

EMG Gramophone Horns and Remanufacture

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Mk IX horn stub broken off at 21 inches from base. The casting extends to 17 inches (9 1/2 inches inside the paper) and there is no further support---not a good design and large numbers of horns droop/break in consequence.



Mk IX horn viewed at the joint of casting to paper showing use of the Daily Mirror for the first layer---not London telephone directories !



Mk IX horn showing page 5 girls and the other layers of paper which seem to be some sort of (quite thick) cardboard (some 22 thou') before the finishing paper.



Mk IX horn showing details of finishing layer of paper. The "reptilian" pattern was used as being the easiest and cheapest way of confusing the eye for the final cosmetic homogenous product.



Early Mk X horn stub concealing casting of only 10 inches in length but with longer attached strengthening gusset strip extending to some 31 inches from the base. Both casting and gusset are made in bronze---a feature of many early EMG materials---cheaper aluminium was used later, presumably as the depression took hold.



Early Mk X horn stub showing broken off paper or cardboard but no use of newspapers or telephone directories.



Early Mk X horn stub showing close up of paper products used. Individual paper/cardboard layer thickness appears to be in the region of 11 thou'. It is thought that "sugar" paper was used.

Total wall thickness of some 113 thou' would indicate that approximately ten layers were employed to build the whole.



Early Mk X horn stub showing finishing paper detail. It is interesting to note, that in this case, a marbled decorative paper was used, such as might be found on the inside cover of a high quality leather bound book.

The colour, although a uniform dull brown now, was clearly many attractive shades of maroon, blue and even white 80 years ago.

The passage of time has rendered probably the majority of extant horns brown but it is important to try to imagine the huge variety of original colours used. The gramophile of yesteryear would not have been peering into a "black hole"!



Mk Xb aluminium swan's neck horn casting---original.



Mk Xb aluminium swan's neck horn casting---new.

This is the end product of many years work by a number of people, starting with detailed measurement and drawing of the original casting which was supplied by Frank James.

Wooden patterns were then made. In the latter respect, it is worth noting that the original castings were two piece---joined at the "knuckle", but it was felt that if the job could be done in one "hit", then many potential alignment problems might be avoided. It is a huge credit to the skill of the foundry that this was actually achieved---an extremely difficult task for various technical reasons. The material used was LM 6 and NO heat treatment was carried out, thus averting possible increased resonance.

Machining was the next process and the 33 inch height of the single piece component was somewhat daunting. 80 years ago, it would not have been a practicable notion to swing or otherwise accurately cut in one piece, but, thanks to contemporary CNC (computer numerically controlled) 5 axis milling machines, the complicated knife edge taper at the paper (or in this case fibreglass) end was produced. The base facing, bore and thread also required accurate cutting.

To complete the first half of the horn, bronze taper spigots were made to attach to the plumbing outlet. Brass would not have been strong enough.



The wooden patterns used for making the sand moulds for casting.



Manufacture of former used as the basis of construction for horn bell.

On the right, the wooden pattern made up of segmented rings laminated together and shaped by hand using a template rotated on the axis.

On the left, one half of the fibreglass female taken from the wooden pattern.



Manufacture of former used as the basis of construction for horn bell.

On the right, the other half of the fibreglass female taken from the wooden pattern.

On the left, the two halves of the mould taken from the wooden pattern offered up together.



Manufacture of former used as the basis of construction for horn bell.

On the right, the mould is bolted together and the inner form is moulded in fibreglass which will create the final male tool.

On the left, one half of the mould has been taken away revealing the inner form.



Manufacture of former used as the basis of construction for horn bell.

On the right, the mould has been completely removed revealing the male tool. Note the loose section bolted in place to enable removal of the fibreglass (or papier appliqué) horn moulding in production.

On the left, the assembled fibreglass tool for making the fibreglass (or papier appliqué) horn. Note the loose ring at the bottom of the tool made from a portion of the first female mould to enable production of 29 1/2 inch bell mouth diameter horns. The full mould will produce "Oversize" horns with a bell mouth diameter of 33 1/2 inches.



The casting positioned on the former, in turn positioned in the jig to ensure correct geometry.

The picture shows the removable collar which either needs to be present or removed according to the bell mouth diameter required---29 1/2" or 33 1/2".

The base plate has adjustable feet to ensure it is absolutely level in all planes.



Projection calibration of the horn base plane to ensure the mouth has a forward tilt of some two inches (at a diameter of 33 1/2") to speak to the listener in his/her chair rather than overhead ! There is not a direct correlation between the scale as shown and verticality but a quick bit of trigonometry gives the formula to work to.



Detail of connection at base of horn casting.

The five side stays are articulated and adjustable and work in opposition to each other to ensure complete stability and perfect geometry.



Detail of connection at "knuckle".

Both caps (black nylon at the knuckle and swinging aluminium at the base boss) are removable to facilitate the changeover to the next casting.

The sixth arm in the centre is to stop the front stays from collapsing when changing over to the next casting.



Another angle of detail of connection at "knuckle".

It is of paramount importance to ensure everything is true and straight (hence the plumb bobs) as, especially with an Oversize horn, a slight variation at the base will be magnified into an immediately obvious and impossibly unsightly result at the bell mouth. Also, another reason for ensuring that the bell tilts forward is that, should it be vertical, the impression of leaning backwards is given.



Fibreglass matting torn into template shape to form continuous circular build up of horn. A torn, rather than cut, edge minimises potential "ridge" problems. Such was the method used when papier appliqué was employed.



The bell is gradually developed, starting with a gel coat against the former (having first applied a release agent coating)---the gel coat gives a very smooth final internal surface finish. Each layer of fibre glass must be well stippled and then rolled in to exclude air---four layers to give a final wall thickness of 146 thou' or just under 5/32". It has later been found that three layers are adequate, both from the point of view of structural integrity and acoustic delivery.



The final layer has been completed and three days later the raw horn can be removed from the former. The outer surface is somewhat rough but this can be ground back to a smooth finish or, in another method, left with a final coat of tissue which gives a pleasing mottled effect.

The act of removal from the former or mould is not always straightforward as some adhesion can occur which is why the removable section of the mould was factored in to the design. Removal of this fillet (unbolting), together with the use of water which dissolves the release agent usually ensures separation in about ten minutes.



Prior to removal from mould.



25th July 2007: a ragged-edged first trial---exciting moment ! (I think a historical first for a Mk X fibreglass horn). Note highly smooth and therefore reflective internal horn finish.



The assembled company were slightly disappointed at the initial sound which was a little bright. Studious use of glasspaper and much elbow grease soon ensured an abraded and matt internal finish which helped greatly.



The sound was still not quite up to the magical level we had been hoping for but, a friend who happened to be present and who also happened to be a French horn player, then assured us that the sound quality would be transformed when the ragged edges were trimmed off.....



Having reformed the rim into a perfect and smooth circle, the sound was wonderful to behold.

The point about the well formed edge was slightly counter-intuitive in as much as the sound waves were evolving **INSIDE** the bell and it was not immediately obvious that anything **OUTSIDE** the direct lines of development would have a deleterious effect. However, we were learning fast and it was explained that it is the mouth of all brass instruments which is of critical importance in voicing the instrument.



The completed horn next to its father---Ian Maxted's magnificent original Export Model Oversize from which all dimensions have been faithfully copied.

The results have been very encouraging indeed and Ian and I both agree that we cannot tell the difference when listening to the same record played through each horn in turn, on the same machine, with the same soundbox.

Finally, there is still the opportunity to either paper---wonderful hand made prints are available---or paint one or both sides of the horn. When I say paint, it is my thought and dream that these majestic and noble sound projectors, conceived and executed so brilliantly by the genii at EMG all those years ago, will form the backdrop for magnificent paintings from as many artists as there are horns. It is my hope that items of acoustic and cosmetic beauty and satisfaction will be created.



Since then, a final total of twelve horns has been manufactured, most of which have been built into complete and working gramophones. This picture shows the breeding grounds.....



This rather amusing shot shows the various types of horn (both EMG and Expert) to have been built over the years. The day of the Triffids is at hand....! Other suggested captions on a postcard please.....



This photo shows the internal conduit (Xb & Oversize) in rough-cast form (LM 6 aluminium---no heat treatment) prior to machining. The additional spigot is used for centring purposes and is eventually cut off at the end of the process.



Here are a few photos to show the final article with the horn in unpainted and/or unpapered form. Some gramophones have converted Lumière/HMV cases.











