The variety in the design of laser targets experimented at CEA requires versatile and adaptable assembly stations

- Automation is a valuable solution to improve productivity and target quality (the assembly technician know-how remains essential)
- Automation is investigated as an operator support on some specific and repetitive tasks
- The gluing of LEH membrane on gas target is a typical example
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- **The gluing of LEH membrane on gas target is a typical example:**

  - LEH membrane on ring (Polyimide 0.5 to 1 µm thick)
  - Manual laying of the glue cord
  - Manual positioning of the membrane on the hohlraum
  - Membrane rough cutting
PRESENTATION OF THE STATION
Station objectives:

- Increase reproducibility (reduce sensibility to technician know-how)
- Increase productivity (assembly of all membranes of the whole fabrication campaign in a same run)
- No slack period on assembly station (specific station)

Specifications to be met:

- LEH gas tightness
- No glue jut out inside LEH
- Limited glue jut out from hohlraum external edge (used for target positioning)
SPECIFIC STATION FOR AUTOMATED MEMBRANE GLUING

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Two issues:

- Automation of glue laying
- Mastering of membrane laying
SPECIFIC STATION FOR AUTOMATED MEMBRANE GLUING

Pneumatic glue injector Nordson EFD®

Hohlraum and membrane positioning device

Supervision and command control

Robot (X, Y, Z) Janome JR2303®

Automated membrane gluing station
AUTOMATION OF GLUE LAYING
AUTOMATED GLUE LAYING

Equipment:

- Robot movements: X on plate – Y, Z on injector holder - precision 5 µm
- Glue injector needle: 15 µm inner diameter

Supervision:

- Stand alone Labview® user interface
- Gluing path calculation (or manual design)
- Hohlraum pointing (match mark with cameras)
- Robot and glue injector control
- Hohlraum positioning device control
AUTOMATED GLUE LAYING

Gluing path calculation:

- Definition of hohlraum geometry (through few typical points)

  ![Definition of a few characteristic points](image1)

  ![On line automated shape generation](image2)

  Creation of a geometry file

- Gluing path calculation (3 types) with automatic glue jut out correction

  ![Circular](image3)

  ![Equidistant from inner and outer edge](image4)

  ![Along outer edge](image5)

- Jut out detection and correction

- Real hohlraum position fitting

  The real hohlraum angular position is pointed on screen on two characteristic points

  ![Gluing path automated fitting](image6)
Examples:

Glue: Hysol 9466
MASTERING OF MEMBRANE LAYING
MEMBRANE PRE-TENSIONING

Manual prototype to test concept:

- PI membrane positioning on the tensioning tool
- Hohlraum glued on tool
- Checking of the membrane stretching
  - PI membrane positioning on the tensioning tool
  - Membrane is stretched with strong wrinkle reduction
- Adjustment of the tensioning tool position (fit to hohlraum height)
  - Hohlraum glued on tool
MEMBRANE LAYING

- Glue laying (with robot)
- Membrane laying
- Final checking

- Glue cord (height < 50 µm, width ~ 150 µm)
- Glue migration

- No glue jut out inside LEH
- No wrinkle
- Helium leak test OK

Concept validated
Automation of the manual prototype: hohlraum holding

- Hohlraum maintained with a diaphragm system
  - Two $\frac{1}{2}$ diaphragms in SU8 resin (50° rotation for max aperture)
  - Max clamping diameter: 3.2 mm
  - Max flange diameter: 5 mm
  - Max clamping strength: 400 μN / contact point

- Setting of diaphragm bending with a stepper motor
  - Max torque: 0.25 mN.m
  - Coupled with a reduction gear (178 steps for max aperture)
  - Normally closed position
Automation of the manual prototype: holhraum vertical positioning against membrane

- Vertical positioning with a stepper motor
  - Max load: 2,5 N (z movement + membrane cladding)
  - Coupled with a reduction gear
  - Min incremental movement: 0,4 µm
  - Custom made screw – nut device behind reduction gear

- Guiding with ball bearing casing

Membrane tensioning and positioning device:
- Automation OK
- Control command integrated on supervision

Final integration
The station is now operational

Some upgrades are on the way:

- Correction of loose in diaphragm jaws: done
- Optimization of vertical translation mechanics: done
- Design of a metallic diaphragm system to enhance robustness and make assembly easier: in fabrication

Coming next (2017):

- Parametric studies for glue deposition optimization
- Design and fabrication of a 7 hohlraums device
The automated membrane gluing station is under final optimization

Station with 7 hohlraums tools planned to be ready for service in 2018

A strong increase of productivity is foreseen:

- Put membranes (on ring) in ring rests
- Put hohlraums on the diaphragm holders
- Clench diaphragms and point angular positions
- Define glue path
- Fill the glue injector
- Lay glue on hohlraums
- Put ring rests on tools
- Position hohlraums against membranes

Estimated time for 7 hohlraums:

- Preparation phase: 1 day
- Membrane gluing: 20 mn
Thank you for attention
Any questions?