

# SPF Institute für Solar Technology



## Project FRESH NRG FP7- ENERGY-2012-1-2STAGE

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ESTIF Workshop  
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**HSR**  
HOCHSCHULE FÜR TECHNIK  
RAPPERSWIL

FHO Fachhochschule Ostschweiz

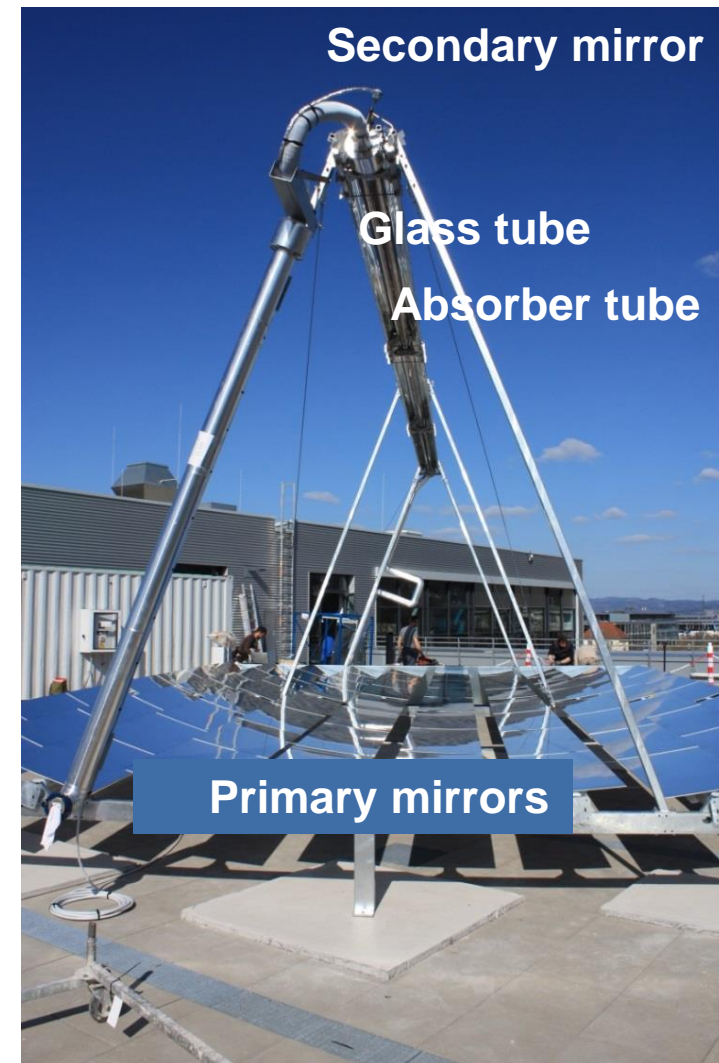


INSTITUT FÜR  
SOLARTECHNIK



- 1. Detailed characterization of components during the development phases**
- 2. Test of whole collector in the 100-250°C temperature range**
- 3. Characterization of collector field performance under real conditions**
  - ISE (reflectors, collector lab test)
  - HSR-SPF (coatings, reflectors, collector field monitoring)
  - Cranfield University (Sol-Gel coatings, manufacturing)
  - Mutah University (collector field installation)
  - Soltigua (collector lab installation, collector field installation)

- **Testing of the Sol-Gel Coatings for receiver glass tube and absorber tube**
  - Characterization of optical properties
  - Durability testing (ALT, Damp/Heat, abrasion)
- **Testing of primary and secondary mirrors**
  - Characterization of optical properties
  - Geometrical characterization
  - Hail resistance
- **Testing of thermal properties of receiver tube**
- **Geometrical characterization**
- **Field Monitoring**





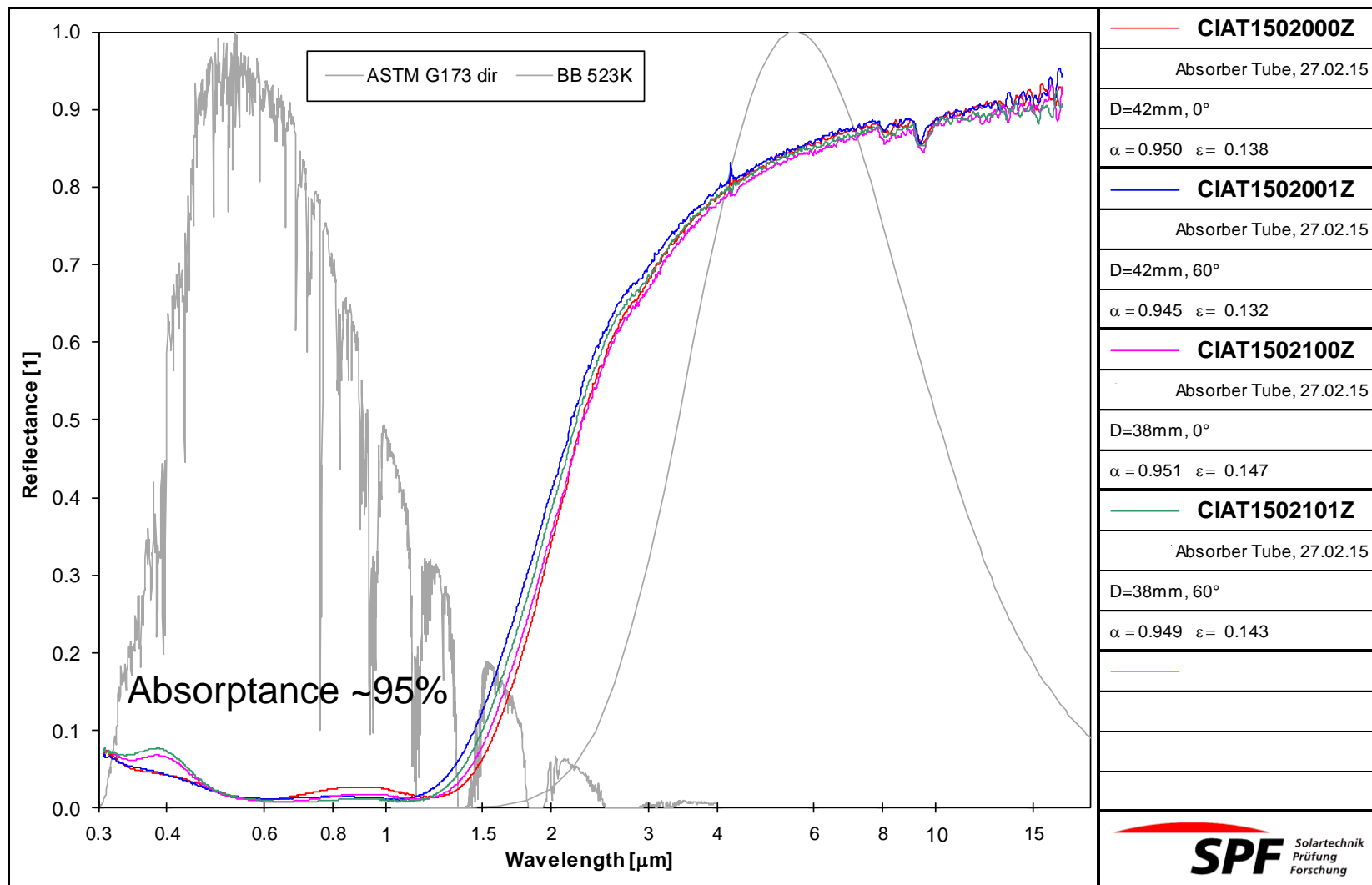
# Testing of the Sol-Gel Coatings for absorber tube



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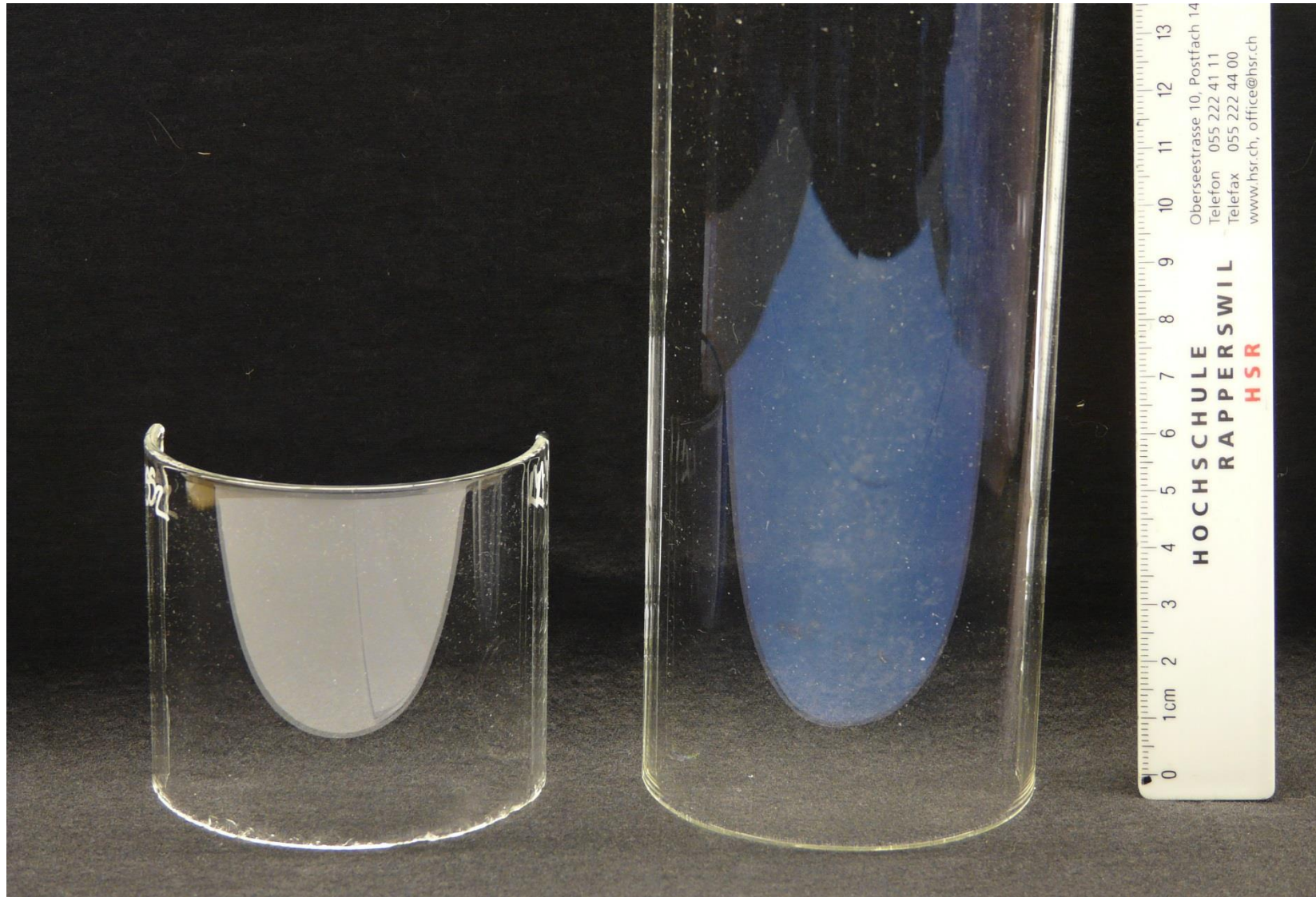


## Characterization of optical properties of selective coating





# Testing of Sol-Gel AR Coating on receiver glass tubes

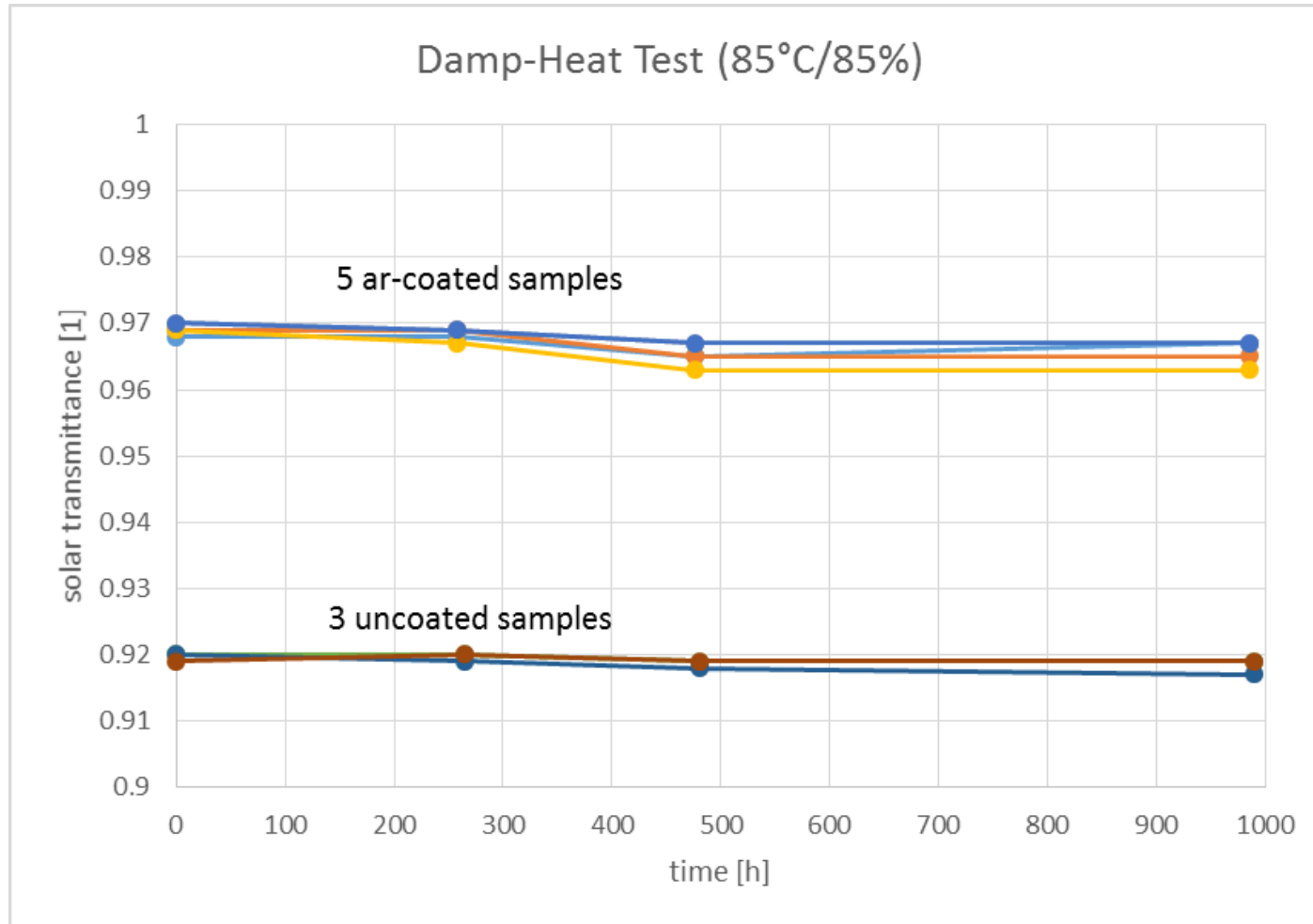




# Testing of Sol-Gel AR Coating on receiver glass tubes



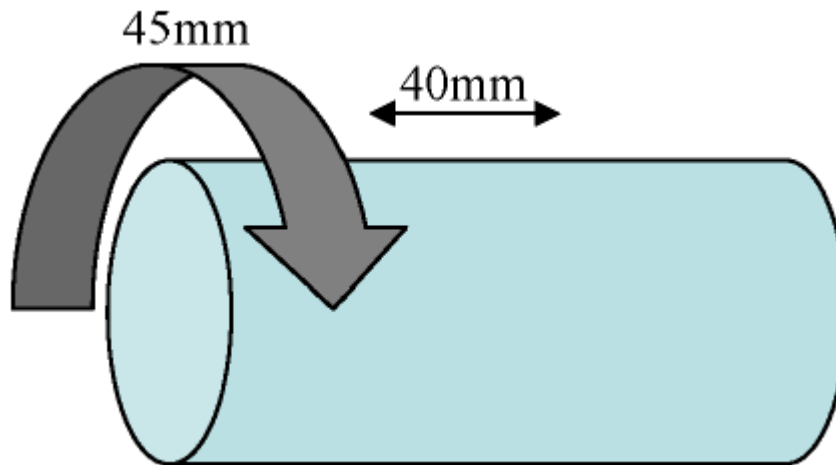
## Durability testing on Sol-gel AR coating





## Abrasion Test Procedure

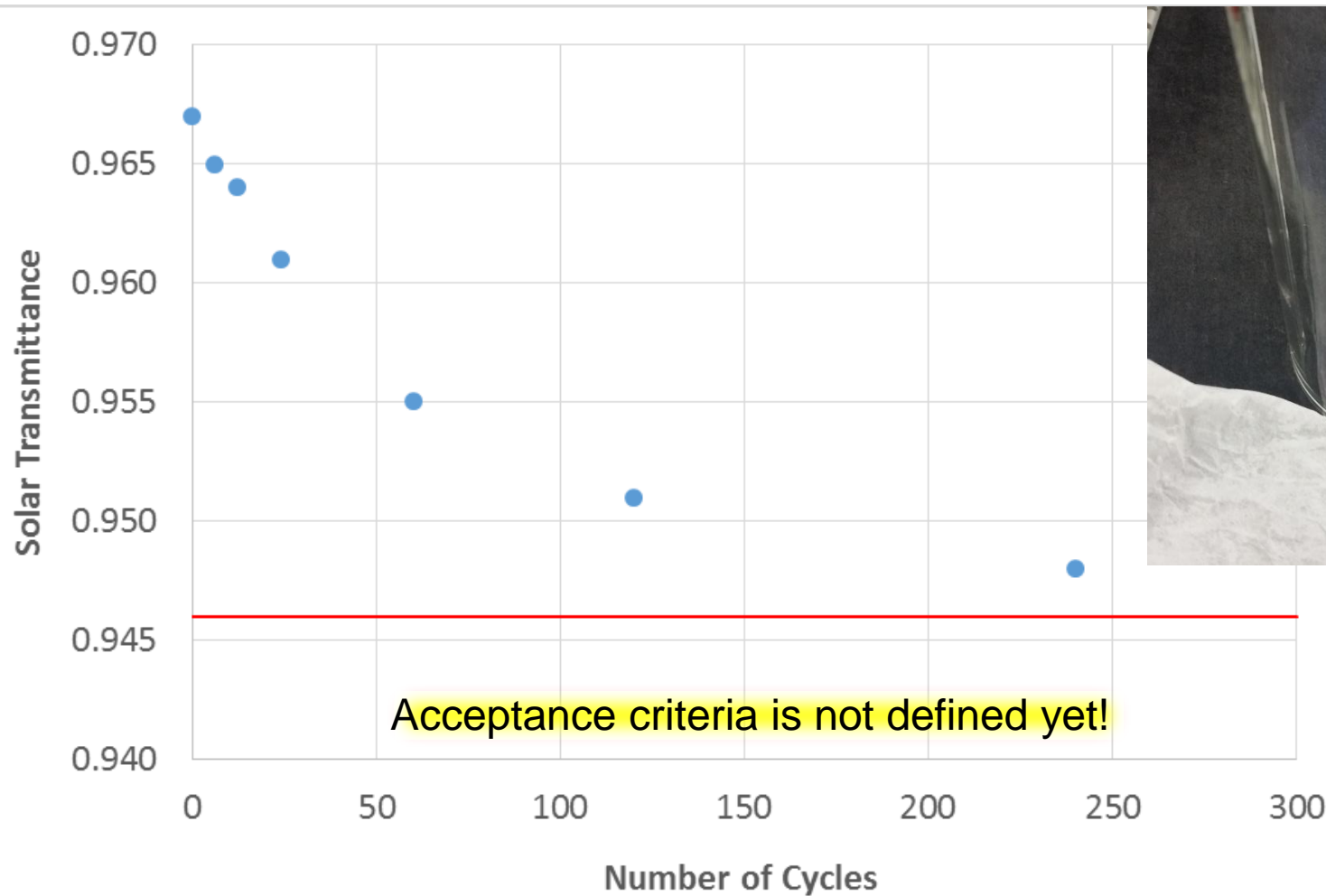
- An abrasion test has been performed basing on the proposed IEC 62862-3-3 *“Solar thermal electric plants - Part 3-3: Systems and components - General requirements and test methods for solar receivers”*
- This test consists of rubbing the dry glass tube with an abrasive rubber.
- An abrasion head is moving with low pressure on the glass surface in a straight line back and forth thus producing grinded stripes on the glass surface.
- By rotating the glass tube a test surface of at least  $45 \times 40 \text{ mm}^2$  is created where the transmittance can be measured.



# Testing of Sol-Gel AR Coating on receiver glass tubes



## Abrasion Test Procedure



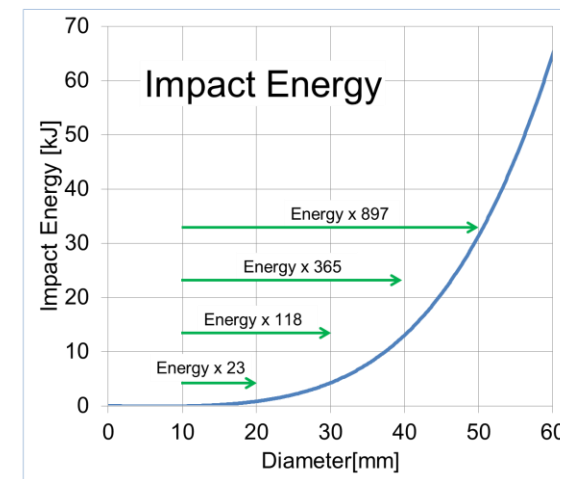
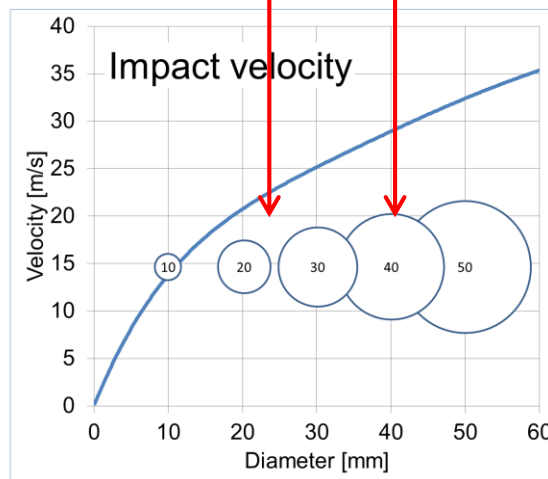
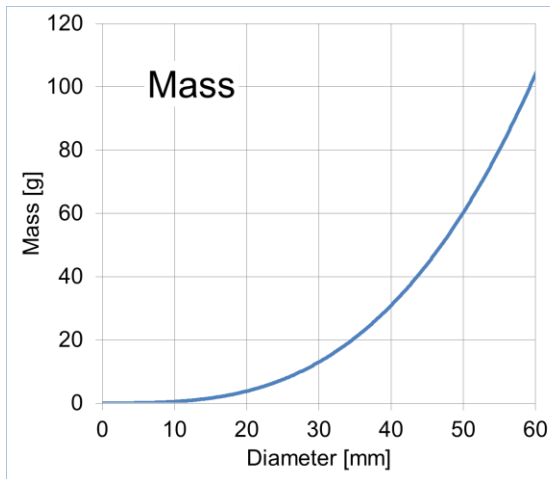


## Hail-test on ultra-light reflecting panels

impact resistance

old

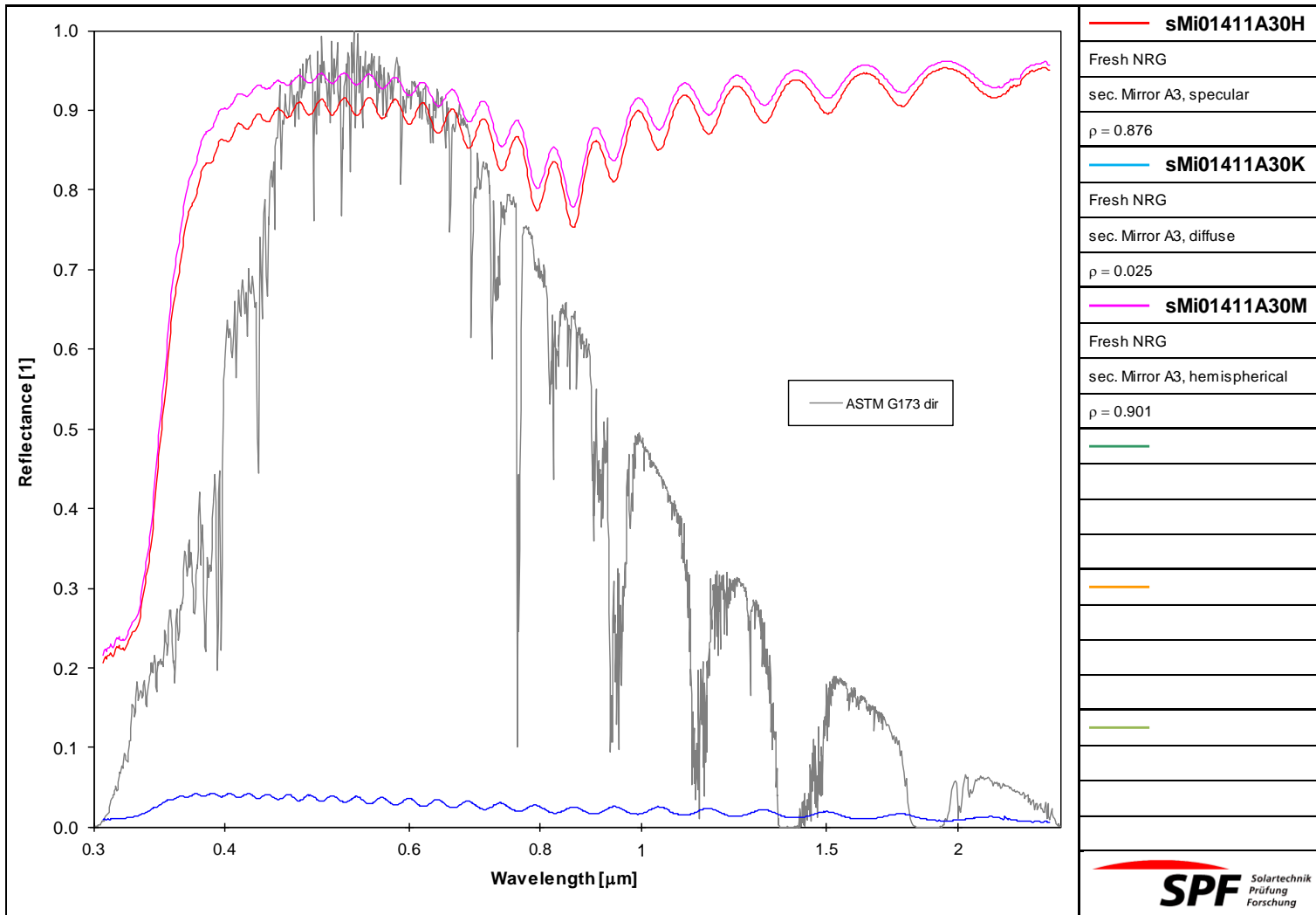
new



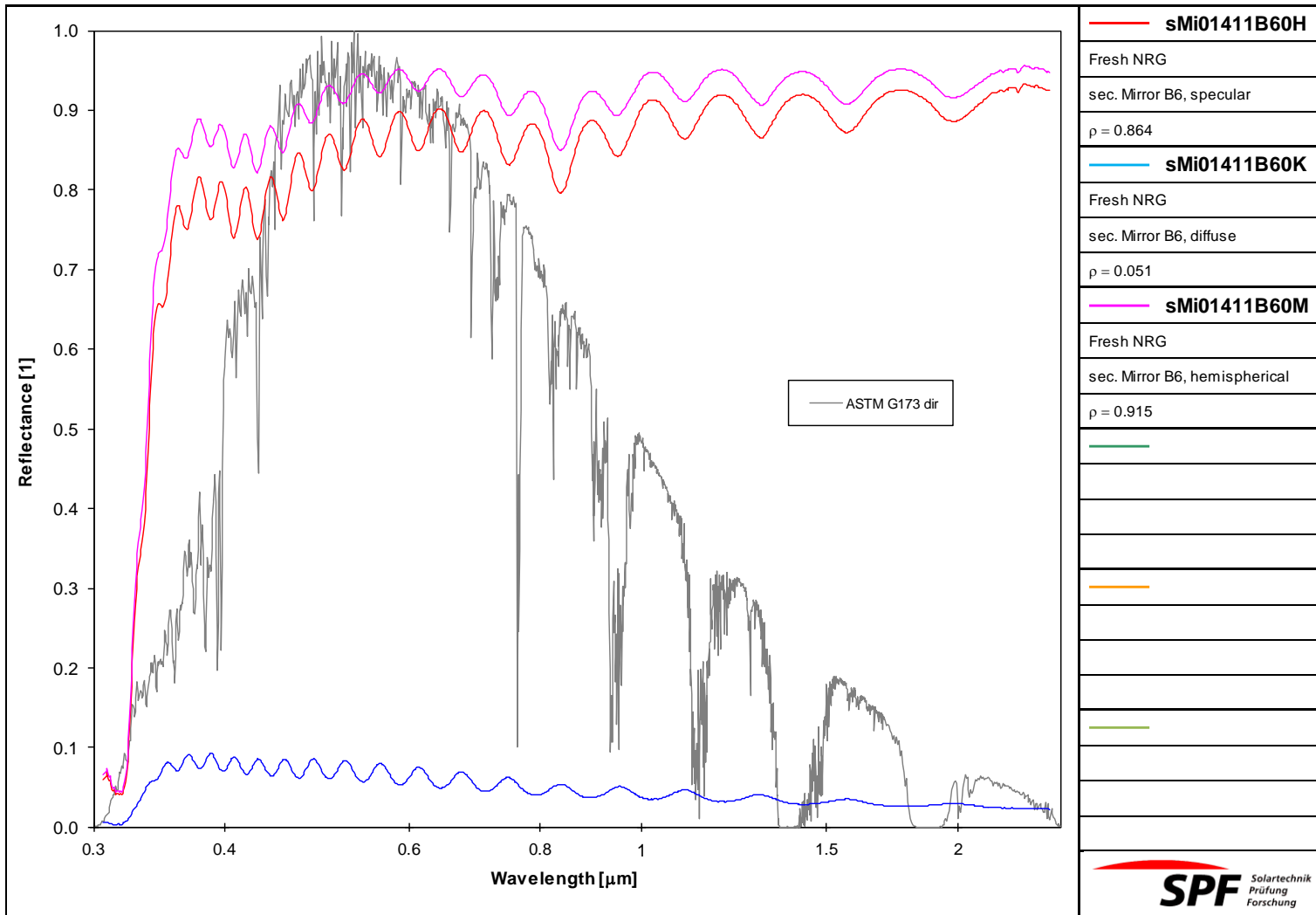
The velocity of the ice balls increases with size. The increase of the impact energy is significant (4th power of diameter).



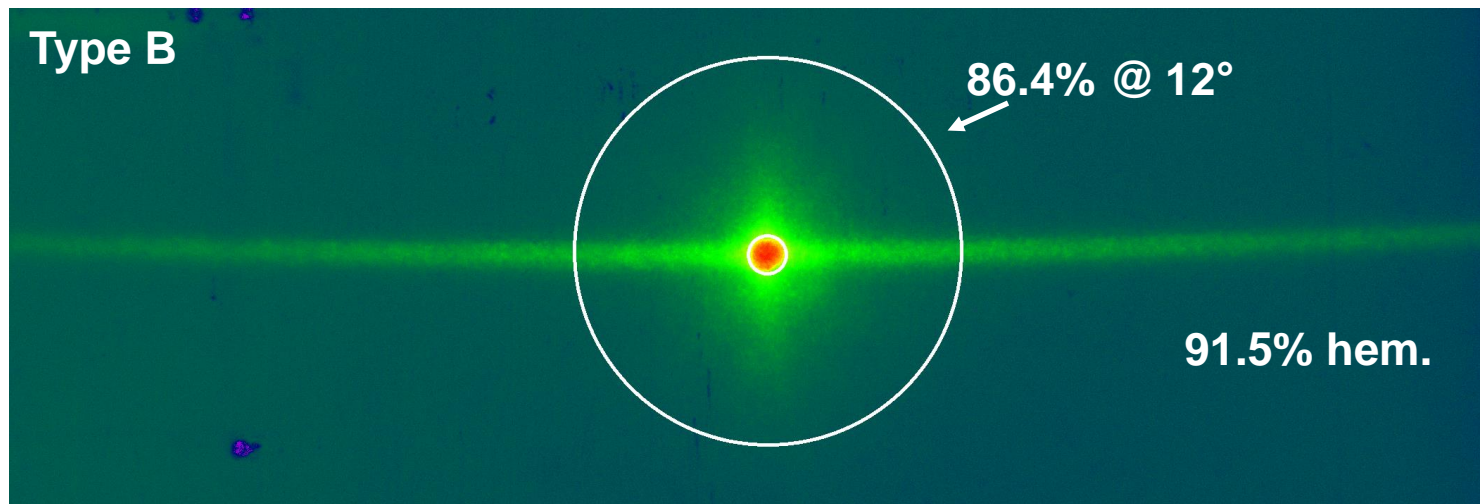
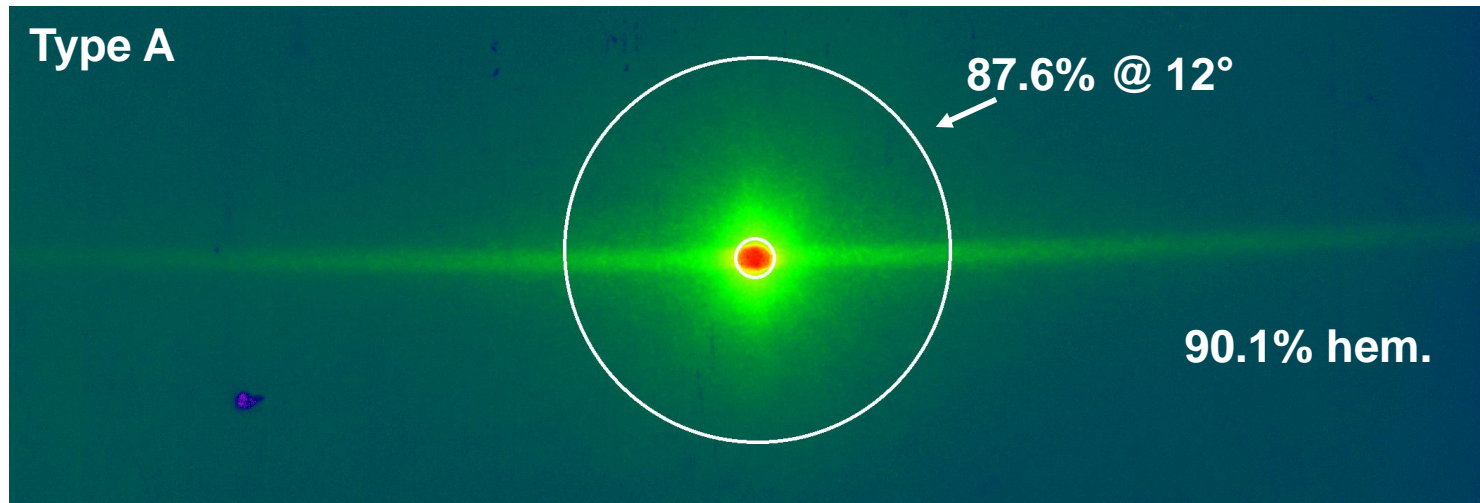
## Reflectance of secondary mirror A



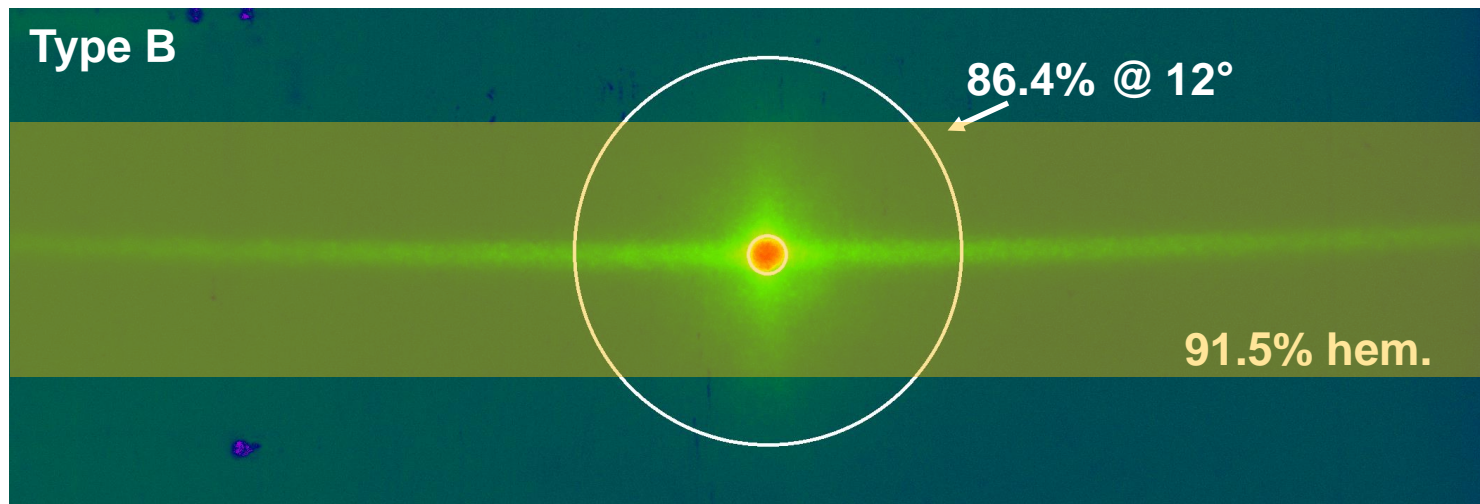
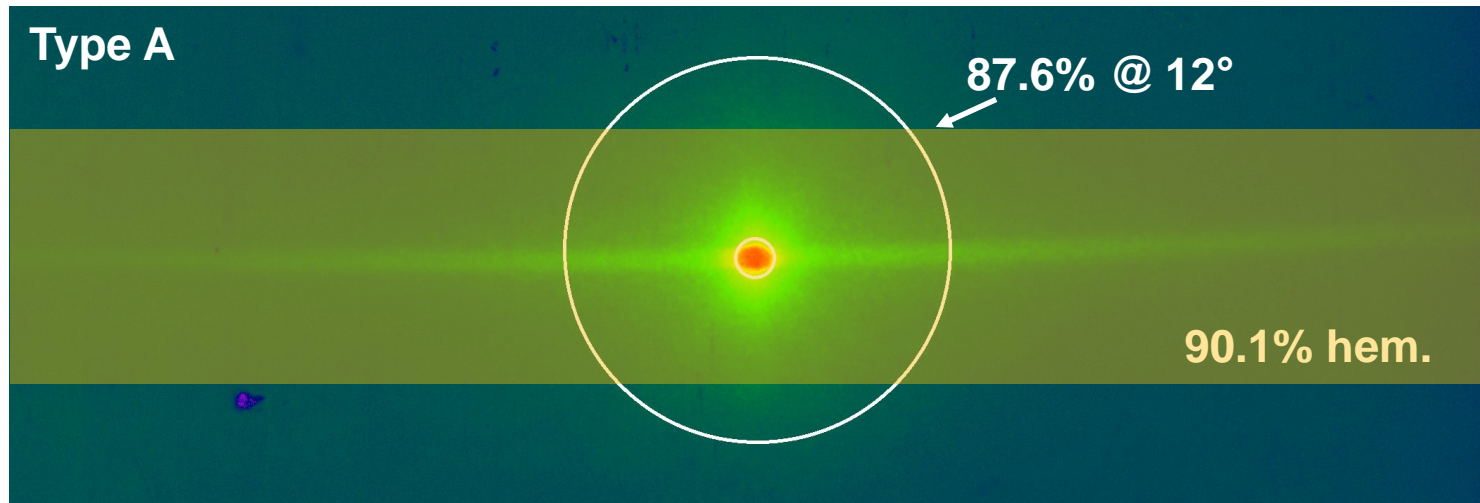
## Reflectance of secondary mirror B



## Reflectance pattern of secondary mirrors

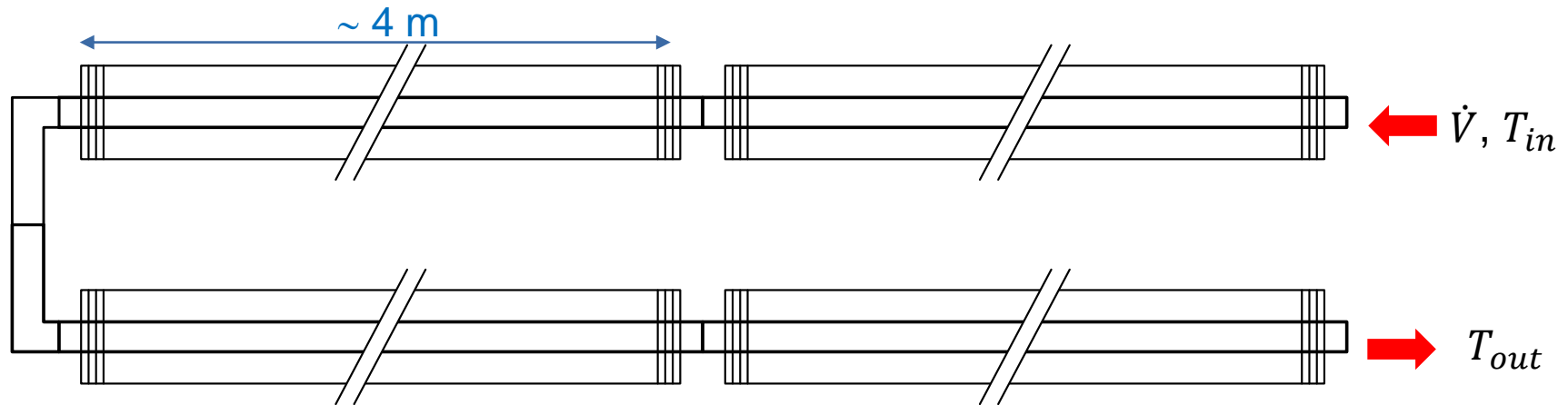


## Reflectance pattern of secondary mirrors





# Testing of thermal properties of receiver tube

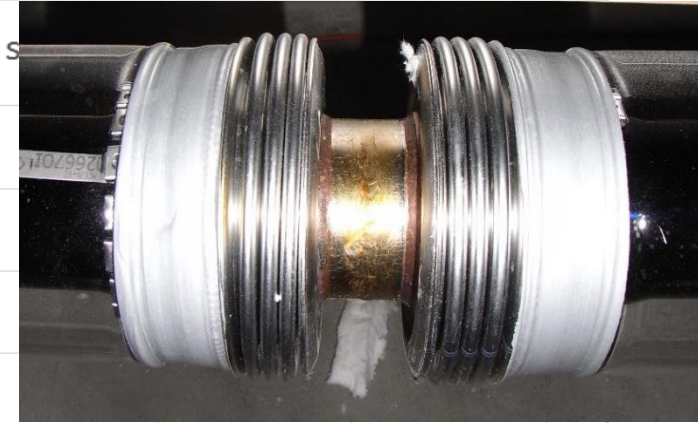
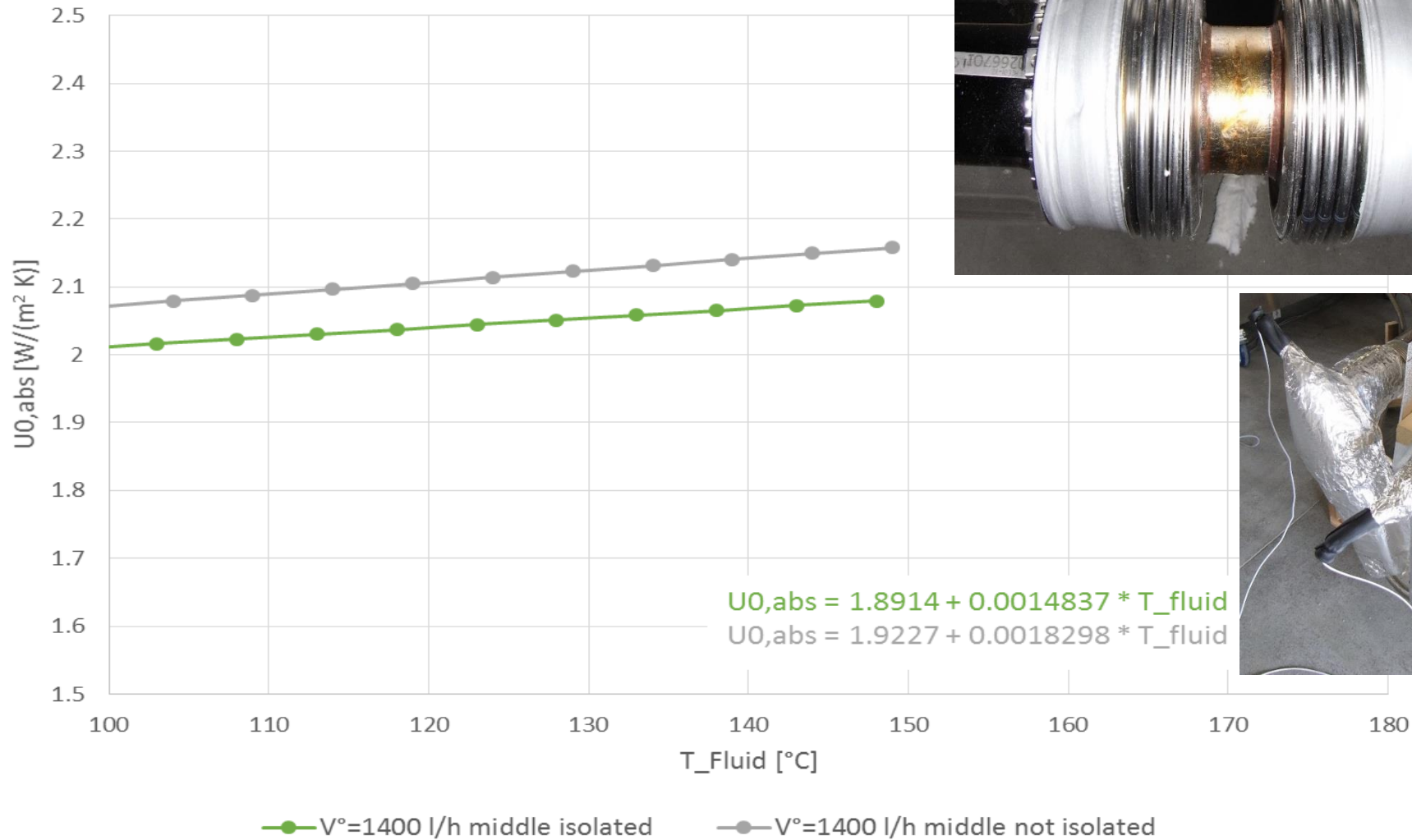


key data: hcf = water (@ 20 bar)  
 $T_{in} \approx 100^{\circ}\text{C} \dots 200^{\circ}\text{C}$   
 $T_{out} - T_{in} \approx 0.5 \text{ K} \dots 0.8 \text{ K}$   
 $Re \approx 19'000 \dots 40'000$  (@  $\dot{V} = 1'000 \text{ l/h}$ )  
 $Re \approx 27'000 \dots 56'000$  (@  $\dot{V} = 1'400 \text{ l/h}$ )  
 $A_{tube} \approx 0.9 \text{ m}^2$

# Testing of thermal properties of receiver tube



## Thermal loss with and without insulation



- **The optical properties and the durability of the Sol-Gel AR Coatings for receiver tube have been characterized and show good performance**
- **The testing of primary and secondary mirrors show an improvement of the new mirrors**
- **Thermal properties of the receiver tube were perform up to 200°C**
- **The upcoming field test will allow to compare lab results with collector under real conditions**

**Due to the detail testing of each component during the development phase the Fresnel collector shows a promising good performance**

# Thank you for your attention!



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