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About Stationary Vacuum Systems

Substantial savings can be realized by installing a Dustontrol system. Following are some example installations:

- All grinders and finishing tools in an FRP production facility are equipped with suction casings and connected to a central extraction system. Capture of the dust at source contributes to an improved working environment, higher productivity - shorter clean-up, cleaner process and improved product quality.

- Cleaning of saws, mills, lathes and other process machines with a centralized system. More efficient production, cleaner machines, faster production, efficient lubrication use and a higher return on prompt scrap through more effective collection. Your people spend less time on tasks that do not add to the bottom line.

- Extraction of chips and lube directly at the source: Cleaner parts throughout the production process, and a cleaner environment on the shop floor. Cleaner machines mean better functioning lube systems, better function means cooler running tools. Cooler tools mean better parts and longer tool life.

- Fume extraction with extraction integrated welding guns. Reduced exposure to fume, healthier welders, higher productivity.

- Vacuum cleaning systems and air cleaning equipment in bakeries reduces airborne flour dust that is dangerous to health and can cause asthma. The health and safety regulations are met and at the same time the workplace environment and overall efficiency is improved. Fewer health problems from employees will affect insurance rates positively.

- Extraction/vacuum systems in pharmaceutical production for source extraction in the process and for cleaning of production machinery and areas. To eliminate hazardous dusts generated during pharmaceutical production is a must from a health perspective as well as a product quality issue.
1. Complete Extraction System.
2. Vacuum Producer.
3. Filter Unit.
4. Pre-Separators.
5. Installed Tubing System.
6. Work Place Equipment.
7. Cleaning Accessories and Suction Casings.
8. Main System Control.
The Complete System

1 Introduction
To attain the desired efficiency and benefits with an extraction system, the system must be complete; from the suction casing to the vacuum producer to the control system. All the components of the system are equally important in implementing its functionality.

2 Vacuum Producers
The vacuum producer is the heart of the system. Here the vacuum is created that drives the system. In Dustcontrol extraction systems, the vacuum level is generally from 6–40 kPa. Our normal source extraction and vacuum cleaning systems use turbopumps. This device has an ideally suited characteristic capacity for this type of system. Vacuum level increases as more resistance is presented, an important quality in minimizing the possibility of blockages in the tubing system. For applications involving fume and light dust, such as paper, radial blowers are used. These have larger air-flows and operate at a lower, relatively constant vacuum level. Our turbopumps and radial blowers have very high quality built-in silencing, see technical specifications.

3 Filter Units
An extraction system should always be equipped with a filter unit. Dustcontrol filter units separate coarse material in the cyclone body of the unit and fine dust in an internal arrangement of conical pleated cartridge filters. Pleated filters have very high filter areas in relation to their physical size. The filter units therefore have high capacity while maintaining compact overall dimensions. Filters are cleaned with reverse pulse which results in very effective cleaning, long filter life and low maintenance. Normally the filter units are equipped with a plastic sack for collection of the extracted material but other types of discharge arrangements can also be installed.

4 Pre-Separators
Pre-separators can be used in all applications where the extracted material is coarse or voluminous. These can be placed in the actual workplace for separate handling or recovery of the extracted material, or centrally. Pre-separators separate material from the air flow using cyclonic action or with inertial separation. Inertial separators are generally configured as containers with the inlet and outlet in the same wall of the container. When the air flow changes direction abruptly, separation occurs for the particles with higher relative mass. When pre-separation is used to accommodate higher material volumes it is also important to consider the type of material discharge to be used. Dustcontrol offers a range of different standard options including; screw compaction, airlocks or container collection.

5 Tubing System
The tubing system transports the material from the point of collection to the central unit. Dust is generally abrasive, some more than others,

Therefore, the standard material thickness of the tubing system is 1.5 mm. Applications with fume and light dust use reinforced spiral duct. Stainless tubing systems and extra abrasion resistant fittings are available. Dustcontrol has a very comprehensive assortment of tubing fittings and installation hardware. This gives greater flexibility in design and installation of our tubing systems. Our mechanical jointing system makes alterations and additions very easy to carry out. Cones, branch pipes and bends are manufactured in EPDM- and NBR- rubber. The components are hard-wearing and sound deadening.

6 Work Place Equipment
An extraction system is sized for only those outlets which are to be used simultaneously. This is in order to maximize efficiency and minimize the size of the central unit. All outlets must have some type of closure, either a flap valve or shutter. These can be manually actuated, such as flap valves or manual shutter valves, or automatically controlled for actuation only when extraction is required. The Flexpipe can be used for fume extraction, high flexibility and small diameter allow it to be placed very close to the fume source. Overhead suspension arrangements such as swing-arms and hose reels can increase the usefulness of the system, increase ergonomics and minimize potential trip hazards from hose left on the floor. When large volumes of material are to be introduced into the system, stainless floor funnels can be used from which the material is then extracted.

7 Accessories
A hose must have many qualities, the foremost for the operator however is flexibility. It should also be tough enough to withstand the abrasion created when transporting the extracted material. Hose selection should include consideration of abrasion, chemical and heat resistance as well as conductivity to static electricity. Dustcontrol has a comprehensive assortment of hose types, diameters and hose connections. Cleaning tools, suction casings and special nozzles are those components that are actually used to capture the dust. The design and effectiveness of these will determine the efficiency and acceptance of the entire system. This demands a varied and complete assortment of specially designed products. Dustcontrol has that. If a standard product does not exist, we have the capacity to design and manufacture it.

8 Control Systems
Motor starters and System Control Panels control the operation of the system, both operation of the vacuum producers and cleaning of the filter. A variety of other control functions can be installed as required. Even with a rather basic control system, intelligent features can be included to clear coarse material in the main tubing runs or control vacuum production and therefore energy consumption according to actual requirements.
Planning and Design of Extraction Systems

The following points must be considered and a clear definition must be developed before design of the system can be undertaken.

- Determine the function of the system – source extraction, cleaning or pneumatic transportation. In many cases it can be wise to equip the system for different functions apart from the main function of the system, for example; cleaning.
- Choose the outlet configuration. Determine for each outlet the type of extraction equipment required as well as the type of closure (automatic or manual). To determine this, a detailed study of the types of activities in each work place must be undertaken. Determine the number of outlets in simultaneous use. The system will be designed for a maximum number of users at any point in time. In larger systems, the number of simultaneous users in different parts of the system should be determined.
- Decide the routing of the tubing runs and location of the central unit. Consider the degree of difficulty for installation; ceiling height, wall and roof perforations, moving equipment into place, etc.
- Consider the type of material to be extracted, the degree of abrasion, risk for explosion and risk for clogging, etc.
- Determine the volume of material to be collected per unit time. Select the type of pre-separator and type of material handling for collected material. Material discharge etc, must be determined according to the customer requirement.
- Select the type of control system to be used, for example; programmable start – stop or work place start - stop.
- Determine electrical and compressed air supply requirements for the system. Indicate location of the requirement and assign responsibility for the supply and installation.

Tube Sizing

The tube dimensions are selected on the basis of maintaining the correct transportation velocity in all parts of the tubing system. It is necessary not only to consider the velocity in the main runs but also in all the branches of the tubing system. The tube diameter should be selected so that a velocity of > 20 m/s is maintained for particle transportation – for fume, a lower velocity of > 12 m/s is used.

As an exception in normal systems, we recommend that the smallest tube diameter be 76 mm, even if the minimum transportation velocity recommended is not maintained.

System Design

Always try to maintain a star configuration for the tubing system where the main runs are of more or less equal length leading to the central unit in the middle.

A balancing of the system must be done to ensure that air-flows are sufficient for proper extraction at all points in the system and that transportation velocities are maintained.

In a system for fume extraction, a large main duct can distribute the system’s capacity. Any combination of outlets can be used. Conversely, in a system for the pneumatic transportation of heavy material, the transportation velocity must be maintained. In these systems, one open outlet per tubing run is the norm (usually 76 mm).
The system’s capacity is determined by the worst case – usually the maximum number of users with the highest air-flow collectively. If you are unable to determine which scenario gives the highest pressure loss, several calculations may need to be performed.

### System Part

<table>
<thead>
<tr>
<th>System Part</th>
<th>Q (m³/h)</th>
<th>Calculation</th>
<th>Δp (kPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Suction Casing, hand-held Tool</td>
<td>200</td>
<td>Δp = 3.5 kPa</td>
<td>3.5 kPa</td>
</tr>
<tr>
<td>B Hose Ø 38x3m</td>
<td>200</td>
<td>Δp = 1.2 kPa/m x 3 m + 3.6 kPa</td>
<td>3.6 kPa</td>
</tr>
<tr>
<td>C Swingarm 4.5 m</td>
<td>200</td>
<td>Δp = 0.7 kPa</td>
<td>0.7 kPa</td>
</tr>
<tr>
<td>D1 Tubing Ø 76 x 10 m + bends (bend is counted as 2 m)</td>
<td>200</td>
<td>Δp = 0.02 kPa/m x 10 m + 0.28 kPa</td>
<td>0.28 kPa</td>
</tr>
<tr>
<td>D2 Tubing Ø 108x15 m</td>
<td>750</td>
<td>Δp = 0.06 kPa/m x 15 m</td>
<td>0.9 kPa</td>
</tr>
<tr>
<td>D3 Tubing Ø 76x25 m + 4 bends</td>
<td>1350</td>
<td>Δp = 0.02 kPa/m x (25 + 6) m</td>
<td>0.7 kPa</td>
</tr>
<tr>
<td>E Pre Separator, F 20000</td>
<td>1350 m³/h</td>
<td>inlet Ø 160. Δp = 1.1 kPa</td>
<td>1.1 kPa</td>
</tr>
<tr>
<td>F Filter Unit, S 32000</td>
<td>1350 m³/h</td>
<td>inlet Ø 160. Δp = 1.8 kPa</td>
<td>1.8 kPa</td>
</tr>
<tr>
<td>Total pressure loss</td>
<td>12.6 kPa</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Design capacity: 1350 m³/h @ 13.9 kPa**

**Vacuum Producer Selection:** TPR 50, 30 kW
Pneumatic Material Transportation

To transport larger volumes of coarse dust or other material requires a series of special considerations to minimise the possibility of clogs in the tubing system or problems discharging collected material. Analyse both the type and volume of material according to the following considerations:

1. Material Volume
   - Average volume litre/hour ...................................................
   - Max. volume litre/hour ......................................................

2. Material Characteristics
   - Description of material ............................................................
   - Material created by .................................................................
   - Particle size distribution ..........................................................
   - Bulk density ..........................................................................
   - Max. moisture content ............................................................
   - Hygroscopic material? .............................................................

3. Abrasion and Clogging
   - Chemically aggressive material? ............................................
   - Explosive material ................................................................

4. Operating Conditions
   - System in operation ............................................................... hours/day
   - Filter cleaning
     a) after shut down .................................................................
     b) during operation ...............................................................  
   - Material to be introduced into system with ..............................
   - Transport distance ............................................................... m
   - Number of bends ................................................................. pcs

Configuration of Extraction Systems for Material Transportation

- The system should be designed for transportation velocities from 20 – 25 m/s. Higher velocities result in increased wear. Ensure minimum transportation velocity is maintained in the tubing system (only one outlet in use per run).
- Select tools and accessories which allow sufficient transport air into the system.
- Minimize the number of 90° bends. Never install two 90° bends closer together that 25 times the tube diameter.
- Select horizontal or vertical tubing runs. Avoid sloping runs where material “corning” may occur. In sloping runs material will have a tendency to precipitate and run down against the direction of flow in the bottom of the tube.
- Select, hose, tubing and separator with consideration to abrasion.
- Select material discharge with consideration to the consistency and volume of material to be discharged.
- Plan emptying intervals and routines (plastic bag or container).

Pressure Loss Calculation in a Material Transport System

Pressure loss calculations for this type of system are influenced by a number of different factors and exact calculations can be very complex. In general, the following calculation can be used. With material loadings greater than 1:1 (= 1,2 kg material per m³ air), a practical test should always be done.

Calculate the pressure loss for clean air from the extraction point to the pre-separator according to the calculation on the previous page. Calculate the added pressure loss that the transported material will result in according to the following:

\[ \Delta p_{\text{system}} = \Delta p_{\text{system}} \times m_1/(Q \times 1.2) \text{ (kPa)} \]

where \( Q \) is air-flow in m³/hm, \( m_1 \) is material flow in kg/h

Calculate then the pressure loss for the remaining system (pre-separator to vacuum producer). Add this value together with the pressure loss value from the previous calculation. Add the safety factor to the sum of these.

Example:

- Suction Lance 2 kPa
- Hose 8 kPa
- Tubing 3 kPa
- Sum 13 kPa
- Air-flow 350 m³/h
- Material flow 100 kg/h
- Added pressure loss from material \( \Delta p = 13 \times 100/(350 \times 1.2) = 3 \text{ kPa} \)
- Pre-separator 2 kPa
- Filter unit 2 kPa
- Sum 4 kPa
- Sum tot 13 + 3 + 4 + 20 = 28 kPa
- Safety factor 10% =>
- Required negative pressure = 22 kPa