Hydraulic Cylinder (General)

	For Vehicle Application		For Industrial Application, etc.
Products included in this catalog	Double-acting cylinder For excavator For mini-excavator	Single -acting cylinder For forklift truck (lifting)	Electro-hydraulic cylinder (MMP)
KYB products not included in this catalog.	For forklift truck (tilt cylinder) For steering (double rod cylinder)		Special design (very large models) may be available.
Not included in KYB product lineup			For industrial equipment (JIS type, etc.)

[Basic Construction and Calculation Formula of Hydraulic Cylinder]

[Construction and Mechanism]

1. The pressurized hydraulic fluid through the bottom port extends the cylinder rod, and the fluid on the rod side returns to the reservoir.
2. The pressurized hydraulic fluid from the rod port retracts the cylinder, and the fluid on the bottom side returns to the reservoir.

<Calculating Thrust >

● Theoretical thrust

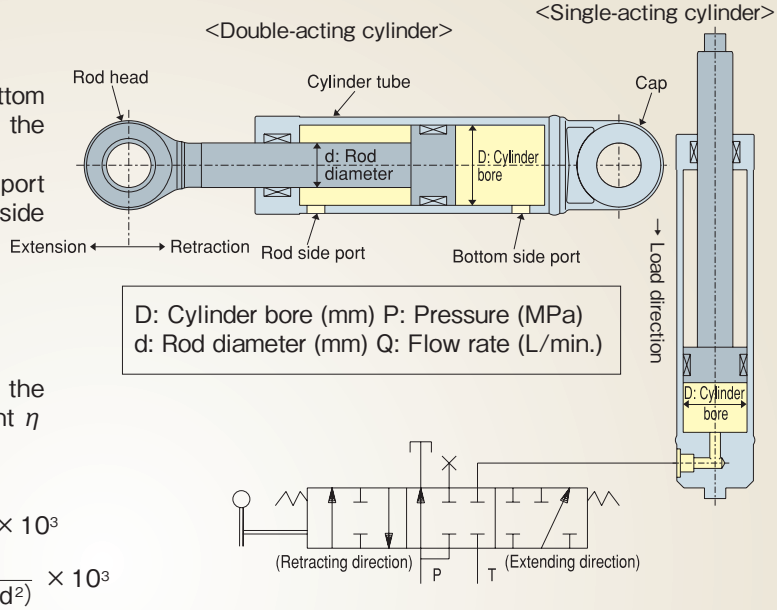
Extension thrust F_1 N= $\pi/4 \cdot D^2 \times P$

Retraction thrust F_2 N= $\pi/4 \cdot (D^2-d^2) \times P$

● Actual thrust: To be obtained by multiplying the above theoretical thrust value with the coefficient η (0.95 for vehicle)

<Double-acting cylinder>

<Single-acting cylinder>



D: Cylinder bore (mm) P: Pressure (MPa)
d: Rod diameter (mm) Q: Flow rate (L/min.)

<Calculating velocity>

● Extending velocity V_1 [m/min] = $\dfrac{Q}{\pi/4 \cdot D^2} \times 10^3$

● Retracting velocity V_2 [m/min] = $\dfrac{Q}{\pi/4 \cdot (D^2-d^2)} \times 10^3$

※ Flow rate Q is calculated using the pump's delivery flow (meter-in), but the value may be significantly affected by the flow control with the valve return-side restriction (meter-out) depending on the load direction and pressure. In such case, calculate the tank return-side flow rate using the following formula:

Flow rate Q[L/min] = $60CA\sqrt{\frac{2\Delta P}{\rho}}$ Then go back to the above formula and calculate the velocity based on the return-side cylinder area. (Single -acting cylinder, etc.)

C: Flow coefficient (0.6-0.7) A: Valve restriction (opening) area (mm^2) ΔP: Pressure difference before and after restriction (MPa) : Hydraulic fluid density (kg/m^3)

<Buckling strength and stroke>

● The stroke of the cylinder to which retraction load is applied is restricted by the buckling strength. An approximate value of the buckling load is obtained from the following formula:
Wa (allowable retraction load (at full extension: N)) = Pk (buckling strength N) / S (safety ratio: typically 1.5-2.5 or more)
Since the value will vary depending on the support mechanism (whether the load is supported by the rod only or the tube as well.) please contact us.

● Consider installing a cylinder support and linkage mechanism to avoid thrust load on the cylinder.

[Precautions for operation]

● Speed

① A speed exceeding 60 m/min affects the durability of the cylinder with standard specifications.
② Install a cushion device for equipment protection and safety if a stroke end speed consistently exceeds 18 m/min.
③ For protection and safety of the cylinder, care must be taken not to cause a great impact on it when stopping it.
④ When designing a hydraulic circuit, pay attention to return flow rate increase at cylinder retraction.
⑤ Operation slower than 0.5 m/min will affect performance (particularly vibration performance). Please contact us when a low speed operation is expected.

● Starting operation

① Remove air inside the cylinder completely when starting an operation. If air remains, operate at a low speed until the air is removed completely.
② A rapid pressure rise while air remains in the cylinder may damage/burn the seal due to a so-called diesel effect (abnormal air temperature rise caused by isentropic compression).
③ Avoid negative pressure inside the cylinder during the operation because cavitation may cause malfunction.

Cylinder: For construction equipment and industrial vehicles

KCH, KCM, and KCFL Series

For excavator, mini-excavator, and forklift truck applications

KCH

KCM

KCFL

【Model code】

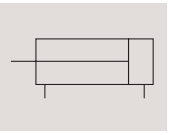
Example

KCH	–	230	–	160	–	2800
1		2		3		4

1	Model	KCH for excavator, KCM for mini-excavator, and KCFL for forklift truck
2	Cylinder bore	mm
3	Rod diameter	mm
4	Stroke	mm

Series	Tube i.d. (mm)	Max. stroke (mm)	ax. working pressure (MPa)	Main applications
KCH	95～170 170～360	2800 2800	35.0 32.0	Excavator
KCM	50～65 70～125	800 1200	24.5 29.4	Mini-excavator, Wheel loader, etc.
KCFL	45～70 65～120	1000～2500 650～1300	18.1	Forklift truck

※Please contact us for other applications.
(Very large models with a cylinder bore over 1200 mm are available.)
※See Page 61 for accessory valves
(flow control valve, down safety valve, and hose rupture valve)

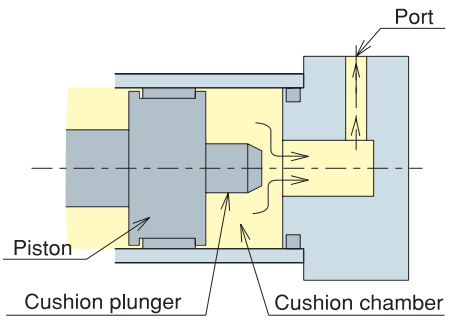


Symbol

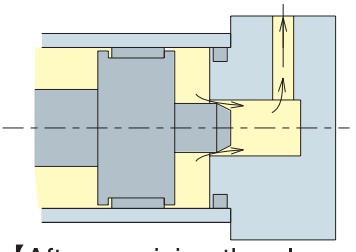
Main Features of the KCH and KCM Series

- Compact, lightweight, and strong
  KYB has developed its compact, lightweight, and durable cylinders based on their long marketing experience, in-house test systems, capability to design products according to its strength and fatigue analysis, and manufacturing and inspection technologies enabling high quality product production.
- Seal
  KYB enhanced its seal's durability by developing and evaluating seals and sealing systems in-house, protecting them from dirt and dust, and optimizing the oil film.
- Piston rod
  Piston rod sliding surfaces are treated with induction hardening and protected with hard chromium plating for engineering purposes or nickel-chrome plating to improve wear- and corrosion-resistance and surface strength against scratches.
- Safety precautions
  Please install a cushioning device to reduce the stroke end shocks, and various valves such as hose rupture and slow return valves if required. (See Page 61 for additional valves.)

Cushion Mechanism for Cylinders



【Before receiving the plunger】

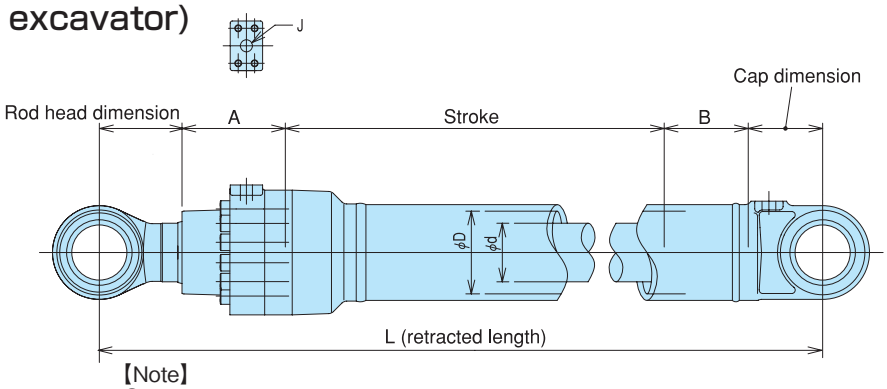


【After receiving the plunger】

- As the piston approaches the stroke end, compressed oil reduce shocks at the stroke end.
- The cushioning device can be installed on either the rod or bottom side of the cylinder or on both ends.

Dimensions (unit: mm)

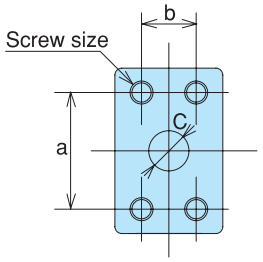
KCH Series (for excavator)



【Note】
- The cylinder head portion length A, piston portion length B, and the port position depend on customers'request. Please contact us for details.
- See the opposite page (p.38) for standard sizes of a rod head and a cap.
- Cylinder bore D greater than the figures in the table below are also available. However, the construction of those models may be slightly changed.

Cylinder bore φ D	Rod diameter φ d	Max stroke	Retracted length L (min.)	Port size J
95	65,70	1100	1250	1/2
100	70	1100	1250	1/2 or 3/4
105	70,75	1200	1250	1/2 or 3/4
110	70,75,80	1200	1250	1/2 or 3/4
115	80,85	1400	1250	1/2 or 3/4
120	80,85	1400	1250	1/2 or 3/4
125	85,90	1500	1300	3/4 or 1
130	85,90,95	1600	1350	3/4 or 1
135	90,95,100	1700	1350	3/4 or 1
140	90,90,95	1700	1350	3/4 or 1
145	90,95,100,105	1900	1530	3/4 or 1
150	95,100,105,110	1900	1530	1 or 1-1/4

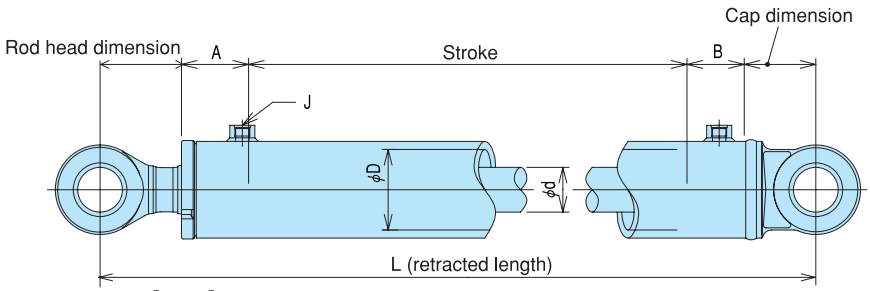
<Port sizes>



Port size	a	b	c	Screw size
1/2	40.5	18.2	φ 13.5	M8 × 1.25
3/4	50.8	23.8	φ 17.5	M10 × 1.5
1	57.2	27.8	φ 22	M12 × 1.75
1-1/4	66.7	31.8	φ 26.5	M14 × 2

The port shape is equivalent to an SAE high pressure flange.

KCM Series (for compact excavator)



【Note】
- The cylinder head portion length A, piston portion length B, and the port position depend on customers request. Please contact us for details.
- See the opposite page (p. 38) for standard sizes of a rod head and a cap.

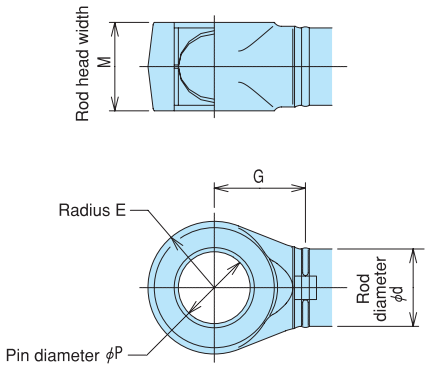
Cylinder bore φ D	Rod diameter φ d	Max stroke	Retracted length L (min.)	Port size J
70	40	500	400	G3/8(PF3/8)
75	40,45	600	400	G3/8(PF3/8)
80	45,50	700	400	G3/8(PF3/8)
85	45,50,55	800	530	G1/2(PF1/2)
90	50,55	800	530	G1/2(PF1/2)
95	55,60,65	900	530	G1/2(PF1/2)
100	55,60,65	900	530	G1/2(PF1/2)
105	55,60,65,70	900	700	G1/2(PF1/2)
110	60,65,70	900	750	G1/2(PF1/2)
115	65,70,75	1000	750	G1/2(PF1/2)
120	65,70,75	1000	800	G1/2(PF1/2)
125	70,75	1000	800	G1/2(PF1/2)

Dimensions of the Rod Head and Cap

● Standard clevis dimensions for KCH/ KCM series are shown as follows.
● When different sizes on clevis widths of the rod heads and caps and pin diameters are required, please contact us.

■ Rod head dimensions

※ KCH and KCM



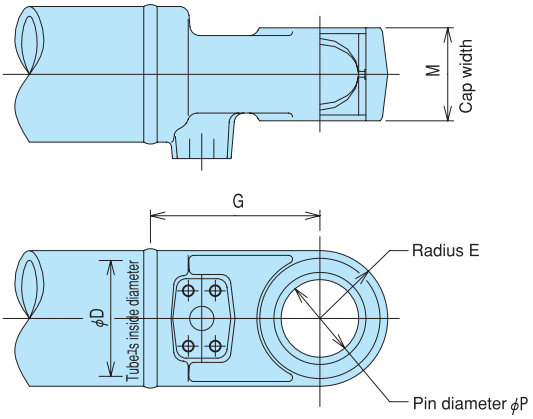
ϕ d	ϕ P	E	M	G
40	35	39	50	60
45	40	42	60	60
50	45	50	70	75
55	50	50	70	75
60	50	55	70	80
65	60	60	85	85
70	65	62	98	88
75	60	68	90	95
80	75	70	105	95
85	85	75	95	95
90	85	75	95	90
95	85	83	105	105
100	85	105	120	110
105	90	85	120	125
110	110	100	140	135

■ Cap dimensions

● With port on cap

※ KCH and KCM

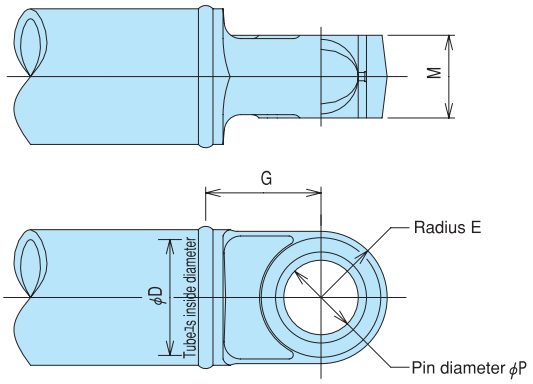
The drawing shows the KCH series dimensions. KCM has the standard PF (O ring boss) port. Please contact us when an SAE flange port is required.



ϕ D	ϕ P	E	M	G
95	50	55	70	110
100	60	55	85	136
105	70	62	85	155
110	65	65	95	170
115	70	70	95	170
120	60	70	95	175
125	65	70	95	165
130	75	70	110	170
135	65	70	105	150
140	75	75	120	185
145	90	85	120	150
150	85	85	130	190

● With port on cap

※ KCM only
Please contact us regarding the position and size when installing ports on the cylinder tube.



ϕ D	ϕ P	E	M	G
70	40	36	55	60
75	50	45	60	65
80	50	50	60	80
85	60	55	70	75
90	50	50	70	80
95	60	55	70	75
100	60	55	75	80
105	60	55	75	80
110	65	58	75	85
115	60	58	70	125
120	75	65	90	165

KCFL Series (for forklift truck)

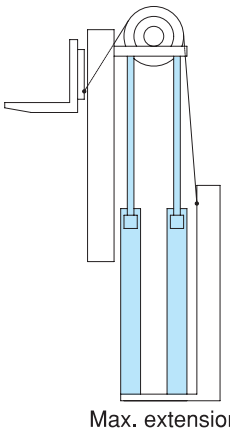
KCFL series cylinders are designed to fit forklift truck masts and be adequate for lifting work. Three types (L1, L2, and L3) are available for three mast types.

● KCFL series lifting cylinder types

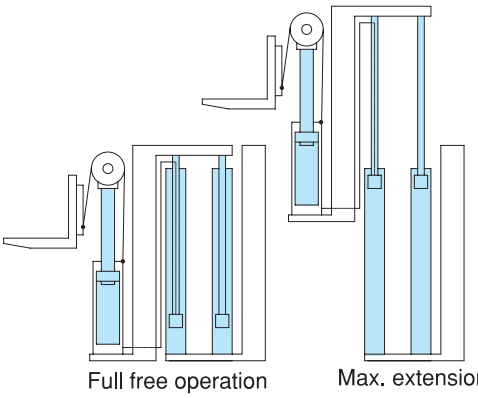
L1 for the second cylinder of standard and 3-stage mast, L2 for the second cylinder of 2-stage mast, and L3 for the first cylinder of 2/3 stage full free mast

Forklift truck mast mechanism and lifting cylinder

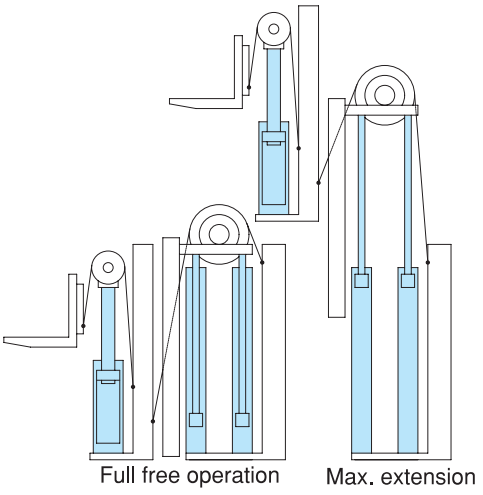
(1) 2-stage standard mast



(2) 2-stage full free mast



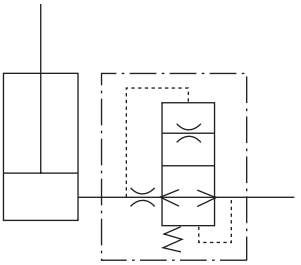
(3) 3-stage full free mast



Main Features of KCFL Series

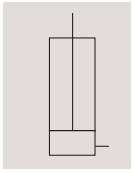
- Small diameter, light weight, and high strength…Cylinders for forklift mast applications are designed to fit the mast mechanism with small diameters and high strength. The single-acting cylinder with a small diameter and light weight has been achieved by a thinner tube and special welding technologies. The second cylinder for 2-stage masts employs a hollow ram for lighter weight and easy lubrication.
- Seal…Seals made by KYB are utilized for smooth motion and prevention of internal leakage.
- Tube…The inside wall is finished with roller burnishing for smooth motion and high durability.
- Rod…The surface is hard-chromium plated for engineering purposes (nickel-chromium plated for special specifications) for rust proof and wear resistance.
- Safety/shock absorption … A down safety valve may be added to ensure safety in the event of piping rupture or other accidents, which may bring the cylinder to a complete stop. A cushion mechanism may be built in each cylinder to reduce shocks at the time of retraction.
- KYB's standard models are of the internal drain type. Visibility can be improved due to no drain hose.
- Special valves for forklift truck use…Low energy consumption type valves (KVMF series) to enable a precise and safe forklift operation, flow control valves to control a lowering speed, and down safety valves are available. (See pages 49, 58, 61, and 62 for additional valves.)

<Down safety valve installation circuit example>



Dimensions (unit: mm)

KCFL1 (for the second cylinder of standard and 3-stage mast)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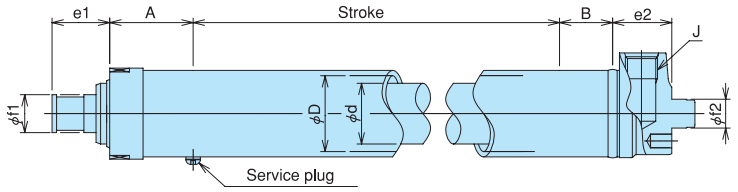
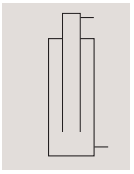
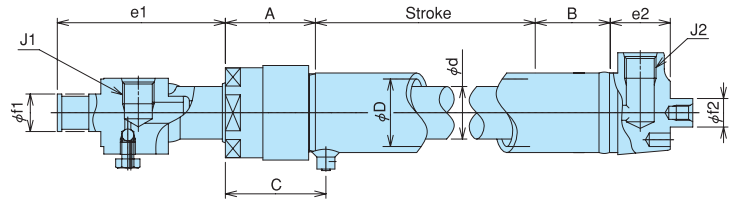


ϕ D	ϕ d	J	Standard stroke
45	35	G3/8(PF3/8)	1000 ~ 2500
50	40	G3/8(PF3/8)	
55	45	G1/2(PF1/2)	
60			
65	50	G1/2(PF1/2)	

- The cylinder head length A and piston length B depend on customer's request. Please contact us for details.
- Contact us for mounting part dimensions: ϕ f1, e1, ϕ f2, and e2

KCFL2 (for the second cylinder of the 2-stage mast)

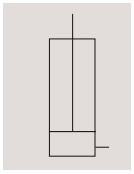

Symbol



ϕ D	ϕ d	C	J1	J2	Standard stroke
45	30	65	G1/2(PF1/2)	G3/8(PF3/8)	1000 ~ 2500
	32			G1/2(PF1/2)	
	35	67		G1/2(PF1/2)	
50	38	68			
	40		G1/2(PF1/2)		
55	42	68.5	G3/4(PF3/4)		

- The cylinder head length A and piston length B depend on customer's request. Please contact us for details.
- Contact us for mounting part dimensions: ϕ f1, e1, ϕ f2, and e2
- J1 port is connected to J port on KCFL3. (KCFL2 extends after KCFL3 extends.)

KCFL3 (for the first cylinder of 2- and 3-stage mast)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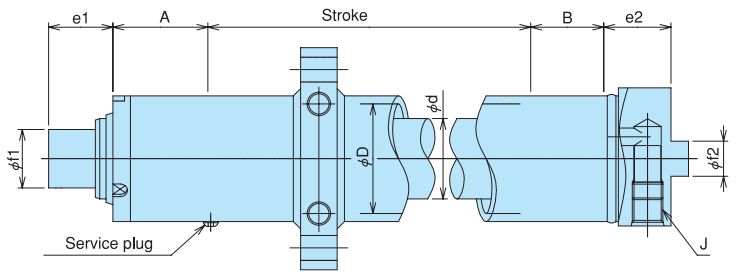

ϕ D	ϕ d	J	Standard stroke
65	50	G1/2(PF1/2)	500 ~ 1300
70	55		
75			
80	60		
85	65		
90			

- The cylinder head length A and piston length B depend on customer's request. Please contact us for details.
- Contact us for mounting part dimensions: ϕ f1, e1, ϕ f2, and e2