

Foil Sealing Assembly used on 11 MeV Proton Targets

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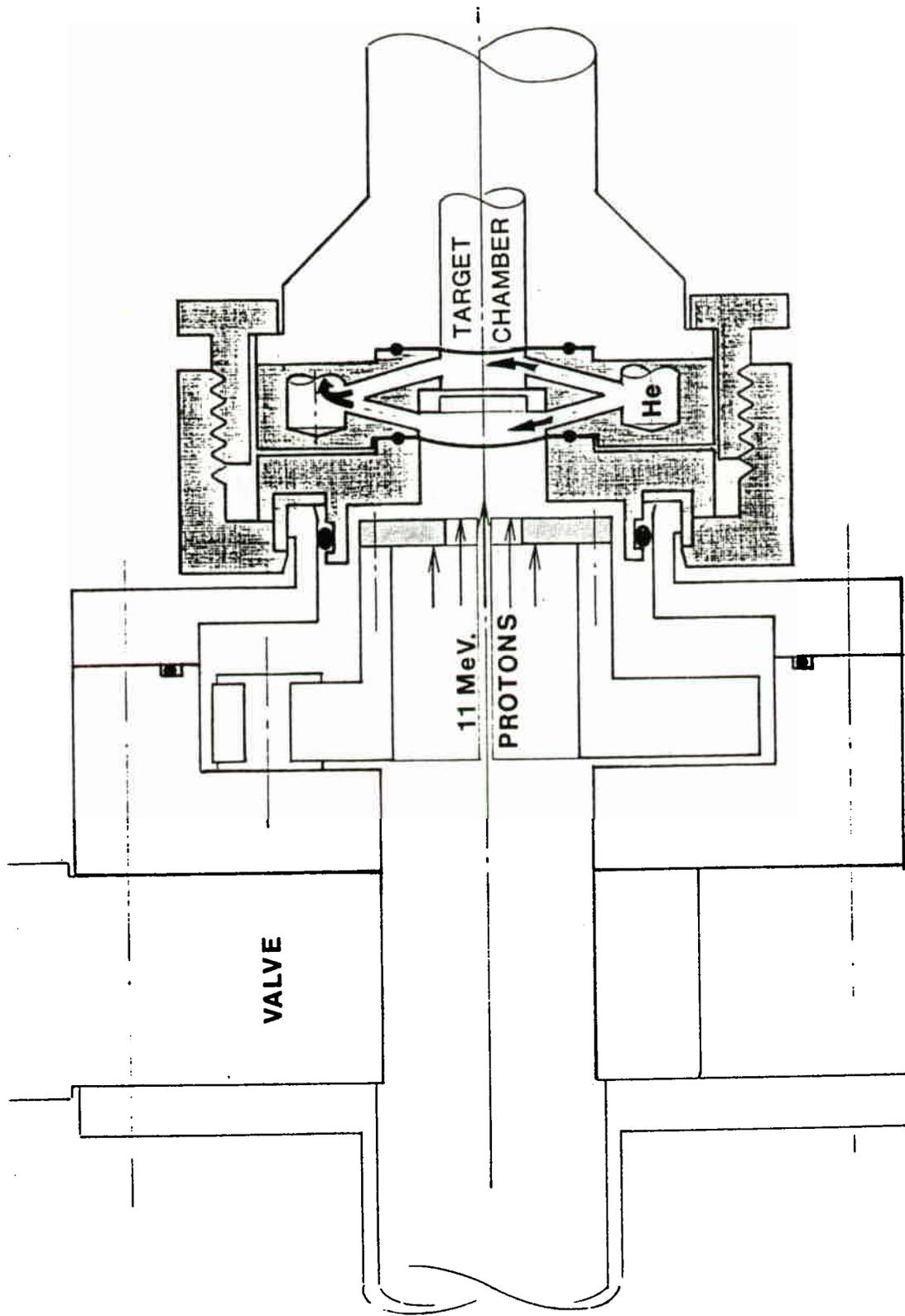
All CTI, Inc. targets for producing ^{11}C , ^{13}N , ^{15}O and ^{18}F using 11.2 MeV protons utilize an identical screw-together beam foil assembly, which includes gold seals on two sides of both the vacuum and target foils, He jets (placed in the space between the foils) to cool both windows, an optional carbon energy degrader, and a nose piece to attach the target assembly to any of the four beam lines. The foil/coupler parts are illustrated in figures 1 and 2. The seals are accomplished by small circular ridges machined on both sides of the Al-foil cooling spacer. Table 1 gives target foil parameters. A test assembly using a 0.025 mm Havar target foil has been pressurized to failure with no beam. It remained leak tight until rupture occurred at 65 atmospheres. It was successfully operated up to 50 atmospheres with a 45 μA incident beam on a gas target. This exceptional ability to operate thin foils leak tight at high pressures with high beam currents is due to three key features:

- extremely uniform beam distribution
- small foil frame size (stress is proportional to diameter)
- effective sealing/clamping design
- Helium jet cooling

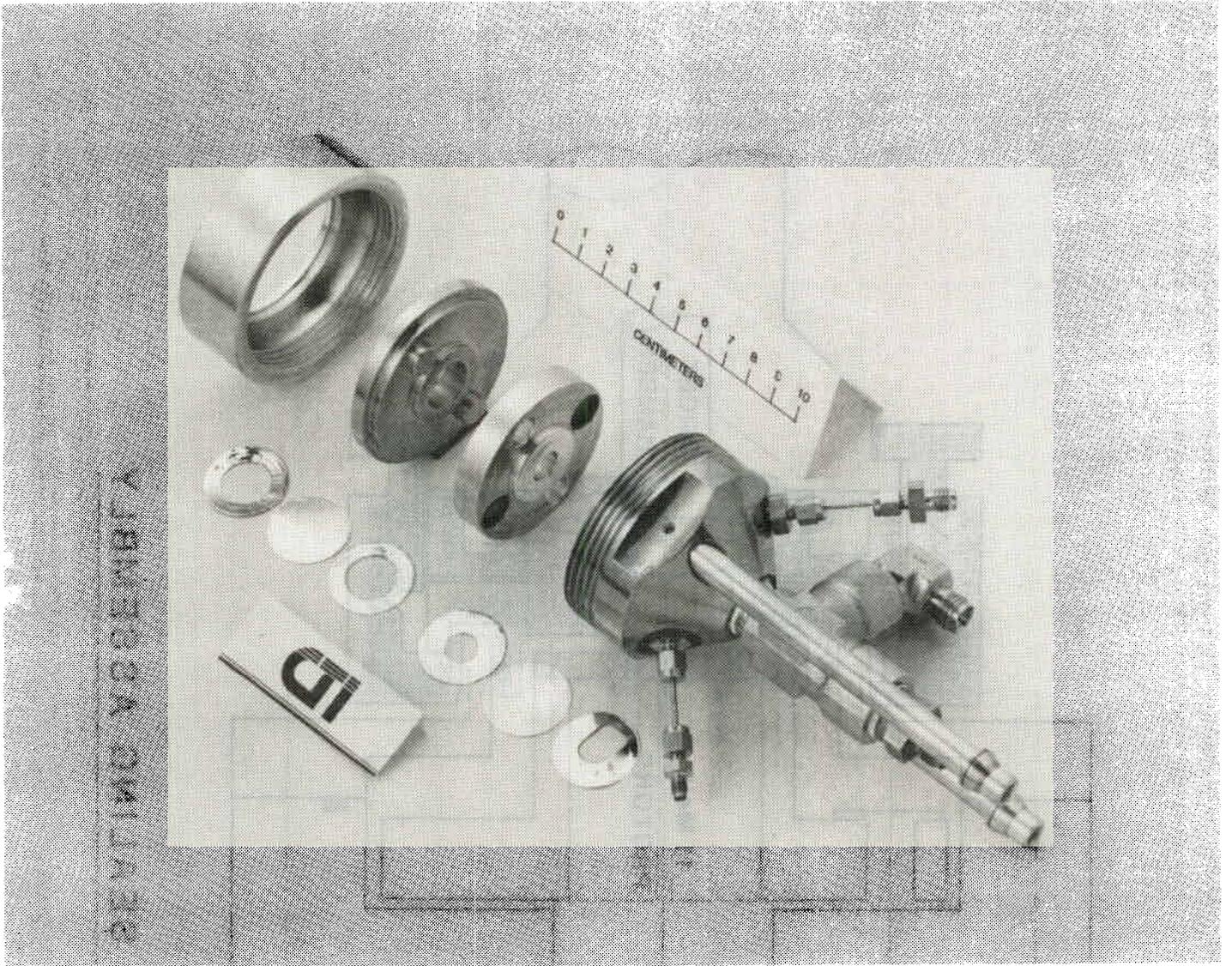
The seal design was derived from screw couplings used by J. Nickles and tests on several gold seal techniques by B. Wieland (BNL 1983-1985). The foil/coupler hardware provides rapid simple "plug in" installation and removal from the collimator socket at the end of the beam delivery tube.

Table 1.
Target Foil Parameters

Target product	Reaction	Foil Materials	Energy loss [MeV]
$^{11}\text{CO}_2$	$^{14}\text{N}(\text{p},\alpha)$	25 μm Al + 25 μm Havar	11.2 -> 10.4
$^{13}\text{NH}_3$	$^{13}\text{C}(\text{p},\text{n})$ and $^{16}\text{O}(\text{p},\alpha)$	25 μm Al + 25 μm Ti	11.2 -> 10.7
$^{15}\text{O}_2$	$^{15}\text{N}(\text{p},\text{n})$	25 μm Al + 250 μm C + 25 μm Havar	11.2 -> 8.5
$^{18}\text{F}-$	$^{18}\text{O}(\text{p},\text{n})$	25 μm Al + 12 μm Havar	11.2 -> 10.7



WINDOW SEALING ASSEMBLY



Exploded View of CTI Target Assembly