# On the development of accelerated aging tests based on thermal stress impact to assess the reliability of 1000 suns CPV modules

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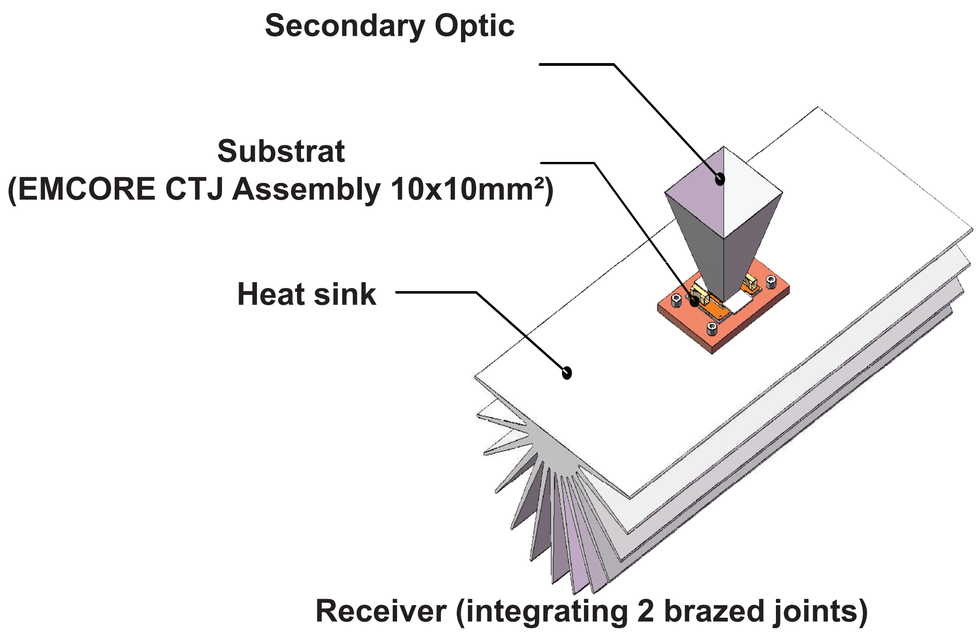
## Background

- Development of CPV systems by the French company HELIOTROP
- Technical and research support by CEA
- Reliability assessment of modules and receivers is performed according to the IEC 62108:2007, whereas sub-components follow other suitable qualification standards (MIL-STD-883H, IEC 60068-2-21…)




**Receiver (integrating 2 brazed joints)**

## Technology

- CPV system with a concentration factor of 1000 suns
- First generation module based on EMCORE Solar triple junction cell receiver
- Developed modules are mounted on a commercial tracker


**Module (concentration of 1000 suns)**

**Tracker installed in CEA-Cadarache (south of France)**

## Issues

**Accelerated aging tests are needed to assess the design 's robustness of the whole module during product's life**

**=> How to develop simple but pertinent accelerated aging tests reflecting the real environment?**

## Methodology

- A special Instrumented Module (IM) is developed with precise measurements of temperature, relative humidity, pressure, surrounding air velocity and I(V) characteristics

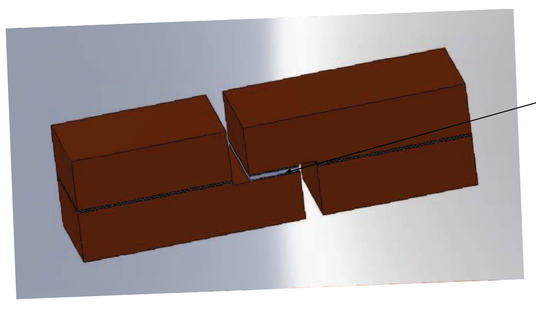
- Data from a weather station is used to link the conditions measured inside the IM with global weather data
  ⇒ Aim is to link the climate of CEA-Cadarache (sunny place in the south of France) with the temperature repartition inside the module (especially the receiver) during a long period of time
  ⇒ Measurements are used to check the thermal model of the module developed in parallel
  ⇒ Experimental data obtained at the module level allow a better prediction of the climate stress (duration and number of cycles) accumulated during products' life

- Aging of polymer (encapsulants and Fresnel lens) is studied apart (UV, humidity, temperature aging and cycling)

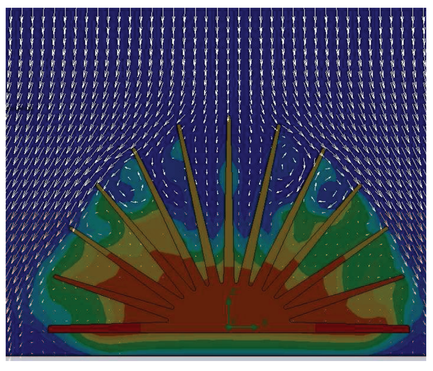
- Aging of the braze (that is integrated in the receiver) is studied by means of analytical tests (composite Double Notches Specimens are fabricated and submitted to thermal aging and thermomechanical cycling aging)

- Thermomechanical calculations are used to compare the design of the different receiver generations and orient the design in order to reduce the mechanical stress inside braze and cell

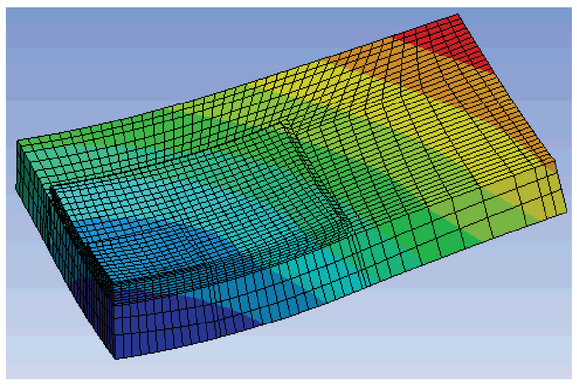
- A Special testing bench (receiver level) is being developed to reproduce the thermal map around the receiver for better simulate the transient thermal behavior of the receiver during thermal cycling.




**Composite Double Notched Specimens used to evaluate the aging of the braze**



**Air velocity and temperature repartition around the heat sink placed outside the module (Vz = 3 m/s)**



**Deformation of the brazed assembly (Cell + DBC + copper heat sink) during brazing operation**

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