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Passion Creation Technical Vitality Dream

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Basic of Air Compressor System Installation

1 Air Compressor Selection

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To select correct air compressor

- Oil flooded or Oil free?
- How much air capacity is required?
- Discharge pressure? (Consider pressure at use point and pressure loss at piping, dryer and filters.)
- Consider increasing pressure loss by aging deterioration.

Air compressor discharge pressure =
(Necessary discharge pressure at use point) + (Pressure loss) +
(Pressure Setting Differential*)

*Compressor needs 0.1MPa pressure differential setting.

1 Air Compressor Selection

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Example 1

Selected Oil injection type		
Total required air capacity	:	**10m3/min.**
Necessary discharge pressure at use point	:	**0.49 MPa**
Pressure loss: Piping 0.03 MPa		
Dryer 0.02 MPa		
Filter 0.05 MPa		
Total Pressure Loss	:	**0.10 MPa**

1. Add pressure loss 0.49 + 0.10 = 0.59MPa

2. Add pressure setting deferential 0.59 + 0.1 = 0.69MPa

10m³/min, 0.69MPa

1 Air Compressor Selection

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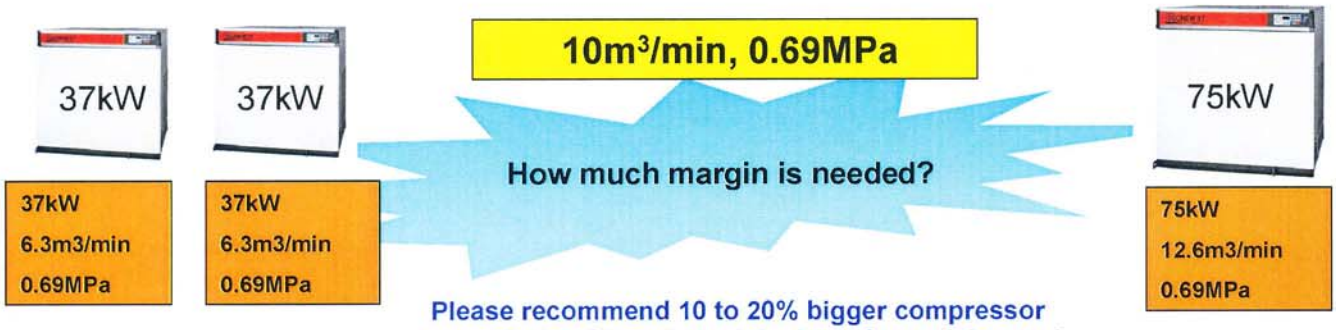
Number of air compressor (to make risk smaller)

- ☐Is stand-by unit necessary?
- ☐Is maintenance cost considered?
- ☐Is there future expansion plan?



Sand-by unit : 37kW x 1
Stan-by cost : small
Installation space : big

Please recommend 10 to 20% bigger compressor considering filter clog, air leakage from piping and temperature differential between compressor room and production line.

Sand-by unit : 75kW x 1
Stan-by cost : big
Installation space : small

1 Air Compressor Selection

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Check control method based for energy saving.

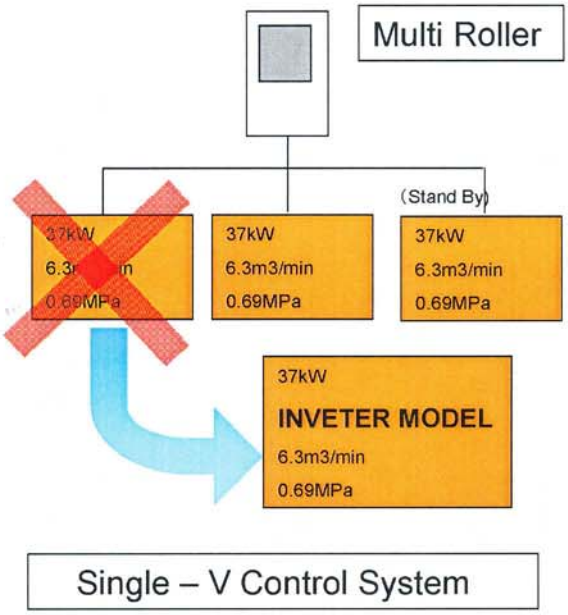
(Inverter, Multi control, Auto Start/Stop)

- Check current compressor running status. (Max. and Min. Capacity, Compressor load ratio etc.)
- Check demand for inverter and auto start/stop.
- If some units are needed, multi unit controller is effective.

-Best is to select same air capacity model.

-Inverter model could be more effective if customer required further saving energy.

Example 3



Single – V Control System

1 Air Compressor Selection

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Dryer Selection

- Check required dew point
- Check dryer performance and air capacity.
- Check condition (temperature of compressed air and ambient.)
- Select dryer reading dryer catalog very well.
- For Heatless dryer, consider purge volume .

When Heatless Dryer is selected…

Necessary air capacity at use point + Purge Air = Air Compressor air capacity

Purging volume of heatless dryer is 15 to 20% of dryer capacity.

Example : When 10m^3/min is needed, 12m^3/min compressor should be selected.

2 Compressor System Flow

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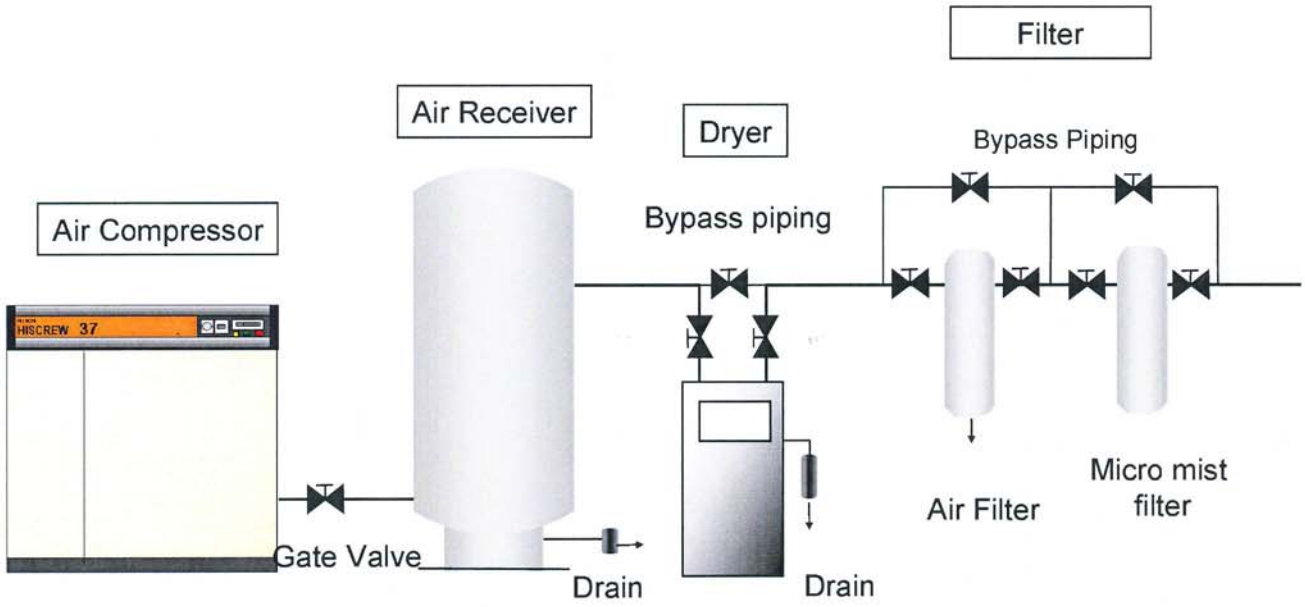
Recommended compressor system layout

Air Compressor ⇒ Receiver Tank ⇒ Dryer ⇒ Filter



2 Compressor System Flow

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Point

1) Receiver tank should be installed near by air compressor.

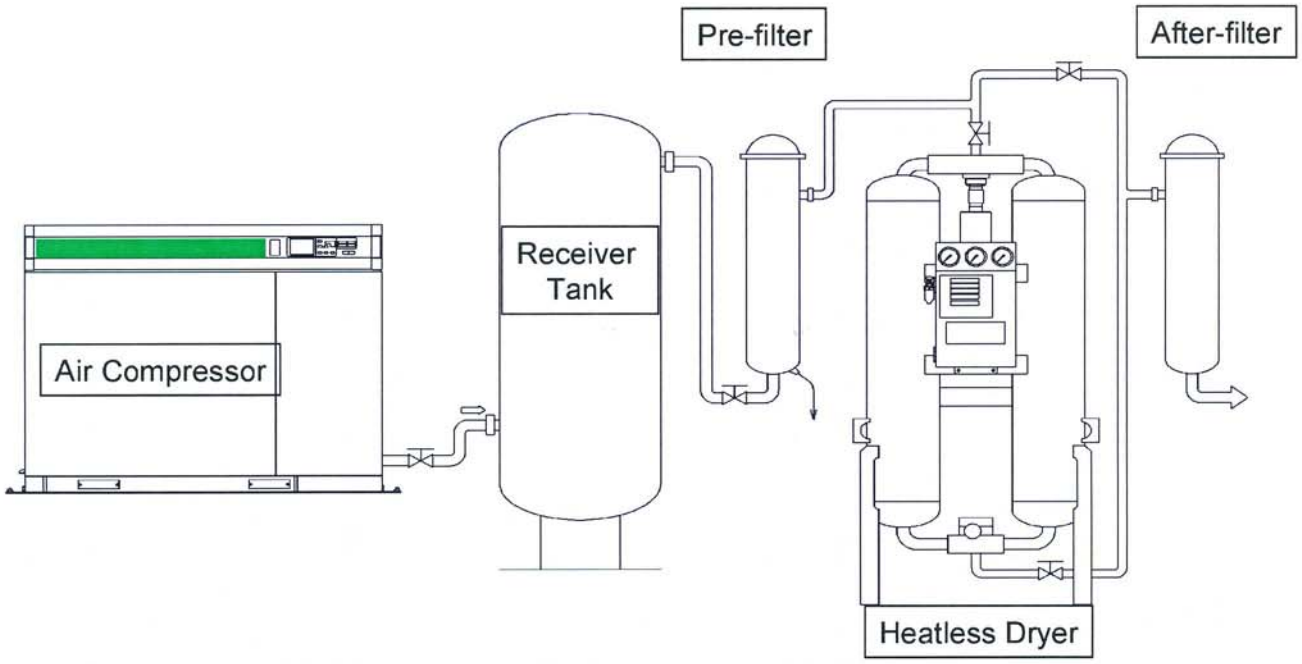
2) Dryer should be installed after receiver tank due to reducing pressure load from the compressor.

3) In order to avoid filter element clogged by moistures, air-filter should be installed after dryer.

*** When pre-filter is installed before dryer, select drain filter (3 to 5 μ m).**

Recommended compressor system layout (Heatless Dryer)

Air Compressor ⇒ Receiver Tank ⇒ Pre-filter ⇒ Heatless Dryer ⇒ After filter



2 Compressor System Flow

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POINT

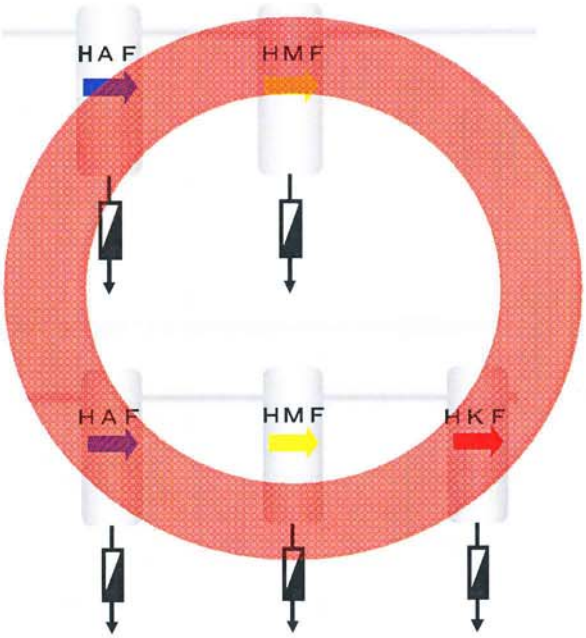
1) Heatless dryer should be used combine with oil-free compressor.

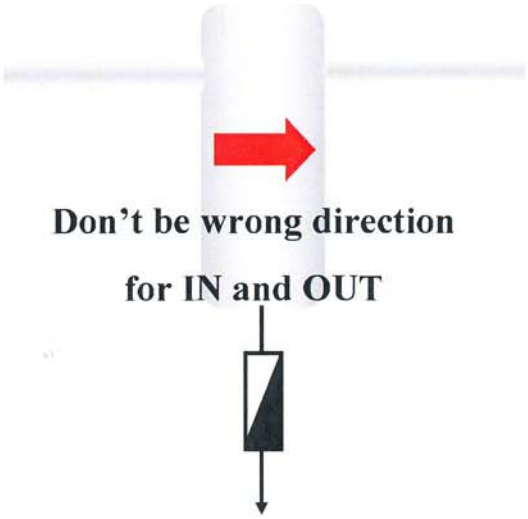
2) In order to avoid hunching, receiver tank should be selected suitable capacity and installed before heatless dryer.

3) In order to avoid heatless dryer trouble by moisture, pre-filter should be installed before heatless dryer. The pre-filter should be with drain trap.

4) In order to prevent desiccant particles of the heatless dryer going into compressor dry air, after filter should be installed.

Filter construction

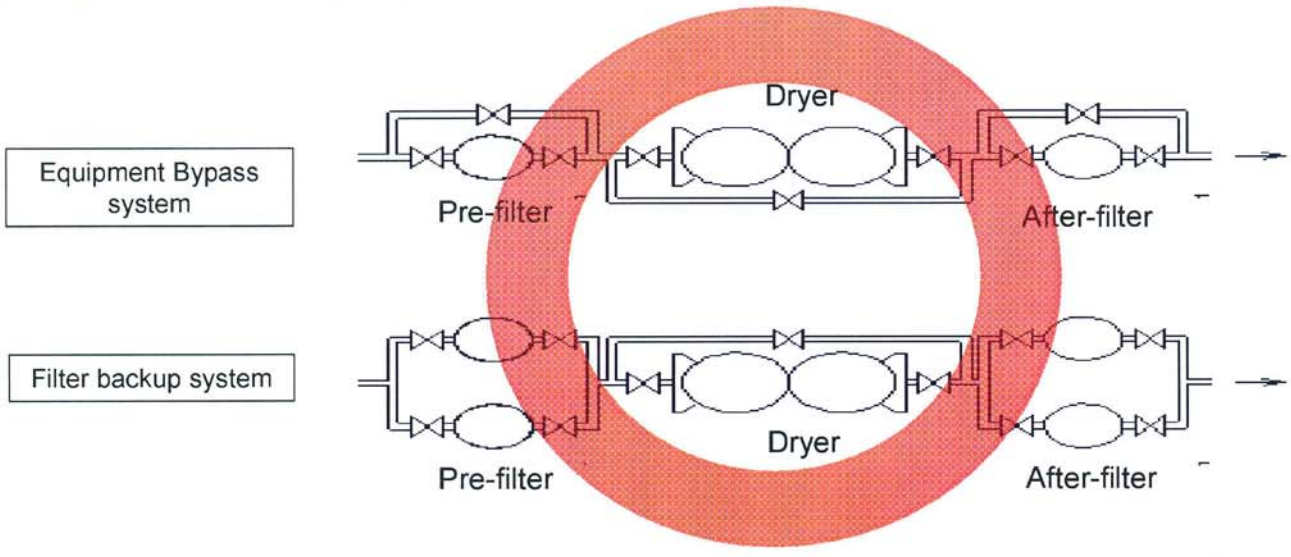




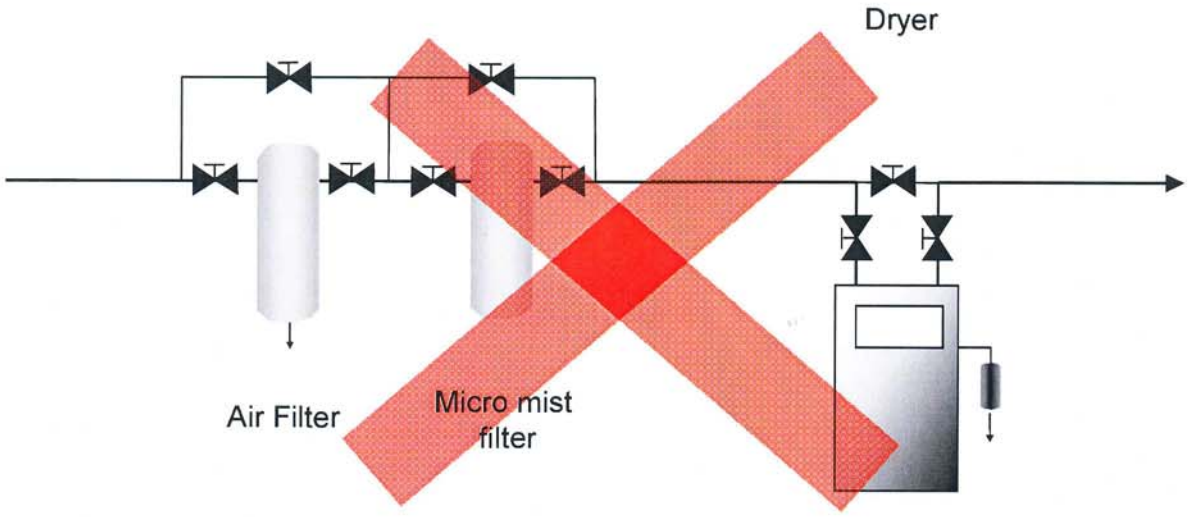
For the maintenance and trouble shooting,

bypass piping for dryer and filters is recommended.

Example of heatless dryer system



Air System Example : Bad case



2 Compressor System Flow
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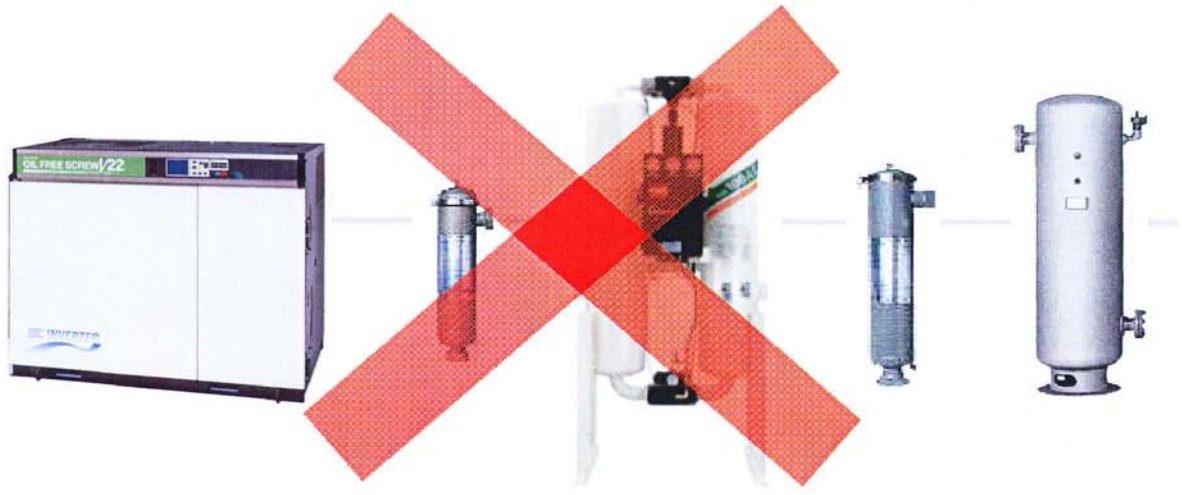
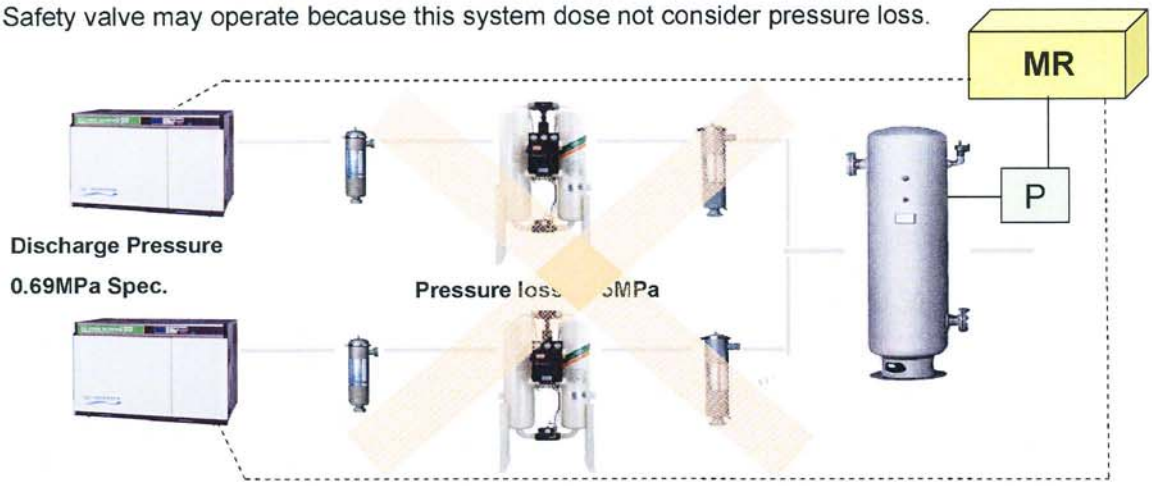
Air System Example : Bad case



Air System Example : Bad case

Pressure setting
Below 0.54MPa

1) Heatless dryer installed before receiver tank
2) Safety valve may operate because this system dose not consider pressure loss.



When pressure is enough at receiver tank, compressor is usually unloading but heatless dryer is using few air for re-generation of inside desiccant so that outlet pressure level goes down slowly and then finally became atmosphere level. In this case, there is a possibility that suction unloaded does not come back.

2 Compressor System Flow

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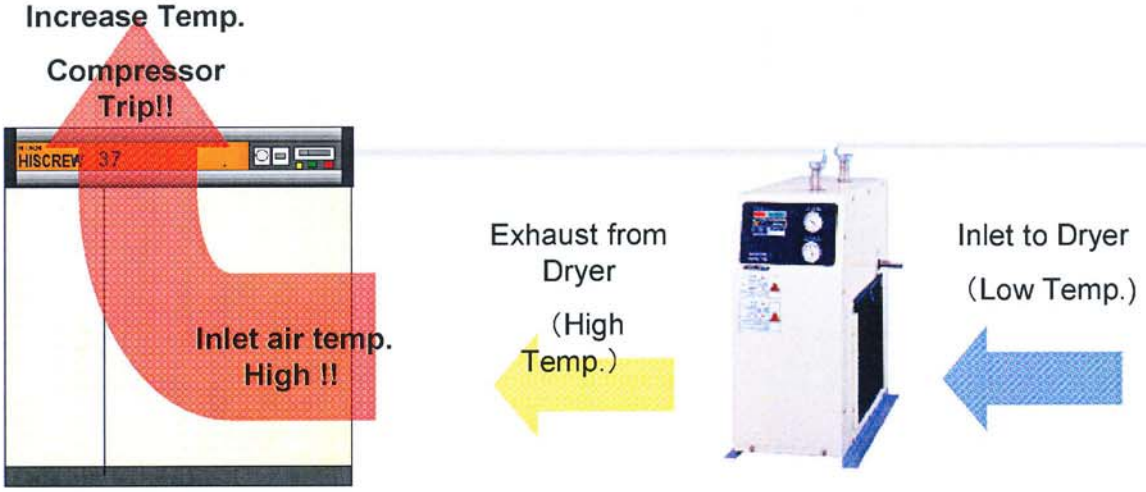
Pay attention to all equipment installation direction and place

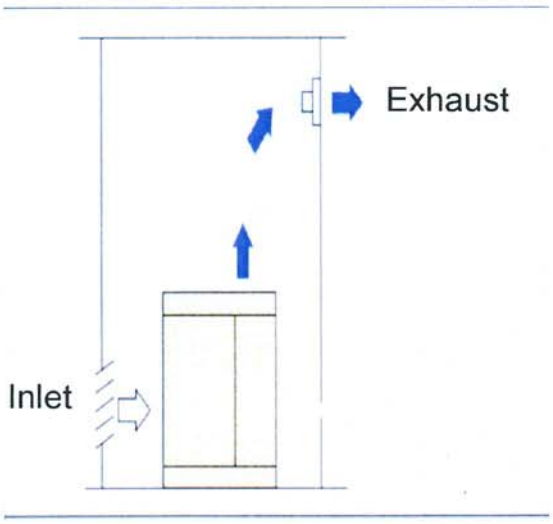
Trouble Example

Trouble : Compressor tripped due to high discharge temperature

Reason : Compressor takes exhaust air from dryer.



Ventilation Method (1) Ventilation for whole room



Remarks:

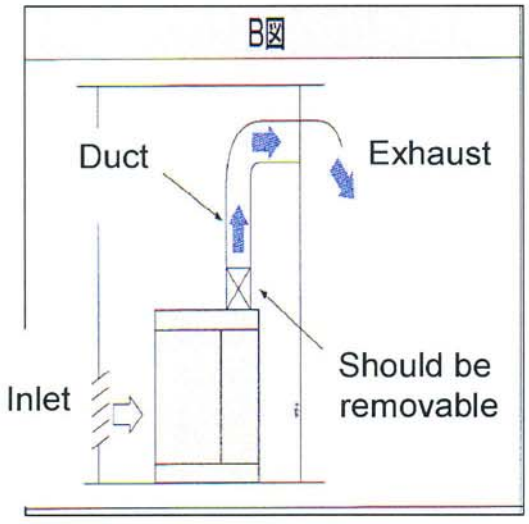
Cooling air inlet to compressor room should be located at lower point.

Cooling air exhaust from compressor room should be located at higher point. When hood is equipped to prevent rain from coming in, ventilation fan is needed considering resistance (back pressure).

<Feature of this method>

Needs bigger ventilation fan.

Ventilation Method (2) Ventilation through ducting



Remarks:

Ventilation duct should be removable for maintenance.

When ventilation duct is connected to compressor, pressure loss in the duct must be less than 20Pa.

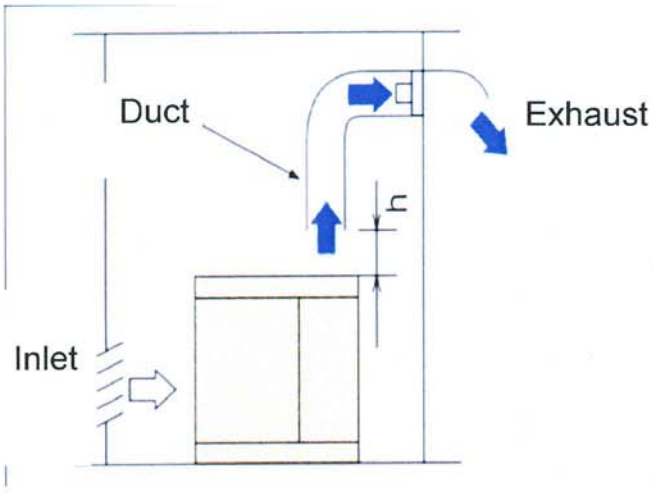
Ventilation duct needs to be retentive of heat. If not, heat is discharged from the duct and room temperature increases. In that case, additional ventilation fan should be installed.

OSP-15kW and below have louver at compressor cooling air exhaust. Remove the louver before duct is connected.

<Feature of this method>

As duct is connected to compressor, ventilation fan is not needed.

Ventilation Method (2) Ventilation through ducting



Remarks:

When pressure loss in duct become 20Pa or more, install ventilation fan in the duct.

In that case, do not connect the duct to compressor and prepare hood at inlet of the duct. Keep distance between compressor and hood (more than diameter of the duct).

Ventilation duct needs to be retentive of heat. If not, heat is discharged from the duct and room temperature increases. In that case, additional ventilation fan should be installed.

Common Contents

1) Cooling air intake louver

Cooling air intake louver should be positioned as low as possible.

2) Ventilation fan

To reduce compressor room temperature, ventilation fan must be installed.

3) Ventilation fan size

Calculated as follows.

$$Q = \frac{n \times H}{0.0753 \times \Delta T}$$

Q: Necessary exhaust value (m3/min)
H: heating value per unit (MJ/h) (1kW=3.6MJ/h)
n: Compressor numbers
T: Allow temperature increase value
(If Ambient temp. 35℃、Compressor allowed max. temp. 40℃,
ΔT=40-35=5℃)

Example

(1) OSP-75S5AI x 3 units (2) HDR-120AE x 3 units

Air Compressor and Dryer case

$$Q = \frac{n \times H}{0.0753 \times \Delta T} \Rightarrow Q = \frac{3 \times (306+43.7)}{0.0753 \times 5}$$

※ ΔT: 5℃
H: Heat generation per unit(MJ/h)
OSP-75S5AI = 306 MJ/h
HDR-120AX = 43.7 MJ/h

In case of this condition, recommended ventilation fan capacity is 2,787m3/min.

(2) Direct connect with exhaust duct with compressor (only consider Dryer case)

$$Q = \frac{3 \times 43.7}{0.0753 \times 5}$$

※ ΔT: 5℃
H: Heat generation per unit(MJ/h)
HDR-120AX = 43.7 MJ/h

Dryer is necessary ventilation fan that capacity is 348m3/min.

The above calculation is for heat discharged from equipment by fan. In actual situation, heat is discharged from ventilation duct, piping and surface from equipment. Therefore, we recommend to calculate with additional 5 to 10% heat.

If 5% is added... $Q = \frac{3 \times 43.7 + (306+43.7) \times 0.05}{0.0753 \times 5}$ = 718m3/min

3 Ventilation

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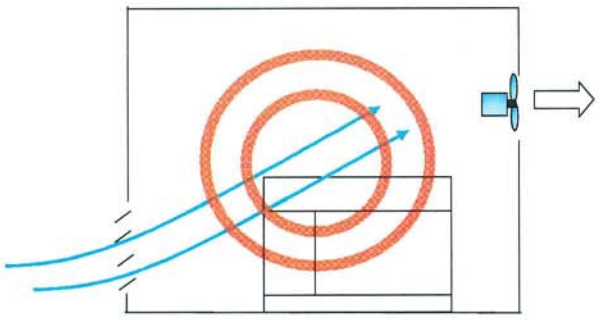
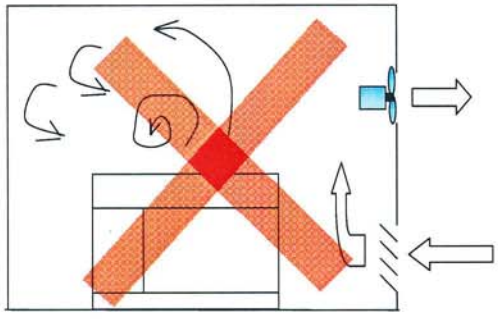
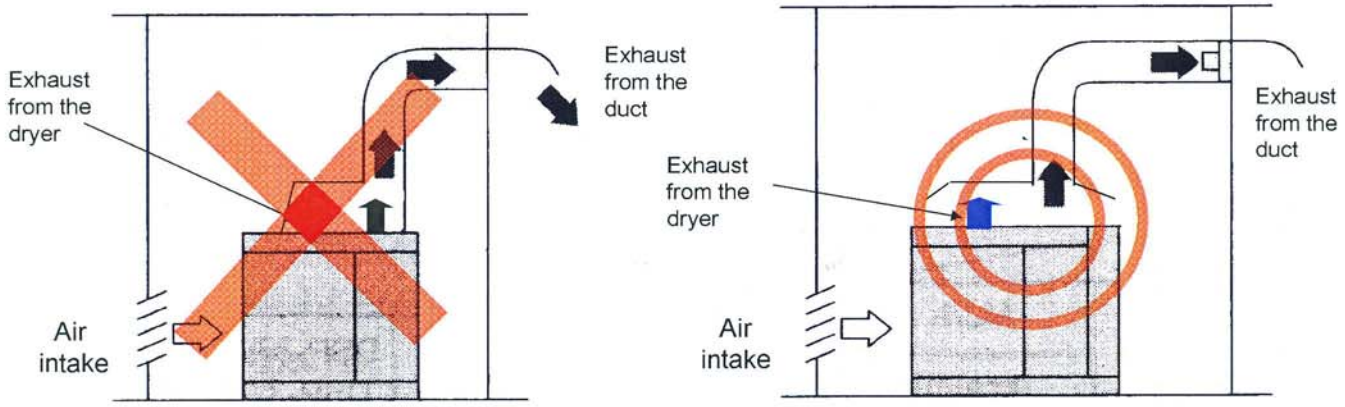
Which is correct layout for intake and exhaust ventilation?





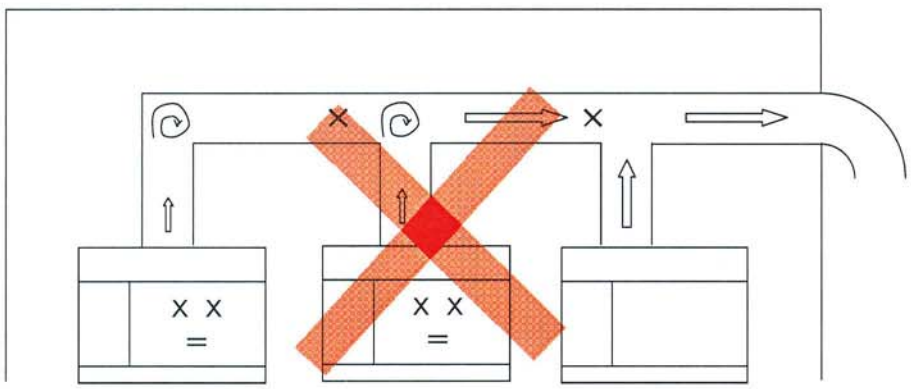
Which is correct layout of built in dryer model for intake and exhaust ventilation?

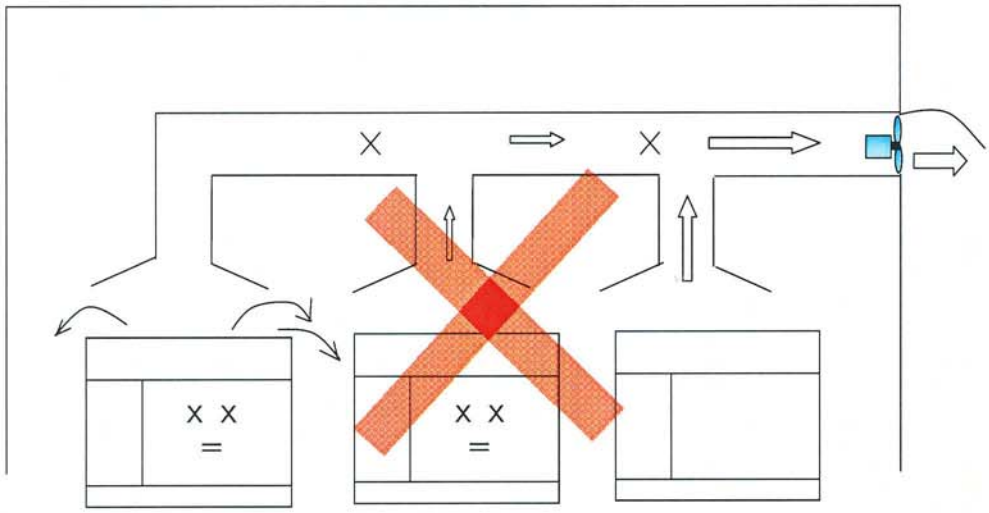


Don't close exhaust from the dryer portion.

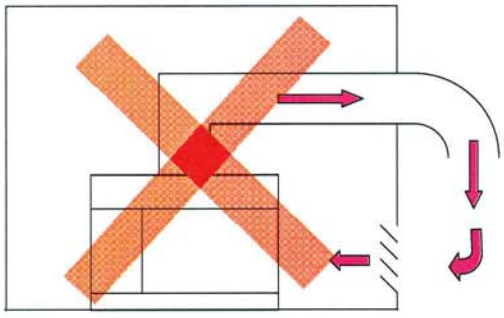
Exhaust duct should be prepared one by one and don't use 2 or 3 compressor for 1 duct.

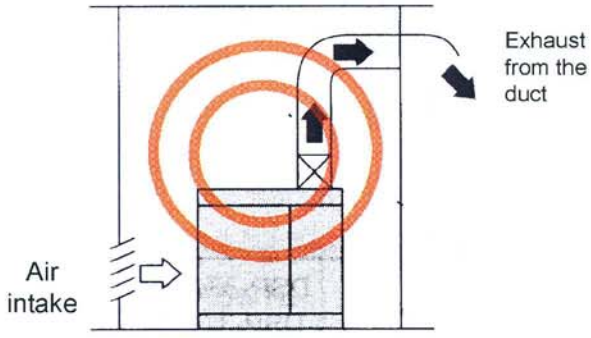
It is same as ventilation fan case.





Which is correct layout for intake and exhaust ventilation?





3 Ventilation

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Calculation of intake louver opening size

Formula

Total intake air capacity												
	/	(	Inlet velocity	x	Hour Conversion	x	Rate of louver opening	)	=	Required louver size
m3/h			m/s		Second					m2

Inlet velocity: If inlet velocity is high, much dirt will be inhaled at a compressor room. 2.5 - 3.0 m/s of inlet velocity is accepted theory.

Hour Conversion: Since an inlet-velocity unit is generally m/s, it changes into the same Hour as an air capacity unit.

Rate of louver opening: In order to prevent rain penetration, as for a standard louver, it is common that the rate of opening is 30%.

Example : In case 4 unit of OSP-150M5AD and 4 units of HDR-190F are installed.

							Hour Conversion
Comp. exhaust capacity	300	x	4	=	1,200		72,000
Comp. air discharge capacity	25	x	4	=	100		6,000
Ventilation fan capacity	300	x	4	=	1,200		72,000
	m3/min		Nunber of unit		m3/min		m3/h
						Total	150,000 m3/h

Total intake air capacity										
	/	(	Inlet velocity	x	Hour Conversion	x	Rate of louver opening	)	=	Required louver size
m3/h			m/s		Second					m2
150,000	/	(	3	x	3,600	x	0.3	)	=	46.30

4 Piping

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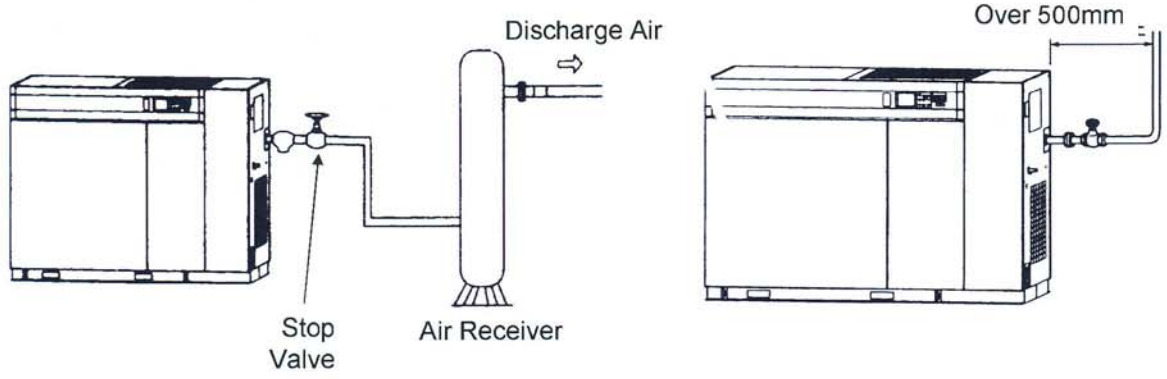
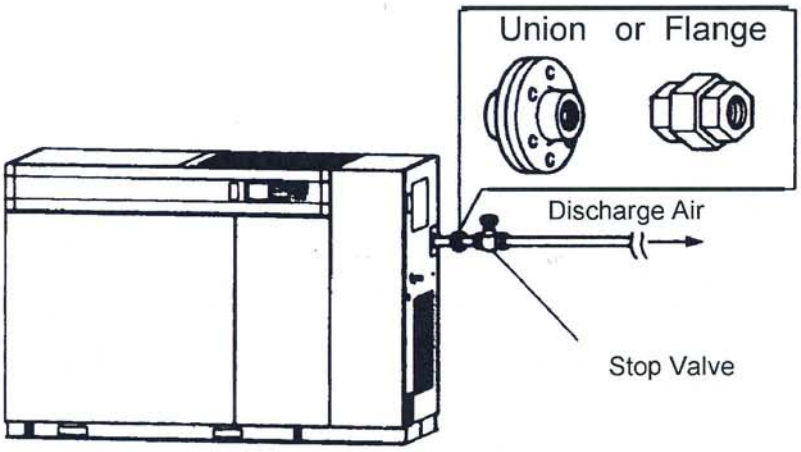
Stop valve and air receiver tank must be installed after air compressor. If distance between pipe and compressor is less than 500mm, cabinet could not be removed during maintenance work.

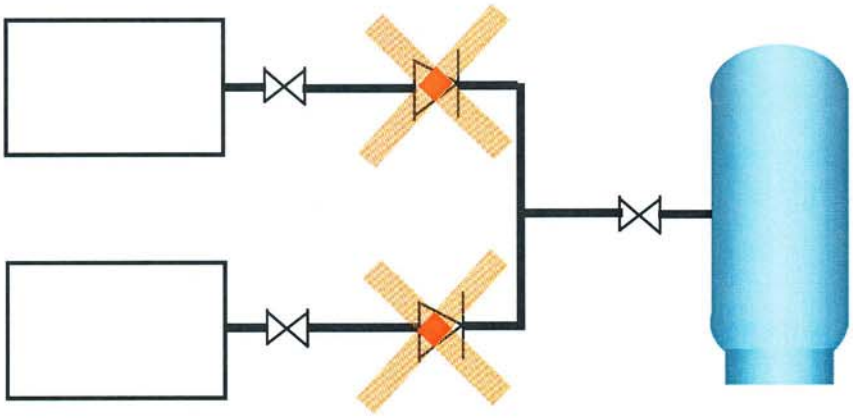


Connection should use union or flange.



Don't install check valve between air compressor and receiver. Because screw compressor is equipped check valve in the package. If check valve is installed at that position, load and unload repeat frequently (Chattering), which causes compressor trouble

(Except for Bebicon)



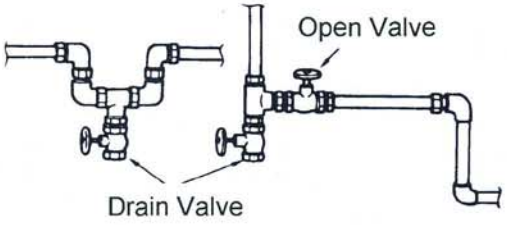
Install drain valve in standing up piping.

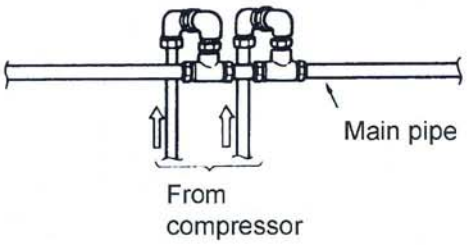
Connect the standing up piping from the top side to prevent back current of drain water.

Moreover, put slope (1/100) from the upstream side to the downstream side, and install the drain valve on the edge of piping.

If there is concaved or standing up piping, install drain valve at the bottom to prevent drain water remaining.

Don't put piping underground because air leakage can not be found.

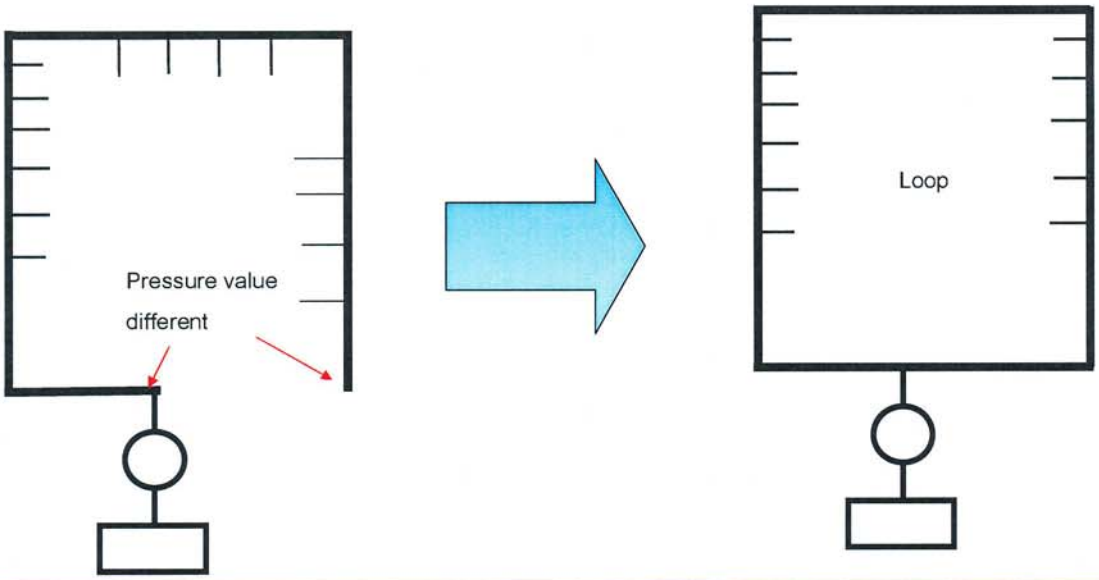




Loop piping in the factory is recommended.

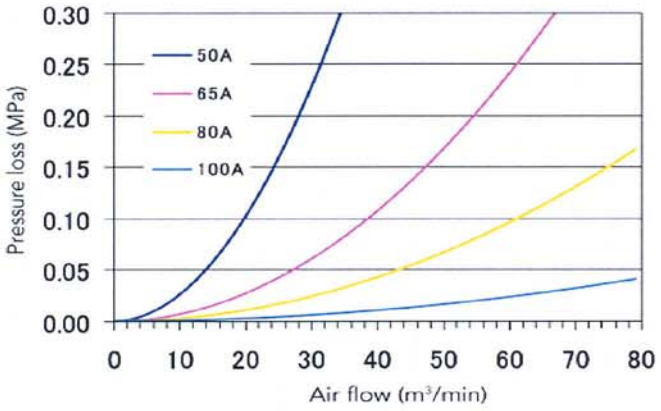
Loop piping enables to reduce pressure loss.

For below example, pressure loss becomes ¼.

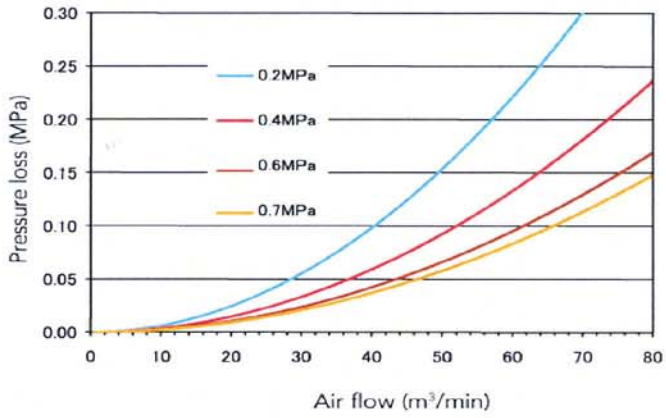


Piping system without pressure loss

Pressure loss is changed by piping diameter
- Air pressure 0.60 MPa
- For 100m straight pipe

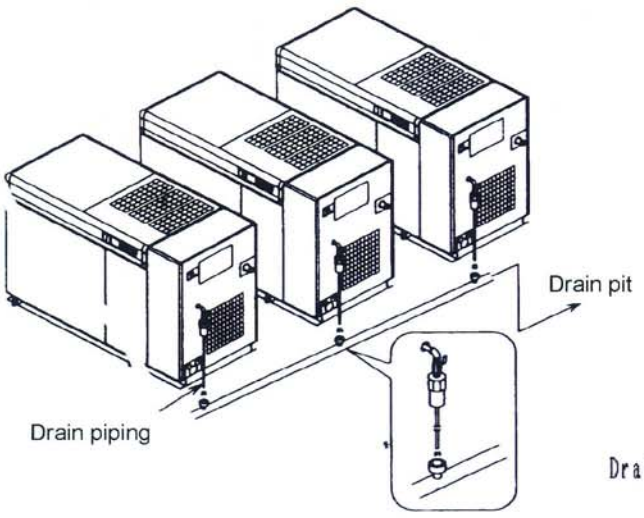


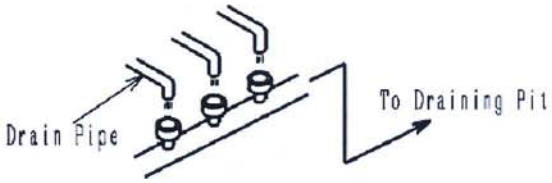
Pressure loss is changed by air pressure
- Piping diameter: 80A (or 3B)
- For 100m straight pipe



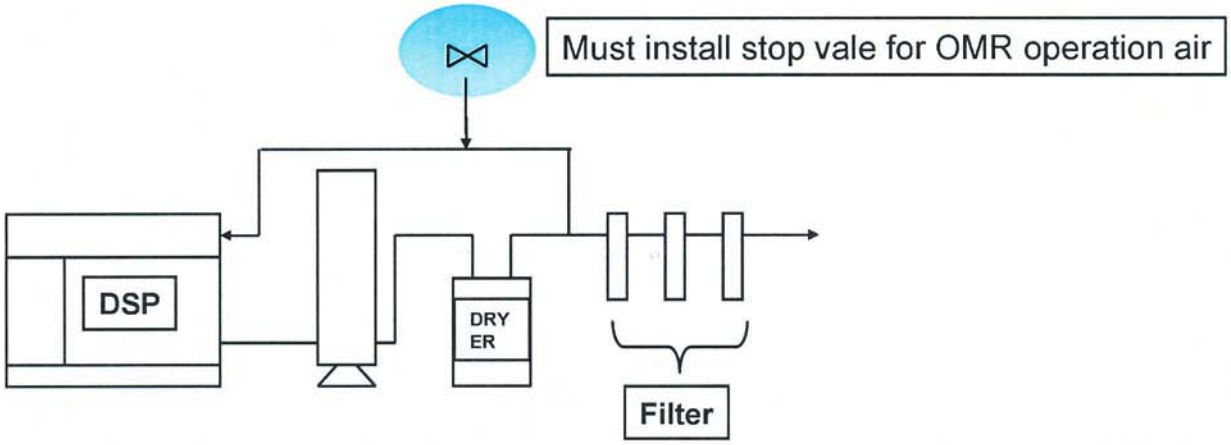
Drain piping

Make single piping and receive drain opened to atmosphere to check drain is discharged well. If not, it become difficult to find out that drain piping is clogged.

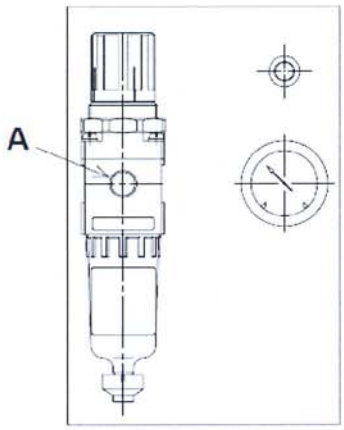




Stop valve should be installed on the air piping connected to oil mist remover (OMR) because piping could not be removed if air leaks from oil mist remover.



Connecting with the Control Air Pipe



Oil Mist Remover needs the compressed air control air of 0.10 to 0.28 MPa as a control air. Prepare the air compressor, and connect the control air pipe to the "A" part of the Oil Mist Remover.

IMPORTANT

The control air must be as dry as possible. Connect the control air pipe, therefore, to the downstream of the air dryer or, if the air dryer is not used, to the upper section of the air receiver. This allows you to less frequently drain the condensate from the filter bowl.

4 Piping

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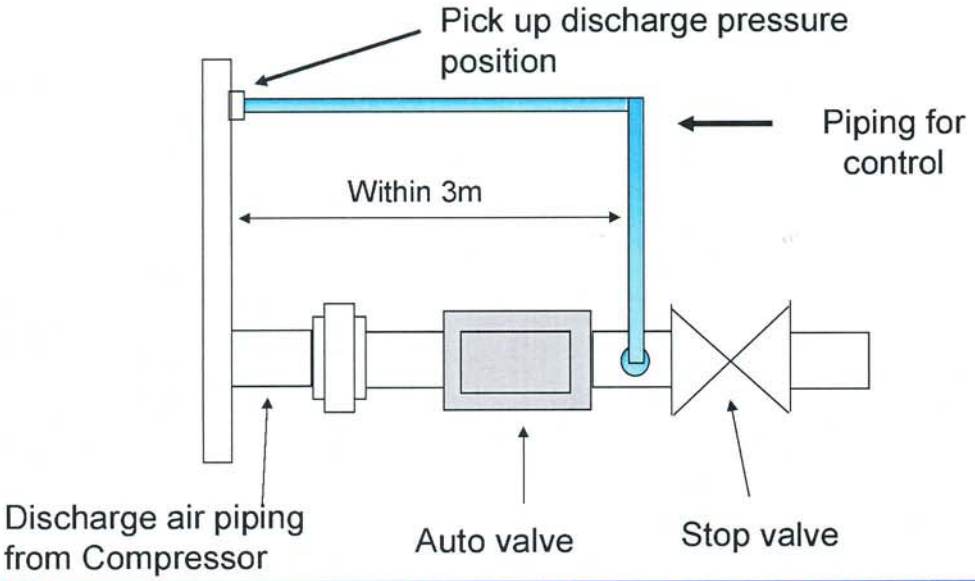
For oil-free inverter unit and fixed speed unit with auto stop/start function, control piping is needed for pressure pick-up.

If not, compressor does not start operation even though pressure drops.



5 Tank Capacity Calculation

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Tank capacity calculation formula is as follows.

Condition: Unloading should be less than 1Million time within 8,000Hr.

C = Air receiver capacity(m3)

ΔP = Pressure setting differential between load and unload(MPa)

Formula

$$C = \frac{0.012156 \times Qs}{\Delta P}$$

Easy method

In case ΔP=0.098MPa

C=0.124Qs

(Sample) DSP-55A6Ⅱ-7K

Qs=6.4 ΔP=0.05

$$C = \frac{0.012156 \times 6.4}{0.05} = 1.56$$

Bigger air receiver tank than 1.56m3 is needed.

5 Tank Capacity Calculation

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REC 1 in below chart is for protection of compressor, maximize energy saving function. Moreover, it minimizes load against dryer and realizes stable dew point.

REC 2 is to absorb change of demanded capacity. Especially, it works as buffer when demanded capacity is more than capacity of compressor.

The calculation in last page was to calculate size of REC 1. The below is formula to calculate size of REC 2.

$$C = \frac{Qs}{\frac{Ts}{Ps}} \times \frac{t}{\left[\frac{Pf}{Tf} - \frac{Pi}{Ti}\right]}$$

t	:	Drop dwon time from air-receiver internal-pressure Pi to Pf	(min)
Qs	:	Discharge air capacity of the compressor	(m3/min)
Ts	:	Absolute temperature of the intake air	(K)
Ps	:	Absolute pressure of the intake air	(Mpa)
C	:	Capacity of the air-receiver tank	(m3)
Pf	:	Allowable absolute pressure of the air-receiver tank	(Mpa)
Tf	:	Allowable absolute temperature of the air-receiver tank	(K)
Pi	:	Originally absolute pressure of the air-receiver tank	(Mpa)
Ti	:	Originally absolute temperature of the air-receiver tank	(K)

Atmospheric pressure is 0.1013MPa.

5m3/min air is demanded for 1 minute. Current pressure is 0.59MPa. How big tank is needed to keep pressure to 0.49MPa?

$$C = \frac{5}{\frac{273 + 30}{0.1013}} \times \frac{1}{\left[\frac{0.59 + 0.101}{273 + 30} - \frac{0.49 + 0.101}{273 + 30}\right]} = \frac{5}{1} = 5.07 \text{ (m3)}$$