Review on Manufacturing Process Study of Ducting used in Industrial and Commercial Application

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***Abstract*: It's review of process study on ducting used mostly in industrial and commercial application with their manufacturing process and timing study was done ZECO Aircon Ltd. Thane past one year where creating ideal product that perform even in the harshest of condition while still bracing the practice of energy efficiency.**

***Keywords*: GID, PID, HVAC**

1. INTRODUCTION

ZECO manufactures two types of ducting GID and PID for commercial and industrial application .Ducts are conduits or passages used in heating, ventilation, and air conditioning (HVAC) to deliver and remove air. The needed airflows include, for example, supply air, return air, and exhaust air. Ducts commonly also deliver ventilation air as part of the supply air. A duct system is also called ductwork [1]

2. TYPE OF DUCTING

2.1 *GID DUCT*

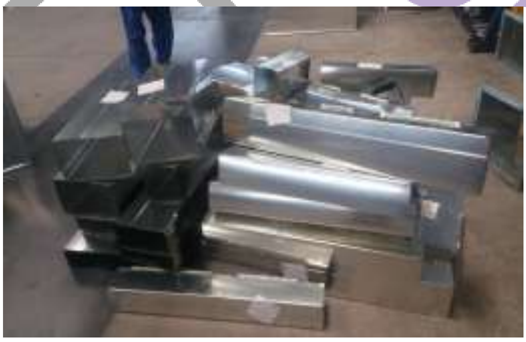

Figure1. GID

Galvanized mild steel is the standard and most common material used in fabricating ductwork because the zinc coating of this metal prevents rusting and avoids cost of painting. For insulation purposes, metal ducts are typically lined with faced fiberglass blankets (duct liner) or wrapped externally with fiberglass blankets (duct wrap). When necessary, a double walled duct is used. This will usually have an inner perforated liner, then a 1–2" layer of fiberglass insulation contained inside an outer solid pipe.[1]

2.2 PID Duct

Figure2. PID

Traditionally, air ductwork is made of sheet metal which was installed first and then lagged with insulation. Today, a sheet metal fabrication shop would commonly fabricate the galvanized steel duct and insulate with duct wrap prior to installation. However, ductwork manufactured from rigid insulation panels does not need any further insulation and can be installed in a single step. Both polyurethane and phenolicfoam panels are manufactured with factory applied aluminum facings on both sides. The thickness of the aluminum foil can vary from 25 micrometers for indoor use to 200 micrometers for external use or for higher mechanical characteristics.[2]

3. MANUFACTURING PROCESS

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Rectangular ductwork commonly is fabricated to suit by specialized metal shops. For ease of handling, it most often comes in 4' sections.[1]

3.1 Aluminum (Al)

Aluminum ductwork is lightweight and quick to install. Also, custom or special shapes of ducts can be easily fabricated in the shop or on site.

The ductwork construction starts with the tracing of the duct outline onto the aluminum pre insulated panel. The parts are then typically cut at 45°, bent if required to obtain the different fittings (i.e. elbows, tapers) and finally assembled with glue. Aluminum tape is applied to all seams where the external surface of the aluminum foil has been cut. A variety of flanges are available to suit various installation requirements. All internal joints are sealed with sealant.[1]

Polyurethane and phenolic insulation panels (pre-insulated air duct).

3.2 Bending process

Figure3.bending machine

Bending is a manufacturing process that produces a V-shape, U-shape, or channel shape along a straight axis in ductile materials, most commonly sheet metal .Commonly used equipment include box and pan brakes, brake presses, and other specialized machine presses. Typical products that are made like this are boxes such as electrical enclosures and rectangular ductwork.[5]

must be over-bent to achieve the proper bend angle. The amount of spring back is dependent on the material, and the type of forming. When sheet metal is bent, it stretches in length. The *bend deduction* is the amount the sheet metal will stretch when bent as measured from the outside edges of the bend.[3]

1. 3.2.1 *Air bending*

This bending method forms material by pressing a punch (also called the upper or top die) into the material, forcing it into a bottom V-die, which is mounted on the press. The punch forms the bend so that the distance between the punch and the side wall of the V is greater than the material thickness (T).

Either a V-shaped or square opening may be used in the bottom die (dies are frequently referred to as tools or tooling). Because it requires less bend force, air bending tends to use smaller tools than other methods.[3]

3.2.2 *Bottoming*

In bottoming, the sheet is forced against the V opening in the bottom tool. U-shaped openings cannot be used. Space is left between the sheet and the bottom of the V opening. The optimum width of the V opening is 6 T (T stands for material thickness) for sheets about 3 mm thick, up to about 12 T for 12 mm thick sheets. The bending radius must be at least 0.8 T to 2 T for sheet steel. Larger bend radius require about the same force as larger radii in air bending, however, smaller radii require greater force—up to five times as much—than air bending. Advantages of bottoming include greater accuracy and less spring back. A disadvantage is that a different tool set is needed for each bend angle, sheet thickness, and material. In general, air bending is the preferred technique.[2]

3.2.3 *Coining*

In coining, the top tool forces the material into the bottom die with 5 to 30 times the force of air bending, causing permanent deformation through the sheet. There is little, if any, spring back. Coining can produce an inside radius as low as 0.4 T, with a 5 T width of the V opening. While coining can attain high precision, higher costs mean that it is not often used.[3]

3.2.4 Three-point bending

Three-point bending is a newer process that uses a die with an adjustable-height bottom tool, moved by a servo motor. The height can be set within 0.01 mm. Adjustments between the ram and the upper tool are made using a hydraulic cushion, which accommodates deviations in sheet thickness. Three-point bending can achieve bend angles with 0.25 deg. precision. While three-point bending permits high flexibility and precision, it also entails high costs and there are fewer tools readily available. It is being used mostly in high-value niche markets.[2]

3.2.5 Folding

In folding, clamping beams hold the longer side of the sheet. The beam rises and folds the sheet around a bend profile. The bend beam can move the sheet up or down, permitting the fabricating of parts with positive and negative bend angles. The resulting bend angle is influenced by the folding angle of the beam, tool geometry, and material properties. Large sheets can be handled in this process, making the operation easily automated. There is little risk of surface damage to the sheet.[5]

3.2.6.Wiping

In wiping, the longest end of the sheet is clamped, then the tool moves up and down, bending the sheet around the bend profile. Though faster than folding, wiping has a higher risk of producing scratches or otherwise damaging the sheet, because the tool is moving over the sheet surface. The risk increases if sharp angles are being produced.[1]

This method will typically bottom or coin the material to set the edge to help overcome spring back. In this bending method, the radius of the bottom die determines the final bending radius.[2]

3.2.7 *Rotary bending*

Rotary bending is similar to wiping but the top die is made of a freely rotating cylinder with the final formed shape cut into it and a matching bottom die. On contact with the sheet, the roll contacts on two points and it rotates as the forming process bends the sheet. This bending method is typically considered a "non-marking" forming process suitable to pre-painted or easily marred surfaces. This bending process can produce angles greater than 90° in a single hit on standard press brakes process.[3]

3.2.8 Roll bending

Figure4. Roll bending

The roll bending process induces a curve into bar or plate work pieces. There should be proper pre-punching allowance.[3]

4 . RAW MATERIAL

At ZECO sourcing of raw material plays a very important role. we import Aluminum sheet from across the globe to meet the international standards, plain and internally grooved .the Aluminum foil used is available in original Aluminum/blue color with or without hydrophilic coating. We import chemical that use for pre- insulating duct.[1]

5. DESIGN

GID ducts made out of sheets will be out of alignment as the reference point is the corner of the sheet which itself is not at right angle. The straight ducts are made on Auto fold mc, which aligns, makes stiffening braces, notches, and bends, and cuts the duct to the size all in a sequence as data is fed into the machine directly from the drawing. SMART Panels are manufactured of CFC & HCFC free closed cell Poly iso foam “sandwiched” between Aluminum foil or Kraft Paper with standard size of 4 m x 1.2 m and thickness varying from 10 mm to 75 mm.[4]

6. TESTING

Quality control engineering are very picky when it comes to clearing a duct for dispatch .As the machines are all CNC automated we provide a detailed computer generated packing list and area summary with each duct numbered.[4]

7. MARK OF QUALITY

- With G.I. Coils we have consistency in the quality of the material, while in sheets we do not know if the entire lot is of the same quality as there is a lot of seconds material available in market which cannot be differentiated by naked eye.
- The elbows, offsets, profiles, tapers etc are made on a machine called plasma profile cutter.
- The male parts of the profile are made on a machine called flinger and not by hand thus loosing consistency.
- The LAPAT (curved side) of the elbow is made on the rolling machine and not by hand again. The Pittsburgh lock is made on the Roll-formar[1].

8. VICON FABRICATION SOFTWARE

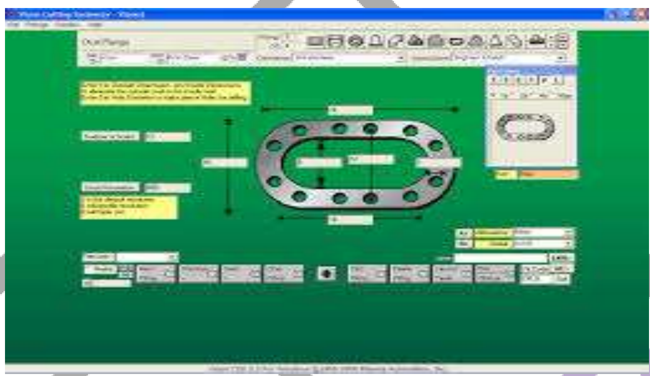

Figure5. vicon fitting screen

Software exclusively developed for us by **veteran Uncials U.S.**.Galvanized steel end plates have extruded tube holes for maximum tube protection & support. Stacking flanges provides additional rigidity & facilitate installation in coil banks. Casing and end sheets are also available in stainless steel coils larger than 1000mm are provided with center support and aluminum.[1]

This vicon software is use for plasma cutting machine. Software fits into any shop large or small. This user-friendly, user-oriented program is extremely customizable. Time is saved from the first day you start using it because the program is preloaded with all the standards and settings that are needed to produce parts.

Software support is just a phone call away for as long as you own the machine.

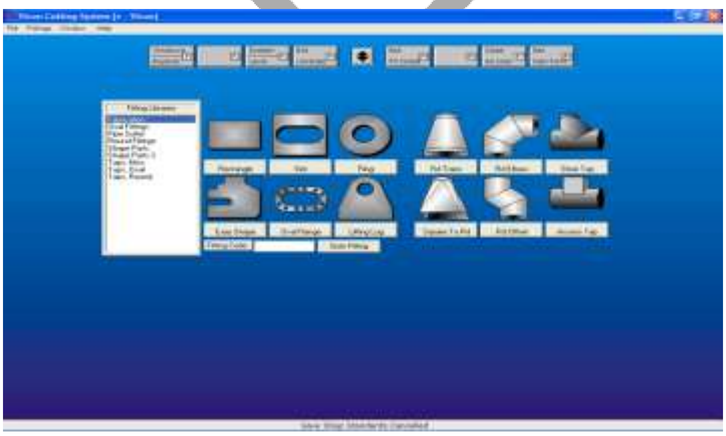

Figure6. vicon maim screen

special needs. e.g. automobile sector are also available from the house if Zeco Evaporators to suit multiple needs are available for various applications.

Steam Coils At Zeco we manufacture steam coils for varied applications. Coils can be produced which can with stand extreme high pressure. here can built coils in different combinations namely copper to copper, copper to aluminum. . steam coils can be made from one to four rows with custom circuitry. vicon Fitting screen[1]

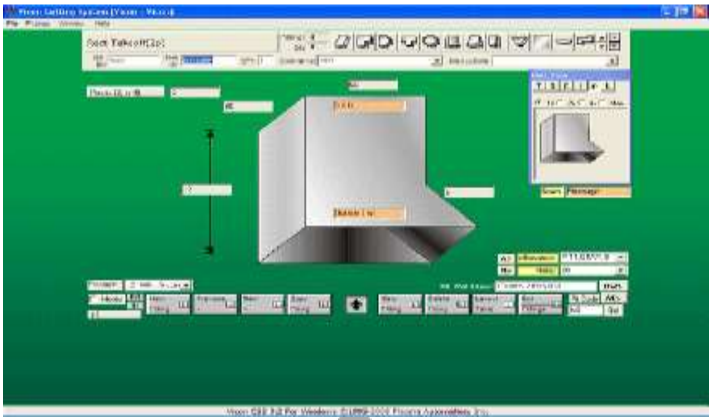

Figure7. vicon fitting scree

CONCLUSION

As outhouse project in ZECO Aircon Ltd. I am focus mainly on manufacturing process study of varies ducting which include GID & PID section .Plasma cutting machine using vicon software for GID and POLYOL & ISO use for making sandwich panel in PID section. Their respective applications not only in industrial but Commercial / Industrial Air-conditioning, Window / Split Air conditioners, Refrigeration Systems, Bus / Car / Railway /Ship Air-conditioning, Specialized steam / Hot water coils.

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