QUALICOAT Specifications 2022
Appendix A13

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Appendix A13 – QUALICOAT 3.0

1. QCT 3.0 Testing

1.1. Sampling

Three different extruded profiles shall be selected, and test samples shall be prepared according to § 1.1.1 or § 1.1.2 of this appendix. For each sample, three test pieces shall be prepared in a testing laboratory approved for QCT 3.0, as per § 1.2.1 of this appendix.

1.1.1. Samples taken from the production before coating process (bare aluminium)

a) The samples obtained from the extruded profiles shall be cut to the appropriate size for the corrosion cell.

b) The surfaces of the samples shall be treated with organic solvents (acetone, ethyl alcohol, etc.) to eliminate the remains of oils, coolants, aluminium chips, etc. deposited on the surface during the cutting process.

c) The surface chosen for performing the tests shall be flat.

1.1.2. Samples taken from the production after coating process (coated aluminium)

a–c) Same as 1.1.1

d) The coating layer shall be removed with an appropriate product.

e) The conversion layer shall be removed with an appropriate product.

1.2. Tests methods and requirements

1.2.1. Optical Emission Spectroscopy (OES)

TEST METHOD

This test is based on the **EN 14726:2019** standard.

The test shall be performed on three different samples.

The sample for analysis is prepared mechanically and its thickness shall must be at least 1 mm.

REQUIREMENTS:

For **Aluminium QUALICOAT 3.0 grade,** the weights (%) of alloying elements for 6060 and 6063 alloys are as follows (acc. EN 573-3):

- Alloy 6060 composition:

Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti
0.30-0.60	0.10-0.30	≤ 0.10	≤ 0.10	0.35-0.60	≤ 0.05	≤ 0.15	≤ 0.10

- Alloy 6063 composition:

Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti
0.20-0.60	≤0.35	≤ 0.10	≤ 0.10	0.45-0.90	≤ 0.10	≤ 0.10	≤ 0.10

Final assessment of the OES test:

RATIO	VALUE	ASSESSMENT
Fe/Si	<0.55	Satisfactory
Mg/Si	0.80 – 1.30	Satisfactory
Weight of alloying elements*	Within the limits	Satisfactory

(*) The QCT recommendation for Cu weight (%) is a maximum of 0.03. Nevertheless, it will be possible to use EN AW 6060 and EN AW 6063 alloys with a copper content higher than 0.03, provided that the copper content is balanced.

1.2.2. Anodic Cyclic Polarization (ACP)

TEST METHOD

This is based on the ASTM G102 - 89(2015) e1 and ASTM G69 standards.

The test shall be performed on three different samples.

The surface for the test will be 1 cm^2. To achieve this surface, portholes or electrochemical masks can be used.

Once the sample is prepared, it shall be submerged in the cell solution for a period of 0.5–1 hour to achieve electrochemical stabilization.

REQUIREMENTS:

For alloys 6060 and 6063 with **Aluminium QUALICOAT 3.0 grade**, the requirements and parameters of the ACP test are indicated in the following table:

Anodic Cyclic Polarization (ACP) - Recommended parameters
Surface to be tested: 1 cm^2
Potential scan limits: - 0.1v (start) / 0.1v (stop)
Counter electrode material: Platinum (Pt) Counter electrode area: 3 cm (approximately) Distance from test area: 1–4 mm
Concentration of the cell solution | NaCl | = 3,5%
Concentration of the reference electrode solution | KCl | = 3,0 M
Stabilization time: 0,5–1 hour
Test temperature: 23 ± 2 ºC
Electrical insulation: the equipment shall be inside into a Faraday box connected to ground
Scan rate: 10 mV/min
Parameter to be determined: Corrosion Potential (Ecorr)

Final assessment of the ACP test:

For aluminium alloys 6060 and 6063 (Aluminium QUALICOAT 3.0 grade), the corrosion potential values of extruded profiles are shown in the following table:

PARAMETER	VALUE (V)	ASSESSMENT
Ecorr	AW 6060: ≥ -0.744 V	SATISFACTORY
	AW 6063: ≥ -0.774 V	SATISFACTORY

1.2.3. Metallographic study for Aluminium QUALICOAT 3.0 grade

TEST METHOD

This is based on the ASTM-E112-2010 (only to determine the grain size).

The test shall be performed on three different samples.

The metallographic study shall be carried out in two phases: initially on a polished surface of the profile, and then on an etching surface with acid solutions.

Metallographic sample preparation

Polishing can be achieved by using different methods/procedures. The choice of procedure depends on each laboratory. A typical example of the process would be as follows (each laboratory may use the one it deems most appropriate):

1. Sample preparation by cutting.
2. Dipping the sample in both hot and cold mounting resin (acrylic resins, diallylphthalate resin, etc.)
3. Grinding with sandpaper abrasive sheets (silicon carbide P-180, 240, 360, 400, 600, 800, 1000, and 1200 grit.
4. Polishing: using aluminium oxide powder 1µm-0,3 µm, diamond polishing paste (0.25 µm), etc.
5. Remove the alumina from the surface using ammonia solution.
6. Clean the aluminium surface with ethyl alcohol.
7. Chemical attack using hydrofluoric acid 0.5% in weight. (Only for Part 2).

PART 1. Metallographic study on polishing samples without chemical etching

In polished samples without chemical etching, the surface of the extruded aluminium profile will be analysed. The extruded surface will have no defects or external inclusions.

TEST: Metallography study		
STANDARD/PROCEDURE: QUALICOAT Specifications (Appendix A13)		
OPERATOR:		
Codification	PART 1 (without chemical etching)	
	DEFECT ON SURFACE	RESULT NUMERICAL VALUE (**)
xxxx-yy-zz	Die lines	
	Strikes	
	Tearing	
	Dark bands	
	Blistering	
	Pick-up	
TOTAL		
FINAL ASSESSMENT A(*) - (**limit value: ≥ 11**)		

(*): FINAL ASSESSMENT:
TOTAL **6–10**: UNSATISFACTORY
TOTAL **≥ 11** : SATISFACTORY

(**) NUMERICAL VALUE:
1= PRESENT AND CRITICAL
2= PRESENT BUT NOT CRITICAL
3= NOT PRESENT
3= NOT PRESENT

TEST: Metallography study		
STANDARD/PROCEDURE: QUALICOAT Specifications (Appendix A13)		
OPERATOR:		
Codification	PART 1 (without chemical etching)	
	DEFECT ON SURFACE	RESULT NUMERICAL VALUE (**)
xxxx-yy-zz	Inclusions	
	Overpressure extrusion	
	Slag	
	Oxides	
TOTAL		
FINAL ASSESSMENT B (*) - (**limit value: ≥ 8**)		

(*): FINAL ASSESSMENT:
TOTAL **4–7**: UNSATISFACTORY
TOTAL **≥ 8** : SATISFACTORY

(**) NUMERICAL VALUE:
1= PRESENT AND CRITICAL
2= PRESENT BUT NOT CRITICAL
3= NOT PRESENT

PART 2. Metallographic study on polishing samples with chemical etching

TEST: Metallography study		
STANDARD/PROCEDURE: QUALICOAT Specifications (Appendix A13)		
OPERATOR:		
Codification	PART 2 (with chemical etching)	
	DEFECT ON SURFACE	RESULT NUMERICAL VALUE (**)
xxxx-yy-zz	Secondary recrystallization	
	Determination of grade (Grain size ≥5)	
	Precipitates compounds	
	Inclusion present in the grain	
	Inclusion present in the grain boundary	
TOTAL		
FINAL ASSESSMENT C (*) - (**limit value: ≥ 11**)		

(*): FINAL ASSESSMENT:
TOTAL **5–10**: UNSATISFACTORY
TOTAL **≥ 11** : SATISFACTORY

(**) NUMERICAL VALUE:
1= PRESENT AND CRITICAL
2= PRESENT BUT NOT CRITICAL
3= NOT PRESENT

REFERENCE PHOTOGRAPHS FOR EVALUATING THE METALLOGRAPHIC TEST RESULTS

Metallographic study of aluminium extruded surface without chemical etching (Part 1)

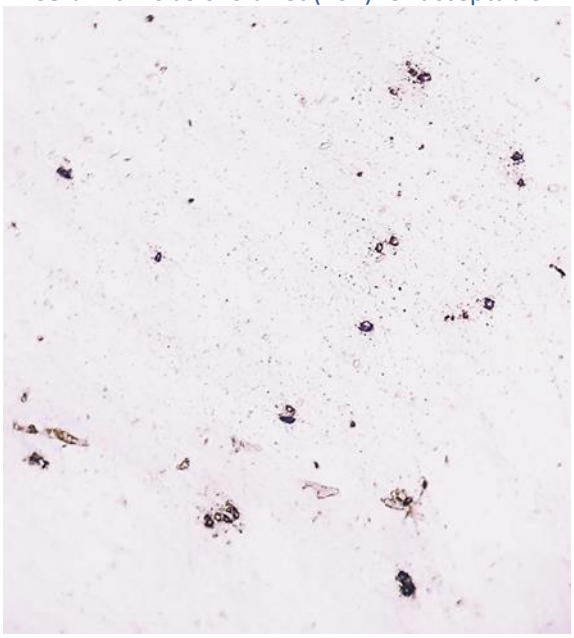
Die lines. Unacceptable

Streaks and tearing(40X). Unacceptable

Dark bands. Unacceptable

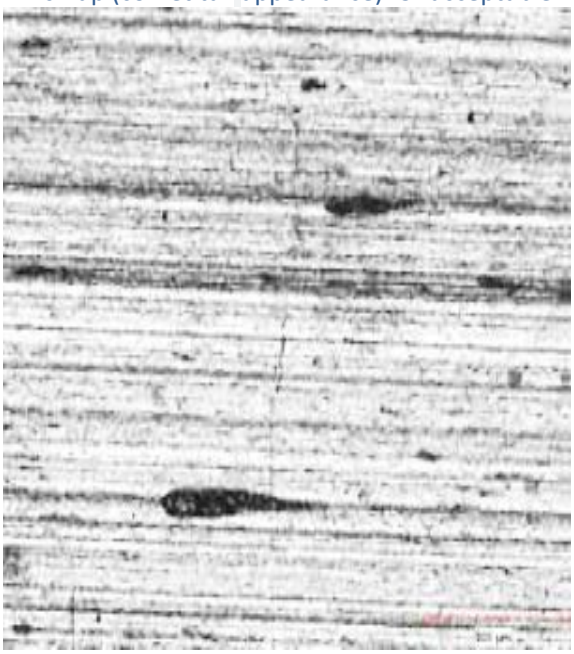
Slag billet. Unacceptable

Ceramic inclusions billet (40X). Unacceptable

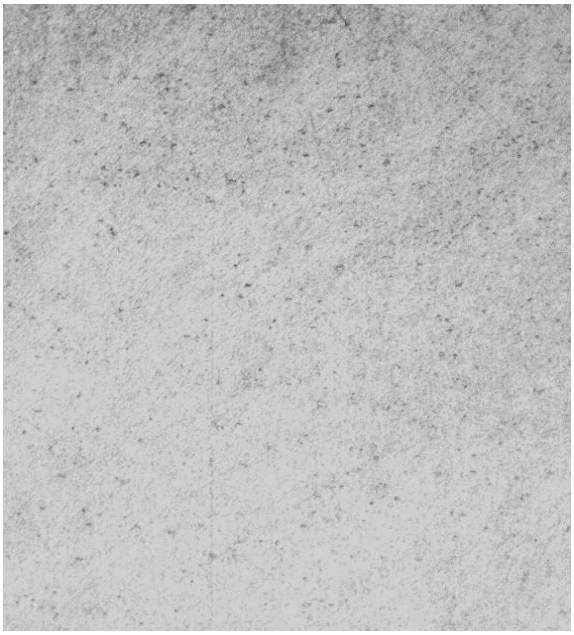


Overpressure hitch (40X). Unacceptable

Pick-up (comet tail appearance). Unacceptable

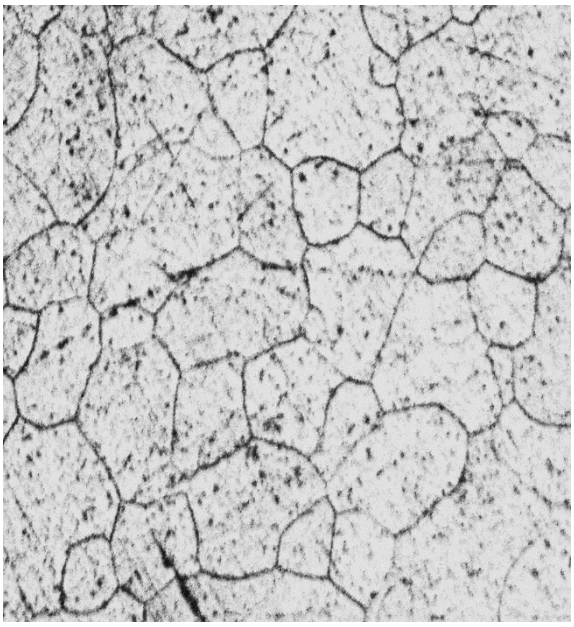


Metallic particles inclusion (40X). Unacceptable

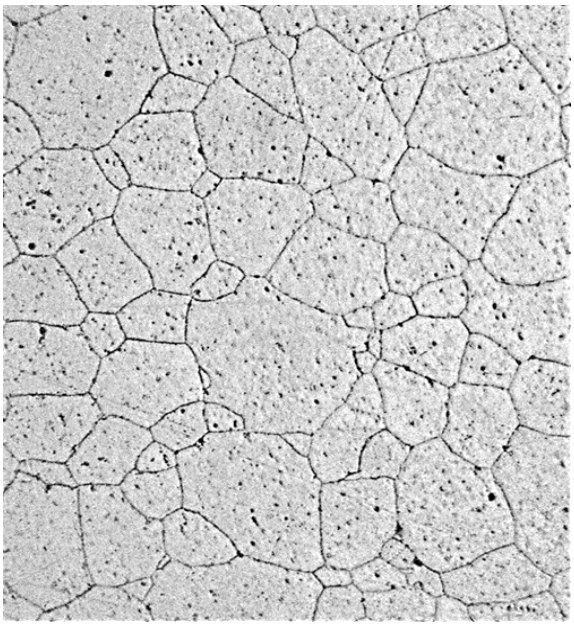
Inclusions billet (100X). Acceptable	Inclusions billet(100X). Unacceptable
	
Oxides (100X).Acceptable	Oxides (100X). Unacceptable
	

Metallographic study of aluminium surface polishing with chemical etching (part 2)

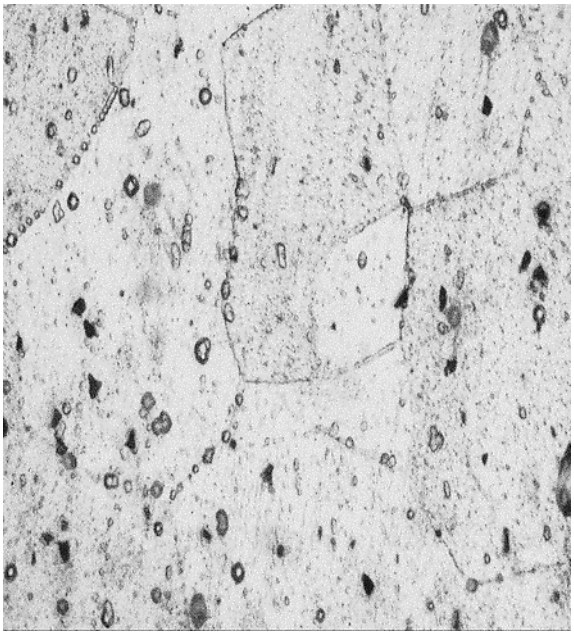
Recrystallization Secondary (40X). Acceptable



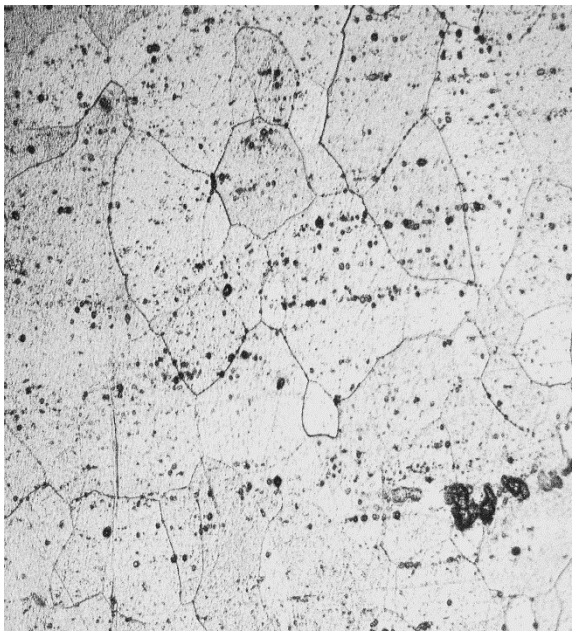
Recrystallization Secondary (40X). Unacceptable

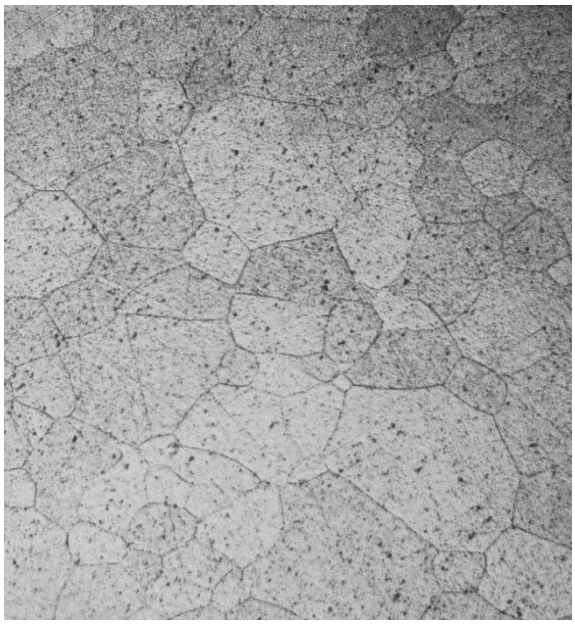
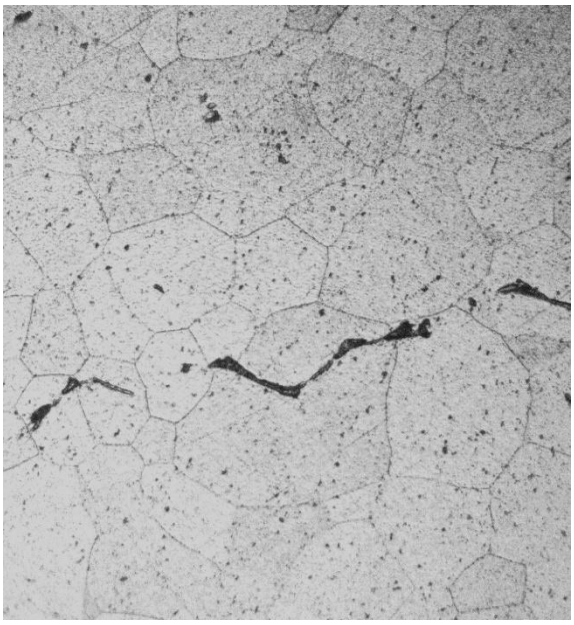
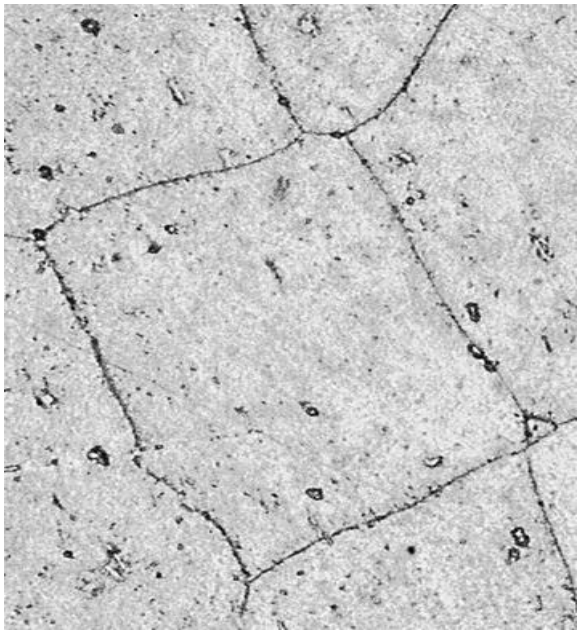
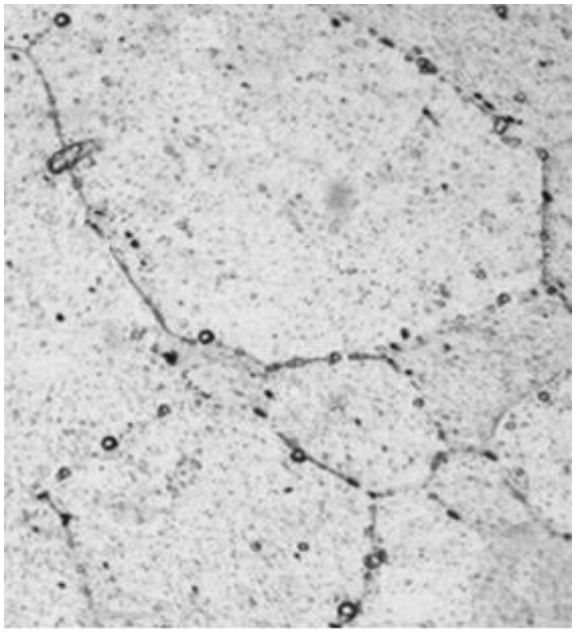


Precipitates compounds (400X). Unacceptable

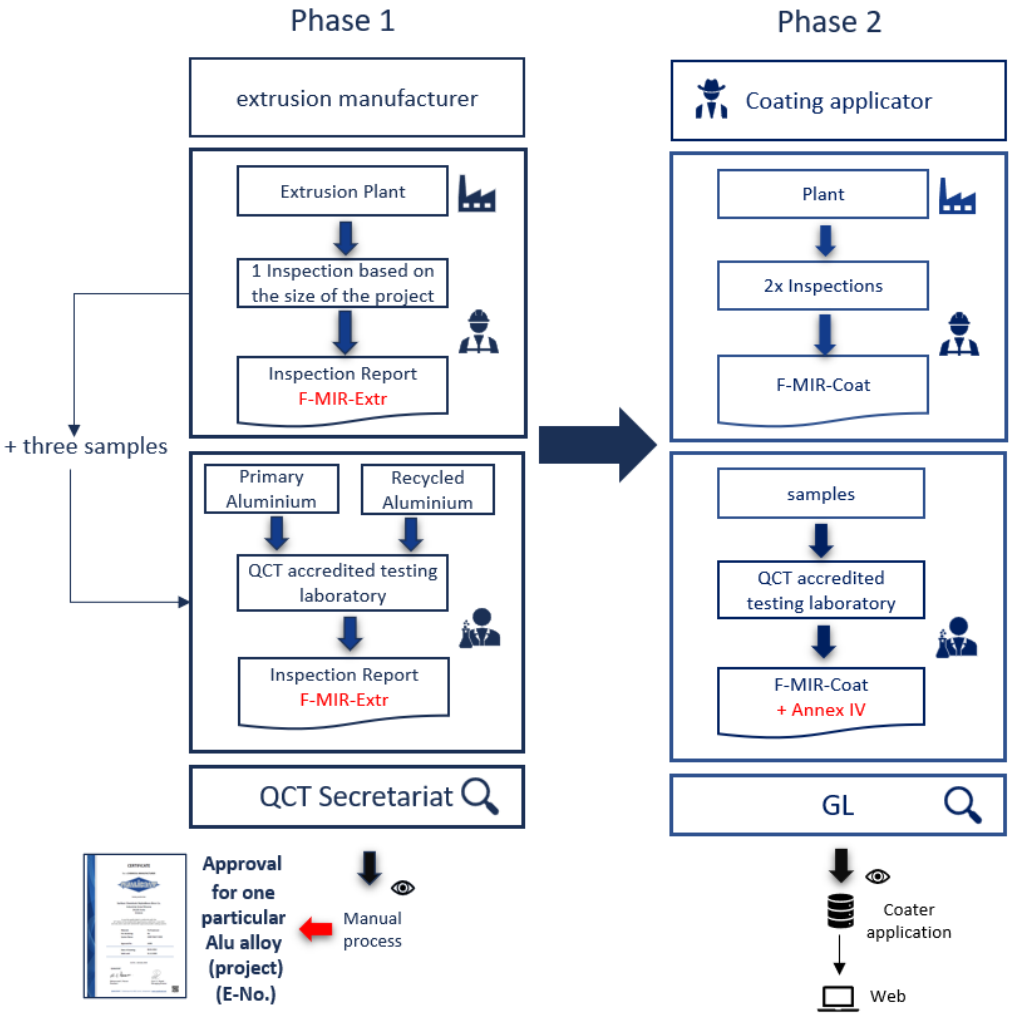


Ceramic inclusions (100X). Unacceptable



Inclusions in grain (100X). Acceptable	Inclusions in grain (100X). Unacceptable
	
Inclusions in grain boundering (400X). Acceptable	Inclusions in grain boundering (400X). Unacceptable
	

2. Project-based Implementation



F-MIR Coat - Annex IV:

The inspector shall ask the coater applicators if they are involved in the QCT 3.0 Project.

The inspector shall verify if the material from the extruder has passed the QCT 3.0 tests (E-No.)

The inspector shall take three samples after the coating and send them to one of the three involved testing laboratories (Decotec, IFO DE or Qualital) for performing the three QCT 3.0 tests.

For the first year, QCT will pay for the AASS and FFC tests to collect data for a study (report to TC).