Preparative Dynamic Axial Compression Column

DAD series

Preparative Dynamic Axial Compression Column Instruction Manual

YMC

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1 PRODUCT WARRANTY

This instrument has a 1-year product warranty. In the case of damage to the instrument for which we are responsible, the instrument will be repaired, or the parts will be replaced at no charge.

However, this warranty does not apply to any damages as stated below:

(1) In the event of failure or performance deterioration due to improper handling, use conditions, or environment
(2) In the event the cause of failure is attributable to any reason other than our Products Delivered
(3) In the event of failure due to a device supplied / designated by the customer
(4) Secondary accidents caused by our products
(5) Failure or damage due to force majeure, such as fire, earthquake, wind and flood, lightning strikes, etc.
(6) Other failures and performance deterioration that are not considered our responsibility.
(7) Consumables and maintenance matters that are not attributable to our defects

2 PRECAUTIONS FOR USE

Carefully read the precautions for use and the instruction manual before installation and use, and use the product properly.

In this manual, risk severity and risk levels are classified as follows.

⚠Warning	**Those which may result in death or serious injury if not avoided.**
⚠Note	**Those which may cause minor or moderate injury if not avoided.**
Notification	**Information and content that must be informed for operation and maintenance**
	**Prohibited conduct**
	**Mandatory actions to be taken**

⚠Warning

The movable plug (hydraulic cylinder) moves up and down by the hydraulic circuit.
Do not insert fingers or other objects into moving parts.

Do not apply more than the maximum working pressure to the equipment.

Make sure to connect the ground (earth) correctly. Static electricity may cause ignition, etc.
In addition, take measures against static electricity for all equipment and personnel in contact with this device.

For safety reasons, two or more people should work when handling heavy objects.

⚠Note

The equipment should be installed parallel to the floor which has sufficient strength and flatness. It is recommended to install the anchor after installation.

The equipment regularly makes a noise of 80～90 dB while the movable stopper is in operation. Assess the environment and use earplugs, etc., if necessary.

Wear proper personal protective equipment for operation and maintenance.

Liquid, dust : Safety glasses, masks, gloves
Falling object : Safety shoes and gloves
Static electricity : Antistatic safety shoes and antistatic work clothes
Noise : Earplugs or earmuffs

If the temperature fluctuation in the installation environment is large, the oil pressure in the cylinder will fluctuate.
Keep the room temperature while the column is being packed.

3 PRODUCT SPECIFICATIONS

This manual describes the specifications of our standard models. Please refer to the specifications of each product for modified specifications based on the request of the custom-made equipment by the customer.

3-1 DAC Column

Model	DAD-50-700S	DAD-100-700
Method	Dynamic Axial Compression	
Column I.D. [mm]	50	100
Effective length [mm]	700	
Maximum column volume [L]	1.37	5.4
Recommended bed length [mm]	100 - 400	
Wetted materials	SUS316L, SUS316, PTFE, PEEK (*), PCTFE	
Column interior finish	Honing + Electropolishing	
Filter	Nominal filtration accuracy of 2 μm, recommended resin of 10 μm or more	
Max. working pressure [MPaG]	10.0	
Hydraulic pump	Air-driven booster pump	
Air consumption	Max. 600 L/min (ANR, when feeding at 0.50 MPaG)	
Ratio of oil pressure	47 times	
Supply air conditions	Dry air between 0.50 MPaG and 0.80 MPaG	
Column connection	Swagelok fitting 1/8”	Swagelok fitting 1/4”
Air supply connection	φ6 push-in fitting	φ10 push-in fitting
Slurry port connection	ISO 15A ferrule	
Operating temperature	10 - 40 ℃, ≦60%RH	
Approximate Size (W x D x H) [mm]	570 x 500 x 1970	760 x 800 x 2340
Empty weight [kg]	About 50	About 250

* DAD-50 only

Model	DAD-150-700	DAD-200-700	DAD-300-700
Method	Dynamic Axial Compression		
Column I.D. [mm]	150	200	300
Effective length [mm]	700		
Maximum column volume [L]	12.3	21.9	49.4
Recommended bed length [mm]	100 - 400		
Wetted materials	SUS316L, SUS316, PTFE, PCTFE		
Column interior finish	Honing + Electropolishing		
Filter	Nominal filtration accuracy of 2 μm, recommended resin of 10 μm or more		
Max. working pressure [MPaG]	10.0		
Hydraulic pump	Air-driven booster pump		
Air consumption	Max. 800 L/min (ANR, when feeding at 0.50 MPaG)		
Ratio of oil pressure	50 times		
Supply air conditions	Dry air between 0.50 MPaG and 0.80 MPaG		
Column connection	Swagelok fitting 1/4”		Swagelok fitting 3/8”
Air supply connection	φ10 push-in fitting		
Slurry port connection	ISO 15A ferrule		ISO 1S ferrule
Operating temperature	10 - 40 ℃, ≦60%RH		
Approximate Size (W x D x H) [mm]	980 x 1000 x 2510	980 x 1020 x 2700	1100 x 1200 x 2930
Empty weight [kg]	About 450	About 800	About 1300

Model		DAD-450-700	DAD-600-700
Method		Dynamic Axial Compression	
Column I.D. [mm]		450	600
Effective length [mm]		700	
Maximum column volume [L]		111	197
Recommended bed length [mm]		100 - 400	
Wetted materials		SUS316L, SUS316, PTFE, PCTFE	
Column interior finish		Honing + Electropolishing	
Filter		Nominal filtration 2 µm, Recommended resin: 10 µm or more	
Max. working pressure [MPaG]		7.0	
Hydraulic pump		Air-driven booster pump	
Air consumption		Max. 1600 L/min (ANR, when feeding at 0.50 MPaG)	
Ratio of oil pressure		50 times	
Supply air conditions		Dry air between 0.50 MPaG and 0.80 MPaG	
Column connection		Swagelok fitting 1/2”	Swagelok fitting 3/4”
Air supply connection		φ12 push-in fitting	
Slurry port connection		ISO 1S ferrule	ISO 1.5S ferrule
Operating temperature		10 - 40 ºC, ≦60%RH	
Approximate Size (W x D x H) [mm]	Column body	1350 x 1200 x 3150	1600 x 1600 x 3330
	Hydraulic unit	760 x 710 x 1120	900 x 800 x 1140
Model	Column body	About 2400	About 5000
	Hydraulic unit	About 300	About 350

3-2 Slurry Container

Model	SC-2-20	SC-10-20	SC-10-20SA
Slurry capacity [L]	2.0	6.7	6.7
Wetted materials	SUS316L, SUS316, SCS14, PTFE, PFA, FEP, fluorocarbons		
Hopper interior finish	#400 + Electropolishing		
Slurry pump	Air driven diaphragm pump		
Discharge rate [L/min]	1 - 20		
Average discharge pressure [MPaG]	0 - 0.6		
Suction head	Dry: to 1 m, wet: to 6 m		
Agitator	No agitator Circulation agitation by slurry pump		
Supply air conditions	Dry air between 0.50 MPaG and 0.80 MPaG		
Air consumption	Max. 200 L/min (ANR)		
Fluid condition	Viscosity 1000 mPa •s or less		
Piping connection	ISO 15A ferrule		
Air supply connection	φ6 push-in fitting		
Operating temperature	10 - 40 ℃, ≦60%RH		
Approximate Size (W x D x H) [mm]	300 x 210 x 470	370 x 290 x 580	370 x 270 x 730
Empty weight [kg]	About 5	About 15	About 20

Model	SC-22-20	SC-30-20	SC-45-45
Slurry capacity [L]	15	22	31
Wetted materials	SUS316L, SUS316, SCS14, PTFE, PFA, FEP, Fluorocarbons		SUS316L, SUS316, SCS14, PTFE, PFA, FEP
Hopper interior finish	#400 + Electropolishing		
Slurry pump	Air driven diaphragm pump		
Discharge rate [L/min]	1 - 20		5 - 45
Average discharge pressure [MPaG]	0 - 0.6		
Suction head	Dry: to 1 m, wet: to 6 m		Dry: Up to 2 m Wet: Up to 6 m
Agitator	No agitator Circulation agitation by slurry pump		
Supply air conditions	Dry air between 0.50 MPaG and 0.80 MPaG		
Air consumption	Max. 200 L/min (ANR)		Max. 300 L/min (ANR)
Fluid condition	Viscosity 1000 mPa •s or less		
Piping connection	ISO 15A ferrule		
Air supply connection	φ6 push-in fitting		
Operating temperature	10 - 40 ℃, ≦60%RH		
Approximate Size (W x D x H) [mm]	450 x 330 x 800	480 x 350 x 810	590 x 420 x 860
Empty weight [kg]	About 20	About 25	About 45

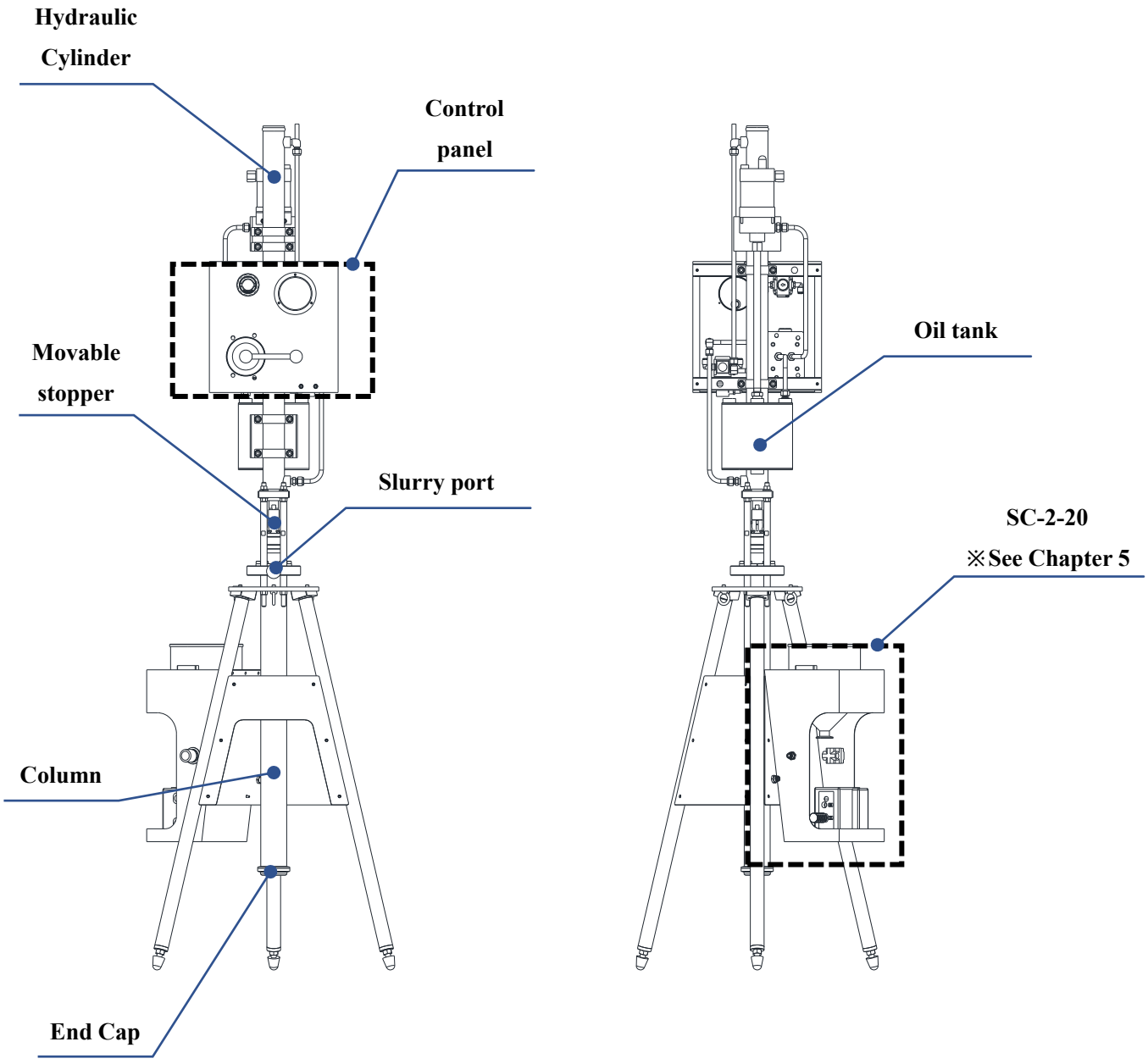
Model	SC-80-45	SC-140-45	SC-300-135
Slurry capacity [L]	60	111	240
Wetted materials	SUS316L, SUS316, SCS14, SCS14A, PTFE, PFA, FEP, tempered glass	SUS316L, SUS316, SCS14, PTFE, PFA, FEP, tempered glass	SUS316L, SUS316, SCS14, SCS14A, PTFE, PFA, FEP, CF8M, tempered glass
Hopper interior finish	#400 + Electropolishing		
Slurry pump	Air driven diaphragm pump		
Discharge rate [L/min]	5 - 45		Up to 135
Average discharge pressure [MPaG]	0 - 0.6		0 - 0.6
Suction head	Dry: Up to 2 m Wet: Up to 6 m		Dry: Up to 2.8 m
Agitator	Air motor driven, 3-blade impeller type		
Rotational speed [rpm]	150 - 360		
Supply air conditions	Dry air between 0.50 MPaG and 0.80 MPaG		
Powder transfer unit included*	Dry air between 0.60 MPaG and 0.80 MPaG		
Air consumption			
Slurry pump	Maximum 300 L/min (ANR)		Maximum 600 L/min (ANR)
Agitator	Maximum 250 L/min (ANR)		Maximum 400 L/min (ANR)
Washing pump*	Maximum 200 L/min (ANR)		Maximum 200 L/min (ANR)
Powder transfer unit*	Maximum 350 L/min (ANR)		Maximum 350 L/min (ANR)
Fluid condition	Viscosity 1000 mPa •s or less		
Piping connection	ISO 1S ferrule		ISO 1.5S ferrule
Air supply connection	φ10 push-in fitting	φ12 push-in fitting	
Operating temperature	10 - 40 ℃, ≦60%RH		
Approximate Size (W x D x H) [mm]	650 x 620 x 1290	740 x 750 x 1460	1030 x 920 x 1750
Powder transfer unit included* [mm]	-	H+260	
Empty weight [kg]	About 95	About 160	About 250
Washing pump included* [kg]	Approximately +10		
Powder transfer unit included* [kg]	Approximately +20		

*Option

4 STRUCTURE OF DAC COLUMN

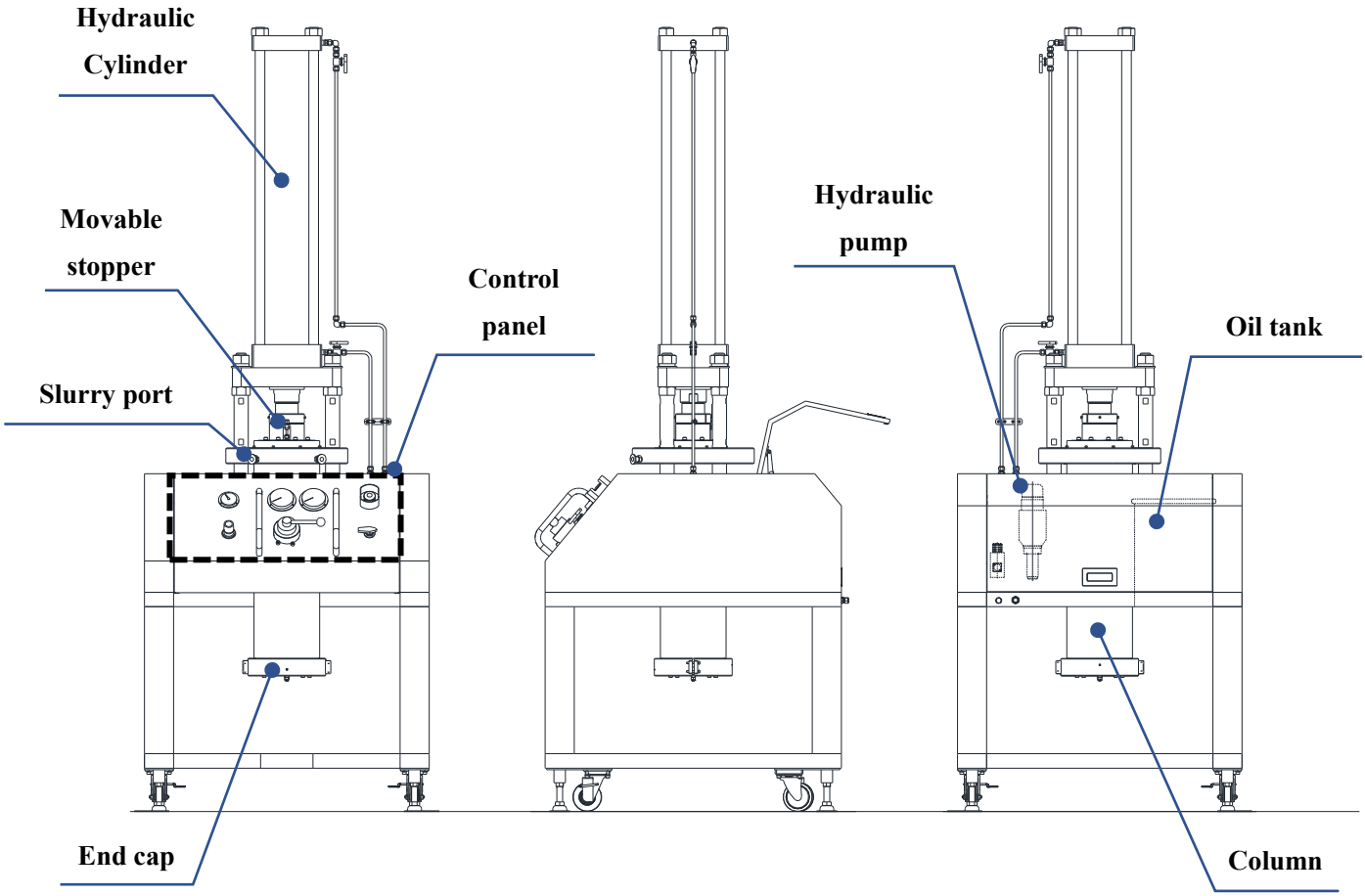
4-1 Overall View

DAD-50-700S



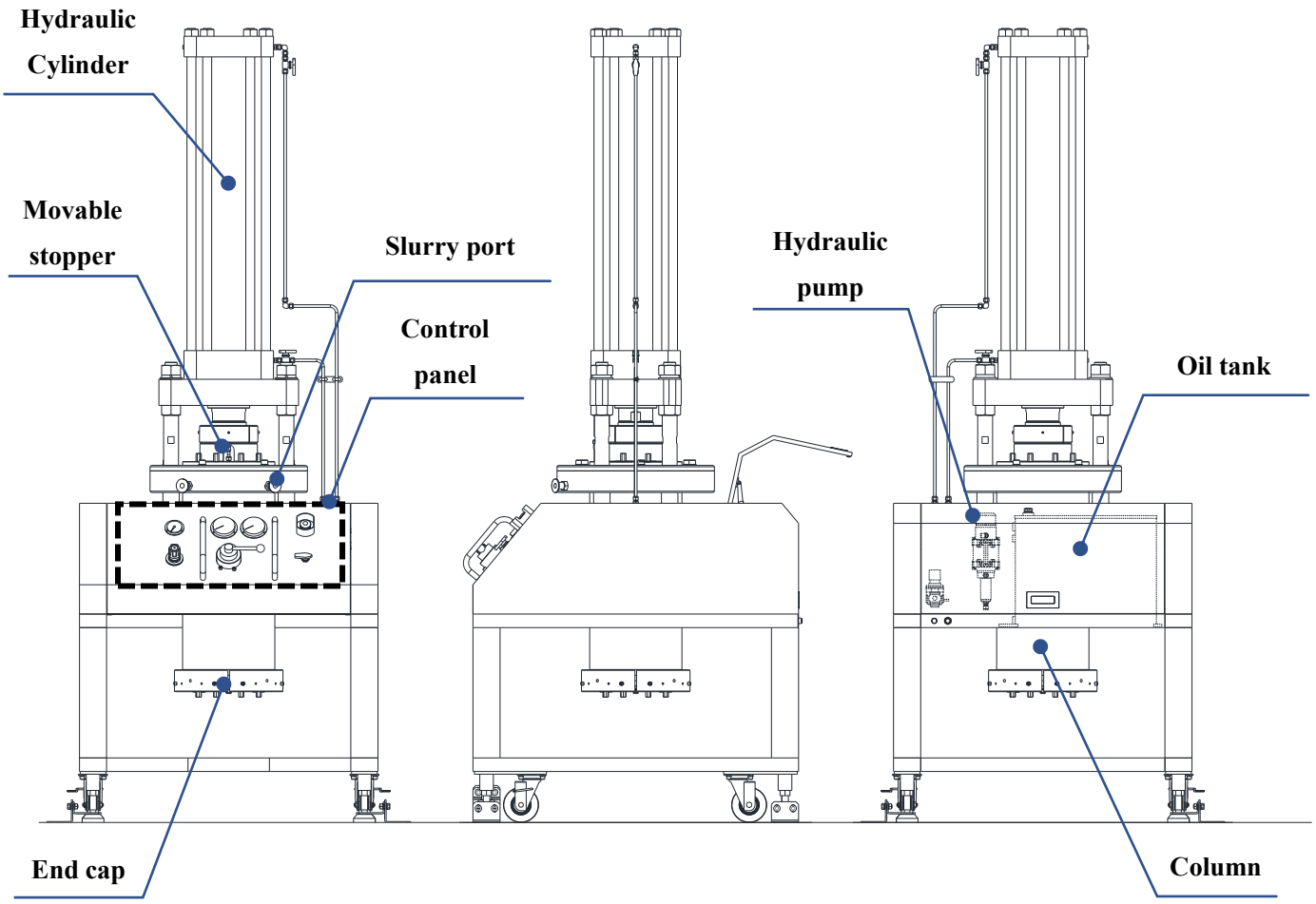
Empty weight	Approx. size (W×D×H) [mm]
About 50 kg	570×500×1970

DAD-100-700, DAD-150-700, DAD-200-700



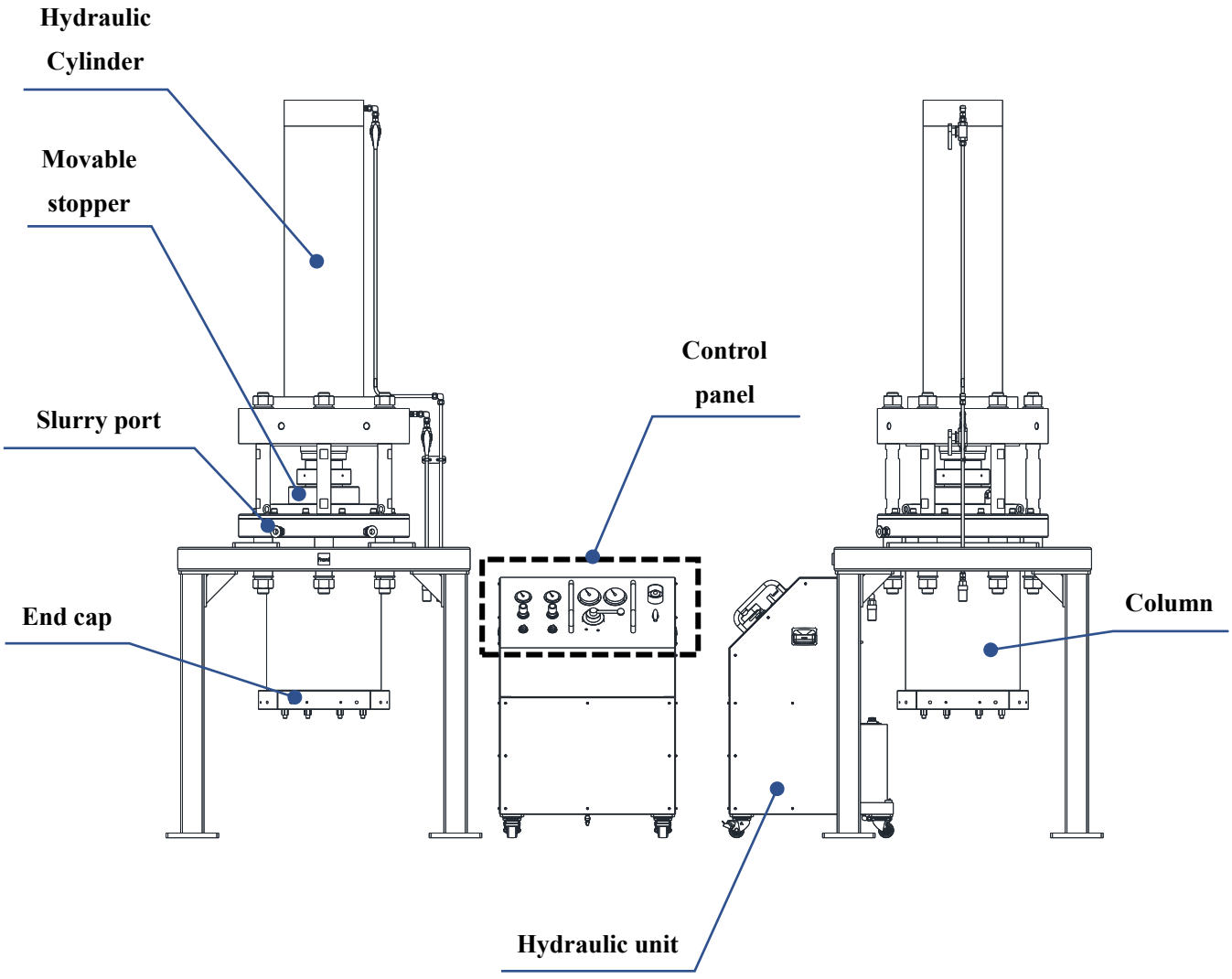
DAD-100-700	**Empty weight**	**Approx. size (W×D×H) [mm]**
	About 250 kg	**760×800×2340**
DAD-150-700	**Empty weight**	**Approx. size (W×D×H) [mm]**
	About 450 kg	**980×1000×2510**
DAD-200-700	**Empty weight**	**Approx. size (W×D×H) [mm]**
	About 800 kg	**980×1020×2700**

DAD-300-700



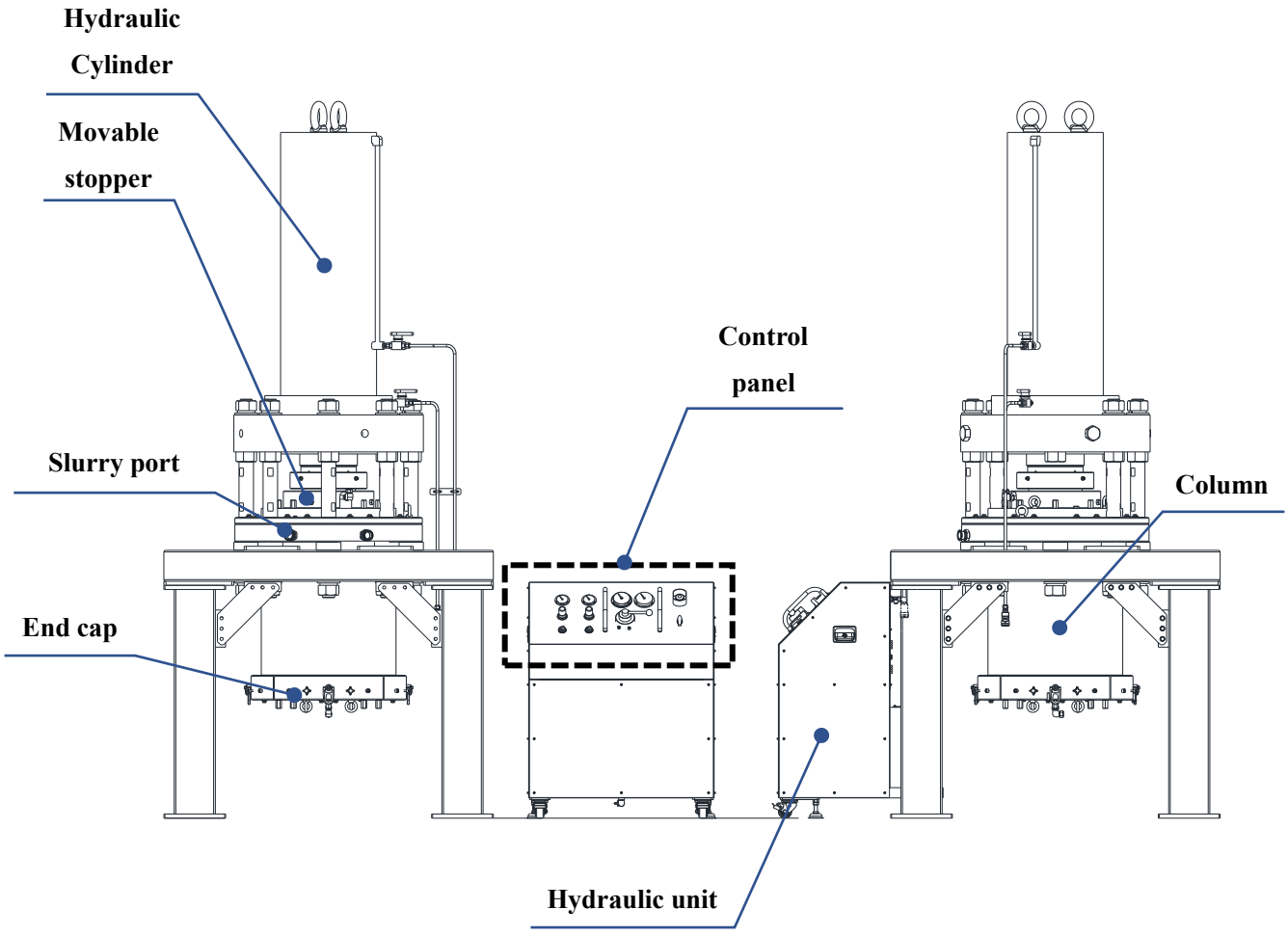
Empty weight	Approx. size (W×D×H) [mm]
About 1300 kg	1100×1200×2930

DAD-450-700



Empty weight of column body	Approx. size (W×D×H) [mm]
About 2400 kg	1350×1200×3150
Empty weight of hydraulic unit	**Approx. size (W×D×H) [mm]**
About 300 kg	760×710×1120

DAD-600-700



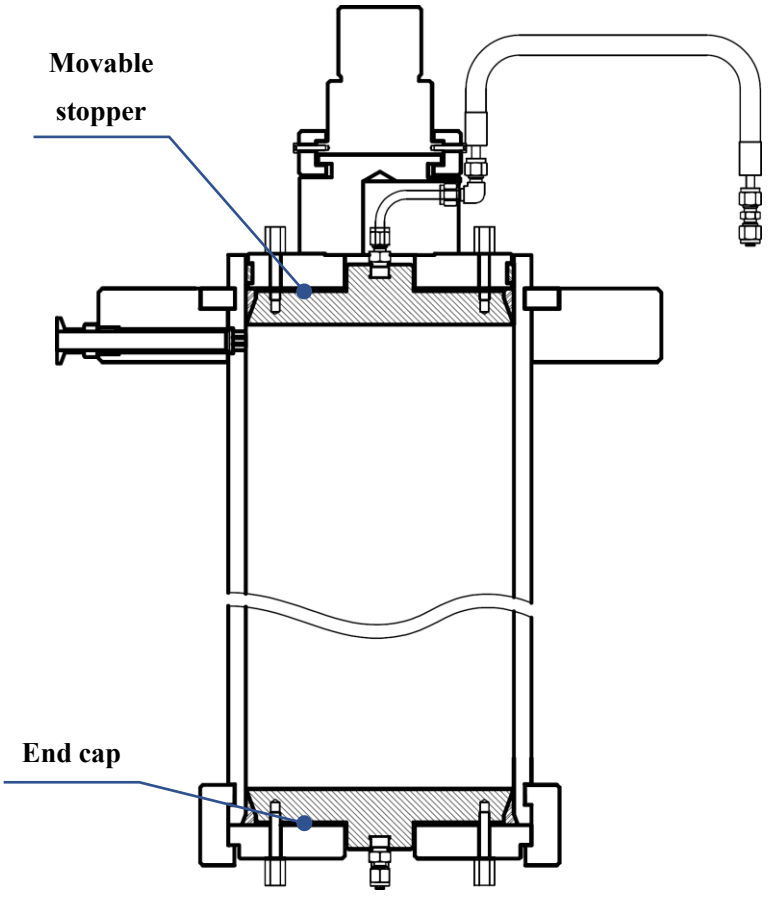
Empty weight of column body	Approx. size (W×D×H) [mm]
About 5000 kg	1600×1600×3330
Pneumatic weight of hydraulic unit	Approx. size (W×D×H) [mm]
About 350 kg	900×800×1140

4-2 Operating principle

The DAC column is powered by compressed air and hydraulically operated. The column is pressurized by feeding hydraulic oil from the hydraulic pump to the cylinder. The column pressure can be set by adjusting the air pressure applied to the hydraulic pump.

4-3 Movable stopper and End cap

Movable stopper	It connects with a hydraulic cylinder and can be moved vertically along the column inner wall.
	It can be detached from the hydraulic cylinder by the cylinder clamp.
End cap	It is fixed to the column body end by clamp.
	It can be attached and detached by the end cap clamp.



Note

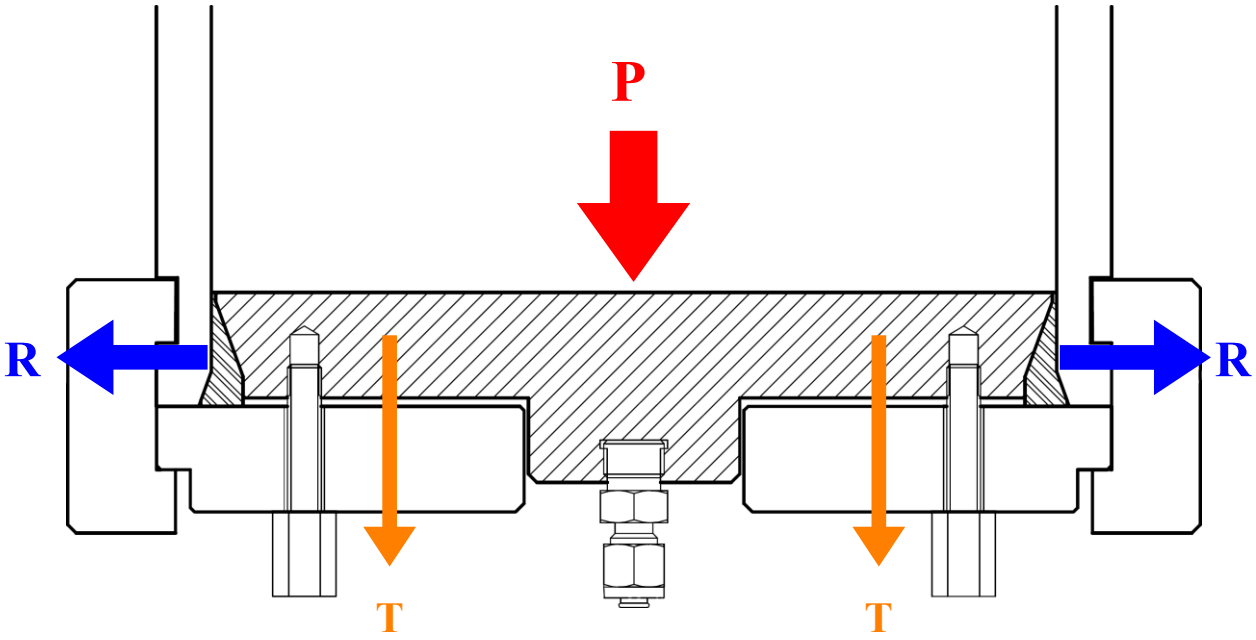
The wetted parts of the movable stopper and end cap are SUS316, SUS316L, PTFE, PCTFE*.

Refer to the wetted material inspection record for details of wetted material.

* DAD-600 only

4-4 Seal Structure

The following is a schematic diagram of the column. The tightening force of the seal nuts (↓ T in the drawing) causes PTFE seal to spread radially and seal in close contact with the column wall surface. When pressure is applied inside the column (↓ P in the figure), the seal is further spread (in the figure ←→R) to prevent leakage due to internal pressure (self-sealing method). As the pressure in the column increases, the seal nuts float, but the seal remains sealed.



Note

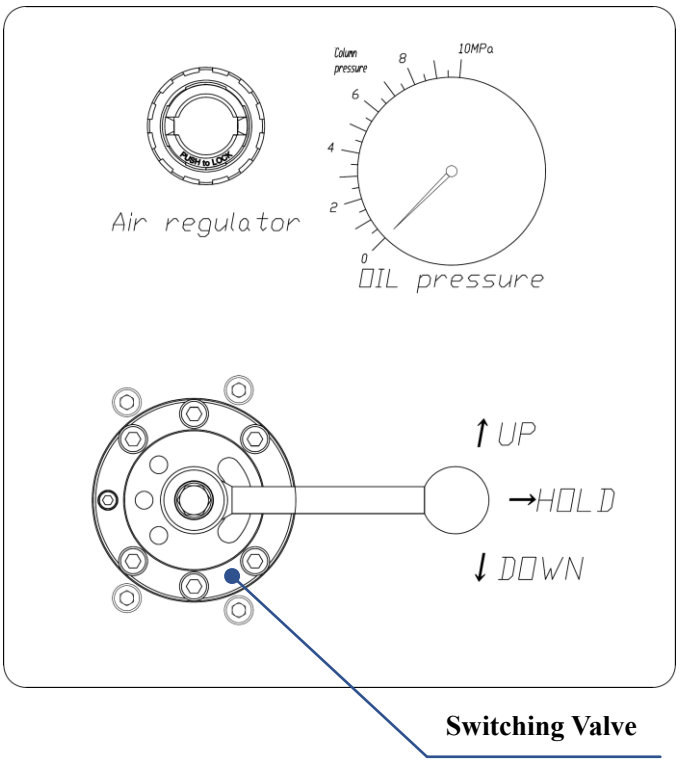
Do not tighten the seal nuts anymore if the column does not leak under no pressure.

When the column pressure increases, the seal nuts float.

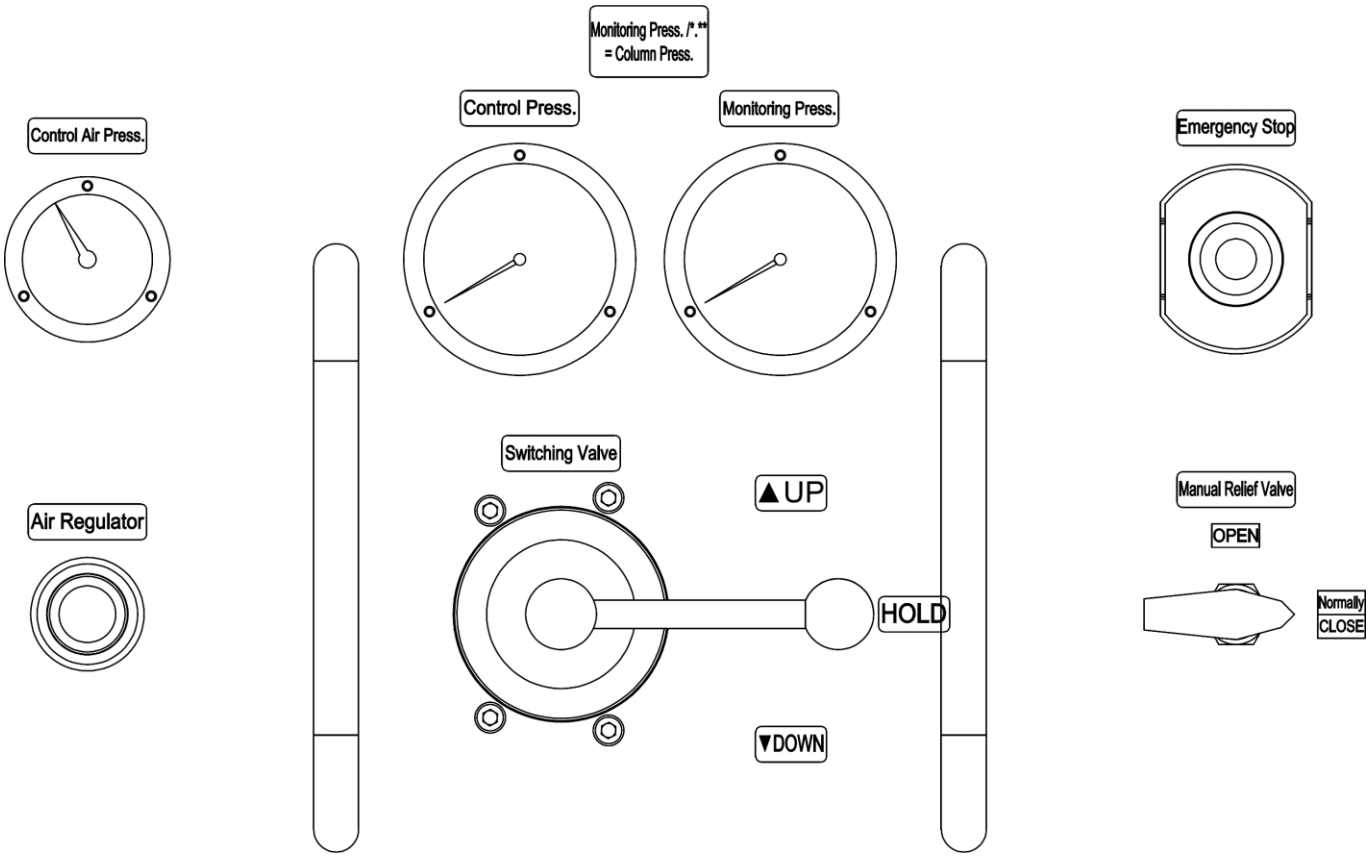
Do not tighten the nuts in this state.

4-5 Control Panel

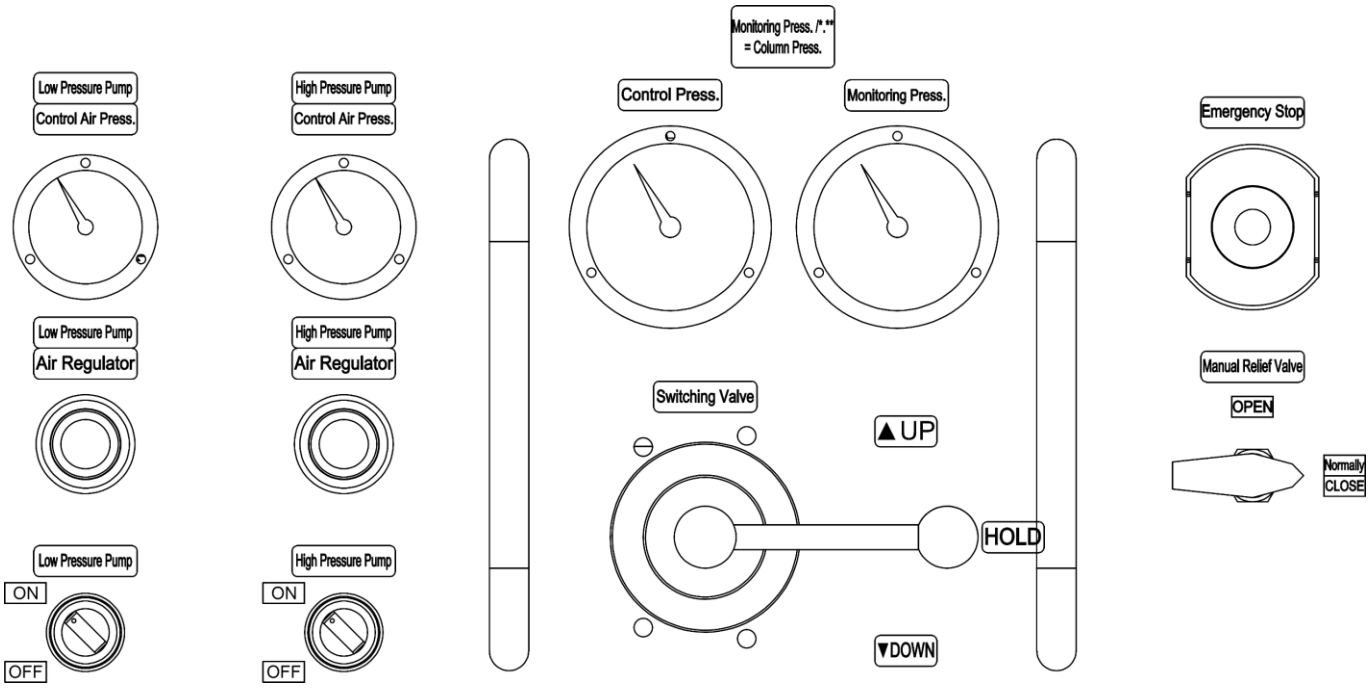
DAD-50-700S



DAD-100-700, DAD-150-700, DAD-200-700, DAD-300-700



DAD-450-700, DAD-600-700



■ **Control Air Press. / Supply air pressure**

This indicates the air pressure supplied to the hydraulic pump.

Depending on the model, it may be directly displayed on the pressure control valve body.

■ **Air Regulator / Pressure-regulating valve**

This adjusts the air pressure that drives the hydraulic pump. Turn clockwise to increase, and counterclockwise to decrease the pressure. Pull the dial to unlock and push the dial to lock.

□ **Large columns (For models 450 mm I.D. or more)**

The models equipped with two types of hydraulic pumps are used as follows depending on the application.

ON/OFF can be switched by switching.

High Pressure Pump → Pressurizing columns in high-pressure condition. The movable stopper moves slowly.

Low Pressure Pump → Pressurizing columns in low-pressure condition. The movable stopper moves quickly.

For detailed usage, refer to the table below.

	Movable stopper Slow movement	Movable stopper Quick movement	Column packing Packing press. ≥ 2 MPaG	Column packing Packing press. < 2 MPaG
High-pressure pump pressure control valve	Open according to the lifting speed	Open according to the lifting speed	Open according to the packing pressure	Fully close or switch OFF
Low pressure pump pressure control valve	Fully close or switch OFF	Open according to the lifting speed	Fully open	Open according to the packing pressure

Notification

Do not turn the dial of the pressure adjustment valve while it is locked.

The equipment may be damaged.

■ **OIL PRESSURE / Oil pressure (only for models 50 mm I.D.)**

This indicates the discharge pressure of the hydraulic pump. When packing, the pressure that the hydraulic cylinder pressurizes the column is displayed.

This value is used to set and calculate the packing pressure.

■ **Control Press. / Set oil pressure**

This indicates the discharge pressure of the hydraulic pump. This is the pressure between the pump and the switching valve. It means the set thrust of the hydraulic cylinder. Used to set the packing pressure.

■ **Monitoring Press. / Monitoring oil pressure**

This indicates the pressure at which the hydraulic cylinder is pressurizing the column. The pressure is indicated only if the cylinder is in operation to lowering direction. Used to calculate the packing pressure. Refer to "■ Packing Pressure" in this chapter for details.

■ Switching Valve

Used to switch the cylinder movement. Select UP, HOLD, DOWN.

UP → The cylinder moves up.

HOLD → The cylinder stops.

DOWN → The cylinder moves down.

□ Operation for the column packing direction

①Make sure that the switching valve is in HOLD position.

②Turn the pressure control valve to set the desired hydraulic pressure.

③Switch the switching valve to the column packing direction. The cylinder starts operating.

④Turn the switching valve to HOLD to stop the cylinder operation.

□ Operation against the column packing direction

①Make sure that the switching valve is in HOLD position.

②Turn the pressure control valve to set the desired hydraulic pressure.

③Switch the switching valve in the opposite direction to the column packing. The cylinder starts operating.

④Turn the switching valve to HOLD to stop the cylinder operation.

□ Switching operation when pressure is applied to the packing direction

①Switch the switching valve to HOLD position.

②Slowly turn the manual relief valve to OPEN and return it to CLOSE.

③Operate the switching valve in the desired direction.

Note

The change in the set oil pressure when the switching valve is HOLD is not reflected in the cylinder thrust and the column packing pressure. When UP or DOWN is selected, the set oil pressure is reflected in the cylinder thrust.

⚠Note

The cylinder is designed to apply pressure to the packing direction. Do not operate the cylinder in the opposite direction of packing and continue to pressurize even if the operation stops. Since the pressure generated in this case cannot be released by the manual pressure release valve, the operation of the switching valve next time in the packing direction may cause a loud noise due to a sudden change in hydraulic pressure. When the cylinder operation is stopped, immediately turn the switching valve to HOLD.

When this device is not in use (when the column is not packed, etc.), fully close the pressure-regulating valve and turn HOLD the switching valve.

■ **Emergency Stop / Emergency stop button**

When the button is pressed, the compressed air supply is cut off and the hydraulic pump stops operation.
Turn the push button clockwise to release it.

■ **Manual relief valve**

The hydraulic pressure in the packing direction of the hydraulic cylinder can be released by opening/closing the 2-way valve.

Notification

Operate the manual relief valve slowly as high pressure is applied inside the cylinder.

■ **Packing pressure (or column pressure)**

The oil pressure gauge indicates the pressure of the oil boosted by the oil pressure pump. The pressure applied to the packing material by the movable stopper in the column is calculated by dividing the pressure that the hydraulic cylinder receives from the hydraulic pump by the cross-sectional area ratio of the cylinder and the column.

◆Packing pressure (internal column pressure) = Monitoring Press. / [Oil pressure/Packing pressure ratio]

Refer to the following table for the [Oil pressure/Packing pressure ratio] used for calculation.

Column I.D. [mm]	50	100	150	200	300	450	600
Max. working pressure [MPa]	10	10	10	10	10	7	7
Oil pressure/Packing pressure ratio	1.56	1.56	1.44	1.56	1.79	2.58	2.49

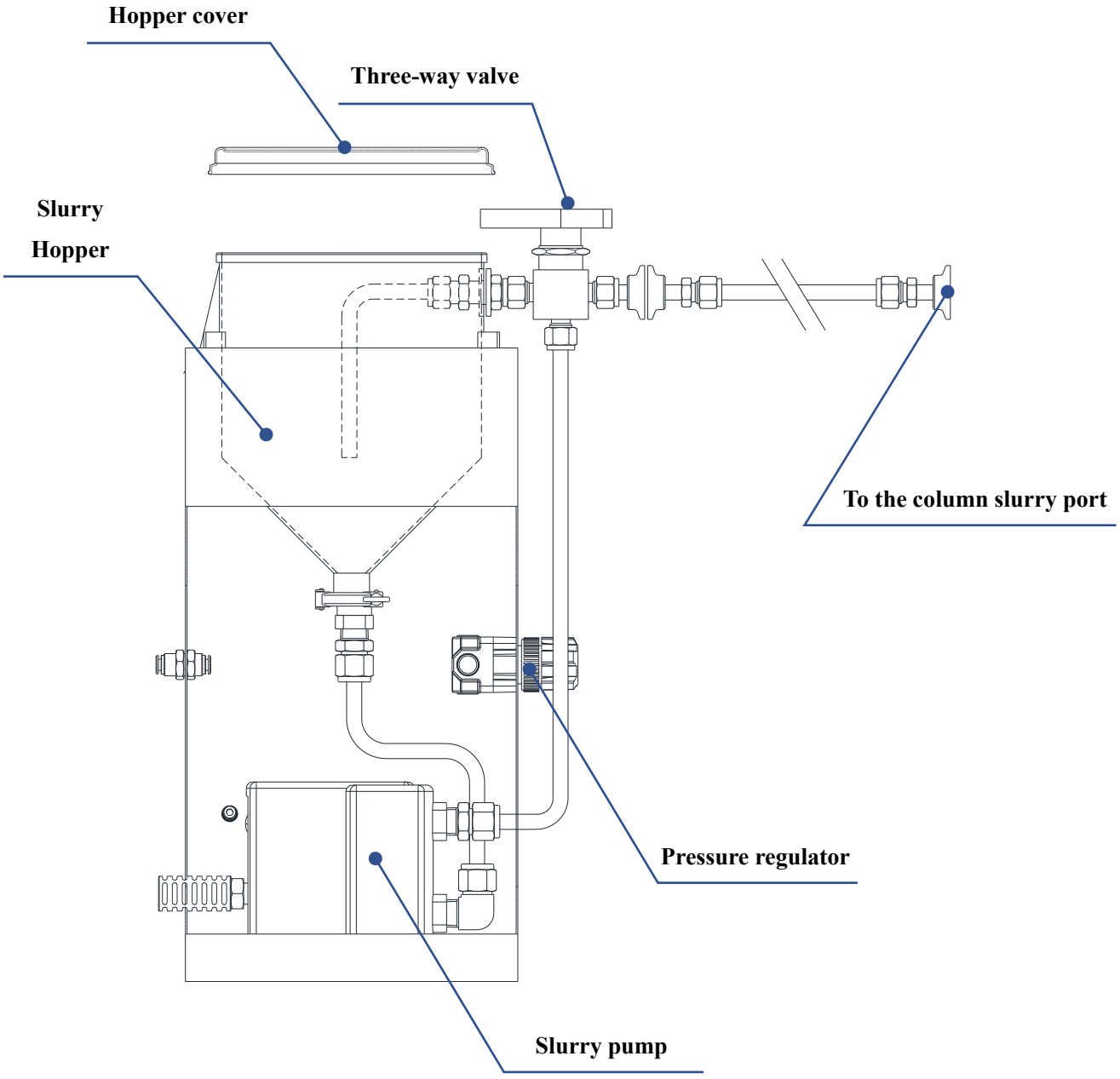
⚠Note

Do not change the setting of the pressure control valve located outside the control panel. The pressure of the valve, which is not located on the control panel, is fixed for safety reason.

5 STRUCTURE OF SLURRY CONTAINER

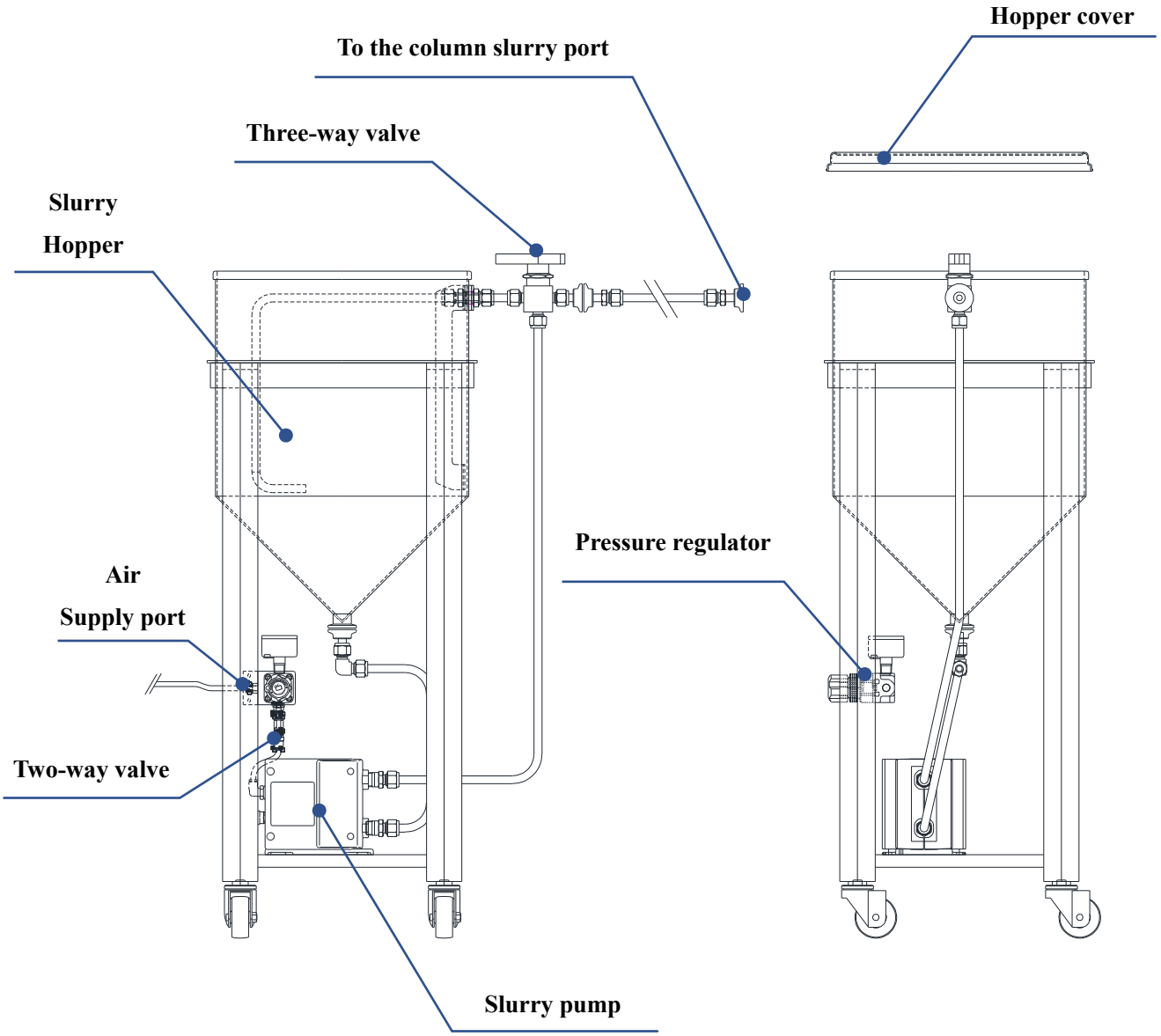
5-1 Overall View

SC-2-20, SC-10-20



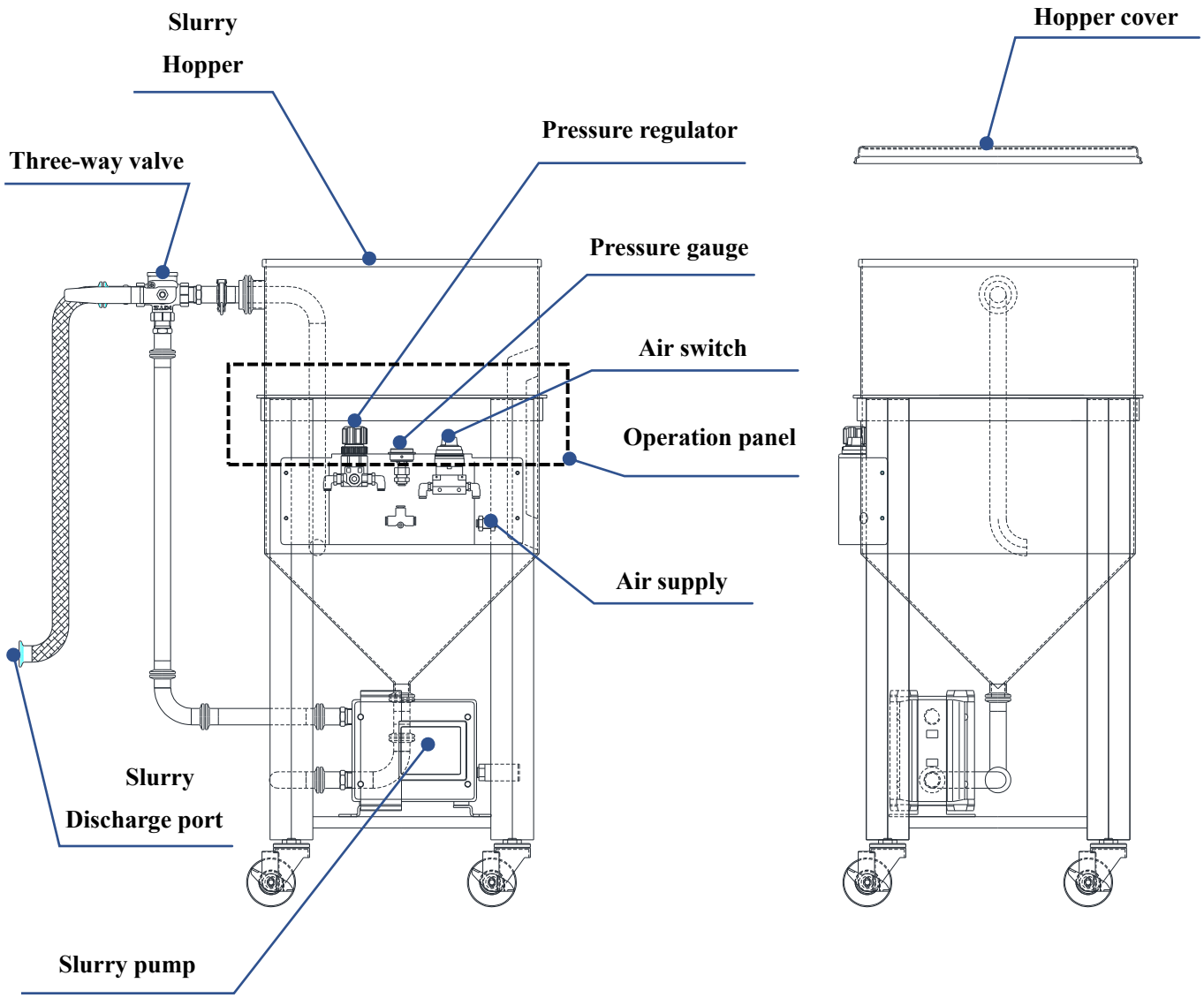
SC-2-20	Empty weight	Approx. size (W×D×H) [mm]
	About 5 kg	300×210×470
SC-10-20	Empty weight	Approx. size (W×D×H) [mm]
	About 15 kg	370×290×580

SC-10-20SA, SC-22-20, SC-30-20



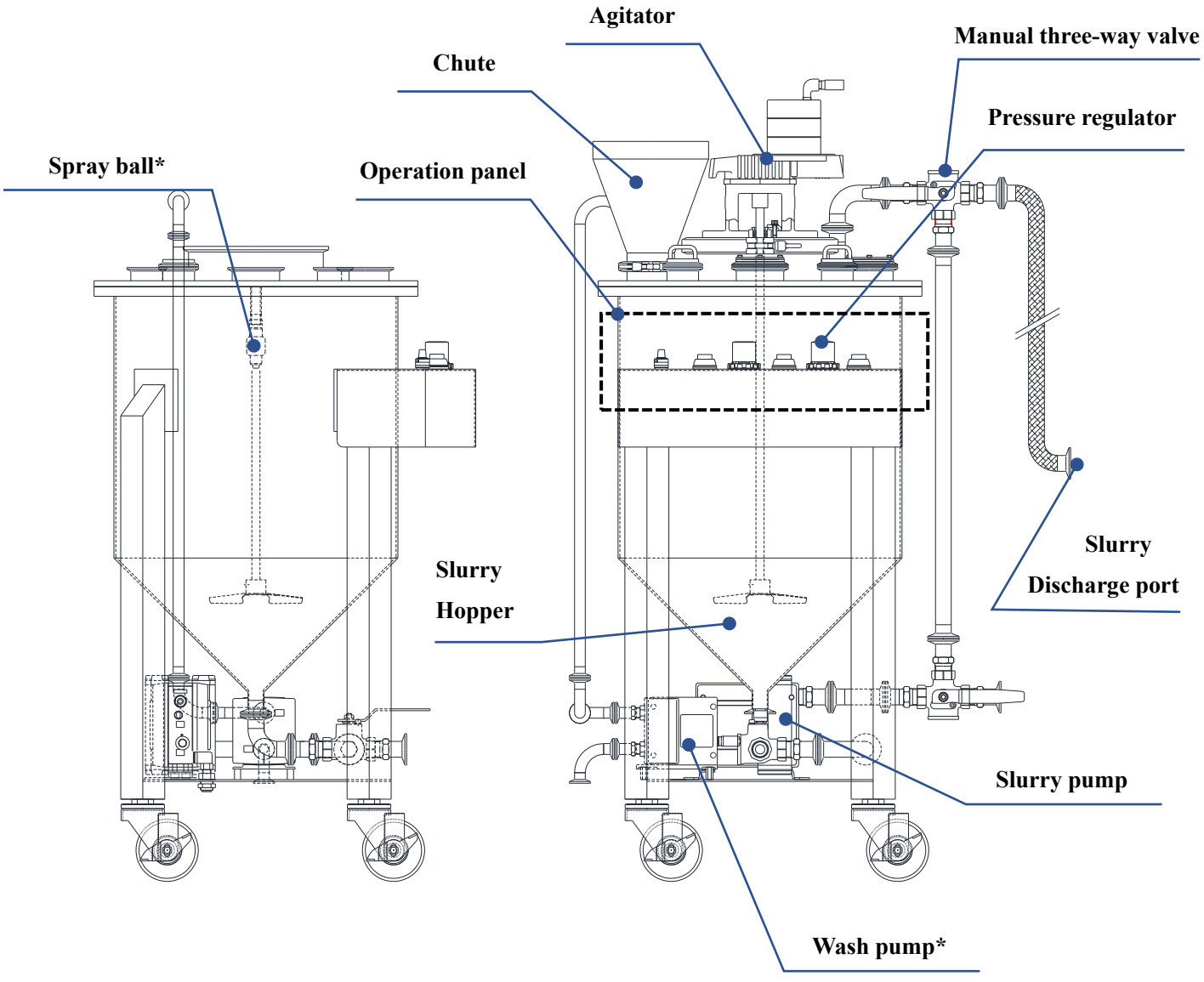
SC-10-20SA	Empty weight	Approx. size (W×D×H) [mm]
	About 20 kg	370×270×730
SC-22-20	Empty weight	Approx. size (W×D×H) [mm]
	About 20 kg	450×330×800
SC-30-20	Empty weight	Approx. size (W×D×H) [mm]
	About 25 kg	480×350×810

SC-45-45



Empty weight	Approx. size (W×D×H) [mm]
About 45 kg	590×420×860

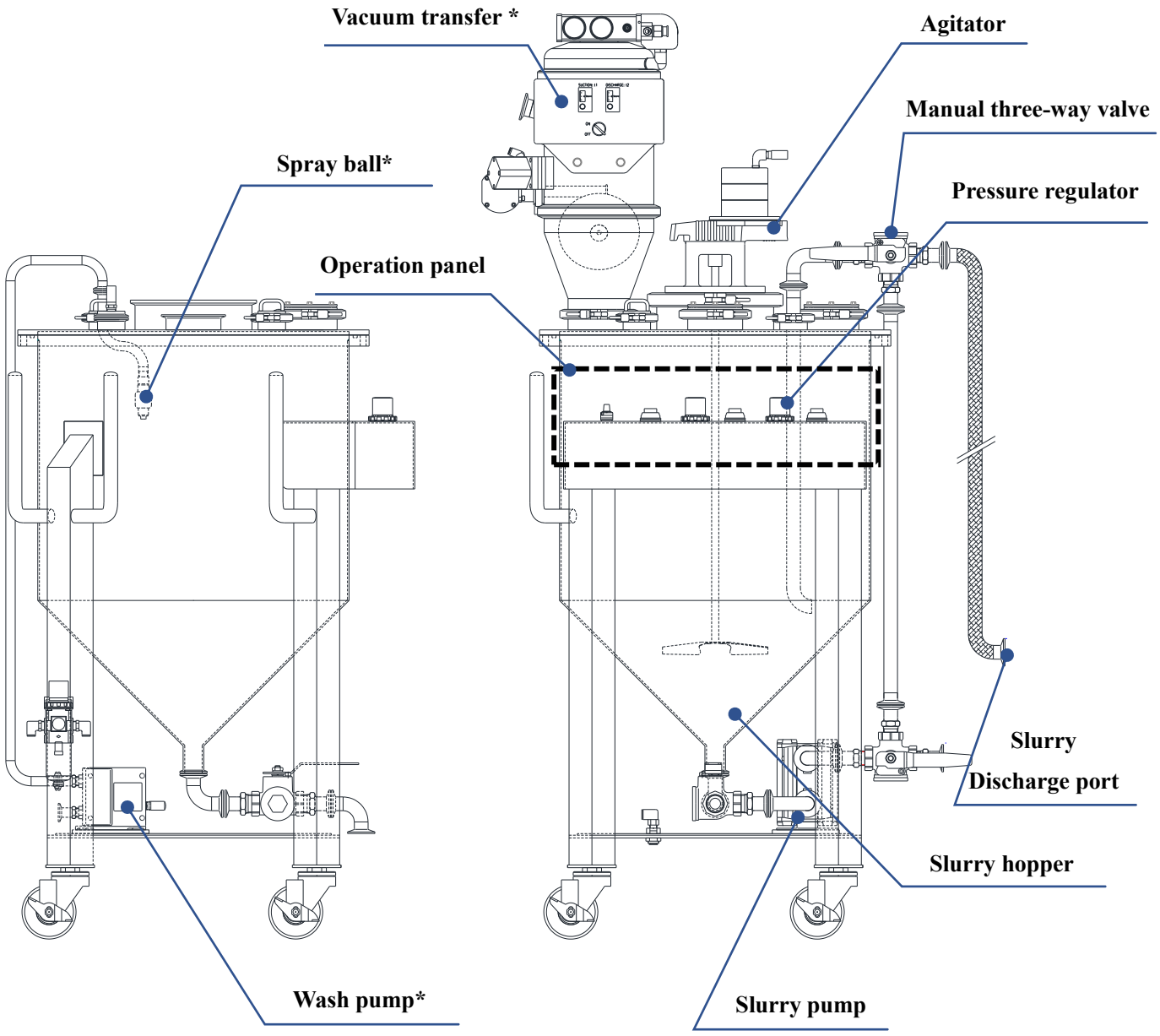
SC-80-45



*Option

Empty weight	Approx. size (W×D×H) [mm]
About 95 kg	650×620×1290

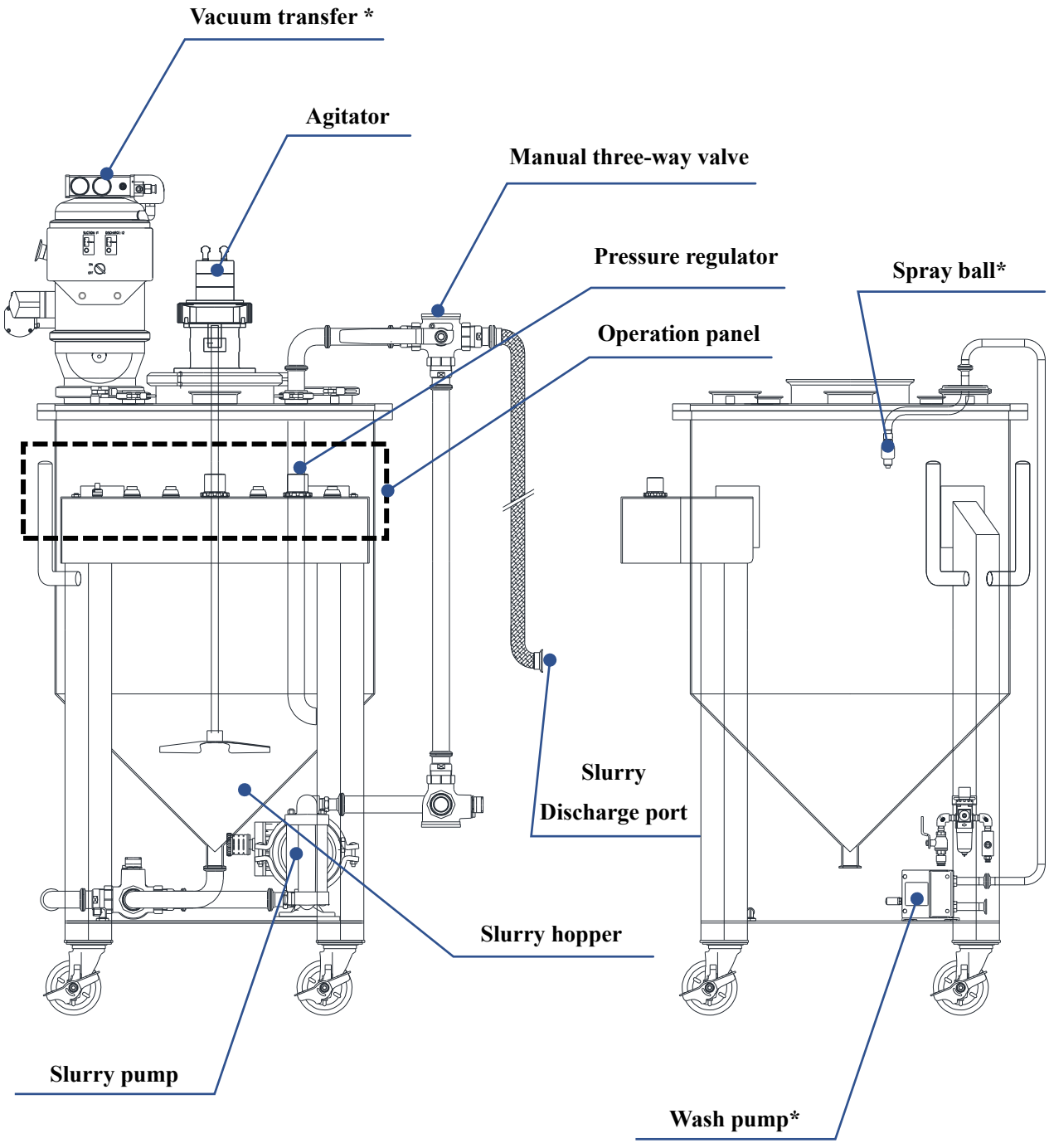
SC-140-45



*Option

Empty weight	Approx. size (W×D×H) [mm]
About 160 kg	740×750×1460

SC-300-135



*Option

Empty weight	Approx. size (W×D×H) [mm]
About 250 kg	1030×920×1750

5-2 Operation Method

■ Onboard equipment

・Slurry pump : This is a diaphragm pump for circulating and stirring the slurry and feeding it to the column.

・Three-way valve : Switches the slurry flow.
Normally, the valve is set for circulation which returns to the tank to agitate the slurry.

For large slurry containers, the equipment shown below can be applied (♦ is optional).

・Agitator : This rotary blade agitator agitates the slurry.

◆Vacuum transfer : This unit is used to load packing material into the hopper.

◆Wash pump, spray ball : This unit cleans containers.

■ 3-Way Manual Ball Valve

This switches the slurry flow path (circulation direction/column direction). When the slurry is prepared, use the valve to set the flow path (circulation flow path) back to the slurry container. In a model without an agitator, the slurry is agitated by running in the circulation passage.

When the slurry is fed into the column, switch the valve to the column direction.

■ Air regulator / pressure-regulating valve

This adjusts the air pressure that drives the device. Turn clockwise to increase, and counterclockwise to decrease the pressure. Pull the dial to unlock and push the dial to lock.

⚠Note

Do not change the setting of the pressure control valve located outside the operation panel. The pressure of the valve, which is not located on the operation panel, is fixed for safety reason.

Notification

Do not turn the dial of the pressure adjustment valve while it is locked.
The equipment may be damaged.

■ Speed controller

The amount of air supplied to the agitator can be adjusted. Used to change the speed of the agitator.

⚠Note

Do not change the setting of the throttle valve located outside the operation panel.
For safety reasons, the maximum speed is limited and fixed.

6 ASSEMBLY AND DISASSEMBLY

⚠Note

For columns with 200 mm I.D. or more, the movable stopper and end cap are heavy. Handle with care.

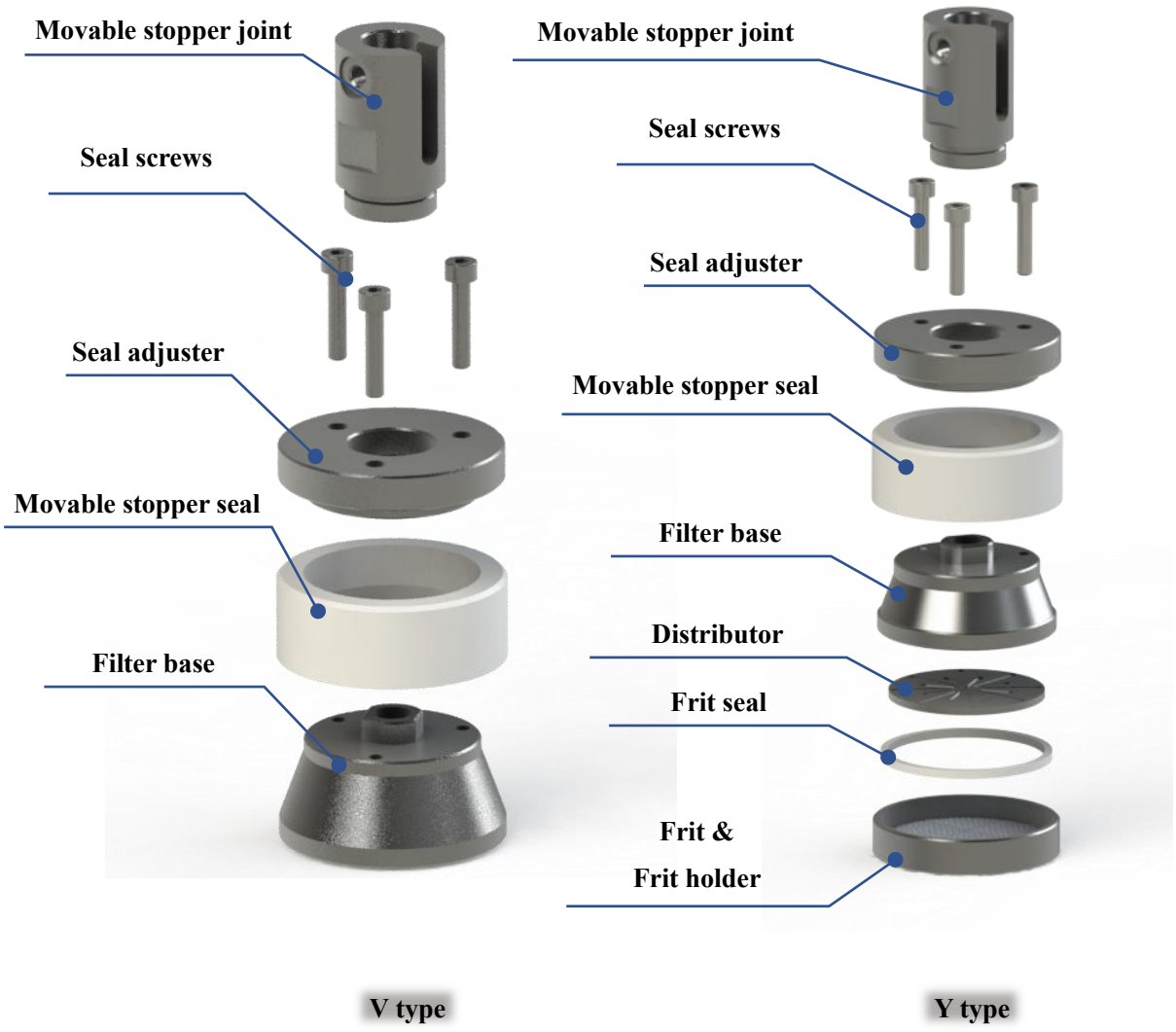
Note

Assemble each item in the order shown in the figure.

Connect the movable stopper pipe to the piping mounting fitting part at the center of the filter base after assembling the filter base, movable stopper seal and seal adjuster in order.

6-1 DAD-50-700S

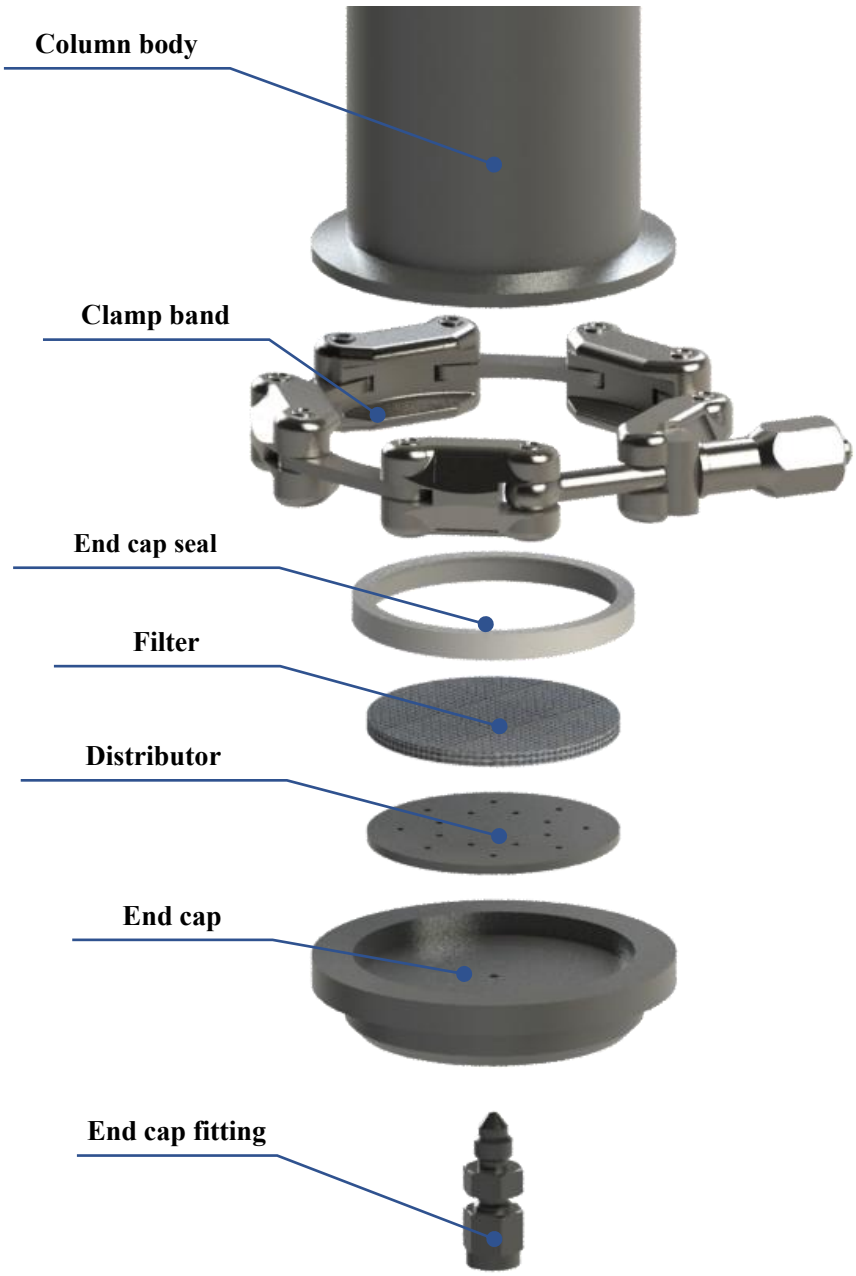
■ **Movable stopper**



V type **Y type**

Weight
About 0.6 kg

■ End cap



Weight
About 1.0 kg

※Excluding column body and clamp band

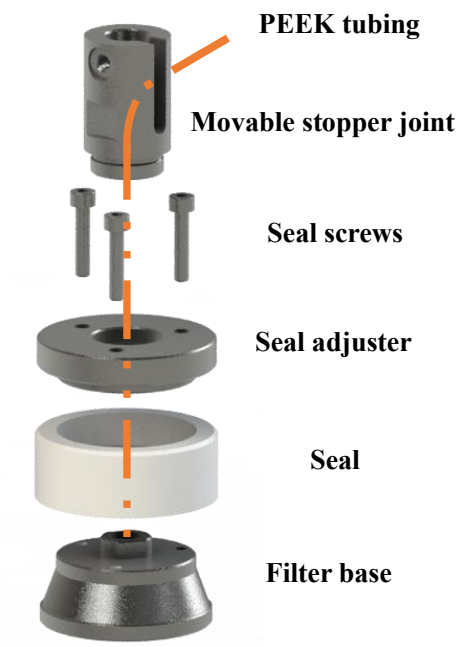
Movable stopper assembly procedure

① Pass PEEK tubing through the movable stopper joint, the seal adjuster, and the seal in this order, and attach it to the filter base.

② Fix the seal adjuster and filter base with the seal screws.

Note

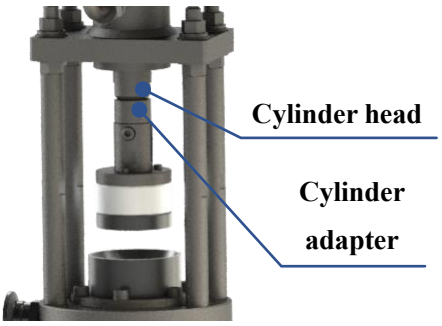
Do not tighten the screws strongly. This may prevent the movable stopper from inserting the column afterwards.



③ Fix the movable stopper joint and the seal adjuster.

④ Raise the cylinder to the top and check that the hydraulic and pneumatic pressures are 0.

⑤ Attach the movable stopper joint to the cylinder adapter.



⑥ Operate the control panel to lower the movable stopper to the position where the top edge of the seal adjuster is as high as the top edge of the column body (see the right figure).

Notification

Do not run the movable stopper quickly.
Set the hydraulic gauge below 2 MPa and check that the movable stopper slowly enters the center of the column body.

⚠Note

Be careful not to pinch your fingers.

⑦ Tighten the seal screws evenly. The seal is pushed out and sealed.

End cap assembly procedure

① Align the distributor with the filter and attach the packing. Fit them to the end cap in the correct direction.

Notification

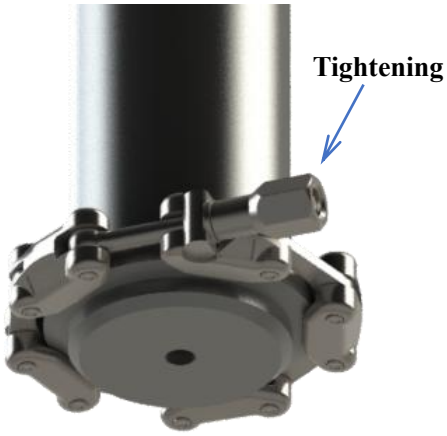
Be careful not to mistake the direction of the distributor. The filter side has a lot of holes.

② Attach the end cap to the column body using the clamp band.

Notification

Attach the clamp band while adjusting the end cap so that the periphery of the end cap and the flange periphery of the column body are the same. If it is misaligned, it may cause liquid leakage.

③ Tighten the clamp nut on the clamp band to secure it to the column body.



Notification

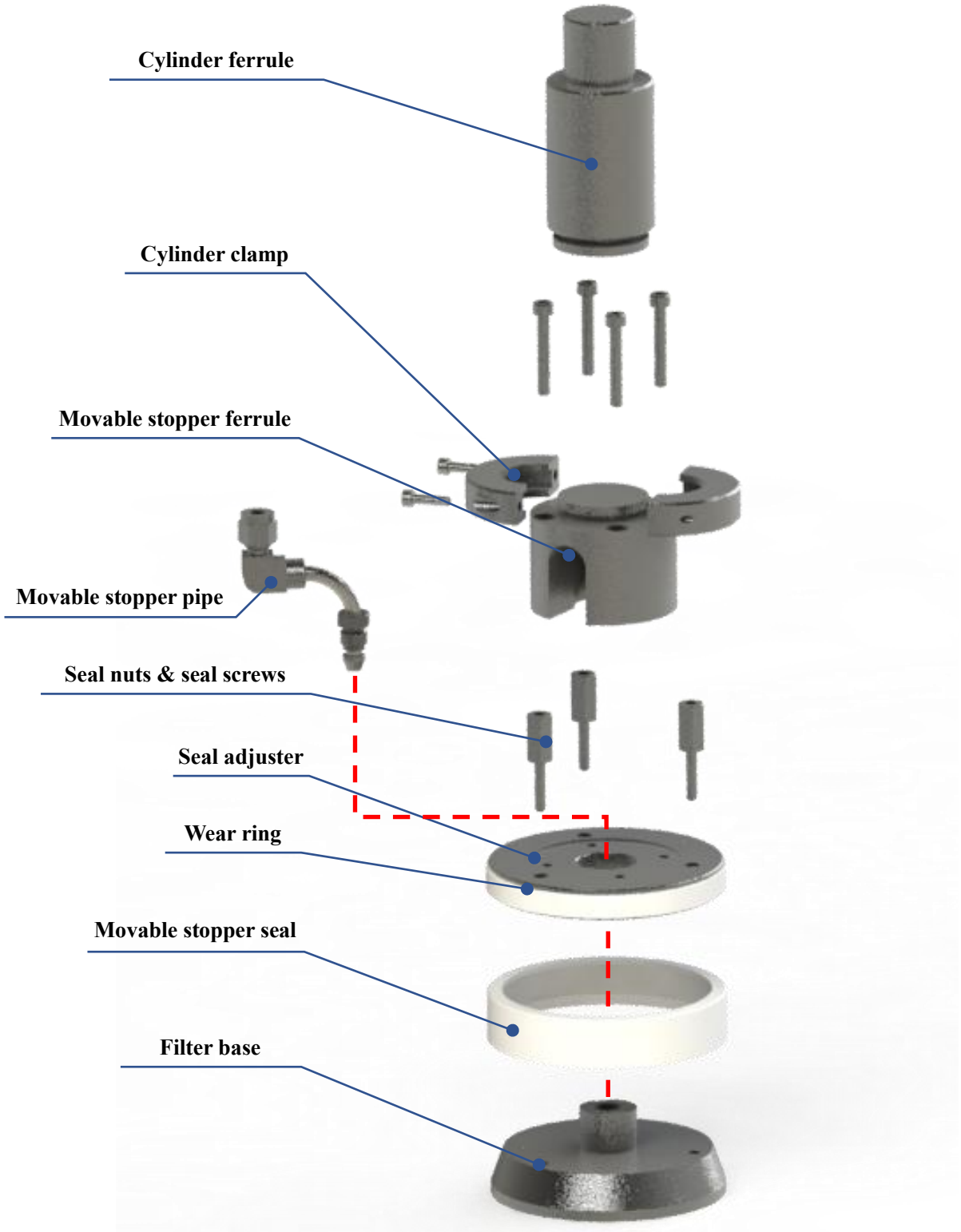
Tighten the band by hand until it is no longer loose.
Then, tighten the screw approximately 3-4 times.
Be careful not to over-tighten as this can cause damage.

Disassembly procedure

Remove it in the reverse order of the assembly procedure.

6-2 DAD-100-700

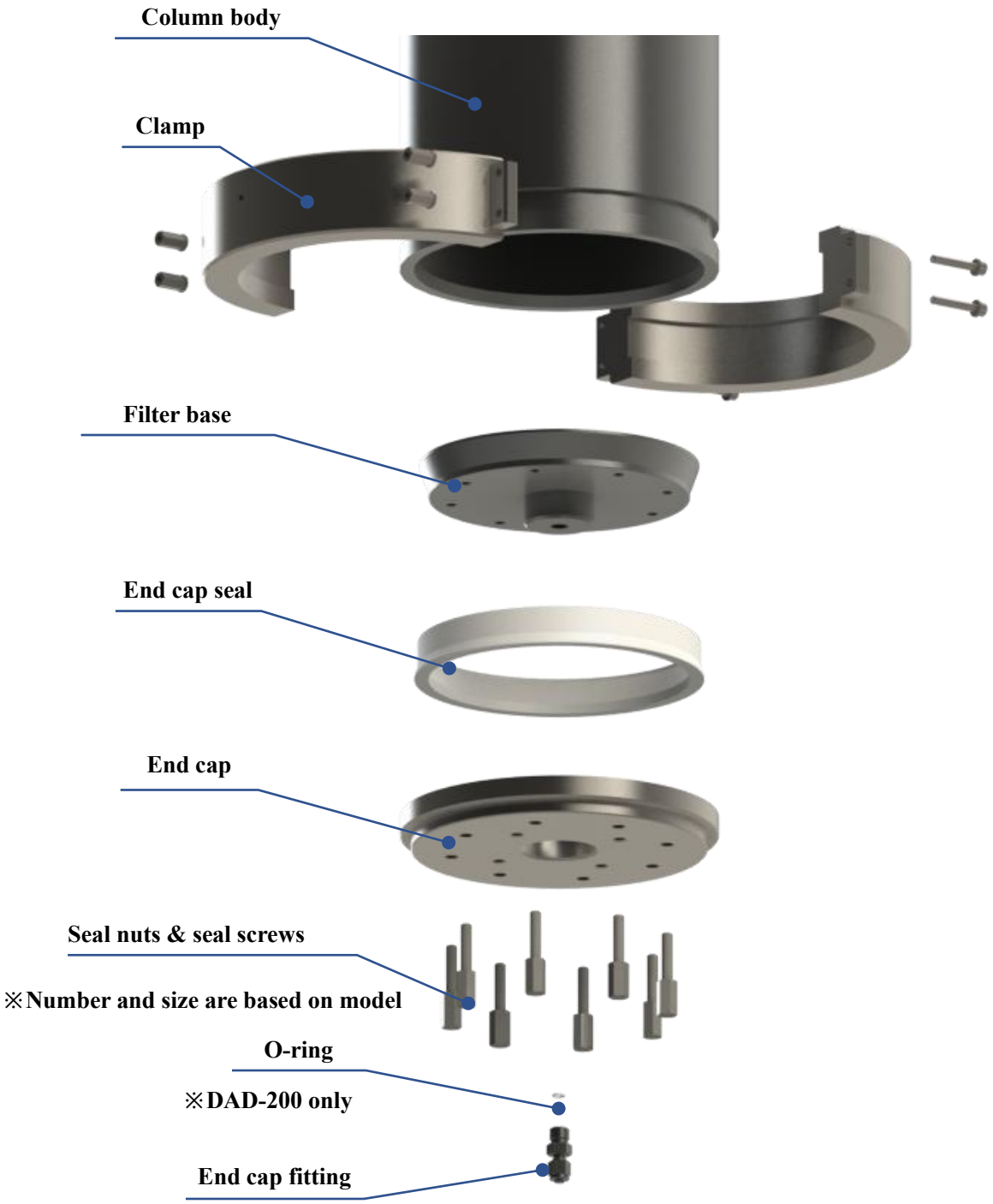
■ **Movable stopper**



Weight
About 2.7 kg

※Excluding cylinder ferrule, cylinder clamp

■ End cap

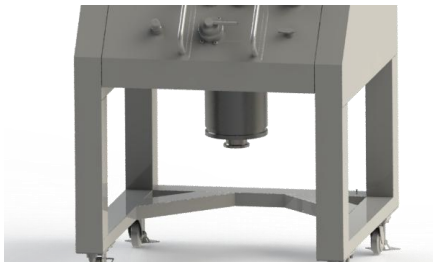


Seal Nut & Number of seal screws	Weight
3 each	About 2.0 kg

※Excluding column body and clamp

Movable stopper assembly procedure

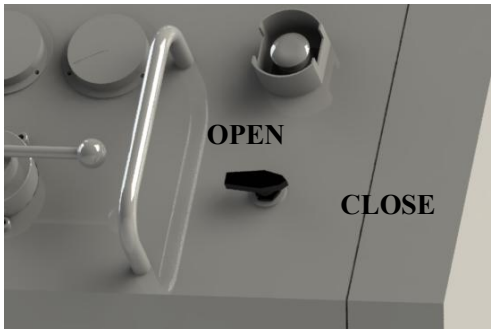
① Operate the hydraulic cylinder and lower it to the bottom.
The cylinder rod is exposed at the bottom of the column.
Turn the switching valve HOLD after the pump stops.



② Slowly turn the manual relief valve OPEN to release the oil pressure.
After releasing the hydraulic pressure, return the manual relief valve to CLOSE.

⚠Note

Do not put anything or body under the column.



③ Put the movable stopper on the lift table truck facing down the filter surface. The lift table truck is an option.

Notification

Be careful not to damage the filter surface.

④ Step on the lever at the foot to raise the lift table truck.
Push the movable stopper ferrule straight against the movable stopper joint.
Fix them with cylinder clamp and fasten with attached screws.

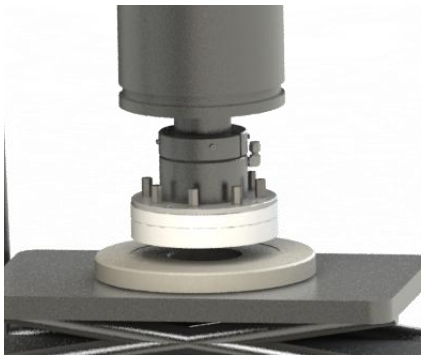
⚠Note

Be careful not to pinch your fingers.

Note

Cylinder clamps cannot be fastened if the movable stopper ferrule and the movable plug joint are not parallel.

⑤ Loosen all seal nuts to the extent that they can be turned by hand. Then, turn all the seal nuts until they are in light contact with the seal adjuster. Slowly lift the cylinder to ensure that the seal enters smoothly into the column.



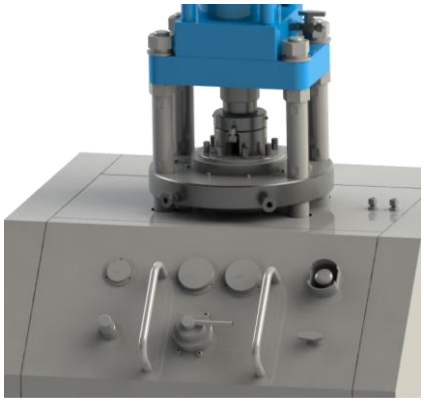
Notification

Check that the seal is loose before operating the product. If the cylinder is run without confirming if the seals are loosened, the seal may contact the column body end and cause deformation or damage.

⚠Note

Be careful not to get your fingers caught.

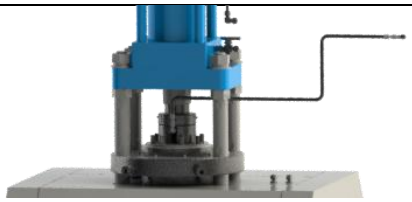
⑥ Raise the cylinder until the movable stopper is above the slurry port position. Look inside the column from the slurry port and check that the movable stopper seal does not block the slurry port hole.



Notification

When moving the cylinder to the top, be sure to observe the precautions for its operation in Section 4-5. When the movable stopper reaches the top, immediately turn the switching valve HOLD.

⑦ Attach the flexible tube to the movable stopper.



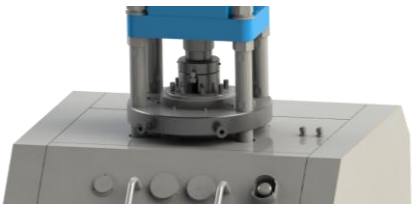
⑧ Tighten the seal nuts evenly. The seal is pushed out and sealed.

Notification

Tighten the seal nuts diagonally in small increments. If the nut is not tightened evenly, the filter base will tilt, leading to leakage or seal deformation.

End cap assembly procedure

① Check that the cylinder with the movable stopper is fully raised.

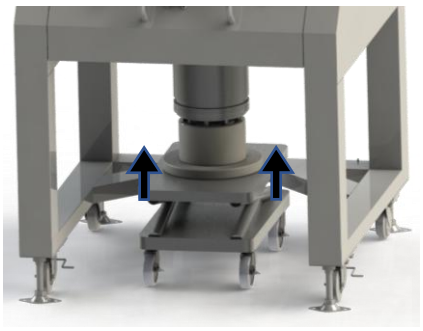


② Make sure that the sealing nuts of the end cap are loosened evenly, approximately 5 to 10 mm. Place jig A on the lift table truck and place the end cap on it. Place the end cap with the filter facing up. The lift table truck is an option.

③ Place the lift table truck under the column and press the lever on the foot several times to raise and insert the end cap into the column. Raise the column until the end cap is fully inserted.

⚠Note

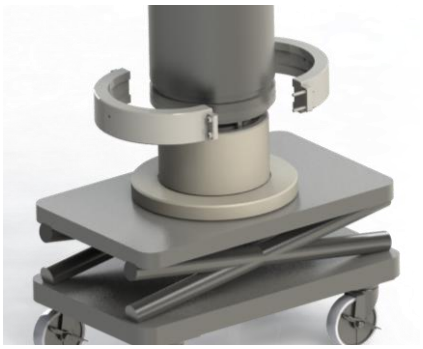
Be careful not to pinch your fingers.



④ After confirming that the end cap has inserted, attach the clamps. Fix the clamps with the clamp lock bolts.

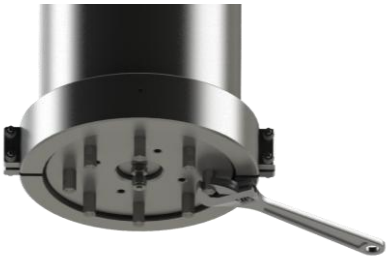
⚠Note

Never move the lift table truck until the clamp is securely tightened.



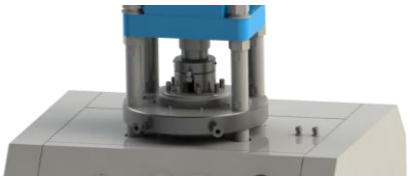
⑤ Make sure that the end cap is securely attached, and then slowly lower the lift table truck.

⑥ Tighten the seal nut evenly. The seal is pushed out and sealed.



End cap disassembly procedure

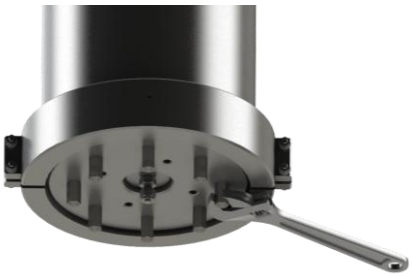
① Check that the cylinder with the movable stopper is fully raised.



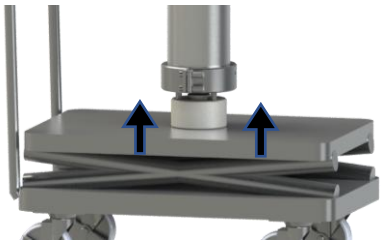
② Disconnect the piping (flexible hose) of the end cap.
Loosen the sealing nuts of the end cap evenly, approximately 5 to 10 mm.

⚠Note

Do not remove the seal nuts completely. When they are completely removed, the end cap filter may be left inside the column and may fall at unintentional timing.

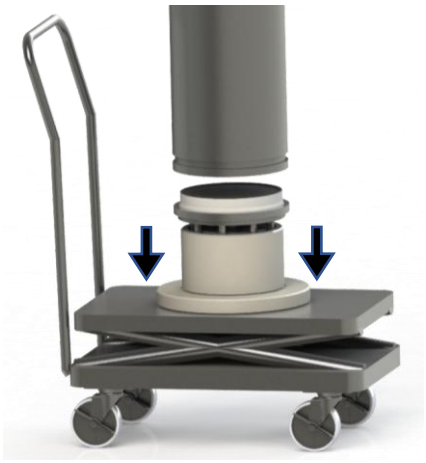


③ Install jig A on the lift table truck and move it directly below the end cap. Step on the lever at the foot to raise the lift table truck. When the seal nuts are pushed up by the lift table truck, the filter base is lifted, and the seal is loosened. Confirm that the end cap is not at a tilt and that the lift table truck securely supports the weight.



④ Check that the seal is loose, and the end cap is lifted, and then remove the clamp.

⑤ Rotate the valve of the lift table truck counterclockwise to slowly lower the top plate. At this time, observe whether the end cap is descending as the lift table truck moves down.



⚠Note

Slowly descend the end cap. Do not move the lift table truck down suddenly. It is dangerous because the end cap drops afterwards.

Note

The end cap is supposed to move down by its own weight. However, if it is not lowered along with the lift table truck, attach the clamp again and refer to step ③ while the load of the end cap is held by the truck.

Movable stopper disassembly procedure

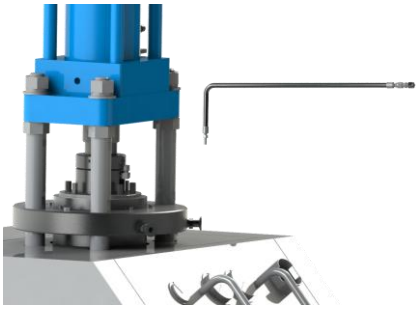
① Remove the end cap first to remove the movable stopper.

② Prepare the lift table truck, if any. It is optional.

Notification

The lift table truck surface comes in direct contact with the filter or seal. Make sure that there is no dirt, etc., on the contact surface.

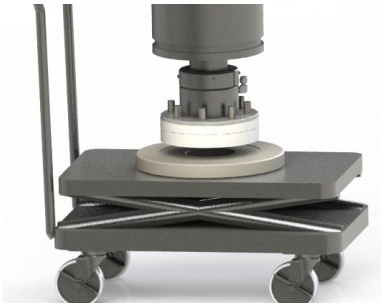
③ Remove the flexible tube with the cylinder at the top position. Loosen the seal nuts.



⚠Note

Do not remove the seal nuts completely. It is very dangerous as the filter base can drop suddenly.

④ Operate the cylinder and lower it to the bottom and then put the lift table truck under the movable stopper. At this time, confirm that the top plate of the lift table truck is at the lowest position. (Turn the valve under the handle to the left to lower the table.)

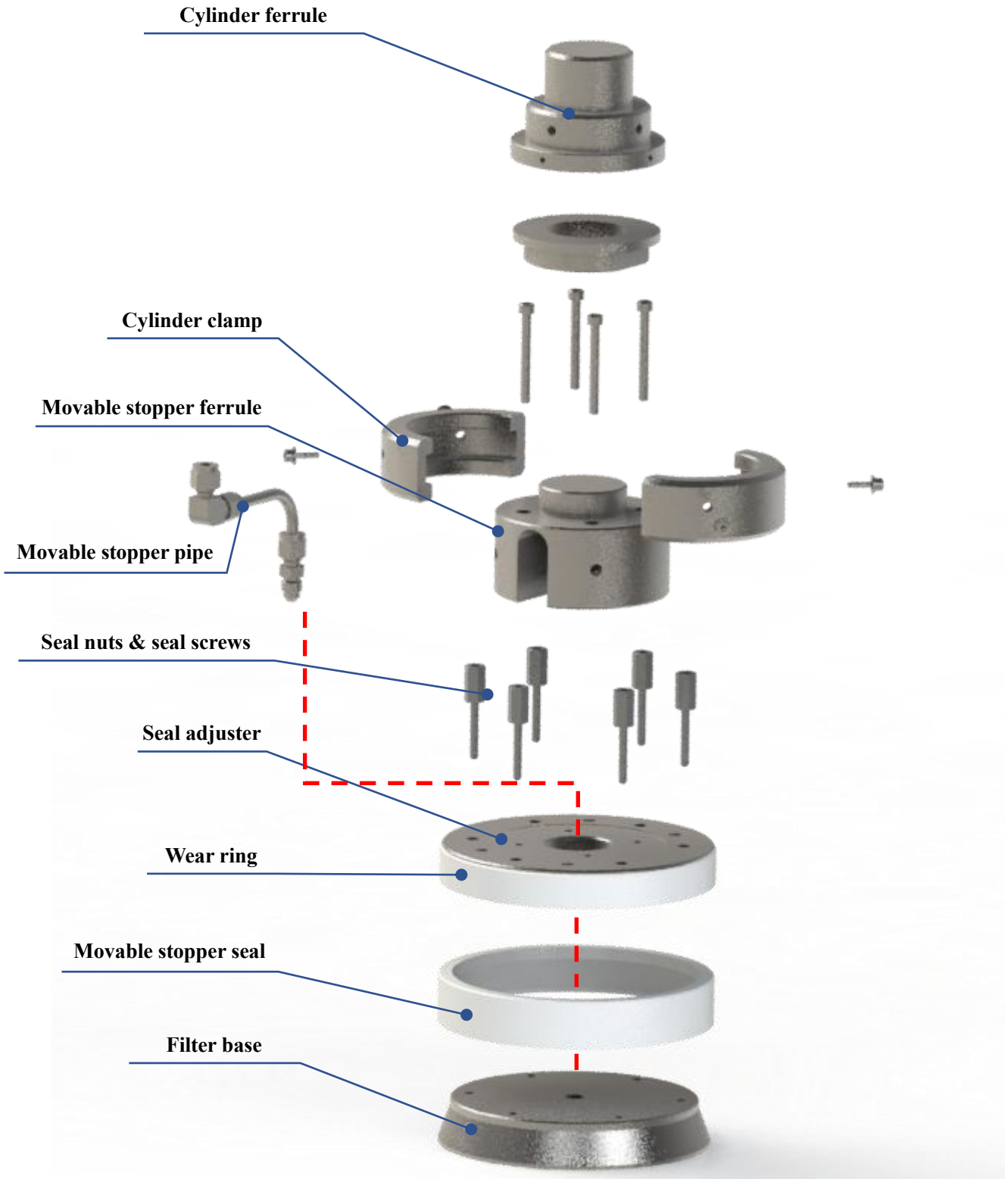


⑤ Step on the lever at the foot several times to raise the lift table truck which is located just under the movable stopper. Confirm that the movable stopper is not placed diagonally and that the lift table truck supports the weight securely.

⑥ Remove the cylinder clamp.
Lower the lift table truck to complete the disassembly.

6-3 DAD-150-700, DAD-200-700

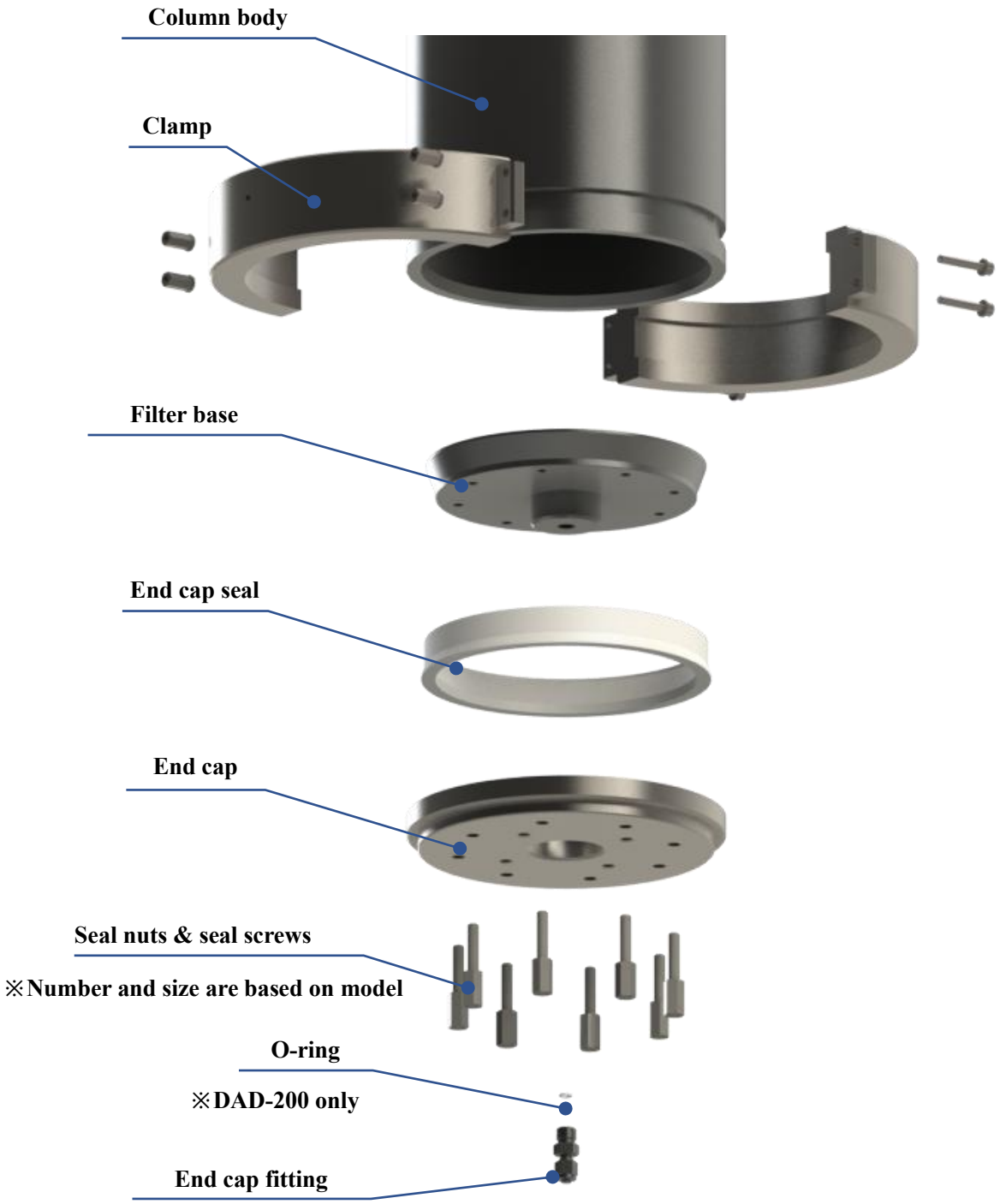
■ **Movable stopper (DAD-150-700)**



Weight
About 8.5 kg

※Excluding cylinder ferrule, cylinder clamp

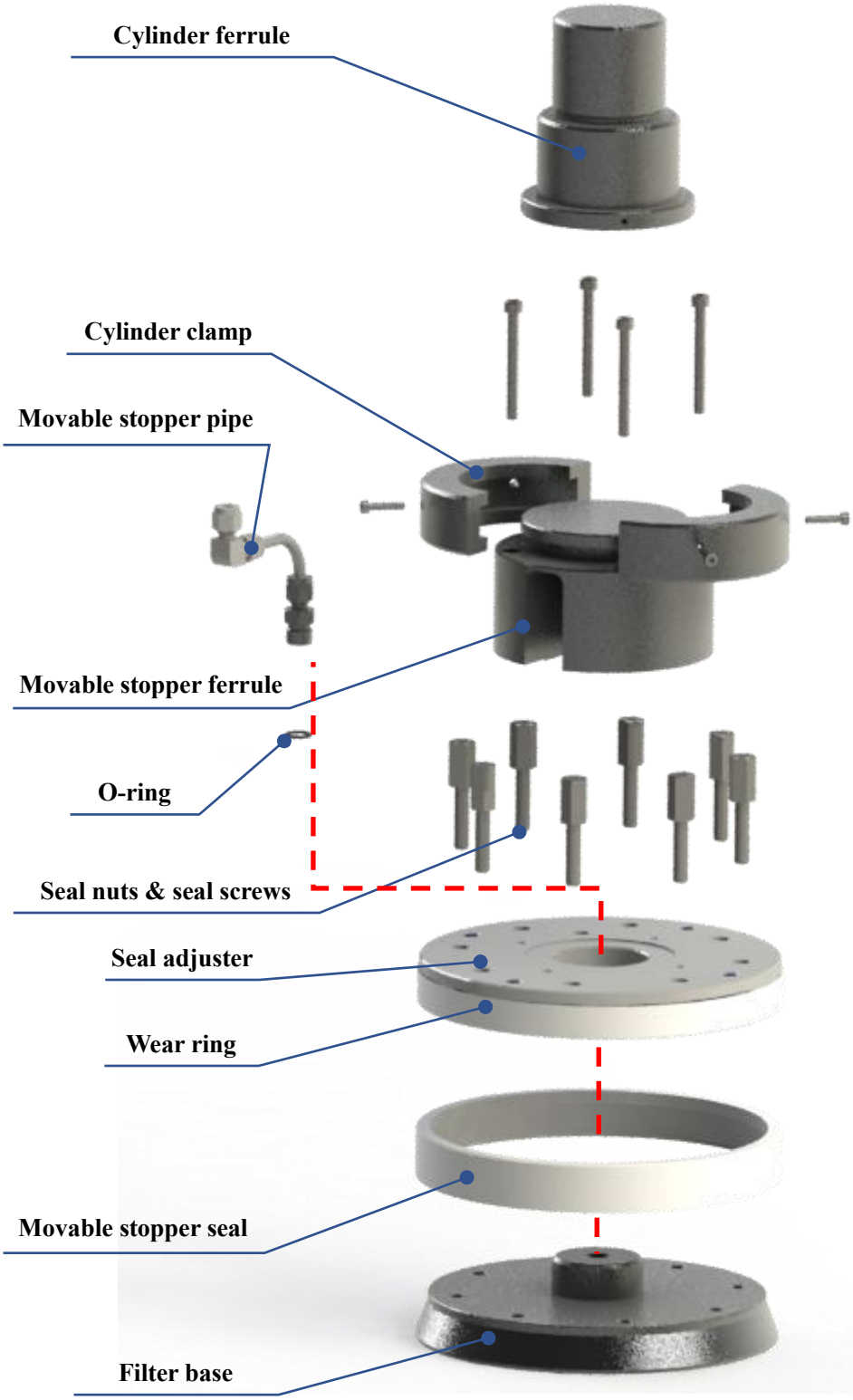
■ End cap (DAD-150-700)



Model	Number of seal nuts &seal screws	Weight
DAD-150-700	6 each	About 6.1 kg

※Excluding column body and clamp

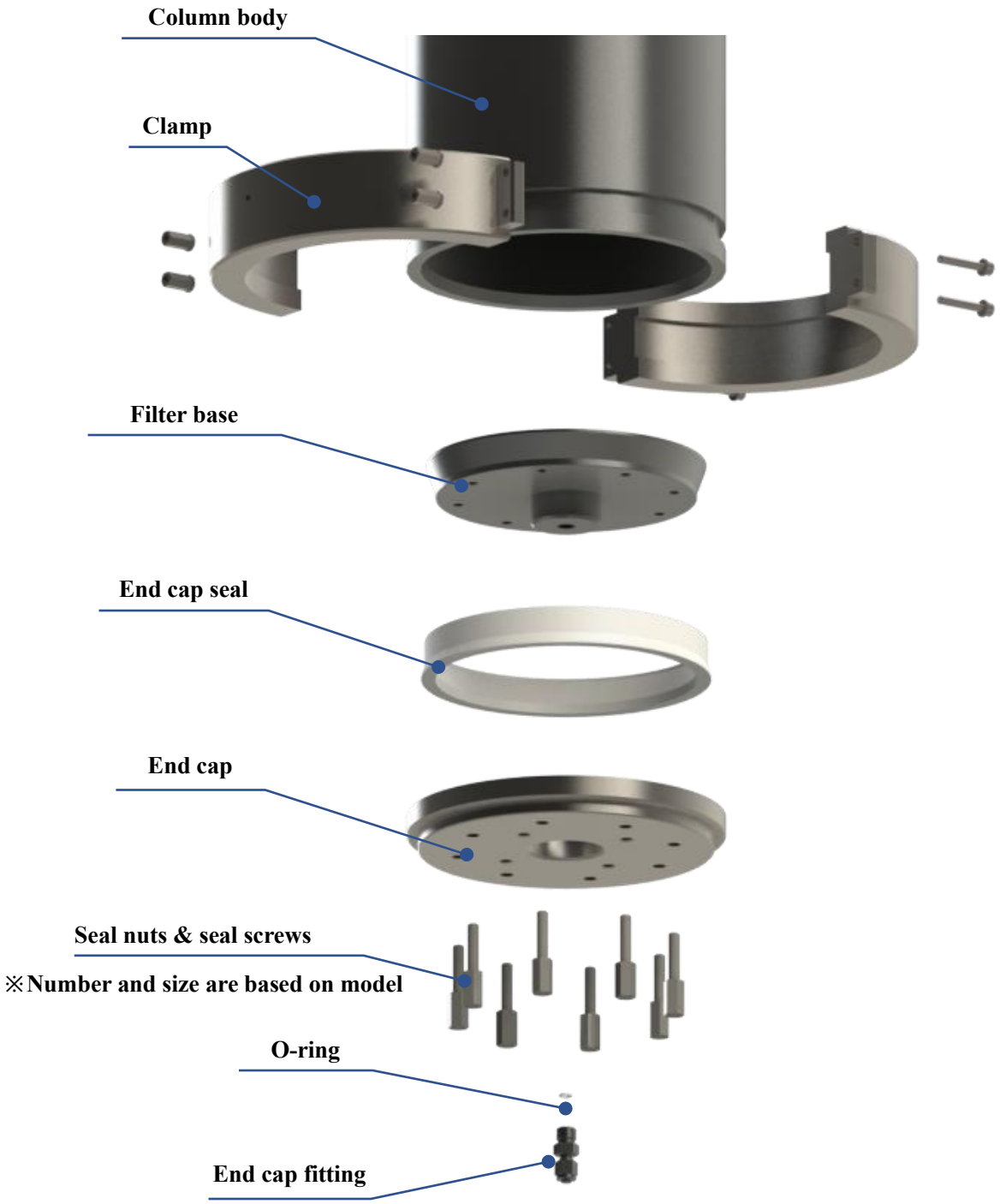
■ Movable stopper (DAD-200-700)



Weight
About 16.7 kg

※Excluding cylinder ferrule, cylinder clamp

■ End cap (DAD-200-700)

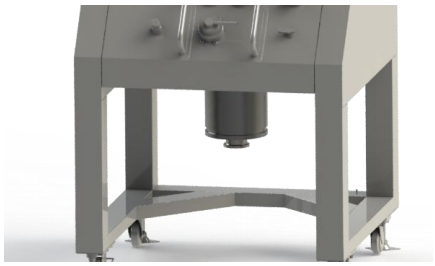


Model	Number of seal nuts &seal screws	Weight
DAD-200-700	8 each	About 13.0 kg

※Excluding column body and clamp

Movable stopper assembly procedure

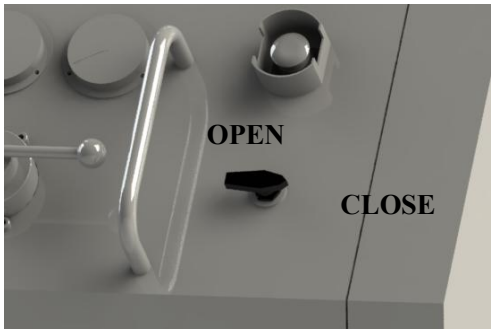
① Operate the hydraulic cylinder and lower it to the bottom.
The cylinder rod is exposed at the bottom of the column.
Turn the switching valve HOLD after the pump stops.



② Slowly turn the manual relief valve OPEN to release the oil pressure.
After releasing the hydraulic pressure, return the manual relief valve to CLOSE.

⚠Note

Do not put anything or body under the column.



③ Place jig B on the lift table truck.
Put the movable stopper on the jig B facing down the filter surface.
Move the lift table truck so that the movable stopper ferrule matches the cylinder ferrule from the bottom of the column.

Notification

Be careful not to damage the filter surface.

④ Step on the lever at the foot to raise the lift table truck.
Push the movable stopper ferrule straight against the movable stopper joint.
Fix with cylinder clamp and fasten with attached screws.

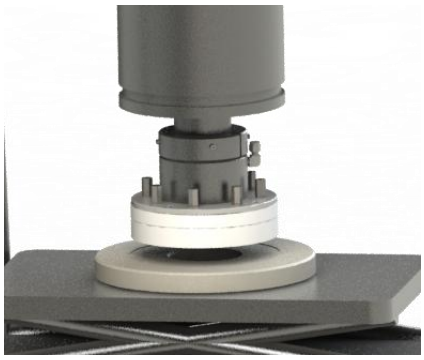
⚠Note

Be careful not to pinch your fingers.

Note

Cylinder clamps cannot be fastened if the movable stopper ferrule and the movable plug joint are not parallel.

⑤ Loosen all seal nuts to the extent that they can be turned by hand. Then, turn all the seal nuts until they are in light contact with the seal adjuster. Slowly lift the cylinder to ensure that the seal enters smoothly into the column.



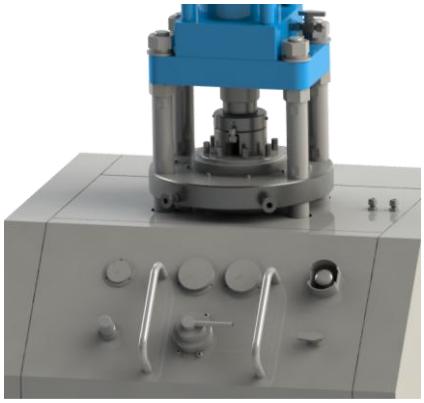
Notification

Check that the seal is loose before operating the product. If the cylinder is run without confirming if the seals are loosened, the seal may contact the column body end and cause deformation or damage.

⚠Note

Be careful not to get your fingers caught.

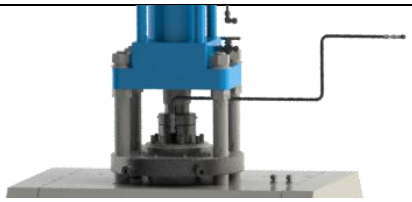
⑥ Raise the cylinder until the movable stopper is above the slurry port position. Look inside the column from the slurry port and check that the movable stopper seal does not block the slurry port hole.



Notification

When moving the cylinder to the top, be sure to observe the precautions for its operation in Section 4-5. When the movable stopper reaches the top, immediately turn the switching valve HOLD.

⑦ Attach the flexible tube to the movable stopper.



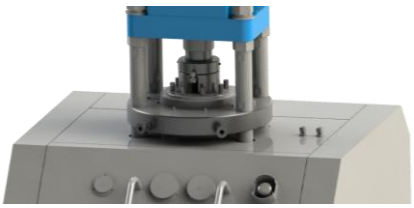
⑧ Tighten the seal nuts evenly. The seal is pushed out and sealed.

Notification

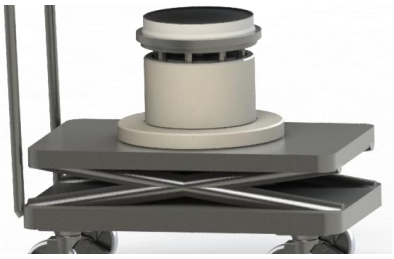
Tighten the seal nuts diagonally in small increments. If the nut is not tightened evenly, the filter base will tilt, leading to leakage or seal deformation.

End cap assembly procedure

① Check that the cylinder with the movable stopper is fully raised.



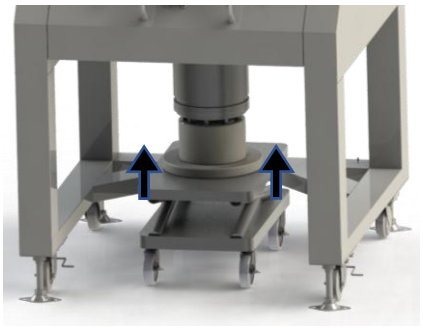
② Make sure that the sealing nuts of the end cap are loosened evenly, approximately 5 to 10 mm. Place jig A and jig B on the lift table truck and place the end cap on them. Place the end cap with the filter facing up.



③ Place the lift table truck under the column and press the lever on the foot several times to raise and insert the end cap into the column. Raise the column until the end cap is fully inserted.

⚠Note

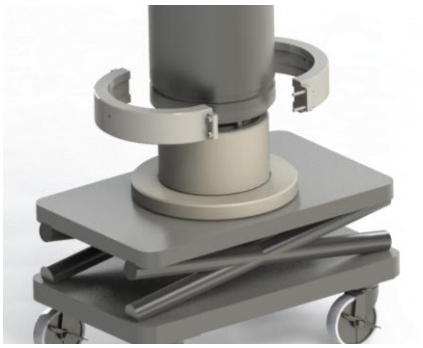
Be careful not to pinch your fingers.



④ After confirming that the end cap has entered, attach the clamp. Fix the clamps with the clamp lock bolts.

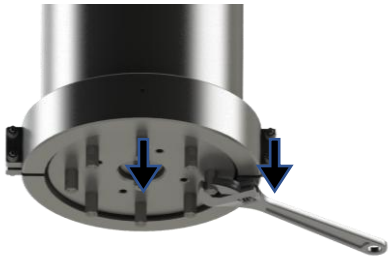
⚠Note

Never move the lift table truck until the clamp is securely tightened.



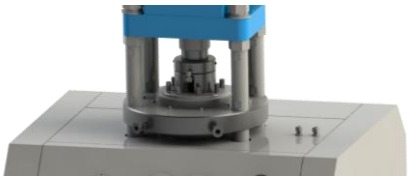
⑤ Make sure that the end cap is securely attached, and then slowly lower the lift table truck.

⑥ Tighten the seal nuts evenly. The seal is pushed out and sealed.



End cap disassembly procedure

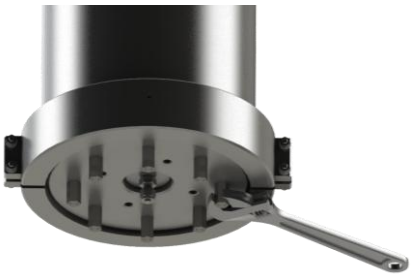
① Check that the cylinder with the movable stopper is fully raised.



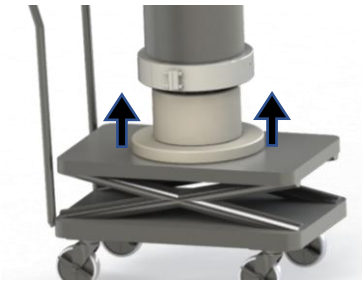
② Disconnect the piping (flexible hose) of the end cap.
Loosen the sealing nuts of the end cap evenly, approximately 5 to 10 mm.

⚠Note

Do not remove the seal nuts completely. When they are completely removed, the end cap filter may be left inside the column and may fall at unintentional timing.

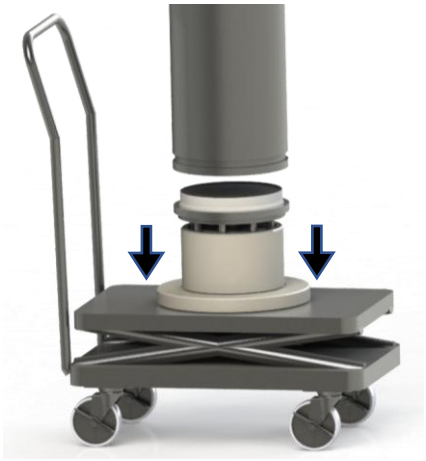


③ Install jig A and jig B on the lift table truck and move it directly below the end cap. Step on the lever at the foot to raise the lift table truck. When the seal nuts are pushed up by the lift table truck, the filter base is lifted, and the seal is loosened. Confirm that the end cap is not at a tilt and that the lift table truck securely supports the weight.



④ Check that the seal is loose, and the end cap is lifted, and then remove the clamp.

⑤ Rotate the valve of the lift table truck counterclockwise to slowly lower the top plate. At this time, observe whether the end cap is descending as the lift table truck moves down.



⚠Note

Slowly descend the end cap. Do not move the lift table truck down suddenly. It is dangerous because the end cap drops afterwards.

Note

The end cap is supposed to move down by its own weight. However, if it is not lowered along with the lift table truck, attach the clamp again and refer to step ③ while the load of the end cap is held by the truck.

Movable stopper disassembly procedure

① Remove the end cap first to remove the movable stopper.

② Put jig B on the lift table truck.

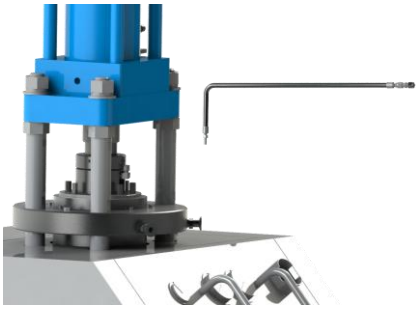
Notification

The jig surface comes in direct contact with the filter or seal. Make sure that there is no dirt, etc., on the contact surface.

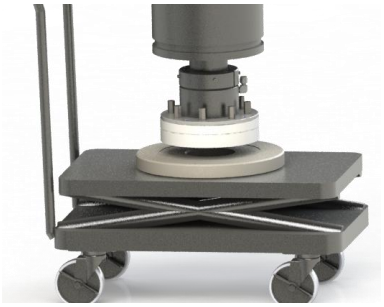
③ Remove the flexible tube with the cylinder at the top position. Loosen the seal nuts.

⚠Note

Do not remove the seal nuts completely. It is very dangerous as the filter base can drop suddenly.



④ Operate the cylinder and lower it to the bottom and then put the lift table truck under the movable stopper. At this time, confirm that the top plate of the lift table truck is at the lowest position. (Turn the valve under the handle to the left to lower the table.)

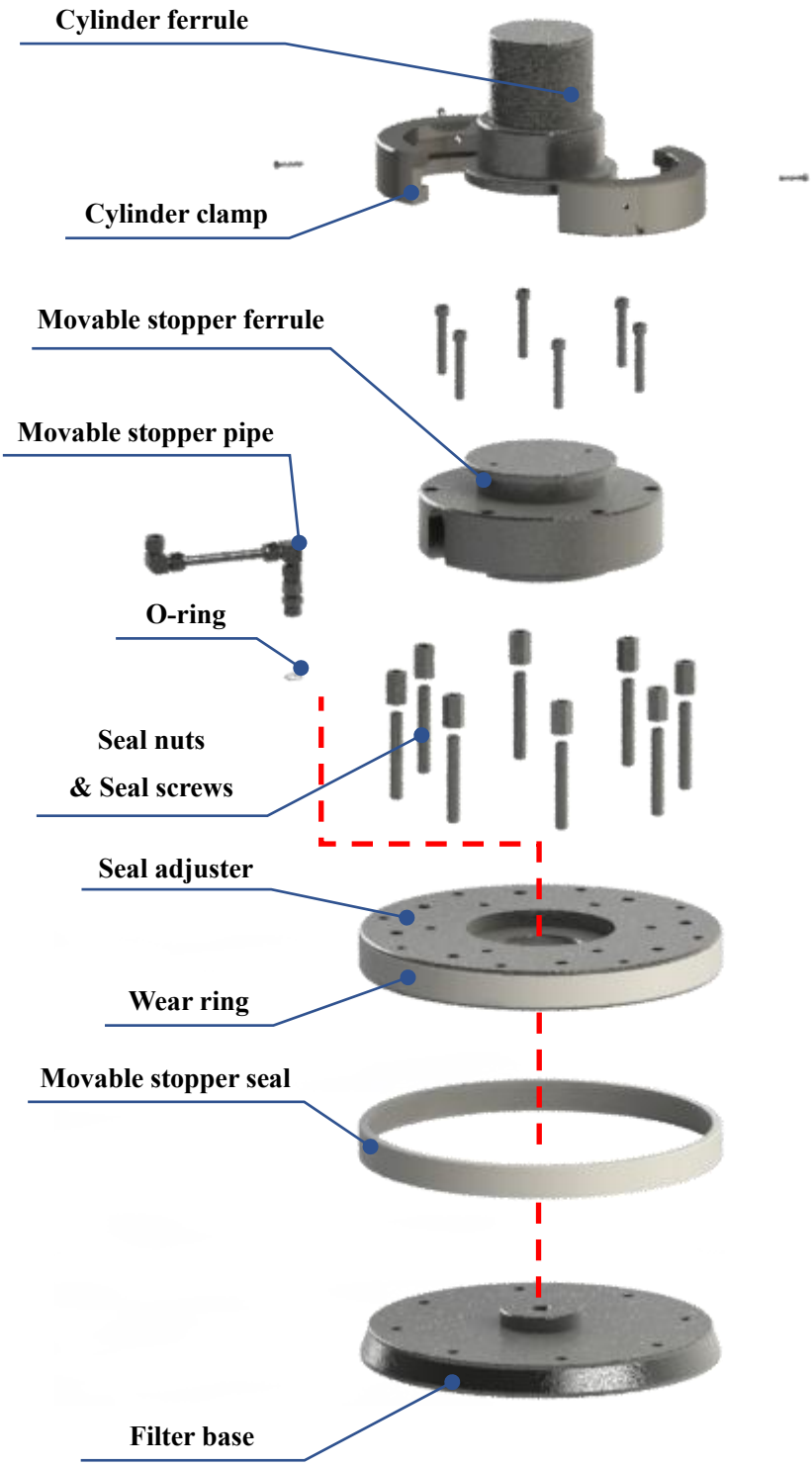


⑤ Step on the lever at the foot several times to raise the lift table truck which is located just under the movable stopper. Confirm that the movable stopper is not placed diagonally and that the lift table truck supports the weight securely.

⑥ Remove the cylinder clamp.
Lower the lift table truck to complete the disassembly.

6-4 DAD-300-700, DAD-450-700

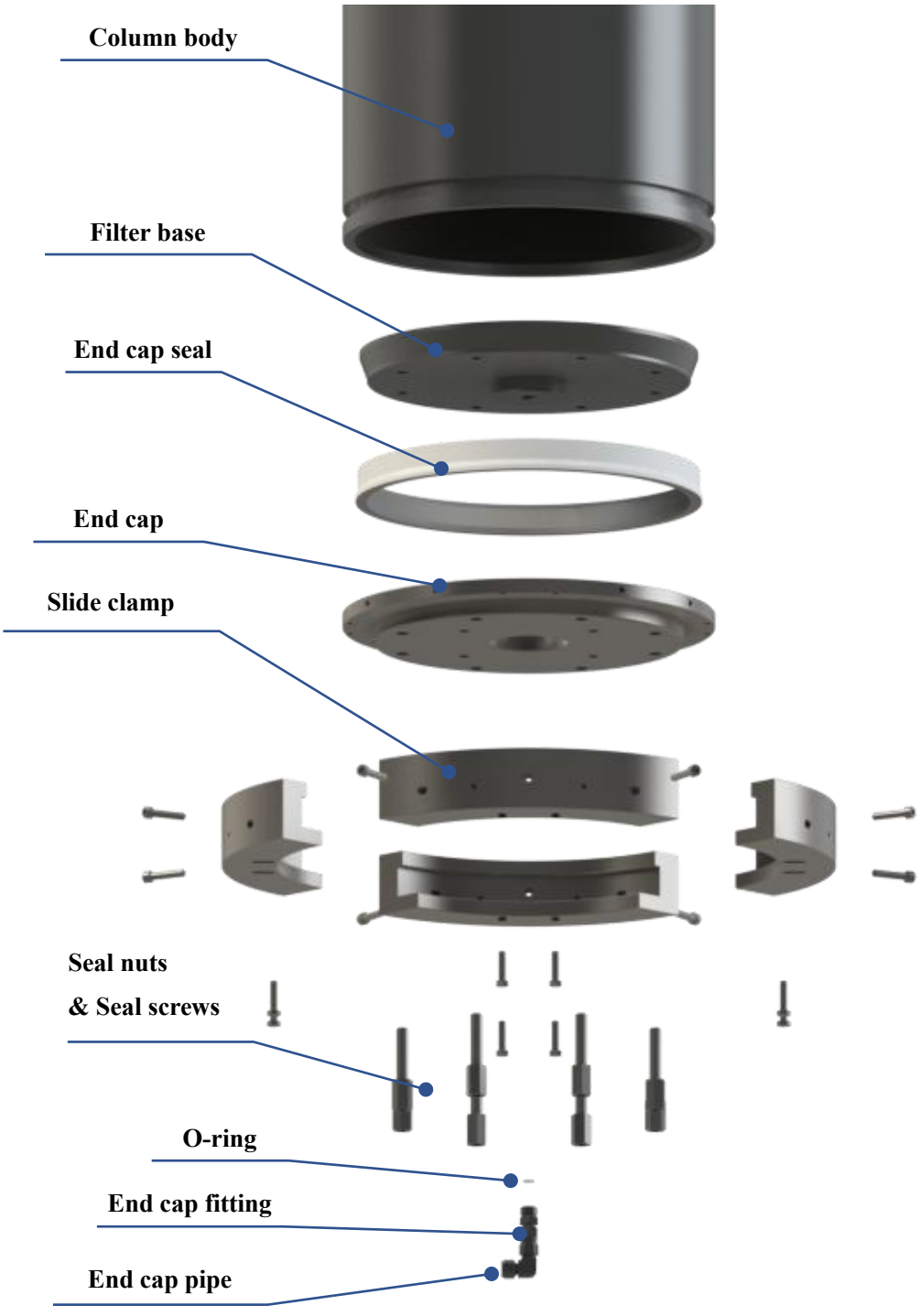
■ Movable stopper (DAD-300-700)



※Excluding cylinder ferrule, cylinder clamp

Model	Weight
DAD-300-700	About 54.2 kg

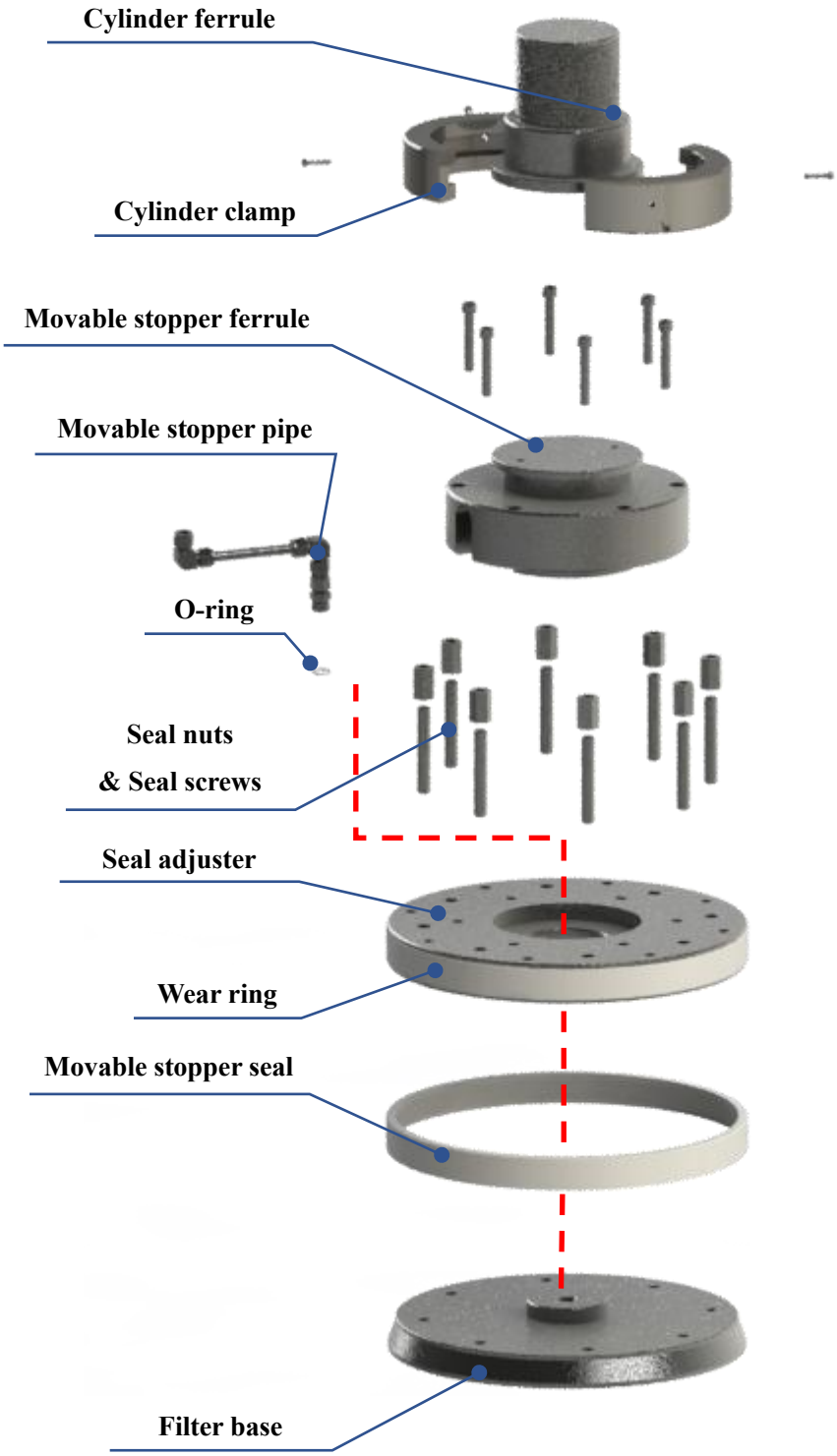
■ End cap (DAD-300-700)



Model	Weight
DAD-300-700	About 65.6 kg

※Excluding column bodys

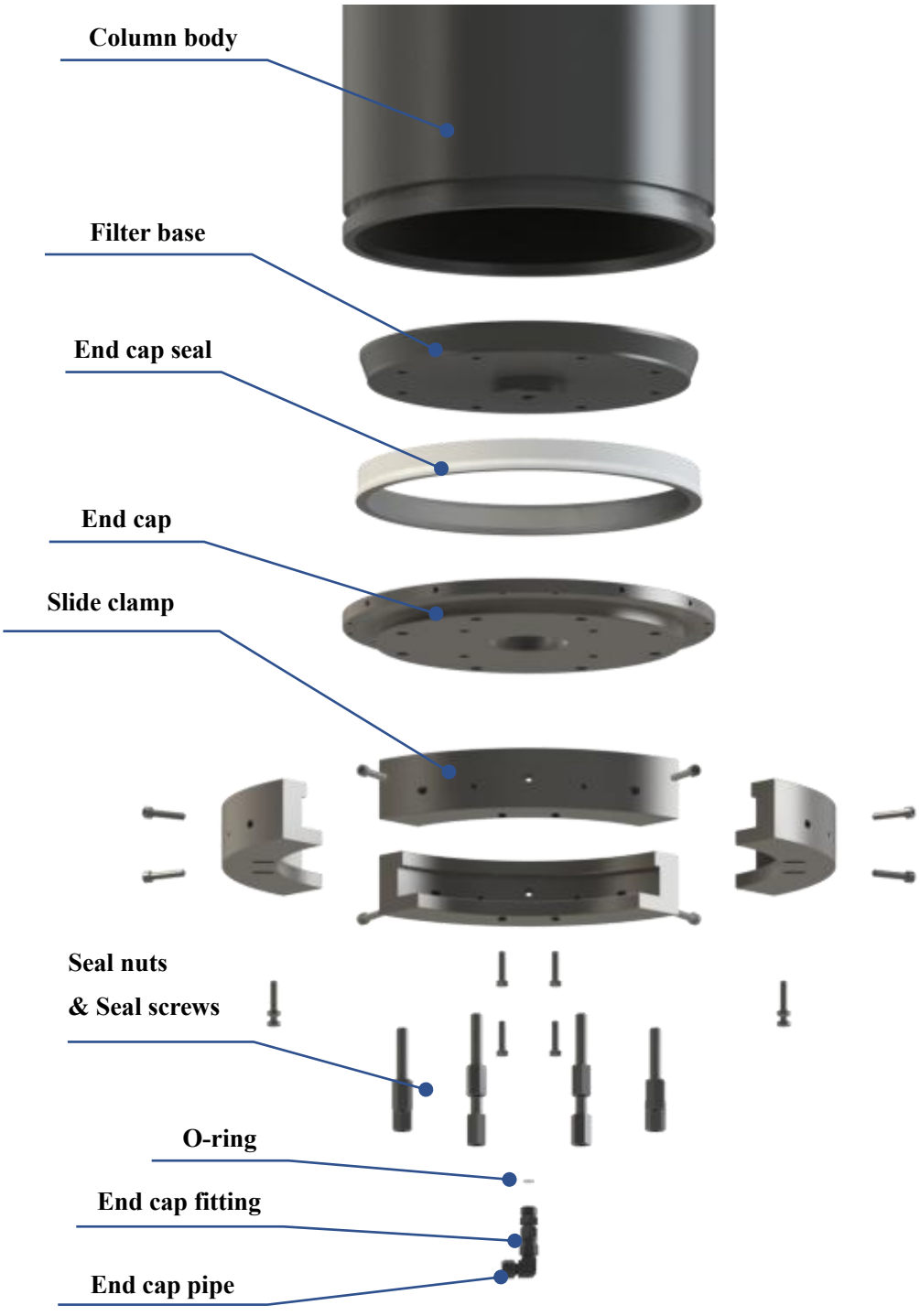
■ Movable stopper (DAD-450-700)



※Excluding cylinder ferrule, cylinder clamp

Model	Weight
DAD-450-700	About 151.3 kg

■ End cap (DAD-450-700)

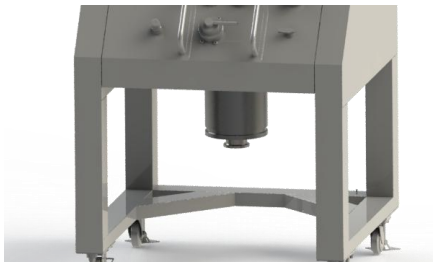


Model	Weight
DAD-450-700	About 146.5 kg

※Excluding column body

Movable stopper assembly procedure

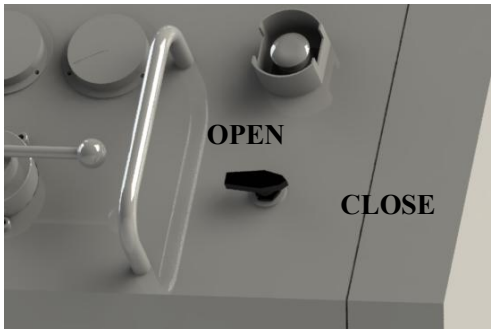
① Operate the hydraulic cylinder and lower it to the bottom.
The cylinder rod is exposed at the bottom of the column.
Turn the switching valve HOLD after the pump stops.



② Slowly turn the manual relief valve OPEN to release the oil pressure.
After releasing the hydraulic pressure, return the manual relief valve to CLOSE.

⚠Note

Do not put anything or body under the column.



③ Place jig B on the lift table truck.
Put the movable stopper on the jig B facing down the filter surface.
Move the lift table truck so that the movable stopper ferrule matches the cylinder ferrule from the bottom of the column.

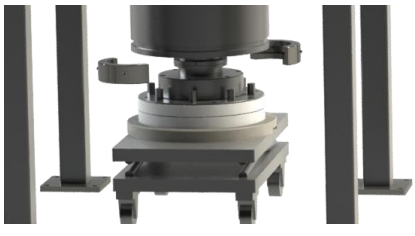
Notification

Be careful not to damage the filter surface.

④ Step on the lever at the foot to raise the lift table truck.
Push the movable stopper ferrule straight against the movable stopper joint.
Fix with cylinder clamp and fasten with attached screws.

⚠Note

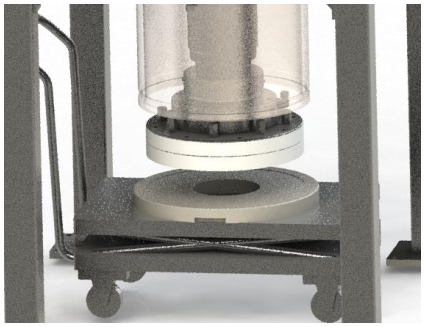
Be careful not to pinch your fingers.



Note

Cylinder clamps cannot be fastened if the movable stopper ferrule and the movable plug joint are not parallel.

⑤ Loosen all seal nuts to the extent that they can be turned by hand. Then, turn all the seal nuts until they are in light contact with the seal adjuster. Slowly lift the cylinder to ensure that the seal enters smoothly into the column.



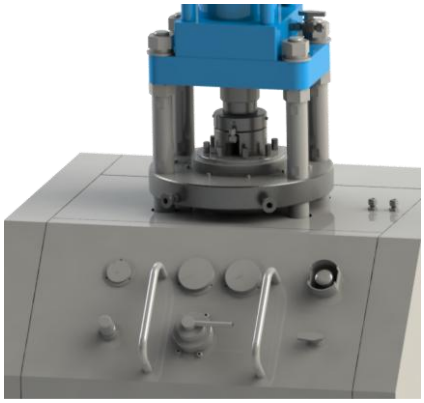
Notification

Check that the seal is loose before operating the product. If the cylinder is run without confirming if the seals are loosened, the seal may contact the column body end and cause deformation or damage.

⚠Note

Be careful not to get your fingers caught.

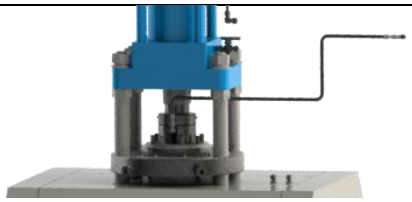
⑥ Raise the cylinder until the movable stopper is above the slurry port position. Look inside the column from the slurry port and check that the movable stopper seal does not block the slurry port hole.



Notification

When moving the cylinder to the top, be sure to observe the precautions for its operation in Section 4-5. When the movable stopper reaches the top, immediately turn the switching valve HOLD.

⑦ Attach the flexible tube to the movable stopper.



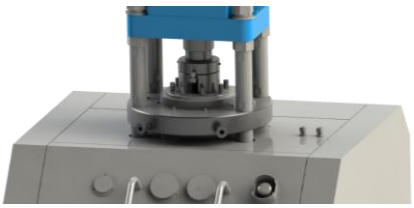
⑧ Tighten the seal nut evenly. The seal is pushed out and sealed.

Notification

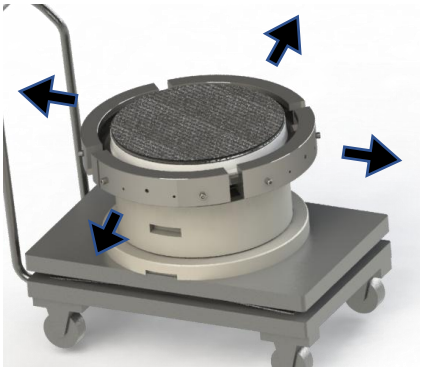
Tighten the seal nuts diagonally in small increments. If the nut is not tightened evenly, the filter base will tilt, leading to leakage or seal deformation.

End cap assembly procedure

① Check that the cylinder with the movable stopper is fully raised.



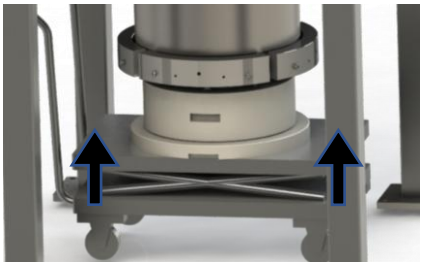
② Make sure that the sealing nuts of the end cap are loosened evenly, approximately 5 to 10 mm. Place jig A and jig B on the lift table truck and place the end cap on them. Place the end cap with the filter facing up. Extend each slide clamp to the maximum.



Notification

Be careful not to damage the seal or filter.

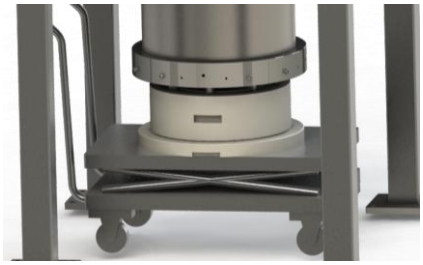
③ Place the lift table truck under the column and press the lever on the foot several times to raise and insert the end cap into the column. Raise the column until the end cap is fully inserted. If the slide clamp is not fully extended, it will collide the column body when inserting the end cap.



⚠Note

Be careful not to pinch your fingers.

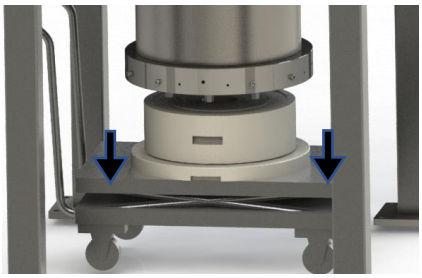
④ Attach the slide clamp after confirming that the end cap is inserted. Tighten the set screws of the slide clamp.



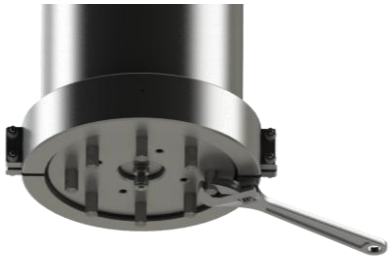
⚠Note

Never move the lift table truck until the clamp is securely tightened.

⑤ Make sure that the end cap is securely attached, and then slowly lower the lift table truck.

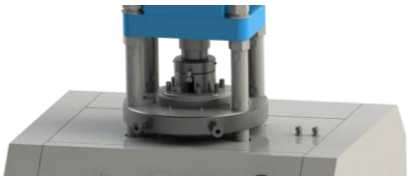


⑥ Tighten the seal nuts evenly. The seal is pushed out and sealed.



End cap disassembly procedure

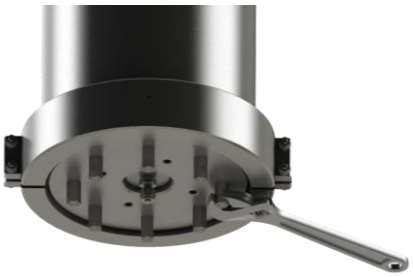
① Check that the cylinder with the movable stopper is fully raised.



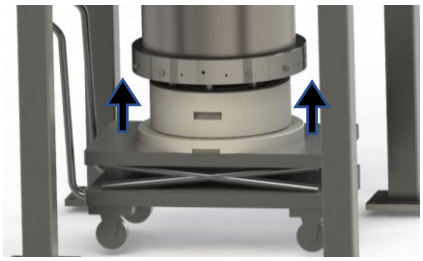
② Disconnect the piping (flexible hose) of the end cap.
Loosen the sealing nuts of the end cap evenly, approximately 5 to 10 mm.

⚠Note

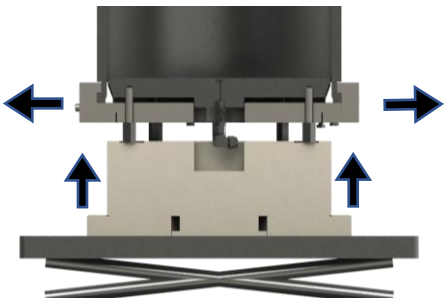
Do not remove the seal nuts completely. When they are completely removed, the end cap filter may be left inside the column and may fall at unintentional timing.



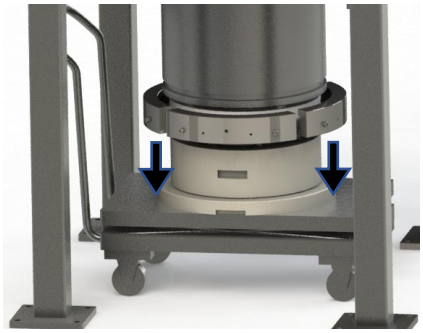
③ Install jig A and jig B on the lift table truck and move it directly below the end cap. Step on the lever at the foot to raise the lift table truck. When the seal nuts are pushed up by the lift table truck, the filter base is lifted, and the seal is loosened. Confirm that the end cap is not at a tilt and that the lift table truck securely supports the weight.



④ Check that the seal is loose, and the end cap is lifted, and then loosen the clamp.



⑤ Rotate the valve of the lift table truck counterclockwise to slowly lower the top plate. At this time, observe whether the end cap is descending as the lift table truck moves down.



⚠Note

Slowly descend the end cap. Do not move the lift table truck down suddenly. It is dangerous because the end cap drops afterwards.

Note

The end cap is supposed to move down by its own weight. However, if it is not lowered along with the lift table truck, attach the clamp again and refer to step ③ while the load of the end cap is held by the truck.

Movable stopper disassembly procedure

① Remove the end cap first to remove the movable stopper.

② Put jig B on the lift table truck.

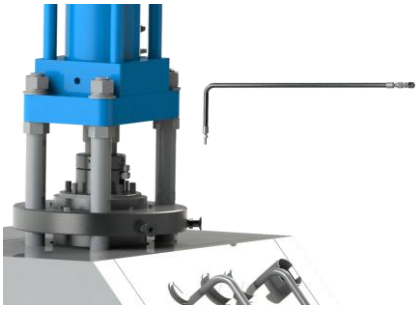
Notification

The jig surface comes in direct contact with the filter or seal. Make sure that there is no dirt, etc., on the contact surface.

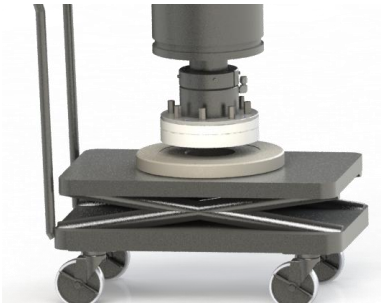
③ Remove the flexible tube with the cylinder at the top position. Loosen the seal nuts.

⚠Note

Do not remove the seal nuts completely. It is very dangerous as the filter base can drop suddenly.



④ Operate the cylinder and lower it to the bottom and then put the lift table truck under the movable stopper. At this time, confirm that the top plate of the lift table truck is at the lowest position. (Turn the valve under the handle to the left to lower the table.)

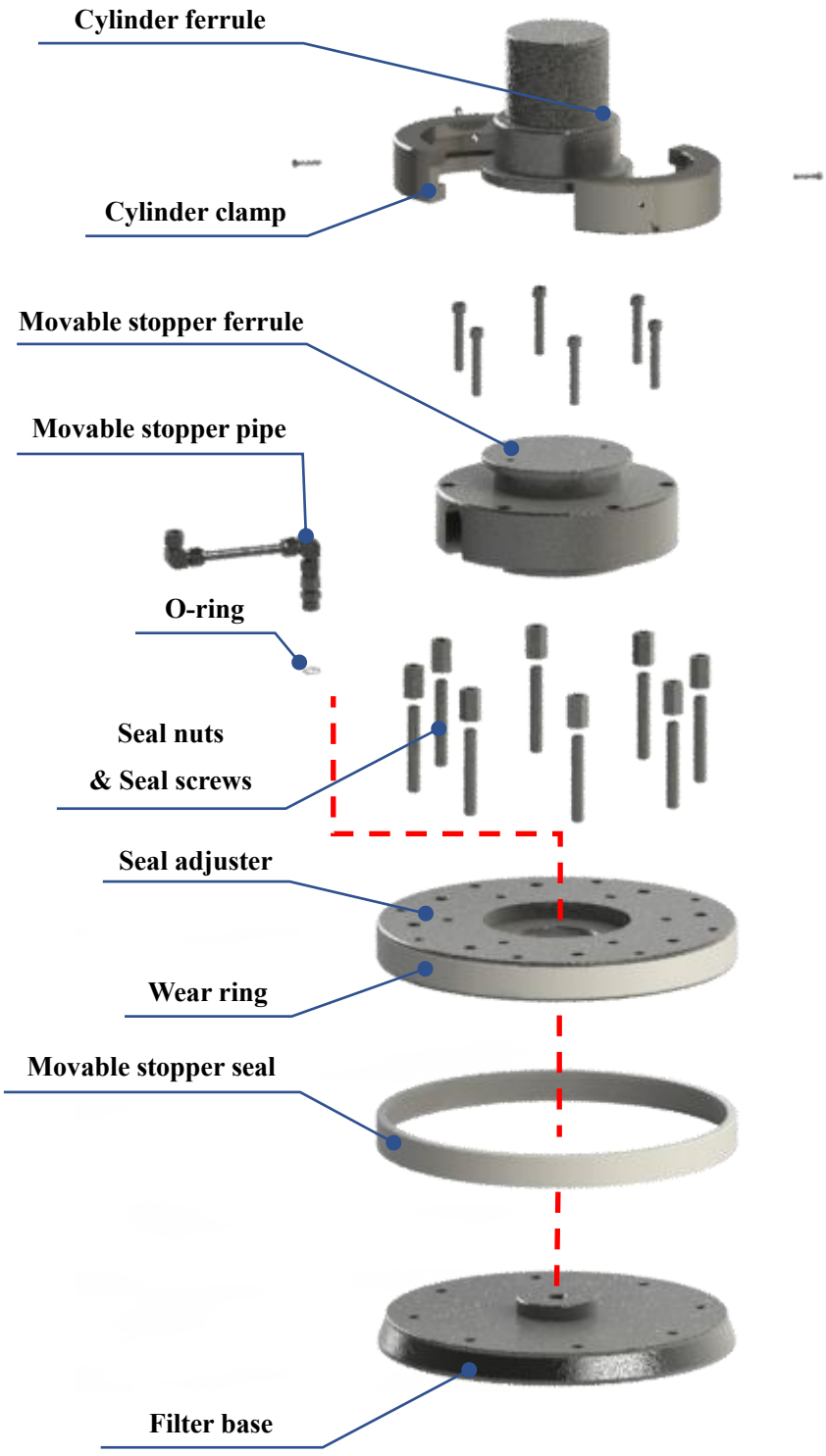


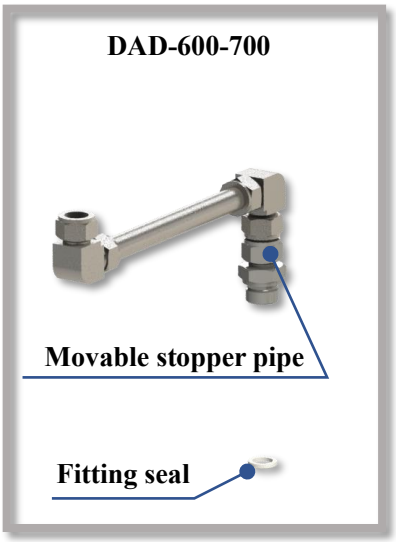
⑤ Step on the lever at the foot several times to raise the lift table truck which is located just under the movable stopper. Confirm that the movable stopper is not placed diagonally and that the lift table truck supports the weight securely.

⑥ Remove the cylinder clamp.
Lower the lift table truck to complete the disassembly.

6-5 DAD-600-700

■ **Movable stopper**

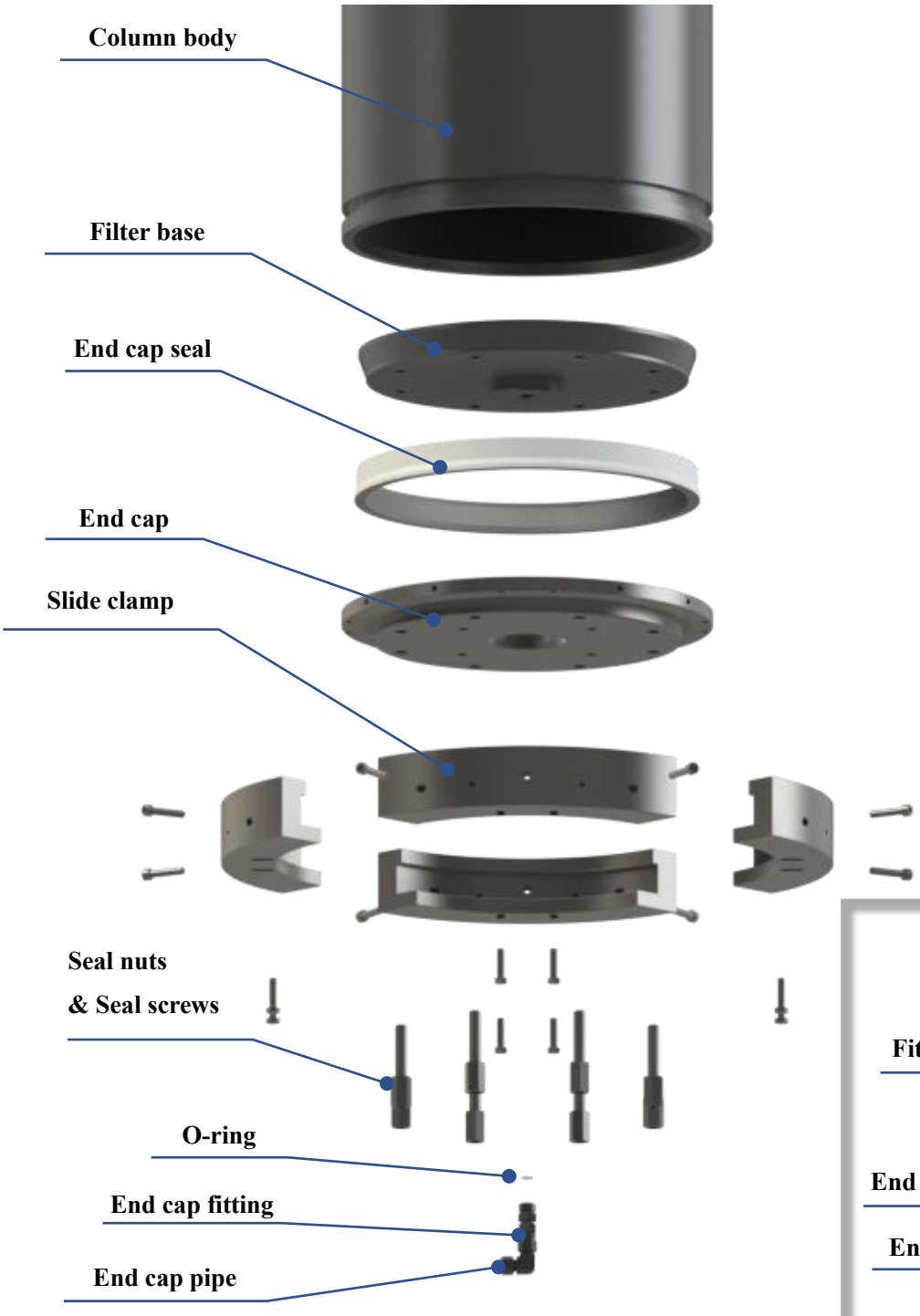


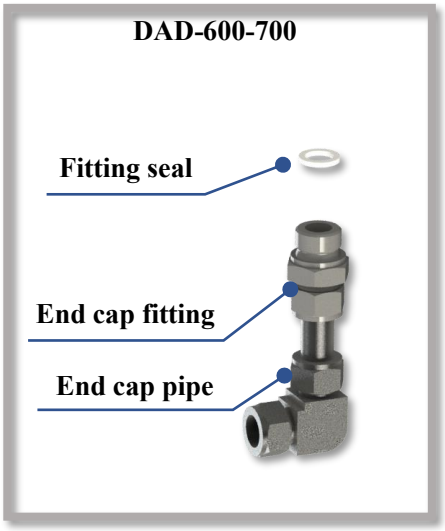


※Excluding cylinder ferrule, cylinder clamp

Model	Weight
DAD-600-700	About 336.5 kg

■ End cap





Model	Weight
DAD-600-700	About 378.3 kg

※Excluding column body

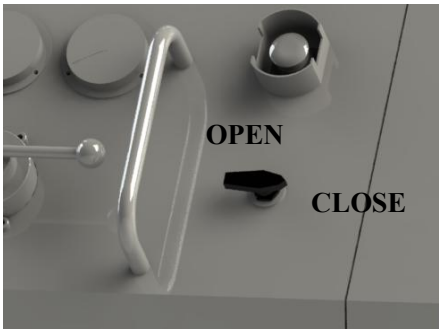
Movable stopper assembly procedure

① Operate the hydraulic cylinder and lower it to the bottom.
The cylinder rod is exposed at the bottom of the column.
Turn the switching valve HOLD after the pump stops.

② Slowly turn the manual relief valve OPEN to release the oil pressure.
After releasing the hydraulic pressure, return the manual relief valve to CLOSE.

⚠Note

Do not put anything or body under the column.



③ Insert the hand pallet truck into SUS pallet.
Place the movable stopper on SUS pallet with the filter side facing down.
Move the hand pallet truck so that so that the movable stopper ferrule matches the cylinder ferrule from the bottom of the column.

Notification

Be careful not to damage the filter surface.

④ Step on the lever at the foot to raise the hand pallet truck.
Push the movable stopper ferrule straight against the movable stopper joint. Fix with cylinder clamp and fasten with attached screws.

⚠Note

Be careful not to pinch your fingers.

⑤ Loosen all seal nuts to the extent that they can be turned by hand. Then, turn all the seal nuts until they are in light contact with the seal adjuster. Slowly lift the cylinder to ensure that the seal enters smoothly into the column.

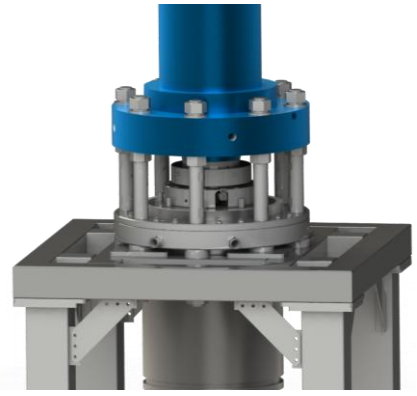
Notification

Check that the seal is loose before operating the product. If the cylinder is run without confirming if the seals are loosened, the seal may contact the column body end and cause deformation or damage.

⚠Note

Be careful not to get your fingers caught.

⑥ Raise the cylinder until the movable stopper is above the slurry port position. Look inside the column from the slurry port and check that the movable stopper seal does not block the slurry port hole.

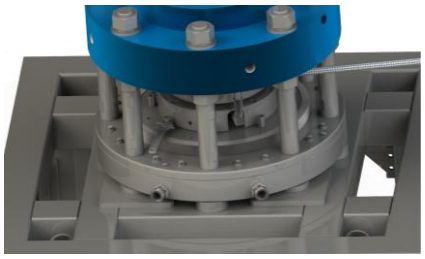


Notification

When moving the cylinder to the top, be sure to observe the precautions for its operation in Section 4-5. When the movable stopper reaches the top, immediately turn the switching valve HOLD.

⑦ Attach the flexible tube to the movable stopper.

⑧ Tighten the seal nut evenly. The seal is pushed out and sealed.



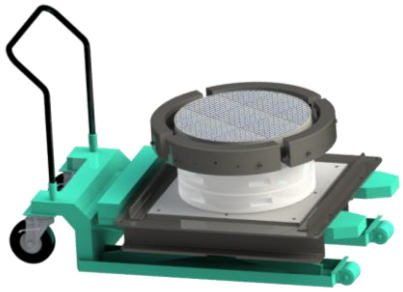
Notification

Tighten the seal nuts diagonally in small increments. If the nut is not tightened evenly, the filter base will tilt, leading to leakage or seal deformation.

End cap assembly procedure

① Check that the cylinder with the movable stopper is fully raised.

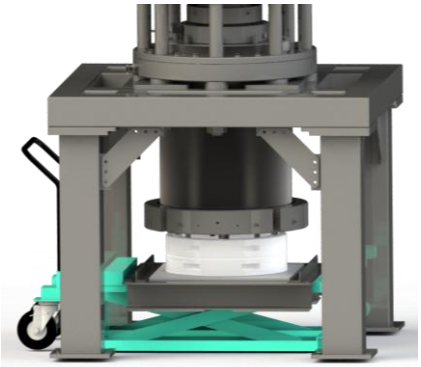
② Make sure that the sealing nuts of the end cap are loosened evenly, approximately 5 to 10 mm. Place jig A and jig B on the SUS pallet in this order and place the end cap on them. Place the end cap with the filter facing up.
Extend each slide clamp to the maximum.



③ Slide the end cap under the column and lift the hand pallet truck up to insert it into the column. Raise the column until the end cap is fully inserted. If the slide clamp is not fully extended, it will collide the column body when inserting the end cap.

⚠Note

Be careful not to pinch your fingers.



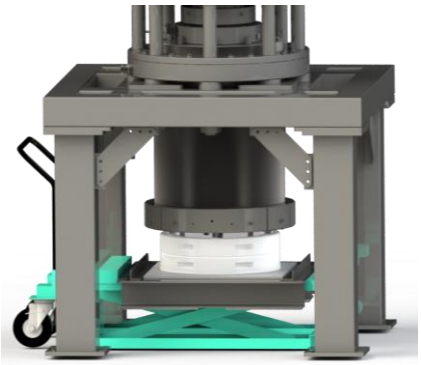
④ Attach the slide clamp after confirming that the end cap is inserted. Tighten the set screws of the slide clamp.

⚠Note

Never move the hand lifter truck until the clamp is securely tightened.

Note

The slide clamp cannot be fastened if the lower end of the column body and the end cap are not parallel.



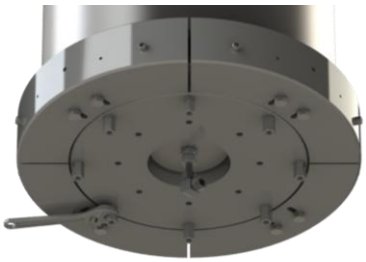
⑤ Make sure that the end cap is securely attached, and then slowly lower the hand pallet truck.

⑥ Tighten the seal nuts evenly. The seal is pushed out and sealed.

End cap disassembly procedure

① Check that the cylinder with the movable stopper is fully raised.

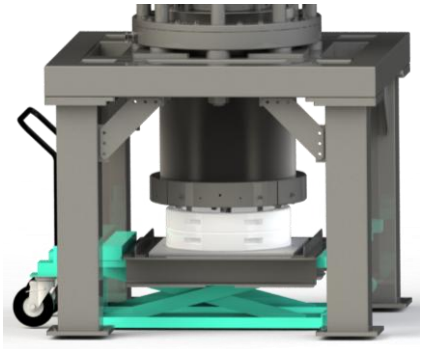
② Disconnect the piping (flexible hose) of the end cap.
Loosen the sealing nuts of the end cap evenly, approximately 5 to 10 mm.



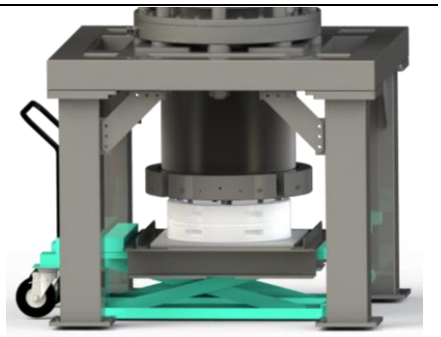
⚠Note

Do not remove the seal nuts completely. When they are completely removed, the end cap filter may be left inside the column and may fall at unintentional timing.

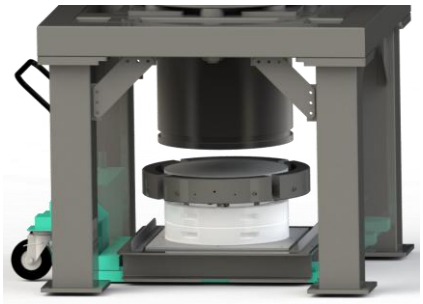
③ Insert the hand pallet truck into SUS pallet and place jig A and jig B on this in this order. After moving directly below the end cap, raise the hand pallet truck by stepping on the lever at the foot several times.
When the seal nuts are pushed up by the hand pallet truck, the seal is loosened as the loosened seal nuts are pushed up by the hand pallet truck. Confirm that the end cap is not at a tilt and that the lift table truck securely supports the weight.



④ Check that the seal is loose, and the end cap is lifted, and then loosen the slide clamp.



⑤ Pull the lever of the hand pallet truck to slowly lower the top plate.
At this time, observe whether the end cap is descending as the hand pallet truck moves down.



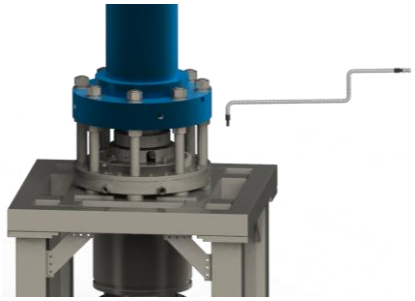
⚠Note

Slowly descend the end cap. Do not move the hand pallet truck down suddenly. It is dangerous because the end cap drops afterwards.

Movable stopper disassembly procedure

① Remove the end cap first to remove the movable stopper.

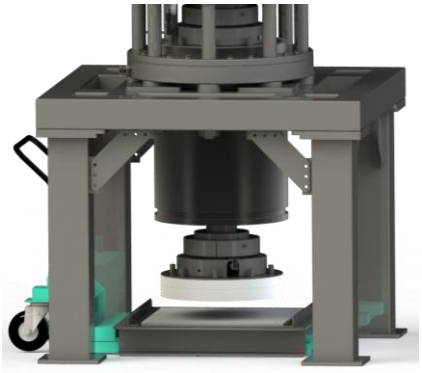
② Remove the flexible tube with the cylinder at the top position. Loosen the seal nuts.



⚠Note

Do not remove the seal nuts completely. It is very dangerous as the filter base can drop suddenly.

③ Operate the cylinder and lower it to the bottom position. Put SUS pallet under the movable stopper. At this time, confirm that the height of the hand pallet truck is at the lowest position. (Turn the valve under the handle to the left to lower the hand pallet truck.)

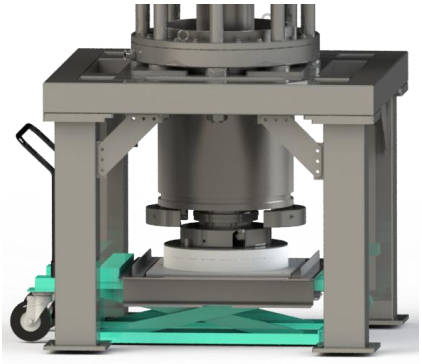


Notification

The upper surface of the SUS pallet comes in direct contact with the filter or seal. Make sure that there is no dirt, etc., on the contact surface.

④ Step on the lever at the foot several times to raise the lift table truck which is located just under the movable stopper.
Confirm that the movable stopper is not placed diagonally and that the lift table truck supports the weight securely.

⑤ Remove the cylinder clamp.
Lower the SUS pallet to complete the procedure.



7 PACKING

7-1 Precautions for Packing

Notification

Be sure to prepare and check this section before packing.

⚠Warning

When using an organic solvent, avoid fire and take sufficient countermeasures against static electricity.
Provide adequate ventilation.

Make sure to connect the ground (earth) correctly. Static electricity may cause ignition, etc.
In addition, take measures against static electricity for all equipment and personnel in contact with this device.

⚠Note

Do not feed slurry larger than the column capacity.

Wear proper personal protective equipment.

Liquid, dust : Safety glasses, masks, gloves
Falling object : Safety shoes and gloves
Static electricity : Antistatic safety shoes and antistatic work clothes
Noise : Earplugs or earmuffs

7-2 Preparation

① Inside column is empty.

② Supply air pressure is sufficient.

③ The movable stopper does not block the slurry port hole, and the slurry can be fed into the column.

④ The flexible tube is attached to the movable stopper side and the end of the tubing is opened.

⑤ The flexible tube is attached to the end cap side and the end of the tubing is closed.

⑥ The seal nuts of the movable stopper are securely tightened.

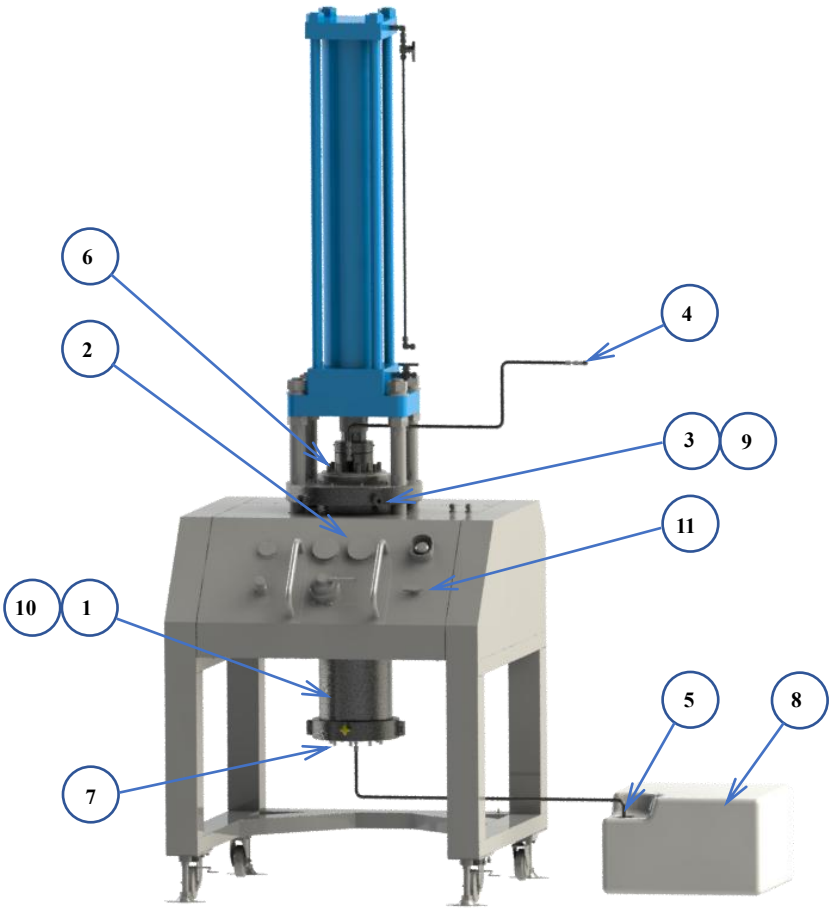
⑦ The seal nuts of the end cap are securely tightened.

⑧ A waste liquid container is provided.

⑨ The pipe of the slurry container (or other slurry transfer unit) is connected to the slurry port of the column and the other slurry port is unplugged.

⑩ The column and slurry container shall be grounded.

⑪ The manual pressure-release valve is CLOSE (except for DAD-50).



7-3 Slurry Preparation

Note

The packing conditions vary depending on the type of resin.

Contact the resin manufacturer for optimal conditions such as slurry solvent, slurry concentration, and packing pressure.

① Examples of packing conditions can be found in Chapter 11, Reference. Calculate the amount of resin and the amount of slurry from the desired bed length and weigh them. Calculate the total slurry volume, which is the sum of the slurry volume (resin volume + slurry solvent volume) and the wash-in solution, beforehand, and keep the volume below the maximum capacity of the column.

② Operate the valve of the slurry container so that the fluid discharged by the slurry pump becomes the circulation flow path returning to the slurry hopper.

③ Feed the slurry solvent into the slurry hopper.
When feeding, use a slurry pump to suck in the solvent or load it from the upper part of the hopper.
You can wash the inner wall by placing about 10% of the required amount of slurry solvent separately.

④ Make sure that compressed air is supplied to the slurry container.
If there is a stirrer, read the pressure indication on the pressure control valve of the agitator and check that sufficient compressed air is supplied.

⑤ Add the resin while agitating the slurry solvent.
For the agitation method, follow the method A or B in ⑥ below.

⑥ **A: Without agitator**
Set the pressure adjustment valve to the desired pressure and operate the slurry pump.
Check that the solvent is sufficiently agitated by circulating agitation with the slurry pump.
B: With agitator
Turn ON the agitator with the flow restrictor dial on the agitator being the desired value.
Make sure the stirrer is rotating, and the solvent is well stirred.

Note

If the agitator blade is exposed, reduce the rotation speed slightly.

If more than one solvent is used, the mixing time should be set.

When the resin is fed, increase the rotation speed as appropriate according to the condition of the liquid level. With the addition of resin, the liquid amount and the viscosity increases. The rotation speed required to eventually equalize the slurry should be more than 250 rpm.

⑦ Feed the resin into the hopper while the solvent is agitated. During the feed, the slurry becomes uniformed more smoothly if the resin mass is loosened.

Note

If the resin is fed at one time, it will accumulate on the liquid surface and more likely to adhere to the wall.

It can also cause deposit of the resin.

The resin should be fed below 2.5 kg/min.

⑧ After the resin is fed, stir for about 10 minutes so that the slurry is sufficiently uniform. The slurry solvent removed in step ③ can be used to wash the inner wall.

⑨ Observe the hopper liquid surface to ensure that it is sufficiently uniform. If a mass is found, add a stirring time of 10 minutes. If the agitator speed can be increased, raise the agitator speed.

⑩ Connect the hose between the column and the slurry container before the slurry is stirred sufficiently.
Also, make sure that the column ready for packing at this point.

⑪ **(with agitator only)**
Turn ON the switch with the pressure-regulating valve on the slurry pump being the desired value. Perform circulation operation to uniform the slurry including in the flow passage.

Notification

Do not circulate with the slurry pump for more than 30 minutes.
Especially for large particle size resin, prolonged operation can lead to particle crushing.

The slurry should be stirred uniformly for packing. If you pack with insufficient agitation (such as when the resin mass remains), the resin may not be packed properly.

7-4 Packing

① Connect the discharge port of the slurry container and the slurry port of the column with the piping.

② Turn the switching valve HOLD.

③ Turn the dial of the pressure control valve to increase the hydraulic pressure to the required value.

Note

Refer to "4-5 Control Panel" for the items related to the pressure control valve.

Refer to the item on packing pressure in "4-5 Control Panel" for the hydraulic pressure setting.

④ Check that the slurry is stirred uniformly and switch the valve of the slurry container so that the flow path is connected from the slurry pump to the slurry port.

⑤ The slurry pump feeds the slurry into the column.

Note

Air in the column is discharged from the ends of the other slurry port or movable stopper tube.

If air is ejected, a small amount of slurry solvent may be discharged together.

The solvent should be directed to a slurry container or other container.

⑥ When the slurry is running out, the pump starts to idle. Stop the slurry pump.

Just before the slurry runs out, the flow path can be flushed by feeding additional slurry solvent to the slurry container.

Notification

For models equipped with an agitator, stop the agitator when the slurry in the hopper decreases and the agitating blade is exposed.

⑦ Operate the switching valve in the packing direction. As the movable stopper moves, air is discharged from there for a while.

⑧ Turn the switching valve HOLD once the slurry solvent is discharged from the movable stopper.
Since slurry solvent is discharged from the movable stopper pipe, it should be directed to the waste liquid container.

⚠Note

Slurry solvent is vigorously discharged from the movable stopper pipe.
Take appropriate measures to avoid scattering.

⑨ Plug the movable stopper pipe and unplug the end cap pipe. Since slurry solvent is discharged from the end cap piping, it should be directed to the waste liquid container.

⑩ Turn the switch valve to the packing direction to move the movable stopper. Packing starts.

⑪ A packing bed is formed, and the movable stopper stops automatically when the monitoring oil pressure reaches the set oil pressure.
To stabilize the packing bed, leave it in this condition for about one hour.

⑫ Packing is complete.

Notification

Do not operate the switching valve, pressure control valve, or other devices on the control panel or shut off the utility supply until the packing material is removed. This can cause a drop in column performance.

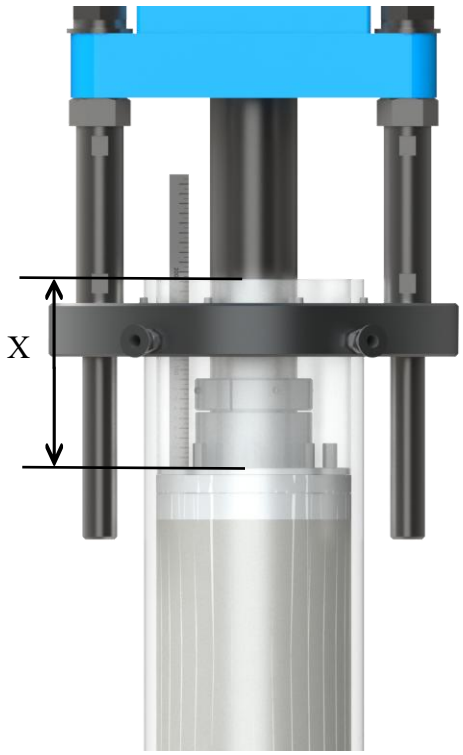
Note

When the particle size of the resin is 50 μm or more, the sedimentation speed of the particles increases, and the packing results vary depending on the time required for the task. "Sedimentation packing" that forms a natural sedimentation layer with a standing time of 12 hours or more after step ⑤ tends to be more stable and high performance.
When performing "Sedimentation packing", skip the procedures ⑦ to ⑨.

7-5 Bed Length Measurement

Calculate the bed length of the packed column. Measure the length of X with a tape measure for calculation.

X is the distance from the end of the column body to the seal adjuster surface.



The bed length is calculated using the following formula.

Bed length = Effective column length - X [mm]

Note

Refer to "3-1 DAC column" for the effective length.

7-6 Equilibration

Connect a HPLC system to the column. Feed the solvent to be used upwards to discharge air. The column is then equilibrated according to the conditions of equilibration.

After equilibration is completed, evaluate the number of theoretical plates under the specified evaluation conditions.

7-7 Unpacking

① Just before unpacking, pass 1CV or more of the solvents through the columns to moisten the resin.

Note

The recommend the alcoholic solvents such are methanol, ethanol, and IPA as wetting solvents for common C18, silica gel, and other resins.

Notification

Without this procedure, the resin inside the column may fall during unpacking.

Depending on the property of the resin, the wetting solvent, and the preparative sample, the resin inside the column may fall during unpacking even after this procedure. Contact the resin manufacturer for details.

② Plug the flexible tube on the movable stopper side and unplug the end cap side.

Notification

If this procedure is not done properly, the resin inside the column may fall during unpacking.

③ Turn the switching valve HOLD and slowly open the manual pressure-relief valve.
Check that the pressure indication of the monitoring oil pressure has returned to 0, and close the manual pressure release valve again.

④ Turn the switching valve in the opposite direction to the packing. Move the movable stopper about 50 to 100 mm and then turn HOLD the switching valve.

⑤ Remove the end cap.

Note

Refer to "Disassembly procedure" for the procedure for removing the end cap.

⑥ Push the resin out with a movable stopper and collect it.

⑦ After collecting the resin, the residual resin inside the column should also be removed.

8 MAINTENANCE

8-1 Disassembly and Cleaning of Movable stopper

Packing and unpacking of movable stoppers may cause contamination of resin, etc.

The product can be used in a clean condition without accumulating dirt if disassembling and cleaning is done each unpacking.

■ **Columns up to 200 mm I.D.**

① Remove the movable stopper from the column by referring to Chapter 6.

② Place jig B or on a clean worktable with the filter side of the movable stopper facing down.

③ Disassemble the movable stopper ferrule, movable stopper pipe, seal adjuster, and movable stopper seal in order.

④ Wipe off any dirt sticking to the disassembled parts. At this time, each of the components (filter base and other parts) can be jet cleaned or ultrasonically cleaned individually.

⑤ After drying, assemble the movable stopper by referring to Chapter 6.

■ **Columns 300 mm I.D or more**

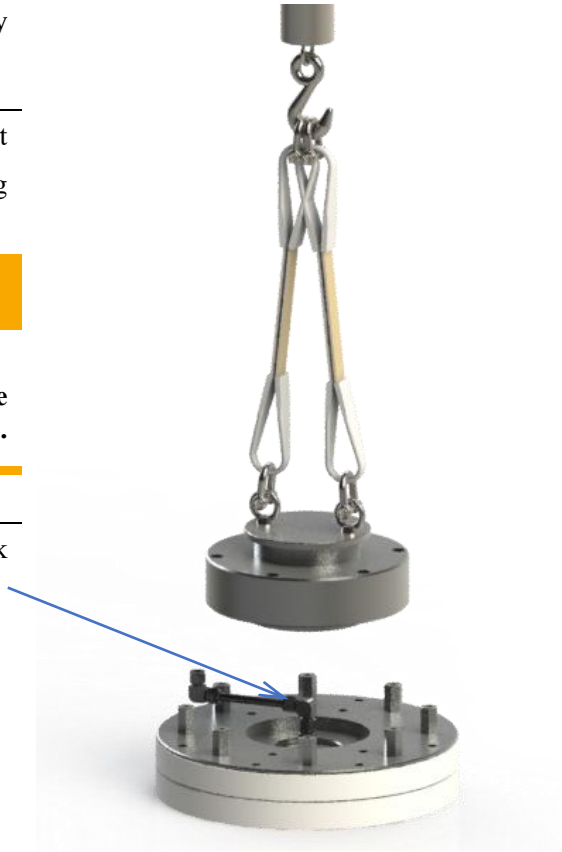
① Remove the movable stopper from the column by referring to Chapter 6.

② Remove the movable stopper ferrule. For models that have screw holes for hanging, use the attached hanging tools (eyebolts, shackles, and sling belts).

⚠Note

The movable stopper parts are heavy. Handle with care. Work with qualified personnel as required.

③ Remove the movable stopper pipe from Swagelok fitting.



④ Remove all sealing nuts. Leave the seal screws attached to the filter base.

⑤ Remove the seal retainer using the supplied hanging tools.

⑥ Remove the movable stopper seal.

⑦ Wipe off any dirt sticking to the disassembled parts. Each part can be wiped or jet cleaned while hanging.

Note

Clean so that no resin remains in the arrow points.

⑧ After drying, assemble the movable stopper by referring to Chapter 6.

Note

Tips on assembly

- Align the pipe and the movable stopper ferrule at the step of returning the seal adjuster.
- After aligning the seal screws and the holes of the seal adjuster, move the filter base up with the lift table truck and assemble it.
- Tighten the seal nuts until they make light contact with the seal adjuster, and then loosen it by 90°.

8-2 Disassembly and Cleaning of End cap

Packing and unpacking of the end cap may cause contamination of the resin, etc.

The product can be used in a clean condition without accumulating dirt if disassembling and cleaning is done each unpacking.

■ **Columns up to 200 mm I.D.**

① Remove the end cap from the column by referring to Chapter 6.

② Place jig B or on a clean worktable with the filter side of the end cap facing down.

③ Disassemble the end cap and the end cap seal in order.

④ Wipe off any dirt sticking to the disassembled parts. At this time, each of the components (filter base and other parts) can be jet cleaned or ultrasonically cleaned individually.

⑤ After drying, assemble the end cap by referring to Chapter 6.

■ **Columns 300 mm I.D or more**

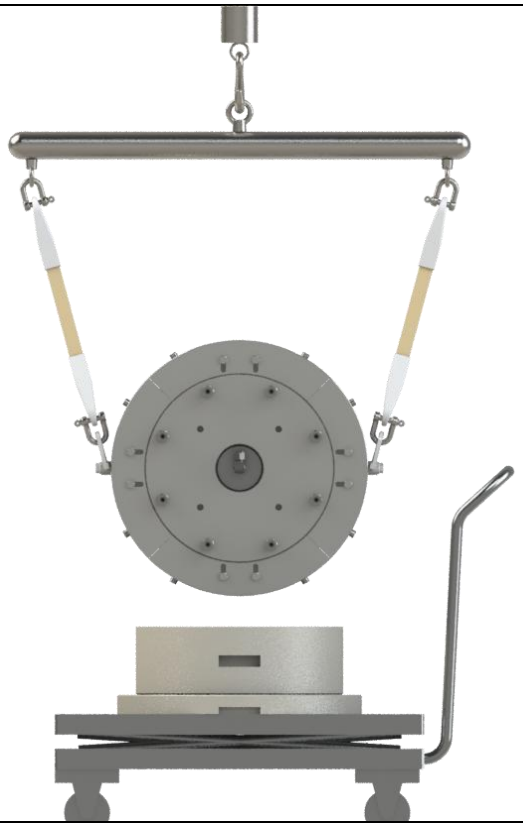
① Remove the end cap from the column by referring to Chapter 6.

② Close the slide clamp and fix it with the screws for the clamp. Attach the rotational eyebolt attached to the slide clamp.

③ Use the attached lifting gear (lifting beam, shackle, sling belt) to lift the end cap assembly.

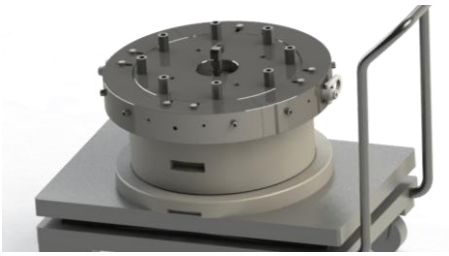
⚠Note

End cap parts are heavy. Handle with care. Work with qualified personnel as required.



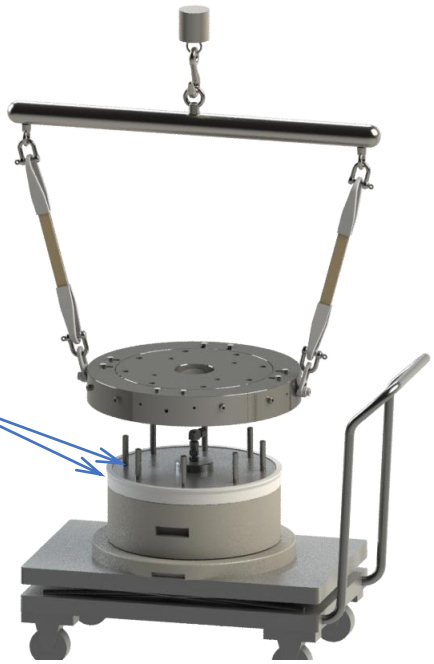
④ Turn the end cap so that the filter surface is at the bottom while lifting.

⑤ Place the end cap on the jig with the filter side facing down.



⑥ Remove all sealing nuts. Leave the seal screws attached to the filter base.

⑦ Remove the end cap + slide clamp using the supplied lifting gear.



Note

Clean so that no resin remains in the arrow points.

⑧ Remove the end cap seal.

⑨ Wipe off any dirt sticking to the disassembled parts. Each part can be wiped or jet cleaned while hanging.

⑩ After drying, assemble the end cap + slide clamp to the filter base and attach all sealing nuts. Tighten the sealing nuts until they make light contact with the end cap.

⑪ Suspend a set of end cap and turn the filter face up.

⑫ While lifting, loosen the sealing nuts evenly, approximately 5 to 10 mm.

⑬ After lowering the set of end cap, align the set with the center of the jigs before placing it on the lift table truck

Note

It is easy to place the end cap set on the jigs by raising the lift table truck.

⑭ Assemble the end cap by referring to Chapter 6.

8-3 Filter Cleaning

The filter may become blocked by sample sticking, resin, or other factors.

Perform cleaning according to the following method. Periodic cleaning is more effective.

■ **Blockage by sample**

Attach the movable stopper and end cap with the column empty and connect the column to HPLC pumps.

Feed appropriate solvents so that stuck sample can be dissolved. Reverse flow cleaning is also effective.

■ **Blockage by resin particles**

If the filter is clogged with resin, perform jet cleaning or ultrasonic cleaning.

The effect of cleaning can be confirmed by observing the filter surface with a microscope, etc.

If the cleaning described above does not work, perform the following cleaning using basic solutions.

① Remove the end cap and movable stopper.

② Soak in cleaning solution. Prepare the following cleaning liquid according to the packing material used.

Normal phase: 1 mol/L NaOH aqueous solution

Reverse phase: 2 mol/L NaOH in 50～60% EtOH aqueous solution (EtOH can be replaced by MeOH or IPA)

* It is more effective if the temperature of the solution is about 40℃.

③ Ultrasonically wash for about 30 minutes.

④ Soak in purified water and wash ultrasonically.

Repeat this 2-3 times to completely remove the wash solution in the filter until pH reading is neutral.

⑤ Cleaning is complete. If the effect cannot be confirmed, perform ultrasonic cleaning again.

⚠Note

The wash solution is strongly basic. Be careful not to splash.

Wear proper personal protective equipment (eyeglasses, masks, gloves, goggles, etc.) during the operation.

■ **Cleaning by pressure immersion**

When it is difficult to disassemble a large column, it is also possible to immerse the washing liquid in the column and perform pressure immersion.

① Empty the inside of the column.
② Plug the piping at the bottom of the column and pour wash solution.
③ Head the piping on the upper side of the column to the waste container.
④ Operate the pressure control valve to set the supply air pressure to zero.
⑤ Operate the switching valve to the same direction as when packing. The pump will not run in this condition.
⑥ Operate the pressure control valve to increase the supply air pressure as slowly as possible.
⑦ The immersion is performed with the air pressure at the time when the hydraulic pump starts operating.
If too high pressure is applied, it is dangerous. Soak as low pressure as possible.
⑧ Turn the switching valve HOLD when the wash solution begins to drain from the upper piping of the column.
⑨ Plug both movable stopper and end cap, operate the switching valve again in the same way as when packing, and pressurize.
⑩ Leave the column for several hours to about a day.
⑪ Release the pressure of the column. Turn the switching valve HOLD and operate the manual pressure-relief valve.
⑫ Drain the cleaning liquid.
⑬ Clean the solution with pure water. Repeat the cleaning until pH reading is neutral.

8-4 Cleaning of Column

Packing, unpacking, and other factors can cause resin to adhere to the inside of the column.
If resin is found, clean it on the inner surface of the column when unpacking.

9 TROUBLESHOOTING

9-1 Column Trouble

Problem	Location	Check Items	Measures
No solution flow (high pressure)	Unknown or Flow path after the column	Is the piping connected correctly? (For DAD-50) is the distributor installed the correct orientation?	Check the piping. Bypass (or open) all post-column pipes.
		Check if the flow rate is too high	Check the flow rate.
		Check if the pressure gauge is out of order.	Check the pressure gauge.
	Flow path before the column	Does the sample contain solids?	・Filter the sample through a filter. ・Wash the filter of the column. ・Replace the precolumn filter. ・Perform reflux washing.
		Is the sample soluble to the solvent?	Check the solvent and concentration.
	Column filter	Is the filter filled with resin?	Wash the filter of the column.
Leakage	Outer circumstance of movable stopper and end cap seal (areas contact with column inner surface)	Has the inside of the column been thoroughly cleaned?	Clean the inside of the column. * Resin or sample adhered to the inner surface of the column may affect airtightness.
	Movable stopper and end cap piping	Is the piping loose?	Retighten the fitting.
	Leakage from movable stopper, end cap, and other gaps	Are the sealing nuts of the movable stopper and end cap tightened properly?	Loosen the seal nuts and re-tighten all nuts so that the nuts seal evenly. * Make sure that the filter base is parallel to the end cap and seal adjuster.
		Is there resin or foreign material in unusual locations such as between the seal and the filter base?	Disassemble the seal and filter base from the end cap or seal adjuster and clean the trapped solid material.
		Are movable stopper and cylinders perpendicular to the column body?	If it is not the case, do not force it to run, and contact us.
Movable stopper does not move.	Compressed air Utility	Is the pressure of the primary regulator sufficient? →Yes	Check if the emergency stop button is not pressed.
		Is the pressure of the primary regulator sufficient? →No	Check the compressor. Check if the valve is not closed on the way to the column.
	Hydraulic pump	Can you hear operating noise? →Yes	Check the oil level and leakage. Check that the manual relief valve is closed.
		Can you hear operating noise? →No	・Check the hydraulic pressure. ・Check hydraulic piping and valves. ・Attempt a spool reset of the hydraulic pump. ・Replace hydraulic pump.
Oil leakage	Inside the enclosure or Inside the hydraulic unit	Where is the leak happening?	Retighten the corresponding fitting. If the leak does not stop, the device or fitting should be replaced.

9-2 Slurry Container Trouble

Problem	Location	Check Items	Measures
Solvent does not flow	Slurry flow path	Is the valve switched correctly?	Check the valve.
		Is resin clogged in piping?	Remove resin in piping. Disassemble the piping if necessary.
	Slurry pump	Is compressed air sufficiently supplied?	Check valves and switches on the flow path. Check the corresponding pressure control valve and pressure gauge and supply the required pressure.
		※When the slurry container does not work even though compressed air is supplied	Press in the reset button on the back of the pump. * If a similar problem occurs frequently, the pump needs to be replaced. Contact us.
		Has the particles settled?	・Make stirring stronger. ・Slow the feeding rate of resin.
Agitator does not rotate.	Power supply	Is compressed air sufficiently supplied?	Check valves and switches on the flow path. Check the corresponding pressure control valve, pressure gauge, and throttle valve, and supply the required amount of air. * Rotation in the low-speed range may not be stable due to changes in the condition of the fluid. Adjust the rotation speed with the throttle valve as necessary.
	Physical issue of the agitator	Is the agitator blade in contact with foreign matter? Or is the agitator shaft in contact with foreign matter?	Visually inspect from the agitator blade to the stirrer shaft. Check if the agitator shaft can rotate. * Turn off the compressed air supply completely before inspecting the agitator blade.
		Is the agitator shaft perpendicular to the container?	If it is not the case, do not force it to run, and contact us.
		Has the particles settled?	Sediment should be removed with shutting off the air.
Abnormal noise or vibration of agitator blade	Excessive rotation speed	Is the regulating part of the controlling throttle valve fixed?	The controlling throttle valve limits the maximum speed, which has been adjusted during installation. If readjustment is required, contact us.
	Wear of sliding parts	Check the total operation time.	The sliding parts wear off as the total operation time increases. We will suggest preventive maintenance depending on the operation time for each model. Contact us for details.

10 CONSUMABLES

The following parts must be replaced depending on the number of years or the number of times used.

The replacement schedule varies depending on the frequency of use and the environment.

Part	Name	Wearing judgment	Replacement guideline
Movable stopper / end cap (common)	Filter base	・Increase in hydraulic pressure ・Column performance worsened when compared just after packing (if not improved by the specified cleaning).	・Depending on the degree of wearing off
	O-ring for fitting (Seal for fitting)	・When liquid leakage is found	・In each case mentioned in the left ・Every time the fitting is removed
	Seal nuts & Seal screws	・Thread wear ・Deterioration of operability	・In each case mentioned in the left
Movable stopper	Movable stopper seal	・When liquid leakage begins	・In each case mentioned in the left <Recommended> ・1 year or 10 packings
End cap	End cap seal		
Slurry port	Port seal	・When the fitting is removed ・When liquid leakage is found	・From time to time as shown in the left
Hydraulic oil	Hydraulic oil ISO VG32	・Deterioration caused by oxidization	・About three years

11 REFERENCE

11-1 Referenced Packing Conditions

Resin type	Slurry solvent	Slurry concentration
ODS	100% IPA 85% Methanol	30%
Silica	Hexane / Ethyl acetate = 1 / 1	
Chiral	100% IPA	

Resin particle size D (µm)	Packing pressure (MPa)
≦10	7
10<D<50	5
≧50	3

■ **Indication of slurry concentration**

Slurry density is the value obtained by dividing the resin weight (W g) by the slurry volume (V mL) in W/V%. The slurry volume here is the total volume when the resin and slurry solvent are mixed.

■ **Simplified calculation of slurry solvent volume**

Example: Simplified calculation when 30% slurry is made with 500g resin.

Amount of resin : 500 g

Slurry concentration : 500 g / X mL x 100 = 30W/V%

Slurry volume : X mL = 500 g / 30W/V% x 100 = 1667 mL

Actual resin volume: 500 g ÷ 1.6 g/mL* = 312 mL

Amount of slurry solvent required: 1667 mL - 312 mL = 1355 mL

*This 1.6 is a typical value for the resin density [g/mL] and the actual value varies depending on the resin.

In this instance, mix 500 g resin and 1355 mL slurry solvent to create slurry with the volume of 1667 mL and the density of 30%. If a more accurate slurry concentration is required, mix the mixture while adding the slurry solvent to the resin little by little, and increase the total slurry volume until the desired volume is achieved.

11-2 Conversion Table of Resin Amount and Slurry Solvent Amount for Bed Length

The table below shows the relationship between the amount of resin and the amount of slurry solvent for the packing bed length.

Calculate the weight of the resin and the amount of slurry solvent for the desired bed length.

Note

The bulk specific gravity of the resin depends on the type and the production lot. If you need to adjust the bed length correctly, contact the resin manufacturer for bulk specific gravity.

Refer to "Chapter 3 Specifications" for the maximum column capacity. It is recommended to paint the mass that exceeds the capacity in black.

■ DAD-50-700S

Column volume : _____ L

Specific gravity of resin : **1.6** g/mL

Bulk specific gravity of resin : **0.5** g/mL

Bed length	Resin weight	Resin volume	Slurry solvent volume (L) for each concentration				
			25%	30%	35%	40%	45%
100 mm	0.10 kg	0.06 L	0.33	0.27	0.22	0.18	0.16
150 mm	0.15 kg	0.09 L	0.50	0.40	0.33	0.28	0.24
200 mm	0.20 kg	0.12 L	0.66	0.53	0.44	0.37	0.31
250 mm	0.25 kg	0.15 L	0.83	0.66	0.55	0.46	0.39
300 mm	0.29 kg	0.18 L	0.99	0.80	0.66	0.55	0.47
350 mm	0.34 kg	0.21 L	1.16	0.93	0.77	0.64	0.55
400 mm	0.39 kg	0.25 L	1.33	1.06	0.88	0.74	0.63
500 mm	0.49 kg	0.31 L	1.66	1.33	1.10	0.92	0.78
550 mm	0.54 kg	0.34 L	1.82	1.46	1.21	1.01	0.86
600 mm	0.59 kg	0.37 L	1.99	1.60	1.31	1.10	0.94

Bulk specific gravity of resin : **0.6** g/mL

Bed length	Resin weight	Resin volume	Slurry solvent volume (L) for each concentration				
			25%	30%	35%	40%	45%
100 mm	0.12 kg	0.07 L	0.40	0.32	0.26	0.22	0.19
150 mm	0.18 kg	0.11 L	0.60	0.48	0.39	0.33	0.28
200 mm	0.24 kg	0.15 L	0.80	0.64	0.53	0.44	0.38
250 mm	0.29 kg	0.18 L	0.99	0.80	0.66	0.55	0.47
300 mm	0.35 kg	0.22 L	1.19	0.96	0.79	0.66	0.56
350 mm	0.41 kg	0.26 L	1.39	1.12	0.92	0.77	0.66
400 mm	0.47 kg	0.29 L	1.59	1.28	1.05	0.88	0.75
500 mm	0.59 kg	0.37 L	1.99	1.60	1.31	1.10	0.94
550 mm	0.65 kg	0.40 L	2.19	1.75	1.45	1.21	1.03
600 mm	0.71 kg	0.44 L	2.39	1.91	1.58	1.33	1.13

■ DAD-100-700

Column volume : _____ L

Specific gravity of resin : **1.6** g/mL

Bulk specific gravity of resin : **0.5** g/mL

Bed length	Resin weight	Resin volume	Slurry solvent volume (L) for each concentration				
			25%	30%	35%	40%	45%
100 mm	0.39 kg	0.25 L	1.33	1.06	0.88	0.74	0.63
150 mm	0.59 kg	0.37 L	1.99	1.60	1.31	1.10	0.94
200 mm	0.79 kg	0.49 L	2.65	2.13	1.75	1.47	1.25
250 mm	0.98 kg	0.61 L	3.31	2.66	2.19	1.84	1.57
300 mm	1.18 kg	0.74 L	3.98	3.19	2.63	2.21	1.88
350 mm	1.37 kg	0.86 L	4.64	3.72	3.07	2.58	2.20
400 mm	1.57 kg	0.98 L	5.30	4.25	3.51	2.95	2.51
500 mm	1.96 kg	1.23 L	6.63	5.32	4.38	3.68	3.14
550 mm	2.16 kg	1.35 L	7.29	5.85	4.82	4.05	3.45
600 mm	2.36 kg	1.47 L	7.95	6.38	5.26	4.42	3.76

Bulk specific gravity of resin : **0.6** g/mL

Bed length	Resin weight	Resin volume	Slurry solvent volume (L) for each concentration				
			25%	30%	35%	40%	45%
100 mm	0.47 kg	0.29 L	1.59	1.28	1.05	0.88	0.75
150 mm	0.71 kg	0.44 L	2.39	1.91	1.58	1.33	1.13
200 mm	0.94 kg	0.59 L	3.18	2.55	2.10	1.77	1.51
250 mm	1.18 kg	0.74 L	3.98	3.19	2.63	2.21	1.88
300 mm	1.41 kg	0.88 L	4.77	3.83	3.16	2.65	2.26
350 mm	1.65 kg	1.03 L	5.57	4.47	3.68	3.09	2.63
400 mm	1.88 kg	1.18 L	6.36	5.11	4.21	3.53	3.01
500 mm	2.36 kg	1.47 L	7.95	6.38	5.26	4.42	3.76
550 mm	2.59 kg	1.62 L	8.75	7.02	5.79	4.86	4.14
600 mm	2.83 kg	1.77 L	9.54	7.66	6.31	5.30	4.52

■ DAD-150-700

Column volume : _____ L

Specific gravity of resin : **1.6** g/mL

Bulk specific gravity of resin : **0.5** g/mL

Bed length	Resin weight	Resin volume	Slurry solvent volume (L) for each concentration				
			25%	30%	35%	40%	45%
100 mm	0.88 kg	0.55 L	2.98	2.39	1.97	1.66	1.41
150 mm	1.33 kg	0.83 L	4.47	3.59	2.96	2.49	2.12
200 mm	1.77 kg	1.10 L	5.96	4.79	3.94	3.31	2.82
250 mm	2.21 kg	1.38 L	7.46	5.98	4.93	4.14	3.53
300 mm	2.65 kg	1.66 L	8.95	7.18	5.92	4.97	4.23
350 mm	3.09 kg	1.93 L	10.44	8.38	6.90	5.80	4.94
400 mm	3.53 kg	2.21 L	11.93	9.57	7.89	6.63	5.65
500 mm	4.42 kg	2.76 L	14.91	11.97	9.86	8.28	7.06
550 mm	4.86 kg	3.04 L	16.40	13.16	10.85	9.11	7.76
600 mm	5.30 kg	3.31 L	17.89	14.36	11.83	9.94	8.47

Bulk specific gravity of resin : **0.6** g/mL

Bed length	Resin weight	Resin volume	Slurry solvent volume (L) for each concentration				
			25%	30%	35%	40%	45%
100 mm	1.06 kg	0.66 L	3.58	2.87	2.37	1.99	1.69
150 mm	1.59 kg	0.99 L	5.37	4.31	3.55	2.98	2.54
200 mm	2.12 kg	1.33 L	7.16	5.74	4.73	3.98	3.39
250 mm	2.65 kg	1.66 L	8.95	7.18	5.92	4.97	4.23
300 mm	3.18 kg	1.99 L	10.74	8.61	7.10	5.96	5.08
350 mm	3.71 kg	2.32 L	12.52	10.05	8.28	6.96	5.93
400 mm	4.24 kg	2.65 L	14.31	11.49	9.47	7.95	6.77
500 mm	5.30 kg	3.31 L	17.89	14.36	11.83	9.94	8.47
550 mm	5.83 kg	3.64 L	19.68	15.79	13.02	10.93	9.31
600 mm	6.36 kg	3.98 L	21.47	17.23	14.20	11.93	10.16

■ DAD-200-700

Column volume : _____ L

Specific gravity of resin : **1.6** g/mL

Bulk specific gravity of resin : **0.5** g/mL

Bed length	Resin weight	Resin volume	Slurry solvent volume (L) for each concentration				
			25%	30%	35%	40%	45%
100 mm	1.57 kg	0.98 L	5.30	4.25	3.51	2.95	2.51
150 mm	2.36 kg	1.47 L	7.95	6.38	5.26	4.42	3.76
200 mm	3.14 kg	1.96 L	10.60	8.51	7.01	5.89	5.02
250 mm	3.93 kg	2.45 L	13.25	10.64	8.77	7.36	6.27
300 mm	4.71 kg	2.95 L	15.90	12.76	10.52	8.84	7.53
350 mm	5.50 kg	3.44 L	18.56	14.89	12.27	10.31	8.78
400 mm	6.28 kg	3.93 L	21.21	17.02	14.02	11.78	10.04
500 mm	7.85 kg	4.91 L	26.51	21.27	17.53	14.73	12.54
550 mm	8.64 kg	5.40 L	29.16	23.40	19.28	16.20	13.80
600 mm	9.42 kg	5.89 L	31.81	25.53	21.04	17.67	15.05

Bulk specific gravity of resin : **0.6** g/mL

Bed length	Resin weight	Resin volume	Slurry solvent volume (L) for each concentration				
			25%	30%	35%	40%	45%
100 mm	1.88 kg	1.18 L	6.36	5.11	4.21	3.53	3.01
150 mm	2.83 kg	1.77 L	9.54	7.66	6.31	5.30	4.52
200 mm	3.77 kg	2.36 L	12.72	10.21	8.41	7.07	6.02
250 mm	4.71 kg	2.95 L	15.90	12.76	10.52	8.84	7.53
300 mm	5.65 kg	3.53 L	19.09	15.32	12.62	10.60	9.03
350 mm	6.60 kg	4.12 L	22.27	17.87	14.73	12.37	10.54
400 mm	7.54 kg	4.71 L	25.45	20.42	16.83	14.14	12.04
500 mm	9.42 kg	5.89 L	31.81	25.53	21.04	17.67	15.05
550 mm	10.37 kg	6.48 L	34.99	28.08	23.14	19.44	16.56
600 mm	11.31 kg	7.07 L	38.17	30.63	25.24	21.21	18.06

■ DAD-300-700

Column volume : _____ L

Specific gravity of resin : **1.6** g/mL

Bulk specific gravity of resin : **0.5** g/mL

Bed length	Resin weight	Resin volume	Slurry solvent volume (L) for each concentration				
			25%	30%	35%	40%	45%
100 mm	3.53 kg	2.21 L	11.93	9.57	7.89	6.63	5.65
150 mm	5.30 kg	3.31 L	17.89	14.36	11.83	9.94	8.47
200 mm	7.07 kg	4.42 L	23.86	19.14	15.78	13.25	11.29
250 mm	8.84 kg	5.52 L	29.82	23.93	19.72	16.57	14.11
300 mm	10.60 kg	6.63 L	35.78	28.72	23.67	19.88	16.94
350 mm	12.37 kg	7.73 L	41.75	33.50	27.61	23.19	19.76
400 mm	14.14 kg	8.84 L	47.71	38.29	31.56	26.51	22.58
500 mm	17.67 kg	11.04 L	59.64	47.86	39.45	33.13	28.23
550 mm	19.44 kg	12.15 L	65.61	52.65	43.39	36.45	31.05
600 mm	21.21 kg	13.25 L	71.57	57.43	47.33	39.76	33.87

Bulk specific gravity of resin : **0.6** g/mL

Bed length	Resin weight	Resin volume	Slurry solvent volume (L) for each concentration				
			25%	30%	35%	40%	45%
100 mm	4.24 kg	2.65 L	14.31	11.49	9.47	7.95	6.77
150 mm	6.36 kg	3.98 L	21.47	17.23	14.20	11.93	10.16
200 mm	8.48 kg	5.30 L	28.63	22.97	18.93	15.90	13.55
250 mm	10.60 kg	6.63 L	35.78	28.72	23.67	19.88	16.94
300 mm	12.72 kg	7.95 L	42.94	34.46	28.40	23.86	20.32
350 mm	14.84 kg	9.28 L	50.10	40.20	33.13	27.83	23.71
400 mm	16.96 kg	10.60 L	57.26	45.95	37.87	31.81	27.10
500 mm	21.21 kg	13.25 L	71.57	57.43	47.33	39.76	33.87
550 mm	23.33 kg	14.58 L	78.73	63.18	52.07	43.74	37.26
600 mm	25.45 kg	15.90 L	85.88	68.92	56.80	47.71	40.64

■ DAD-450-700

Column volume : _____ L

Specific gravity of resin : **1.6** g/mL

Bulk specific gravity of resin : **0.5** g/mL

Bed length	Resin weight	Resin volume	Slurry solvent volume (L) for each concentration				
			25%	30%	35%	40%	45%
100 mm	7.95 kg	4.97 L	26.84	21.54	17.75	14.91	12.70
150 mm	11.93 kg	7.46 L	40.26	32.31	26.63	22.37	19.05
200 mm	15.90 kg	9.94 L	53.68	43.07	35.50	29.82	25.40
250 mm	19.88 kg	12.43 L	67.10	53.84	44.38	37.28	31.75
300 mm	23.86 kg	14.91 L	80.52	64.61	53.25	44.73	38.10
350 mm	27.83 kg	17.40 L	93.93	75.38	62.13	52.19	44.45
400 mm	31.81 kg	19.88 L	107.35	86.15	71.00	59.64	50.81
500 mm	39.76 kg	24.85 L	134.19	107.69	88.75	74.55	63.51
550 mm	43.74 kg	27.34 L	147.61	118.45	97.63	82.01	69.86
600 mm	47.71 kg	29.82 L	161.03	129.22	106.50	89.46	76.21

Bulk specific gravity of resin : **0.6** g/mL

Bed length	Resin weight	Resin volume	Slurry solvent volume (L) for each concentration				
			25%	30%	35%	40%	45%
100 mm	9.54 kg	5.96 L	32.21	25.84	21.30	17.89	15.24
150 mm	14.31 kg	8.95 L	48.31	38.77	31.95	26.84	22.86
200 mm	19.09 kg	11.93 L	64.41	51.69	42.60	35.78	30.48
250 mm	23.86 kg	14.91 L	80.52	64.61	53.25	44.73	38.10
300 mm	28.63 kg	17.89 L	96.62	77.53	63.90	53.68	45.72
350 mm	33.40 kg	20.87 L	112.72	90.46	74.55	62.62	53.35
400 mm	38.17 kg	23.86 L	128.82	103.38	85.20	71.57	60.97
500 mm	47.71 kg	29.82 L	161.03	129.22	106.50	89.46	76.21
550 mm	52.48 kg	32.80 L	177.13	142.14	117.15	98.41	83.83
600 mm	57.26 kg	35.78 L	193.24	155.07	127.80	107.35	91.45

■ DAD-600-700

Column volume : _____ L

Specific gravity of resin : **1.6** g/mL

Bulk specific gravity of resin : **0.5** g/mL

Bed length	Resin weight	Resin volume	Slurry solvent volume (L) for each concentration				
			25%	30%	35%	40%	45%
100 mm	14.14 kg	8.84 L	47.71	38.29	31.56	26.51	22.58
150 mm	21.21 kg	13.25 L	71.57	57.43	47.33	39.76	33.87
200 mm	28.27 kg	17.67 L	95.43	76.58	63.11	53.01	45.16
250 mm	35.34 kg	22.09 L	119.28	95.72	78.89	66.27	56.45
300 mm	42.41 kg	26.51 L	143.14	114.86	94.67	79.52	67.74
350 mm	49.48 kg	30.93 L	167.00	134.01	110.45	92.78	79.03
400 mm	56.55 kg	35.34 L	190.85	153.15	126.22	106.03	90.32
500 mm	70.69 kg	44.18 L	238.56	191.44	157.78	132.54	112.90
550 mm	77.75 kg	48.60 L	262.42	210.58	173.56	145.79	124.19
600 mm	84.82 kg	53.01 L	286.28	229.73	189.34	159.04	135.48

Bulk specific gravity of resin : **0.6** g/mL

Bed length	Resin weight	Resin volume	Slurry solvent volume (L) for each concentration				
			25%	30%	35%	40%	45%
100 mm	16.96 kg	10.60 L	57.26	45.95	37.87	31.81	27.10
150 mm	25.45 kg	15.90 L	85.88	68.92	56.80	47.71	40.64
200 mm	33.93 kg	21.21 L	114.51	91.89	75.73	63.62	54.19
250 mm	42.41 kg	26.51 L	143.14	114.86	94.67	79.52	67.74
300 mm	50.89 kg	31.81 L	171.77	137.84	113.60	95.43	81.29
350 mm	59.38 kg	37.11 L	200.39	160.81	132.54	111.33	94.84
400 mm	67.86 kg	42.41 L	229.02	183.78	151.47	127.23	108.38
500 mm	84.82 kg	53.01 L	286.28	229.73	189.34	159.04	135.48
550 mm	93.31 kg	58.32 L	314.91	252.70	208.27	174.95	149.03
600 mm	101.79 kg	63.62 L	343.53	275.67	227.20	190.85	162.58

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