Introduction of Polyurethane (PU) and Phenolic Air Duct System

• Polyurethane (PU) Duct Introduction
• Phenolic Duct Introduction
• Comparison Table
• Fabrication and Installation
Polyurethane Air Duct system Introduction
AirTrojan zero ODP Polyurethane air duct system is one of the most advanced and energy saving air duct systems all over the world, and it’s eco-compatible and environment-friendly as well. The system consists of pre-insulated aluminium panels and accessories.

**AirTrojan zero ODP insulation panels**

comprise rigid polyurethane (PU) insulation foam faced on both sides with a protective low vapour permeability 80 micron aluminium foil. They are completely CFC and HCFC free, and are of highly thermal resistance. This panel is especially suited for use in heating, ventilation and air-conditioning system installations.

**Accessories:**

Jack Plane (Cutter), Flange, Adhesive, Air Vent, Air Valve and other accessories for duct joining and installation. All of the accessories are customized for the duct system, assuring its perfect technical performance.
### Specification and Technical Data

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Specification/Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
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</tr>
<tr>
<td>Density</td>
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<td>Thermal Conductivity</td>
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<tr>
<td>Compressing Strength</td>
<td>MPa</td>
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<tr>
<td>Bending Strength</td>
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<td>Water Absorption</td>
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<td>Dimension Change</td>
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<td>Working Temperature</td>
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<tr>
<td>Maximum Wind Velocity</td>
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</tr>
<tr>
<td>Max Continuous operating Temperature</td>
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</tbody>
</table>

### Product Data

#### Thermal Performance

The thermal conductivity of **AirTrojan** zero ODP rigid polyurethane insulation panels is 0.025 W/m.K(10°C) almost the lowest of any commonly available zero ODP insulation material used in air duct, which allows the thinnest possible insulation to achieve the required thermal performance.

#### Environmental Properties

In addition to its contribution to energy efficiency, the **AirTrojan** zero ODP system’s rigid polyurethane insulation panels are entirely CFC and HCFC-free with zero Ozone Depletion Potential (ODP). They provide designers and specifiers with optimum solutions towards compliance with international environmental agreements.

#### Moisture Resistance

**AirTrojan** zero ODP rigid polyurethane insulation panels have a >90% closed cell structure which means they are highly resistant to moisture penetration and are also non-wicking.

#### Heat Resistance

The **AirTrojan** zero ODP System is suitable for use in peak temperatures as high as 80°C and continuous operating temperatures up to 70°C.
Fire and Smoke Performance

The rigid polyurethane insulation in the AirTrojan zero ODP system has a resistance to burning and spread of flame as the flame retardants has been added. In addition, there is an almost complete absence of smoke when subjected to a flame source. AirTrojan zero ODP rigid polyurethane insulation panels are conforming to the Chinese national standard: Fire Resistance Class B1.

Quality Assurance

AirTrojan zero ODP rigid polyurethane insulation panels are manufactured according to GB/T19001-2000 - ISO 9001: 2000 (Quality Management Systems).

System Advantages

**Thermal Insulation:** constant and continuous in all duct sections. Special closed-cell insulation guarantees low thermal conductivity and limit the risk of condensation.

**Airtight Seal:** airtightness of AirTrojan ducts is eight times more than traditional ducts.

**Energy Saving:** perfect thermal insulation and optimum airtight seal allow for maximum exploitation of air handling unit capacity, increasing efficiency and reducing operating costs.

**Hygiene and Air Quality:** the use of aluminium for the internal surfaces of the ducts ensures hygiene and cleanliness. The problem of ageing of the insulation and consequent release of particles is non-existent.

**Safety:** AirTrojan ducts have a low participation in fire, do not drop and smokes have a reduced opacity and toxicity. AirTrojan duct is in conformity with the requirements of the most restrictive international regulations.

**Silent Operations:** the sandwich structure (aluminium - insulating material - aluminium) guarantees a good acoustic behaviour. Vibration and reverberation are stopped by the insulating material, contributing to a higher comfort in the environment where AirTrojan duct is installed.

**Light Weight:** the very light weight allows a reduction of weight on the structures, supporting points, workmanship costs and materials necessary for the installation.

**Duration:** the outer aluminium coating coupled with the insulating material provides sturdiness, rigidity and good resistance to corrosion, erosion and deformation even in special applications.
**Construction Easiness**: possibility of manufacturing ducts in the work shop or directly at job site with considerable advantages on transport costs.
AirTrojan International

Phenolic Air Duct system Introduction
Phenolic Foam Pre-insulated Ducting Panel Compounded with Aluminum Foil is of high strength, which takes phenolic foam as the core material with reinforcing the aluminum foil on both sides. It’s a kind of non-combustible material which gives off no smoke and no poisonous gas when exposing to fire. Its bending strength reaches over 1Mpa and the thermal conductivity index 0.020w/mk. The phenolic foam can be fabricated into all kinds of rectangular (bended) ducts by cutting and adhesive connecting, then can be assembled into the air ducts of different specifications by using the fire-proof flange and adhesive. It’s widely used for the ventilation systems of central air conditioning units in hotels, apartments, hospitals, office buildings and other deluxe buildings.

The Advantages of AirTrojan Phenolic Foam Air Duct System:

Lower heat conductivity, higher thermal efficiency
Low density, light weight
Foamed with CFC free materials, environment protective
Hermetic seal ensures little air leakage
With aluminum foil reinforced on both sides, it’s corrosion protective, hygeian, and has a beautiful appearance.
Foamed with closed-cell structure, it’s water-proof and sound-insulated.
Easy making, rapid installing and convenient maintenance save cost.
No protrudent flange on the connections, it can save a lot of building space.

<p>| MAIN TECHNICAL INFORMATION OF PHENOLIC FOAM AIR DUCT |
|-----------------|------------------------------|-----------------|
| Item            | Unit            | Specification   |
| Density         | kg/m³           | 50-60           |
| Thermal Conductivity | w/m.k         | 0.02            |
| Compressing Strength | Mpa              | 0.25            |
| Bending Strength  | Mpa             | 1.0             |
| Combustibility Property |                | Non-combustible Class A |
| WATER ABSORPTION | %               | 1.9             |
| MAX SMOKE DENSITY | %               | 2               |
| DIMENSION CHANGE  | %               | 0.3             |
| WORKING TEMPERATURE | °C               | -260-+150       |</p>
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<thead>
<tr>
<th>NAME</th>
<th>MATERIAL</th>
<th>UNIT</th>
<th>PHOTO</th>
</tr>
</thead>
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<tr>
<td>PVC Flange</td>
<td>PVC Plastics</td>
<td>double meter</td>
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<tr>
<td>Aluminum Alloy Flange</td>
<td>Aluminum Alloy</td>
<td>double meter</td>
<td><img src="image2.jpg" alt="Photo" /></td>
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<tr>
<td>Phenolic Glue</td>
<td>Liquid Glue</td>
<td>drum</td>
<td><img src="image3.jpg" alt="Photo" /></td>
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<td>Plastic 90° Cover</td>
<td>PVC Plastics</td>
<td>pcs</td>
<td><img src="image4.jpg" alt="Photo" /></td>
</tr>
<tr>
<td>Special Cutters</td>
<td>Stainless Steel</td>
<td>set</td>
<td><img src="image5.jpg" alt="Photo" /></td>
</tr>
<tr>
<td>Strengthening Gasket</td>
<td>Steel with Zinc-coat (Disc Gasket)</td>
<td>pcs</td>
<td><img src="image6.jpg" alt="Photo" /></td>
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<tr>
<td>Metal 90° Cover</td>
<td>Steel with Zinc-coat (Metal 90°)</td>
<td>pcs</td>
<td><img src="image7.jpg" alt="Photo" /></td>
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<tr>
<td>Clasp Nail</td>
<td>Steel with Zinc-coat</td>
<td>pc</td>
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Compare PU/Phenolic Duct with Traditional Duct
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<thead>
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<th>名称</th>
<th>地址</th>
<th>电话</th>
<th>传真</th>
<th>邮箱</th>
<th>备注</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>境内公司</td>
<td>中国北京市</td>
<td>12345678901</td>
<td>01234567890</td>
<td><a href="mailto:air.trojan@msa.hinet.net">air.trojan@msa.hinet.net</a></td>
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</tr>
<tr>
<td>2</td>
<td>境外公司</td>
<td>美国纽约市</td>
<td>12345678901</td>
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<tr>
<td>3</td>
<td>其他公司</td>
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<td>12345678901</td>
<td>01234567890</td>
<td><a href="mailto:air.trojan@msa.hinet.net">air.trojan@msa.hinet.net</a></td>
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</tbody>
</table>

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The Fabrication and Installation of PU/Phenolic Foam Air Ducts
Chapter One: The Introduction of Service Tools and Accessories

1. Introduction of Service Tools

AirTrojan Phenolic Foam Air Ducts are made with a set of special service tools and special process technology.

The service tools include: Special Jack Plane/cutters (including four planers per set, Jack Plane with double knives; Left 45º Jack Plane with single knife; Right 45º Jack Plane with single knife; Vertical Jack Plane), Utility knives, Flexible Compasses, Plastics Scraper, Square Aluminum Alloy Ruler, Aluminum Alloy Angle Square, Rubber Hammer, Aluminum Alloy Cutting Machine, Abrasive Wheel Cutting Machine, Bending Machine, Glue Squeezing Gun, Glue Brush, Screwdriver, and so on.

The Jack Plane with double knives, Left 45º Jack Plane with single knife and Right 45º Jack Plane with single knife are the main tools for fabricating the air ducts and they are used to cut a V-shape slot on the phenolic foam pre-insulated ducting panel. All the planes are mounted with sharp and high-precision blades. When installing the blades, make sure they are slanting to the right or the left by 45º, so the angle of the slots will be 90º. The length of the blades must be adjusted accurately so that the insulation part of the panel will be cut through and the aluminum foil will not be lacerated.

The Flexible Compasses are used to determine the size and the shape of elbows and T-pieces.

The Square Aluminum Alloy Ruler and the Aluminum Alloy Angle Square are used for lineation on the panels, so that the panels will be cut accurately.

The Aluminum Alloy Cutting Machine and Abrasive Wheel Cutting Machine are used to cut the alloy and the PVC accessories.

The Bending Machine is used to fabricate the flexure of the air ducts. It is used to make creases of different distance.

The Plastics Scraper is used to smooth the aluminum foil tape on the air duct and make the air ducts surface more beautiful.

With all the above tools, the worker can fabricate AirTrojan phenolic foam pre-insulated ducting panel into air ducts of different sizes and shapes. With the special tools and the processing technology, the installation worker can make the air ducts with beautiful appearance, good seal and smooth running.

Overall dimension drawing of the special cutters
The list of the main processing tools

<table>
<thead>
<tr>
<th>No</th>
<th>Tools Name</th>
<th>Specification</th>
<th>Usage</th>
<th>Note</th>
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</thead>
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<tr>
<td>1</td>
<td>Jack Plane with double knives</td>
<td>Special tools</td>
<td>for cutting 90° slot</td>
<td>Provided by AirTrojan</td>
</tr>
<tr>
<td>2</td>
<td>Jack Plane with single knife</td>
<td>Special tools</td>
<td>for cutting 45° slot</td>
<td>Provided by AirTrojan</td>
</tr>
<tr>
<td>3</td>
<td>Vertical Jack Plane</td>
<td>Special tools</td>
<td>for cutting and edge trimming</td>
<td>Provided by AirTrojan</td>
</tr>
<tr>
<td>4</td>
<td>Square Aluminum Alloy Ruler</td>
<td>4m/2m</td>
<td>for the shaping of arc panel</td>
<td>made of rectangle aluminum alloy</td>
</tr>
<tr>
<td>5</td>
<td>Steel Ruler</td>
<td>1m</td>
<td>for edge trimming of aluminum tape</td>
<td>outsourcing</td>
</tr>
<tr>
<td>6</td>
<td>Aluminum Alloy Angle Square</td>
<td></td>
<td>for lineation on the panels</td>
<td>outsourcing</td>
</tr>
<tr>
<td>7</td>
<td>Flexible Compasses</td>
<td></td>
<td>for lineation on the panels</td>
<td>outsourcing</td>
</tr>
</tbody>
</table>

The fabrication of Working Platform: 2 pcs
(1) The size of the platform: 4m*1m*0.8m
(2) Materials: use wood board (thickness more than 20mm) as the table-board and cover the table-board with cardboard or carpet. Use the angle steel or the box steel to make the frame.

2. Introduction of the Accessories

We provide a series of accessories for the quick and easy installation of AirTrojan sandwich air duct system, including the connections between air ducts and the connections between equipment and other components.

The main accessories include: PVC flange, U-shape tiger, Φ-shape aluminum alloy flange, corner metal cover, round metal washer, sealing gasket and so on.

PVC Flange, Φ-shape aluminum alloy flange, F-shape aluminum alloy flange are used for the connections between air ducts.

F-shape aluminum alloy flange are also used for connections between air duct and equipment or air vent or air valve.

Corner metal cover, round metal washer, sealing gasket are used to reinforce the pressure-resistance and the resistance to deformation of the air ducts.
We will detail the information of the above accessories in the following chapters.

H-shape PVC flange; Vertical PVC Flange; F-shape alloy flange; Y-shape alloy flange; U-shape tiger

Chapter 2 The fabrication of air duct

1. This chapter introduces the process of air duct’s fabrication; the fabrications of the different type air ducts, flange or tiger were used for connection during the reinforcement or repair process.

1). The process of fabrication

Because of the specific performance of AirTrojan air duct panel, the process of fabrication for air duct is much more controllable and convenient compared with the fabrication of conventional panel.

The main process of air duct’s fabrication

Flange connection

Partition the panel → Cut → Paste → Strengthen → Connection

Tiger connection

A. Plate alignment

In order to improve the usage of panel and when it’s impossible to produce the single side of duct by single panel, cut a V-shaped slot by 45° on the panel, and then paste the panel. (Fig 2-1)

B. Lineation and Cut

During the real construction, the process of AirTrojan panel’s fabrication is the same with the conventional panel, partition the duct on the drawing reasonably. The dimension of AirTrojan panel is 4000(L)*1200(W) mm and 2000(L)*1200(W) mm, and the dimension of the duct is also different, so the accurate calculation is required during lineation, reasonable line and cut is the most important way to reduce the wastage. In order to ensure the strength after fabrication, keep 20mm thickness of aluminum foil of the panel.

The several techniques of lineation and cut are as follows; it can be changed based on the real construction.

Based on the different length of sides (Fig 2-2), six techniques are supplied:
a. Technique (1): the total length of 4 sides $2(A+B) \leq 1020\text{mm}$, duct can be made by a panel which the longest length is 4m by lengthways cutting. (Fig 2-3)

b. Technique(2): the length of 3 sides $2A+B \leq 1080$ or $A+2B \leq 1080$, the duct can be made by applying U shape and covered with a panel by lengthways cutting.(Fig 2-4)

c. Technique (3): The length of 2 sides $A+B \leq 1100\text{mm}$, duct can be produced by two "L" shape panel, lengthways cutting. (Fig 2-5)

d. Technique (4): the single length $A$ or $B \leq 1140\text{mm}$, take each panel by lengthways cutting then connect it. (Fig 2-6)

e. Technique (5): the single length $A$ or $B > 1140\text{mm}$, when each side of panel is larger than 1140mm:

i) Plate alignment, then based on the cutting technique (1)~(4)

ii) Apply the lengthways cutting, the length of duct is 1200mm by this way.
1) Bending the Curve shape

A. Making the curve side of the panel
When making the curve side, make the panel to be curve shape, the length \( L \) is decided by the length of curve MN. \( L = MN \), (Fig 2-7)

B. The curving technique of panel
Press the panel by bender, make the panel appeared "V" shape, and make it to be bendable. the pressing distance is between 30-70cm, when the radius of arch is smaller than 150mm, the distance of pressing is 30mm, when the radius of arch is between 150~300mm, the distance of pressing is between 50~70mm, if the distance is too small, it's quite easy to make aluminum foil to be plump, but it's easy to bend it. Vise versa. The depth of press should be less than 5mm, if it's too deep, it's easy to fracture the panel; if it's too low, and it's not easy to bend it. When the panel is curve shape, make them connected closely, it's easy to be shaped and strengthened.

C. The sample of bending the curve shape
a. The elbow duct (Fig 2-8)

b. The reducing duct (Fig 2-9)

c. The bifurcated duct
The bifurcated duct is composed by two parts (elbow + elbow; elbow + reducing duct; elbow duct + elbow), it's used for the air flow towards the diffuence and direction changed of the other system (Fig 2-10)
4) Formation by plating
A. Plating time: after brushing the glue, when it's not adhesive by hand's touching.
B. Plate: ensure the edge of the duct connected firmly, make sure that there's no semicircular angle to affect the beautiful appearance of duct when the angle should be 90°
C. Put the adhesive plate on out wall of duct after plating
D. Plug the inner joint by glass cement or 30mm aluminum adhesive plate, the joint should be clean before plugging, and then strengthen it.
E. Deburring to make the nozzle and flat surface to be vertical, this process affect the levelness of duct directly.
5). Install flange or plug
A. "H" type and vertical PVC flange is used for butt joint notice the direction of flange during installation, it will bring the big trouble for the duct installation if the direction of flange is wrong, and it should alternate the direction of flange again.
B. The installation of Vertical PVC flange. (Fig2-12)

C. The installation of “H” shape aluminum alloyed flange.

D. The installation of “F” shape aluminum alloyed flange.

E. The usage of Tiger “U” shape Tiger:
a. The Tiger is made of 0.88mm zincification steel, dimension: 74mm*50mm
b. The outer catch of connection, the distance of Tiger is 250mm, Seal the joint by 80mm aluminum adhesive plate after connecting by Tiger
c. The inner catch of connection, when the dimension of duct between 600~800mm, it need inner catch. The distance of tiger is 500mm; Seal the joint by 80mm aluminum adhesive plate after connecting by Tiger.
d. When the edge of duct is between 800~1200mm, the joint cannot always connected by Tiger, it should use PVC flange or aluminum alloyed flange to strengthen it after using two Tiger
2. Strengthen/reinforce

1). Strengthen the angle,
When the rectangular duct’s edge $\geq 250$mm, put 0.75mm galvanized pad/washer on the four angle of duct, strengthen the hardness of four angles to avoid the duct to distort. It’s enough to strengthen one side of duct when applying the metal flange; strengthen both sides of duct when applying PVC flange. Installation method (Fig 2-15)

![Diagram](attachment:fig2-15.png)

2). Strengthen the flat surface: one sided reinforcement and crossed reinforcement, showed as the following Fig:

![Diagram](attachment:fig2-16.png)

A. The requirement of material: the knighthead adopts DN15 galvanized tube or $\Phi 10$ aluminum foil (outside diameter), put 60mm length of batten or $\Phi 8$ plastic expansion screw. The bolt fastened by $\Phi 6 \times 60$ self tapping screw.
B. When A or B $\geq 2000$mm, adopt inner reinforcement, the quantity and distance of reinforcement based on the following table.
C. When A or B $\geq 2000$mm, need to increase outer reinforcement, adopt $30 \times 3$ angle iron to make the anchor ear, and then hoop the duct.
Table of the minimum quantity of transverse reinforcement and lengthways distance

<table>
<thead>
<tr>
<th>pressure Pa</th>
<th>Edge mm</th>
<th>300-350</th>
<th>310-750</th>
<th>510-1000</th>
<th>760-1250</th>
<th>1100-1500</th>
<th>1260-2000</th>
<th>1510-2500</th>
<th>2100-2500</th>
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<td>610-800</td>
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<tr>
<td>810-1000</td>
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<td>4</td>
<td>4</td>
<td>4</td>
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</tr>
</tbody>
</table>

The lengthways distance of reinforcement

| 800        | 800        | 400        |

III. The repair of AirTrojan duct
The main factors causing the damage and the protection method
It will be broken when the duct was hit accidentally
The movement and loading will cause the duct damage
The duct of outdoor should be protected in order to avoid the damage which caused by collision.
The duct which install on the ground or near the sidewalk should be protected to avoid damage.
During the installation, because of the technical crossed construction, it may cause the damage, there should be warning sign to remind it.
The repair technique of different situation
There’s scratch and dent on the surface of the duct, level the surface or re-plate the surface by aluminum adhesive plate.
There is hole on the duct
The hole is large, cut the diamond on panel at 45°, and then plug it with the equal diamond, put the aluminum adhesive plate on the joint.
The hole is small; it can be blocked by glass cement, and plate the aluminum adhesive plate.
(3) The fracture of flange, cut the duct away 300mm of flange, supplement a new short duct.

Chapter Three: the installation of the air ducts
1. The Inspection of the air ducts before installation
1) Mark all the finished air ducts according to the sequence of the central air conditioning system.
2) Make sure all the air ducts are of the right sizes and all the flanges are installed accurately.
3) Aberration is allowed in the fabrication of the air ducts and the flanges, but the aberration must meet the
specification showed in the below chart.

<table>
<thead>
<tr>
<th>The side length (b)</th>
<th>The Aberration of the side length</th>
<th>The Smoothness of Surface</th>
<th>The Aberration of diagonal of the air ducts</th>
<th>The smoothness of Flange or the ducts orifice</th>
</tr>
</thead>
<tbody>
<tr>
<td>b≤320</td>
<td>≤2</td>
<td>≤3</td>
<td>≤3</td>
<td>≤2</td>
</tr>
<tr>
<td>320≤b≤2000</td>
<td>≤3</td>
<td>≤5</td>
<td>≤4</td>
<td>≤4</td>
</tr>
</tbody>
</table>

4. The dust and other waste in and on the surface of the air ducts must be cleaned before installation.

2. The installation of the brackets and the hangers

1) The choice of the brackets and the hangers
   a) Choose round steel or screw bolt (φ≥6) when the size of hemline ≤1500mm
   b) Choose round steel or screw bolt (φ≥8) when the size of hemline > 1500mm

2) The choice of the transversal bar
   a) Choose angle iron (specification ≥ 25×3) when the size of the hemline ≤1000mm
   b) Choose angle iron (specification ≥ 30×3) when the size of the hemline is between 1000mm and 2000mm.
   c) Choose angle iron (specification ≥ 40×4) when the size of the hemline > 2000mm

2) The distance between the brackets and the hangers must meet the below specification
   a) When the air ducts are installed horizontally and the size of the hemline ≤1000mm, the distance between the brackets and the hangers should be less than 3m.
   b) When the air ducts are installed horizontally and the size of the hemline > 1000mm, the distance between the brackets and the hangers should be less than 2m.
   c) When the air ducts are installed vertically, the distance between the brackets and the hangers should be less than 3m and there should be at least two brackets or hangers on every piece of air duct.
   d) When the air ducts are installed horizontally and the length of main ducts are more than 20m, at least a jigging-proof bracket should be installed.

3. The preventive measure when installing the air ducts

1) If the air ducts passing through floors or side walls, the air ducts should be reinforced with a metal cover (Zinc-coated steel) whose thickness is no less than 0.75mm or use metal conduits instead.

2) The air valves or other components which are connecting to the air ducts should be suspended by independent hangers or brackets.

3) Be careful when moving and installing the air ducts.

4. The Installation of the Air Ducts

1) Connected by PVC Flanges
2) Connected by ч-shape Aluminum Alloy Fangles
   a) Apply Silicone Adhesive to each corner after the connection
   b) Seal the joint Aluminum Foil Tape
3) Connected by F-shape Aluminum Alloy Flanges
   a) Use bolts (size no less than M6×25) to fasten the F-shape Aluminum Alloy Flanges on the air ducts
   b) The distance between bolts should be less than 120mm
   c) Use washers or pads when connect a flange to another
4) The connection mode of branch ducts
   a) Adopt 'a' mode when the side length of air ducts is less than 500mm
   b) Adopt 'b' mode when the side length of air ducts is no less than 500mm

5) The connection mode of components: use F-shape Flange

6) Round Flanges are used for connection with round diffusers or round soft tubes. The round flanges are made of zinc-coated steel (thickness: 0.3-0.75mm) at site.

7) The installation of air vents
8) Seal the end air duct according to figure 3-8
Established in 2006, AirTrojan International Co., Ltd. dedicated in providing the best products and services to our valued customers not only locally but also worldwide. We focus on environment-friendly and energy-saving products as well as genial and prompt service.

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