Window Chambers for Optical Flow Investigation

ILA also offers a ray tracing software, which is a great help to perform measurements in an efficient way

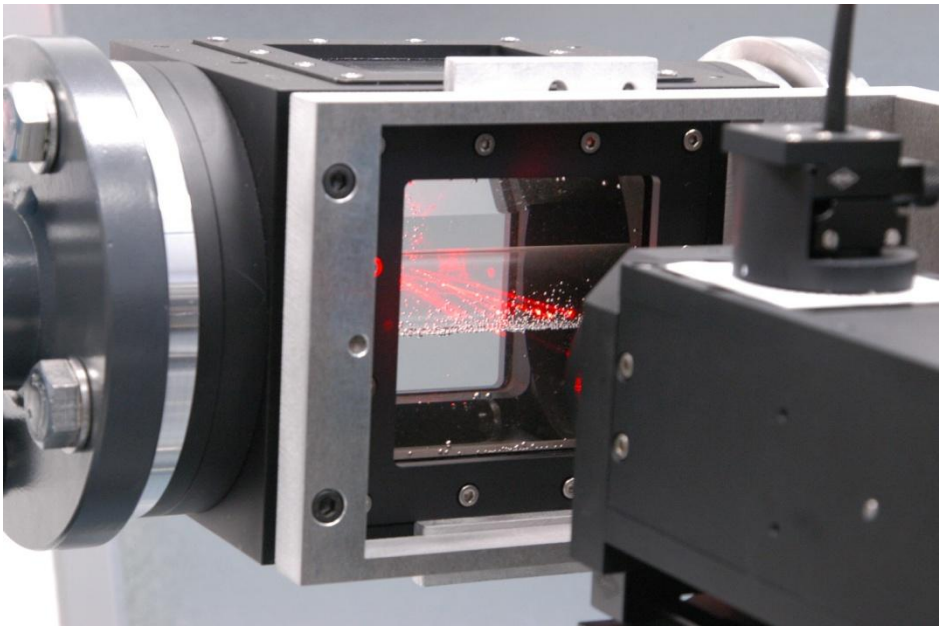
APPLICATIONS

- test and calibration of flow velocity instruments and sensors
- basic research on flow phenomena in pipes and behind obstacles
- measurement and verification of flow quality (velocity profile, turbulence level)
- two- and three-dimensional flow pattern investigations
- suitable both for LDV- and PIV measurement, customizable for all kinds of optical survey

MOTIVATION AND DECISION CRITERIA

Optical measurement allows the investigation of flow phenomena with a very high precision and without any disturbances by a sensor (e.g. hot wire anemometer). However an optical access to the fluid must be assured. For this purpose ILA is offering tailor made windows chambers to fulfill a diversity of requirements which may partially be contradictory:

– **practice** (assembling, cleaning, installation, interruption of operation)
– **visibility** (size, opening, quality and shape of the glass, arrangement of the windows, refraction index of the fluid and the window material, transparency)
– **strength** (design depending on pressure, temperature, fluid, dynamic loads)
– **safety** (depending of the risk special measures for installation and operation)
– **costs**



ILA is offering two series of standard windows chambers. According to the flow parameters and fluid you can choose between a window chamber made from polyamide or stainless steel.

PA6G Window Chambers

These window chambers from polyamide are **lighter** and produce **less reflections** than the stainless steel window chambers. They are manufactured from a single piece of material, which improves the mechanical strength. Our standard design is as following:

PN: 5 bar, DN: 15 up to 50, T°: 90°C, Medium: Water
PN: 5 bar, DN: 65 up to 150, T°: 90°C, Medium: Water
PN: 5 bar, DN: 200 up to 250, T°: 90°C, Medium: Water
PN: 5 bar, DN: 250 up to 300, T°: 90°C, Medium: Water

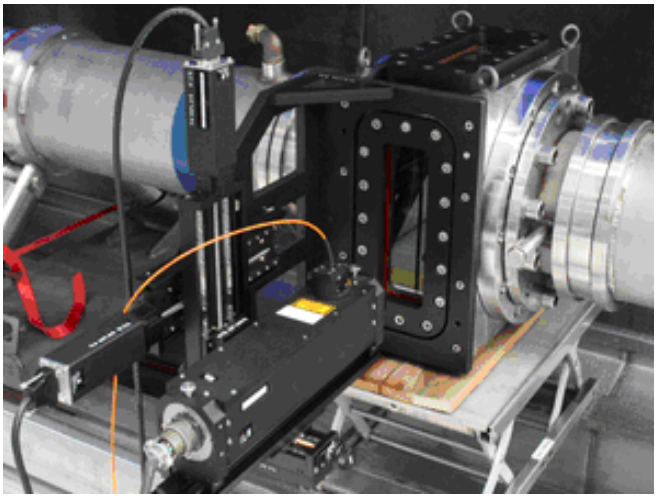
Window chamber getting tested at the PTB Berlin testing facility.

Stainless Steel Window Chambers

These window chambers present a **robust design**, which allows it to support enormous axial forces. The window chambers are offered with a LDV system, in order to measure the velocity profile across the entire glass duct's cross-section.

Our standard design is as following:

PN: 5 bar , DN: 200, T°: 90°C, Medium: Water.
PN: 16 bar, DN: 100, T°: 130°C, Medium: Water.



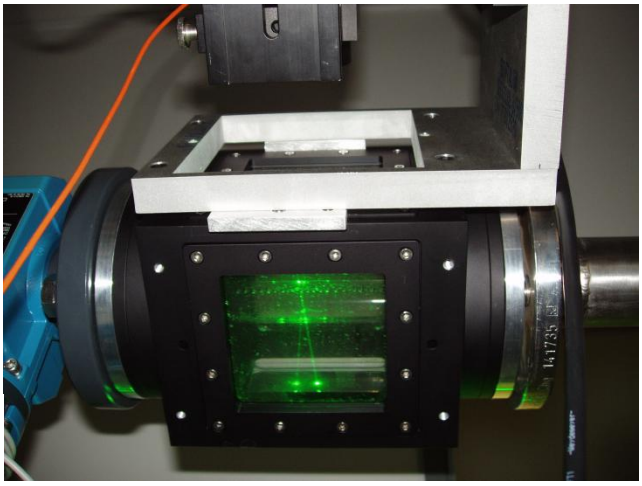
Window chamber produced for the PTB Berlin, Div. 7.5 Heat and Vacuum.

Used for the high temperature testing facility, DN 200 mm, fluid is hot water at max. 90°C, PN 10. Investigations are carried out to identify thermal layers within the laminar pipe flow.

Some details of the construction

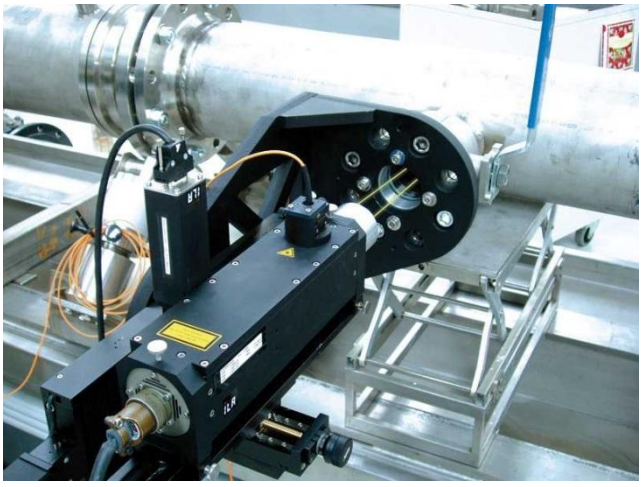
Among the big number of customized window chambers designed by ILA in the last two decades following versions are presented as an example:

Window chamber with sizable rectangular glass panes on two or four sides. The pane is bearing the pressure forces The internal pipe flow is guided by a non pressurized **glass cylinder.** The cavity between the cylinder and the outer case is filled with a refractivity matched transparent fluid.
Size and medium can be adopted to the measuring task.
(See also the similar example on page 1)

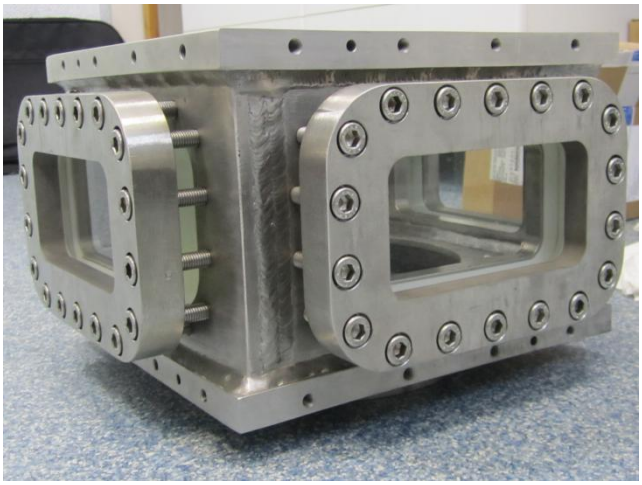


Similar design like above. The overlaying windows are used for **Stereo-PIV**. So the two cameras are located perpendicular in front of the glass pane and there is no lateral offset of the light by optical refraction.

A particular application for district heating is the so called **hot tapping**, where a ball valve and window can be installed **without interruption** of the flow. Due to the circular orifice (Ø55) LDV-measuring of the velocity profile is carried our and the flow can be determined
(max. PN 40, max. Temp. 200°C).



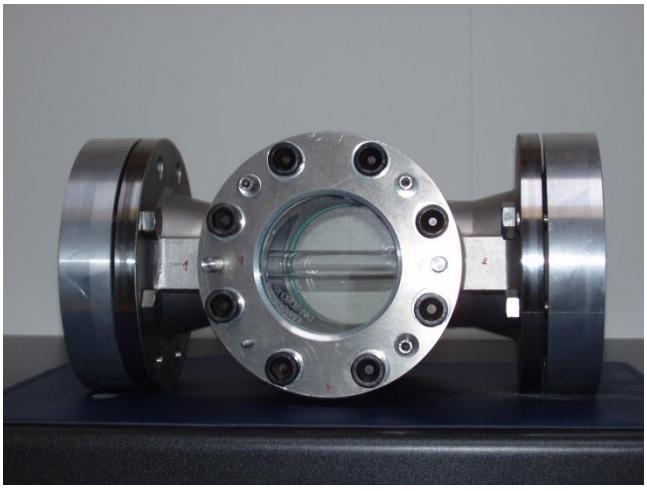
More customized window chambers designed by ILA:

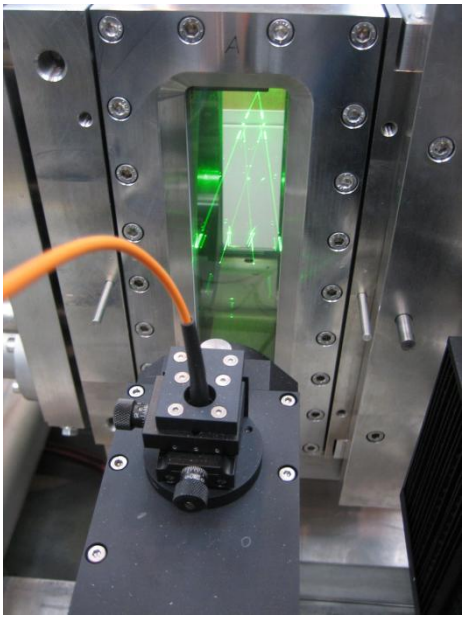


Solid layout of a window chamber used for a high pressure (10 bar) and high tempera-ture (180°C) pipe flow. The application was the 2-component LDV measurement of the velocity distribution in the whole cross section. The typical window size is about
30 mm more than the tube diameter.

This construction was carried out in stainless steel and is suitable also for corrosive fluids.

Window chamber with a **reduced cross section** to equalize the velocity profile inside. The space between the glass tube an the window can be filled up a refraction adapted liquid.





Setup for the investigation of a rectangular pipe flow. Due to the window on the opposite side LDV with forward scattering (e. g. Profile Sensor Technology) can be carried out in order to improve the spatial resolution of the boundary layer significantly.

DATA

More customized window chambers designed by ILA:

Window chamber with a rectangular cross section and a number of circular junctions. Model was used for studies regarding the flow distribution in a solar collector and to optimize the heat transfer.

This is only one example of the versatile scope of designs to provide an insight into complex flow fluid flow.

Window chambers with different openings depending on the region of interest and the measuring technique applied.