Design Criteria for Ducted Dust Extraction Systems

Ducted dust extraction systems invariably fail to function correctly, or fail to meet client’s expectations because the supplier is all too often ignorant of the finer technical points and characteristics of airflow.

As such it is very important that all companies involved in the design, manufacture and installation of these systems fully understand the problems involved with the movement of dust particles within a high velocity air stream, and not simply how to manufacture ductwork.

Too often initial savings are made on systems which appear to be good value but which prove to be inefficient, and result in loss of time and money through blockages and poor extraction. As a company specialising in dust extraction, Mardon Engineering is frequently called in to examine such inadequate systems, but unfortunately can do little to correct major faults such as the proportioning of the ductwork, type of junctions, design of hoods and so on. Thus these seemingly low-cost systems require additional expenditure.

As such Mardon Engineering ensures that such problems are avoided by providing the correct system from the outset.

The following checklist is used to ascertain that you are being offered the appropriate specification of equipment:

1) Type of duct used

   Dust extraction ducting should be circular and of straight ‘seam locked’ construction, manufactured from galvanised mild steel of no less than 0.8mm thick. Spiral wound ducting can be used in some circumstances but tends to create contra-flow obstructions at each joint.

2) Method of making joints

   The ideal method of making joints is to flare each end of the ductwork out, creating a small projection from the parent metal. The rims are then joined together and locked into position using a ‘V’ section tension clip with nuts and bolts spaced 180° apart, giving equal tension all around the circumference of the joint. This produces a ‘step free’ internal joint, irrespective of the direction of airflow. The mechanical strength of these joints is as strong as a conventional light gauge duct. As very accurate tolerances must be observed when using this system, Mardon uses the mass produced J.K.F system of ductwork for most applications.

   An alternative method of connecting ductwork is the use of close fitting internal slip joints. These are used for joining spiral ductwork or for making a longitudinal adjustment piece within a straight lock seam system. This type of joint is best locked using the ‘slit and jubilee clip’ system, where short sealing pop rivets can also be used. One edge of this type of joint will always face the airflow, therefore close-fitting tolerances must be observed. Some manufacturers chose to use tapered ducts so that each piece fits into the next. This system is fine until a company wishes to relocate or to rearrange the machinery; it also requires full riveting, and inspection doors at bends in case of obstructions.

   With J.K.F. systems a bend can easily be removed for inspection and has another advantage in the fact that the tension clips are so strong at adjacent joints that the bend is easily reassembled. It is for these reasons that Mardon uses J.K.F. systems as standard.
3) Method of construction of bends

Pressed, smooth bore bends with a centre line radius of no less than 1.5 x diameter, made from galvanised steel are the best. If segmented bends (sometimes called lobster back bends) are used, then the quality of manufacture needs to be known as internal frictional losses of this type of bend rise dramatically if weld splatter, misalignment of sections or rivets etc are present. Such obstructions can also cause blockages.

4) Design and construction of junctions

This is the area that most dust extraction systems fail in, due to lack of knowledge of airflow and how it affects designs.

Consider a single feeder lane on the motorway full of cars travelling at 70mph, entering a two-lane motorway of cars also travelling at 70mph. Providing the angle of the slip road is shallow and at the point of intersection the motorway expands into three lanes, then all vehicles should be able to maintain their velocity and there will be no congestion.

The same rules apply to branches of ductwork entering the main trunk. Any branch entering a main trunk should do so at an angle of 30° or less, and should be on the conical face of the expanding main trunk. At the point of entry the main area should increase by the same area as the incoming branch, thus maintaining a constant carrying velocity with minimum turbulence. In some cases branches do enter a main without expanding the area, but this can only be done successfully using isolation dampers further down and the angle of entry must still be no more than 30°.

5) Velocity required to convey dust/chips from source to collection point

Design velocities range from 2000 to 5000 feet per minute depending upon the density, shape, size and quantity of the particles to be extracted. A good average conveying velocity for the majority of dusts, chips, shavings, etc is 3500 fpm.

6) Flexible ducting

The use of flexible ducting should be kept to a minimum, as its internal corrugated surface creates high frictional losses to airflow, and therefore wears rapidly if the dust is abrasive. This would be comparable to driving over a cobbled motorway with sharp bends, for example.

Its main purpose is for connecting the extraction hood of a machine to the main duct system. In this situation it fulfills several purposes. Some machine hoods need regular adjustment for their process, vibrations from the machine are not transmitted to the main duct, complex bends can be achieved inexpensively and simply, and finally, installation costs can be reduced as exact locations are not so critical when using drop pipe.

Flexible ducting should never be used in a straight run as it wastes fan power and it costs two to three times the equivalent metal duct. All flexible ducting should be of spiral wound, reinforced construction, and produced from either wire or special plastic. There are dozens of varieties on the market, and unless their properties are known then the wrong type can be fitted. Generally for light non-abrasive dusts such as wood waste etc, the medium duty P.V.C. types give a very good life span. For heavy and abrasive dusts, the rubber impregnated canvas types are more suitable but the cost is considerably higher.
7) **Design and construction of machine hoods**

If a system was perfect but the design of the hood was incorrect, the collection efficiency of that system would be drastically reduced. The analogy here would be to try to use a very good vacuum cleaner without the correct attachments.

The design of efficient hoods can only be achieved by engineers with a good working knowledge of airflow and dust movement from the cutting heads of machines. The object is to use the minimum volume of air at the maximum velocity possible.

Unfortunately some manufacturers of machines fit so called ‘extraction hoods’ to their equipment and all too often they are the wrong size and fitted in the wrong place because they do not have a full understanding of airflow and dust extraction.

8) **Methods of fixing and supporting ducting**

Ductwork supports and brackets are often too few and of poor quality, creating an untidy appearance. The ducting can sometimes become blocked and so the weight of a given section can be considerable. If not adequately supported this can be a danger to people working below.

Mardon Engineering co. has developed a range of standard brackets, clips, hangers and duct cleats which allow for multi-directional adjustment, producing a strong and attractive finish.

9) **Control dampers**

Any dampers fitted within a dust extraction system must be of the blast gate design, so that when open the blade is completely out of the air stream. Butterfly dampers must not be used as they cause blockage.

10) **Weather proofing of outside ducting**

If the ducting is on the negative pressure side of the fan, then even the most minute gap in a seam of joint will allow rain water to be sucked inside the duct. This will cause the dust to stick and will eventually lead to a blockage.

In order to prevent this from happening there are several methods that can be used to seal the ducting, including the use of heat shrink bands, aluminium tape, silglass tape, bitumastic paint, etc.

In conclusion, we cannot over emphasise that it is in the client’s own interest to ensure that the supplier of his choice is skilled at both design and installation of these systems.

Mardon Engineering Co. Ltd ensures that the systems put in place function efficiently and therefore avoid any disappointment to management, machine operators and factory inspectors. The company puts health and safety at the top of the list of priorities, and its vast experience and expertise in this field mean that cost effective solutions are always delivered.