

Appendix C

Micro-Channel Plate Detector

Electron detection for the magnetic bottle spectrometer was accomplished with a custom designed micro-channel plate detector. The detector consists of two plates biased at ~ 1 kV each. The plates are made up of many micron-size diameter channels. Any electron that impacts the front of the detector kicks off secondary electrons. These electrons are then accelerated towards the anode, while building up signal with each additional impact to the channel walls, allowing ~ 60 times signal gain. The micro-channel plate detector was designed to be compact enough to fit on a NW40 flange. Figure *C.1* shows the basic design. The two plates are separated by a stainless steel spacer. The front and outer part of the detector is grounded while the anode is held at a high voltage. Vespel is used as the insulator. The anode is connected to a feedthrough which supplies the high voltage and transmits the fast current signal from the micro-channel plates. Separation of the fast signal is accomplished with a Bias Tee (Picosecond Pulse Labs, Model 5531). The feedthrough was purchased from Ceramaseal, Inc. (model 1084-01-W), designed for 50 Ohm impedance. To prevent any signal reflection which could cause multiple counts for one electron, the detector was designed to have 50 Ohm impedance from the feedthrough to the anode. The impedance of a coaxial waveguide is given by the expression,

$$Z_0 = \frac{276}{\sqrt{\epsilon}} \ln \frac{b}{a} \quad (\text{C.1})$$

where ϵ is the permittivity of the insulator between the conductors, a is the inner conductor radius, and b is the radius to the inner edge of the outer conductor. For Vespel, $b/a=4.81$ for 50

Ohm impedance.[52] Figure C.2 shows the detailed dimensions of all the parts of the detector.

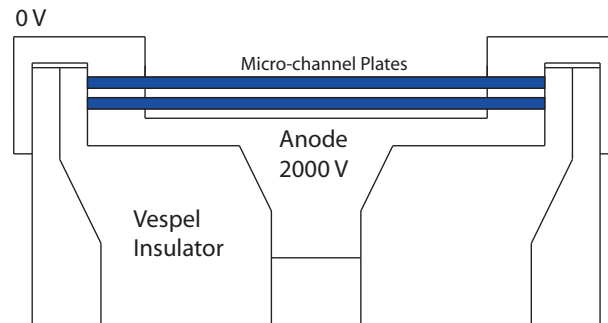


Figure C.1: MCP detector design. The micro-channel plates are in dark blue. The anode is biased at 2 kV and is insulated from the grounded stainless steel housing.

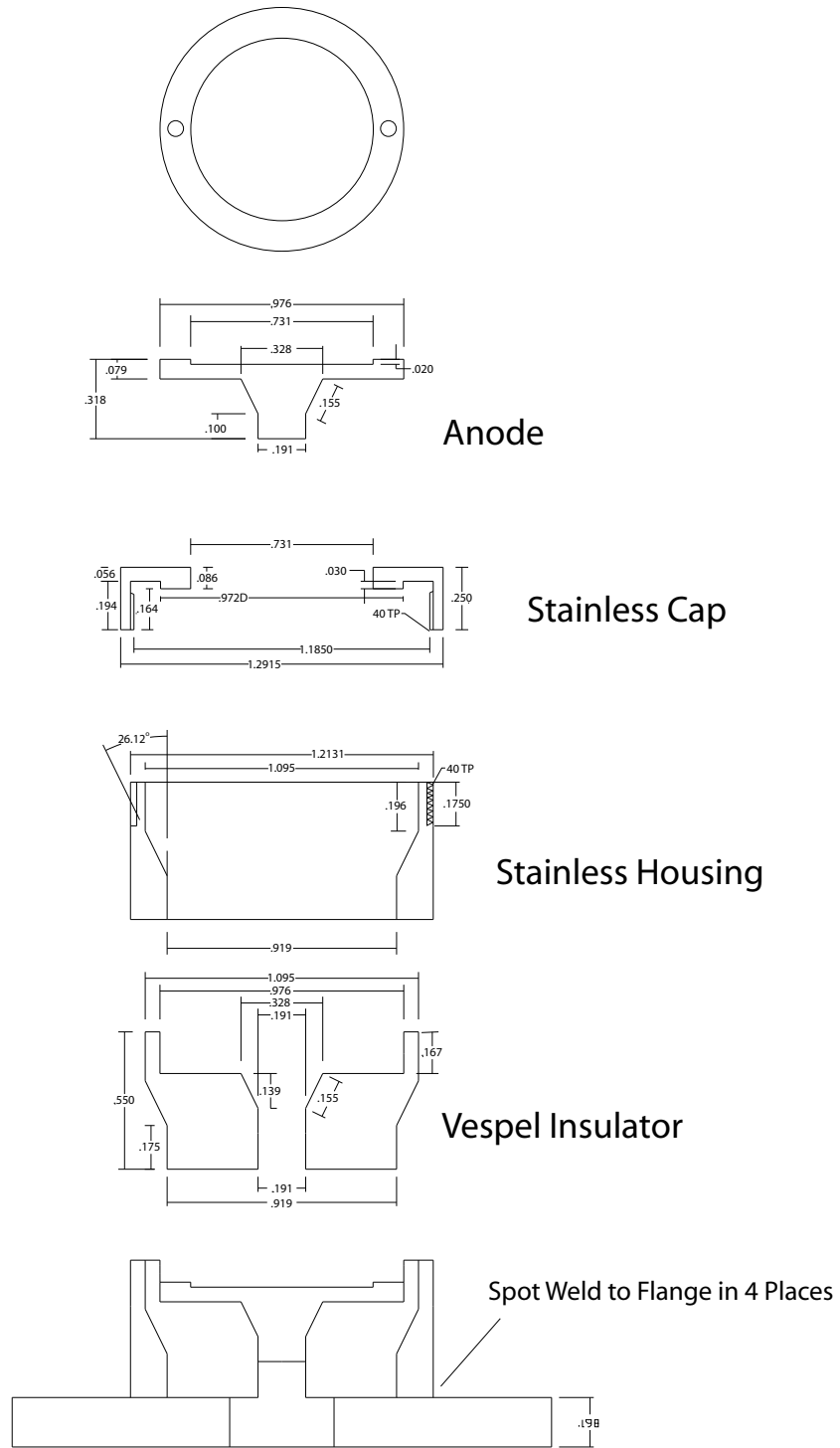


Figure C.2: Detailed schematic of the MCP detector giving dimensions for each part. All dimensions are in inches.