04/03/2022

ENG 1102

Assignment 2 Report: Prototype Development with 3D Printing

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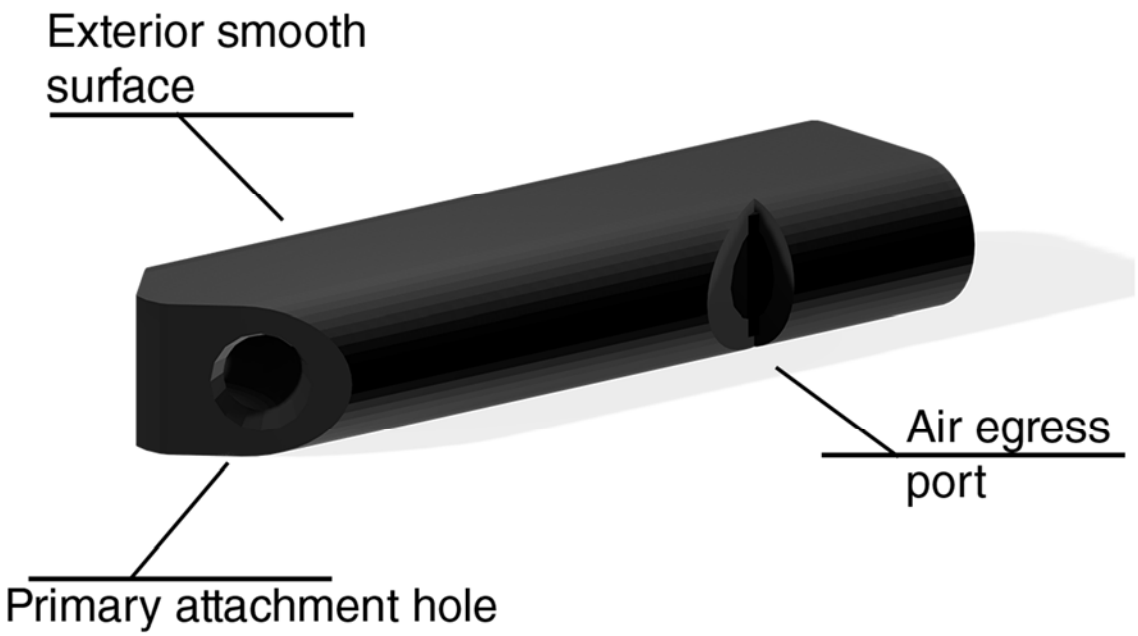
Lassonde School of Engineering

Miryam Kaduri, B.Sc *she/they*

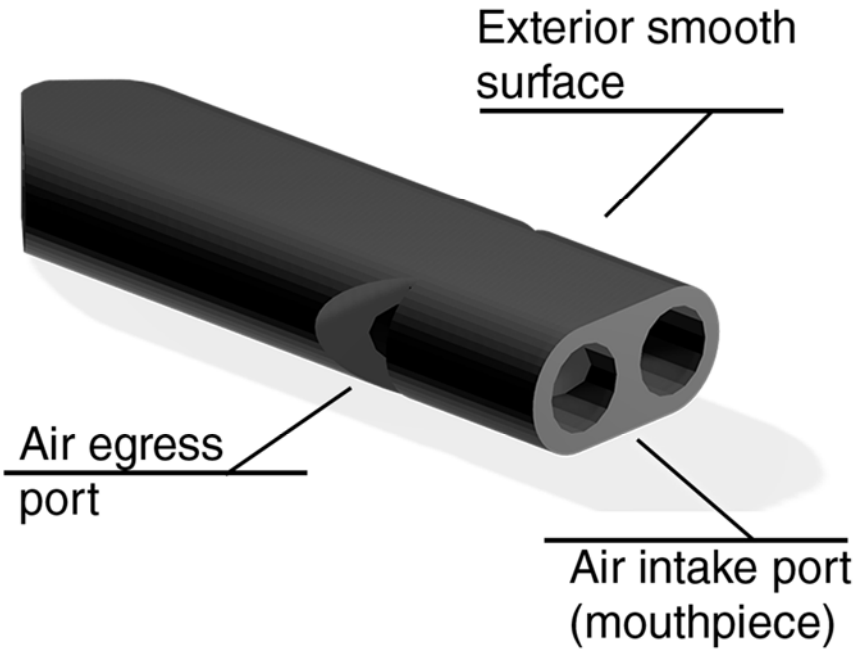
[redacted]

Part A: Two Chamber Whistle Seed

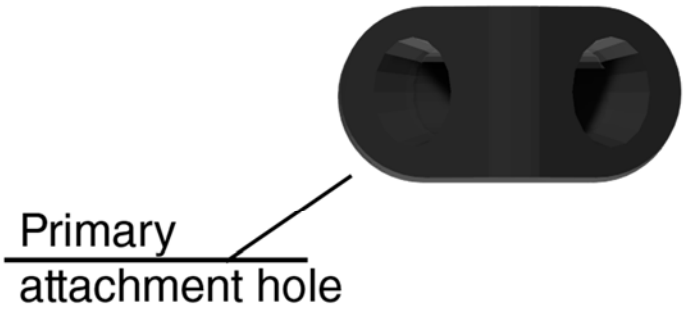
i. Annotated Screenshots



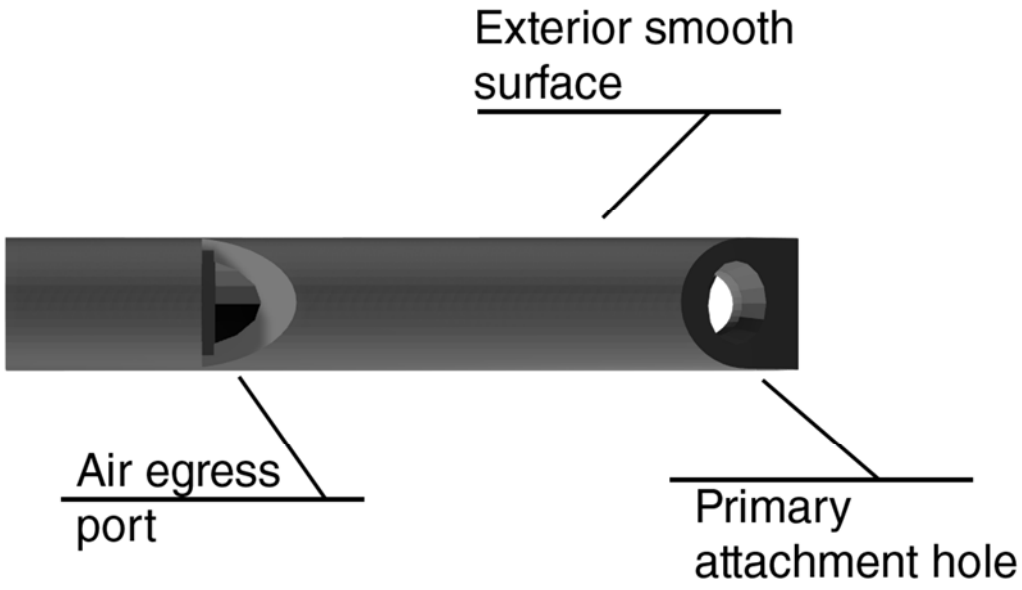
SEED WHISTLE 1: 45° FRONT LEFT VIEW



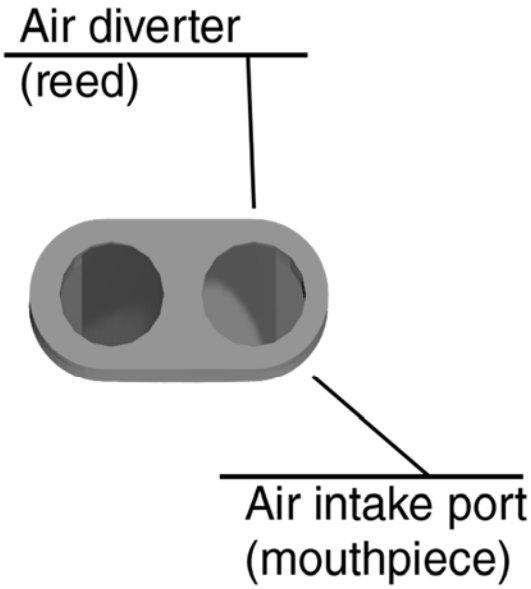
SEED WHISTLE 2: 45° BACK LEFT VIEW



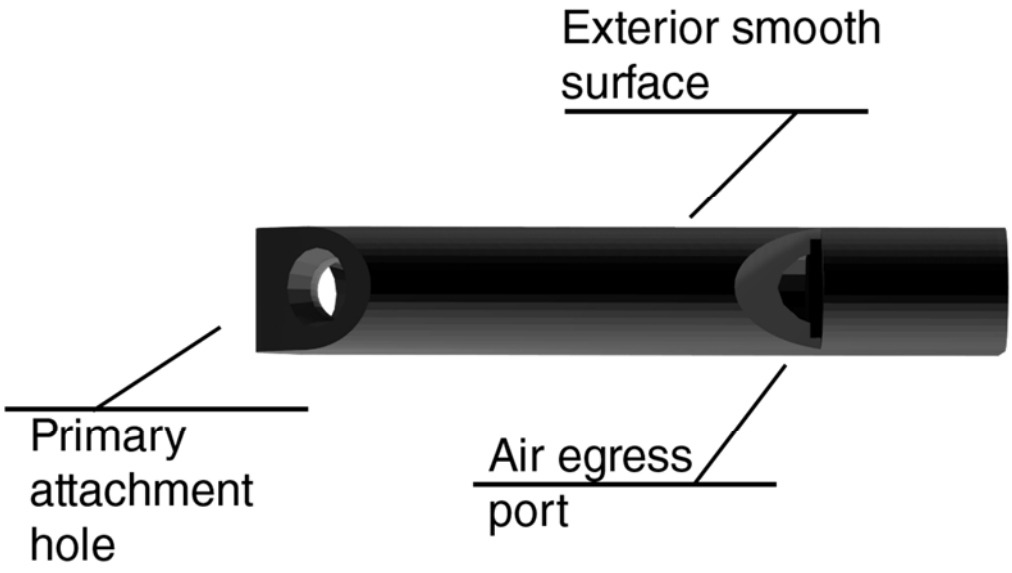
SEED WHISTLE 3: FRONT VIEW



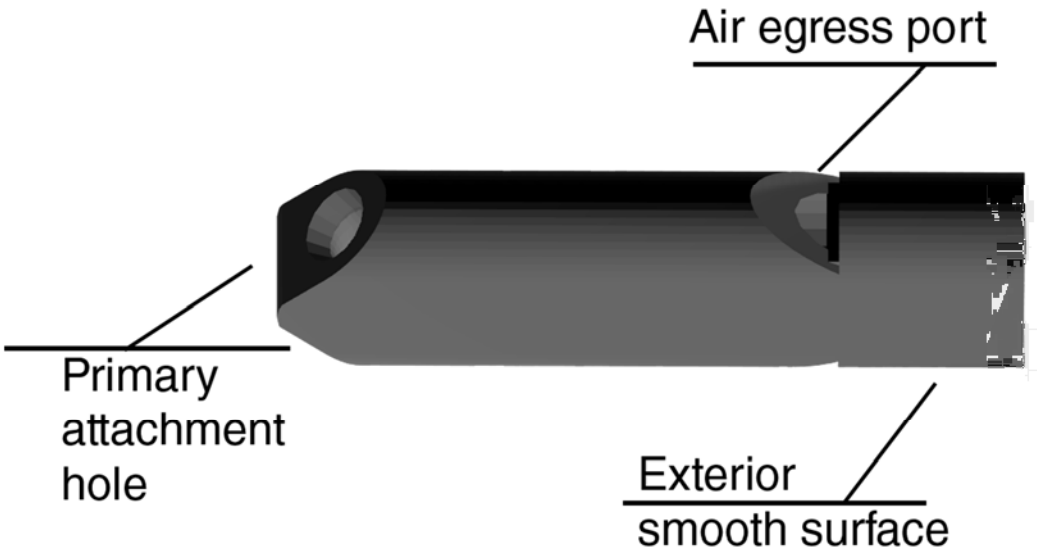
SEED WHISTLE 4: LEFT VIEW



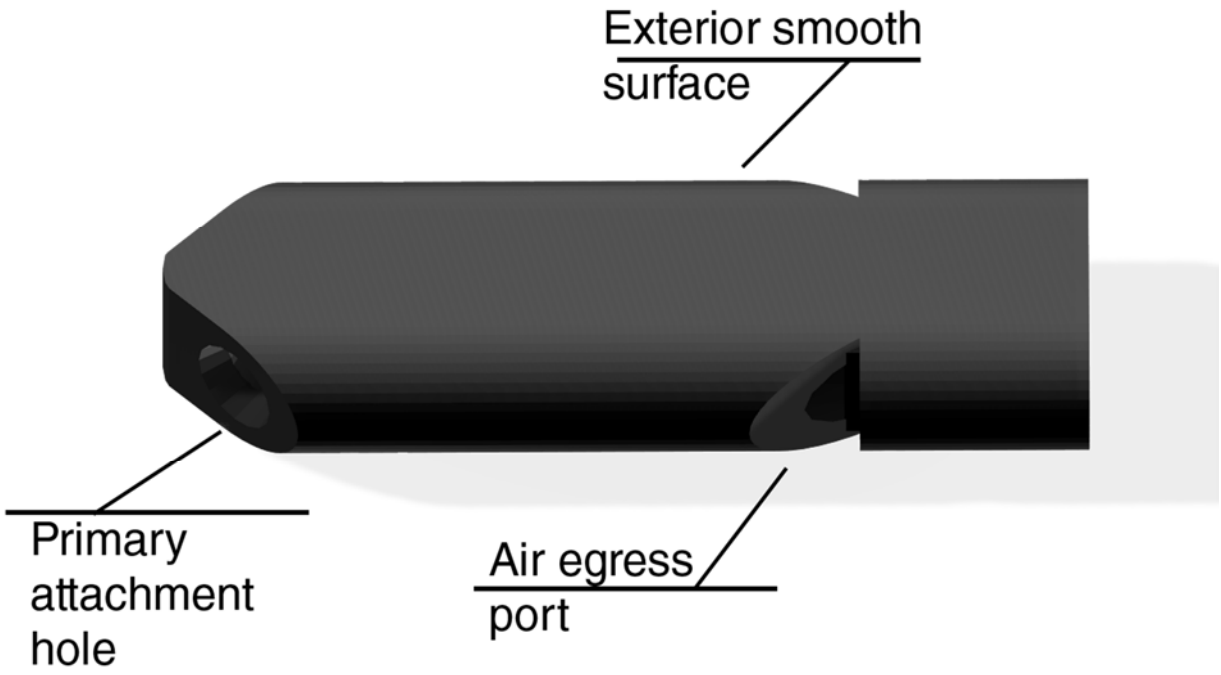
SEED WHISTLE 5: REAR VIEW



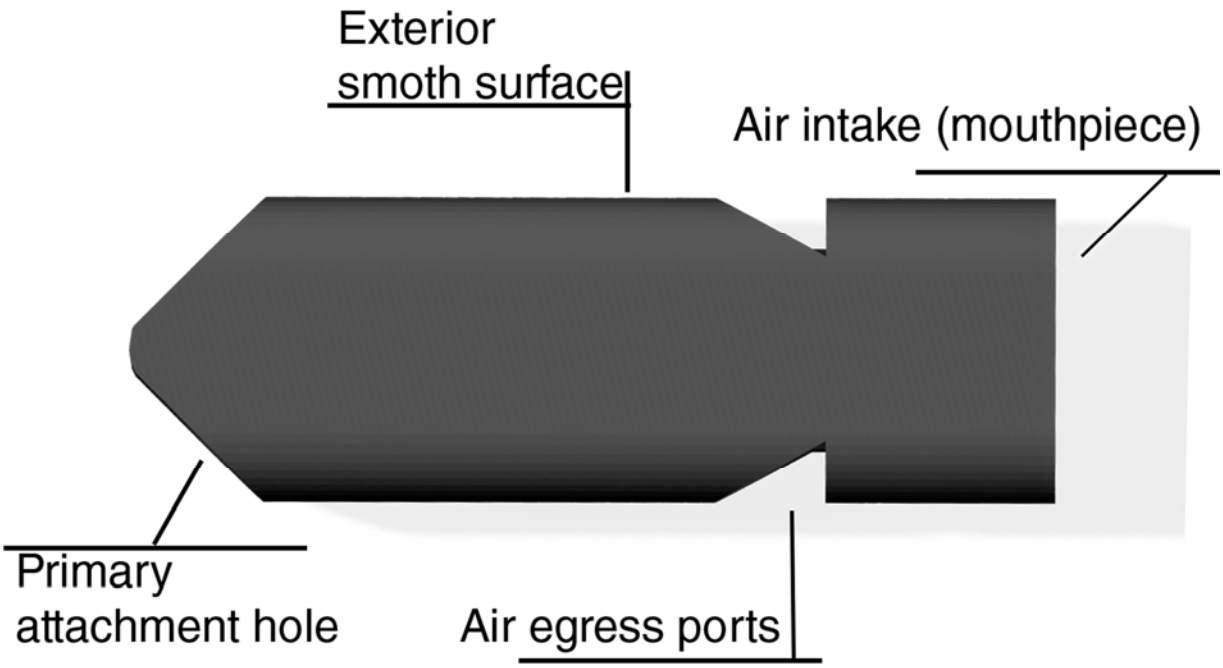
SEED WHISTLE 6: RIGHT VIEW



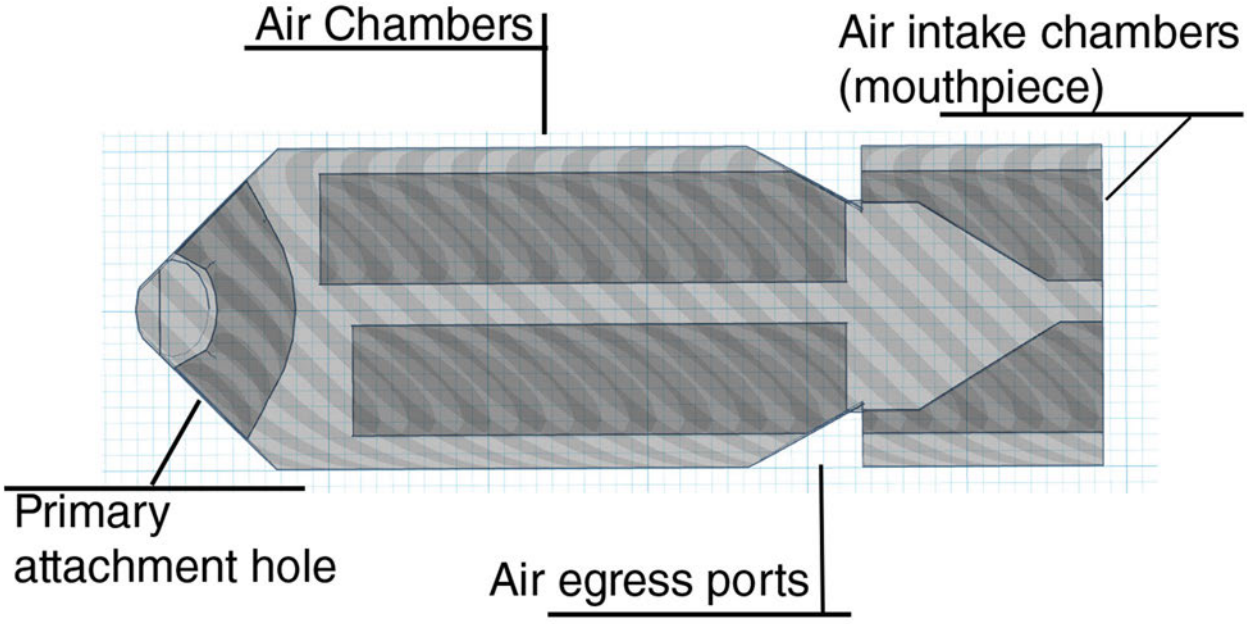
SEED WHISTLE 7: TILT LEFT BOTTOM VIEW



SEED WHISTLE 8: TILT LEFT TOP VIEW



SEED WHISTLE 9: TOP/BOTTOM VIEW



SEED WHISTLE 10: TOP TRANSPARENT VIEW

ii. Motivation for Engineering Function

A whistle transforms air pressure and streaming flow into an audible frequency by creating oscillating sound waves that pass through a resonating chamber, and then egress through a port creating a specific pitch (or multiple chambers and ports for a multi-pitched sound, as is the case with this dual chambered whistle). This particular whistle is a warning/danger whistle; a relatively constant pitch is considered a warning whistle, including rape whistles and survival/rescue whistles, whereas a warbling sound usually created by a spherical "pea" freely moving within the resonating chamber is usually considered a signaling device, which could be used for any number of things including sporting events, lifeguarding, hunting, dog training, etcetera. Some whistles are designed for entertainment or even musical purposes. This whistle is a dual-chambered whistle, which is designed to be very loud. It is compact, relatively lightweight, inexpensive, and should fit easily in the pocket, bag or hand of the user. It includes provision for attachment to a lanyard for wearing around the user's neck or wrist; it could similarly be attached to a bag or hung from a hook on a wall or similar device.

iii. Seed Link

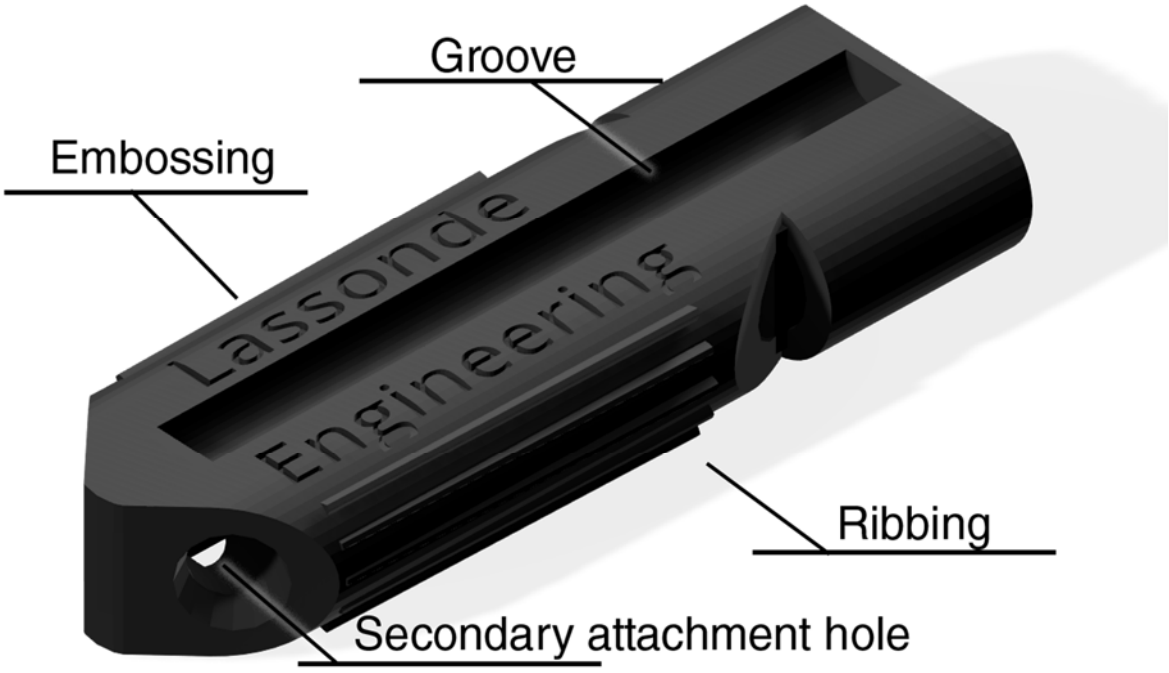
https://www.thingiverse.com/thing:1564108/files

iv. E-class seed file submission

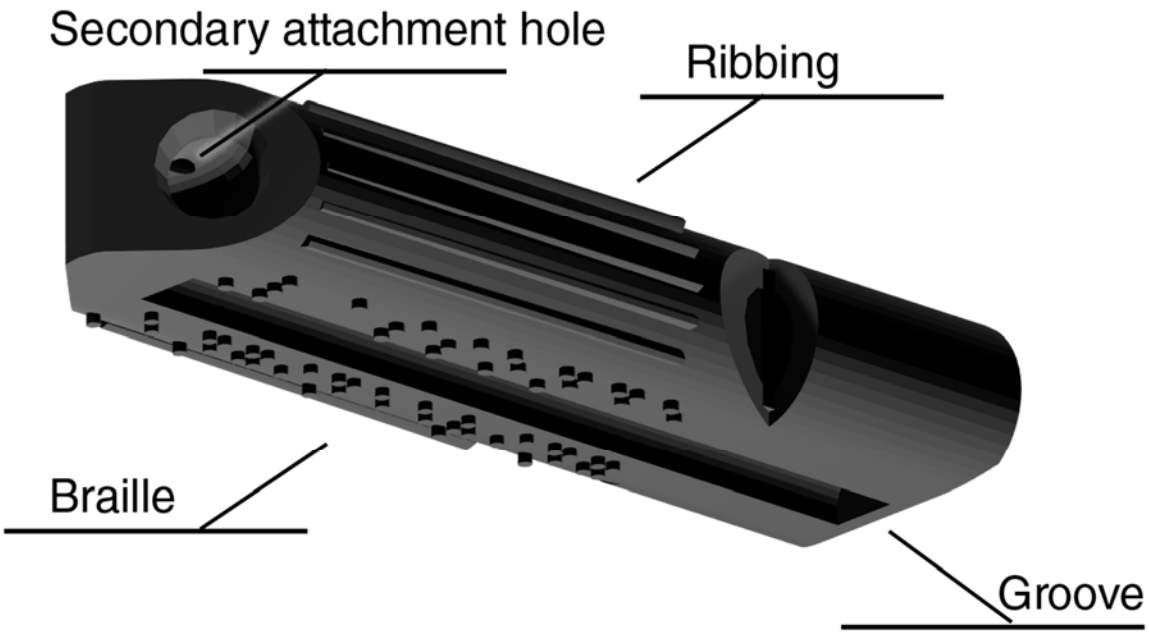
See submission for other included files.

Part B: Lassonde Engineering Whistle

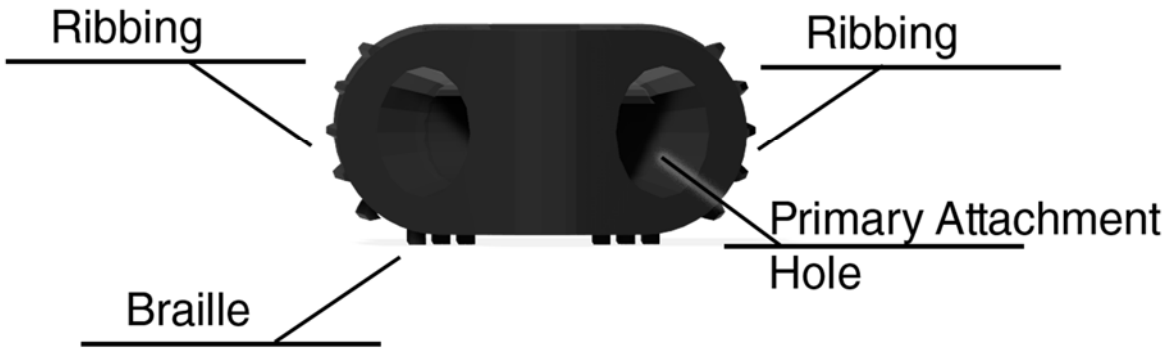
i. Annotated Screenshots



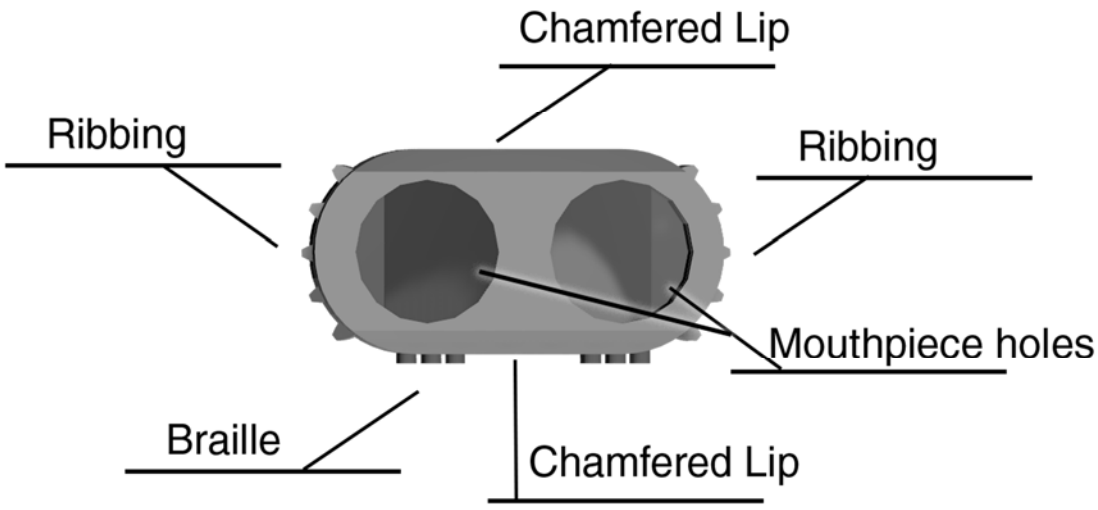
LASSONDE WHISTLE 1: 45° LEFT FRONT TOP VIEW



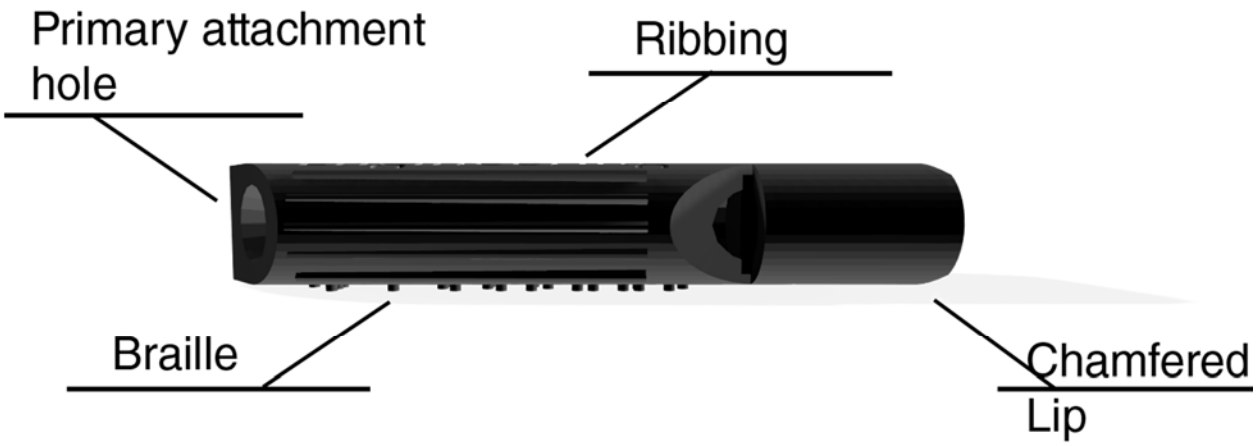
LASSONDE WHISTLE 2: 45° LEFT FRONT BOTTOM VIEW



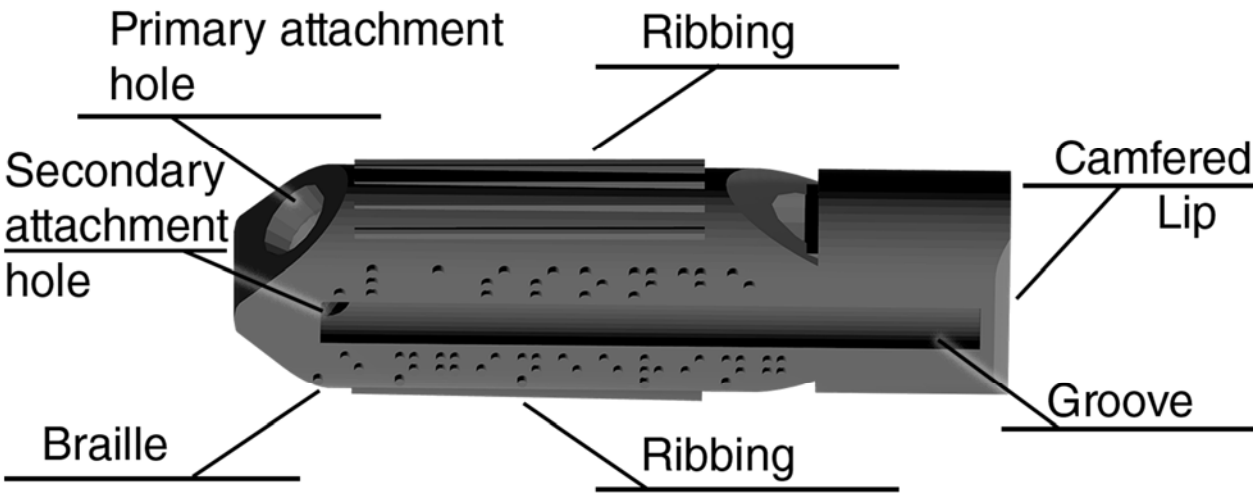
LASSONDE WHISTLE 3: FRONT VIEW



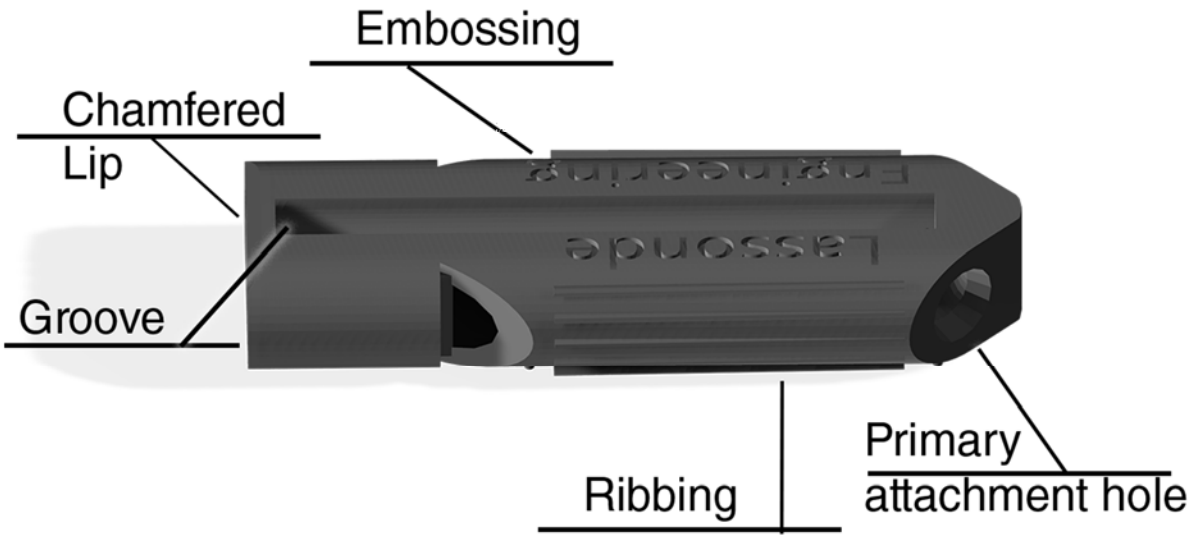
LASSONDE WHISTLE 4: REAR VIEW



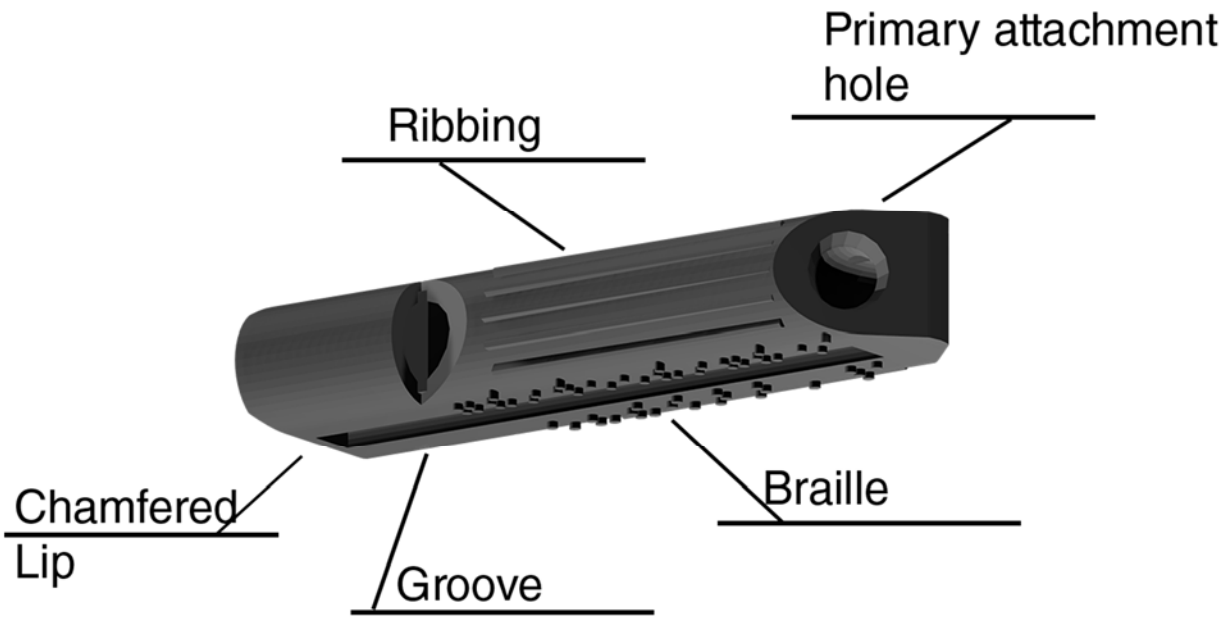
LASSONDE WHISTLE 5: RIGHT VIEW



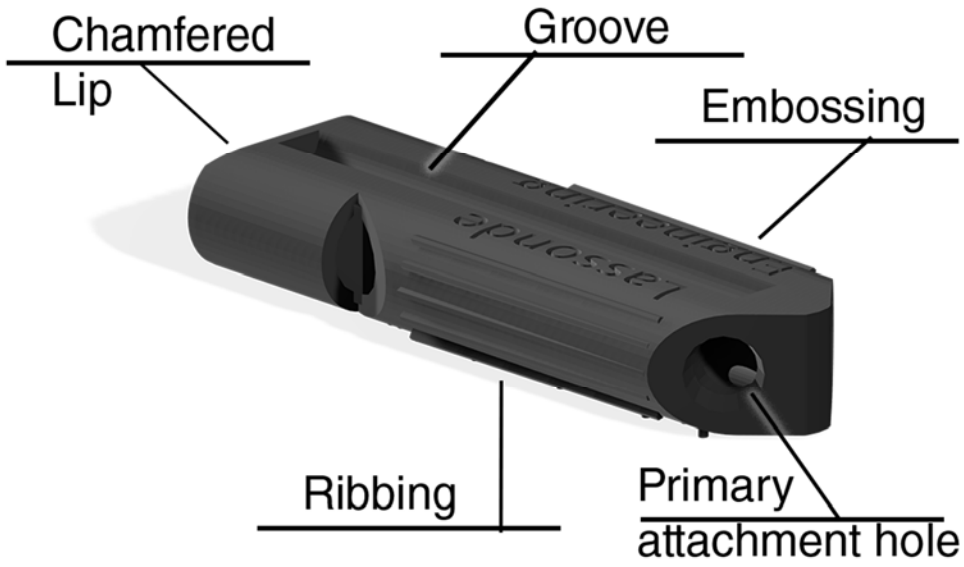
LASSONDE WHISTLE 6: TILT LEFT BOTTOM VIEW



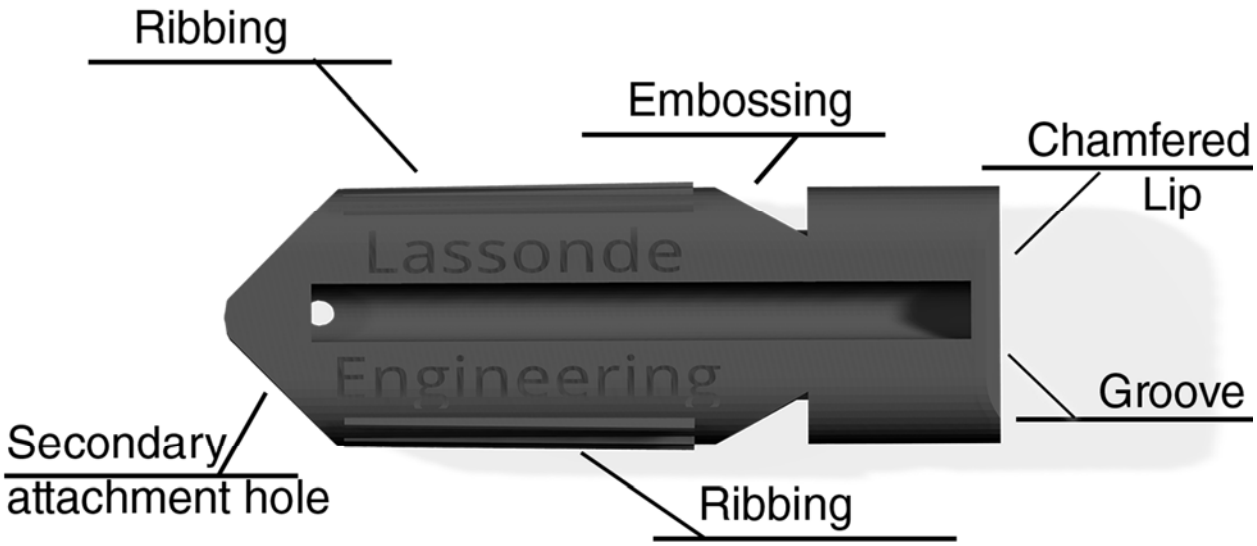
LASSONDE WHISTLE 7: TILT RIGHT TOP VIEW



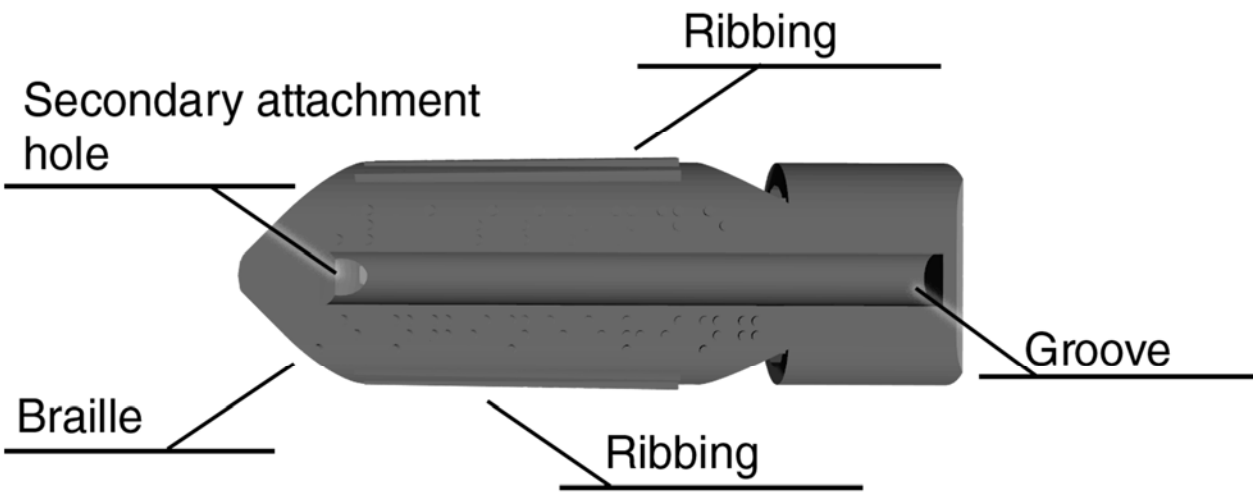
LASSONDE WHISTLE 8: TILT RIGHT BOTTOM VIEW



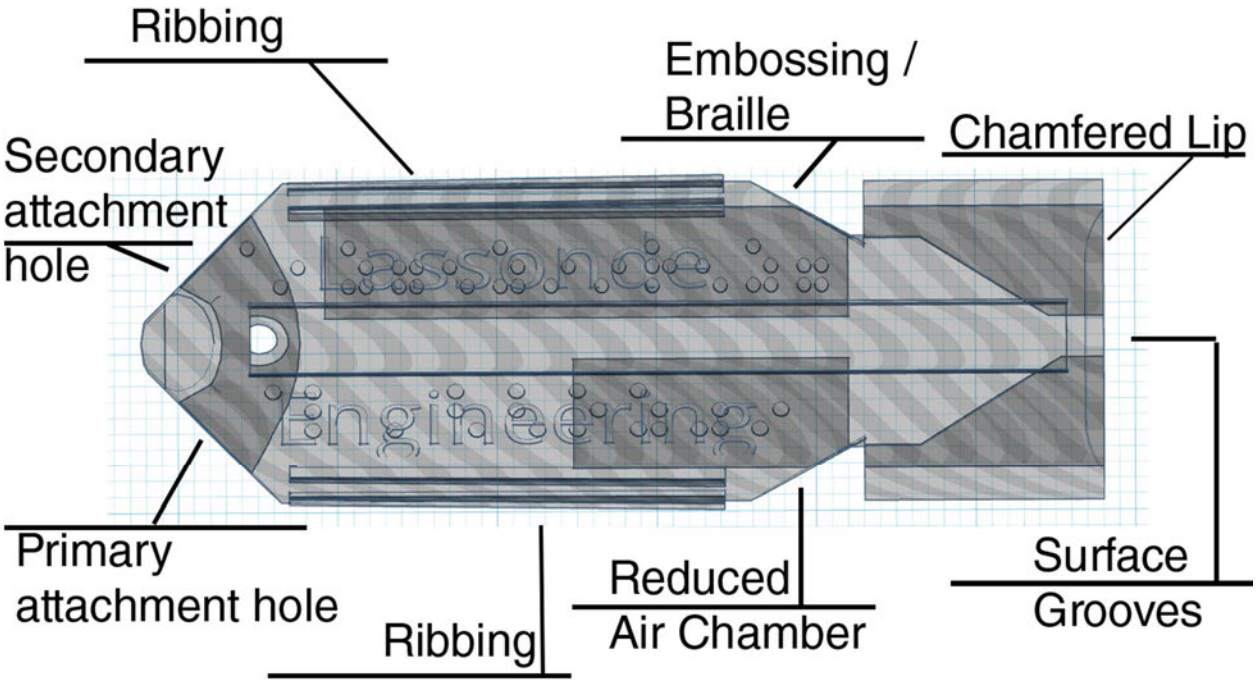
LASSONDE WHISTLE 9: 45° TILT RIGHT TOP VIEW



LASSONDE WHISTLE 10: TOP VIEW



LASSONDE WHISTLE 11: BOTTOM VIEW



LASSONDE WHISTLE 12: TOP TRANSPARENT VIEW

ii. Motivation for Modifications

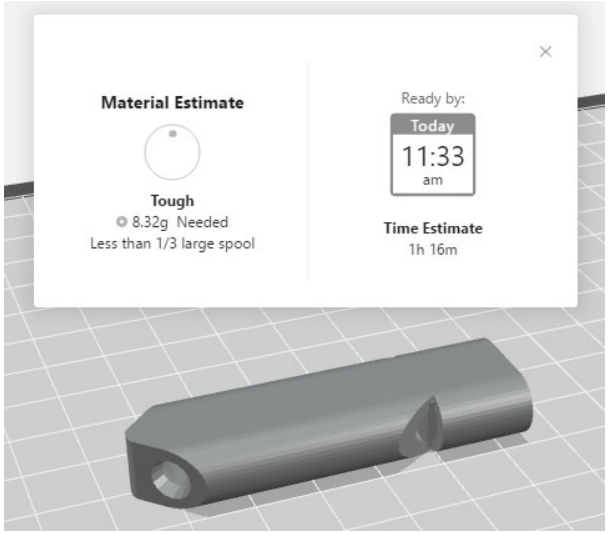
Several different modifications were made to the original device, improving the principal functions of the device. The grooves cut out of the top and bottom of the whistle reduce the total amount of material needed to produce the device, lowering the cost of production and shipping through mass reduction. This reduction also permits the addition of several desirable features that will require additional material. Careful balance between reduction and addition is maintained in order to ensure provision of an overall reduction in material used. Both the reduction of material via grooves, and the addition of material through ribbing, provide the user with an improved grip surface, and additional holding positions on the device so that fundamentally it can be gripped in different hand positions. The increased surface area of this textured surface provides a superior surface for the user to grip onto in different weather conditions which can see reduced surface friction from lubricants on the surface, such as water or snow). These two modifications would permit a user to be able to hold the device in less ideal conditions, which improves the whistle as an emergency device. Removing material allowed for addition of other features that help make the device better able to serve its purpose without adding additional material cost or weight to the device. Notably, including both the English and Braille to the faces of the device introduces an entirely new userbase that was formerly precluded from accessing the device, and adds further gripping surface as a tertiary characteristic. The mouthpiece lip was also chamfered to improve ergonomics, so that it would slide easier across the lips and more softly abut the teeth. Modifications were made to one of the two resonance chambers in order to introduce harmonics, reducing the amplitude fluctuations that come with dissonance, and without affecting the other sound properties like volume.

iii. E-class modified file submission

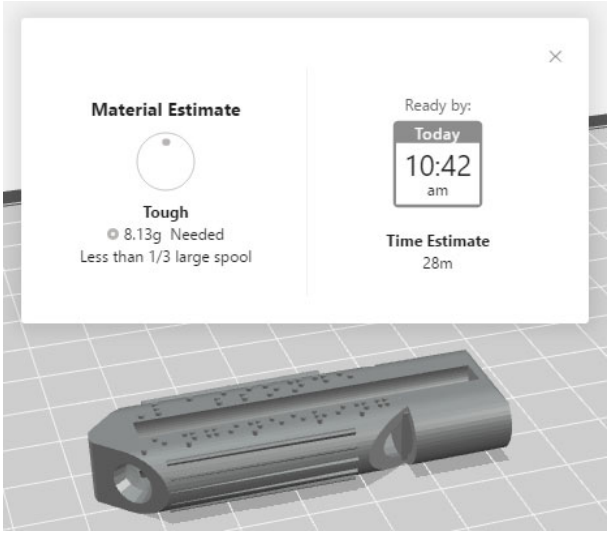
See submission for other included files.

Part C: Evidence of Modification

i. Diagram Comparison (with Annotations)

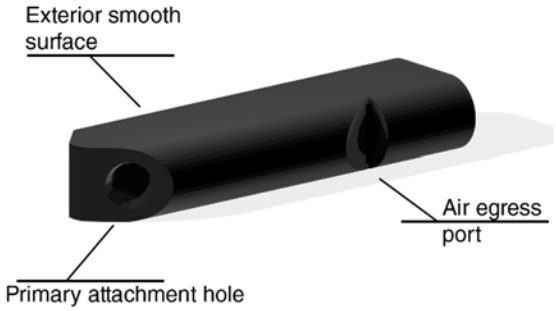


SEED WHISTLE 11: PRINT TIME

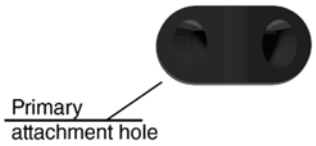


LASSONDE WHISTLE 13: PRINT TIME

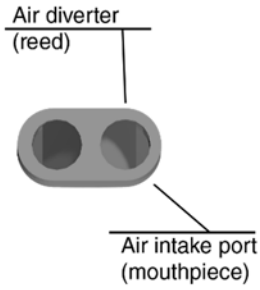
The modified whistle (left) takes approximately 36.8% of the print time of the seed file, and uses 0.19g less material than the seed (around 2.3% less volume).



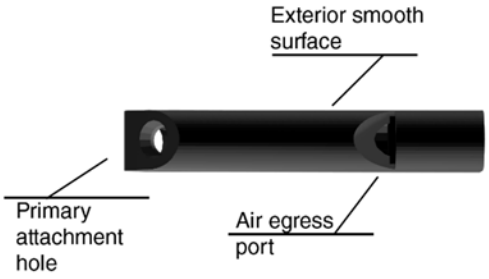
SEED WHISTLE 11: 45° FRONT LEFT VIEW



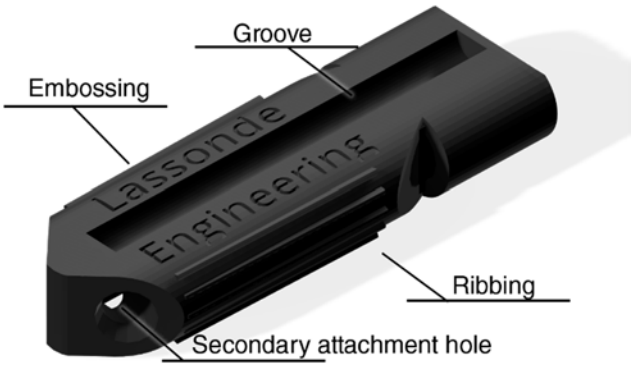
SEED WHISTLE 12: FRONT VIEW



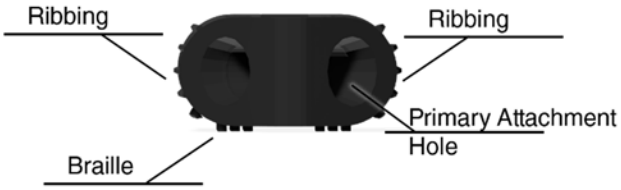
SEED WHISTLE 13: REAR VIEW



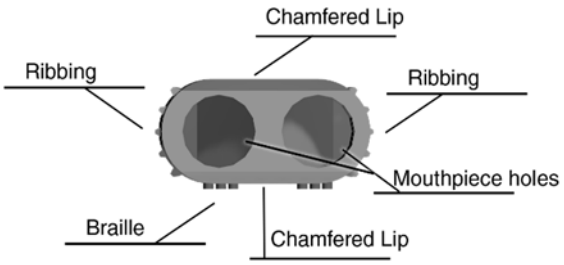
SEED WHISTLE 14: RIGHT VIEW



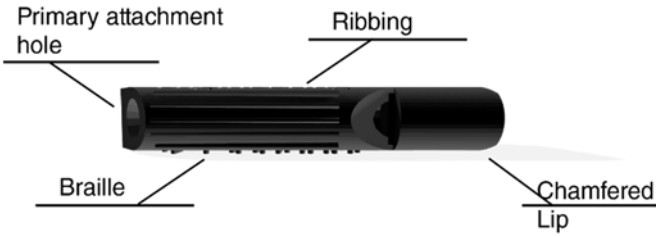
LASSONDE WHISTLE 14: 45° LEFT FRONT TOP VIEW



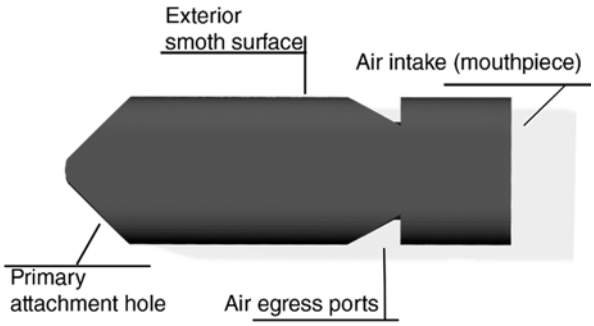
LASSONDE WHISTLE 15: FRONT VIEW



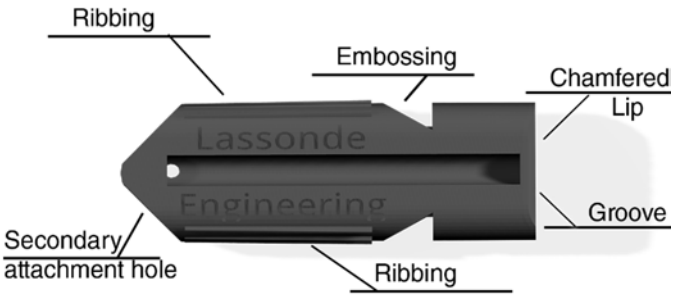
LASSONDE WHISTLE 16: REAR VIEW



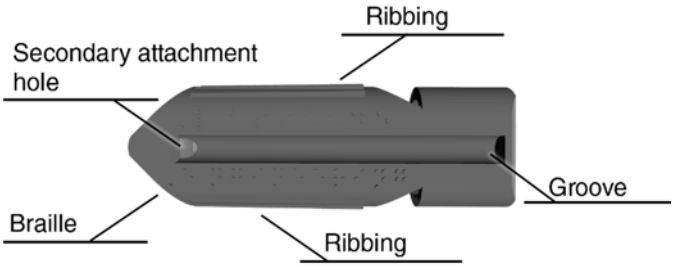
LASSONDE WHISTLE 17: RIGHT VIEW



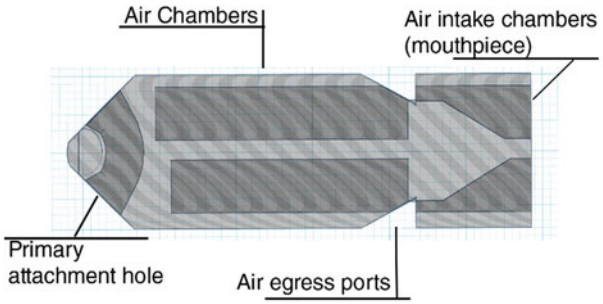
SEED WHISTLE 15: TOP/BOTTOM VIEW



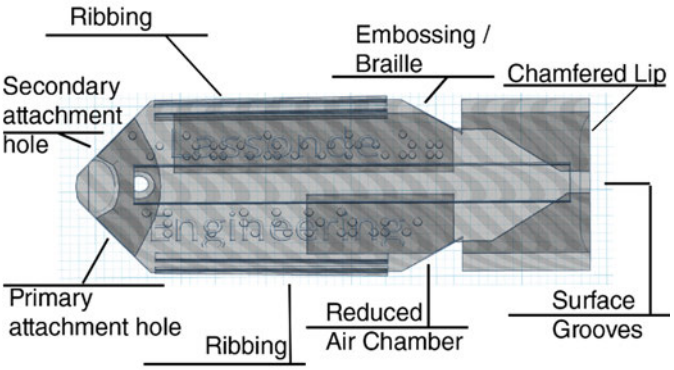
LASSONDE WHISTLE 18: TOP VIEW



LASSONDE WHISTLE 19: BOTTOM VIEW



SEED WHISTLE 16: TOP TRANSPARENT VIEW



LASSONDE WHISTLE 20: TOP TRANSPARENT VIEW

ii. Modification Explanation, by Groupings

a. Cut out groove on bottom surface

Cutting a rounded groove from the mouthpiece towards the nose in the center bottom of the whistle, parallel to the resonating chambers, reduces the amount of material needed to print the object and thus decreases production time and cost, without interfering with the primary function of the device. This modification also reduces the total mass, providing a lighter device for the user to carry and reducing shipping costs from manufacturer to end user. The placement of the groove also provides increased surface area along with an additional edge on the interior of the device, providing a superior gripping point. Retaining some of the original dimensionality and surface properties on both ends of the groove, between it and the ends of the device, preserves its structural integrity and rigidity.

b. Cut out groove on top surface

As with the groove on the bottom (vide a), removing material for a similar groove from the top of the device further reduces the printing material, and thereby production cost and time. Device mass is also reduced. These grooves, being placed parallel to each other on opposite sides, provide several comfortable place holding positions between the users thumb and fingers.

c. Introduced secondary attachment option

A determined secondary effect of the depth and placement of the grooves on the top and bottom of the device, is an intersection with the existing attachment point hole at the front of the device; this provides a hole from the top through to the bottom of the device. This added hole introduces a secondary attachment option. This secondary attachment does not permit the easy sliding of the device along the rope or lanyard as does the principal attachment orientation, and it adds the option for the device to be attached in a front-to-back lanyard orientation rather than only the side-to-side lanyard orientation of the principal attachment hole. The user can thus choose between flat or rotated orientation when on a lanyard. This also provides the third alternative of threading the lanyard through both orientations, providing redundancy in the attachment and reduced risk of loss.

d. Resize one resonance chamber

One of the two resonance chambers was shortened to half the length of the other, in order to provide a recalibration of the pitch provided by that chamber. This modification provides a harmonic pair of pitches, that is less abrasive than the original, without sacrificing its other auditory properties (principally volume).

e. Embossing (Added branding in English (Lassonde Engineering))

Embedded embossing (i.e. debossing) is used to carve the words “Lassonde Engineering” across the top surface of the device, reducing the material weight, cost, and production time. This also increases brand recognition and can help identify the user in a crisis. Additionally, the tactile and visual modification distinguishes the device from similar whistles.

f. Added branding in Braille (Lassonde Engineering)

Relief embossing is used to lift the words “Lassonde Engineering” across the bottom surface of the device, reducing the material weight, cost, and production time. Adding this clearly distinguishes it from other similar products, and addresses the needs of an otherwise neglected user base with additional accessibility needs. The device can thus serve a more socially inclusive user base.

g. Chamfer (45°) top and bottom lip of mouthpiece

To improve the ergonomics of the mouthpiece, the edge of the lip has been chamfered, removing the blunt edge that would otherwise be sliding across the user's lips and abutting their teeth. This modification also reduces the material needed to produce the device.

h. Ribs added to both sides

In addition to the increased surface area and additional edges for grip provided by the grooves, additional ribbing has been added on both sides of the device, to further increase surface area and improve the user's ability to grip the device even when wet or otherwise affected by a lubricant on the surface of the device. These ribs secondarily provide additional structural integrity to the device along the lengths of the resonance chambers, and provide for less unintended vibration in those chambers.