dustair
DUST CONTROL AND AIR FILTRATION ENGINEERS

www.dustair.co.uk

# OPERATING & MAINTENANCE INSTRUCTIONS FOR CYCLONIC DUST SEPARATOR

*Issue 1, March 2011*

## CONTENTS

## BEFORE USING THE EQUIPMENT

**General**

The manufacturer does not accept any liability for damage to the product or personal injury caused by non-observance of the safety instructions in this manual, or by negligence during installation (where installation is not performed by Dustair ltd.), use, maintenance and repair of this product.

Specific working conditions and / or connected equipment may require additional safety instructions. Please contact your supplier or Dustair Ltd if you detect a potential danger when using this product.

**The user of this product is always fully responsible for observing the local safety instructions and regulations.**

**Observe all safety instructions and regulations which apply to machinery or similar connected items.**

**User Manual**

- All persons using this product must be familiar with the contents of this manual and observe the instructions herein.
- The management should instruct the personnel in accordance with the manual and observe all instructions and directions given.
- Never change the order of the steps to perform.
- Always keep a copy of this manual with the product.
- This product should be used only by authorized, trained personnel.
- This manual is intended to cover a range of units. Therefore some aspects may not apply to your particular unit.

## CYCLONIC SEPARATORS (CYCLONES) - GENERAL DESCRIPTION

Much has been written on the subject of passing dust through a unit having cyclone proportions. In analysing the numerous references which are available, the reader finds great difficulty in isolating basic facts on which he can begin to build his understanding.

The first rule which is generally accepted is the simple empirically proved fact that the end product, which can be termed as 'collecting efficiency', is related to energy expended. In more basic terms we set out the rough yardstick 'collecting efficiency' increases as the 'water gauge' goes up. There are exceptions to this rule as in the case of the multi-cellular cyclone, which uses a number of small cyclonets housed within a plenum chamber. The rule of thumb 'CE is proportional to WG" is modified with formula too complicated and bulky to discuss in this text; our comment is confined to broad generalizations in the hope that reader may pass on to informative references, which deal with the subject in detail.

With all cyclone work it must be appreciated that to separate the particles from the airstream tangential entry and airspeed are necessary to create a vortex which does the spiralling action of downward and upward air movement; this is in essence all that the fabricated steel shell and inner thimble induces.

The density of the particle will determine together with its shape and size what can be done with it once it enters the cyclone. It is impossible to supply momentum to an object if the object is not capable of receiving it. To explain this more fully let us consider two balls each measuring two inches diameter. The first ball can be a balloon; this is a plastic skin containing air which pressurizes to maintain spherical shape. The second can be more dense, say something like a cricket ball. Now we imagine the human arm throwing object 1 (the balloon), the thrower expends energy, say 200 ft and the ball travels no more than 5ft. In the case of object 2 (the cricket ball), the same amount of energy is expended and the ball travels 100 yards. This simply means certain physical characteristics are required before one can create momentum from air speed and the tangential entry on the cyclone in order that the dust may be centrifuged out.

After appreciating that density plays a part in the behaviour of the particle the next consideration is that of shape. The physical contours of the particle are of the utmost importance, they determine the sail cloth effect that resists natural settling in free air. Particles are never truly spherical; all shapes are involved, varying between two uniformed extremes, i.e., the ball bearing and the postage stamp, which has a very high sail effect with resultant slow settling rate.

The problems involved in calculating settling rates are relatively easy if the particle is of uniformed shape. In considering any dust sample it inevitably transpires that the shapes are anything but uniformed, this makes calculation labourious and in some cases well nigh impossible.

At this stage special equipment is employed to aid analysis. This equipment consists of a long thin transparent tube coupled at the base with an air connection and required auxillaries to meter

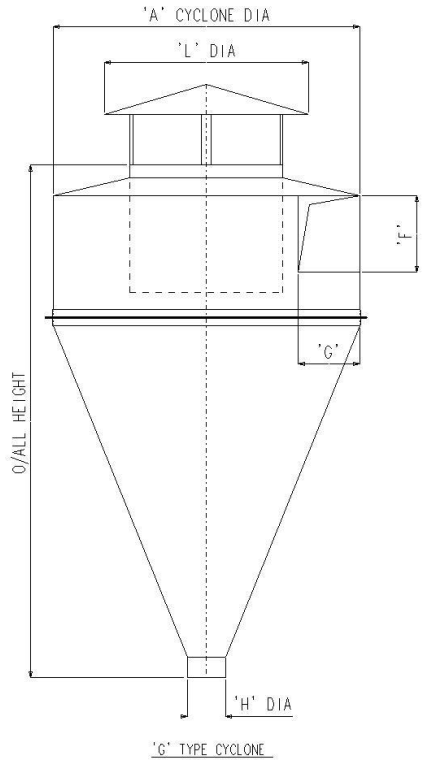
airflow. The dust sample is placed in the tube and air is introduced to create a fluidizing action; the performance of the particles are noted, some will fall against the airflow, others will be blown up the tube to be captured in a container interconnected with the equipment.

Numerous tests are carried out at varying up-draft velocities and the physical performance of the dust recorded. This method known as elutriation or terminal velocity analysis automatically takes into account particle shape, weight and size. With the application of Stokes law, which expresses terminal velocity for spherical particles of known specific gravity and size the dust to be handled can be specified. The unit of measurement is the micron ($1/1000^{th}$ millimetre) the analysis will record the percentage weights through a range of micron sizes.

On completion of the analysis consideration is then given in order to place the dust to be collected into a category where it can be handled by a particular type of cyclone.

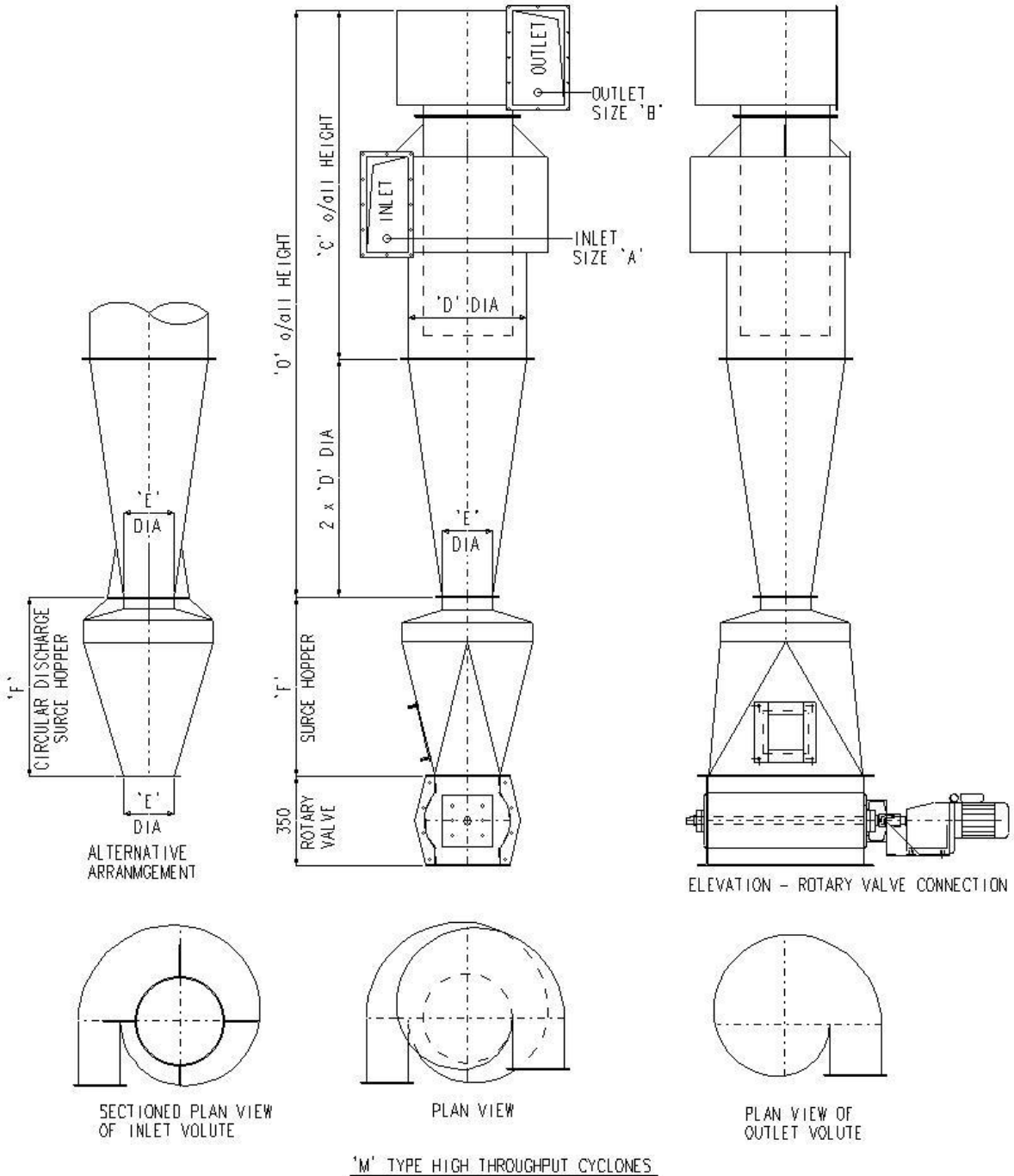
Having placed the dust into a category where a certain type of unit is best suited, the diameter of the cyclone (or cyclones) has to be investigated. In some instances several small units are desirable in preference to one big one. To appreciate this point more fully the happenings within the cyclone must be understood. The body of the unit in conjunction with the thimble induces a vortex. Air enters the inlet port and screws down the body of the cylinder in company with dust particles. The body diameter can be thought of as a deflector plate working in conjunction with the tangential inlet. See figure 1. If we consider Fig. 2 where we have the tangential inlet with two distinct body diameters superimposed it can be appreciated that for equal conditions of air speed, shape and S.G. the smaller body diameter will have contact with the particle in advance of its bigger counterpart.

The figures analysing types G, M, H and MC can now be understood.

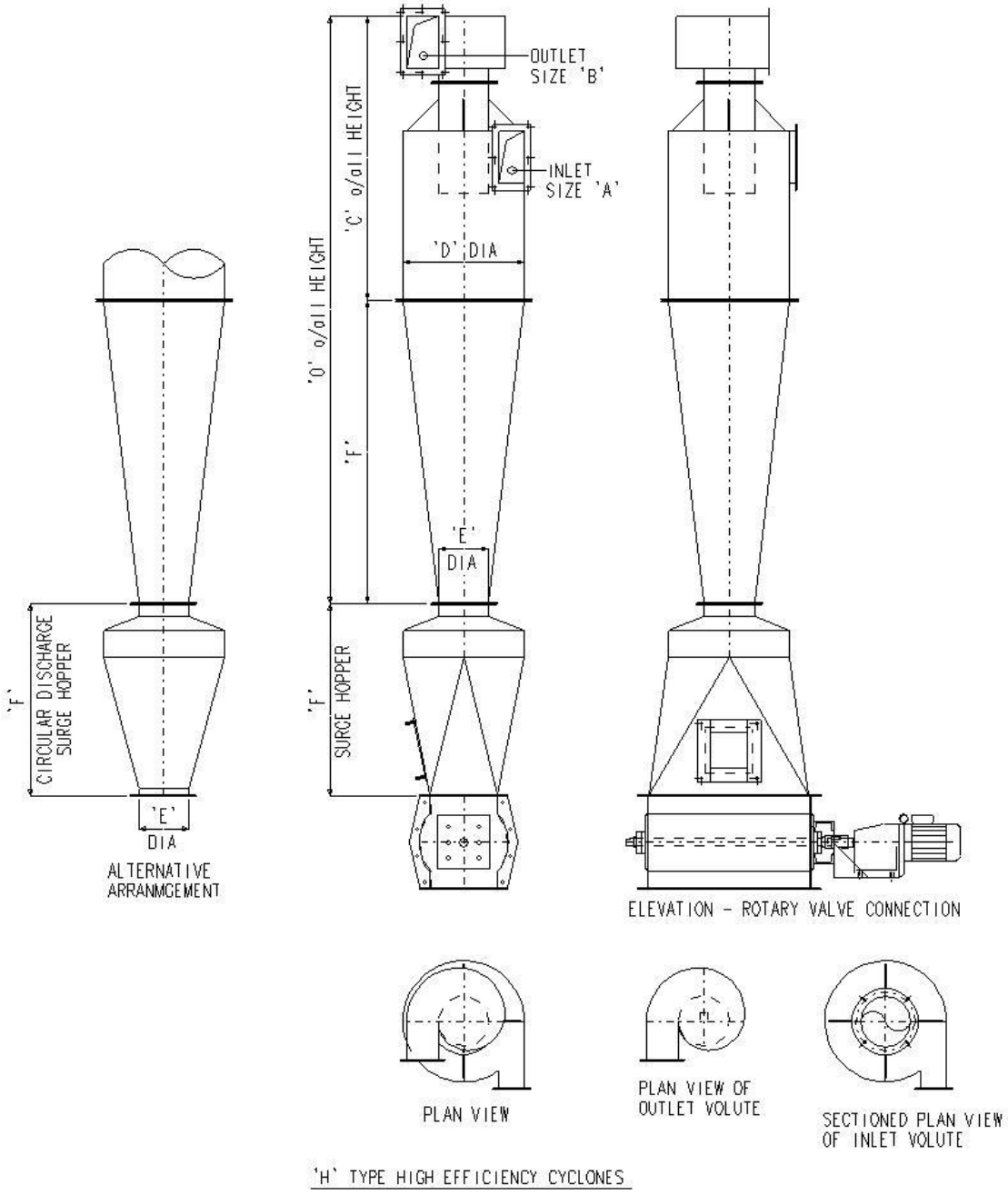



In the case of the 'G' inlet speed increases as the body diameter goes up in order to counteract the angular distance travelled before the particle comes into contact with the cyclone body. As pressure consumption measured in inches water gauge is a function of inlet speed it can be observed that the W.G. increase with body diameter.

When considering type M, H and MC we have the reverse condition in the case of W.G. consumed; this is held constant throughout the range, this also means that the inlet port speed is standard for all sizes. As no attempt is made to counteract the efficiency drop with increasing size the maximum economical size is about 48", although in some cases sizes up to 60" can be successfully applied in some cases.




'M' TYPE HIGH THROUGHPUT CYCLONES




'H' TYPE HIGH EFFICIENCY CYCLONES

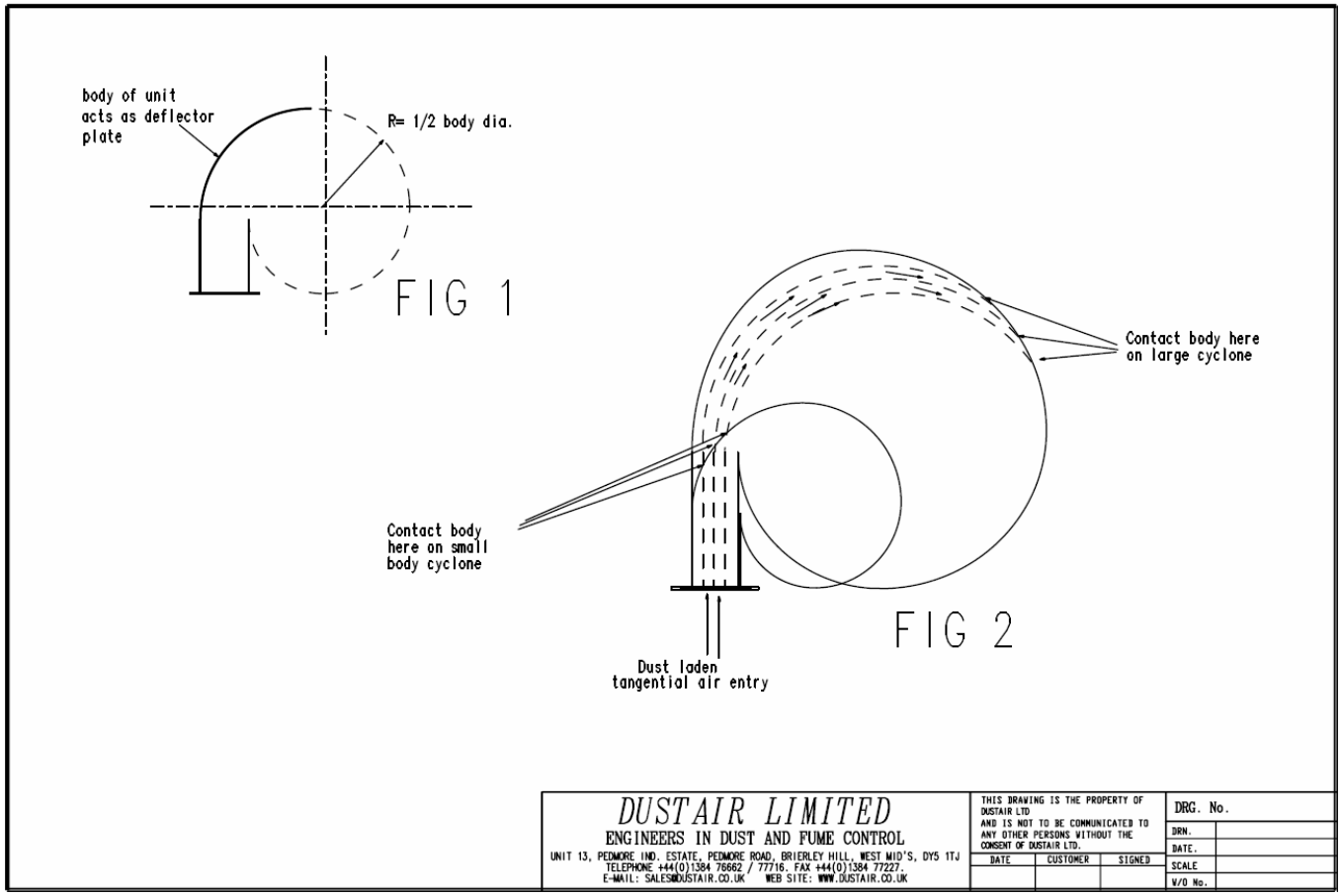
These units have been applied extensively by Dustair over the years, the largest at a rating of 30,000 cfm (14.16 $m^3/s$) on a 15ft (4.57m) body diameter. In the past the 'G' type has been used indiscriminately, but as time has progressed more informative information has come to hand, which has narrowed its suitability drastically. The cyclone was introduced approximately 70 years ago and the 'G' type that we know today varies very little from the original design. It has, however, done much to propagate the thinking and development of the other four main groups of cyclones that are in use today, which are namely:-

| | |
|---|---|
| G type | High throughput / Low Efficiency |
| M type | Medium-High throughput / Medium Efficiency |
| H type | Low (relative) throughput / High Efficiency |
| MC type | Multi-cellular design for optimised throughput and efficiency |

In passing it is worth noting that the 'G' type cyclone can be used as a coarse pre-cleaner in series with cyclones of higher efficiency to give classification or to take the buttress load prior to passing on to a bag filter. Its singular filter role is new in most cases confined to wood waste and the rare grain, dried sugar beet and polishing exhaust duties.

In some cases 'Z' type cyclones are now used on wood waste which is the last stronghold of the 'G' type as the singular filter. It would be fair to say that as the Clean Air Acts become more stringent its role as the 'only filter on line' will be very rare indeed.

It is impossible to isolate applications for which the types G , M, H and MC are suitable. Each case is treated as an individual consideration at the project stage, when points of durability, flexibility, efficiency and running costs, to mention, but a few points, are evaluated. In instances where sufficient quantities of dust are available tests are carried out by us to ensure the suitability of the equipment offered. Fig 1 and Fig 2 illustrate small body (M type / H type) verses large body (G type) designs:



## HANDLING & INSTALLATION

In normal circumstances the cyclone would be supplied and installed by Dustair Limited. Our engineers are experienced in the mechanical installation of such systems, as well as associated ductwork, fans and filtration equipment. However, on some occasions the end user may wish to perform the installation themselves or it may be arranged through an agent.

Care must be exercised when moving or lifting of the components that make up the cyclone, however small. Some components are large and heavy, which could cause injury if not handled correctly. Installation engineers must assess the mass of the components prior to attempting any manual lifting. Proprietary lifting equipment is readily available for hire which would assist in this task. Large cyclones tend to be installed using a crane or similar.

In general, the cyclone will stand vertically as a relatively tall structure. Support is usually by a bespoke steel framework to which the cyclone is bolted via external mounting plates around its main circular body. The support frame will either comprise of a number of vertical legs or horizontal beams, depending upon the application. Vertical legs need to be bolted down securely to a sound floor such as concrete, the thickness of which should be to suit the design loadings of the equipment placed upon it. Horizontal beams are used where the cyclone may be supported from adjacent building structures rather than from the floor. Consideration must be given to the stresses placed upon any structure by supporting the cyclone in this manner.

## GENERAL OPERATION

As the cyclone is a static piece of equipment, operating instructions tend to be included with the connected fan or filtration equipment. However, there are some general points to note, as follows:-

- Once commissioned, do not adjust balancing dampers in the connected ductwork system
- Avoid damage to the cyclone
- Clean / maintain the cyclone as specified

## EXPLOSION VENTING

Note should be taken of the installation and maintenance instructions concerning any proprietary ATEX explosion venting panel(s) fitted to the cyclone and/or the associated ductwork system. These proprietary items are usually manufactured by FIKE. Where applicable, the appropriate literature is included within this document and forms part of the overall operating and maintenance instructions. Special attention must be paid to the warning in relation to positioning of the explosion panel(s) where personal injury may occur in the event of the panel(s) bursting.

PRECAUTIONS IN USE

The extraction systems are used in the removal of dust and/or fume from a wide range of industrial processes. Some applications may require special precautions in operating and/or maintenance due to the nature of the materials being conveyed within the extraction system. Any safety procedures or advice given on material-specific COSHH data sheets should be adhered to by the end user. General first aid advice is given here as a supplement to specific requirements for substances in use on site. Consult the substance data sheets for more advice.

Splashes to the skin

1. Irrigate the affected area thoroughly with copious quantities of running water and continue for at least 10 minutes or until satisfied that no chemical remains in contact with skin. The removal of solvents, solutions and chemicals known to be insoluble in water will be facilitated by the use of soap.

2. Remove all contaminated cloth taking care not to contaminate yourself in the process.

3. Refer for medical advice to the nearest doctor or if warranted arrange transport to hospital. Provide information to accompany the casualty on the type of chemical responsible and brief details of the first aid treatment administered.

Splashes to the eyes

1. Irrigate the eye thoroughly with copious quantities of gently running water from either a tap or eye wash bottle and continue for at least 10 minutes. If only one eye is affected do not allow contaminated water to flow into the uncontaminated eye.

2. Ensure the water bathes the eyeball by gently opening the eyelid and keeping them apart until treatment is complete.

3. All eye injuries from chemicals require medical advice. Arrange transport to hospital. Provide information to accompany the casualty on the type of chemical responsible and brief details of the first aid treatment administered.

Ingestion of poisonous chemicals

1. If the chemical has been confined to the mouth then give large quantities of water as a mouth wash. Ensure that the mouth wash is not swallowed.

2. If the chemical has been swallowed then give copious amounts of water or milk to drink to dilute it in the stomach.

3. DO NOT INDUCE VOMITING!

4. Arrange for immediate transport to hospital. Provide information to accompany the casualty on the type of chemical ingested with brief details of the first aid treatment administered and if possible an estimate of the quantity and concentration of the chemical consumed.

## GENERAL MAINTENANCE

**IMPORTANT NOTE!**

**At all times when carrying out maintenance and inspection of the cyclone, duct systems, the fan, rotary valves, etc. all associated units must be electrically isolated and a minimum of three minutes must be allowed from the stopping of the fan before opening any access doors. This ensures that any rotating or mechanical parts and air flow will have come fully to rest before attempting inspection or maintenance.**

### Daily

(i) Inspect the cyclone and the connected local exhaust ventilation system to ensure that there are no blockages or accumulation of material within the system. This includes inspection of the cyclone discharge point, areas adjacent to any duct bends, flexible joints or within hood connections, as blockages will prevent the correct operation of the equipment. Accumulation in horizontal ducts can cause failure of supports due to the weight of material, with possible catastrophic results. Accumulation of material inside a cyclone will reduce its operating efficiency.

(ii) Inspect the mechanical integrity of the cyclone and connected dust extraction system to ensure that there are no perforations, breaks or wear holes within the equipment. This would include the inspection of any flexible hoses to ensure that these are not perforated, as again any air leakage will reduce the efficiency of the exhaust system as a whole.

### Monthly

Visually inspect the cyclone, ductwork and associated extraction components for signs of fatigue, wear or other faults. This is of particular importance in systems conveying abrasive dusts or large particulate where constant abrading of surfaces may occur. In such instances it is wise to perform these checks more frequently.

Six Monthly

(i) The impellor of any associated fan should be inspected with the aid of a torch for any signs of material build up on its blades. This can be done by electrically isolating the fan motor, then removing the bolted access panel on the outside of the curved fan casing. If desired, the impeller can be removed externally by unbolting of the motor mounting plate. By suitably supporting the motor, the impellor, shaft and motor can be removed as one complete unit. It is recommended that the customer contact Dustair engineers before attempting removal of the motor or fan impeller assembly. It is inevitable that, over time, some build up of material will occur on the blades of the fan impellor. During normal operation a noisy or vibrating fan is indicative of this and Dustair should be contacted in such a situation. DO NOT ALLOW THIS TO GO UNCHECKED – IT WILL GET WORSE!

(ii) Remove access panels on cyclone body and make internal inspections to assess condition and check for signs of excessive wear or fatigue.

Annually

In addition to the foregoing, it is a requirement of Health and Safety / C.O.S.H.H. that an extraction system be tested for correct and safe operation every fourteen months or less.

During such tests pressure and flow rate readings are taken at various points on the extraction system in order to ascertain correct and efficient operation. Differential pressure readings are also taken on any connected filter unit to assess its condition and operational efficiency.

Dustair Limited can provide engineers and equipment to carry out any of the above operations, with prices available upon request.

# Appendix I

## FAN OPERATION & MAINTENANCE INSTRUCTIONS

See fan manufacturer's Instruction Manual

# Appendix II

## PROPRIETARY EQUIPMENT
## OPERATING & MAINTENANCE INSTRUCTIONS

See also any individual instruction manuals

# INSTALLATION AND MAINTENANCE INSTRUCTIONS

## Explosion Vents
## CV, CV-S, CV-CF, CV-H

### General

An explosion vent is a pressure relief device, designed to give an instantaneous opening at a predetermined pressure to a closed system. Its purpose is to protect this system from excessive pressures caused by dust or gas explosions.

Warning: Do not locate the vent assembly where people are exposed to the vent itself or to the area above or in front of the vent as they may be injured by the escaping pressure, fire, noise, chemicals, and/or fragmenting particles. The location of the explosion vent must be such that the discharge cannot be the ignition source of secondary explosions. Interfacing equipment and/or machinery must also be protected.

### Installation

Rectangular explosion vents are mounted into lightweight angular frames. Circular explosion vents are also available for mounting in the lightweight angular frames or weldneck flanges in accordance with DIN or ANSI standards. Explosion vent frames can be supplied by Fike or can be constructed by customer, in which case Fike will supply construction drawings. Frames are available in different configurations and can be bolted or welded to the system.

Important: When explosion vents are installed horizontally, the use of drainage holes in the holdownframe are required. When installing CV vents support/safety bars placed across the vessel opening flush with the mounting flange, is to be considered to prevent the risk of persons falling through the opening and increase the service life of the vent.

Warning: Provisions have to be taken to prevent that personel can stand or walk on explosion vents. Furthermore it must be prevented that goods or products can be left on top of explosion vents.

Installation: Use base of explosion vent frame as template to indicate placement of explosion vent on vessel to be protected. After cutting relief area and drilling mounting holes, bolt the base into place. If using studs, be sure the threads are clean and are not damaged. Place the vent carefully on the base; position holddown frame on vent.

Fit nuts or fit bolts and nuts. Studs and nuts should be free running and coated with high temperature light oil or grease.Torque to values specified on the explosion vent tagplate (fig.1/2). The explosion vent tagplate should always be placed to the atmospheric side. If the explosion vent is equipped with a vacuum support, the bulged side is the atmospheric side. When the system operates at other than atmospheric pressure, it is recommended that sealant material (gasket) or other means be used to prevent leakage. The gasket should be dimensioned so that it is flush with the inside edge of the frame.

The recommended gasket material is to be selected in accordance with the process requirements and should have similar compression characteristics as provided by non-asbestos material (type IT, DIN 2690-2691).

Welded installation: Similar to above except base is welded to vessel.

Caution: Handle explosion vent with extreme care. Do not bend, poke or in any way distort the vent membrane.

### Insulation

Fike explosion vents can be supplied with 2 optional types of insulation (Armaflex or ceramic fibre). If ceramci fibre, please consult additional installation instructions 8.8350.00.


Figure 1


Figure 2

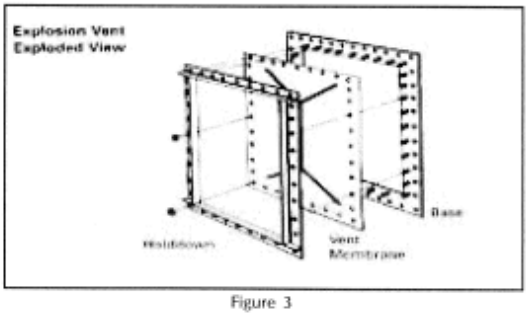



Figure 3

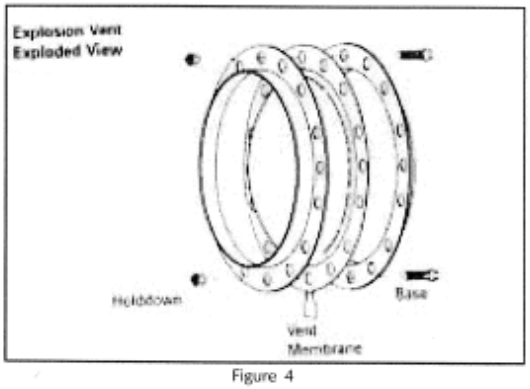



Figure 4

## Burst indicator

The Fike explosion vents can have as an option an integrated electric burst indicator designed for intrinsically safe service. Alternatively Fike can supply a magnetic reed switch burst indicator.

Caution: Unacceptably high voltage or currents will permanently damage the electrical system and the use of a non approved intrinsically safe power supply may even be the eventual ignition source of a dust or gas explosion. All burst indicators must be installed in an intrinsically safe circuit which conforms to the applicable national standard.

Warning: Do not bend the electrical cable at any angle at a distance of less than 20cm from the mechanical bracing part and do not lift the explosion vent by the electrical cable, as this may damage the electrical circuit.

Warning: The maximum torque values as mentioned on the nameplate must not be exceeded as this will permanently damage the electrical circuit.

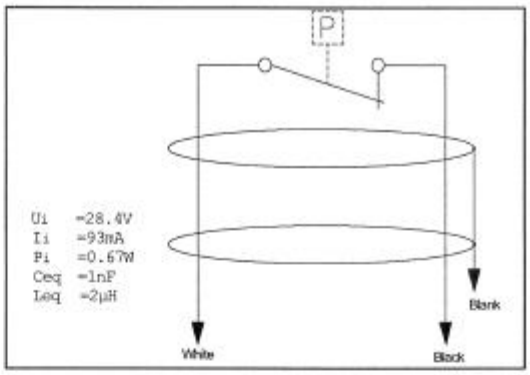


Figure 5

## Replacement of explosion vents

Inspect the explosion vent carefully. Check that the tag number and data on the tagplate (fig.1/2) correspond with location and system specifications. Place the new vent carefully on the base, replace the holddown frame on vent. Fit nuts to studs or fit bolts and nuts. Torque to values specified on the explosion vent tagplate (fig.1/2). When using a gasket or sealant material, it should be placed between the vent and the base. All torque values are based on new free running studs coated with light oil. Torque should be applied crosswise and in at least two steps. It is recommended that after initial start-up and system is brought to working pressure and temperature, the studs are retorqued to the values shown. Care must be taken during installation that flange or frame faces are brought down at an equal rate and that faces are parallel.

Caution: The maximum torque values should not be exceeded as this may possibly affect the burst pressure.

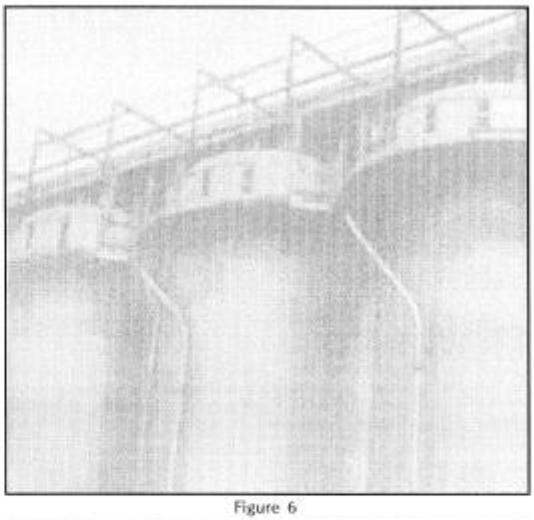


Figure 6

When reordering explosion vents always indicate vent lot number (see tagplate fig.1/2).

## Maintenance

The explosion vent assembly is maintenance-free due to its basic design and concept. Maintenance could consist of periodic visual inspections, consistent with the operating parameters and severity of service.

Note: Severe service is defined as rapid changes in pressure, high pressure, high temperature, or corrosive process. Explosion vents should be replaced if they appear damaged, corroded, or leaking.

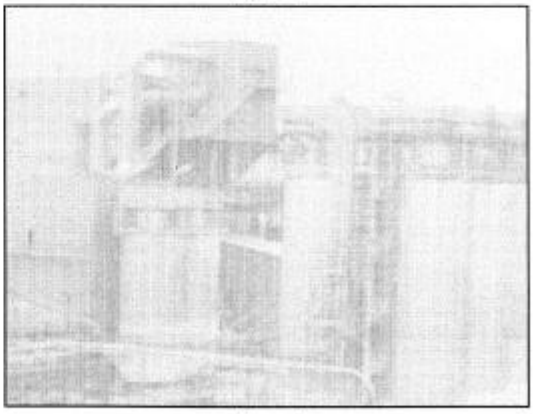


Figure 7



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# Appendix III

## CERTIFICATION

Engineers in
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# Dustair Ltd

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REGISTERED OFFICE
**UNIT 13~PEDMORE IND. EST.~PEDMORE RD~BRIERLEY HILL
WEST MIDLANDS DY5 1TJ**

## E.C. DECLARATION OF CONFORMITY

THE MANUFACTURER / DISTRIBUTOR:-

**Dustair Limited**
Unit 13, Pedmore Industrial Estate,
Pedmore Rd, Brierley Hill,
West Midlands, DY5 1TJ, UK.

Herewith declares that the product described below complies with the relevant Health and Safety requirements of the U.K. Supply of Machinery ( Safety )Regulations 1992 as amended by the Supply of Machinery (Safety Amendment ) Regulations 1994 and EEC. Directive 89/392 EEC as amended by Directive 91/368 EEC , 93/44/EEC, 93/68 EEC and 98/37/EC.
The product has been identified, labeled and assembled with C.E. Mark in compliance with the above directives.



**Product Description.**

**DESCRIPTION:** **Wet Dust Scrubber**

**MODEL (If Applicable):** **3000 cfm Pipe De-Sludge**

**SERIAL/CONTRACT No.** **E11562 / WO 6360**

Applicable Transposed Harmonised Standard:- N/A.

National Standards: For Fans: BS5304 & BS3042.
N/A for other equipment.

Signed on behalf of Dustair Ltd.

| Director | I Marshall | 28-4-08 |
|---|---|---|
| | Name | Date: |

DIRECTORS. M G Marshall. I C Marshall.
F:\DOCUMENTS\MANUALS\E11562-DEC_CONF.doc

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Toekomstlaan 52, B–2200 Herentals, Belgium
Tel +32 14 210031 Fax +32 14 210743
Email fike–europe@fike.com
WWW.FIKE.BE

# Declaration of Conformity
# Explosion Vents

## CUSTOMER INFORMATION

| | | | |
|---|---|---|---|
| Customer: | DUSTAIR LTD | Sales Order#: | 321030 S2 1,000 |
| Customer P.O.#: | 5031 | | |

## PRODUCT SPECIFICATIONS

| | | | |
|---|---|---|---|
| Product Type: | CV | Code Requirement: | CE + EN ISO 4126–2 |
| Nominal Size: | 400X500 MM | Flange Rating: | LAF |
| Material: | 304 FEP | | |
| Spec. Temperature: | 22,00° C | | |
| Spec. Burst Pressure: | 100,00 MBAR | | |

## TESTING/MARKING INFORMATION

MFG. Lot#: **0814251** Lot Size: **6**

| | | | | | |
|---|---|---|---|---|---|
| Marked Pressures: | MBAR @ *Ambient | Spec: | 100,00 | | |
| Burst Tolerance: | MBAR @ *Ambient | Min: | 75,00 | Max: | 125,00 |

Burst Tests: MBAR @ *Ambient

| | |
|---|---|
| 99,00 | 95,00 |

***Ambient temperature is defined as 59° – 86° F (15° – 30° C). Explosion Vents are manufactured at ambient temperature to tolerance values derived from Fike Temperature Compensation data unless actual temperature tests are performed.**

## MATERIALS OF CONSTRUCTION

| Component | Material | Cert. Nr. |
|---|---|---|
| Top | 1.4301 | 084515 |
| Top Side Gasket | | N/A |
| Seal | FEP | N/A |
| Bottom | 1.4301 | 084515 |

## PED CERTIFICATION INFORMATION

| | | | |
|---|---|---|---|
| Notified Body (NB): | TÜV SÜD Industrie Service GmbH | | |
| (NB) Address: | Westendstrasse 199, D–80686 München | | |
| (NB) Registration No.: | 0035 | EU Directives: | PED 97/23/EC |
| Harmonized Standards: | EN ISO 4126–2 | Year Built: | 2008 |
| Conformity Assessment Proc: | Module H1 | Examination of the Design: | B000351/FE1 |

## ATEX CERTIFICATION INFORMATION

| | | | |
|---|---|---|---|
| Notified Body (NB): | IBExU Institut für Sicherheitstechnik GmbH | | |
| (NB) Address: | Freiberg – Duitsland | | |
| (NB) Registration No.: | 0637 | EU Directives: | ATEX 94/9/EC |
| Harmonized Standards: | EN 1127–1/EN 13463–1 | Year Built: | 2008 |
| Conformity Assessment Proc: | Annex IV | Type–test: | IBEXU03ATEX2056 X |

## SPECIAL NOTES

**MBAR signifies millibar gauge.**

**We certify these components meet applicable specifications, drawings, and requirements of your purchase order. Evidence of compliance is maintained on file in our records and is available for review upon request.**

PETER DE HAES
Authorized Quality Representative

17/04/08
Date: (DMY)