FAN ENGINEERING

Fans & Blowers Twin City

Information and Recommendations for the Engineer **FE-2200**

Spark Resistant Fan Construction

Introduction

Fans are often used to handle a variety of gases, dusts and materials other than clean air. Some of these gases and solid particles are combustible. When mixed at certain concentrations, ignition can result in an explosion. Even systems which are normally "safe" can become explosive under abnormal conditions. System designers must consider the safety hazard that each component of the system carries. This discussion presents some considerations that must be given to the fan.

Almost any fan could serve in explosive environments under normal operation. The temperatures encountered are low enough that few (if any) materials will ignite. However, fans have been involved with causing explosions since the fan operating integrity varies over its life. In order to reduce the risk of explosion, fan construction is modified.

AMCA Standards

A widely used standard for specifying these modifications is the Air Movement and Control Association's (AMCA) Standard 99-0401, "Classification for Spark Resistant Construction." This standard has the following characteristics:

1. It identifies who is responsible for what.
2. It allows for three different levels of construction: Type A, B, and C.
3. It is general in nature to allow different fan manufacturers to comply using alternative methods.
4. It provides disclaimers and warnings to users concerning residual risks.
5. It does not require qualification testing.

While not explicitly stated, AMCA 99-0401 is limited to applications for which the explosive materials are present in a sealed ducted airstream, but not present on the outside of the fan housing.

For all classes of spark resistance, bearings and electrical devices (motors, sensors, etc.) are not allowed in the direct airstream. From the lowest level of protection to the highest, the classifications of spark resistant construction are:

Type C: The fan is designed so that if the impeller or shaft comes loose and shifts during operation, two ferrous parts will not come into contact.

Type B: In general, this requires a nonferrous impeller and a nonferrous rubbing ring around the shaft hole. Also, extra locking systems are required to prevent the fan impeller, shaft, and bearings from shifting.

Type A: This requires a nonferrous airstream. Also, the extra locking systems are required as in Type B.

All spark resistant types require the fan to be electrically grounded so as to prevent static electricity from building up. The end user is responsible for installing the ground strap.

A common material used by fan manufacturers in achieving spark resistance is aluminum. The AMCA standard provides a warning that aluminum rubbing on rusty steel will create sparks. It is the end user's responsibility to ensure that steel surfaces are suitably coated, and that fans are kept clean from iron oxides.

The AMCA standard allows fans to be constructed of any material which has "demonstrated ability to be spark resistant." Metals containing less than 5% iron are allowed. Although aluminum is the most common construction material, copper, brass, Monel, and other metals are used where corrosion and temperature limit the suitability of aluminum. NOTE: Stainless steel does NOT comply.

Non-metallics are often avoided as a construction material for the fan impeller due to the potential for buildup of static electricity. Some fan wheels are constructed of fiber reinforced plastic (FRP) which has an electrically conductive surface coat. This coating should be electrically grounded to the shaft.

Alternative Standards

The AMCA standard is widely used in the United States, and is referenced by other standards. An equipment specifier need only state "AMCA Spark Resistant Type B" to convey a multitude of fan design requirements. The standard is effective in that the risks of fan-induced explosion can be dramatically reduced without excessive cost additions.

Internationally there are other standards which are used. At the time of writing this article there is a developing European "CEN" standard. This standard is attempting a much more comprehensive approach to this subject. While the AMCA standard does not claim to make fans truly "explosion proof," the CEN standard may well make that claim. It could do this by including many more considerations that may be relevant in reducing the likelihood of an explosion, including:

1. Fan modifications required to accommodate the presence of explosive environments *outside* the airstream.
2. A more limited set of construction materials.
3. Specifications on design durability and other mechanical aspects.

4. Requirements on gas stream sealing, motor construction, bearing design and shafting design.
5. Fan qualification testing.
6. Operating temperature limits.
7. Maintenance and cleaning requirements.
8. Limiting the ability of foreign materials to enter the fan (by use of screens).
9. Use of larger internal clearances for the fan rotor.
10. Other safety equipment and sensors.

If adapted internationally, this standard would likely reduce the likelihood of explosions. However, it would also add to the first cost, installation cost, and the operating cost of a fan system.

Conclusion

Until such time as a uniformly accepted code clearly defines all specifications of a “safe” system, system designers must decide on their own. The fan manufacturer can usually accommodate the fan modifications necessary to comply with more comprehensive specifications. However, the system designer must assess the risks and identify what is needed. Fan manufacturers usually are not in a position to advise what modifications are necessary to make a system acceptably safe for every possible environment.

The AMCA spark resistant standard is adequate for the vast majority of all fans used in potentially explosive environments. However, where the hazards are extremely severe, consider adding more detailed specifications to reduce the potential for explosion to exceptionally low levels.