Instruction Manual

Centrifugal Fan / Mild Fan

Model: CMFⅡ, CMF3

Note

Thank you for purchasing a TERAL Fan.
Do not operate, maintain, or inspect the fan until you have read and fully understood this instruction manual.
Retain this manual where it can be consulted at any time of operation, maintenance and inspection of the fan.

To whom is performing the utility work:

Please submit this manual to the customer performing the operation, maintenance and inspection of the fan.

TERAL INC.

Limited warranties

1. In the event of failure or breakage under proper use of the product during the warranty period, equipment supplied by TERAL INC. will be repaired or replaced free of charge within the scope of the relevant part, provided that such failure or breakage is attributable to inadequacy of the design or workmanship of the equipment.
2. The warranty mentioned in the above clause shall be only the mechanical warranty of the defective part, and shall not cover any expenses or other damage arising from the failure or breakage.
3. In the event of the following failures and breakage, the costs of the repairs shall be for the account of the user.
   (1) Failures and breakage attributable to equipment that was not delivered by TERAL INC.
   (2) Failures and breakage after the expiration of the warranty period
   (3) Failures and breakage caused by disasters or force majeure, such as fire, acts of God or earthquakes
   (4) Failures and breakage resulting from repairs or modifications made without the consent of TERAL INC.
   (5) Failures and breakage when parts other than those designated by TERAL INC. are used
4. TERAL INC. shall not be liable for the damage caused by incorrect or reckless use of the fan. Cost and expenses incurred for sending engineer(s) in such a case shall be borne by the user.
5. If the cause of the failure is unclear, necessary actions shall be determined through mutual consultation.

Purpose of this manual

The purpose of this manual is to provide the user with detailed information necessary to properly operate, maintain and inspect the fan.

This manual contains the following information and is intended for persons experienced in the operation of fans, or for those who have been trained by such experienced persons. Only qualified personnel such as electrical engineers are allowed to carry out the electrical wiring work.

Contents

1. Safety precautions

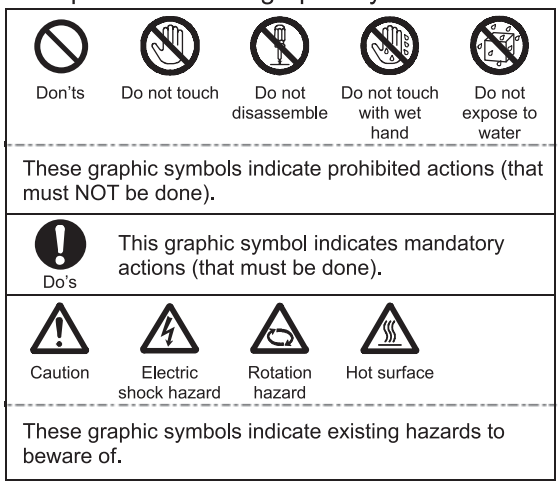
1.1 Types and meanings of safety terms and graphic symbols

This instruction manual divides precautions into the following four categories according to the level of hazards (or the severity of the accident). Be sure to understand the meanings of the following signs and comply with the content (instructions) of the instruction manual.

■ Explanation of warnings

Safety sign	Meaning
Danger	Indicates an imminently hazardous situation. Failure to observe this will result in death or serious injury.
Warning	Indicates a potentially hazardous situation. Failure to observe this will result in death or serious injury.
Caution	Indicates a potentially hazardous situation. Failure to observe this will result in minor or moderate injury or property damage.
Note	Indicates information that is in particular to be noted or emphasized.

■ Explanation of the graphic symbols



1.2 Safety precautions

Warning	
Instruct the vendor to move and carry the fan in consideration of the center of mass and its weight. Otherwise, the fan may fall, thus leading to an injury or damage.	Do not carry out any work with/on the fan that is being lifted. Otherwise, the unit may fall, thus leading to an injury or damage.
Before hoisting the fan, refer to the catalog, dimensional outline drawing, and other documents to check the weight of the units. Do not hoist any unit if its weight exceeds the rated load of the hoisting equipment/devices. Otherwise, the fan may fall, thus leading to an injury or damage.	Do not hoist the whole unit using the main shaft of the fan, the eyebolt on the motor, or any other parts not intended for the purpose. Otherwise, the unit may be damaged.
Only those who are authorized by the site manager are allowed to operate the fan. Operation by unskilled personnel may lead to an unforeseen accident.	Installation, maintenance, and inspection must only be carried out by personnel who have been trained to handle the fan. Operation by unskilled personnel may lead to an unforeseen accident.
Only qualified personnel, such as licensed electrical engineer, is allowed to carry out electric work. Otherwise, it may lead to an electric shock, fire, failure, or other problems.	Use high-quality wiring equipment and devices, and carry out wiring work safely and securely according to the technical standards for electrical facilities, as well as the indoor wiring regulations. Otherwise, it may lead to an electric shock, fire, or other problems.
Do not connect the ground wire to a gas pipe, water pipe or lightning rod. Such a connection is illegal and leads to an electric shock, explosion, or fire.	Securely install the ground wire and ensure to carry out grounding work. Otherwise, it may lead to an electric leak or electric shock.
Do not operate the fan if abnormal condition is observed in any operation, movement, parts, etc. Otherwise, it may lead to an injury, failure, or various accidents.	Correctly and securely connect the wires according to the wiring diagram within the terminal box and the instruction manual. Incorrect wiring may cause a fire, electric shock, failure, or other problems.

⚠ Warning

Be sure to keep the terminal box cover attached before turning on the power. Otherwise, it may lead to an electric shock.	Be sure to install a belt guard, bearing guard, and coupling cover during running the fan. Otherwise, it may lead to an injury or damage.
The main shaft, impeller, V-belt pulley, and V-belt are rotating during operation. Be extra careful not to get your clothes or other parts caught in these parts. Otherwise, it may lead to an injury or damage.	Do not forcibly bend, pull, or pinch the power cable or any lead wires of the product. Otherwise, it may lead to an electric shock or fire.
Check the wiring sections and wires for any looseness. A loose connection may cause a fire or electric shock.	Before starting the maintenance or inspection work, be sure to stop the fan and turn off the main power of the panel board. Otherwise, it may lead to an electric shock, injury, damage, or leakage.
Before starting the fan or carrying out maintenance/inspection work, ensure that all the relevant workers are informed of the operation and that there are no workers in the dangerous zone. Otherwise, it may lead to an unforeseen accident.	Before rotating the fan shaft by hand to check its smooth rotation, be sure to turn off the main power. Otherwise, it may lead to an injury or damage.
After turning on the power, do not touch the fan other than those required for operation. Otherwise, it may lead to an electric shock or injury.	Be sure to install a protective wire mesh on the suction port of the fan if it is open. Otherwise, it may lead to an injury or damage.
If the blowing gas is hot, do not touch the fan body or ducts. Touching the hot surface may result in burns.	Do not use it if the insulation resistance of the motor is 1MΩ or less. Otherwise, it may cause damage to the motor, electric shock or fire.
Do not put your fingers or foreign objects into any openings or rotating part of the motor during operation. Otherwise, it may lead to an injury or damage.	For overhaul, parts replacement, and repairs that involve disassembly, contact TERAL INC. If unskilled personnel carry out work that requires special knowledge, it may lead to an accident or failure.
In the event of a power failure, be sure to turn off the main power supply. Otherwise, the fan may suddenly start up on restoration of the power, thus leading to an injury.	If you leave the fan unused for a long time, be sure to turn off the main power. Otherwise, it may lead to a fire or electric shock.
Be sure to turn off the main power before changing any wiring of the fan. Otherwise, it may lead to an electric shock or injury.	Be sure to install a ground fault interrupter to the main power.
Do not put your fingers or any rods into the suction port or blowout port.	Do not place any objects around the suction port or blowout port of the fan.
Regularly inspect your equipment and perform maintenance on each component.	If motors or control panels are used for more than a certain period of time, it may cause ignition or other accidents due to aging deterioration.
Electric motor or control panel insulation degradation may result in electric leakage, electric shock, or fire. Keep the ambient temperature at 0 to 40°C with sufficient ventilation to prevent damage to the equipment and deterioration of its life. Avoid dust, corrosive or explosive gases, salinity, humidity, condensation. For indoor installations avoid direct sunlight or wind and rain.	

⚠ Caution

Do not use the fan outside the range of the product specifications. Otherwise, it may lead to an electric shock, fire, leakage, failure, or other problems.	Do not use the fan at an incorrect power voltage. An incorrect voltage may damage the motor.
Do not use a single fan unit as the only means of directly operating key facilities or sustaining life. In the event of a failure, necessary ventilation may not be performed due to malfunction. Ensure to make a backup unit available for operation.	Before unpacking the delivered container, check that the container is placed in the correct orientation (not upside down). Carefully unpack the container, while paying special attention to nails. Otherwise, it may lead to an injury or damage.
Do not install the fan anywhere exposed to direct flame or with any other risk of high temperature. Otherwise, it may lead to damage or fire.	Do not install the fan in any humid places such as the bathroom. Otherwise, it may lead to damage or fire.

⚠ Caution

Do not install the fan in any places where toxic gases are produced from acids, alkalis, organic solvent, paint or other substances or where corrosive gases are produced. Otherwise, it may lead to an injury or damage.	Install the open suction port at a position far away from the exhaust vents of combustion gas and other gases. Otherwise, it may lead to damage or fire.
Do not expose the motor to liquid. Otherwise, it may lead to an electric shock, electric leak, failure, or other problems.	If the fan is fitted with a drain port, be sure to drain water. Water leaking through gaps may cause stains and corrosion on the equipment and surrounding areas.
In the event of an alarm or abnormal condition that cannot be resolved, immediately stop the operation, turn off the power, and then contact For overhaul, parts replacement, and repairs that involve disassembly, contact TERAL INC. Otherwise, it may lead to an accident.	Do not run the fan with tools or other objects placed on the unit. Otherwise, it may lead to an injury or damage.
Check that the delivered items are exactly what you ordered. The use of a wrong product may cause an injury or failure.	Do not place any combustibles around the product. Otherwise, it may lead to a fire.
Check the rotation direction of the fan before connecting it to the duct. Otherwise, it may lead to an injury or damage.	Do not place any obstacles around the product that may hinder ventilation. Otherwise, it may lead to a fire.
The start frequency of air-conditioning fan should be once a day. Otherwise, the fan may be damaged.	
Do not run the fan if it has any defects or faulty parts. Otherwise, it may lead to an injury or damage.	Periodically clean the fan if dust or oil adheres to the machine. Otherwise, it may lead to an injury or damage.
Do not use a 60Hz model in a 50Hz area. Otherwise, the specified performance cannot be obtained.	Do not use a 50Hz model in a 60Hz area. Otherwise the fan may be damaged, and the motor may burn out.
Be sure to install an overcurrent protection device. Installation is obligatory according to the Electrical Equipment Technical Standards. Failure to do so may result in a fire or damage to the product. It is also recommended to install a protective device such as a leakage circuit breaker.	Do not touch any terminals or wires when measuring the insulation resistance. Otherwise, it may lead to an electric shock.
The impeller must not be rotating in reverse when the power is turned on. Otherwise the fan may be damaged.	Do not allow the weight of the duct system to be applied to the fan. Otherwise, it may cause vibration of the fan or damage it.
Do not make the duct significantly thinner than the fan diameter, and do not install a curved part immediately before the duct. Otherwise, an unexpected pressure loss may occur, resulting in insufficient performance.	Dispose of the product as industrial waste.
When you lift the product by hand, pay attention to its weight. Do not allow a single person to lift a product heavier than 15 kg. Otherwise, it may put strain on the body, thus leading to an injury.	Be sure to conduct inspection according to the Maintenance checklist. Otherwise, you cannot prevent potential failures, thus leading to a higher risk of accidents.

1.3 Location of the safety labels

Figure 1 shows the locations to which each safety label is affixed. If these labels become dirty and hard to read or if they are peeled off, replace them with a new one.

> **Warning** **Caution**
>
> Observe all the instructions in the warnings and cautions affixed to the fan as well as those described in this instruction manual.

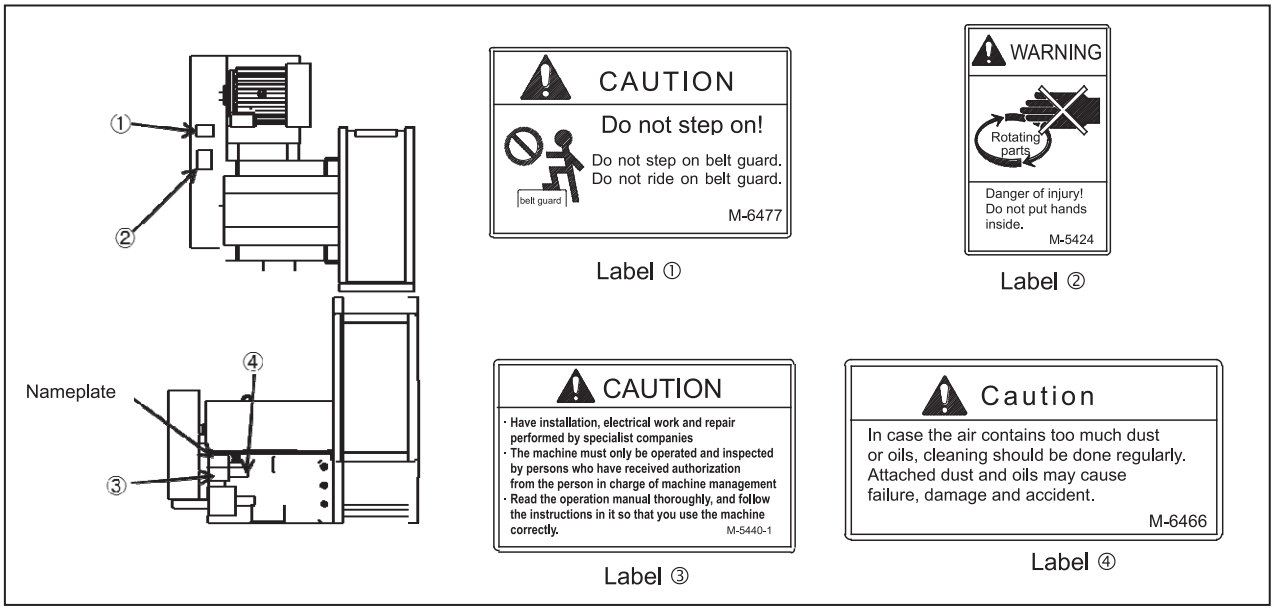
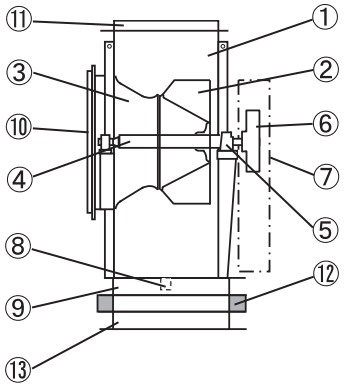


Figure 1 – Example of safety labels and the locations (CMF3-No.2-TH-R-OB)

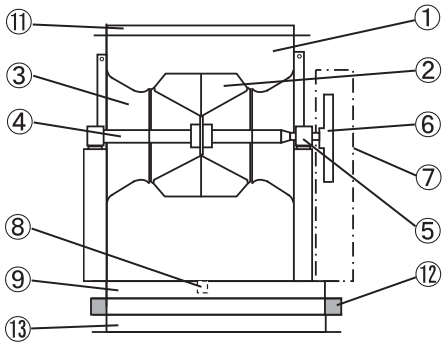
2. Configuration and overview of the fan

2.1 Structure and part names classified by driven method

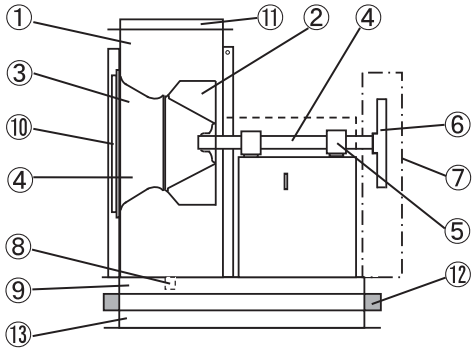
(1) RS type



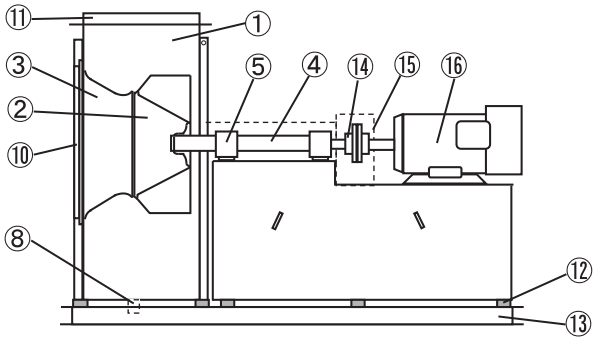
(2) RD type



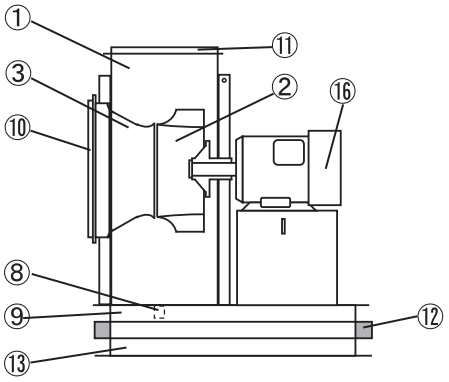
(3) OB type



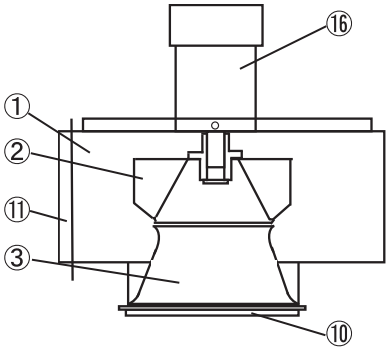
(4) MOB type



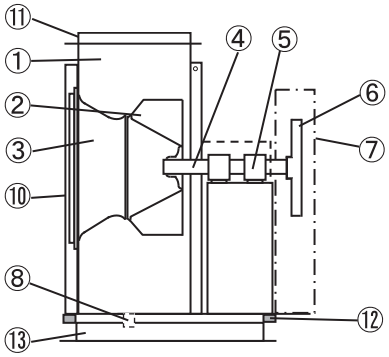
(5) HOH type



(6) VOH type



(7) SOB type



No.	Part name	No.	Part name
①	Casing	⑨	Common base
②	Impeller	⑩	Suction companion flange
③	Suction port	⑪	Discharge companion flange
④	Main shaft	⑫	Vibration isolation rubber (pad)
⑤	Bearing	⑬	Vibration absorber base
⑥	V-belt pulley	⑭	Shaft joint
⑦	Belt guard	⑮	Shaft joint guard
⑧	Drain	⑯	Electric motor

* The position of the drain port depends on the impeller size.

2.2 Specifications and accessories of the fan

If you have purchased our standard product, refer to the items specified as the “Standard specifications.” Also for a custom-made product with special specifications, refer to the specifications including the dimensional outline drawing.

> **Caution**
>
> Do not use the fan under any conditions other than those provided in the specifications. Otherwise, it may lead to an electric shock, fire, or failure.

(1) Standard specifications and special specifications

●: Standard specifications, ◎: Special specifications, -: Not available

Model			CMF3-HOH	CMFⅡ-VOH	CMF3（L）-SOB	CMF3-RS	CMF3（L）-OB	CMF3-OB	CMFⅡ-MOB	CMFⅡ-RD
Impeller size			No.2～6	No.2～6	No.2～6	No.6.5～10	No.2～6	No.6.5～12	No.2～6	No.2～6
Gas handled	Clean air	0 to 40°C	●	●	●	●	●	●	●	●
		41 to 90°C	●	–	●	–	●	●	●	–
Structure	Backward curved blade (Turbo)		●	●	●	●	●	●	●	●
	Closed type bearing		●	●	–	–	–	–	–	–
	Open type bearing		–	–	–	–	●	●	●	–
	Pillow block unit		–	–	●	●	–	–	–	●
	Companion flange (discharge)		●	●	●	●	●	●	●	●
	Companion flange (suction)		●	●	●	●	●	●	●	–
	Drain		●	–	●	●	●	●	●	●
	Inspection port		●	●	◎	◎	●	●	●	◎
	Shaft seal		–	–	–	–	●	●	●	–
	Split casing (upper and lower)		◎※1	–	◎※1	◎※1	◎※1	◎※1	◎※1	◎※1
	Special discharge direction		–	–	–	◎	–	◎	◎	◎
	Bearing guard		–	–	●	–	●	●	●	–
	Belt guard	Standard	–	–	●	●	●	●	–	●
		Enclosed	–	–	◎	◎	◎	◎	–	◎
		W/speed measuring port	–	–	◎	◎	◎	◎	–	◎
		w/inspection port	–	–	◎	◎	◎	◎	–	◎
Installation method	Floor type		●	–	●	●	●	●	●	●
	Anti-vibration floor type		◎	–	◎	◎	◎	◎	◎	◎
	Ceiling-suspension type		◎※2	–	◎※2	◎	◎※2	–	◎※2	◎※2
	Anti-vibration ceiling-suspension type		◎※2	–	◎※2	◎	–	–	◎※2	–
	Equipment mounting		–	●	–	–	–	–	–	–
Electric motor	Totally enclosed fan-cooled r type		●	●	●	●	●	●	●	●
	Special voltage		◎	◎	◎	◎	◎	◎	◎	◎
Coating	Prime coating and internal surfaces: Epoxy resin		●	◎	●	–	●	–	◎	◎
	Finish coating on external surfaces: Polyesterurethane powder coating, Munsell 7.5BG5/1.5		●	◎	●	●※3	●	●※3	◎	◎
	Prime coating and internal surfaces: Anti-corrosive coating (alkyd resin paint)		–	●	–	–	–	–	●	●
	Finish coating on external surfaces: Acrylic alkyd resin paint, Munsell 7.5BG5/1.5		–	●	–	–	–	–	●	●
	Heat resisting silver coating		◎	–	–	–	◎	◎	◎	–
	Vinyl chloride resin coating		◎	◎	◎	◎	◎	◎	◎	◎
	Salt resistant coating		◎	◎	◎	◎	◎	◎	◎	◎
	Specified color coating		◎	◎	◎	◎	◎	◎	◎	◎

*1 Available for No. 4½ or higher models only. (For No. 9 or higher models, the split casing (upper and lower) is standard.
*2 Available for No. 4½ or lower models only.
*3 Internal/external surfaces are coated in Polyesterurethane powder, Munsell 7.5BG5/1.5.

(2) Special accessories

Special accessories	
Suction wire mesh	Foundation bolt
Suction damper	Suction filter
Discharge damper	Connecting pipe
Bolts, nuts for companion flange	Companion flange packing
Expansion joint	

3. Transportation and installation

3.1 Before using the fan

When you receive the fan, check the following points first. If there are any problems, contact the sales agent you purchased the product from.
Handle the motor according to the instruction manual of the motor.
Incorrect handling may result in an accident or failure.

(1) Check the nameplate to verify that the product is what you ordered.
(2) Check the directions of discharge and rotation as well as the power transmission method against your order.
(3) All the accessories that you ordered have been delivered.
(4) No part of the product is damaged during transportation.
(5) All fastening parts such as bolts and nuts are securely tightened.

3.2 Precautions during transportation and storage

3.2.1 Precautions for transportation

Warning

Instruct the vendor to place the fan in consideration of the center of mass and its weight.

Warning

Before hoisting the fan, refer to the catalog, dimensional outline drawing, and other documents to check the weight of the units.
Do not hoist any units if its weight exceeds the rated load of the hoisting equipment/devices.

Warning

Do not enter the area under the suspended fan.
You may be pinned/crushed under the fan.

Caution

Pay special attention to nails when opening a wooden crate. Otherwise, you may get injured.

(1) When you hoist the fan, ensure to keep it level using the lifting lug or eye bolts fitted with the unit. Do not, however, hoist the whole unit using the main shaft of the fan, the eyebolt on the motor, or any other parts not intended for the purpose. Hoist the fan using appropriate hoisting equipment considering the fan's center of mass.
(2) If it is difficult to keep the fan level, use the common base etc. when you hoist it.
(3) If the fan is small-sized and has no lifting lug, hoist the fan by passing a rope or wire under the common base.
(4) If the hoisting equipment comes in contact with the fan, prevent any damage by applying cloth in between or by using hoisting equipment that does not cause scratches or flaws.

Note

Any scratches or flaws on coating may cause rusting.
Ensure to carry out repair coating in such a case.

(5) If you hoist divided casings or the impeller, apply cloth or other protection to the contact points with a rope or wire in order to prevent the deformation of those parts.
(6) Use as long ropes and wires as possible to hoist the fan at 90° or less and thus prevent the fan from being deformed by the lifting load.
(7) When the casing surface is covered with lagging (for heat insulation), even a very small load will cause deformation. Ensure that the rope should not contact the lagging surface.

3.2.2 Precautions for storage

(1) Do not allow rust to be formed on the product while you store it before installation.
In particular, take measures to prevent any rainwater or dust from entering the inside, particularly the bearing section, for example by covering it with a vinyl sheet.
(2) Store indoor-type motors and other electrical devices indoors.
Also for equipment for outdoor use, protect its wiring and cable openings against moisture.
(3) If you store the fan for over one month, remove the V-belt from the unit and avoid a hot, humid, or dusty place.
(4) If a film is wrapped around the fan on shipment and the film is exposed to sunlight or rainwater, it may stick to the product. Pay attention to the location where you store the fan.

3.3 Precautions for the location of installation

Install the fan at a location where the following conditions are all satisfied:

(1) Do not use an indoor type fan outdoors.
Ensure that the fan does not suck in any rainwater.
(2) A well-ventilated place with minimum exposure to dust and moisture.
If you install the unit in a fully enclosed room—such as a machine room, install a ventilator so that heat generated from the motor or other sources will not increase the room temperature.
(3) A place with an ambient temperature of 0°C to 40°C.
(4) A place where the fan cannot be accessed or operated by unauthorized persons.
Take measures to prevent unauthorized persons from having access to the fan, for example by installing a barrier.

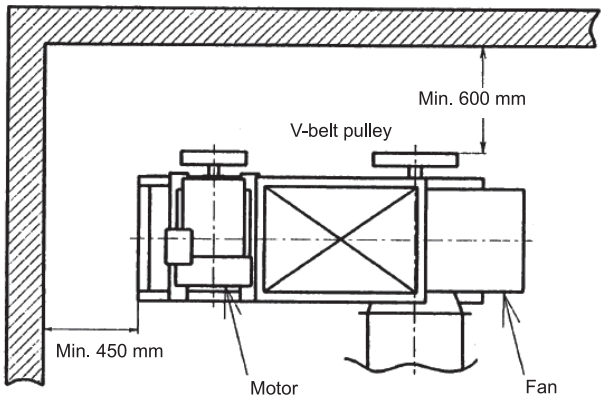


Figure 2 - Installation of the fan (recommended)

(5) A place where the fan can be easily inspected and repaired.
Secure enough space to replace the V-belt pulley and make adjustments for centering (see Figure 2. Installation of the fan [recommended]). If you install the model of split casing type, secure enough space to place the upper casing, impeller and other parts as well as to assemble, disassemble and repair the fan.
(6) If you install the fan indoors, ensure that the room has doors that are wide enough to allow the fan to pass through.
(7) If you place a large-sized fan or if you frequently need to replace or repair a fan because of corrosion or wear on the impeller, consider using minimal hoisting equipment.

Warning

Electric motor or control panel insulation degradation may result in electric leakage, electric shock, or fire.
Keep the ambient temperature at 0 to 40°C with sufficient ventilation to prevent damage to the equipment and deterioration of its life. Avoid dust, corrosive or explosive gases, salinity, humidity, condensation. For indoor installations avoid direct sunlight or wind and rain.

Caution

Do not place any objects that may obstruct ventilation or any combustibles around the motor. They may prevent heat from escaping, thus resulting in overheating or fire.

Note

Any scratches or flaws on coating may cause rusting.
Ensure to carry out repair coating in such a case.

3.4 Foundations

(1) The foundations must be strong enough to support the fan's weight and the load and vibration produced by the running fan.
(2) Lay foundation concrete so that it remains level and is not affected by ground subsidence. If the ground is soft or weak, reinforce it with driving piles or other means.
(3) The weight of the foundations must be 2 to 4 times the total weight of the fan including the motor.
(4) Separate the foundations of the fan from the pillars or floor of a structure so that vibrations cannot be transmitted to the structure.
(5) If you lay foundations for two or more fans, separate the foundations for each unit to prevent the transmission of vibration.
(6) In principle, make blockout holes in the foundation concrete, and then fix the foundation bolts into the holes during the installation of the fan. For the positions of the foundation bolt holes, see the dimensional outline drawing. If you need to set the foundation bolts before placing the fan, use a template or other means to ensure that the positions are correct.
(7) If you need to lay the foundations on the second or higher floor to install the fan as building equipment or for other purposes, align the foundations with a beam and set them as close to a wall of the building as possible.

3.5 Installation

3.5.1 Floor mounting types

Carry out the following steps to install the fan using the foundation bolts (blockout method).
(Select appropriate steps according to each case, for example where foundation bolts are set in place before installation.)

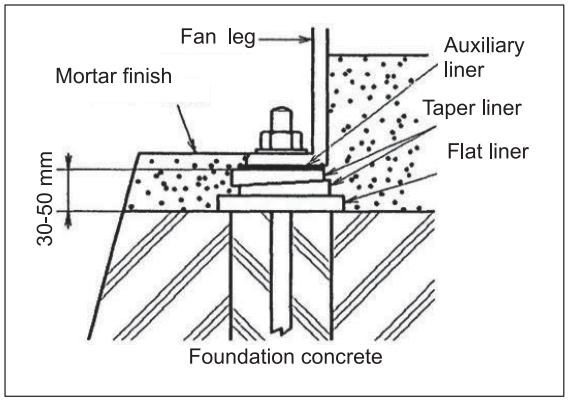


Figure 3 – Example of liner placement

(1) Clean the surface of the foundation concrete, and check the levelness.
(2) Carry out chipping work as needed.
(3) Clean each foundation bolt hole, and remove any dust or debris.
Although the foundation bolt holes need to be wet, do not allow any water to accumulate inside the holes. Thoroughly drain water from the holes.
(4) As shown in Figure 3, place one flat liner and two taper liners so that they are displaced to either side around the foundation bolt hole on the fan base.
Use an auxiliary liner (3 mm or thicker) as needed.
If the distance between foundation bolts exceeds 1 m, place additional liners between the foundation bolts.
(5) Place the fan base on the liners. Then pass each foundation bolt through an foundation bolt hole on the fan base to allow the bolt to suspend inside the blockout hole.
To make the fan earthquake-resistant, weld each foundation bolt to reinforcing bars of the foundation concrete.
(6) Adjust the position and height of the fan using the taper liners.
(7) If the casing is separated from the bearing and the base, set the height and the position in consideration of the clearance between the rotating body and the casing (Refer to Figure 4). Adjust the clearance between the impeller and the air intake and the clearance between the main shaft and the casing (shaft seal) so that they are as even as possible in terms of circumference.

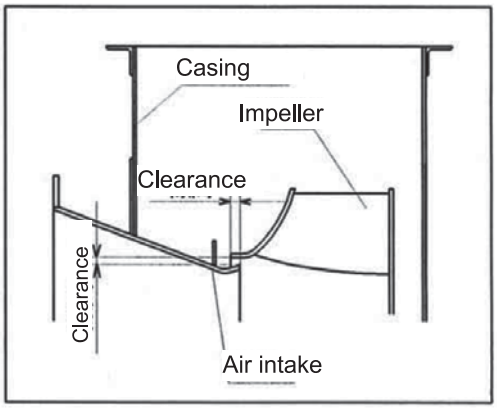


Figure 4 - Clearance

(8) However, if the fan handles a gas at a temperature exceeding 200°C, adjust the height in consideration of thermal expansion of the casing center. Calculate the expansion of the center height by assuming that it expands about 1 mm per meter when temperature increases by 100°C.
(9) After sufficiently roughing the inner wall of each foundation bolt hole, pour non-shrinkage mortar into the hole.
At that time, ensure that the foundation bolt is positioned vertically at the center of the hole.
(10) After the mortar has set sufficiently, securely tighten the nut of each foundation bolt.
At that time, ensure to tighten the nuts evenly. Use tapered washers if the fan base is made of channel steel. To prevent the liners from shifting during operation, weld them in place.
(11) Pour a sufficient amount of mortar into the gap between the fan base and the foundation concrete to form a concrete structure.
(12) Check the mortar for shrinkage, cracks, or any other defects.
If you need to install a drain pipe or a bearing cooling water system, consider structures such as a drainage pit.
(13) If your fan comes with a vibration-proof device, fix its vibration-proof base (lower base) in place with the foundation bolts.
If you install the fan for building facilities and use a vibration-proof device of a spring type, install the vibration-proof device so that the vibration absorbing materials are evenly placed around the fan assembly's center of mass.
(14) When you have installed the fan and properly connected the duct, carry out the alignment work described in the upcoming section 3.6.
Ensure to carry out the alignment and measurement after tightening the foundation bolts.

3.5.2 Ceiling mounting types

(1) By connecting the fan's base to the hanging bolts that are embedded in the ceiling, horizontally suspend the fan. Ensure that the load of the fan is evenly distributed among all the hanging bolts.
(2) Be sure to use hanging bolts that are strong enough to sustain the load (in terms of the strength of the bolt itself as well as the pre-installed condition).
(3) After you have installed the fan, lock the nut on each hanging bolt to prevent them from coming loose.
(4) To make the fan earthquake-resistant, firmly install the fan onto a section steel frame fixed onto a building structure.
(5) As shown in Figure 5, firmly fix the hanging type vibration absorber base onto the ceiling hang bolts. To prevent the unit from vibrating horizontally, install a vibration-proof bracket at an angle onto each ceiling hang bolt using a continuous-thread stud, turn buckle, or other parts.

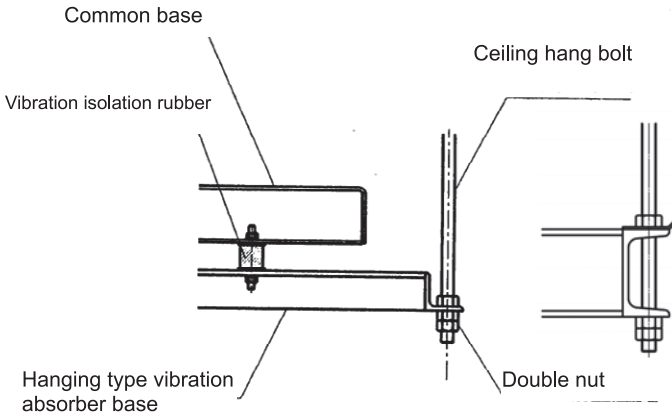


Figure 5 – Example of ceiling mounting

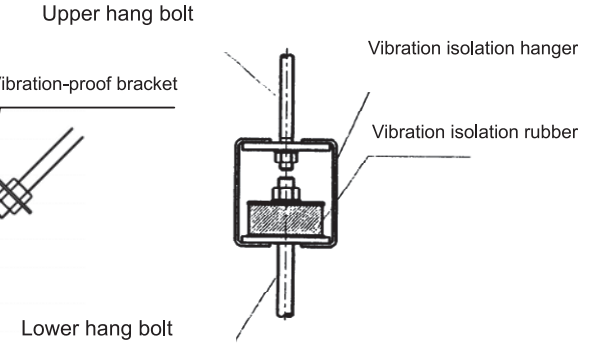


Figure 6 – Structure of hanger type vibration isolation rubber

3.5.3 Vibration-proof, earthquake-resistant types

(1) If you use vibration isolation rubber during the installation, ensure that the upper and lower sides of the hole are positioned in a vertical line and that no part of the rubber is twisted or distorted, as shown in Figure 7.

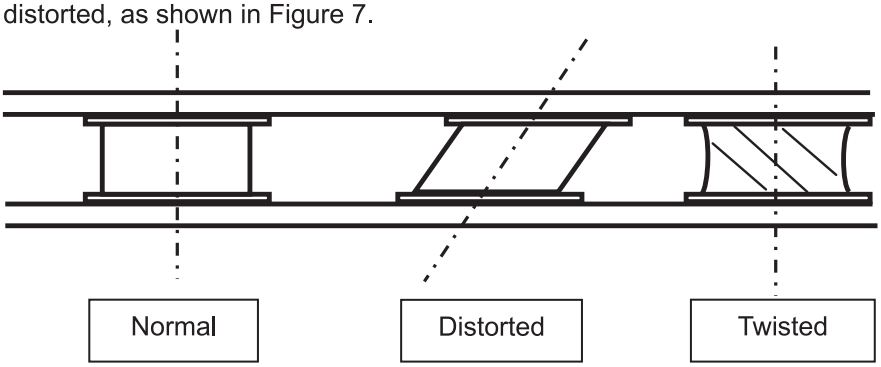


Figure 7 - Example installing vibration isolation rubber

(2) The product is shipped with the stopper bolts tightened as shown in Fig. 8_"When shipped." After installation of the product at the delivery site, be sure to fix the stopper bolts in the position shown in Fig. 8_"After installation."

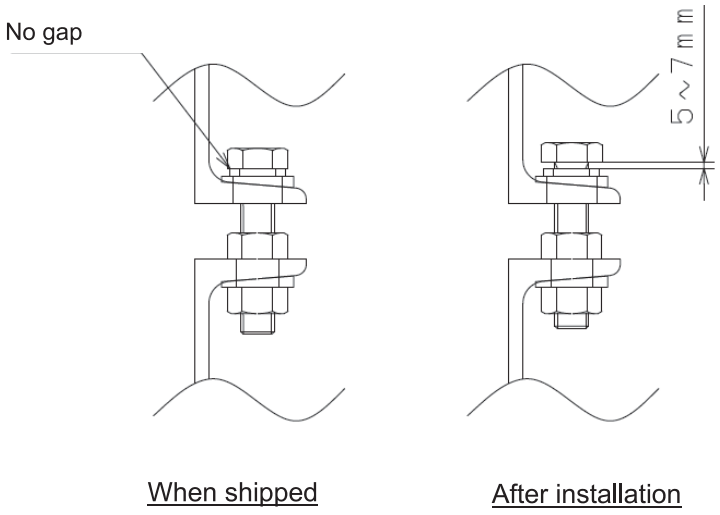


Figure 8 – Stopper bolt adjustment

Caution

If the fan is operated with the stopper bolts locked (see Figure 8), the expected vibration-proof effect cannot be obtained.

(3) For fans of a vibration-proof, earthquake-resistant type, be sure to use expansion joints, and do not connect the fan and the duct directly.

3.5.4 With vibration isolation pad (CMF3/3L-No.2～6-SOB/OB-ND)

At the time of shipment, double nuts for fastening a stopper bolt (hexagon nut ①, ②) are tightened to prevent a special packing from jumping out as shown in Figure 9. After installing the fan at the delivery site, be sure to loosen the double nuts for fastening the stopper bolt to the position shown in Figure 9 and fix them.

Hexagon nut dimensions

Type	CMF3/3L-OB/SOB-ND		
Impeller size	2~2½	3~4	4½~6
Hexagon nut	M8	M10	M12

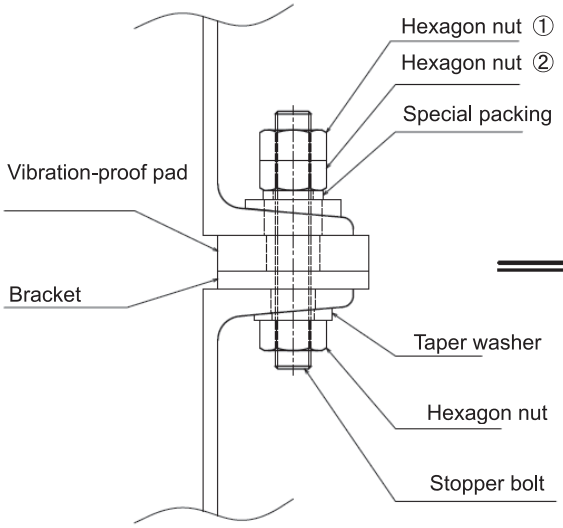


Figure 9

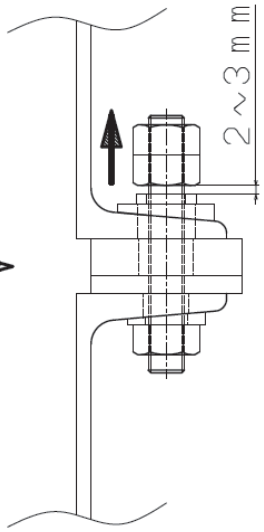


Figure 10

Double nut fastening procedures

(1) Hold the hexagon nut ② with a tool and return the hexagon nut ① in the loosening direction.

(2) Return the hexagon nuts ① and ② in the loosening direction and set the clearance between the hexagon nut ② and the special packing at 2 to 3 mm.

(3) Hold the hexagon nut ② with the tool, tighten the hexagonal nut ① and lock it.

Caution

If the fan is operated with the double nuts locked (see Figure 9), the expected vibration-proof effect cannot be obtained.

3.6 Alignment

Although the fan is aligned at the factory before shipping, it could get misaligned during transportation. Check the alignment and realign the fan after the installation is complete.

Warning

Remove the belt guard and shaft coupling guard when you carry out the alignment. Before you operate the fan, however, be sure to attach them again.

Do not operate the fan without the belt guard or shaft coupling guard.
Failure to observe this, you may get caught into the machinery and injured.

Caution

Improper alignment may lead to machine damage, vibrations, or noise. Ensure to achieve accurate alignment.

3.6.1 Alignment of belt drive type

(1) As shown in Figure 11, place a ruler or a piano wire onto the outer ends of the V-belt pulleys on the fan and motor sides, and check that the ends of the pulleys are in a straight line and adjust the positions if they are misaligned.

(2) If you can depress the middle of the V-belt with your finger up to about the same depth as the thickness of the V-belt, the tension of V-belt is appropriate. Use the slide base of the motor to adjust the tension of the V-belt.

(3) Make high tension V-belts slightly tighter than standard V-belts. Too loose tension may cause the belt to slip during startup, and excessive tension may apply a large load to the shaft and bearing, thus resulting in failure.

(4) Since V-belts tend to stretch at an early stage of use, ensure to readjust the tension in the first several days of operation (about 50 hours after the start of operation). Otherwise, the belt may break prematurely or come off.

(5) First obtain the value of deflection δ by the relationship δ=0.016ℓ. (Where ℓ is the distance between the pulleys) Then provide the deflection δ mm to the middle of the V-belt and adjust the tension using a tension meter so that deflection load at this point becomes the value shown in the table below.

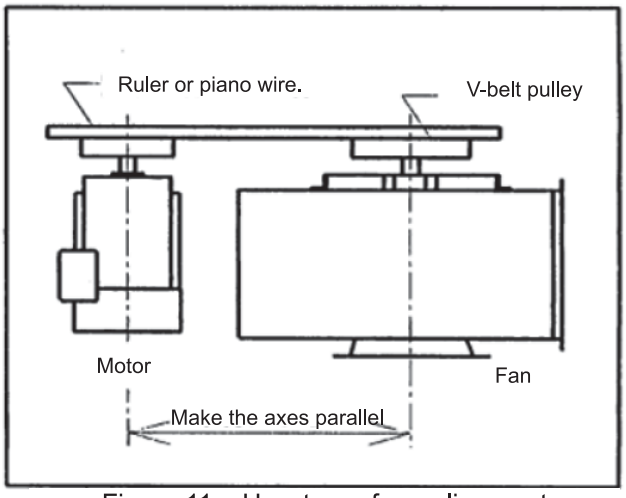


Figure 11 – How to perform alignment

Note

When alignment and belt tension adjustment is performed, the coating film on the sliding part near the motor mounting leg may be peeled off and rust may be generated.
If you install the fan in a humid place or outdoors, apply repair coating to bolts and nuts, including the peeled areas in order to prevent rusting.

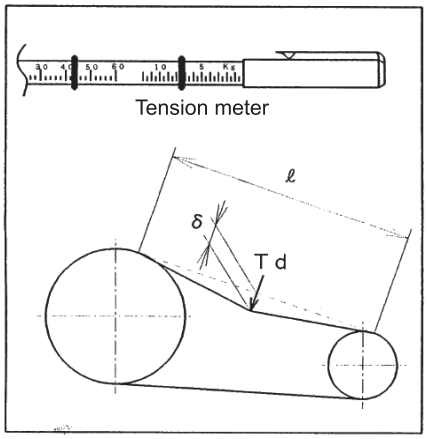


Figure 12 - How to measure the belt deflection load

For standard V-belt and Red seal type

A Type

Qty	Motor output kW	Td for each V-belt Unit : N	
		For new belt	For re-tensioning
1	0.2	9 ~ 11	8 ~ 9
	0.4	9 ~ 11	8 ~ 9
	0.75	12 ~ 14	10 ~ 12
	1.5	17 ~ 19	15 ~ 16
	2.2	21.5 ~ 23.5	18.5 ~ 20.5
	3.7	25.5 ~ 27.5	22 ~ 24
2	0.75	7 ~ 9	6 ~ 8
	1.5	13.5 ~ 15.5	11.5 ~ 13.5
	2.2	15.5 ~ 17.5	13.5 ~ 15.5
	3.7	18.5 ~ 20.5	16 ~ 18
	5.5	22.5 ~ 24.5	19.5 ~ 21.5
3	3.7	14.5 ~ 16.5	12.5 ~ 14.5

B Type

Qty	Motor output kW	Td for each V-belt Unit : N	
		For new belt	For re-tensioning
2	1.5	11 ~ 13	9 ~ 11
	2.2	14.5 ~ 16.5	12.5 ~ 14.5
	3.7	16.5 ~ 18.5	14.5 ~ 16.5
	5.5	21.5 ~ 23.5	18.5 ~ 20.5
	7.5	27.5 ~ 29.5	23.5 ~ 25.5
	11	33.5 ~ 35.5	28.5 ~ 30.5
	15	42 ~ 44	36.5 ~ 38.5
3	5.5	19.5 ~ 21.5	17 ~ 19
	7.5	23.5 ~ 25.5	20 ~ 22
	11	30.5 ~ 32.5	26 ~ 28
	15	35.5 ~ 37.5	30.5 ~ 32.5
	18.5	39 ~ 41	34 ~ 36
4	15	29.5 ~ 31.5	25.5 ~ 27.5
	18.5	33.5 ~ 35.5	28.5 ~ 30.5
	22	35.5 ~ 37.5	30.5 ~ 32.5
	30	43 ~ 45	37 ~ 39

For narrow V-belts

3V Type

Qty	Motor output kW	Td for each V-belt Unit : N	
		For new belt	For re-tensioning
2	2.2	10 ~ 12	8 ~ 10
	3.7	14.5 ~ 16.5	12.5 ~ 14.5
	5.5	17.5 ~ 19.5	15 ~ 17
	7.5	19.5 ~ 21.5	17 ~ 19
	11	23.5 ~ 25.5	20 ~ 22
	15	28.5 ~ 30.5	24.5 ~ 26.5
3	5.5	12.5 ~ 14.5	11 ~ 13
	7.5	17.5 ~ 19.5	15 ~ 17
	11	19.5 ~ 21.5	17 ~ 19
	15	22.5 ~ 24.5	19.5 ~ 21.5
	18.5	23.5 ~ 25.5	20 ~ 22
4	11	14.5 ~ 16.5	12.5 ~ 14.5
	15	18.5 ~ 20.5	16 ~ 18
	18.5	22.5 ~ 24.5	19.5 ~ 21.5
	22	22.5 ~ 24.5	19.5 ~ 21.5

5V Type

Qty	Motor output kW	Td for each V-belt Unit : N	
		For new belt	For re-tensioning
2	11	31.5 ~ 33.5	27 ~ 29
	15	39 ~ 41	34 ~ 36
	18.5	44 ~ 46	38 ~ 40
	22	56 ~ 58	48 ~ 50
	30	67.5 ~ 69.5	58.5 ~ 60.5
3	15	29.5 ~ 31.5	25.5 ~ 27.5
	18.5	33.5 ~ 35.5	28.5 ~ 30.5
	22	40 ~ 42	34.5 ~ 36.5
	30	55 ~ 57	47.5 ~ 49.5
	37	61.5 ~ 63.5	53.5 ~ 55.5
	45	72.5 ~ 74.5	62.5 ~ 64.5
	55	76.5 ~ 78.5	66 ~ 68
4	30	45 ~ 47	39 ~ 41
	37	51 ~ 53	44 ~ 46
	45	59 ~ 61	51 ~ 53
	55	67.5 ~ 69.5	58.5 ~ 60.5

3.6.2 Alignment of direct type shaft coupling

The following is an example of the case a flange type flexible shaft coupling is used.

(1) Put a parallel ruler at four places on the circumference of the shaft coupling and check the gap between levels of the circumferences.
(2) Measure the clearance between the mating surfaces of the shaft coupling using a taper gauge or a feeler gauge (see Figure 13).
The tolerances are within 0.05 mm for the gap between the levels and within 0.1 mm for the unevenness of the clearance

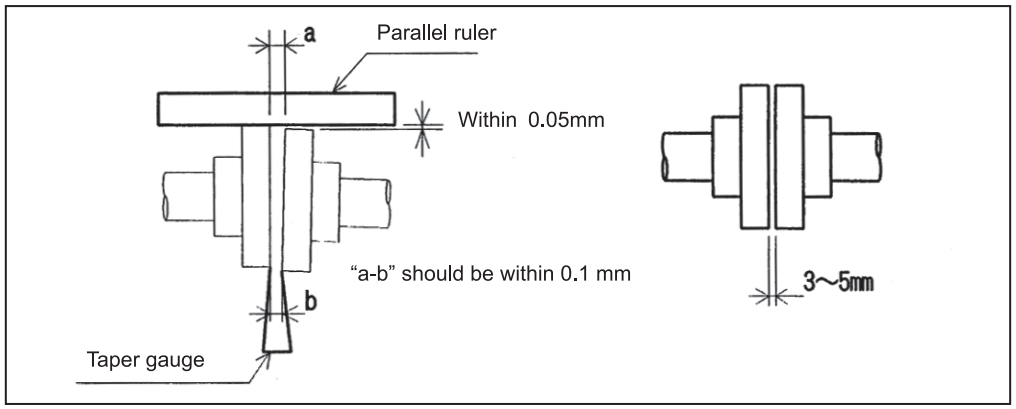


Figure 13 – How to perform alignment

Correct the alignment by inserting a shim under the motor.
Use a dial gage for the adjustment of a spring coupling or the like which requires preciseness.

3.7 Precautions for connecting the duct

Caution

Do not allow the weight of the duct system to be applied to the fan.
Failure to observe this may result in a failure, damage, or vibration.

(1) To prevent the transmission of vibration and noise to the outside, connect the fan's flange and the duct using an expansion joint. Particularly when the blowing gas is hot, be sure to install expansion joints in order to prevent the fan from being subjected to the reaction force of the duct caused by thermal expansion.
(2) Before connecting the duct, check the inside of the duct and fan, and remove any foreign objects such as waste cloth or tools.
(3) If the duct diameter is tapered significantly compared to the fan bore, if the duct is fitted with a series of bends, or if bends are provided immediately before or after the fan, pressure loss will increase. Refer to the piping example shown in Figure 14.
(4) Provide a damper for air flow control as needed.
(5) To prevent the suction of foreign matter, install a wire mesh at the duct intake as well as at the fan suction port where the atmospheric air is directly sucked in. In addition, if dust and/or water droplets may get into the fan, be sure to install a filter to prevent the entry.

Warning

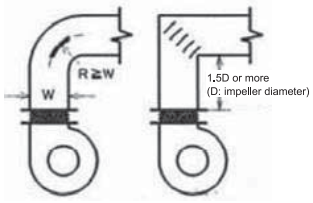
Be sure to install a protective wire mesh on the suction port of the fan if it is open.

(6) If the fan is exposed to the wind opposite to its blowing direction, install a check valve to prevent reverse rotation of the impeller.
Starting the fan with the impeller rotating in the opposite direction may damage the impeller or cause the motor to burn out.

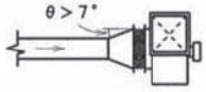
Note

If there is a wall in front of the fan suction port, provide a clearance of at least the size of the port between the suction port and the wall.

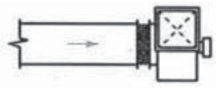
There is a bend near the discharge port.
[Incorrect]



Vanes are provided in a bend or a right-angle bend.
[Correct]

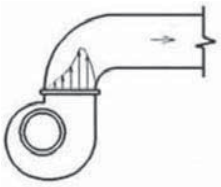


θ exceeds 7°.
[Incorrect]



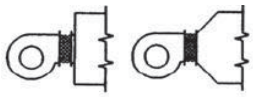
A straight air passage is provided.

[Correct]

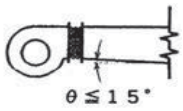


A bend with the direction opposite to the impeller rotation is provided near the discharge port.
[Incorrect]

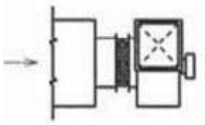
A bend with the same direction as the impeller rotation is provided near the discharge port
[Correct]



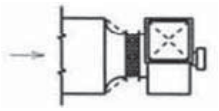
The bore size is expanded at a sharp angle on the discharge side.
[Incorrect]



The bore size is expanded at 15° or less on the discharge side.
[Correct]



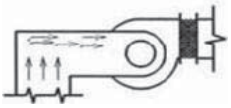
Local resistance is large.
[Incorrect]



A bell mouth is provided to reduce a local resistance.
[Correct]

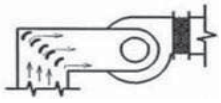
Intake air is subjected to a swirl opposite to the impeller rotation.
[Incorrect]

Vanes are provided to prevent a swirl of intake air.
[Correct]



There is a right-angle bend near the suction port

[Incorrect]



Vanes are provided in a right-angle bend.

[Correct]

Figure 14 – Examples of duct installation

3.8 Precautions for wiring work

> **Warning**
>
> Use high-quality wiring equipment and devices, and carry out wiring work safely and securely according to the technical standards for electrical facilities, as well as the indoor wiring regulations.
> Only qualified personnel such as licensed electrical engineers are allowed to carry out electrical wiring work. Unqualified persons are prohibited by law to carry out wiring work, and it is very dangerous.

(1) Be sure to install a ground fault interrupter and an overload protection device on the primary side of the fan.
In case that a thermal relay is used as an overload protection device, the fan may trip at a start-up due to its starting characteristics.
* The starting current of premium efficiency (equivalent to IE3) motors may become higher than that of standard efficiency (IE1) motors. Therefore, it is necessary to verify the applicability of its ground fault interrupter and overload protection device.
If you have any questions, contact TERAL INC.

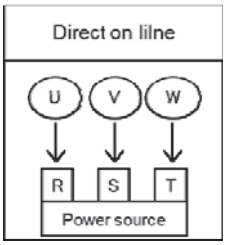
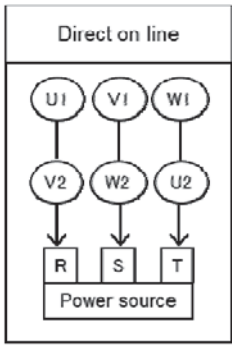
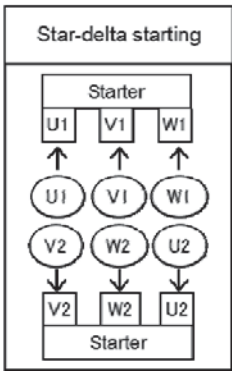
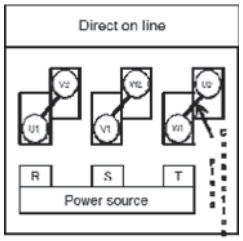
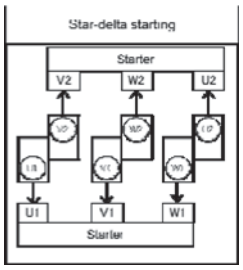
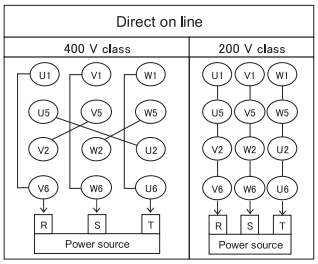
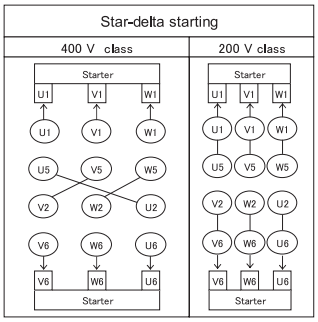
(2) Be sure to install a ground wire in order to prevent an electrical shock.
- Connect the ground wire to the ground terminal, which is located inside the terminal box of the motor.
- Do not connect the ground wire to a gas pipe, water pipe, lightning rod, or the ground wire for a telephone.

> **Warning**
>
> It is prohibited by law to perform improper grounding work, which exposes personnel to a great danger.

(3) For the connection patterns, see Figure 15.

(4) Limit the fluctuations of the power voltage within ±10% of the rated voltage, and also limit the fluctuations of the frequency between –5% and +3% of the rated value. Although you can run the fan in these ranges, avoid the operation for a long time if the voltage is not within ±5% of the rated value or if the frequency is not within ±2% of the rated value. Even if the fluctuations fall within the allowable ranges, the fan characteristics and motor characteristics may differ from those at the rated voltage and frequency.

(5) Before running the fan, check the following points again:
① Wiring is correct.
② The fan is securely grounded.
③ An appropriate fuse (breaker) is installed.
④ None of the three wires of the motor has come loose or is disconnected. Keep in mind that running the motor with connection of only two wires results in an open-phase fault, which may lead to motor burnout.

Number of terminals	3	6		12
Connection pattern	 Terminal block type	  Terminal block type	  Lug terminal type	  Lug terminal type

* The above connection patterns cause the motor to run counterclockwise when viewed from the shaft end of the motor.
If you need to run the motor in reverse direction, reverse the connections to R and T terminals of the power wires.

Figure 15 – Connection patterns of the motor terminals

4. Preparation for operation

4.1 Check items before test operation

4.1.1 Check items related to the electrical system

(1) Check that the fan is correctly wired.
(2) Check the frequency.
Running the fan at a frequency other than the specifications may reduce its performance, burn out the motor, or damage the impeller and main shaft.
(3) Check the terminals for any loose connection.
(4) Check that the unit is securely grounded.
(5) Check that the setup value of the overload protection device is consistent with the rated current value of the motor. The rated current value is indicated on the motor nameplate.

4.1.2 Check items related to the fan

(1) Check the inside of the fan for any accumulated water, and check for any tools or other foreign objects that are left behind.
(2) Check for any loose connection at foundation bolts, fan main unit, accessories, piping, and other parts.
(3) Check that the damper and valves can fully open and close without any problems with the motion.
(4) Check that a specified amount of lubricant is filled (to the specified level in the oil gauge) when the bearing is lubricated in an oil bath.
(5) Check the cooling water when the bearing is cooled in an oil bath or by a water-cooling system.
Supply about 10 to 14 ℓ/min of clean water at a temperature of 25 °C or lower and a water pressure of 0.3 MPa or less.
(6) When using a spring coupling, fill grease into the clearance between the tooth flanks before combining them.
Make sure that an appropriate amount of grease is filled.
(7) Check the alignment of V-belt pulleys and the tension of V-belt.
(8) Rotate the fan by hand or by inching a motor to check that it can rotate smoothly without any internal obstructions.

Before turning the fan shaft by hand to check its rotation, be sure to turn off the main power.

(9) Place an operator in advance so that the fan can be turned off immediately at the supervisor's command.

Do not operate the fan if you notice any abnormal condition such as abnormal noise. Be sure to contact the vendor or the service company specified by the manufacturer.

4.1.3 Precautions for inverter operation

(1) If you use the fan with an inverter, let us know before placing an order.
Some standard motors may not allow inverter operation.

(2) The initial settings of off-the-shelf inverters are not tailored for running the fan.
The use of the inverter at its initial settings may cause abnormal vibration or damage of the fan.
Be sure to make the settings of the inverter before operation, referring to the following information. Changing the inverter settings may solve some abnormal condition.

<Inverter setup values (for reference only)>

① Base frequency	:	Set this to the specified frequency (indicated on the nameplate)
② Maximum frequency	:	Set this to the specified frequency (indicated on the nameplate)
③ Maximum output voltage	:	Set this to the rated voltage of the motor.
④ Upper limit frequency	:	Set this to the specified frequency (indicated on the nameplate)
⑤ Lower limit frequency	:	Set this to a value between 25 Hz and 30 Hz. Running the fan at a lower frequency may cause the motor to stall or generate heat or may make the inverter output unstable.
⑥ V/F characteristics	:	Set this to square reduction torque.
⑦ Acceleration / deceleration time	:	Set this to a value between 30 and 40 seconds. Starting/stopping the fan in a shorter period may trip the inverter.
⑧ Carrier frequency	:	The factory settings of the carrier frequency depend on the manufacturer. If the fan produces any abnormal vibration or noise with the current settings, the problem may be solved by changing the carrier frequency setting according to the following table.

Carrier frequency	Low	-	High
Noise from the motor (high-pitched noise)	Loud	-	Small
Noise from the inverter	Small	-	Loud
Number of times surge voltage is applied	Few	-	Frequent

(3) If you use the fan with an inverter, check during test operation that the fan runs normally at all the frequencies you use. Running the fan in an abnormal condition such as abnormal vibration may damage the fan.
To avoid abnormal vibration, make the settings of the inverter to enable the frequency jump function for eigenvalue of the resonance frequency values of the fan, motor, fan + base, and other parts.

4.2 Test operation

4.2.1 Precautions during startup

If your fan comes with a belt guard, be sure to attach the belt guard before operation.

(1) Close the damper and turn the power switch ON and OFF once or twice to check for any abnormal operating condition such as abnormal noise or vibration. Also check the rotation direction of the fan at that time.
If the fan rotates in the opposite direction, swap two of the three wires of the power supply connections.

Be sure to turn off the main power before changing any wiring of the fan.

(2) Turn on the power, and monitor the unit closely until it reaches its maximum speed. At that time, check for any abnormal noise, vibrations, current, or other abnormal conditions.
(3) Proceed with continuous operation, and gradually open the damper.
In order to check the condition of each part, keep the fan running at a low flow rate (light load) for 20 to 30 minutes. At that time, ensure that the fan does not run at a rate where surging may occur.
(4) Open the damper gradually until the fan reaches the full load operation.
Keep the fan running in this condition for 1 to 3 hours; and check the temperature, vibration, and noise at each section of the fan. In addition, check that the current value of the motor is normal. Pay special attention to blowing of hot air because the current value becomes higher in such a case compared with blowing of air at the room temperature. The bearing temperature may become slightly higher than usual for about 1 to 2 hours after the start of operation. If there are no errors in the machine, however, the temperature stabilizes afterwards.
(5) If the blowing gas is hot, thermal expansion after the steady-flow operation may cause misalignment. Therefore, when the temperature has risen enough after the operation, stop the fan and check the alignment.

If the blowing gas is hot, do not touch the fan body, duct, or any other hot parts. Failure to observe this may cause burn on the skin.
In addition, do not place any combustibles around the unit.

Note

If an air-cooled bearing is used, provide enough space so that the heat dissipation from the air-cooled parts (radiator blade, radiator plate) would not be hindered by lagging or other objects.

4.2.2 Precautions during operation

(1) Avoid starting and stopping the fan frequently as it will damage the fan and motor quickly.
If you need to start and stop the fan frequently (e.g. when carrying out test operations), refer to the following table for the startup frequency.

Motor output power	7.5kW or less	11kW - 22kW	30kW or more
Starting frequency	Max. 6 times per hour	Max. 4 times per hour	Max. 3 times per hour

During normal operation, please use the fan for 10 hours of continuous operation per day.
If the fan is to be used under conditions where the starting frequency is high, please consult with us.
The expected design life is based on 10-15 years of 10hours of continuous operation per day and 300 operating days per year.
(The expected design life is not a guaranteed value.)
*Do not use a fan of the straddle mounted impeller type (RS • RD) for exhausting high-temperature gas such as in kitchens. This may lead to bearing damage at early stage

Warning

In the event of a power failure, be sure to turn off the main power.
The fan suddenly starts on restoration of the power, and it is very dangerous.

4.2.3 Precautions for stopping the operation

(1) To stop the fan, gradually close the damper to the full and then turn off the power switch.
(2) If the fan is blowing 200°C or hotter air, close the damper and then keep running the fan for a while. When the inside of the fan has completely cooled down, stop the operation.
At that time, ensure that the fan does not run at a rate where surging may occur.
(3) If cooling water is used for the system, stop the fan and then close the cooling water valve.
(4) If the fan is blowing a toxic gas, pay attention to any gas leak from the shaft seal section.

5. Long-term shutdown

5.1 Precautions for long-term shutdown

If you do not use the fan for a long time (1 month or longer), observe the following points:

Warning

If you leave the fan unused for a long time, be sure to turn off the main power.

(1) If you do not use the fan for a long time, apply appropriate anti-corrosive agent to the areas prone to rust. In addition, refill or change grease to put fresh grease in the bearing.
(2) Take measures to prevent dust or other foreign matter from accumulating on the fan main unit or the motor.
(3) To prevent the entry of dust or other foreign matter into the connected ducts, close the suction port and the discharge port. If a damper is installed, close the damper.
(4) Protect the motor and other electrical devices against moisture.
(5) Detach the V-belt, and store it in an appropriate place; i.e. avoid a hot, humid, or dusty place.
(6) Cover the bearing with tarpaulin or other covering to prevent contact with ambient atmosphere and to prevent the entry of dust.
(7) Before you run the fan after a long period of shutdown, inspect each part, and refill or change grease of the bearing.
(8) Once or twice a month, rotate the impeller shaft by hand and protect the bearing.
(9) During the long-term shutdown, take measures to keep unauthorized persons away from the fan, for example by installing a barrier or by locking it out.
(10) Drain water to prevent water from freezing and cracking the piping during the winter if the bearing is cooled with water.

6. Maintenance and inspection

> **Warning**
>
> Regularly inspect your equipment and perform maintenance on each component.

6.1 Daily inspection

(1) Check for any abnormal vibration, noise, bearing temperature, electric current or other conditions. If there is any unusual condition, it may be a sign of a failure. In such a case, you need to take measures as soon as possible. For this purpose, it is recommended to keep an operation log.

> **Warning**
>
> The main shaft, impeller, V-belt pulley, and V-belt are rotating during operation. Be extra careful not to get your clothes or other parts caught in these parts.

(2) The bearing temperature must be equal to or lower than [the normal room temperature plus 40°C] or [70°C], whichever is lower.

(3) If strong vibrations occur, stop the operation and inspect the V-belt alignment, duct connections, tightening of the mounting bolts and foundation bolts, and check for accumulation of dust on the impeller and damage to the bearings. If the vibration is within the region specified as "Acceptable" in JIS B 8330, you can run the fan, although the vibration level is preferable in the region specified as “Good” (see Figure 16). Note that, if your fan comes with a vibration-proof device, the vibration is not transmitted to the foundations, but vibration of the fan itself becomes somewhat stronger. In such a case, a vibration lower than the broken line is considered normal.

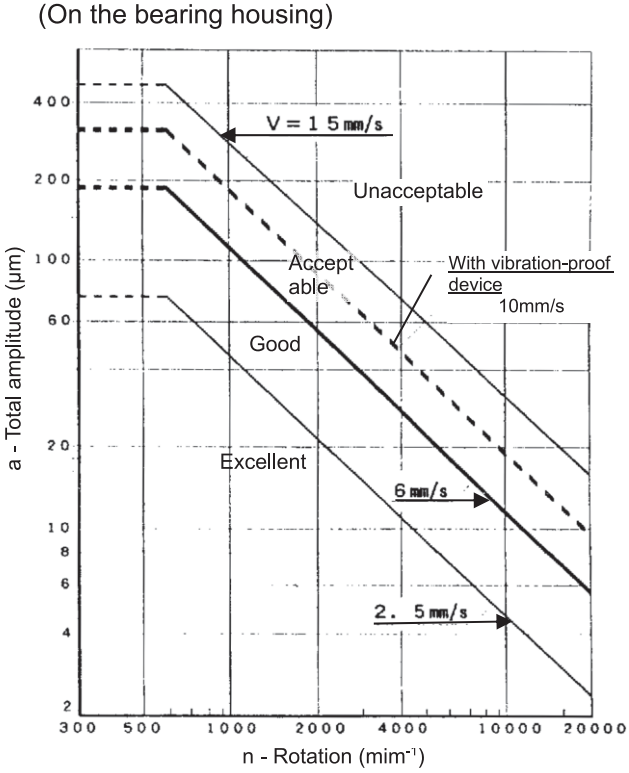


Figure 16 - Acceptable vibration range

(4) In addition to vibrations, noise is an important factor in judging the operating condition. For example, if you hear a metallic noise possibly made by contact with the rotor, stop the operation immediately. Although the continuous rasping noise of air inside the casing is normal, the discontinuous rumbling noise is a sign of surging operation. You must take measures in the latter case, for example by changing the degree of damper opening.

(5) Bearings generate a certain level of noise even in normal condition. Although it is rather difficult to identify an abnormal noise because bearings produce complicated noises, familiarize yourself with the patterns to prevent an accident.

Normal noise produced at bearings

Type of noise	Normal noise
Raceway noise	A constant hissing noise. This noise is generated when a ball rolls on the raceway surface.
Roller falling noise	Clattering sound. When load is applied in the radial direction (which is the case for most fans), the balls are alternately loaded and unloaded. Noise is produced at the switching point of loaded/unloaded state. It occurs mostly with low speed rotation.
Retainer noise	A retainer maintains the relative position of the balls. There is a small gap between the retainer and the outer ring, which allows the retainer to rotate; however, a continuous chunking noise is generated when the retainer is occasionally in contact with the outer ring. It is a slightly annoying noise, but cannot be eliminated easily. It occurs mostly with low speed rotation.

Abnormal noise produced at bearings

Type of noise	Abnormal noise
Contamination noise	Foreign matter could get into a bearing through careless handling of grease or for other reasons. In such a case, the bearing makes an irregular grinding noise. Replace with new grease.
Flaw noise	Any flaws on the bearing generate a discontinuous irregular noise. Any flaws on the raceway surface of the inner or outer ring generate a continuous noise. If the noise is faint or insignificant, the bearing may still be used after being refilled with grease. If the nose becomes serious, replace the part.
Rust noise	It is the same type of noise as “Noise caused by flaw.” If the nose becomes serious, replace the bearing.
Squeaking noise	It is a squeaking noise without a regular cycle. This noise is generated when a slip occurs between the ball and raceway or between the ball and retainer or when lubrication is not effective. Replace with high-quality grease.

6.2 Periodic inspection

Warning

Before you inspect the fan, be sure to turn off the main power.
Otherwise, the fan may suddenly start up through automatic run or from other causes, and it is very dangerous.

Warning

If motors or control panels are used for more than a certain period of time, it may cause ignition or other accidents due to aging deterioration.

Taking the upcoming “Periodic inspection items” as a guide, carry out the periodic inspection at least once a year. The periodic inspection items include the following points, in addition to the daily inspection items. Furthermore, replace parts and make repairs taking the upcoming “Guidelines for part replacement” as a guide.

(1) Refill the bearings with grease.
(2) Re-inspect the alignment and the V-belt.
Check the V-belt for any wear or damage, and check the tension. Replace or re-tension the V-belt as needed.
(3) Check the fit between the impeller hub and the shaft for any play.
(4) Check the impeller, shaft, or other parts for any corrosion and wear.
(5) Clean the inside of the fan, and apply anti-corrosive agent or otherwise make repairs.

Note

The alignment and belt tension adjustment may peel off the coating in the sliding section around the motor mounting leg, resulting in rusting.
If you install the unit in a humid place or outdoors, carry out repair coating in order to prevent rusting.

Periodic inspection items

Part	Inspection item	Inspection method	Acceptance criterion (as a guide)
Entire fan unit	Noise, vibration	Listen, touch	No noise or vibration significantly larger than the initial state.
Casing	Appearance (such as corrosion, adhesion, deformation, and leakage)	Visual check	No significant adhesion of dust, deformation, flaws, corrosion, or other problems related to appearance.
	Noise, vibration	Listen, touch	No abnormal noise or vibration.
Impeller	Check the running condition	Visual check (rotating by hand)	No contact or abnormal noise.
	Appearance (e.g. corrosion, adhesion, and deformation)	Visual check	No significant corrosion, deformation, or adhesion.
Main shaft	Appearance (e.g. corrosion, adhesion, deformation, and fit)	Visual check	No color change on the shaft. No rust at the fit.
	Looseness of fixing nuts	With a tool	No looseness
Bearing	Amount of grease	Check the hours of operation.	Grease is periodically applied according to this manual.
	Operation status (noise)	Listen	No abnormal noise.
	Operation status (vibration)	Vibration meter	Refer to the “Acceptable vibration range” shown in Figure 16.
	Surface temperature	Surface thermometer	Not higher than [the ambient temperature +40°C] or [70°C], whichever is lower
	Rotation movement	Touch	Can be rotated by hand smoothly and uniformly.
	Appearance (e.g. corrosion, adhesion and wear)	Visual check	No significant corrosion, wear, or deformation.
	Looseness of screws	With a tool	No looseness
V-belt	Check the tension	Tension meter	The amount of deflection and tension load must comply with the values calculated for each case, or must be within the range specified by the V-belt manufacturer.
	Rattling of the V-belt	Visual check	No significant rattling.
	Alignment of V-belt pulleys	Visual check using a straight ruler or piano wire	The parallelism and eccentricity of the V-belt pulleys must be within 1/3°.
	Appearance, wear, flaws	Visual check	No significant twisting, flaws, or cracks.
V-belt pulley	Appearance, flaws	Visual check	No significant flaws or cracks.
	Wear of the groove	Visual check	The new V-belt must not touch the bottom of the groove. No local wear or left/right partial side wear.
	Wear (fit with the main shaft)	Visual check	No significant wear.
	Looseness of fixing screws	With a tool	No displacement or looseness of the V-belt pulleys.
Belt guard	Appearance	Visual check	No significant rust or deformation.
Motor	Insulation	500 V megger Check by smelling	Insulation resistance must comply with the value specified for the motor. No smell of varnish burning.
	Noise	Listen Auscultation rod	No significant noise. No increase in noise level compared to normal values.
	Vibration	Touch Vibration meter	No significant vibration. No increase in vibration amplitude compared to normal vibration amplitude.
	Temperature	Visual check Surface thermometer	No change in coating color. No abnormal heat generation.
	Current	Measure	The measured value may not exceed the value shown on the motor nameplate.
	Smell	Smell	No burning smell.
	Rotation movement	Touch	Can be rotated by hand smoothly.
Vibration-proof device	Appearance	Visual check	No significant degradation such as cracks. No displacement.

Guidelines for periodic inspection interval and part replacement

The guideline of annual operation hours is 10 (hours/day) × 300 (days/year) = 3,000 (hours/year). In addition, the service life of the fan differs significantly depending on factors such as the operating conditions, the status of installation, and the status of maintenance. If you find any abnormal condition, stop the operation, replace the parts, and make repairs.

Part name	Replacement interval (guide)	Elapsed years														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Entire fan unit	15 years	○	○	○	○	○	○	○	○	○	◆	○	○	○	○	Replace the fan unit
Casing	15 years	○	○	○	○	○	○	○	○	○	◆	○	○	○	○	
Impeller	15 years	○	○	○	○	○	○	○	○	○	◆	○	○	○	○	
Main shaft	10 years	○	○	○	○	○	○	○	○	○	◆	○	○	○	○	
Bearing	3 years	○	○	▲	○	○	▲	○	○	▲	◆	○	▲	○	○	
V-belt pulley	5 years	○	○	○	○	▲	○	○	○	○	▲	○	○	○	○	
V-belt	1 year	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	
Belt guard	15 years	○	○	○	○	○	○	○	○	○	◆	○	○	○	○	
Motor	10 years	○	○	○	○	○	○	○	○	○	◆	○	○	○	○	
Vibration-proof device	15 years	○	○	○	○	○	○	○	○	○	◆	○	○	○	○	
Description of symbols		○: Periodic inspection (including cleaning and adjustment). Replace parts and make repairs based on the inspection results. ▲: Periodic replacement of consumables ◆: Replace parts or time-change parts based on the inspection results (perform overhaul as needed)														

6.3 Refilling and replacing grease

6.3.1 Pillow block

(1) If your fan is fitted with the pillow block, you can use the fan without lubrication. For longer use, however, it is recommended to refill grease during periodic inspection.
(2) The following tables show the intervals of refilling grease and the amounts. Do not refill too much. Basically, use Shell Alvania Grease No.3 for refilling. If your fan blows 150°C or hotter gas, the heating resistant pillow block (HR5) will be used; therefore, refill Super Lube No.3 by Yuken Kogyo Co., Ltd. Do not refill any other grease.
(3) Avoid using the fan in a dusty place or a place that could be exposed to moisture. If such use is unavoidable, refill grease more often than the specified intervals.
(4) While the fan is running, apply grease through the grease nipple using the grease pump.
(5) The structure of some fans may not allow grease to be refilled. In such a case, after using bearings for the duration of their service life, replace them with new ones.

Grease refilling interval for the pillow block

Ambient environment	Bearing temperature (°C)	Refilling interval
Clean	50°C or less	1 to 12 months
Dusty	70°C or less	1 to 4 months
Humid		1 week

Amount of refilling grease for the pillow block

Bearing number	Refilling amount g	Bearing number	Refilling amount g	Bearing number	Refilling amount g
UCP204	1.2	UCP214	13.6	UCP314	31.5
UCP205	1.4	UCP216	18.8	UCP315	38
UCP206	2.2	UCP306	3.8	UCP316	41
UCP207	3.2	UCP307	5.7	UCP317	52
UCP208	3.9	UCP308	7.8	UCP318	62
UCP209	5	UCP309	9.4	UCP319	73
UCP210	5.4	UCP310	12.8	UCP320	92
UCP211	7.4	UCP311	16.4	UCP321	106
UCP212	10	UCP312	21	UCP322	133
UCP213	11.8	UCP313	26	UCP324	158

6.3.2 Rolling bearing

(1) An insufficient application of grease may cause poor lubrication. On the contrary, excessive grease may cause the grease to be stirred and generate heat. After a long time of use, grease deteriorates partially, resulting in lower lubrication properties. Refill the proper amount of grease at the proper intervals.

(2) The following tables show the intervals and quantities of refilling grease. Be careful not to overfill. Use COSMO GREASE DYNAMAX EP No.2. or the equivalent of another brand. Do not mix in or apply any other type of grease.

(3) While the fan is running, apply grease through the grease nipple using the grease pump. Old grease collects in the bearing housing. Drain it through the drain port at the bottom.

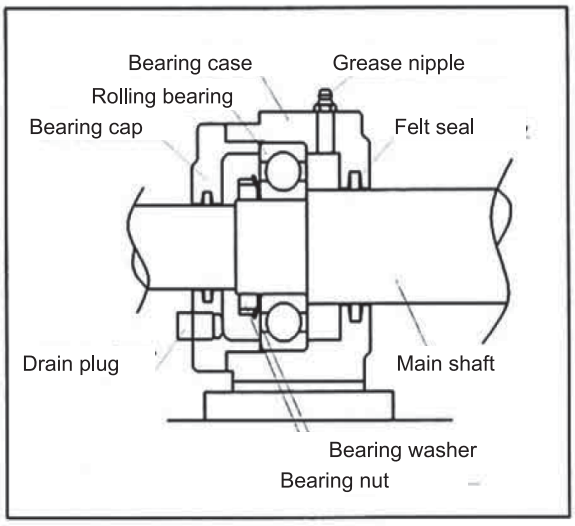
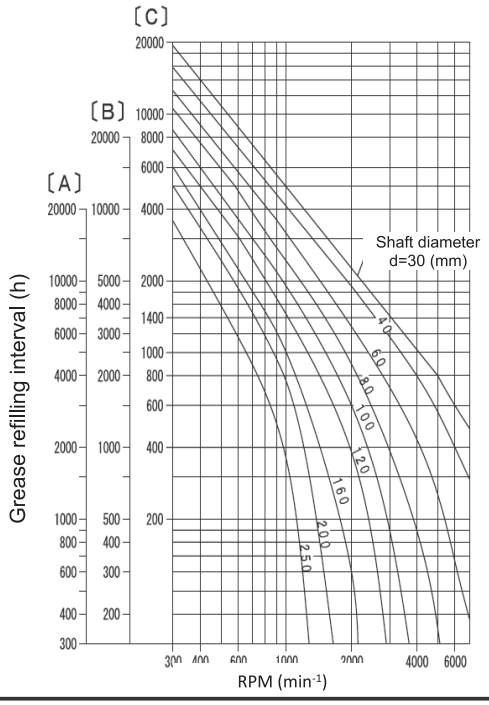


Figure 17 - Structure of rolling bearing

Grease refilling quantity and refilling interval of rolling bearing

Shaft diameter (mm)	Refilling Qty (g)
35	20
40	20
45	20
50	30
55	30
60	30
65	30
70	50
80	50
90	60
100	80
120	100
140	190
150	220
200	440
250	700

[A]: Deep groove ball bearing
[B]: Cylindrical roller bearing
[C]: Self-aligning roller bearing



6.3.3 Oil bath type bearing

(1) Since the oil is contaminated rapidly during the first six months from the start of operation, replace the entire volume of the oil.
(2) Change the oil after the first 300 hours operation, and every 2000 hours thereafter.
(3) Cosmo ALLPUS 32 of Cosmo Oil is used. Select the equivalent oil if you use oils from other brands.
(4) Be careful that dust or foreign matters should not mix with oil when you change the oil.
(5) The volume of oil is as shown in the table. Be careful not to overfill the oil bath.

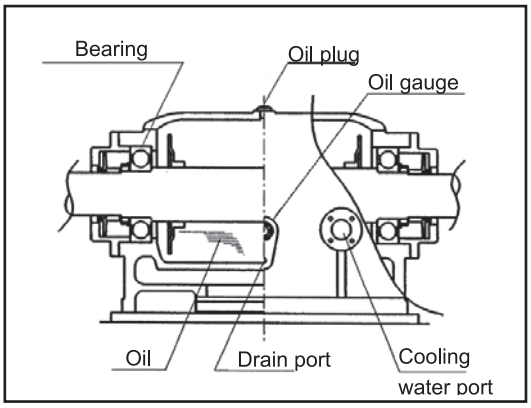


Figure 18 – Oil bath type bearing

Amount of oil for oil bath type bearing

Shaft diameter (mm)	Amount of oil (ℓ)	Shaft diameter (mm)	Amount of oil (ℓ)
40	1.5	65	2.3
50	2.3	80	3.3
55	1.7		

6.3.4 Refilling grease in spring coupling

(1) The spring and the gear coupling are combined in the grease filled in the clearance between the tooth flanks. A large centrifugal force acts on the grease inside the coupling and causes the grease to decompose and deteriorate.
Refill and change the grease periodically.
(2) Use COSMO GREASE DYNAMAX EP No.2 or equivalent.
(3) Refill or change the grease once a year as a general guide.

6.4 Consumables

Warning

For part replacement and repairs, contact TERAL INC.
Improper procedures may lead to malfunctions or accidents.

Refer to the table below for intervals to replace consumables.

Consumable	Timing of replacement (as a guide)	Cycle to replace (as a guide)
Bearing	Abnormal noise	Once every 3 years
Gland packing	Deterioration or wear	Once a year
Coupling rubber	Deterioration or wear	Once a year
V-belt	Deterioration or wear	Once a year
V-belt pulley	Wear	Once every 5 years

There are slight differences in length even if V-belts are the same size.
Use a V-belt of the same matched set for a single unit of the fan.
Do not use a combination of any parts of new and old belts.
Please use the same consumable parts as shipped for replacement.
If you would like to consider changing the type, please contact us.

7. Troubleshooting

7.1 Troubleshooting

The cause of the failure and the corrective measures against it may be different even if the fan shows the same symptom. In addition, there may be two or more causes.
If you cannot find the cause or corrective measures in the following table, immediately stop the operation and contact TERAL INC.

Symptom	Cause	Action	Reference page
Bearing temperature is high	Excess or lack of grease	Adjust it to the proper amount.	p.26
	Poor fit between the inner ring of a bearing and the shaft	Replace the shaft. Replace the motor.	
	Poor fit between the outer ring and housing of a bearing	Replace the bearing. Replace the motor.	
	Deterioration of grease, or entry of moisture	Change the grease. Replace the bearing.	p.26
	Poor heat radiation from the air-cooling parts	Inspect the air-cooling parts. Check ambient temperature and the conditions of heat radiation	
	Poor cooling water conditions, or temperature rise	Inspect the piping of cooling water. Check the water temperature.	p.19
	Excessive tension of the V-belt	Readjust the V-belt tension.	p.13
	Poor alignment of the direct coupling	Correct the alignment of shaft coupling	p.15
Strong vibration	Foreign matter adhered to the impeller, corrosion, wear	Remove the foreign matter adhered to the impeller. Correct the balance of the impeller.	
	Poor fit between the impeller hub and the shaft	Replace the impeller or shaft (motor).	
	Unbalance of V-belt pulleys	Replace any of the V-belt pulleys or correct the balance.	
	Bending of the shaft	Replace the shaft. Replace the motor.	
	Poor alignment of the direct coupling	Realignment of direct coupling	p.15
	Contact between the rotor and casing	Reassemble the casing.	
	Uneven contact of the gland packing	Correct the gland packing	
	Resonance resulting from poor foundations	Reinforce the foundations.	
	Poor tightening of mounting bolts	Retighten bolts and nuts.	
	Damage to a bearing	Replace the bearing.	
Abnormal noise	Damage to a bearing	Replace the bearing.	
	Suction of foreign matter	Inspect the inside of the casing.	
	Contact between rotator and casing	Break the contact between the rotor, casing, and suction port.	p.9
	Slipping of the V-belt. V-belt comes in contact with the belt guard	Readjust the V-belt tension. Correct the position of the guard.	p.14
	Low voltage of the main power	Adjust the main power.	
Low performance	Low rotation speed, or low frequency	Adjust the main power.	
	Low voltage of the main power	Adjust the main power.	
	Reverse rotation	Swap the wires of the motor.	p.17
	Corrosion or wear in the impeller, or foreign matter on the impeller	Clean, repair, or replace the impeller.	
	Clogging of the suction filter	Clean the suction filter.	p.30
	Improper opening/closing of the damper	Repair the damper.	
	Dust accumulated in the casing and duct	Clean the inside.	
	Excessive resistance	Consider installing a booster fan, or replace the V-belt pulley.	
	Errors in the calculation of gas specific gravity	Measure the specific gravity. Analyze the gas.	
Motor overload	Insufficient resistance	Adjust it with the damper.	p.30
	Excessive rotation speed (belt drive)	Replace the V-belt pulley.	
	Errors in the calculation of gas specific gravity	Reduce the rotation speed.	
	Low voltage of the main power	Adjust the main power.	

8. Special accessories

8.1 Dampers

(1) Referring to the dimensional outline drawing that is submitted separately, install the damper in place. At that time, pay attention to the rotation direction of the fan's impeller (see Figure 19).
(2) If the damper is of an electric or air cylinder type, carefully read the instruction manual of the actuator before use.

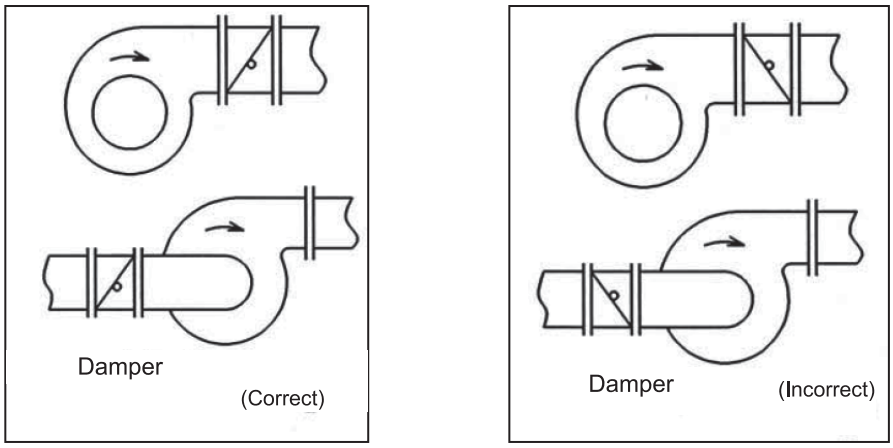


Figure 19 – Installation direction of the damper

8.2 Expansion joint

Its face-to-face dimension must comply with the value specified in the dimensional outline drawing. Do not pull or push the joint forcibly. In addition, do not correct the misalignment between the fan and the duct with the expansion joint.

8.3 Filter

Careful consideration must be given to the installation of the filter so that the fan can be disassembled easily, for example by using a short duct. Before installing the filter, thoroughly clean the inside of the fan and duct. The filter tends to clog easily immediately after the start of operation. Therefore, inspect the filter earlier than usual. After that, periodically remove the filter and wash it with water.

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