TALAT Lecture 4205

Testing Methods for Welded Joints

5 pages, 3 figures

Basic Level

prepared by Ulrich Krüger,
Schweißtechnische Lehr- und Versuchsanstalt Berlin

Objectives:

− to give information about the relevant non-destructive and destructive testing methods for aluminium welded joints

Prerequisites:

− background in production welding and quality assurance

Date of Issue: 1994
© EAA - European Aluminium Association
4205 Testing Methods for Welded Joints

Table of Contents

4205 Testing Methods for Welded Joints...............................................................2

4205.01 Non-Destructive Testing of Welded Aluminium Joints....................... 3

NDT Methods for Aluminium Welds......................................................................3

Example of an X-Ray Catalogue .............................................................................4

4205.02 Destructive Testing of Aluminium Welded Joints.............................. 4

List of Test Methods ...............................................................................................4

4205.03 Literature/References...............................................................................5

4204.04 List of Figures.......................................................................................... 5
4205.01 Non-Destructive Testing of Welded Aluminium Joints

- NDT methods for aluminium welds
- Example of an X-Ray Catalogue

NDT Methods for Aluminium Welds

The quality of welds in welded joints can be tested using testing standards specific for aluminium or by using methods adapted from testing methods for steels. The magnaflux test (magnetic particle test) cannot be used for testing the non-magnetic aluminium (Figure 4205.01.01).

![Non-Destructive Testing of Welded Aluminium Joints](image)

The types of testings heads used for the ultrasonic testing of steel can also be used to test aluminium welds; only the wave entry angle is somewhat smaller for aluminium.

The different absorption capacities of the aluminium alloys influence the quality of the results obtained using the radiographic examination.

Both testing methods can be used to determine the presence of cracks, fusion defects, inclusions and pores.

When using the radiographic method for testing thin-walled aluminium parts, it must be remembered that the allowed weld thickness (weld root reinforcement including part thickness) is much thicker than the part itself, thus causing larger blacking differences on the radiograph film. This can make the evaluation more difficult.
Example of an X-Ray Catalogue

X-ray catalogues based on experience are available for certain fields of application and are of great help in evaluating the radiographic films when weld seams with internal discontinuities have to be classified in certain evaluation groups or have to fulfil certain requirements. Figure 4205.01.02 shows an example taken from the evaluation catalogue DVS 1611 relevant for the field of application of railway wagon construction. This comparative chart makes a quick evaluation by comparison possible, without having to actually measure and count the pores present.

<table>
<thead>
<tr>
<th>Mixed porosity (coarse and medium)</th>
<th>d = 0.25 t \text{ mm}</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 x (0.8)</td>
<td>(0.5) (\text{(d_{max})})</td>
</tr>
<tr>
<td>2 x (0.8)</td>
<td>(0.8) (\text{(d_{max})})</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Medium porosity (uniformly distributed)</th>
<th>d=0.025 t ( \times 0.6\text{mm} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 pores each ( \geq 0.8 )</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fine porosity (uniformly distributed)</th>
<th>d=0.02 t ( \times 0.35\text{mm} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>120 pores each ( \geq 0.5 )</td>
<td></td>
</tr>
</tbody>
</table>

Example of an X-Ray Catalogue (according to DVS 1611)

\[ d = \text{pore diameter} \]
\[ t = \text{weld thickness} \]
\[ l_p = \text{reference length} \]
\[ f = \text{pore cross section area} \]
\[ F = \text{total pore cross sectional area} \]

1) Valid for pore spacing within a line of pores.
2) Valid for pore spacing, if a pore has the maximum allowable pore diameter.

Example: Pore Class B

Example for allowable porosity in welded joints for \( t = 10 \text{ mm} \) and for a reference length \( l_p = 150\text{mm} \) allowable total pore area \( F = \sum f \leq 22.5 \text{mm}^2 \)

4205.02 Destructive Testing of Aluminium Welded Joints

- List of test methods

List of Test Methods

The destructive test methods are analogous to those used for steel. Metallographic tests and mechanical testing methods are employed (Figure 4205.02.01).

The material, testing loads, punch diameter, distance between supports, etchant etc. are chosen to conform to the physico-chemical properties of the material

TALAT 4205

4
Destructive Testing of Aluminium Welded Joints

Bending Test (3-point, over root/cover pass, longitudinal/transverse to weld seam)
Tensile test
Fatigue test
Notch impact test
Creep rupture test
Crack propagation test
Corrosion test
Hardness test
Metallographic examination of structure (macro, micro, SEM)
Chemical analysis

4205.03 Literature/References

- Aluminium-Taschenbuch, 14. Auflage, 1984, Aluminium-Verlag, Düsseldorf

-Welding Kaiser Aluminium, Kaiser Aluminium & Chemical Sales Inc., Kaiser Center, Oakland, California, 1978

-Beurteilung von Durchstrahlungsaufnahmen im Schienenfahrzeugbau - Schmelzschweißverbindungen an Aluminium und Aluminiumlegierungen. Merkblatt DVS 1611, Deutscher Verlag für Schweißtechnik, Düsseldorf

CEN-Standards on destructive and non-destructive testing of aluminium weldments are in preparation. Inquire about new issues via your national standards organisation.

4204.04 List of Figures

<table>
<thead>
<tr>
<th>Figure No.</th>
<th>Figure Title (Overhead)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4205.01.01</td>
<td>NDT Methods for Welded Aluminium Joints</td>
</tr>
<tr>
<td>4205.01.02</td>
<td>Example of an X-Ray Catalogue</td>
</tr>
<tr>
<td>4205.02.01</td>
<td>Destructive Testing of Aluminium Welded Joints</td>
</tr>
</tbody>
</table>