September, 2006

## Products for Magnetic Resonance Imaging (MRI) Applications

Magnetic resonance imaging (MRI) is a technique used to produce high quality images of the inside of the human body. The MRI machine applies a radio frequency (RF) pulse directed towards the area of the body to be examined.

There are numerous things which may disrupt the performance of the MRI machine, or cause inaccurate results, errant radio frequencies are one. The MRI uses a radio frequency pulse to create the image. If radio frequencies from outside areas are coming into the MRI Room, the resulting image will most likely be affected, giving inaccurate results. To combat this, every MRI room is shielded to prevent the introduction of outside radio frequencies.

Another problem, and the one which most affects our industry, is the presence of ferrous materials. The MRI machine produces a very strong magnetic field. Any ferrous materials which are too close to the machine will distort the magnetic field, again resulting in errors in the imaging. To combat this, ferrous materials are best kept outside of the magnetic field; however this is not always possible. For example, many, if not all, MRI Rooms have concrete floors, and the roof above is concrete construction as well. There is rebar in this concrete. It is unavoidable that this will be within the magnetic field, especially directly below the MRI machine. As long as the rebar is arranged symmetrically around the MRI machine, any magnetic field distortion can be adjusted for and accurate imaging produced.

Small ferrous objects, such as screws, bolts, washers and similar sized particles should not have a significant effect, if any, on the imaging. They present more of a hazard if they are not secure. Ferrous items in an MRI Room will pose a hazard if they are loose, or free to move. Depending on their location ferrous articles may become air borne and fly to the magnet, right to the spot where the patient is. The larger the item or the more mass it has, the more dangerous it can be since the force with which it is attracted to the magnet is much stronger. It is not recommended to have any loose ferrous items in the MRI Room.

So, how does this relate to our air outlets? We have two zones of interest here, please refer to Figure 1. The first zone is the 50 Gauss (5 mT) magnetic field. Based on a 1.5T magnet, the 50 Gauss (5 mT) field extends approximately 5'-8" radially around the MRI machine and 8'-2" axially out from the machine. These dimensions are measured from the center of the magnet.

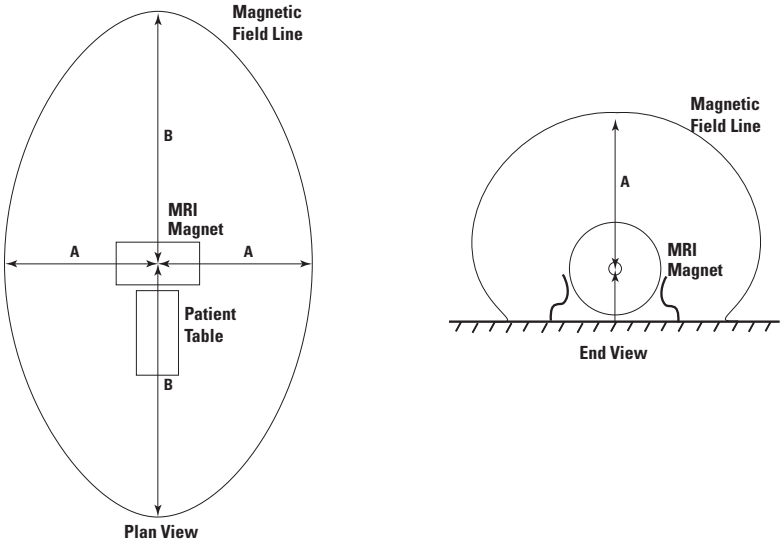
As we move beyond the 50 Gauss (5 mT) line, the second zone is the 5 Gauss (0.5 mT) magnetic field. Based on a 1.5T magnet, the 5 Gauss (0.5 mT) field extends approximately 8'-2" radially around the machine and 13'-5" axially out from the machine. As above, these dimensions are measured from the center of the magnet.

Ideally, we want to have the air outlets, louvers and ductwork installed outside of the 50 Gauss (5 mT) magnetic field. If they must be installed inside the 50 Gauss (5 mT) field, they should be non-ferrous construction.

Outside the 50 Gauss (5 mT) field, but still within the 5 Gauss (0.5 mT) magnetic field it is recommended that the air outlets and ducting be non-ferrous (eg aluminum or 300 grade stainless steel). Conventional ferrous air handling equipment may be allowed as long as the ferrous materials are arranged symmetrically and are anchored.

For comparison of the magnetic fields, the naturally occurring magnetic field of the earth is 0.5 Gauss (0.05 mT). In the MRI Room, this magnetic field occurs approximately 11'-10" radially around the machine and 23'-7" axially out from the machine. Again, measured from the center of the magnet.

(Refer to Figure 1 - Magnetic Fields for 1.5T Magnet.)




**Magnetic Field**

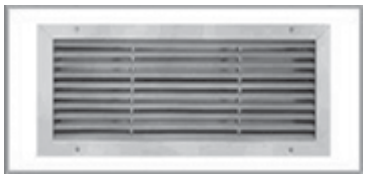
| | 50 G | 5 G | 0.5 G |
|---|---|---|---|
| **Radial Distance A** | 5'-8" | 8'-2" | 11'-10" |
| **Radial Distance B** | 8'-2" | 13'-5" | 23'-7" |

* Distances will vary for magnets of differing strengths.

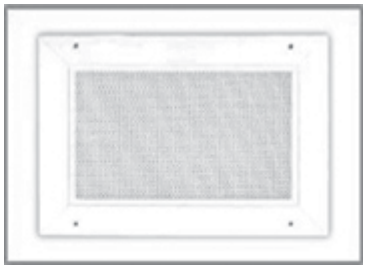
Typically air distribution products are located outside of the 5 Gauss (0.5 mT) field however it is still suggested to use non-ferrous construction as much as possible. Some of our products may contain small amounts of ferrous material, but the ferrous materials are small enough that they should not interfere with the magnetic field and are anchored in the diffuser.

Price offers a wide range of products which are suitable for installation in MRI applications. Following are some of the products which are suitable for use in MRI rooms with no modifications:

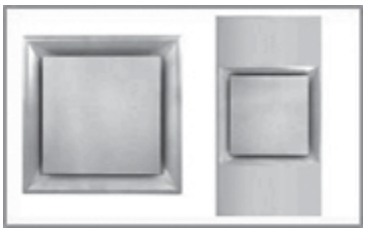
- The 630 and 635 return grilles are all aluminum construction with no ferrous components;
- Similarly, the 700 series grilles are all 300 grade stainless steel;



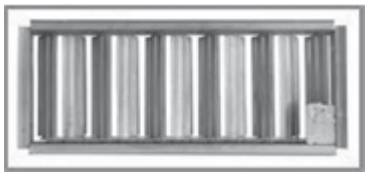
- The 10A perforated return grille is all aluminum construction;



- The ASPD is all aluminum construction;

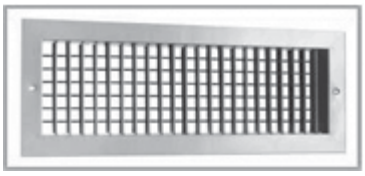


- The VCS3SS damper is all 300 grade stainless steel;

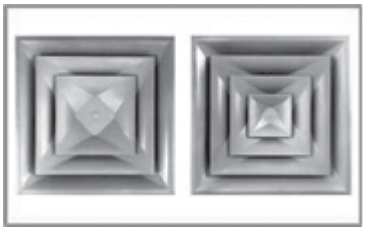


The following products can be made MRI compatible with some minor modifications;

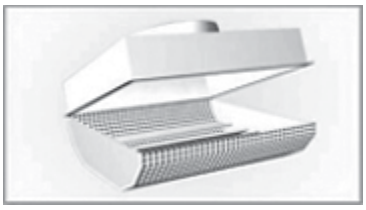
- The 610 and 620 supply grilles can be made MRI compatible by replacing the blade pins with non-magnetic stainless steel pins;



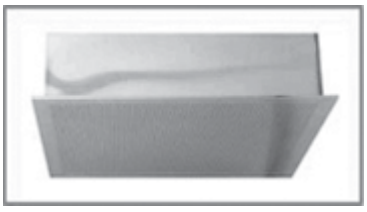
- The ASCD is modified by changing the rivets to aluminum and replacing the center plug button with a brass or plastic plug button;



- The RFD is modified by changing all rivets to aluminum. The standard hinge on the RFD is already aluminum construction. The studs and wing nuts holding the face on are changed to stainless steel;



- The LFD is modified simply by replacing the quarter turn fasteners with zeus fasteners;



The above is a partial list of the Price products which are suitable for use in MRI applications. If you are unsure, require a different type of air outlet, or would like assistance selecting air outlets for your MRI application please contact the Price Application Engineering department.

Some of our products may contain small amounts of ferrous material, but the ferrous materials are small enough that they should not interfere with the magnetic field and are anchored in the diffuser.