Mute Acoustics

The mute for horn as well as any brass instrument is a cone-shaped enclosure with an opening at its small end. Acoustically, it is a kind of Helmholtz resonator with resonance frequencies, for horn, in the range of 110 to 165 cycles per second. Like any Helmholtz resonator, the mute has three parts: aperture, bottle or enclosure, and neck which when combined, give the mute its total volume.

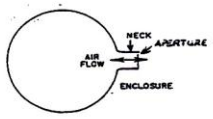

Fig. 1. Helmholtz resonator.

The odd thing about all horn non-transposing mutes is that the neck is actually Inverted and is within the bottle. This makes the mute appear much smaller in volume than it actually is. Its true volume is easily seen if the inner shaft is attached to the aperture as in the following example.

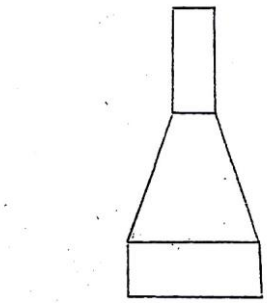

Fig. 2. Inner shaft of horn mute placed on top of mute.

In this configuration the mute would not fit into the bell of the horn and would be quite difficult to transport as it would not fit in most cases. Still, the total volume of the horn non-transposing mute is smaller proportionally to the bell than that of the mutes for the other brass instruments.

How the Mute Works

The mute's primary purpose is to reduce or attenuate the sound of the open horn. How much it actually does is dependent on the materials from which it is made. Theoretically, mutes made of harder surfaced materials like metal will have less attenuation than a mute made of a more porous material such as wood or fiberboard with the dimensions being identical. However, all straight mutes for brass instruments act similarly with regard to the reduction of sound. A thesis written by Martin Kurka found that mutes attenuate the sound of the instrument the greatest in the low register, approximately nine decibels. The mute softened the instrument's sound by six decibels in the upper register and only four and one-half in the middle register.

The mute gives the brass instrument a brighter, less mellow sound because it dampened the fundamental of the sounding pitch and strengthened the upper partials. On most pitches the mute would add at least one upper partial.

Sound Lens

The mute also acts as a sort of sound lens which projects the sound along the axis of the bell. This is especially true in the upper register.

Pitch Issues with the Mute

Hornists, as well as other brass players, have always known that mutes greatly affect the pitch of the instrument. Kurka found that the mute tends to (IN GENERAL) lower the pitch of the instrument in the middle register. In the lower register, the pitch is raised and some notes may not be centered enough to produce a steady sound (a problem particularly on pre-Rittich style horn mutes). The muted upper register is affected with greater diversity but generally is sharp.

Response

It is also well known by players that the response of the instrument is different. Usually, smooth slurs and clean articulations are more difficult to produce and the player must always supply more air pressure when using the mute.

Other Issues

1. Volume: The volume of the mute may not be large enough for the sound wave, since the mute's bottom presents a boundary. This is particularly true in the lower register causing some notes to be un-centered. The biggest problem is the wide range of horn parts in orchestral settings – three to four

octaves. This is a bigger range than that found in the playing range of the rest of the brass instruments which may explain why they don't ever seem to be as concerned by their muted passages as do horn players. Related to this is the fact that when the mute is being used, the hornist no longer has the ability to "fine tune" particular notes on the horn with the right hand in the bell. This is especially true in the extreme registers and causes pitch and response problems because hand tuning is a very necessary and unconscious part of horn playing.

2. Corks: All mutes use cork strips to allow them to adhere to the inner walls of the horn bell. The thickness of the corks can affect the sound and, to a lesser degree, the pitch of the muted horn. The thicker the cork strips are, the further the mute is away from the bell which results in a more open tone.

3. Mute Shape: The shape of the mute may also have an effect on its performance. While the total volume of the mute is of most importance, tests by Gossick showed that a spherical shaped, larger mute with a "tweeder" device for sound projection was most efficient. However, the large size and need to clamp the mute to the bell made this design too impractical to be useful for even trumpet players much less hornists.

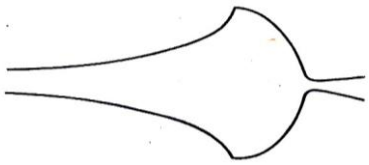

Fig. 3 Spherical shaped mute with tweeder.

A compromise might be found in a more traditional shaped mute with a spherical shaped bottom. Problems could arise when handling this mute, especially setting it down in an ensemble setting where it could actually roll around.

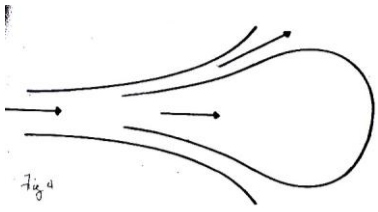

Fig. 4 Traditional cone shaped mute with spherical bottom.

The best mute I own is actually an old glass wine bottle with a half gallon liquid capacity. Its shape is spherical and its volume is almost twice that of the Rittich style mutes. While the pitch and tone color are superior to all my other mutes it has a several of major drawbacks. First, it is really rather large and heavy and won't fit in my case. Second, it can dent the bell of the horn if not very carefully inserted. And third, it is fragile and could shatter if dropped on stage – not something you want to happen in a performance situation

Fig. 5. Wine bottle mute

More experimentation should be done to improve the performance of current mute design.