STAINLESS STEEL CHAMBER CONSTRUCTION METHOD

Kevin Kahmark and Neville Millar

W.K. Kellogg Biological Station, Michigan State University

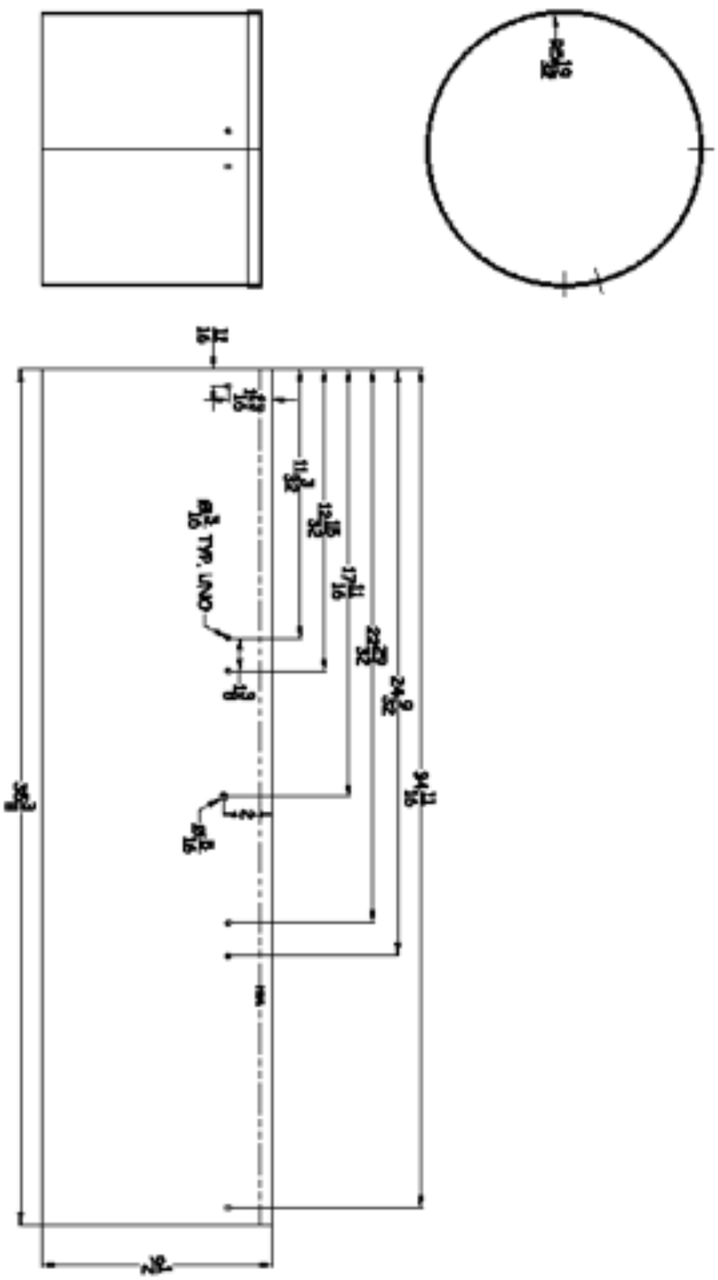
OBJECTIVE

This document outlines the construction of closed cover stainless steel chambers used within an agricultural field environment. These chambers are designed for use at the Great Lakes Bioenergy Research (GLBRC) sites in S.W. Michigan and Wisconsin. These chambers are appropriate for nitrous oxide (N_2O), methane (CH_4), and carbon dioxide (CO_2) flux determination.

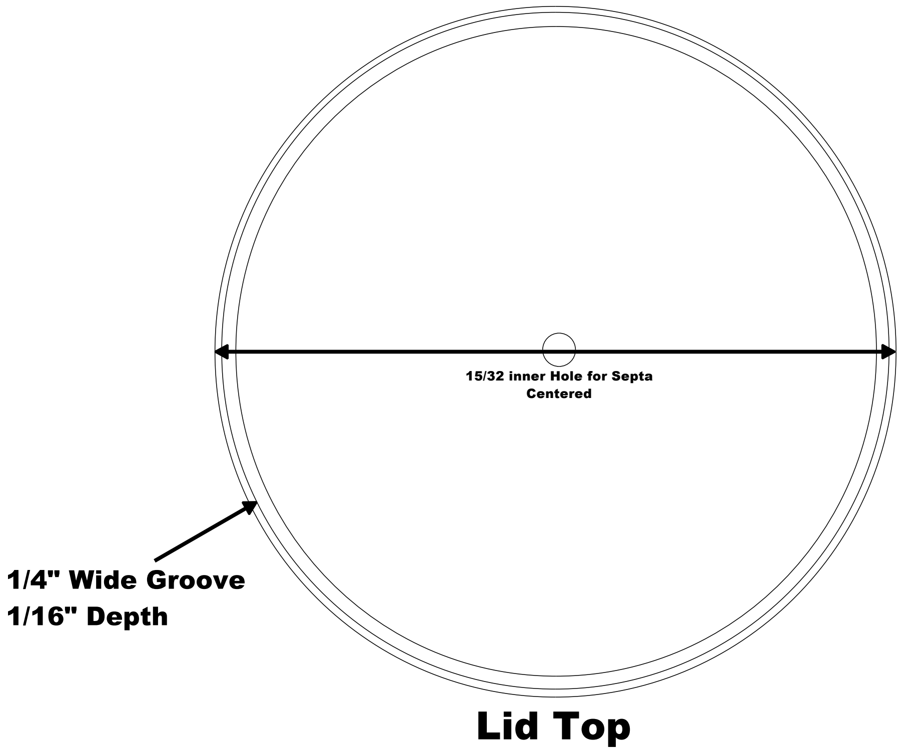
There are many reviews and publications in the scientific literature discussing similar sampling protocols and procedures for determining gas fluxes using various chamber systems, and readers are encouraged to conduct their own research on these. However, we hope this construction protocol will act as a useful guide for researchers and technicians undertaking GHG sampling in the field. Naturally, modifications and replacement of the equipment we list and other laboratory or field operations may be necessary depending upon the particular working environments encountered, and should be adopted when and where appropriate.

CHAMBER CONSTRUCTION

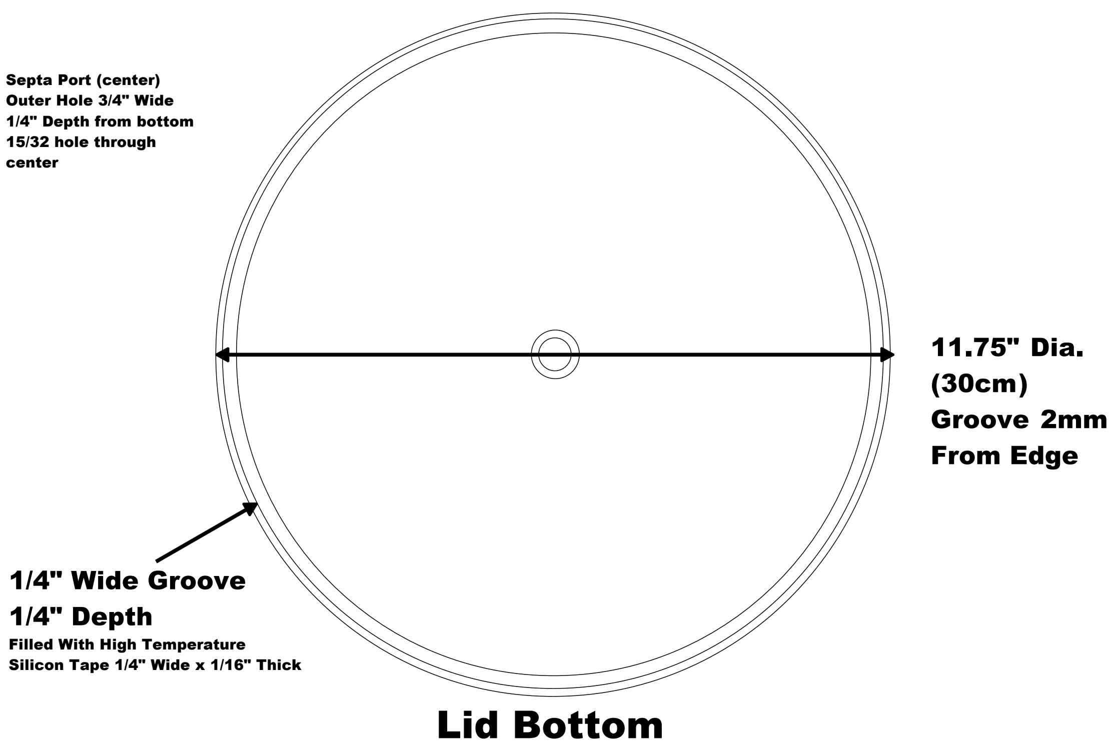
1. The chamber drawings below were used to construct the shell and lid of the chamber. KBS contracts with a local mechanical fabrication company to stamp and weld the cylinder and holes to the drawing specifications (Drawing 1). The top of the cylinder is folded prior to welding for additional strength.



1. Stainless Steel Chamber Construction (16G).



Drawing 2. HDPE Lid Top



Drawing 3. HDPE Lid Bottom

Figure 1. Lid Bottom with dimensions

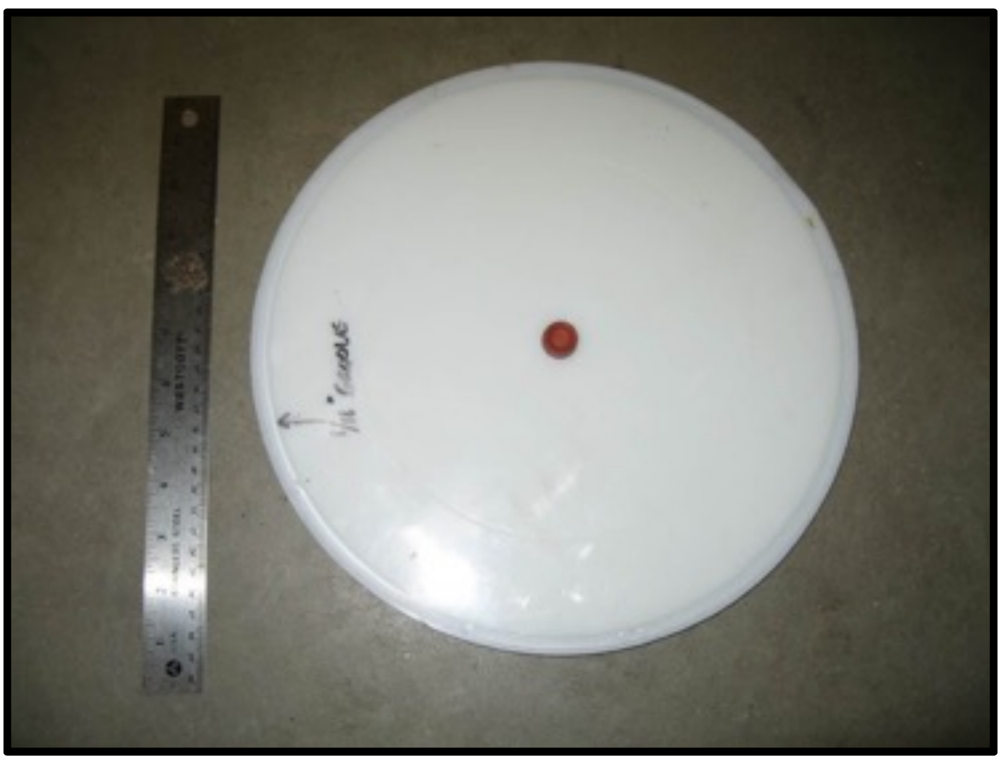


Figure 2. Lid Top with 1/4"x1/16" depth groove

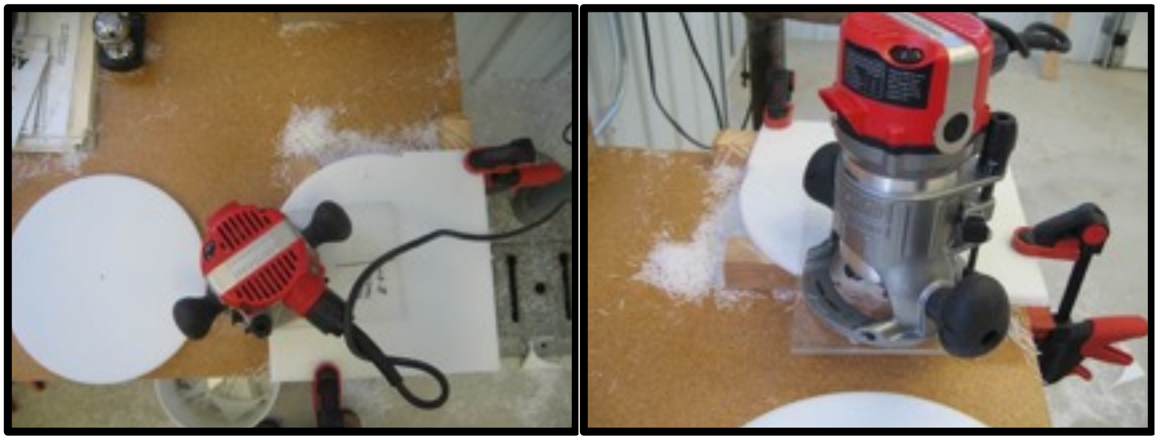


Figure 3. Routing the lid outer dimension

2. The lid is fabricated at KBS from ½” HDPE white plastic. Twelve inch squares are cut and a center hole is measured and drilled. Several router templates were fabricated to aid in the completion of the lid design (Drawings 2 and 3). Figures 1 and 2 show dimensions and a completed lid (top and bottom) design.

3. The lid is routed to size using a template that cuts a circle from the HDPE square to a 29.8 (+/-.1) cm diameter using a ¼” straight routing bit (Figure 3).

Figure 4. Routing the lid groove for a complete seal.

4. The bottom groove is made with the ¼” routing bit using a template. The groove should be 2mm from the lid edge, and routed to ¼” depth to allow installation of the seal (Figure 4). The seal is a high temperature silicone ¼” strip with adhesive backing. The strip end is cut at an angle, inserted into the groove and set firmly around the groove (Fig. 4A) A 24-hr wait ensures the seal will not shrink from the installation stretching. The end of the strip is to length with an angle that matches the start end cut so the two end pieces can be joined flat for an airtight seal. A dab of silicone gasket material is used to seal the joint.

Figure 4A. Seal installation into the lid bottom groove.

Figure 5. Lid top groove routed to 1/16" depth.

5. The top of the lid has a groove routed so the chamber clamps can grab the lid and provide enough force for a firm seal. The groove is routed with the ¼" straight router to a 1/16" depth (Figure 5).

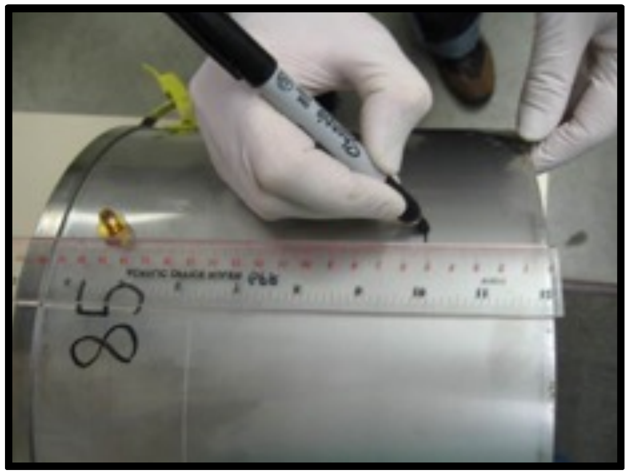


Figure 6. Depth of chamber soil penetration mark

6. Mark several places around the outside of the chamber, using a permanent marker, at 5 cm (4") above the bottom of the chamber (Figure 6). With the GLBRC chambers, this mark demarcates an internal headspace volume of approximately 11.7 liters (L) following deployment of the chamber into the soil up to the depth marked by the line. Actual chamber headspace volumes are determined subsequently under field conditions and discussed later.

Figure 7. Lid/Septa Construction

7. A 15/32" drill bit is used to increase the center hole for septa installation. On the bottom seal side of the lid, a 3/4" recess is drilled ¼" in depth to allow the septa expansion room once the septa is installed on the top of the chamber (Figure 7). This allows the septa to fit firmly in place to create a gas tight seal. The septum acts as the sampling port through which the needle will be inserted and removed during gas sampling.

Figure 8. Vent installation

8. The vent is installed using a 1/8" swagelok bulkhead union and a 15 cm long coiled copper tube. A buna washer/o-ring is installed between the inside chamber wall and the bulkhead union nut to prevent leakage around the fitting (Figure 8).

Figure 9. Clamp design and installation

9. There are three clamps on the outside of the chamber that firmly hold the lid in place. These clamps (draw latch) are purchased from McMaster-Carr, Inc. (Part# 1863A21). The clamp plate is bent partially to fit the curve of the chamber, then tool dipped to prevent corrosion. The clamps are installed with stainless or black oxide machine screws with a rubber washer on each side of the chamber to prevent leakage around the screws (Figure 9).