Document of quality management system on the basis of ISO 9001: 2008

Installation, Operation and Maintenance Manual of Exhaust Fan

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General Description

TAHVIEH provides a wide range of utility type exhaust fans for different air volume flows and static pressures. This allows the designer to select the best and the most economic size for optimized operation

Construction Specification

Fan

TAHVIEH utility type exhaust fans are available in both forward and backward curved blades, specially designed for maximum efficiency and low noise operation. In forward curved fan, wheel and housing shall be constructed from galvanized steel sheet. In backward curved fan, wheel is made of mild steel, which is coated with proper layer of epoxy painting and housing is made of galvanized sheet of proper thickness.

All fans are statically and dynamically balanced and tested according to AMCA Standard 210-99.

All forward curved fans are equipped with adjustable stay rods for maximum rigidity and preventing from accidental deformation. Stay rods are factory adjusted during balancing procedure.

All fans are equipped with a circular flange at inlet and a rectangular flange at outlet. Also a mesh screen is placed at air outlet to prevent external objects from entering when the fan is off.

All fans have been designed to work in normal conditions but they can be manufactured to become anti spark, anti corrosion, explosion proof, and suitable for operation at high temperatures upon request.

Shaft, Pulley & Belt

Shafts are turned, ground and polished from CK 45 carbon steel and coated with synthetic material to be protected against humid air.

Pulleys are made of aluminum with a cast iron core to reduce the weight of units and the load on the shaft and bearing. High Quality V Type belts are used in the units. Belt, pulleys and shaft are protected by a galvanized steel guard.

Frame

Frame shall be made of galvanized steel angular bars. To protect against corrosion, all external parts shall be covered with Epoxy Zinc-Rich Coating. All units are provided with rubber vibration isolator.

Bearing

Bearings are of self-aligning type with cast iron housing and grease fitting to secure full performance and longer service life. Bearings shall be double-sealed with a combination of heat resistant oil-proof synthetic rubber and steel slinger.

Electric Motors

All electric motors are of IP 54 protection and class F insulation. Other IPs are also available upon request. All motors are protected by galvanized steel guards. Electric motors up to 1 hp are available both in one and three phase types. Those above 1 hp will only be offered in three phase type.

Receiving and Inspecting the Product

All Tahvieh products are carefully checked before delivery to assure the best standard quality. It is customer responsibility to control that the received units are in accordance with the order and have not been damaged during the transport.

Tahvieh is not responsible for damage incurred during shipping.

If you discover any damage, Please refer to the insurance of product.

In particular we suggest checking the following points:

• The goods quantity, type and design must fit what was stated in the order and listed in the transport bill

• Make sure that there are not damaged or missing parts

• Verify if the housing or the flange have dents

• Check if some parts are not correctly fixed

• The wheel must rotate easily, without touching other parts; make sure that the wheel is still balanced and fixed correctly on the shaft

• Verify the correct tightening of the screws

• Make sure that the inner ring of the bearings is locked on the shaft

• Check if shafts and frames have been bent during transport

Note: for any other information, please refer always to the relevant drawing, catalogue or contact our Technical Department.

Lifting and Storage

Lifting the Product

Lifting the unit as shown in figure 1.

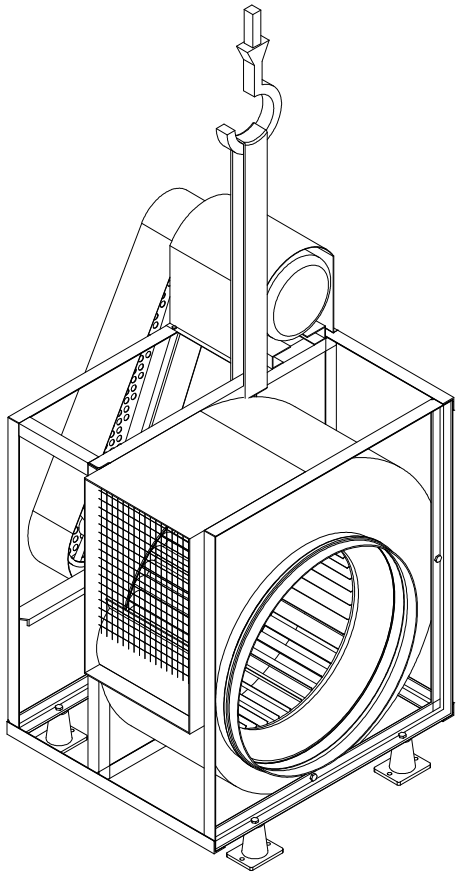


Figure 1. Lifting Configuration

Storage

All Tahvieh fans are designed to be stored under the following conditions:

· In a normal temperature with relative humidity < 60%

· Protect the fans against direct rain or snow

· Store the fans in premises, which are adequately ventilated and heated so that no condensation will occur on the units

· Rotate the wheel at least once a week, to permit the redistribution of the grease inside the bearing and prevent corrosion

· Special attention should be given to bearings to prevent the entrance of water or dust. Proper lubrication of bearings should be periodically checked.

· Protect the units from external loads or vibrations

· Avoid the exposure to direct sunshine and UV rays

· Protect the fans from corrosive agents

· Put fan belt in low tension

Installation

Special attention should be made in fan installation. Improper installation will adversely affect fan and system performance resulting in increased energy consumption. This may also increase noise levels. The ideal fan installation has long sections of straight duct at fan inlet and outlet.

Foundation and Fixing the Fan

Pay attention to the following points:

· The fan must be fixed to a base or to a rigid frame designed to avoid vibrations and resonance, all units are provided with rubber vibration isolator.

· Using a proper metal chassis for fixing the fan is strongly recommended.

· Use all the fixing points and verify that the frame or the feet will rest on the whole surface, the unit must be set level (A schematic drawing of exhaust fan fixing is shown in figure 2).

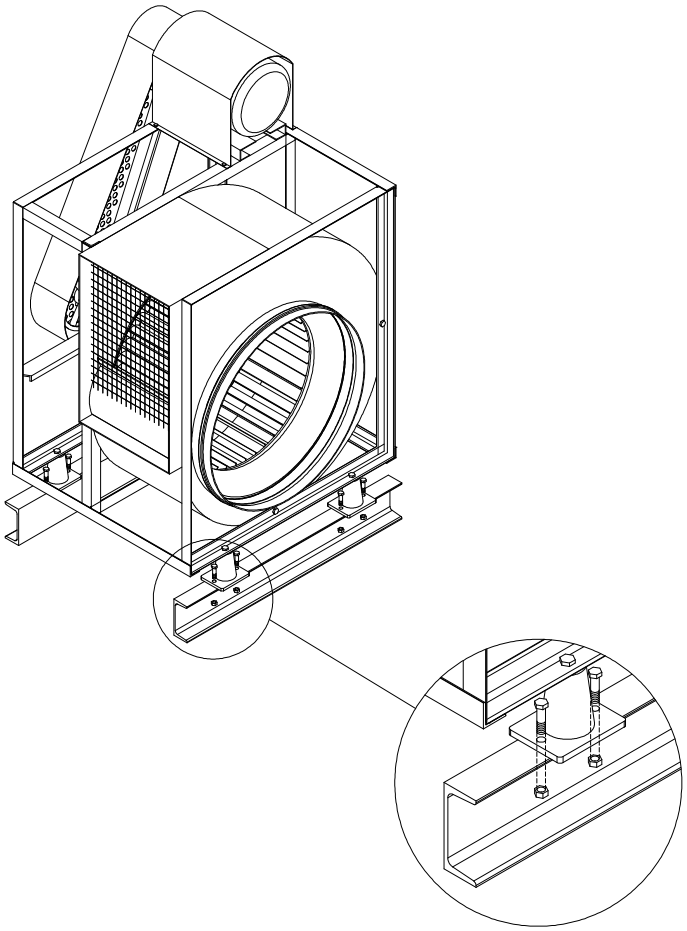


Figure 2. Fan Fixing Configuration

Discharge Positions:

The discharge is factory set as specified by customer order; however, it can be rotated to other discharge positions in the field if necessary (Figure 3). Removal of the housing bolts allows the discharge to be rotated to the clockwise positions below.

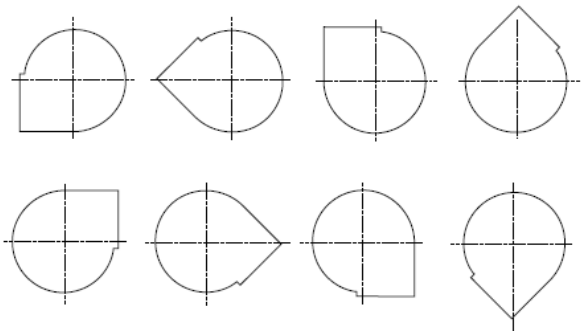


Figure 3. Discharge Positions

Affect of Installation on Performance:

Restricted or unstable flow at the fan inlet can cause pre-rotation of incoming air or uneven loading of the fan wheel, yielding large system losses, increased sound levels and structural failure of the fan wheel. Free discharge or turbulent flow in the discharge ductwork will also result in system effect losses.

Duct elbow and branches located too close to the fan, and abrupt changes in duct size are some features that cause air stream turbulence. The impact of these features can be minimized by proper installation, use of turning vanes and use of smooth transition sections.

The sketches below intend to show correct and incorrect methods for handling the most common fan installations. Several good references are available on the subjects of fan performance and fan installation. Some of these references are published by AMCA and ASHRAE.

Typical Inlet Conditions

Correct Installations

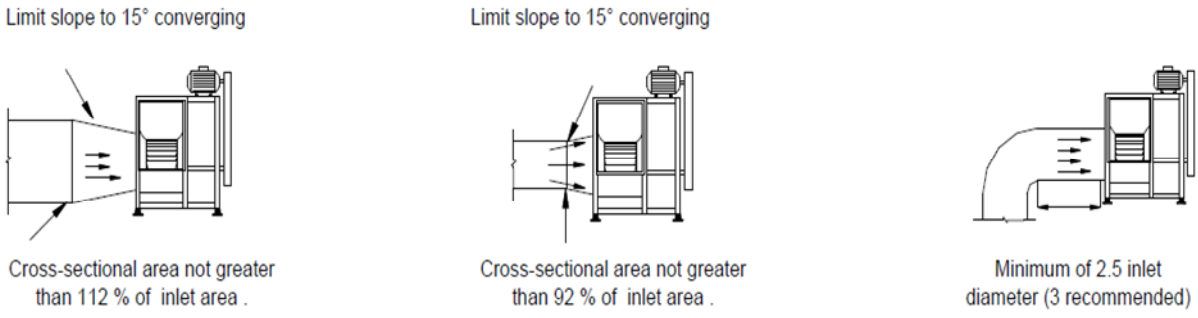


Figure 4. Correct Inlet Conditions

Incorrect Installation

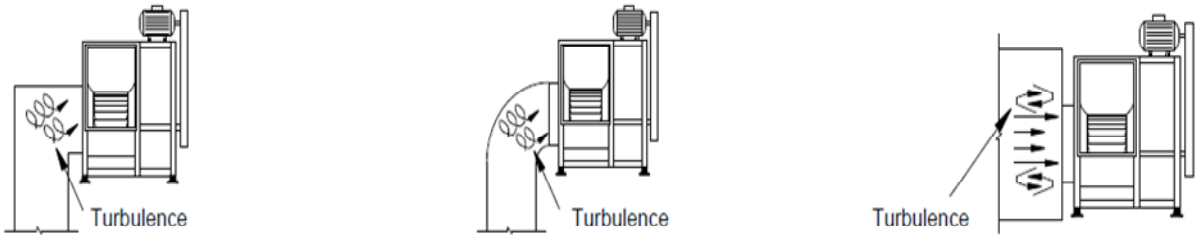
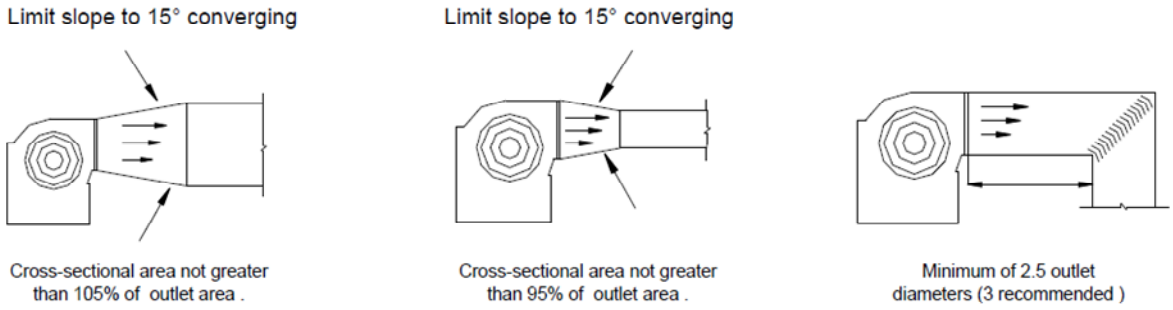


Figure 5. Incorrect Inlet Conditions

Typical Outlet Conditions

Correct Installations



Incorrect Installations

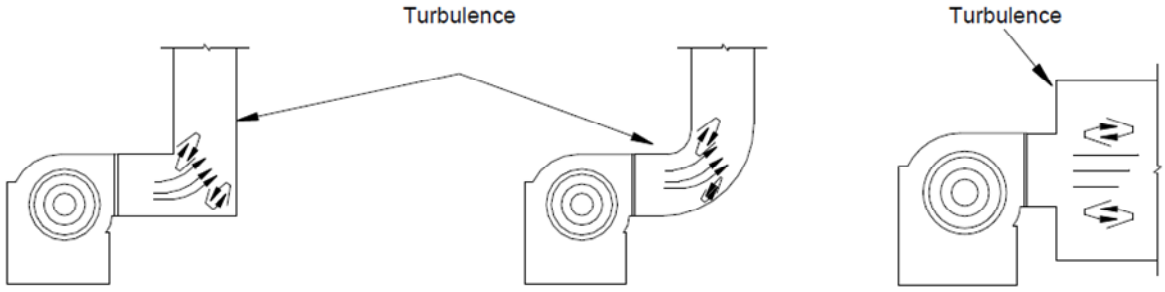


Figure 6. Correct and Incorrect Outlet Conditions

Electrical Recommendations

For better electrical protection of your exhaust fan units, you can follow the electrical diagrams below (Figure 7). These electrical protection systems are not generally included in Tahvieh appliances.

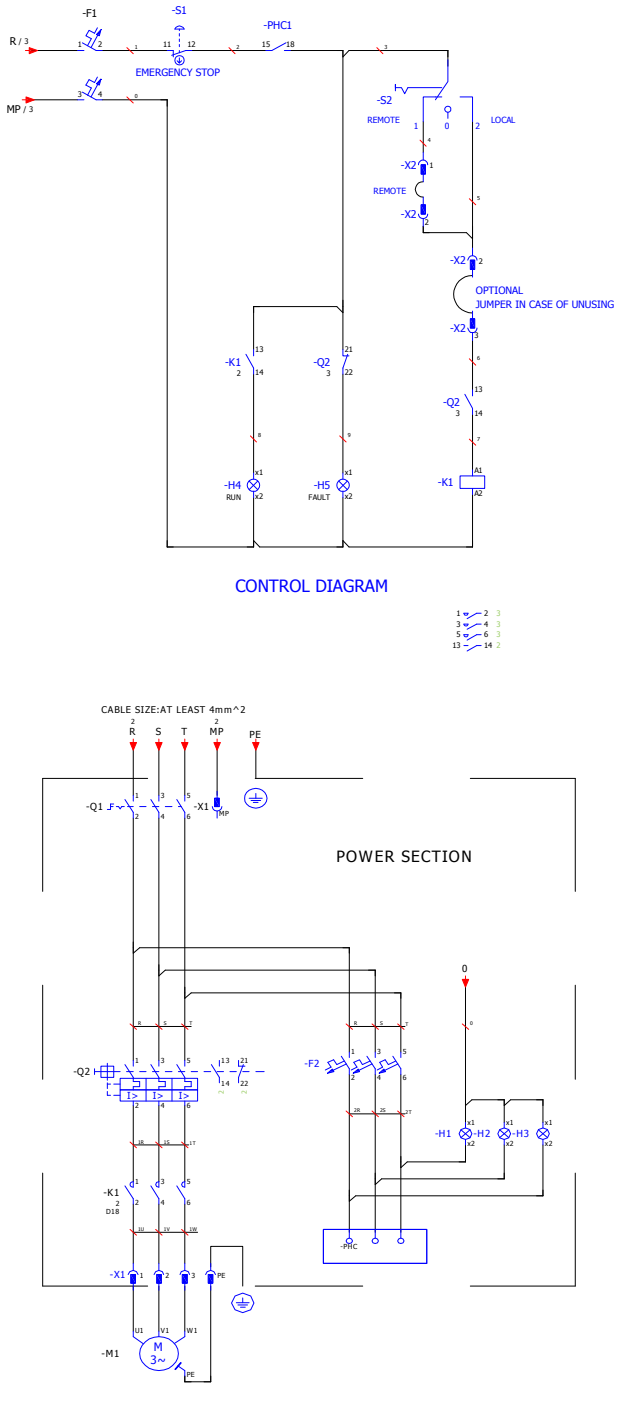


Figure 7. Suggested Control & Power Section Diagrams

Dimensional Data

Forward Curved Exhaust Fans (AS Model)

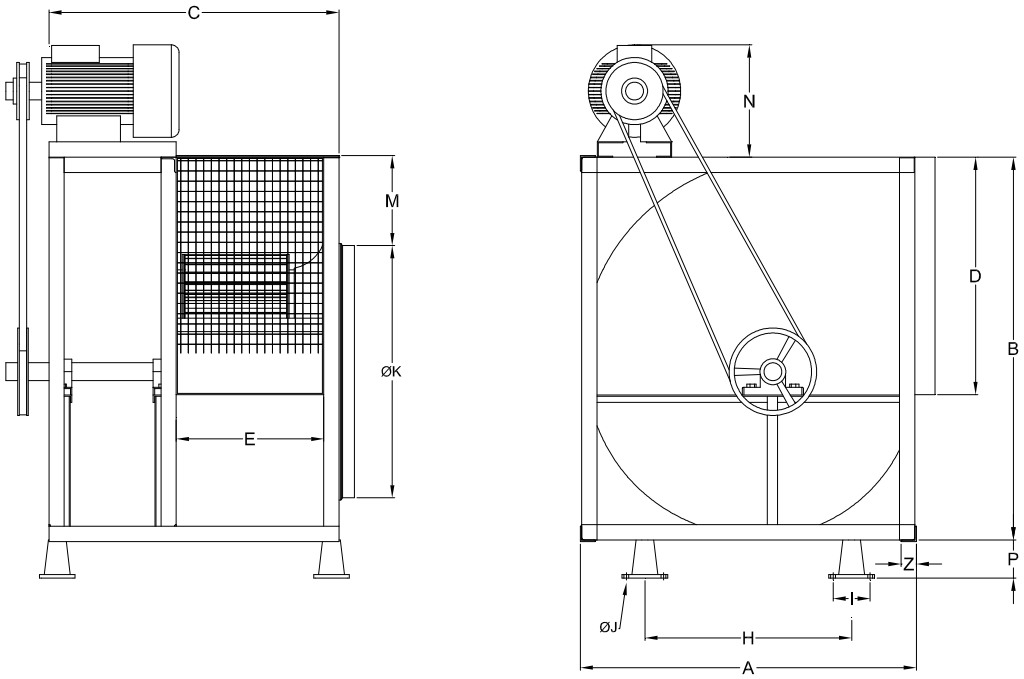


Figure 8. Forward Curved Exhaust Fans Dimensions

Fan Size	A	B	C	D	E	H	I	J	K	M	N	P	Z
9 - 3	1 3.7	15.4	12.0	10.3	5.4	10.1	3	0.5	9.	3.5	12.2	2.2	1.2
10 - 4	15.5	17.6	14.1	11.4	6.2	11.4	3	0.5	10.2	5.1	13.0	2.2	1.6
10 - 5	15.5	17.6	15.2	11.4	7.3	11.4	3	0.5	10.2	5.1	13.0	2.2	1.6
12 - 4	1 .0	20.	14.7	13.4	6.9	12.9	3	0.5	13.0	5.5	13.0	2.2	1.6
12 -	1 .0	20.	16.5	13.4	.7	12.9	3	0.5	13.0	5.5	14.0	2.2	1.6
15 - 5	21.0	24.2	15.9	15.9	.0	15.9	3	0.5	15.0	5.7	14.0	3.0	1.6
15 - 7	21.0	24.2	1 .0	15.9	10.1	15.9	3	0.5	15.0	5.7	15.0	3.0	1.6
1 -	25.4	29.3	19.2	1 .	9.3	20	3	0.5	1 .1	6.6	14.0	3.0	1.6
1 - 9	25.4	29.3	22.4	1 .	11.7	20	3	0.5	1 .1	6.6	15.0	3.0	1.6
20 - 7	30.4	36.0	24.4	24.	10.6	24.9	4.1	0.5	22.	9.4	15.0	3.0	2.0
20 - 10	30.4	36.0	27.0	24.	13.2	24.9	4.1	0.5	22.	9.4	16.0	3.0	2.0
22 - 11	33.3	39.6	2 .2	27.4	14.4	27.9	4.1	0.5	24.6	10.2	16.0	3.0	2.0
25 - 10	37.5	44.9	27.6	31.4	14.3	32	4.1	0.5	27.6	12.6	16.5	3.0	2.0
25 - 12	37.5	44.9	30.2	31.4	16.4	32	4.1	0.5	27.6	12.6	16.5	3.0	2.0
30 - 10	44.	53.5	27.9	36.9	14.1	39.3	4.1	0.5	33.1	13.0	16.5	3.0	2.0
30 - 14	44.	53.5	31.7	36.9	17.9	39.3	4.1	0.5	33.1	13.0	16.5	3.0	2.0

All dimensions are in inches

Backward Curved Exhaust Fans (RSZ Model – Side Discharge)

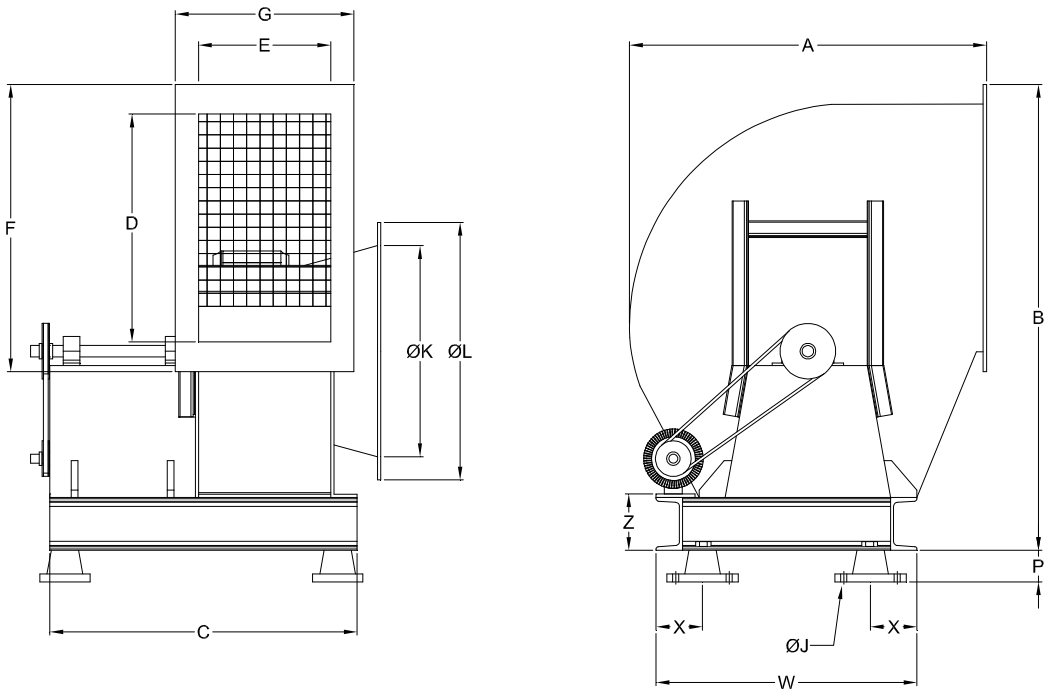


Figure 9. Backward Curved Exhaust Fans Dimensions (Side Discharge)

Fan Size	A	B	C	D	E	F	G	J	K	L	P	W	X	Z
315	20.6	27.	19.4	15.9	.1	1 .2	10.4	0.5	12.5	15.4	2	24.	4	3.1
400	26.5	35.3	24.6	20.0	10.1	23.1	13.2	0.5	14.1	17.3	2	2 .3	4	3.1
450	30.4	39.6	27.5	22.4	11.3	25.6	14.5	0.5	15.7	1 .9	2	32.3	4	3.1
500	33	43.	2 .5	25.2	12.4	2 .3	15.5	0.6	17.7	20.9	3	33.4	4	3.9
5 0	37	47.0	30.3	2 .1	14.2	31.3	17.3	0.6	19.6	23.6	3	35.4	4	3.9
30	40	52.0	35.0	31.5	15.7	35.4	19.6	0.6	22	26.0	3	37.	4	3.9
710	45.	5 .1	37.4	35.4	1 .1	39.3	22	0.6	24.	2 .7	3	42.5	4	3.9
00	51.2	65.4	39.	39.6	20.0	43.5	23.9	0.6	27.9	31.9	3	46.2	4	3.9
900	5 .5	73.7	47.	44.5	22.4	4 .4	26.3	0.6	35.4	39.4	3	5 .	4	3.9

All dimensions are in inches

Backward Curved Exhaust Fans (RSZ Model – Top Discharge)

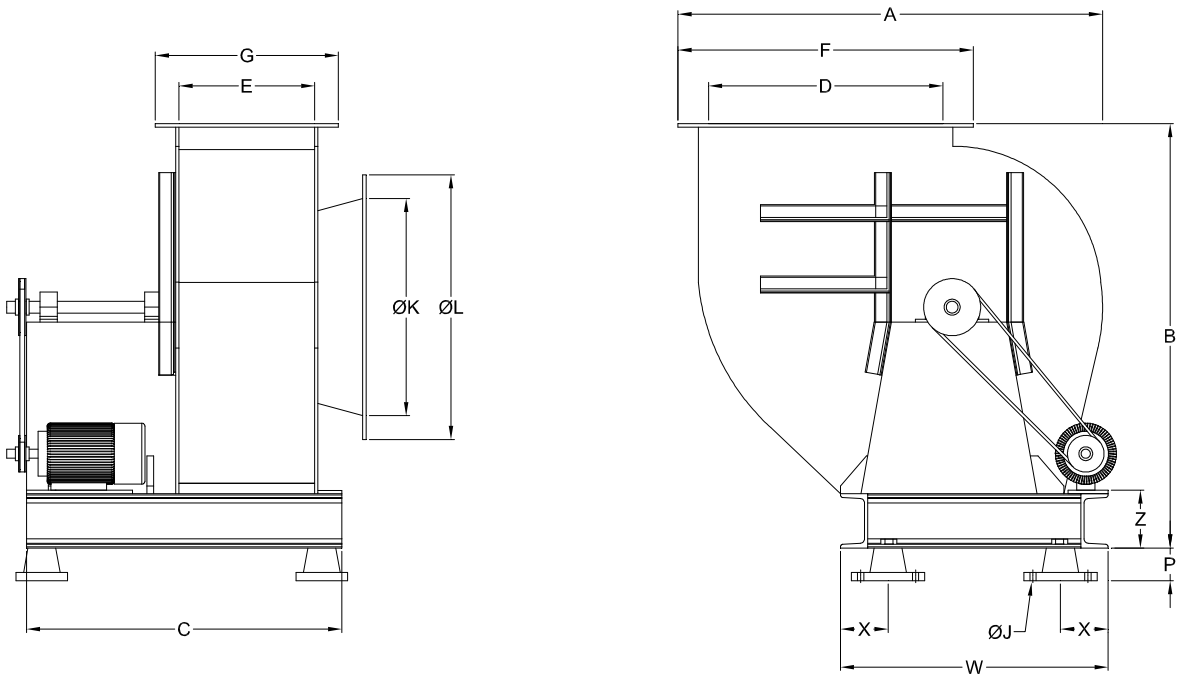


Figure 10. Backward Curved Exhaust Fans Dimensions (Top Discharge)

Fan Size	A	B	C	D	E	F	G	J	K	L	P	W	X	Z
315	24.1	23.4	19.4	15.9	.1	1 .2	10.4	0.5	12.5	15.4	2	26.	4	3.1
400	30.6	31.5	24.6	20.0	10.1	23.1	13.2	0.5	14.1	17.3	2	30.3	4	3.1
450	34.	35.2	27.5	22.4	11.3	25.6	14.5	0.5	15.7	1 .9	2	34.3	4	3.1
500	3 .7	37.	2 .5	25.2	12.4	2 .3	15.5	0.6	17.7	20.9	3	35.4	4	3.9
5 0	42.7	42.3	30.3	2 .1	14.2	31.3	17.3	0.6	19.6	23.6	3	37.4	4	3.9
30	47.6	44.7	35.0	31.5	15.7	35.4	19.6	0.6	22.0	26.0	3	39.	4	3.9
710	53.	50.4	37.4	35.4	1 .1	39.3	22.0	0.6	24.	2 .7	3	44.5	4	3.9
00	59.5	56.3	39.	39.6	22.1	43.5	23.9	0.6	27.9	31.9	3	4 .2	4	3.9
900	67.3	63.0	47.	44.5	24.4	4 .4	26.3	0.6	35.4	39.4	3	60.	4	3.9

All dimensions are in inches

Pre – Starting Checks (Inspection after Installation)

Disconnect electrical power to the fan prior to inspection or servicing. Failure to comply with this safety precaution could result in serious injury or death.

Prior to operating the fan the following preoperative checks should be made:

1. Rotate fan wheel by hand to check for free rotation. Check for shifting of wheel and shaft which might have occurred in transit.

2. Rotation direction of the wheel is critical and incorrect rotation will result in reduced air performance, increased motor loading and possible motor burnout.

Check wheel rotation by momentarily energizing the unit and noting if rotation is in the same direction as the airflow at the outlet and conforms to the rotation decal affixed to the unit (Figure 11). If fan rotates opposite arrow re-wire according to wiring instructions.

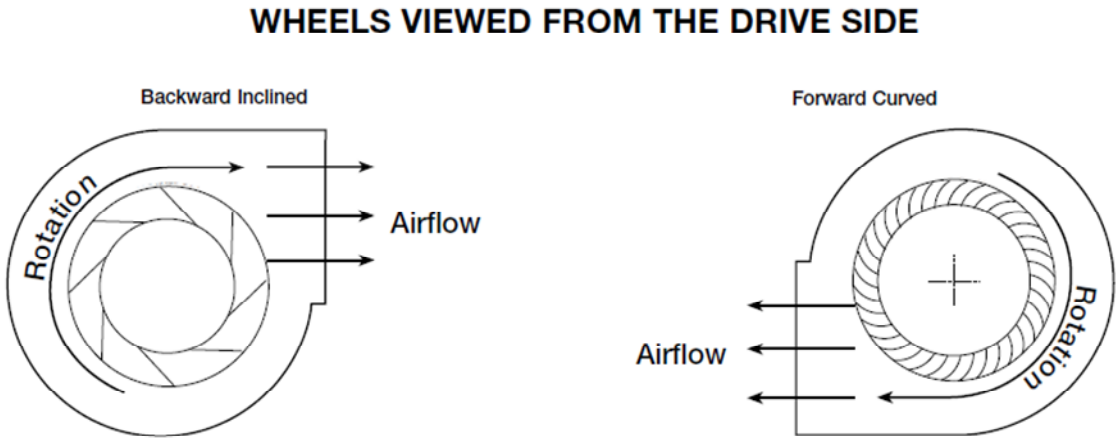


Figure 11. Correct Direction of Air Flow

3. Check fan for excessive vibration and noise. If vibration or abnormal noise is evident shut fan off and determine cause. DO NOT operate until the source of vibration is eliminated.

4. Check static pressure. If static pressure is lower than specified, the fan will produce additional CFM and excessive vibration.

5. To avoid motor overheating and possible burnout, motor load amperes should always be checked and compared to nameplate rating when fan speed is increased. **Do not operate motor under overload conditions as this could cause motor to fail and void manufacturer's warranty.**

6. Check alignment of pulleys. Wheel movement may occur during shipment or installation and wheel alignment may be necessary. Check pulleys and belts for proper alignment to avoid unnecessary belt wear, noise, vibration and power loss.

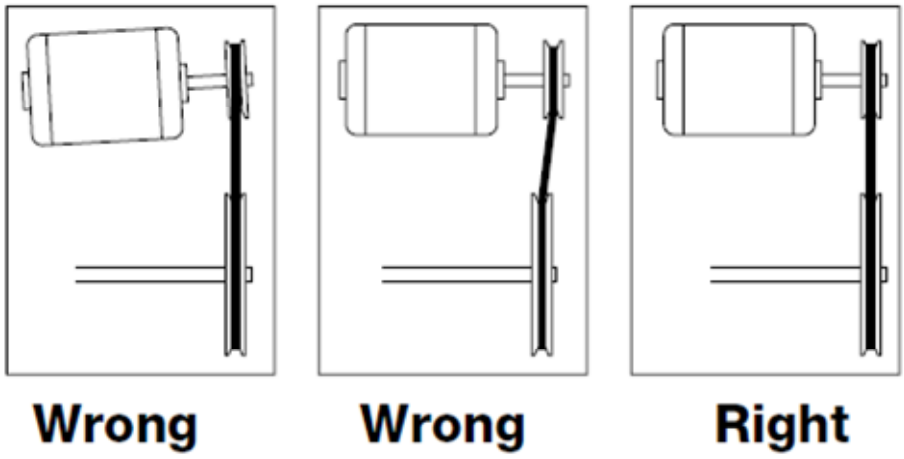


Figure 12. Pulleys alignment

Motor and drive shafts must be parallel and pulleys in line. A straight bar or a string can be used to put on pulleys side plane. (Figure 13)

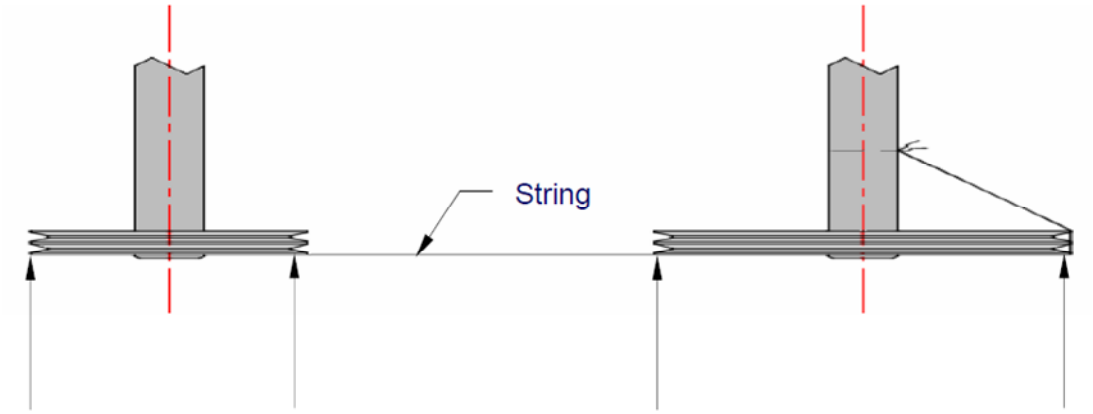


Figure 13. Using a string or a straight bar, align pulleys by touching all four points as indicated by arrows.

5. Check that the belt is not damaged and fit properly into the pulley groove.

6. Proper lubrication of bearings should be checked and bearing should be greased before operation if it is required.

7. A motor protective switch should be used on input power of motor, if the fuse blows frequently, shut fan off and determine cause.

8. Check belt tension. Belt tension depends on many factors such as installed power, fan speed and type and dimension of pulleys. It is very important to apply the correct tension which is one of the most important factors for a correct working of the fan. Too high belt tension can cause excessive loads on bearings, shaft and motor with a consequent decrease of their life and increase in vibration and noise.

Too low belt tension can cause belts to turn over in pulley grooves with excessive wear; also it can cause excessive running noise, severe belt vibration and anomalous loads. Start the drive and check belts under load. The belts should have a slight bow as indicated below. After a few days of operation the belts will seat themselves in the pulley grooves. It may be necessary to readjust so that the drive again shows a slight "bow" in the slack side (Figure 14). (For more information please refer to the belt maintenance section). Belt tension should be checked after 8 hours, 24 hours, 48 hours and 100 hours of operation.

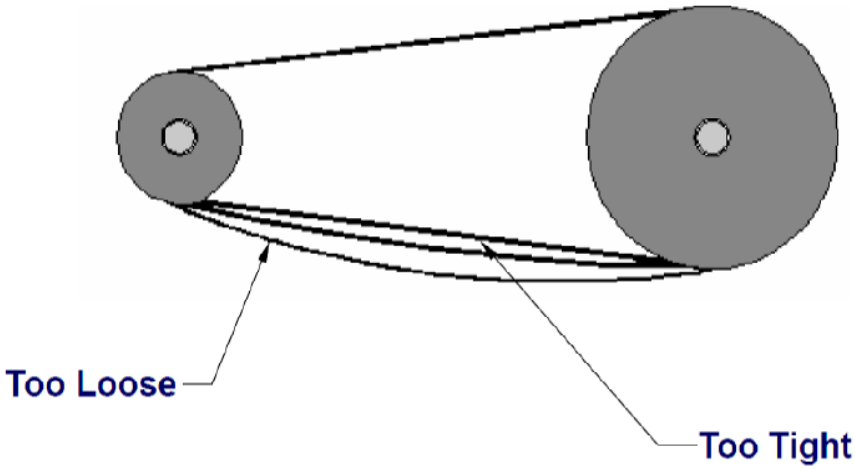


Figure 14. Proper belt tension

9. The screws must be tightened. Re-check all set screws and bolts after 8 hours of operation and again after 2 weeks.

10. Make sure that inside the housing or wheel there are no foreign objects which can be ejected during start up (for example screws fallen during mounting etc).

Disconnect electrical power to the fan prior to inspection or servicing. Failure to comply with this safety precaution could result in serious injury or death.

Inspections

To guarantee smooth operation, the fan must be serviced regularly.

To ensure complete safety do not start any maintenance procedure or inspection without disconnecting the unit from the power supply and before the fan and motor have completely stopped rotating.

The most important inspection measures, to be made are:

· Inspection of fan wheel, bearing and drive should be performed on a regular basis. Inspect for corrosion which could result in mechanical failure. Any corroded parts should be replaced immediately. Check bearings lubrication every three months and grease bearings according to lubrication schedule in maintenance section. Check motor for excessive vibration and temperature periodically. Removing dust and grease buildup on the motor housing assures proper motor cooling. Use caution and do not allow water or solvents to enter the motor or bearings. Under no circumstances should motors or bearings be sprayed with steam, water or solvents.

· Belt tension should be checked after 8 hours, 24 hours, 48 hours and 100 hours of operation. After start operating, check belt tension and its integrity monthly; in case of damage, replace the belt

· Check pulleys alignment every three months and make sure that pulley grooves are clean

· Checking vibration and sound level; anomalous values indicate a problem on the unit

· Check all set screws and bolts and tighten them if necessary

· Cleaning of the fan, in particular of the impeller, to avoid dust deposits which can create unbalance of the impeller and reduction in bearing life, vibrations and noise.

Maintenance

Maintenance of the fan equipment should only be carried out by skilled and adequately trained staff.

To ensure complete safety do not start any maintenance procedure or inspection without disconnecting the unit from the power supply and before the fan and motor have completely stopped rotating. Close any inlet or outlet damper to avoid a rotation of the impeller due to induced airflow.

Belt Maintenance

Belts tend to stretch after a period of time. They should be periodically checked for tension and wear. The ideal tension is the lowest tension at which the belt will not slip under peak load conditions. When replacing belts, use the same type as supplied with the unit. Replacement of belts should be accomplished by loosening the tensioning of belt with sliding the motor base plate (shown in figure 16), so the belts can be removed by hand. Do not force belts on or off as this may cause breakage of cords and lead to premature belt failure. After replacing the belt, check pulleys alignment.

Belt tension should be adjusted to allow 1/64 in. of belt deflection per 1 in. of belt span. For example, a 16 in. belt span should have 16/64 in. or 1/4 in. of deflection with moderate thumb pressure at mid-point between the pulleys (Figure 15).

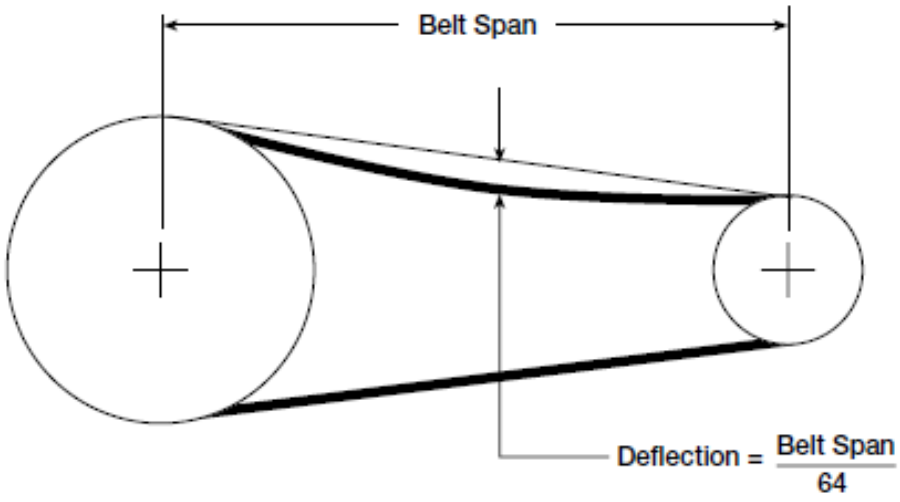
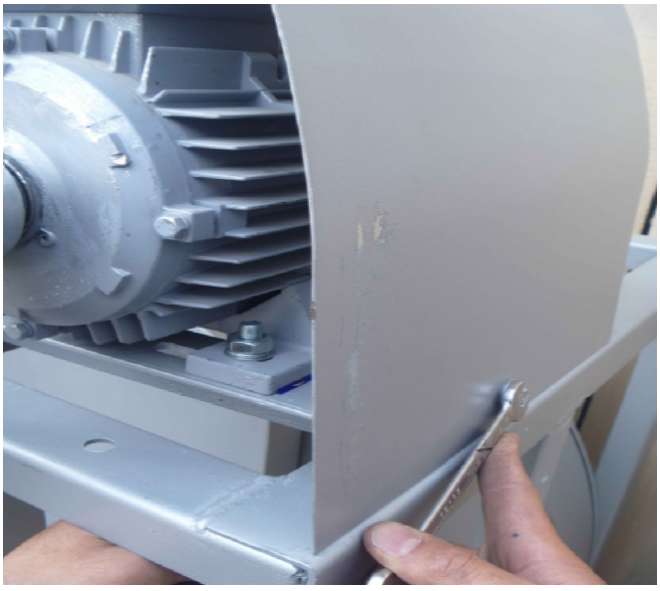


Figure 15. Belt tension

Figure 16. Belt replacing process

1. **Remove belt and pulleys guard**



2. **Remove motor guard**

3. **Loosen the screws to allow motor to slide**

Bearing Maintenance

Shaft bearings are the most critical moving part of a fan. Therefore, special attention should be given to keeping the bearings clean and well lubricated. A first check of the bearing can be done simply by listening to it. A normal bearing generates a smooth and uniform sound; while a damaged bearing generates a loud and irregular sound. A low metallic noise, due to standard gap between the components, is normal, especially at low speed. Excessive vibrations or temperature are often a sign of possible damages. Check periodically seals integrity and the bearing locking system. Exhaust fan bearings are mounted inside pillow block with grease fitting for re-lubrication. Periodical re-lubrication is necessary to achieve the full mechanical life of bearings. Make sure that there is not excessive leak of grease from the bearing. A leak of a little quantity of grease is normal, especially in the first working hours.

Proper lubrication provides for reduction in friction and wear, transmission and dissipation of heat, extended bearing life and prevention of rust. In order for a lubricant to fulfill these tasks, the proper grease applied at regular intervals is required. See the recommended bearing lubrication schedule (Table 1). If unusual conditions exist – very low or very high temperatures, moisture or contaminants – more frequent lubrication is required. Greasing should be made from grease fitting. The grease quantity depends on the shaft size and speed is from 20% to 80% of the initial grease quantity.

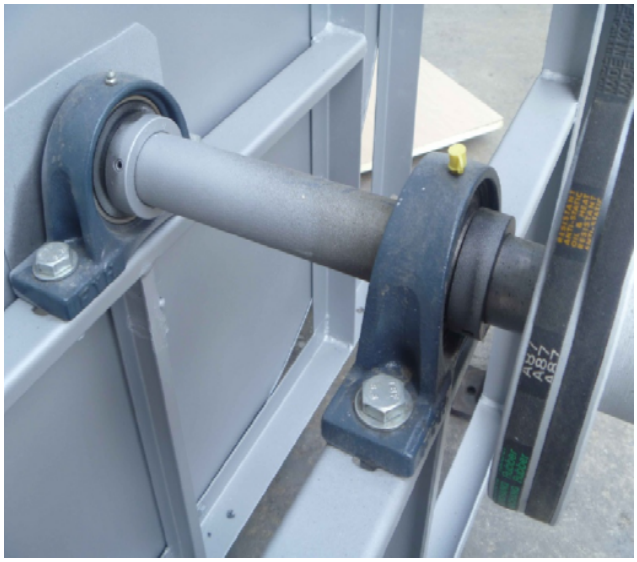
High quality lithium based grease such as those listed below should be used. Do not use greases with different chemical base.

- Texaco-Multi Fak #2
- Shell Alvania #2
- Mobil Mobilux #2
- Exxon Unirex #2
- Texaco Prem. RB
- Mobil 532
- Exxon Beacon
- Keystone 84H

Disconnect the unit from the power supply; add grease through grease fitting with a manual grease gun until fresh grease appears at the seal gap (Figure 17).The old grease must be allowed to flow out unhindered. The older grease will have a dark color and look like it is grimy while the

new grease will not have any dirt or grime in it. Turn the fan with hand while applying grease to the bearings. This helps to ensure that the grease gets into every part of the bearing.

Figure 17. Bearing lubrication process



1. Remove shaft guard

2. Attach grease gun to the grease fitting and add grease very slowly

Bearing Lubrication Schedule

Recommended greasing intervals for exhaust fan with forward curved blades and in application under normal conditions are as the table below. In case of using backward curved fans please contact Tahvieh technical department.

Table 1. Greasing Interval

Operating Temperature of Bearing (°C)	Environmental Condition		
	Clean	Dirty	Very Dirty Heavy Humid
50	3 Years	6 Months	3 Months
70	1 Year	2 Months	1 Month
100	3 Months	2 Weeks	1 Week

In addition to lubricating the bearings at specified intervals, set screws in the bearing collars should be checked for tightness. A bearing collar which has loosened will cause premature failure of the fan shaft. Fasteners attaching the bearings to the drive frame should also be checked.

Wheel and Fastener Maintenance

Wheels require very little attention when exhausting clean air, however, air heavily laden with grease or dirt will tend to accumulate on the wheel causing unbalance.

Wheels exhausting dirty or grease-laden air require frequent cleaning to assure smooth and safe operation.

Troubleshooting

PROBLEM	CAUSE	CORRECTIVE ACTION
Excessive Vibration & Noise	Wheel out of balance	Clean all dirt off wheel. Check wheel corrosion. Check wheel balance; rebalance it in place if necessary.
	Belt & Pulleys – Bent shaft	Tighten pulleys on motor/fan shaft. Adjust belt tension. Align pulleys properly. Replace worn belts or pulleys.
	Bearings	Replace defective bearing(s). Lubricate bearings. Align bearings. Tighten collars & fasteners.
	Fan Foundation	Foundation should be flat and level, reinforce the foundation and prevent resonance. Tighten mounting bolts. Isolate vibrating parts from building.
High Bearing Temperature	Lubrication	Check for excessive or insufficient grease in the bearing. Check for proper lubricant.
	Mechanical	Replace damaged bearing. Relieve excessive belt tension. Align bearings. Check for bent shaft.
High Motor Temperature	Defective bearing	Check input power, Check fan rotation, Check for obstructions around motor shroud, Check system static pressure
Air Flow Too High	Static pressure too low	Change obstructions in system. Use correction factor to adjust for temperature/altitude. Resize ductwork. Dampers, filters and grills not installed or need to be adjusted

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Air Flow Too High	Static pressure too low	Change obstructions in system. Use correction factor to adjust for temperature/altitude. Resize ductwork. Dampers, filters and grills not installed or need to be adjusted
Air Flow too Low	Static pressure too high	Check for obstructions or leaks in ductwork, Sharp elbows at fan inlet or outlet, Clogged filters. Consider straight duct prior to fan inlet
	Wheel Rotation	Check wheel for correct rotation
Fan does not Operate	Electrical Supply	Check fuses/circuit breakers. Check for switches off. Check for correct supply voltage.