60-130
3-2-80	R3/4	29	103	NBH-80 · PBH(E)-80
3-2-100	R1	35	105	NBH-100

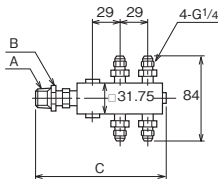
LT Series



Dimensional Table

Symbol Model number	A	B	C	Applicable boosters
4-1-40	R1/2	23	101	NBH3-40 · PBH(E)3-40 NBH3-60 · PBH(E)3-60 NBH3-60-130
4-1-80	R3/4	29	103	NBH-80 · PBH(E)-80
4-1-100	R1	35	105	NBH-100

LT Series



Dimensional Table

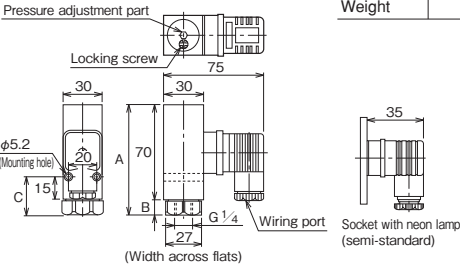
Symbol Model number	A	B	C	Applicable boosters
4-2-40	R1/2	23	138	NBH3-40 · PBH(E)3-40 NBH3-60 · PBH(E)3-60 NBH3-60-130
4-2-80	R3/4	29	140	NBH-80 · PBH(E)-80
4-2-100	R1	35	142	NBH-100

Pressure Sensor



Specifications (for high pressure)

Model number	0882100	0882200	0882300	0882400
Item				
Port size	G1/4			
Working fluid	Hydraulic fluid or non-corrosive liquid			
Set pressure range	0.5 to 7 MPa	1 to 16 MPa	2.5 to 25 MPa	4 to 40 MPa
Proof test pressure	40 MPa			60 MPa
Difference between opening pressure and closing pressure	0.8 to 2 MPa	1.2 to 3.5 MPa	1.5 to 4 MPa	1.8 to 4.5 MPa
Working temperature range	-10 to +70°C (No freezing)			
Protection structure	Dust-proof and drip-proof structure			
Accessories	Socket with neon lamp, reducing nipple			
Weight	0.2 kg			



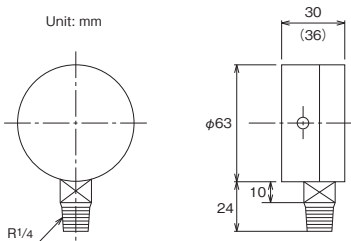
Pressure Gauge **SZZ**



· Without glycerine · Containing glycerine

Specifications

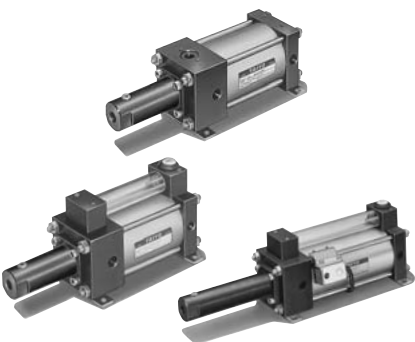
Model number	Port size	Remarks
PG150Q-2	R1/4	For 15 MPa
PG250Q-2	R1/4	For 25 MPa
PG150Q-2G	R1/4	For 15 MPa (containing glycerine)
PG250Q-2G	R1/4	For 25 MPa (containing glycerine)



· The parenthesized value is the dimension of the pressure gauge containing glycerine.

Conversion of pneumatic pressure to hydraulic pressure

- Direct pressure type and pre-pressure type are available.
- Boosters with sensors are available. (Optional)
- Sensors can be fitted later.
- Non-lubrication type



Main Body Specifications

Type	Direct pressure type	Pre-pressure type
Item	35HBN63-30	35HBN63-50
Boosting ratio	7.8	
Discharge oil capacity (cm³)	30	50
Theoretical output oil pressure at max. working pneumatic pressure	4.7 MPa	
Note) Frequency of operation	6 times/min or less (Booster stroke time: each way for 5 sec or more, reciprocation for 10 sec or more)	
Hydraulic fluid to be used	Cosmo New Mighty Super 10 (COSMO OIL) or its equivalent	
Working temperature range	+5 to +60°C	
Working fluid	Air	
Lubrication	Unnecessary (but possible)	
Working pressure range	0.2 to 0.6 MPa	
Recommended lubricant	JIS K2213 Class (non-additive turbine oil ISO VG32) or its equivalent	
Weight (kg)	2.9	3.2
With reed sensor	Provided	
Related equipment	Pressure sensor, pressure gauge	

Note) In the case of direct-pressure type, check carefully the return speed and the amount of returned fluid. If the return speed is high, the fluid may suddenly sucked into the reservoir tank, and the fluid may leak from the lubricating plug, or air bubbles may be mixed in the fluid.

Iron Proximity Sensor Specifications

Model number	With 1 m cord	L3-241	L3-101
	With 5 m cord	L3-245	L3-105
Rated voltage	24 V DC		100/200 V AC
Load voltage range	DC: 20 to 28 V		AC: 80 to 220 V
Load current range	3 to 50 mA		2 to 20 mA
Max. switching capacity	1.5 W		2 VA
Leakage current	0 mA		1 mA
Operating time	1.2 ms or less		
Return time	1 ms or less		
Impact resistance	196 m/s² (unrepeated)		
Indicating lamp	LED (Lights when sensing) Neon lamp (Lights when not sensing)		
Applicable load	Small relay, programmable controller		

• For handling of sensors, be sure to see the sensor specifications at the end of this catalog.

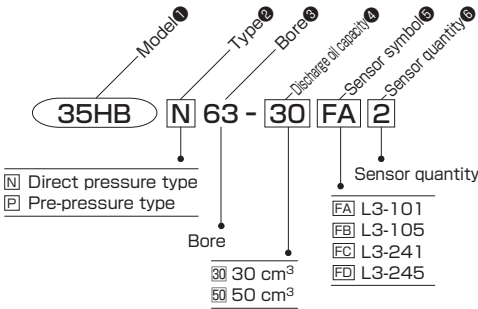
L3 type sensor



- Number of mountable sensors
35HBN-63-30: Up to 1 pc. on one surface (up to 2 pcs. in all on right and left surfaces as viewed from front)
35HBP-63-30: Up to 1 pc. on one surface (up to 3 pcs. in all on right, left and upper surfaces as viewed from front)
35HBN-63-50: Up to 2 pcs. on one surface
35HBP-63-50: Up to 2 pcs. on one surface
- In an environment with severe vibration, the sensors may be dislocated. In such an environment, it is recommended to use the tri-band type. (Order made)

How to Order

When placing an order, specify the model number shown below.



Delivery conditions

- The boosters will be delivered without sensors or mounting accessories mounted.
- The boosters will come with 1 l of adaptable fluid.

Assembly number of sensor and bracket

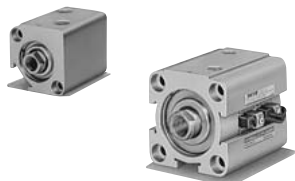
- When placing an order for sensors only, specify the assembly number of sensor and bracket.



How to order pressure gauge
PG511Q-0

• For details, see "Just Power System" in the general catalog of hydraulic equipment.

Compact Design Hydraulic Cylinder 35S-1 Series
Space-saving type compact design hydraulic cylinders for 3.5 MPa



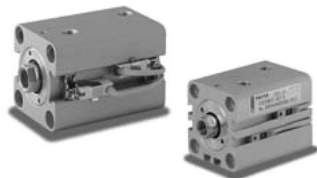
Bore : $\phi 20 \cdot \phi 25 \cdot \phi 32 \cdot \phi 40 \cdot \phi 50 \cdot \phi 63$
Nominal pressure: 3.5 MPa
Model : General purpose type
Double acting single rod/double rod
Standard type/Switch Set

Compact Design Hydraulic Cylinder 160S-1 Series
Compact design hydraulic cylinders for 16 MPa using iron bodies



Bore : $\phi 20 \cdot \phi 25 \cdot \phi 32 \cdot \phi 40 \cdot \phi 50 \cdot \phi 63 \cdot \phi 80 \cdot \phi 100 \cdot \phi 125$
Nominal pressure: 16 MPa
Model : General purpose type/cutting oil proof type
Double acting single rod/double rod
Standard type/Switch Set

Compact Design Hydraulic Cylinder HQS2 Series
Compact design hydraulic cylinders having rated pressure of 16 MPa



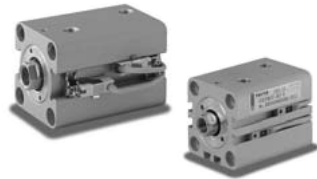
Bore : $\phi 20 \cdot \phi 25 \cdot \phi 32 \cdot \phi 40 \cdot \phi 50 \cdot \phi 63 \cdot \phi 80 \cdot \phi 100$
Rated pressure: 16 MPa
Model : General purpose type/cutting oil proof type
Double acting single rod/double rod
Standard type/Switch Set

Compact Design Hydraulic Cylinder 210S-1 Series
21-MPa compact design hydraulic cylinders with magnetic proximity type sensors



Bore : $\phi 32 \cdot \phi 40 \cdot \phi 50 \cdot \phi 63 \cdot \phi 80$
Nominal pressure: 21 MPa
Model : General purpose type
Double acting single rod
Standard type/Switch Set

Compact Design Hydraulic Cylinder 100S-1 Series
Aluminum body compact design hydraulic cylinders excelling in cost performance



Bore : $\phi 20 \cdot \phi 25 \cdot \phi 32 \cdot \phi 40 \cdot \phi 50 \cdot \phi 63 \cdot \phi 80 \cdot \phi 100$
Nominal pressure: 10 MPa
Model : General purpose type/cutting oil proof type
Double acting single rod/double rod
Standard type/Switch Set

Body Screwed Cylinder 210N-1 Series
Body screwed type hydraulic cylinders suitable for holding and clamping work



Bore : $\phi 12 \cdot \phi 20 \cdot \phi 32$
Nominal pressure: 21 MPa
Model : Standard type
With block/with cap

• For details, see "Space-saving Hydraulic Cylinders" in the general catalog of hydraulic equipment.



Clamping Elements

LE2 ED52



Low pneumatic pressure is converted to high hydraulic pressure by the principle of booster, and the hydraulic pressure is given to the outside by the hydraulic piston to use it as power. Easy-to-use small and light boosters integral with clamp head

- Cylindrical shape with reduced overall length and external dimensions
- Since the cylinder volume is extremely small, the air consumption is very low.
- The mounting position can be adjusted with the clamp ring. The stroke is so short, that they can be tightened quickly.



Specifications

Model number \ Item	Nominal stroke mm	Boosting ratio	Theoretical clamping force at max. working pneumatic pressure kN	Working pneumatic pressure range	Weight kg
LE2-3603-03	3	7.84	3.73	0.15 to 0.9 MPa	0.7
LE2-3606-03	6				0.9
LE2-3609-03	9				1.0
LE2-4803-08	3	8.16	8.34	0.15 to 0.9 MPa	1.3
LE2-4806-08	6				1.5
LE2-4809-08	9				1.7
LE2-4812-08	12				2.0
LE2-4803-12	3	16	12.1	0.15 to 0.7 MPa	1.4
LE2-6006-18	6	11	18.0	0.15 to 0.9 MPa	2.6
LE2-6009-18	9				3.4
LE2-6012-18	12				3.8
LE2-6003-21	3	17.36	20.8	0.15 to 0.7 MPa	2.5
LE2-6006-21	6				3.7

Theoretical Tightening Force

Unit: kN

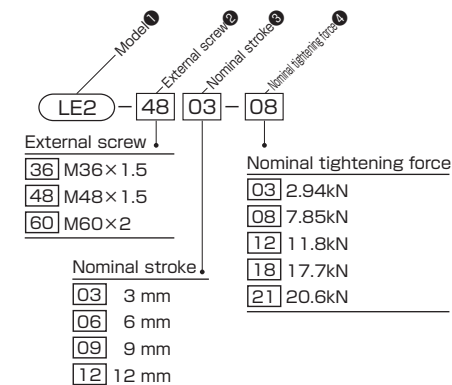
Model number	Item	Working pneumatic pressure (MPa)								
		0.15	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
LE2-3603-03	0.392	0.637	1.08	1.52	1.96	2.40	2.84	3.29	3.73	
LE2-3606-03										
LE2-3609-03										
LE2-4803-08	0.981	1.47	2.45	3.43	4.41	5.39	6.37	7.35	8.34	
LE2-4806-08										
LE2-4809-08										
LE2-4812-08	1.67	2.50	4.41	6.37	8.24	10.2	12.1	—	—	
LE2-4803-12										
LE2-6006-18										
LE2-6009-18	2.60	3.63	5.69	7.75	9.81	11.9	13.9	16.0	18.0	
LE2-6012-18										
LE2-6003-21										
LE2-6006-21	3.33	4.9	7.85	11.3	14.5	17.7	20.8	—	—	

Use the nominal stroke subtracted by 1 mm as an effective stroke.

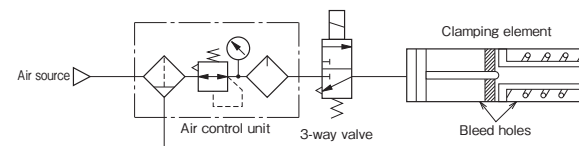
Common specifications

- Working fluid : Air
- Lubrication : Usable without lubrication
- Hydraulic fluid to be used: Cosmo Pure Safety 830 made by Cosmo Oil Lubricants
- Working temperature range : +5°C to +60°C

How to order

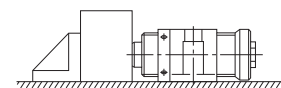


Structure

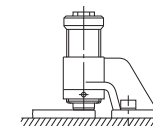


The internal mechanism of the clamping element is extremely simple. The boosting piston of the pneumatic cylinder at the rear of the body is inserted to the hydraulic chamber, large hydraulic pressure is generated by the area ratio between pneumatic piston and hydraulic piston, and power is applied to the hydraulic piston. The hydraulic piston is returned by the spring when the pneumatic circuit is turned off.

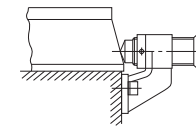
Application Examples



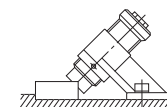
The clamping element is installed horizontally for clamping work to be drilled, polished, tapped or milled.



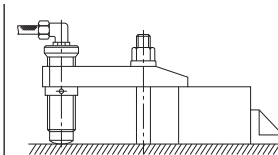
The clamping element is installed vertically for clamping plate-like work.



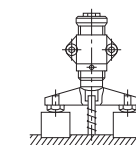
Used for clamping large parts having irregular shapes, such as castings and blank members.



The clamping element is installed at 45° and combined with a V-shaped clamping jig to give clamping force of x-y component.

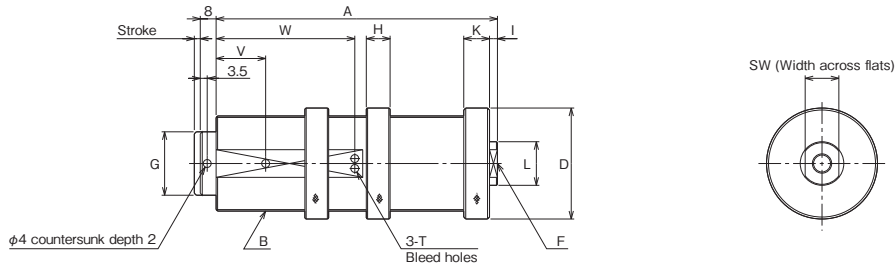


Clamping using a clamp lever. Lever ratio: 1:2



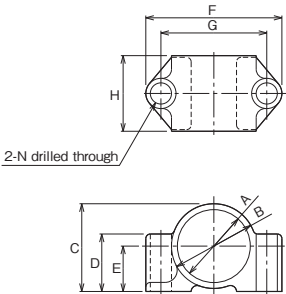
Simultaneously clamping two pieces of work

LE2

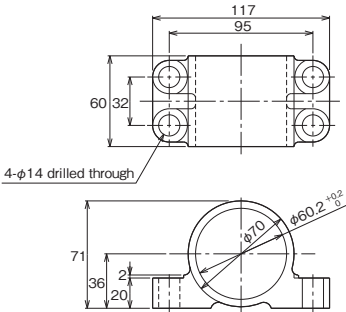


Mounting Bracket **SZZ**

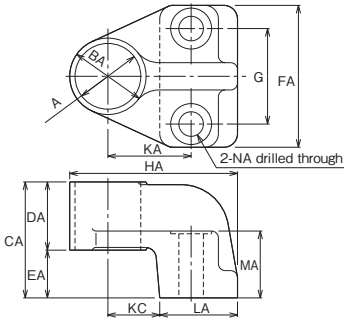
H3600
H4800



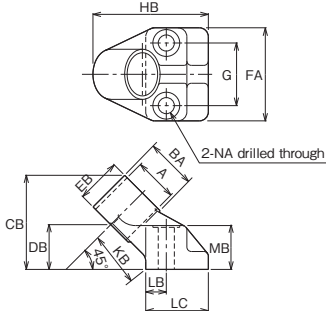
H6000



V3600
V4800
V6000



D3600
D4800
D6000



Dimensional Table/LE2

Symbol Model number	Nominal stroke mm	A	B	D	F	G	H	I	K	L	SW	T	V	W
LE2-3603-03	3	100	M36x1.5	$\phi 42$	$G^{1/8}$	$\phi 22f8$	12	4	13	$\phi 22$	17	$\phi 3$	25	56
LE2-3606-03	6	142											25	72
LE2-3609-03	9	192											46	96
LE2-4803-08	3	112	M48x1.5	$\phi 56$	$G^{1/8}$	$\phi 32f8$	12	4	13	$\phi 22$	17	$\phi 4$	26	66
LE2-4806-08	6	147											20	75
LE2-4809-08	9	188											34	90
LE2-4812-08	12	236	M48x1.5	$\phi 56$	$G^{1/8}$	$\phi 32f8$	12	4	13	$\phi 22$	17	$\phi 4$	40	111
LE2-4803-12	3	142											25	70
LE2-6006-18	6	175											30	85
LE2-6009-18	9	245	M60x2	$\phi 70$	$G^{1/4}$	$\phi 40f8$	14	5	18	$\phi 25$	22	$\phi 4$	60	122
LE2-6012-18	12	291											60	134
LE2-6003-21	3	168	M60x2	$\phi 70$	$G^{1/4}$	$\phi 40f8$	14	5	18	$\phi 25$	22	$\phi 4$	40	83
LE2-6006-21	6	283											70	133

● Use the nominal stroke subtracted by 1 mm as an effective stroke.

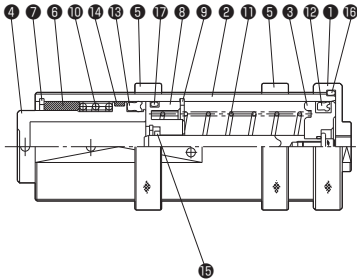
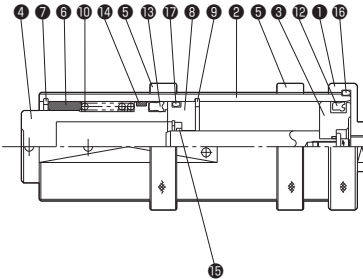
Dimensional Table/Mounting bracket

Symbol Model number	A	B	BA	C	CA	CB	D	DA	DB	E	EA	EB	F
*3600	$\phi 36.2^{+0.1}_0$	$\phi 42$	$\phi 44$	45	65	85	34	35	44.5	24	30	35	72
*4800	$\phi 48.2^{+0.1}_0$	$\phi 56$	$\phi 56$	58	85	105	38	50	50	30	35	50	90
*6000	$\phi 60.2^{+0.1}_0$	$\phi 70$	$\phi 70$	71	105	146	—	70	71.5	36	35	70	117

Symbol Model number	FA	G	H	HA	HB	MA	MB	N	NA	KA	KB	KC	LA	LB	LC
*3600	81	54	40	102	99	38	38	$\phi 11$	$\phi 14$	48	55	32	48	18	50
*4800	104	70	50	123	129	49	49	$\phi 14$	$\phi 18$	61	63	38	57	23	70
*6000	135	90	60	169	173	59	52	$\phi 14$	$\phi 22$	82	88	52	82	27	95

● To fit the bracket, use hex. socket head cap screws.

LE2



[LE2-3603-03 · LE2-3606-03 · LE2-3609-03
LE2-4803-08 · LE2-4806-08 · LE2-4809-08 · LE2-4812-08
LE2-6006-18 · LE2-6009-18 · LE2-6012-18]

[LE2-4803-12 · LE2-6003-21 · LE2-6006-21]

Parts List

No.	Name	Material	Qty.
1	Upper cover	Carbon steel for machine structural use	1
2	Tube	Carbon steel for machine structural use	1
3	Pneumatic piston assembly	Hardened and polished (plated with hard chrome)	1
4	Output shaft (hydraulic piston)	Carbon steel for machine structural use (plated with hard chrome)	1
5	Clamp ring	Carbon steel for machine structural use	2
6	Bush	Oil-impregnated metal	1
7	Bush retainer	Carbon tool steel	1
8	Intermediate ring	Free cutting brass	1
9	Intermediate ring retainer	Carbon tool steel	1
10	Return spring	Piano wire	1
11	Pneumatic piston return spring	Piano wire	1
12	Pneumatic piston seal	Nitrile rubber	1
13	Hydraulic piston seal	Nitrile rubber	1
14	Hydraulic piston wear ring	Resin	1
15	Boosting piston seal	Nitrile rubber	1
16	Tube gasket	Nitrile rubber	1
17	Intermediate ring gasket	Nitrile rubber	1

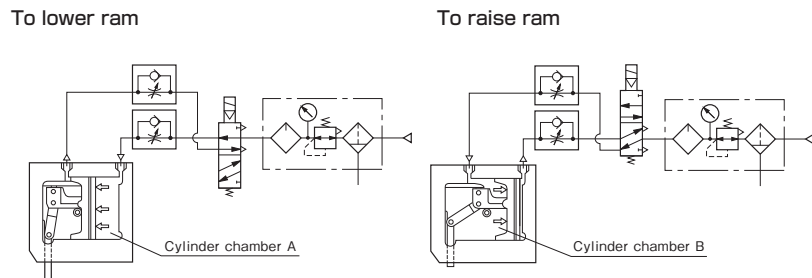


Toggle Presses

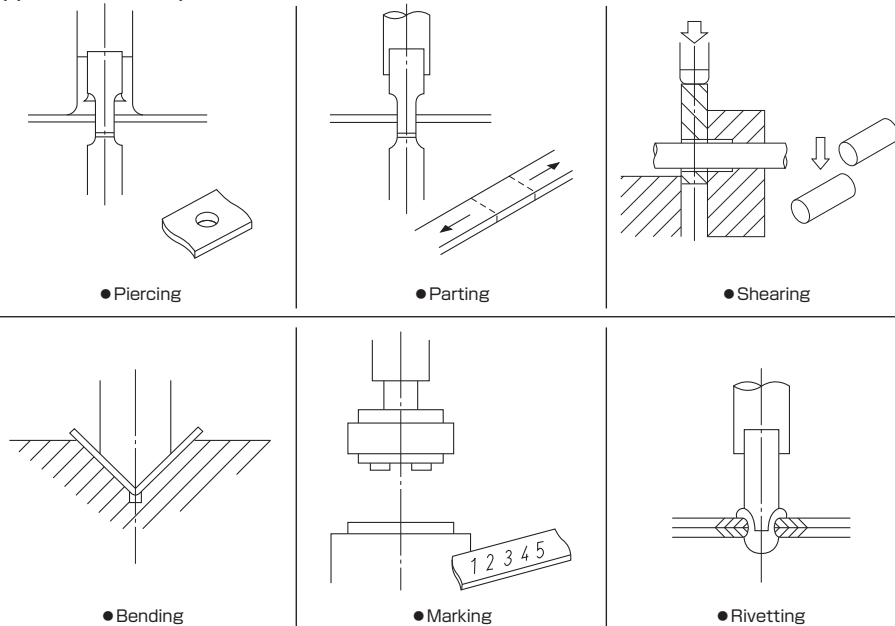
TPH.....ED58



Principle of Operation



Application Examples



Selection Materials

■ Selection of model for piercing in sheet

To select a toggle press, it is necessary to: 1. determine the force (working force) necessary for operation, and 2. determine the working stroke. Then, check the determined force and stroke with the output characteristics of the toggle press.

The working stroke consists of work thickness and bite allowance as shown in the figure. Therefore, the stroke can be obtained by the formula (1).

$$\ell = t + \ell' \dots\dots\dots ①$$

Where, ℓ : working stroke

t : work thickness

ℓ' : bite allowance (depth of bite of punch into die)

The force (working force) necessary for piercing in a sheet is determined from the product of shear stress and shear area by the formula ② or ③.

$$F = \ell t \tau \dots\dots\dots ②$$

F : shear load (N)

ℓ : overall length of side to be sheared (mm)

t : thickness (mm)

τ : shear stress (N/mm²)

$$F = \pi D t \tau \dots\dots\dots ③$$

D : round hole diameter

The toggle press output-displacement (F - ℓ) characteristic curves shown in the figure are plotted at a load rate of 90% ($P=0.5$ MPa) and 75% ($P=0.7$ MPa) because the impact force caused by collision of the piston and the body must be reduced when a load is removed in the middle of ram stroke as in the case of piercing in a sheet. If the load rate is too low (the allowance is large), the bolts and body may be damaged by the impact caused upon collision of the piston and the body. The load range is limited to a range of 4 mm from the bottom dead center for the same reason.

● Example of working conditions { Round hole piercing, $D=15$ $t=0.8$ $\gamma=294$ N/mm²

Selecting procedures (See Fig. 1.)

1. For a shear stress of 294 N/mm²
2. Determine the point A corresponding to the thickness $t=0.8$ and the hole diameter $D=15$.
3. Draw a vertical line upward from the point A, and extend the line to the toggle press characteristic diagram.
4. Read the value of ℓ from the intersection of the line drawn in 3 and the characteristic curve.

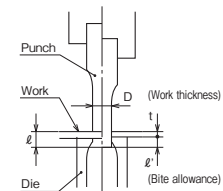
- ① B...TPH-015040 $P=0.5$ MPa $B=2.4$ mm
- ② C...TPH-020040 $P=0.5$ MPa $C=4.0$ mm
- ③ E...TPH-015040 $P=0.7$ MPa $E=2.9$ mm

Since the values of dimension ℓ corresponding to B, C, E are identical with ℓ in the formula ①, calculate the maximum bite allowance based on the model and operating pressure.

Shear Stress γ of Each Material

Unit: N/mm²

Material	Shear stress		Material	Shear stress		Material	Shear stress	
	Soft	Hard		Soft	Hard		Soft	Hard
Lead	19.6 to 29.4	—	Zinc	118	196	Steel 0.1%C	245	314
Tin	29.4 to 39.2	—	Copper	177 to 216	245 to 294	Steel 0.2%C	314	392
Aluminum	68.6 to 88.3	127 to 157	Brass	216 to 294	343 to 392	Steel 0.3%C	353	471
Aluminum alloy	68.6 to 108	127 to 177	Rolled bronze	314 to 392	392 to 588	Steel 0.4%C	441	549
Duralumin	216	373	Soft copper sheet	314	392	Steel 0.6%C	549	706
Phosphor bronze	490	—	Iron sheet for deep drawing	294 to 343	—	Steel 0.8%C	706	883
Nickel silver	275 to 353	441 to 549	Steel sheet	441 to 490	539 to 588	Steel 1.0%C	785	1030
Nickel sheet	245	—	Stainless steel sheet	510	549	Silicon steel sheet	441	549
						Permalloy	510	—

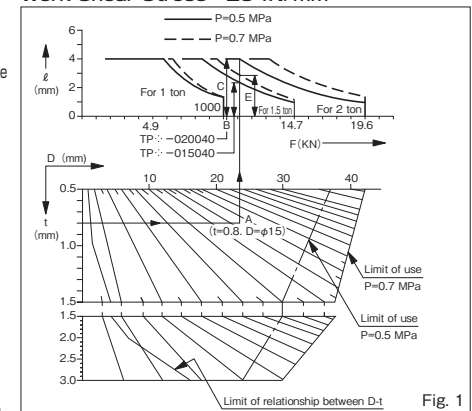


Bite allowance

- ① $\ell - t = 2.4 - 0.8 = 1.6$ (mm)
- ② $\ell - t = 4.0 - 0.8 = 3.2$ (mm)
- ③ $\ell - t = 2.9 - 0.8 = 2.1$ (mm)

Determine the model in consideration of the bite allowance. The "limit of use" shown in the D-t diagram (Fig. 1) refers to the limit of the difference between thickness and hole diameter (thickness-hole diameter) at which the sheet can be machined when the min. bite allowance is 1 mm and the output of the toggle press is taken into account.

Work Shear Stress 294N/mm²



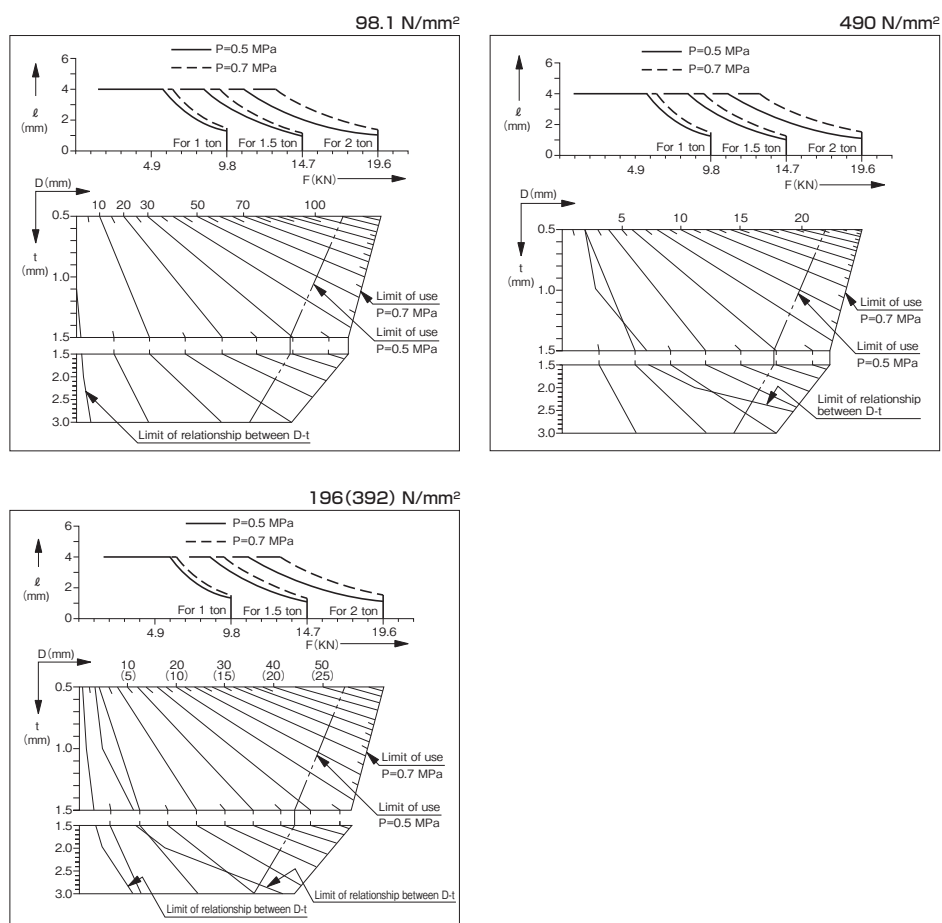
● Limit of relationship between D-t

For general piercing work, the hole diameter which can be made (min. diameter) for any sheet thickness is limited. Therefore, the limit determined from the min. hole diameter for each thickness is shown for reference.

● Piercing of holes other than round hole

For piercing of a hole other than a round hole (slotted or square hole), find the working force calculated from the formula ② on the horizontal axis (F) of the output-displacement (F-ℓ) diagram shown in Fig. 1., confirm the bite allowance in the same manner as in the case of a round hole, and determine the model.

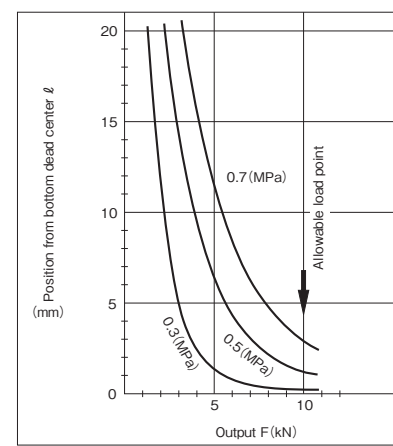
Work Shear Stress



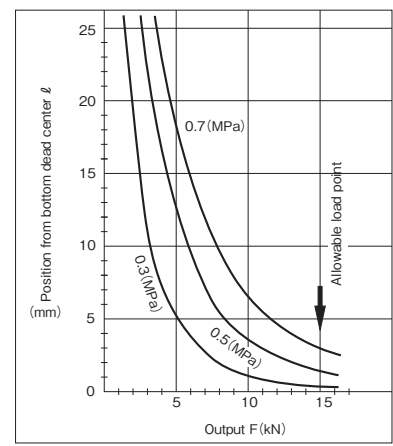
*The parenthesized values are obtained at a shear stress of 392 N/mm².

Output Diagrams

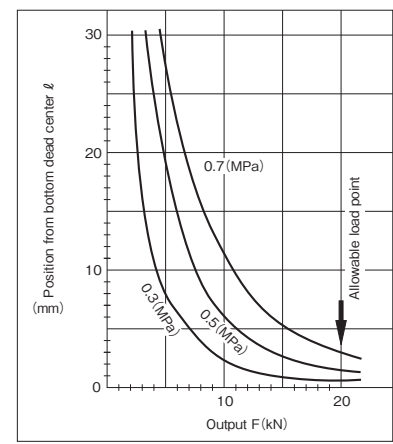
●TPH-010040-R1



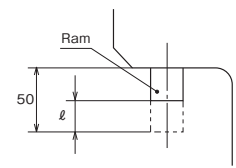
●TPH-015040-R1



●TPH-020040-R1



●The position from bottom dead center shown in the output diagram refers to the position of the ram elevated by ℓ from the max. stroke point.



Compact, high-output and high-speed actuators containing boosting mechanism in pneumatic cylinder

- Space-saving air presses. The volume is 1/10 compared to conventional presses (compared to our conventional products).
- Light presses with strong aluminum alloy body
- The presses can be used not only for cutting, piercing, bending and caulking as ordinary presses, but also for driving various machines as high-output actuators.
- They can operate at high speed with the aid of the characteristics of pneumatic pressure. They are useful in improving the productivity and cycle time. They excel in durability.

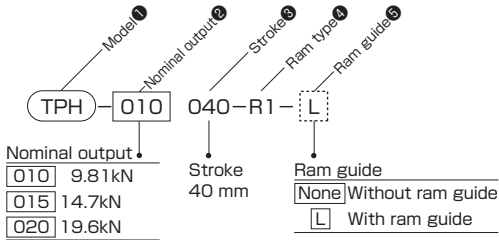


Specifications

Model number	TPH-010040	TPH-015040	TPH-020040
Item			
Working pressure range	0.15 to 0.7 MPa		
Working temperature range	+5 to +60°C		
Lubrication	JIS K2213 Class (non-additive turbine oil ISO VG32) or its equivalent		
Applicable fluid	Air		
Nominal output KN	9.81	14.7	19.6
Stroke mm	40 ⁰ ₋₁		
Max. use frequency (times/min)	60		
Note) Air consumption (Nℓ/cycle)	5.4	8.2	10.8
Installing direction	Free		
Weight kg	11	13	14

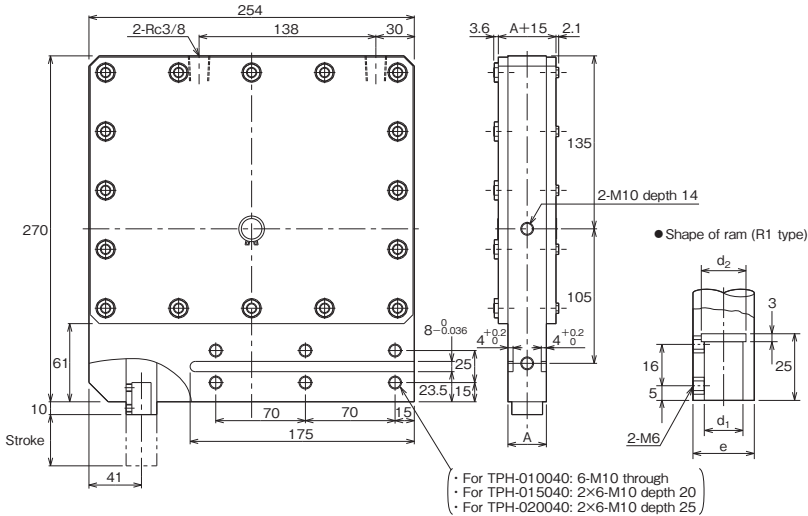
Note) At working pressure of 0.5 MPa

How to Order

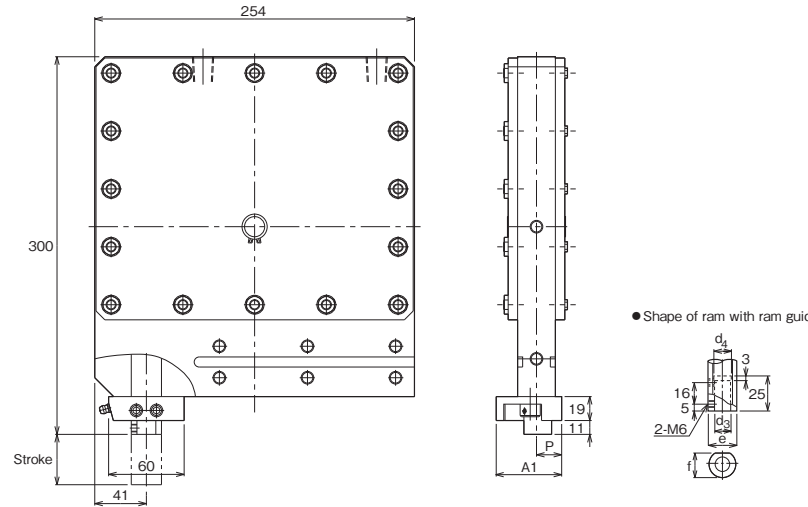


● Rams with different shapes and models with sensors can be manufactured to order. Consult us.

TPH



Dimensions of End of Press with Ram Guide



Dimensional Table

Symbol	A	A1	d1	d2	d3	d4	e	f	p
Model number									
TPH-010040-R1	30	52	φ15H6	φ15.5	φ13H6	φ13.5	φ24	22	20
TPH-015040-R1	45	52	φ15H6	φ15.5	φ13H6	φ13.5	φ24	22	20
TPH-020040-R1	60	64	φ20H6	φ21 or less	φ15H6	φ15.5	φ30	27	30



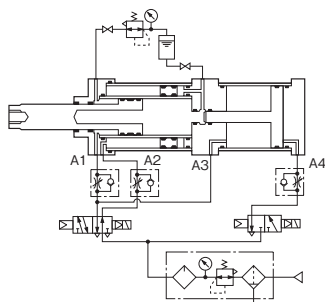
Oil Pack Cylinders (Order Made)

HSP3.....ED66

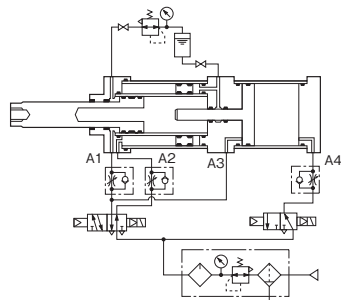


Principle of Operation

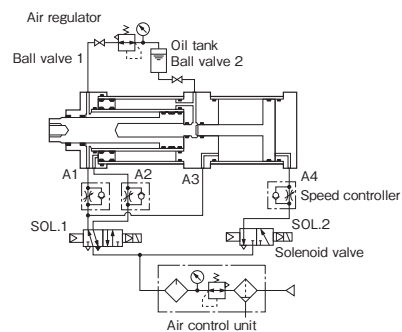
● Pre-pressure process



● Boosting process



● Stopping and returning



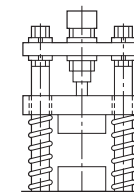
Explanation of operation

Pre-pressure process: Pneumatic pressure is supplied to the port A2 to move the piston rod forward (downward). The output in this process is the primary output.

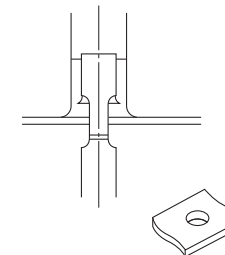
Boosting process: Pneumatic pressure is supplied to the port A4 according to the timer setting, and the hydraulic pressure in the hydraulic cylinder is increased to generate high output.

Returning : Pneumatic pressure is supplied simultaneously to the ports A1 and A3 according to the timer setting to return the piston rod to the original position.

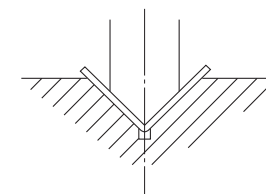
Application Examples



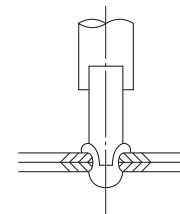
● Clamping device



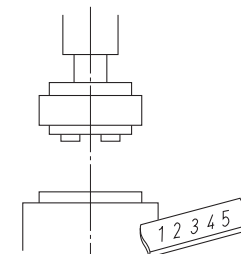
● Piercing



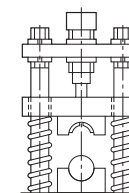
● Bending



● Rivetting

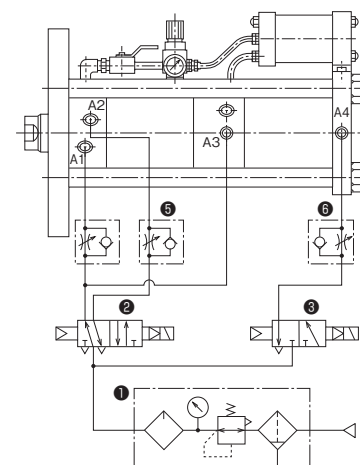


● Marking



● Caulking

Related Equipment



Related Equipment

Model number	HSP3F-100	HSP3F-150	HSP3F-200
Product name	TC18-T3	TC18-T4	TC18-T4
① Air control unit	TC18-T3	TC18-T4	TC18-T4
② Solenoid valve	5ER-08E	5HR-15	5HR-15
③ Solenoid valve	3EC-08E	3HC-15E	3HC-15E
④ Speed controller	SC-10	SC-15	SC-15
⑤ Speed controller	SC-10	SC-15	SC-15
⑥ Speed controller	SC-10	SC-15	SC-15

HSP3

Oil Pack Cylinder

Output of 82.7 to 331 kN can be obtained only from pneumatic pressure.

- High output can be maintained for a long time.



Specifications

Model number	HSP3F-100-*-10		HSP3F-150-*-10		HSP3F-200-*-10	
Item	HSP3F-100-*-10		HSP3F-150-*-10		HSP3F-200-*-10	
Pneumatic cylinder bore mm	φ100		φ150		φ200	
Hydraulic cylinder bore mm	φ55		φ90		φ110	
Full stroke mm	100 · 200					
Boosting stroke mm	10					
Boosting ratio	44.4		28.7		44.4	
Working pressure range	0.5 to 0.8 MPa		0.3 to 0.8 MPa			
Working temperature range	+5 to +60°C					
Max. hydraulic pressure	35.5 MPa		23 MPa		35.5 MPa	
Max. output kN	84.4		146.1		337.6	
Addaptable fluid	Cosmo New Mighty Super 10 (COSMO OIL)					
Weight	Full stroke mm					
	100	200	100	200	100	200
	46 kg	50 kg	116 kg	125 kg	200 kg	215 kg

- Notes) ● The full stroke is the stroke obtained by adding the boosting stroke to the pre-pressure stroke
● If other specifications are required, please consult us.

Output

Unit: kN

Model number	Output	Working pneumatic pressure					
		0.3	0.4	0.5	0.6	0.7	0.8
HSP3F-100- *-10	Primary output	—	—	1.2	1.4	1.6	1.9
	Secondary output	—	—	52.7	63.3	73.8	84.4
	Return output	—	—	0.3	0.4	0.5	0.6
HSP3F-150- *-10	Primary output	1.9	2.5	3.2	3.8	4.5	5.1
	Secondary output	54.8	73.0	91.3	109.5	127.8	146.1
	Return output	0.5	0.7	0.9	1.0	1.2	1.4
HSP3F-200- *-10	Primary output	2.8	3.8	4.8	5.7	6.6	7.6
	Secondary output	126.6	168.8	211.0	253.2	295.4	337.6
	Return output	0.8	1.1	1.4	1.7	1.9	2.2

- Note) The target efficiency shall be 80% for the primary output, 90% for the secondary output and 60% for the return output.

Oil Pack Cylinder

HSP3

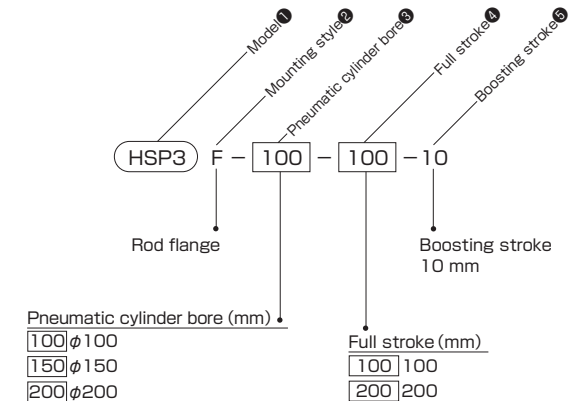
Operating Speed

Unit: mm/s

Model number	HSP3F-100- *-10	HSP3F-150- *-10	HSP3F-200- *-10
Item	HSP3F-100- *-10	HSP3F-150- *-10	HSP3F-200- *-10
Pre-pressure process	180	115	230
Boosting process	10	10	5
Return process	120	70	115

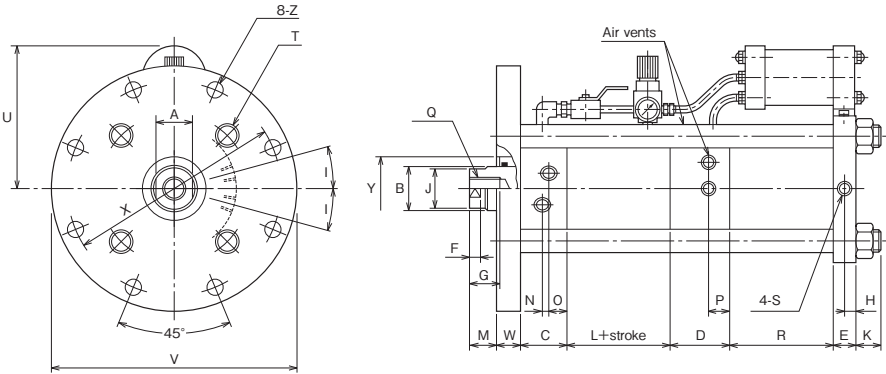
- The operating speed is the horizontally operating speed obtained at a pneumatic pressure of 0.5 MPa under no load with a piping length of 2 m.
Note) The operating speed varies depending on the operating method. Use the table as a guide.

How to Order



- The cylinder will come with hydraulic fluid (Cosmo New Mighty Super 10).

HSP3

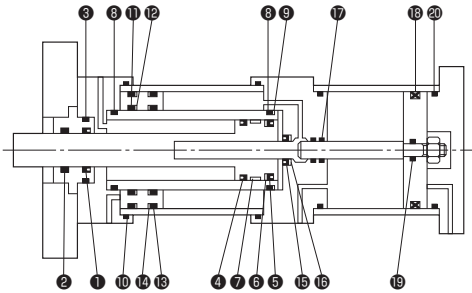


Dimensional Table

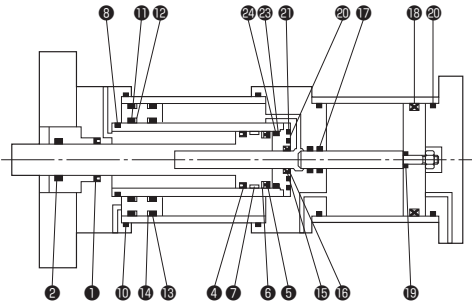
Symbol Model number	A	B	C	D	E	F	G	H	I	J	K	L	M	N
HSP3F-100	28	φ35	55	64	30	15	25	15	15°±5°	φ34	24	14	35	11
HSP3F-150	54	φ60	65	77	40	20	40	20	15°±5°	φ59	28	14	43	8
HSP3F-200	65	φ70	65	96	48	26	40	24	15°±5°	φ69	40	8	45	20

Symbol Model number	O	P	Q	R	S	T	U	V	W	X	Y	Z
HSP3F-100	23	19	M20×1.5	200	Rc ³ / ₈	M20×1.5	172	φ240	30	φ210	φ60H8	φ14
HSP3F-150	27	23	M30×1.5	179	Rc ¹ / ₂	M30×1.5	204	φ340	40	φ300	φ90H8	φ22
HSP3F-200	27	32	M39×1.5	233	Rc ¹ / ₂	M36×2	229	φ450	50	φ380	φ140H8	φ33

HSP3F-100/150



HSP3F-200



Seal List

Name	1	2	3	4	5	6	7	8	9	10	11	12
Material	Rod seal	Scrapper	Bush gasket	Hydraulic piston seal A	Hydraulic piston seal B	Hydraulic piston backup ring	Wear ring	Hydraulic cylinder tube gasket A	Hydraulic cylinder tube backup ring A	Pre-pressure tube gasket	Pre-pressure piston seal A	Pre-pressure piston backup ring A
Bore mm	Nitrile rubber	Urethane rubber	Nitrile rubber	Nitrile rubber	Urethane rubber	Fluororesin	Phenol	Nitrile rubber	Fluororesin	Nitrile rubber	Nitrile rubber	Fluororesin
φ 100	DUP-35	DH-35	G-55	DUP-45	UNS-40	For UNS-40	SW-55	G-60	For G-60	G-105	P-70	For P-70
φ 150	DUP-60	DH-60	G-85	DUP-80	UNS-70	For UNS-70	SW-90	G-105	For G-105	AS568-165	P-112	For P-112
φ 200	DUP-70	DH-70	—	DUP-95	UNS-90	For UNS-90	SW-110	G-145	—	G-210	P-155	For P-155

Name	13	14	15	16	17	18	19	20	21	22	23	24
Material	Pre-pressure piston seal B	Pre-pressure piston backup ring B	Boosting rod seal A	Boosting rod backup ring	Boosting rod seal B	Pneumatic piston seal	Pneumatic piston gasket	Pneumatic cylinder tube gasket	Seal retainer gasket A	Seal retainer gasket B	Hydraulic cylinder tube gasket B	Hydraulic cylinder tube backup ring B
Bore mm	Nitrile rubber	Fluororesin	Urethane rubber	Fluororesin	Nitrile rubber	Nitrile rubber	Nitrile rubber	Nitrile rubber	Nitrile rubber	Nitrile rubber	Nitrile rubber	Fluororesin
φ 100	P-90	For P-90	UNS-15	For UNS-15	P-15	DXP-100	P-8	G-95	—	—	—	—
φ 150	P-140	For P-140	UNS-28	For UNS-28	P-28	DXP-150	P-10	G-145	—	—	—	—
φ 200	P-185	For P-185	UNS-30	For UNS-30	P-30	DXP-200	P-15	G-190	G-120	G-75	G-120	For G-120