

## TOWEL BAR – AL ALLOY – MODERN TIMES – FRANCE

Artefact name	Towel bar
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Url	/artefacts/410/

### ✕ The object

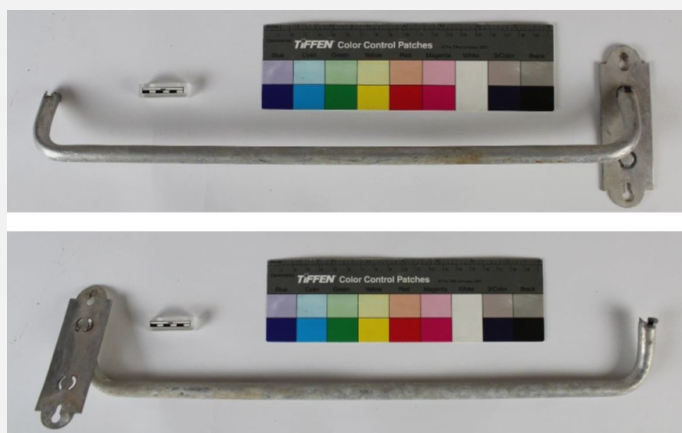


Fig. 1: Front and back sides of a towel bar,

Credit HE-Arc CR, J.Schröter.

### ✕ Description and visual observation

Description of the artefact	Towel bar with traces of use and a broken section (Fig. 1). White deposits have developed on the metal surface. Dimensions: L = 45cm.		
Type of artefact	Household implement		
Origin	Château de Germolles, Mellecey, Bourgogne, France		
Recovering date	Unknown		
Chronology category	Modern Times		
chronology tpq	1801	A.D.	▼
chronology taq	2000	A.D.	▼
Chronology comment	19th - 20th century		

<b>Burial conditions / environment</b>	Indoor atmosphere
<b>Artefact location</b>	Château de Germolles, Mellecey, Bourgogne
<b>Owner</b>	Château de Germolles, Mellecey, Bourgogne
<b>Inv. number</b>	None
<b>Recorded conservation data</b>	Not conserved

#### Complementary information

Nothing to report.

#### Study area(s)

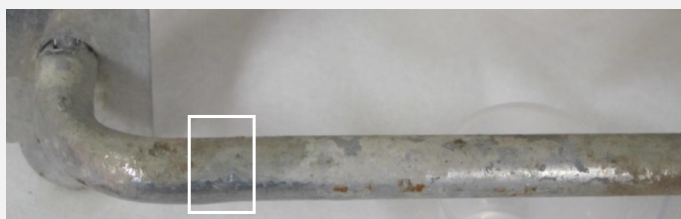


Fig. 2: Detail of the back side of the towel bar showing the location of the sampling area,

*Credit HE-Arc CR, J.Schröter.*

#### Binocular observation and representation of the corrosion structure

Stratigraphic representation: none.

#### MiCorr stratigraphy(ies) – Bi

#### Sample(s)

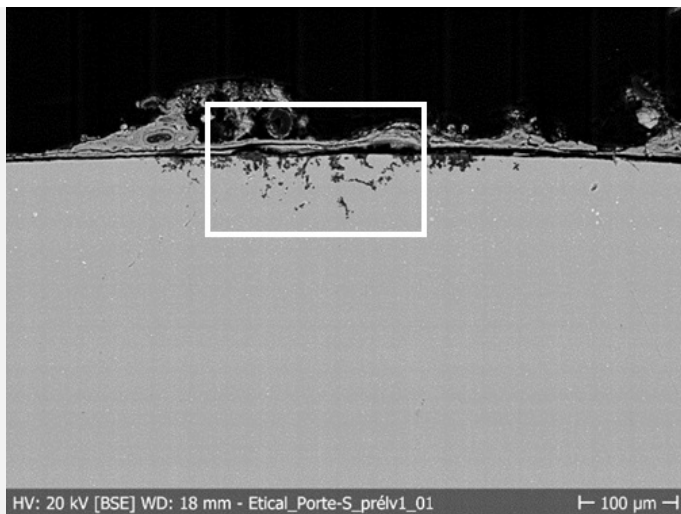


Fig. 3: SEM image of the cross-section showing the location of Fig. 5,

<b>Description of sample</b>	Sample cut from the back side of the towel bar (Fig. 2).
<b>Alloy</b>	Al Alloy
<b>Technology</b>	None
<b>Lab number of sample</b>	
<b>Sample location</b>	HE-Arc CR, Neuchâtel, Neuchâtel
<b>Responsible institution</b>	HE-Arc CR, Neuchâtel, Neuchâtel
<b>Date and aim of sampling</b>	2017, the EtICAL project (a study of corrosion forms of aluminium alloys)

#### Complementary information

Nothing to report.

#### ✧ Analyses and results

**Analyses performed:**  
Metallography, SEM/EDS.

#### ✧ Non invasive analysis

#### ✧ Metal

The metal is a relatively pure aluminium alloy with numerous inclusions (Fig. 5). From their chemical composition they can be interpreted as  $\text{Al}_3\text{Fe}$  intermetallic compounds (Fig. 6). Pitting corrosion as well as a start of intergranular

corrosion develops locally under the deposits, outlining some of the grains (Fig. 5).

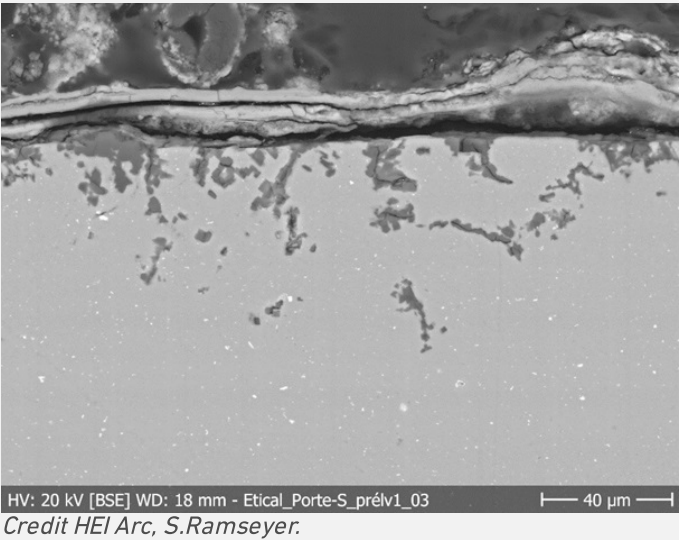


Fig. 5: SEM image of the metal sample from Fig. 3 (detail), BSE-mode. We observe the presence of numerous inclusions,

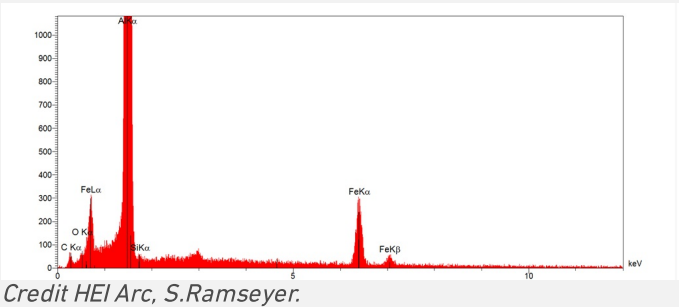


Fig. 6: EDS spectrum of the inclusions of Fig. 5,

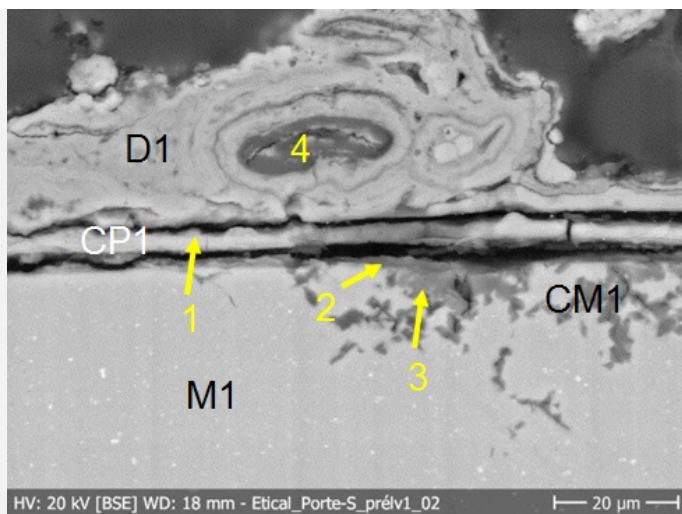
Microstructure	None
First metal element	Al
Other metal elements	Fe

Complementary information

Nothing to report.

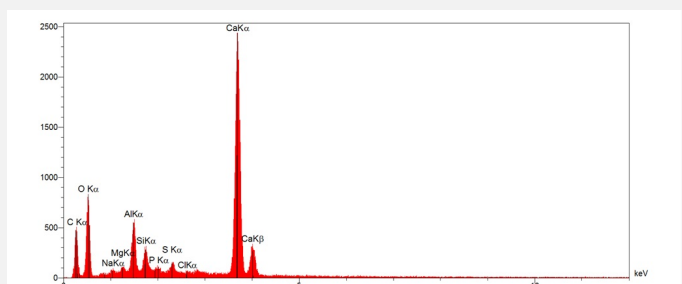
Corrosion layers

A very thin and loose oxide film has formed on the metal surface (CP1) and is locally covered by white deposits (D1). Intergranular corrosion has developed under the deposits (Fig. 7). Analysis by SEM-EDS indicates that the Al and O-rich oxide layer is contaminated with P and Si (area 1 on Fig. 7 and Fig. 8). These elements are even more present at the interface between CM1 and CP1 with Cl and S (area 2 on Fig. 7 and Fig. 9). The concentration of P and Si decreases in CM1 (area 3 on Fig. 7 and Fig. 10) while the concentration of S and Cl increases (Fig. 11). The deposit is mainly constituted of Ca, O, C and Si (probably CaCO3 and SiO2, area 4 on Fig. 7 and Fig. 12).



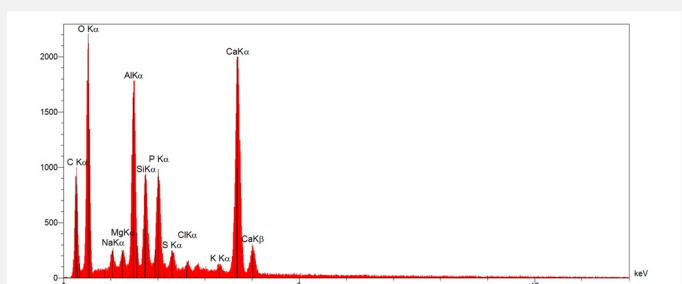
Credit HEI Arc, S.Ramseyer.

Fig. 7: SEM picture with location of EDS analyses of areas 1 to 4), BSE-mode. From bottom to top: the metal (M1) in light grey, the corroded metal (CM1), CP1 and D1,



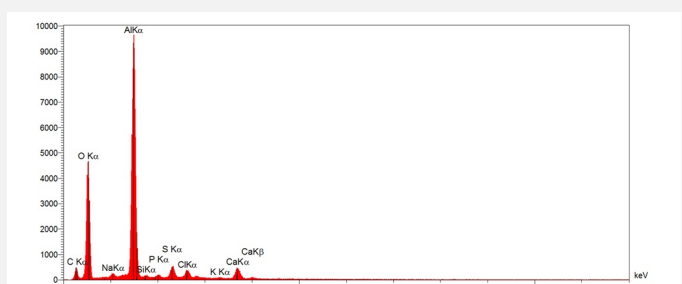
Credit HEI Arc, S.Ramseyer.

Fig. 8: EDS spectrum of area 1 of Fig. 7,



Credit HEI Arc, S.Ramseyer.

Fig. 9: EDS spectrum of area 2 of Fig. 7,



Credit HEI Arc, S.Ramseyer.

Fig. 10: EDS spectrum of area 3 of Fig. 7,

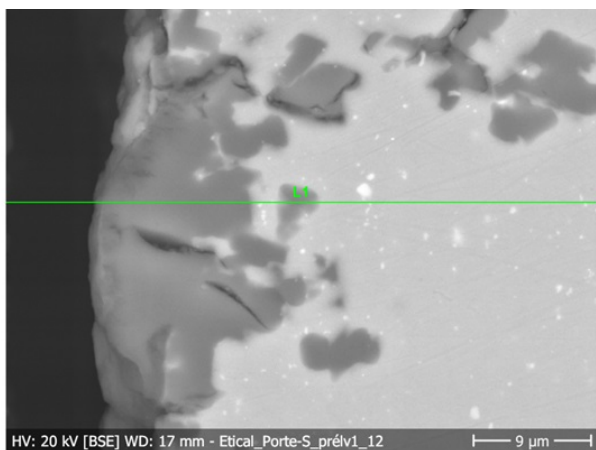
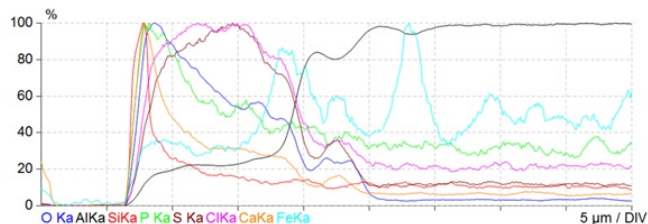
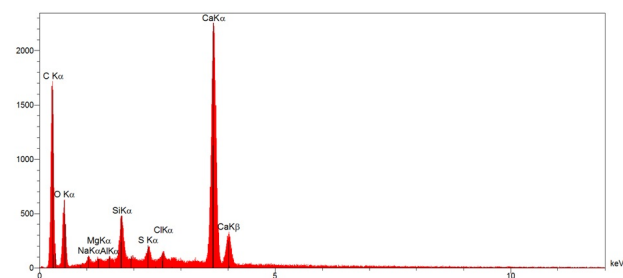


Fig. 11: EDS Linescan from CM1 to M1,



Credit HEI Arc, S.Ramseyer

Fig. 12: EDS spectrum of area 4 of Fig. 7,



Credit HEI Arc, S.Ramseyer.

**Corrosion form**                      Multiform - intergranular

**Corrosion type**                      None

### Complementary information

Nothing to report.

✧ MiCorr stratigraphy(ies) – CS

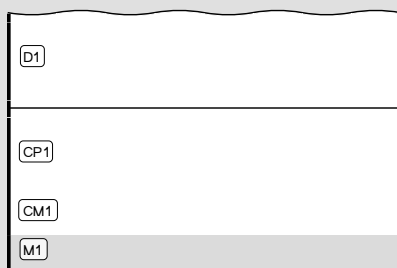


Fig. 4: Stratigraphic representation of the object in cross-section using the MiCorr application. This representation can be compared to Fig. 9, Credit HE-Arc CR, C.Degrigny.

## ✧ Synthesis of the binocular / cross-section examination of the corrosion structure

Corrected stratigraphic representation: none.

## ✧ Conclusion

This aluminium alloy has a composition similar to a primary aluminium with an Al content between 99 and 99.8 mass%. The main impurity is Fe forming intermetallic (Al<sub>3</sub>Fe) inclusions. It is covered by a thin oxide layer (probably aluminium oxide). Pitting corrosion has formed under calcareous white deposits with a local distribution. It seems to develop as intergranular corrosion.

## ✧ References

### References object

1. Degrigny, C. (2018) Etude, identification des objets en aluminium patrimononiaux et classification de leurs forms de corrosion - projet EtICAL, rapport interne HE-Arc CR.

### References sample

2. Degrigny, C. (2018) Etude, identification des objets en aluminium patrimononiaux et classification de leurs forms de corrosion - projet EtICAL, rapport interne HE-Arc CR.