Fortress Metal Detectors

SYSTEM INSTALLATION GUIDE

GRAVITY METAL DETECTOR

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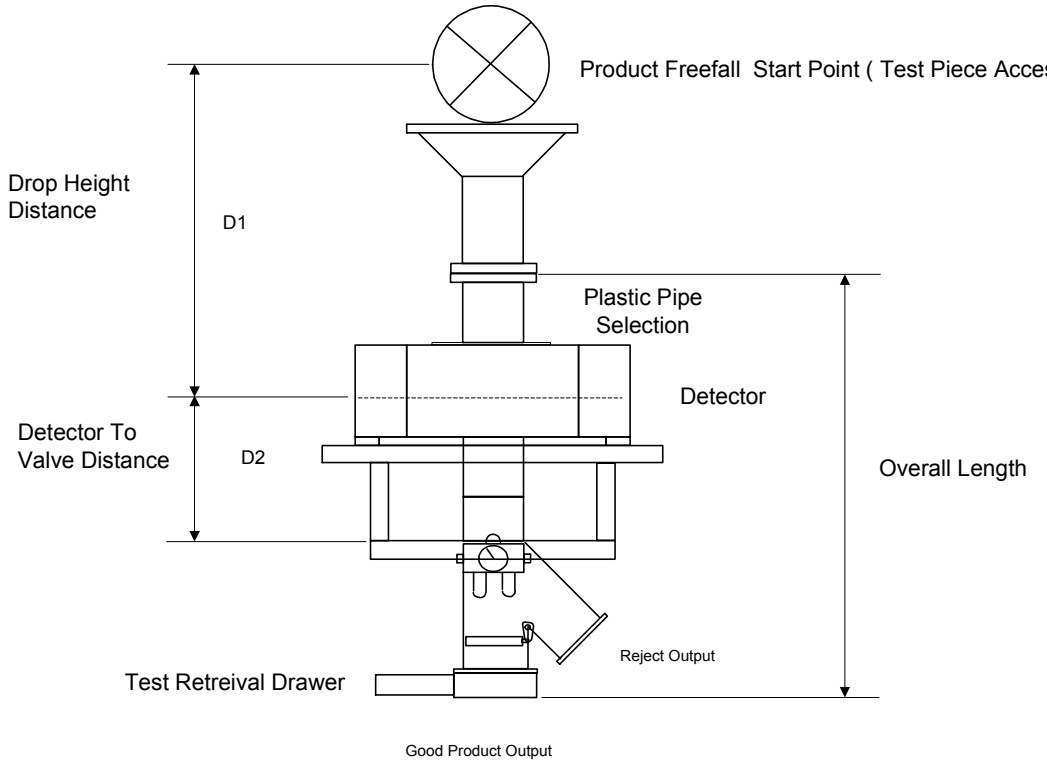
SYSTEM INSTALLATION GUIDE

Drop Through / Gravity Metal Detector

On the surface, the drop through application of metal detector is very simple. However, care must be taken in the initial design to avoid having to make major modifications after installation. Please consider all the following steps when designing a drop through detection system.



Design Issues

A gravity detection system is ideally suited to inspecting dry, free flowing products such as:

- Grains, flours, cereals
- Rice, nuts, sugar
- Plastic pellets and flakes

The product must remain free flowing and never back up into any part of the system.

Determine Pipe Internal Dimension

Often the existing piping will determine the pipe and detector size, or use the following formula based on knowing the peak expected flow rate of the product and its bulk density.

$$\text{Area of throat required (inches square)} = \frac{0.024 \times \text{FLOW RATE (\#/hr)}}{\text{BULK DENSITY (\#cu.ft.)}}$$

Example: A product with a flow rate of 30,000 pounds / hour, and a bulk density of 40 pounds / cubic foot will require a calculated pipe area of 0.024 x 30,000 / 40 = 18 square inches.

Round Versus Rectangular Pipes

A round pipe will utilize the pipe area required for product flow more efficiently than a square or rectangular pipe, and therefore the flow capacity of rectangular pipes should be de-rated by at least 20%.

A rectangular system may sometimes have an advantage of allowing a shorter overall length due to the shorter stroke and reaction time of the valve (see below).

System Overall Length

Once the proper pipe size has been established, the overall system length can be considered. The bigger the pipe I.D. (or smaller dimension of a rectangular system) the longer the system must become. The detector through dimension must increase as aperture size increases, the valve height will also increase due to the increased stroke, and the required distance between the valve and the detector must increase. The latter is due to the larger valve taking more time to reach full divert position and therefore it must be located further from the detector.

It is very important to consider the relationship between valve response time and, product free fall height, and system length.

In order to properly design the system, the following must be known.

- product pipe size (from above)
- valve response time (from manufacturer-bigger valves require more time)
- product free fall distance from initial drop to the centerline of the detector (D1 - see diagram).

If the free fall height is increased, the distance between the detector and valve must be increased in order to maintain adequate time for the valve to respond.

Due to the fact that the product is accelerating as it falls at 32ft/sec squared, small changes in the detector to valve distance will have a drastic effect on the maximum allowable free-fall distance.

For example, given a valve response time of 50ms and a detector to valve distance of 8”, the calculated maximum free-fall would be 29”. If the valve were moved 2” closer to the detector (to 6”), the maximum free-fall would now be only 16”.

Testing

One of the not so obvious drawbacks with a drop through detector system is that it is very difficult to test. However, if testing access and recovery is designed into the system, then testing can be done quickly and reliably. It is important to recognize that the testing procedure must confirm the detectors' performance as well as the response of the reject valve.

To achieve this, the design must incorporate:

- Test Access Port
  An access port to introduce a test sample (plastic ball with metal sample imbedded) must be provided at the product free-fall origin. The test port should allow the sample to fall from the same place that the product begins its fall, so that the test sample speed will be the same as the product.

- Test Sample Safety Retrieval Gate
  A safety catch gate should be inserted into the normal product flow below the valve "good" product output when testing is carried out, so that the test sample can be safely recovered if the detector fails to detect the sample, or the valve fails to react properly.

In a good design, the test gate can be quickly inserted into the product flow during a test, and removed from the flow afterwards.

Automatic Testing

A manual test must be performed upon initial installation and at reasonable time intervals. However, in this application an Automatic Test system can offer considerable benefits. If correctly designed this test system can ensure that testing is both consistent and relevant.

Other Considerations - Static

With all falling dry powders and granules, static electricity is generated. Some products are more prone to do this more than others, and environmental conditions like humidity will also contribute to the equation.

To help reduce static damage and interference, the following measures should be considered:

- All metal near the detector system (pipes, flanges, structural supports) should be properly grounded so that large charges can not accumulate.

- Plastic parts (product tube, etc.) may need to have conductive shields wrapped around them to help dissipate large charges. However, grounding standard (non-conductive) plastics will not eliminate static. Some conductive plastics are available for food use, but may interfere with the detector.

- The detector itself should also have a major single point ground (consult the manufacturer for their recommendations). Detectors then use remote power supplies may be more susceptible to damage.

- As a last resort, an ionizing anti-static device may be considered.

With careful design and accurate information, the drop through gravity application of metal detectors can provide excellent sensitivity and early warning of product contamination concerns, but the critical parameters must considered in the early design stages.