



TECHNICAL REPORT

Assessment procedure for
durability of thin metallic
composite panels

TR 038

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This EOTA Technical Report has been elaborated by the EOTA WG 21 *Internal & External wall and ceiling finishes/Internal partition kits*, convened by IETcc and was adopted by the EOTA Technical Board 17/16.

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1 SCOPE

This EOTA Technical Report 038 (edition 2017) is used, if necessary, as substituting document of the chapters related to durability assessment for external uses of thin metallic composite panels (hereafter TMCP) contained in an EAD/ETAG used as EAD. This TR specifies the provisions, tests methods and expressions of results in order to determine the effect of accelerated ageing exposures on various characteristics by specific and/or comparative testing.

Thin metallic composite panels covered by this TR are those able to be machined or joined (e.g. screwed, drilled, routed, bent, etcetera), with total thickness between 3 and 8 mm, composed by:

- Faced skins made of:
 - Aluminium alloy sheets according to EN 485 (parts 2 or 4) ⁽¹⁾, surface treated (coil coated according to EN 1396 ⁽²⁾, anodized according to EN ISO 7599 ⁽³⁾) or not, with nominal thickness of external/internal sheet ≥ 0.5 mm [$\pm 8\%$].
 - Stainless steel sheets according to EN 10088 parts 1 and 2 ⁽⁴⁾ with nominal symmetric thicknesses of sheet from 0.20 up to 0.40 mm [$\pm 5\%$].
- Core made mainly of low density polyethylene and/or made of mineral compounds, fulfilling its previously characterized fingerprint (e.g. by TGA, infrared analysis) at initial type testing.
- Adhesive layer for bonding faced skins and core through a continuous industrial process.

The assessment of durability of other panels deviating from those described above is not covered by this TR.

The assessment of durability of other fully / partially bonded cladding kits / panels is not covered by this TR.

2 ACRONYMS AND SYMBOLS

Table 1: Alphabetically ordered list of acronyms and symbols used in EOTA TR 038

Acronym or symbol	Concept, characteristic or procedure	Units	Remarks
CPR	Construction Products Regulation		UE 305/2011 ⁽⁵⁾
d_m	Deflection in the middle of span	mm	--
$d_{80 ME}$	Deflection at 80° C mean value	mm	FPB 1 h at 80° C
$d_{20 ME}$	Deflection at 20° C mean value	mm	FPB 1 h at 20° C
ΔE	Colour difference after ageing	--	EN 13523-3 ⁽¹⁰⁾
EAD	European Assessment Document		--
ETA	European Technical Assessment	--	--
ETAG	European Technical Approval Guideline	--	--
$F_{AGED u,5}$	Load characteristic aged value	N	Annex IV of this TR
$F_{INI u,5}$	Load characteristic initial value	N	
FPB	Four points bending test	--	--
Gloss _{AGED}	Specular gloss aged value	%	EN 13523-2 ⁽¹¹⁾
Gloss _{INI}	Specular gloss initial value	%	
LDPE	Low density polyethylene	--	--
L, a, b	CIELAB coordinates	--	EN 13523-3 ⁽¹⁰⁾
NPD	No performance determined	--	--
PVDF	Polyvinylidene Fluoride	--	--
RB	Riveted boards	--	--
RH	Relative Humidity	%	--
SC	Suspended cassettes	--	--
T_{AGED}	Torque peel average aged value	N.mm/mm	ASTM D 1781 ⁽⁷⁾
T_{INI}	Torque peel average initial value	N.mm /mm	
TGA	Thermogravimetric analysis	--	--
TMCP	Thin metallic composite panel	--	--
TPB	Three points bending test	--	--
TR	EOTA Technical Report	--	--
UV	Ultraviolet radiation (type A or B)	--	--

3 PRINCIPLES

3.1 Working life category

The evaluation of durability has been considered mainly as decay of performance characteristics after ageing exposures. The panel and/or kit based on these panels can be considered as “repairable or replaceable with some more efforts”. For this reason the provisions, test and assessment methods described or referred to in this TR, have been written based upon the **assumed intended working life of at least 25 years** provided that panel and/or kit are subjected to appropriate use and maintenance. These provisions, tests and assessment methods are based upon the current state of art and available experience.

3.2 General stipulations for sampling

Sampling for tests shall be representative enough of panel and/or kit foreseen to be delivered to the market. For this purpose, the manufacturer shall carry out an adequate factory production control including registration of obtained data. For each test, the set of specimens shall be sampled from the same batch at least 24 h after its manufacture. For panels which are produced in more than one thickness, the tests shall be conducted as minimum on samples of maximum and minimum thickness. For initial state, specimens shall be conditioned before tests for 24 hours under laboratory conditions, considered in this TR as a temperature of 23 (± 2) °C and RH of 50 (± 5) % in accordance with ISO 554 ⁽⁶⁾. An example of sampling is specified in Annex I.

3.3 Durability reference framework

The characteristics in relation to the Basic Requirements have to be assessed in accordance with the corresponding EAD/ETAG.

Table 2: List of characteristics

Durability aspect	Characteristic (C) (expression)	Exposure (E)	TR paragraph
Thermal	Decay of delamination resistance (Torque peel average value T)	Hygrothermal cycles test	(C): § 4.1 (E): § 5.1
	Decay of flexural resistance * (Maximum load characteristic value $F_{u,5}$)		(C): § 4.2 (E): § 5.1
Water	Decay of delamination resistance (Torque peel average value T)	Immersion 6 h in boiling water at 90 °C	(C): § 4.1 (E): § 5.2
	Decay of flexural resistance * (Maximum load characteristic value $F_{u,5}$)		(C): § 4.2 (E): § 5.2
	Decay of delamination resistance (Torque peel average value T)	Immersion in water 500 h at 20 °C	(C): § 4.1 (E): § 5.3
	Decay of flexural resistance * (Maximum load characteristic value $F_{u,5}$)		(C): § 4.2 (E): § 5.3
Frost	Decay of delamination resistance (Torque peel average value T)	Freeze-thaw Cycles	(C): § 4.1 (E): § 5.4
	Decay of flexural resistance * (Maximum load characteristic value $F_{u,5}$)		(C): § 4.2 (E): § 5.4
Heat	Decay of delamination resistance (Torque peel average value T)	Long term exposure to heat (2.500 h at hot dry air 80 °C)	(C): § 4.1 (E): § 5.5
	Decay of flexural resistance * (Maximum load characteristic value $F_{u,5}$)		(C): § 4.2 (E): § 5.5
	Decay of flexural stiffness (Maximum increment of deflection mean value d_{ME})	Short term exposure 1 h +80 °C	(C): § 4.3 (E): § 4.3
Fatigue (only SC)	Decay of resistance of routed and returned edge (Maximum load characteristic value $F_{u,5}$)	TPB test Flexural pulsating loads	(C): § 4.4 (E): § 4.4
	Decay of resistance of slot and its fixing device (Maximum load characteristic value $F_{u,5}$)	Pull out pulsating loads	(C): § 4.5 (E): § 4.5
Corrosion	Corrosion protection (Infiltration length plus quantity and size of blisters for coil coated aluminium sheets)	Salt spray (fog) (Accelerated test)	(C): § 4.6.1 (E): § 4.6.1
	Humidity (quantity and size of blisters for coil coated aluminium sheets)	(Continuous condensation) Accelerated test	(C): § 4.6.2 (E): § 4.6.2
Others	Retention of colour (ΔE) and gloss (%) (only coil coated aluminium sheets)	Humidity. (Continuous condensation) Accelerated test	(C): § 4.7 (E): § 4.7
		UV-and water condensation	
		Accelerated ageing by heat	

* Remark: Required only for TMCP with core made of post-consumption LDPE, with or without mineral compounds

4 DECAY OF CHARACTERISTICS

4.1 Delamination resistance by peeling test

Peeling tests shall be carried out following procedure described below. Delamination resistance is a fundamental parameter for the assessment of deterioration of panels in comparative terms, and the results are not intended to be used for calculus.

4.1.1 Preparation and conditioning of specimens

Couples of specimens shall be taken from left, central and right side of panels cut in perpendicular sense of lamination ^[1]. For each panel thickness considered a set of 6 specimens per initial state and 6 per each ageing exposure considered shall be prepared. 3 specimens of each set shall be subjected to top metallic sheet - core peeling test and other 3 to bottom metallic sheet – core peeling tests. Specimens shall be length x width = 305 mm x 76 mm. An example of sampling is shown in Annex I.

4.1.2 Testing procedure

4.1.2.1 Delamination resistance by peeling test

Peeling test shall be carried out according to ASTM D 1781 ⁽⁷⁾. The test shall be carried out in laboratory conditions at initial state and after the required exposures.

4.1.2.2 Exposures

The following and non consecutive exposures shall be carried out:

- Hygrothermal cycles.
- Immersion for 6 h in boiling water at 90 °C.
- Immersion for 500 h in water at 20 °C.
- Freeze-thaw cycles.
- Long term exposure to heat (2.500 h at hot dry air 80 °C).

Following any of these ageing exposures as specified at § 5 of this TR, specimens shall be tested according to the required procedure.

4.1.3 Expression of results

The report shall contain the following data:

- Description of specimens: Batch and date of manufacture, type of panel, thickness of panel, thickness of sheet, location on panel side (left, central or right) and metal sheet – core position (top or bottom).
- Initial individual and average values of torque peel strength, (T_{INI}) expressed in N.m/m.
- Aged individual and average values (T_{AGED}), expressed in N.m/m, and if average result $T_{AGED} \geq 0.75 T_{INI}$ OR if $T_{AGED} < 0.75 T_{INI}$.
- In particular, no cracks or breakage on metallic sheet shall occur during peeling test due to unacceptable tensile strength.
- Description of any signs of degradation after visual inspection on each specimen after exposure and after testing.

[1] If required, at least other 6 specimens from left, central and right side of panels cut in the sense of lamination (perpendicular to panel width) shall be tested at initial conditions in order to verify there is no influence of the lamination manufacturing process.

4.2 Flexural resistance by FPB test

4.2.1 Preparation and conditioning of specimens

A set of 36 specimens samples (length x width: 1000 mm x 100 mm [± 0.5] mm) per panel thickness (6 per initial conditions and 6 per each exposure) shall be prepared.

4.2.2 Testing procedure

4.2.2.1 Flexural resistance by four points bending test

Four points bending (FPB) tests shall be carried out. For this purpose a universal testing device class 0.5, a deflection measurement device type LVDT and four steel cylinders diameter 35 mm helped supported by thin strips in order to avoid damages on metallic sheets shall be used, according to the Figure 1. Specimens shall be placed with its front sheet facing downwards and its rear sheet facing upwards. The test shall be carried out in laboratory conditions.

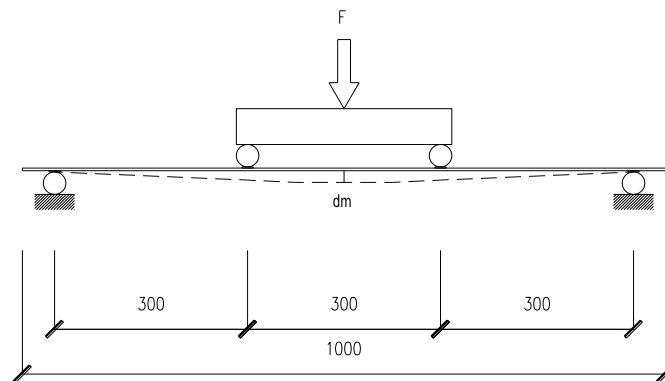


Figure 1. Scheme of FPB test (dimensions in mm)

Load F shall be applied at uniform speed of 5 mm/min, and deflection d_m has to be measured on the middle of span. The test is stopped when maximum deflection declared by the manufacturer is reached or when breakage occurs and the F value is registered.

4.2.2.2 Exposures

The following and non consecutive exposures shall be carried out:

- Hygrothermal cycles.
- Immersion 6 h in boiling water at 90 °C.
- Immersion 500 h in water 20 °C.
- Freeze-thaw cycles.
- Long term exposure to heat (2 500 h at hot dry air 80 °C).

Following any of these ageing exposures as specified at § 5 of this TR, specimens shall be tested according to the required procedure.

4.2.3 Expression of results

The report shall content the following data:

- Description of specimens: Batch and date of manufacture, type of panel, thickness of panel and thickness of sheets.
- The initial individual, mean and characteristic ($F_{INI u,5}$) values of maximum load F (corresponding to maximum deflection or breakage) expressed in N.
- Aged individual, mean and characteristic ($F_{AGED u,5}$) values of maximum load F , (corresponding to maximum deflection or breakage) expressed in N and if $F_{AGED u,5} \geq 0.75 F_{INI u,5}$ Or if $F_{AGED u,5} < 0.75 F_{INI u,5}$.
- Description of any signs of degradation after visual inspection on each specimen after exposure and testing.

4.3 Flexural stiffness by FPB test

4.3.1 Preparation and conditioning of specimens

As minimum, a set of 12 specimens longitudinally oriented (length x width: 1000 mm x 100 mm [± 0.5] mm) per panel thickness shall be prepared (6 specimens per initial conditions and 6 specimens per final temperature).

4.3.2 Exposure/Testing procedure

Four-points bending (FPB) tests shall be carried out. For this purpose two weight units ($\varnothing 100$ mm) able to reach maximum admissible load corresponding to permissible stress in cover sheets shall be used, as well as a deflection measurement device suitable to work at $80 (\pm 2) ^\circ\text{C}$ and two steel cylinders diameter 35 mm accompanied by thin strips in order to avoid damage on metallic sheets. The visible panel surface shall be positioned facing downwards.

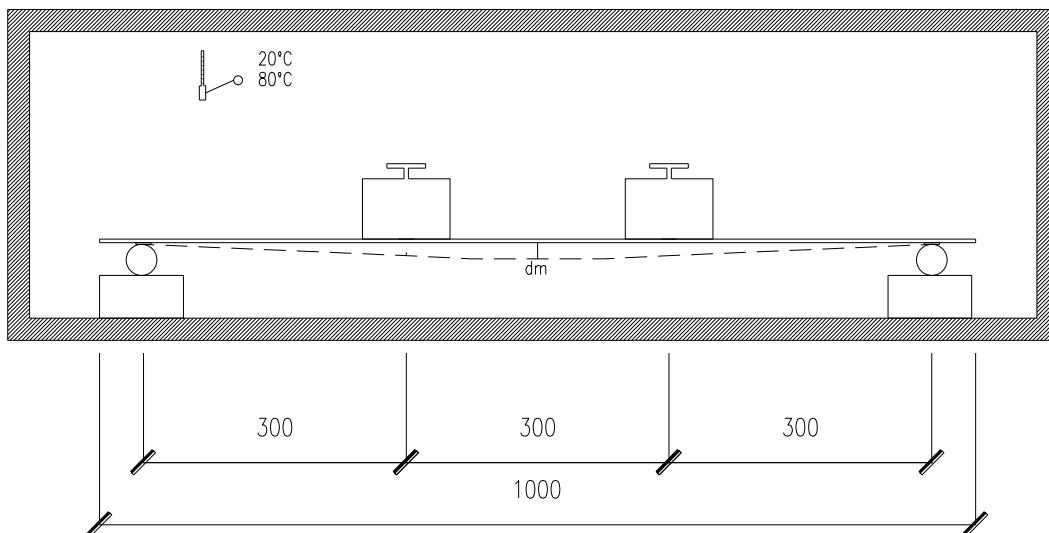


Figure 2. Scheme of creep resistance test (dimensions in mm)

According to Figure 2, specimens shall be placed in an adequate heat chamber. Weight units (allowing the panel to reach the declared tensile maximum permissible stress ^[2] of its metallic sheets) shall be applied when test temperature is reached and deflection d_m shall be measured at initial conditions ($20 (\pm 2) ^\circ\text{C}$) and at $80 (\pm 2) ^\circ\text{C}$, after 1 hour submitted to these respective expositions.

4.3.3 Expression of results

The report shall content the following data:

- Description of specimens: Batch and date of manufacture, type of panel, thickness of panel and thickness of sheets.
- Individual and mean deflection values (expressed in mm) corresponding to initial conditions after 1 hour at $20 (\pm 2) ^\circ\text{C}$ ($d_{20 \text{ ME}}$) and after 1 hour at $80 (\pm 2) ^\circ\text{C}$ ($d_{80 \text{ ME}}$) respectively and whether following criteria are fulfilled:
 - No cracks, breakage or delamination shall occur during test.
 - $d_{80 \text{ ME}} \leq 1.25 d_{20 \text{ ME}}$.
- Description of any signs of degradation after visual inspection on each specimen after exposure and after testing.

[2] The characteristic value divided by the partial safety factors γ_M and γ_F according to Eurocodes (and national application regulations of Eurocodes, if available).

4.4 Resistance of routed and returned edge to flexural - pulsating loads

4.4.1 Preparation and conditioning of specimens

A set of 12 specimens per panel thickness, (6 per initial conditions and 6 per pulsating loads) with routed and returned edges on its short sides, and dimensions as defined in Figure 3 shall be prepared. Specimens edges shall be riveted to testing rigid profiles (which can be also component of the kit) fixed to testing frame. Dimensions "a" and "b" of the routed and returned edge shall correspond to manufacturer's declared values.

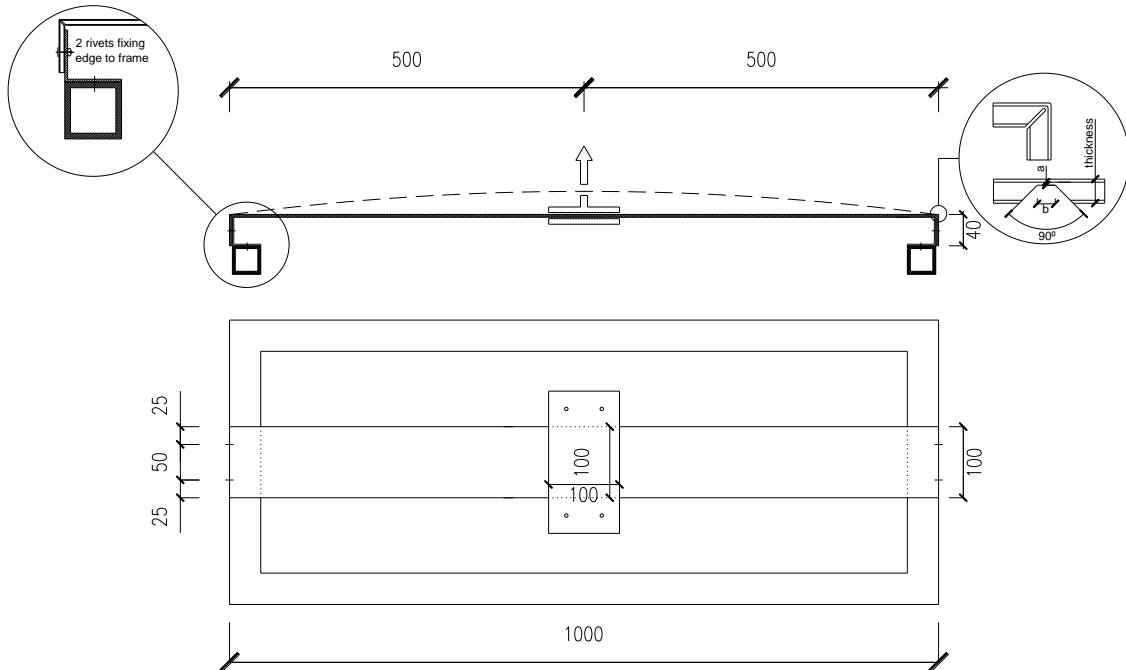


Figure 3. Scheme of test (dimensions in mm)

4.4.2 Testing procedure

4.4.2.1 Flexural strength by three point bending test (TPB)

Three-points bending tests shall be carried out under normal laboratory conditions. For this purpose a universal testing device class 0.5, a deflection measurement device type LVDT and an adequate clamping device shall be used, according to the Figure 3. Specimens shall be placed with their external side facing upwards.

Load shall be applied under normal laboratory conditions at a speed rate of 5 mm/min on the middle of span, until maximum initial load (F_{INI}) corresponding to maximum deflection or breakage of routed and returned edge occurs.

4.4.2.2 Exposure

Resistance to flexural - pulsating loads shall be tested by TPB under normal laboratory conditions. For this purpose, specimens shall be clamped at the middle of the span by adequate testing device able to transmit pulsating loads. Specimens shall be exposed to 10 000 load cycles at a frequency of 0.02 to 0.06 Hz. The maximum and the minimum pulsating loads (in N) shall be chosen accordingly. The following loads can be considered as appropriate:

- Maximum pulsating load $F_{max} = 50 \% F_{INI u,5}$.
- Minimum pulsating load $F_{min} = 20 \% F_{INI u,5}$.

Where $F_{INI u,5}$ is the characteristic value determined according to Annex IV calculated from individual values obtained according to § 4.4.2.1. During each cycle the load shall vary like a sine curve between F_{max} and F_{min} . The edges shall be examined for cracks during the first loading up to max N and after 1, 10, 100, and 10 000 load cycles.

After the completion of load cycles, the specimen shall be unloaded, the displacement shall be measured and a final TPB test shall be carried out according to § 4.4.2.1 until maximum load (F_{AGED}) corresponding to maximum deflection or breakage of routed and returned edge occurs.

4.4.3 Expression of results

The report shall content the following data:

- Description of specimens: Batch and date of manufacture, type of panel, thickness of panel and thickness of sheets, and dimensions “a” and “b” (see Figure 3).
- Individual, mean and characteristic values ($F_{INI\ u,5}$), expressed in N, at initial state and after cycles ($F_{AGED\ u,5}$ and if $F_{AGED\ u,5} \geq 0.75 F_{INI\ u,5}$ or $F_{AGED\ u,5} < 0.75 F_{INI\ u,5}$. In particular, no cracks, delamination or breakage shall occur during exposure to cycles.
- Load / displacement curves.
- Description of any signs of degradation after visual inspection on each sample after testing.

4.5 Resistance of slot and its fixing device to pull out - pulsating loads

4.5.1 Preparation and conditioning of specimens

A set of 12 specimens per panel thickness, (6 for the initial conditions and 6 for the pulsating loads) and dimensions defined at Figure 4, plus their corresponding fixing devices shall be prepared. Distance “A” and dimension “B” shall correspond to manufacturer’s declared values.

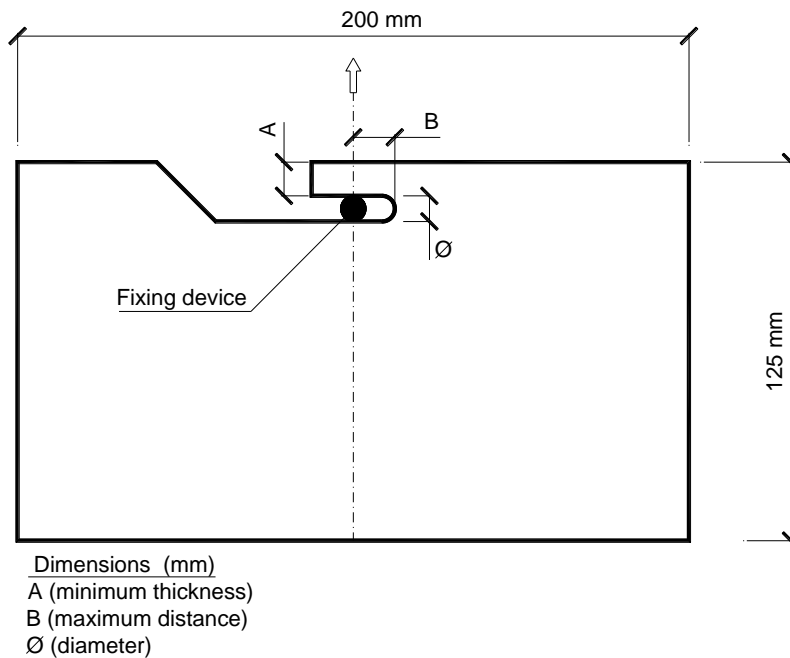


Figure 4. Example of specimen

4.5.2 Testing procedure

Initial resistance of slot (to pull out loads) reinforced or not by riveted profile on its lateral side, shall be tested in normal laboratory conditions, applying a speed rate of 5 mm/min on the specimen’s fixing device until maximum initial load (F_{INI}) expressed in N, corresponding to maximum displacement or breakage is reached.

In case of doubt on dead load or anti-lift up resistances, tests in the vertical direction of the cassette may be performed.

4.5.3 Exposure

Pull out pulsating loads resistance shall be tested under normal laboratory conditions. Specimens shall be exposed to 10 000 load cycles at a frequency of 2 to 6 Hz. The maximum and the minimum pulsating loads (in N) shall be chosen accordingly. The following loads can be considered as appropriate:

- Maximum pulsating load $F_{\max} = 50 \% F_{\text{INI } u,5}$
- Minimum pulsating load $F_{\min} = 20 \% F_{\text{INI } u,5}$.

Where $F_{\text{INI } u,5}$ is the characteristic value determined according to Annex IV calculated from individual values obtained according to § 4.5.2. During each cycle the load shall vary like a sine curve between F_{\max} and F_{\min} . The displacement shall be measured during the first loading up to F_{\max} , and after 1, 10, 100, and 10 000 load cycles. After completion of load cycles, the specimen shall be unloaded, the displacement measured and a final pull out test shall be carried out according to § 4.5.2 until load (F_{AGED}) corresponding to maximum deflection or breakage of slot occurs.

4.5.4 Expression of results

The report shall content the following data:

- Description of specimens: Batch and date of manufacture, type of panel, thickness of panel and thickness of sheets.
- Description of any signs of degradation after visual inspection on each specimen after exposure and/or testing.
- Individual, mean and characteristic values at initial state $F_{\text{INI } u,5}$ and after cycles $F_{\text{AGED } u,5}$ (expressed in N) and if $F_{\text{AGED } u,5} \geq 0.75 F_{\text{INI } u,5}$ Or if $F_{\text{AGED } u,5} < 0.75 F_{\text{INI } u,5}$. In particular, no cracks, delamination or breakage shall occur during exposure to cycles.
- Load/displacement curves.

4.6 Corrosion protection

4.6.1 Resistance to salt spray (fog) according to EN 13523-8 ⁽⁸⁾ of coil coated aluminium

4.6.1.1 Preparation and conditioning of specimens

Specimens shall be sampled from the same panel or coil and carefully cleaned and prepared according to applicant 's instructions. For sampling at least 3 flat specimens (option 1 according to § 7.2 of EN 13523-8) per coating type (e.g. PVDF and thickness range) and exposure shall be prepared for test.

4.6.1.2 Testing procedure

- 500 h and 1 000 h exposed to neutral salt fog as described at standard EN 13523-8.

4.6.1.3 Expression of results

- Number and description of specimens: For panels, batch, date of manufacture, type and thickness. For sheets, its thickness, alloy, temper, coating type and coating thickness.
- Corrosion infiltration and blistering values as described at Table C.5 of EN 1396 ⁽²⁾ for both exposures (500 h and 1 000 h) according to the declared index of corrosion resistance.

4.6.2 *Resistance to humidity of coil coated aluminium*

4.6.2.1 Preparation and conditioning of specimens

Specimens shall be sampled from the same coil and carefully cleaned and prepared according to applicant's instructions. At least 3 flat specimens (length 150 mm x width 75 mm, where length refers to lamination procedure) per coating type (e.g. PVDF - two layers) shall be prepared.

4.6.2.2 Testing procedure

The resistance to humidity of sheet shall be determined after 500 h and 1 000 h exposed to continuous condensation according to EN ISO 6270-1 ⁽⁹⁾.

4.6.2.3 Expression of results

- Number and description of specimens: For panels, batch, date of manufacture, types and thicknesses. For sheets, its thickness, alloy, temper, coating product and coating thickness).
- Blistering value as described at C.6.4 of EN 1396 ⁽²⁾

4.7 **Retention of colour and gloss of coil coated aluminium sheets**

The assessment of these characteristics shall be carried out according to the following tests procedures:

- Colour: EN 13523-3 ⁽¹⁰⁾ only for solid colours (not for metalized or iridescent coatings).
- Gloss: EN 13523-2 ⁽¹¹⁾ measured at an angle of 60 ° for solid colours
- At initial conditions and after all of these independent and non continuous exposures, according to the corresponding standards:
- Humidity (continuous condensation according to EN ISO 6270-1) ⁽¹⁰⁾.
- UV and water condensation (according to EN 13523-10) ⁽¹²⁾.
- Accelerated ageing by heat (according to EN 13523-13) ⁽¹³⁾.

4.7.1 *Preparation and conditioning of specimens*

The quantity and size of specimens shall be sampled from same coil as described below. In any case, their lengths refer to lamination direction.

- Humidity (continuous condensation): See § 4.6.2.1 of this TR.
- UV and water condensation: Three flat specimens (length x width: 150 x 75 mm) shall be sampled from the same coil per coating type (e.g. PVDF - two layers).
- Accelerated ageing by heat: Three flat specimens (length x width: 150 x 75 mm) shall be sampled from the same coil per coating type (e.g. PVDF - two layers).

Conditioning before and after exposure, if required, shall be carried according to the exposure standard.

4.7.2 Exposure and testing procedure

- Humidity (continuous condensation): See § 4.5.2.2 of this TR.
- UV and water condensation: According to EN 13523-10 ⁽¹⁰⁾ only UV-A or UV-B shall be used, taking into account the following inputs from Annex C of EOTA TR 010 ⁽¹⁴⁾:
 - Climate: Moderate or severe according to Table C.1 and mean annual radiant exposure by global radiation isolines map of Europe.
 - 5 years equivalent radiation dose for an assumed working life of 25 years.
 - UV Irradiance = 55 W/m².
- Accelerated ageing by heat: 72 h exposed to 90 °C.

4.7.3 Expression of results

- Type of lamps, length of exposition, as well as number and description of specimens. For panels, batch, date of manufacture, types and thicknesses. For sheets, its thickness, alloy, temper, coating product and coating thickness).
- Initial values (L, a, b and Gloss_{INI}) plus aged values (ΔE and Gloss_{AGED}) and if:
 - $\Delta E \leq 5$ or if $\Delta E > 5$
 - Gloss_{AGED} $\geq 0,8$ Gloss_{INI} or if Gloss_{AGED} $< 0,8$ Gloss_{INI}

5 COMMON AGEING EXPOSURES

Specimens shall be conditioned in accordance with ISO 554 ⁽⁷⁾ at 23 (± 2) °C and 50 (± 5) % RH before the ageing exposure. After exposure, specimens shall be conditioned, if required, and tested immediately as described in the particular procedure.

5.1 Hygrothermal cycles

Considering as initial conditions 23 (± 2) °C and 50 (± 5) % RH, and increase in temperature and relative humidity shall be applied at a heating rate of 1.5 °C/min in order to start the hygrothermal cycle defined as follows:

- Exposure to temperature and humidity 90 °C and 90% RH along 1 h.
- Decrease of temperature to -40 (± 2) °C (or optionally to -20 (± 2) °C along 2 ½ h.
- Exposure to temperature -40 (± 2) °C (or optionally to -20 (± 2) °C) along 1 h.
- Increase of temperature and humidity up to +90 °C and 90 % RH along 1 ½ h.

Total: 6 h / cycle

Eight cycles shall be carried out uninterruptedly.

For panels which are produced in more than one thickness, the tests shall be conducted with samples from panels of both maximum and minimum thickness. The worst result shall apply to panels of all intermediate thicknesses.

5.1.1 Apparatus

- Climatic chamber with internal dimensions able to contain different sizes of specimens and carry out steps and ranges of temperatures described above.
- Shelves: To support the test specimens and enabling a uniform heating or cooling and moisture exposition with dimensions to fix the test specimens.

5.1.2 Procedure

- Introduce specimens and start cycle tests according to required conditions.
- After the end of the exposure period, specimens shall be removed from the chamber and cooled to ambient temperature (23 ± 2 °C) at a rate of 1.5 °C/min before further testing.

5.2 Immersion 6 h in boiling water at 90° C

In order to determine effects on core and adhesive layer of water vapour diffusion, specimens shall be fully immersed in boiling water ^[3] during 6 hours at 90 °C.

5.2.1 Apparatus

- Containers of adequate volume able to storage different specimens.
- Connector: A socketed flat flanged lid used for connecting between flask and condenser.
- Condenser: To condense water vapour driven off by boiling to ensure a constant volume of water.
- Heater: An electric heating blanket providing uniform heating to the flask.
- Timer: A suitable device capable to measure duration.
- Thermometer: A suitable (accuracy ± 1 °C) device capable to measure water's temperature.

5.2.2 Procedure

1. Fill container to 2/3 of its volume using tap water.
2. Heat water to boiling using heating blanket.
3. Add prepared specimens to water, start timer, connect condenser and start condenser.
4. After six hours in boiling water, specimens shall be taken out and cooled to ambient temperature (23 ± 2 °C) before further testing.

5.3 Immersion 500 h in water at 20° C

In order to determine effects on core and adhesive layer of liquid water, specimens shall be fully immersed along 500 h at 20 °C uninterruptedly.

5.2.3 Apparatus

- Containers of adequate volume able to storage different specimens, capable to avoid water evaporation.
- Thermometer: A suitable (accuracy ± 1 °C) device capable of measuring temperature of water.

5.3.2 Procedure

1. Immerse specimens in tap water.
2. After the exposure period, remove water from sample before further testing.

5.4 Freeze - thaw cycles

50 freeze-thaw cycles shall be carried out.

[3] Although strictly speaking boiling point of water is at 100° C under normal atmospheric pressure, it is maintained this term due to its extended use for testing conditions of 90° C

5.4.1 Apparatus

- Freeze-thaw chamber with internal dimensions able to contain different sizes of specimens and to carry out steps and ranges of temperatures described at 5.4.2.
- Shelves: To support the test sample and enabling a uniform exposition with dimensions to fix the test specimens.

5.4.2 Procedure

Each cycle shall be composed of:

- Full immersion of specimens in tap water bath for 8 h at initial temperature of $20 (\pm 2) ^\circ\text{C}$.
- Decrease to $-20 (\pm 2) ^\circ\text{C}$ for 2 h (in conditioned air).
- Exposure to $-20 (\pm 2) ^\circ\text{C}$ (in conditioned air) for 14 h.

In case of interruption, specimens shall always be positioned in water between the cycles. Specified temperatures shall be measured at specimen surface.

For panels which are produced in more than one thickness, the tests shall be conducted with samples from panels of maximum and minimum thickness. The worst result shall apply to panels of all intermediate thicknesses.

5.5 Long term exposure to heat (2.500 h at hot dry air $80 ^\circ\text{C}$)

Specimens shall be exposed 2.500 h to dry air at $80 (\pm 2^\circ \text{C})$ uninterruptedly.

5.5.1 Apparatus

- Oven: With forced air circulation and with temperature regulation to a range of 50 to $100 ^\circ\text{C}$ with an accuracy of $\pm 2 ^\circ\text{C}$. The internal dimensions are such to contain the different sizes of specimens.
- Shelf: To support the test sample and enabling a uniform heating with dimensions to fix the test specimen.

5.5.2 Procedure

1. Bring the oven to the required temperature.
2. Place the test specimen on its supporting frame in the oven.
3. Maintain the required temperature during the specified period of time.
4. After the exposure period remove the sample from the oven, bring it back to ambient temperature ($23 \pm 2 ^\circ\text{C}$) and maintain it at that temperature for 24 hours before further testing.

ANNEX I EXAMPLE OF SAMPLING

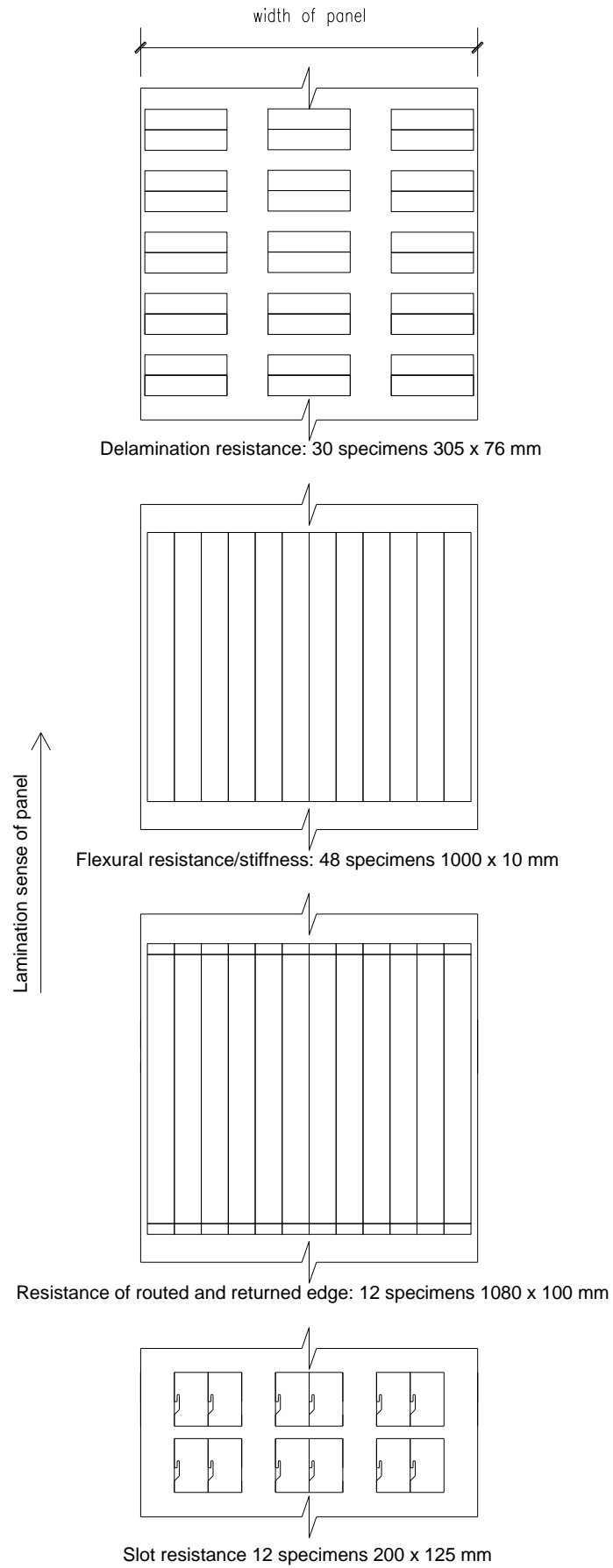


Figure 5. Scheme of sampling

ANNEX II TERMINOLOGY

1 Thin metallic composite panel

A prefabricated non-load bearing, thin (thickness range from 3 mm to 8 mm) lightweight self supporting panel according to the description in section 1 (Scope) that, by virtue of its composition and shape, will transmit loads to structural supports.

2 Cladding kit based on thin metallic composite panel

A specific kit made of an external cladding based on thin metallic composite panels, mechanically fixed to the wall using a subframe and defined fixing devices which are normally, but not always, delivered together on site. The following types have been considered for this TR:

- RB fixed to frame composed mainly by vertical profiles (Fig. 6, left).
- SC on a frame composed mainly by vertical profiles (Fig. 6, right).

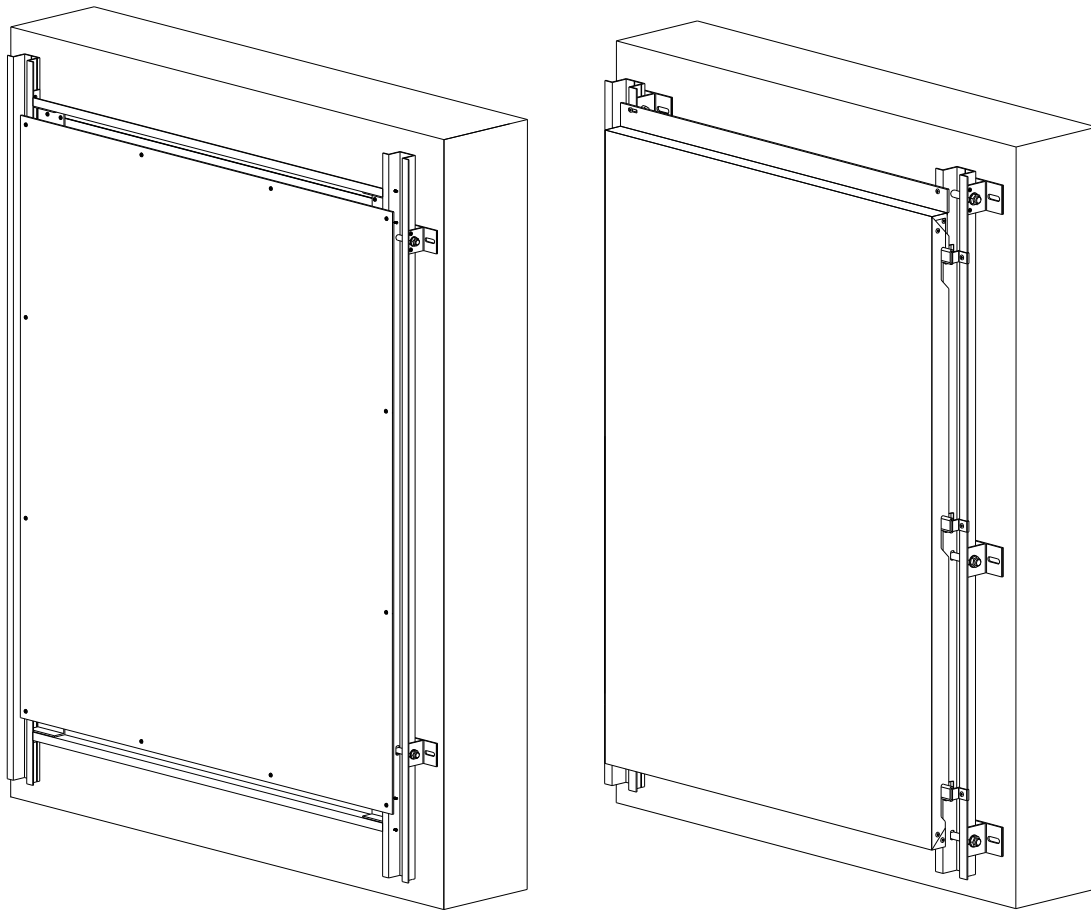
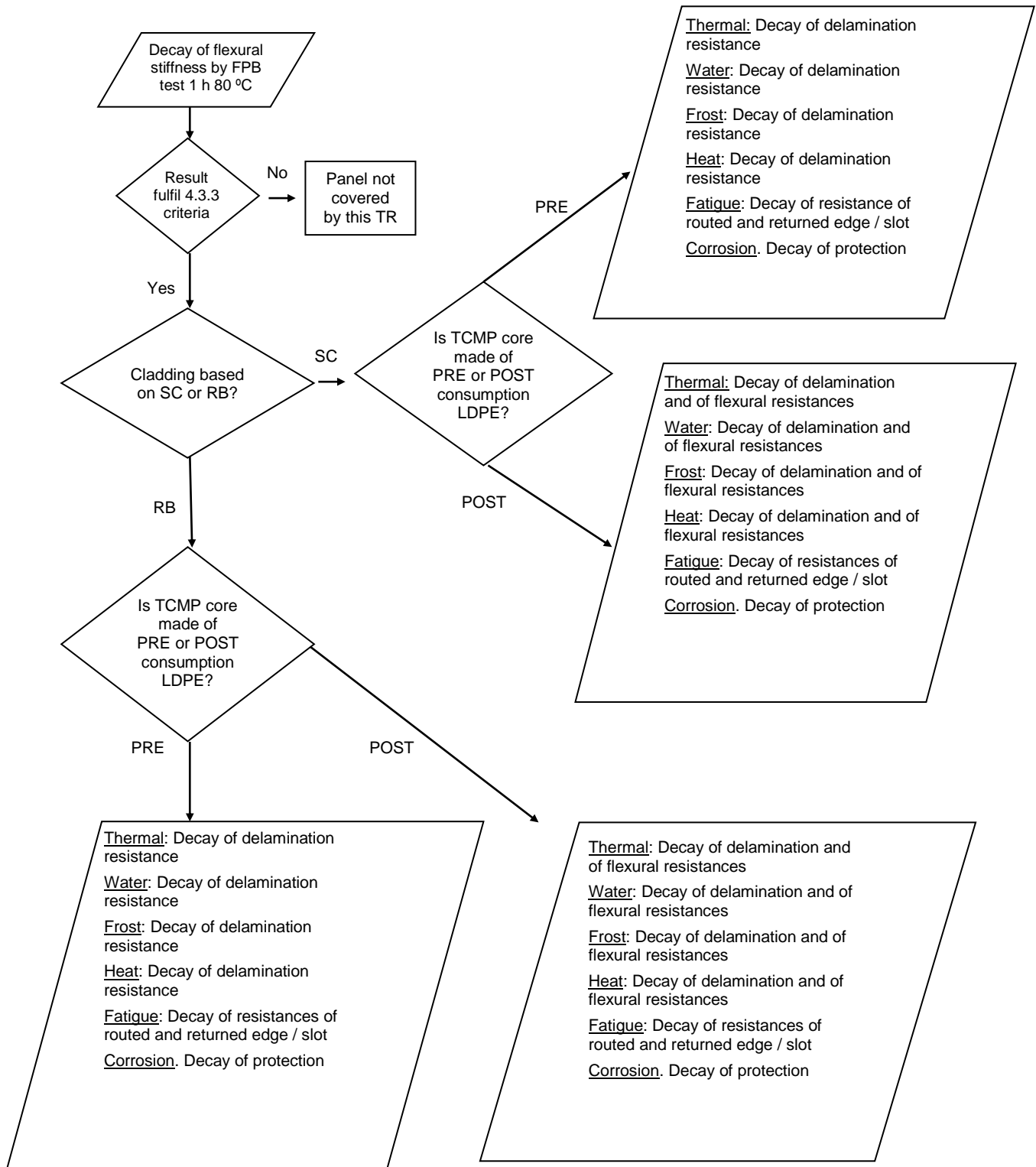


Figure 6. Examples of cladding kits

ANNEX III SYNOPSIS OF ASSESSMENT PROCEDURE



ANNEX IV: GENERAL TEST RESULTS STATISTICAL INTERPRETATION

$$F_{u,5} = F_{\text{mean}} - k_n \cdot S$$

Where:

$F_{u,5}$ = the characteristic breaking force giving 75 % confidence that 95 % of the test results will be higher than this value.

F_{mean} = the mean breaking force, either under tension or shear.

k_n = the variable as a function of the number of test specimens for 5% ($p=0,5\%$) with 75% confidence level when the population standard deviation is unknown (see Table 3).

S = the standard deviation of series under consideration.

Table 3: The variable k_n as a function of the number of test specimens (see EN 1990 Eurocode: Basis of structural design, Table D1, V_x unknown).

Number of specimens	3	4	5	6	7	8	10	20	30	∞
Variable k_n	3,37	2,63	2,33	2,18	2,10	2,00	1,92	1,76	1,73	1,64

ANNEX V REFERENCE DOCUMENTS

It has been considered the documents referred to at this TR and listed below, unless specific advice is given by EOTA.

-
- 1 EN 485-2:2008. Aluminium and aluminium alloys - Sheet, strip and plate - Part 2: Mechanical properties.

EN 485-4:1993. Aluminium and aluminium alloys – Sheet, strip and plate – Part 4: Tolerances on shape and dimensions for cold-rolled products.
 - 2 EN 1396:2015. Aluminium and aluminium alloys. Coil coated sheet and strip for general applications. Specifications.
 - 3 EN ISO 7599:2010. Anodizing of aluminium and its alloys -- General specifications for anodic oxidation coatings on aluminium.
 - 4 EN 10088-1:2014. Stainless steels - Part 1: List of stainless steels.

EN 10088-2:2014. Stainless steels – Part 2: Technical delivery conditions for sheet/plate and strips for general purposes.
 - 5 Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC Text with EEA relevance.
(OJ L 88, 4.4.2011, p. 5–43)
 - 6 ISO 554:1976. Standard atmospheres for conditioning and/or testing – Specifications.
 - 7 ASTM D 1781-98 (2012): Standard Test Method for Climbing Drum Peel for Adhesives.
 - 8 EN 13523-8:2010 Coil coated metals - Test methods - Part 8. Resistance to salt spray (fog).
 - 9 EN ISO 6270-1:2001. Paints and varnishes. Determination of resistance to humidity. Part 1. Continuous condensation.
 - 10 EN ISO 13523-3:2014. Coil coated metals - Test methods - Part 3: Colour differences.
 - 11 EN ISO 13523-2:2014. Coil coated metals - Test methods - Part 2: Specular gloss.
 - 12 EN 13523-10:2010. Coil coated metals - Test methods - Part 10. Resistance to fluorescent UV light and water condensation.
 - 13 EN 13523-13:2014. Coil coated metals - Test methods - Part 13: Resistance to accelerated ageing by the use of heat.
 - 14 EOTA TR 010. Exposure procedure for artificial weathering, May 2004.