# "*NADI*" Centrifugal Fans

# Installation
# &
# Maintenance Manual

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# INDEX

## 1.O GENERAL

The NADI Radial / Centrifugal fans are designed and built for industrial application. These fans are normally supplied in any one of the 9 arrangements as detailed in drawing STD-ARRT-001. The outlet orientation would be in any one of the position as illustrated in Drawing no. STD-ARRT-006.

1.1 The Technical specification of the unit supplied is shown on the name plate attached to the fan unit. Further information is shown on the dispatch note accompanying the units. All information should be cross-checked and if doubt or clarification is required then NADI Airtechnics or its agent should be consulted. The fan will be generally as per relevant GA DRG.REF NO...........

1.2 All NADI FAN equipment must be installed by personnel trained in the appropriate disciplines.

1.3 Further a copy of this document should be placed with the fan unit before attempting installation.

1.4 CAUTION : Being a rotating machine the fan has the po N M677Ytential for causing serious injuries, if operators get close to the fan impeller blade or shaft or pulley/coupling when in operation or attempt is made to stop it by hand or any mechanical obstruction. If bird screens / shaft guard / belt guard have not been ordered and if fan is likely to operate with its rotating parts exposed or easily accessible (without protective duct / guard) then more care should be taken by operators & other individuals working in the viscidity of the fan

1.5 Being a fan driven by an electric motor please ensure that the earthing / wiring / the starter, the cable size and the electrical installation are in keeping with the statutory safety regulations as well as Electrical Authority / Factory Inspectors regulations with sufficient factors of safety.

1.6 It is further paramount that all installation and maintenance instructions are correctly and fully adhered to.

1.7 Special Note: Prior to despatch, all fan units have been inspected and mechanically run. Due consideration is given to the smooth running of the unit, electrical inputs and rotational speed. Every fan is dynamically balanced in accordance with ISO 21940 Grade 6.3 or 2.5. The Vibration are measured to be within acceptable limits of ISO 14694. The performance will be as per Tolerance specified in IS 4894 (or any other standard agreed with the customer). Hence NADI expects that if handled correctly and installed professionally then, the fan should give long trouble-free service.

(Please see section 9.9 for further information)

## 2.0 UPON RECEIPT

2.1 Immediately upon receipt, the fan equipment should be visually inspected for any transit damage or loss. This includes the hand rotation of the impeller within the fan casing. If damper is supplied, the free movement of the damper blades should be checked by hand and other appropriate manual tests that the customers trained personnel think should be carried out on fan accessories.

Motors, 'V' Pulleys / Couplings / Bearing blocks & Belt guards are especially prone to Transit damage and therefore these must be meticulously examined.

Transit damage to be intimated to Insurance Co. Within 24 hours of receipt.

2.2 Should any damage, concern or technical queries result then NADI Airtechnics, or its agents should be contacted stating fan type, NADI Job number and fan serial number.

( Please see section 5 for further information).

## 3. Handling & Storage (upto 4 weeks)

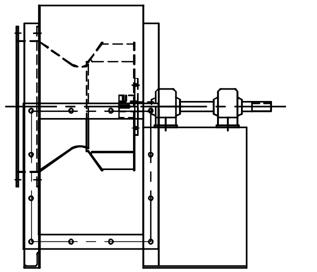
3.1 Please use the lifting lugs and lifting hooks provided on the fan for lifting by means of mechanical methods. Do not put lifting slings any where on the fan shaft or the impeller. Fans in Arrangement 3 & /or Double inlet fans especially, must be handled with extra care as these are more susceptible to damage by mis-handling.

3.2 If the fan is not erected promptly after it is received, it should be stored in a dry location with the bearings and all machined surfaces, including the shaft, protected against dust, moisture, corrosion and physical damage.

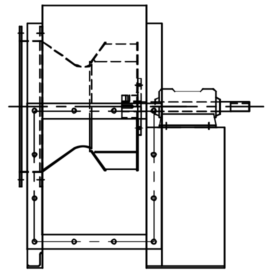
3.3 If fan must be exposed to the elements, extreme care must be taken to protect against these elements with particular attention given to the bearings, shaft-bearing journals, impeller blades & motor.

3.4 It is recommended that the fan shaft may be rotated at Regular intervals (to prevent BRINELLING of bearing) and frequent inspection to be made of the equipment to verify that protection is adequate to preclude damage to the equipment or entry of water into the bearing.

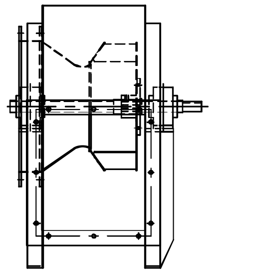
3.5 For fans in upblast orientation (CW2 & ACW - 10) please close the fan outlet when in store or under erection. This will prevent water/other foreign matters from entering the casing.



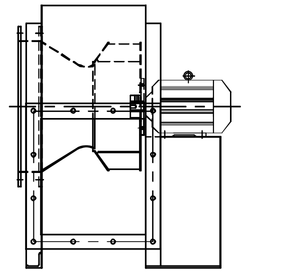
ARRT-1 : OVERHUNG IMPELLER FOR 'V' BELT DRIVE OR THROUGH FLEXIBLE COUPLING, BEARINGS ON WIDE BASE



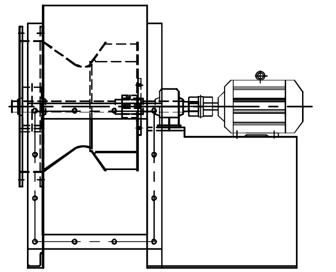
ARRT-2 : OVERHUNG IMPELLER FOR 'V' BELT DRIVE OR THROUGH FLEXIBLE COUPLING, FAN HOUSING WITH NARROW BASE BEARING IN MONO BLOCK SUPPORT.



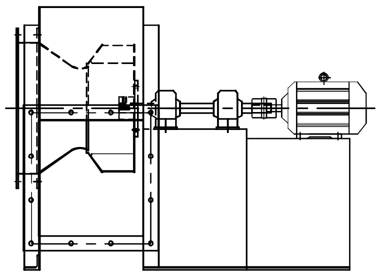
ARRT-3 : SIMPLY SUPPORTED IMPELLER FOR 'V' BELT DRIVE ONE BEARING SUPPORTED BY FAN HOUSING ONE BEARING IN THE AIR STREAM.



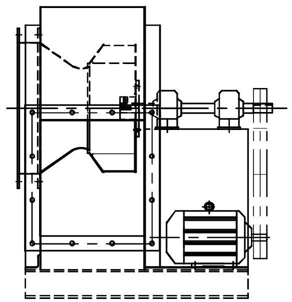
ARRT-4 : OVERHUNG IMPELLER FOR DIRECT MOUNTING ON MOTOR SHAFT NO SEPERATE BEARING ON FAN.



ARRT-7 : SIMPLY SUPPORTED IMPELLER WITH COMMON BASE FOR DRIVE THROUGH FLEXIBLE COUPLING.

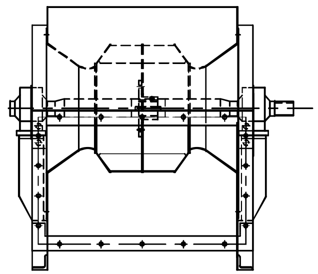


ARRT-8 : OVERHUNG IMPELLER FOR DRIVE THROUGH FLEXIBLE COUPLING WITH EXTENDED BASE FOR MOTOR.

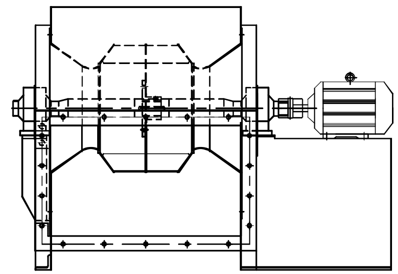


ARRT-9 : OVERHUNG IMPELLER FOR 'V' BELT DRIVE WITH TWO BEARINGS MOTOR ON BEARING BASE OR ON COMMON CHANNEL BASE.

FOR DOUBLE INLET FANS



ARRT-3 : SIMPLY SUPPORTED IMPELLER ONE BEARING ON EITHER SIDE WITH ONE BEARING IN THE AIR STREAM.



ARRT-7 : SIMPLY SUPPORTED IMPELLER WITH COMMON BASE FOR DRIVE THROUGH FLEXIBLE COUPLING.

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NADI INDUSTRIAL FANS

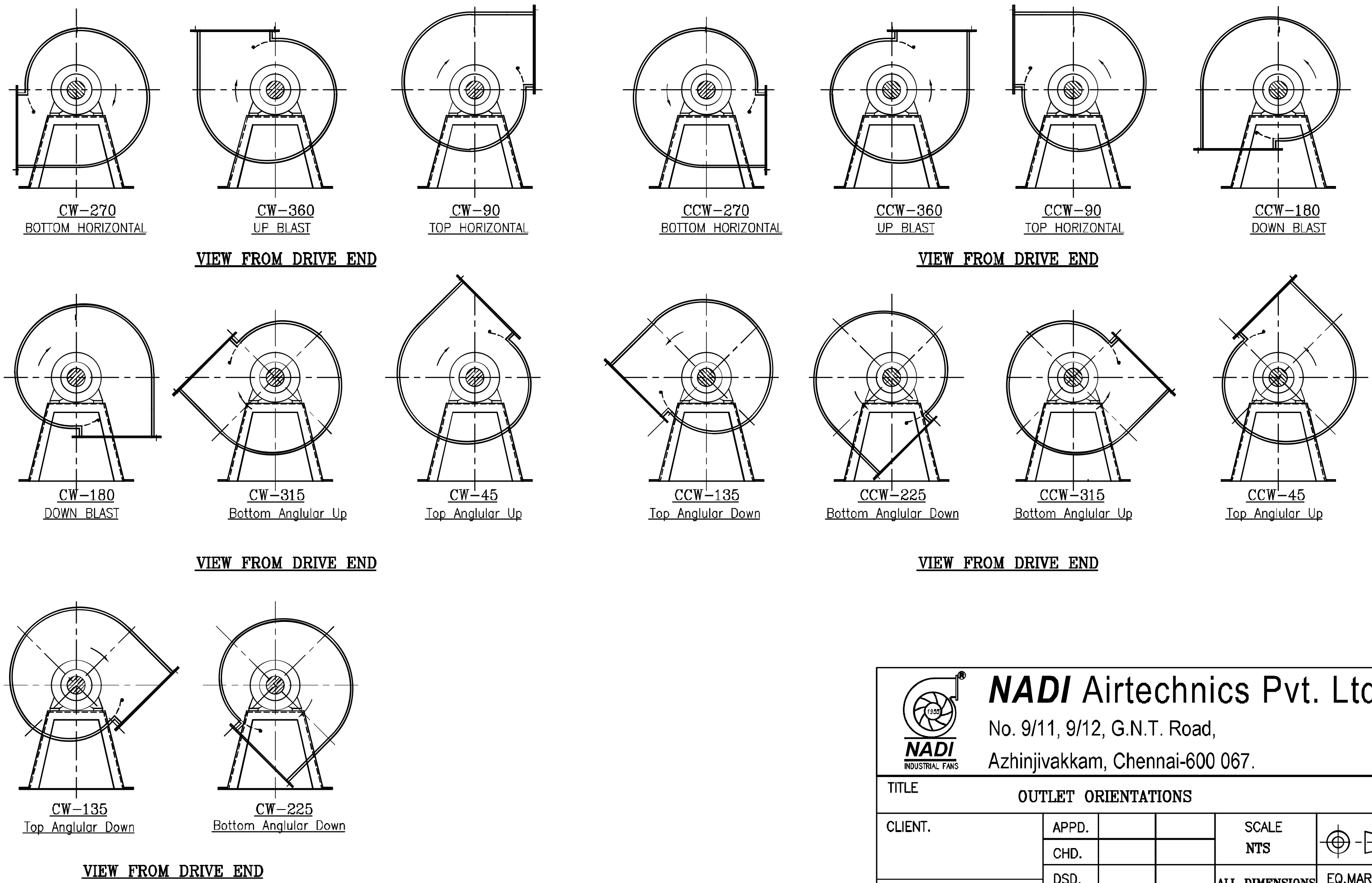
TITLE: STANDARD ARRANGEMENTS

| | | | | |
|---|---|---|---|---|
| CLIENT. | APPD. | | | SCALE NTS |
| | CHD. | | | |
| JOB No. | DSD. | | | ALL DIMENSIONS ARE IN MM |
| | DRN. | SAN | 11.01.03 | |

EQ.MARK
SL.NO.

DRAWING NO. STD-ARRT-001

REV. 0
DT. 11.01

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| | | | | | |
|---|---|---|---|---|---|
| TITLE | OUTLET ORIENTATIONS | | | | |
| CLIENT. | APPD. | | | SCALE NTS | |
| | CHD. | | | | |
| JOB No. | DSD. | | | ALL DIMENSIONS ARE IN MM | EQ.MARK |
| | DRN. | SAN | 11.01.03 | | SL.NO. |
| | DRAWING NO. STD-ARRT-006 | | | | REV. 0 / DT. 11.01 |

## 4. Long Storage

If fans are required to be in store for more than 4 weeks then,

4.1 Fan must be stored in a covered shed and protected from rain / dust etc.

4.2 The fan wheel must be rotated once in 3 days and left in a different position to prevent BRINELLING of the bearing (Otherwise this may lead to Premature Bearing Failure when fan is commissioned).

4.3 For up-blast fan, the outlet & inlet must be closed with a steel sheet or wooden plate and bottom drain plug (if provided) must be kept open.

4.4 Once a month open and examine the bearing block cover to ensure that the grease is not contaminated by water or dust or becomes hard.

4.5 If fans have been in store for more than 3 months, the grease must be fully replaced and, in some cases, the bearing may have to be removed, cleaned and refitted.

4.6 Caution: If fans are in storage for more than 4 -5 months and if above procedures have not been followed, the grease and even the bearing may require replacement. Do not attempt to start without consulting NADI or its agents.

4.7 Use only the correct type & quantity of grease as recommended in Section 10 "LUBRICATION".

4.8 Packing gland rope may have become Hard & dry. This may need to be oiled or replaced before commissioning the fan.

4.9 'V' Belts may require to be protected with French-Chalk Powder.

4.9A Cautions: Electric motors in long storage may have absorbed moisture. Do not attempt to start without removing the moisture and ensuring that the insulation resistance is atleast 1 Meg.Ohm. Bearing of the motor also may be affected same as Fan bearing (see 4.2 & 4.6).

Flame proof motor must be handled with special care. Contact motor manufacturer or NADI Airtechnics for this.

## 5. PRE-INSTALLATION - INSPECTION

### 5.1 INSPECTION OF THE MOTOR

I. a) Invariably the motor is a totally enclosed fan ventilated type. Please therefore ensure that The motor Fan cover / Motor cooling fan is not damaged in transit. If it is damaged / dented then :

b) Remove the cover and tap out the dent or replace cover as necessary. If the bolts for fixing the cover are broken, please replace them. Do run the motor only with all the fixing bolts in position & fully tight.

c) Before refitting the cover examine the motor cooling fan to ensure that it is not damaged. Refit the cover, then rotate the motor shaft by hand to make sure that the cooling fan is not fowling with its cover.

d) In rare cases, motor mounting foot or flange may have broken in transit. These may be checked.

II. Check (and tighten if necessary) the 4 bolts fixing the motor to the motor Support stand.

III. If motor has been in transit for more than 3 weeks, especially during rainy season, please check insulation value. This must be 1 meg.ohme at least

### 5.2 INSPECTION OF FAN

Depending on the type of FAN arrangement, different points should be considered for inspection upon receipt or pre-installation inspection.

The 4 most popular arrangements are given below:

a. Arrangement - 4 (Drg Nr. STD-ARRT-004) - Impeller mounted directly on the motor shaft .

b. Arrangement - 8 (Drg Nr STD-ARRT-004) - Impeller mounted on a shaft running on 2 externally mounted bearing and driven by a motor through a flexible coupling.

c. Arrangement - 9 (Drg Nr STD-ARRT-005) Overhung impeller mounted on shaft which is supported on 2 externally mounted bearings and driven through V belt & Pulley by a suitable motor. The entire assembly mounted on a common base frame of MS channel.

d. Arrangement - 3 (Drg Nr STD-ARRT-002 & STD-ARRT-003) Single inlet fan or double inlet fan with simply supported impeller(s) on a shaft with one bearing on either side of the impeller(s) Bearings are in the path of the air flow.

## 5.3 INSPECTION PROCEDURES FOR THE FAN/BLOWER IN ARRANGEMENT - 4

Relevant part descriptions are shown in all GA Drawing.

I. Examine the fan/blower casing for external damages.

II. Rotate the impeller by hand to ensure that it is rotating freely. If the impeller is not rotating freely, then :

a. Check if the motor shaft is touching the volute casing at the point of entry into the casing.

b. Ensure that the inlet cone is not fowling with the Impeller Front Shroud. If it is fowling, then the inlet cone and the impeller should be properly aligned by loosening and then retightening the motor bolts & inlet cone bolts.

c. Fans with packing gland may be a little hard to rotate due to the tightness of the packing rope. This will become free after the initial run.

III. Check all other bolts also for tightness.

Caution:

IV. Please use correct spanners for tightening the bolts. Avoid use of monkey spanner - pipe wrench -chisel and hammer.

## 5.4 INSPECTION OF THE FAN/BLOWER IN ARRANGEMENT 8

Relevant parts are identified in GA drawing. Follow the entire inspection procedure applicable for arrangement 4 and then check the following also :

a) If the impeller is fowling either with the volute casing or the inlet cone, then realign the impeller with the inlet cone. The inlet cone can be marginally realigned by loosening the bolts holding it to the fan inlet plate (door) i.e. Part no. 4 on the drawing. ensure that the bearing blocks (Housing) bolts are tight as they may cause lateral movement of the shaft.

b) Please check that the coupling alignment is correct, and the motor fan assembly is rotating freely (by hand).

c

c) If fan is fitted with heat slinger, please ensure that the heat slinger is not fowling either with the guard or with the volute casing or with bolts of the shaft seal.

d) Please OPEN the BEARING COVER - (ONLY ONE at a time) make sure the grease in the bearing is not dried up & there is no water or any other dust. If in doubt change the grease. Specification & Quantity of grease is given in Section 10 of this manual. Replace the cover & tighten correctly AS otherwise the bearing will be damaged.

e) If fan is fitted with single unit bearing & block assembly with sealed & self aligning bearing, it cannot be & should not be opened.

## 5.5 THE FAN/BLOWER IN ARRANGEMENT 9

Part list is shown in GA drawing. After going through all the steps in respect of inspection for arrangement 4 & 8, please also check the following :

a) Is the pulley already fitted on to the fan shaft? If yes, please ensure that it is tightly fitted without lateral movement on the shaft. For pulleys with taper lock bush, ensure that the allan bolts are fully tight.

b) Examine pulley for transit damage. If any of the grooves are broken replace pulley. Ensure that all the grooves are clean and dry.

c) If motor and fan pulleys are received separately packed, then identify which is the fan pulley and which is the motor pulley and mount them on to the respective shaft. Inter changing the pulleys by mistake can cause change in the fan speed. Slower fan speed may reduce the Fan performance, but the higher speed could overload the motor and perhaps even damage the fan.

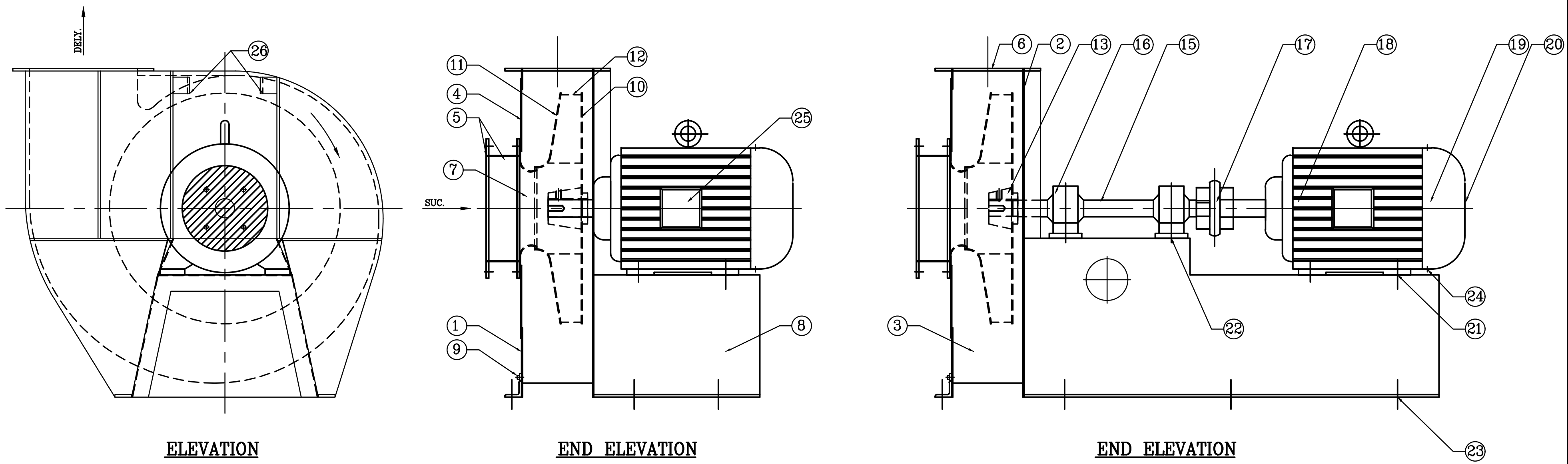
d) If in doubt please check the name plate of the fan and motor to know the respective RPM and then identify the pulleys for fan / motor.

e) Please ensure that both pulleys are properly aligned & rotating true (Without Wobbling).

f) Also ensure that the belts are not cut or damaged in transit.

g) Ensure that you have Fenner "PB" belts of same size or if they are not "PB" belts, then the belts must have identical batch numbers to ensure that they are of same length. We only supply "Fenner" space saving wedge belts.

h) Ensure that the slide rail is not broken or damaged in transit. Once again check all bolts and nuts for tightness.




ELEVATION

END ELEVATION

DIRECT DRIVE

ARRANGEMENT-4

END ELEVATION

DIRECT THROUGH FLEXIBLE COUPLING

ARRANGEMENT-8

| PART No. | DESCRIPTION | PART No. | DESCRIPTION |
|---|---|---|---|
| 13 | HUB | 26 | LIFTING HOOK |
| 12 | IMPELLER – BLADE | 25 | TERMINAL BOX |
| 11 | IMPELLER – FRONT SHROUD | 24 | FIXING SCREW FOR COOLING FAN COVER |
| 10 | IMPELLER – BACK PLATE | 23 | FOUNDATION BOLTS |
| 09 | DRAIN PLUG | 22 | BEARING BLOCK FITTING BOLTS |
| 08 | MOTOR / BEARING SUPPORT STAND | 21 | MOTOR MOUNTING BOLTS |
| 07 | INLET CONE | 20 | MOTOR – COOLING FAN |
| 06 | OUTLET FLANGE | 19 | MOTOR – COOLNG FAN COVER |
| 05 | INLET FLANGE, WITH PIPE | 18 | MOTOR |
| 04 | INLET PLATE (Door) | 17 | COUPLING |
| 03 | CASING SCROLL | 16 | BEARING BLOCK |
| 02 | VOLUTE CASING – BACK PLATE | 15 | SHAFT |
| 01 | VOLUTE CASING – FRONT PLATE | 14 | HEAT SLINGER (FOR HOT AIR FAN ONLY) |

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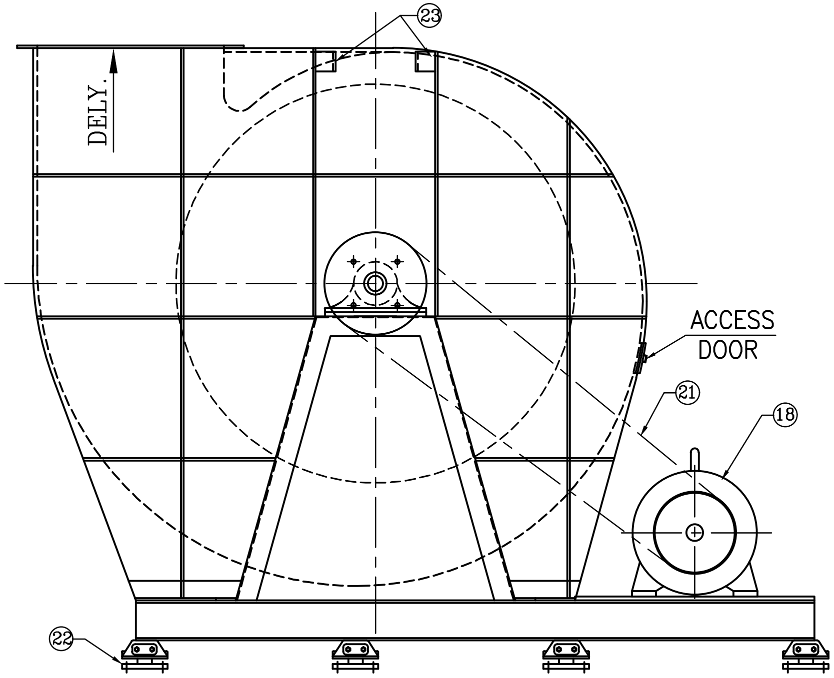
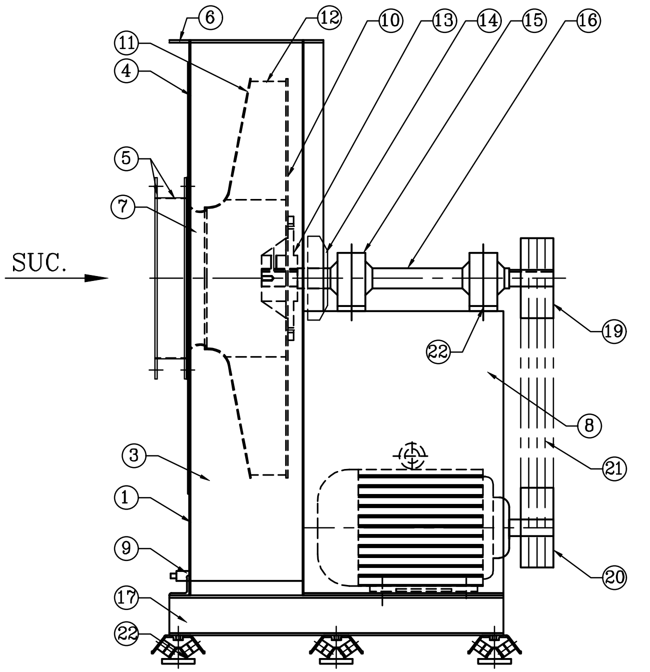
| | | | | | |
|---|---|---|---|---|---|
| TITLE | PART LIST : ARRT- 4 & ARRT – 8 | | | | |
| CLIENT. | APPD. | | | SCALE NTS | |
| | CHD. | | | | |
| JOB No. | DSD. | | | ALL DIMENSIONS ARE IN MM | EQ.MARK |
| | DRN. | SAN | 11.01.03 | | SL.NO. |
| | DRAWING NO. STD-ARRT-004 | | | | REV. 0 DT. 11.01 |




ELEVATION




END ELEVATION

BELT DRIVE

ARRANGEMENT–9

| | | | |
|---|---|---|---|
| | | 23 | LIFTING HOOK |
| 11 | IMPELLER – FRONT SHROUD | 22 | VIBRATION ISOLATER |
| 10 | IMPELLER – BACK PLATE | 21 | BELT |
| 09 | DRAIN PLUG | 20 | MOTOR PULLEY |
| 08 | BEARING SUPPORT STAND | 19 | FAN PULLEY |
| 07 | INLET CONE | 18 | MOTOR |
| 06 | OUTLET FLANGE | 17 | COMMON CHANNEL BASE FRAME |
| 05 | INLET FLANGE, WITH PIPE | 16 | SHAFT |
| 04 | INLET PLATE (Door) | 15 | BEARING BLOCK |
| 03 | CASING SCROLL | 14 | HEAT SLINGER (FOR HOT AIR FAN ONLY) |
| 02 | VOLUTE CASING – BACK PLATE | 13 | HUB |
| 01 | VOLUTE CASING – FRONT PLATE | 12 | IMPELLER – BLADE |
| PART No. | DESCRIPTION | PART No. | DESCRIPTION |

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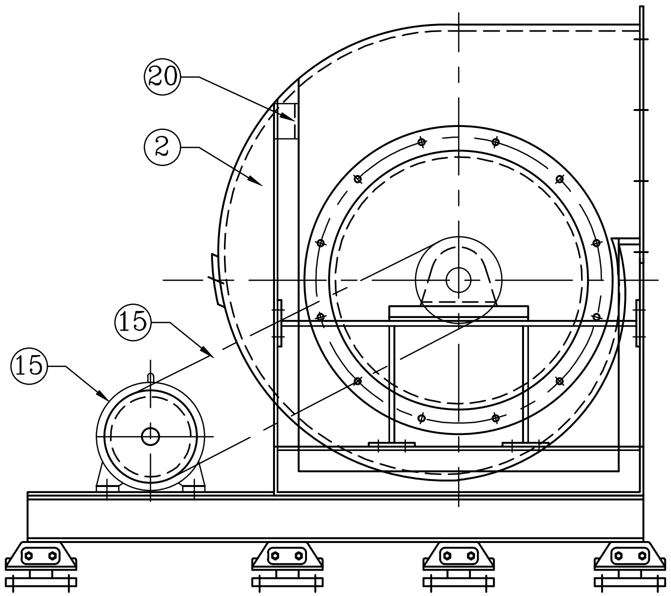
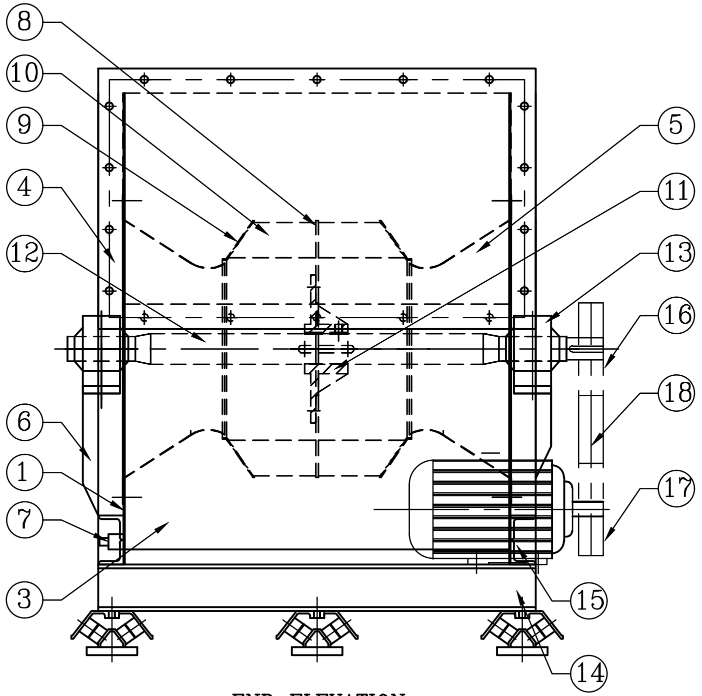
| | | | | | |
|---|---|---|---|---|---|
| TITLE | PART LIST : ARRANGEMENT– 9 | | | | |
| CLIENT. | APPD. | | | SCALE NTS | |
| | CHD. | | | | |
| JOB No. | DSD. | | | ALL DIMENSIONS ARE IN MM | EQ.MARK |
| | DRN. | SAN | 11.01.03 | | SL.NO. |
| | DRAWING NO. STD ARRT-005 | | | | REV. 0 DT. 11.01 |




ELEVATION




END ELEVATION

BELT DRIVE

ARRANGEMENT-3

| PART No. | DESCRIPTION | PART No. | DESCRIPTION |
|---|---|---|---|
| 10 | IMPELLER – BLADE | 20 | LIFTING HOOK |
| 09 | IMPELLER – FRONT SHROUD | 19 | VIBRATION ISOLATER |
| 08 | IMPELLER – BACK PLATE | 18 | BELT |
| 07 | DRAIN PLUG | 17 | MOTOR PULLEY |
| 06 | BEARING SUPPORT STAND | 16 | FAN PULLEY |
| 05 | INLET CONE | 15 | MOTOR |
| 04 | OUTLET FLANGE | 14 | COMMON CHANNEL BASE FRAME |
| 03 | CASING SCROLL | 13 | BEARING BLOCK |
| 02 | VOLUTE CASING – BACK PLATE | 12 | SHAFT |
| 01 | VOLUTE CASING – FRONT PLATE | 11 | HUB |

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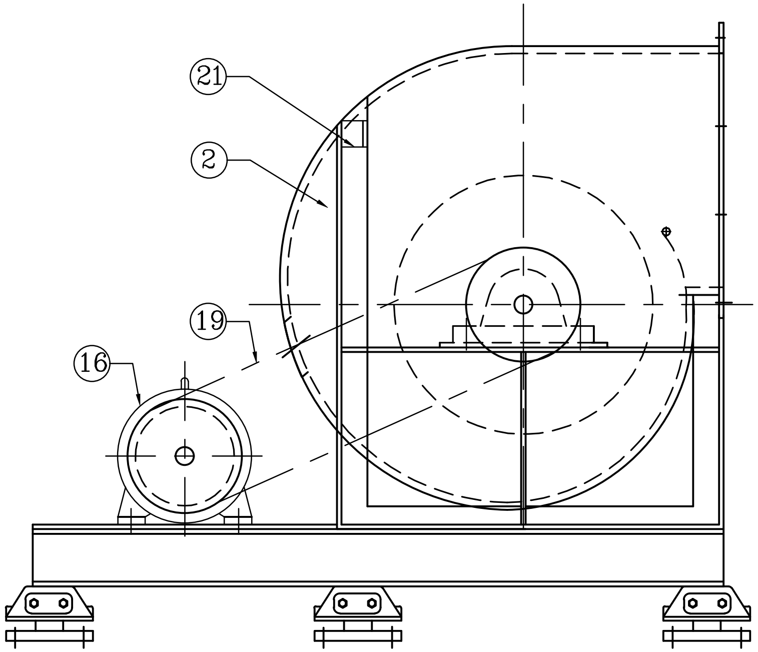
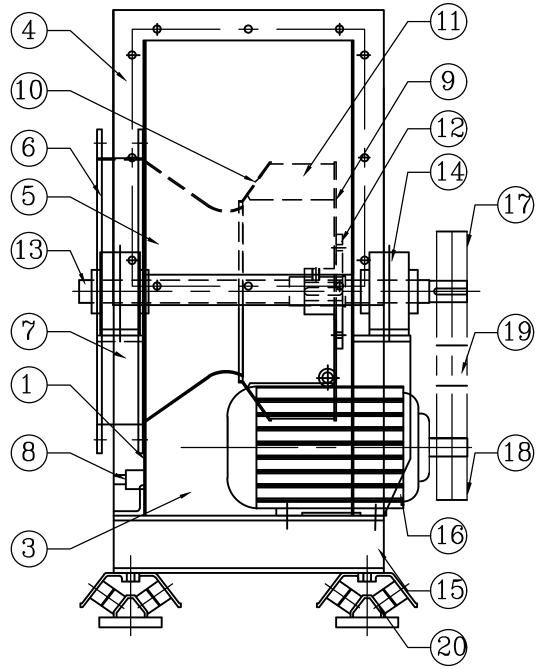
TITLE: PART LIST : ARRANGEMENT- 3 (DIDW)

| CLIENT. | APPD. | | | SCALE NTS | |
|---|---|---|---|---|---|
| | CHD. | | | | |
| JOB No. | DSD. | | | ALL DIMENSIONS ARE IN MM | EQ.MARK |
| | DRN. | SAN | 11.01.09 | | SL.NO. |
| | DRAWING NO. STD-ARRT-002 | | | | REV. 0 DT. 11.01 |




ELEVATION




END ELEVATION

BELT DRIVE
ARRANGEMENT–3

| | | | |
|---|---|---|---|
| 11 | IMPELLER – BLADE | | |
| 10 | IMPELLER – FRONT SHROUD | 21 | LIFTING HOOK |
| 09 | IMPELLER – BACK PLATE | 20 | VIBRATION ISOLATER |
| 08 | DRAIN PLUG | 19 | BELT |
| 07 | BEARING SUPPORT STAND | 18 | MOTOR PULLEY |
| 06 | INLET PIPE | 17 | FAN PULLEY |
| 05 | INLET CONE | 16 | MOTOR |
| 04 | OUTLET FLANGE | 15 | COMMON CHANNEL BASE FRAME |
| 03 | CASING SCROLL | 14 | BEARING BLOCK |
| 02 | VOLUTE CASING – BACK PLATE | 13 | SHAFT |
| 01 | VOLUTE CASING – FRONT PLATE | 12 | HUB |
| PART No. | DESCRIPTION | PART No. | DESCRIPTION |

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| | | | | | |
|---|---|---|---|---|---|
| TITLE | PART LIST : ARRANGEMENT– 3 (SISW) | | | | |
| CLIENT. | APPD. | | | SCALE NTS | |
| | CHD. | | | | |
| JOB No. | DSD. | | | ALL DIMENSIONS ARE IN MM | EQ.MARK |
| | DRN. | SAN | 11.01.03 | | SL.NO. |
| | DRAWING NO. STD–ARRT–003 | | | | REV. 0 DT. 11.01 |

5.6 <u>Fans in other Arrangements</u>

All other fan arrangements are derivation of one of the 4 arrangement mentioned above.

5.7 In double inlet fans or in arrangement 3 the impeller is mounted between 2 bearings and therefore one or both the bearings are in the path of the air flow. Hence it is doubly important to check that the bearing covers are fully tight and all the bolted support structures of the fan are fully tight.

## 6. General Erection Instruction: Foundations

6.1 A plan view of the base of the fan with foundation bolt pockets is given in the GA drawing with all essential dimensions. The fans must be mounted on a rigid and substantial foundation. Poured concrete, suitably reinforced should be used in the construction.

6.2 The foundation should weigh at least five times the weight of the supported equipment. The bottom of the foundation should be longer and wider than the finished top. Vertical sides can be used with a good footing course. An allowance for not less than 20 mm for grouting should be made when the top level of the foundation is being determined.

6.3 Suitable anchor bolts should be located accurately before the concrete is poured. When determining length of bolts required, allow for 30 - 40 mm for grout and overall leveling as well as nut thickness and extra threads for draw down. Pipe sleeves/foundation pockets should be provided around the anchor bolts to permit minor bolt adjustment after concrete has cured. If fans are not installed at ground level and it is necessary to use masonry or steel foundations, the 5:1 mass ratio should be observed. This foundation must be heavy enough to afford permanent rigid support and to absorb the normal amount of vibration that may develop from any cause. Installation should be located as near as possible to main supporting columns, structural beams or walls.

6.4 <u>Caution:</u> If fans are mounted on steel structures, these should be designed to take the combined Static & Dynamic load of the fan, motor & accessories. In this case, Anti Vibration mounting (Dunlop Cushy foot) may be used to achieve 70 - 80% isolation of vibrations.

6.5 FRICTION PAD

In case friction pads are used these should be placed between the surface of the foundation platform and bottom of the fan base (or common channel base as the case may be). Friction pads are only to be used in conjunction with the restraining bolts.

6.6 ANTI-VIBRATION MOUNTING (Dunlop cushy foot)

If anti vibration mounting (Cushy foot) is used then the bottom of the cushy foot should be fixed to the level floor with suitable screws in order to arrest movements of the cushy foot while lowering the fan . Please study the cushy foot catalogue and ensure that all cushy foot are placed in the same orientation with respect to the direction of vibrations, Cushy foots absorb vibration only when deflected in one direction.

6.7 CURING

Assuming that the machine foundation platform has already been cured, the concrete inside the foundation pockets should be allowed to cure properly before commissioning the fan.

## 7. Fan Locations & Ducting connection

7.1 The fan must be located at an appropriate place keeping in mind its noise level. Proximity to sensitive area / operators / source of fresh air supply & ease of access for inspection & maintenance.

7.2 Particular attention must be paid to its location with respect to other equipment which may generate heat or vibrations which can affect the fan bearing / belts / other parts.

7.3 In the case of SISW Fresh air supply fan, please ensure that the distance between open fan inlet and nearest wall / obstructions is equal to 1D (where D is the Diameter of the fan impeller).

7.4 Sometimes, DIDW fans are placed inside a room with 3 side of the room closed and one side acting as a filter area through which air enters the fan. Here also, the above (7.3) distance / location from walls should be maintained.

7.5 Caution : Be extremely careful when opening the door of rooms housing DIDW fans mentioned above (7.4). These may either open or close with a sudden force depending on the direction of opening. Such a door may be provided with big shutters / windows which should be opened before opening the door. This will reduce the air pressure on the door due to the fan suction. The window can be closed after the door is closed.

## 8. Pre-Commissioning Checks

8.1 Assuming that the equipment has been installed in accordance with the foregoing instructions as well as those of the manufacturers of components, and that a check has been made for tightness of all hardware and mounting bolts, the fan will be ready to operate after some final safety checks to prevent injury to personnel or damage to the equipment.

8.2 Accessories / Ducting

a. Please ensure that belts are properly alligned and tensioned as otherwise there could be temperature-rise or premature failure. Estimated drive loss figures reproduced from AMCA Publications are enclosed.

b. Flexible canvas or Metallic bellows (for higher temperature) must be used to connect the ductings with fan inlet / outlet or both. This will not only take care of minor misalignments, but also isolate the Fan / Duct vibrations from each other.

c. Ducting & Accessories must be suitably supported to ensure that its weight is not taken by the fan inlet & outlet flanges.

d. Ensure that dampers are secured & operating properly.

e. Ensure that filter / filter frames & flexible joints are secured well and have no chance of getting sucked into the fan.

8.3 CAUTION : Fan performance can be greatly reduced if inlet ducts & outlet ducts are not properly connected. Please see annexures to this manual, wherein copies of certain AMCA Publication are reproduced with suggested ducting connections.

8.4 a . Check bearings for tightness of fasteners / alignment, proper lubrication, cleanliness, burrs or corrosion and pipe connections for cooling systems (Where applicable).

b. Check keys and wheel set screws for tightness. Check foundation bolts for tightness.

c. Check inside the fan housing and duct work for extraneous matter and debris, such as bolts, nuts, washers, pieces of cotton, wood and or concrete cement.

d. Secure all access doors.

e. Turn impeller over by hand if possible, to see that it rotates freely.

f. Ensure that 'V' Belts are tight, and you have a matched set.

g. Check impeller position for proper clearance at inlet.

h. Close inlet volume control and/or dampers to lessen starting load on the motor.

i. Ensure that 'V' pulley grooves are clean.

j. Please ensure that there is no dust - cloth - waste - or any such foreign particle inside the fan casing or in the gap between the motor fan cover and the motor cooling fan.

k. In the case of V belt driven fan please ensure that the V belt alignment is proper and the belt tensions are in accordance with installation and maintenance provided by the respective manufacturer.

8.4A Water Cooling Jackets ( WCJ )

Water cooling jackets are by and large obsolete in most parts of the world as they have been effectively replaced by more reliable Heat slingers which require little or no maintenance. If, however, WCJ is specifically provided, please ensure that the water supply is steady and well controlled. Normally this should not exceed 3 - 5 litres/min. (Depending on fan size / temperature / speed). Gravity flow is enough. If excess pressure or amount of water is supplied, the water will leak though the sides and enter the bearings. If this happens, remove and clean the bearing as well as the grease. In Water cooling jackets with a packing gland (with adjustable nut), a slight leakage of water is permissible as long as this does not get past the retaining disc and enter the the bearing.

Caution: If fans are covered with glass wool insulation, please leave a tip clearance equal to 1/2 D between the heat slinger periphery and the beginning of insulation, so as to allow free air flow (D=diameter of heat slinger). Please also ensure that insulation thickness does not protrude beyond the heat slinger front face.

## 8.5 Electrical Connections

Before energizing the motor, please ensure the following :

a. The motor used is of the rated Horsepower, Speed and Voltage.

b. The electrical cable used should be designed to withstand the starting current as well as the full load current of the motor when in operation.

c. Please ensure that the correct type of starter (DOL or Fully automatic star delta or auto transformer starter) has been used in accordance with our recommendations Consult motor manufacturers for specific application.

d. It must be noted here that the starting current will depend on the type of starter used. It could be 6 times the full load current in the case of a DOL starter, 3 times of full load current in the case of Star Delta Starter and twice the full load current in the case of auto transformer starter.

8.6 Caution: The following guideline may be useful, but customers are advised to consult our engineers or motor suppliers for the correct starter recommendation.

## 8.7 DOL Starter

This is recommended for all fans up to 3 HP and fans in arrangement 4 up to 20 HP provided that adequate power supply is available for taking care of the starting current.

## 8.8 Star Delta Starter

When a fully automatic Star Delta starter is used it must conform to the following description: **“**fully automatic star delta starter with a 60 seconds timer with overload relay bi-passed in the star connection.**”**

8.9 a. The over load relay should be of adequate capacity to protect the motor against over load in the delta connection.

b. A 60 seconds timer is suggested because many fans requires at least 40 seconds to reach the required speed before changing from Star to Delta. But often the starter would trip within the first 30 Seconds itself. That is why a star delta starter has to conform to the specifications given above.

c. By trial and error, you can set the starter timer, so that it changes from Star to Delta at the right speed (not too soon or not too late).

d. Details of starting time & starting current etc observed during FACTORY runs can be obtained from NADI.

e. Auto transformer starter is to be used only under certain special condition and must be installed in consultation with us as well as the motor manufacturer.

8.9B CAUTIONS:

a. Please ensure that the motor and the fan are individually & separately earthed.

b. If motor takes longer than 40 seconds to accelerate to required speed, please stop further trials and contact NADI or its agents or Motor manufacturers.

## 9. Commissioning

9.1 Close the inlet damper and start the fan only for a few seconds to ensure that the fan is rotating in the right direction as indicated by the arrow on the fan casing.

9.2 Start the fan with the correct starter as specified in Section 8, keeping the inlet closed but the outlet opened to the atmosphere. In the case of star delta starter, Please set the timer for changing from star to delta in 30 seconds or as specified by us for specific cases.

9.2A Caution:

SAFETY FIRST: Stay away from the open inlet / outlet of the fan when starting. Do not attempt to peep into the fan for a view of the running impeller. Stay away from Heat slinger / Belts / Pulleys & shaft when in motion.

9.3 The fan should now run freely without tripping (with damper closed). Run the fan for 10 minutes to ensure that there is no unusual noise, or fowling of stationery parts with rotating parts. In case of any unusual sound STOP Fan at once & examine the cause (or contact our representative).

9.4 Switch off the fan, carry out the necessary correction/rechecks and restart the fan after 10 minutes once again with the damper fully closed.

9.5 Caution:

Please do not stop and restart frequently as this may damage the motor and / or cause the starter to trip. Permissible no. of starts/ hour for each motor varies according to size and duty conditions. Please refer motor manufacturer’s instruction as otherwise you may damage or burn the motor.

9.6 If the fan is not connected to the system the damper may be opened gradually while carefully noting the current consumption of the motor to ensure that it does not exceed the full load current of the motor.

9.7 Once the full load Current is reached the damper should not be opened beyond this point. In the case of high pressure fans (MHP series,P-50 & P-56 series) & Forward curved fan, there will be specific warning on the fan advising that the fan should not be run with the outlet open to atmosphere. This warning also means that if a damper is provided on the suction side the same should be gradually & partly opened (as above) keeping an eye on the current consumption. Such fan will consume excess power if the system resistance is less than specified.

9.7A The over load relay on the starter must be set to trip the motor at 5% overload.

9.8 Please ensure that the motor is protected against single phasing.

9.9 Permissible limits:

A. Fan performance:

As per IS 4894, the following tolerances in performance are permissible.

| | |
|---|---|
| Air volume | -5% |
| Speed | ±10% |
| Power input | +10% |

B. Vibrations:

As per VDI guidelines 2056, maximum permissible vibrations in mm/sec. are as follows:

a. For fans upto 15 KW : 4.8 mm/sec.
b. For fans between 16 - 75 KW : 7.1 mm/sec.
c. For fans between 76 - 300 KW : 11 mm/sec.

These vibrations to be measured on the Fan Bearings with the Fan secured firmly on a solid foundation.

C. Bearing temperature:

For fans handling normal air and lubricated with Lithium soap based grease (Castrol AP2 & AP3 grease), the max. permissible temperature is 85°C (bearing outer rase)

For ID fans & Hot air fans and lubricated with Molycote High temperature grease , the max. Permissible temperature is 120°C at the bearing outer rase. In this case, it will be a C-3 clearance bearing. In certain cases, max. Permissible temperature can be 150°C also. Please refer NADI for this operating condition.

10. Lubrication:

10.1 Please use correct quanity and type of grease as per chart enclosed.

For fans handling normal air : Use Castrol AP2 / AP3 grease.
For ID fans & Hot air fans : Use Molycote High temp. Grease capable of withstanding temperature up to 150°C.

10.2 Frequency of relubrication (complete change of grease) depends on the type and size of the bearings as well as speed (RPM) of the fan and its duty condition. Please see enclosed Re-lubrication chart.

10.3 Spherical roller bearings requires to be relubricated most frequently. Typically a 45 mm size bearing (22209 K) running at 2800 RPM would need to be relubricated once in 800 hours.

10.4 Cautions: Excess / in sufficient lubrication can both cause problems. The effect can be seen from the Time - Temperature graph enclosed herewith.

10.5 Frequency of relubrication should be as indicated in the enclosed chart.

## 11. Fan Maintenance

Due to different periods of operation, no rigid inspection and maintenance period can be recommended. It is suggested therefore that inspection and if necessary, fan cleaning (by non-abrasive means) is carried out at regular intervals of at least 700 running hours or once in 2 months, whichever is sooner.

All fasteners of whatever type should be checked for tightness. The integrity of the rotating items should be checked.

Inspection of parts for wear should be made at regular intervals depending on site conditions but not less than three times each year. In a dust laden atmosphere, internal parts should be checked for possible erosion and dust accumulation on impeller blades once in a week or more if required.

Periodically check the rubber tire of the flexibly coupling for wear /undue temperatures.

Periodically check and adjust the tension of the V Belts and also the temperature of the V Pulleys which is sure indicator of the condition of the V Belt drive system.

RUBBER-LINED / FRP LINED FANS:

Depending on the nature of application, fans must be frequently inspected and if necessary cleaned to remove the deposits of powder / dust / foreign material on the impeller.

As these fans are normally used in corrosive atmosphere, it is absolutely essential to ensure (by frequent inspection) that the lining is not damaged / cracked.

CAUTION: In continuous process plants, it is essential to periodically check bearing temperature rise and vibrations as these are sure indicators of impending trouble. A timely stoppage of even a short duration may not only save expensive bearing & other parts but also prevent an unplanned major shut down.

## 12. Trouble shooting:

### 12.1 Excessive vibration:

Should excessive vibration develop check the following possibilities :

a) Build up of dirt or foreign matter on wheel especially for ID fans, Rubber-lined / FRP lined fans.

b) Sometimes fine balance weights made up of rubber and stuck to the impeller might have flown off leading to unbalance ( for Rubber Lined Fans only ).

c) Bolts on bearings, Housings and motor loose.

d) Ducting loads transfered onto the fan inlet / outlet.

e) V belt drives improperly aligned, belts must have proper tension, pulleys must be balanced.

f) Check bearing clearance and alignment.

g) Check coupling alignment.

h) Check wheel for tightness on the shaft.

i) Has foreign matter entered fan, causing damage to wheel shaft or bearings ?

j) Is the vibration coming form a source other than the fan ? Stop the fan and determine if the vibration still exists. Disengage the motor from the fan and operate it by itself to determine if it produces vibration.

k) Is shaft / impeller / pulley moving laterally ?

### 12.2 Motor overloading / drawing excessive current:

If motor is overloading, please check if,

a) Voltage & frequency are within limits.

b) Fan rotation in right direction.

c) Belts are not too tight.

d) System resistance is reduced / there are leaks in the ducting or some inspection door has been left open.

e) Bearing are seizing.

f) Packing gland is too tight or impeller / shaft rubbing somewhere.

g) Some wire connection (terminal screw) is loose or incoming cable is undersized.

h) In ID Fans, motor might be selected for hot start and air temperature may be less than specified.

CAUTION: Please shut down fan immediately, if,

a. Motor continuously overloading.

b. Unusual noise or vibration on fans.

c. Bearing vibrations / temperature is 15% more than specified permissible limits(Sec.9.9).

d. Slightest lateral movement of shaft or pulley or impeller is observed.

## 12.3 Pulsation or surge in fan / ductings:

This phenomenon particularly comes in High Pressure fans.

a) When fan is throttled/ air delivery restricted causing fan to operate in the surge region / poor point of rating on the curve.

b) Fan is too large for the application.

c) Ducts vibrating at same frequency as fan pulsation

d) Distorted inlet flow.

## 12.4 Insufficient AIR flow:

a) Impeller installed or running backward in the wrong direction.

b) Incorrect fan speed.

c) Impeller not centred with inlet collar / inlet cone.

d) Impeller / fan inlet dirty or clogged.

e) Inlet flexible canvas blocking the airflow.

f) Inlet guidevane damper improperly set.

g) System resistance more than specified.

h) Dampers closed.

i) Duct internal insulation / lining come loose.

j) Filters clogged.

k) Duct velocities too high.

## 12.5 Insufficient Static pressure:

a) Fan inlet and/or outlet conditions not same as when tested to IS 4894.

b) Fan speed too low.

c) Belts may be slipping.

d) Motor speed may be wrong.

e) Impeller running in the wrong direction.

f) System resistance to flow less than estimated. This is a common occurrence and fan speed may be reduced suitably.

g) Gas density less than specified due to higher temperatures.

h) Improper running clearance between inlet cone and impeller front shroud.

## 12.6 Recommended spares for Clean AIR Fans :

a) Bearings / Adopter Sleeve & Bearing Housing. (Set)

b) V - Belts / Coupling Tyre.

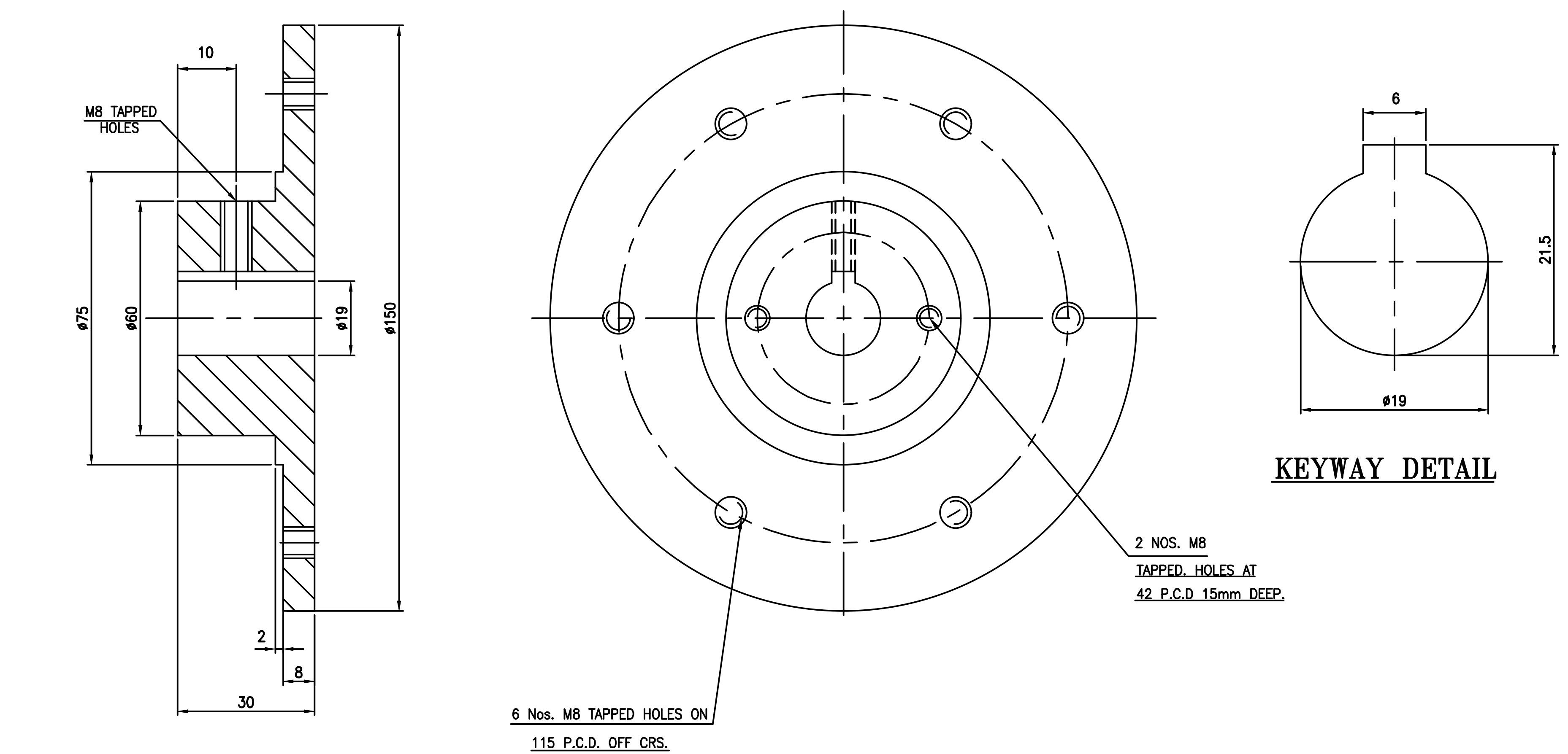
c) Grease.

d) Fuse & Starter Relay.

## 12.7 RECOMMENDED SPECIAL INSTRUMENTS FOR CONTINUOUS PROCESS PLANTS :

a) Digital Thermometer for measuring Bearing Surface Temperatures.

b) “BALMAC” Portable Vibration Meter for measuring the velocity of vibrations.

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MATL : C.I

QTY : 1 No.

| | | | | | |
|---|---|---|---|---|---|
| 01 | HUB | 01 | C.I | | |
| S.NO | DESCRIPTION | QTY | MATL | WT | REMARKS |

NADI INDUSTRIAL FANS 1955

NADI AIRTECHNICS PRIVATE LTD.
No. 9/11, 9/12, G.N.T. Road,
Azhinjivakkam, Chennai-600 067.

| REV | DATE | DETAILS OF REVISION |
|---|---|---|
| | | |

| GENERAL TOLERANCE & INSTRUCTION | | | |
|---|---|---|---|
| RANGE | TOL | RANGE | TOL |
| 0.5 – 3 | ±0.2 | 120– 400 | ±2.5 |
| 3 – 6 | ±0.5 | 400–1000 | ±4.0 |
| 6 – 30 | ±1.0 | 1000–2000 | ±6.0 |
| 30 – 120 | ±1.5 | 2000–4000 | ±8.0 |

| DESCRIPTION | TOL |
|---|---|
| KEY WIDTH | : +0.0/–0.1 |
| KEY DEPTH ON SHAFT | : 0/–0.2 |
| KEY DEPTH ON BORE | : 0/+0.2 |
| HOLES | : +0.5/–0.0 |
| PCD INLET & OUTLET | : ±1 |
| PCD FOUN. HOLES | : ±3 |

| ID/OD(ø) (RANGE) | SHAFT * | HUB/ PULLEY | WELDED HUB |
|---|---|---|---|
| 0–100 | +0.00 –0.02 | +0.03 –0.00 | +0.03 +0.05 |
| 100–200 | +0.00 –0.04 | +0.04 –0.00 | +0.04 +0.08 |
| SHAFT RUNOUT 0.05 MAX | | | |

(STITCH WELD LENGTH TOLERANCE
WELD LENGTH : –5/+ NIL ;
GAP LENGTH : +5/– NIL)
FILLET SIZE & WELDING COVERAGE REF DOC–09–03–MFG
INSP OF WELDING WI–10–02–QA
1x45° CHAMFERING AT MACHINED SHARP EDGES
BALANCING AS PER IS01940 G6.3
TACK WELD AT FOUR FACES OF BALANCING WEIGHT

| TITLE | HUB DETAIL OF PHX–150, CW–2 | | |
|---|---|---|---|
| ID NO: | APPD. | | SCALE : 1 : 1 |
| | CHD. | | ALL DIMENSIONS ARE IN MM U.O.S |
| JOB NO.: | DRN. | / | |
| | DRAWING NO. 150-B | | REV. 0 DT. 04.03 |

<u>SUGGESTIONS FOR BETTER OPERATION AND PERFORMANCE</u>

Proper fan installation, obtaining the best possible inlet and outlet conditions, will pay dividends in fan performance.

The ideal fan installation would have an open inlet or straight inlet duct and a straight discharge duct. Ideal conditions such as these are not always attained in actual installation.

When ideal conditions must be modified, the best arrangement for proper air flow should be considered.

Elbows and changes in duct section are the common problem involved.

The use of an elbow at the fan inlet causes non-uniformity of flow and may affect the fan performance seriously. elbows located near the fan outlet can result in high pressure losses. Allow as much straight ducts as possible between the fan and elbow; atleast 1 or 2 duct diameters is preferred. Turning vanes will greatly improve elbow conditions at either fan inlet or outlet by maintaining a more uniform air velocity around the turn, thus reducing turbulence losses, and increasing fan performance.

Abrupt changes in duct section should be avoided. In an abrupt contraction, the flow contracts due to the sharp edge and then expands again to fill the smaller duct with resulting loss. The shock loss in an abrupt enlargement is due to the widening jet of air into the larger duct. Gradual area changes offered by a cone transformation piece are preferred. The sketches illustrate poor and improved duct connections.

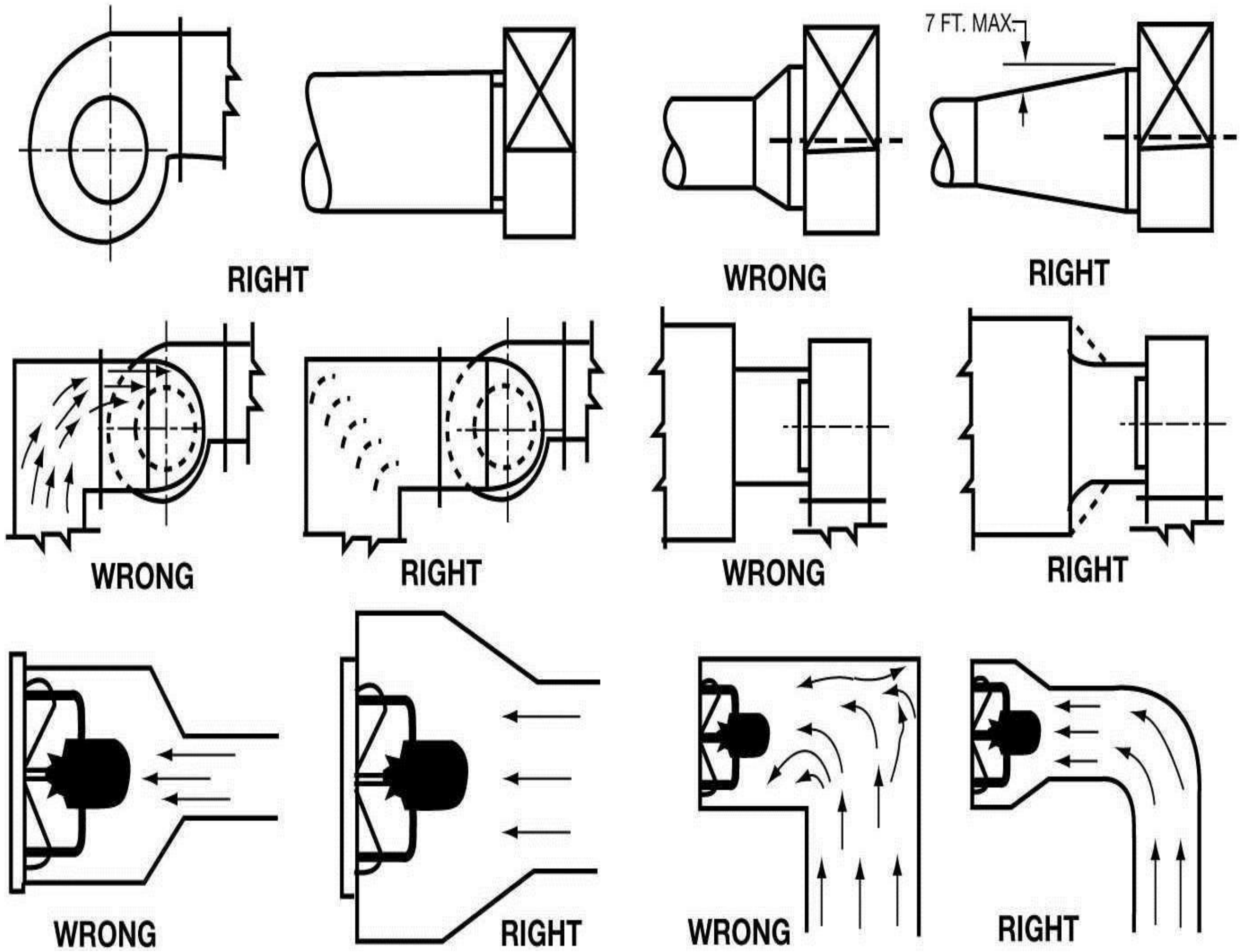
Flexible connections should be used to connect ducts to fan inlet and outlet. Unpainted canvas, rubber or other flexible connections must be used.

A fire resistant material should be used if a fire hazard exists. When fan is mounted on a floating base, flexible connections must be used.

Access doors in duct connections should be provided for maintenance of the inlet bearing on arr. 3 fans and for inspection and maintenance of rotors.

SUGGESTED INLET/OUTLET
CONNECTION FOR
BETTER FAN PERFORMANCE

INLET DUCTING CONNECTIONS:

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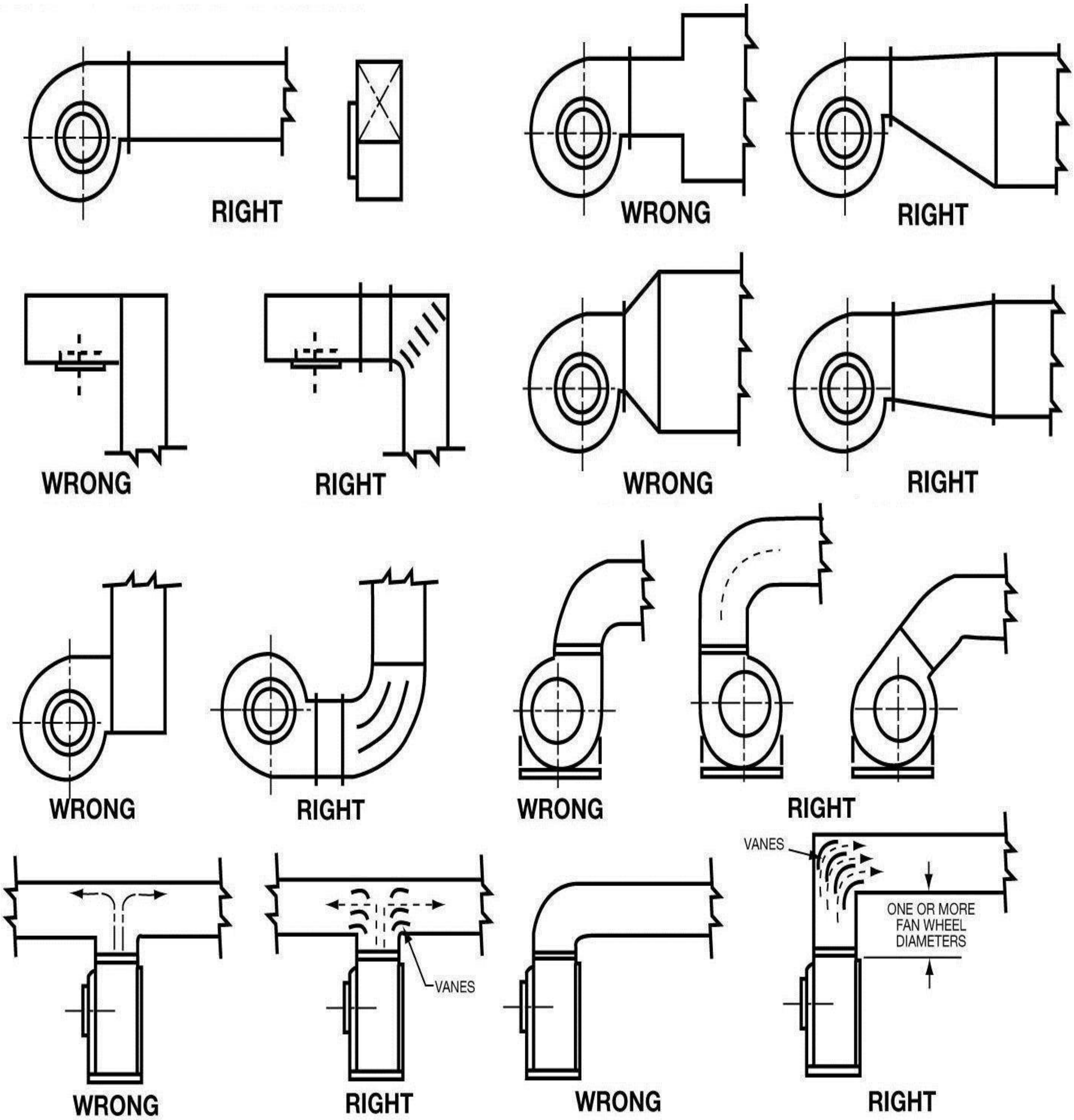
OUTLET DUCTING CONNECTIONS:

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Fenner®

Reliable | Trusted | Connected

# INSTALLATION GUIDE

## Friction Belt Drives

Although comparatively old in principle today's belt drive is an extremely efficient method of transmitting power between prime mover and machinery.

It owes its present high performance standards to many years of research and development by engineers and technologists, leading to significant refinements in materials and processes.

To derive maximum benefit from such advances it is important that the simple installation and operation procedures set out here are closely followed. Making these routines standard practice will ensure optimum performance and long, trouble-free life from Fenner belt drives. An electronic, sonic tension indicator is also available.

### PULLEYS

Before assembling the drive, check the pulley grooves are free from scores or sharp edges, and all dimensions conform to the relevant standard.

Drive installation is straightforward with Taper Lock – but follow all steps on the installation leaflet provided with every Taper Lock bush.

### ALIGNMENT

Good alignment of pulleys is important to avoid belt flank wear. The diagrams opposite show some of the common alignment faults.

Pulley misalignment should not exceed 1/2° angular and 10mm / metre drive centre distance, axial.

A laser alignment device is available, which facilitates quick, easy and accurate pulley alignment.

### BELT INSTALLATION

When the pulleys have been correctly positioned on the shafts, the belts can be installed to complete the drive.

The drive centre distance should be reduced prior to the installation of the belts so that they may be fitted without the use of force.

Under no circumstances must belts be prised into the grooves. Belts and pulley grooves can easily be damaged by using sharp tools to stretch the belts over the pulley rim.

The installation allowance given in the table opposite is the minimum recommended reduction in centre distance for the various belt sections and lengths to allow for correct fitting.

The take-up allowance given in the same table should be added on to the calculated centre distance to allow for belt stretch/bedding in.

### GUARDS

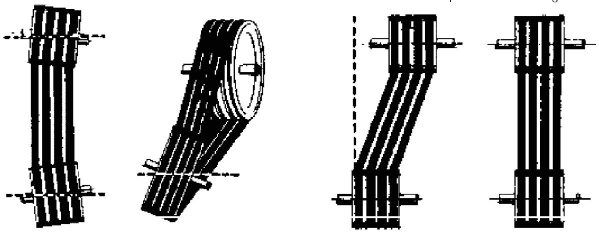
Where guards are necessary it is desirable to use mesh materials to permit adequate ventilation. Guards should be generously sized to allow for incidental belt flap.

### TENSIONING PULLEYS

If tensioning (jockey) pulleys are to be used on wedge belt drives, they must be grooved pulleys working on the inside of the drive, preferably on the slack side.

The pulley should be positioned as close as possible to the large pulley. Flat tensioning pulleys, bearing on the outside of the drive are permissible only with V and not with wedge belts. They should be positioned within one third of the centre distance from the small pulley.

The tensioning pulley must have at least the same diameter as the small pulley of the drive. Tensioning pulley movemement must allow for passing the belts over the outside diameter of one of the drive pulleys on installation, and should also allow for belt stretch/bedding in.




**The modern wedge belt drive is a highly efficient power transmission medium, but optimum performance will not be achieved without correct tension and alignment.**

**INSTALLATION AND TAKE-UP ALLOWANCE**

| Belt Pitch Length (mm) | Installation Allowances SPZ Z | SPA A | SPB B | SPC C | 8V D | Take-up (mm) |
|---|---|---|---|---|---|---|
| 410 to 530 | 20 | | | | | 5 |
| 530 to 840 | 20 | 25 | 30 | | | 10 |
| 850 to 1160 | 20 | 25 | 30 | 50 | | 15 |
| 1170 to 1500 | 20 | 25 | 30 | 50 | | 20 |
| 1510 to 1830 | 20 | 25 | 30 | 50 | | 25 |
| 1840 to 2170 | 20 | 25 | 30 | 50 | | 30 |
| 2180 to 2830 | 20 | 25 | 30 | 50 | 65 | 40 |
| 2840 to 3500 | 20 | 25 | 30 | 50 | 65 | 50 |
| 3520 to 4160 | 20 | 25 | 30 | 50 | 65 | 60 |
| 4170 to 5140 | 20 | 25 | 30 | 50 | 65 | 70 |
| 5220 to 6150 | | 25 | 30 | 50 | 65 | 85 |
| 6180 to 7500 | | | 30 | 50 | 65 | 105 |
| 7600 to 8500 | | | 30 | 50 | 65 | 125 |
| 8880 to 10170 | | | | 50 | 65 | 145 |
| 10600 to 12500 | | | | 50 | 65 | 175 |

### Taper Lock

All Fenner V and wedge belt pulleys use Taper Lock shaft fixing. Detailed instructions for fitting and dismounting Taper Lock products are included with Taper Lock bushes.

FPT FAR EAST | ASIA PACIFIC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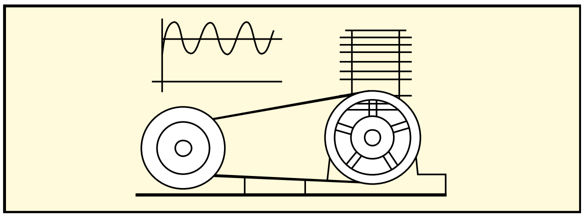
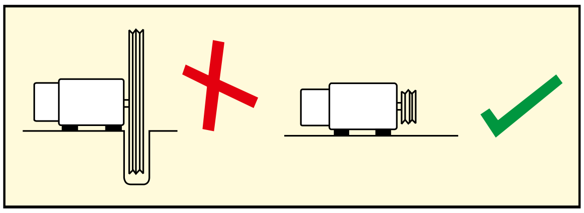
# How to get maximum productivity from your Fenner V Belt drives

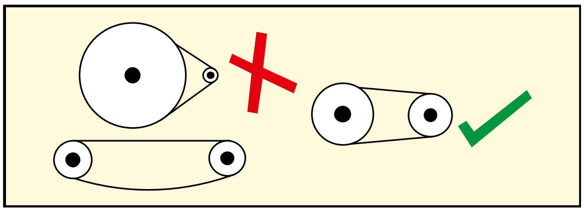
**1. Drive designing :** When assessing the power requirements of the drive, do not forget to apply the appropriate service factor for the combination of prime mover and driven machine. Consider not only the running characteristics of the machines ( i.e smooth, heavy shock, pulsating) but also any normal loads applied during starting by high torque motors, or the inertia of the driven machine.

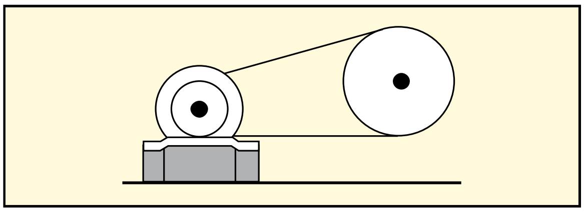




**2. Pulley Diameter selection:** Pulley diameters should be appropriate to the other components of the drive. Minimum diameter pulleys cause an unnecessary flexing of the belts and may lead to premature bearing failure on the machines. Large pulleys have obvious space and additional cost disadvantages.

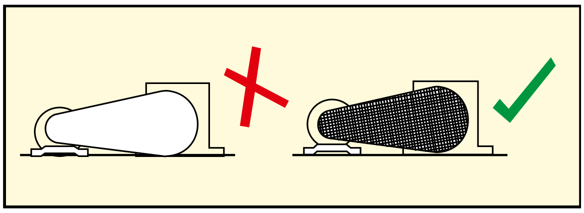
**3. Belt Length Selection:** For any combination of pulley diameters, a suitable length of belt should be chosen to maintain an adequate arc of contact on the small pulley. Unnecessarily long belts require more take-up adjustment and can cause problems with the catenary sag of the slack side of the drive. Choose a drive site which provides adequate room for belt tensioning procedures, a part of installation and maintenance routines.

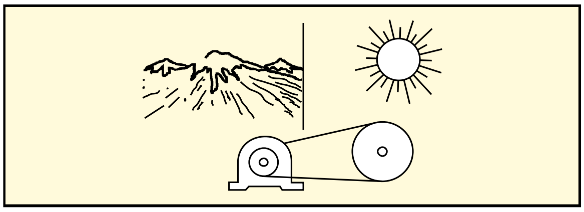




**4. Mounting of Belt Drive:** The base-plate or mounting for the drive should be rigid to prevent variations in belt tension under load. Rubber mountings must not be used with either driven or driver machine. The base-plate should be designed to allow belt tensioning and enable the drive alignment to be easily maintained.

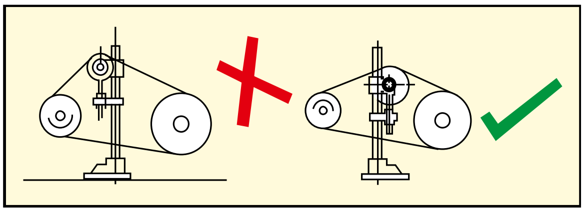
**5. Belt Guards:** Drives should not be completely enclosed by guards. Open mesh guards which allow normal air circulation but prevent any accidental contact with the drive are recommended.





**6. Belt Storage:** Belts should not be subjected to extremes of heat and cold. Standard belts can tolerate a considerable range of temperatures between $18^{\circ}$ C and $60^{\circ}$ C without damage.

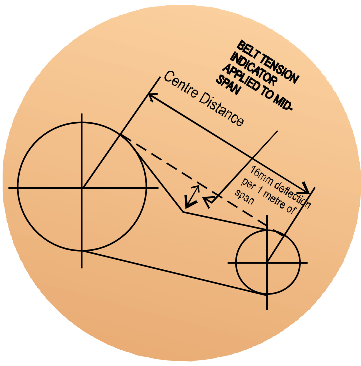
**7. Jockey Pulley Tensioners:** On fixed centre drives, it is the usual practice to tension the belts by Jockey Pulleys. If using a grooved Jockey Pulley, place it on inside of the V-Belts, mounted as near as possible to the larger pulley and on the slack side of the drive. Jockey Pulley diameters should be at least equal to that of the smaller pulley of the drive, ideally a little larger.



## Belt Tensioning Method Using Fenner Belt Tension Indicator

1. Calculate the deflection distance in mm on a basis of 16 mm per metre of span.
   Centre Distance (m) x 16 = Deflection (mm)

2. Set the lower marker ring at the deflection distance required in mm on the lower scale.




3. Set the upper marker ring against the bottom edge of the top tube.

4. Place the belt tension indicator on top of the belt at the centre of the span. Apply a force at right angles to the belt deflecting it to the point where the lower marker ring is level with the top of the adjacent belt*

5. Read off the force value indicated by the top edge of the upper marker ring.

6. Compare this force to the kgf value shown in Table-1

** For single belt drives a straight edge should be placed across the two pulleys to act as a datum for measuring the amount of deflection.*

If the measured force falls within the values given, the drive should be satisfactory. A measured force below the lower value indicates under-tensioning. A new drive should be tensioned to the higher value to allow for the normal drop in tension during the running-in period. After the drive has been running for 30 minutes, the tension should be checked and readjusted to the higher value, if necessary.

***The high performance and efficiency of Fenner Precision Built belts require correct tension. We recommend using the Fenner Belt Tension Indicator.***

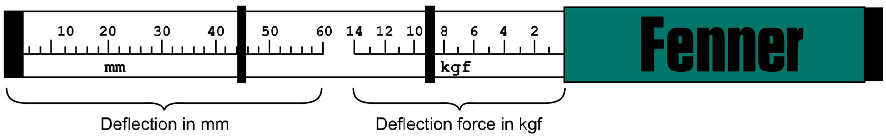



**Table 2: Tensioning Forces**

| Belt Section | Force Required to deflect belt 16 mm per metre of span | | |
|---|---|---|---|
| | Small Pulley Diameter (mm) | Newton (N) | Kilogram force (kgf) |
| **SPZ** | 67 to 95 | 10 to 15 | 1.0 to 1.5 |
| | 100 to 140 | 15 to 20 | 1.5 to 2.0 |
| **SPA** | 100 to 132 | 20 to 27 | 2.0 to 2.7 |
| | 140 to 200 | 27 to 35 | 2.8 to 3.6 |
| **SPB** | 160 to 224 | 35 to 50 | 3.6 to 5.1 |
| | 236 to 315 | 50 to 65 | 5.1 to 6.6 |
| **SPC** | 224 to 355 | 60 to 90 | 6.1 to 9.2 |
| | 375 to 560 | 90 to 120 | 9.2 to 12.2 |
| **8V** | 335 & above | 150 to 200 | 15.3 to 20.4 |
| **A** | 80 to 140 | 10 to 15 | 1.0 to 1.5 |
| **B** | 125 to 200 | 20 to 30 | 2.0 to 3.1 |
| **C** | 200 to 400 | 40 to 60 | 4.1 to 6.1 |
| **D** | 355 to 600 | 70 to 105 | 7.1 to 10.7 |
| **E** | 500 & above | 120 to 180 | 12.2 to 18.3 |

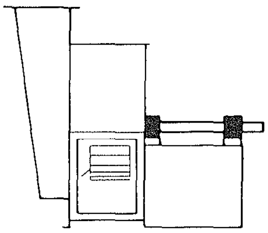
**Table 3: Installation Take-up Allowance Table**

<table>
<tr><th rowspan="2">Belt Pitch Length (mm)</th><th colspan="5">Installation Allowances</th><th rowspan="2">Take-up (mm)</th></tr>
<tr><th>SPZ</th><th>A & SPA</th><th>B & SPB</th><th>C & SPC</th><th>D & 8V</th></tr>
<tr><td>410 to 530</td><td rowspan="10">20</td><td rowspan="11">25</td><td rowspan="13">30</td><td rowspan="15">50</td><td rowspan="15">65</td><td>5</td></tr>
<tr><td>530 to 840</td><td>10</td></tr>
<tr><td>850 to 1160</td><td>15</td></tr>
<tr><td>1170 to 1500</td><td>20</td></tr>
<tr><td>1510 to 1830</td><td>25</td></tr>
<tr><td>1840 to 2170</td><td>30</td></tr>
<tr><td>2180 to 2830</td><td>40</td></tr>
<tr><td>2840 to 3500</td><td>50</td></tr>
<tr><td>3520 to 4160</td><td>60</td></tr>
<tr><td>4170 to 5140</td><td>70</td></tr>
<tr><td>5220 to 6150</td><td rowspan="5"></td><td>85</td></tr>
<tr><td>6180 to 7500</td><td rowspan="4"></td><td>105</td></tr>
<tr><td>7600 to 8500</td><td>125</td></tr>
<tr><td>8880 to 10170</td><td rowspan="2"></td><td>145</td></tr>
<tr><td>10600 to 12500</td><td>175</td></tr>
</table>

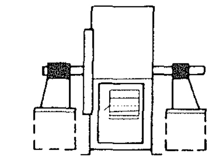
**Table 4: Recommended Minimum Pulley Pitch Diameters (mm)**

| A | B | C | D | E | SPZ | SPA | SPB | SPC | 8V |
|---|---|---|---|---|---|---|---|---|---|
| 80 | 125 | 200 | 315 | 450 | 67 | 95 | 160 | 224 | 335 |

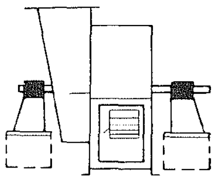
**SW** - Single Width **DW** - Double Width
**SI** - Single Inlet **DI** - Double Inlet



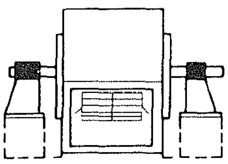
**ARR. 1 SWSI WITH INLET BOX** For belt drive or direct connection. Impeller overhung, two bearings on base. Inlet box may be self-supporting.



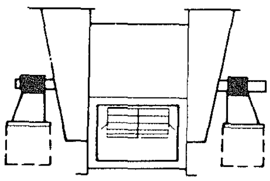
**ARR. 3 SWSI WITH INDEPENDENT PEDESTAL** For belt drive or direct, connection fan. Housing is self-supporting. One bearing on each side supported by independent pedestals.



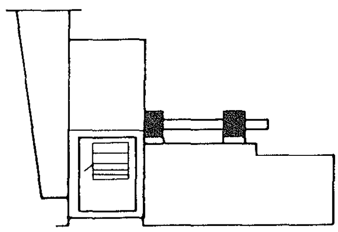
**ARR. 3 SWSI WITH INLET BOX AND INDEPENDENT PEDESTALS** For belt drive or direct connection fan. Housing is self-supporting. One bearing on each side supported by independent pedestals with shaft extending through inlet box.



**ARR. 3 DWDI WITH INDEPENDENT PEDESTAL** For belt drive or direct connection fan. Housing is self-supporting. One bearing on each side supported by independent pedestals.



**ARR. 3 DWDI WITH INLET BOX AND INDEPENDENT PEDESTALS** For belt drive or direct connection fan. Housing is self-supporting. One bearing on each side supported by independent pedestals with shaft extending through inlet box.



**ARR. 8 SWSI WITH INLET BOX** For belt drive or direct connection. Impeller overhung, two bearings on base plus extended base for prime mover. Inlet box may be self-supporting.

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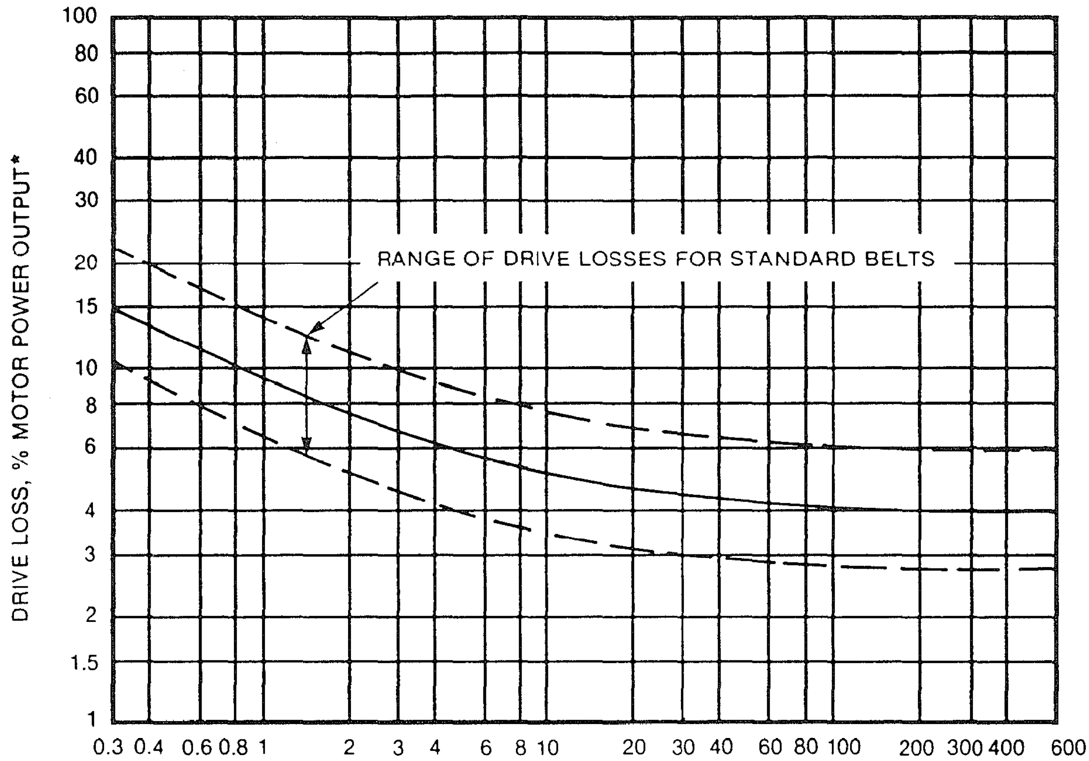
AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS

*DRIVE ARRANGEMENTS FOR CENTRIFUGAL FANS*

DATE *5-92* FIGURE *6-5b*




HIGHER BELT SPEEDS TEND TO HAVE HIGHER LOSSES
THAN LOWER BELT SPEEDS AT THE SAME HORSEPOWER

*Drive losses are based on the conventional V-belt which has been the "work horse" of the drive industry for several decades.

EXAMPLE

- Motor power output, $H_{mo}$, is determined to be 13.3 hp
- The belts are the standard type and just warm to the touch immediately after shutdown
- From chart, drive loss = 5.1%
- Drive loss, $H_L$ = 0.051 x 13.3 = 0.7 hp
- Fan power input, H = 13.3 − 0.7 = 12.6 hp.

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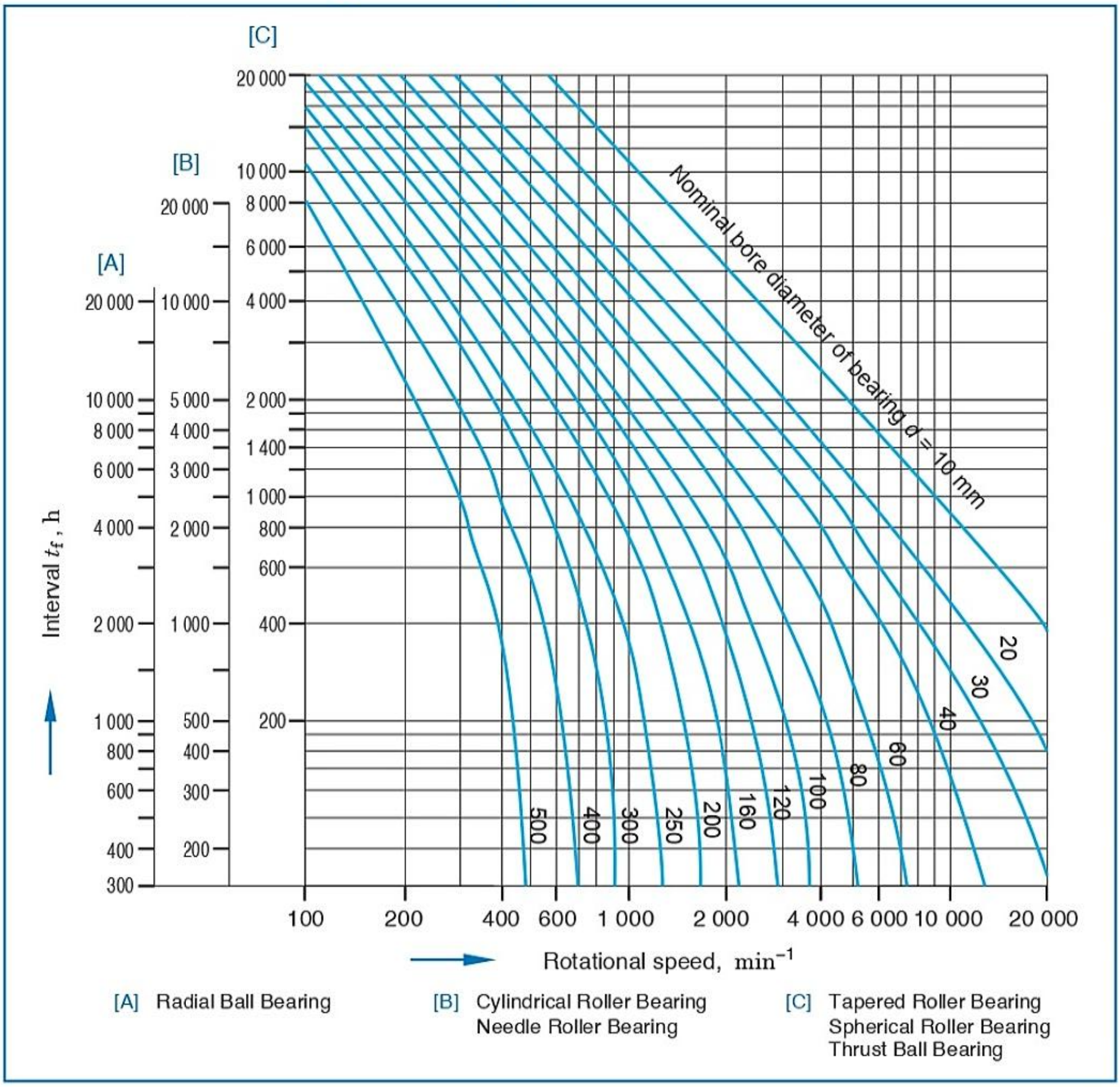
| AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS | *ESTIMATED BELT DRIVE LOSS* |
|---|---|
| | DATE *5−92* FIGURE *6−6* |

# Bearing Lubrication Guide

## Regreasing Interval Chart



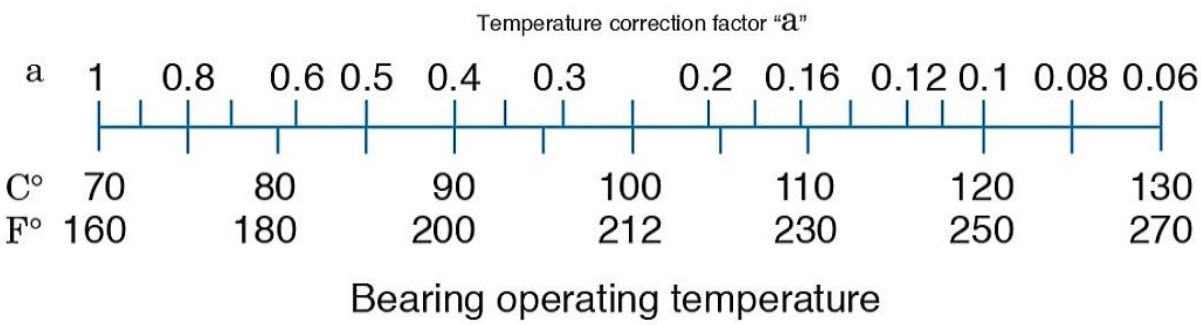

## Temperature Correction

When the bearing operating temperature exceeds 70°C, $t_f'$, obtained by multiplying $t_f$ by correction coefficient a, found on the scale below, should be applied as the feeding interval.

$t_f' = t_f$

$t_f'$ = Grease interval time corrected for temperature

$t_f$ = Grease interval time for size & speed only



## INITIAL GREASE CHARGE FOR SPLIT BEARING BLOCKS

The approximate Initial Grease Charge ( GMS ) for split Bearing Blocks is in the Table given below. The Recommended Initial Grease Charge is one - third to one - half the volume of the free space in the Bearing Block Base. This recommendation is for moderate speeds and normal or light bearing loads (C/P >= 8.3). The table gives the Grease mass for a charge of one - third of the base free space volume.

| BEARING BLOCK | GREASE CHARGE ( GMS ) | BEARING BLOCK | GREASE CHARGE ( GMS ) |
|---|---|---|---|
| 505 | 11.5 | 520 | 310 |
| 506 | 28.5 | 522 | 395 |
| 507 | 37.0 | 524 | 440 |
| 509 | 51.0 | 526 | 610 |
| 510 | 58.5 | 530 | 795 |
| 511 | 76.5 | 532 | 895 |
| 513 | 120 | 534 | 1100 |
| 515 | 145 | 536 | 1150 |
| 516 | 180 | 538 | 1500 |
| 517 | 220 | 540 | 1850 |
| | | 544 | 2250 |

# BEARING RELUBRICATION CHART

## RECOMMENDED GREASE - SKF LGMT3

NADI
INDUSTRIAL FANS

| Sl No | Shaft Size | Bearing Housing | Regular Re-Lubrication Grease (Grams) | Relubrication Interval | | |
|---|---|---|---|---|---|---|
| | | | | Speed Upto 1000 RPM | Speed Upto 1000 - 3000 RPM | High Temperature Fans |
| 1 | 25 | SN506/MB306 | 10 | 720 Hrs | 480 Hrs | 336 Hrs |
| 2 | 30 | SN507/ MB307 | 15 | 720 Hrs | 480 Hrs | 336 Hrs |
| 3 | 35 | SN508/MB308 | 15 | 720 Hrs | 480 Hrs | 336 Hrs |
| 4 | 40 | SN509/MB309 | 20 | 720 Hrs | 480 Hrs | 336 Hrs |
| 5 | 45 | SN510/MB310 | 25 | 720 Hrs | 480 Hrs | 336 Hrs |
| 6 | 50 | SN511 | 25 | 720 Hrs | 480 Hrs | 336 Hrs |
| 7 | 55 | SN512 | 30 | 720 Hrs | 480 Hrs | 336 Hrs |
| 8 | 60 | SN513 | 30 | 720 Hrs | 480 Hrs | 336 Hrs |
| 9 | 65 | SN515 | 35 | 720 Hrs | 480 Hrs | 336 Hrs |
| 10 | 70 | SN516 | 40 | 720 Hrs | 480 Hrs | 336 Hrs |
| 11 | 75 | SN517 | 50 | 720 Hrs | 480 Hrs | 336 Hrs |
| 12 | 80 | SN518 | 50 | 720 Hrs | 480 Hrs | 336 Hrs |
| 13 | 85 | SN519 | 60 | 720 Hrs | 480 Hrs | 336 Hrs |
| 14 | 90 | SN520 | 70 | 720 Hrs | 480 Hrs | 336 Hrs |
| 15 | 100 | SN522 | 80 | 720 Hrs | 480 Hrs | 336 Hrs |
| 16 | 110 | SN524 | 100 | 720 Hrs | 480 Hrs | 336 Hrs |
| 17 | 125 | SN528 | 125 | 720 Hrs | 480 Hrs | 336 Hrs |
| 18 | 135 | SN530 | 150 | 720 Hrs | 480 Hrs | 336 Hrs |
| 19 | 140 | SN532 | 150 | 720 Hrs | 480 Hrs | 336 Hrs |

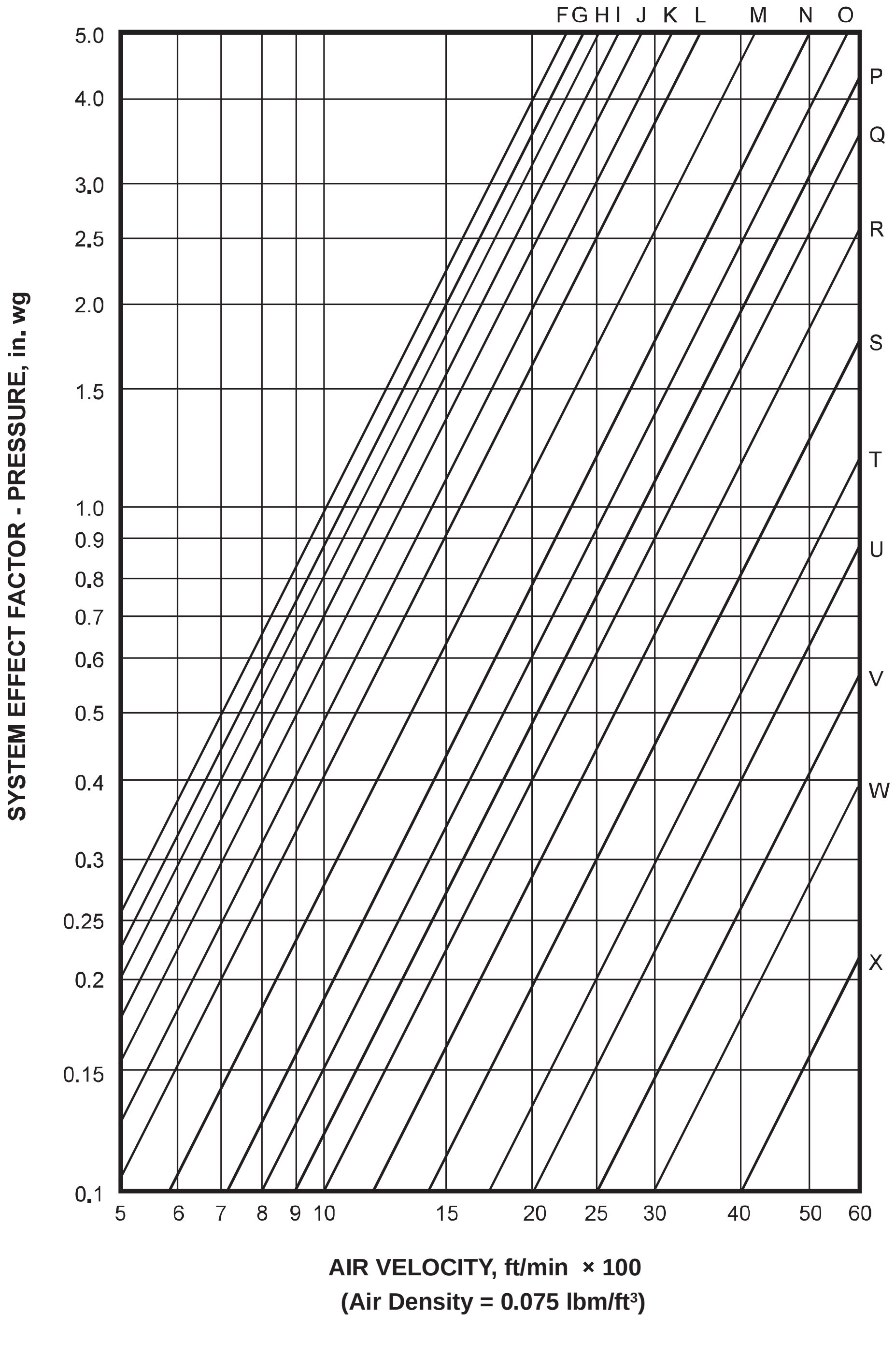



**Figure 7.1 - System Effect Curves (I-P)**

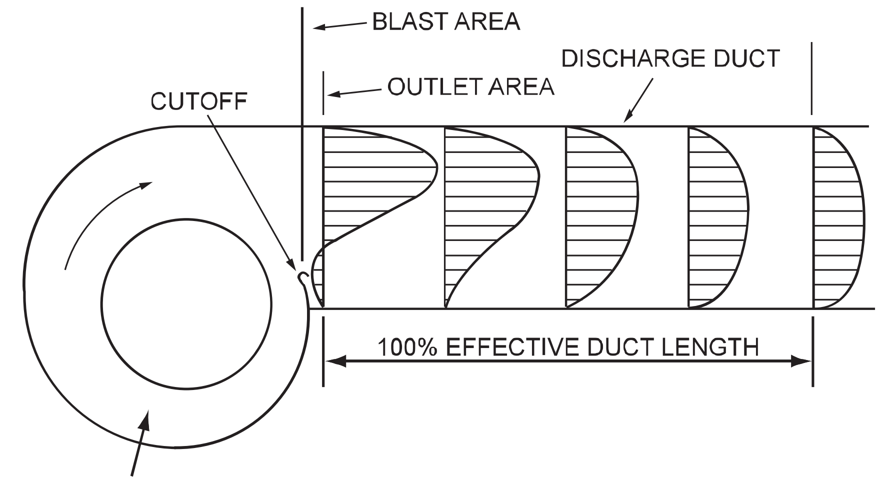
velocity as it approaches the larger area, and a portion of the change (reduction) in velocity pressure is converted into static pressure. This process is called "static regain", and is simply defined as the conversion of velocity pressure to static pressure. The efficiency of conversion (or loss of total pressure) will depend upon the angle of expansion, the length of the evasé section, and the blast area/outlet area ratio of the fan.

The fan manufacturer will, in most cases, be able to provide design information for an efficient diffuser.

See AMCA Publication 200 *Air Systems*, for an example showing the effect of a diffuser on a duct exit.

### 8.3 Outlet duct elbows

Values for pressure losses through elbows, which are published in handbooks and textbooks, are based upon a uniform velocity profile at entry into the elbow. Any non-uniformity in the velocity profile ahead of the elbow will result in a pressure loss greater than the industry-accepted value.




To calculate 100% duct length, assume a minimum of 2½ duct diameters for 2500 fpm or less. Add 1 duct diameter for each additional 1000 fpm.

EXAMPLE: 5000 fpm = 5 equivalent duct diameters. If the duct is rectangular with side dimensions *a* and *b*, the equivalent duct diameter is equal to $(4ab/\pi)^{0.5}$.

| | No Duct | 12% Effective Duct | 25% Effective Duct | 50% Effective Duct | 100% Effective Duct |
|---|---|---|---|---|---|
| Pressure Recovery | 0% | 50% | 80% | 90% | 100% |
| *Blast Area / Outlet Area* | System Effect Curve | | | | |
| 0.4 | P | R-S | U | W | — |
| 0.5 | P | R-S | U | W | — |
| 0.6 | R-S | S-T | U-V | W-X | — |
| 0.7 | S | U | W-X | — | — |
| 0.8 | T-U | V-W | X | — | — |
| 0.9 | V-W | W-X | — | — | — |
| 1.0 | — | — | — | — | — |

Determine *SEF* by using Figure 7.1

**Figure 8.3 - System Effect Curves for Outlet Ducts - Centrifugal Fans**

## 8.4 Turning vanes

Turning vanes will usually reduce the pressure loss through an elbow, however, where a non-uniform approach velocity profile exists, such as at a fan outlet, the vanes may serve to continue the non-uniform profile beyond the elbow. This may result in increased losses in other system components downstream of the elbow.

## 8.5 Volume control dampers

Volume control dampers are manufactured with either "opposed" blades or "parallel" blades. When partially closed, the parallel bladed damper diverts the airstream to the side of the duct. This results in a non-uniform velocity profile beyond the damper and airflow to branch ducts close to the downstream side may be seriously affected.

The use of an opposed blade damper is recommended when air volume control is required at the fan outlet and there are other system components, such as coils or branch takeoffs downstream of the fan. When the fan discharges into a large plenum or to free space a parallel blade damper may be satisfactory.

For a centrifugal fan, best air performance will usually be achieved by installing an opposed blade damper with its blades perpendicular to the fan shaft; however, other considerations, such as the need for thrust bearings, may require installation of the damper with its blades parallel to the fan shaft.

When a damper is required, it is often furnished as accessory equipment by the fan manufacturer (see Figure 8.6). In many systems, a volume control damper will be located in the ductwork at or near the fan outlet.

Published pressure drops for wide-open control dampers are based on uniform approach velocity profiles. When a damper is installed close to the outlet of a fan the approach velocity profile is non-uniform and much higher pressure losses through the damper can result. Figure 8.7 lists multipliers that should be applied to the damper manufacturer's catalog pressure drop when the damper is installed at the outlet of a centrifugal fan. These multipliers should be applied to all types of fan outlet dampers.

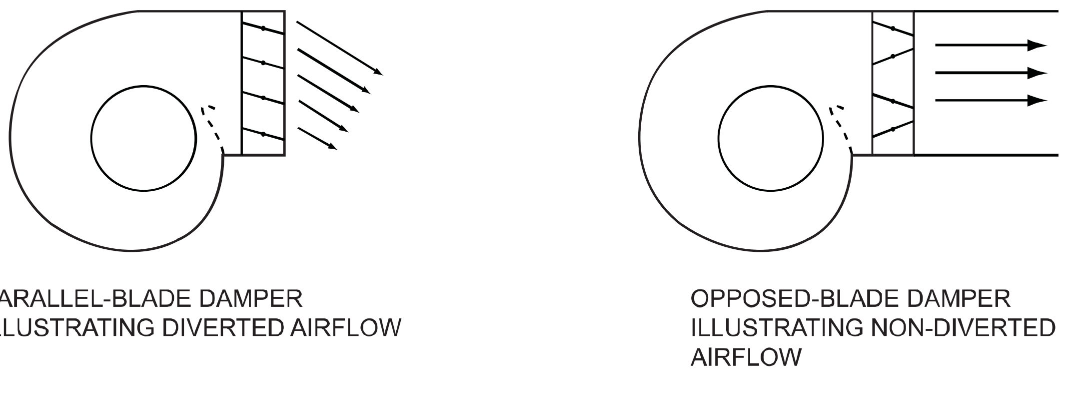
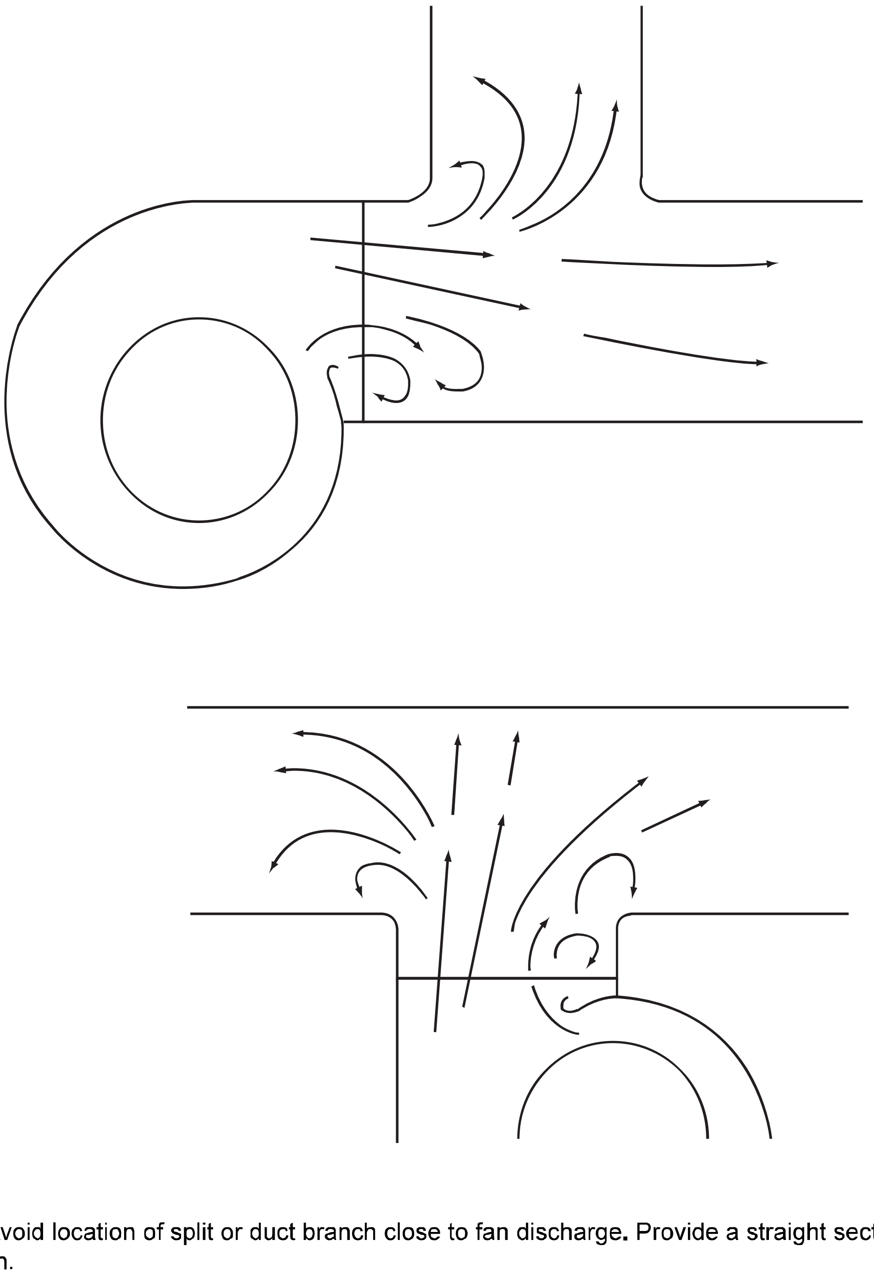



**Figure 8.6 - Parallel Blade vs. Opposed Blade Damper**

### 8.6 Duct branches

Standard procedures for the design of duct systems are based on the assumption of uniform airflow profiles in the system.

In Figure 8.8 branch takeoffs or splits are located close to the fan outlet. Non-uniform airflow conditions will exist and pressure loss and airflow may vary widely from the design intent. Wherever possible a length of straight duct should be installed between the fan outlet and any split or branch takeoff.



**Note**: Avoid location of split or duct branch close to fan discharge. Provide a straight section of duct to allow for air diffusion.

**Figure 8.8 - Branches Located Too Close to Fan**

## 9. Inlet System Effect Factors

Fan performance can be greatly affected by non-uniform or swirling inlet flow. Fan rating and catalog performance is typically obtained with unobstructed inlet flow. Any disruption to the inlet airflow will reduce a fan's performance. Restricted fan inlets located close to walls, obstructions or restrictions caused by a plenum or cabinet will also decrease the performance of a fan. The fan performance loss due to inlet airflow disruption must be considered as a System Effect.

### 9.1 Inlet ducts

Fans intended primarily for use as "exhausters" may be tested with an inlet duct in place, or with a special bell-mouthed inlet to simulate the effect of a duct. Figure 9.1 illustrates variations in inlet airflow that will occur. The ducted inlet condition is shown as (a), and the effect of the bell-mouth inlet as (b).

Fans that do not have smooth entries (c), and are installed without ducts, exhibit airflow characteristics similar to a sharp edged orifice that develops a *vena contracta*. A reduction in airflow area is caused by the *vena contracta* and the following rapid expansion causes a loss that should be considered as a System Effect.

If it is not practical to include such a smooth entry, a converging taper (d) will substantially diminish the loss of energy, or even a flat flange (e) on the end of the duct or fan will reduce the loss to about one half of the loss through an un-flanged entry.

ANSI/AMCA 210 limits an inlet duct to a cross-sectional area no greater than 112.5% or less than 92.5% of the fan inlet area. The slope of transition elements is limited to 15° converging and 7° diverging.

### 9.2 Inlet duct elbows

Non-uniform airflow into a fan inlet is a common cause of deficient fan performance. An elbow located at, or in close proximity to the fan inlet will not allow the air to enter the impeller uniformly. The result is less than cataloged air performance.

A word of caution is required with the use of inlet elbows in close proximity to fan inlets. Other than the incurred *System Effect Factor*, instability in fan operation may occur as evidenced by an increase in pressure fluctuations and sound power level. Fan instability, for any reason, may result in serious structural damage to the fan. Axial fan instabilities were experienced in some configurations tested with inlet elbows in close proximity to the fan inlet. Pressure fluctuations approached ten (10) times the magnitude of fluctuations of the same fan with good inlet and outlet conditions. **It is strongly advised that inlet elbows be installed a minimum of three (3) diameters away from any axial or centrifugal fan inlet**.

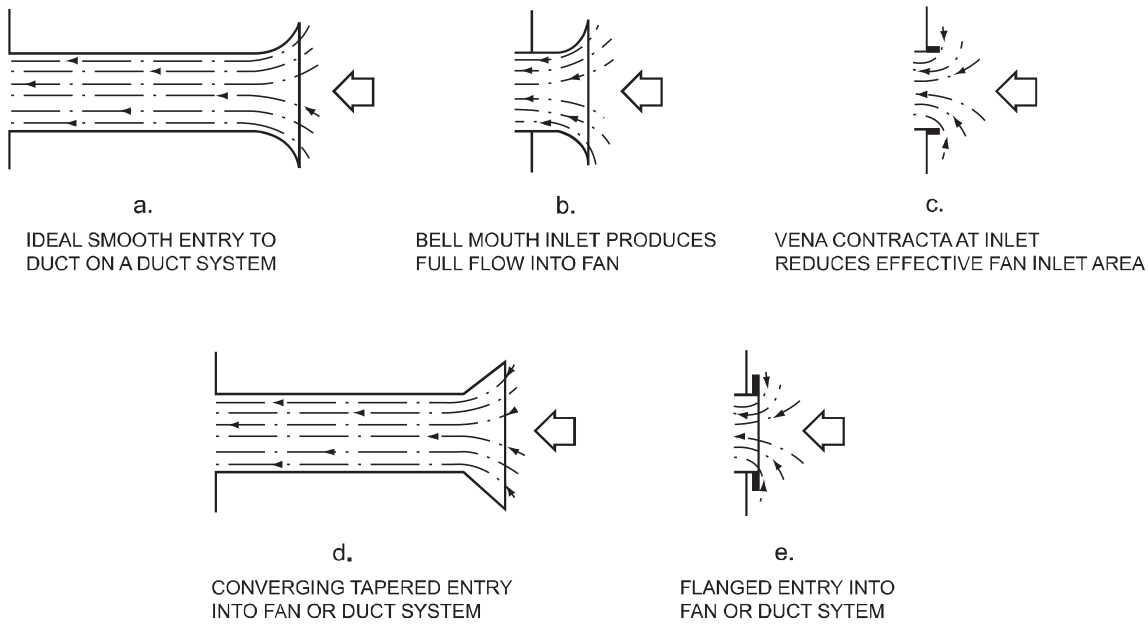
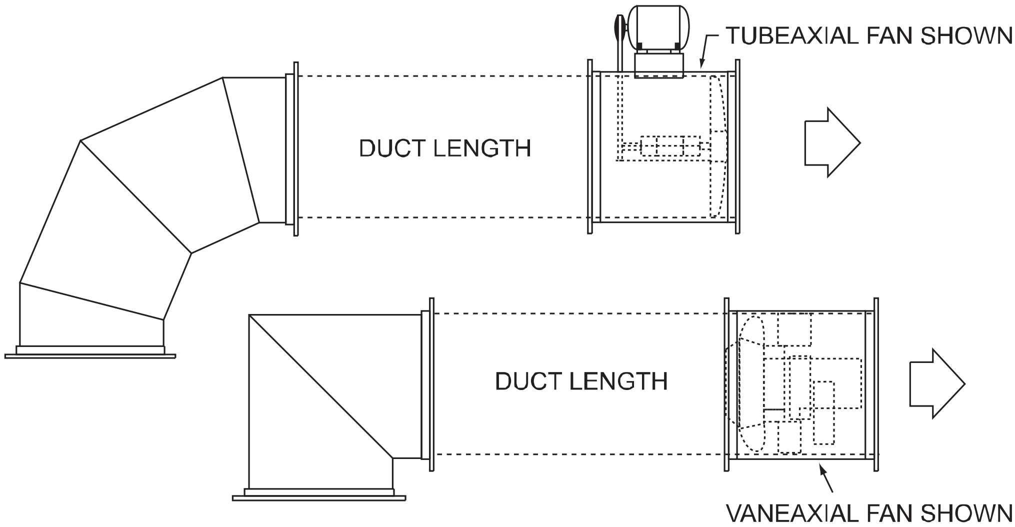



**Figure 9.1 Typical Inlet Connections for Centrifugal and Axial Fans**

**9.2.1 Axial fans - inlet duct elbows.** The System Effect Curves shown in Figure 9.2 for tubeaxial and vaneaxial fans are the result of tests run with two and four piece mitered inlet elbows at or in close proximity to the fan inlets. Other variables tested included hub-to-tip (H/T) ratio and blade solidity. The number of blades did not have a significant affect on the inlet elbow *SEF*.

**9.2.2 Centrifugal fans - inlet duct elbows**. Non-uniform airflow into a fan inlet, Figure 9.3A, is a common cause of deficient fan performance. The System Effect Curves for mitered 90° round section elbows of given radius/diameter (*R*/*D*) ratios are listed on Figure 9.4, and the System Effect Curves for various square duct elbows of given radius/diameter ratios are listed on Figure 9.5. The *SEF* for a particular elbow is found in Figure 7.1 at the intersection of the average fan inlet velocity and the tabulated System Effect Curve.

This pressure loss should be added to the friction and dynamic losses already determined for the particular elbow. Note that when duct turning vanes and/or a suitable length of duct is used (three to eight diameters long, depending on velocities) between the fan inlet and the elbow, the *SEF* is not as great. These improvements help maintain uniform airflow




| | H/T | 90° Elbow | No Duct [1][2] | 0.5*D* [1][2] | 1.0*D* [1][2] | 3.0*D* |
|---|---|---|---|---|---|---|
| Tubeaxial Fan | .25 | 2 piece | U | V | W | --- |
| Tubeaxial Fan | .25 | 4 piece | X | --- | --- | --- |
| Tubeaxial Fan | .35 | 2 piece | V | W | X | |
| Vaneaxial Fan | .61 | 2 piece | Q-R | Q-R | S-T | T-U |
| Vaneaxial Fan | .61 | 4 piece | W | W-X | --- | --- |

**Notes**:

[1] Instability in fan operation may occur as evidenced by an increase in pressure fluctuations and sound level. Fan instability, for any reason, may result in serious structural damage to the fan.

[2] The data presented in Figure 9.2 is representative of commercial type tubeaxial and vaneaxial fans, i.e. 60% to 70% fan static efficiency.

**Figure 9.2 - System Effect Curves for Inlet Duct Elbows - Axial Fans**

into the fan inlet and thereby approach the airflow conditions of the laboratory test setup.

Occasionally, where space is limited, the inlet duct will be mounted directly to the fan inlet as shown on Figure 9.3B. The many possible variations in the width and depth of a duct influence the reduction in performance to varying degrees and makes it impossible to establish reliable *SEF*. **Note: Capacity losses as high as 45% have been observed in poorly designed inlets such as in Figure 9.3B. This inlet condition should be AVOIDED**.

Existing installations can be improved with guide vanes or the conversion to square or mitered elbows with guide vanes, but a better alternative would be a specially designed inlet box similar to that shown in Figure 9.6.

**9.2.3 Inlet boxes.** Inlet boxes are added to centrifugal and axial fans instead of elbows in order to provide more predictable inlet conditions and to maintain stable fan performance. They may also be used to protect fan bearings from high temperature, or corrosive / erosive gases. The fan manufacturer should include the effect of any inlet box on the fan performance, and when evaluating a proposal it should be established that an appropriate loss has been incorporated in the fan rating. Should this information not be available from the manufacturer, refer to Section 10.4 for an approximate System Effect.

## 9.3 Inlet vortex (spin or swirl)

Another major cause of reduced performance is an inlet duct design or fan installation that produces a vortex or spin in the airstream entering a fan inlet. An example of this condition is illustrated in Figure 9.7.

An ideal inlet condition allows the air to enter uniformly without spin in either direction. A spin in the same direction as the impeller rotation (pre-rotation) reduces the pressure- volume curve by an amount dependent upon the intensity of the vortex. The effect is similar to the change in the pressure-volume curve achieved by variable inlet vanes installed in a fan inlet; the vanes induce a controlled spin in the direction of impeller rotation, reducing the airflow, pressure and power (see Section 10.6).

A counter-rotating vortex at the inlet may result in a slight increase in the pressure-volume curve but the power will increase substantially.

There are occasions, with counter-rotating swirl, when the loss of performance is accompanied by a surging airflow. In these cases, the surging may be more objectionable than the performance change. Inlet spin may arise from a great variety of approach conditions and sometimes the cause is not obvious.

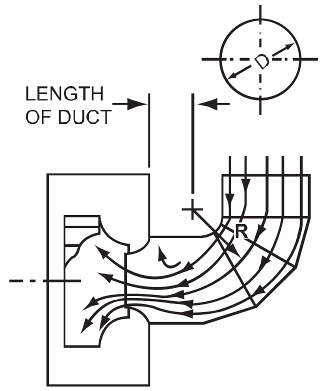



**Figure 9.3A - Non-Uniform Airflow Into a Fan Inlet Induced by a 90°, 3-Piece Section Elbow--No Turning Vanes**

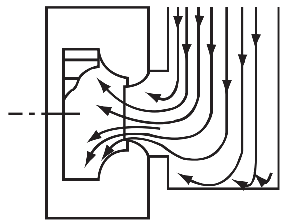
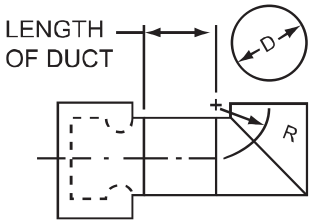


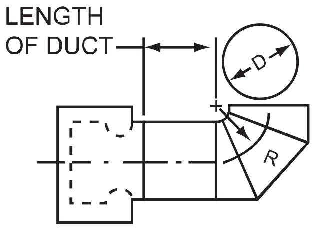
**Figure 9.3B - Non-Uniform Airflow Induced Into Fan Inlet by a Rectangular Inlet Duct**




**SYSTEM EFFECT CURVES**

| R/D | NO DUCT | 2D DUCT | 5D DUCT |
|---|---|---|---|
| — | N | P | R-S |

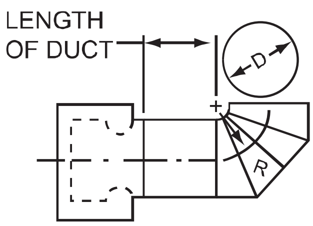
**Figure 9.4A - Two Piece Mitered 90° Round Section Elbow - Not Vaned**




**SYSTEM EFFECT CURVES**

| R/D | NO DUCT | 2D DUCT | 5D DUCT |
|---|---|---|---|
| 0.5 | O | Q | S |
| 0.75 | Q | R-S | T-U |
| 1.0 | R | S-T | U-V |
| 2.0 | R-S | T | U-V |
| 3.0 | S | T-U | V |

**Figure 9.4B - Three Piece Mitered 90° Round Section Elbow - Not Vaned**




**SYSTEM EFFECT CURVES**

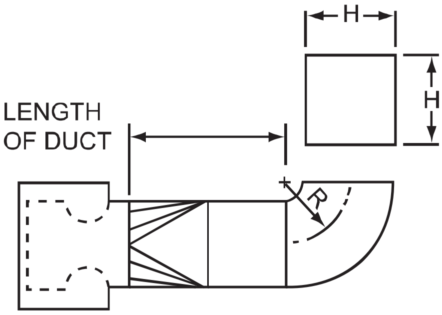
| R/D | NO DUCT | 2D DUCT | 5D DUCT |
|---|---|---|---|
| 0.5 | P-Q | R-S | T |
| 0.75 | Q-R | S | U |
| 1.0 | R | S-T | U-V |
| 2.0 | R-S | T | U-V |
| 3.0 | S-T | U | V-W |

**Figure 9.4C - Four or More Piece Mitered 90° Round Section Elbow - Not Vaned**

DETERMINE *SEF* BY USING FIGURE 7.1

**Figure 9.4 - System Effect Curves for Various Mitered Elbows without Turing Vanes**

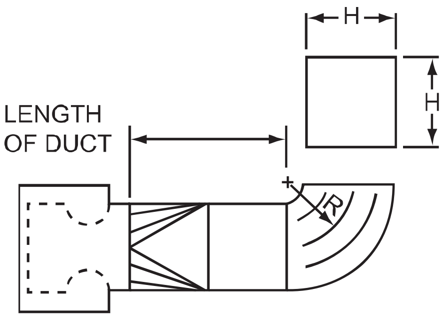
( )




**SYSTEM EFFECT CURVES**

| R/D | NO DUCT | 2D DUCT | 5D DUCT |
|---|---|---|---|
| 0.5 | O | Q | S |
| 0.75 | P | R | S-T |
| 1.0 | R | S-T | U-V |
| 1.0 | S | T-U | V |

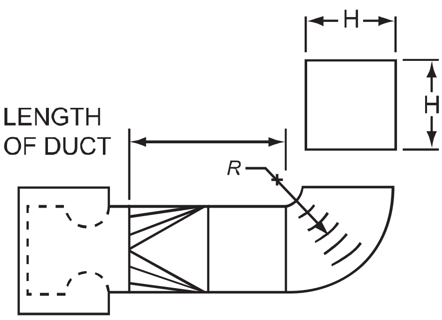
**Figure 9.5A - Square Elbow with Inlet Transition - No Turning Vanes**




**SYSTEM EFFECT CURVES**

| R/D | NO DUCT | 2D DUCT | 5D DUCT |
|---|---|---|---|
| 0.5 | S | T-U | V |
| 1.0 | T | U-V | W |
| 2.0 | V | V-W | W-X |

**Figure 9.5B - Square Elbow with Inlet Transition - 3 Long Turning Vanes**




**SYSTEM EFFECT CURVES**

| R/D | NO DUCT | 2D DUCT | 5D DUCT |
|---|---|---|---|
| 0.5 | S | T-U | V |
| 1.0 | T | U-V | W |
| 2.0 | V | V-W | W-X |

**Figure 9.5C - Square Elbow with Inlet Transition - Short Turning Vanes**

*D* = Diameter of the inlet collar
The inside area of the square duct (H x H) should be equal to the inside area of the fan inlet collar.
* The maximum permissible angle of any converging element of the transition is 15°, and for a diverging element, 7°.

DETERMINE *SEF* BY USING FIGURE 7.1

**Figure 9.5 - System Effect Curves for Various Square Duct Elbows**

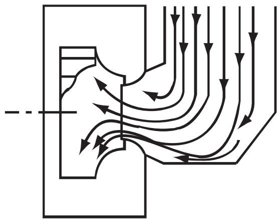
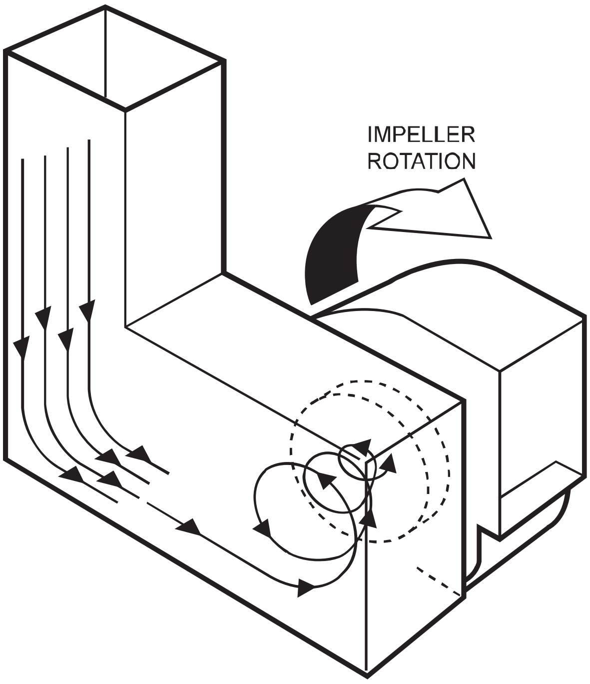
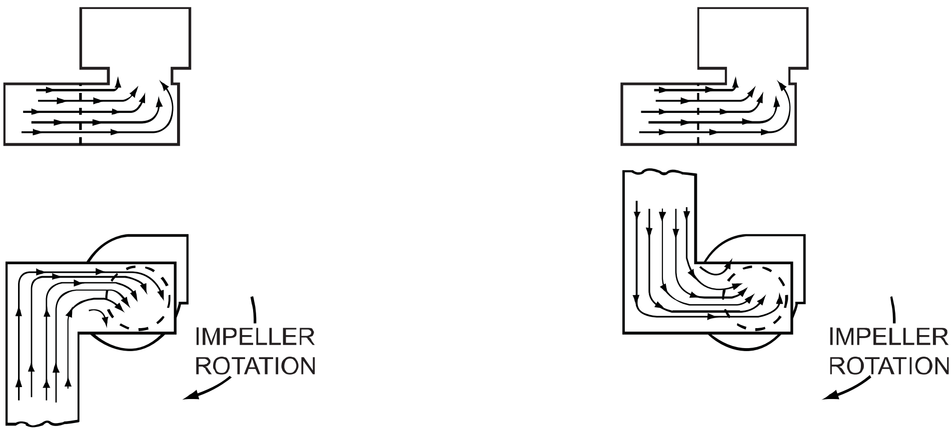


**Figure 9.6 - Improved Flow Conditions with a Special Designed Inlet Box**




COUNTER-ROTATING SWIRL

**Figure 9.7 - Example of a Forced Inlet Vortex**




PRE-ROTATING SWIRL

COUNTER-ROTATING SWIRL

**Figure 9.8 - Inlet Duct Connections Causing Inlet Spin**