

# demande de TAV

CX-0683C

|                                            |                                           |                                |
|--------------------------------------------|-------------------------------------------|--------------------------------|
| Litige <input checked="" type="checkbox"/> | Expertise / A.T. <input type="checkbox"/> | Vigie <input type="checkbox"/> |
| Suite à une visite                         | Oui <input type="checkbox"/>              | Non <input type="checkbox"/>   |
| Date :                                     |                                           |                                |
| Visiteur :                                 | R.KEFFERSTEIN                             |                                |
| N° CRV :                                   |                                           |                                |

Copie de la demande

Imputation  
32502

(IRD/AUP/MTO/F/03 - éd. 6 - IRD/AUP/CBS/MTO/06/I/01)

**Client : FORD/MAGNA**
**Produit : USIBOR**
**Qualité :**
**Format : 1.6 mm**

| Séquentiel   | Commande | Travail / Bobine         |                          |                          | Coil                     |                          |                          | Brame                    |                          | Coulée                   | Code Acier          |
|--------------|----------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|---------------------|
|              |          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                     |
|              |          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                     |
|              |          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                     |
|              |          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                     |
|              |          |                          |                          |                          |                          |                          |                          |                          |                          |                          |                     |
| USINE        |          | FL                       | MZ                       | DK                       | MK                       | MT                       | BI                       | FOS                      | CS                       | EK                       | Autres (à préciser) |
| A chaud :    |          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |                     |
| A froid :    |          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |                     |
| Revêtement : |          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |                     |
| Autre :      |          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |                     |

Pièces incriminées ou à réaliser : B-Pillar

N° de litige + tonnage dénoncé :

Problème : casse...différée ?

Infos : emboutissage MAGNA à Bopfingen.

Echantillonnage : 1 pièce

## Essais demandés

|                                                                                                                                                                            |                                               |                                                                                                                                                                                                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Dureté <input type="checkbox"/>                                                                                                                                            | Critères de rugosité <input type="checkbox"/> | <b>ENJEUX : techniques, financiers,...</b><br><b>Photo macro</b><br><b>Microstructure+HV1</b><br><b>Revêtement Alusi</b><br><b>MEB fracto</b><br><b>Fissure avant ou après détournage ?</b><br><br><b>Délai demandé le 19/12/2005</b> |
| Traction <input type="checkbox"/>                                                                                                                                          | Taux de revêtement <input type="checkbox"/>   |                                                                                                                                                                                                                                       |
| n et r 3d <input type="checkbox"/>                                                                                                                                         | Taux de passivation <input type="checkbox"/>  |                                                                                                                                                                                                                                       |
| Micro <input type="checkbox"/>                                                                                                                                             | Essais d'émaillage <input type="checkbox"/>   |                                                                                                                                                                                                                                       |
| Analyse <input type="checkbox"/>                                                                                                                                           |                                               |                                                                                                                                                                                                                                       |
| <b>Diffusion des résultats :</b><br><b>R.KEFFERSTEIN</b><br><b>M.BABBIT</b><br><b>A.MOULIN</b><br><b>A.CARMET</b><br><b>P.DRILLET</b><br><b>H.GUYON</b><br><b>T.STUREL</b> |                                               | <b>Rapport labo le : 14/12/2005</b>                                                                                                                                                                                                   |

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## FORD / MAGNA

### Rupture sur B-Pillar en USIBOR ép. 1,6mm. Emboutissage à Bopfingen.

**Echantillonnage** : nous avons reçu la pièce et le squelette de détourage laser.

☞ Voir aspect macro planche 1: pièce et squelette + détail des fissures : ☞ Voir planche 2.

### Résultat des examens :

Caractérisation du métal de base :

- ⇒ Santé interne : RAS
- ⇒ Structure martensitique
- ⇒  $\mu$ -dureté HV1 : 496 soit  $\approx$  1600 MPa.

Caractérisation du revêtement Alusi : ☞ Voir aspect MEB planche 3.

☞ 1 seule face illustrée car les 2 sont identiques.

- ⇒ Morphologie : RAS
- ⇒ Rapport O/Al : 0.25 (moyenne sur 3 champs)
- ⇒ Coupe MEB :
  - Ep. alliage interfacial = 17  $\mu$ m
  - Ep. Totale = 41  $\mu$ m.

Rmq: légère sur-alliation du revêtement Alusi. Effet Kirkendale marqué.

Caractérisation de la fissuration : ☞ *Avant ou après détourage laser ?*

⇒ **Fissuration antérieure** à l'opération de détourage. Voir illustration planche 4.

Faciès de rupture : ☞ Voir planche 5

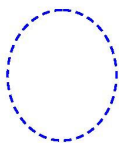
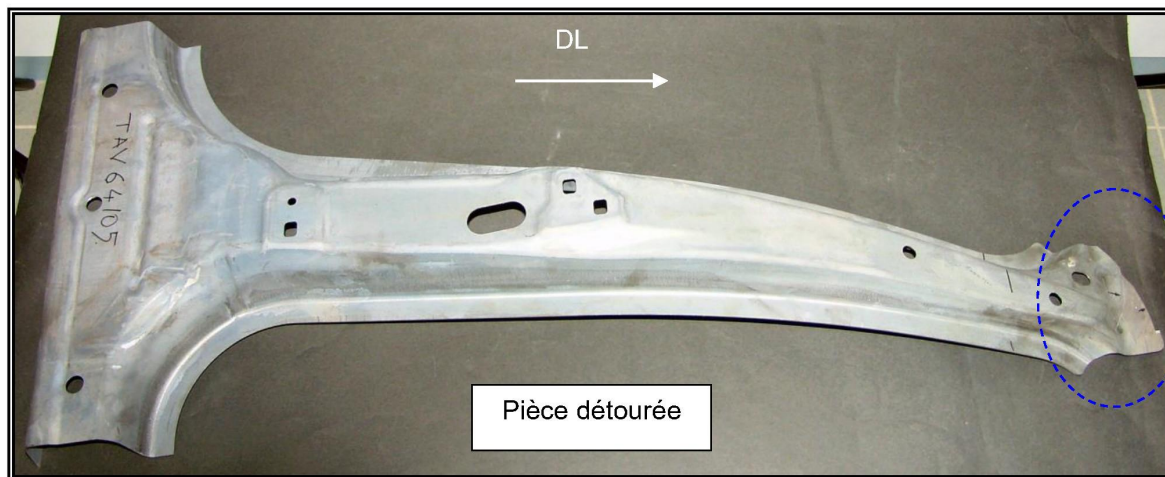
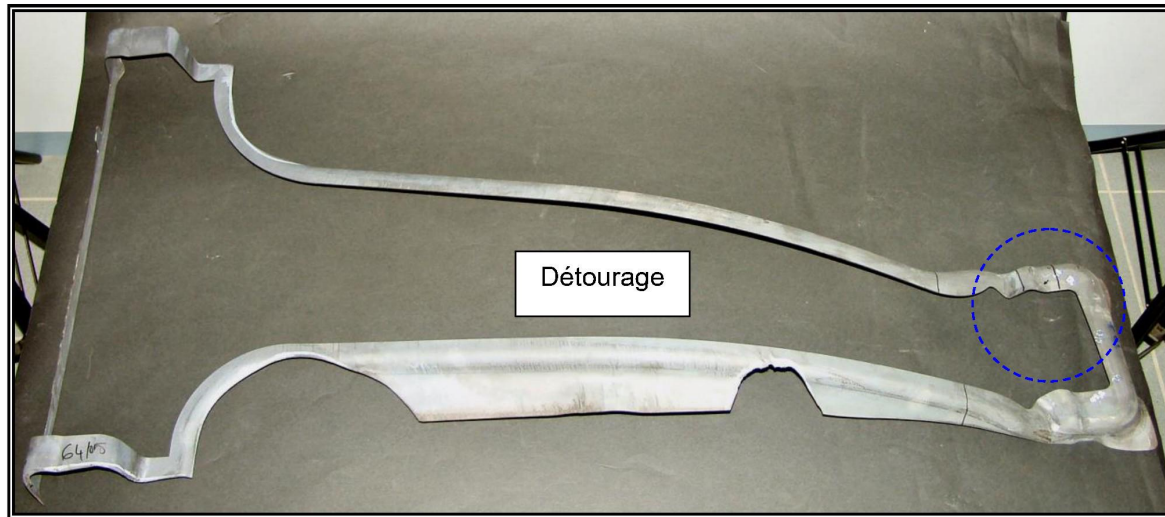
⇒ **Faciès de rupture intergranulaire avec présence de pédoncules et  $\mu$ -cavités caractéristiques d'une casse différée.**

### Conclusion :

- ⇒ Métal de base : - structure martensitique
  - Rm estimé à partir de la  $\mu$ -dureté HV1 = 496 soit Rm  $\approx$  1600 MPa
- ⇒ Revêtement Alusi : légère sur-alliation
- ⇒ **Casse différée (hydrogène) antérieure à l'opération de détourage laser.**

F.COLIN

R.MELLINGER  
Le 14/12/2005

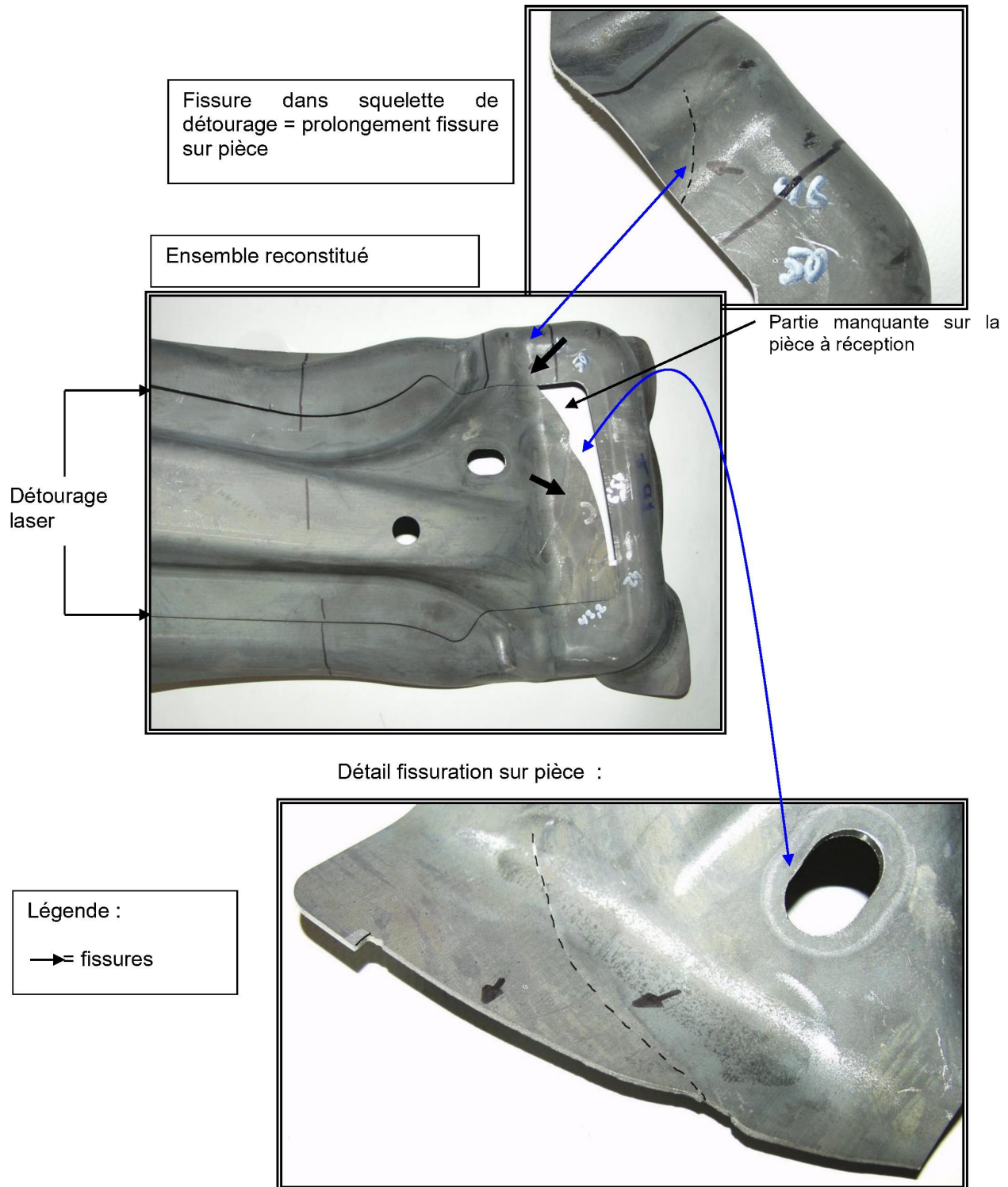


Zones fissurées à expertiser

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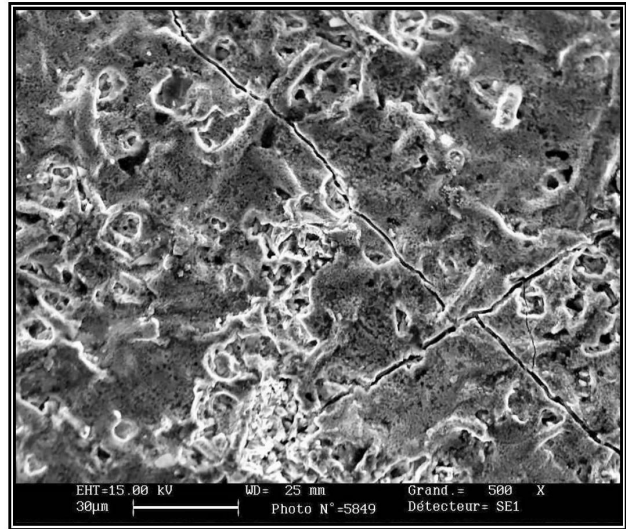
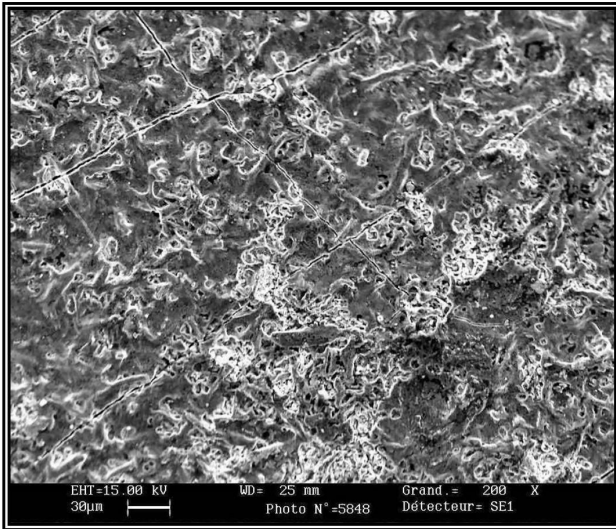
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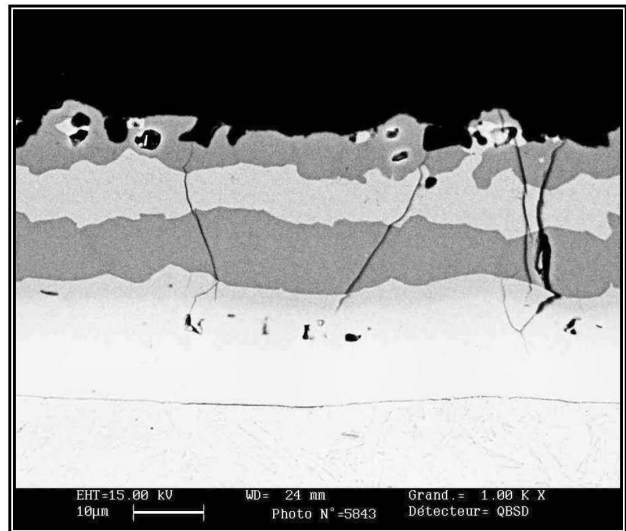
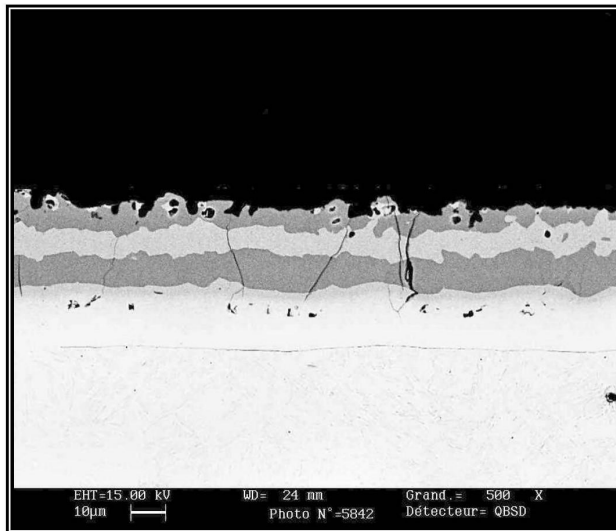




Morphologie du revêtement



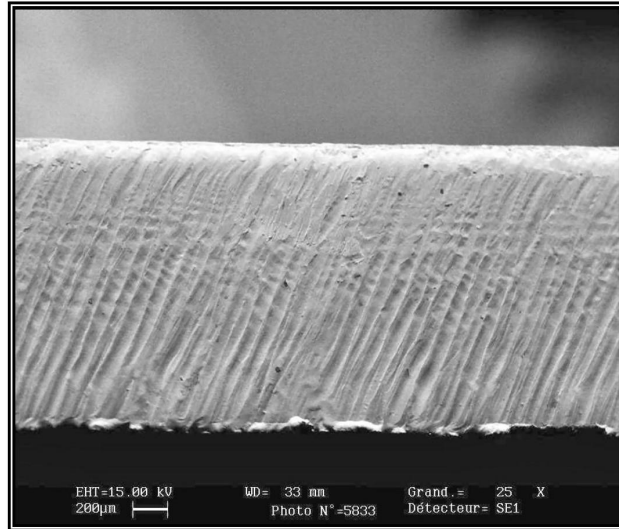
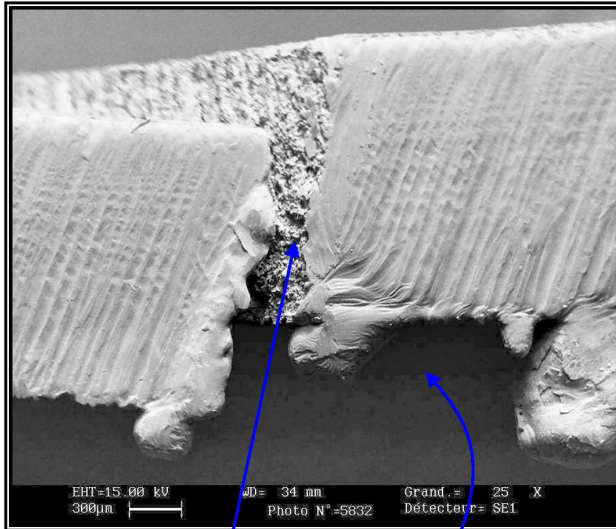
Coupe MEB



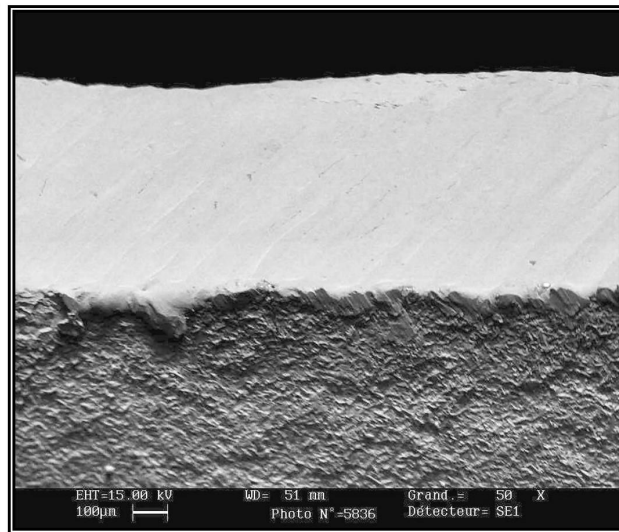
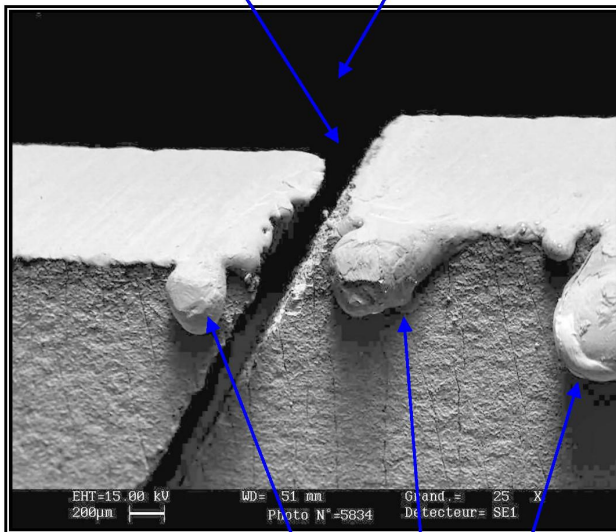


Zone fissurée

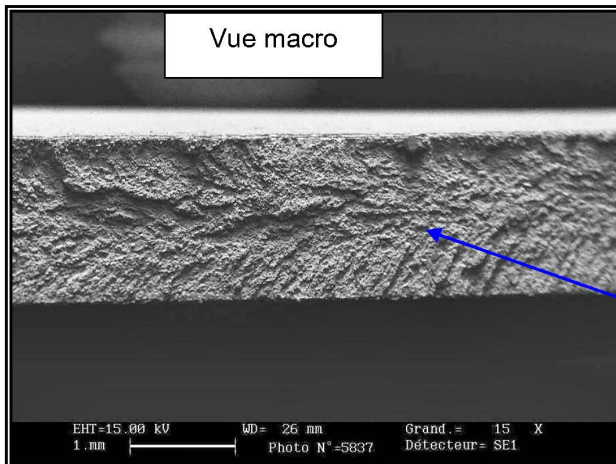
Zone hors fissure



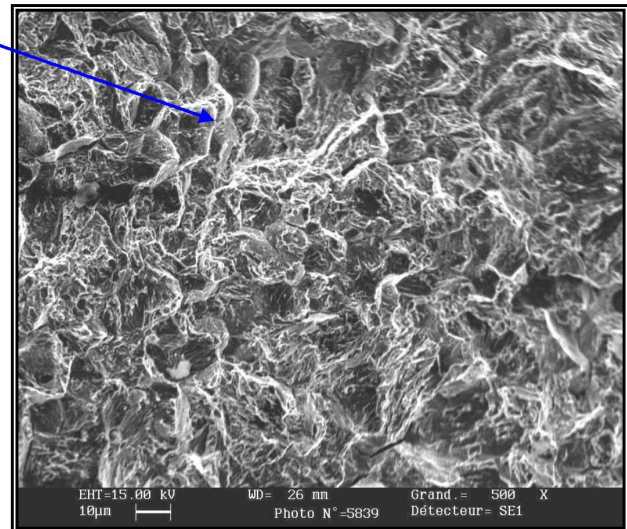
fissure



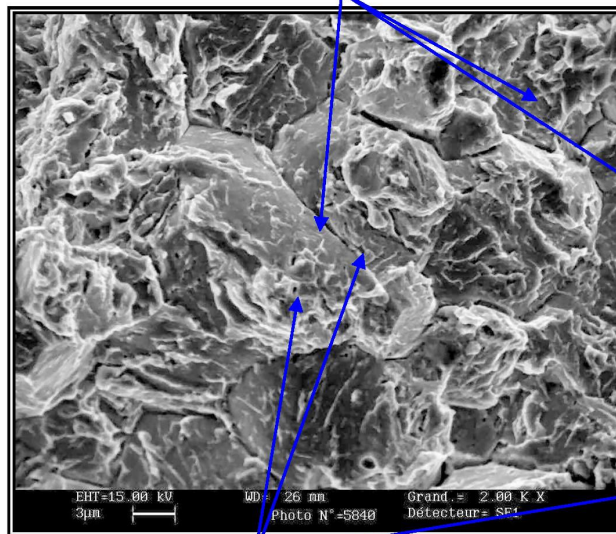
Gouttelettes de métal fondu



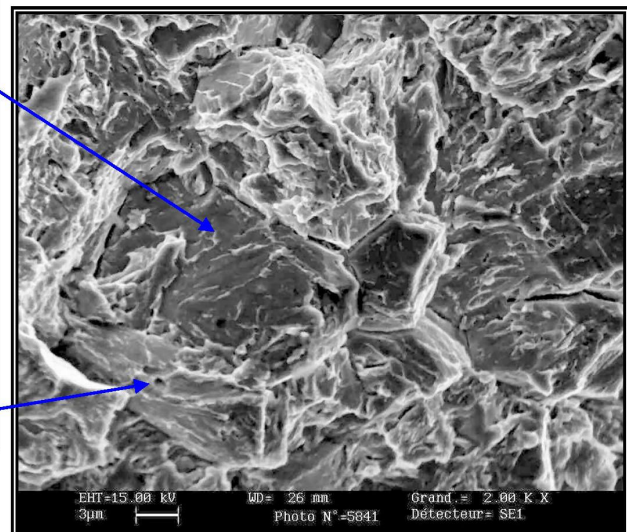
Faciès de rupture intergranulaire



pédoncules



Autre zone



µ-cavités

|                                                |                                                                 |                                                          |
|------------------------------------------------|-----------------------------------------------------------------|----------------------------------------------------------|
| Dispute<br><input checked="" type="checkbox"/> | Expertise /<br>Technical<br>opinion<br><input type="checkbox"/> | Monitoring<br><input type="checkbox"/>                   |
| Following a visit                              |                                                                 | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| Date:                                          |                                                                 |                                                          |
| Visitor:                                       |                                                                 | R. KEFFERSTEIN                                           |
| CRV No.:                                       |                                                                 |                                                          |

# TAV request

Copy of the request

Allocation  
32502

(IRD/AUP/MTO/F/03 - edition 6 - IRD/AUP/CBS/MTO/06/I/01)

## Client: FORD/MAGNA

Product: USIBOR

Quality : \*

Format: 1.6 mm

| Serial | Order | Job /<br>Roll | Coil | Slab | Casting | Steel Code |
|--------|-------|---------------|------|------|---------|------------|
|        |       |               |      |      |         |            |
|        |       |               |      |      |         |            |
|        |       |               |      |      |         |            |
|        |       |               |      |      |         |            |

| PLANT    | FL                       | MZ                       | DK                       | MK                       | MT                       | BI                       | FOS                      | CS                       | EK                       | Others (to be specified) |
|----------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Hot:     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |                          |
| Cold:    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |                          |
| Coating: | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |                          |
| Other:   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |                          |

Incriminated pieces or to produced: B-Pillar

No. of dispute + claimed tonnage:

Problem: breakage... delayed?

Info: MAGNA deep drawing in Bopfingen.

Sampling: 1 piece

### Test requested

|                                                                                                                                                                                  |                                             |                                                                                                                                                                                                                                                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Hardness <input type="checkbox"/>                                                                                                                                                | Roughness criteria <input type="checkbox"/> | <b>IMPLICATIONS: technical, financial,...</b><br><b>Macro photo</b><br><b>Microstructure + HV1</b><br><b>Alusi® coating</b><br><b>SEM fractography</b><br><b>Fissure before or after trimming?</b><br><br><b>Requested deadline 12/19/2005</b> |
| Traction <input type="checkbox"/>                                                                                                                                                | Coating rate <input type="checkbox"/>       |                                                                                                                                                                                                                                                |
| n and r 3d <input type="checkbox"/>                                                                                                                                              | Passivation rate <input type="checkbox"/>   |                                                                                                                                                                                                                                                |
| Micro <input type="checkbox"/>                                                                                                                                                   | Enameling tests <input type="checkbox"/>    |                                                                                                                                                                                                                                                |
| Analysis <input type="checkbox"/>                                                                                                                                                |                                             |                                                                                                                                                                                                                                                |
| <b>Distribution of results:</b><br><b>R. KEFFERSTEIN</b><br><b>M. BABBIT</b><br><b>A. MOULIN</b><br><b>A. CARMET</b><br><b>P. DRILLET</b><br><b>H. GUYON</b><br><b>T. STUREL</b> |                                             | <b>Lab report: 12/14/2005</b>                                                                                                                                                                                                                  |



Flat Carbon Steel

I-R&D

ARCELOR RESEARCH — Metallographic platform



TAV 64/2005

## FORD / MAGNA

**Break on B-Pillar made of USIBOR thickness 1.6 mm. Deep drawing in Bopfingen.**

**Sampling:** We have received the piece and the laser trimming skeleton.

☞ See macro view plate 1: piece and skeleton + detail of the fissures: ☞ See plate 2.

### Results of the examinations:

#### Characterization of the base metal:

- => Internal health: Nothing to report
- => Martensitic structure
- =>  $\mu$ -hardness HV1: 496 which is to say  $\approx 1600$  MPa.

#### Characterization of the Alusi® coating: ☞ See SEM view plate 3.

☞ only 1 surface illustrated since both are identical.

- => Morphology: Nothing to report
- => O/Al ratio: 0.25 (average over 3 ranges)
- => SEM cut:
  - Interfacial alloy thickness = 17  $\mu$ m
  - Total thickness = 41  $\mu$ m.

Quality Management Officer: mild over-alloying of the Alusi® coating. Noted Kirkendall effect.

#### Characterization of the fissuring: ☞ *Prior or after laser trimming?*

=> **Fissuring prior** to the trimming operation. See illustration plate 4.

#### Facies of the break: ☞ See plate 5

=> **Intergranular break facies with presence of peduncles and  $\mu$ -cavities which are characteristic of a deferred break.**

#### Conclusion:

- => Base metal: - martensitic structure
  - Rm estimated using the  $\mu$ -hardness HV1 = 496 which is to say Rm  $\approx 1600$  MPa
- => Alusi® coating: mild over-alloying
- => **Deferred break (hydrogen) prior to the laser trimming operation.**

F. COLIN

R. MELLINGER  
12/14/2005

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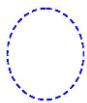
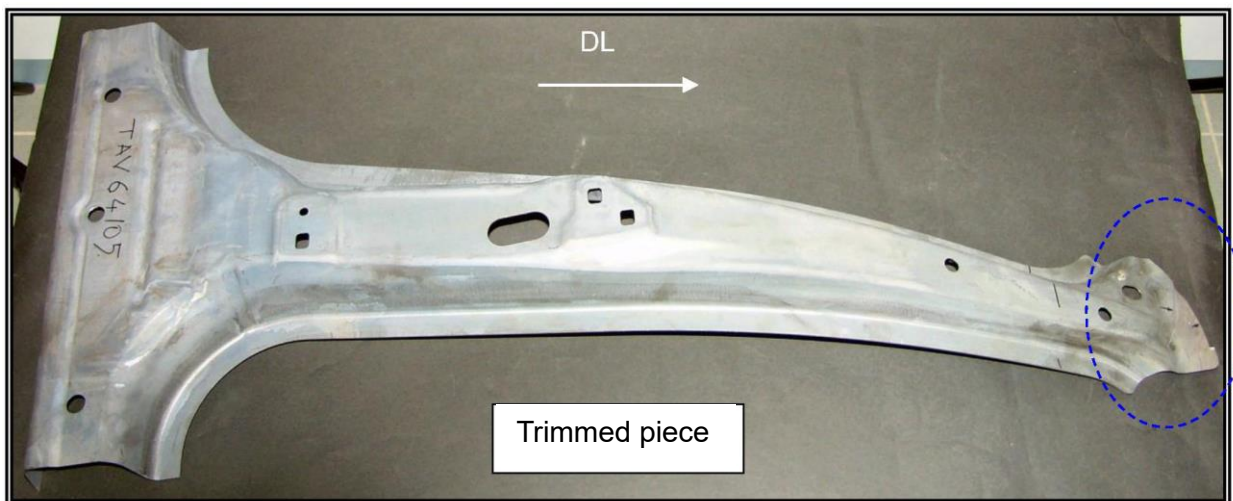
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IPR2024-01376

AM-ITC-0102171

CX-0683C.0009



Macro view

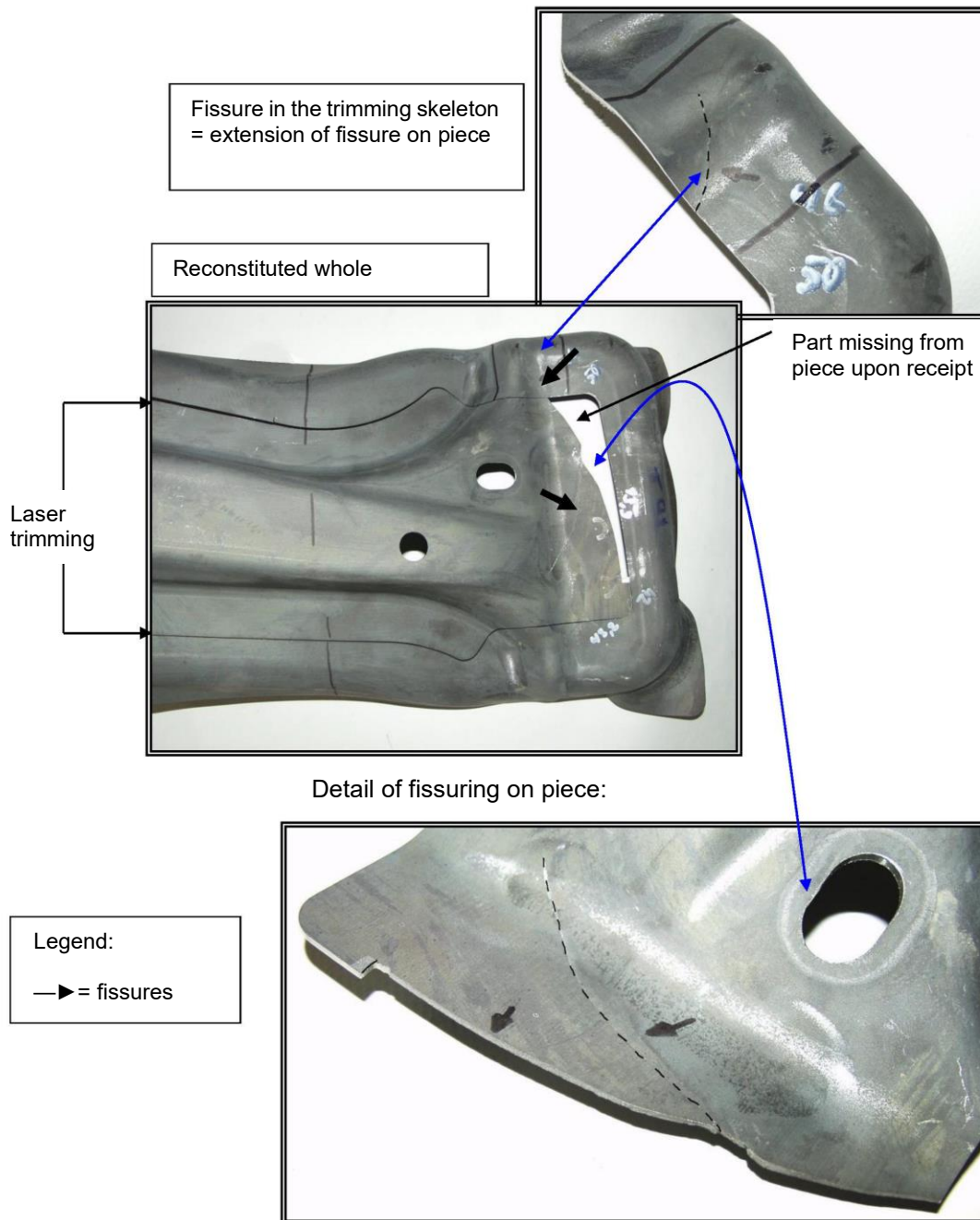


Fissured areas to be assessed



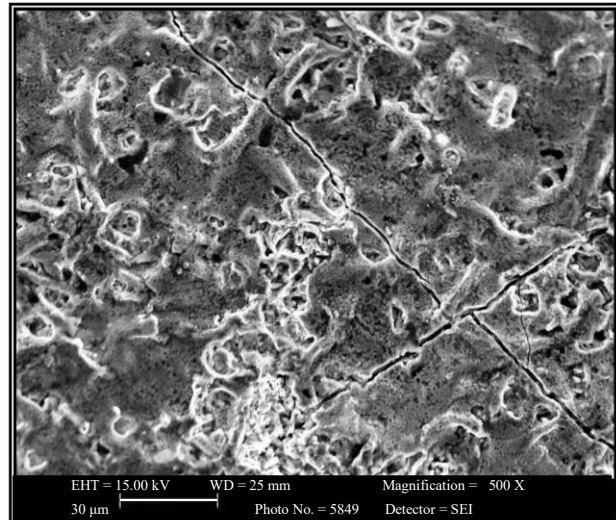
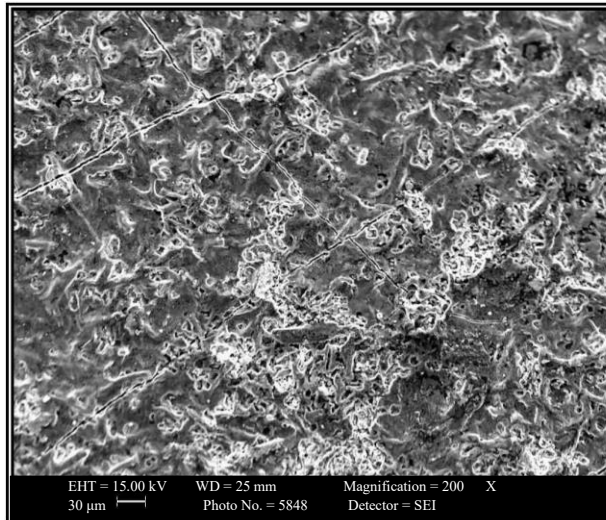
Macro view – detail of the fissures

Plate 2/5  
TAV 64/2005

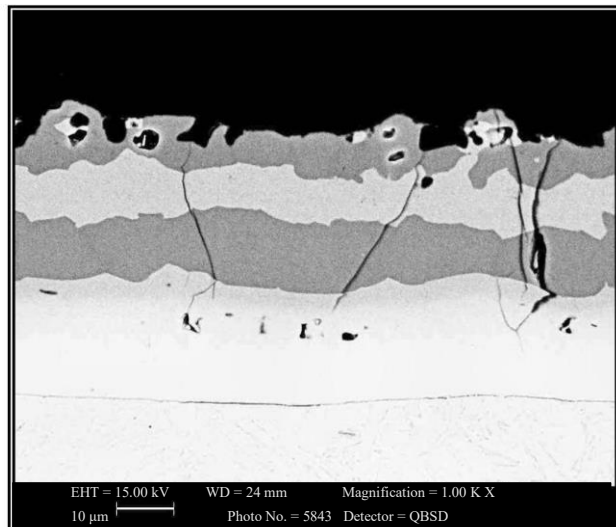
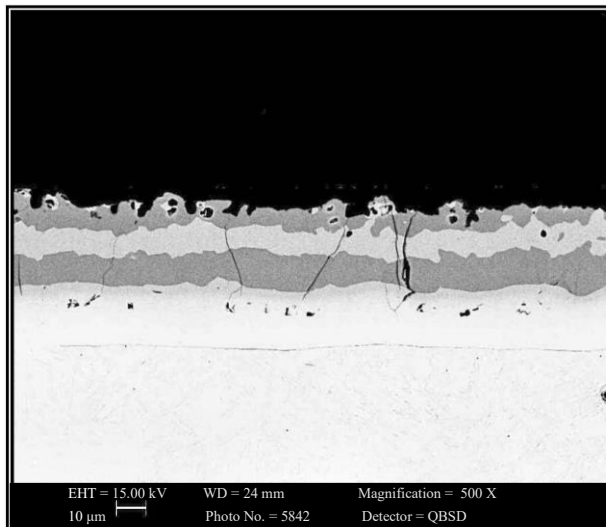




## Morphology of the coating



## SEM cut



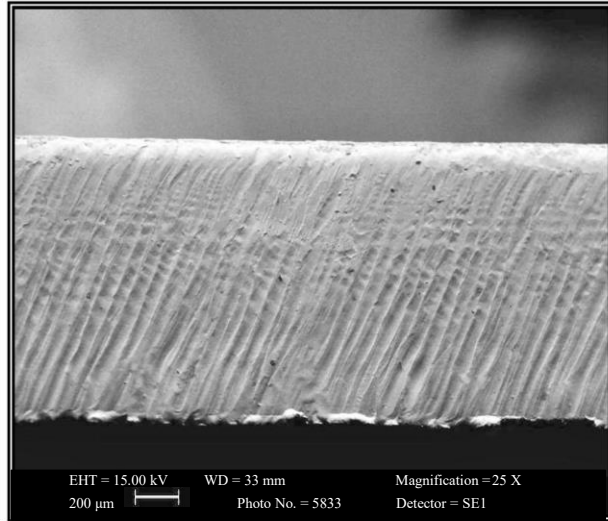
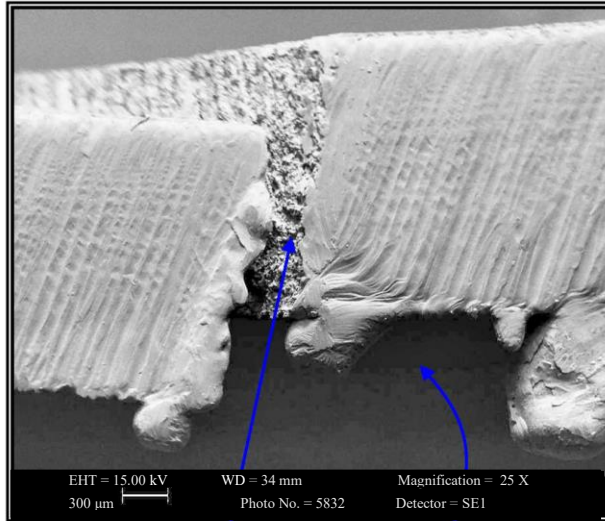


**SEM view of the fissures**

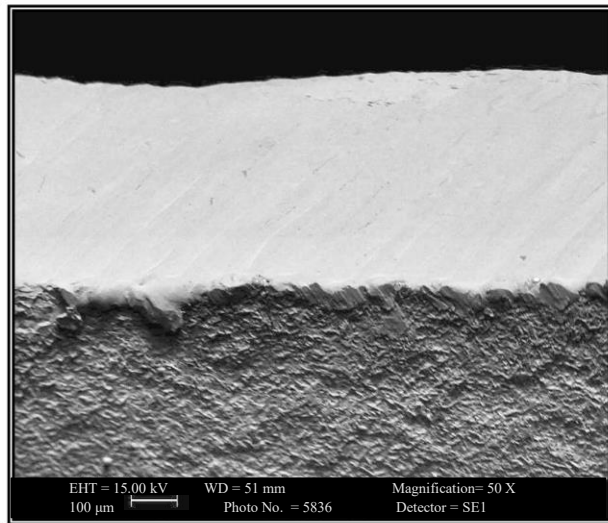
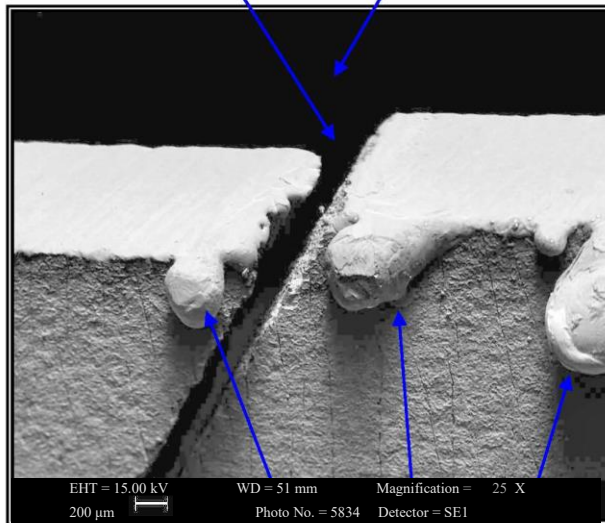
**Plate 4/5**  
**TAV 64/2005**

Fissured area

Non-fissured area



fissure



Droplets of molten metal

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**IPR2024-01376**

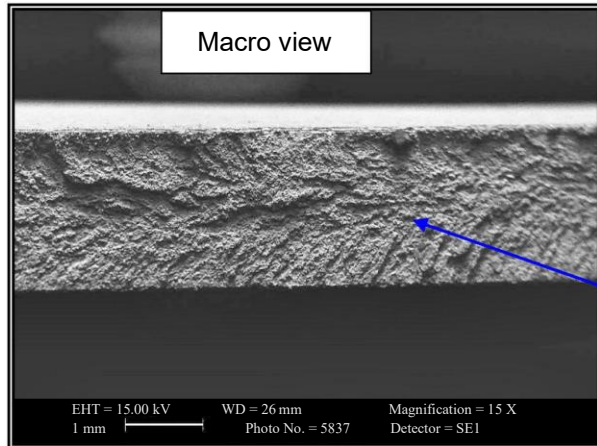
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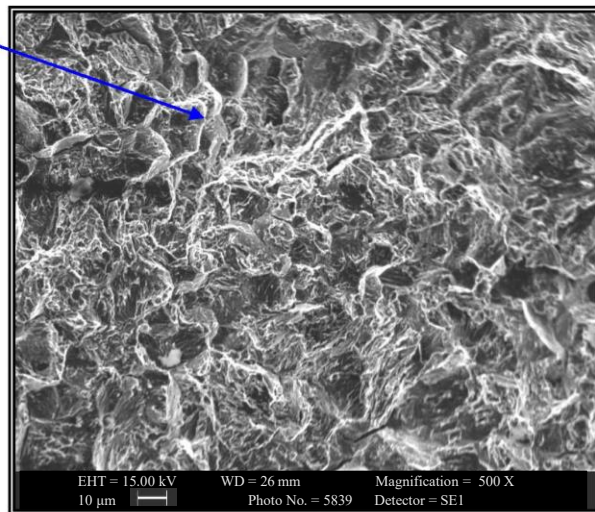
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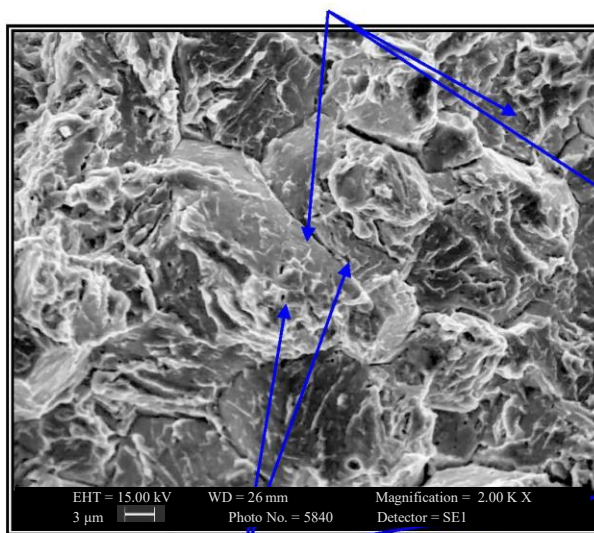
Facies of the break: deferred break?



Facies of intergranular break



peduncles



µ-cavities

Other area

