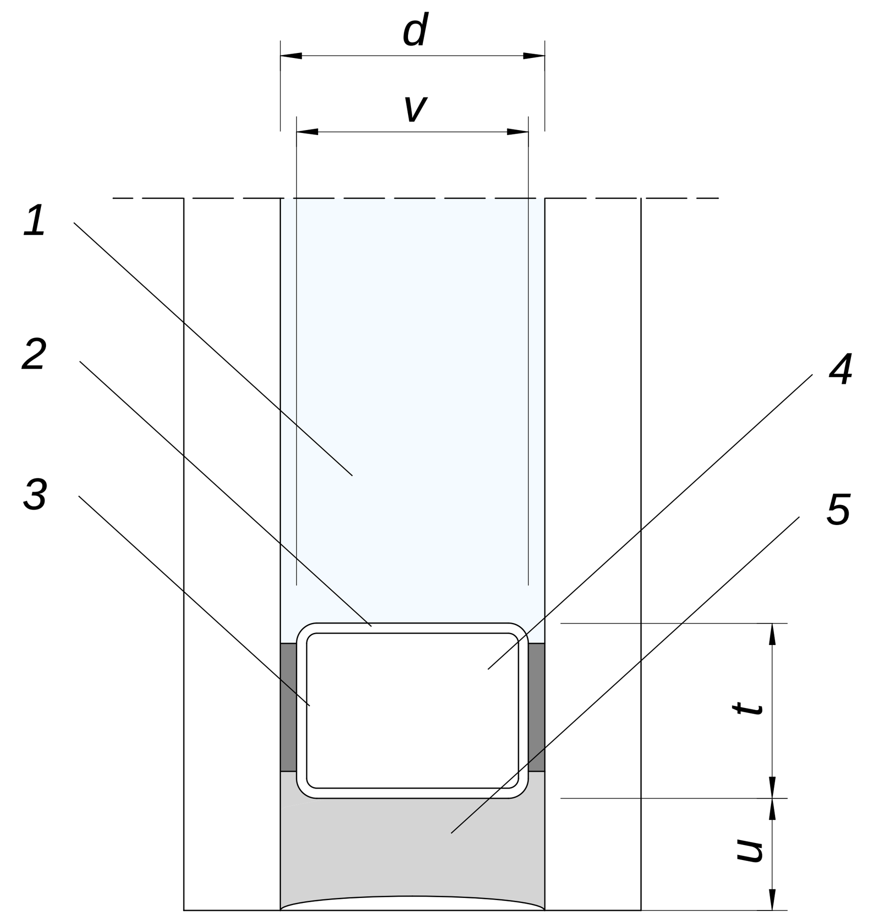
# ADHESIVE SELECTION FOR THE REALIZATION OF A BONDED EDGE SEAL FOR FLUID FILLED IGU’s

CertBond
COST Action CA18120


## Alina Joachim

### Supervisors: Christian Louter / Bernhard Weller


1 Fluid-filled pane cavity
2 Stainless steel profile
3 First functional zone
4 Space for technical equipment
5 Second functional zone
*d* Width of the cavity
*v* Width of the first functional zone
*u* Average height of the second functional zone
*t* Height of the profile

Figure 1: Design of the structrurally bonded edge seal for fluid-filled IGU

## Motivation

Modern architecture strives for a maximum degree of transparency. Especially in office buildings, the number of all-glass façades is constantly increasing. Multi-pane insulating glass units (IGUs) are used. The principle of a IGU is based on the good thermal insulation of the gas-filled cavity. However, in the case of long-lasting and large temperature differences, heat exchange takes place even in high-efficient IGUs. The idea of filling the cavity with a fluid is based on the high thermal conductivity of a circulating fluid. Compared to air, water reacts about ten times more sensitively to temperature changes and can therefore be quickly adapted to building conditions and requirements. The temperature in the interior can be kept constant by heating or cooling the fluid in the cavity.

Structural-sealant glazings are used in modern façade designs to replace external clamps and create a homogeneous glass surface. The current research project *fluidIGU* is working on the development of a structurally bonded edge seal that can withstand the high hydrostatic loads and is also resistant to the ageing caused by permanent contact with fluids. The aim is to create a façade element in full floor-to-ceiling size with the height of 3000 mm.

## Structurally Bonded Edge Seal Design

The design of the novel edge seal is based on the principle of a conventional edge seal of gas-filled IGUs. Two functional zones are used. The first functional zone is located between the spacer and the glass and is responsible for the sealing. The second zone on the outside of the spacer takes all structural loads from the hydrostatic pressure in the cavity, the wind and the live loads.

This leads to the following structurally bonded edge seal design for the fluid-filled IGU (compare Figure 1):

- Hollow stainless-steel profile as a spacer
- $v = t = 15$ mm installation space for technical equipment
- Water-ethylene glycol mixture (70:30) as a fluid (ethylene glycol prevents the growth of algae and serves as an antifreeze)
- Optimal thickness of the first functional zone $d_{zone\ 1} = 4$ mm (determined by numerical analysis)
- Total cavity width $d_{total} = 23$ mm

## Test Program for Material Selection

For the preselection of the adhesives for both functional zones, the following requirements have to be fulfilled by the adhesives:

**Adhesive for First Functional Zone**

- High adhesion to glass and to stainless steel
- Desired adhesive joint dimensions can be realized
- High resistance to water and ethylene glycol
- Impermeability to the fluid
- Viscosity >10 000 mPa·s

**Adhesive for Second Functional Zone**

- Two-component curing
- Desired adhesive joint dimensions can be realized
- Valid European Technical Approval (ETA) according to ETAG 002-1
- Design stress resistance $\sigma_d > 0.20$ MPa

Based on the preselection requirements 14 commercial available adhesives were tested in small-scale tests for their suitability for the first functional zone and 5 adhesives for the second functional zone. According to uniaxial tensile tests performed at the TU Dresden, all tested adhesives show elastic behavior and a tensile strength of 1–10 N/mm$^2$ with an average elongation at break of 70–300 %.

Experimental tests of the test program presented below are currently running. With progressing test program, adhesives are eliminated based on the results obtained.

| First Functional Zone | Second Functional Zone |
| --- | --- |
| Uniaxial tensile test | Uniaxial tensile test |
| Tensile bonding test | Tensile bonding test |
| Compatability of adhesives | Compatability of adhesives |
| Leak test | Creep test |
| Permament load test | |


Funded by the Horizon 2020 Framework Programme of the European Union


cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

TECHNISCHE UNIVERSITÄT DRESDEN

BAUKO