

# Fog Deflectors

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## Introduction

When people think of the safety hazards that deminers face, their minds jump to the most obvious and dramatic - the accidental setting off of mines, with the resulting possible injuries or death. But there are more subtle hazards that can contribute to the likelihood of this or other accidents - small things that sufficiently distract or impede deminers to make them less likely to be safe.

One such subtle hazard, in certain weather conditions, is that of visor fogging. In cold or humid weather, the normal breathing by a deminer on his or her visor can fog the visor to the point that the deminer cannot see properly. This lack of vision can lead to possibly devastating mistakes. To improve their visibility, deminers may be tempted to raise his or her visor, risking face or throat injury or death from shrapnel if a mine is triggered.

We have addressed this problem of visor fogging through the design of a breath deflector which will prevent the deminer's breath from reaching the visor and causing fog, and which will not injure the deminer in the event of an explosion.

## Design

We have designed a fog deflector that uses super-magnets to attach itself to a standard demining visor. It is primarily made out of clear PVC film. It is slightly cupped so that it will hold its shape and has a large, flat area for attachment to the visor.



Pictures of our final design.

This design addresses our issues of durability, comfort, and image. The super-magnets are extremely effective at holding the visor in place, work well in dirty conditions, and do not lose their attachment property over time. The deflector's shape allows it to rest lightly on or above the wearer's nose and does not weigh heavily on nor stifle the speech of the wearer. We also plan to add a small strip of cloth at the top of the deflector where it touches the wearer's nose in order to make it even more comfortable. Finally, by making the visor clear, the wearer's face is not obscured. It also allows us to see when fog accumulates on the deflector, showing users that it is being effective.

Because our design has a small part that lies outside the visor, there is a small chance that it will not survive blast testing. Should this happen, we have an alternate design that uses a suction cup to attach the deflector to the visor. However, this attachment method is not quite as durable so it is not our first preference.



Pictures of the alternative, suction cup-based design.

The shape of this design is similar to the magnet version's design. However, the attachment point between the deflector and visor is pointed instead of flat in order to facilitate attaching the suction cup to the deflector.

## Testing

A previous team had already designed a breath deflector attached to the visor by a metal clip, but when their breath deflector was blast-tested, the metal clip disappeared, indicating that it would probably be unsafe for actual use in the

field. We started with their design and worked on trying to fix the method of attachment.

We made prototypes using last year's mask design and hard orange felt but with various different attachment mechanisms both on and off the face. Eventually we decided that attaching the deflector with a magnet would be the top alternative. Using a suction cup to attach the deflector came in as a close second choice. Our experiments are detailed in the Appendix.



This early prototype, made of sewn hard felt, illustrates the original breath deflector shape, which had a substantial pucker in the middle and a heart-like shape at the top. Here we are testing both the magnet and suction cup methods of attachment.

The bright orange prototypes also made us think more about what we wanted the final material and appearance of the deflector to be. After some discussion and more prototypes, we decided the a transparent deflector would be best.



You can see a clear deflector working.

Over the course of the making of prototypes, we also discovered that the original shape of the breath deflector was not always comfortable to wear - for some people's face shapes it worked fine, for others less so - and the ridges on the top pushed towards the wearer's eyes, possibly risking damage to them in an accident. As a result, we made another round of prototypes with differently shaped masks.

We ended up choosing a shape that was smaller and had fewer contact points with a wearer's face. We also discovered that by strongly angling the deflector downward, we could direct a wearer's breath downward. As a result, we could block more fog with less material. This discovery is reflected in our final design.

In an attempt to reduce the cost of the magnet model, we tested prototypes of deflectors that used different configurations of smaller magnets to attach themselves. However, the small magnets were too weak to hold the deflector up.

With each prototype, we had at least two people try it on with the demining visor and try to fog up the visor. We also ran some tests in a humid restroom.

## Manufacture

Discuss the manufacture of the prototype verses the intended manufacture of the final design. Indicate desired manufacturing methods and materials. Highlight any critical manufacturing aspects, such as those aspects that strongly influence safety, performance or reliability. Identify key specifications that should be met in the manufacture of the design.

Our final design uses two 0.7" D x 0.11" neodymium disc magnets, two pieces of .02" thick, clear PVC (Type I) heavy-duty film, and a bit of cloth. It also uses a strip of .012" thick, clear PVC film to hold the outside magnet. The two thicker pieces of film are pressed together, holding the magnet between them in the appropriate spot. We also wedge one end of the thin film strip at the bottom of the deflector. Then we then used a soldering iron to hold the magnet in place and weld the joints together. Finally, we used glue to attach the soft bit of cloth at the top of the deflector.

Our alternative design uses one medium OOK Suction Cup, two pieces of .02" thick, clear PVC (Type I) heavy-duty film, a bit of cloth, and some glue. Again we stuck the two pieces of film together and used a soldering iron to weld the two ends of the film in order to make a cup shape. We then squeezed the suction cup into a hole we left at the top of the weld and added some glue to keep it at the correct angle and to hold the bit of cloth on.

We expect manufacturers to come up with a better way of welding the PVC together and to sew in the cloth. For the suction cup design, manufacturers should just use one piece of .04" film instead of two pieces of .02" film.

Manufacturers have to be careful when placing the magnet (or suction cup) because slight variations can significantly change the angle of the deflector. If the angle is off, it might become uncomfortable or ineffective at deflecting fog.



Cloth patterns for the deflectors.

### Future work

Three or four breath deflectors should be manufactured to send to demining leaders and organizations for field use. If they engender positive feedback, a manufacturing protocol will need to be developed and sent to demining equipment manufacturing organizations so that the breath deflectors can be widely distributed.

### Appendices

#### Appendix 1: Considered Attachment Mechanisms for Breath Deflector

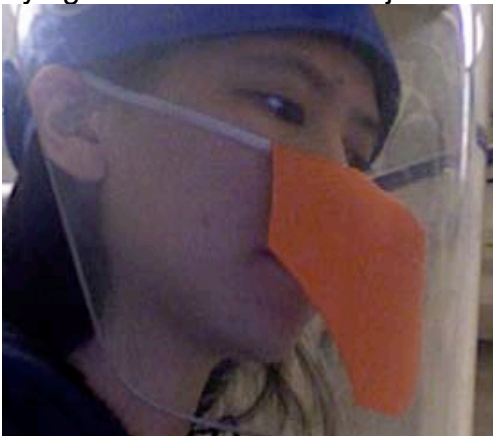


Attachment by magnets on either side of visor – selected for functionality, durability, comfort (they were easily adjustable)



Suction cup attachment - selected for safety, functionality, low cost

Tying around the head – rejected for discomfort



Glasses-style hooks over ears - rejected for holding deflector against face uncomfortably

Velcro attachment - rejected for lack of adequate functionality, especially when it gets dirty



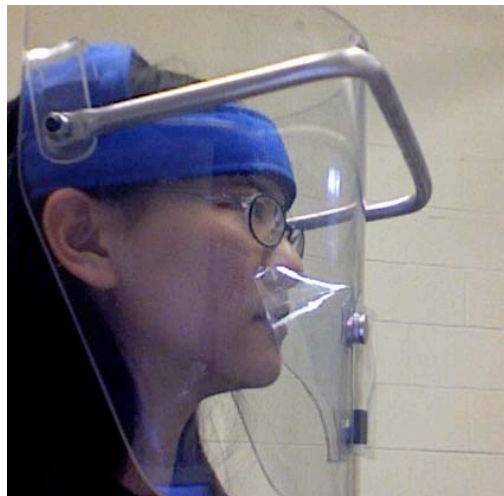
Attachment by plug embedded in visor - rejected for being too destructive to visor

#### Appendix 2 – Evolution of Deflector Shape

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