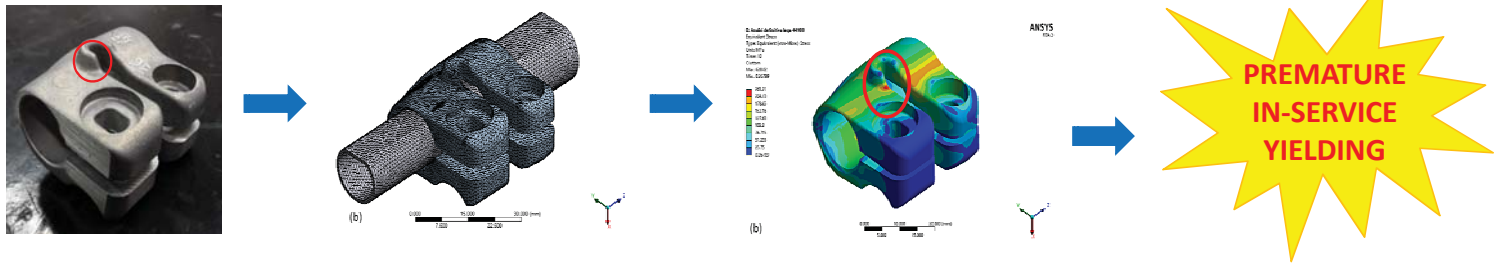


An AlSi12(b) commercial high pressure die casting, used for photographic accessories, showed an early in-service yielding due to the presence of a geometrical discontinuity acting as stress concentration zone. The Finite Element simulation model, developed by means of Ansys Workbench®, confirmed the presence and the detrimental effect of the stress concentration zone due to the geometrical discontinuity.

## WORK PURPOSE

The work aims at investigating the influence of casting defects on the component mechanical properties with reference to their distance from the critical zone, their type and entity. To this end, a damage criterion combining FE simulation and defect detection has been elaborated.



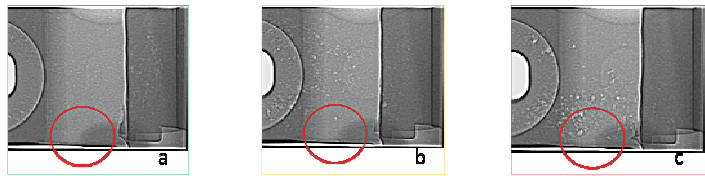
## EXPERIMENTAL RESULTS

### 1. NDT analysis

A qualitative classification based on the radiographic investigation, according with ASTM E0505-01, was elaborated.

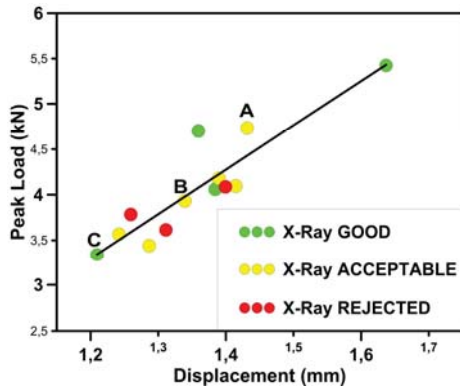
Porosity was adopted as the only qualitative discriminating element during x-ray investigation for its ease to be observed.

- a) **GOOD** – no defects near the critical point
- b) **ACCEPTABLE** – small or negligible defects
- c) **BAD** – significant defects

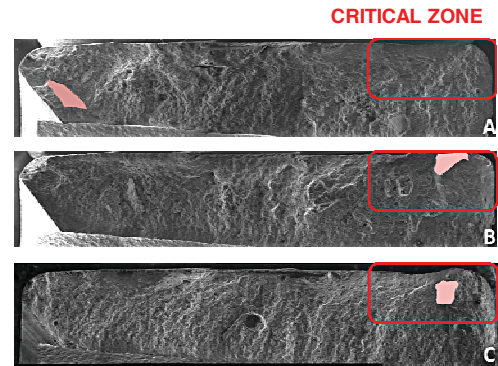


### 2. Mechanical testing

The castings were statically tested and then the mechanical properties were correlated with the qualitative X-Ray classification.



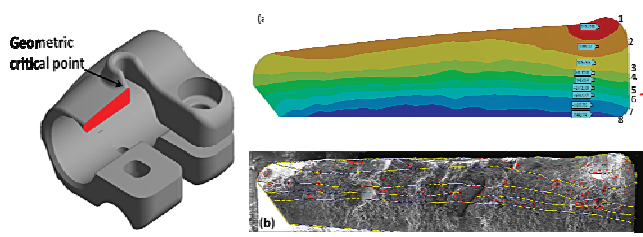
**! NO CORRELATION MECHANICAL PROPERTIES – QUALITATIVE X-RAY CLASSIFICATION**  
X-ray analysis does not take into account oxide position, orientation and dimension.



**CRITICAL ZONE**

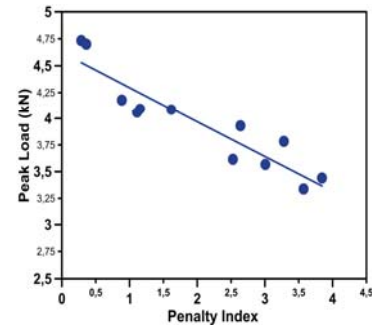
### 3. Damage criterion elaboration: PENALTY INDEX

Defect positions were weighed with reference to their distance from the critical point, according to the stress band distribution obtained from the FE analysis.



$$Penalty\ Index = \sum_{z=1}^5 \left[ \frac{(Defect\ area)_z}{(Stress\ band\ area)_z} * weight_z \right]$$

- $z$  = stress band considered (1 to 5);
- $Defect\ area$  = projected area of each defect;
- $Stress\ band\ area$  = area of the  $z^{\text{th}}$  band;
- $Weight_z$  = weight referred to a precise band



## CONCLUSIONS

- ✓ Radiographic investigation is not enough to predict the casting quality
- ✓ Oxides strongly influence the casting quality, but they are difficult to be observed through non destructive techniques
- ✓ The **Damage Criterion** elaborated shows **good correlation** between mechanical properties and defect content
- ✓ The only negative aspect is that the damage criterion is a destructive technique; this implies the component yielding