DAIKIN

Application Manual

Rooftops

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Rooftops

Introduction

The rooftop unit is a packaged unit which capacity ranges from 6hp to 42hp.

Figure A is an illustration of the unit

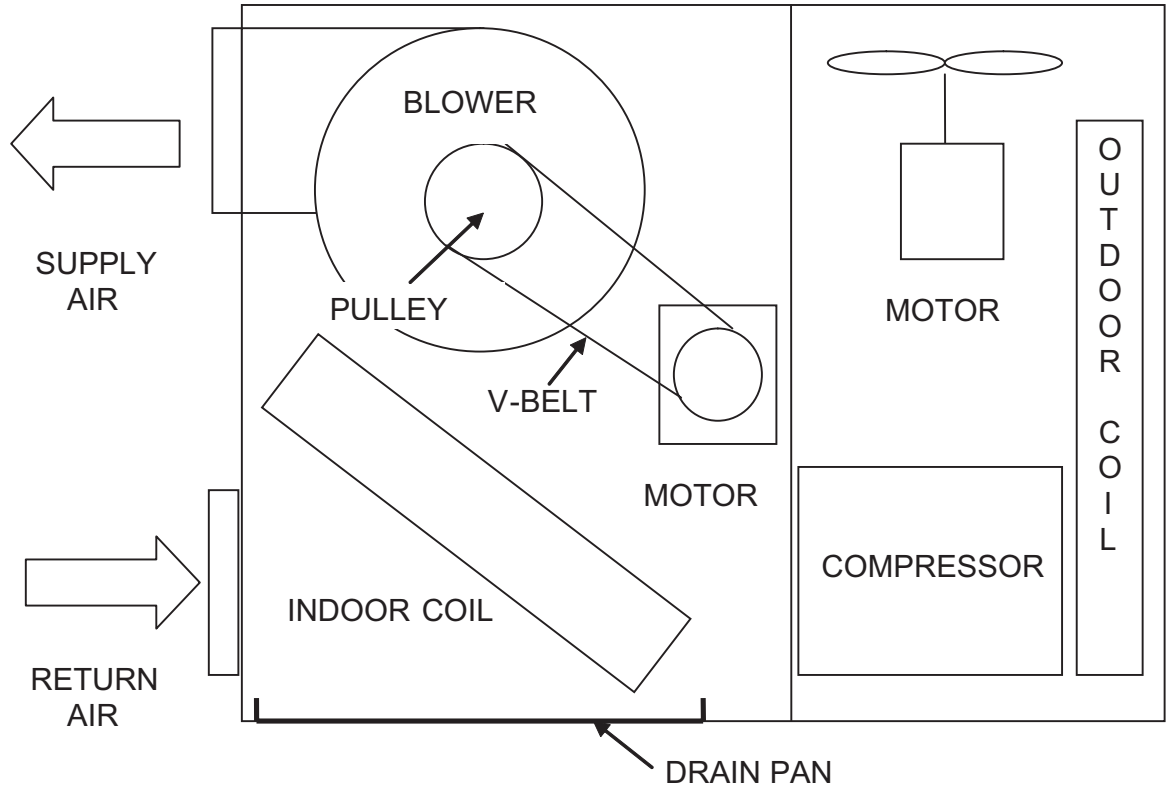


Figure A

The configuration of the unit is a draw-through operation, whereby air is drawn through the indoor coil into the blower inlet and discharged out.

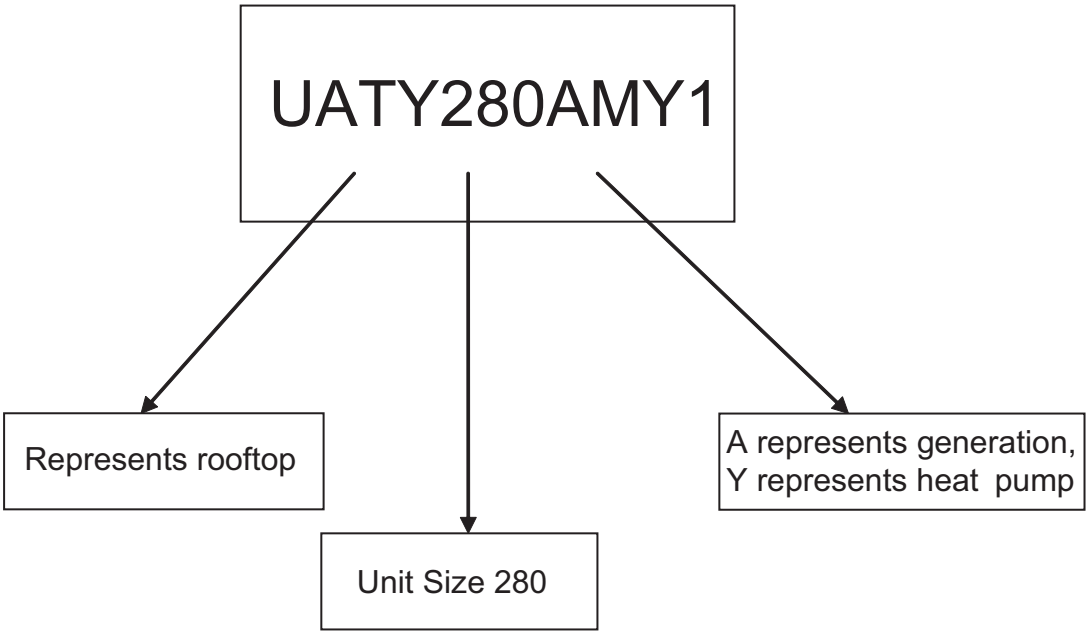
The rooftop units have external static pressure range from 0.4 inch wg to 1.4 in wg depending on the unit size.

The rooftop units can discharge air and draw return air from the front or down. Details will be covered in Chapter 1.

Rooftop units are placed on rooftops where the roof is flat. Air supply ducts are used to channel air to multiple zones and return air duct are used to return air to the unit. A branch-out duct from the air return duct is used for fresh air intake.

Nomenclature

The nomenclature of the rooftop unit are as follows:



UAT/TY180AMY1 to UAT/TY320AMY1 consist of one compressor while UAT/TY450AMY1 to UATC/TYC12AMY1 consist of two compressors. The two compressors' units allow for part loading of 0-50-100%

Scope of Manual

This manual covers the application aspect of the roof top unit and must be use in conjunction with the technical manual.

Chapter 1: Installation

In general there are several ways to install the roof top units. The roof tops units can be

1 cushioned by rubber pads and seated on a flat platform like concrete plinth or steel frame with air flow at the side or at the bottom of the unit.

2 seated on isolator springs mounted on concrete or steel structures with air flow at the side or at the bottom of the unit.

The methods of installation depend on several factors like cost, space, unit weight, unit centre of gravity and unit vibration.

The air ducts can be channeled through openings at the side of walls or openings on the roof surface like shafts or curbs. Refer Figure 1-1(a) to (d)

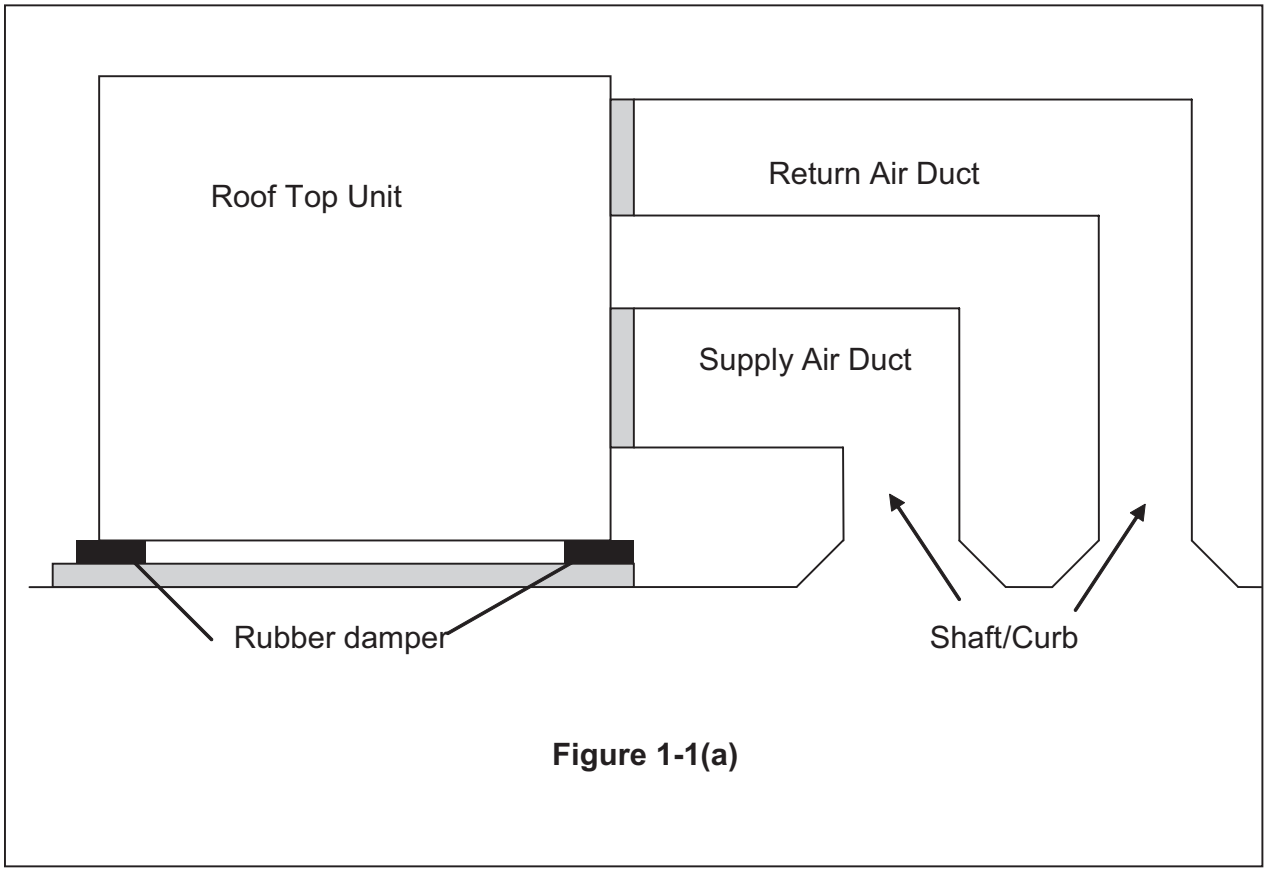


Figure 1-1(a)

Figure 1-1(a)

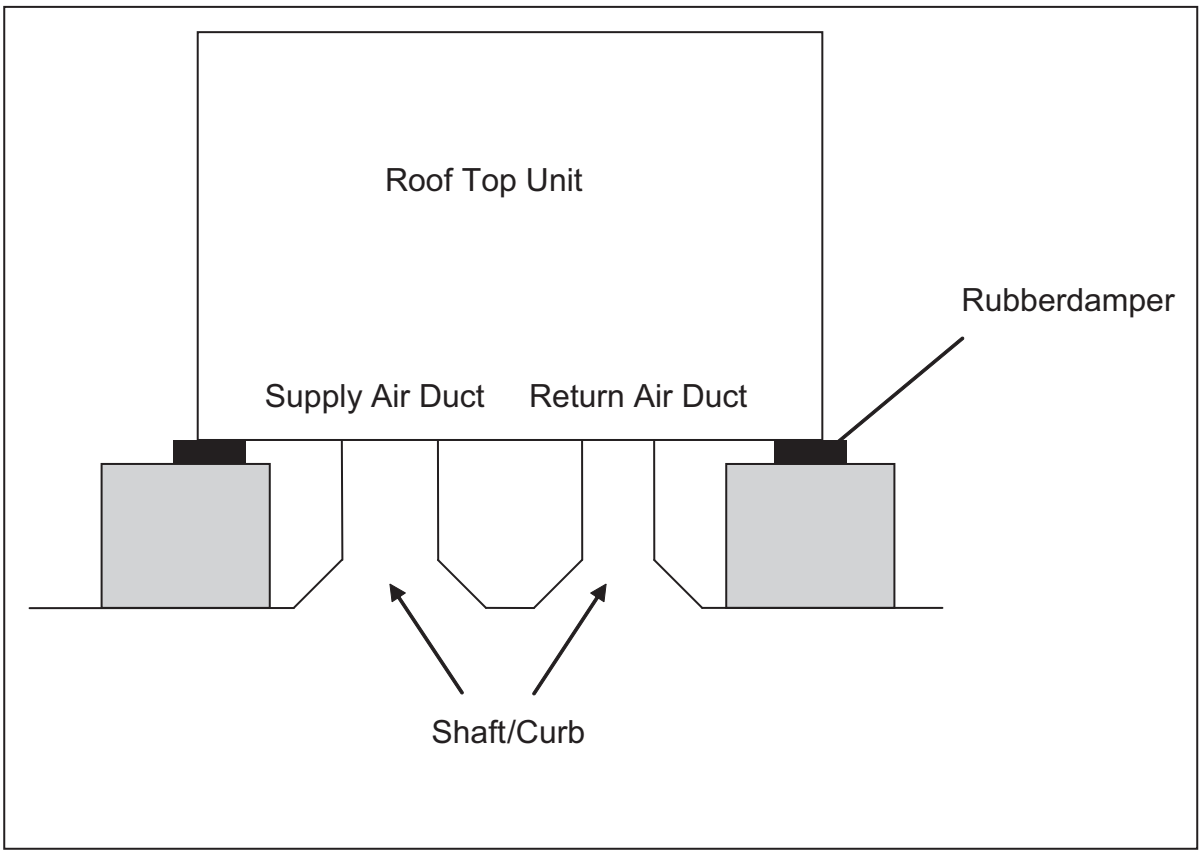


Figure 1-1(b)

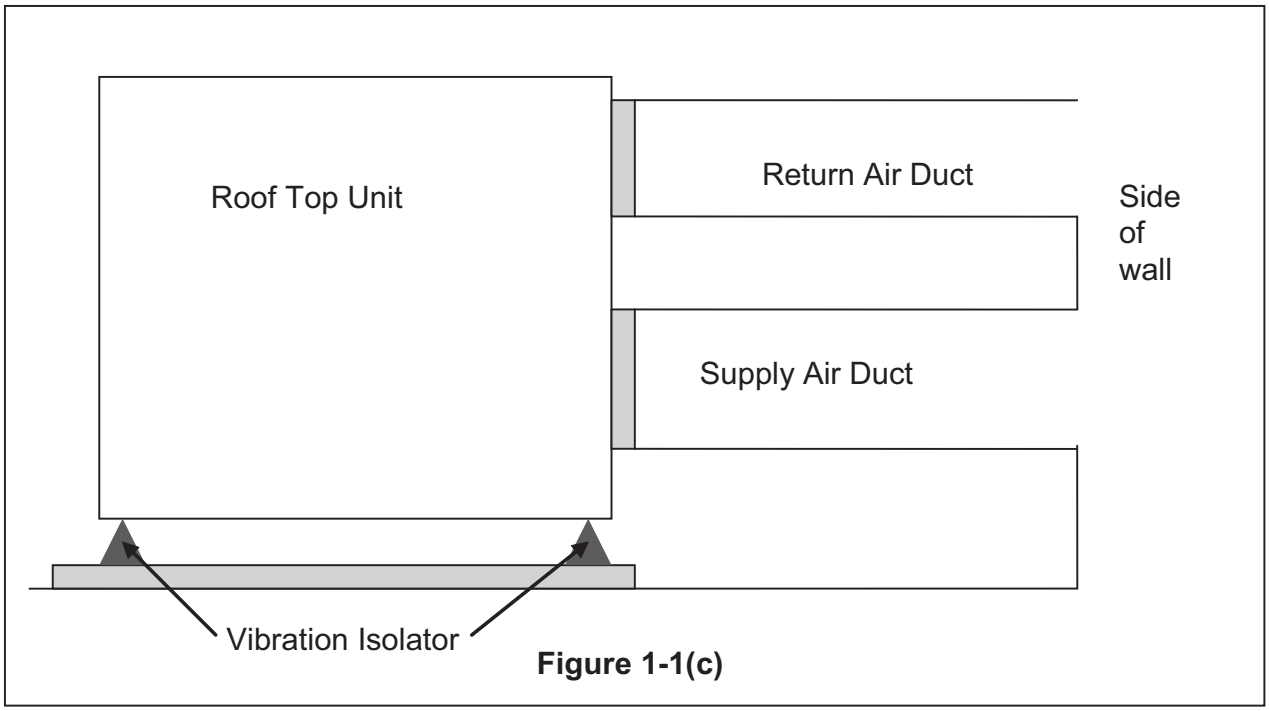


Figure 1-1(c)

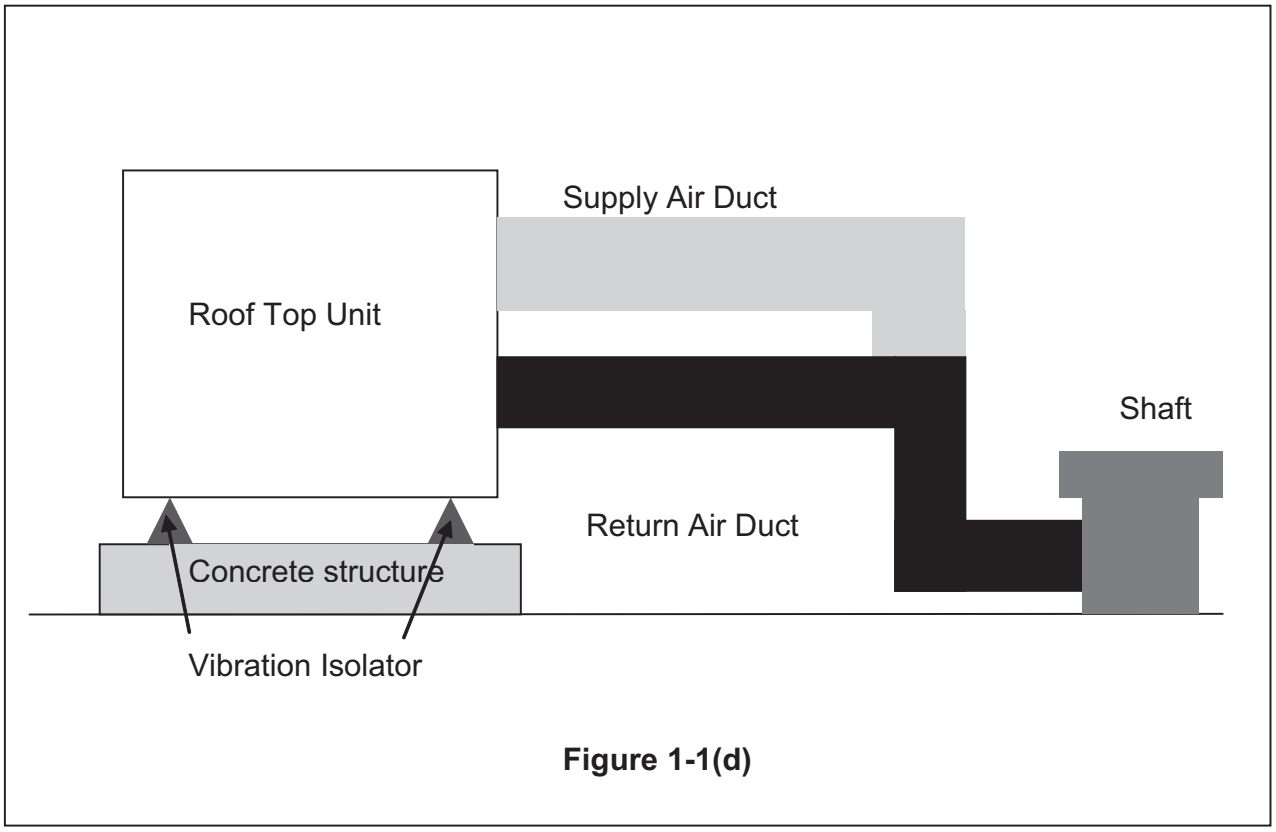
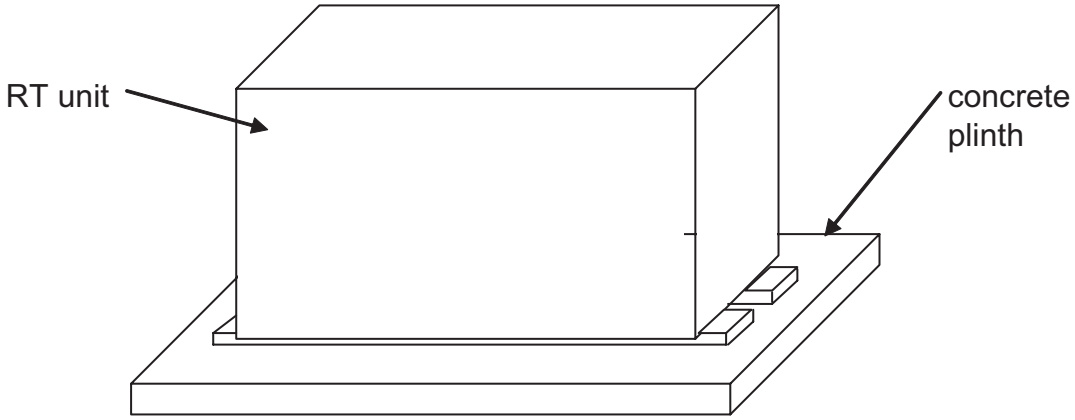


Figure 1-1(d)

Figure 1-1(d)

The first method of installation is the simplest and the cheapest. Roof top units are placed on a flat platform and cushioned with rubber pad underneath. The rubber pad acts as vibration absorber. For details on rubber pads refer to *Appendix 1*. If concrete slab are used as the platform, the concrete slab must have a footprint that is bigger than the unit to allow stability. The height should be at least 50mm or 2” to allow sufficient height for drain pipe installation. Refer **Figure 1-2(a) and (b)**



Figue 1-2(a)

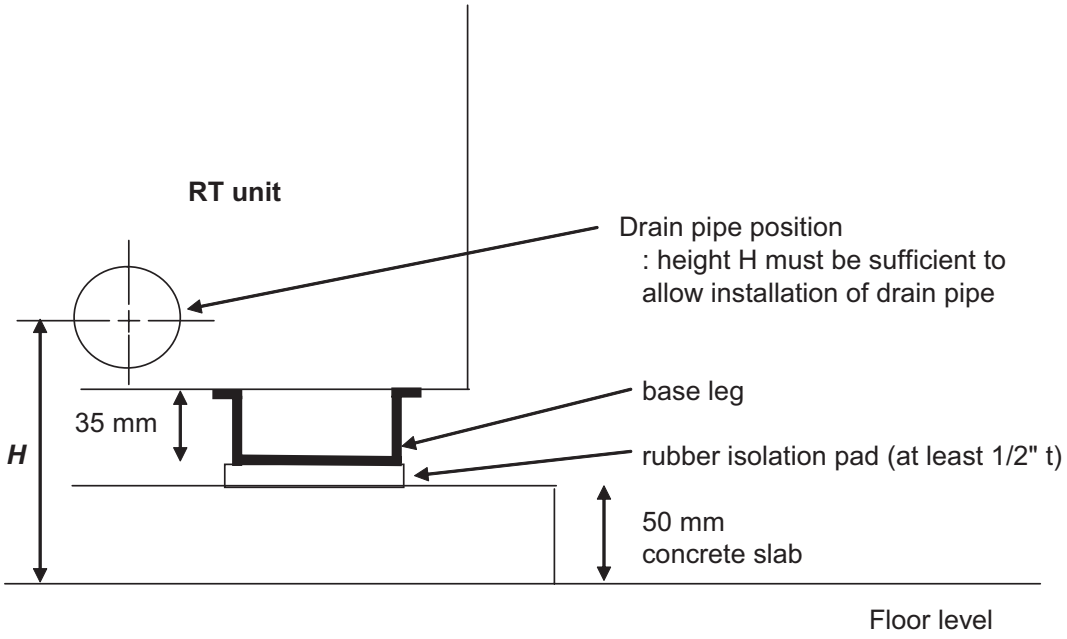


Figure 1-2(b)

For units which require low vibration level, isolator springs are used. The springs can be seated on concrete or steel structure mounted on the floor. Refer to **Figure 1-3** for details.

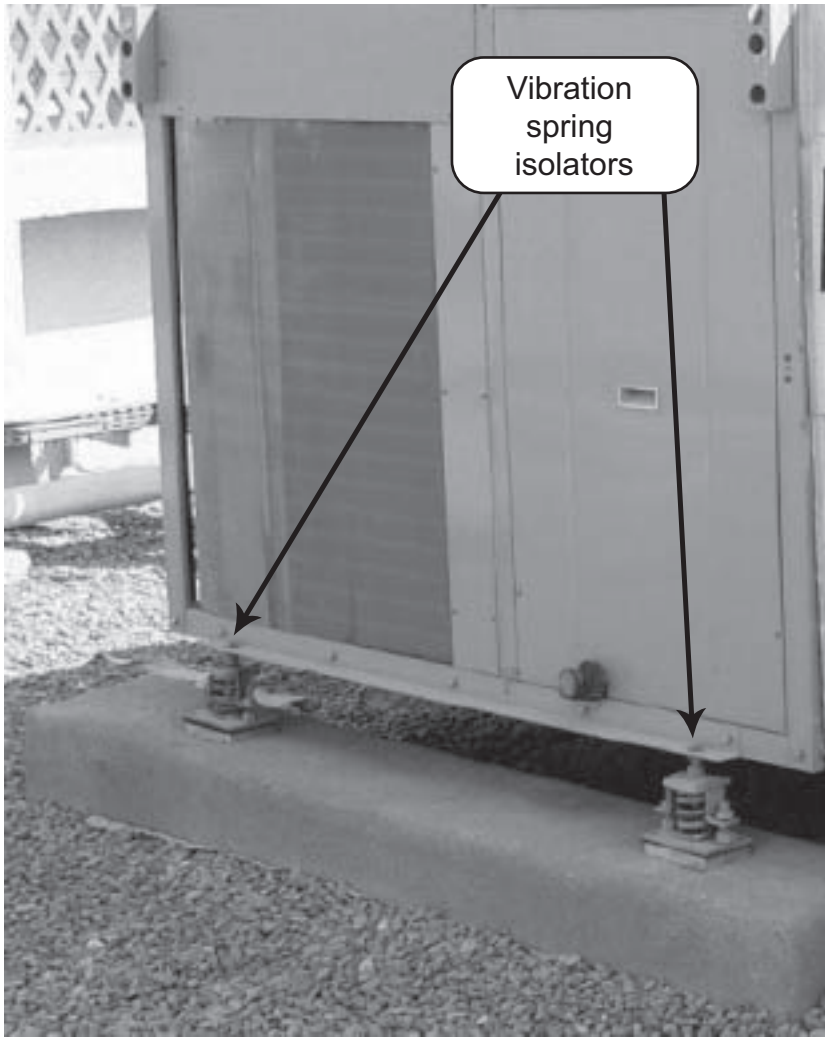


Figure 1-3

The down throw roof top units require ducting to be channeled downwards as shown in Figure 1-1(b)This method gives better aesthetic as less duct work is seen on the roof top.

Guidelines for Duct Penetration of Roof

1. Roof shaft or curb is made to specified size (Refer **Figure 1-4** for air supply and return flange dimension)
2. Join the connecting duct to the shaft or curb. Allow the connecting duct to extend between 3” to 4” below the top of the curb (Refer **Figure 1-5**) Sealant like gasket is placed between the duct and curb, and mastic are applied on all the joints to ensure water tight connection.
3. Curbs are furnished with wood nailer that provide a minimum 3-1/2” of nailing surface, mounted at the top of the curb, to permit mechanical attachment of the flashing material. Counter-flashings are made to ensure no air leak between connecting duct and curb. These counter-flashings are extended down over the base flashing to reduce the danger of foot abuse.

Model	Flange Supply Air Length x Width (mm)	Flange Return Air Length x Width (mm)
UATP/TYP180AMY1	540 x 230	668 x 412
UATP/TYP240/280/320AMY1	1020 x 230	1020 x 412
UATP/TYP450/560AMY1	1744 x 428	1744 x 428
UATP/TYP700/850AMY1	566 x 640	758 x 1302
UATPC/TYPC10/12AMY1	895 x 783	1642 x 660

Figure 1-4

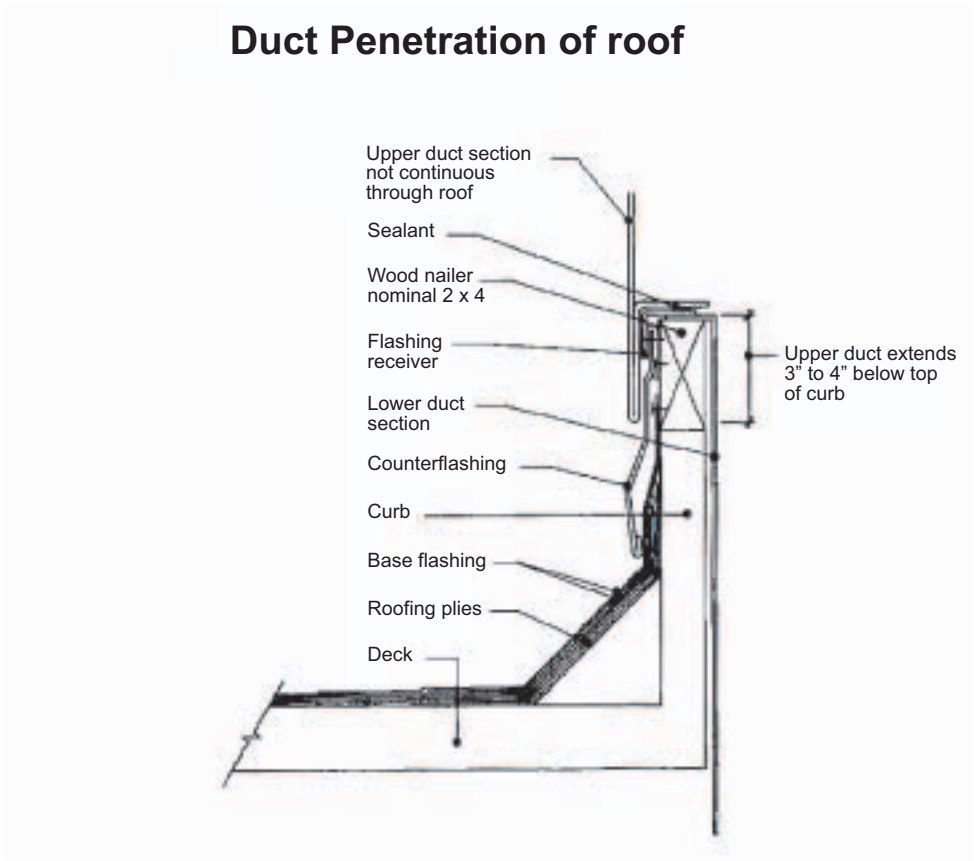


Figure 1-5

Spring Isolator

The spring isolator is selected based on the unit weight distribution at the four corners. The weights are calculated using moment of force. **Figure 1-6(a)** to **1-6(f)** shows the centre of gravity for each unit and the weight distribution at each corner

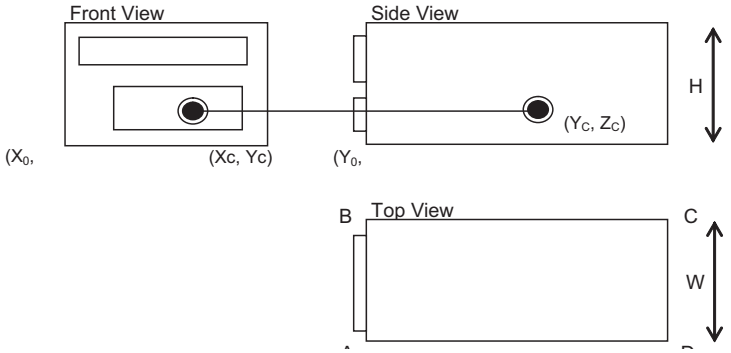


Figure 1-6(a)

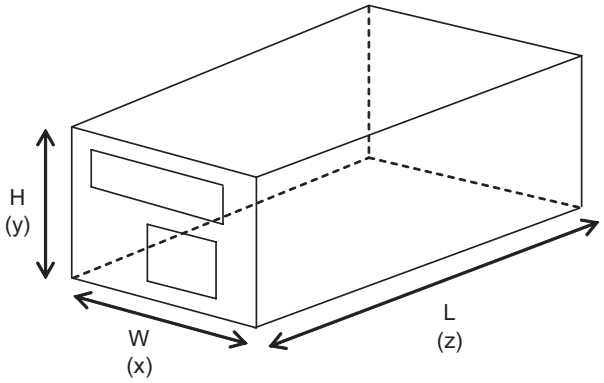


Figure 1-6(b)

Center of Gravity (mm)		UAT180A	UAT240A	UAT280A	UAT320A	UAT450A
	Xc	610.0	737.0	727.0	725.0	1012.0
	Yc	467.0	465.0	470.0	470.0	555.0
	Zc	870.0	810.0	830.0	835.0	871.0
Unit Dimension (mm)	W	1100.0	1300.0	1300.0	1300.0	1990.0
	H	1000.0	1000.0	1000.0	1000.0	1200.0
	L	1530.0	1530.0	1530.0	1530.0	1670.0

Figure 1-6(c)

Center of Gravity (mm)		UAT560A	UAT700A	UAT850A	UATC10A	UATC12A
	Xc	1022.0	1035.0	1090.0	1831.0	1831.0
	Yc	557.0	760.0	730.0	1170.0	1170.0
	Zc	880.0	1455.0	1525.0	766.0	766.0
Unit Dimension (mm)	W	1990.0	2200.0	2200.0	2250.0	2250.0
	H	1200.0	1735.0	1735.0	1974.0	1974.0
	L	1670.0	2800.0	2800.0	3100.0	3100.0

Figure 1-6(d)

4 Corner Weight Distribution (kg)		UAT180A	UAT240A	UAT280A	UAT320A	UAT450A
	A	70.6	98.7	102.3	107.7	161.8
	B	56.7	75.4	80.7	85.4	156.4
	C	93.0	111.1	121.3	129.4	176.4
	D	74.7	84.8	95.6	102.6	170.5
	Total	295.0	370.0	399.9	425.1	665.1

Figure 1-6(e)

4 Corner Weight Distribution (kg)		UAT560A	UAT700A	UAT850A	UATC10A	UATC12A
	A	185.9	271.2	304.6	314.5	314.5
	B	176.0	305.2	310.2	340.7	340.7
	C	207.0	293.4	364.3	453.5	453.5
	D	196.1	330.2	371.0	491.3	491.3
	Total	765.0	1200.0	1350.1	1600.0	1600.0

Figure 1-6(f)

Let us consider the following equation, whereas:

$F = mg + kx$ ..... **Equation 1-1**

F= weight distribution at each edge in $kgms^{-2}$

m= mass distribution at each edge in kg

g= gravitational constant in ms^{-2}

k= stiffness of spring kgs^{-2}

x= vertical displacement of spring / static deflection in m

Isolation is the amount of vibration energy prevented from being transmitted through the isolator. Isolators are usually specified by their static deflection x. Coil spring isolators are available in up to 3" static deflection. If more flexibility is needed, air springs are used. The normal isolation required are between 80% to 90%. For more critical application, isolation can go above 90%

The natural frequency of the system (assuming a single degree of freedom) can be calculated by:

$$f_n = \frac{1}{2\pi}\sqrt{\frac{k}{m}} = \frac{1}{2\pi}\sqrt{\frac{kg}{F}} = \frac{1}{2\pi}\sqrt{\frac{g}{x}} = 3.13\sqrt{\frac{1}{x}} \quad Hz$$ ..... **Equation 1-2(a)**

When a system is excited at its natural frequency, the system will be in resonance and the disturbance forces will be amplified rather than reduced. It is important that the right isolator be selected in order that the natural frequency be excited as little as possible. As a general guide, the natural frequency of the isolator must be 40% or less of the system natural frequency to avoid resonance. In other word, the natural frequency of the spring determines the efficiency of the isolator. Effective isolators have a low natural frequency.

Relations between the natural frequency of the system, f_n and the disturbing frequency f_d are as follows:

when $\frac{f_d}{f_n} \le \sqrt{2}$, T ≥ 1 amplification occurs ..... **Equation 1-3(a)**

when $\frac{f_d}{f_n} = \sqrt{2}$,T = 1 isolation begins ..... **Equation 1-3(b)**

when $\frac{f_d}{f_n} \ge \sqrt{2}$,T ≤ 1 isolation begins ..... **Equation 1-3(c)**

Where T is the transmissibility of the system.

Transmissibility is the amount of vibration energy which is transmitted from the vibrating source to the surrounding environment.

$$T = \sqrt{\frac{1+\left(2\frac{f_d}{f_n}\bullet\frac{C}{C_c}\right)^2}{\left(1-\frac{f_d^{\,2}}{f_n^{\,2}}\right)^2+\left(2\frac{f_d}{f_n}\bullet\frac{C}{C_C}\right)^2}}$$ ..... **Equation 1-3(d)**

For negligible damping, T becomes

$$T = \left|\frac{1}{1-\left(\frac{f_d}{f_n}\right)^2}\right|$$ ..... **Equation 1-3(e)**

When resonance occurs and T is at its max

$$T_{\max} = \frac{1}{2\frac{C}{C_C}}$$ ..... **Equation 1-3(f)**

Disturbing frequency is the frequency of the motion which needs to be isolated. Disturbing frequency f_d for rotating equipment like fan motor and compressor is usually equal to the rotating speed of the equipment expressed in revolutions per minute (RPM) or cycles per minute (CPM).

In practical there is more than one disturbing frequency but only the lowest frequency will be taken into account. Once the lowest frequency is isolated all the other higher frequencies will be isolated.
Rearrange Equation 1-3b we have,

$$f_n = \frac{f_d}{\sqrt{2}}$$ ..... **Equation 1-4**

If f_n is exceeded, the isolation system will not perform properly and amplification occurs. Isolators with f_n lower than the calculated value will provide isolation.

In order to determine the natural frequency that will provide the desired level of isolation, Equation 1-3e is used with a condition that f_d/f_n >1. This will give rise to.

$$f_n = \frac{f_d}{\sqrt{1+\frac{1}{T}}}$$ ..... **Equation 1-5**

Damping

The majority of isolators possess damping in varying degrees. Damping factor C/C_c for various materials is as shown in Appendix 2.
Damping is advantageous when the mounted system is operating at or near its natural frequency because it helps to reduce transmissibility.

$$Damping\ Factor = \frac{C}{C_C}$$ ..... **Equation 1-6**

Shock

Shock is a motion in which there is a sharp, nearly sudden change in velocity.
Shock transmission is shock transmitted to the object subjected to the shock.
This is defined as

$$G_T = \frac{V(2\pi f_n)}{386} = \frac{V(f_n)}{61.4}$$ ..... **Equation 1-7**

Where V represents an instantaneous velocity shock. The dynamic linear deflection of an isolator under shock can be determined by the following equation:

$$X_D = \frac{V}{2\pi f_n}$$ ..... **Equation 1-8**

Example 1

A rooftop unit runs on a compressor driven by a 1080 rpm motor. This unit causes vibration disturbance to the floor on which it is mounted. The weight of the unit is 400 pounds. There are four mounting points for the isolators. The required isolation is 80%.

1 Calculate f_n of isolator
F = 400 pounds
Weight per mounting point = 400/4 = 100 pounds
Isolation required = 80%
Transmissibility = 100% - Isolation% = 100%-80% = 20%
Disturbing frequency f_d = 1080 rpm = 18 rps

2 Calculate static deflection x of isolator

Using Equation 1-5

$$f_n = \frac{f_d}{\sqrt{1+\frac{1}{T}}} = \frac{18}{\sqrt{1+\frac{1}{0.2}}} = 7.35 \quad Hz$$

$$x = \frac{3.13^2}{f_n^{\,2}} = \frac{3.13^2}{7.35^2} = 0.18 \quad inch$$

3 Calculate the damping factor C/C_c to limit transmissibility at resonance to 10

$$\frac{C}{C_C} = \frac{1}{2T} = \frac{1}{2(10)} = 0.05$$

4 Use Appendix 2 to determine the resilient media which could be used in the isolator selected to provide the C/C_c required.
From *Appendix 2*, the natural rubber or neoprene can be selected.

Example 2

UAT700A is required to be installed in a villa. The requirement for installation is to use isolators. The outdoor fan rpm is 850, the compressor rpm is 1500 while the indoor fan rpm is 800rpm. Select the types of isolators required.
From Figure 1-6(d), the weights at the four corners A, B, C and D are 271.2kg (600lb), 305.2kg (673lb), 293.4kg (646lb) and 330.2kg (728lb).
The isolator efficiency for normal application is 80%. This gives us a transmissibility of 20%. The disturbing frequency f_d is 800 rpm or 13.3Hz (the equipment with the lowest rpm is considered).

From Equation 1-5 and 1-2(a),

$$Isolator\ Natural\ Frequency\ f_n = \frac{f_d}{\sqrt{1+\frac{1}{T}}} = \frac{13.3}{\sqrt{1+\frac{1}{0.2}}} = 5.5 \quad Hz$$

From Appendix 3-5, RSM-1-156 can be selected.
Calculate the deflection caused by the four corners using Equation 1-1 and Appendix 3-5
For 600lb the deflection is 0.67”, for 673lb the deflection is 0.75”, for 646lb the deflection is 0.72” while for 728lb the deflection is 0.80”.
Calculate the isolator frequency at these points using Equation 1-2(a)
For 600lb the frequency is 3.82Hz, for 673lb the frequency is 3.61Hz, for 646lb the frequency is 3.69Hz while for 728lb the frequency is 3.5Hz. These isolator values fall below the minimum isolator frequency which is 5.5Hz. Therefore this isolator can be used to isolate vibration caused by the roof top unit.

Considerations for Selection of Vibration Isolator

1 Install the roof top unit as far as possible from vibration sources and on rigid foundation.

2 Size isolator to correct stiffness and considerations must be taken for shock loads and during system startup or shutdown. Overloaded isolator may cause unit to transmit its vibration to the building structure and emit unnecessary noise. Check to ensure that isolator size has been sized correctly by calculating the static deflection. This is done by subtracting the loaded isolator height from the unloaded isolator height.

3 Isolator should be equally loaded and the roof top unit should be installed on level ground.

4 The diameter of the isolator spring should be greater than its compressed height and occupy a wide footprint for stability.

5 Isolator should not be fully compressed and must not have any obstruction to its movement

For more details on vibration isolators refer to *Appendix 3*.

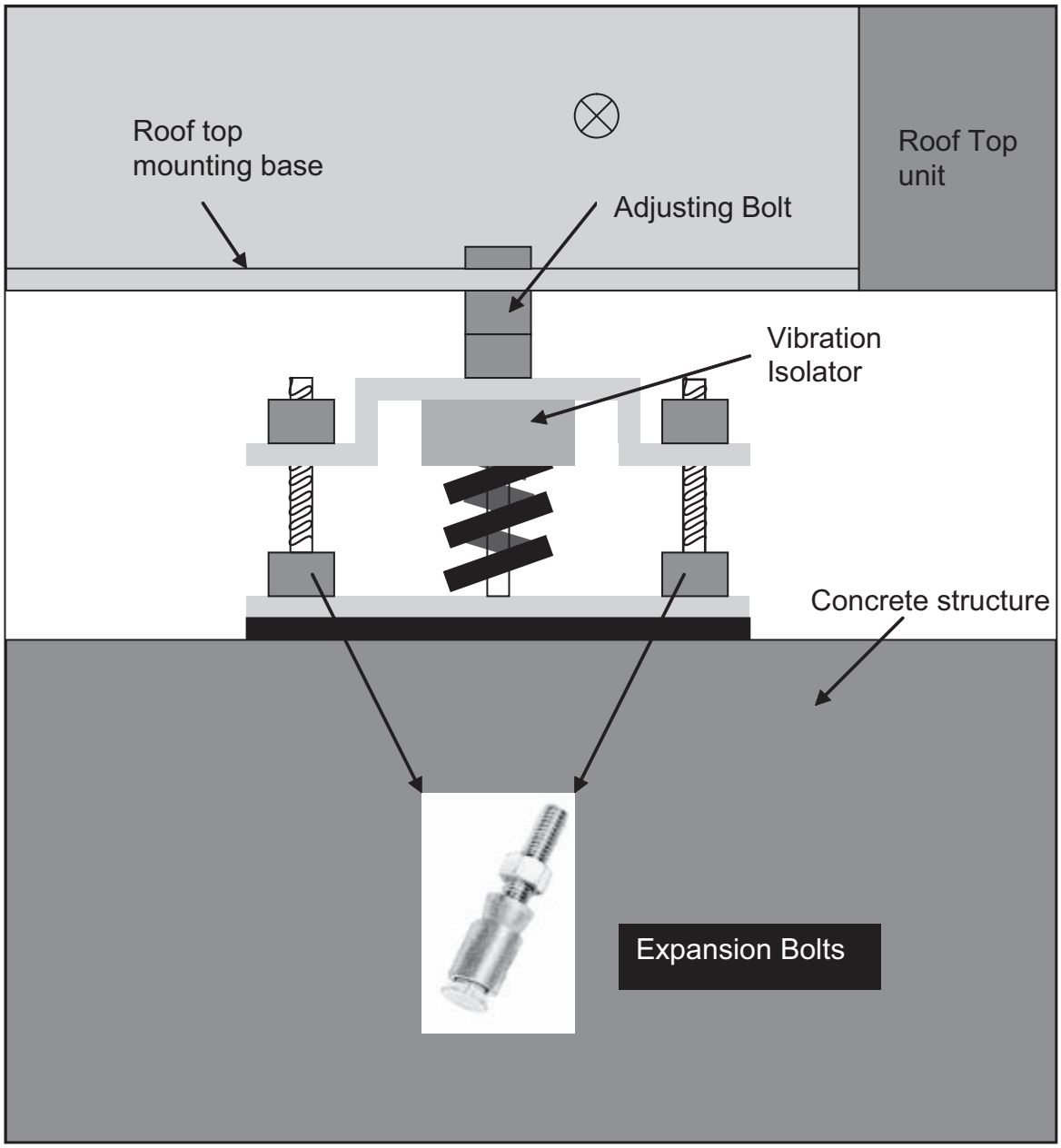
Installation of Vibration Isolator

1 Determine the position to install the vibration isolators. Refer to *Appendix 4* for base mounting holes position.

2 Position the vibration isolators on a level surface. Mark the positions of the mounting holes on the isolator mounting bracket. Drill a hole into the mark position and insert expansion bolt. Screw the threaded part of the bolt into the hole. The bolt will begin to expand and grip the ground or concrete floor.

3 Tighten the nut to the mounting bracket. Refer to **Figure 1-7**

4 After the roof top unit is mounted on the isolators, the unit can be leveled by adjusting the isolator bolt



Unit Lifting

Every roof top unit has a centre of gravity point. This point is as shown in Figure 1-6(c)-(d). Before lifting the unit, mark this point on the unit top.

When the roof top unit is lifted and moved, attach ropes to the hoisting hangers (4pieces) provided on the top corners of the unit. When the unit is lifted, the unit will shift to one side. To prevent this align the hook to the point marked on the unit as close as possible.

Be careful not to stand below or beside the unit during the unit lifting.

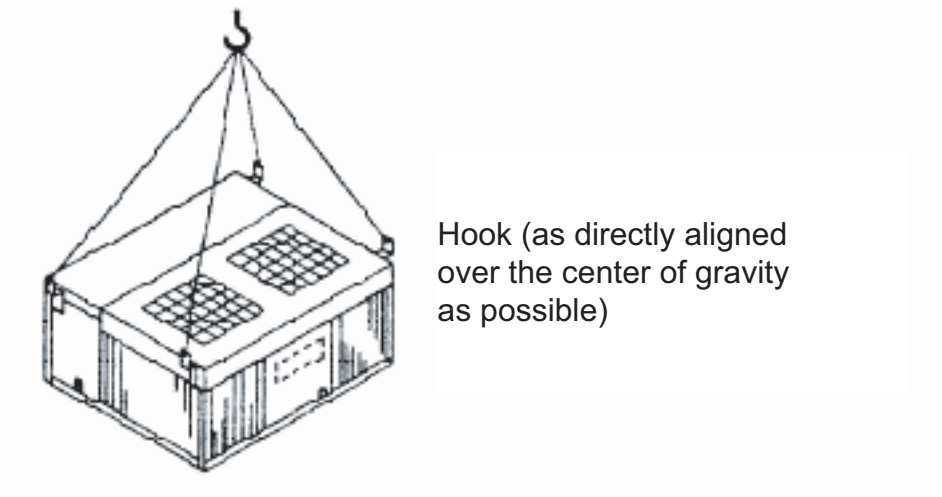


Figure 1-8: Method of balance and unit lifting.

Space Required Around Roof Top Unit

It is important to ensure that air surrounding the roof top is easily circulated. This will prevent the air-conditioning unit from tripping owing to high discharge pressure. Besides that there must be sufficient working space for service personnel. Figure 1-9(a) to 1-9(c) shows the minimum distance required between the roof top unit and barrier such as walls, awnings and etc.

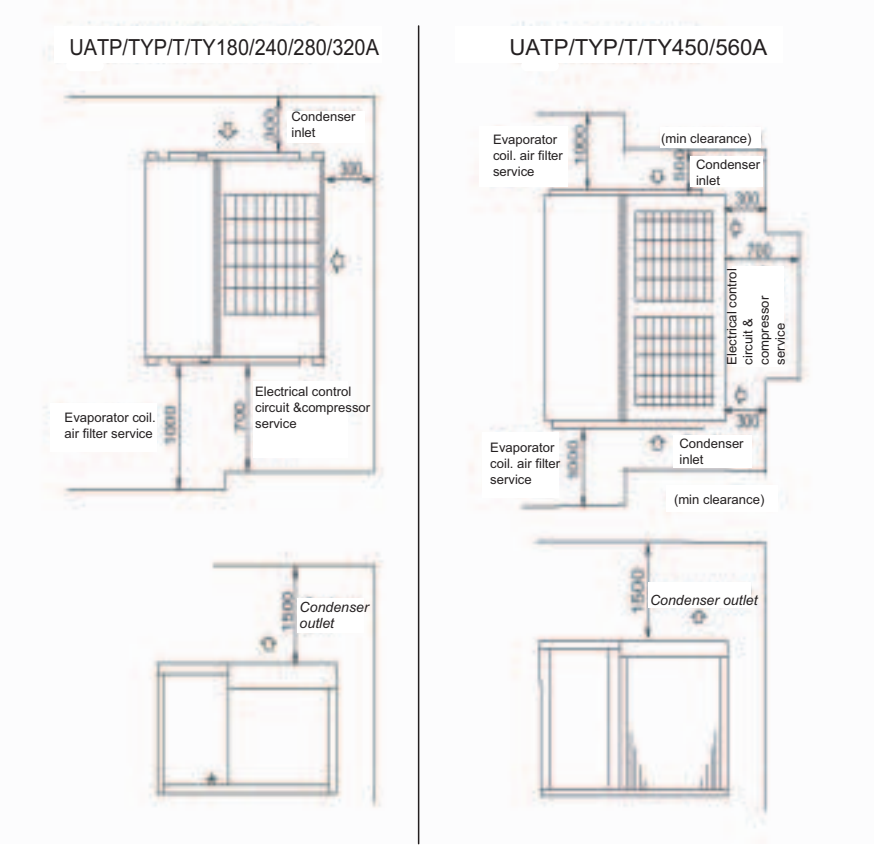


Figure 1-9(a)

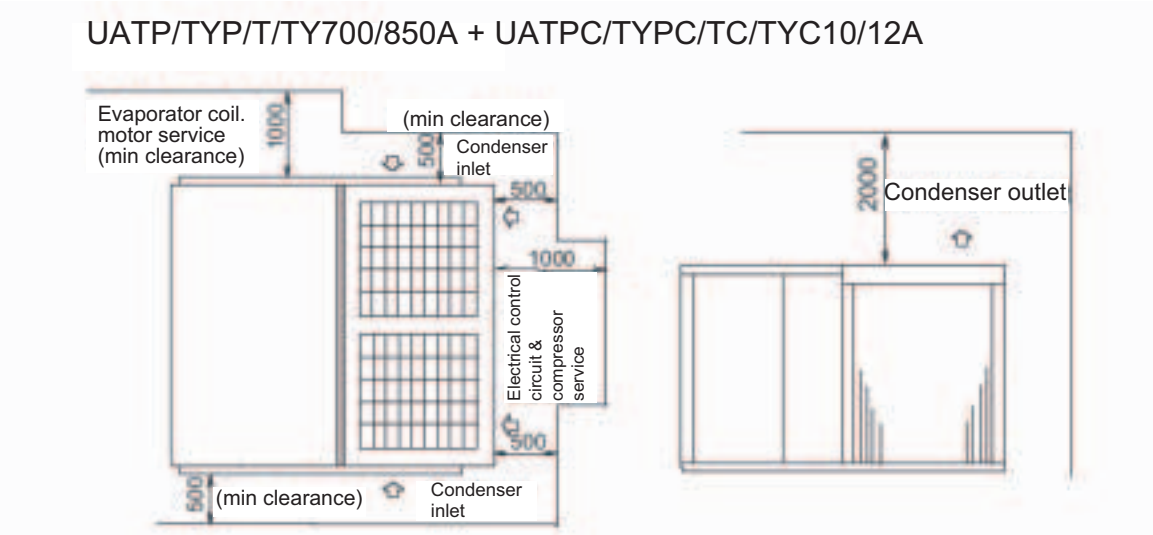


Figure 1-9(b)

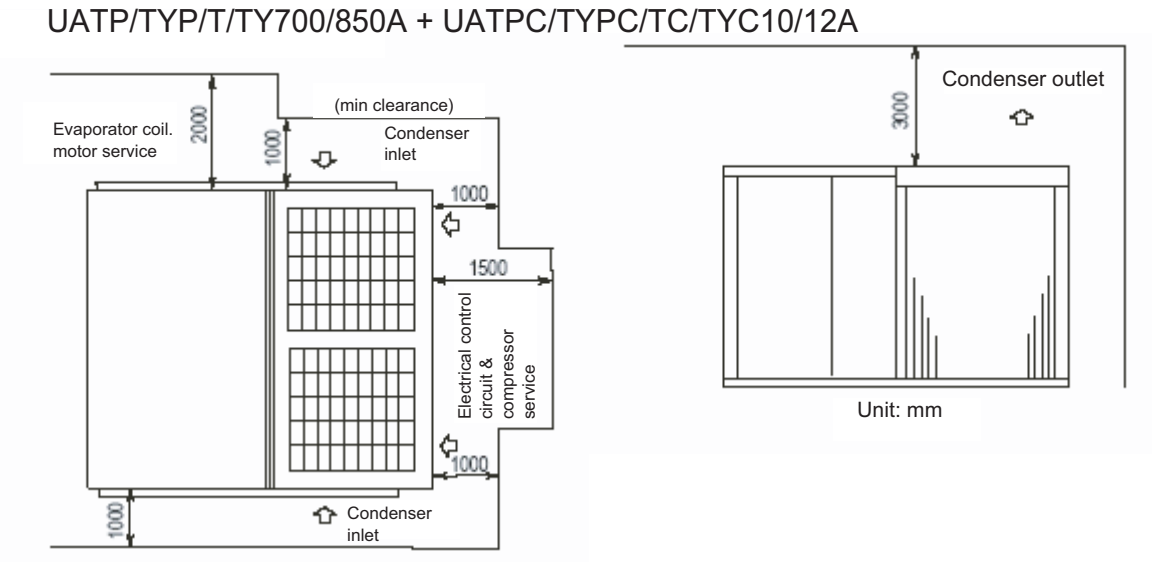


Figure 1-9(c)

When locating the rooftop unit, it is important to consider the following:

a Do not install the duct facing an obstacle or obstruction. This will reduce the flow rate from the unit and reduce the unit performance. This will also cause wastage of energy.

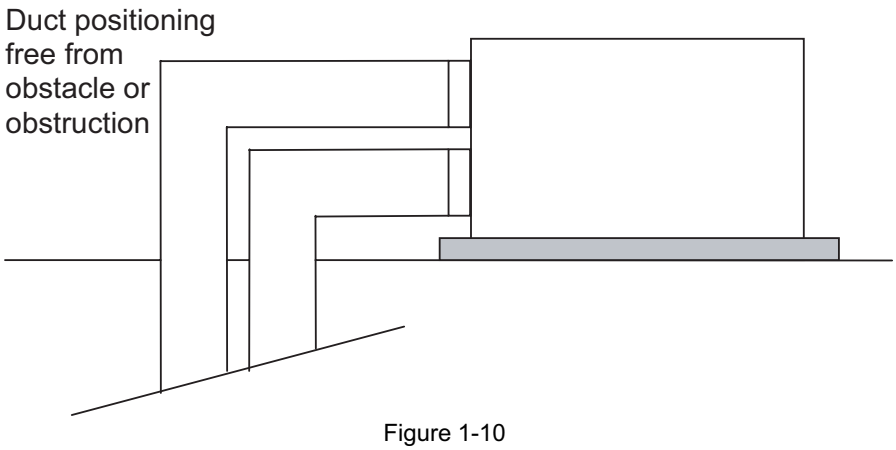


Figure 1-10

Duct Construction

All roof top units supply and return air direction are summarized in Figure 1-11

Model	Supply Air	Return Air
UATP/TYP/T/TY180A	Side Throw	Side Throw
UATP/TYP/T/TY240A to UATP/TYP/T/TY560A	Side Throw Convertible	Side Throw Convertible
UATP/TYP/T/TY700A to UATP/TYP/T/TY850A	Side Throw	Side Throw
UATP/TYP/T/TY700A to UATPC/TYPC/TC/TYC12A	Side Throw	Side Throw

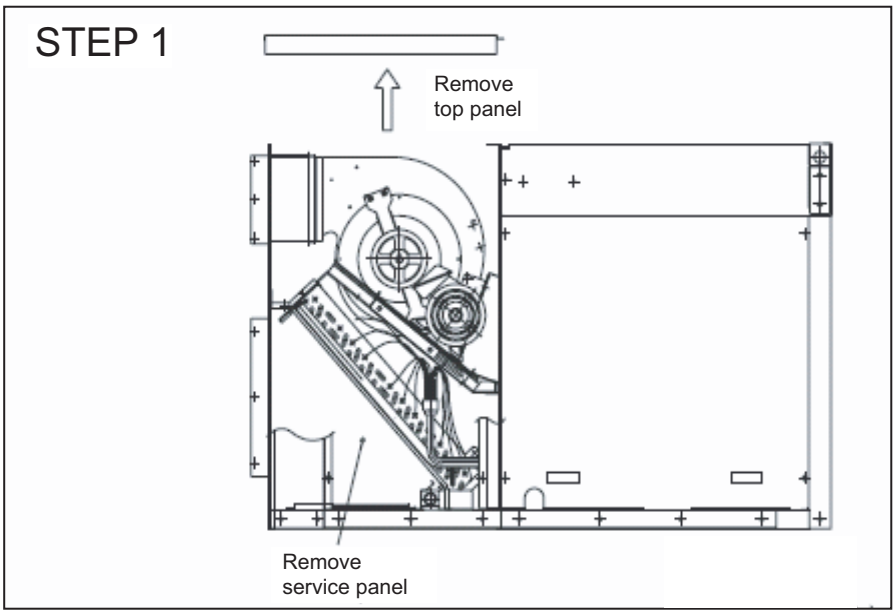
Figure 1-11

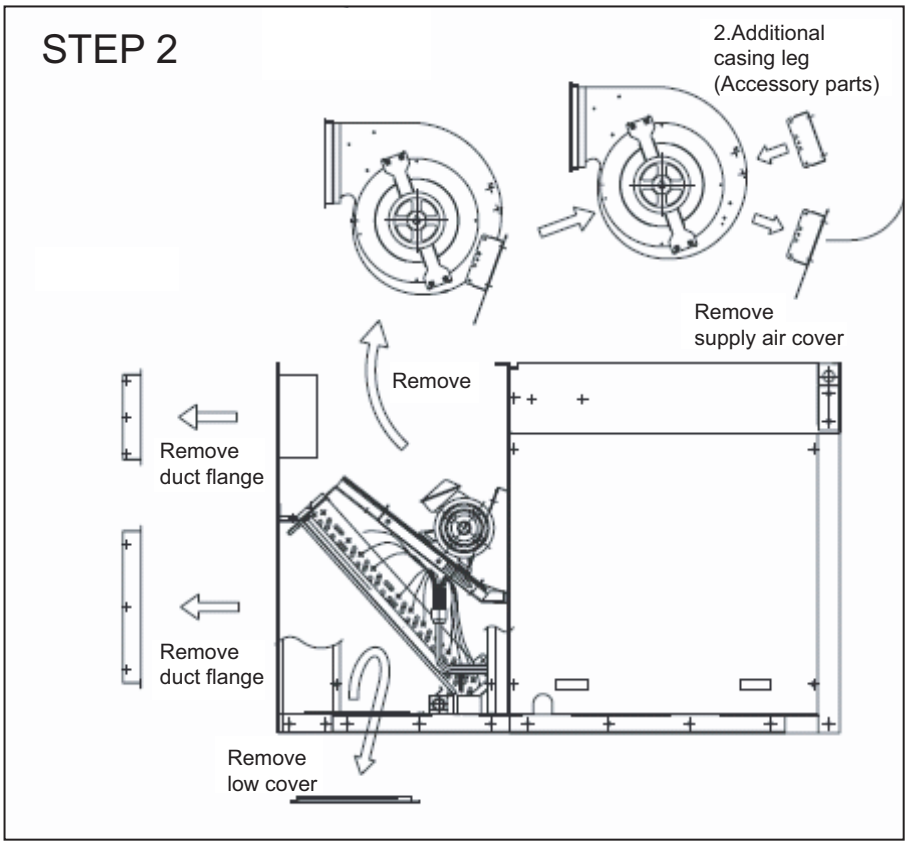
Note: Side Throw Convertible refers to unit that is factory installed for side throw supply and return air but when required can be field converted to down throw. For details on conversion method refer to Figure 1-13
All rooftop units come with two metal flanges to be connected to supply and return air duct. The dimensions of these flanges are as follows:

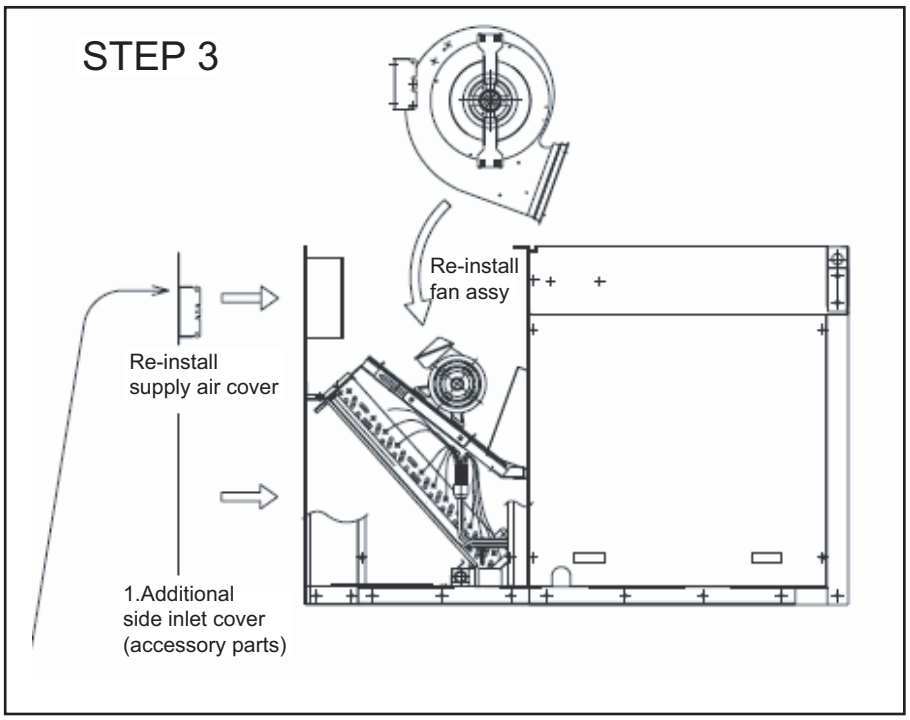
Model	Flange Supply Air Length x Width (mm)	Flange Return Air Length x Width (mm)
UATP/TYP/T/TY180A	540 x 230	668 x 412
UATP/TYP/T/TY240/280/320A	1020 x 230	1020 x 412
UATP/TYP/T/TY450/560A	1744 x 428	1744 x 428
UATP/TYP/T/TY700/850A	566 x 640	758 x 1302
UATPC/TYPC/TC/TYC10/12A	895 x 783	1642 x 660

Figure 1-12

Rubber gasket is inserted between the duct and flange before riveting or screwing them together. A layer of duct tape or mastic can be applied over the joint to cover any gaps in between.


STEP 1
Remove
top panel
Remove
service panel


STEP 2
2.Additional
casing leg
(Accessory parts)
Remove
supply air cover
Remove
Remove
duct flange
Remove
duct flange
Remove
low cover



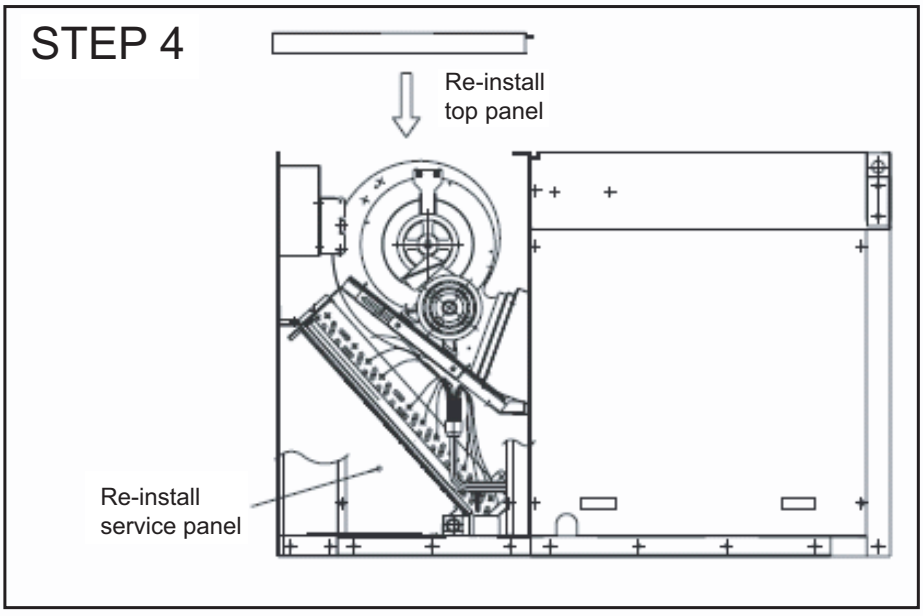


Figure 1-13:Detail Steps of Conversion from Side Throw to Down Throw

In general ducts are divided into low pressure and high pressure. All rooftop unit require low pressure ducts (< 2.0 inch H_2O)

Two types of duct are commonly used:

a square / rectangular duct

b round duct

Duct are usually made from galvanized sheet steel and insulated with fiberglass.
The ducts are divided to air supply and air return.
As a general guide, the following steel material is recommended to fabricate ducts for rooftop units:

Duct Dimensions	Material Gauge, galvanized steel		
	No	Inch	mm
Up to 24”	24	0.028	0.71
24” to 30”	24	0.028	0.71
31” to 60”	22	0.034	0.86
61” to 72”	20	0.040	1.02

Figure 1-14

The larger the duct the thicker is the material required to provide rigidity. If the duct is not rigid, it will swell and make noises when the blower starts or stops.
The rooftop unit is connected to the duct via flexible canvas joint. This is to prevent any vibration from the blower startup to be transmitted to the air ducts. Refer Figure 1-15. The canvas joint is made of a piece of canvas clamped at both sides with flanges. These flanges are then screwed or riveted onto the unit and duct.

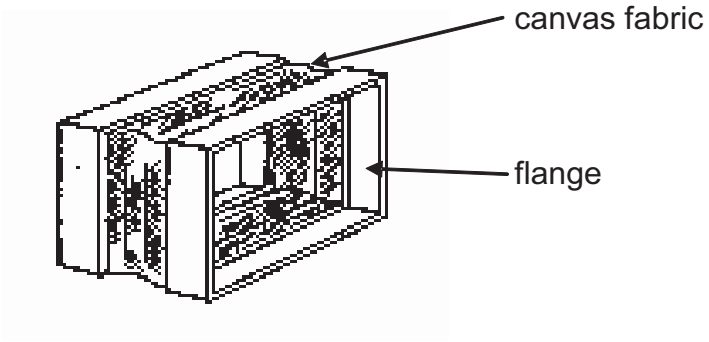


Figure 1-15

A filter slot is built into the air return duct. Typically a 2” aluminium filter mesh is used for this purpose. Refer Figure 1-16

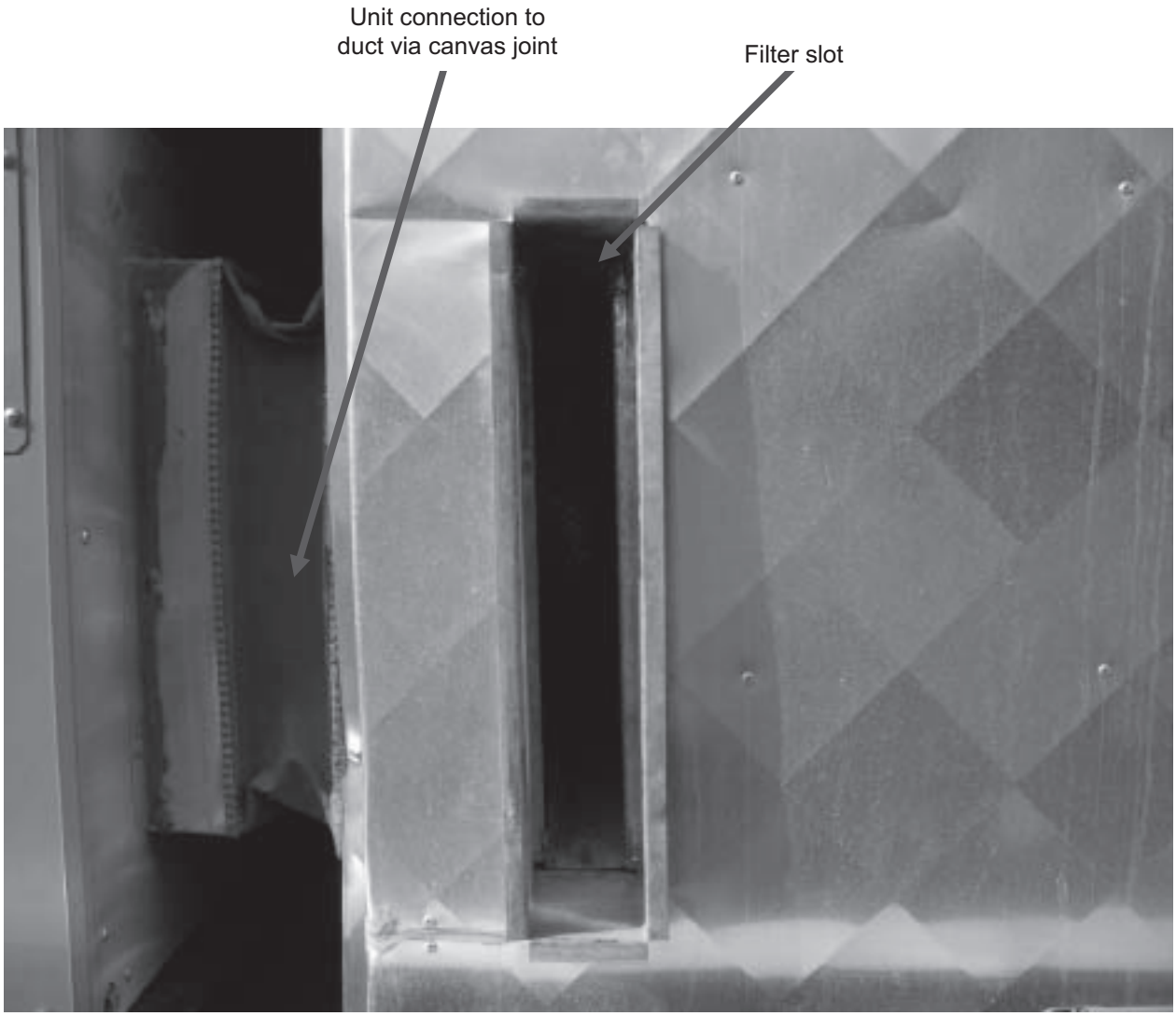


Figure 1-16: Air return filter slot and duct connection to unit with canvas

Duct Sealing

Duct sealing is important to prevent air leak. Air leak causes infiltration of dust, humidity, and outdoor fumes and odours. Thus good duct sealing can improve comfort by delivering the optimum air volume to the conditioned space. Besides these, duct leaks up to 15% can cause approximately 50% additional energy to run the fan (Refer to Figure 1-17 for details). This will incur higher operation cost for running the fan alone.

% of Duct Leakage	Fan bhp Ratio
0	1.00
1	1.03
5	1.16
10	1.33
15	1.52
20	1.73

Figure 1-17

Note: Fan Brake Horsepower is proportional to the cube of the Airflow (Fan Law).
There are many ways to seal the air duct. One of the common ways to seal duct is to use metal compression strap and mastic (adhesive).
Mastic is a rubbery, fibre-reinforced adhesive which is easily applied with a brush. It is suitable for small gap area, typically less than ¼" gap. For larger gaps more than ¼" or joint that will be under stress, use mesh tape to reinforce the mastic. Refer Figure 1-18(a).
Areas which need to be opened for service are sealed with gaskets. Two connecting ducts which are joined together are also sealed using gasket. It is recommended to seal duct during duct installation as sealing work can be done easily. Normally after a duct is installed, it is difficult to access inside the duct to do any sealing work.

Areas that need to be sealed include the following:

a Duct connection to flanges

b Duct connection through walls or cavity

c Filter access panels

d Knock-outs for wiring and other purposes

e Duct T's, Y's and L's

f Joints between sections

g Seams

For examples on mastic application refer to Figure 1-18(b) and (c).
Ensure that all working surface is clean from dirt or oil. Mastic used must be water based type which is easy to wash off from hands. However it is difficult to be removed from clothing, carpet and furniture. When using mastic, protect all surfaces below or near ducts with a drop cloth.

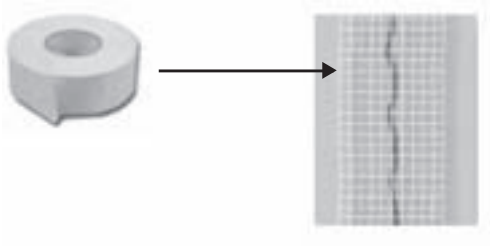


Figure 1-18(a): Use Mesh Tape to Seal Large Gaps

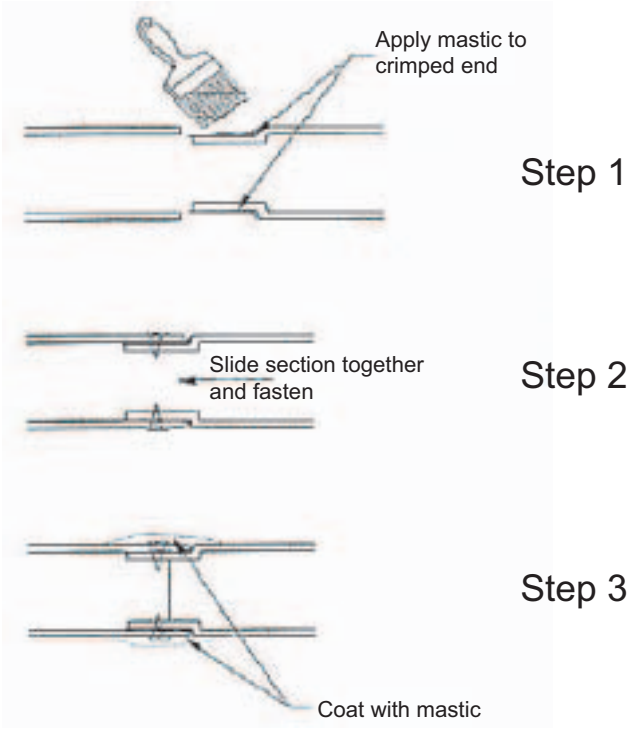


Figure 1-18(b): Example of Duct Sealing with Mastic

Step 1
Roll back outer liner insulation. Spread mastic on duct.

Step 2
Slide inner liner over connector and install metal compression strap.

Step 3
Secure outer linder with compression strap.

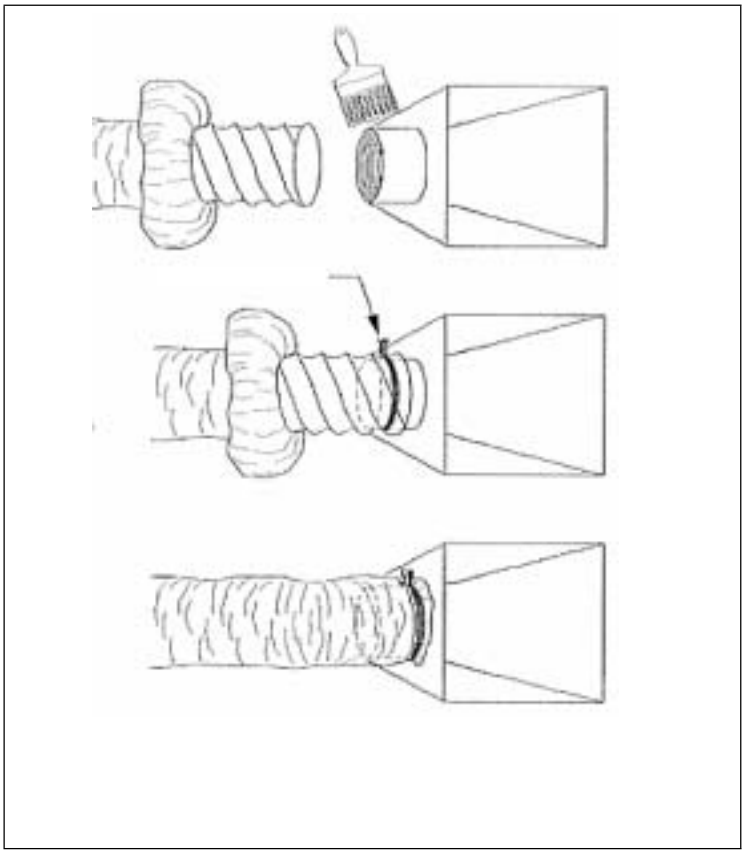


Figure 1-8(c): Example of Duct Sealing with Mastic and Metal Compression Strap.

Duct Joint and Reinforcement

Ducts are usually made in shorter sections which are then joined together to form the complete network. Several methods may be used to join and reinforce these sections which are:

a Adding a band iron around the duct

b Diagonal angle reinforcement

c Forming ribs on the duct

d Join two angle flanges with bolts and nuts. Gaskets are used to ensure air tightness.

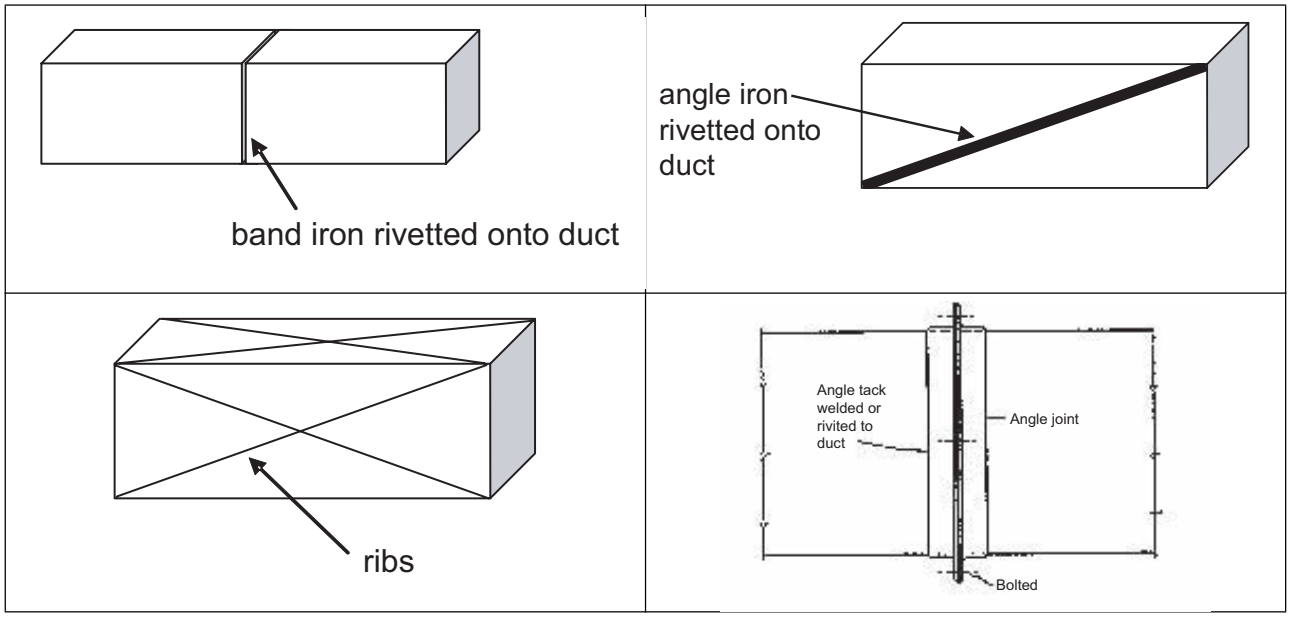


Figure 1-19

For details of other types of joints refer to Appendix 5

Fittings

Several types of fittings are used as transitions to connect a rectangular duct to a round duct (or vice-versa) and to connect rectangular duct of different sizes. Refer Appendix 6.

Duct Supports

As the ducts are made from metal, they are heavy and tend to sag. Thus supports are needed to prevent sagging.
Angle iron saddles can be installed at specific intervals to support the ducting. Hollow section or C-section bars can also be used for this purpose. In general the intervals must be not more than 7 feet.
Refer Appendix 7 for more details.

Duct Insulation

After fully sealing return and supply duct, insulate all ducts. The most common type of insulation is fiberglass.

Fiberglass is available in either a flexible or rigid form and comes in a variety of densities and thicknesses. The flexible type is sold in rolls while the rigid insulation comes in pre-formed boards. All duct insulation should have a foil or vinyl facing on the exterior side to prevent moisture from being absorbed into the fiberglass.

The thickness of the fiberglass must be selected properly to prevent condensation. The methods for calculating the right thickness of insulation are as follows:

1 Determine the dew point temperature of the most severe surrounding condition. e.gAn ambient air temperature, T_{amb}= 27°C with a relative humidity of 50% the dew point temperature is 15.7°C

2 The air temperature inside the duct, T_{air} is assumed to be 13°C. This yield a temperature difference across the insulation as

$$dT = 27 – 13 = 14°C$$

3 The type of insulation used is fiberglass. The thermal conductivity, kins is 0.03W/mK. The thermal conductivity of the sheet metal, km is 44.6W/m.K while the surface convective heat transfer coefficient h is 5 W/m2K (for metallic surface polished). The duct is made of metal with a thickness of xm=1mm while the fiberglass thickness x ins is 25.4mm. The air film coefficient on the inside of the duct, finside is 8.29W/m2.K and outside of the duct, foutside is 34.0 W/m2.K

The overall thermal resistance R is calculated as follows:

$$R = (x/k)_m + (x/k)_{ins} + 1/f_{inside} + 1/f_{outside}$$

$$R = (0.001/44.6) + (0.0254/0.03) + (1/8.29) + (1/34.0)$$

$$R = 0.997 m^2.K/W$$

The overall heat transfer coefficient U is calculated as follows:

$$U = 1/R$$

$$U = 1/0.997$$

$$U = 1.0\ W/m^2.K$$

The heat transfer equation gives us:

$$hA(T_s – T_{amb}) = - UAdT$$

where A = Heat transfer surface area and

T_s = Surface temperature

Rearranging the above equation, we have as follows:

$$T_s = - UdT/h + T_{amb}$$

Substituting these we have

$$T_s = - (1.0*14/5) + 27$$

T_s = 24.2°C

The surface temperature is higher than the dew point temperature. Condensation will not occur.

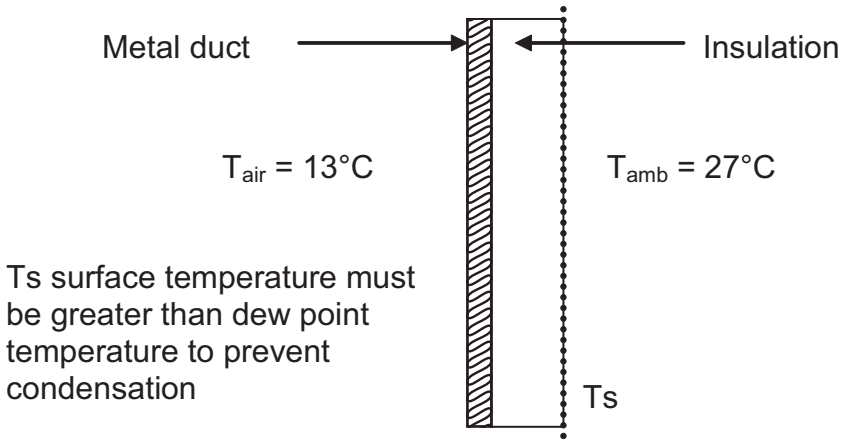


Figure 1-20: Air Temperature Inside and Surrounding Duct

Now let's consider duct that runs through a ceiling space with a temperature of 38°C and 85% RH. Using the above method the suitable fiberglass thickness is at least 2 ½ inch.
Refer Appendix 8 for details Thermal Resistance values

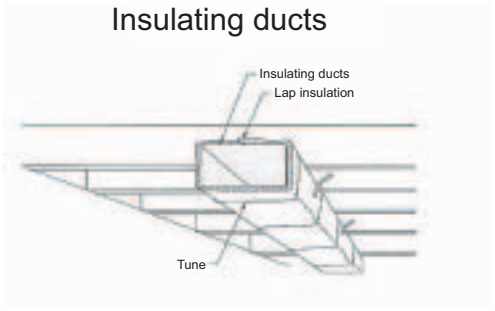


Figure 1-21/ Method of Duct Insulation

When fiberglass is used on straight duct, be sure to overlap the insulation by about 3 inch. Reinforce the insulation every 2 feet with rust proof wire or polyethylene twine. Do not compress the insulation more than ½" as this will reduce the insulation property and could cause condensation.
Be sure to use a respirator mask to prevent the inhalation of dust or fiberglass.
Sometimes insulation is applied inside the duct surface. This is mainly for aesthetic purpose. Fiberglass materials are usually used as insulation. The insulation sticks to the internal duct using adhesive glue or tabs. The tabs can be glued on the duct itself or spot welded. Each tab has a sharp shaft like a nail to hold the insulation sheets. A washer is slided into the tab and the end bended to secure the insulation. Refer Figure 1-22

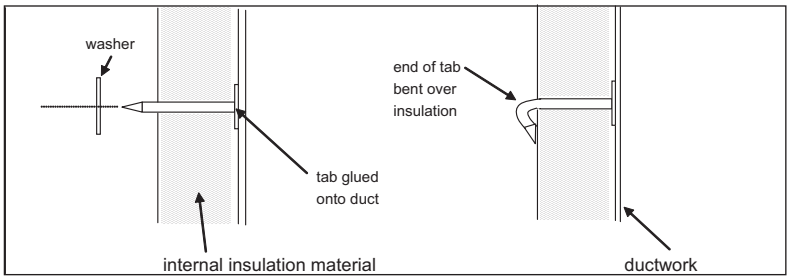


Figure 1-22

Duct Coating

Under severe hot weather and rain, left alone the duct insulation will be subject to wear and tear. As such canvas typically made of coarse cloth weighing 60 ounzes are wrapped around the duct to protect the duct insulation. Then another protective coat is applied on the canvas to act as a vapour barrier.
For details refer to Appendix 9.

Duct Terminal

Several types of equipment are available at the end of both the supply and return duct. These include various types of diffusers and air registers, which can be installed on the ceiling, walls or floors.

To achieve the desirable comfort level in the conditioned space, the air velocity in the room should be between 25 to 50 fpm. This would mean that the air velocity leaving the diffusers or grilles should be 500 to 750 fpm (except for larger applications where higher velocities are needed to reach further areas) However the higher the velocity the louder the noise of air leaving the diffuser or grille. For residential area the velocity should be about 300 to 500 fpm.

Refer to Appendix 10 for various types of diffusers and air registers.

Types of duct system

In general for rooftop application there are three types of duct system namely

a Trunk and Branch System (Extended Plenum System)
This system consists of a main supply duct of one size which is connected to the rooftop unit. Smaller branch ducts are connected to the main trunk. The trunk is limited to about 24 feet to ensure sufficient air flow into the branches.

b Trunk and Branch System (Reducing extended plenum system)
This system is similar to (a) but the trunk duct is reducing in size as branch ducts are added. It has an advantage of savings in material cost and is able to maintain the same pressure from one end to the other. The design naturally becomes more complex than (a)

c Plenum system
This system does not have a main duct. A small supply plenum is connected to the rooftop unit. Direct duct runs out from this plenum. This is the most economical system.

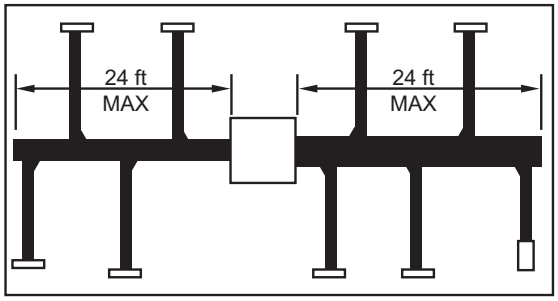


Figure1-23(a): Trunk and Branch System (Extended Plenum System)

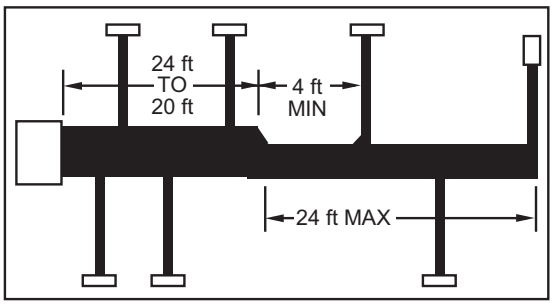


Figure1-23(b): Trunk and Branch System (Reducing extended plenum system)

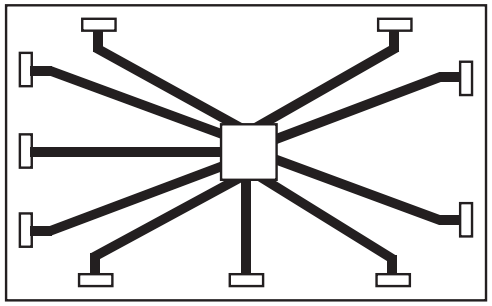


Figure 1-23(c): Plenum System

Economizer

An economizer is an additional damper cabinet opening that draws air from outside air when outside air is cooler than the temperature inside the building.
It reduces energy between 15-80% depending on the design of the economizer.

An economizer is sized to provide up to 100% of the supply air when outdoor air conditions are suitable for “free cooling” capability as mentioned above.

However economizer is only suitable in dry climate countries. This is because outdoor air which is too humid cannot produce comfort for the building occupants.

UATP/TYP/T/TY180A to UATPC/TYPV/TC/TYC12A does not have an economizer built-in the unit. However economizer can be built in the return duct system. Refer **Figure 1-24.**Various types of sensor (labeled as M1 in Figure 1-24) can be used to measure the outdoor air condition such as Enthalpy Sensor or Thermostat. Enthalpy Sensor method is more energy saving and gives better comfort control (controls humidity) compared to thermostat. The sensor measures the outdoor air humidity and/or dry bulb temperature and feedbacks to the controller (labeled as C1 in Figure 1-24).The controller in return will control the economizer damper as well as the return air damper to open or close accordingly. This is done via motorized dampers. A gravity damper is used to exhaust excess air from the system. It works in such a way that when the return air damper begins to close, static is created causing some air to push the gravity damper and opens it. This air is exhausted via the gravity damper and at the same time outside air is taken in via the economizer. The settings on the enthalpy controller vary and are dependant on the application and outdoor air dry bulb temperature and relative humidity. Another thermostat M2 is wired to the rooftop unit controller C2. This thermostat will sense the return air dry bulb temperature.

Example

The controller C1 is set to 18±2°C and relative humidity of 50%°±10%. The roof top controller C2 is set to run Auto Mode at 20°C (available with Sequential Controller only) Once the enthalpy sensor senses the outside air within the controller setting range, the economizer damper will begin to open while the return air damper begins to close. This will continue until the controller setting mentioned above is met. If the air temperature goes above the setting, the economizer damper will close while the return air damper will open. The rooftop unit will then run in cooling mode. If the air temperature goes below the setting range, the economizer damper will close while the return air damper will open. The rooftop unit will then run in heating mode.

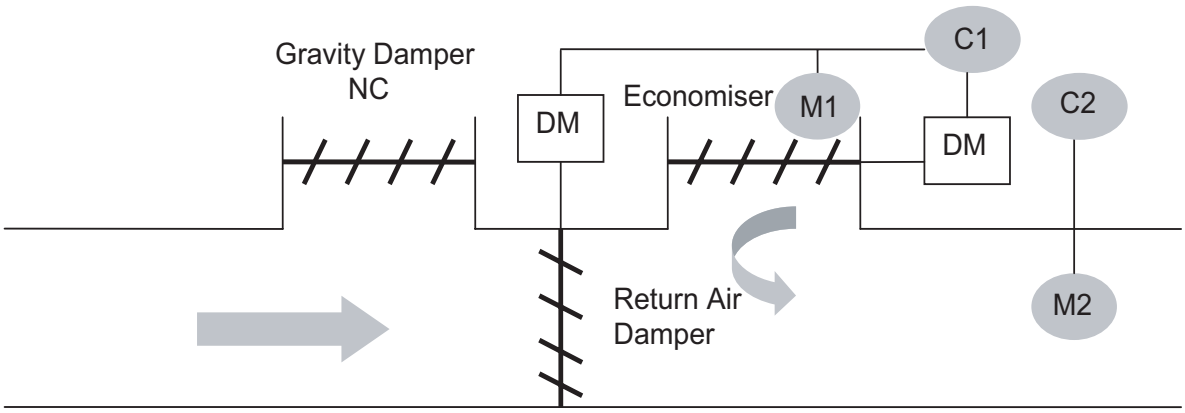


Figure 1-24

Fresh Air Intake

Fresh air intake can be taken in via a branch-out duct from the air return duct. Typically the fresh air intake is 10– 15%. A filter slot is built into the duct to ease maintenance. Normally a 4” aluminium filter mesh is used.

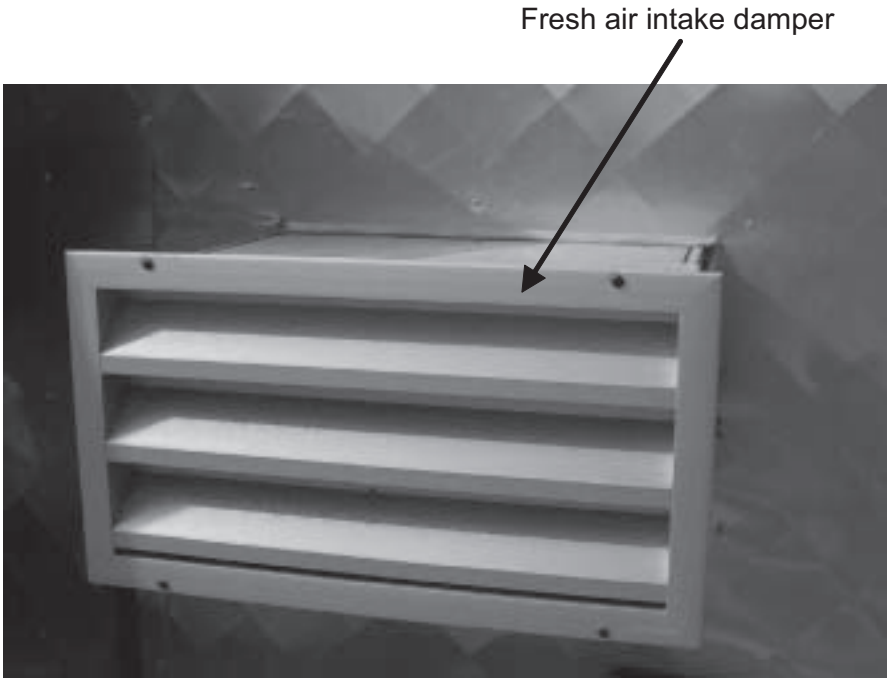


Figure 1-25: Fresh air damper fastened to a branch-out duct of the air return side

Drain Pipe Installation

The condensate drain pipe must be installed properly to prevent water leakage at pipe joints and air leakages through the drain pipe. Drain pipe are normally made from PVC and joined with contact adhesive. However in some instance GI pipes are used as they have the mechanical strength compared to PVC. The disadvantages of GI is that they are more costly and prone to rust and form deposits on the internal pipe surface. The rooftop unit comes with 1" drain pipe hole with threaded end to allow for easy connection. A 1" PVC female socket adaptor is used to screw into the drain pipe hole. Adhesive is used to attach a 1" PVC pipe into the adaptor. Refer **Figure 1-26**.

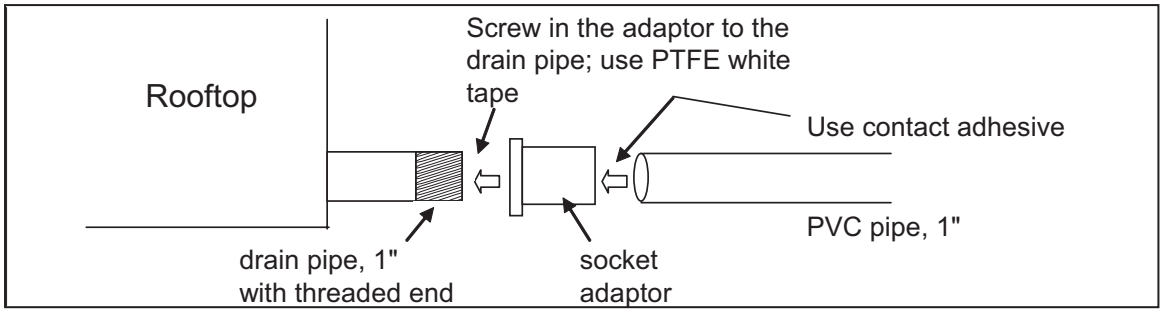


Figure 1-26

The entire length of the drain pipe is insulated to prevent condensation forming on the drain pipe surfaces. This will happen as the condensate water temperature is close to the evaporating temperature of the finned tube heat exchanger. Normally closed cell elastomeric insulation material (e.g. Superlon, Armaflex) with a thickness of 3/8" is recommended.

In hot weather area, the insulation material is wrapped with canvas and painted with a protective coat to prevent wear and tear of the insulation. Refer **Figure 1-27** for example of drain pipe installation.

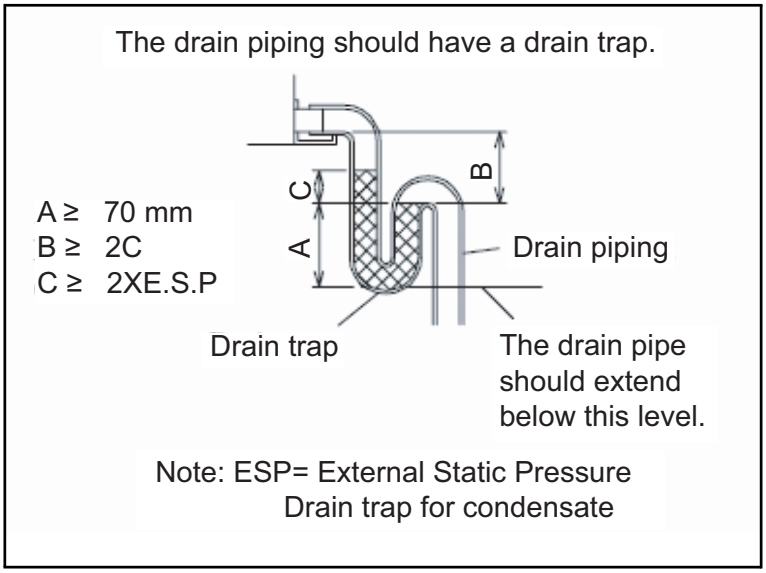


Figure1-27: Drain Trap Construction

When the roof top unit is running cooling mode, the condensate water from the evaporator coil will flow unto the drain pan. This water need to be drained out to prevent the drain pan from overflowing. However the evaporator compartment experienced negative static pressure as the fan draws air through the evaporator. The atmospheric pressure is greater than the pressure in the compartment and will prevent the condensate water from flowing out of the drain pan. In order to solve this problem, a drain trap is build.

The drain trap in the form of a U shape will cause condensate water to be trapped in it and prevent outside air from stopping the water from flowing out of the drain pan.
Note that the trap loop must not be higher than the drain hole position on the unit else the condensate water will not flow out. Refer **Figure 1-28**.

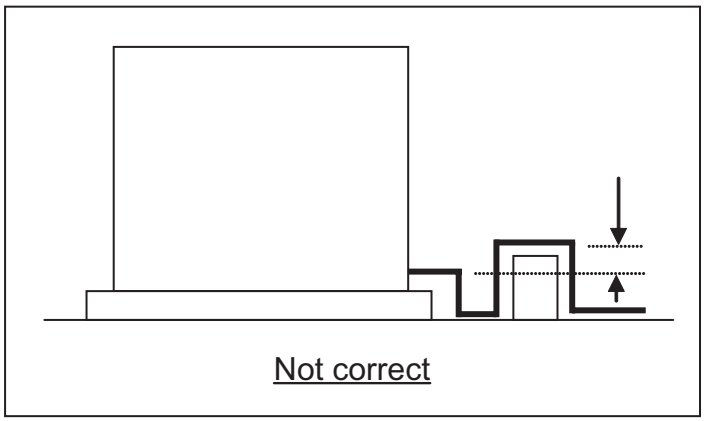


Figure 1-28

For horizontal straight length of the drainage pipe, it is recommended that the pipe inclination to be at least 1/100. Refer **Figure 1-29**.

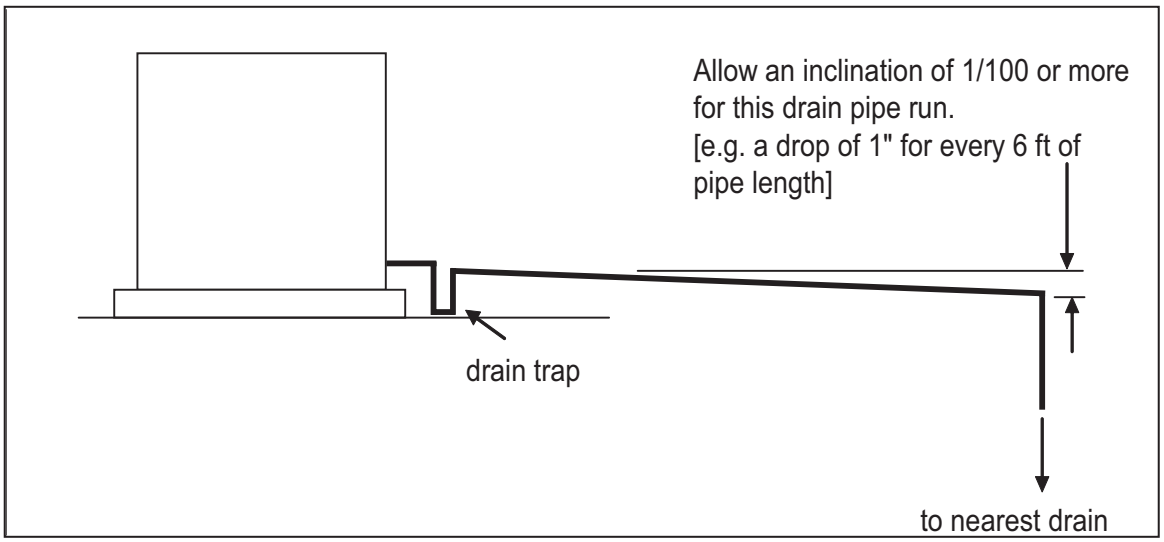


Figure 1-29

Filters

Rooftop units have been designed to accommodate for filter element on the air return side.

UATP/TYP/T/TY180A to UATP/TYP/T/TY560A is supplied with saranet filter while UATP/TYP/T/TY700A to UATPC/TYPC/TC/TYC12A has filter section made ready for insertion of 2" filter frame. The filter is field install.

The saranet filter is made from the synthetic fibers and it is usually black in colour. It is a low pressure drop filter with an arrestance of about 53% at a velocity of 2.5m/s. The filter element is attached to a rectangular wire frame of size 622mm * 433mm. The frame is only 12.7mm (1/2" thick). The recommended filter is the Vilene PS/150. This type of filter is the washable type.

For the field supplied filters it is recommended that the viledon type of filter or the aluminium mesh type of filter be used. The viledon filter is made from synthetic fibers but it has a higher average arrestance value of 85%. It is recommended to use AAF R29 filter. The aluminium mesh filter is made from aluminium sheets staggered in graduated mesh sizes. It has an arrestance value of 80%. It is recommended to use AFS-Alu mesh filter. For more details refer Appendix 11.

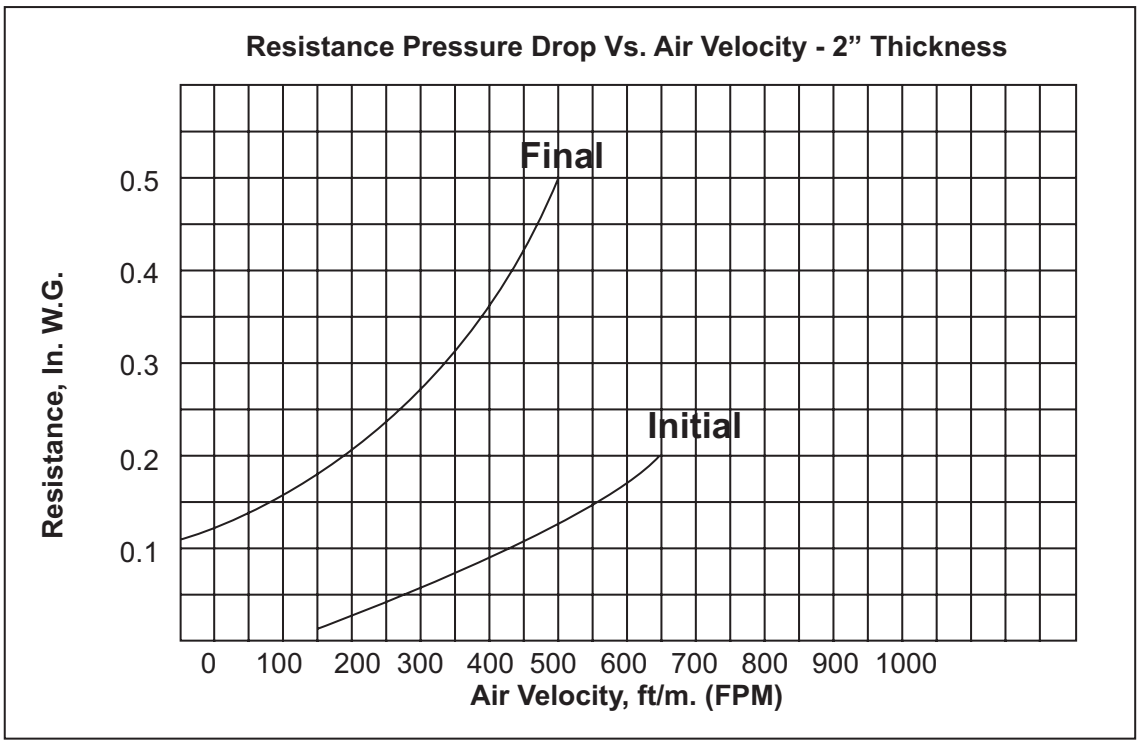
Refer to Technical Manual for number of filters required for each model.

Filter Performance

Filters performance are classified in terms of efficiency and arrestance. In general efficiency refers to the performance of filter which traps fine dust while arrestance refers to the performance of filter which traps coarse dust. These two parameters are laboratory tested.

However in the field another method must be employed. This is the air pressure drop measurement. The initial pressure drop is measured for a new filter while the final pressure drop is measured after the filter has been used for sometime. The final pressure drop is determined and the filter is changed or cleaned.

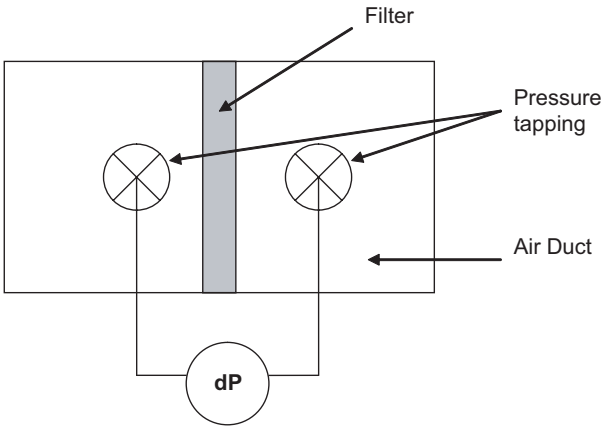
Refer **Figure 1-30** and **Figure 1-31**.



AFS-Alu mesh filter resistance (pressure drop) against air velocity.

Filter Type, Model	Recommended Final Arrestance, (Pa)
Saranet, Vilene PS/150	200
Viledon, AAF R29	200
AFS-Aluminium	125

Figure 1-30



Measures differential pressure before and after air filter to determine initial and final resistance. This will prompt user to conduct maintenance or change filter

Figure 1-31

Chapter 2: Controls

Roof top controllers are made up of

a wired-controller SLM3

b wired-controller Sequential

c NIM Sequential (for networking purpose)

UATP/TYP/T/TY180A to UATP/TYP/T/TY320A consist only one compressor and is controlled by SLM3 while UATP/TYP/T/TY450A to UATPC/TYPC/TC/TYC12A consist of two compressors and is controlled by Sequential Controller.
For more than one roof top unit in used the Network Interface Module (NIM) can be used together with SLM3 or Sequential Controller for networking purpose.
The controllers used are as follows:

a U1SB125 MB LC (for UATP/T180A to UATP/T320A)

b U1SB125 MB AP (for UATYP/TY180A to UATYP/TY320A)

c SQC2 1011-01WE000001 (for UATYP/TY450A to UATYPC/TYC12A)

d SQH22 1011-01WA700001 (for UATYP/TY450A to UATYPC/TYC12A)

SLM3

SLM3 is a wired controller which is supplied in plastic casing and placed in the control box of the roof top unit. The wiring connection is as shown in Appendix 12.

It has a 5 way socket with 4 way wire. The maximum wire length is 10m.
The socket is connected to CN2 of the main control board.

The limitation of SLM3 is that it can only control one compressor only. Thus it is only supplied with the model of roof top units as mentioned above.

Sequential Controller

Sequential Controller is a wired controller which controls roof top unit with two compressors. The wiring connection is as shown in Appendix 12 and **Figure 2-8** . Ensure that wire polarities are correct: GND to GND, +5V to +5V, B to B and A to A. The maximum wire length is 10 m.

NIM Sequential

NIM Sequential (NIM SEQ) is a network interface module controller. It can only be used with Sequential Controller (as master unit) and SLM3 (as slave unit). It is wire-linked to the roof top sequential main control board, sequential controller / SLM3 and communication cables via the following connectors

NIM SEQ	Linked to
Connector CN1	Sequential Control Board
Connector CN2	Sequential Controller / SLM3
Connector CN3	Communication Cable

Figure 2-1

Installation for SLM3

1 Screw steel mounting plate onto wall

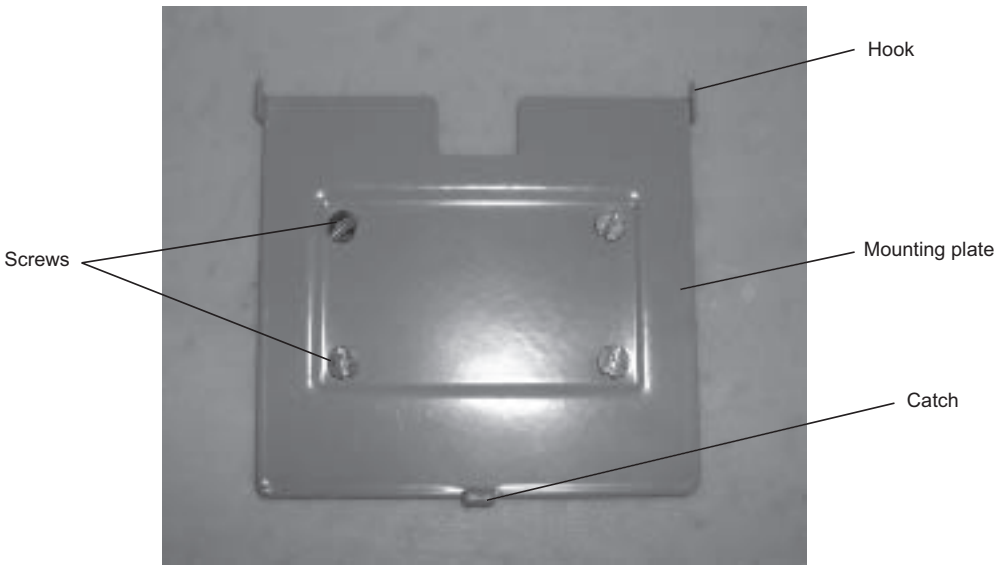


Figure 2-2(a)

2 Hook the top notches of the SLM onto the mounting plate

Figure 2-2(b)

3. Snap the SLM onto the bottom catch

Figure 2-3: SLM3

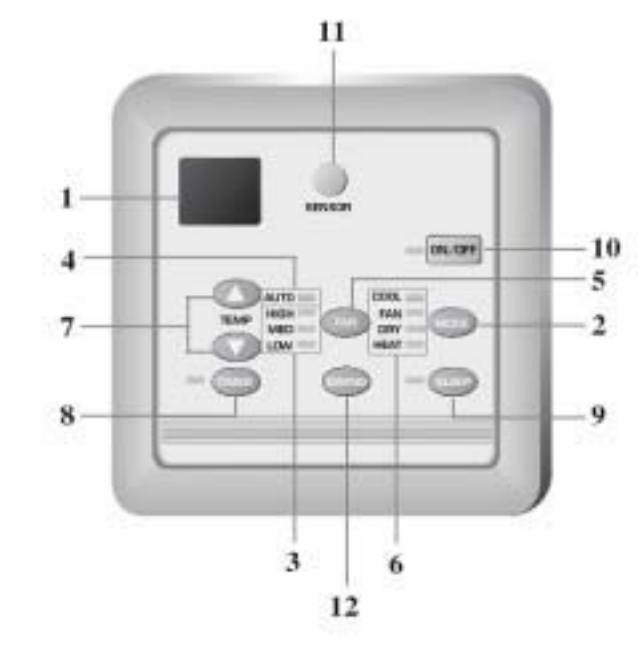


Figure 2-3: SLM3

1	LED Display	7	Temperature Setting
2	Mode Selection	8	Timer
3	Fan Speed LED	9	Sleep Mode
4	Auto Fan Speed LED	10	ON/OFF
5	Fan Speed Selection	11	IR Sensor (to be used with credit card wireless remote only)
6	Mode LED		

Control features for SLM3

a Timer
This function enables user to preset the duration to run the roof top unit. The setting is between one to fifteen hours

b Operation Mode
There are three modes (for cooling only model) namely Cool, Dry and Fan and five modes (for heat-pump model) namely Auto, Cool, Dry, Heat and Fan

Mode selection

The available operating modes are COOL, HEAT, DRY and FAN. Selection is done by pressing the MODE button on the keypad. The range of room temperature that can be set with these modes is from 16 ~ 30ºC.

For both the COOL and HEAT modes, the controller has been programmed in such a manner whereby the compressor will run and stop with respect to the (Set Temperature) ± a dead band temperature. This is similar to what is seen in Figure 2-4. The dead band will help in the room temperature control stability.

The DRY mode is also available. The moisture removal is done by regulating the indoor fan speed.

In the same manner, the FAN mode will allow the user to select from the three fan speeds available, i.e. High, Medium and Low. The AUTO FAN mode is also available to enhance the room temperature control by load regulation. Basically, when running Cool Mode, the fan speed will reduce when the room temperature becomes colder than the set-point (and vice-versa). In the Heat Mode, the fan speed will reduce when the room temperature becomes hotter than the set-point.

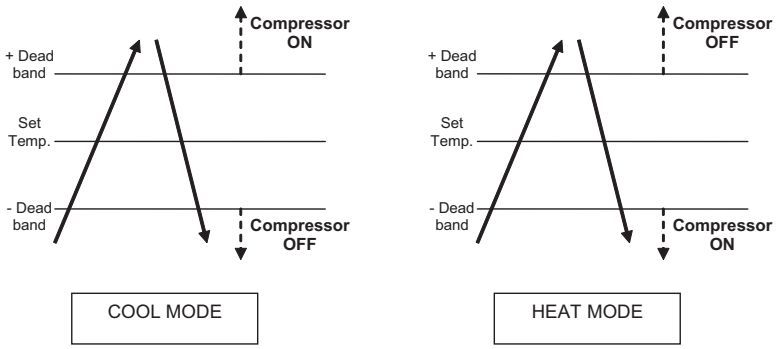


Figure 2-4

- SLEEP mode
  SLEEP mode provides night setback features.

One advantage of this mode is the energy savings which can be realized when activated. In general, the room set temperature will be increased with time during the COOL mode, and decreased during the HEAT mode. This is useful during the sleeping hours where with a lower body metabolism, the room temperature can be higher to prevent over-cooling or lower to prevent over-heating.
The change in the room set point is shown in the following diagram:

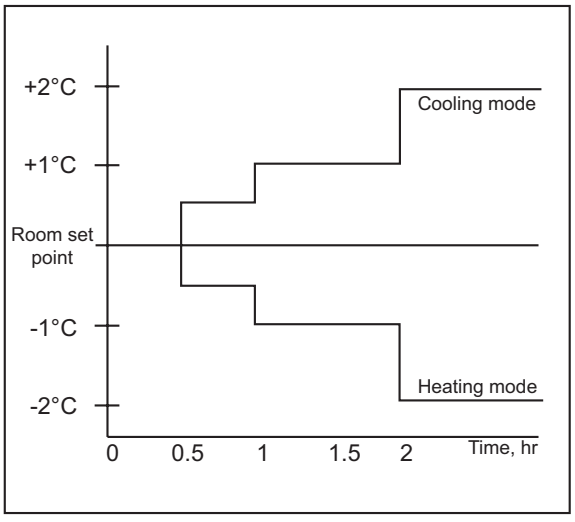


Figure 2-5

Example

Initial room temperature set-point = 24ºC before the SLEEP function is activated. After running in the Cool Mode for 1.5 hours, the controller will reset the set-point to 24 + 1 = 25ºC. Thus, the compressor will cycle ON/OFF less frequently and save the energy consumption.

If it is running in the Heat Mode, the set-point will become 24 – 1 = 23ºC.

- Cold start

A unit which restarts after stopping for more than 2 hours will be considered as a cold start.
In order to help restore and achieve the room temperature, the Cooling Mode, the room set-point is decreased by 2ºC for a period of 20 minutes; after which it is reset back to the original set-point. And in the Heating Mode, the room set-point to increase by 2ºC for a period of 20 minutes; after which it is then reset back to the original.

- Hot start & Hot keep

The control parameter used is just the indoor coil sensor temperature.

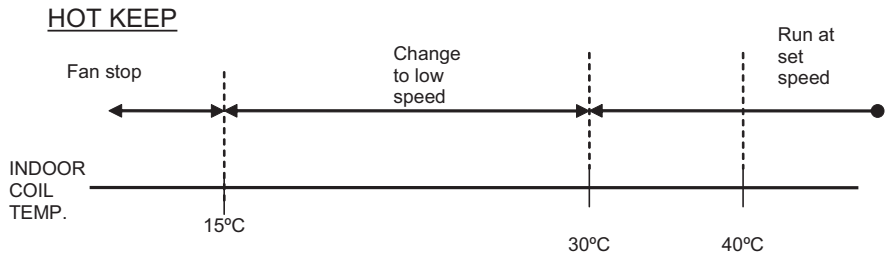


Figure 2-6(a)

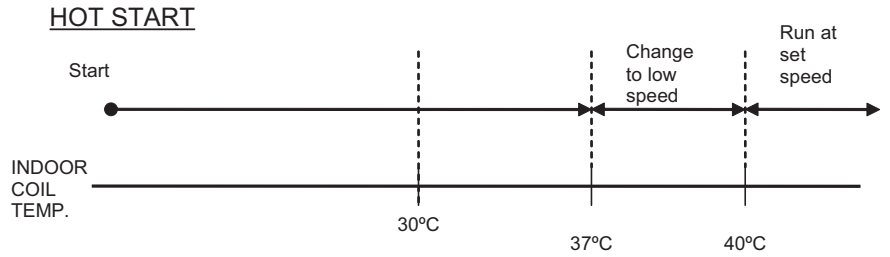


Figure 2-6(b)

a Fan on option

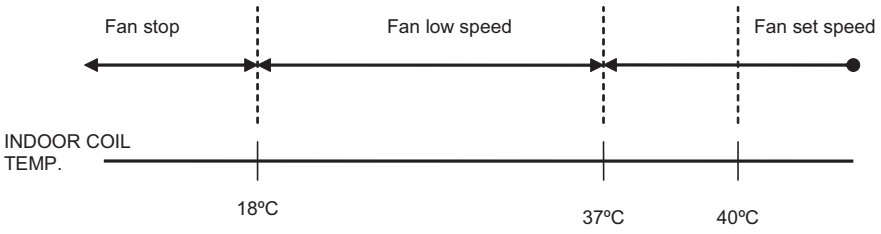


Figure 2-6(c)

This option is used in moderate temperature countries (e.g. Mediterranean) where the winter conditions are not so cold. A low speed cold draft is still acceptable to maintain air circulation in the room.

b Fan off option

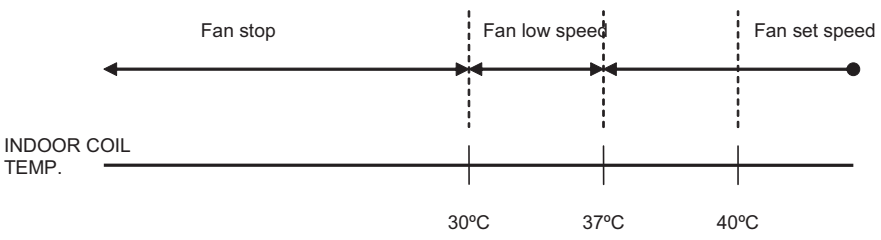


Figure 2-6(d)

Here, the fan will be switched off much faster. It is used in colder countries where a cold draft will cause discomfort to the occupants.
The SLM3 controller also comes with error code display to warn of the following faults that may occur during operation

Fault	Error Code
Room sensor missing / short	E1
Indoor coil sensor missing / short	E2
Outdoor coil sensor missing / short	E3
Compressor overload	E4
Gas leak	E5

Figure 2-7

Protections

a 140 seconds minimum run time for compressor.
During thermostat cycles, a compressor can only cut out after running a minimum of 140 seconds in the current cycle.

b 3 minutes minimum off time for compressor.
During thermostat cycles, a compressor can only cut in after a minimum of 3 minutes from the time it cuts off. This does not apply during 4-way valve changeover.

c Indoor Coil Sensor Protection.
When running cooling mode the sensor will give anti-freeze protection when Indoor coil temperature reaches 0°C and below for at least 1 minute and the compressor has run for at least 10 minutes. OR when the indoor coil temperature reaches 1°C for at least 4 minutes.

d Gas Leak detection.
This happens when indoor coil temperature is >24°C in cooling mode and <20°C in heating mode and compressor has run for thirty minutes. A five minutes reconfirmation is done before an error code is displayed

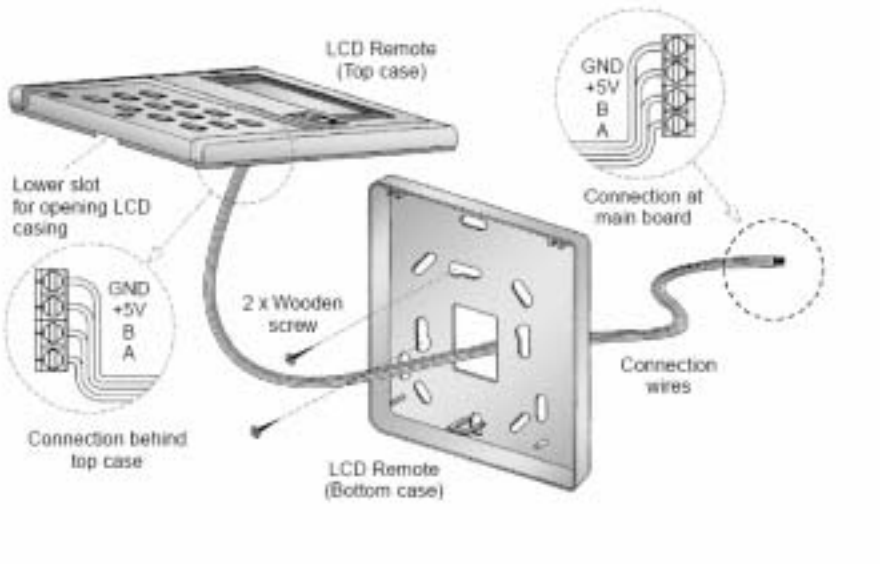


Figure2-8: Wiring between Sequential Controller and main control board

Sequential Controller Installation Guide

1 Open the panels of the LCD remote controller from the top and bottom with a screwdriver. Do this by inserting the screwdriver into the lower slot and slide it in the outward direction.

2 Insert the communication cable through the slot at the lower center of the bottom panel. Fix the bottom panel unto the wall with the wooden screws provided

3 Connect each end of the cables to the terminal blocks on the top panel and main control board. Ensure that the polarities are correct. CAUTION: Wrong polarity may cause the board to burn or failure in communication.

4 Align the top panel to the bottom panel by hooking the two upper claws to their respective slots and lastly snap to fasten the top panel to the bottom panel.

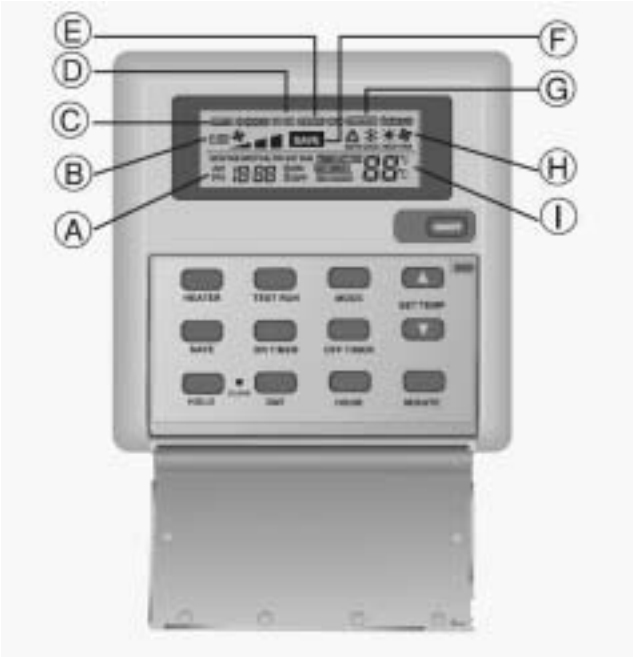


Figure 2-9: Sequential Controller

A	Time Display	F	Energy Saving Mode Display
B	Error Indication	G	Compressor Defrost Cycle Display
C	Compressor Running Display	H	Operation Mode Display
D	Key Lock Display	I	Temperature Set Display
E	Heater Display		

The dip switches on the main control board can be set to 0 (OFF) or 1(ON) as shown in the following figure

	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
No Heater	0	0						
1 heater	1	0						
2 Heater	1/0	1						
Stage diff temp default			0	0				
Stage diff temp 0.5°C			1	0				
Stage diff temp 1.0 °C			0	1				
Stage diff temp 1.5°C*			1	1				
Auto Mode On					0			
Auto Mode Off					1			
Hot Keep Option Fan Off						0		
Hot Keep Option Fan On						1		
Derivative Defrost Off							0	
Derivative Defrost On							1	
Defrost Cycle Comp Off								0
Defrost Cycle Comp On								1

Note:*Valid for 2 compressors model only

Figure 2-10

When the EEPROM Backup Option JH1 is shorted, the controller will follow last state memory prior to power off. When JH1 is open, the controller will start in OFF mode.

Control features for Sequential Controller

a ON Timer and OFF Timer (7 days timer).
This function enables user to preset the time, day and duration to run the roof top unit via the ON Timer key and to preset the time, day and duration to stop the roof top unit via the OFF Timer. Ensure that the real time clock is set correctly.

b Operation Mode.
There are three modes (for cooling only model) namely Cool, Auto and Fan and four modes (for heat-pump model) namely Auto, Cool, Heat and Fan

c Save Mode.
This function enables user to save energy by increasing the set temperature (for cooling mode) and decreasing the set temperature (for heating mode) This feature is similar to the Sleep Mode for SLM3

d Key Lock .
Under the KEY LOCK function only the ON/OFF key is valid. This is useful to prevent non-authorised personnel from changing the setting of the controller.

e Heater.
This feature enable field supplied auxiliary heater to be controlled by the controller. The maximum heaters allowed are two. The heater relay (rating of 250V AC 3A) on the controller is connected to contactor. The heater is interlocked with the indoor fan. It will not energise when the indoor fan is OFF. The heater can act as additional load required for heating or for dehumidification during cooling mode. To ensure that the heater is not overheated, a thermostat is connected in series to the heater.

f Test Run.
This feature enable user to run the unit in Cool or Heat mode and the roof top unit can run up to two hours. It can be disabled by pressing the ON/OFF key.

g Cold Start.
During cold start, the set temperature is set to user set temperature -2°C. This will enable the conditioned space to cool down faster. This feature is not available for Save Mode or Auto Mode.

h Spurt Heat.
During spurt heat, the set temperature is set to user set temperature +2°C. This will enable the conditioned space to heat up faster. This feature is not available for Save Mode or Auto Mode.

i Hot start & Hot keep.
The control parameter used is just the indoor coil sensor temperature.

When all the compressors cuts out or compressors are not running, the indoor fan will run as follows. Hot Keep can be enabled using SW6 is ON. When SW6 if OFF, indoor fan will stop when all compressors cut off.

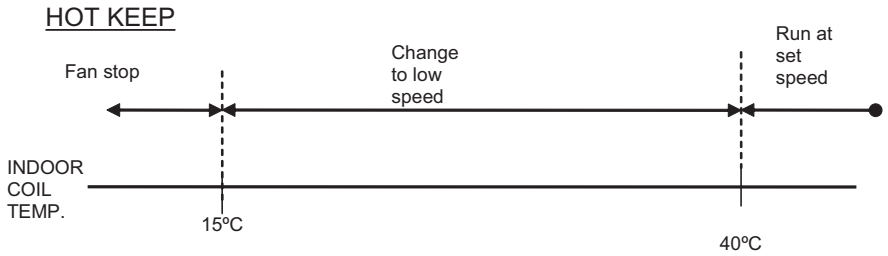


Figure 2-11(a)

When at least one compressor cuts in, the indoor fan will run as follows. When auxiliary heater is running, indoor fan always runs.

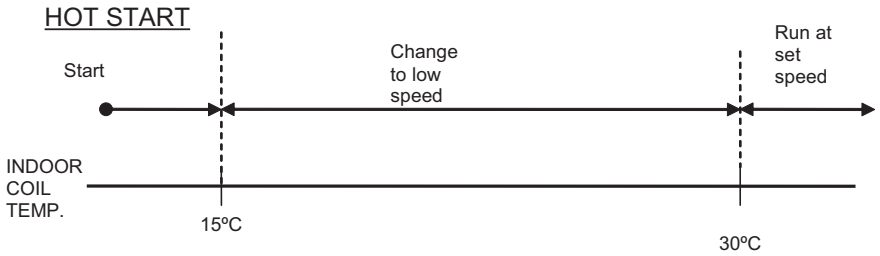


Figure 2-11(b)

j Auto Mode.
In Auto Mode, operating mode is selected automatically by the controller. The selection will be based on the Room Temperature and the Set Temperature. Cold Start or Spurt Heat will not work during Auto Mode.

The Sequential Controller also comes with error code display to warn of the following faults that may occur during operation

Fault	Error Code
Require Manual Reset	E01
Compressor 1 high temperature (overload)	E02
Compressor 2 high temperature (overload)	E03
Compressor 3 high temperature (overload)	E04
Compressor 4 high temperature (overload)	E05
Compressor 1 high pressure trip (or contact open)	E06
Compressor 2 high pressure trip (or contact open)	E07
Compressor 3 high pressure trip (or contact open)	E08
Compressor 4 high pressure trip (or contact open)	E09
Compressor 1 low refrigerant	E10
Compressor 2 low refrigerant	E11
Compressor 3 low refrigerant	E12
Compressor 4 low refrigerant	E13
Room sensor short	E14
Room sensor open	E15
Indoor coil sensor 1 short	E16
Indoor coil sensor 2 short	E17
Indoor coil sensor 3 short	E18
Indoor coil sensor 4 short	E19
Indoor coil sensor 1 open	E20
Indoor coil sensor 2 open	E21
Indoor coil sensor 3 open	E22
Indoor coil sensor 4 open	E23
Outdoor coil sensor 1 short	E24
Outdoor coil sensor 2 short	E25
Outdoor coil sensor 3 short	E26
Outdoor coil sensor 4 short	E27
Outdoor coil sensor 1 open	E28
Outdoor coil sensor 2 open	E29
Outdoor coil sensor 3 open	E30
Outdoor coil sensor 4 open	E31
Compressor 1 deice	E32
Compressor 2 deice	E33
Compressor 3 deice	E34
Compressor 4 deice	E35

Figure 2-12

Protections

a 5 minutes minimum run time for compressor
During thermostat cycles, a compressor can only cut out after running 5 minutes in the current cycle.

b 3 minutes minimum off time for compressor
During thermostat cycles, a compressor can only cut in after 3 minutes from the time it cuts off. This does not apply during 4-way valve changeover.

c Compressor High Pressure
After a compressor cuts OFF due to high pressure, the compressor is not allowed to cut in for 3 minutes. If the compressor experienced three times high pressure trip in 30 minutes, the unit cannot restart automatically but must be manually reset using the ON/OFF key.

d Compressor High Temperature Protection
During cooling or auto cooling mode when the outdoor coil sensor senses the coil temperature to exceed 68°C, the compressor and the outdoor fan will stop. The indoor fan will continue to run.

e During heat or auto heat mode when the indoor coil sensor senses the coil
Temperature to exceed 59°C, the outdoor fan will stop. When the indoor coil temperature exceeds 62°C the compressor and outdoor fan will stop. The indoor fan will continue to run but subject to hot keep condition. Compressor Trip / Low Refrigerant. After compressor run for at least 5 minutes and the indoor coil is not cold enough Troom-Tindoor coil <=3°C (for cooling mode) or not hot enough Tindoor coil-Troom<=3°C (for heating mode) then error code will be displayed, compressor number will be blinking on LCD panel and LED blinks. At this point the compressor is still running to enable user to check the problem.
e.g Error Code E10 is shown on the LCD ,COMP 1 blinks and LED blinks to warn of low refrigerant charge in the system

f Indoor Antifreeze Protection and Filter Check
This feature is only available in Cool Mode. A compressor will enter Antifreeze mode when
a) the indoor coil sensor senses the coil temperature <=1°C for at least 1 minute.
b) the compressor has run for at least 10 minutes
The compressor and the outdoor fan will then stop. This will enable the servicemen to check the filter for clogging or indoor fan not working.

g Outdoor defrost
This feature is only for heat mode.

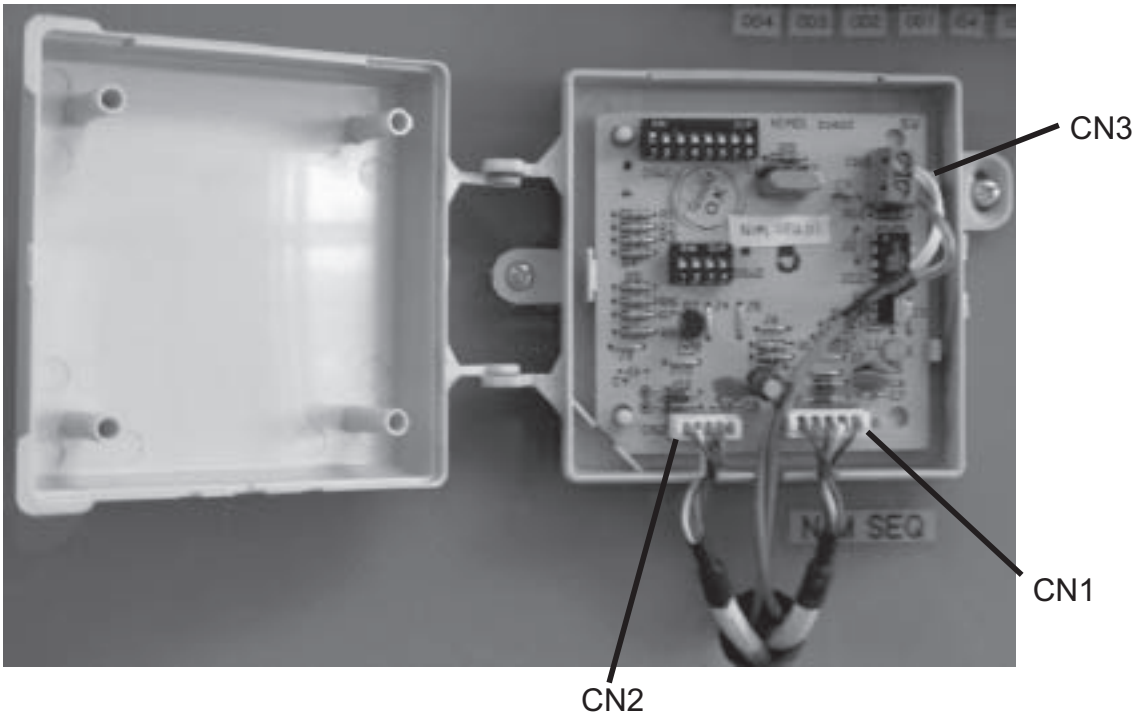


Figure 2-13(a) : NIM Sequential wire-linked to main control board and sequential controller / SLM3 for networking purpose

The NIM sequential board consists of dip switches for setting of group and unit address.
Group address is set via dip switch DSW1 while unit address is set via dip switch DSW2. Group address ranges from 0 to 254 (00000000-11111110) while unit address ranges from 0 to 15 (0000-1111) Settings are in binary format.
Example:

Group address 5 => Setting is 10100000

Group address 20 => Setting is 00101000

Group address 100 => Setting is 00100110

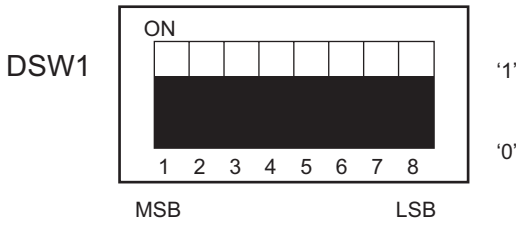
Unit address 0 => Setting is 0000 (This is for the Master Unit)

Unit address 5 => Setting is 0101

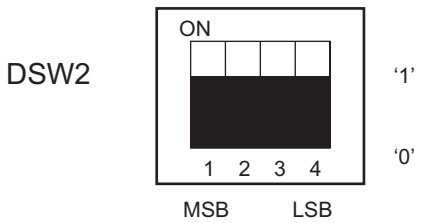
Unit address 15 => Setting is 1111

For details of address setting refer to Appendix 13

Note:
Super master in a PC system will be assigned with Group Address 11111111



DSW1 for setting of Group Address



DSW2 for setting of Unit Address

Figure 2-13(b)

The network system can have a total of 254 groups and each group can have 1 Master Unit and up to fifteen Slave Units.

Installation of NIM Sequential

The NIM Sequential can be installed inside the roof top unit control box. The connections are done as follows

Connector	Between
CN1	NIM Sequential and Main Board
CN2	NIM Sequential and wired remote controller
CN3	NIM Sequential and other NIM Sequential

Figure 2-14

The following steps can be used to install the NIM controller

a Plug in wires to connectors CN1 and CN2

b Plug in communication cables to CN3 and make sure that both end of the cables are of the same polarity

c Align the cables on the hole slots of the NIM casing

d Snap the top casing and hook the claws into their slots. Ensure that the wires are properly covered in the hole slots

e Screw the assembly onto the wall using screws provided.

Several precautions need to be taken when installing NIM

a Do not expose to direct sunlight

b Do not expose to electromagnetic waves

c Do not expose to heat source

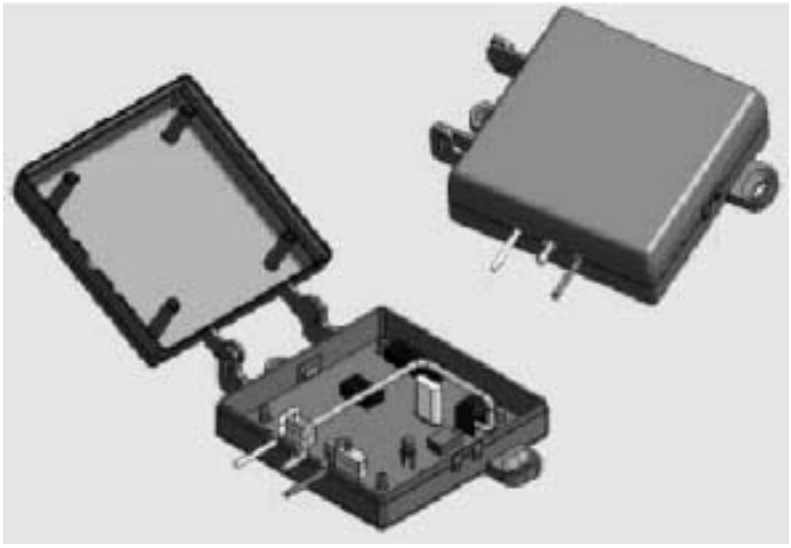


Figure 2-15: Completed NIM assembly

For networking purpose, it is recommended to use the following types of communication cables.

No	Item	Requirements
1	Type of cable	The cable shall comply at least with IEC 189-2 or equivalent national standard unless otherwise specified
2	Cable diameter	Min: 0.8mm Max: 1.0mm
3	Cable cross sectional area	0.5-1.0mm^2
4	Cable material	Copper and solid wires
5	Cable outer structure	Sheath and screened
6	Cable cores	One twisted pair with different colour of cores
7	Cable structure twist	Minimum five twist per meter
8	Tensile strength	2 core cable, minimum 50N

Figure 2-16(a)

The recommended cable lengths are as follows

Connection	Recommended Maximum Bus Length (m)
NIM SEQ(Master) to NIM SEQ(Furthest Slave)	1000
NIM SEQ to SEQ Main board	10
NIM SEQ to SQLCD Wired Controller	10
NIM SEQ to Transceiver Board (MB TXR)	10
Between Transceiver Board	1000
Transceiver Boards (Wired PTXR) to SQLCD Wired Controller	10
NIM SEQ to NIM PC Gateway	10

Figure 2-16(b)

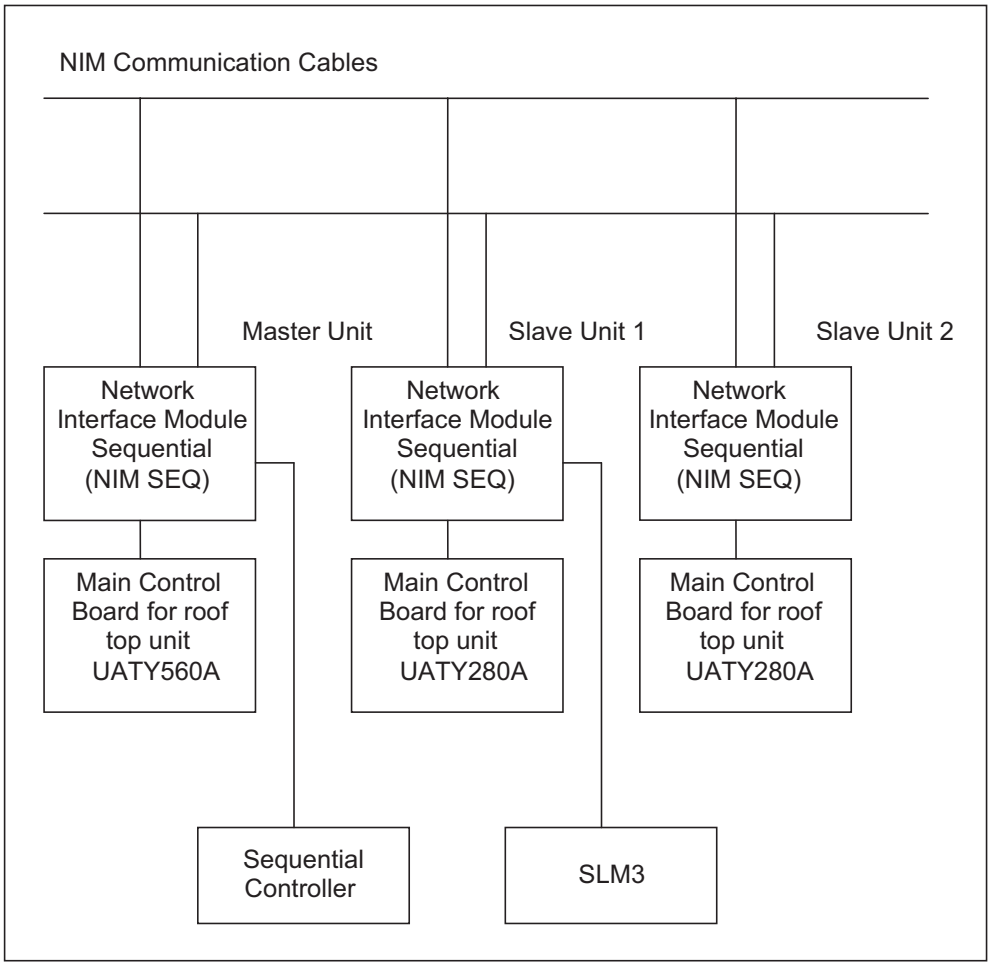


Figure 2-17: Networking with NIM Sequential, roof top main control board and controller

Once the networking wiring is completed, all the rooftop units can now be controlled by the Master Unit using the sequential controller. The advantages of this type of network system are:

a One Master Unit can be used to turn on and off all other Slave Units at the same time. This is useful for centralized control of all the roof top units.

b Whenever there is an error, the error code indicating the fault and unit address can be read from the sequential controller. This will help servicemen to identify the fault easily.

c A 7 day programmable timer and centralized control of all the roof top units will help save energy consumption

For networking, error code will be displayed on the Master Unit LCD sequential controller to warn of faults that may occur during operation. For the Master Unit the error code are the same for sequential controller while for Slave Unit the display will only show that error has occurred for the respective slave unit but the type of error will not be displayed.
EX_1X_2
E: Error
X_1: Error type or “F” ; F indicates that error has occur for slave unit
$X_{2:}$ Error type or Slave Unit Address which has the error
e.g.E06 indicates that error has occur for Master Unit and the error is compressor 1 high pressure trip / contact open;
EF7 indicates that error has occur for Slave Unit number 7

Mechanical Control

Alternatively the roof top controls can be converted to mechanical control using the wiring diagrams as shown in Appendix 14. The list of recommended main electrical components specifications are as shown in Appendix 14

Chapter 3: Application

Pulley and Belt

All the roof top units blower are belt driven. This is done by passing the V-belt through 2 pieces of pulleys; one mounted on the motor shaft while the other on the blower shaft. When the motor shaft turns it will turn the pulley which in turn pulls the belt causing the belt to transmit torque to the blower pulley. In general the motor pulley has a smaller diameter compared to the blower pulley; and the motor rotates at a higher speed than the blower.

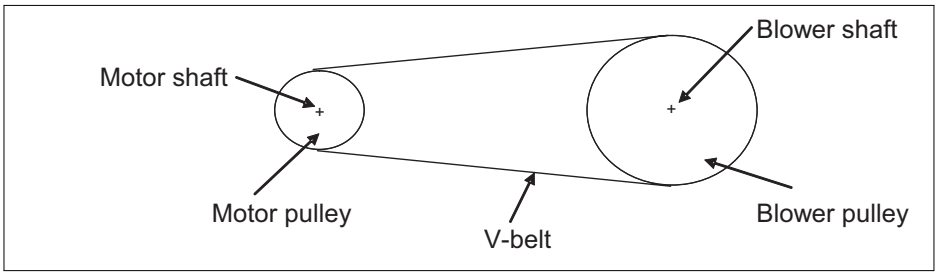


Figure 3-1: Pulley and Belt

The following equation is used to calculate motor/pulley size,

$$D_m / D_b = N_b / N_m \quad \text{..... Equation 3-1}$$

where D_m is motor pulley size, D_b is blower pulley size, N_m is motor speed and N_b is pulley speed

Example 1

Given D_m = 5" and D_b = 10" and N_b = 700 rpm, calculate N_m.

$N_m = (D_b / D_m) * N_b$

$= (10/5)*700$

$= 1400$ rpm

The following equation is used to calculate belt length,

$$L = 2C + \{/2(D_b + D_m)\} + \{(D_b - D_m)^2/4C\} \quad \text{..... Equation 3-2}$$

where C is the distance between the centre of the two pulleys

Taking =3.14 and simplifying Eq 4-2, and neglecting $(D_b - D_m)^2/4C$,

we have, $L \sim 2C + 1.57(D_b + D_m)$ ..... **Equation 3-3**

Example 2

Given D_m = 7" and D_b = 10" and C = 24", calculate L

$L \sim (2*24) + 1.57(10 + 7) = 74.69$"

The slack of the belt can be adjusted by tensioning the motor bracket as shown in Figure 3-2

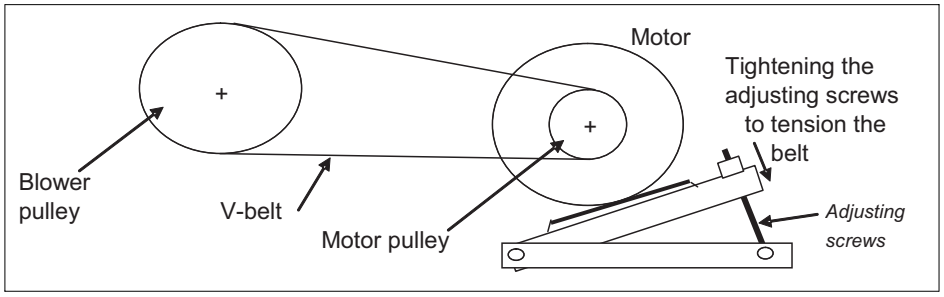


Figure 3-2

For pulley sizes and belt length used in roof top unit refer to Appendix 15. The current pulley or belt used cannot meet all requirements. Thus it must be resized. Refer Example 3

Example 3

All roof top units use belt driven blower such that the required air volume and static can be adjusted. The following steps show how to size a belt.

Step 1

Determine the roof top model, supply air quantity and external static pressure required.
Example
Model: UAT280A
Supply Air Quantity: 3800 CFM
External Static Pressure: 150 Pa

Step 2

From the blower curve in Figure 3-3 and at 3800 CFM, the internal static pressure is 150 Pa. This gives rise to a

Total Static Pressure =Internal Static Pressure + External Static Pressure

= 150 Pa + 150 Pa

= 300 Pa

Note that the design required point falls on the 1200 rpm line and the motor output power required is below the motor output power limit of 1.5kW

Step 3

From Appendix 15, the factory installed motor and blower pulley size for UAT280A is shown as follows:

Motor Pulley Size,Dm = 114 mm

Blower Pulley Size,Db = 152 mm

Motor RPM = 1080
In order to obtain the required rpm of 1200, the following steps are used
Calculate the new blower pulley (while maintaining the motor pulley)
New blower pulley size Db = Motor Pulley Size x (Motor rpm / Blower rpm)

= 114 x (1080/1200)

= 103 mm

We select a blower pulley size of 100mm.
Using a blower pulley size of 100mm, we have

Blower rpm = Motor rpm x (Motor Pulley Size / Blower Pulley Size)

=1080 x (114/100)

=1231 rpm

Step 4
After changing the pulley, the V-belt length must be rechecked. For horizontal air throw configuration, we have

V-belt length, $L = 2C + 1.57 (Db + Dm) + (Db - Dm)^2 / 4C$

$= (2 \times 184) + 1.57 (114 + 100) + (114-110)^2 / (4 \times 184)$

= 704 mm

where, C = nominal distance between the centre of the blower pulley and the centre of the motor pulley
We select a belt with length of 704 mm. For details on belt specifications refer to Appendix 15.

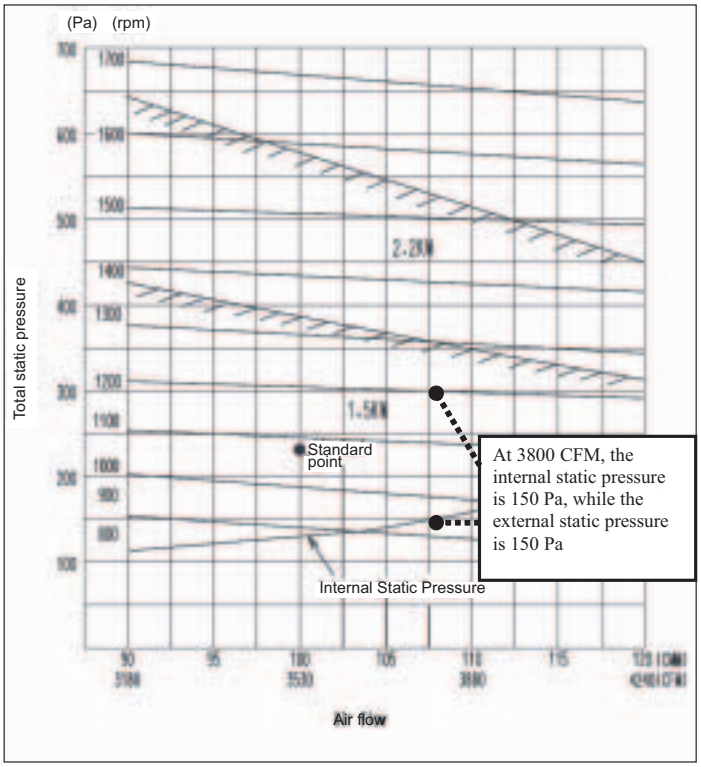


Figure 3-3:UAT280A Blower Curve

For details of other fan curves refer to Appendix 15
In general two types of pulleys are recommended to be used for the roof top units:

a standard V-pulleys

b taper lock pulleys

The number of V-belts used in the unit vary according to the loading of the pulley. Correspondingly the number of grooves along the periphery of the pulley is the same with the number of belts used.

Standard V-pulley

It is recommended to use the NBK, Japan B type pulley and the corresponding B type V-belts. The models of standard V-pulley used in roof top units are B1 and B2.

The cross section of the B type V-Belt is as shown in Figure 3-4. For details on specifications refer to Appendix 6

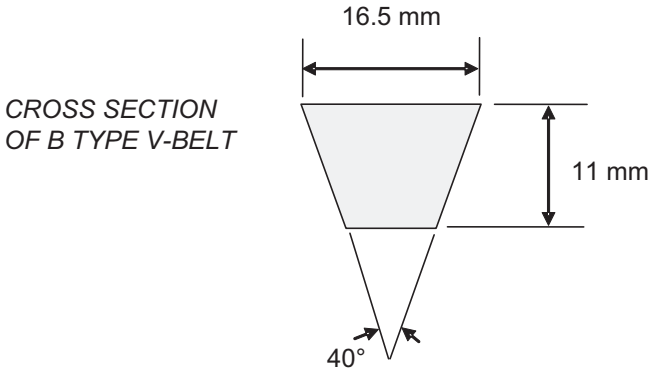


Figure 3-4

Figure 3-5 shows a summary of the available B type pulley designs

	B1	B2	B3
Solid Pulleys	up to 6”	up to 6.5”	up to 6.5”
4 arms	6.5” – 18”	7” – 15”	7” – 14”
6 arms	20” – 22”	16” – 30”	15” – 40”

Note: B# refers to B type pulley and # refers to no of groove

Installation of the Pulley

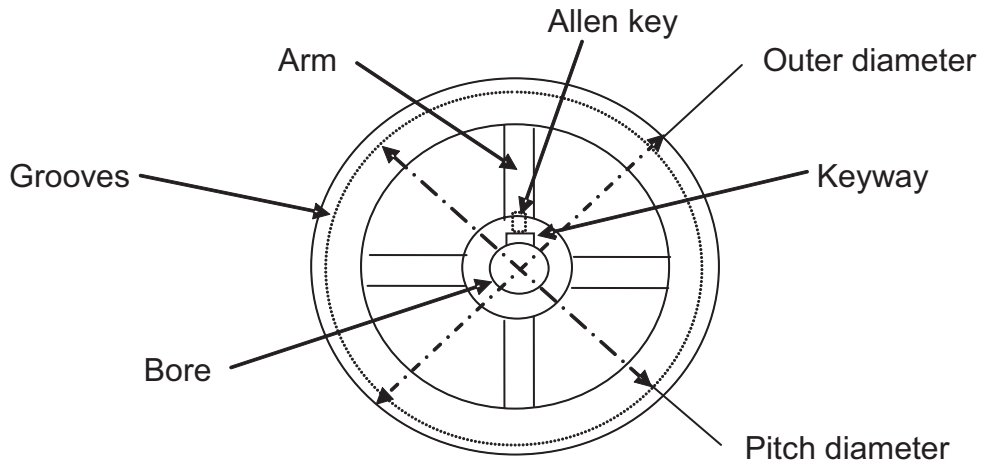


Figure 3-6 shows a picture of a 4 arm pulley.

The following steps are used to install the pulley to the shaft.

1 Insert the bore through the shaft of the motor / blower
2 Use a mallet and slowly knock the pulley into the shaft. CAUTION: Do not use steel hammer as this will damage the pulley
3 Insert the rectangular key into the keyway to secure the pulley
4 Once fitted, tighten the allen key onto the shaft key.

In order to remove the pulley use a bearing puller arm and slowly jack-out the pulley as shown in **Figure 3-7**

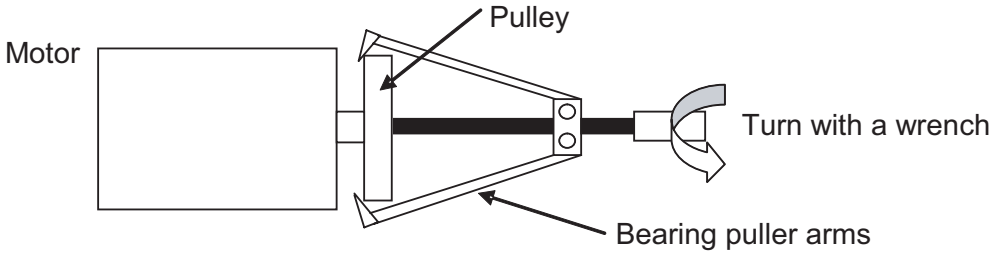


Figure 3-7

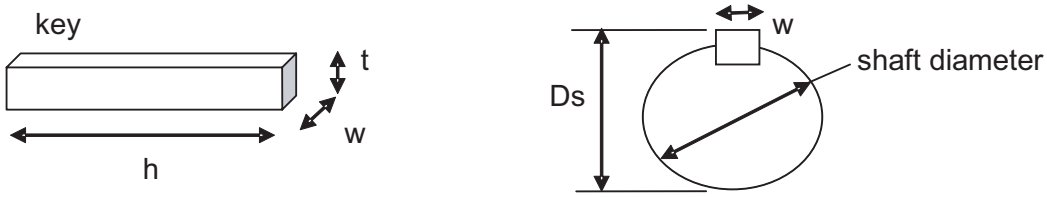
The motor and blower shaft sizes and the key dimensions are as shown in **Figure 3-8(a) and 3-8(b)**

Roof Top Model	Motor, kW	Shaft Ømm	Key dimension,mm (h*w*d)	Ds,mm
UATP/TYP/T/TY180A	0.75kW 50Hz R P714566X03 Hitachi	19.00	32*6*6	21.5
UATP/TYP/T/TY240A	1.1kW 50Hz R P714595X03 Hitachi	24.00	38*8*7	27.0
UATP/TYP/T/TY280A	1.5KW 50HZ R P714567X03 Hitachi	24.00	38*8*7	27.0
UATP/TYP/T/TY320A	1.5kW 50Hz R P714567X03 Hitachi	24.00	38*8*7	27.0
UATP/TYP/T/TY450A	2.2KW 50HZ R P714568X03 Hitachi	28.00	48*8*7	31.0
UATP/TYP/T/TY560A	MOTOR, 3.7KW 50HZ R P714569X03 Hitachi	28.00	48*8*7	31.0
UATP/TYP/T/TY700A	TECO D132S 5.5kW (7.5hp)	38.00	56*10*8	41.0
UATP/TYP/T/TY850A	TECO D132M 7.5kW 4P (10hp)	38.00	56*10*8	41.0
UATPC/TYPC/TC/ TYC10A	TECO D132M 7.5kW 4P (10hp)	38.00	56*10*8	41.0
UATPC/TYPC/TC/ TYC12A	TECO D132M 7.5kW 4P (10hp)	38.00	56*10*8	41.0

Figure 3-8(a)

Roof Top Model	Blower Model	Blower Shaft Ømm	Key dimension,mm (h*w*d)	Ds,mm
UATP/TYP/T/TY180A	D286274, Plastic W125148G05	25.0	Not applicable	Not applicable
UATP/TYP/T/TY240A	L274P712144X04(P712306X01)	25.0	Not applicable	Not applicable
UATP/TYP/T/TY280A	L274P712144X04(P712306X01)	25.0	Not applicable	Not applicable
UATP/TYP/T/TY320A	L274P712144X04(P712306X01)	25.0	Not applicable	Not applicable
UATP/TYP/T/TY450A	D384.5x374 Plastic W125160G04	35.0	Not applicable	Not applicable
UATP/TYP/T/TY560A	D384.5x374 Plastic W125160G04	35.0	Not applicable	Not applicable
UATP/TYP/T/TY700A	CPLT Fan KAT 18/18C D25 Kruger	25.0	40*8*7	28.0
UATP/TYP/T/TY850A	CPLT Fan KAT 18/18C D25 Kruger	25.0	40*8*7	28.0
UATPC/TYPC/TC/TYC10A	CPLT FDA 560 CMV L/H Kruger CCW	40.0	70*12*9	43.0
UATPC/TYPC/TC/TYC12A	CPLT FDA 560 CMV L/H Kruger CCW	40.0	70*12*9	43.0

Figure 3-8(b)



When changing pulleys, it is important that the pulley bore dimensions match the above data. In some instances, the bore must be machined on the new pulley to suit accordingly.

One of the main disadvantages of the standard V-pulley is the difficulty in installing and removing them from the shafts. This is caused by the interference fit of the pulley bore and shaft diameter

Taper lock pulley

This type of pulley consists of two main components

a pulley body

b taper bush

These two components are locked together using 2 Allen hexagonal screws.
Two types of taper lock pulley are available namely

a 3-hole taper bush

b 4-hole taper bush

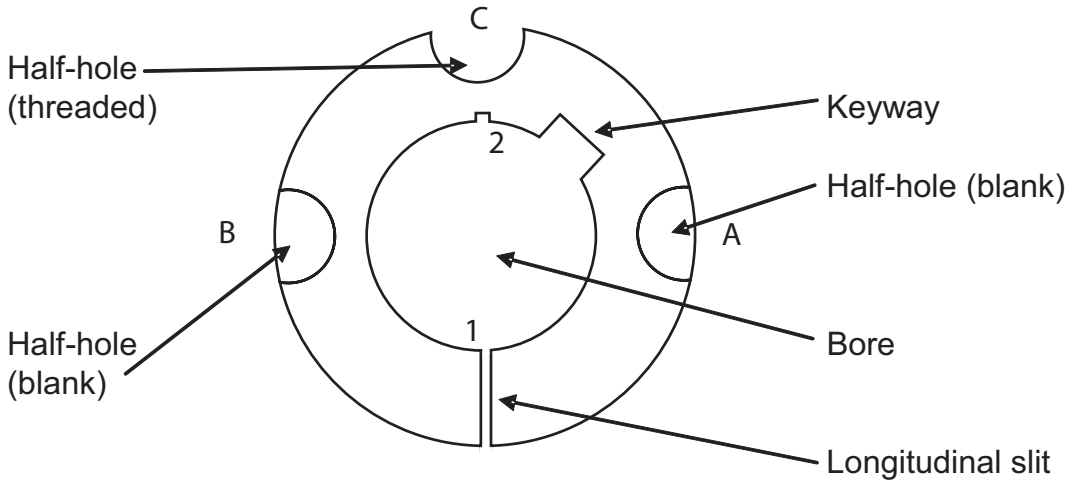


Figure 3-9(a): 3 hole taper bush

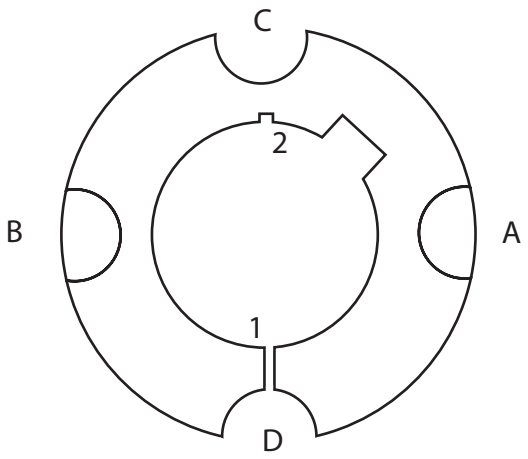


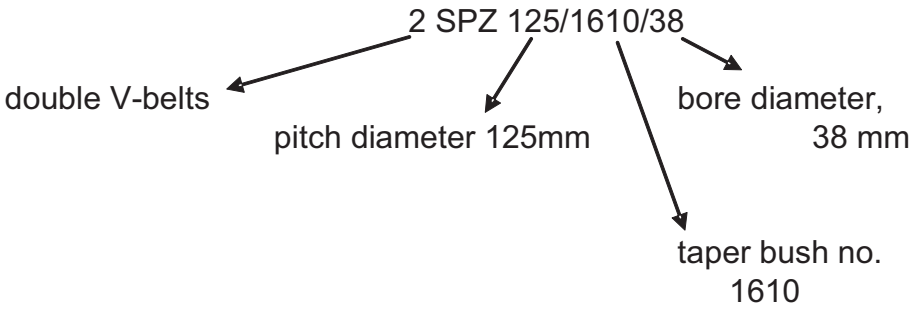
Figure 3-9(b): 4 hole taper bush

The main difference between these two types of taper bush is the three-hole taper bush has an inherent balancing problem while the four-hole taper bush gives a more balanced performance.

It is recommended to use UNIDRIVE taper type pulley with cast iron material and phosphate blackened surface finishing (to prevent rusting)

The models of the UNIDRIVE pulley used in roof top units are SPZ and SPA. The numbers at the back refers to the number of grooves.

Example of taper lock pulley model nomenclature



The dimension of the pulley grooves are different compared with standard V-pulley. Therefore different V-belt sizes are used with the taper pulleys. In general the belts used are smaller in size as can be seen in **Figure 3-10**

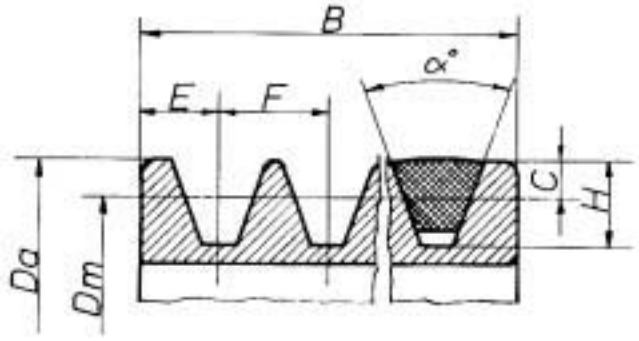


Figure 3-10

where, Da is pulley outer diameter

Dm is pulley pitch diameter

n is number of grooves

B = F(n-1) + 2E

	Dm	E	F	C	H	α°
Taper pulley SPZ	<=80	8	12	2	11	34
	>80	8	12	2	11	38
Taper pulley SPA	<=118	10	15	2.75	13.75	34
	>118	10	15	2.75	13.75	38
Standard V-pulley Type B	<160	12	20	11	15	34
	160-200	12	20	11	15	36
	>200	12	20	11	15	38

Note: All dimensions are in mm

Figure 3-11

The dimensions of the V-belts used for taper pulleys are as shown in Figure 3-12

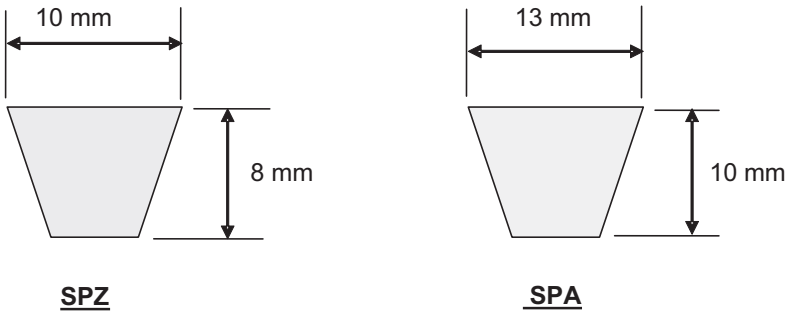


Figure 3-12

Due to its size the V-belt is also called narrow V-belt or wedge belt.

The pitch length is used to describe the model of the belt. For example
SPZ 2360 refers to V-belt SPZ profile with a pitch length of 2360mm

For more details on type of motor pulleys, blower pulleys and belt size used in roof top unit refer to Appendix 15.

Adjustable Pitch V-Belt Pulley

There is another type of pulley where the pitch can be adjusted to give different speed to the motor and blower. This will be useful for application where a slight change in air volume is required. For details on specification refer to Appendix 15-13

All the pulleys installed on the roof top units have fixed pitch. The following steps can be used to change these pulleys to adjustable pitch type.

1 Release the motor mounting bracket and remove the belt.

2 Remove the securing screw that holds the locking cap and then remove the cap.

3 Hold the fixed sheave with one hand and adjust the adjustable sheave with another hand. To increase the blower speed, turn the adjustable sheave clockwise. To reduce the blower speed, turn the adjustable sheave anti-clockwise

4 Once the adjustment is made replace the locking cap by aligning the nearest screw holes of the adjustable sheave with the hole in the locking ring. Lock the ring in place with the securing screw.

5 Put back the belt and check the belt tension.

6 When increasing blower speed, the motor ampere will increase. Check motor ampere and ensure that it falls within the recommended rating. Over amperage may cause motor winding to burn.

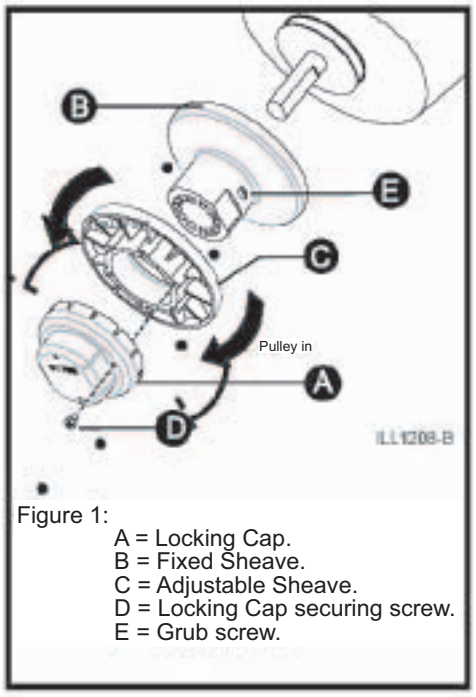
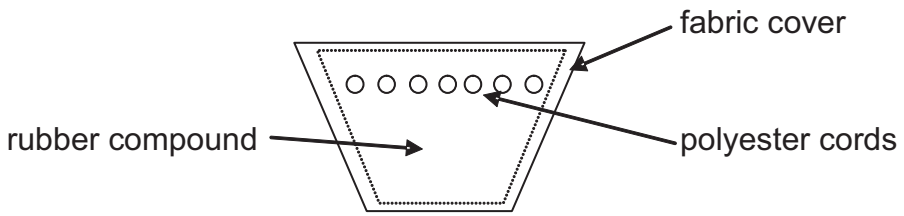


Figure 1:
A = Locking Cap.
B = Fixed Sheave.
C = Adjustable Sheave.
D = Locking Cap securing screw.
E = Grub screw.

Figure 3-13

V-belt characteristic

The V-belt is designed to be oil resistant, heat resistant and anti-static. The types of V-belt recommended are UNIDRIVE, Bando or Mitsubishi. These belts are made from a rubber compound with a fabric cover to resist external influences like oil, dust etc. High tensile polyester cords are embedded inside the belt to give it the necessary tensile strength.



Cross-section of V-belt

Figure 3-14

The smaller the pulley the higher the stress will be on the belt due to bending over a smaller pulley. This will reduce the belt life span as well as transmission power. The following Figure shows the recommended minimum diameter of pulley for each type of pulley used in the roof top units.

Type of pulley	Specifications	Minimum Size
B	B1 (Single belt)	2”
B	B2 (Double belt)	2”
B	B3 (Triple belt)	2”
Taper lock	SPZ	50mm
Taper lock	SPA	60mm

Figure 3-15

Belt Tensioning

In order to have a long, efficient and trouble-free belt operation proper tensioning of the belt is necessary. Loose belts will cause slippage and rapid belt wear and tear. Too tight belt will cause excessive stress on the belt and will reduce the belt life span.

The following steps can be used to install the belt and to ensure proper tensioning of the belt.

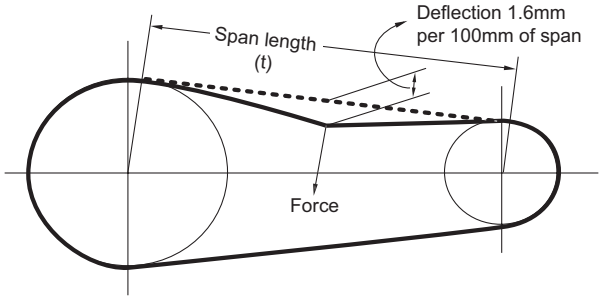
a Calculate and select the right belt length required

b Release the motor mounting bracket to allow the belt(s) to slip and fit over the two motor and blower pulleys. Do not lever the belts over the pulleys. If necessary release the motor mounting legs and adjust the pulley centre distance for the belt to slip in.

c Tighten back the motor mounting bracket assembly and adjust until the belts seat snugly on the grooves and tensioned sufficiently. Refer Figure 3-2

d Run the motor for 5 to 10 minutes and observe the “bow” in the slack side. Tighten until only a slight “bow” appears in the slack side of the belt. For a more thorough check, measure the force needed to be applied to the centre of the span length which produces a deflection of 1.6 mm per 100 mm of span. Refer Figure 3-16 for details. The measured force should fall between the minimum and maximum recommended force.

e A new pulley drive may be tightened up to two times the minimum value to allow for normal drop in tension during run-in. This is due to the new V-belt will seat itself into the pulley groove when in operation especially during the first 24 hours of operation. In this case a retension is necessary.



For standard pulleys:

	Force (min)	Force (max)
Type B sections	3.50 lb-f 1.58 kg-f	5.25 lb-f 2.38 kg-f

Figure 3-16

For taper lock pulleys:

	Force (min)		Force (max)	
	lb-f	kg-f	lb-f	kg-f
SPZ				
50 - 80 mm	2.92	1.32	4.50	2.04
90 - 112 mm	3.60	1.63	5.40	2.45
125 - 160 mm	3.82	1.73	5.84	2.65
180 - 224 mm	4.05	1.84	6.07	2.75
SPA				
50 - 80 mm	3.82	1.73	5.62	2.55
90 - 112 mm	4.94	2.24	7.42	3.37
125 - 160 mm	5.84	2.65	8.77	3.98
180 - 224 mm	6.29	2.86	9.44	4.28

Figure 3-17

Thermostatic Expansion Valves

Thermostatic Expansion Valve (TXV) is a precision device used to regulate the rate of refrigerant liquid flow into the evaporator in the exact proportion to the rate of evaporation of the refrigerant liquid inside the evaporator.

The main components of TXV include a power assembly, a cage assembly and a body flange. The power assembly has a remote sensor bulb and power element which is normally charged with the same refrigerant as the roof top unit. This power assembly makes up a close system. The refrigerant in the power assembly senses the temperature of the gas leaving the evaporator outlet pipe and exerts a pressure which corresponds to the saturation pressure of the gas temperature. In the cage assembly there is a spring which exerts a pressure opposed to the power assembly. The tension of this spring can be either fixed or adjustable. TXV is installed on the liquid pipe and close to the evaporator. The body flange shown in this diagram makes installation easier as during the process of brazing, the power assembly and the cage assembly can be separated to avoid heat transfer that could destroy the components inside.

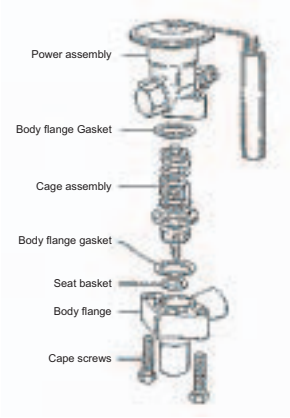


Figure 12

An external equalizer is placed on the evaporator outlet after the sensor bulb to allow for pressure drop in the evaporator coil. The remote sensor bulb and the power element move the valve pin in the opening direction. The pressure exerted by the evaporator and the superheat spring act in the closing direction.

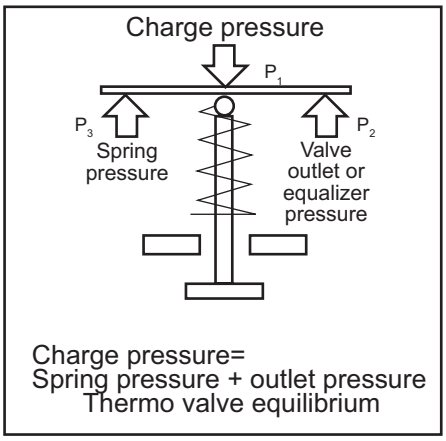


Figure 1A

The function of the TXV is to control the superheat of gas leaving the evaporator.
At equilibrium P1 = P2 + P3. When the refrigerant temperature at the evaporator outlet increases as it becomes superheated, the pressure generated in the sensor bulb P1, increases above P2+P3 and causes the valve pin to move in an opening direction. Likewise when the refrigerant temperature at the evaporator outlet decreases, the pressure in the sensor bulb also decreases causing P1 to be less than P2+P3, the valve will move in the closing direction.

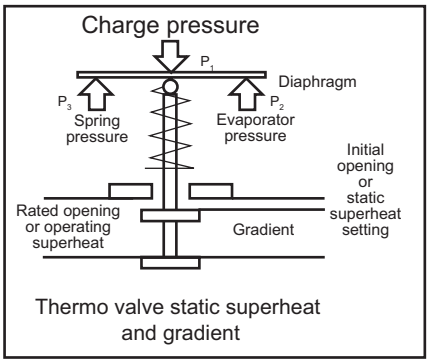
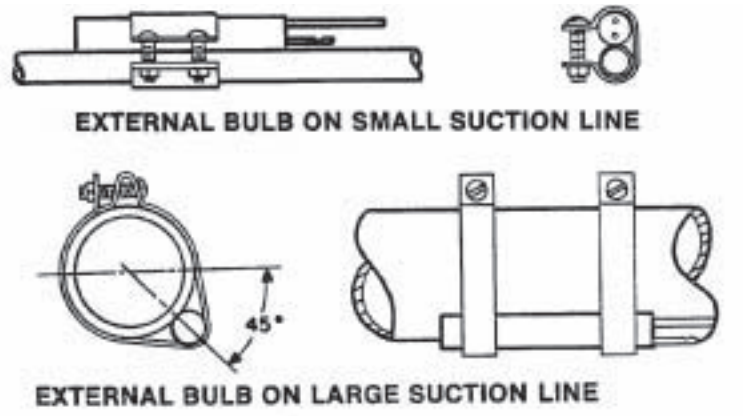


Figure 2

The sensor bulb is placed on the suction line in order to sense the return gas superheat. A metal clamp is wrapped around the bulb and copper pipe and then the clamp is tightened with bolt and nut. The whole assembly is wrapped with cork tape. This is to ensure accurate sensing of the refrigerant temperature of the evaporator outlet. The bulb is placed on a horizontal position.

For suction pipe sizes less than 7/8" diameter the bulb can be positioned on top of the line. For suction pipe sizes 7/8" diameter and above, the bulb can be positioned at 4 or 8 o'clock.



Superheat setting

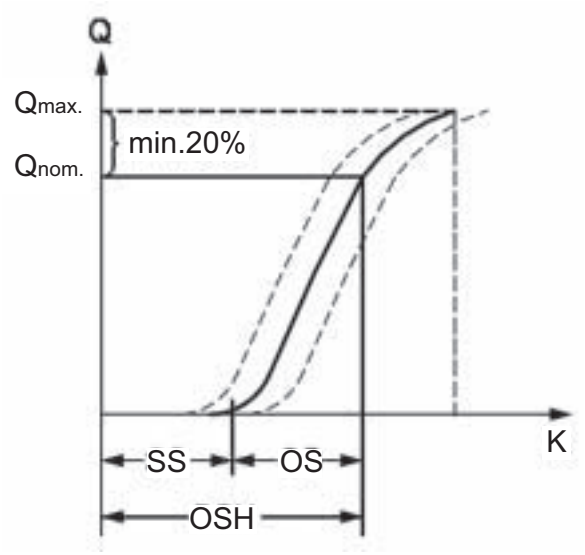
In general, most TXV has a superheat adjustment screw. However, some TXV has a fixed superheat setting. TXV is manufactured with a pre-set superheat setting, but adjustment can be made.

Turning the adjustment screw clockwise will increase the superheat and anti-clockwise will reduce it. This will actually adjust the spring tensioning within the valve and changes the static superheat (SS) of the TXV.

Each TXV will also have a specified opening superheat (OS) which is defined as the superheat which causes the valve to open 100%, giving the nominal rated capacity (Q_{nom}). Thus, the total operating superheat (OSH) of the valve is given as:
OSH = SS + OS

See diagram below.

Refer to manufacturer's specifications for the values of SS and OS.



TXV are designed to operate with a full liquid column seal on the inlet. Insufficient sub-cooling may produce flash gas through the valve and decrease the performance. Recommended sub-cooling is between 3 to 5^{o}C. This can be measured using pressure gauge and thermocouple at the condenser out piping before the TXV.

Chapter 4: Motor

All roof top units use 3 phase squirrel cage induction motors. For details refer to Appendix 15.

All the indoor motors are air-cooled with an external polypropylene fan at one end of the motor which is attached together to the motor shaft. A fan cover is attached over the fan for protection. The air inlet mesh has been designed to prevent fingers from going into the fan compartment.

This motor frame also has fins to dissipate heat from its body. The body is made from cast iron. The motor shaft itself is made from medium carbon steel machined with keyway. It is coated with grease to prevent rusting and this coating should not be removed especially during installation or changing pulleys.

The indoor motors used in the roof top units are horizontally foot mounted. They have a protection index of IP54 which means that they are protected against contact with live or moving parts inside the motor and against water splash on the motor from any direction.

The indoor motors have a Class B winding insulation (for UATP/TYP/T/TY180A to UATP/TYP/T/TY560A) with a maximum winding temperature of 130°C or Class F winding insulation (for UATP/TYP/T/TY700A to UATPC/TYPC/TC/TYC12A) with a maximum winding temperature of 155°C. The motor is air-cooled, therefore the air stream over the motor should not be blocked in any way. Besides this the motor must not be subject to very high external static pressure otherwise the motor winding may overheat and burn. It is recommended to operate the unit within an ambient temperature range of -10°C to 40°C. The outdoor motors have a Class F winding insulation (for UATP/TYP/T/TY180A to UATPC/TYPC/TC/TYC12A) with a maximum winding temperature of 155°C except for UATP/TYP/T/TY320A which has a Class E winding insulation with a maximum winding temperature of 125°C.

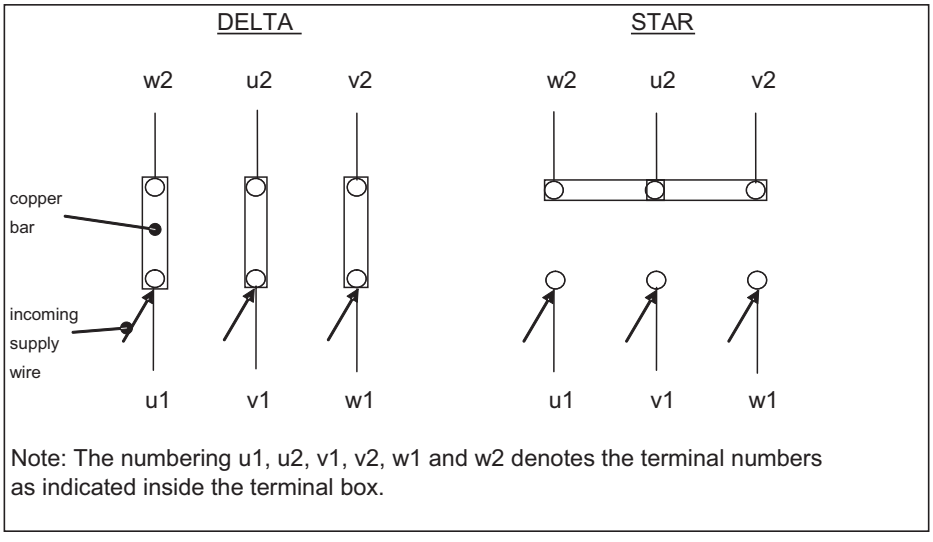
The motors have two pieces of ball bearings at both ends to support the rotor shaft. These bearings are double-shielded and pre-packed with lithium-base grease (Alvania No.3) No additional grease is required during the normal operation of the motor.

Three phase motors are self-starting. Therefore no starting capacitors are needed. It has six terminals as shown in Figure 4-1(a). The connection of these terminals will determine the wiring configuration of the motor. There are two types of connection namely:

a star connection

b delta connection

Each of these motors has three stator windings which are connected to the three-phase power supply as shown in Figure 4-1(b)



Note: The numbering u1, u2, v1, v2, w1 and w2 denotes the terminal numbers as indicated inside the terminal box.

Figure 4-1(a)

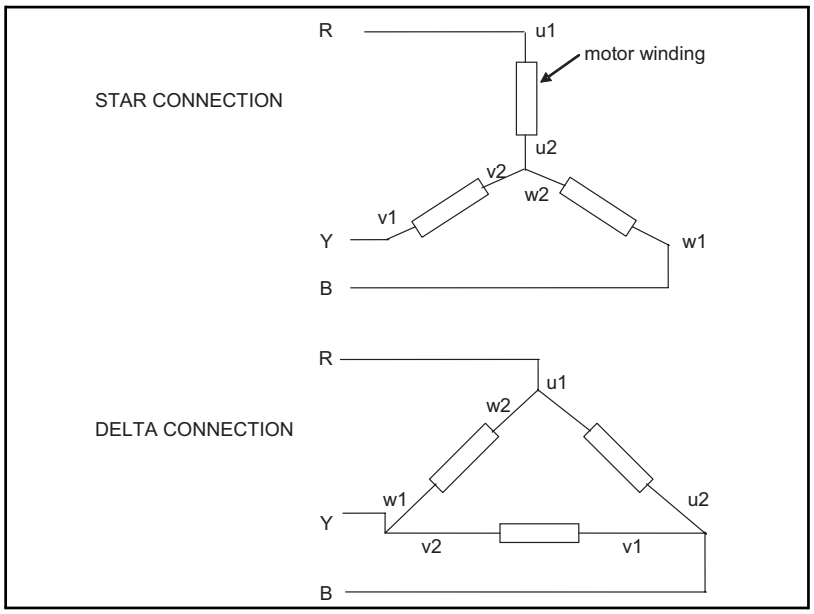


Figure 4-1(b)

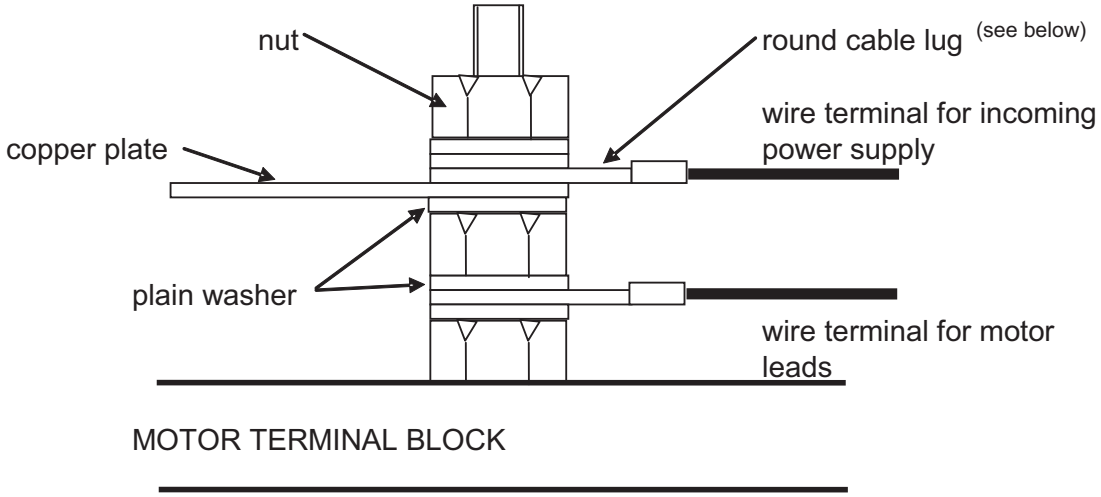
The roof top indoor motors have the following connection

Model	Motor Connection
UATP/TYP/T/TY180A	Star
UATP/TYP/T/TY240A	Star
UATP/TYP/T/TY280A	Star
UATP/TYP/T/TY320A	Star
UATP/TYP/T/TY450A	Star
UATP/TYP/T/TY560A	Star
UATP/TYP/T/TY700A	Delta
UATP/TYP/T/TY850A	Delta
UATPC/TYPC/TC/TYC10A	Delta
UATPC/TYPC/TC/TYC12A	Delta

Figure 4-2

One of the common applications is to use the star connection for starting purpose due to the lower current drawn. For such application, all the copper plates are removed and the six motor terminals are connected externally to a switchboard where a set of relays and magnetic contactors will changeover between start and delta connection. For details refer to Chapter 5 on Electrical Wiring.

The following diagram illustrates how the copper plates and incoming wire terminal should be connected to the motor terminal:



The copper plate has a shape as shown here.

Additional plain washers and nuts are supplied together for wire connection.

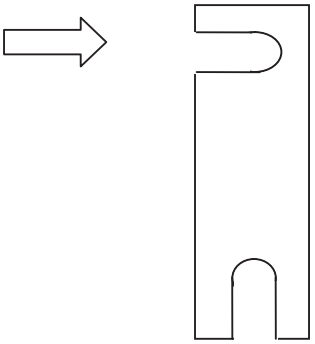


Figure 4-3

Use ONLY round cable lugs to connect the incoming supply wire to the terminals. Do not use “Y” fork cable lugs because these may be pulled out from the terminals when the wire cable is jerked.
During wiring connection, do not damage the rubber gasket on the terminal cover. This rubber gasket is there to prevent ingress of water into the terminal box when water is splashed unto it. All motors have the terminal box by the side of the body with the incoming wire hole beneath the box. This is to prevent water from entering into the box when water is splashed onto the motor.

It is recommended that a “cross” to be cut on the wire rubber bush to pass through the wire cable. Do not cut-off any piece of the rubber as this may cause water to enter the terminal box.

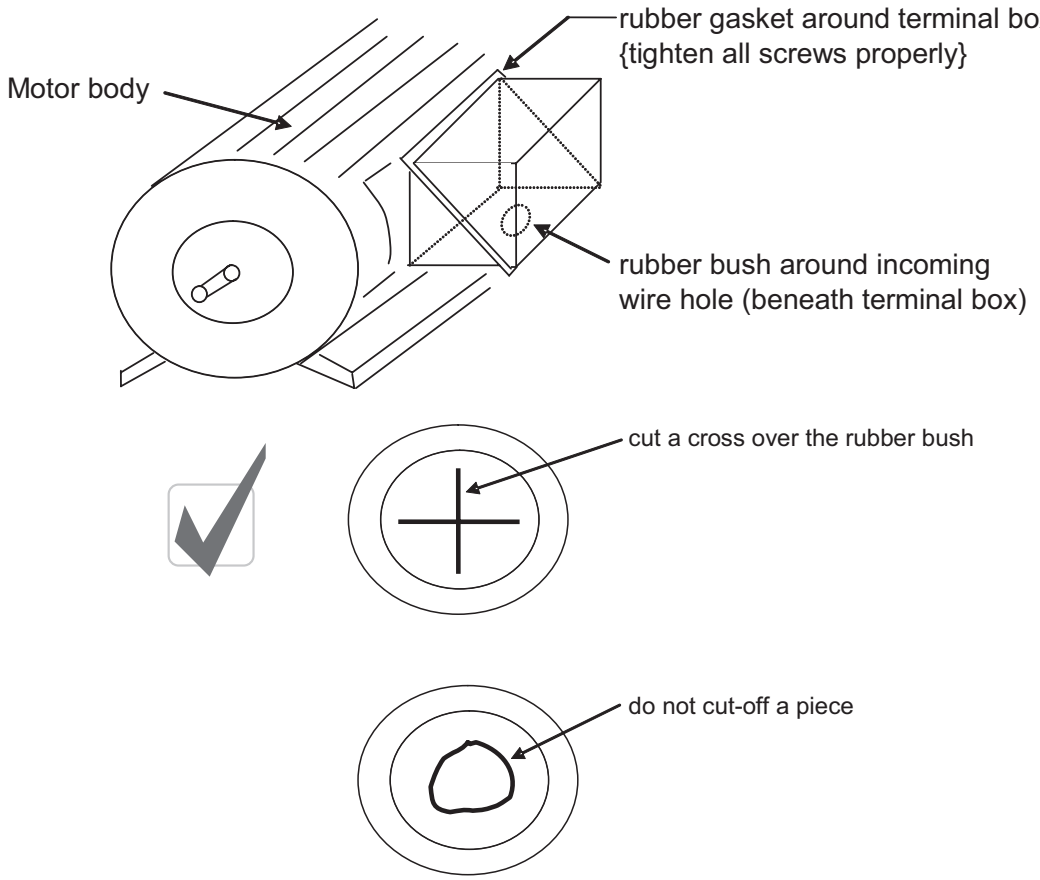


Figure 4-4

Motor Change

Certain applications may require a bigger size motors.
The following steps can be used while changing the indoor motor.

1 Disconnect the main incoming power supply.

2 Remove the service panel.

3 Loosen the motor bracket to un-tension the V-belt.
(Refer to Figure 3-2)

4 Remove the four mounting bolts and nuts to the bracket

5 Take out the motor. For larger and heavier motors it may be necessary to use a chain block to lift and take out the motor. Every motor has an eye bolt on top of it for lifting purpose.

6 Dismantle the pulley from the old motor and install the new motor.

7 Tighten all mounting bolts and nuts. Re-tension the V-belt by adjusting the mounting bracket.

8 Reconnect the incoming cable. Test run and check the rotation of the blower.

The mounting bolt holes for larger size motor have been punched onto the motor mounting bracket. Refer Figure 4-5

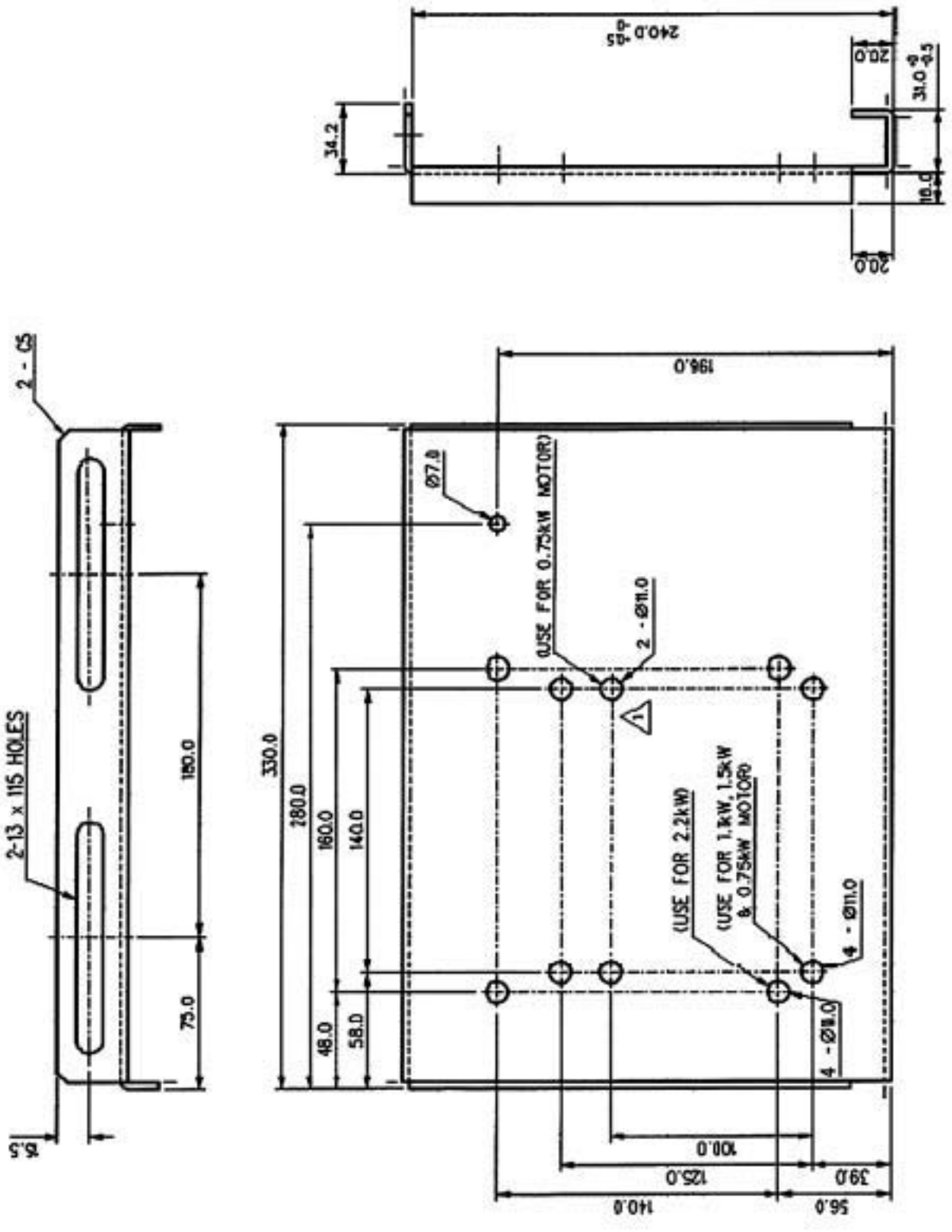


Figure 4-5(a) Motor Mounting Base for UATP/TYP/T/TY180/240/280/320A

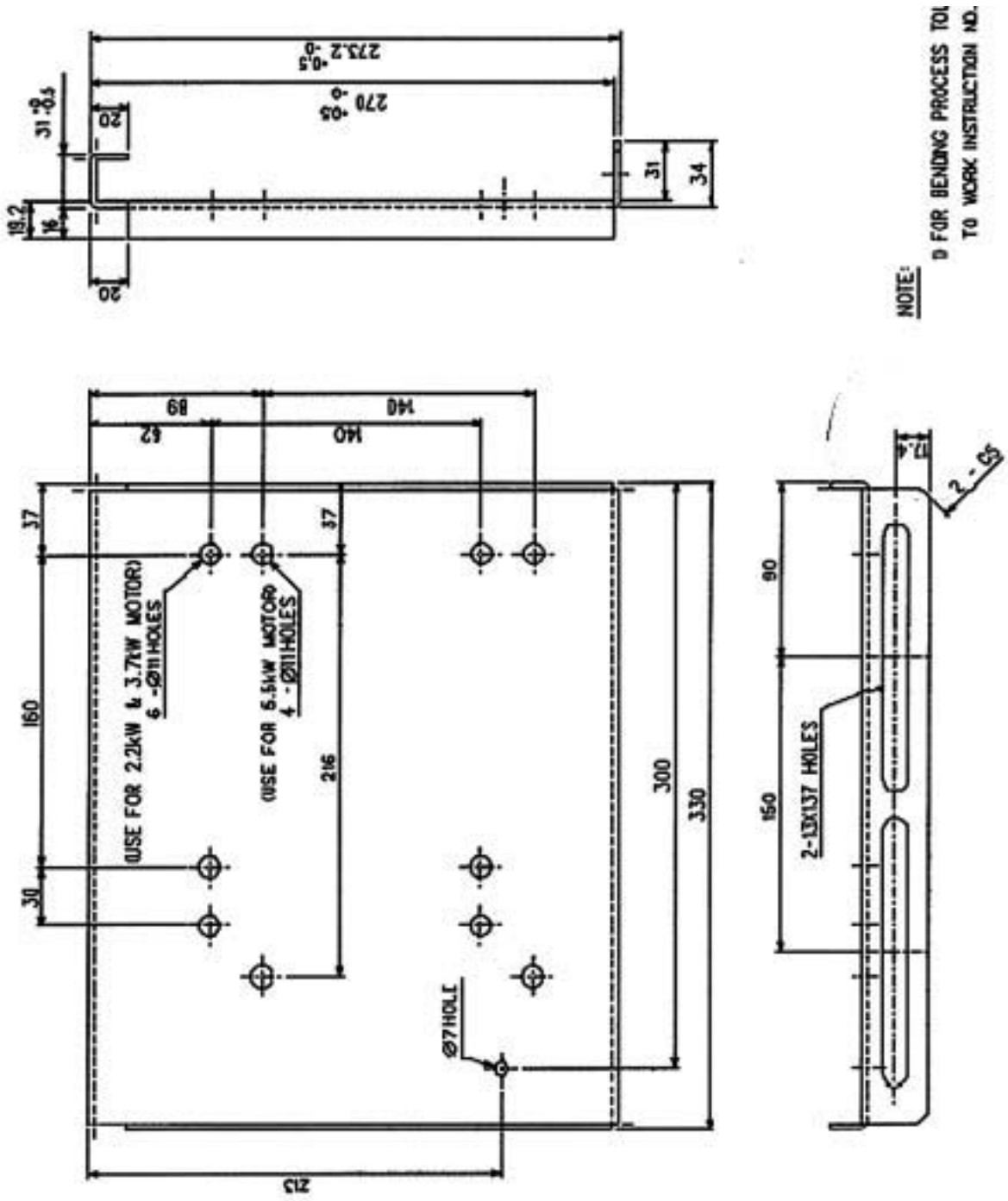


Figure 4-5(b) Motor Mounting Base for UATP/TYP/T/TY450/560A

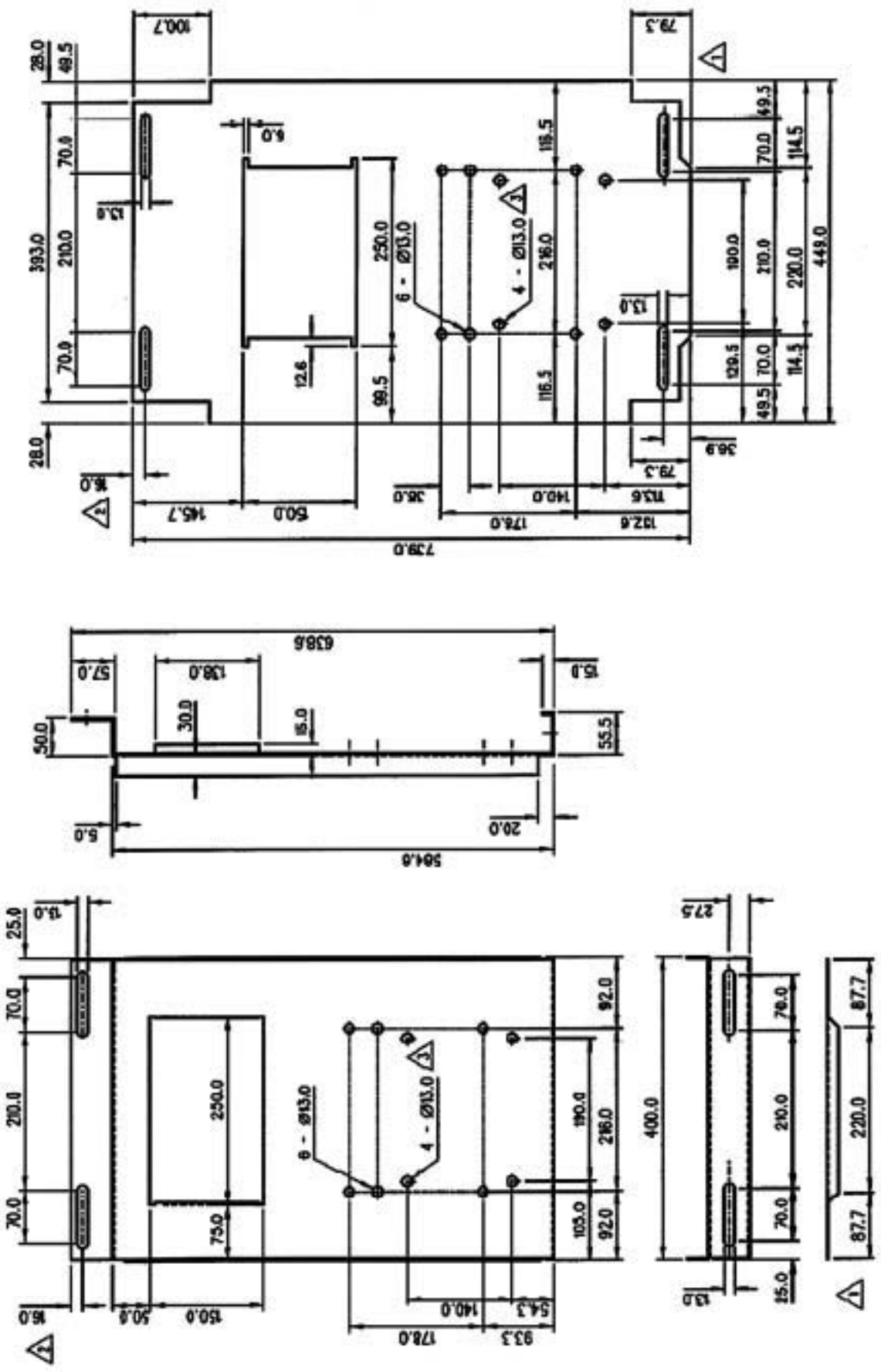


Figure 4-5(c) Motor Mounting Base for UATP/TYP/T/TY700/850A

Motor rotation

It is important to check that the motor rotation is in the right direction. Reverse rotation will cause insufficient air and sometimes abnormal noise and vibrations.
Generally, the blower impeller will rotate in the direction of the increasing housing scroll volute towards the discharge mouth opening. This direction is indicated by a stamped arrow or sticker type on the blower housing itself.

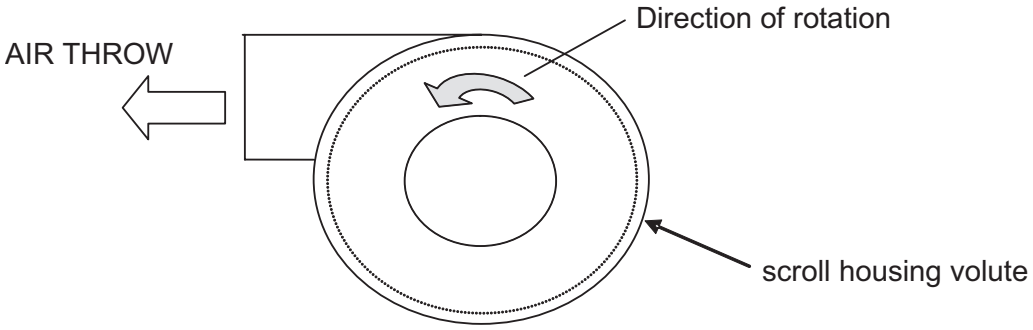


Figure 4-6

In order to determine the rotation of the motor, momentarily switch on and off the motor and see the direction of the blower. If the rotation is reverse, simply switch the wire connection of any two of the three phases.

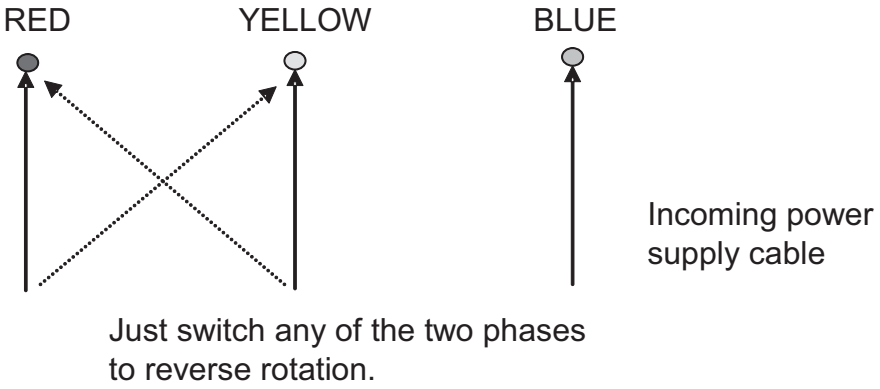


Figure 4-7

Chapter 5: Electrical Wiring

There are several methods which can be used to wire the roof top unit:

a electronic main control board

b star-delta starter

c direct on line (for cooling only model)

Wire Size and Earth Leakage Circuit Breaker

Model	Power cable mm^2	Earth Cable mm^2	Fuse (Class B),A	ELCB (with overload protection)	
				A	mA@0.1s
UATP/TYP/T/ TY180A	8	8	40	40	<=30
UATP/TYP/T/ TY240A	14	14	40	50	<=30
UATP/TYP/T/ TY280A	14	14	40	50	<=30
UATP/TYP/T/ TY320A	14	14	40	50	<=30
UATP/TYP/T/ TY450A	22	22	40	100	<=100
UATP/TYP/T/ TY560A	22	22	40	100	<=100
UATP/TYP/T/ TY700A	38	38	40	125	<=100
UATP/TYP/T/ TY850A	60	60	40	175	<=100
UATPC/TYPC/TC/ TYC10A	60	60	125	175	<=100
UATPC/TYPC/TC/ TYC12A	60	60	125	175	<=100

Figure 5-1

Electronic Main Control Board

All roof top units are installed on the roof top. The wiring diagram is as shown in Appendix 16.

Star-Delta Starter

This type of wiring makes use of the low starting current characteristic of the star connection. By pressing the push start button, the motor is connected as a star. A timer delay of a few seconds changes the connection to delta for normal operation. This changing from star to delta uses two sets of contactors. Refer to Figure for details of wiring.
In order to run the start-delta starter all copper bars are removed from the three phase motor terminals and to run wires from the six terminals as shown. This star-delta circuitry is located in an external switchboard.

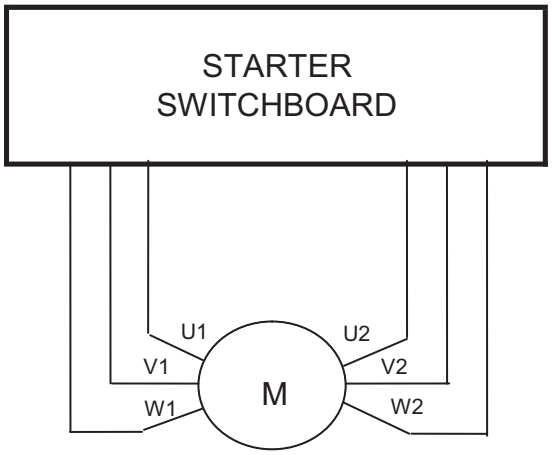
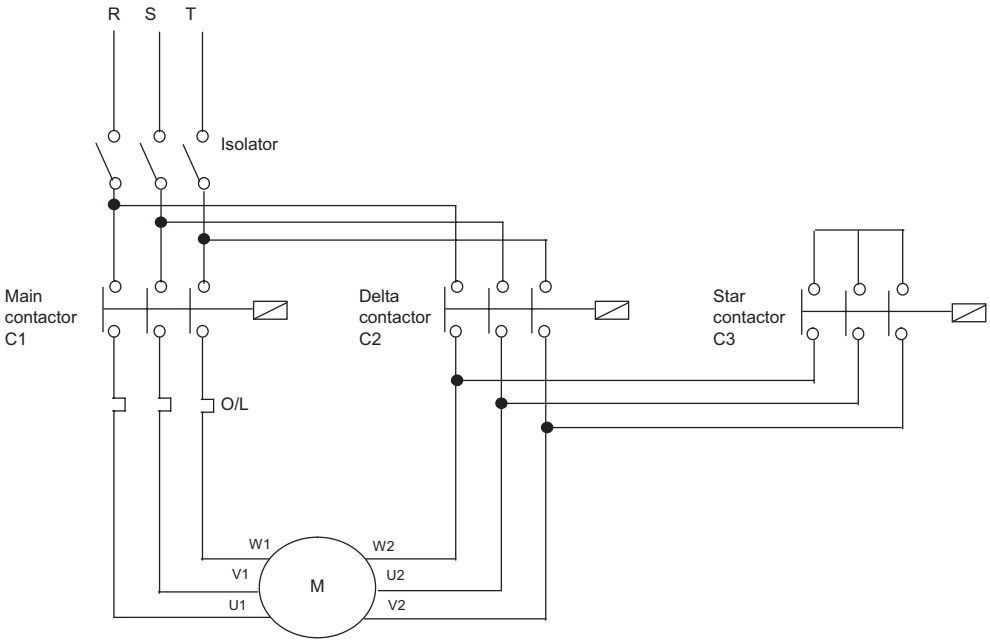


Figure 5-2

STAR-DELTA STARTER WIRING DIAGRAM

Power circuit:



Control circuit:

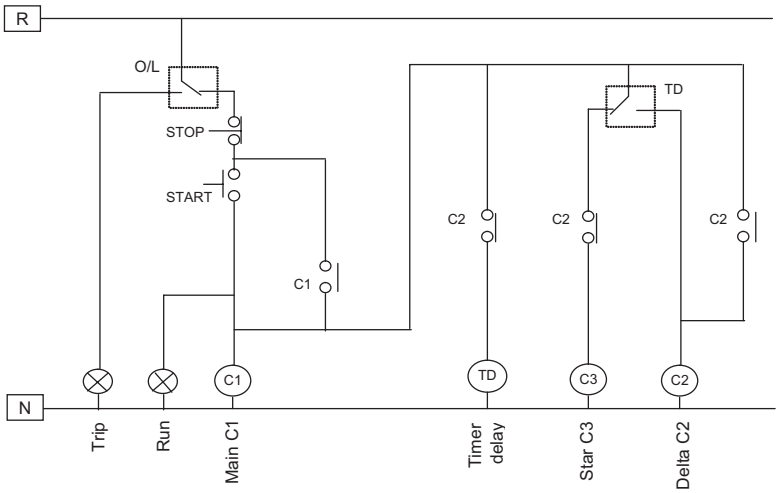


Figure 5-3

Direct on-line

This is a common method for cooling only model. By pushing a button or switch the power supply is directly supplied to each component.
This is done via a magnetic contactor which energizes when the push button or switch is turned on. This button / switch can be located on the external switchboard itself or remotely in the conditioned room itself.

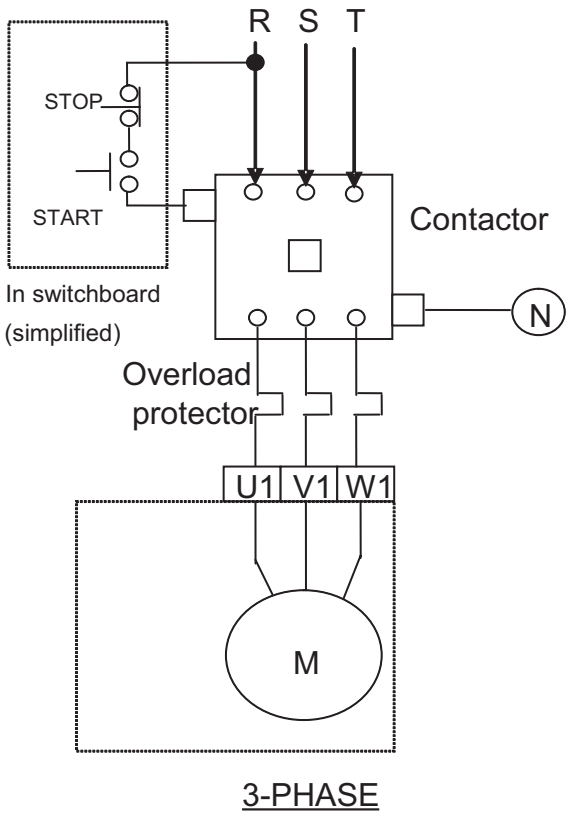


Figure 5-4

The disadvantage of this method of wiring is the high starting current for large three phase motors may cause surge of power supply. Tripping of protective device may occur. Lights may flicker during the starting of the motor.

Other starters

The auto-transformer can be used to step down the incoming supply voltage momentarily (normally 70%) during start-up in order to reduce the current. By using magnetic contactors this voltage is restored to full value after a few seconds of starting. Refer Fig 5-5(a) and (b)for details.
Soft-starters can be used to run the motor to reduce sudden surge of current during start-up. However soft-starters are costly to install. Modification of internal wiring is required.

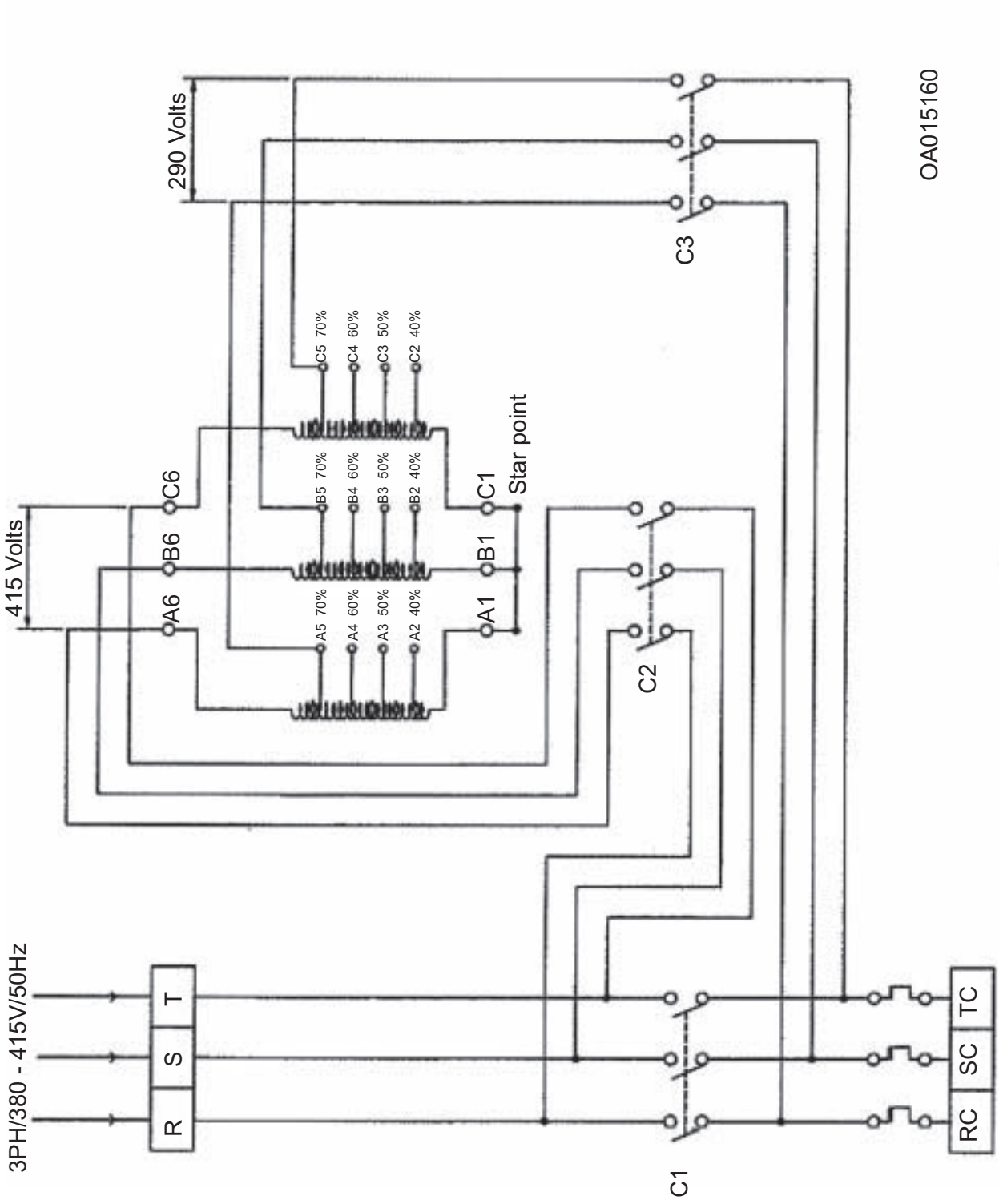

OA015160
290 Volts
C3
C5 70%
C4 60%
C3 50%
C2 40%
B5 70%
B4 60%
B3 50%
B2 40%
A5 70%
A4 60%
A3 50%
A2 40%
C6
B6
A6
C1
B1
A1
Star point
415 Volts
C2
3PH/380 - 415V/50Hz
T
S
R
TC
SC
RC
C1

Figure 5-5(a)

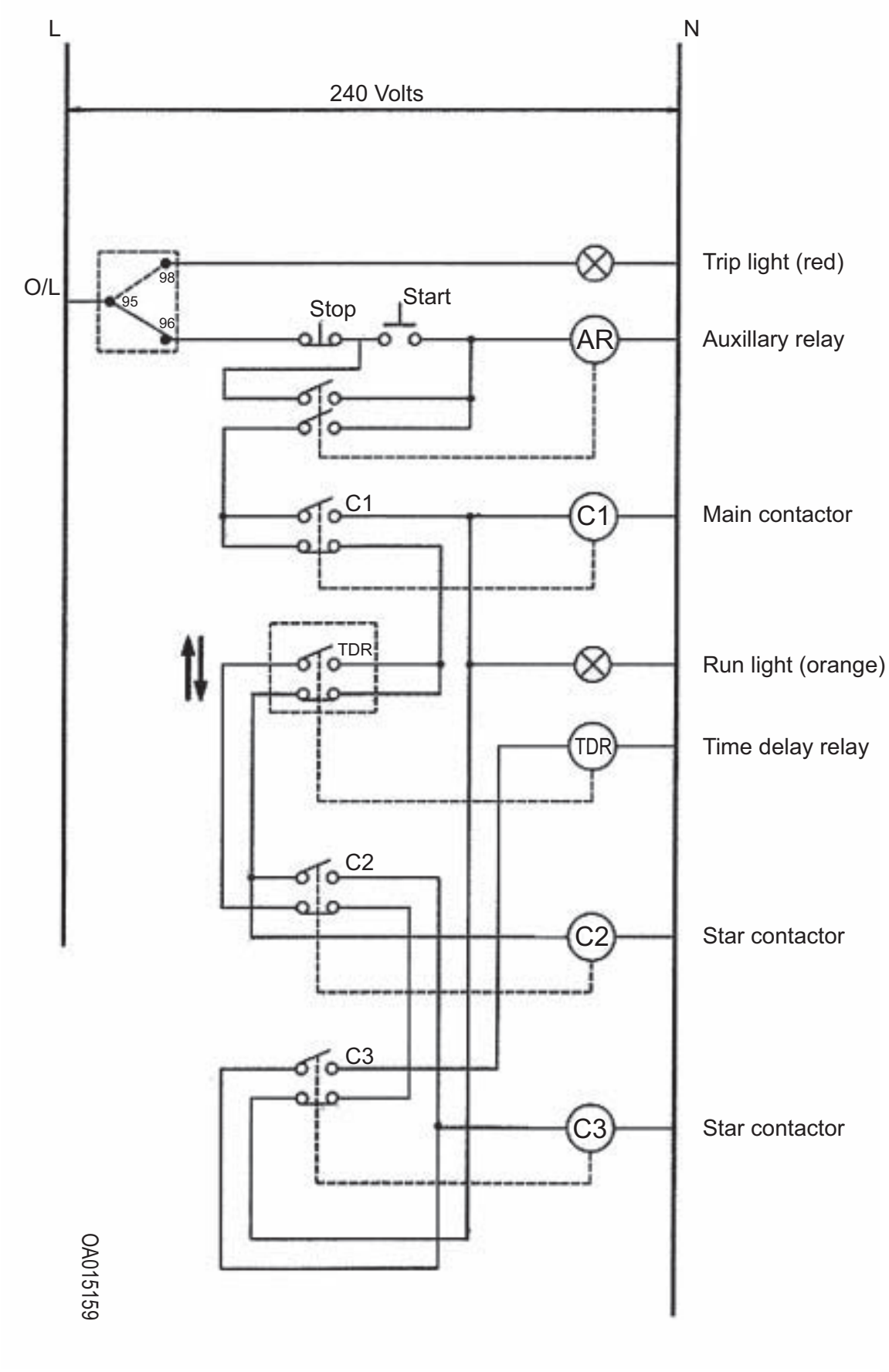

L
N
240 Volts
O/L
98
95
96
Stop
Start
AR
Trip light (red)
Auxillary relay
C1
C1
Main contactor
TDR
TDR
Run light (orange)
Time delay relay
C2
C2
Star contactor
C3
C3
Star contactor
OA015159

Figure 5-5(b)

Appendix 1

Tomahawk

Rubber Pads

Rubber Pads.

Rubber Pads (sheets) have long been the most general and widely used material effective in reducing minor or non-critical noise and vibration. Tomahawk's "MPT" rubber pads (sheets) are "cross-ribbed" design between upper and lower surfaces and have been engaged widely to isolate noise and vibration of many machines and HVAC equipments. It is relatively easy to cut MPT pads to various sizes thanks for its 'ribs' design feature. In general MPT pads are applied free from anchor bolting except when cases of enormous horizontal forces distinctively exist.

Three (3) sizes of MPT rubber pads are available:

Dimension		Unit: mm		Compression Loading:	
Model	Thickness	Width	Length	Recommended Kg/cm² (Psi)	Maximum Kg/cm² (Psi)
MPT-9	9	300	600	3.0 (43)	5.0 (70)
MPT-13	13	300	600	4.0 (57)	8.0 (115)
MPT-19	19	300	600	5.0 (70)	8.0 (115)

Rubber Pads.

Stacking For More Deflection

MPT pads may be stacked to increase deflection for better noise and vibration reduction while shimmed with 1.6 mm thick steel plate (s) for better rigidity.

Example: if 3 layers of pads are stacked thus offering 3 times the deflection of a single layer under the same load.

Appendix 2

Damping factors for materials commonly used for isolators

Material	Approx Damping Factor C/C_c	Tmax (approx)
Steel Spring	0.005	100
Elastomers		
Natural Rubber	0.05	10
Neoprene	0.05	10
Butyl	0.12	4.0
Barry Hi Damp	0.15	3.5
Barry LT	0.11	4.5
Barry Universal	0.08	6.0
Friction Damped Springs	0.33	1.5
Metal Mesh	0.12	4.0
Air Damping	0.17	3.0
Felt and Cork	0.06	8.0

Appendix 3-1

VIBRA SYSTEMS INC.
Anti-Vibration Products

310 Rayette Rd. Concord, Ontario, L4K 2G5
Tel: 905-738-7810 Fax: 905-738-0697
E-mail: info@vibrasystems.com
Web-site: www.VibraSystems.com

E-100 Series
SPRING MOUNT

FEATURES:

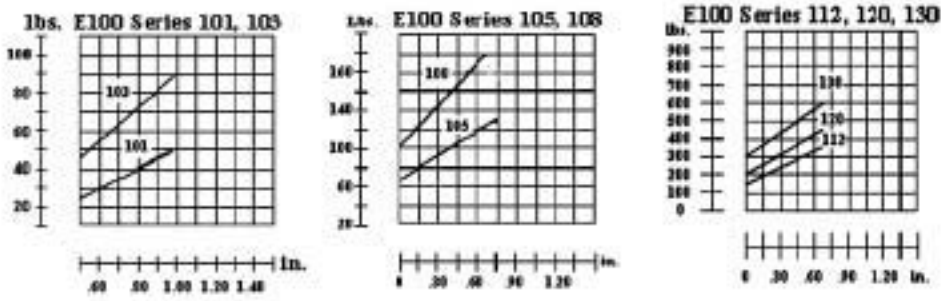
E 100 Series Spring Mounts are a open spring construction with a central internal screw thread on both top and bottom. The steel construction gives a strong and resilient mount suitable for harsh environments. Open spring mounts have a low natural frequency and can absorb lateral interference without restrictive contact. This type has two structures born noise insulating intermediate layers as standard.

SPECIAL FEATURES:

- **Low natural frequency**
- **Quick and easy installation**
- **Suitable for harsh environments**
- **Load ranges from 25 lbs to 700 lbs**
- **Suitable for Fans, chillers, HVAC units, cooling towers, etc.**

Product Code	Min. Load (lbs)	Max Load (lbs)	Thread (T)	Height (ins)	D
E 101 V	25	50	M10	2-3/8	3-1/8
E 103 V	45	90	M10	2-3/8	3-1/8
E 105 V	65	130	M10	2-3/8	3-1/8
E 108 V	95	200	M10	2-3/8	3-1/8
E 112 V	165	330	M12	3-1/2	3-1/8
E 120 V	220	440	M12	3-1/2	3-1/8
E 130 V	300	660	M12	3-1/2	3-1/8

LOAD VS DEFLECTION:



Appendix 3-2

VIBRA SYSTEMS INC.
Anti-Vibration Products

310 Rayette Rd. Concord, Ontario, L4K 2G5
Tel: 905-738-7810 Fax: 905-738-0897
E-mail: info@vibrasystems.com
Web-site: www.VibraSystems.com

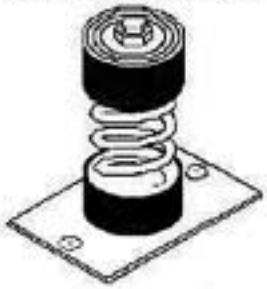
BA or BD Series
SPRING MOUNTS

BA or BD series spring mounts are unhoused laterally stable steel springs contained in molded neoprene acoustical cups (weld free construction) with leveling bolt assembly. Springs are galvanized for long operating life without any rusting and are color coded for easy field identification. Springs have a 50% additional travel to solid load as per ASHRAE recommendations. These spring mounts can also be supplied with a base plate if required to be bolted to floor.

These spring mounts are recommended where both horizontal and vertical stability are required. These series spring mounts are used for vibration & noise control applications such as pumps, centrifugal fans, air handling units, air compressors and similar applications.

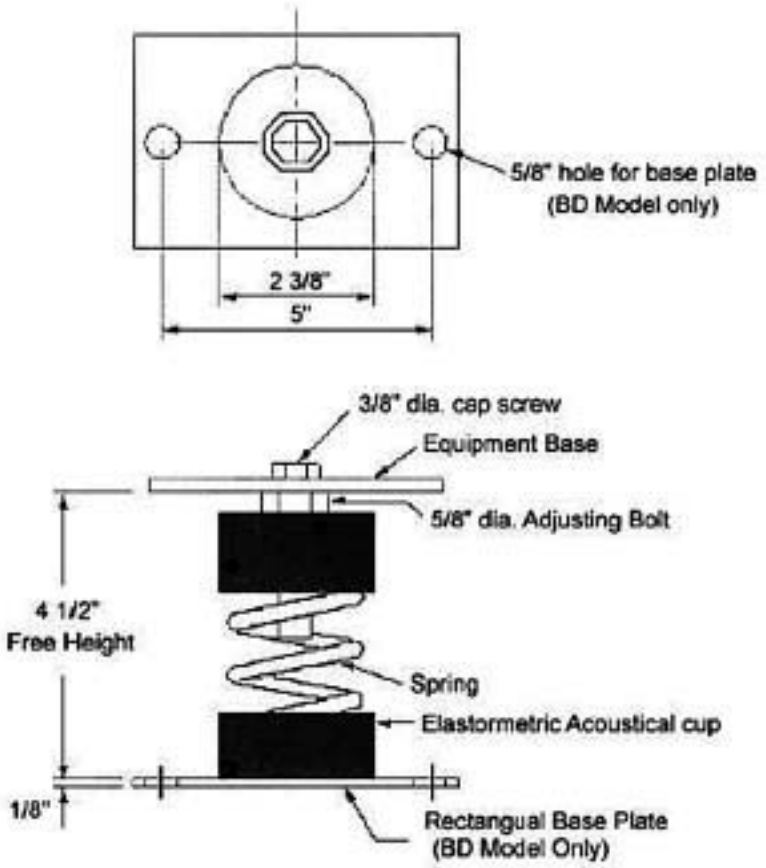
Model 'BA' (w/o base plate)

Model 'BD' (with base plate)



MODEL	Dimension in Inches						
	E	F	G	H	I	J	K
BA OR BD (WITH BASE PLATE)	5	2 3\8	5\8	4 1\2	1\8	3\8	5\8

Appendix 3-3



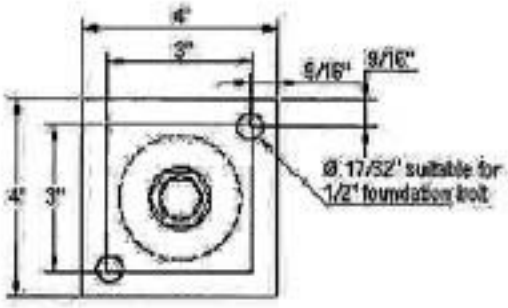
ISOLATOR MODEL	RATED LOAD (LBS)	SOLID LOAD (LBS)	DEFLECTION AT SOLID LOAD (INCH)	COLOR	
				MAIN	STRIPE
BA-121	40	60	1.3	SILVER	BLUE
BA-122	66	100	1.3	SILVER	ORANGE
BA-123	110	165	1.2	SILVER	BROWN
BA-124	173	260	1.0	SILVER	BLACK
BA-125	246	370	0.8	SILVER	YELLOW
BA-126	300	450	0.5	SILVER	RED
BA-127	466	700	0.45	SILVER	GREEN

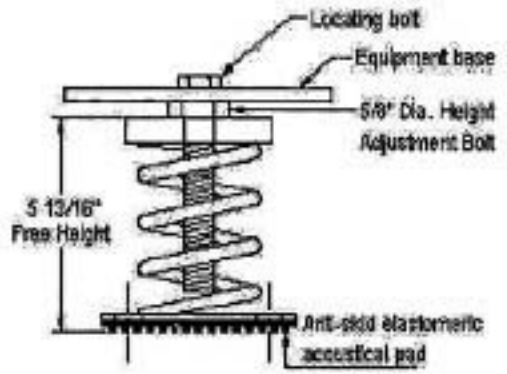
Appendix 3-4

VIBRA SYSTEMS INC.
Anti-Vibration Products

310 Rayette Rd. Concord, Ontario, L4K 2G5
Tel: 905-738-7810 Fax: 905-738-0897
E-mail: info@vibrasystems.com
Web-site: www.VibraSystems.com

OSM-1-140 Series
SPING MOUNTS
2"Deflection





OSM Series spring mounts are unhoused, laterally stable steel springs welded to the top and bottom steel plates. The upper load plate includes a leveling bolt assembly. The lower steel plate features a neoprene acoustical friction pad. Mounting holes are provided on all mounts. These spring mounts have a built leveling device. The Springs are galvanized for long operation life without any rusting problems and are color coded for easy field identification. Springs have a 50% additional travel to solid load as per ASHRAE recommendations.

These spring mounts are recommended where both horizontal and vertical stability are required. In general these series spring mounts are used for vibration & noise control applications such as pumps, centrifugal fans, air handling units, air compressors and for similar applications.

ISOLATOR MODEL	RATED LOAD (LBS)	SOLID LOAD (LBS)	DEFLECTION AT SOLID LOAD (INCH)	COLOR	
				MAIN	STRIPE
OSM-1-140	66	100	2.25	SILVER	BLUE
OSM-1-141	133	200	2.25	SILVER	BLACK
OSM-1-142	250	375	2.0	SILVER	RED
OSM-1-143	333	500	2.0	SILVER	GREEN
OSM-1-144	476	714	2.0	SILVER	GRAY
OSM-1-147	953	1430	2.0	SILVER	WHITE
OSM-1-148A	1261	1892	2.0	SILVER	YELLOW
OSM-1-140-146B	460	690	2.0	SILVER	BLUE
OSM-1-141-146B	518	778	2.0	SILVER	BLACK
OSM-1-142-146B	650	976	2.0	SILVER	RED
OSM-1-143-146B	733	1100	2.0	SILVER	GREEN
OSM-1-144-146B	876	1314	2.0	SILVER	GRAY
OSM-1-147-146B	1353	2030	2.0	SILVER	WHITE
OSM-1-148A-146B	1661	2492	2.0	SILVER	YELLOW

Appendix 3-5

VIBRA SYSTEMS INC.
Anti-Vibration Products

310 Rayette Rd. Concord, Ontario, L4K 2G5
Tel: 905-738-7810 Fax: 905-738-0897
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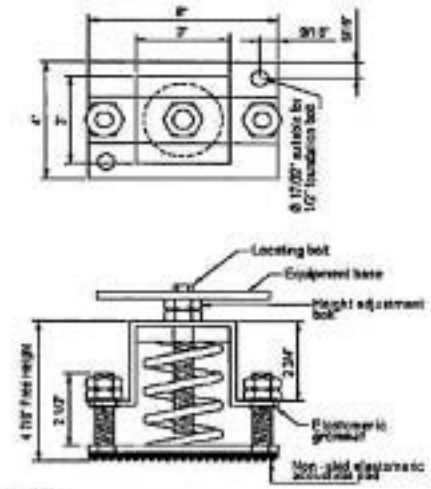
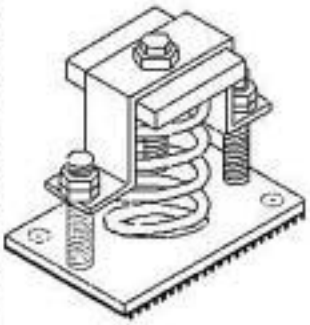
Web-site: www.VibraSystems.com



N.T.S.

RSM-1-150 Series
SPRING MOUNTS
1"Deflection



RSM series are similar to OSM series spring mounts except it has restricted to assembly which limits vertical movement due to reduced loads or external forces (wind loads). RSM series spring mounts are unhoused literally stable steel springs welded to top and bottom steel plates. The upper load plate includes a leveling bolt assembly. Lower steel plate features a neoprene acoustical friction pad. Mounting holes are provided on all mounts.

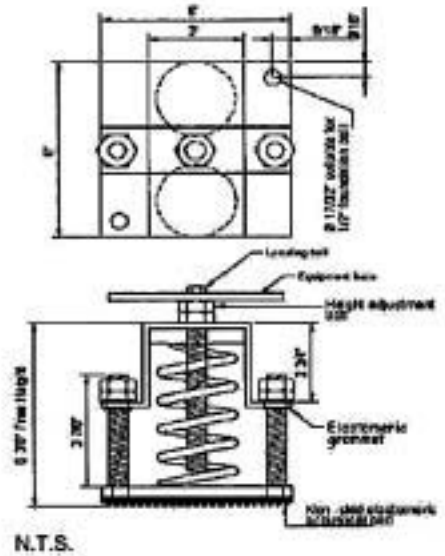
These spring mounts are having in built leveling device. Springs are galvanized for long operating life without any rusting problems and are color coded for easy field identification. Springs are having 50% additional travel to solid load as per ashrae recommendations.

These spring mounts are recommended where both horizontal and vertical stability are required in general these series spring mounts are used for vibration & noise control application of air handling units, cooling towers, chillers, condensing units and boilers etc. These mounts are more suitable & effective when used below equipment with large variations of installed weight and operating weight as well as roof mounted equipments like fans etc.

ISOLATOR MODEL	RATED LOAD (LBS)	SOLID LOAD (LBS)	DEFLECTION AT SOLID LOAD (INCH)	COLOR	
				MAIN	STRIPE
RSM-1-150	83	125	1.3	SILVER	BROWN
RSM-1-151	150	225	1.3	SILVER	ORANGE
RSM-1-152	216	325	1.2	SILVER	GREEN
RSM-1-153	300	450	1.2	SILVER	RED
RSM-1-154	400	600	1.2	SILVER	BLACK
RSM-1-155	500	750	1.1	SILVER	WHITE
RSM-1-156	600	900	1.0	SILVER	GRAY
RSM-1-157	733	1100	0.9	SILVER	BLUE
RSM-1-158	1200	1800	1.0	SILVER	GOLD
RSM-1-159	1666	2500	1.0	SILVER	NIL
RSM-1-150-161	481	722	1.0	SILVER	BROWN
RSM-1-151-161	532	799	1.0	SILVER	ORANGE
RSM-1-152-161	597	896	1.0	SILVER	GREEN
RSM-1-153-161	666	1000	1.0	SILVER	RED
RSM-1-154-161	750	1125	1.0	SILVER	BLACK
RSM-1-155-161	871	1307	1.0	SILVER	WHITE
RSM-1-156-161	1016	1525	1.0	SILVER	GRAY
RSM-1-157-161	1108	1663	0.9	SILVER	BLUE
RSM-1-158-161	1616	2425	1.0	SILVER	GOLD
RSM-1-159-161	2083	3125	1.0	SILVER	NIL

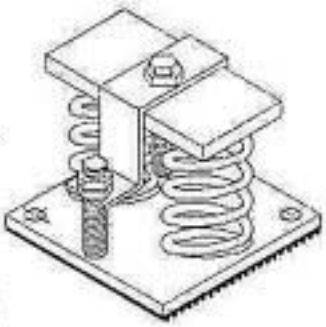
Appendix 3-6

VibraSystems Inc.



N.T.S.

RSM-2-140 Series
SPRING MOUNTS
2"Deflection

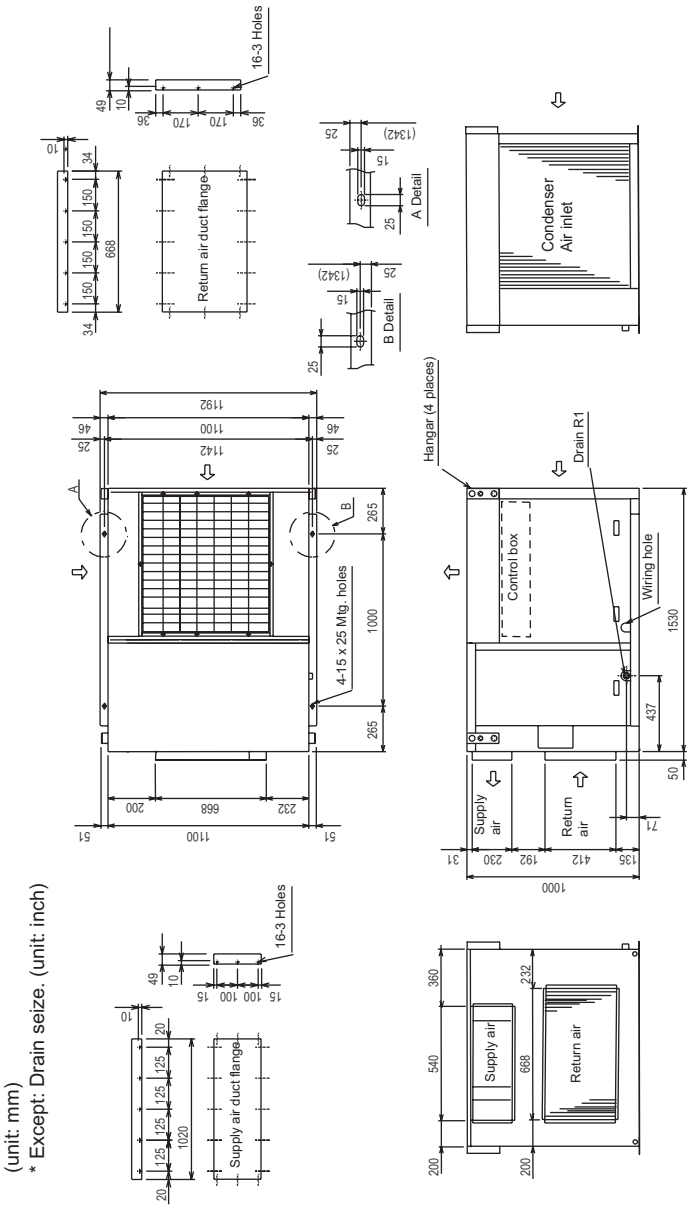


RSM series are similar to OSM series spring mounts except it has restricted to assembly which limits vertical movement due to reduced loads or external forces (wind loads). RSM series spring mounts are unhoused laterally stable steel springs welded to top and bottom steel plates. The upper load plate includes a leveling bolt assembly. Lower steel plate features a neoprene acoustical friction pad. Mounting holes are provided on all mounts. These spring mounts are having built in leveling device. Springs are galvanized for long operating life without any rusting problems and are color coded for easy field identification. Springs are having 50% additional travel to solid load as per ASHRAE recommendations. These spring mounts are recommended where both horizontal and vertical stability are required in general these series spring mounts are used for vibration & noise control application of air handling units, cooling towers, chillers, condensing units and boilers etc. These mounts are more suitable & effective when used below equipment with large variations of installed weight and operating weight as well as roof mounted equipments like fans etc.

ISOLATOR MODEL	RATED LOAD (LBS)	SOLID LOAD (LBS)	DEFLECTION AT SOLID LOAD (INCH)	COLOR	
				MAIN	STRIPE
RSM-2-140	132	200	2.25	SILVER	BLUE
RSM-2-141	266	400	2.25	SILVER	BLACK
RSM-2-142	500	750	2.0	SILVER	RED
RSM-2-143	666	1000	2.0	SILVER	GREEN
RSM-2-144	952	1428	2.0	SILVER	GRAY
RSM-2-147	1906	2860	2.0	SILVER	WHITE
RSM-2-148A	2522	3784	2.0	SILVER	YELLOW
RSM-2-140-146B	920	1380	2.0	SILVER	BLUE
RSM-2-141-146B	1036	1556	2.0	SILVER	BLACK
RSM-2-142-146B	1300	1952	2.0	SILVER	RED
RSM-2-143-146B	1466	2200	2.0	SILVER	GREEN
RSM-2-144-146B	1752	2628	2.0	SILVER	GRAY
RSM-2-147-146B	2706	4060	2.0	SILVER	WHITE
	3322	4984	2.0	SILVER	YELLOW

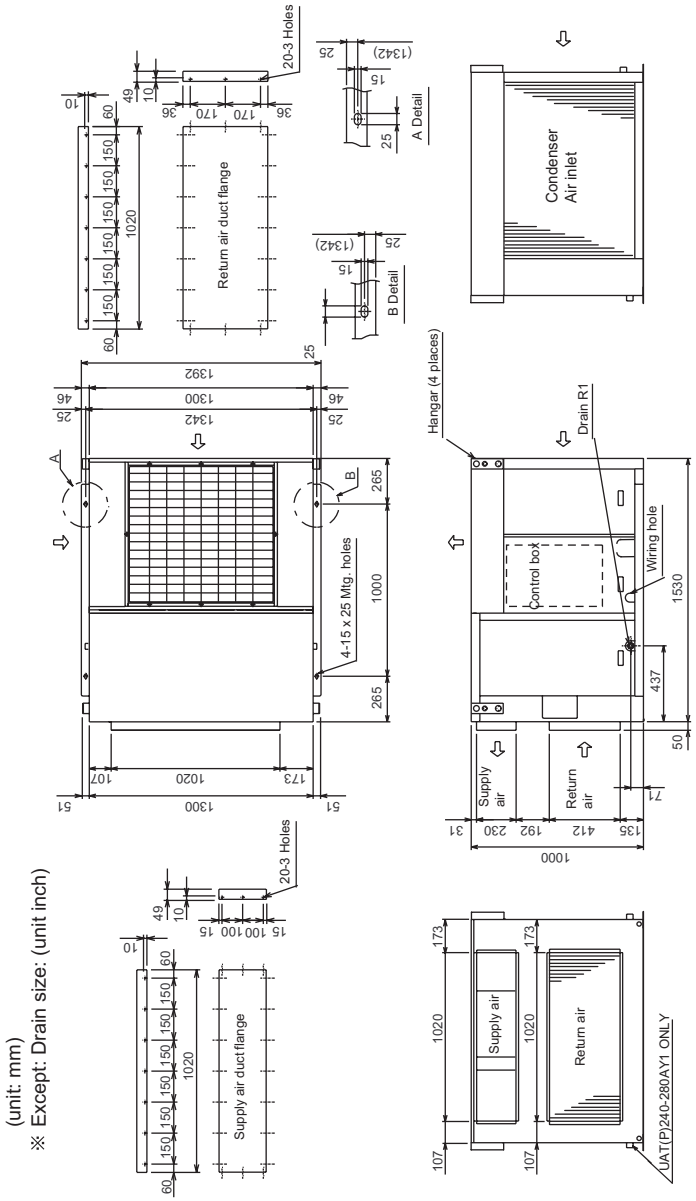
Appendix 4-1

UATP/TYP/TY180A



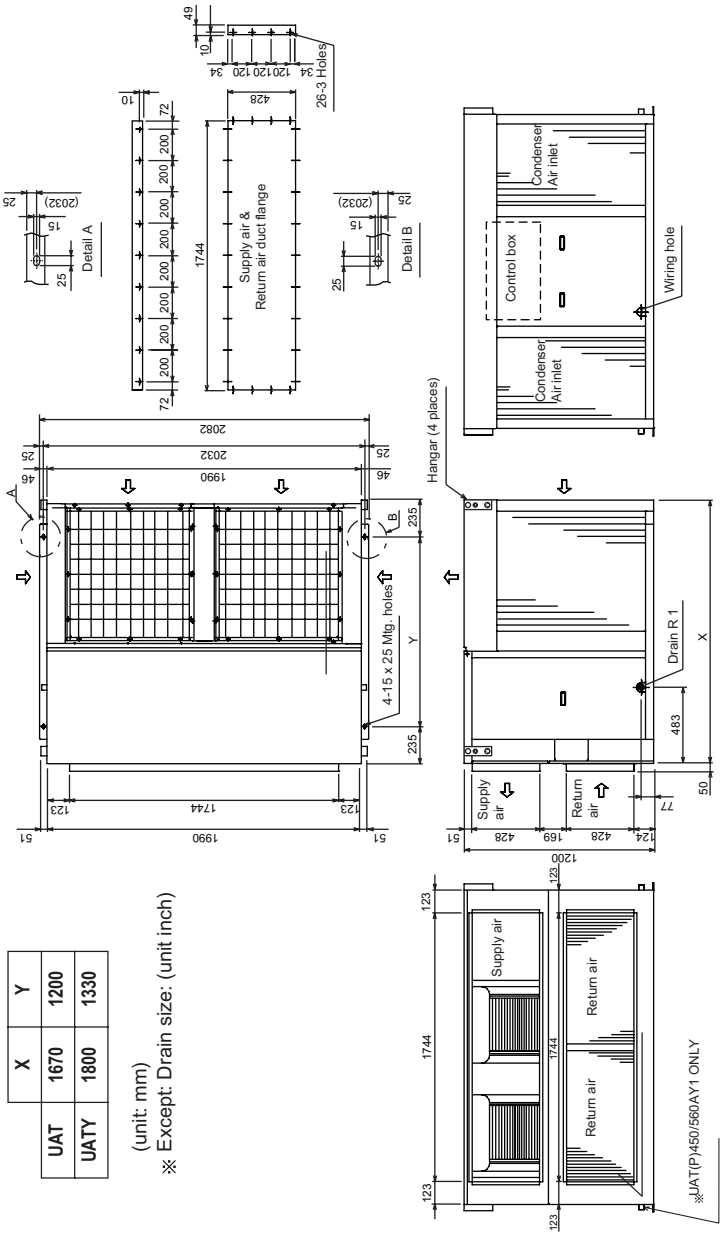
Appendix 4-2

UATP/TYP/T/TY240/280/320A



Appendix 4-3

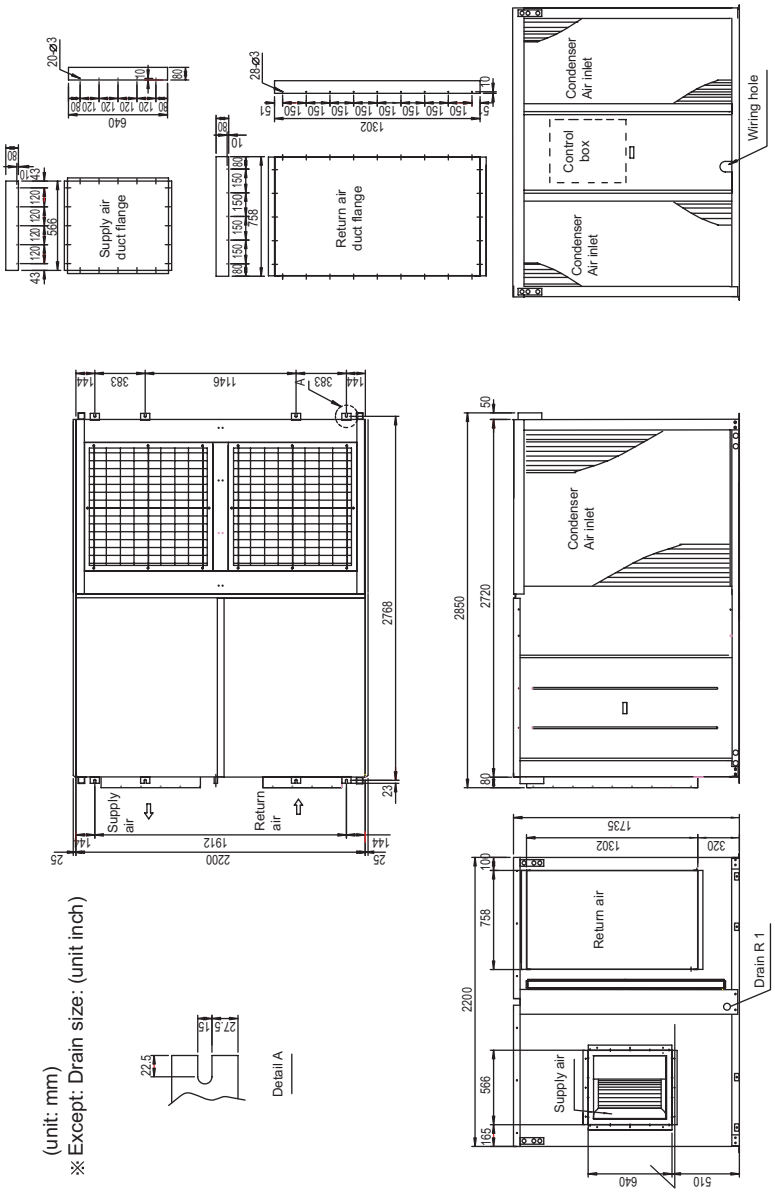
UATP/TYP/T/TY450/560A



	X	Y
UAT	1670	1200
UATY	1800	1330

Appendix 4-4

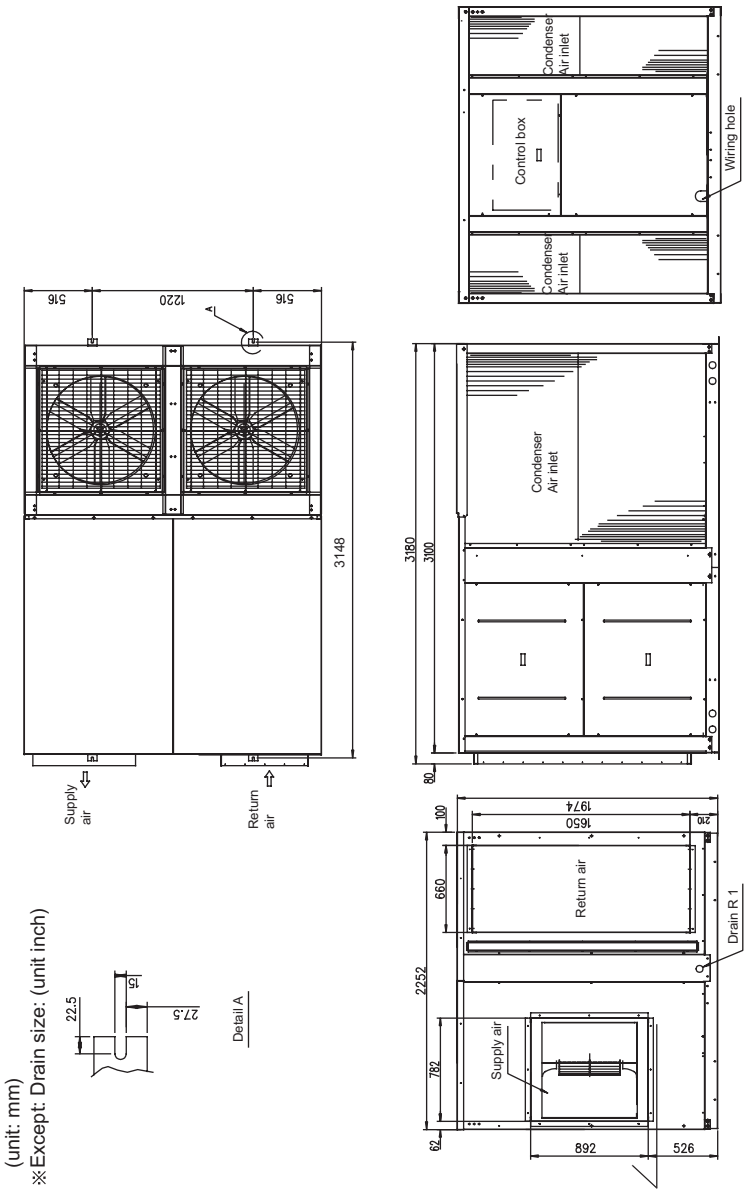
UATPC/TYPC/TC/TYC10/12A



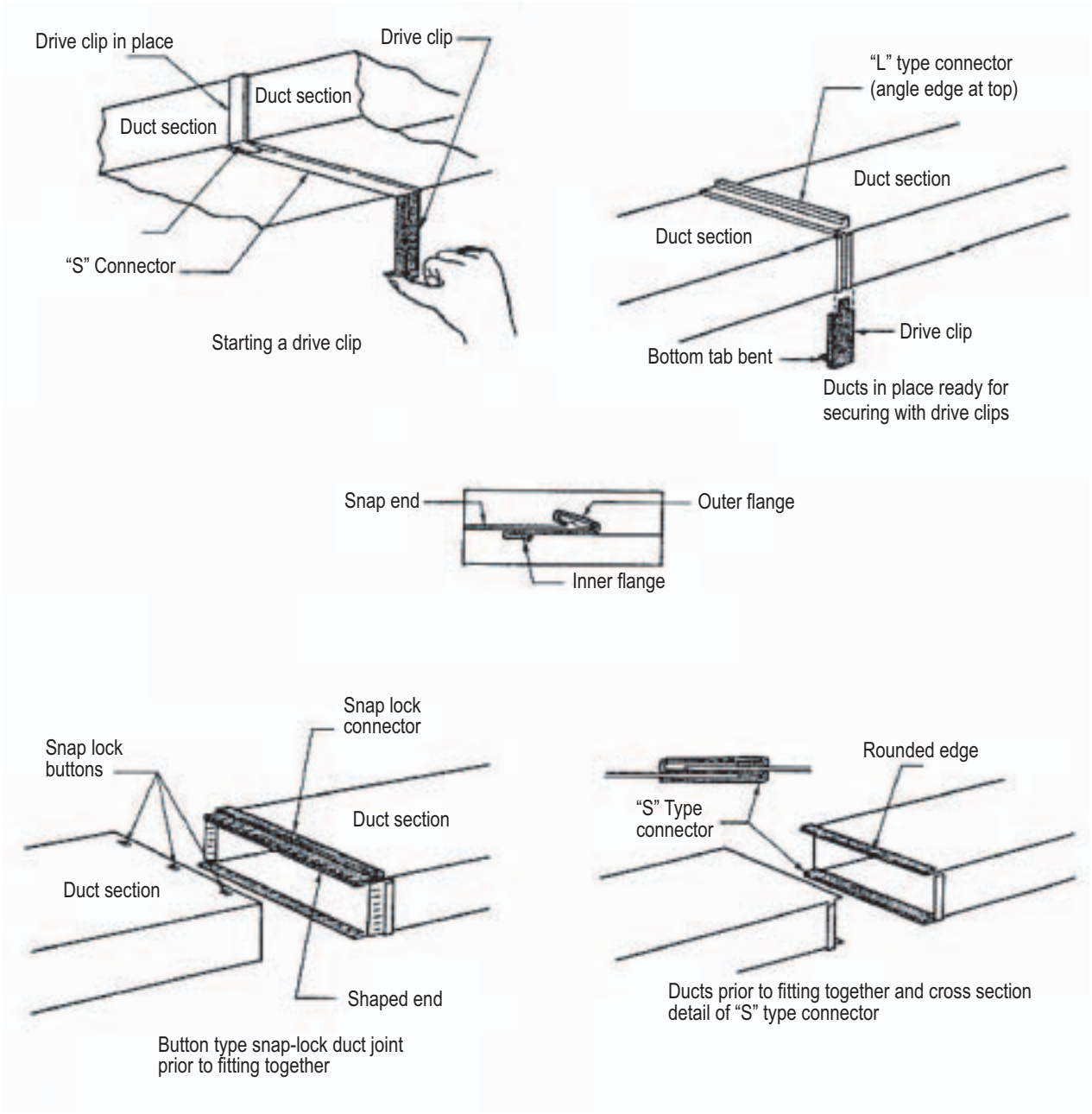
(unit: mm)
※ Except: Drain size: (unit inch)

Appendix 4-5

UATPC/TYPC/TC/TYC10/12A



Appendix 5-1


Drive clip in place
Drive clip
Duct section
Duct section
"S" Connector
Starting a drive clip
"L" type connector
(angle edge at top)
Duct section
Duct section
Drive clip
Bottom tab bent
Ducts in place ready for
securing with drive clips
Snap end
Outer flange
Inner flange
Snap lock
connector
Snap lock
buttons
Duct section
Duct section
Shaped end
Button type snap-lock duct joint
prior to fitting together
Rounded edge
"S" Type
connector
Ducts prior to fitting together and cross section
detail of "S" type connector

Appendix 5-2

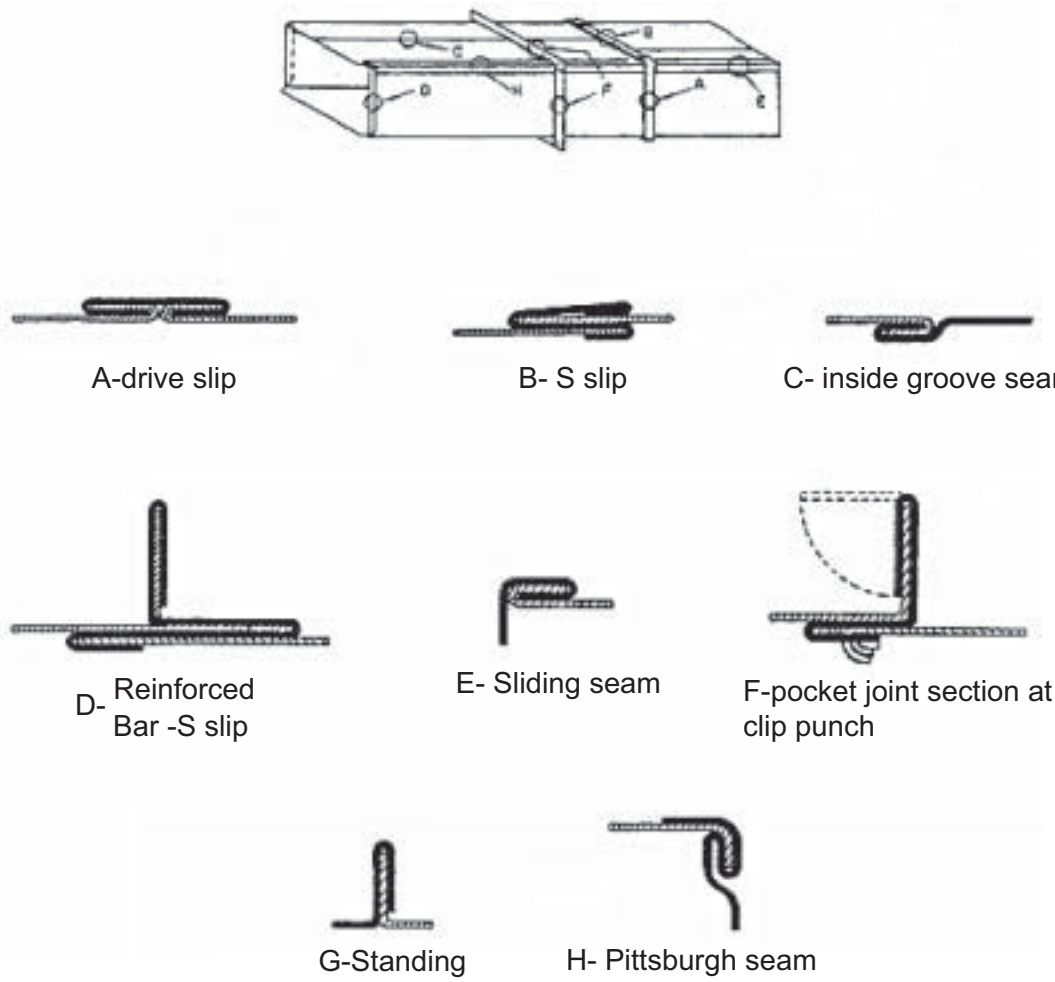


Fig. 58-Joints and seams for low pressure systems

Appendix 6-1

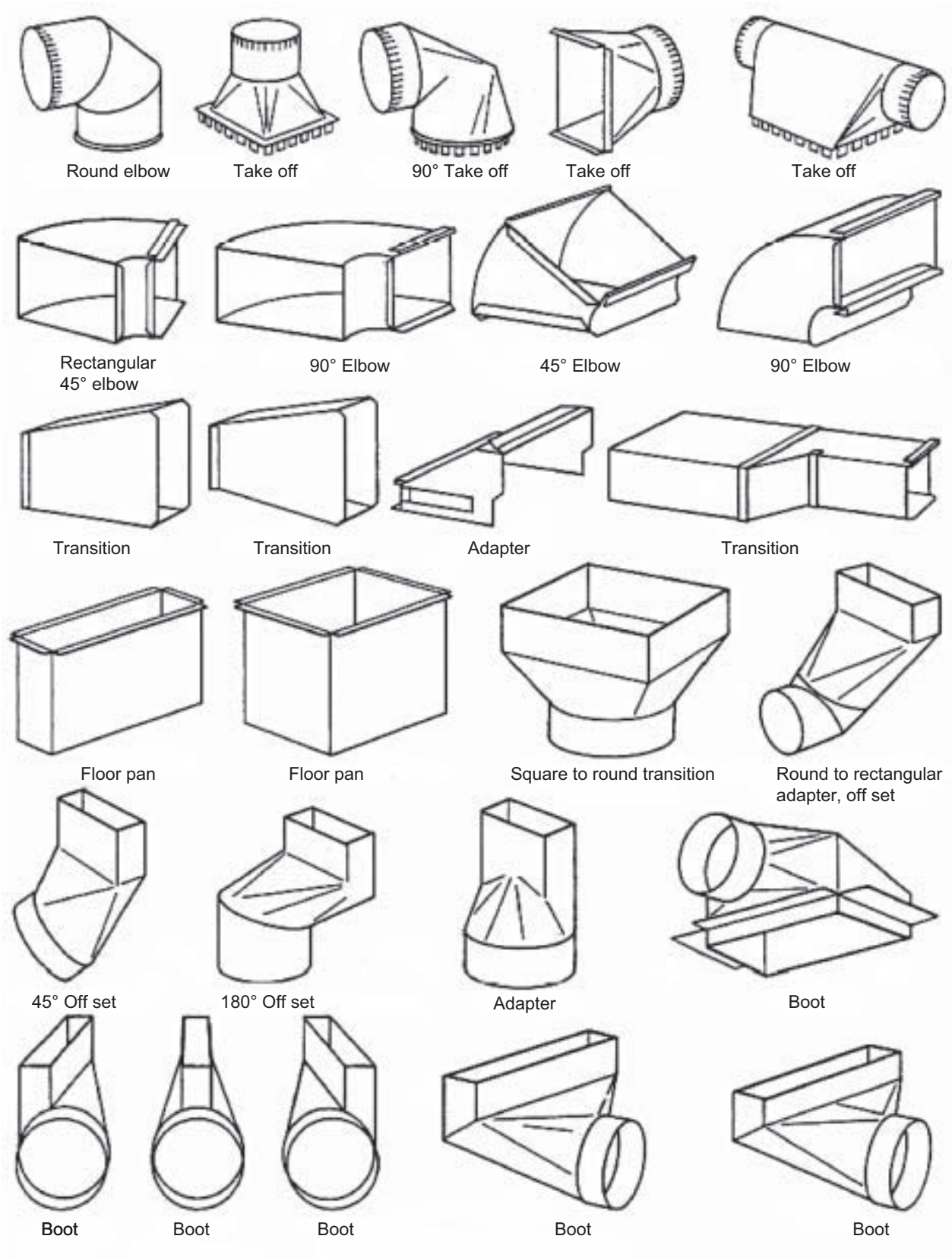
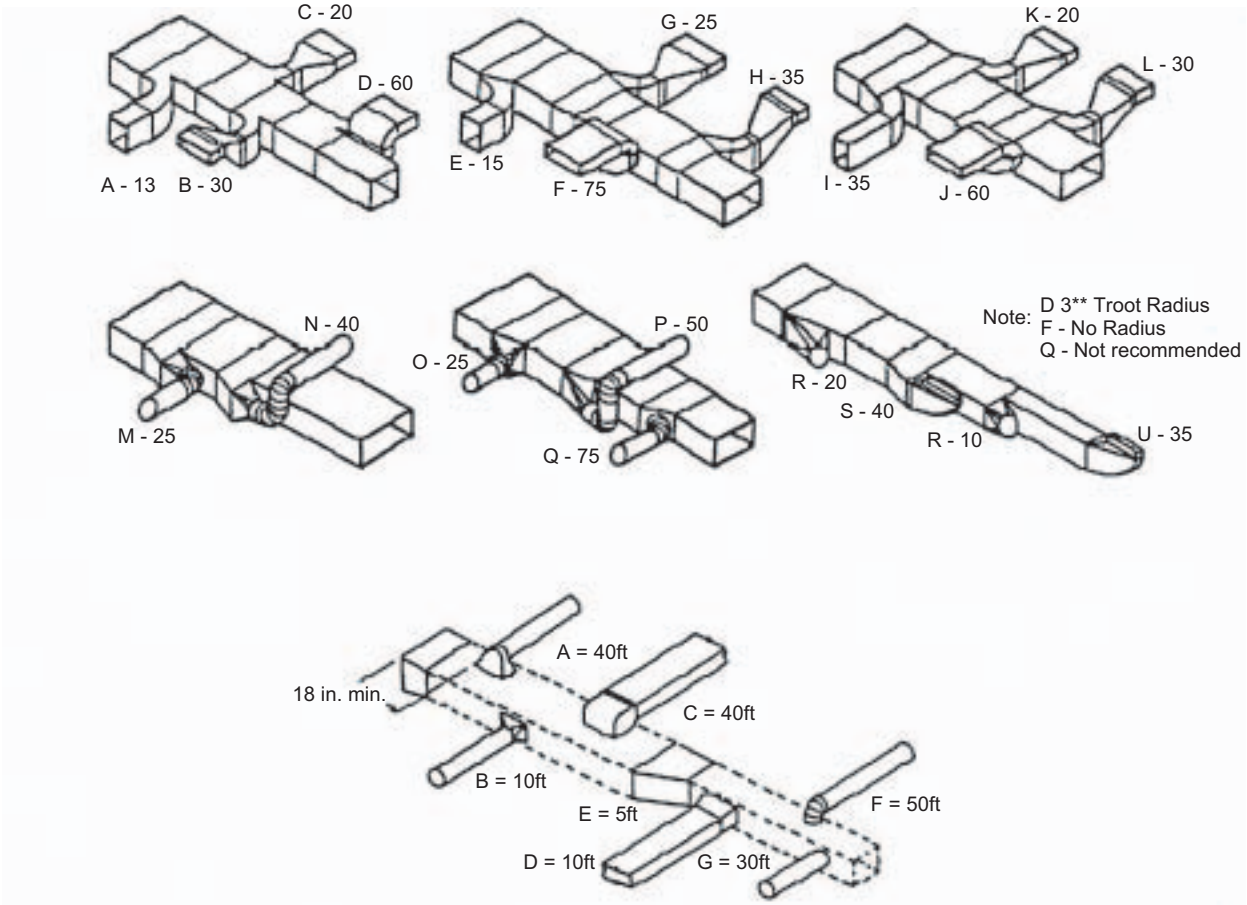


Fig. 40-4. Standard duct fittings.

Appendix 6-2



Group 3

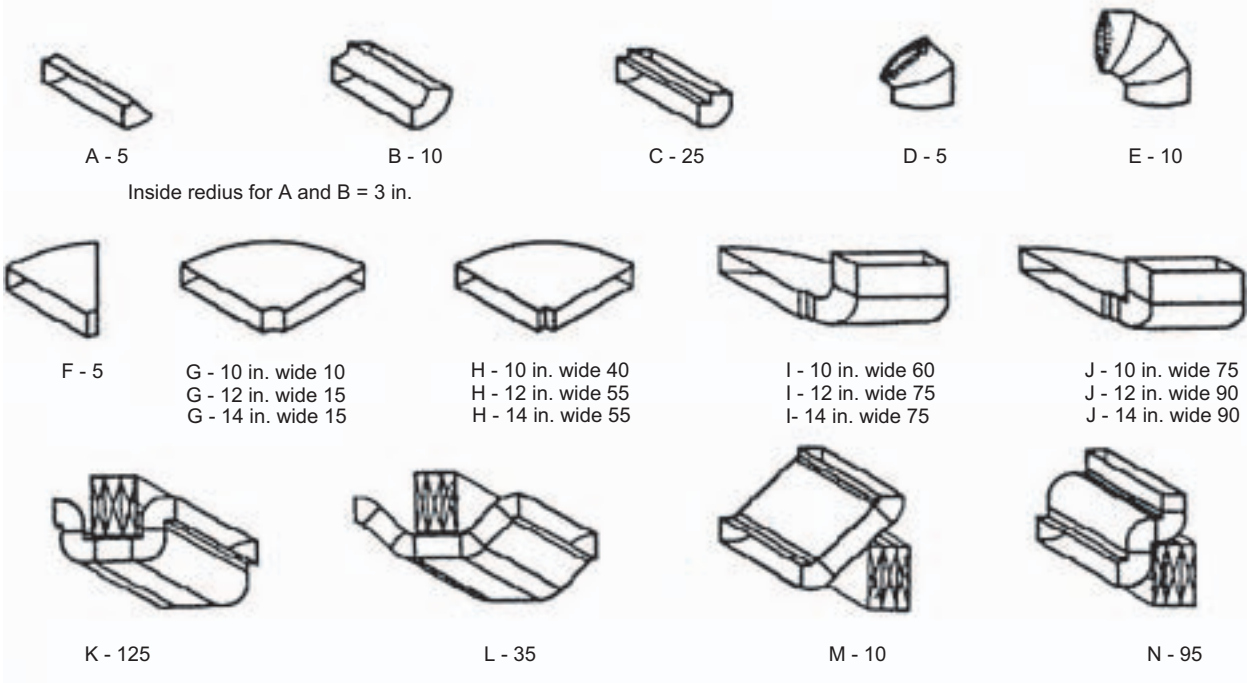
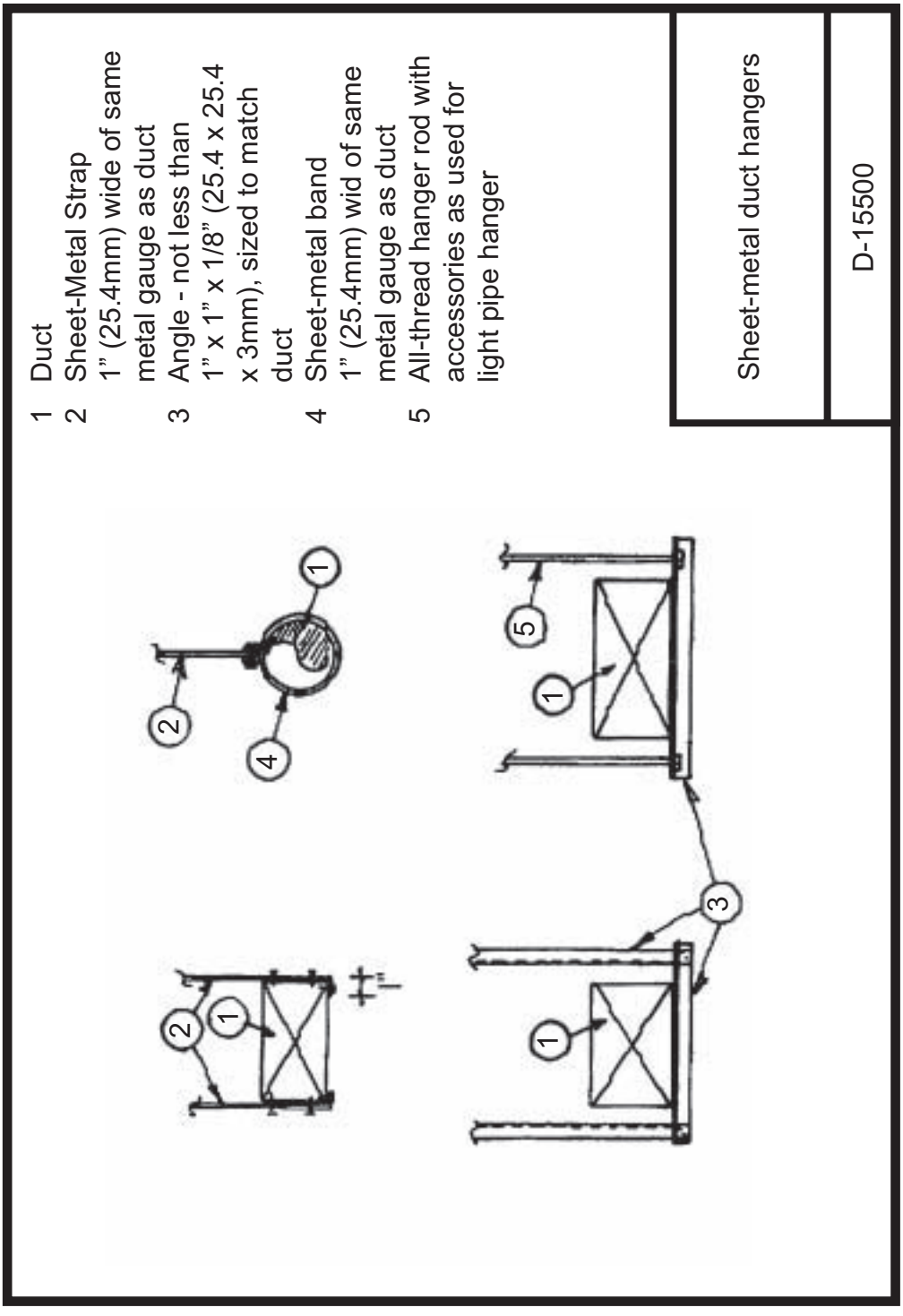


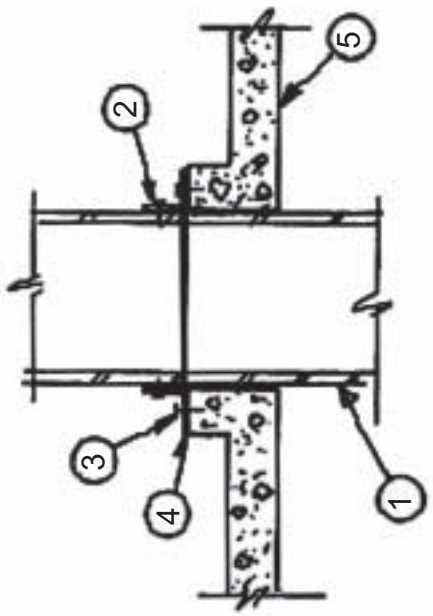
Figure 39-65. (Contined)

Appendix 7-1


1 Duct
2 Sheet-Metal Strap
1” (25.4mm) wide of same metal gauge as duct
3 Angle - not less than
1” x 1” x 1/8” (25.4 x 25.4 x 3mm), sized to match duct
4 Sheet-metal band
1” (25.4mm) wid of same metal gauge as duct
5 All-thread hanger rod with accessories as used for light pipe hanger
Sheet-metal duct hangers
D-15500

Appendix 7-2

1 Vertical ductwork
2 1 1/2" x 1 1/2" x 1/8" (36 x 36 x 3mm) angle, frame-welded together and attached to ductwork with stainless steel screws
3 Attach curb angle frame to curb with expansion bolts 6" (15cm) on centers
4 Caulk airtight
5 Concrete floor



Support for ductwork at floor penetration

D-15500-2

Appendix 8

Table 1 Surface Conductances and Resistances for Air

Position of Surface	Direction of Heat Flow	Surface Emittance, ε: Non-reflective ε = 0.90		Reflective ε = 0.20		Reflective ε = 0.05	
		h_i	R	h_i	R	h_i	R
STILL AIR							
Horizontal	Upward	9.26	0.11	5.17	0.19	4.32	0.23
Sloping — 45°	Upward	9.09	0.11	5.00	0.20	4.15	0.24
Vertical	Horizontal	8.29	0.12	4.20	0.24	3.35	0.30
Sloping — 45°	Downward	7.50	0.13	3.41	0.29	2.56	0.39
Horizontal	Downward	6.13	0.16	2.10	0.48	1.25	0.80
MOVING AIR (Any position)		h_0	***R***				
Wind (for winter) 6.7 m/s (24km/h)	Any	34.0	0.030	—	—	—	—
Wind (for summer) 3.4 m/s (12 km/h)	Any	22.7	0.044	—	—	—	—

Notes:

1. Surface conductance h_i and h_0 measured in W/(m² · K); resistance *R* in m² · K/W.
2. No surface has both an air space resistance value and a surface resistance value.
3. For ventilated attics or spaces above seilings under summer conditions (heat flow down), see Table 5.
4. Conductances are for surfaces of the stated emittance facing virtual blackbody surroundings at the same temperature as the ambient air. Values are based on a surface-air temperature difference of 5.5 K and for surface temperatures of 21°C.
5. See Chapter 3 for more detailed information, especially Tables 5 and 6, and see Figure 1 for additional data.
6. Condensate can have a significant impact on surface emittance (see Table 2).

Appendix 9-1

Foster

60-95/60-96

Product Data Sheet

PROPERTIES

COLOR:
60-95 White
60-96 Gray
Other colors available on special order.

APPLICATION CONSISTENCY:
Airless spray or brush

AVERAGE WEIGHT / U.S. GALLON (ASTM D 1475):
9.8 to 10.0 lbs. (1.15 to 1.20 kg/l)

AVERAGE NON-VOLATILE (ASTN D 1644):
33% by volume (46% by weight)

COVERAGE RANGE (FSTN 72):
(Subject to the nature of material coated.) Wet coverages shown below are for smooth non-porous surfaces. Porous or rough surfaces will require higher gallonage to attain required dry thickness.
Dry Thickness: 0.032 inch (0.8 mm)
Equivalent Wet Coverage: 0.096 inch (2.4 mm)
6 gal./100 sq. ft. (2.4 l/m²)

DRYING TIME (ASTM D 1640):
Set to Touch: 3-4 hours
Dry Through: 24 hours

SERVICE TEMPERATURE LIMITS (FSTM 70):
(Temperature at coated surface)
-50°F to 220°F (-46°C to 104°C)

WATER VAPOR PERMEANCE:
ASTM E 96, Method E, 0.025 perms
(0.016 metric perms) at 51 mils dry (1.3mm)
ASTM E-96 Procedure A, 0.018 perms (0.012 metric perms) at 20 mils (0.66mm) dry
ASTM F 1249, 0.05 perms (0.033 metric perms) at 30 mils dry (0.8mm). Tested at 100°F (38°C) and 90% RH.

WET FLAMMABILITY (ASTM D 3278):
Flash point 110°F (43°C)

SURFACE BURNING CHARACTERISTICS (ASTM E 84):
Flame Spread: 10
Smoke Developed: 15
Tested at coverage rate of 25 sq. ft./gal. (0.61 m²/l). Applied to 1/4 inch (6.4mm) inorganic reinforced cement board. The flame spread may vary at different product thicknesses and/or when applied over other surfaces.

Visit us on the web at www.fosterproducts.com

FOSTER MONOLAR® COATING

FOSTER MONOLAR Coating is a tough flexible fire-resistive elastomeric finish for protection of outdoor thermal insulation. It contains DuPont Hypalon* rubber. It is an excellent vapor barrier for low temperature insulation on tanks, pipework, vessels, ductwork, and fittings.

MONOLAR Coating provides outstanding weather barrier protection, showing good color retention, excellent chemical resistance, and durability. It has excelent resistance to UV and sunlight.

MONOLAR Coating provides outstanding weather barrier and vapor barrier protection for sprayed polyurethane foam in outdoor locations. It is a one-component, high film strength product, usually applied in two coats with standard airless spray equipment. It sprays easily and cleanly with a minimum of cobwebbing.

MONOLAR Coating is an ideal finish for flexible cellular insulation tubing and sheets. Apply by brush in two coats.

MONOLAR Coating is produced under the classifcation and follow-up service of Underwriter's Laboratories, Inc.

MONOLAR Coating meets NFPA 90A and 90B 25/50 requirements.

MONOLAR Coating contains no asbestos, lead, mercury, or mercury compounds.

LIMITATIONS
Store and apply between 40°F (4°C) and 100°F (38°C).
For best results, select Elastolar 95-44 for insulation joint sealing under Monolar coating.
Always test plastic materials for compatibility when using a solvent base product.
Outdoor horizontal surfaces must always drain completely. A pitch of at least 1/2" per foot (4 cm/m) is recommended.
Make certain this product is completely dry and the area free from solvent odor if food is involved.
Select Monolar Mastic 60-90 (white) or 60-91 (gray) for trowel or glove application.

™ Trademark of Specialty Construction Brands, Inc.

*Trademark of E.I. Dupont Company

6/05
DPI

Specialty Construction Brands, Inc.
601 West Campus Drive ○ Suite C7 ○ Arlington Heights, IL 60004 ○ 800-231-9641 ○ fax 800-942-6856

Appendix 9-2

APPLICATION GUIDE
FOR
FOSTER MONOLAR® COATING
60-95/60-96

MATERIAL PREPARATION
Stir well. DO NOT THIN. Apply only to clean dry surfaces. Keep container closed when not in use to prevent solvent evaporation.

APPLICATION
To prevent water vapor and moisture infiltration, proper and complete flashing is required. Follow flashing specifications.

Normal Service:
Apply a tack coat of MONOLAR Coating at a thickness of 1/32 inch (0.8mm). This is equivalent to 2 gal./100 sq. ft. (0.8 l/m²). Embed Foster MAST-A-FAB or Chil-Glas® #10 white membrane into wet tack coat. Smooth membrane to avoid wrinkles and overlap all seams at least 2 inches (5 cm). Apply a finish coat of MONOLAR Coating at a minimum thickness of 1/16 inch (1.6mm). This is equivalent to 4 gal./100 sq. ft. (1.6 l/m²). This finish coat shall be applied no later than 2 hours after the tack coat and shall completely cover membrane. This application shall provide a minimum dry film thickness of 32 mils (0.8mm).

Severe and Cryogenic Service:
After the first two coats have set, 24 hours minimum or until dry, apply an additional coat of MONOLAR Coating at a thickness of 3/64 inch (1.2 mm). This is equivalent to 3 gal./100 sq. ft. (1.2 l/m²). This additional application shall provide a minimum dry film thickness of 48 mils (1.2mm).

Application - Sprayed Polyurethane Foam
Sprayed Polyurethane Foam may be primed with Foster 40-26 Waterbase Primer prior to the application of MONOLAR Coating to improve adhesion. Many Sprayed Polyurethane Foam systems are different; end user should always perform an adhesion test to ensure that the adhesion of MONOLAR Coating and primer system with the foam insulation is sufficient.

Spray:
MONOLAR Coating may be airless spray applied. For spray equipment information, please consult Foster's Airless Spray Recommendations or contact your airless spray equipment supplier. Average viscosity range: 10,000-30,000 cps.

Brush:
Use a good brush, making strokes as long as possible over the surface. Multiple coats may be needed to achieve the minimum dry film thickness. Do not overwork. Best appearance may be achieved by smoothing wet MONOLAR Coating with a clean brush dampened with detergent (not soap) foam, being careful not to pick up any MONOLAR on the brush.

CLEAN-UP
Use xylol (flammable) or chlorinated solvent (non-flammable) for cleaning equipment. (Dried MONOLAR Coating is extremely difficult to remove.)

DATA REPRODUCED FROM UNDERWRITERS' LABORATORIES, INC. BUILDING MATERIALS DIRECTORY

COATING, GENERAL PURPOSE R3503 H.B. Fuller Company	Surface Burning Characteristics 1/4 inch (6.4 mm) Inorganic Reinforced Cement Board
Surface	
Flame Spread	10
Smoke Developed	15
Number of Coats	1
Rate Per Coat (sq. ft. per gal.)	25

ISO 9001 SQS

CUSTOMER SERVICE—800-231-9541 OR 800-338-2975

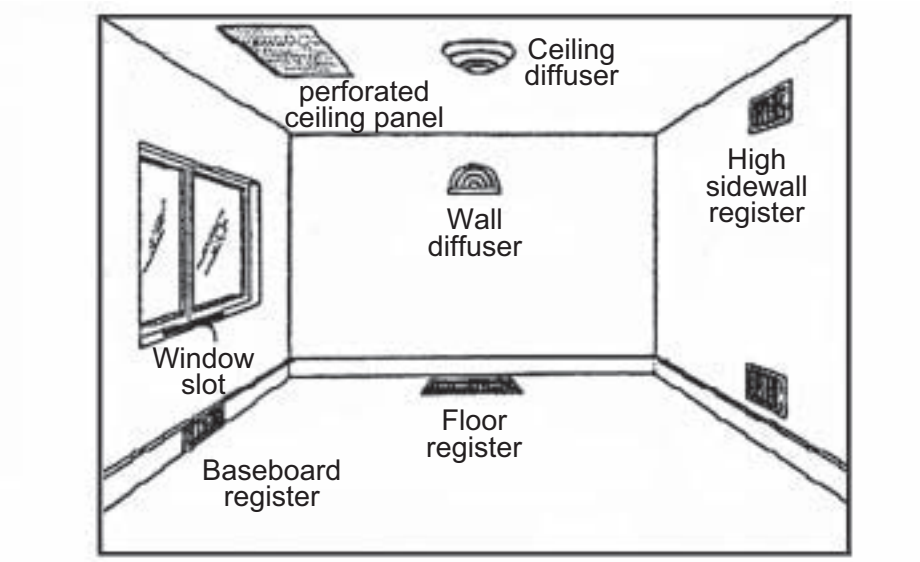
IMPORTANT: Specialty Construction Brands, Inc. warrants that each of its products will be manufactured in accordance with the specifications in effect on the date of manufacture. WE MAKE NO OTHER WARRANTIES AND EXPRESSLY DISCLAIM ANY WARRANTIES OF MERCHANTIBILITY OR FITNESS FOR A PARTICULAR PURPOSE. If a product fails to meet this limited warranty, purchaser's sole and exclusive remedy is replacement of the product or, at our option, refund of the purchase price. OUR ACCEPTANCE OF ANY ORDERS FOR THE PRODUCT IS EXPRESSLY CONDITIONAL UPON PURCHASER'S ASSENT TO THE TERMS ON THE APPLICABLE INVOICE.

ADEQUATE TESTS: The information contained herein we believe is correct to the best of our knowledge and tests. The recommendations and suggestions herein are made without guarantee or representation as to results. We recommend that adequate tests be performed by you to determine if this product meets all of your requirements. The warranted shelf life of our products is six months from date of shipment to the original purchaser.

For industrial use only. Keep out of reach of children.
Consult Material Safety Data Sheet and container label for further information.

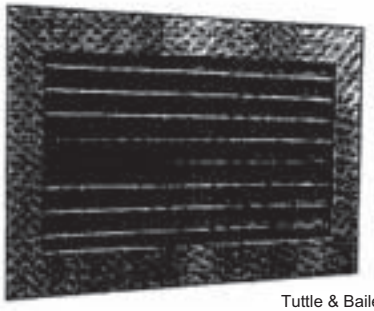
DSF60-95/60-96

Appendix 10-1



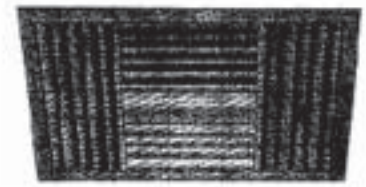
	Floor	Baseboard	Low sidewall	high sidewall	Ceiling
Cooling performence	Excellent	Exellent if used with perimeter systems	Exellent if designed to discharge spward	Good	Good
Heating performence	Excellent	Exellent if used with perimeter systems	Exellent if used with perimeter systems	Fair - should not be used to heat slab houses in Northern climates	Good - should not be used to heat slab houses in Northern climates
Interference with decor	Ensily concealed because it has flush with the door and can be painted to match	Not quite to easy to conceal because it projects from the baseboard	Hard to conceal because it is usualy in a flatwall	Empossible to conceal because it is above furniture and in a dat wall	Empossible to conceal but decorstive types are available
Interference with furniture placement	No interference - located at outside wall under a window	No interference - located at outside wall under a window	can interfere - because air discharge is not vertical	No interference	No interference
Interference with full-length drapes	No interference - located 6 or 7 inches from the wall	When drapes are closed, they will cover the outlet	When located under a window, drapes will close over it	No interference	No interference
Interference with wall-to-wall carpeting	Carpeting must be cut	Carpeting must be nutched	No interference	No interference	No interference
Outlet coast	Low	Medium	Low to medium depending on the type selected	Low	Low to high - wide variety of types are available
Installation cost	Low because the still not be cut	Low when led from below - stll need not be cut	Medium - requires wallstock and cutting of plates	Low on furred ceiling systems high when using under-floor system	High because ducts require installation

Appendix 10-2



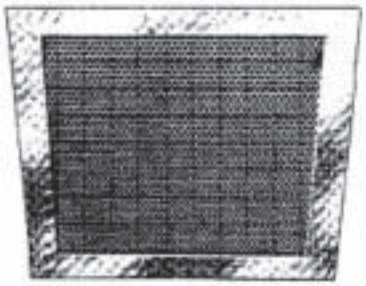
Tuttle & Bailey.

16-29. Ceiling grille.



Tuttle & Bailey.

16-30. Vertical fase vanes in a four-way ceiling supply grille.

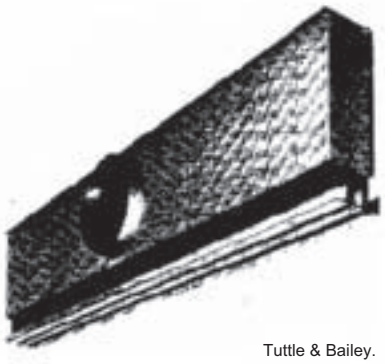


Tuttle & Bailey.

16-31. Perforated face adjustable diffuser for full flow and deflector for ceiling installation.

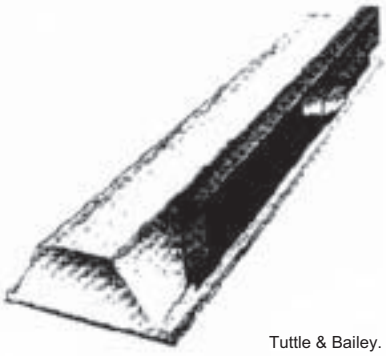
Tuttle & Bailey.

16-34. Antismudge ring.



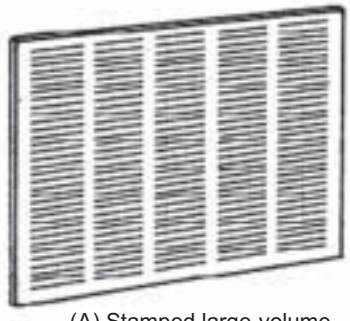
Tuttle & Bailey.

16-35. High-capacity air channel diffuser with fixed pattern for suspended grid ceilings.

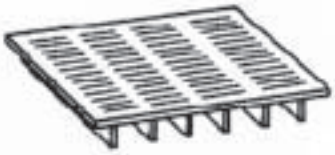


Tuttle & Bailey.

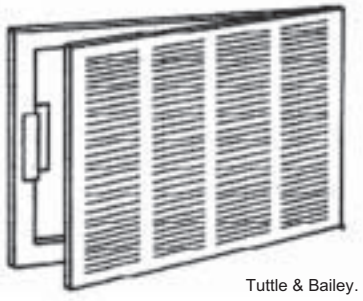
16-36. Single-side diffuser with side inlet.



(A) Stamped large-volume air inlet



(B) Floor air inlet



Tuttle & Bailey.

(C) Filter air inlet grilles

Figure 39-56. Return air grilles.

Appendix 10-3

TABLE 7—RECOMMENDED MAXIMUM DUCT VELOCITIES FOR LOW VELOCITY SYSTEMS (FPM)

APPLICATION	CONTROLLING FACTOR NOISE GENERATION Main Ducts	CONTROLLING FACTOR—DUCT FRICTION			
		Main Ducts		Branch Ducts	
		Supply	Return	Supply	Return
Residences	600	1000	800	600	600
Apartments Hotel Bedrooms Hospital Bedrooms	1000	1500	1300	1200	1000
Private Offices Directors Rooms Libraries	1200	2000	1500	1600	1200
Theatres Auditoriums	800	1300	1100	1000	800
General Offices High Class Restaurants High Class Stores Banks	1500	2000	1500	1600	1200
Average Stores Cafeterias	1800	2000	1500	1600	1200
Industrial	2500	3000	1800	2200	1500

TABLE 8—VELOCITY PRESSURES

VELOCITY PRESSURE (in. wg)	VELOCITY (Ft/Min)	VELOCITY PRESSURE (in. wg)	VELOCITY (Ft/Min)	VELOCITY PRESSURE (in. wg)	VELOCITY (Ft/Min)	VELOCITY PRESSURE (in. wg.)	VELOCITY (Ft/Min)
.01	400	.29	2150	.58	3050	1.28	4530
.02	565	.30	2190	.60	3100	1.32	4600
.03	695	.31	2230	.62	3150	1.36	4670
.04	800	.32	2260	.64	3200	1.40	4730
.05	895	.33	2300	.66	3250	1.44	4800
.06	980	.34	2330	.68	3300	1.48	4870
.07	1060	.35	2370	.70	3350	1.52	4930
.08	1130	.36	2400	.72	3390	1.56	5000
.09	1200	.37	2440	.74	3440	1.60	5060
.10	1270	.38	2470	.76	3490	1.64	5120
.11	1330	.39	2500	.78	3530	1.68	5190
.12	1390	.40	2530	.80	3580	1.72	5250
.13	1440	.41	2560	.82	3620	1.76	5310
.14	1500	.42	2590	.84	3670	1.80	5370
.15	1550	.43	2620	.86	3710	1.84	5430
.16	1600	.44	2650	.88	3750	1.88	5490
.17	1650	.45	2680	.90	3790	1.92	5550
.18	1700	.46	2710	.92	3840	1.96	5600
.19	1740	.47	2740	.94	3880	2.00	5660
.20	1790	.48	2770	.96	3920	2.04	5710
.21	1830	.49	2800	.98	3960	2.08	5770
.22	1880	.50	2830	1.00	4000	2.12	5830
.23	1920	.51	2860	1.04	4080	2.16	5880
.24	1960	.52	2880	1.08	4160	2.20	5940
.25	2000	.53	2910	1.12	4230	2.24	5990
.26	2040	.54	2940	1.16	4310	2.28	6040
.27	2080	.55	2970	1.20	4380		
.28	2120	.56	2990	1.24	4460		

NOTES: 1. Data for standard air (29.92 in. Hg and 70 F)

2. Data derived from the following equation: $h_v = \left(\frac{V}{4005}\right)^2$ where: V = velocity in fpm,
h_v = pressure difference termed "velocity head" (in. wg).

Appendix 11

Code	Size	Actual Dimensions Perimeter Tolerance + 1/16”	CFM Capacity @350 FPM	CFM Capacity @500 FPM
24241	24x24x1”	23-3/8 x 23-3/8 x 7/8	1,400	2,000
20251	20x25x1”	19-5/8 x 24-5/8 x 7/8	1,200	1,700
20201	20x20x1”	19-5/8 x 19-5/8 x 7/8	980	1,400
16251	16x25x1”	15-5/8 x 24-5/8 x 7/8	980	1,400
16201	16x20x1”	15-5/8 x 19-5/8 x 7/8	800	1,150
24201	24x20x1”	23-3/8 x 19-5/8 x 7/8	1,200	1,700
12241	12x24x1”	23-3/8 x 23-3/8 x 7/8	700	1,000
24242	24x24x2”	23-3/8 x 23-3/8 x 1-7/8	1,200	2,000
20252	20x25x2”	19-5/8 x 24-5/8 x 1-7/8	1,000	1,750
20202	20x20x2”	19-5/8 x 19-5/8 x 1-7/8	800	1,400
16252	16x25x2”	15-5/8 x 24-5/8 x 1-7/8	800	1,400
16202	16x20x2”	15-5/8 x 19-5/8 x 1-7/8	640	1,150
24202	24x20x2”	23-3/8 x 19-5/8 x 1-7/8	1,000	1,700
12242	12x24x2”	23-3/8 x 23-3/8 x 1-7/8	640	1,000

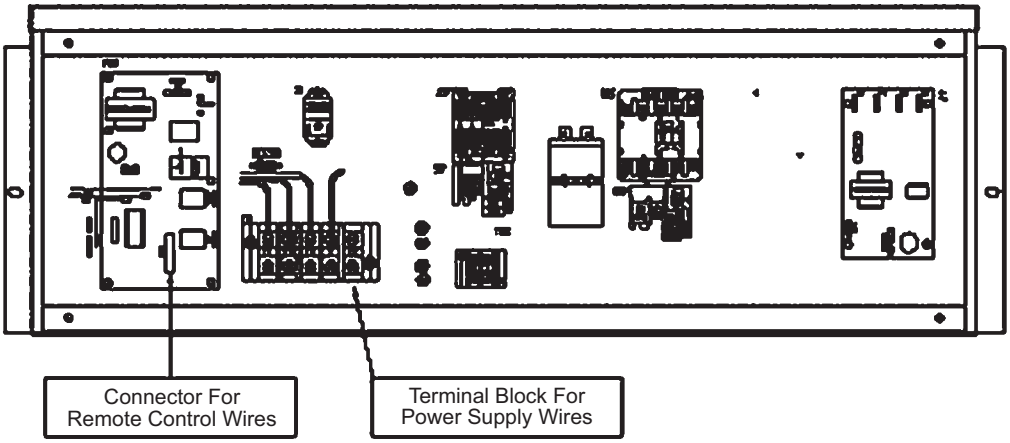
AFS-Alu Mesh Filter

Resistance in Inches H_2O			
FPM	In. W.G.	FPM	In. W.G.
150	.010	400	.063
200	.019	450	.075
250	.025	500	.100
300	.034	600	.120
350	.049	650	.150
150	.015	400	.089
200	.026	450	.110
250	.037	500	.140
300	.051	600	.180
350	.070	650	.200

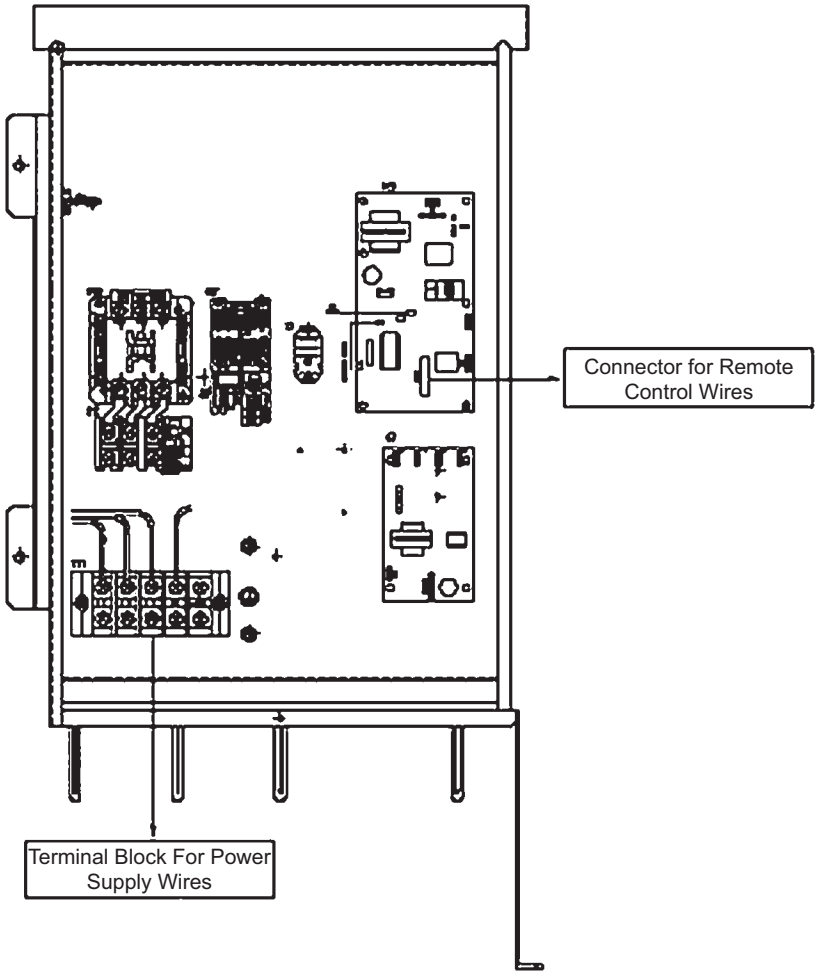
1.80m/s = 350 F.P.M.
2.54m/s = 500 F.P.M.

Appendix 12-1

CONTROL MODULE OF UATP/T/180A

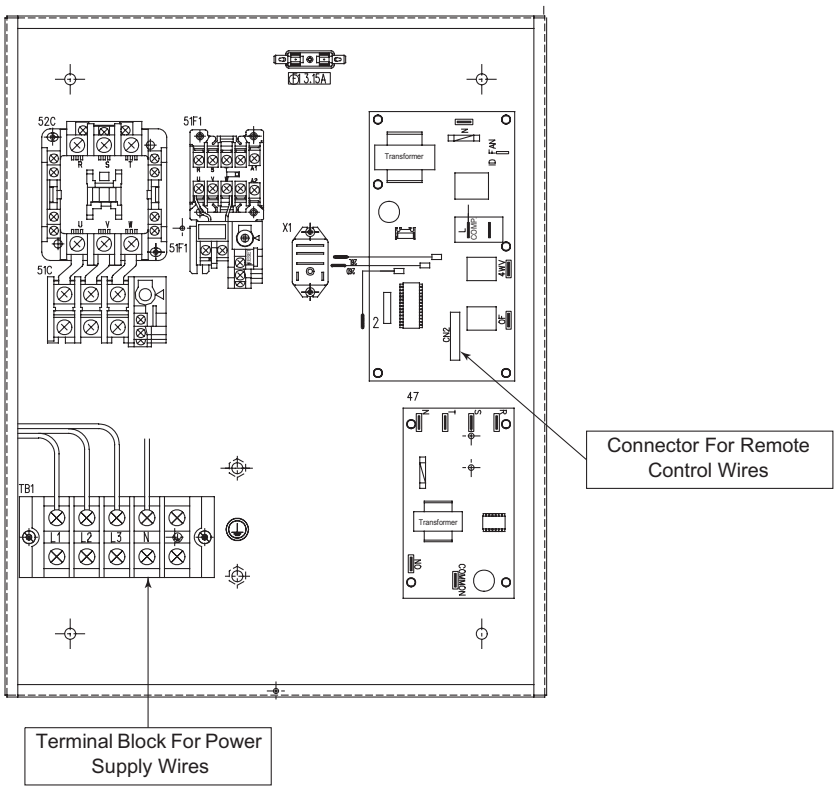


CONTROL MODULE OF UATP/T/240/280A

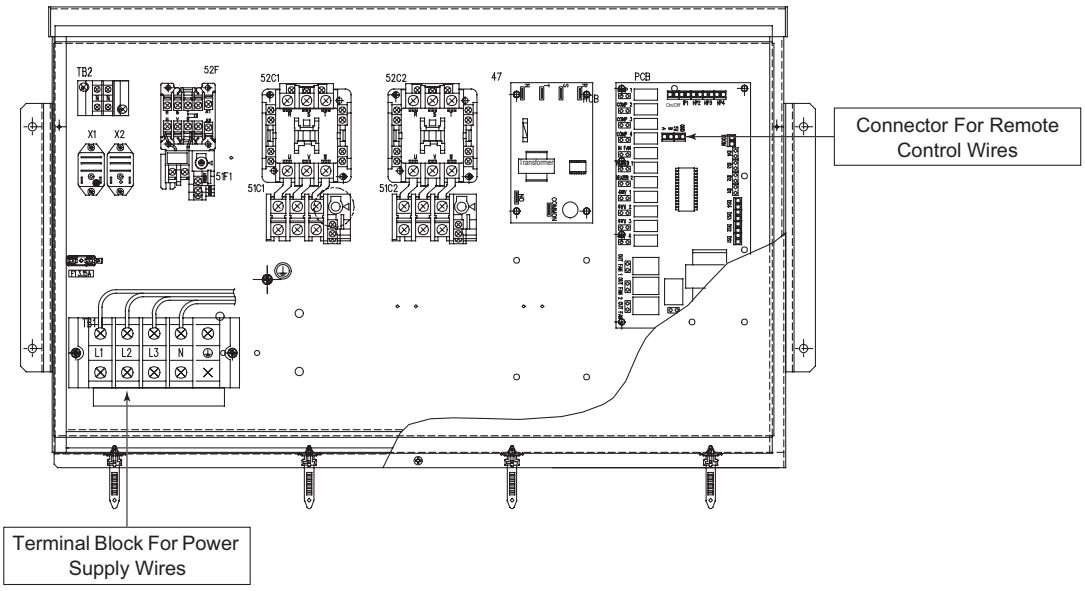


Appendix 12-2

CONTROL MODULE OF UATP/T320A

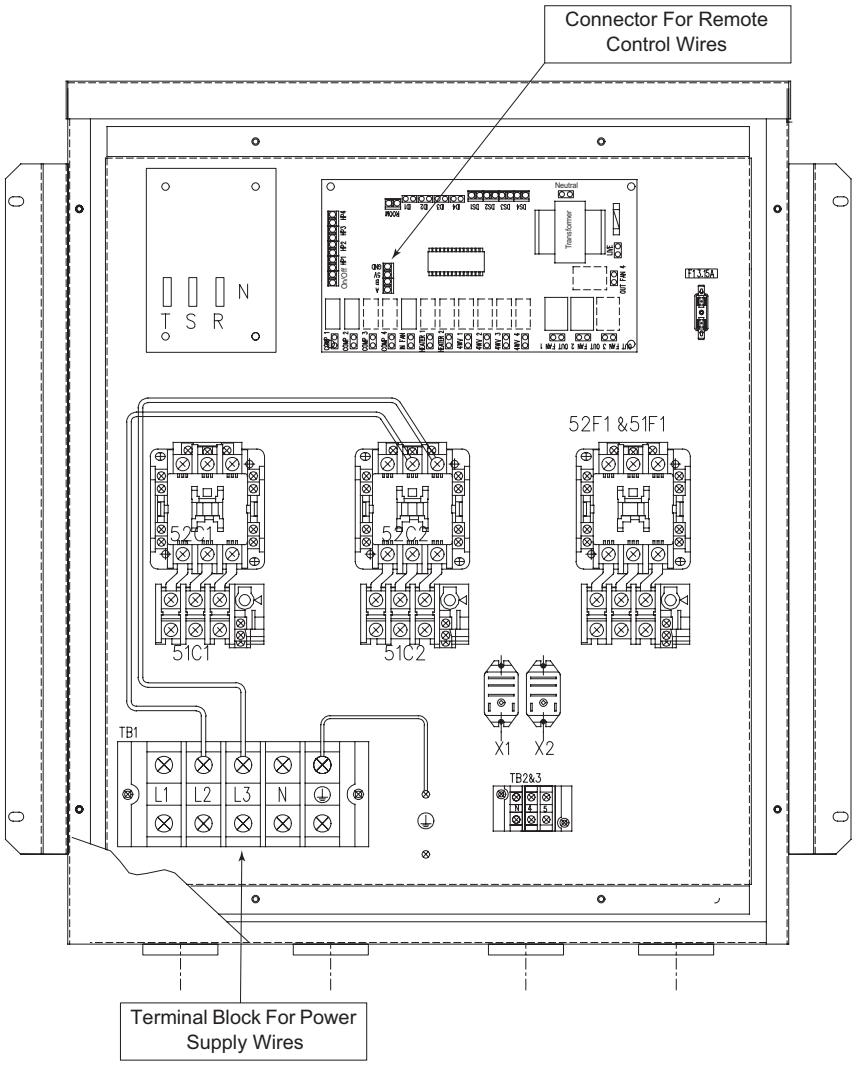


CONTROL MODULE OF UATP/T450/560A

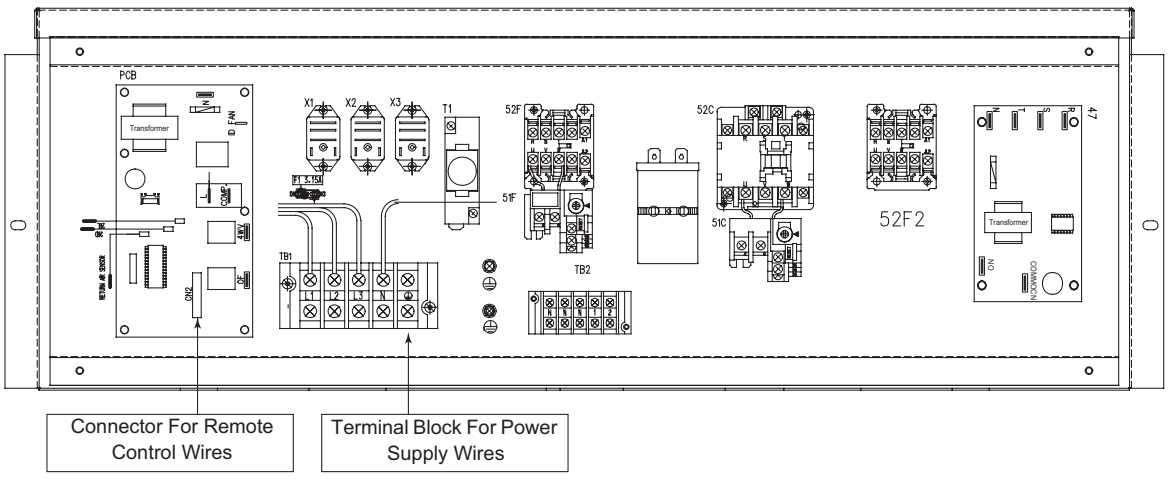


Appendix 12-3

CONTROL MODULE OF UATP/T700/800A

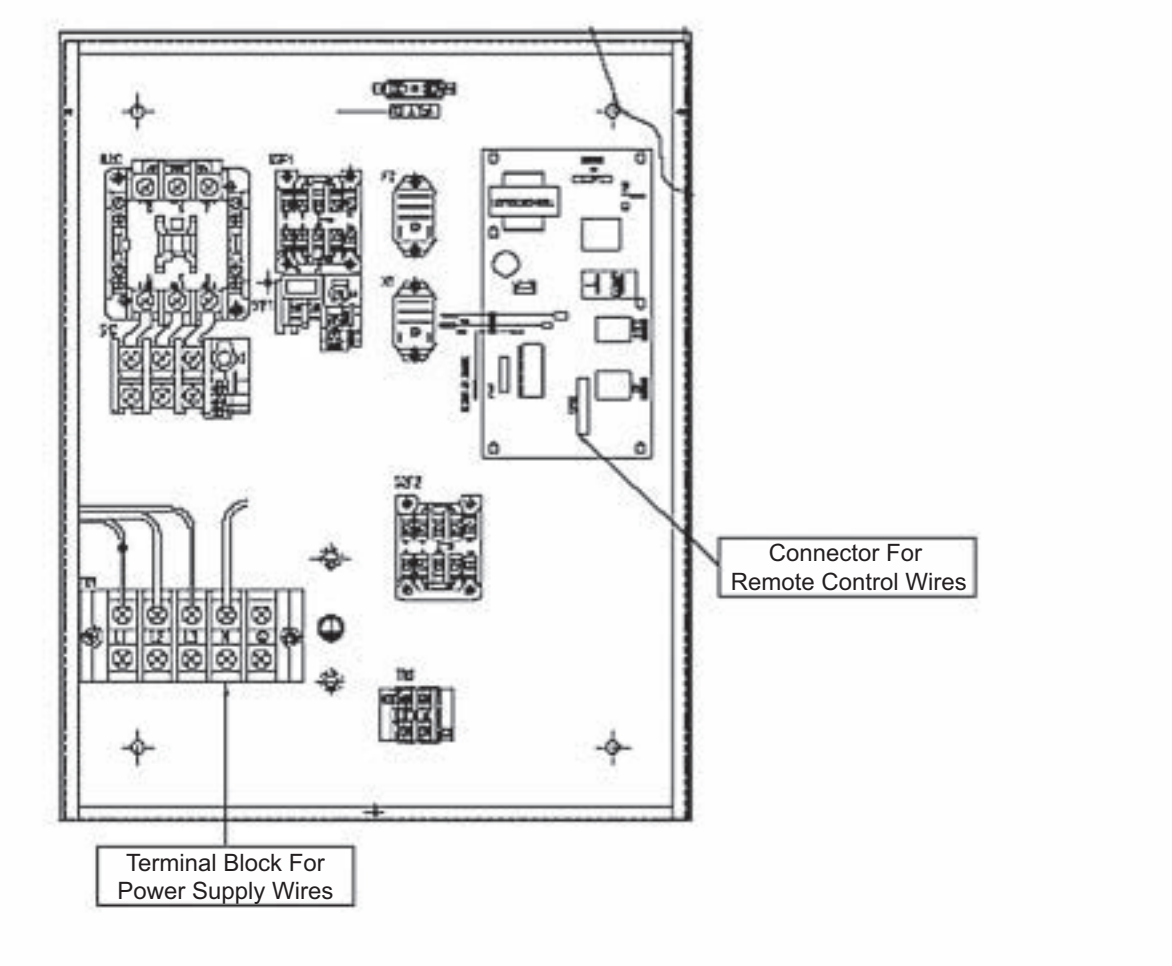


CONTROL MODULE OF UATYP/TY180A

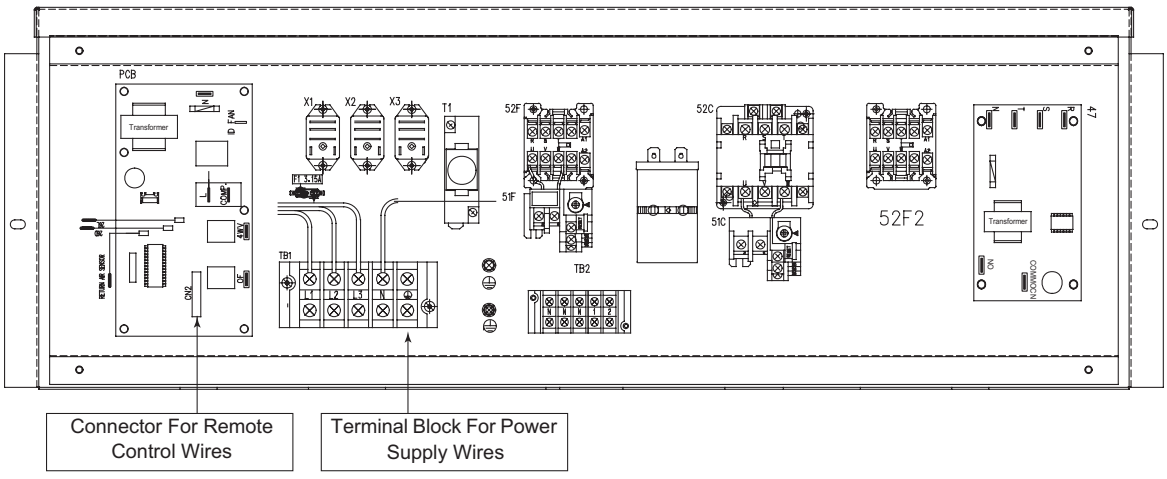


Appendix 12-4

CONTROL MODULE UATY240/280A

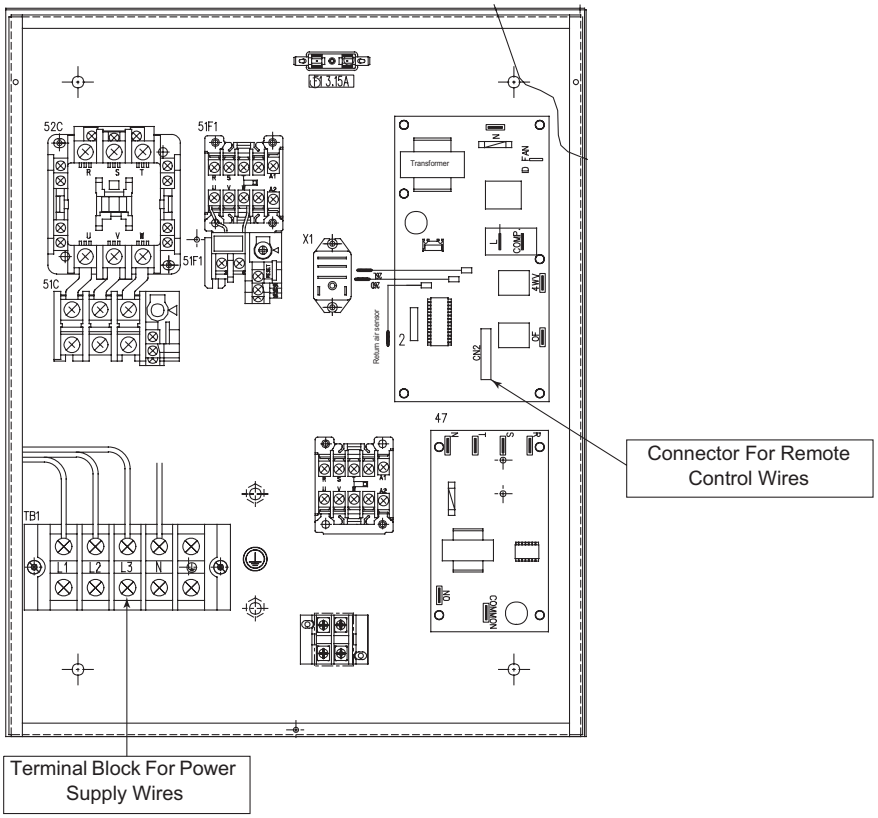


CONTROL MODULE UATYP240/280A

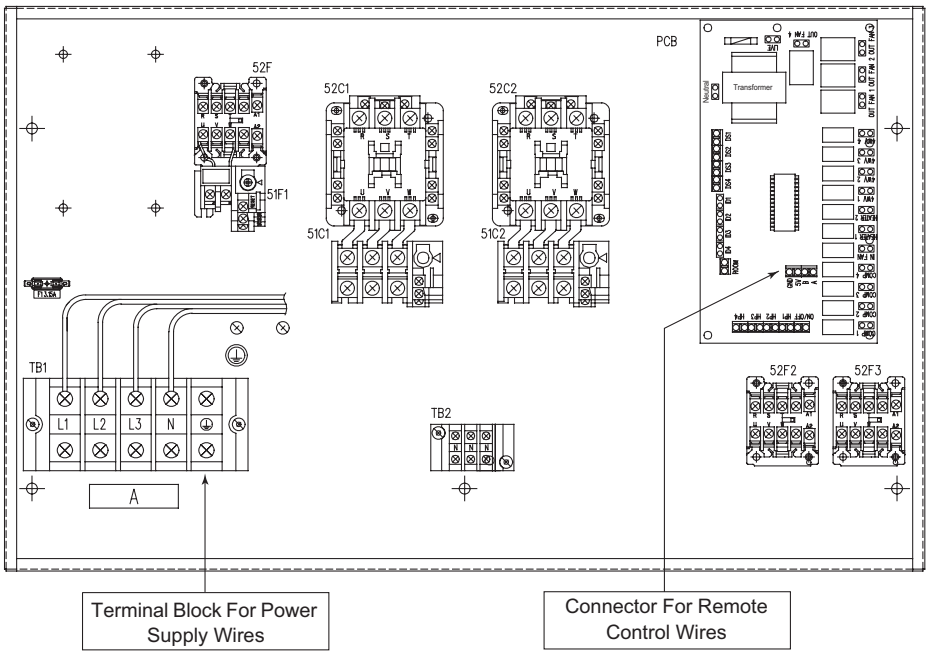


Appendix 12-5

CONTROL MODULE UATYP/TY320A

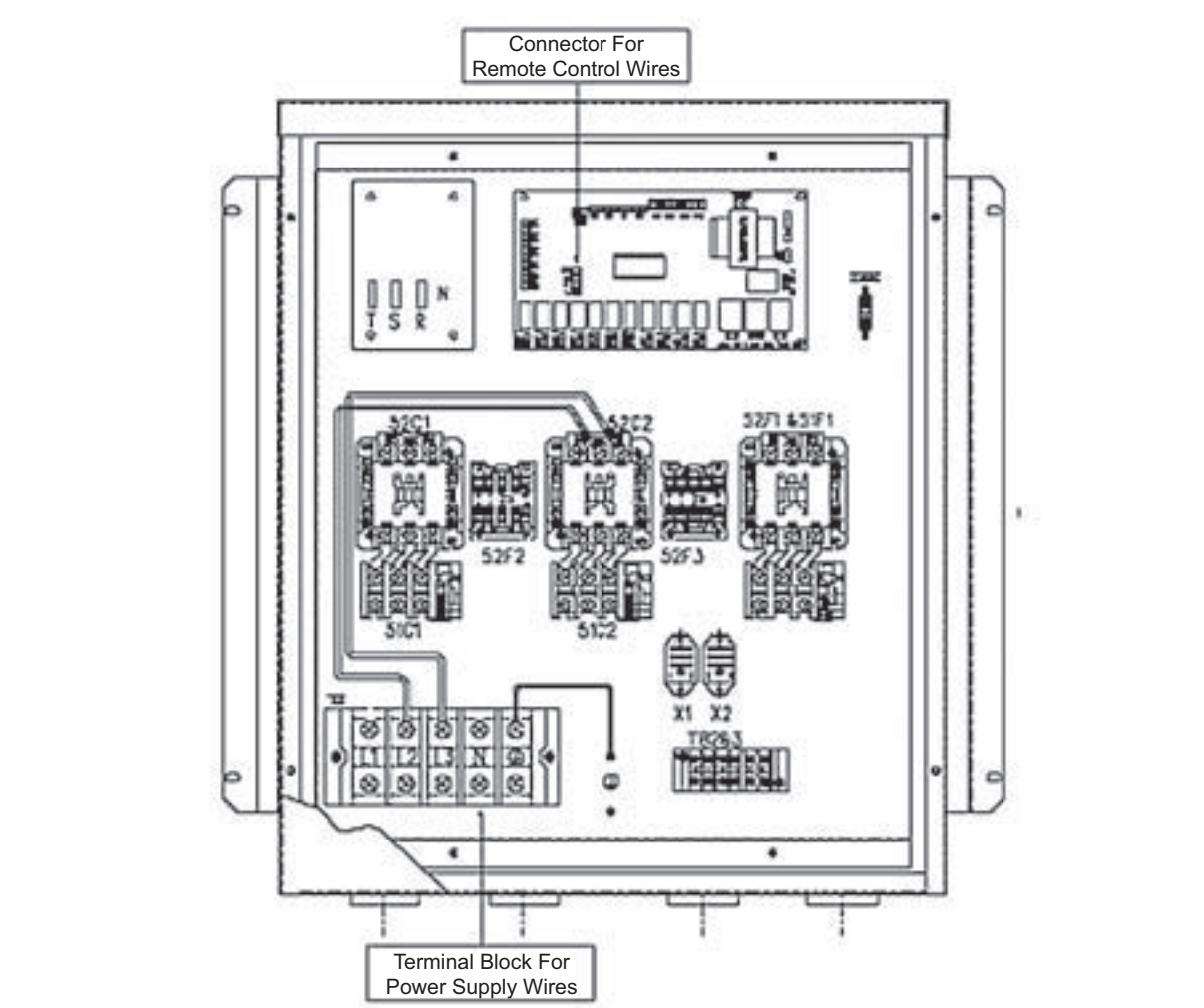


CONTROL MODULE UATYP/TY450/560A

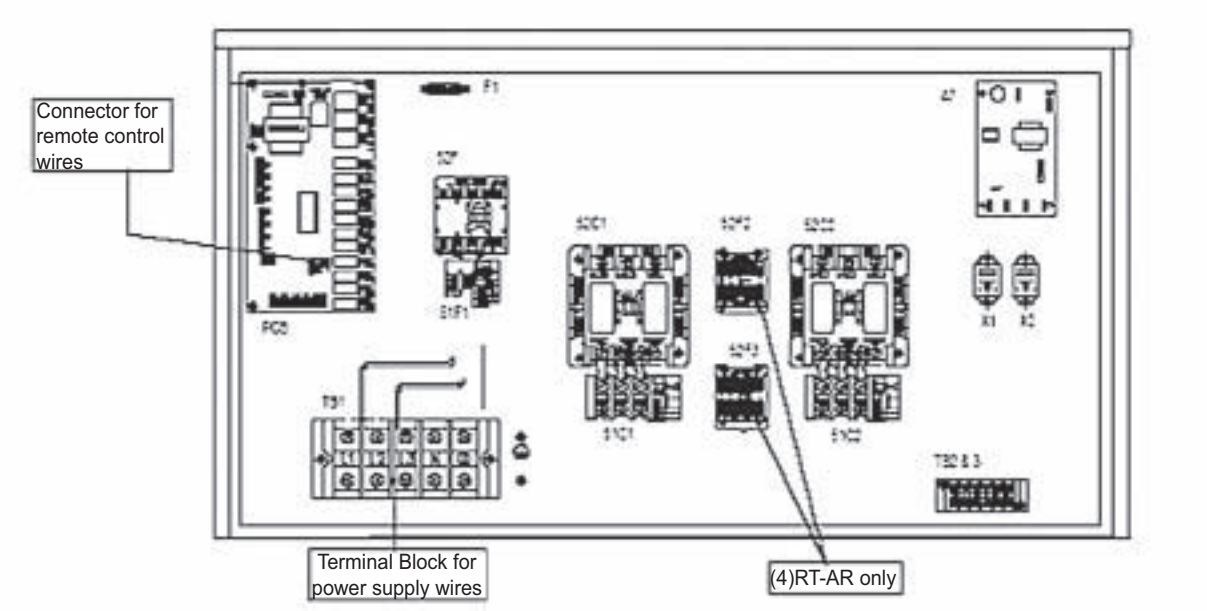


Appendix 12-6

CONTROL MODULE UATYP/TY700/850A



CONTROL MODULE UATYPC/TYC10/12A



Appendix 13-1

Adress Assignment for NIM

Group Address	Settings 12345678	Group Address	Settings 12345678	Group Address	Settings 12345678	Group Address	Settings 12345678
0	00000000	64	00000010	128	00000001	192	00000011
1	10000000	65	10000010	129	10000001	193	10000011
2	01000000	66	01000010	130	01000001	194	01000011
3	11000000	67	11000010	131	11000001	195	11000011
4	00100000	68	00100010	132	00100001	196	00100011
5	10100000	69	10100010	133	10100001	197	10100011
6	01100000	70	01100010	134	01100001	198	01100011
7	11100000	71	11100010	135	11100001	199	11100011
8	00010000	72	00010010	136	00010001	200	00010011
9	10010000	73	10010010	137	10010001	201	10010011
10	01010000	74	01010010	138	01010001	202	01010011
11	11010000	75	11010010	139	11010001	203	11010011
12	00110000	76	00110010	140	00110001	204	00110011
13	10110000	77	10110010	141	10110001	205	10110011
14	01110000	78	01110010	142	01110001	206	01110011
15	11110000	79	11110010	143	11110001	207	11110011
16	00001000	80	00001010	144	00001001	208	00001011
17	10001000	81	10001010	145	10001001	209	10001011
18	01001000	82	01001010	146	01001001	210	01001011
19	11001000	83	11001010	147	11001001	211	11001011
20	00101000	84	00101010	148	00101001	212	00101011
21	10101000	85	10101010	149	10101001	213	10101011
22	01101000	86	01101010	150	01101001	214	01101011
23	11101000	87	11101010	151	11101001	215	11101011
24	00011000	88	00011010	152	00011001	216	00011011
25	10011000	89	10011010	153	10011001	217	10011011
26	01011000	90	01011010	154	01011001	218	01011011
27	11011000	91	11011010	155	11011001	219	11011011
28	00111000	92	00111010	156	00111001	220	00111011
29	10111000	93	10111010	157	10111001	221	10111011
30	01111000	94	01111010	158	01111001	222	01111011
31	11111000	95	11111010	159	11111001	223	11111011
32	00000100	96	00000110	160	00000101	224	00000111
33	10000100	97	10000110	161	10000101	225	10000111
34	01000100	98	01000110	162	01000101	226	01000111
35	11000100	99	11000110	163	11000101	227	11000111
36	00100100	100	00100110	164	00100101	228	00100111
37	10100100	101	10100110	165	10100101	229	10100111
38	01100100	102	01100110	166	01100101	230	01100111

Appendix 13-2

Adress Assignment for NIM

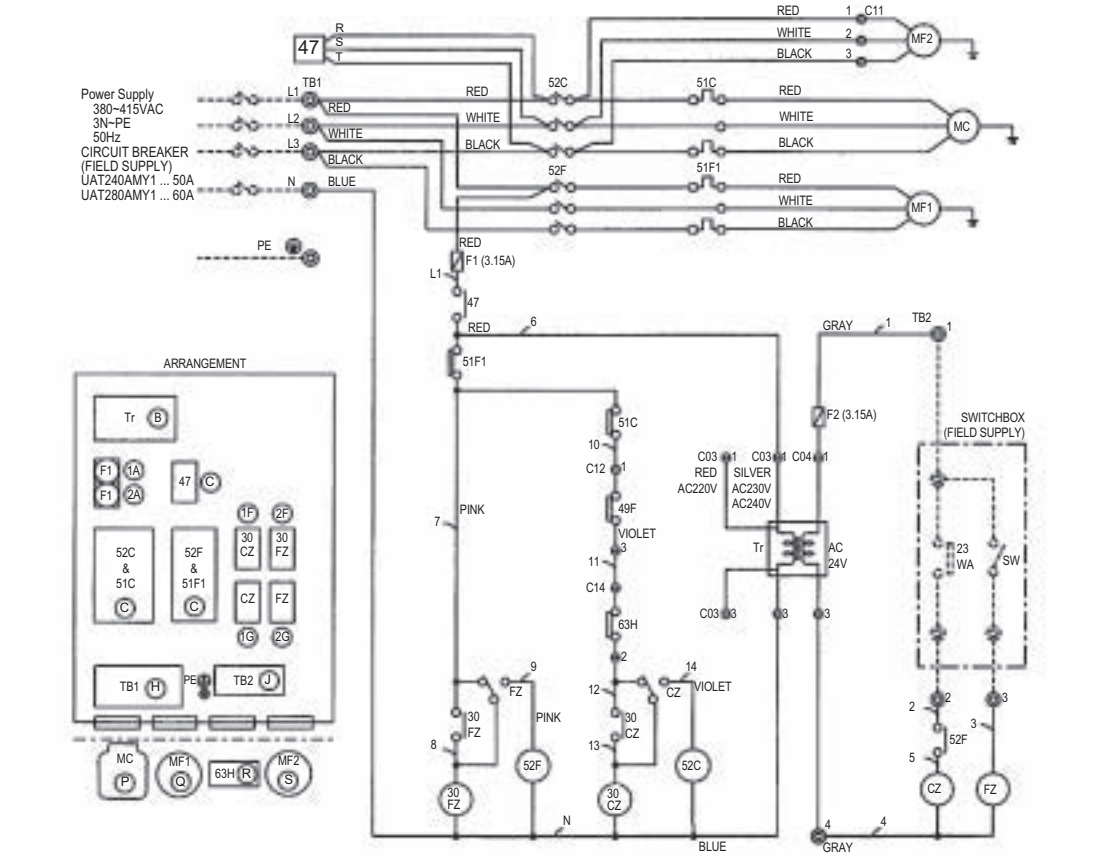
Group Address	Settings 12345678	Group Address	Settings 12345678	Group Address	Settings 12345678	Group Address	Settings 12345678
39	11100100	103	11100110	167	11100101	231	11100111
40	00010100	104	00010110	168	00010101	232	00010111
41	10010100	105	10010110	169	10010101	233	10010111
42	01010100	106	11000010	170	11000001	234	11000011
43	11010100	107	11010110	171	11010101	235	11010111
44	00110100	108	00110110	172	00110101	236	00110111
45	10110100	109	10110110	173	10110101	237	10110111
46	01110100	110	01110110	174	01110101	238	01110111
47	11110100	111	11110110	175	11110101	239	11110111
48	00001100	112	00001110	176	00001101	240	00001111
49	10001100	113	10001110	177	10001101	241	10001111
50	01001100	114	01001110	178	01001101	242	01001111
51	11001100	115	11001110	179	11001101	243	11001111
52	00101100	116	00101110	180	00101101	244	00101111
53	10101100	117	10101110	181	10101101	245	10101111
54	01101100	118	01101110	182	01101101	246	01101111
55	11101100	119	11101110	183	11101101	247	11101111
56	00011100	120	00011110	184	00011101	248	00011111
57	10011100	121	10011110	185	10011101	249	10011111
58	01011100	122	01011110	186	01011101	250	01011111
59	11011100	123	11011110	187	11011101	251	11011111
60	00111100	124	00111110	188	00111101	252	00111111
61	10111100	125	10111110	189	10111101	253	10111111
62	01111100	126	01111110	190	01111101	254	01111111
63	11111100	127	11111110	191	11111101	255	RESERVED

Unit Address	Settings 1234	Unit Address	Settings 1234
0	0000	8	1000
1	0001	9	1001
2	0010	10	1010
3	0011	11	1011
4	0100	12	1100
5	0101	13	1101
6	0110	14	1110
7	0111	15	1111

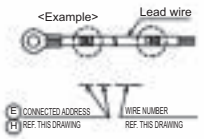
Appendix 14-1

UAT240AMY1
UAT280AMY1
(Mechanical control)

Symbol	Name	Symbol	Name
MC	Compressor motor	63H	High Pressure switch
MF1	Fan motor (indoor)	FZ	Auxilliary relay (fan)
MF2	Fan motor (outdoor)	CZ	Auxilliary relay (compressor)
52C	Contactor (compressor	30CZ, 30FZ	Auxilliary relay (check)
52F	Contactor (fan I/D)	<SW>	Switch (on)
TB1,2	Terminal block	<23WA>	Thermostat (room temp.)
F1,F2	Fuse (3.15A)	47	Phase protector
Tr	Transformer	49F	Internal protector (fan O/D)
51C	Over current relay (compressor)	C03,04,11,12,14	Connector
51F1	Over current relay (fan I/D)		



Note: 1. The dotted lines show field wiring
2. The figure in the parentheses show field supply parts
3. Color of earth wire is yellow and green twisting
4. If the power supply is 380AV, change the IC031 connector with silver color tape to red color tape
5. Refer below example about wiring mark



Caution
1. To protect each Fan motor and Compressor from abnormal current . Over current relays <51C>,<51F1> are installed. Therefore, do not change factory set value of Over current relays.

Controller connection

Symbol	No.	Function	PAC-204RC terminal no.
	1	Power (Active)	24VAC(L)
	2	Cooling operation	COMP1
	3	Fan operation	FAN HI
	4	Power (Neutral)	24VAC(N)

Appendix 14-2

UATP/T240A

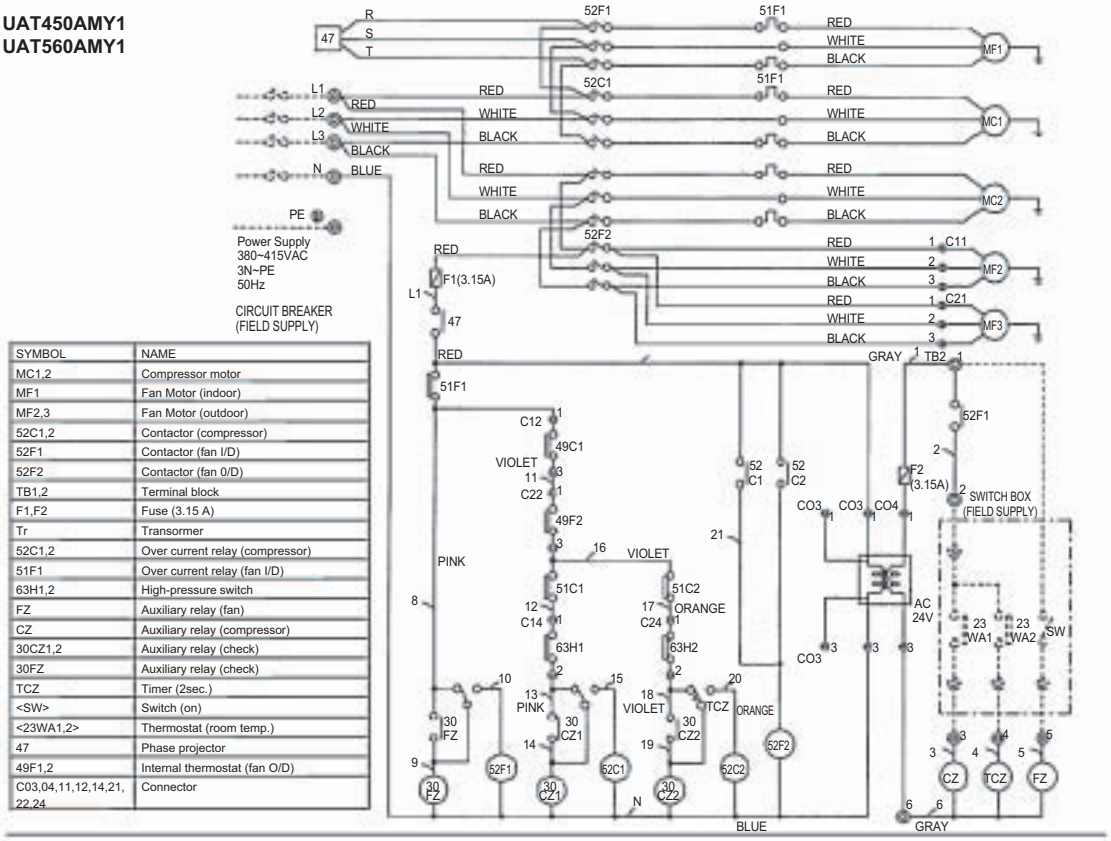
No	Main Electrical Component Required	Quantity Required
1	TER BLOCK, T3011-4P-C1.1 60A	1
2	TERMINAL BLOCK, T3020A-1-4P-C1.0 20A	1
3	CONT,PAK-26JT-F,2N0,2NC,AC240V,27.5A TOGAMI	1
4	CONT,PAK-6JT,1NO,AC240V,2.8A, TOGAMI	1
5	RELAY, LY2F AC220/240V OMRON P421132X01	2
6	RELAY, LY2F AC24V OMRON S421003H03	2
7	TRANSFORMER,240V/24V,TAMURA,P715337X01	1
8	PHASE PROTECTOR, PP1.03, OYL	1

UATP/T280A

No	Main Electrical Component Required	Quantity Required
1	TER BLOCK, T3011-4P-C1.1 60A	1
2	TERMINAL BLOCK, T3020A-1-4P-C1.0 20A	1
3	CONT,PAK-26JT-F,2N0,2NC,AC240V,31.0A TOGAMI	1
4	CONT,PAK-6JT,1NO,AC240V,3.6A, TOGAMI	1
5	RELAY, LY2F AC220/240V OMRON P421132X01	2
6	RELAY, LY2F AC24V OMRON S421003H03	2
7	TRANSFORMER,240V/24V,TAMURA,P715337X01	1
8	PHASE PROTECTOR, PP1.03	1

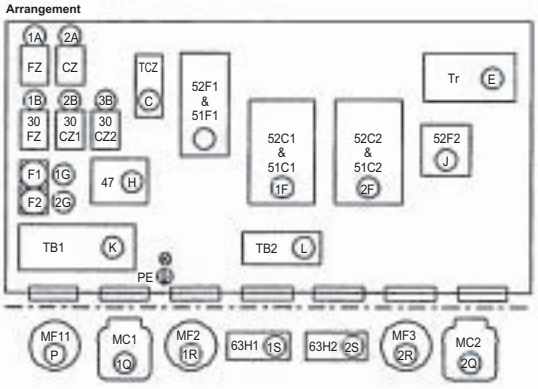
Appendix 14-3

UAT450AMY1
UAT560AMY1



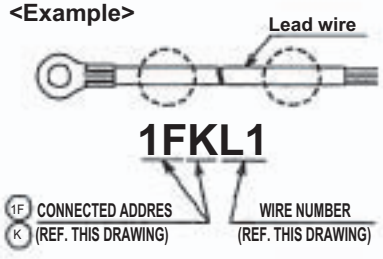
SYMBOL	NAME
MC1,2	Compressor motor
MF1	Fan Motor (indoor)
MF2,3	Fan Motor (outdoor)
52C1,2	Contactor (compressor)
52F1	Contactor (fan I/D)
52F2	Contactor (fan 0/D)
TB1,2	Terminal block
F1,F2	Fuse (3.15 A)
Tr	Transormer
52C1,2	Over current relay (compressor)
51F1	Over current relay (fan I/D)
63H1,2	High-pressure switch
FZ	Auxiliary relay (fan)
CZ	Auxiliary relay (compressor)
30CZ1,2	Auxiliary relay (check)
30FZ	Auxiliary relay (check)
TCZ	Timer (2sec.)
<SW>	Switch (on)
<23WA1,2>	Thermostat (room temp.)
47	Phase projector
49F1,2	Internal thermostat (fan O/D)
C03,04,11,12,14,21, 22,24	Connector

Arrangement



Notes
1. The dotted lines show field wiring.
2. The figure in the parentheses show field supply parts
3. Color of eart wire is yellow and green twisting
4. If the power supply is 380AV, change the C03 connector with silver color tape to red color tape.
5. Refer below example about wiring mark

<Example>



SYMBOL	No.	Function	PAC-204RC terminal no.
TB2	1	Power (Active)	24VAC(L)
	3,4	Cooling operation	COMP1,2
	5	Fan operation	FAN HI
	6	Power (Neutral)	24VAC(N)

Caution,
1. To protect each Fan motor and compressor from abnormal current, Over current relays <51C1,2> and <51F1> are installed. Therefore, do not change factory set value of Over current relays.
2. This timer <TCZ> installed because the power supply breaker may operate if two compressors start at the same time.
3. Do not change the factory set value of Timer.

Appendix 14-4

UATP/T450A

No	Main Electrical Component Required	Quantity Required
1	TERMINAL BLOCK, HP-T3015-4P-100A	1
2	TERMINAL BLOCK, T3020A-1-6P-C1.0 20A	1
3	CONT,PAK-26JT-F,2NO,2NC,AC240V,27.5A TOGAMI	2
4	CONT, PAK-6JTH 1NO 240V 5.0A S427022H79	1
5	CONT,PAK-6J,1NO,AC240V, TOGAMI	1
6	RELAY, LY2F AC220/240V OMRON P421132X01	3
7	RELAY, LY2F AC24V OMRON S421003H03	2
8	TRANSFORMER,240V/24V,TAMURA,P715337X01	1
9	TIMER SOCKET, PYF08A OMRON	1
10	TIMER CLIP (Y92H-3)	2
11	TIMER, H3Y2 5 SEC AC24V OMRON	1
12	PHASE PROTECTOR, PP1.03	1

Appendix 14-5

4RT/RT200A

No	Main Electrical Component Required	Quantity Required
1	TERMINAL BLOCK, HP-T3015-4P-100A	1
2	TERMINAL BLOCK, T3020A-1-6P-C1.0 20A	1
3	CONT,PAK-26JT-F,2N0,2NC,AC240V,31.A TOGA	2
4	CONT,PAK-11JT,1NO,AC240V,7.5A,S427022H50	1
5	CONT,PAK-6J,1NO,AC240V, TOGAMI	1
6	RELAY, LY2F AC220/240V OMRON P421132X01	3
7	RELAY, LY2F AC24V OMRON S421003H03	2
8	TRANSFORMER,240V/24V,TAMURA,P715337X01	1
9	TIMER SOCKET, PYF08A OMRON	1
10	TIMER CLIP (Y92H-3)	2
11	TIMER, H3Y2 5 SEC AC24V OMRON	1
12	PHASE PROTECTOR, PP1.03	1

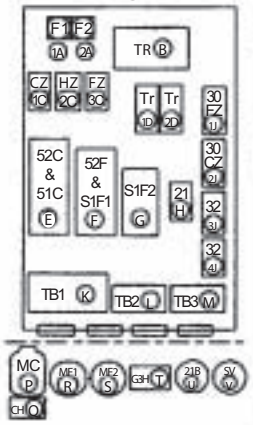
Appendix 14-6

UATY240AMY1 UATY280AMY1 (STANDARD: MECHANICAL CONTROL)

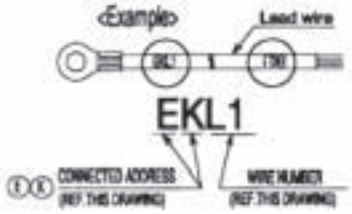
Symbol	Name	Symbol	Name	Symbol	Name
MC	Compressor motor	CR1,2	Surge killer	CH	Crankcase heater
MF1	Fan motor (indoor)	CSH	High-pressure switch	T1,2	Timer (defused)
MF2	Fan motor (outdoor)	FZ	Auxilliary relay (fan)	21S4	4-way valve
52C	Contactor (compressor)	CZ	Auxilliary relay (compressor)	C03, 04, 05, 11-15	Connector
52F	Contactor (fan I/D)	30CZ,FZ	Auxilliary relay (check)	X1	Contactor (fan O/D)
TB1-3	Terminal block	<SW1>	Switch (Operation mode)	X2	Auxilliary relay (defrost)
F1, F2	Fuse (3.15A)	<SW2>	Switch (on)		Thermostat (defrost)
TR	Transformer	<23WA>	Thermostat (room temp.)	HZ	Auxilliary relay (4-way valve)
51C	Over current relay (compressor	49F	Internal protector (fan O/D)	SV	Solenoid valve
51F1,2	Over current relay (fan I/D, O/D)	49C	Internal thermostat compressor		

CIRCUIT BREAKER
(FIELD SUPPLY)
ART080AR ... 50A
ART100AR ... 60A

ARRANGEMENT



Note :
1. The dotted lines show field wiring.
2. The figure in the parentheses show field supply parts.
3. Color of earth wire is yellow and green twisting.
4. If the power supply is 380AV, change the iC03i connector with silver color tape to red color tape
5. Refer below example about wiring mark



Caution,
1. To protect each Fan motor and Compressor from abnormal current, Over current relays <51C>, <51F1,2> are installed. Therefore, do not change factory set value of Over current relays.
2. Do not change factory set value of all timers.

Controller connection.

Symbol	No.	Function	PAC-204RC terminal no.
TB2	1	Power (Active)	24VAC(L)
	3	Cooling or heating operation	COMP 1
	4	Reversing valve for heating operation	4WV
	5	Fan operation	FAN HI
	6	Power (Neutral)	24VAC(N)

Appendix 14-7

UATYP/TY240A

No	Main Electrical Component Required	Quantity Required
1	TER BLOCK, T3011-5P-C1.4 60A W865569G05	1
2	CONT,PAK-26JT-F,AC240V,22.0A,S427021H70	1
3	CONT,PAK-6JT,1NO,AC240V,2.8A, TOGAMI	1
4	T-11N,2.5A,TOGAMI	1
5	CONTACTOR, SRN4 2A2B AC230V*MIT	1
6	RELAY, LY2F AC24V OMRON S421003H03	3
7	RELAY, LY2F AC220/240V OMRON P421132X01	3
8	TERMINAL BLOCK, T3020A-1-6P-C1.0 20A	2
9	THERMOSTAT, RTB-M201 SGNM P425604X03	1
10	TRANSFORMER,240V/24V,TAMURA,P715337X01	1
11	TIMER, H3Y-2 60 MIM AC240V OMRON	2
12	TIMER SOCKET, PYF08A OMRON	2
13	TIMER CLIP (Y92H-3)	4

Appendix 14-8

UATYP/TY280A

No	Main Electrical Component Required	Quantity Required
1	TER BLOCK, T3011-5P-C1.4 60A W865569G05	1
2	CONT,PAK-26JT-F,2N0,2NC,AC240V,31.A TOGAMI	1
3	T-11N,2.5A,TOGAMI	1
4	CONTACTOR, SRN4 2A2B AC230V*MIT	1
5	CONT,PAK-6JT,1NO,AC240V,3.6A, TOGAMI	1
6	TRANSFORMER,240V/24V,TAMURA,P715337X01	1
7	RELAY, LY2F AC24V OMRON S421003H03	3
8	RELAY, LY2F AC220/240V OMRON P421132X01	3
9	TERMINAL BLOCK, T3020A-1-6P-C1.0 20A	2
10	THERMOSTAT, RTB-M201 SGNM P425604X03	1
11	TIMER, H3Y-2 60 MIM AC240V OMRON	2
12	TIMER SOCKET, PYF08A OMRON	2
13	TIMER CLIP (Y92H-3)	4

Appendix 14-9

UATY450AMY1
UATY560AMY1
(STANDARD : MECHANICAL CONTROL)

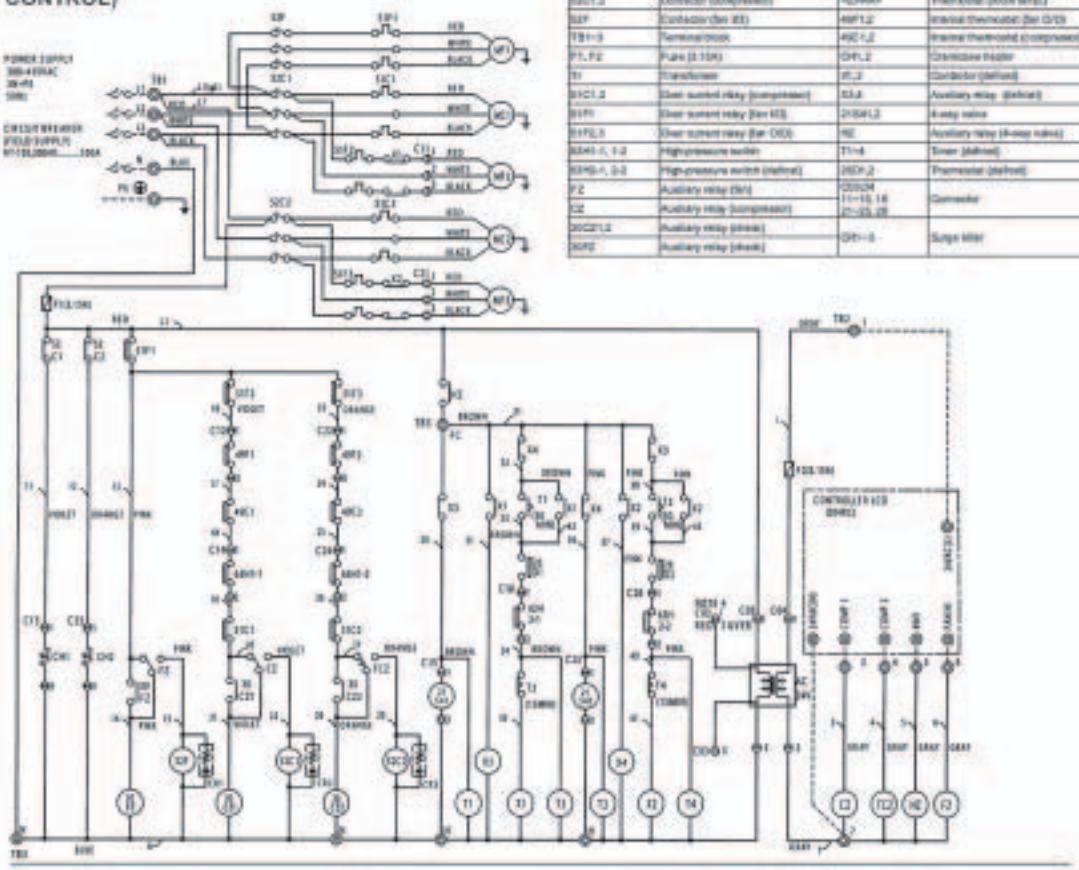


Fig. 1 Control box layout

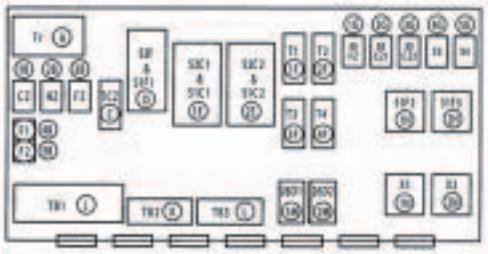
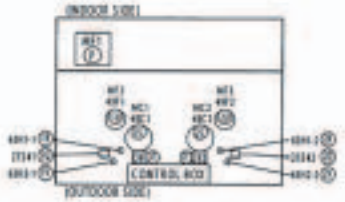


Fig.2 Unit internal layout



Caution.
1. To protect each Fan motor and Compressor from abnormal current, Over current relays <51C1,2>, <51F1~3> are installed. Therefore, do not change factory set value of Over current relays.
2. Do so change the factory set value of all timers.
3. The timer <TC2> installed because the power supply breaker may operate if two compressors start at the same time.

Note :
1. The dotted lines show field wiring.
2. The figure in the parentheses show field supply ports.
3. Color of earth wire is yellow and green twisting.
4. If the power supply is 380VAC, change the H3P connector with silver color tape to one with red color tape.
5. Refer below example about wiring mark.

Controller connection.

Symbol	No.	Function	LCD-334NC terminal no.
TB2	1	Power (Active)	24VAC(L)
	3	Cooling or Heating operation	COMP1
	4	Cooling or Heating operation	COMP2
	5	Reversing valve for Heating operation	4WV
	6	Fan operation	FAN HI
	7	Power (Neutral)	24VAC(N)

Appendix 14-10

UATYP/TY450A

No	Main Electrical Component Required	Quantity Required
1	TERMINAL,BLOCK 100AMP T3015-5P W65569G12	1
2	THERMOSTAT, RTB-M201 SGNM P425604X03	2
3	CONTACTOR, SRN4 2A2B AC230V*MIT	2
4	CONT, PAK-6JTH 1NO 240V 5.0A S427022H79	1
5	CONT,PAK-26JT-F,AC240V,22.A,S427021H70	2
6	T-11N,2.5A,TOGAMI	2
7	RELAY, LY2F AC220/240V OMRON P421132X01	5
8	TIMER, H3Y-2 60 MIM AC240V OMRON	5
9	TIMER SOCKET, PYF08A OMRON	5
10	TIMER CLIP (Y92H-3)	10
11	TRANSFORMER,240V/24V,TAMURA,P715337X01	1
12	RELAY, LY2F AC24V OMRON S421003H03	3
13	TIMER, H3Y2 5 SEC AC24V OMRON	1

Appendix 14-11

UATYP/TY560A

No	Main Electrical Component Required	Quantity Required
1	TERMINAL,BLOCK 100AMP T3015-5P W65569G12	1
2	THERMOSTAT, RTB-M201 SGNM P425604X03	2
3	CONTACTOR, SRN4 2A2B AC230V*MIT	2
4	CONT,PAK-11JT,1NO,AC240V,7.5A,S427022H50	1
5	T-11N,2.5A,TOGAMI	2
6	CONT,PAK-26JT-F,2N0,2NC,AC240V,31.A TOGA	2
7	RELAY, LY2F AC220/240V OMRON P421132X01	5
8	TIMER, H3Y-2 60 MIM AC240V OMRON	5
9	TIMER SOCKET, PYF08A OMRON	5
10	TIMER CLIP (Y92H-3)	10
11	TRANSFORMER,240V/24V,TAMURA,P715337X01	1
12	RELAY, LY2F AC24V OMRON S421003H03	3
13	TIMER, H3Y2 5 SEC AC24V OMRON	1

Appendix 15-1

Model	Blower pully, Db			Motor Pully, Dm		
	Type	Diameter (mm)	Bore (mm)	Type	Diameter (mm)	Bore (mm)
UATP/TYP/T/TY180A	B1	152	20	B1	102	19
UATP/TYP/T/TY240A	B1	152	20	B1	102	24
UATP/TYP/T/TY280A	B1	152	20	B1	114	24
UATP/TYP/T/TY320A	B1	140	20	B1	114	24
UATP/TYP/T/TY450A	B2	254	28	B2	127	28
UATP/TYP/T/TY560A	B2	254	28	B2	152	28
UATP/TYP/T/TY700A	SPZ 2	224	25	SPZ 2	125	38
UATP/TYP/T/TY850A	SPZ 2	224	25	SPZ 2	140	38
UATPC/TYPC/TC/TYC180A	SPA	280	40	SPA	124	38
UATPC/TYPC/TC/TYC12A	SPA	250	40	SPA	118	38

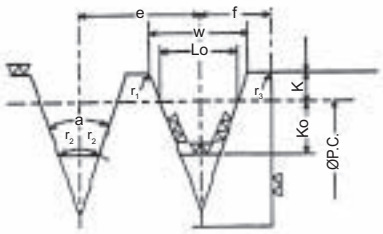
Model	V-belt lenght, L (mm)	Pully Centre Distance, C (mm)			Motor kW	Motor RPM
		Nominal	Minimum	Maximum		
UATP/TYP/T/TY180A	762	180	126	224	0.75	960
UATP/TYP/T/TY240A	762	180			1.1	960
UATP/TYP/T/TY280A	787	184			1.5	1080
UATP/TYP/T/TY320A	762	180			1.5	1100
UATP/TYP/T/TY450A	1067	180	190	306	2.2	730
UATP/TYP/T/TY560A	1092	221			3.7	850
UATP/TYP/T/TY700A	1662	558	558	572	5.5	840
UATP/TYP/T/TY850A	1700	565			7.5	880
UATPC/TYPC/TC/TYC180A	2132	748	730	763	7.5	1440
UATPC/TYPC/TC/TYC12A	2060	739			7.5	1440

Appendix 15-2

Pulley outside dimensions are shown below: (Unit: mm)

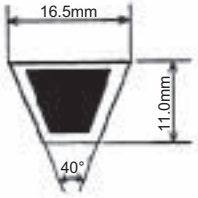
(1) Shape of belt groove

1.1

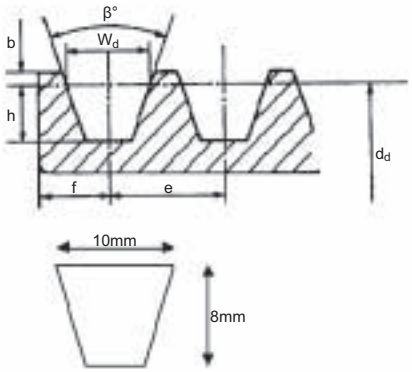


Shape of V-belt	Nominal Dia. ØP.C	A (°)	W	Lo	K	Ko	e	f	r_1	r_2	r_3	V-belt Thickness (Reference)
B	Over 125 Under 160	34	15.86	12.5	5.5	9.5	19.0	12.5	0.2~0.5	0.5~1.0	1~2	11
	Over 160 Under 200	36	16.07									
	Over 200	38	16.29									

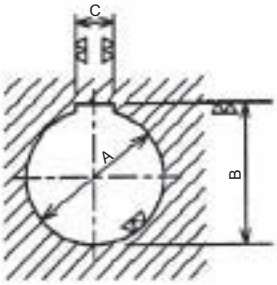
Sectional plan of V-belt



1.2 Taper lock type (ART250/300A/AR)



Section	Sheave dia. d_d	Groove angle β	W_d	b_{min}	h_{min}	e	f
SPZ	71 - 80 > 80	34° 38°	8.5	2.0	9.0	12 ± 0.3	8 ± 1



Motor capacity (kW)	A		B		C	
1.1, 1.5	**Ø24**	+0.028 +0.007	**27**	+0.128 +0.007	**8**	+0.018 -0.018
2.2, 3.7	**Ø28**	+0.028 +0.007	**31**	+0.128 +0.007	**8**	+0.028 -0.013
5.5, 7.5	**Ø38**	+0.028 +0.007	**41**	+0.128 +0.009	**10**	+0.028 -0.013

Appendix 15-3

NBK®

■VARIETY OF NBK STANDARD V-PULLEYS

Unit (inch)

Belt Section	NOS.of V groeves	MIN. Outside DIAM.	MAX. Outside DIAM.
M	1 belt	2 inch	10 inch
A	1 belt	2	24
	2 belt	2	30
	3 belt	2	36
	4 belt	3	30
B	1 belt	2	24
	2 belt	2	30
	3 belt	2	40
	4 belt	3	40
	5 belt	3	40
	6 belt	4	22
C	1 belt	4	18
	2 belt	4	30
	3 belt	4	40
	4 belt	4	40
	5 belt	4	40
	6 belt	4	40
D	4 belt	6	36
	5 belt	6	36
	6 belt	6	36

■OUTSIDE DIAMETER MINUS PITCH DIAMETER

Unit (mm)

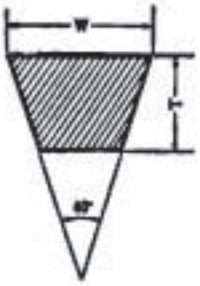
Belt Section	M	A	B	C	D	E
Outside diam. minus pitch diam.	5.5	9	11	14	19	25.5

■SUGGESTED V-PULLEY FOR ELECTRIC MOTOR

Poles	8 P		6 P		4 P		2 P	
Hz	50	60	50	60	50	60	50	60
kw \ r.p.m.	725	870	950	1,180	1,425	1,750	2,850	3,450
0.2	—		—		3A1		3A1	
0.4	3½A1		3½A1		3½A1		3A1	
0.75	3½A2		3½A2		3½A2		3½A1	
1.5	4A3 : 5B2		4½A2 : 5B2		4A2		3½A2	
2.2	5A3 : 5½B2		4½A3 : 5B2		4½A2 : 5B2		4A2	
3.7	6A4 : 6B3		5A4 : 5½B3		5A3 : 5½B2		4A3	
5.5	6½B4		6½A4 : 6½B3		5½A4 : 5½B3		4½A3	
7.5	6½B5		6½B4		6½A4 : 6½B3		5½A3	
11	9C4 : 8B6		9C3 : 8B5		7B4			
15	10C4		9C4 : 8B6		9C3 : 7B5			
18.5	10C5		9C5		9C4 : 8B6			
22	11C5		10C5		9C4 : 9B6			
30	11C6		11C5		10C5			
37	13C6 : 13D5		12C6		10C6			
45	14D5		13C6 : 13D5		11C6			
55	15D5		14D5		11C8 : 22A-8V5			
75	15D6		15D6		11C10 : 22A-8V5			
90	18D6		16D6					
110	18D8 : 42A-8V4		18D8 : 35A-8V4					
132	18D8 : 42A-8V5		18D9 : 48A-8V4					
160			18D11 : 48A-8V5					

Speed ratio 1 : 2 ~ 5 Service factor 1.3
Contact angle 140° (FC=0.90)

■STANDARD DIMENSIONS OF V-BELT

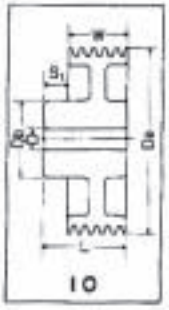


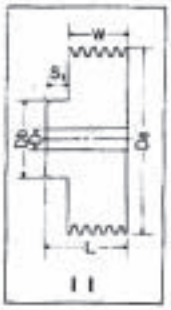
Unit (mm)

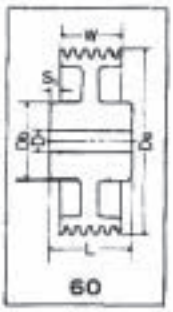
Type	A	B	C	D	E
T	9.0	11.0	14.0	19.0	25.5
W	12.5	16.5	22.0	31.5	38.0

Appendix 14-4

STANDARD V PULLEY







■ Please refer catalog number when ordering.

M – 1 GROOVE

W = 17 Unit (mm)

Catalog Number	Outer Diam. De	Pitch Diam. Dp	Max Bore	Type	Db	L	S_t	Weight (kg)
2 – M – 1	50.8	45.3	16	11U	28	30	13	0.23
2½ – M – 1	63.5	58.0	17	11U	30	30	13	0.34
3 – M – 1	76.2	70.7	17	10U	30	30	13	0.37
3½ – M – 1	88.9	83.4	18	10U	32	30	13	0.5
4 – M – 1	101.6	96.1	18	10S	32	30	13	0.52
4½ – M – 1	114.3	108.8	18	10S	32	30	13	0.58
5 – M – 1	127.0	121.5	18	10S	32	30	13	0.62
5½ – M – 1	139.7	134.2	18	10S	32	30	13	0.65
6 – M – 1	152.4	146.9	16	10S	28	30	13	0.65
7 – M – 1	177.8	172.3	22	10S	38	30	13	0.88
8 – M – 1	203.2	197.7	22	10S	38	30	13	0.96
9 – M – 1	228.6	223.1	17	10S	30	30	13	1.12
10 – M – 1	254.0	248.5	22	10X	38	30	13	1.32
12 – M – 1	305.0	299.6	22	60X	40	32	8	2.16

(Note) Type & its representing number : see drawings in top

Number of arms : U ..... Solid

S ..... 3 arms

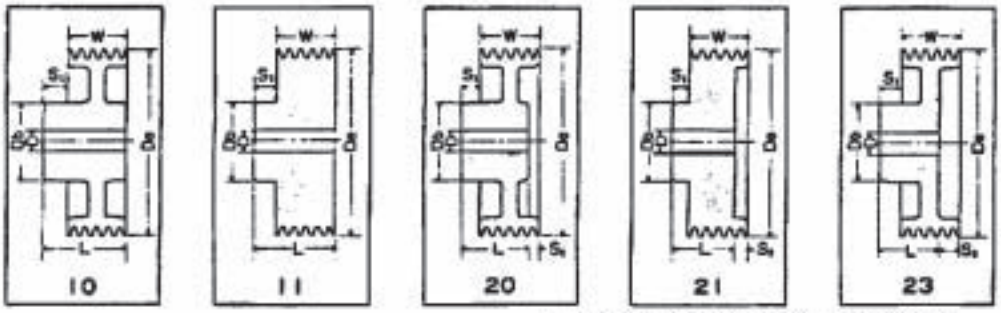
X ..... 4 arms

Y ..... 6 arms

The same applies to the following pages hereafter.

Appendix 15-5

NBK®



■ Please refer catalog number when ordering.

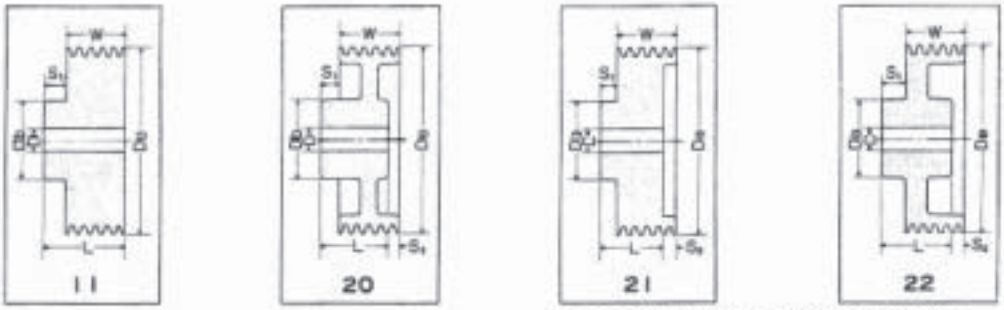
B – 1 GROOVE

W = 24 Unit (mm)

Catalog Number	Outer Diam. De	Pitch Diam. Dp	Max Bore	Type	Db	L	S_1	Weight (Approx.)
2 – B – 1	50.8	39.8	12	11U	34	43	19	0.34
2½ – B – 1	63.5	52.5	19	11U	42	43	19	0.55
3 – B – 1	76.2	65.2	25	21U	44	25	19	0.62
3½ – B – 1	88.9	77.9	25	21U	44	25	19	0.66
4 – B – 1	101.6	90.6	28	21U	50	28	19	0.97
4½ – B – 1	114.3	103.3	28	23U	50	30	15	1.13
5 – B – 1	127.0	116.0	28	23U	50	30	15	1.34
5½ – B – 1	139.7	128.7	28	23U	50	30	15	1.49
6 – B – 1	152.4	141.4	28	23U	50	30	15	1.67
6½ – B – 1	165.1	154.1	32	20X	56	30	8	1.61
7 – B – 1	177.8	166.8	34	10X	60	30	6	1.83
8 – B – 1	203.2	192.2	34	10X	60	30	6	2.15
9 – B – 1	228.6	217.6	34	10X	60	30	6	2.36
10 – B – 1	254.0	243.0	36	10X	64	34	10	2.57
11 – B – 1	279.4	268.4	36	10X	64	34	10	2.86
12 – B – 1	304.8	293.8	36	10X	64	34	10	3.54
13 – B – 1	330.2	319.2	36	10X	64	38	14	4.19
14 – B – 1	355.6	344.6	38	10X	70	40	16	4.53
15 – B – 1	381.0	370.0	42	10X	74	40	16	4.97
16 – B – 1	406.4	395.4	42	10X	74	40	16	5.30
18 – B – 1	457.2	446.2	45	10X	80	40	16	6.36
20 – B – 1	508.0	497.0	45	10Y	80	40	16	8.14
22 – B – 1	558.8	547.8	43	10Y	76	45	21	8.72
24 – B – 1	609.6	598.6	43	10Y	76	45	21	9.47

Appendix 15-6

NBK STANDARD V PULLEY



■Please refer catalog number when ordering.

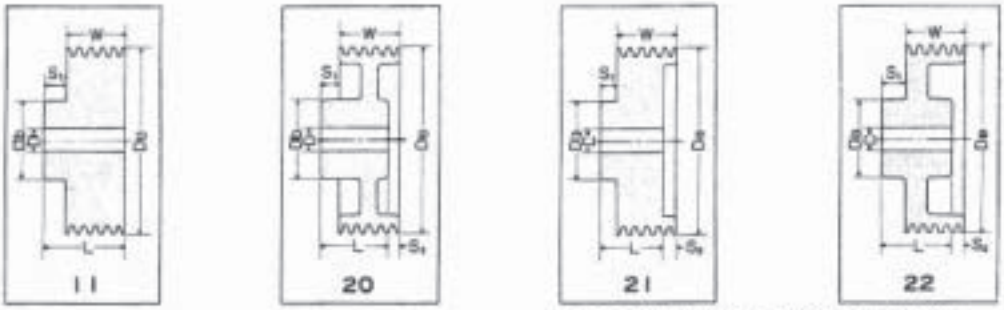
B－2 GROOVE

W＝44 Unit (mm)

Catalog Number	Outer Diam. De	Pitch Diam. Dp	Max Bore	Type	Db	L	Si	So	Weight (Kg)
2－B－2F	50.8	39.8	12	3IU		44			0.35
2－B－2	50.8	39.8	12	IIU	34	63	19		0.50
2½－B－2F	63.5	52.5	19	3IU		44			0.62
2½－B－2	63.5	52.5	19	IIU	41	63	19		0.82
3－B－2F	76.2	65.2	26	4IU		30		14	0.83
3－B－2	76.2	65.2	25	2IU	44	32	19		0.92
3½－B－2F	88.9	77.9	33	4IU		30		14	1.17
3½－B－2	88.9	77.9	28	2IU	50	32	19	31	1.16
4－B－2F	101.6	90.6	40	4IU		30		14	1.56
4－B－2	101.6	90.6	28	2IU	50	32	19	31	1.41
4½－B－2F	114.3	103.3	47	4IU		30		14	2.00
4½－B－2	114.3	103.3	32	2IU	57	32	19	31	1.68
5－B－2F	127.0	116.0	32	40U	57	30		14	1.85
5－B－2	127.0	116.0	32	22U	57	37	19	26	2.07
5½－B－2F	139.7	128.7	35	40U	63	30		14	2.10
5½－B－2	139.7	128.7	35	22U	63	37	19	26	2.66
6－B－2F	152.4	141.4	35	40U	63	30		14	2.38
6－B－2	152.4	141.4	35	22U	63	40	19	23	2.86
6½－B－2F	165.1	154.1	35	40U	63	30		14	2.53
6½－B－2	165.1	154.1	35	22U	63	40	19	23	3.24
7－B－2F	177.8	166.8	43	50X	76	40		2	3.46
7－B－2	177.8	166.8	43	20X	76	46	12	10	3.46

Appendix 15-7

NEK STANDARD V PULLEY



■ Please refer catalog number when ordering.

B – 2 GROOVE

W = 44 Unit (mm)

Catalog Number	Outer Diam. De	Pitch Diam. Dp	Max Bore	Type	Db	L	S_1	S_2	Weight (Kg)
2 – B – 2F	50.8	39.8	12	3I U		44			0.35
2 – B – 2	50.8	39.8	12	1I U	34	63	19		0.50
2½ – B – 2F	63.5	52.5	19	3I U		44			0.62
2½ – B – 2	63.5	52.5	19	1I U	41	63	19		0.82
3 – B – 2F	76.2	65.2	26	4I U		30		14	0.83
3 – B – 2	76.2	65.2	25	2I U	44	32	19		0.92
3½ – B – 2F	88.9	77.9	33	4I U		30		14	1.17
3½ – B – 2	88.9	77.9	28	2I U	50	32	19	31	1.16
4 – B – 2F	101.6	90.6	40	4I U		30		14	1.56
4 – B – 2	101.6	90.6	28	2I U	50	32	19	31	1.41
4½ – B – 2F	114.3	103.3	47	4I U		30		14	2.00
4½ – B – 2	114.3	103.3	32	2I U	57	32	19	31	1.68
5 – B – 2F	127.0	116.0	32	40 U	57	30		14	1.85
5 – B – 2	127.0	116.0	32	22 U	57	37	19	26	2.07
5½ – B – 2F	139.7	128.7	35	40 U	63	30		14	2.10
5½ – B – 2	139.7	128.7	35	22 U	63	37	19	26	2.66
6 – B – 2F	152.4	141.4	35	40 U	63	30		14	2.38
6 – B – 2	152.4	141.4	35	22 U	63	40	19	23	2.86
6½ – B – 2F	165.1	154.1	35	40 U	63	30		14	2.53
6½ – B – 2	165.1	154.1	35	22 U	63	40	19	23	3.24
7 – B – 2F	177.8	166.8	43	50 X	76	40		2	3.46
7 – B – 2	177.8	166.8	43	20 X	76	46	12	10	3.46

Appendix 15-8

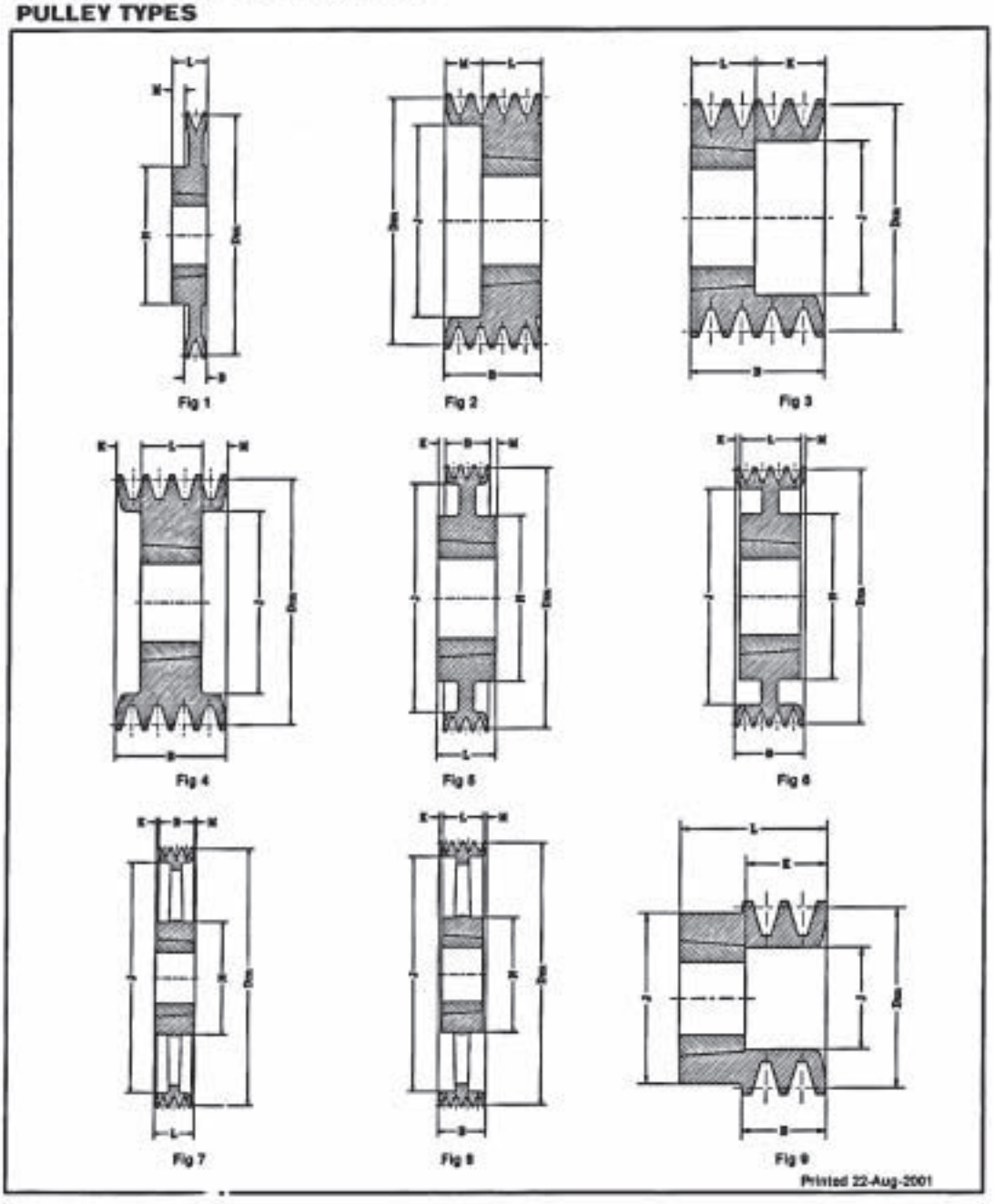
UNI-DRIVE

TAPER BUSHING V-PULLEYS

UNI-DRIVE Taper Bushing Pulleys have been re-designed to ensure suitability for the demands of modern industry. The new design incorporates advantages of modern materials to give the optimum weight strength ratio in the finished pulleys.

UNI-DRIVE Taper Bushing Pulleys are produced with accuracy and consistency of form and are suitable for use on drives with belt speed up to 40 meters per second.

PULLEY TYPES



Appendix 15-9

UNI-DRIVE Taper-Bushing V-Pulleys SPZ

Dm	Groove	Bush No	Max Bore	Figure	B	J	K	L	M	N	Weight (Kgs)
50	1	1008	25	9	16	26	15	37		60	0.3
	2	1008	25	9	28	26	27	49		60	0.4
56	1	1008	25	9	16	30	15	37		60	0.4
	2	1108	28	9	28	30	27	49		60	0.5
60	1	1008	25	1	16			22	6	55	0.2
	2	1108	28	9	28	34	27	49		64	0.6
63	1	1108	28	1	16			22	6	60	0.2
	2	1108	28	3	28	37	6	22			0.3
	3	1108	28	3	40	37	18	22			0.4
67	1	1108	28	1	16			22	6	60	0.3
	2	1108	28	3	28	38	6	22			0.4
	3	1108	28	3	40	38	18	22			0.5
71	1	1108	28	1	16			22	6	60	0.3
	2	1108	28	3	28	42	6	22			0.4
	3	1108	28	3	40	42	18	22			0.6
75	1	1108	28	1	16			22	6	60	0.4
	2	1210	32	3	28	46	3	25			0.4
	3	1210	32	3	40	46	15	25			0.5
80	1	1210	32	1	16			26.5	10.5	75	0.5
	2	1210	32	3	28	51	3	25			0.6
	3	1210	32	3	40	51	15	25			0.7
	4	1210	32	3	52	51	27	25			0.8
85	1	1210	32	1	16			25	9	83	0.6
	2	1610	42	3	28	56	3	25			0.5
	3	1610	42	3	40	56	15	25			0.6
	4	1610	42	3	52	56	27	25			0.9
	5	1610	42	3	64	56	39	25			1
90	1	1210	32	1	16			26.5	10.5	83	0.7
	2	1610	42	3	28	61	3	25			0.7
	3	1610	42	3	40	61	15	25			0.8
	4	1610	42	3	52	61	27	25			1
	5	1610	42	3	64	61	39	25			1.2
95	1	1210	32	1	16			26.5	10.5	83	0.7
	2	1610	42	3	28	66	3	25			0.6
	3	1610	42	3	40	66	15	25			0.9
	4	1610	42	3	52	66	27	25			1.1
	5	1610	42	3	64	66	39	25			1.3
100	1	1210	32	1	16			25	9	83	0.8
	2	1610	42	3	28	71	3	25			0.9
	3	1610	42	3	40	71	15	25			1.1
	4	1610	42	3	52	71	27	25			1.1
	5	2012	50	3	64	71	32	32			1.3
	6	2012	50	3	76	71	44	32			1.4
106	1	1610	42	1	16			25	9	83	0.9
	2	1610	42	3	28			28			1.1
	3	1610	42	3	40	77	15	25			1.3
	4	1610	42	3	52	77	27	25			1.3
	5	2012	50	3	64	77	32	32			1.5
	6	2012	50	3	76	77	44	32			1.6
112	1	1610	42	1	16			25	9	92	1
	2	1610	42	3	28	83	3	25			1.3
	3	2012	50	3	40	83	8	32			1.3
	4	2012	50	3	52	83	20	32			1.5
	5	2012	50	3	64	83	32	32			1.8
	6	2012	50	3	76	83	44	32			1.9
118	1	1610	42	1	16			25	9	92	0.9
	2	1610	42	3	28	89	3	25			1.3
	3	2012	50	3	40	89	8	32			1.6

Dm	Groove	Bush No	Max Bore	Figure	B	J	K	L	M	N	Weight (Kgs)
118	4	2012	50	3	52	89	20	32			1.8
	5	2012	50	3	64	89	32	32			1.8
	6	2517	65	3	76	89	31	45			2
125	1	1610	42	1	16			25	9	92	1
	2	1610	42	3	28	96	3	25			1.4
	3	2012	50	2	40	96		32	8		1.8
	4	2012	50	2	52	96		32	20		2.2
	5	2012	50	3	64	96	32	32			2.3
	6	2517	65	3	76	96	31	45			2.5
132	1	1610	42	1	16			25	9	92	1.1
	2	1610	42	3	28	111	3	25			1.5
	3	2012	50	2	40	111		32	8		2.3
	4	2012	50	2	52	111		32	20		2.5
	5	2517	65	3	64	111	19	45			2.7
	6	2517	65	3	76	111	31	45			2.9
140	1	1610	42	1	16			25	9	92	1.2
	2	1610	42	2	28	111		25	3		1.7
	3	2012	50	2	40	111		32	8		2.6
	4	2012	50	2	52	111		32	20		2.9
	5	2517	65	2	64	111		45	19		3.2
	6	2517	65	2	76	111		45	31		3.5
	8	2517	65	4	100	111	27.5	45	27.5		4
150	1	1610	42	1	16			25	9	92	1.2
	2	2012	50	1	28			33.5	5.5	112	2
	3	2012	50	2	40	121		32	8		3.1
	4	2517	65	2	52	121		45	7		3.7
	5	2517	65	2	64	121		45	19		4
	6	2517	65	2	76	121		45	31		4.4
	8	2517	65	4	100	121	27.5	45	27.5		5.1
160	1	1610	42	1	16			25	9	92	1.3
	2	2012	50	1	28			32	4	112	2.5
	3	2012	50	2	40	131		32	8		3.6
	4	2517	65	2	52	131		45	7		4.4
	5	2517	65	2	64	131		45	19		4.8
	6	2517	65	2	76	131		45	31		5.2
	8	2517	65	4	100	131	27.5	45	27.5		5.6
170	1	1610	42	1	16			25	9	92	1.5
	2	2012	50	1	28			32	4	112	2.5
	3	2012	50	6	40	141		32	8	112	4.2
	4	2517	65	2	52	141		45	7		5.3
	5	2517	65	2	64	141		45	19		5.9
	6	2517	65	2	76	141		45	31		6.5
	8	2517	65	4	100	141	27.5	45	27.5		6.6
180	1	1610	42	1	16			25	9	92	1.6
	2	2012	50	1	28			32	4	112	2.5
	3	2012	50	6	40	151		32	8	112	4.8
	4	2517	65	6	52	151		45	7	124	6.1
	5	2517	65	6	64	151		45	19	124	6.3
	6	2517	65	6	76	151		45	31	124	6.8
	8	3020	75	4	100	151	24.5	51	24.5		7.1
190	1	1610	42	1	16			25	9	92	1.8
	2	2012	50	1	28			32	4	112	2.6
	3	2012	50	6	40	161		32	8	112	4.9
	4	2517	65	6	52	161		45	7	124	5.3
	5	2517	65	6	64	161		45	19	124	6.3
	6	2517	65	6	76	161		45	31	124	6.9
	8	3020	75	4	100	161	24.5	51	24.5		8.2

Appendix 15-10

UNI-DRIVE Taper-Bushing V-Pulleys SPZ

Dm	Groove	Bush No	Max Bore	Figure	B	J	K	L	M	N	Weight (Kgs)
200	1	2012	50	1	16			32	16	112	2.3
	2	2012	50	1	28			32	4	112	2.8
	3	2012	50	6	40	171		32	8	112	3.5
	4	2517	65	6	52	171	3.5	45	3.5	124	4.7
	5	2517	65	6	64	171	9.5	45	9.5	124	5.5
	6	2517	65	6	76	171	15.5	45	15.5	124	6.1
	8	3020	75	4	100	171	24.5	51	24.5		9.3
212	1	2012	50	1	16			32	16	112	2.4
	2	2012	50	1	28			32	4	112	3
	3	2012	50	6	40	283		32	8	112	3.7
	4	2517	65	6	52	283	3.5	45	3.5	124	5
	5	2517	65	6	64	283	9.5	45	9.5	124	5.8
	6	2517	65	6	76	283	15.5	45	15.5	124	6.4
	8	3020	75	4	100	283	24.5	51	24.5		10.6
224	1	2012	50	5	16	195	8	32	8	112	2.5
	2	2012	50	5	28	195	2	32	2	112	3.2
	3	2012	50	6	40	195	4	32	4	112	3.9
	4	2517	65	6	52	195	3.5	45	3.5	124	5.2
	5	2517	65	6	64	195	9.5	45	9.5	124	6
	6	2517	65	6	76	195	15.5	45	15.5	124	6.6
	8	3020	75	4	100	195	24.5	51	24.5		11.8
236	1	2012	50	7	16	207	8	32	8	112	2.7
	2	2012	50	7	28	207	2	32	2	112	3.4
	3	2012	50	8	40	207	4	32	4	112	4.1
	4	2517	65	8	52	207	3.5	45	3.5	124	5.5
	5	2517	65	8	64	207	9.5	45	9.5	124	6.2
	6	2517	65	8	76	207	15.5	45	15.5	124	6.8
	8	3020	75	8	100	207	24.5	51	24.5	145	10.3
250	1	2012	50	7	16	221	8	32	8	112	2.9
	2	2012	50	7	28	221	2	32	2	112	3.5
	3	2012	50	8	40	221	4	32	4	112	4.3
	4	2517	65	8	52	221	3.5	45	3.5	124	5.7
	5	2517	65	8	64	221	9.5	45	9.5	124	6.4
	6	2517	65	8	76	221	15.5	45	15.5	124	7
	8	3020	75	8	100	221	24.5	51	24.5	145	10.5
280	1	2012	50	7	16	251	8	32	8	112	2.9
	2	2012	50	7	28	251	2	32	2	112	4
	3	2517	65	7	40	251	2.5	45	2.5	124	5.3
	4	2517	65	8	52	251	3.5	45	3.5	124	6.4
	5	2517	65	8	64	251	9.5	45	9.5	124	7.1
	6	2517	65	8	76	251	15.5	45	15.5	124	7.8
	8	3020	75	8	100	251	24.5	51	24.5	145	10.8
315	1	2012	50	7	16	286	8	32	8	112	3.1
	2	2012	50	7	28	286	2	32	2	112	4.2
	3	2517	65	7	40	286	2.5	45	2.5	124	6.1
	4	2517	65	8	52	286	3.5	45	3.5	124	7.6
	5	2517	65	8	64	286	9.5	45	9.5	124	8.6
	6	2517	65	8	76	286	15.5	45	15.5	124	9.3
	8	3020	75	8	100	286	24.5	51	24.5	145	12.9
355	1	2012	50	7	16	326	8	32	8	112	3.5
	2	2012	50	7	28	326	2	32	2	112	5.1
	3	2517	65	7	40	326	2.5	45	2.5	124	7.3
	4	2517	65	8	52	326	3.5	45	3.5	124	8.9
	5	2517	65	8	64	326	9.5	45	9.5	124	10
	6	2517	65	8	76	326	15.5	45	15.5	124	10.7
	8	3030	75	8	100	326	12	76	12	145	16

Dm	Groove	Bush No	Max Bore	Figure	B	J	K	L	M	N	Weight (Kgs)
400	1	2012	50	7	16	371	8	32	8	112	6
	2	2517	65	7	28	371	8.5	45	8.5	124	6.3
	3	2517	65	7	40	371	2.5	45	2.5	124	8
	4	2517	65	8	52	371	3.5	45	3.5	124	10.1
	5	3020	75	8	64	371	6.5	51	6.5	159	11.7
	6	3030	75	8	76	371		76		145	14.5
	8	3030	75	8	100	371	12	76	12	145	18.2
450	1	2517	65	7	16	424	14.5	45	14.5	120	6.1
	2	2517	65	7	28	424	8.5	45	8.5	120	8.2
	3	2517	65	7	40	424	2.5	45	2.5	120	9.8
	4	3020	75	8	52	424	0.5	51	0.5	145	11.8
	5	3020	75	8	64	424	6.5	51	6.5	145	13.9
	6	3030	75	8	76	424		76		145	16.9
	8	3535	90	8	100	424	5.5	89	5.5	178	24
500	1	2517	65	7	16	471	14.5	45	14.5	124	6.7
	2	2517	65	7	28	471	8.5	45	8.5	124	9.1
	3	2517	65	7	40	471	2.5	45	2.5	124	11.4
	4	3020	75	8	52	471	0.5	51	0.5	159	14.3
	5	3030	75	7	64	471	6	76	6	145	17.6
	6	3030	75	8	76	471		76		145	19.9
	8	3535	90	8	100	471	5.5	89	5.5	178	26
630	2	2517	65	7	28	601	8.5	45	8.5	124	11.7
	3	2517	65	7	40	601	2.5	45	2.5	124	15.9
	4	3030	75	7	52	601	12	76	12	145	20
	5	3030	75	7	64	601	6	76	6	145	22.7
	6	3535	90	7	76	601	6.5	89	6.5	178	33.6
	8	3535	90	8	100	601	5.5	89	5.5	178	35.8

Appendix 15-11

UNI-DRIVE Taper-Bushing V-Pulleys SPA

Dn	Groove	Bush No	Max Bore	Figure	B	J	K	L	M	N	Weight (Kgs)
63	1	1108	28	0	28	31	18	40		60.5	0.9
	2	1108	28	0	28	31	33	28		60.5	0.8
67	1	1108	28	1	28			28	5	60	0.8
	2	1108	28	3	36	35	13	22			0.5
71	1	1108	28	1	28			28	5	60	0.9
	2	1108	28	3	36	39	13	22			0.5
	3	1108	28	3	48	39	26	22			0.7
75	1	1108	28	1	28			22	2	60	0.4
	2	1108	28	3	36	43	13	28			0.6
	3	1108	28	3	48	43	26	22			0.8
80	1	1610	38	1	28			28	5	60	0.8
	2	1210	32	3	36	50	10	25			0.5
	3	1210	32	3	48	50	25	25			0.9
85	1	1210	32	1	28			25	5	60	0.5
	2	1210	32	3	32	50	10	25			0.7
	3	1210	32	3	48	50	25	25			1
90	1	1210	32	1	28			25	5	60	0.7
	2	1610	42	3	36	50	10	25			0.7
	3	1610	42	3	48	50	23.5	28.5			1
	4	1615	42	3	61	50	27	38			1.2
95	1	1210	32	1	28			25	5	60	0.8
	2	1615	42	3	36	65	10	25			0.9
	3	1615	42	3	48	65	23.5	28.5			1.1
	4	1615	42	3	61	65	27	38			1.6
100	1	1610	42	1	28			25	5	92	0.9
	2	1610	42	3	36	65	10	25			0.8
	3	1610	42	2	48	65		25	25		1.2
	4	1610	42	2	66	65		38	27		1.7
	5	1610	42	0	08	65	46	38			1.3
	6	1610	42	4	66	65	30	25			2.3
106	1	1610	42	1	28			25	5	92	0.9
	2	1610	42	3	36	70	10	25			1.1
	3	1610	42	2	48	70		25	25		1.6
	4	2012	50	3	66	70	33	32			2
	5	2012	50	3	66	70	46	32			2
	6	2012	50	3	96	70	63	32			2.8
112	1	1610	42	1	28			25	5	92	1
	2	1610	42	3	33	77	10	25			1.1
	3	2012	50	3	53	77	58	32			1.1
	4	2012	50	3	65	77	33	32			1.9
	5	2012	50	3	80	77	48	32			2.1
	6	2012	50	3	95	77	63	32			2.4
118	1	1610	42	1	28			25	5	92	1.1
	2	1610	42	3	35	84	10	25			1.4
	3	2012	50	2	50	84		32			1.8
	4	2012	50	2	65	84		32			2
	5	2012	50	2	80	84		32			2.4
	6	2012	50	3	95	84	63	32			2.1
125	1	1610	42	1	28			25	5	92	1.4
	2	1610	42	2	36	90		25	10		1.1
	3	2012	50	2	50	90		32	18		2
	4	2012	50	2	65	90		32	33		2.5
	5	2012	50	2	80	90		32	48		2.9
	6	2012	50	4	95	90	31.5	32	38.5		3
132	1	1610	42	1	28			28.5	6.5	92	1.6
	2	2012	50	3	36	99		32	5		1.8
	3	2012	50	2	50	99		32	18		2.3
	4	2517	65	3	65	99		45	31		2.4
	5	2517	65	3	80	99		45	31		2.9
	6	2517	65	4	96	99	23	45	35		3.3
140	1	1610	42	1	28			35	5	92	1.8

Dn	Groove	Bush No	Max Bore	Figure	B	J	K	L	M	N	Weight (Kgs)
140	1	2012	50	2	36	109		36	1		2
	2	2517	65	2	50	109		45	1		2.8
	4	2517	65	2	65	109		45	20		3.1
	5	2517	65	2	80	109		45	35		3.4
	6	2517	65	4	96	109	24	45	35		4.0
150	1	1810	42	1	28			25	1	92	1.6
	2	2012	50	2	36	115		32	1		2.0
	3	2517	65	2	50	115		45	1		2.5
	4	2517	65	2	65	115		45	20		3.0
	5	2517	65	2	80	115		45	35		4.2
	6	2517	65	4	96	115	25	45	35		4.0
160	1	1610	42	5	28	125		25	1	92	1.9
	2	2012	50	2	36	125		32	1		2.9
	3	2517	65	2	50	125		45	1		3.9
	4	2517	65	2	65	125		45	20		4.4
	5	2517	65	2	80	125		45	35		5.1
	6	2517	65	4	96	125	25	45	35		5.8
170	1	1610	42	5	28	135		25	1	92	2
	2	2012	50	2	36	135		32	1		3.1
	3	2517	65	2	50	135		45	1		4.8
	4	2517	65	2	65	135		45	20		5.5
	5	3020	75	2	80	135		51	20		5.9
	6	3020	75	4	96	135	22	51	22		6.5
180	1	1610	42	5	28	145		25	1	92	2.1
	2	2012	50	6	36	145		32	1	110	3.4
	3	2517	65	2	50	145		45	1		5.1
	4	2517	65	2	65	145		45	20		5.9
	5	3020	75	2	80	145		51	20		6.2
	6	3020	75	4	96	145	22	51	22		6.1
190	1	1610	42	5	28	155		25	1	92	2.3
	2	2012	50	6	36	155		32	1	110	3.8
	3	2517	65	2	50	155		45	1		5.4
	4	2517	65	2	65	155		45	20		6.6
	5	3020	75	2	80	155		51	20		7.4
	6	3020	75	4	96	155	22	51	22		8.1
200	1	2012	50	5	28	165		32	1	112	2.6
	2	2517	65	5	36	165		45	1	124	4.1
	3	2517	65	6	50	165		45	5	124	4.9
	4	3020	75	2	65	165		51	14		7.4
	5	3020	75	4	80	165	14.5	51	14.5		8.4
	6	3020	75	4	96	165	22	51	21		8.4
212	1	2012	50	5	28	177		32	1	112	2.7
	2	2517	65	5	36	177		45	1	124	4.3
	3	2517	65	6	50	177		45	5	124	5.2
	4	3020	75	2	65	177		51	14		7.3
	5	3020	75	2	80	177		51	28		8.2
	6	3020	75	4	96	177	22	51	22		9.2
224	1	2012	50	7	28	189		32	1	112	2.7
	2	2517	65	5	36	189		45	1	124	4.4
	3	2517	65	6	50	189	2.5	45	2.5	124	5.6
	4	3030	75	2	65	189		52.5	12.5		7.4
	5	3020	75	2	80	189		52.5	27.5		8.3
	6	3020	75	4	95	189	22	51	22		8.4
236	1	2012	50	7	28	201		32	1	112	2.8
	2	2517	65	5	36	201		45	1	124	4.6
	3	2517	65	6	50	201	2.5	45	2.5	124	5.7
	4	3030	75	2	65	201		52.5	12.5		7.8
	5	3020	75	2	80	201		52.5	27.5		8.7
	6	3020	75	4	95	201	22	51	23		9.7
250	1	2012	50	7	28	213		32	1	112	2.9
	2	2517	65	7	36	213		45	1	124	4.8

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DIMENSIONS IN MILLIMETRES AND WEIGHT IN KILOGRAM UNLESS OTHERWISE STATED.
SEE PAGE 6 FOR PULLEY DESIGN.
DUE TO LONG TERM DEVELOPMENT, CHANGES TO DIMENSION MAY OCCUR. CHECK WITH UNIDRIVE SYSTEMS (S) PTE LTD IF IN DOUBT.

Appendix 15-12

UNI-DRIVE Taper-Bushing V-Pulleys SPA

Dia	Groove	Bush No	Max Bore	Figure	B	J	K	L	M	N	Weight (Kgs)
250	3	2517	65	6	64	316	2.5	45	35	134	6.9
	4	3020	75	6	66	316	7	51	7	150	8
	5	3030	75	6	66	316	14.5	51	14.5	166	9
	6	3020	75	6	66	316	22	51	22	150	10
265	1	2012	50	7	20	330		32	12	112	5.1
	2	2517	65	7	35	330		45	10	124	6.1
	3	2517	65	6	65	330	2.5	45	35	169	8.9
	4	3020	75	6	65	330	7	51	7	159	9.4
	5	3020	75	6	66	330	14.5	51	15.5	165	9.8
	6	3020	75	6	66	330	22	51	22	159	10.3
280	1	2012	50	7	20	345		32	12	112	5.3
	2	2517	65	7	35	345		45	10	124	6.4
	3	2517	65	6	65	345	2.5	45	35	169	9.7
	4	3020	75	6	65	345	7	51	7	159	9.8
	5	3535	90	6	66	345	7.5	65	7.5	178	13.6
	6	3535	90	5	80	345	4.5	80	45	178	15.5
	8	3535	90	6	95	345	15	65	15	178	16.3
300	1	2012	50	7	20	365		32	12	112	3.5
	2	2517	65	7	35	365		45	10	124	5.6
	3	3020	75	5	50	365	0.5	51	0.5	150	7.4
	4	3030	75	6	66	365	7	51	7	159	9.9
	5	3525	90	6	80	365	7.5	65	7.5	178	13.6
	6	3535	90	6	80	365	4.5	80	45	178	16.2
	8	3535	90	6	95	365	15	65	15	178	13.5
315	1	2012	50	7	20	380		32	12	112	3.8
	2	2517	65	7	35	380		45	10	124	6
	3	3020	75	6	50	380	0.5	51	0.5	159	8.0
	4	3020	75	6	65	380	7	51	7	159	9.7
	5	3525	90	6	80	380	7.5	65	7.5	178	14.9
	6	3535	90	5	80	380	4.5	80	45	178	17
	8	3535	90	6	95	380	15	65	15	178	17.9
335	1	2012	50	7	20	300		32	12	112	3.9
	2	2517	65	7	35	300		45	10	124	6.4
	3	3020	75	7	50	300	0.5	51	0.5	159	8.8
	4	3030	75	6	66	300	7	51	7	159	10.4
	5	3535	90	7	80	300	4.5	80	45	178	17.8
355	1	2012	50	7	20	300		32	12	112	4.2
	2	2517	65	7	35	300		45	10	124	6.7
	3	3020	75	7	50	300	0.5	51	0.5	159	8.5
	4	3020	75	6	65	300	7	51	7	159	11
	5	3535	90	7	80	300	4.5	80	45	178	18.6
	6	3535	90	6	95	300	15	65	15	178	19
375	1	2012	50	7	20	300		32	12	112	4.6
	2	2517	65	7	35	300		45	10	124	7.4
	3	3020	75	7	50	300	0.5	51	0.5	159	10.1
	4	3030	75	6	66	300	7	51	7	159	11.9
	5	3535	90	7	80	300	4.5	80	45	178	19.3
400	1	2012	50	7	20	300		32	12	112	4.9
	2	2517	65	7	35	300		45	10	124	8.1
	3	3020	75	7	50	300	0.5	51	0.5	159	11
	4	3020	75	6	65	300	7	51	7	159	12.8
	5	3525	90	6	80	300	7.5	65	7.5	178	19.3
	6	3535	90	7	80	300	4.5	80	45	178	21
	8	3535	90	6	95	300	15	65	15	178	22
425	1	2012	50	7	20	300		32	12	112	6
	2	2517	65	7	35	300		45	10	124	9.2
	3	3020	75	7	50	300	0.5	51	0.5	159	12.6
	4	3020	75	6	65	300	7	51	7	159	14.2
	5	3535	90	7	80	300	4.5	80	45	178	22.7

Dia	Groove	Bush No	Max Bore	Figure	B	J	K	L	M	N	Weight (Kgs)
460	1	2012	50	7	20	440		32	12	112	7
	2	2517	65	7	35	410	5	45	5	124	10.3
	3	3020	75	7	50	410	0.5	51	0.5	150	14.1
	4	3020	75	6	65	410	7	51	7	159	15.6
	5	3535	90	7	80	410	4.5	80	4.5	178	21.3
	6	3535	90	6	95	410	15	65	15	178	23.2
500	1	2517	65	7	20	465		45	25	134	8
	2	2517	65	7	35	465		45	10	134	11.6
	3	3020	75	7	50	465	0.5	51	2.5	159	16
	4	3030	75	6	66	465	7	51	7	159	19.2
	5	3525	90	6	80	465	7.5	65	7.5	178	26.6
	6	3535	90	6	95	465	15	65	15	178	27.3
560	1	2517	65	7	20	565		45	25	134	11.0
	2	3020	75	7	35	525		51	10	159	13.5
	3	3030	75	7	50	525	0.5	51	0.5	159	17.0
	4	3535	90	7	65	525		65		178	24
	5	3525	90	6	80	525	7.5	65	7.5	178	31.7
	6	3535	90	6	95	525	15	65	15	178	31.5
630	1	2517	65	7	20	595		45	25	134	14.1
	2	3020	75	7	35	595		51	10	159	15
	3	3030	75	7	50	595	0.5	51	0.5	159	22
	4	3535	90	7	65	595		65		178	24.1
	5	3525	90	6	80	595	7.5	65	7.5	178	21
	6	4030	100	6	95	595	0.5	76	0.5	216	42
650	2	3030	75	7	35	700	15	65	15	178	28.6
	3	3535	90	7	50	700	27	80	27	178	35.3
	4	3030	75	7	50	700	7.5	80	7.5	178	31.5
	5	3535	90	7	50	700	19.5	80	19.5	178	34.5
	6	4030	100	7	50	700		80		178	34.3
	4	3535	90	7	65	700	12	80	12	178	30
	5	4030	100	6	80	700	2	76	2	216	40
	6	4040	100	7	80	700	11	102	11	216	56
	8	4030	100	6	95	700	9.0	76	9.0	216	55
800	3	3535	90	7	50	800	7.5	65	7.5	178	36.8
	5	3535	90	7	80	800	19.5	80	19.5	178	37.3
	4	3535	90	7	65	800		65		178	42.8
	4	3535	90	7	65	800	12	80	12	178	45.5
	5	4030	100	6	80	800	2	76	2	216	53.7
	5	4040	100	7	80	800	11	102	11	216	58.7
	6	4030	100	6	95	800	9.5	76	9.5	216	60.5

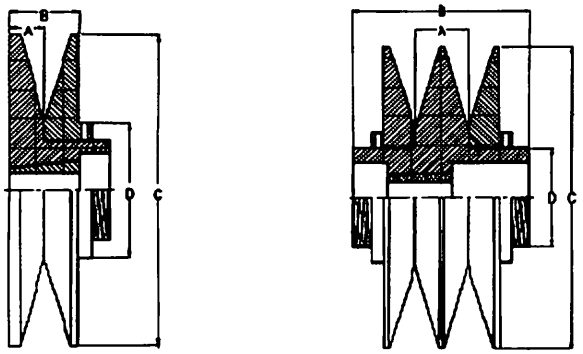
DIMENSIONS IN MILLIMETRES AND WEIGHT IN KILOGRAM UNLESS OTHERWISE STATED.
SEE PAGE 9 FOR PULLEY DESIGN.
DUE TO LONG TERM DEVELOPMENT, CHANGES TO DIMENSION MAY OCCUR. CHECK WITH UNI-DRIVE SYSTEMS (S) PTE LTD IF IN DOUBT.

Appendix 15-13

UNI-DRIVE UNI-ADJUSTABLE PITCH V-BELT PULLEY

SINGLE GROOVE

TYPE	PROFILE	PITCH DIAMETER MIN	PITCH DIAMETER MEAN	PITCH DIAMETER MAX.	BUSH SIZE	A	B	C	D	MAX. BORE	WEIGHT KGS.
UD100-1	Z	63	73	83							
	A	66	79.5	93	1108	10	43	100	75	28	1
	SPZ	70	78	86							
	SPA	70	81	92							
UD120-1	Z	80	90	100							
	A	83	96.5	110	1215	10	43	120	98	32	2
	SPZ	87	95	103	1210						
	SPA	87	98	109							
UD138-1	Z	98	108	118							
	A	111	120	128	1215	10	43	138	98	32	3
	SPZ	105	113	121	1210						
	SPA	105	116	127							
UD155-1	A	106	120.5	135							
	B	100	122.5	145	1615	12	48	155	115	42	4
	SPA	111	122	133	1610						
	SPB	112	129	146							



DOUBLE GROOVES

UD120-2	Z	80	90	100							
	A	86	97	110	1215	17.5	80	120	69	32	3
	SPZ	87	95	103	1210						
	SPB	87	98	109							
UD155-2	A	106	120	135							
	B	100	122	145	1615	19	91	155	115	42	7
	SPA	111	122	133	1610						
	SPB	112	129	146							
UD190-2	A	141	155	170							
	B	145	162	180	2017	19	91	190	115	42	10
	SPA	146	157	168	2012						
	SPB	157	169	181							
UD265-2	B	198	217	236							
	C	200	225	250	2525	25	115	265	160	65	22
	SPB	211	223	235	2517						
	SPC	211	230	249							
UD290-2	B	223	242	261							
	C	225	250	275	2525	25	115	290	160	65	25
	SPB	236	248	260	2517						
	SPC	236	255	274							
UD335-2	B	260	287	305							
	C	270	295	320	3030	25	115	335	210	75	40
	SPB	281	293	305	3020						
	SPC	281	300	319							

DUE TO LONG TERM DEVELOPMENT, CHANGES TO DIMENSION MAY OCCUR.
CHECK WITH UNI-DRIVE SYSTEMS (S) PTE LTD IF IN DOUBT.

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Appendix 15-14

UNI-DRIVE

TAPER BUSHINGS

Bush No	Bore Size (Inches)	Wgts (Kgs)	Keyway Width X Depth		Shallow Keyway	f (Screws Size)	A (Inches)	A (mm)	B (Inches)	B (mm)
1008	3/8 to 7/16	0.13	3/32	3/64		1/4 X 1/2 Set Screws 2 nos	1.386	35.2044	0.875	22.2250
	1/2 to 9/16	0.12	1/8	1/16						
	5/8 to 7/8	0.10	3/16	3/62						
	15/16 to 1	0.07	1/4	1/8						
1108	3/8 to 7/16	0.15	3/32	3/64		1/4 X 1/2 Set Screws 2 nos	1.511	38.3794	0.875	22.2250
	1/2 to 9/16	0.15	1/8	1/16						
	5/8 to 7/8	0.12	3/16	3/62						
	15/16 to 1	0.10	1/4	1/8						
	1-1/16 to 1-1/8	0.08	1/4	1/16	●					
1210	1/2 to 9/19	0.28	1/8	1/16		3/8 X 5/8 Set Screws 2 nos	1.875	47.6250	1	25.4000
	5/8 to 7/8	0.25	3/16	3/62						
	15/16 to 1-1/4	0.22	1/4	1/8						
1215	1/2 to 9/19	0.36	1/8	1/16		3/8 X 5/8 Set Screws 2 nos	1.875	47.6250	1.5	38.1000
	5/8 to 7/8	0.32	3/16	3/62						
	15/16 to 1-1/4	0.27	1/4	1/8						
1310	1/2 to 9/16	0.32	1/8	1/16		3/8 X 5/8 Set Screws 2 nos	2	50.8000	1	25.4000
	5/8 to 7/8	0.32	3/16	3/62						
	15/16 to 1-1/4	0.27	1/4	1/8						
	1-5/16 to 1-3/8	0.27	5/16	5/32						
1315	1/2 to 9/16	0.34	1/8	1/16		3/8 X 5/8 Set Screws 2 nos	2	50.8000	1.5	38.1000
	5/8 to 7/8	0.34	3/16	3/62						
	15/16 to 1-1/4	0.29	1/4	1/8						
	1-5/16 to 1-3/8	0.29	5/16	5/32						
1610	1/2 to 9/16	0.41	1/8	1/16		3/8 X 5/8 Set Screws 2 nos	2.25	57.1500	1	25.4000
	5/8 to 7/8	0.36	3/16	3/62						
	15/16 to 1-1/4	0.32	1/4	1/8						
	1-5/16 to 1-3/8	0.32	5/16	5/32						
	1-7/16 to 1-1/2	0.27	3/8	3/16						
	1-9/16 to 1-5/8	0.23	3/8	1/8	●					
1615	1/2 to 9/16	0.54	1/8	1/16		3/8 X 5/8 Set Screws 2 nos	2.25	57.1500	1.5	38.1000
	5/8 to 7/8	0.50	3/16	3/62						
	15/16 to 1-1/4	0.45	1/4	1/8						
	1-5/16 to 1-3/8	0.36	5/16	5/32						
	1-7/16 to 1-1/2	0.32	3/8	3/16						
	1-9/16 to 1-5/8	0.27	3/8	1/8	●					

BUSH	TIGHTENING TORQUES (NM)
1008	5.6
1108	5.6
1210	20
1215	20
1310	20
1315	20
1610	20
1615	20

Due to long term development, changes to dimensions and approximate weights may occur.
Check with UNI-DRIVE SYSTEMS (S) PTE LTD if in doubts. Printed 22-Aug-2001 Page 302

Appendix 15-15

UNI-DRIVE

TAPER BUSHINGS

Bush No	Bore Size (Inches)	Wgts (Kgs)	Keyway Width X Depth		Shallow Keyway	f (Screws Size)	A (Inches)	A (mm)	B (Inches)	B (mm)
2012	1/2 to 9/16	0.77	1/8	1/16		7/16 X 7/8 Set Screws 2 nos	2.75	69.8500	1.25	31.7500
	5/8 to 7/8	0.73	3/16	3/62						
	15/16 to 1-1/4	0.68	1/4	1/8						
	1-5/16 to 1-3/8	0.64	5/16	5/32						
	1-7/16 to 1-3/4	0.54	3/8	3/16						
	1-13/16 to 1-7/8	0.45	1/2	1/4						
	1-15/16 to 2	0.45	1/2	3/16	•					
2017	1/2 to 9/16	0.82	1/8	1/16		7/16 X 7/8 Set Screws 2 nos	2.75	69.8500	1.75	44.4500
	5/8 to 7/8	0.77	3/16	3/62						
	15/16 to 1-1/4	0.73	1/4	1/8						
	1-5/16 to 1-3/8	0.68	5/16	5/32						
	1-7/16 to 1-3/4	0.59	3/8	3/16						
	1-13/16 to 1-7/8	0.50	1/2	1/4						
	1-15/16 to 2	0.50	1/2	3/16	•					
2517	1/2 to 9/16	1.59	1/8	1/16		1/2 X 1 Set Screws 2 nos	3.375	85.7250	1.75	44.4500
	5/8 to 7/8	1.54	3/16	3/62						
	15/16 to 1-1/4	1.50	1/4	1/8						
	1-5/16 to 1-3/8	1.45	5/16	5/32						
	1-7/16 to 1-3/4	1.36	3/8	3/16						
	1-13/16 to 2-1/4	1.09	1/2	1/4						
	2-5/16 to 2-1/2	0.86	5/8	3/16	•					
2525	3/4 to 7/8	2.22	3/16	3/62		1/2 X 1 Set Screws 2 nos	3.375	85.7250	2.5	63.5000
	15/16 to 1-1/4	2.13	1/4	1/8						
	1-5/16 to 1-1/4	2.04	5/16	5/32						
	1-7/16 to 1-3/4	1.91	3/8	3/16						
	1-13/16 to 2-1/4	1.50	1/2	1/4						
	2-5/16 to 2-1/2	1.13	5/8	3/16	•					
3020	15/16 to 1-1/4	2.95	1/4	1/8		5/8 X 1-1/4 Set Screws 2 nos	4.25	107.9500	2	50.8000
	1-5/16 to 1-3/8	2.86	5/16	5/32						
	1-7/16 to 1-3/4	2.72	3/8	3/16						
	1-13/16 to 2-1/4	2.40	1/2	1/4						
	2-5/16 to 2-3/4	2.04	5/8	5/16						
	2-13/16 to 3	1.77	3/4	1/4	•					
3030	15/16 to 1-1/4	4.17	1/4	1/8		5/8 X 1-1/4 Set Screws 2 nos	4.25	107.9500	3	76.2000
	1-5/16 to 1-3/8	4.04	5/16	5/32						
	1-7/16 to 1-3/4	3.90	3/8	3/16						
	1-13/16 to 2-1/4	3.45	1/2	1/4						
	2-5/16 to 2-3/4	2.81	5/8	5/16						
	2-13/16 to 3	2.27	3/4	1/4	•					

BUSH	TIGHTENING TORQUE (Nm)
2012	31
2517	48
3020	90
3030	90

Due to long term development, changes to dimensions and approximate weights may occur.
Check with UNI-DRIVE SYSTEMS (S) PTE LTD if in doubts. Printed 22-Aug-2001 Page 303

Appendix 15-16

UNI-DRIVE

TAPER BUSHINGS

Bush No	Bore Size (Inches)	Wgts (Kgs)	Keyway Width X Depth		Shallow Keyway	f (Screws Size)	A (Inches)	A (mm)	B (Inches)	B (mm)
3525	1-3/16 to 1-1/4	6.35	1/4	1/8		1/2 X 1-1/2 Cap Screws 3 nos.	5	127.0000	2.5	63.5000
	1-5/16 to 1-3/8	6.35	5/16	5/32						
	1-7/16 to 1-3/4	5.90	3/8	3/16						
	1-13/16 to 2-1/4	5.44	1/2	1/4						
	2-5/16 to 2-3/4	4.99	5/8	5/16						
	2-13/16 to 3-1/4	4.08	3/4	3/8						
	3-5/16 to 3-1/2	3.63	7/8	1/4	●					
3535	1-3/16 to 1-1/4	6.35	1/4	1/8		1/2 X 1-1/2 Cap Screws 3 nos.	5	127.0000	3.5	88.9000
	1-5/16 to 1-3/8	6.35	5/16	5/32						
	1-7/16 to 1-3/4	5.90	3/8	3/16						
	1-13/16 to 2-1/4	5.44	1/2	1/4						
	2-5/16 to 2-3/4	4.99	5/8	5/16						
	2-13/16 to 3-1/4	4.08	3/4	3/8						
	3-5/16 to 3-1/2	3.63	7/8	1/4	●					
4030	1-7/16 to 1-3/4	9.98	3/8	3/16		5/8 X 1-3/4 Cap Screws 3 nos.	5.75	146.0500	3	76.2000
	1-13/16 to 2-1/4	9.53	1/2	1/4						
	2-5/16 to 2-3/4	8.62	5/8	5/16						
	2-13/16 to 3-1/4	7.71	3/4	3/8						
	3-5/16 to 3-5/8	6.80	7/8	7/16						
	3-11/16 to 3-3/4	6.35	7/8	1/4	●					
	3-13/16 to 4	5.90	1	1/4	●					
4040	1-7/16 to 1-3/4	9.98	3/8	3/16		5/8 X 1-3/4 Cap Screws 3 nos.	5.75	146.0500	4	101.6000
	1-13/16 to 2-1/4	9.53	1/2	1/4						
	2-5/16 to 2-3/4	8.62	5/8	5/16						
	2-13/16 to 3-1/4	7.71	3/4	3/8						
	3-5/16 to 3-5/8	6.80	7/8	7/16						
	3-11/16 to 3-3/4	6.35	7/8	1/4	●					
	3-13/16 to 4	5.90	1	1/4	●					
4535	1-15/16 to 2-1/4	13.61	1/2	1/4		3/4 X 2 Cap Screws 3 nos.	6.375	161.9250	3.5	88.9000
	2-5/16 to 2-3/4	12.70	5/8	5/16						
	2-13/16 to 3-1/4	11.79	3/4	3/8						
	3-5/16 to 3-3/4	10.43	7/8	7/16						
	3-13/16 to 4-1/4	9.07	1	1/2						
	4-5/16 to 4-1/2	8.16	1	1/4	●					
4545	1-15/16 to 2-1/4	13.61	1/2	1/4		3/4 X 2 Cap Screws 3 nos.	6.375	161.9250	4.5	114.3000
	2-5/16 to 2-3/4	12.70	5/8	5/16						
	2-13/16 to 3-1/4	11.79	3/4	3/8						
	3-5/16 to 3-3/4	10.43	7/8	7/16						
	3-13/16 to 4-1/4	9.07	1	1/2						
	4-5/16 to 4-1/2	8.16	1	1/4	●					

BUSH	TIGHTENING TORQUES (Nm)
3535	112
4040	170
4545	192

Due to long term development, changes to dimensions and approximate weights may occur.
Check with UNI-DRIVE SYSTEMS (S) PTE LTD if in doubts. Printed 22-Aug-2001 Page 304

Appendix 15-17

UNI-DRIVE

TAPER BUSHINGS

Bush No	Bore Size (Inches)	Wgts (Kgs)	Keyway Width X Depth		Shallow Keyway	f (Screws Size)	A (Inches)	A (mm)	B (Inches)	B (mm)
5040	2-5/16 to 2-3/4	17.24	5/8	5/16		7/8 X 2-1/4 Cap Screws 3 nos.	7	177.8000	4	101.6000
	2-13/16 to 3-1/4	15.88	3/4	3/8						
	3-5/16 to 3-3/4	14.51	7/8	7/16						
	3-13/16 to 4-1/2	12.25	1	1/2						
	4-9/16 to 5	10.89	1-1/4	7/16	●					
5050	2-5/16 to 2-3/4	17.24	5/8	5/16		7/8 X 2-1/4 Cap Screws 3 nos.	7	177.8000	5	127.0000
	2-13/16 to 3-1/4	15.88	3/4	3/8						
	3-5/16 to 3-3/4	14.51	7/8	7/16						
	3-13/16 to 4-1/2	12.25	1	1/2						
	4-9/16 to 5	10.89	1-1/4	7/16	●					
6050	3-13/16 to 4-1/2	27.22	1	1/2		1-1/4 X 3-1/2 Hex Screws 3 nos.	9.25	234.9500	5	127.0000
	4-9/16 to 5-1/2	24.95	1-1/4	5/8						
	5-9/16 to 6	27.22	1-1/2	3/4						
7060	4-9/16 to 5-1/2	38.56	1-1/4	5/8		1-1/4 X 3-1/2 Hex Screws 4 nos.	10.25	260.3500	6	152.4000
	5-9/16 to 6-1/2	34.02	1-1/2	3/4						
	6-9/16 to 7	29.48	1-3/4	3/4						
8065	5-1/16 to 5-1/2	54.43	1-1/4	5/8		1-1/4 X 3-1/2 Hex Screws 4 nos.	11.25	285.7500	6.5	165.1000
	5-9/16 to 6-1/2	47.63	1-1/2	3/4						
	6-9/16 to 7-1/2	40.82	1-3/4	3/4						
	7-9/16 to 8	34.02	2	3/4						
10085	6-9/16 to 7-1/2	117.93	1-3/4	3/4		1-1/2 X 4-1/4 Hex Screws 4 nos.	14.75	374.6500	8.5	215.9000
	7-9/16 to 9	104.33	2	3/4						
	9-1/16 to 10	86.18	2-1/2	7/8						
120100	7-9/16 to 9	185.97	2	3/4		1-1/2 X 4-1/4 Hex Screws 6 nos.	17.25	438.1500	10	254.0000
	9-1/16 to 11	163.29	2-1/2	7/8						
	11-1/16 to 12	131.54	3	1						

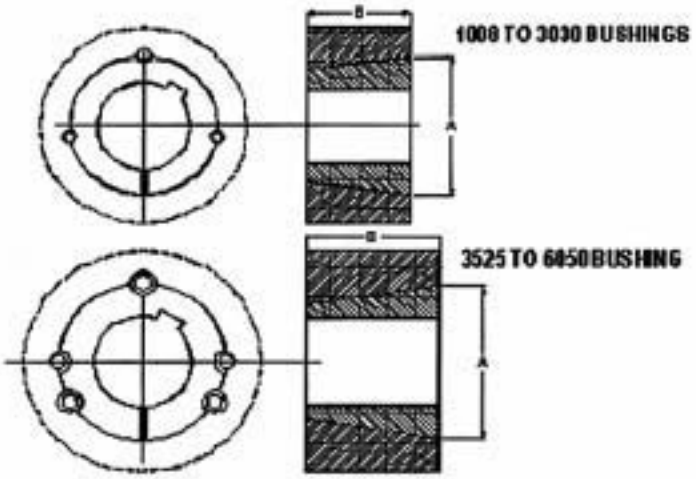
BUSH	TIGHTENING TORQUES (Nm)
5050	271

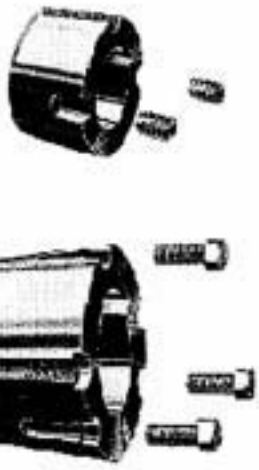
Due to long term development, changes to dimensions and approximate weights may occur.
Check with UNI-DRIVE SYSTEMS (S) PTE LTD if in doubts. Printed 22-Aug-2001 Page 305

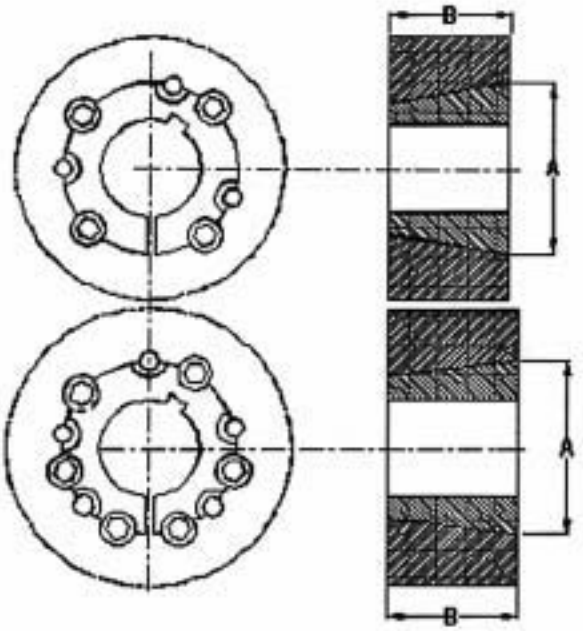
Appendix 15-18

UNI-DRIVE

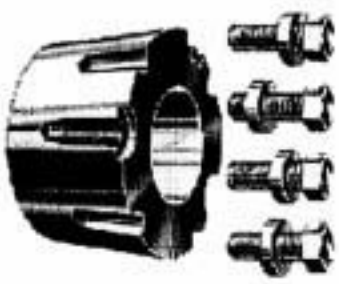
TAPER BUSHINGS







Bushing 7060 to 10085



Bushing 120100

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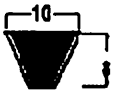
Appendix 15-19

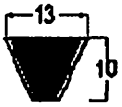
UNI-DRIVE

NARROW V-BELTS
STANDARD BELT LENGTH TABLES

SPZ / 3V



SPA

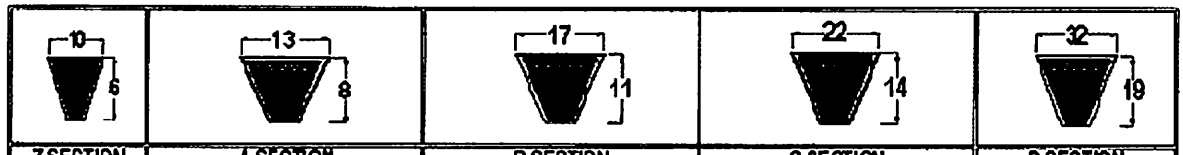


SPZ	3V No	SPZ	3V No	SPZ	3V No	SPA	SPA	SPA	SPA	SPA
487		1107		1812		725	1257	1845	2457	3150
512		1112		1837		732	1260	1850	2470	3170
537		1115		1850	730	745	1272	1857	2482	3182
562		1120		1862		750	1280	1870	2495	3195
587		1125		1870		757	1282	1882	2500	3207
612		1137		1887		770	1295	1895	2507	3220
630	250	1140		1900	750	782	1307	1900	2520	3232
637		1160		1912		800	1320	1907	2532	3260
650		1162		1920		807	1332	1920	2550	3270
662		1170		1937		812	1345	1932	2557	3282
670	265	1180		1950		820	1357	1945	2565	3300
687		1187		1962		825	1360	1950	2580	3315
700		1200		1987		832	1367	1957	2582	3332
710	280	1202		2000		840	1370	1970	2595	3350
722		1212	475	2012		850	1380	1982	2607	3365
725		1237		2020		857	1382	1990	2620	3382
730		1250		2025		865	1400	2000	2625	3400
737		1262	500	2030		875	1407	2007	2632	3425
750	300	1270		2037	800	882	1420	2020	2645	3450
757		1277		2062		895	1432	2032	2650	3475
760		1287		2087		900	1445	2045	2670	3500
762		1300		2090		907	1450	2057	2682	3525
772		1312		2100		912	1457	2060	2695	3550
775		1320		2120		920	1470	2070	2700	3575
780		1337	530	2137	850	925	1482	2082	2707	3600
787		1338		2150		932	1500	2100	2720	3625
795		1340		2160		940	1507	2112	2732	3650
800	315	1347		2170		950	1520	2120	2750	3675
812		1362		2187		957	1525	2125	2765	3700
825		1387		2212		967	1532	2132	2782	3725
837		1400		2240		975	1545	2150	2790	3750
850	335	1412	560	2262		982	1550	2157	2800	3775
862		1420		2280		995	1557	2160	2807	3800
870		1437		2287	900	1000	1570	2162	2820	3850
875		1450		2312		1007	1582	2180	2832	3900
887		1462		2337		1020	1595	2182	2845	3950
900	355	1470		2360		1025	1600	2190	2857	4000
912		1487		2387		1030	1607	2200	2870	4050
925		1500		2410		1032	1620	2207	2882	4200
930		1507		2437		1045	1632	2220	2895	4250
937		1512		2462		1050	1645	2232	2900	4500
940		1520		2487		1060	1650	2240	2907	
950	375	1529		2500		1070	1655	2255	2920	
962		1537		2540	1000	1077	1657	2270	2932	
975		1550		2562		1082	1670	2282	2945	
987		1560		2587		1090	1682	2300	2957	
1000	400	1562	617	2612		1100	1695	2307	2970	
1010		1587		2637		1107	1700	2312	2982	
1012		1600	630	2650		1120	1707	2320	2995	
1018		1612		2690		1132	1720	2332	3000	
1024		1637		2737		1140	1732	2345	3007	
1030		1660		2762		1150	1745	2360	3020	
1037		1662		2800		1157	1750	2372	3032	
1040		1687		2840	1120	1170	1757	2382	3045	
1047		1700	670	2930		1180	1770	2392	3057	
1060		1737		3000	1180	1190	1782	2400	3070	
1070		1760		3150	1250	1200	1795	2407	3082	
1077	425	1762		3170		1207	1800	2420	3095	
1080		1787		3350	1320	1220	1807	2430	3107	
1087		1800	710	3550	1400	1232	1820	2432	3120	
1100						1250	1832	2445	3132	

Appendix 15-20

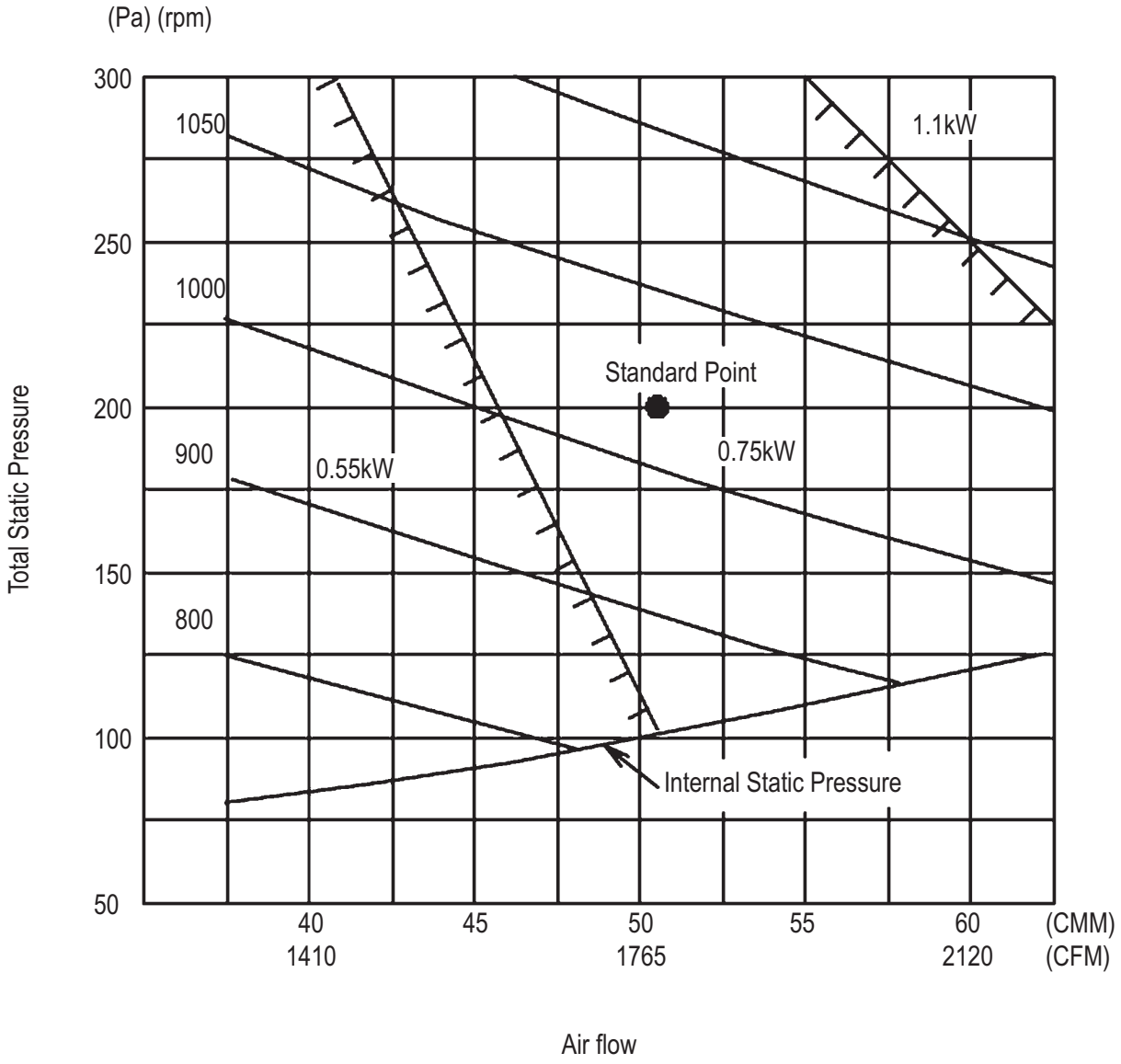
UNI-DRIVE

CLASSICAL V-BELTS
STANDARD BELT LENGTH TABLES



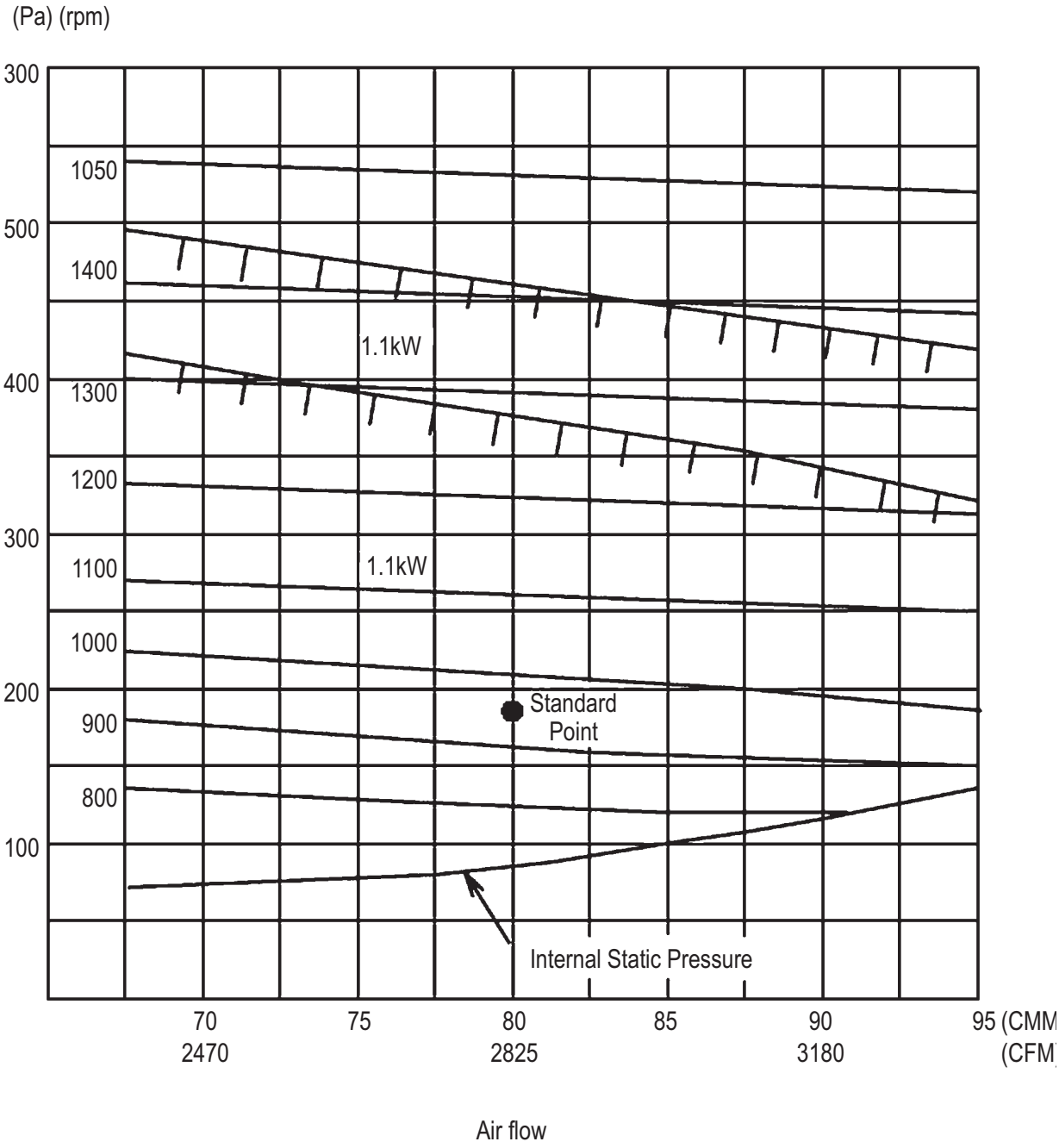
Z SECTION		A SECTION				B SECTION				C SECTION				D SECTION	
mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches	mm	Inches
370		540	20	1990	77	700	28	2230	88	1070	40	4220	164	2740	105
395		570	21	2020	78	750	28	2250	87	1170	44	4320	168	3130	115
410		590	22	2050	79	800	30	2280	88	1300	49	4450	173	3330	128
420		620	23	2070	80	830	31	2300	89	1350	51	4500	175	3730	144
445		640	24	2090	81	860	32	2330	90	1450	55	4600	179	4080	158
470		670	26	2120	82	880	33	2360	91	1480	56	4630	180	4190	162
480		700	26	2140	83	910	34	2380	92	1530	58	4750	185	4470	173
495		720	27	2170	84	930	35	2400	93	1560	59	4780	186	4620	179
510		740	28	2200	85	950	36	2420	94	1580	60	4830	188	4650	180
520		770	29	2220	86	980	37	2450	95	1650	63	4860	190	5030	195
530		790	30	2240	87	1000	38	2480	96	1700	65	5010	195	5260	204
545		820	31	2270	88	1030	39	2500	97	1760	67	5140	200	5400	210
560		850	32	2300	89	1060	40	2530	98	1780	68	5240	204	5790	225
570		870	33	2320	90	1080	41	2580	100	1830	70	5380	210	5870	228
600		890	34	2360	91	1100	42	2630	102	1860	71	5640	220	6100	238
610		920	35	2370	92	1130	43	2660	103	1880	72	5720	223	6120	238
620		930	35.5	2400	93	1160	44	2680	104	1950	75	5850	228	6170	240
630		950	36	2420	94	1180	45	2700	105	2010	77	6050	236	6840	266
650		970	37	2450	95	1210	46	2740	106	2040	78	6100	238	6890	268
660		990	38	2480	96	1240	47	2790	108	2090	80	6150	240	6940	270
700		1020	39	2500	97	1260	48	2840	110	2110	81	6360	248	7620	297
725		1050	40	2570	100	1290	49	2870	111	2160	83	6610	258	7650	298
750		1070	41	2630	102	1310	50	2890	112	2190	84	6660	260	7700	300
780		1100	42	2650	103	1340	51	2940	114	2200	86	6880	268	8060	314
800		1130	43	2680	104	1370	52	2990	116	2270	87	6910	270	5410	328
820		1150	44	2700	105	1390	53	3040	118	2340	90	7120	278	9140	357
840		1180	45	2750	107	1410	54	3090	120	2420	93	7600	297	9170	358
850		1200	46	2780	108	1440	55	3140	122	2440	94	7620	298	9630	384
860		1230	47	2830	110	1460	56	3200	124	2490	96	8030	314	9900	390
875		1250	48	2880	112	1490	57	3240	126	2520	97	8390	328	10700	418
890		1280	49	2910	113	1510	58	3290	128	2550	98	9100	356	12200	478
900		1300	50	2960	115	1540	59	3350	130	2600	100	9150	358	13700	538
920		1330	51	2980	116	1560	60	3400	132	2650	102	9760	382		
930		1360	52	3080	120	1590	61	3450	134	2700	104	10670	418		
940		1380	53	3190	124	1620	62	3500	136	2720	105	10700	419		
950		1410	54	3290	128	1640	63	3550	138	2800	108	11330	444		
965		1430	55	3440	134	1670	64	3600	140	2850	110				
980		1460	56	3490	136	1690	65	3700	144	2880	111				
990		1480	57	3540	138	1720	66	3800	148	2900	112				
1015		1510	58	3690	144	1740	67	3850	150	2950	114				
1035		1530	59	3950	154	1760	68	3870	151	3000	116				
1055		1550	60			1800	69	3900	152	3080	119				
1080		1580	61			1820	70	3950	154	3100	120				
1105		1610	62			1850	71	4060	158	3210	124				
1130		1640	63			1870	72	4160	162	3310	128				
1155		1660	64			1900	73	4200	164	3360	130				
1205		1690	65			1920	74	4310	168	3460	134				
1270		1710	66			1950	75	4430	173	3520	136				
1330		1740	67			1970	76	4610	180	3580	138				
1380		1760	68			2000	77	4740	185	3610	140				
1420		1780	69			2020	78	5000	195	3680	142				
1540		1810	70			2050	79	5220	204	3710	144				
1750		1840	71			2070	80	5370	210	3760	146				
		1860	72			2100	81	5580	218	3870	150				
		1890	73			2130	82	5630	220	3920	152				
		1920	74			2160	83	6070	238	3970	154				
		1940	75			2180	84	7000	274	4060	158				
		1960	76			2200	85			4170	162				

Appendix 15-21



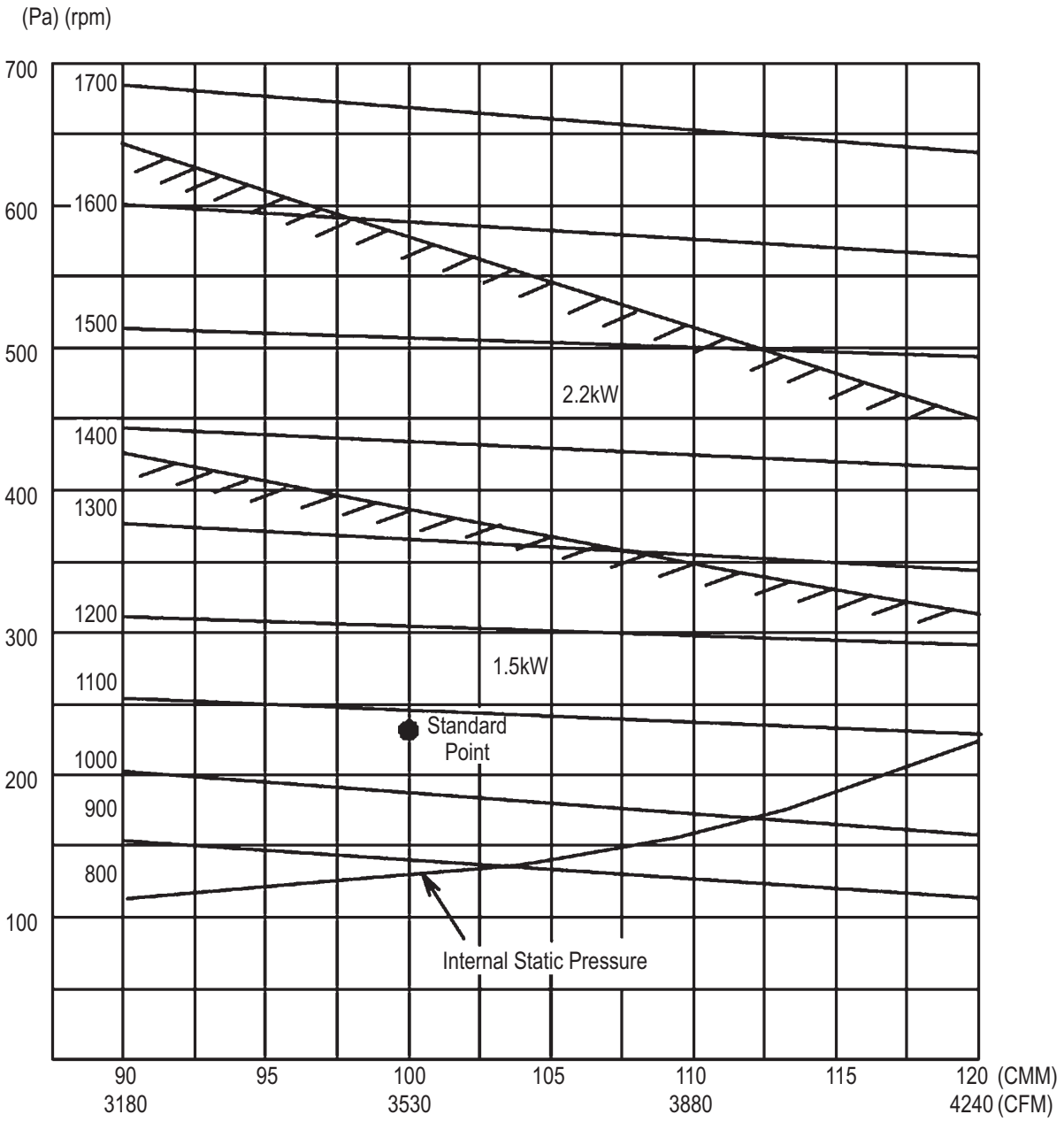
Blower Curve for UATP/TYP/T/TY180A

Appendix 15-22



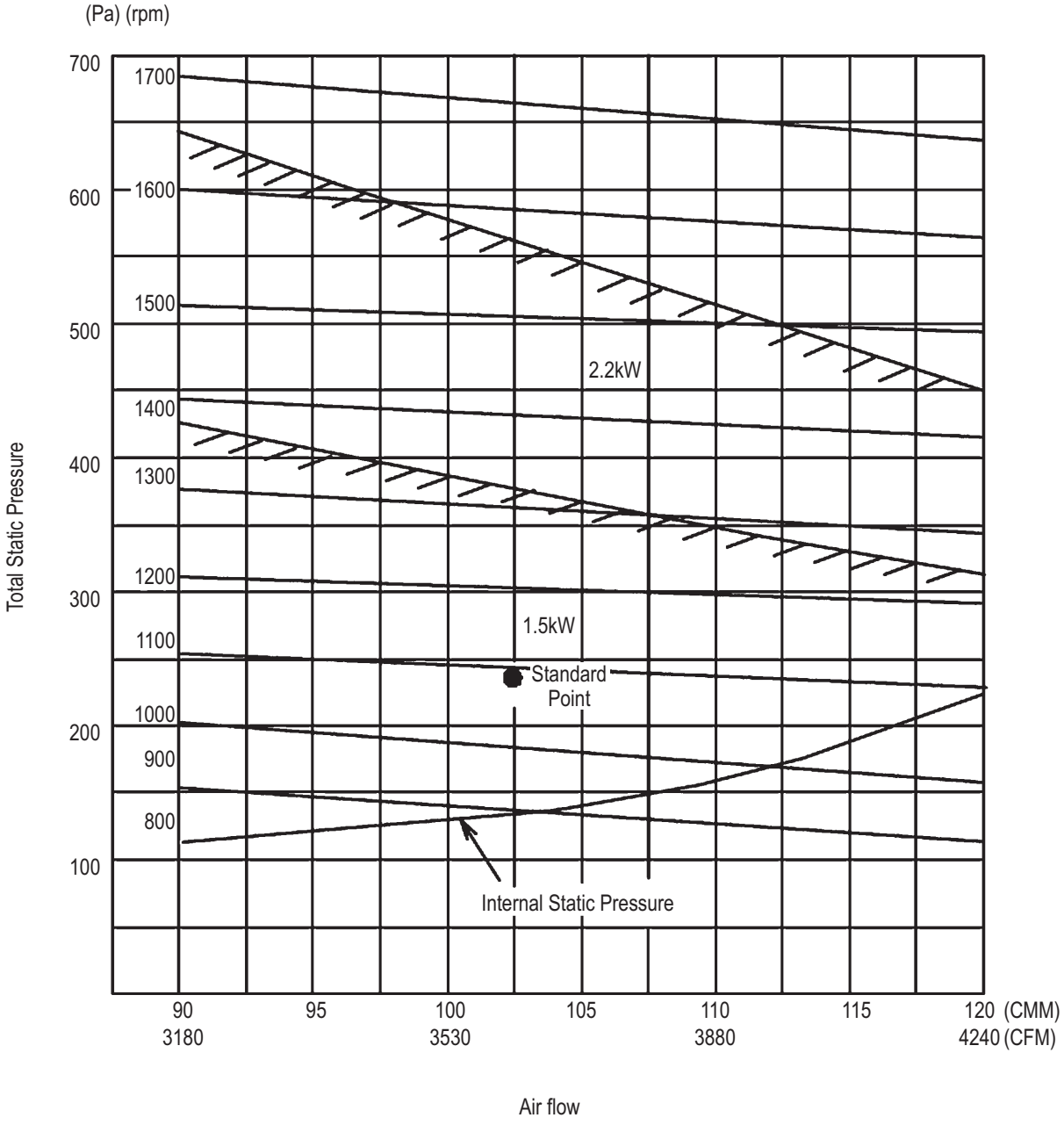
Blower Curve for UATP/TYP/T/TY240A

Appendix 15-23



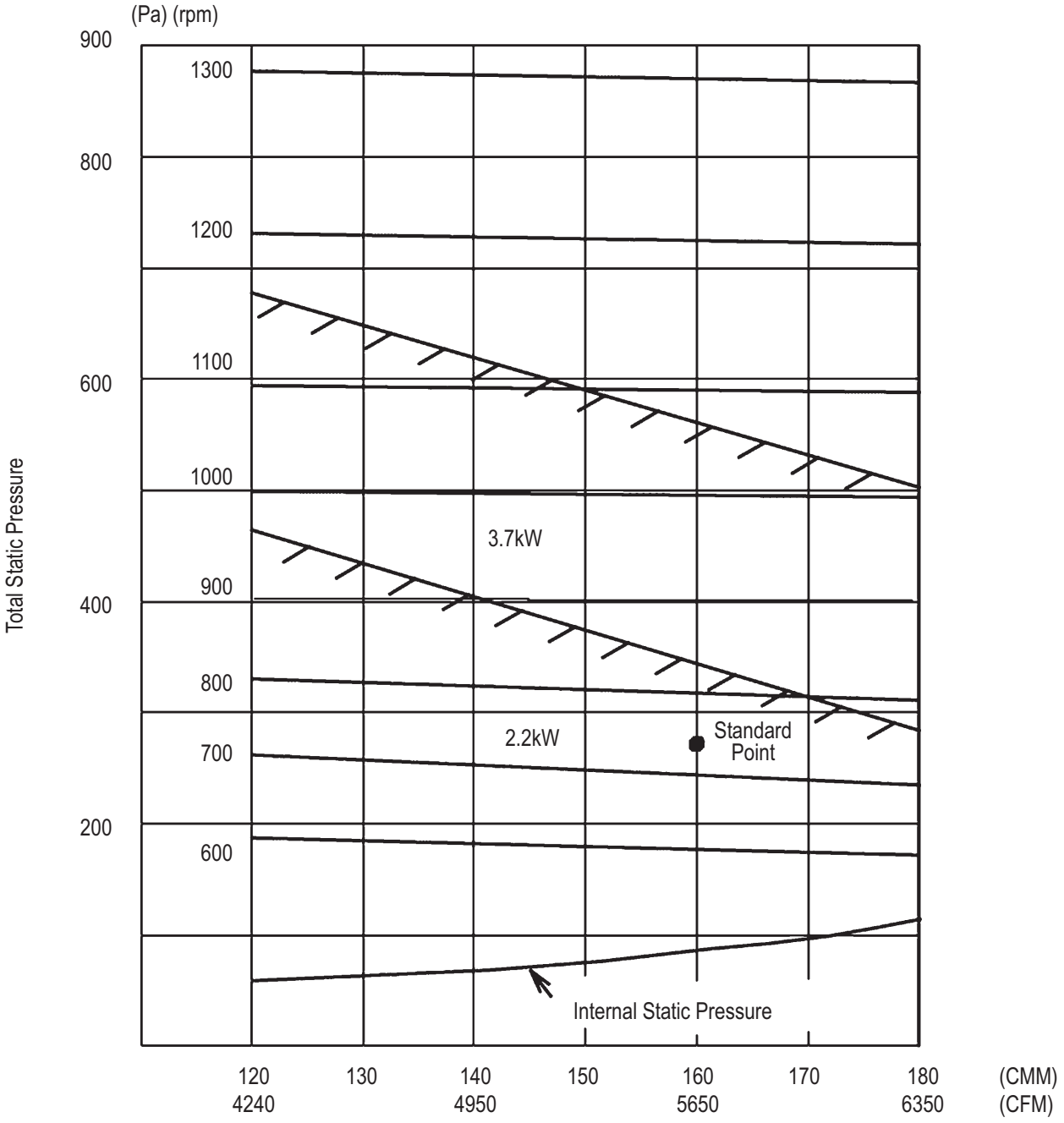
Blower Curve for UATP/TYP/T/TY280A

Appendix 15-24



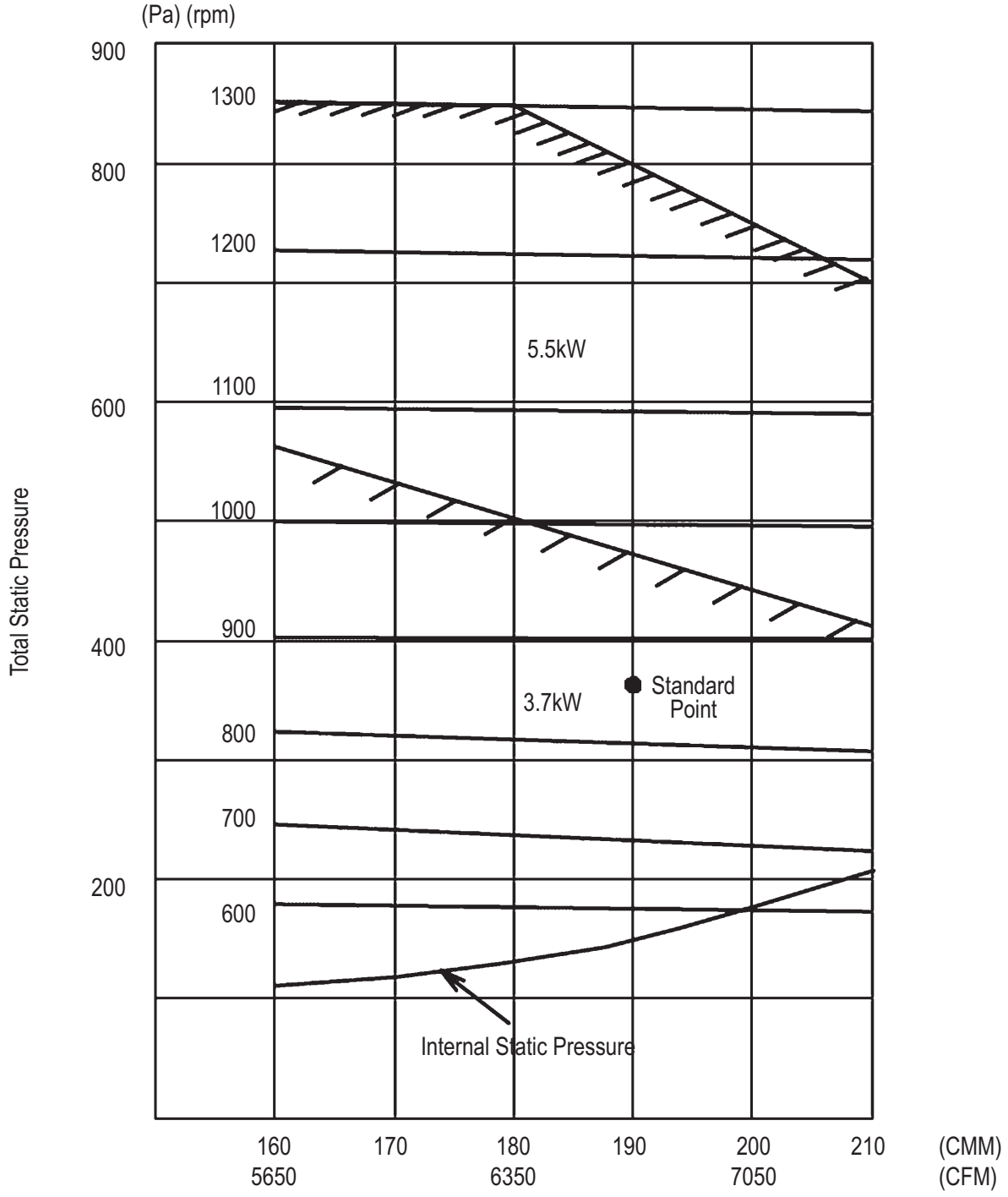
Blower Curve for UATP/TYP/T/TY320A

Appendix 15-25



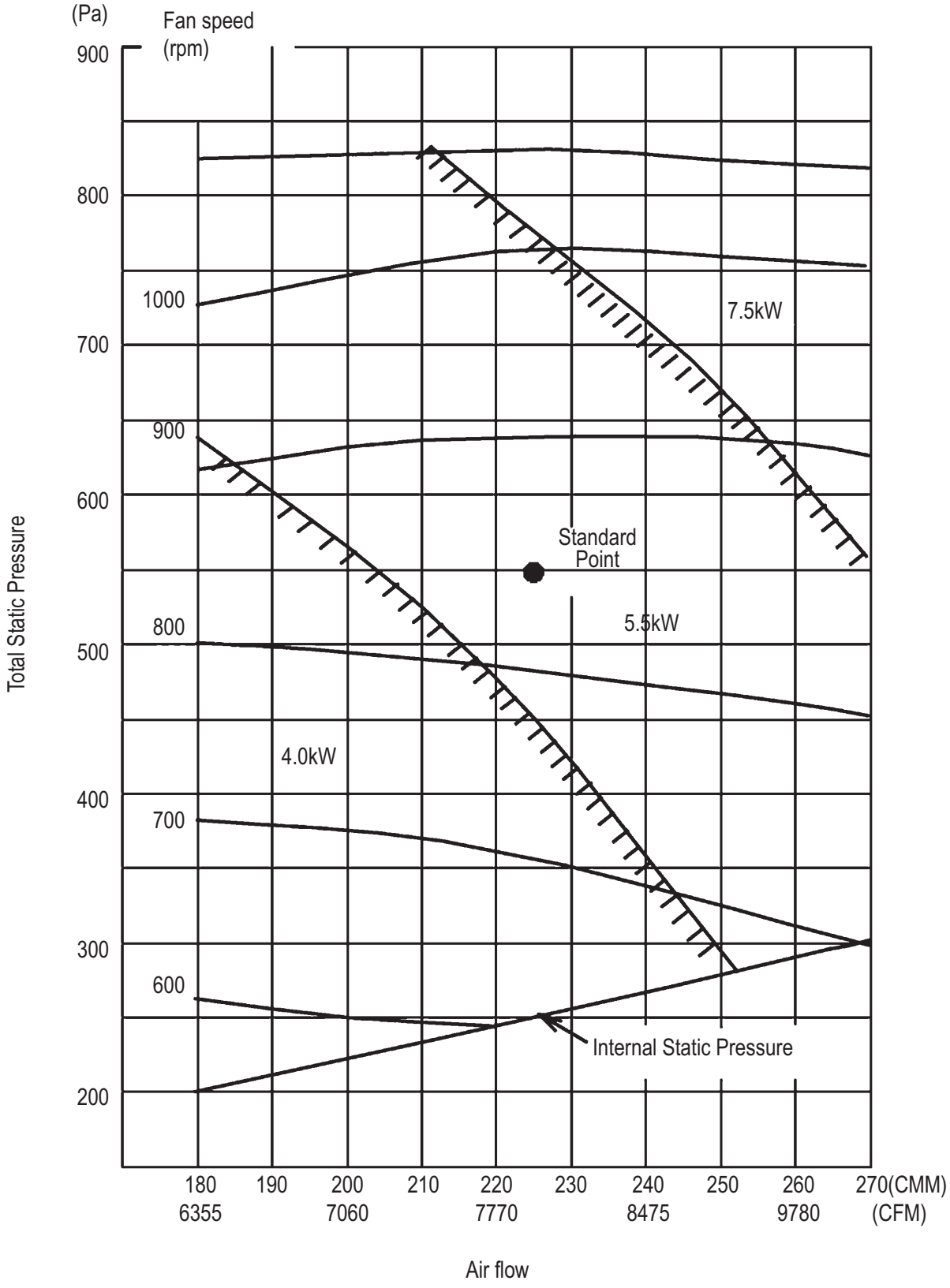
Blower Curve for UATP/TYP/T/TY450A

Appendix 15-26



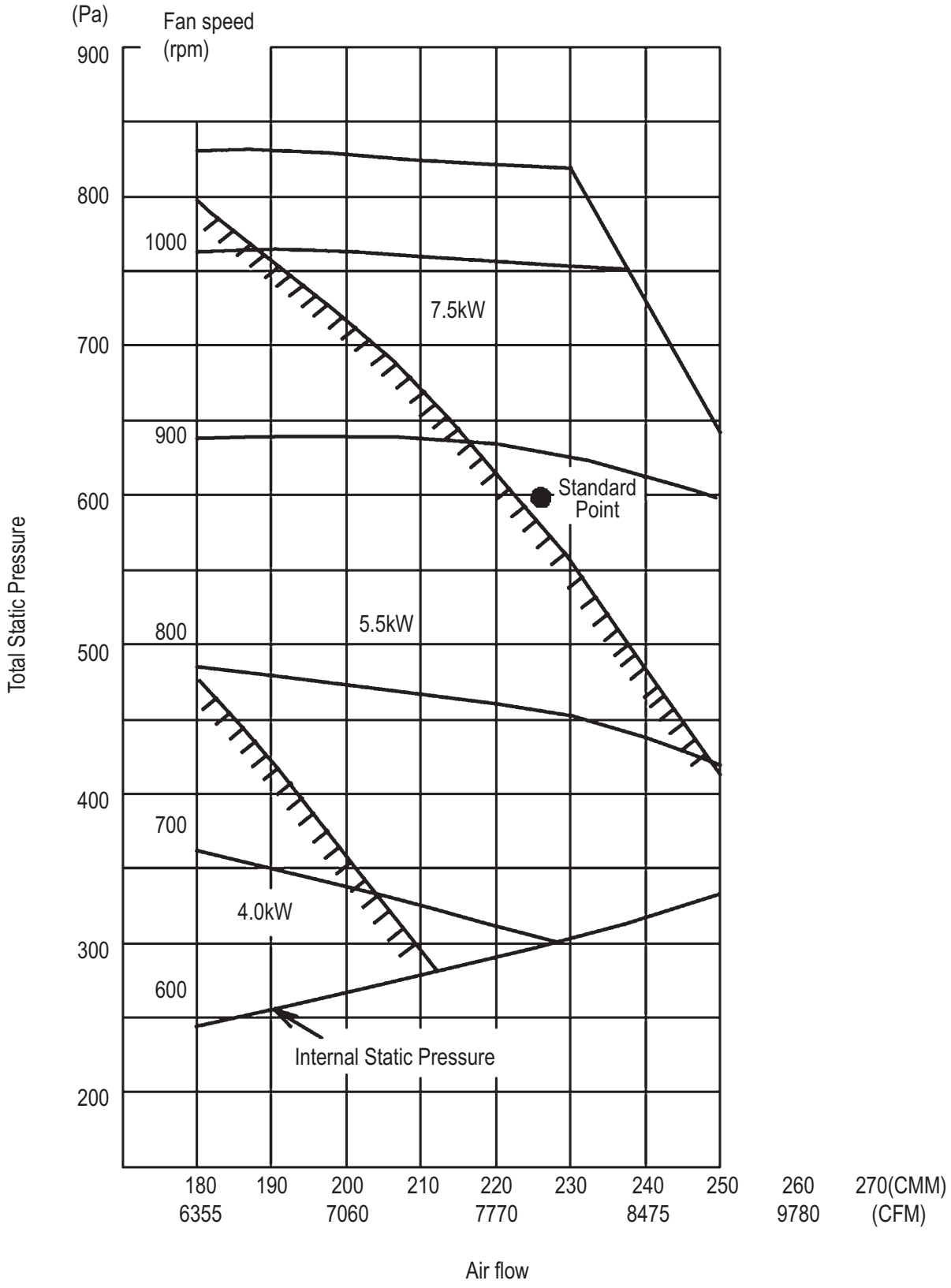
Blower Curve for UATP/TYP/T/TY560A

Appendix 15-27



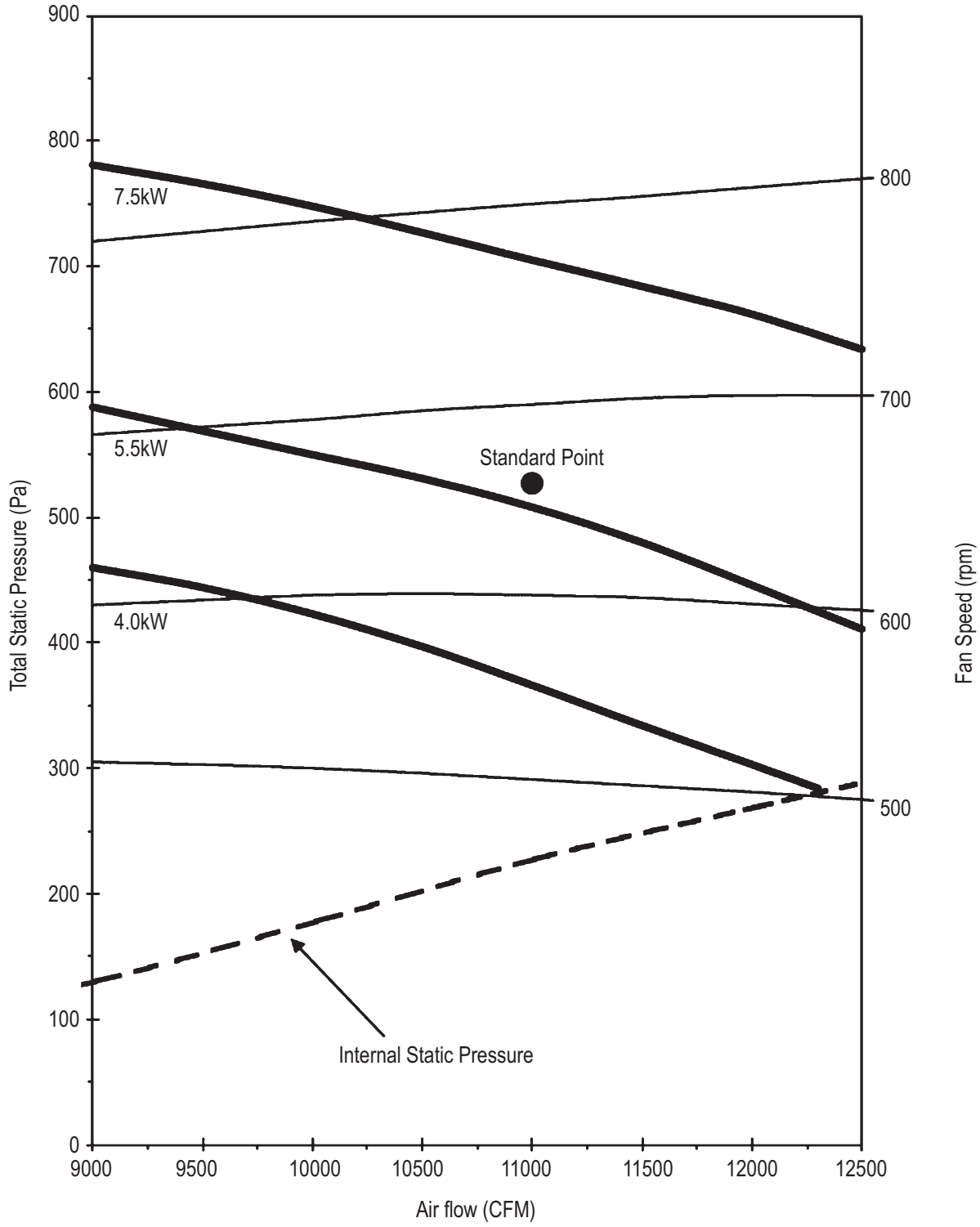
Blower Curve for UATP/TYP/T/TY700A

Appendix 15-28



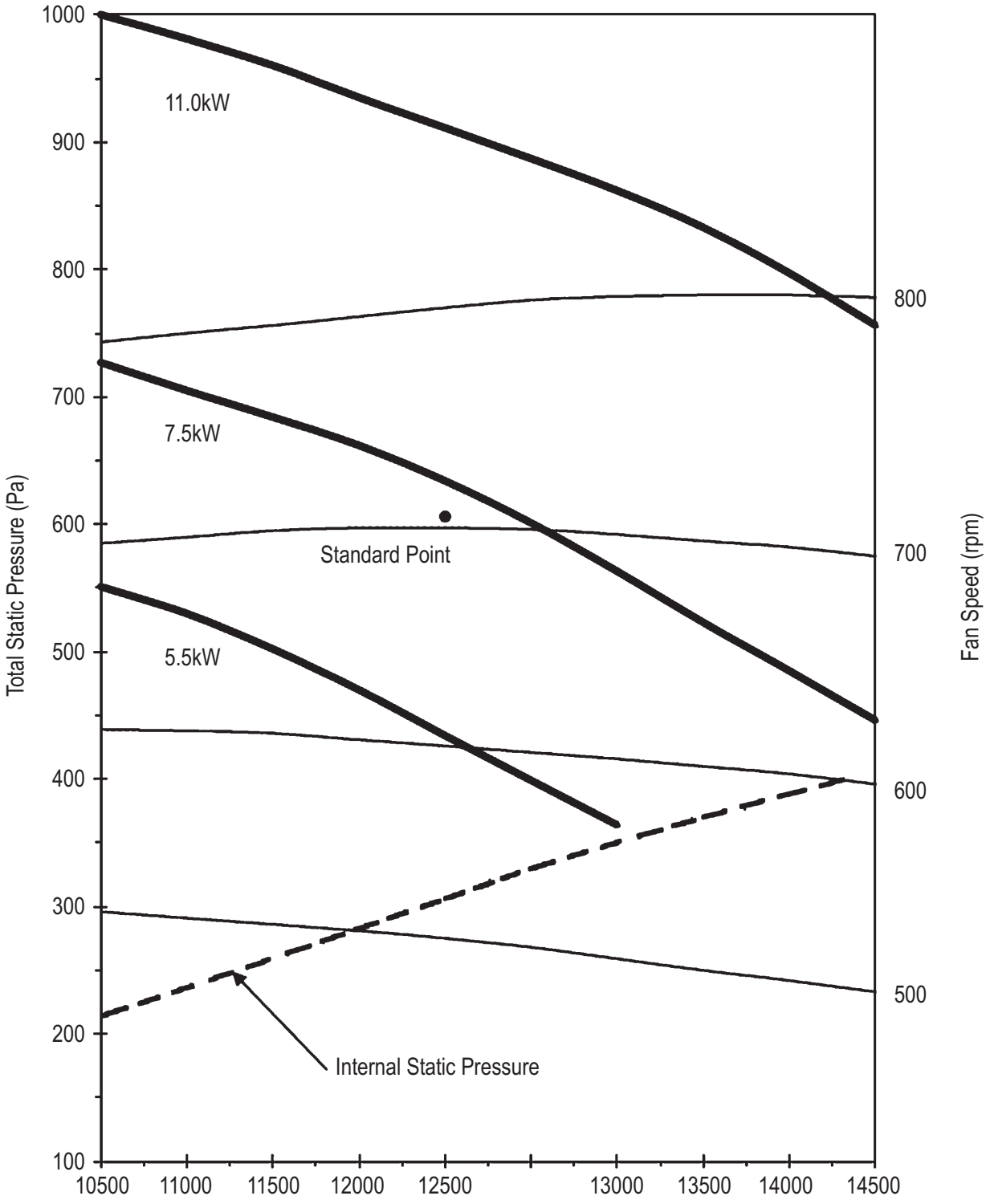
Blower Curve for UATP/TYP/T/TY300A

Appendix 15-29



Blower Curve for UATPC/TYPC/TC/TYC10A

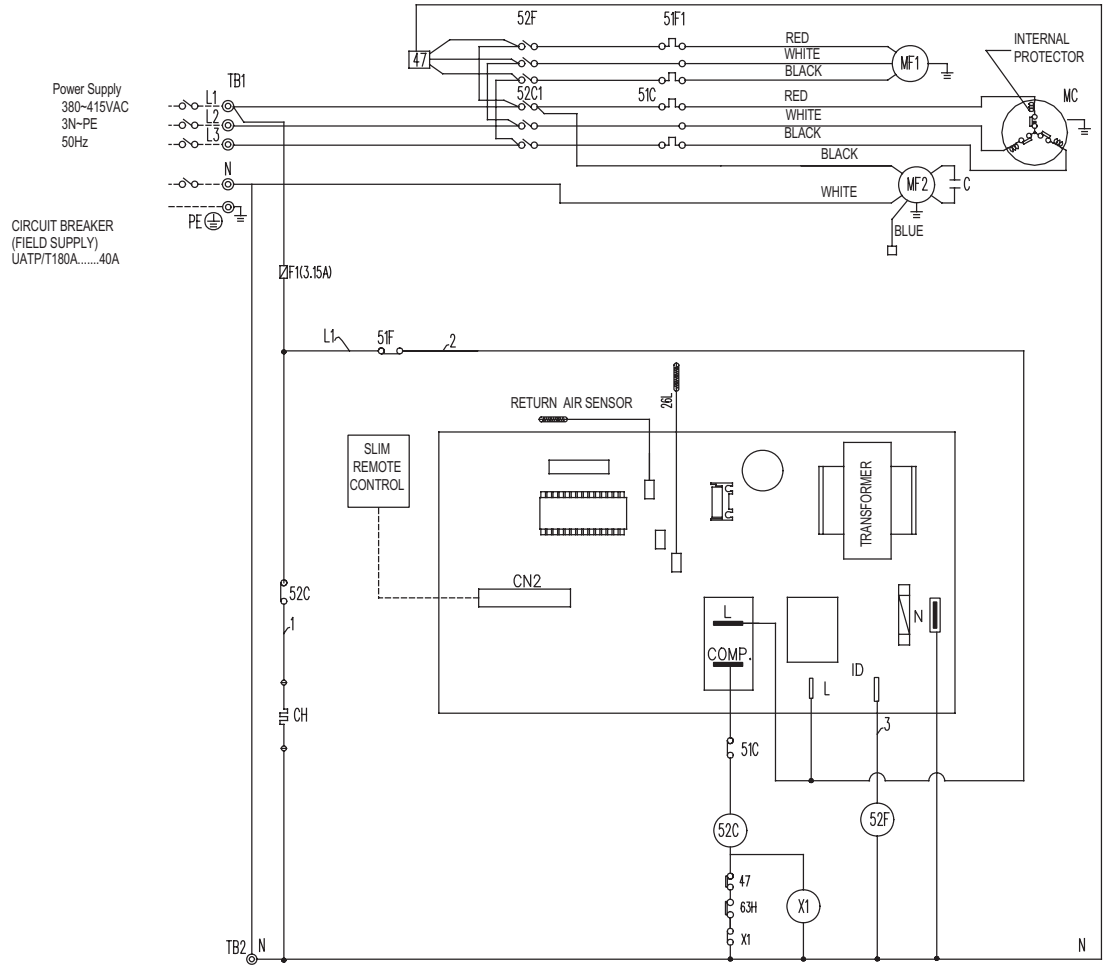
Appendix 15-30

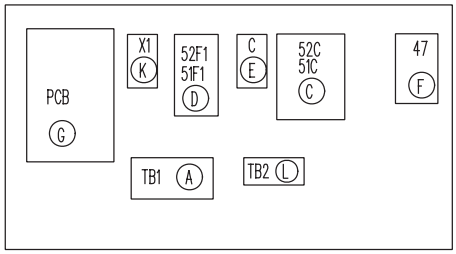


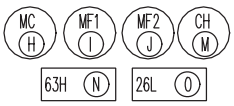
Blower Curve for UATPC/TYPC/TC/TYC12A

Appendix 16-1

UATP/T180A







SYMBOL	NAME
MC	Compressor motor
MF1	Fan motor (indoor)
MF2	Fan motor (outdoor)
52C	Contactor (Compressor)
52F1	Contactor (fan I/D)
51C	Over current relay (comp)
C	Capacitor (o/d fan motor)
TB1,2	Terminal block
51F	Over current relay (fan I/D)
63H	High-pressure switch
CH	Crankcase heater
26L	Sensor (freeze protection)
PCB	Printed circuit board
47	Phase Protector / Discharge thermostat
X1	Auxiliary Relay (Self hold)
F1	Fuse (3.15A)

Caution,

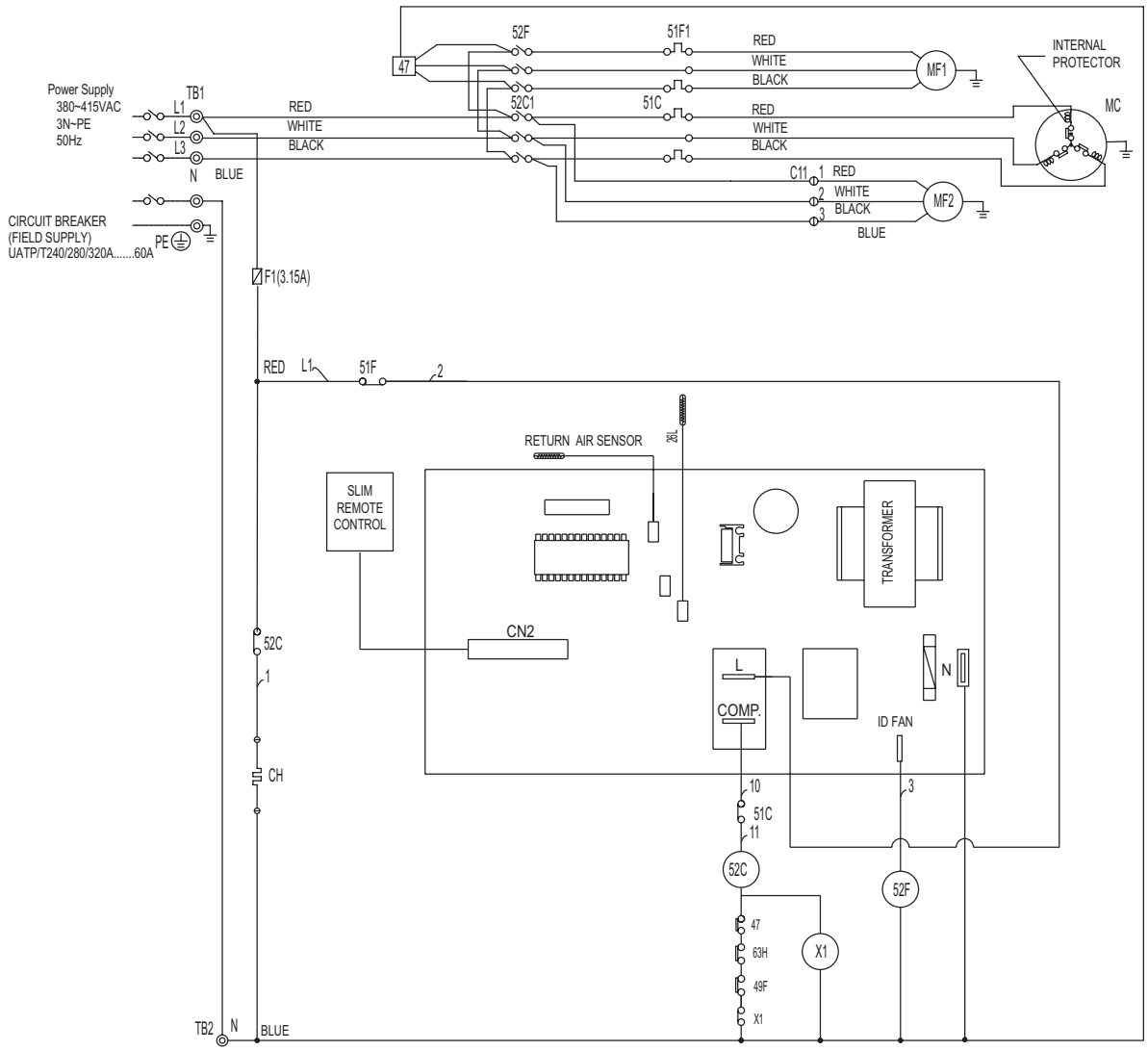
1.To protect each Fan motor and compressor from abnormal current, Over current relays <51C>, <51F> are installed. Therefore, do not change factory set value of Over current relays.

NOTES

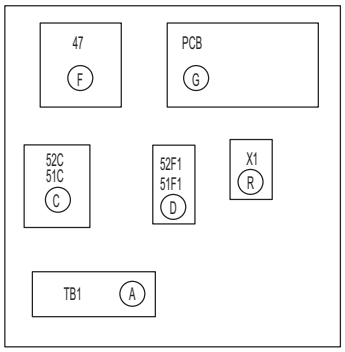
1 The dotted lines show field wiring.
2 The figure in the parenthesis shows field supply parts.
3 Color of earth is yellow and green twisting.

Appendix 16-2

UATP/T240/280/320A



Arrangement



SYMBOL	NAME
MC	Compressor motor
MF1	Fan motor (indoor)
MF2	Fan motor (outdoor)
52C	Contactor (Compressor)
52F1	Contactor (fan I/D)
51C	Over current relay (comp)
TB1	Terminal block
F1	Fuse 3.15A
51F	Over current relay (fan I/D)
63H	High-pressure switch
CH	Crankcase heater
26L	Sensor (freeze protection)
PCB	Printed circuit board
47	Phase Protector / Discharge thermostat
X1	Auxiliary Relay (Self hold)
49F	Internal protector (OD fan) FOR UAT240/280AY1 ONLY

Caution,

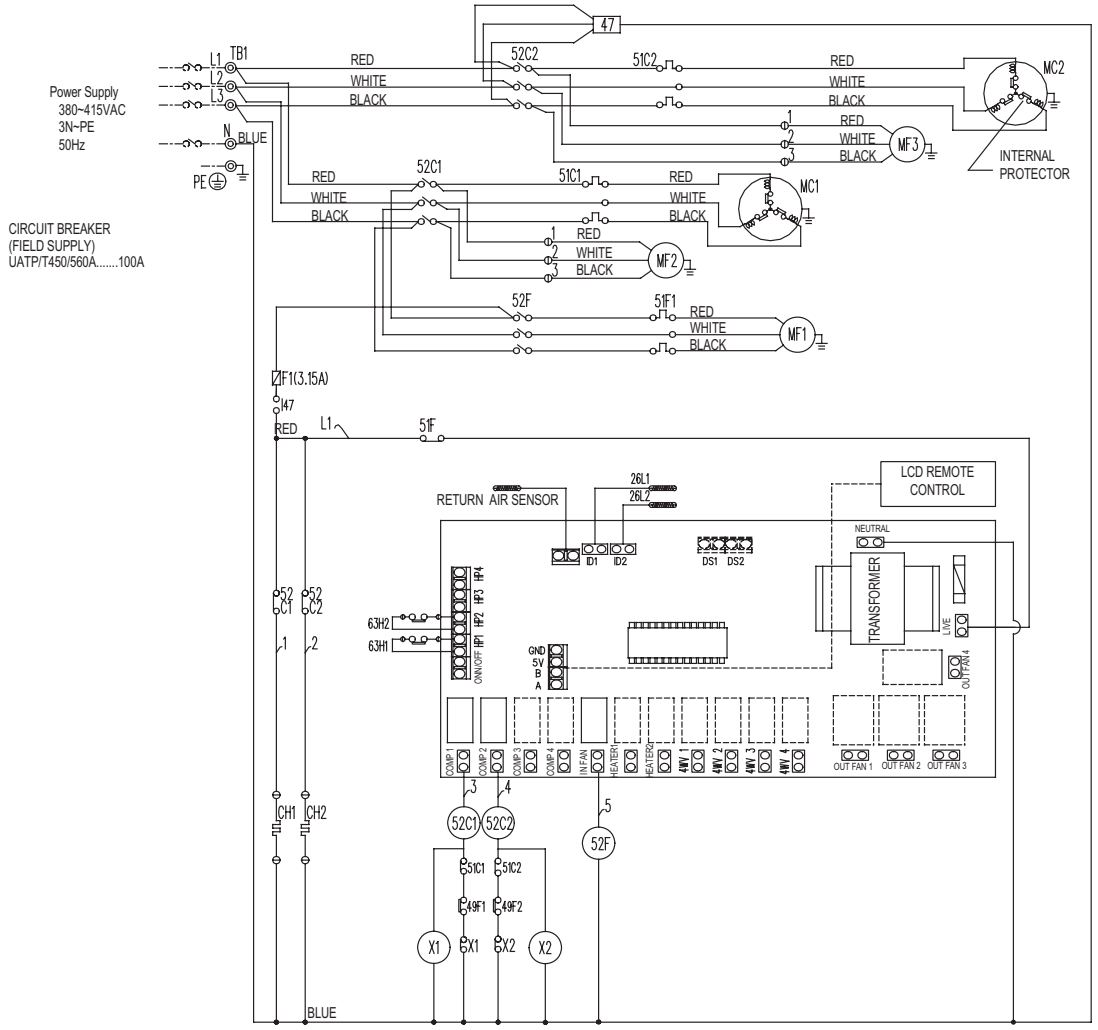
1.To protect each Fan motor and compressor from abnormal current, Over current relays <51C>, <51F> are installed. Therefore, do not change factory set value of Over current relays.

NOTES

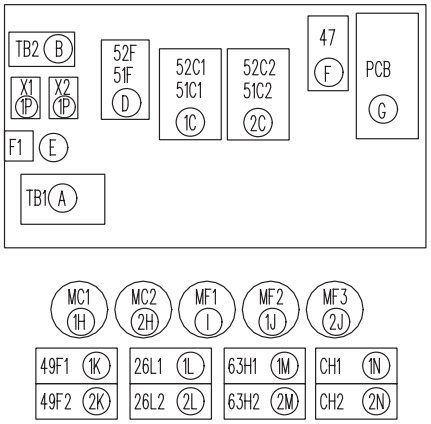
1 The dotted lines show field wiring.
2 The figure in the parenthesis shows field supply parts.
3 Color of earth is yellow and green twisting.

Appendix 16-3

UATP/T450/560A



Arrangement



SYMBOL	NAME
MC	Compressor motor
MF1	Fan motor (indoor)
MF2,3	Fan motor (outdoor)
52C1,2	Contactor (Compressor)
52F	Contactor (fan I/D)
TB1,2	Terminal block
F1	Fuse (3.15A)
51C1,C2	Over current relay (fan I/D)
51F1	Over current relay (fan I/D)
CH1,2	Crankcase heater
26L1,2	Sensor (freeze protection)
PCB	Printed circuit board
47	Phase Protector
49F1,2	Internal protector (OD fan)
63H1,H2	High Pressure Switch
X1,2	Auxiliary Relay (Self Hold)

Caution,

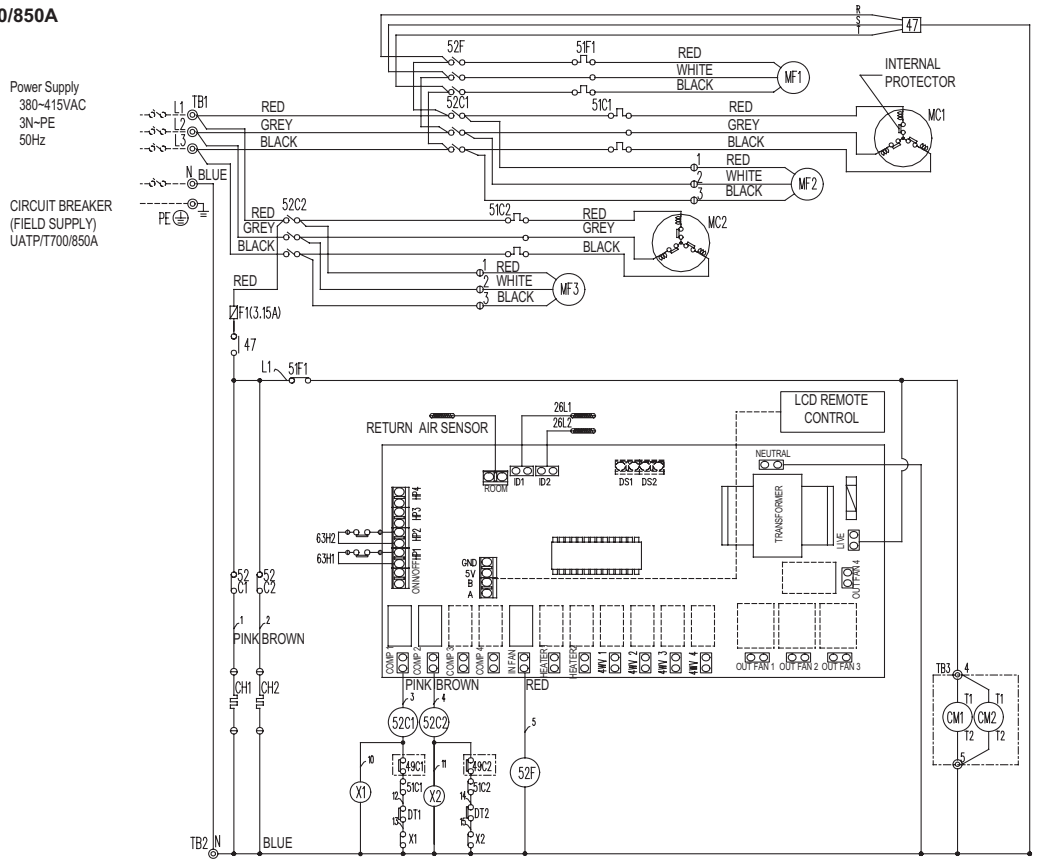
1.To protect each Fan motor and compressor from abnormal current, Over current relays <51C>, <51F> are installed. Therefore, do not change factory set value of Over current relays.

NOTES

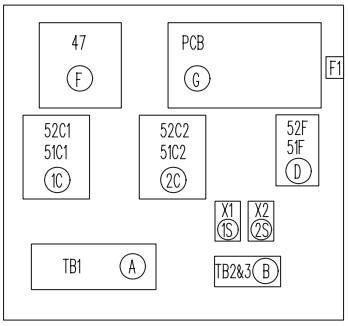
1 The dotted lines show field wiring.
2 The figure in the parenthesis shows field supply parts.
3 Color of earth is yellow and green twisting.

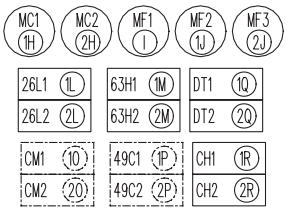
Appendix 16-4

UATP/T700/850A



Arrangement





SYMBOL	NAME
MC1,2	Compressor motor
MF1	Fan motor (indoor)
MF2,3	Fan motor (outdoor)
52C1,2	Contactor (Compressor)
52F1	Contactor (fan I/D)
51C1,C2	Overload protector (compressor)
TB1,2,3	Terminal block
F1	Fuse (3.15A)
51F	Overload protector (fan I/D)
63H1,2	High Pressure Switch
CH1,2	Crankcase heater
26L1,2	Sensor (freeze protection)
PCB	Printed circuit board
47	Phase Protector
DT1,2	Discharged thermostat
X1,2	Auxiliary Relay (Self Hold)
49C1,C2	Compressor internalOverload
CM1,2	Compressor Control Module

* UATP/T700 only

* UATP/T700 only

Caution,

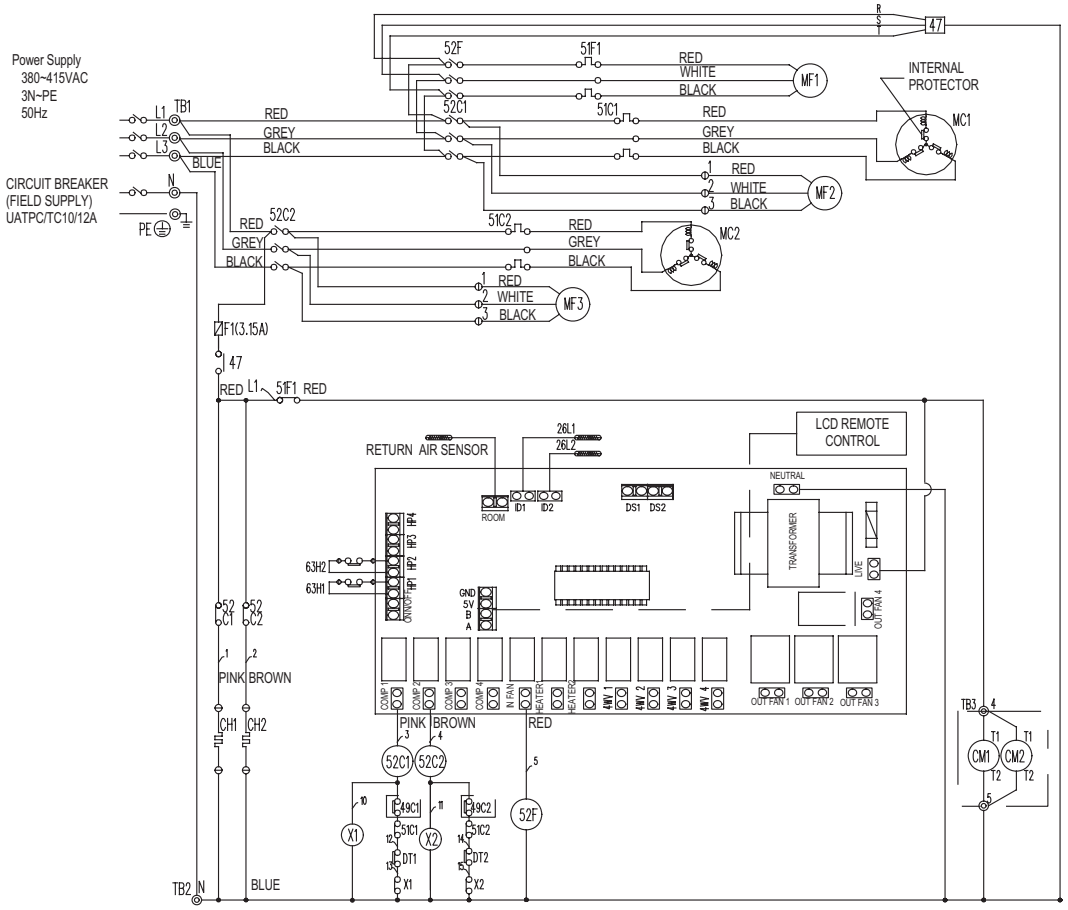
1.To protect each Fan motor and compressor from abnormal current, Overload protectors are installed. Therefore, do not change factory set value of the overload protector.

NOTES

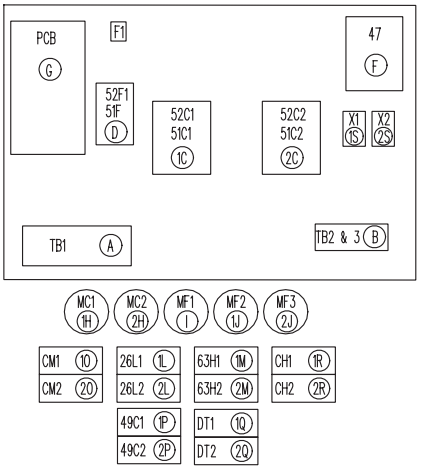
1 The dotted lines show field wiring.
2 Color of earth is yellow and green twisting.
3 Each wire is adressed.
4 [. _ .] shows wiring for model UAT(P)850AY1
In the case of UAT(P)700AY1: no wire connection at TB3(4) and (5), &49C is replaced by single

Appendix 16-5

UATPC/TC10/12A



Arrangement



SYMBOL	NAME
MC1,2	Compressor motor
MF1	Fan motor (indoor)
MF2,3	Fan motor (outdoor)
52C1,2	Contactor (Compressor)
52F1	Contactor (fan I/D)
51C1,C2	Overload protector (compressor)
TB1,2,3	Terminal block
F1	Fuse (3.15A)
51F	Overload protector (fan I/D)
63H1,2	High Pressure Switch
CH1,2	Crankcase heater
26L1,2	Sensor (freeze protection)
PCB	Printed circuit board
47	Phase Protector
DT1,2	Discharged thermostat
X1,2	Auxiliary Relay (Self Hold)
49C1,C2	Compressor internalOverload
CM1,2	Compressor Control Module

Caution,

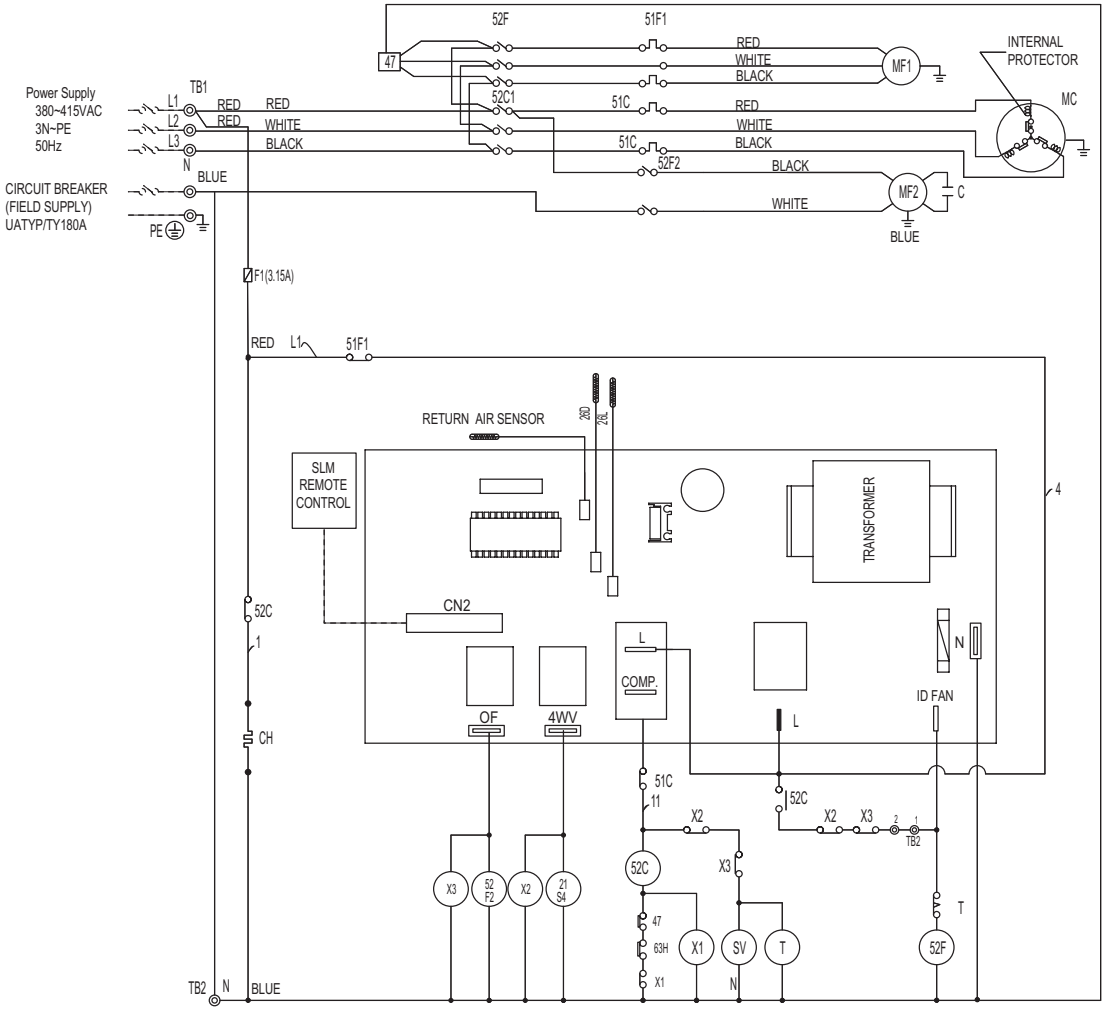
1.To protect each Fan motor and compressor from abnormal current, Overload protectors are installed. Therefore, do not change factory set value of the overload protector.

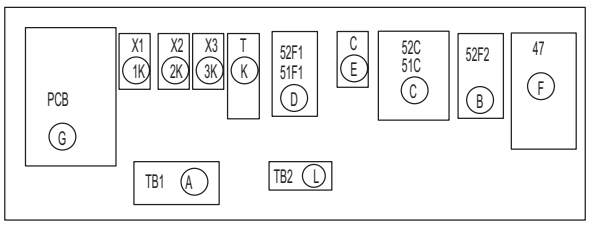
NOTES

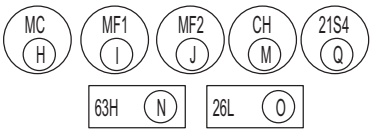
1 The dotted lines show field wiring. - - - - - - - -
2 Color of earth wire is yellow and green twisting.
3 Specification subject to change without notice.
4 Each wire is adressed.

Appendix 16-6

UATYP/TY180A







SYMBOL	NAME
MC	Compressor motor
MF1	Fan motor (indoor)
MF2	Fan motor (outdoor)
52C	Contactor (Compressor)
52F1	Contactor (fan I/D)
52F2	Contactor (fan O/D)
51C	Over current relay (comp)
TB1,2	Terminal block
51F1	Over current relay (fan I/D)
63H	High-pressure switch
CH	Crankcase heater
21S4	4-Way valve
26D	Sensor (defrost)
26L	Sensor (freeze protection)
PCB	Printed circuit board
47	Phase Protector / Discharge thermostat
X1	Auxiliary Relay (Self hold)
X2, X3	Auxiliary Relay (Defrost)
T	Timer (Defrost)
SV	Solenoid Valve

Caution,

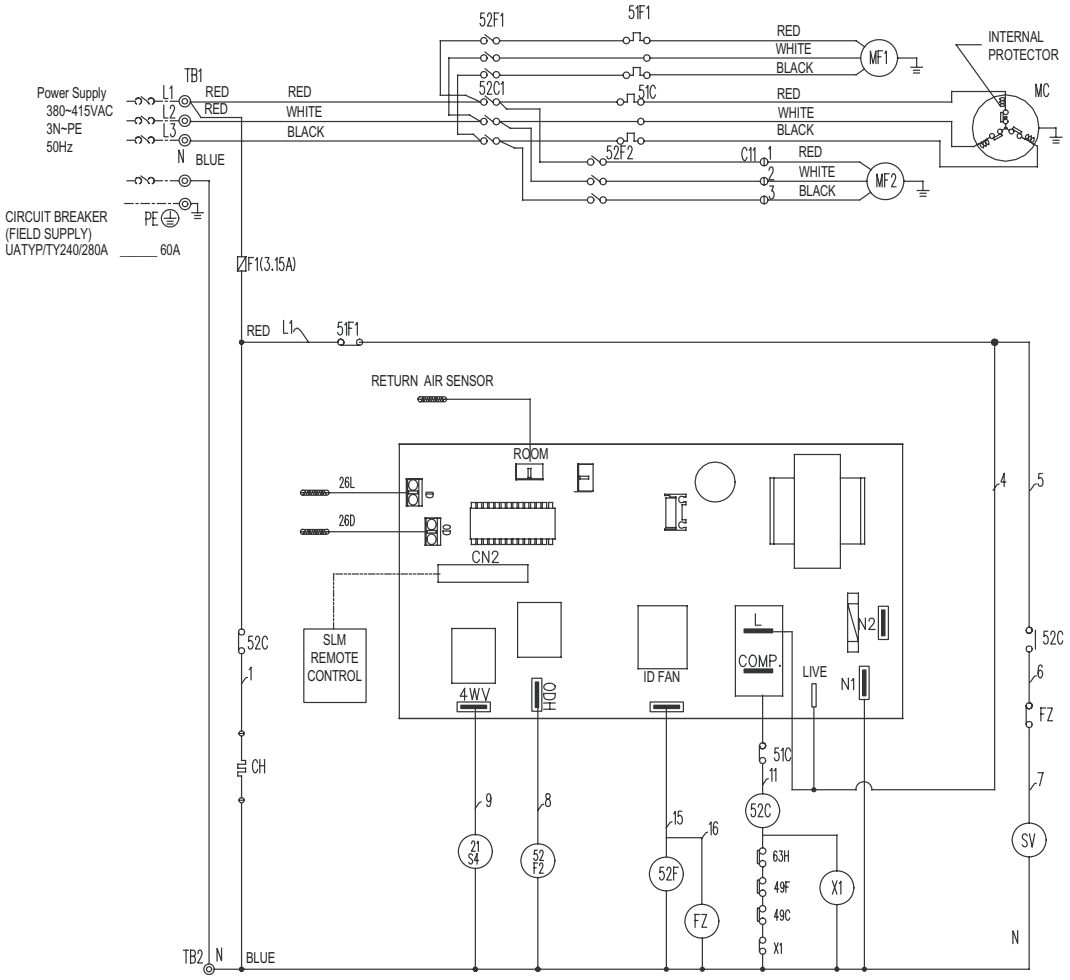
1. To protect each Fan motor and compressor from abnormal current, Ov er current relays <51C>, <51F> are installed. Therefore, d o not change factory set value of Over current relays.

NOTES

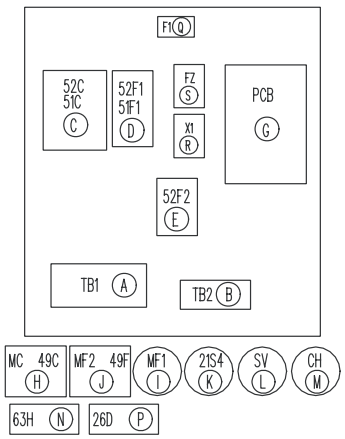
1 The dotted lines show field wiring.
2 The figure in the parenthesis shows field supply parts.
3 Color of earth is yellow and green twisting.

Appendix 16-7

UATYP/TY240/280A



Arrangement



SYMBOL	NAME	SYMBOL	NAME
MC	Compressor motor	CH	Crankcase heater
MF1	Fan motor (indoor)	21S4	4-Way valve
MF2	Fan motor (outdoor)	26D	Sensor (defrost)
52C	Contactor (Compressor)	26L	Sensor (freeze protection)
52F1	Contactor (fan I/D)	PCB	Printed circuit board
52F2	Contactor (fan 0/D)	SV	Solenoid valve
51C	Over current relay (comp)	X1	Auxiliary Relay (Self hold)
51F1	Over current relay (fan I/D)	FZ	Auciliary Relay (defrost)
F1	Fuse (3.15A)	49F	Internal Protector (0D Fan)
TB1,2	Terminal block	49C	Internal Protector (Comp)
63H	High-pressure switch		

Caution,

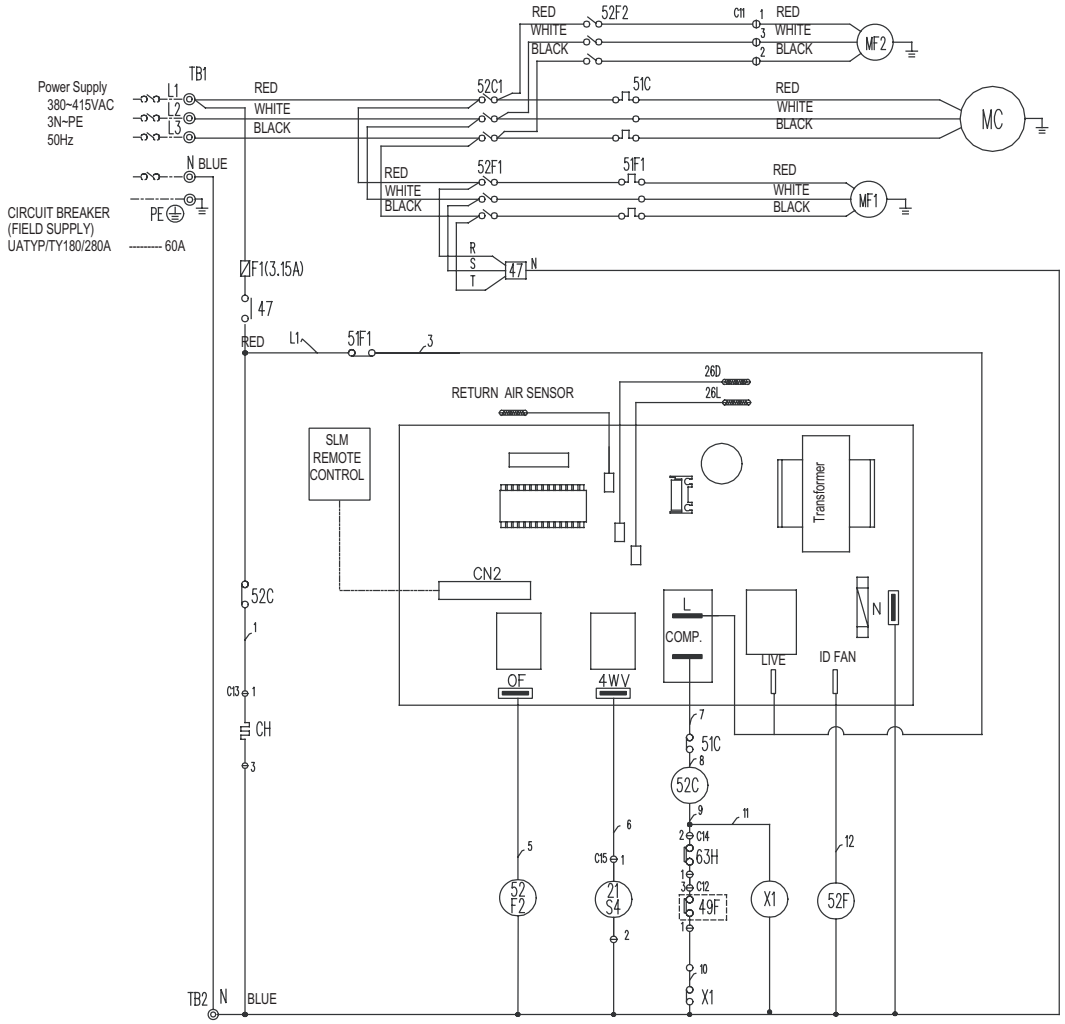
1.To protect each Fan motor and compressor from abnormal current, Over current relays <51C>, <51F> are installed. Therefore, do not change factory set value of Over current relays.

NOTES

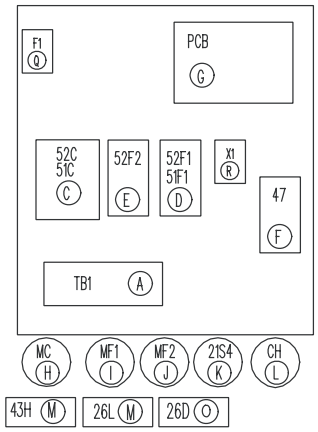
1 The dotted lines show field wiring.
2 The figure in the parenthesis shows field supply parts.
3 Color of earth is yellow and green twisting.

Appendix 16-8

UATYP/TY450/560A



Arrangement



SYMBOL	NAME
MC	Compressor motor
MF1	Fan motor (indoor)
MF2	Fan motor (outdoor)
52C	Contactor (Compressor)
52F1	Contactor (fan I/D)
52F2	Contactor (fan 0/D)
51C	Over current relay (comp)
51F1	Over current relay (fan I/D)
F1	Fuse (3.15A)
TB1,2	Terminal block
63H	High-pressure switch
CH	Crankcase heater
21S4	4-Way valve
26D	Sensor (defrost)
26L	Sensor (freeze protection)
PCB	Printed circuit board
47	Phase protector/Discharge thermostat
X1	Auxiliary relay (Self Hold)
* 49F	Internal Protector (0D Fan)

* UATYP180A only

Caution,

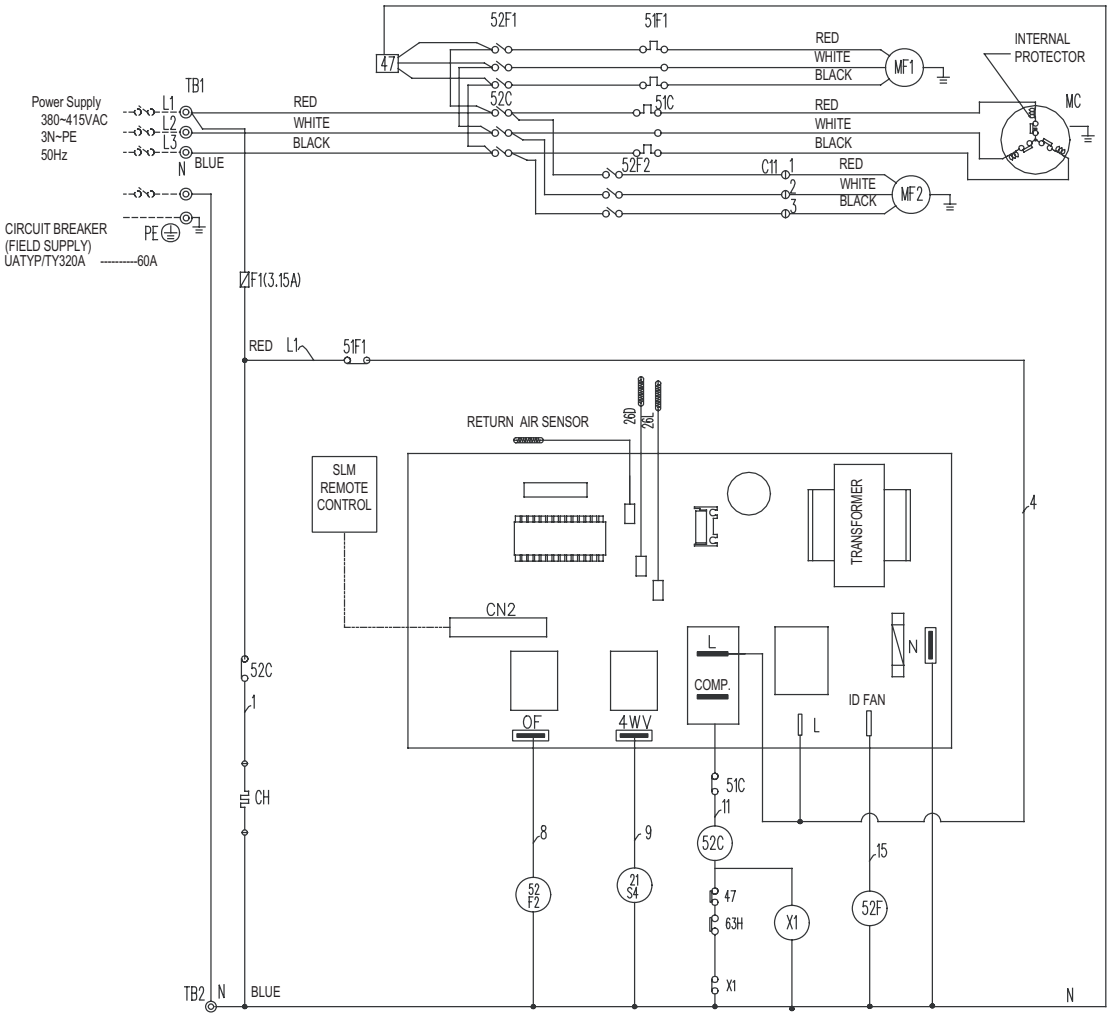
1.To protect each Fan motor and compressor from abnormal current, Over current relays <51C>, <51F> are installed. Therefore, do not change factory set value of Over current relays.

NOTES

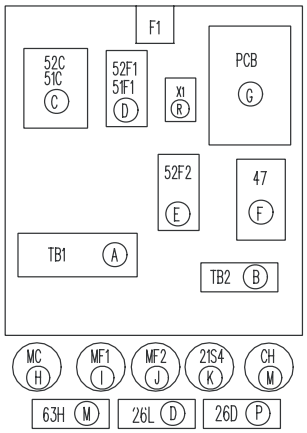
1 The dotted lines show field wiring.
2 The figure in the parenthesis shows field supply parts.
3 Color of earth is yellow and green twisting.

Appendix 16-9

UATYP/TY320A



Arrangement



SYMBOL	NAME
MC	Compressor motor
MF1	Fan motor (indoor)
MF2	Fan motor (outdoor)
52C	Contactor (Compressor)
52F1	Contactor (fan I/D)
52F2	Contactor (fan 0/D)
51C	Over current relay (comp)
51F1	Over current relay (fan I/D)
F1	Fuse (3.15A)
TB1,2	Terminal block
63H	High-pressure switch
CH	Crankcase heater
21S4	4-Way valve
26D	Sensor (defrost)
26L	Sensor (freeze protection)
PCB	Printed circuit board
47	Phase protector/Discharge thermostat
X1	Auxiliary relay (Self Hold)

Caution,

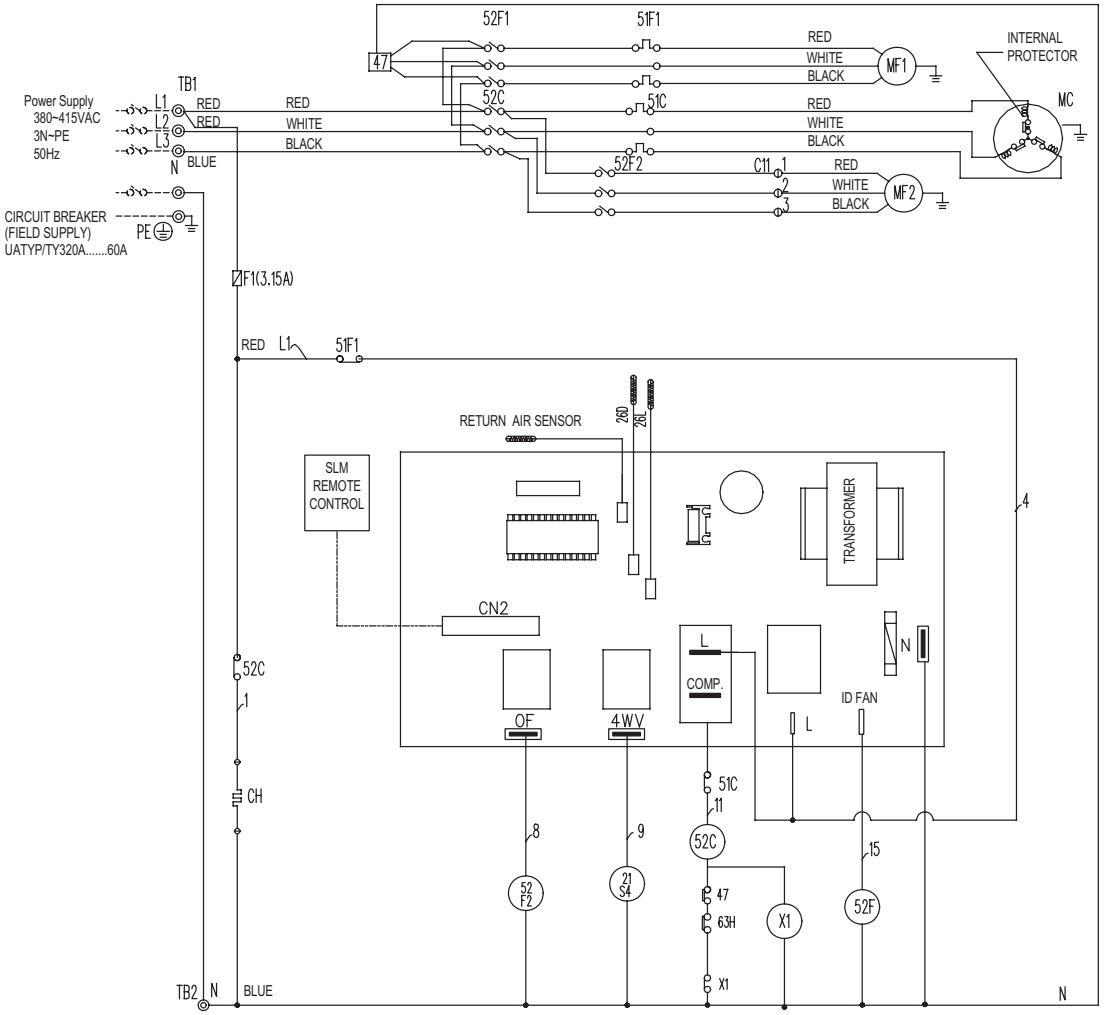
1.To protect each Fan motor and compressor from abnormal current, Over current relays <51C>, <51F> are installed. Therefore, do not change factory set value of Over current relays.

NOTES

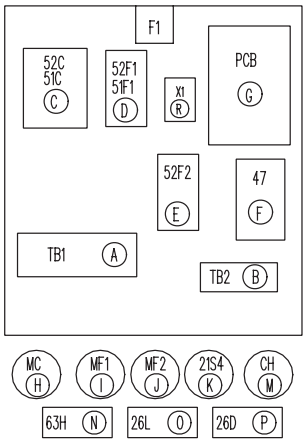
1 The dotted lines show field wiring.
2 The figure in the parenthesis shows field supply parts.
3 Color of earth is yellow and green twisting.

Appendix 16-10

UATYP/TY320A



Arrangement



SYMBOL	NAME
MC	Compressor motor
MF1	Fan motor (indoor)
MF2	Fan motor (outdoor)
52C	Contactor (Compressor)
52F1	Contactor (fan I/D)
52F2	Contactor (fan 0/D)
51C	Over current relay (comp)
51F1	Over current relay (fan I/D)
F1	Fuse (3.15A)
TB1,2	Terminal block
63H	High-pressure switch
CH	Crankcase heater
21S4	4-Way valve
26D	Sensor (defrost)
26L	Sensor (freeze protection)
PCB	Printed circuit board
47	Phase protector/Discharge thermostat
X1	Auxiliary relay (Self Hold)

Caution,

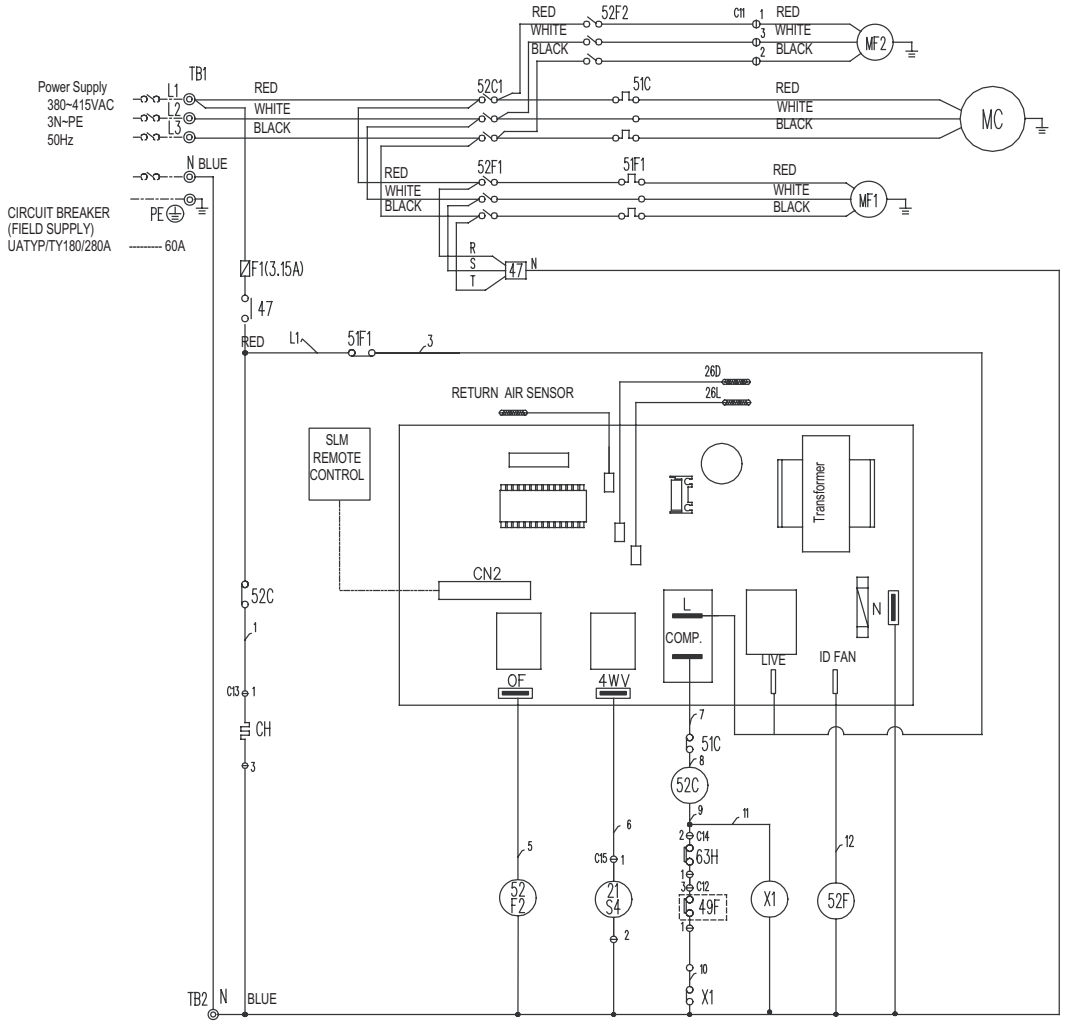
1. To protect each Fan motor and compressor from abnormal current, Over current relays <51C>, <51F> are installed. Therefore, do not change factory set value of Over current relays.

NOTES

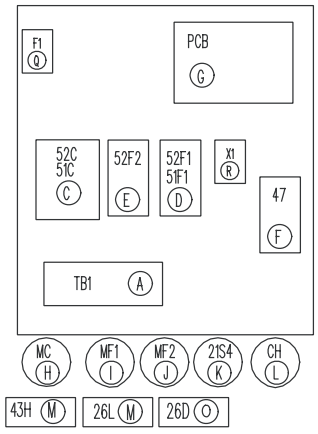
1 The dotted lines show field wiring.
2 The figure in the parenthesis shows field supply parts.
3 Color of earth is yellow and green twisting.

Appendix 16-11

UATYP/TY450/560A



Arrangement



SYMBOL	NAME
MC	Compressor motor
MF1	Fan motor (indoor)
MF2	Fan motor (outdoor)
52C	Contactor (Compressor)
52F1	Contactor (fan I/D)
52F2	Contactor (fan 0/D)
51C	Over current relay (comp)
51F1	Over current relay (fan I/D)
F1	Fuse (3.15A)
TB1,2	Terminal block
63H	High-pressure switch
CH	Crankcase heater
21S4	4-Way valve
26D	Sensor (defrost)
26L	Sensor (freeze protection)
PCB	Printed circuit board
47	Phase protector/Discharge thermostat
X1	Auxiliary relay (Self Hold)
* 49F	Internal Protector (0D Fan)

* UATYP180A only

Caution,

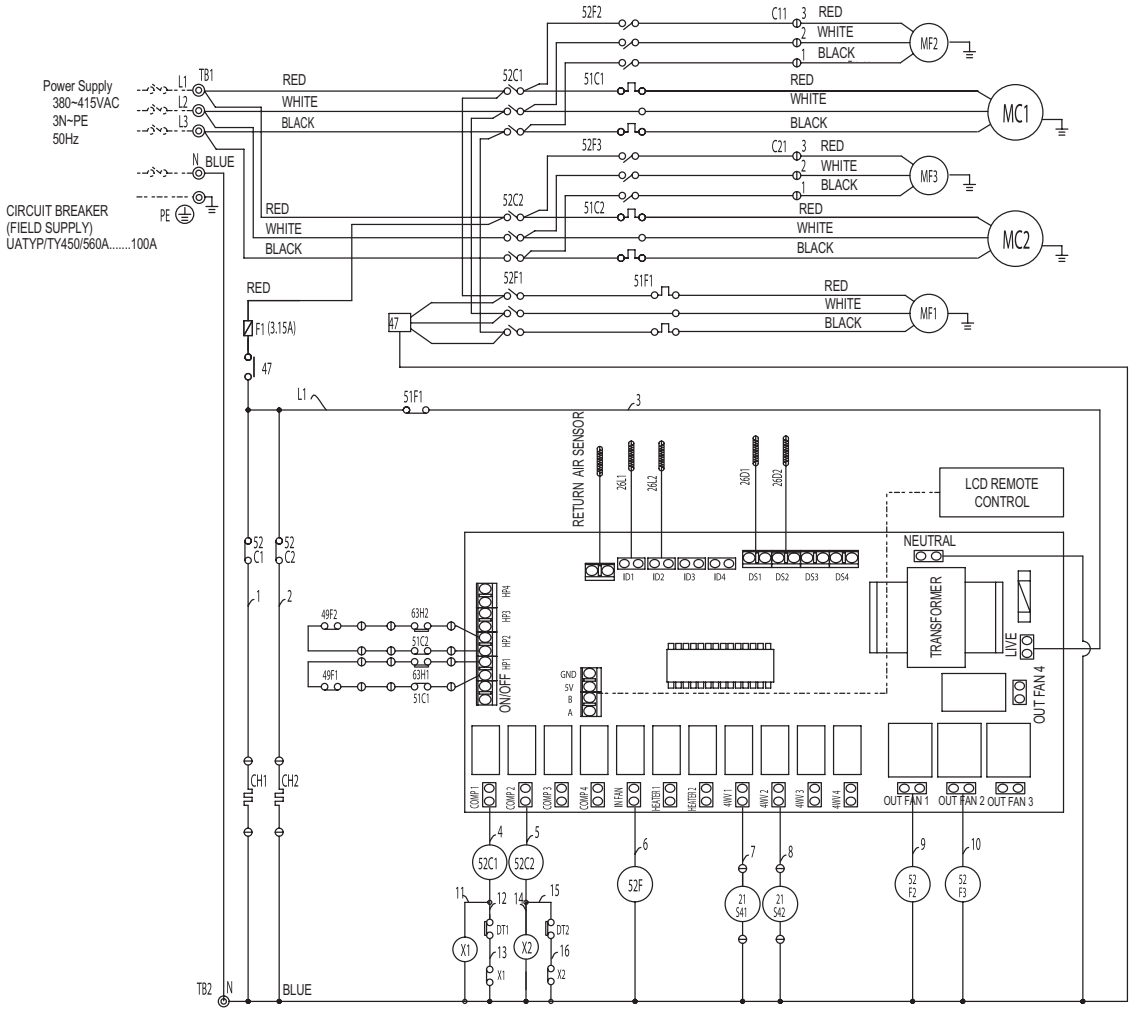
1.To protect each Fan motor and compressor from abnormal current, Over current relays <51C>, <51F> are installed. Therefore, do not change factory set value of Over current relays.

NOTES

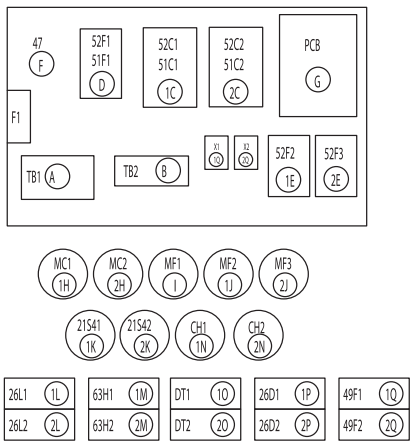
1 The dotted lines show field wiring.
2 The figure in the parenthesis shows field supply parts.
3 Color of earth is yellow and green twisting.

Appendix 16-12

UATYP/TY450/560A



Arrangement



SYMBOL	NAME	SYMBOL	NAME
MC1,2	Compressor motor	63H1,2	High-pressure switch
MF1	Fan motor (indoor)	CH1,2	Crankcase heater
MF2,3	Fan motor (outdoor)	21S41,2	4-Way valve
52C1,2	Contactor (compressor)	26D1,2	Sensor (defrost)
52F1	Contactor (dan I/D)	26L1,2	Sensor (freeze protection)
52F2,3	Contactor (fan 0/D)	PCB	Printed circuit board
TB1,2,3	Terminal block	47	Phase protector
F1	Fuse (3.15A)	DT1,2	Discharge thermostat
51C1,C2	Over current relay (COMP)	49F1,2	Internal protector (0d fan)
51F1	Over current relay (fan)	X1,2	Auxiliary relay (Self hold)

Caution,

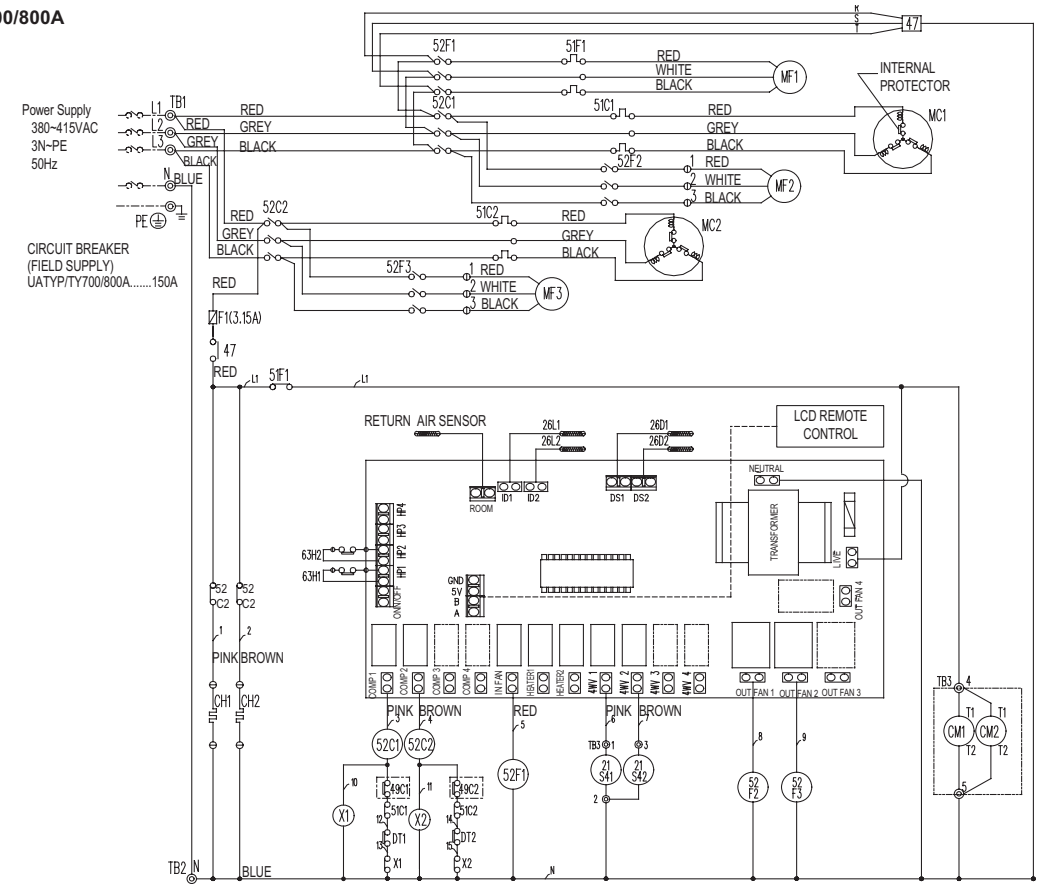
1. To protect each Fan motor and compressor from abnormal current, Over current relays <51C>, <51F> are installed. Therefore, do not change factory set value of Over current relays.

NOTES

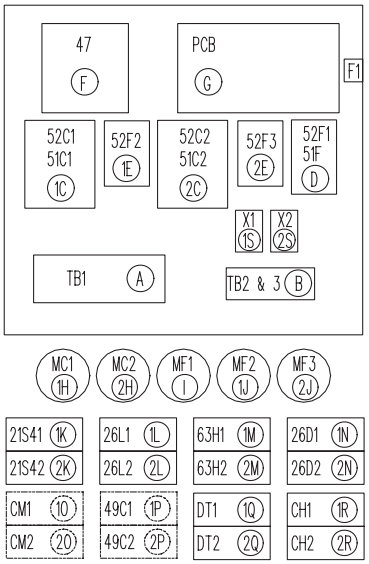
1 The dotted lines show field wiring.
2 The figure in the parenthesis shows field supply parts.
3 Color of earth is yellow and green twisting.

Appendix 16-13

UATYP/TY700/800A



Arrangement



*UATYP/TY700A only
*UATYP/TY800A only

SYMBOL	NAME
MC1,2	Compressor motor
MF1	Fan motor (indoor)
MF2,3	Fan motor (outdoor)
52C1,2	Contactor (compressor)
52F1	Contactor (fan I/D)
52F2,3	Contactor (fan O/D)
51C1,C2	Overload protector (compressor)
TB1,2,3	Terminal block
F1	Fuse (3.15A)
51F	Overload protector (fan I/D)
63H1,2	High-pressure switch
CH1,2	Crankcase heater
21S41,2	4-Way valve
26D1,2	Sensor (defrost)
26L1,2	Sensor (freeze protection)
PCB	Printed circuit board
47	Phase protector
DT1,2	Discharge thermostat
X1,2	Auxiliary relay (self hold)
49C1,C2	Compressor internal overload
CM1,2	Compressor control module

Caution,

1.To protect each Fan motor and compressor from abnormal current, Overload protectors are installed. Therefore, do not change factory set value of the overload protector.

NOTES

1 The dotted lines show field wiring. - - - - - -

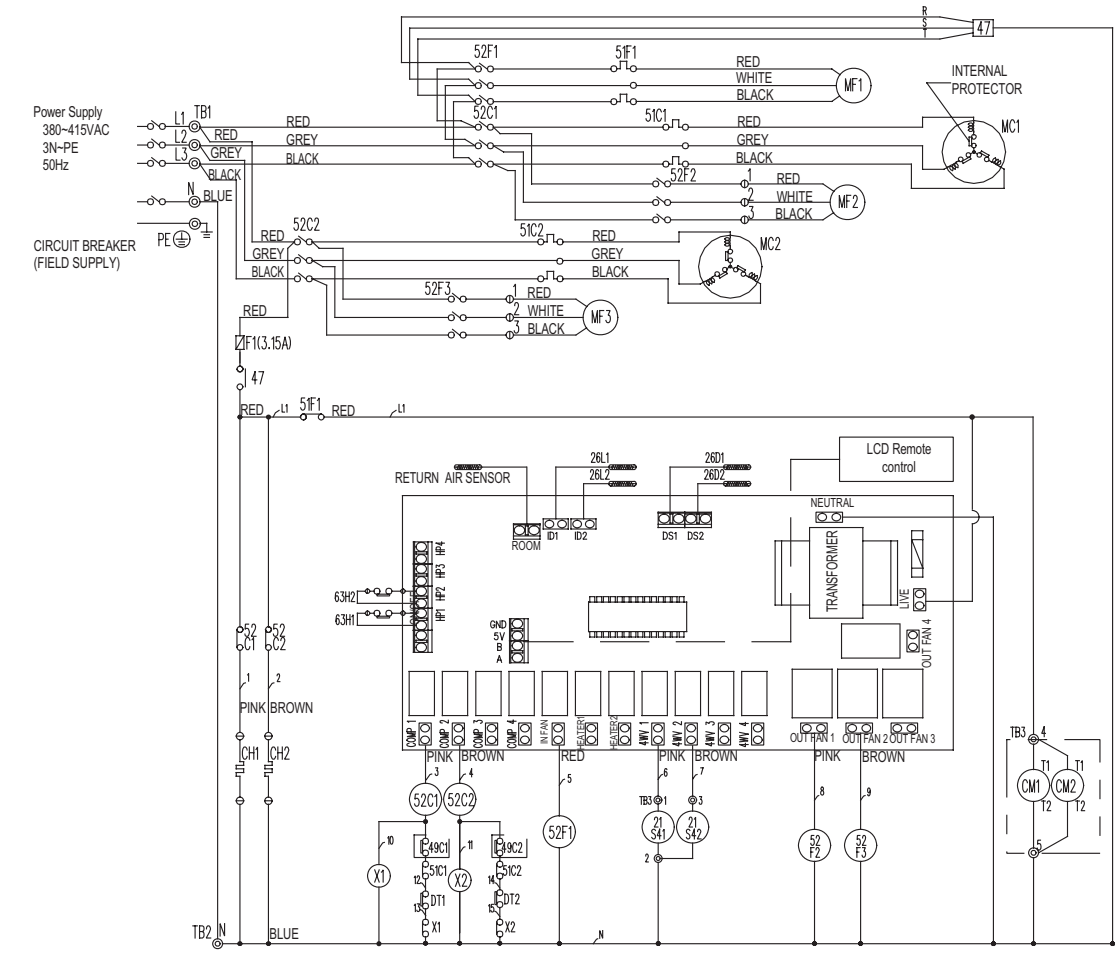
2 Color of earth is yellow and green twisting.

3 Each wire is adressed.

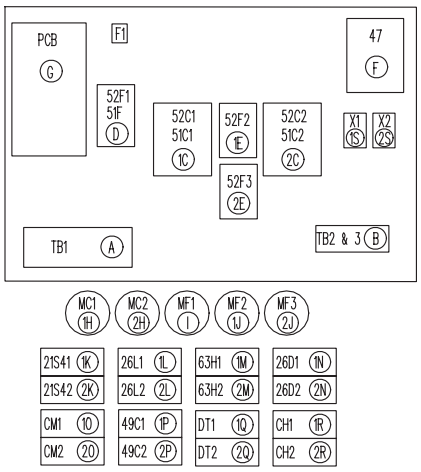
4 [· — ·] shows wiring for model UAT850AY1
In the case of UATP700AY1: no wire connection at TB3(4) and (5), &49C is replaced by single

Appendix 16-14

UATYPC/TYC10/12A



Arrangement



SYMBOL	NAME
MC1,2	Compressor motor
MF1	Fan Motor (indoor)
MF2,3	Fan Motor (outdoor)
52C1,2	Contactor (compressor)
52F1	Contactor (fan I/D)
52F2,3	Contactor (fan 0/D)
51C1,C2	Overload protector (compressor)
TB1,2,3	Terminal block
F1	Fuse (3.15 A)
51F	Overload Protector (fan I/D)
63H1,2	High-pressure switch
CH1,2	Crankcase heater
21S41,2	4-Way valve
26D1,2	Sensor (defrost)
26L1,2	Sensor (freeze protector)
PCB	Printed circuit board
47	Phase protector
DT1,2	Discharge Thermostat
X1,2	Auxiliary relay (Self Hold)
49C1,C2	Compressor internal overload
CM1,2	Compressor control module

Caution,

1.To protect each Fan motor and compressor from abnormal current, Overload protectors are installed. Therefore, do not change factory set value of the overload protector.

NOTES

1 The dotted lines show field wiring. - - - - - - -
2 Color of earth wire is yellow and green twisting.
3 Specification subject to change without notice.
4 Each wire is adressed.

In all of us,
a green heart

Daikin's unique position as a manufacturer of air conditioning equipment, compressors and refrigerants has led to its close involvement in environmental issues. For several years Daikin has had the intension to become a leader in the provision of products that have limited impact on the environment. This challenge demands the eco design and development of a wide range of products and an energy management system, resulting in energy conservation and a reduction of waste.

Daikin Europe N.V. is approved by LRQA for its Quality Management System in accordance with the ISO9001 standard. ISO9001 pertains to quality assurance regarding design, development, manufacturing as well as to services related to the product.

ISO14001 assures an effective environmental management system in order to help protect human health and the environment from the potential impact of our activities, products and services and to assist in maintaining and improving the quality of the environment.

Daikin units comply with the European regulations that guarantee the safety of the product.

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