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TECHNICAL DOCUMENT

VINYL COMPOUNDS AND THEIR MANUFACTURE FOR PVC WINDOW PROFILES

Technical document 34-03

Vinyl compound certification

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le futur en construction

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MODIFICATION HISTORY

Parts modified	Revision No.	Effective date	Modifications made
-	00	13/11/2018	Creation of the document
1/4	01	18/05/2020	No. 1 note added (3) No. 4 initial Charpy impact test added
1/4	02	01/09/2021	No. 1 DHC determination (number) No. 4 DHC determination (number)

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No. 1: CERTIFICATION OF THE VINYL COMPOUND

Certification of vinyl compounds applies to the shades defined in standard NF EN 12608-1, namely:

$$\begin{cases} L^* \geq 82 \\ -2.5 \leq a^* \leq 5 \\ -5 \leq b^* \leq 15 \end{cases}$$

Durability of the vinyl compound is assessed in accordance with technical document no. 2.

The nominal values supplied by the applicant are compared with the results obtained on the new sample provided.

	IDENTIFICATION CHARACTERISTICS (determined from new profile)		
	standard	***tolerances***	***specific measures***
density (g/cm^{-3})	NF EN ISO 1183-1	± 0.02 g/cm^{-3}	immersion method
ash content(2) (%)	NF EN ISO 3451-5	+ 7%	method A, test portion: 2 g
DHC(1) (min)	NF EN ISO 182-2	+ 15%	cell A
Vicat needle test point temperature (°C)	**NF EN 12608-1**	**± 2°C**	**method B50**
colorimetry		**L* ± 1 a* ± 0.5 b* ± 0.8**	**field of observation: 2°**
modulus of elasticity under bending stress (MPa) (3)		**≥ 2200 MPa**	**-**

(1) DHC method

If using Ca/Zn stabilisation, the oil bath temperature will be selected by the applicant (190 or 200°C). This choice applies to the entire production unit. In the case of tin stabilisation, DHC determination is carried out using the conductimetry method, in accordance with standard NF EN ISO 182-3.

A single determination compared to two determinations included in the standard since these are verifications of values provided by the applicant

Should the values be unsatisfactory, it might be possible to take a new measurement before any decisions are made

(2) The furnace calcination method is the benchmark method. Using a microwave oven is permitted; in this case, a correlation for the duration at a set temperature must be defined and sent to CSTB.

(3) the modulus of elasticity is determined based on profiles

The dimensions of the specimens are as follows: width, see table 2 page 9 of standard NF EN ISO 178

Length: length/thickness = 20 ± 1

MECHANICAL CHARACTERISTICS (determined from new profile)			
	standard	***requirement***	***specific measures***
welding factor, Fs[(4)]	-	≥ 0.7	type 1A specimen according to standard NF EN ISO 527-2
tensile-impact strength (kJ/m^{-2})	**NF EN 12608-1**	**≥ 600 kJ/m^{-2}**	**type 5 specimen, single shoulder**
Double-notch Charpy impact resistance 1fA (kJ/m^{-2})		**≥ 60 kJ/m^{-2}**	**determined for profile with walls ≥ 2.5 and < 2.8 mm wide**
		≥ 55 kJ/m^{-2}	**determined for profile with walls ≥ 2.8 mm wide**

(4) Determining the welding factor

The idea is to assess the vinyl compound's fitness for welding. A specimen is cut from a previously welded profile and its tensile strength is measured. The resistance stress value is compared to that of the non-welded profile.

The operating procedure involves welding two lengths of one main profile cut at a 90° angle, so as to form a 180° angle.

The welding conditions must respect the specifications given by the profile's producer. The weld is completed by fusion hot-plate welding with no added materials and using a welder from the joinery production workshops. The width of the welding seam will not be trimmed to less than 1 mm using the welder's deburring blades and the welding seam is not finished.

To conduct the test, five type 1A specimens (respecting standard NF EN ISO 527-2), made from two 20 cm lengths, are cut from the outer wall of the thus welded profile, such that the weld plane is perpendicular to the tensile axis and located in the centre of the narrow part of the specimen.

The width of the specimen is measured at 0.01 mm near the centre of the narrow part, at the weld plane. The thickness of the specimen is taken from the narrow part, measured as close as possible to the welding seam.

The maximum tensile strength force is measured according to standard NF EN ISO 527-2.

Testing speed: 5 mm/min^{-1}

The welding factor is determined by Fs = $\frac{Rs}{Rp}$.

Rs: *average maximum tensile strength of five welded specimens (MPa)*

Rp: *average maximum tensile strength of five non-welded specimens (MPa)*

No. 2: VINYL COMPOUND DURABILITY L*≥ 82

- ***Artificial Ageing***

Artificial ageing[1] of the vinyl compound is carried out according to standard NF EN 513 under the following conditions:

- the specimens undergoing ageing are cut from a window profile with walls the thickness of which conform to class B, according to standard NF EN 12608-1;
- Climate M exposure conditions;
- exposure time is 4000 hours.

The Charpy impact resistance and colorimetry values before and after artificial ageing are measured according to standard NF EN 12608-1.

the Charpy impact resistance threshold prior to artificial ageing indicated in Table 6 of standard EN 12608.1 is the initial threshold required on the sample provided in order to conduct the artificial ageing test.

maximum reduction of the impact strength after artificial ageing is calculated between the two values determined at the same time according to standard EN 513.

If the results are satisfactory, the vinyl compound is deemed qualified.

Specific case of beige shades:

When $2.5 < \Delta b^* \leq 3$, between the new profile and the aged profile, the visual appearance will be assessed by members of the Durability Committee.

- ***Natural ageing***

In addition to this artificial ageing, natural ageing must be started at the latest the month prior to the examination of the application by the Durability Committee.

The natural ageing station[2] where the profiles are exposed must fulfil all the following conditions[3]:

- Ensure annual radiation amounts of 6.6 ± 0.5 GJ/m-2,
- Receive 2950 ± 150 hours of sunshine annually.

The profiles are exposed according to standard NF EN ISO 877-1 at an exposure angle of 45°. The generatrix of the specimen is positioned horizontally.

Cleaning with unpressurised water is permitted on samples in case of pollution by sand or ash dust outside rainy periods.

A control profile sample is kept out of the light, on which the exposed surface and the unexposed surface are identified.

The exposure duration is 2 years. Up to 6 months longer is acceptable. Beyond this deadline, the exposed profiles can no longer be taken into account for qualification. The 2-year natural ageing will have to be repeated.

After the first year of ageing, the colorimetric characteristics are determined by the mark's laboratory (for informational purposes). If the grey scale measurement results taken following standard NF EN ISO 20105-A02 are greater than or equal to 3, qualification of the vinyl compound is maintained and natural ageing continues.

Once two years of natural ageing are complete:

- The identification characteristics on the unexposed side of the aged profile are checked to ensure that they are within the specifications submitted at the time of initial certification;
- The characteristics defined in the below table are verified. If they meet the three essential requirements, qualification of the profile is maintained.

	standards	***requirement***	***specific measures***
Difference in colour*	NF ISO EN 12608-1	$\Delta E^*_{ab} \leq 5$ and $\Delta b^* \leq 3$ $\Delta b^* \leq 2.5$ for beige shades	Field of observation: 2°
Grey scale*	NF EN ISO 20105-A02	≥ 3	-
Tensile-impact resistance on the side exposed to ageing (kJ/m^{-2})	NF EN ISO 8256	average ≥ 250 kJ/m^{-2} and no value < 120 kJ/m^{-2}	Type 5 specimen, single shoulder

**between the control profile and aged profile*

When $2.5 < \Delta b^* \leq 3$, between the control profile and the aged profile, the visual appearance will be assessed by members of the Durability Committee.

(1) The artificial ageing is conducted in the CSTB's laboratory, except in the case where mutual recognition will be established between CSTB and another laboratory.

(2) Independent site accredited in accordance with NF EN 17025 and recognised by CSTB.

(3) The SEVAR station in Bandol and ATLAS station in Sanary-sur-Mer meet these conditions.

No. 3: VINYL COMPOUND L* $\geq$ 82 INTENDED FOR OVERSEAS DEPARTMENTS AND TERRITORIES

If the specimens are sent after Climate M qualification, the identification characteristics are to be determined and verified as compliant with the stated specifications.

After 6000 hours of artificial ageing under Climate M conditions, the characteristics defined in the table below are checked. If they meet the three essential requirements, the vinyl compound is qualified for overseas departments and territories.

	standards	***requirement***	***specific measures***
Difference in colour*	NF EN 12608-1	$\Delta E^*_{ab} \leq 5$ and $\Delta b^* \leq 3$	field of observation: 2°
Grey scale*	NF EN ISO 20105-A02	≥ 3	-
Tensile-impact resistance on the side exposed to ageing (kJ/m^{-2})	NF EN ISO 8256	average ≥ 250 kJ/m^{-2} and no value < 120 kJ/m^{-2}	type 5 specimen, single shoulder

**between the control profile and aged profile*

No. 4: CERTIFYING THE BULK DYED VINYL COMPOUND L* < 82

The following specifications apply to extruded profiles made with bulk dyed vinyl compound where L* < 82, for which durability is ensured by the vinyl compound itself.

Determining the vinyl compound's characteristics

The nominal values supplied by the applicant are compared with the results obtained on the new sample provided.

IDENTIFICATION CHARACTERISTICS (determined from new profile)			
	Standard	***tolerances***	***Specific measures***
density (g/cm^{-3})	NF EN ISO 1183-1	± 0.02 g/cm^{-3}	immersion method
ash content (2) (%)	NF EN ISO 3451-5	+ 7%	method A, test portion: 2 g
DHC(1) (min)	NF EN ISO 182-2	+ 15%	cell A
Vicat needle test point temperature (°C)	NF EN ISO 306	± 2°C	method B50
colorimetry	NF EN ISO 18314-1	L* ± 1 a* ± 0.5 b* ± 0.8	field of observation: 2° D65 illuminant; specular reflection included; measuring condition: 8/d or d/8, without gloss trap in both cases
modulus of elasticity under bending stress MPa	EN ISO 178		≥ 2200 N/mm2

(1) DHC method

If using Ca/Zn stabilisation, the oil bath temperature will be selected by the applicant (190 or 200°C). This choice applies to the entire production unit.

A single determination compared to two determinations included in the standard since these are verifications of values provided by the applicant.

Should the values be unsatisfactory, it might be possible to take a new measurement before any decisions are made.

(2) The furnace calcination method is the benchmark method. Using a microwave oven is permitted; in this case, a correlation for the duration at a set temperature must be defined and sent to CSTB.

MECHANICAL CHARACTERISTICS (determined from new profile)			
	Standard	***requirement***	***Specific measures***
welding factor	-	≥ 0.7	type 1A specimen according to standard NF EN ISO 527-2
tensile-impact strength (kJ/m^{-2})	NF EN ISO 8256	≥ 600 kJ/m^{-2}	type 5 specimen, single shoulder
*double-notch Charpy impact resistance 1fA (kJ.m-2)	NF EN ISO 179-1	≥ 60 kJ/m-2	determined for profile with walls ≥ 2.5 and < 2.8 mm wide
		≥ 55 kJ/m-2	determined for profile with walls ≥ 2.8 mm wide

*The specimen must be conditioned at (23 ± 2)°C for at least 16 hours. Unlike EN ISO 179-1 and EN 513, no conditions for humidity are required.

The specimen must be taken from a visible surface of the main profile, such that the longitudinal direction of the specimen is the same as that of the profile. The specimen must have a length of (50 ± 1) mm, a width of (6 ± 0.2) mm and a thickness equal to the wall thickness of the profile. The residual width between the notches must be (3 ± 0.1) mm The supports must have a distance between bearing points of (40 ± 0.5/0) mm.

Determining the welding factor

The idea is to assess the vinyl compound's fitness for welding. A specimen is cut from a previously welded profile and its tensile strength is measured. The resistance stress value is compared to that of the non-welded profile.

The operating procedure involves welding two lengths of one main profile cut at a 90° angle, so as to form a 180° angle.

The welding conditions must respect the specifications given by the profile's producer. The weld is completed by fusion hot-plate welding with no added materials and using a welder from the joinery production workshops. The width of the welding seam will not be trimmed to less than 1 mm using the welder's deburring blades and the welding seam is not finished.

To conduct the test, five type 1A specimens (respecting standard NF EN ISO 527-2), made from two 20 cm lengths, are cut from the outer wall of the thus welded profile, such that the weld plane is perpendicular to the tensile axis and located in the centre of the narrow part of the specimen.

The width of the specimen is measured at 0.01 mm near the centre of the narrow part, at the weld plane. The thickness of the specimen is taken from the narrow part, measured as close as possible to the welding seam.

Maximum tensile strength force

The maximum tensile strength force is measured according to standard NF EN ISO 527-2.

Testing speed: 5 mm/min^{-1}

The welding factor is determined by Fs = $\frac{Rs}{Rp}$.

Rs: *average maximum tensile strength of five welded specimens (MPa)*

Rp: average tensile strength at failure of five non-welded specimens (MPa)

Durability of the vinyl compound

Two years of natural ageing must take place for each colour defined by their colorimetric characteristics.

The natural ageing station(2) where the profiles are exposed must fulfil all the following conditions(3):

- ensure annual radiation amounts of 6.6 ± 0.5 GJ/m^{-2};
- receive 2950 ± 150 hours of sunshine annually.

The profiles are exposed according to standard NF EN ISO 877-1 at an exposure angle of 45°. The generatrix of the specimen is positioned horizontally.

Cleaning with unpressurised water is permitted on samples in case of pollution by sand or ash dust outside rainy periods.

A sample of the control profile is kept out of the light, on which the exposed surface and the unexposed surface are identified.

(2) Independent site accredited in accordance with NF EN 17025 and recognised by CSTB.

(3) The SEVAR station in Bandol and ATLAS station in Sanary-sur-Mer meet these conditions.

Once the two-year ageing period is over, the appearance is verified and a visual assessment is carried out by members of the Durability Committee.

The characteristics defined in the following table must meet the three essential requirements.

	standards	***requirement***	***specific measures***
Difference in colour*	NF ISO 18314-1	Δb* ≤ 3	Field of observation: 2°
Grey scale*	NF EN ISO 20105-A02	≥ 3	-
tensile-impact resistance on the side exposed to ageing (kJ/m^{-2})	NF EN ISO 8256	average ≥ 250 kJ/m^{-2} and no value < 120 kJ/m^{-2}	Type 5 specimen, single shoulder

**between the control profile and aged profile*

If 2.5 < Δb* ≤ 3, the appearance will be assessed by members of the Durability Committee.

The conclusions resulting from this assessment take precedence over measurements of the difference in colour.

An additional two (2) years of exposure are arranged if using Ca/Zn stabilisers and for any new type of stabilisation, in order to verify the appearance after four (4) years of natural ageing.

No. 5: NON-UV-RESISTANT VINYL COMPOUND

The nominal values supplied by the applicant are compared with the results obtained on the new sample provided.

	IDENTIFICATION CHARACTERISTICS		
	standard	***tolerances***	***specific measures***
density (g/cm^{-3})	NF EN ISO 1183-1	± 0.02 g/cm^{-3}	immersion method
Modulus of elasticity (MPa)	EN ISO 178	≥ 2200 MPa	
Vicat needle test point temperature (°C)	NF EN ISO 306	$\pm 2°C$ *and* ≥ 75	

	MECHANICAL CHARACTERISTICS (determined from new profile)		
	standard	***requirement***	***specific measures***
welding factor, Fs	-	≥ 0.7	type 1A specimen according to standard NF EN ISO 527-2
tensile-impact strength (kJ/m^{-2})		≥ 600 kJ/m^{-2} each individual value > 450 kJ/m^{-2}	Type 5 specimen, single shoulder

Determining the welding factor

The idea is to assess the vinyl compound's fitness for welding. A specimen is cut from a previously welded profile and its tensile strength is measured. The resistance stress value is compared to that of the non-welded profile.

The operating procedure involves welding two lengths of one main profile cut at a 90° angle, so as to form a 180° angle.

The welding conditions must respect the specifications given by the profile's producer. The weld is completed by fusion hot-plate welding with no added materials and using a welder from the joinery production workshops. The width of the welding seam will not be trimmed to less than 1 mm using the welder's deburring blades and the welding seam is not finished.

To conduct the test, five type 1A specimens (respecting standard NF EN ISO 527-2), made from two 20 cm lengths, are cut from the outer wall of the thus welded profile, such that the weld plane is perpendicular to the tensile axis and located in the centre of the narrow part of the specimen.

The width of the specimen is measured at 0.01 mm near the centre of the narrow part, at the weld plane. The thickness of the specimen is taken from the narrow part, measured as close as possible to the welding seam.

Maximum tensile strength force

The maximum tensile strength force is measured according to standard NF EN ISO 527-2.

Testing speed: 5 mm/min^{-1}

The welding factor is determined by Fs = $\frac{\mathrm{Rs}}{\mathrm{Rp}}$.

Rs: *average maximum tensile strength of five welded specimens (MPa)*

Rp: average tensile strength at failure of five non-welded specimens (MPa)

No ageing tests need to be carried out. The non-UV-resistant virgin material will be used for the surfaces or materials coated during co-extrusion.

The non-UV-resistant virgin material is not designed to be film-coated or lacquered.

No. 6: CERTIFICATION OF THE VINYL COMPOUND WHERE L* < 82, DESIGNED TO BE FILM-COATED

The following specifications apply to profiles made with a vinyl compound where L* < 82 and designed to be film-coated.

The nominal values supplied by the applicant are compared with the results obtained on the unexposed surface of the aged profile, with the exception of the modulus of elasticity, which can be carried out on a new profile.

	IDENTIFICATION CHARACTERISTICS		
	standard	***tolerances***	***Specific measures***
density (g/cm^{-3})	NF EN ISO 1183-1	± 0.02 g/cm^{-3}	immersion method
Vicat needle test point temperature (°C)	NF EN ISO 306	± 2°C	method B50
Colorimetry	NF EN ISO 18314-1	L* ± 2 a* ± 1 b* ± 1.5	Field of observation: 2° D65 illuminant; specular reflection included; measuring condition: 8/d or d/8, without gloss trap in both cases
Modulus of elasticity under bending stress (MPa*)*	EN ISO 178		$\geq 2200\ \mathrm{N/mm2}$

	MECHANICAL CHARACTERISTICS (determined from new profile)		
	standard	***requirement***	***specific measures***
welding factor	-	≥ 0.7	type 1A specimen according to standard NF EN ISO 527-2

Determining the welding factor

The idea is to assess the vinyl compound's fitness for welding. A specimen is cut from a previously welded profile and its tensile strength is measured. The resistance stress value is compared to that of the non-welded profile.

The operating procedure involves welding two lengths of one main profile cut at a 90° angle, so as to form a 180° angle.

The welding conditions must respect the specifications given by the profile's producer. The weld is completed by fusion hot-plate welding with no added materials and using a welder from the joinery production workshops. The width of the welding seam will not be trimmed to less than 1 mm using the welder's deburring blades and the welding seam is not finished.

To conduct the test, five type 1A specimens (respecting standard NF EN ISO 527-2), made from two 20 cm lengths, are cut from the outer wall of the thus welded profile, such that the weld plane is perpendicular to the tensile axis and located in the centre of the narrow part of the specimen.

The width of the specimen is measured at 0.01 mm near the centre of the narrow part, at the weld plane. The thickness of the specimen is taken from the narrow part, measured as close as possible to the welding seam.

Maximum tensile strength force

The maximum tensile strength force is measured according to standard NF EN ISO 527-2.

Testing speed: 5 mm/min^{-1}

The welding factor is determined by Fs = $\frac{\mathrm{Rs}}{\mathrm{Rp}}$.

Rs: *average maximum tensile strength of five welded specimens (MPa)*

Rp: average tensile strength at failure of five non-welded specimens (MPa)

Partial durability of the compound designed to be film-coated

A) Conducting tests according to the conditions set out in standard EN 513, method 1, for an ageing period of 500 hours.

The grey scale value after these 500 hours are over must be greater than or equal to 4.

The delta E ≤ 5 criterion will be kept on an experimental basis.

Along with the artificial ageing, natural ageing will take place for three (3) months, from 15 June to 15 September.

The grey scale value after natural ageing taking place during the summer must be greater than or equal to 3.

If this specification is confirmed, qualification of the profile is maintained.

Certification via natural ageing only, for one summer, of the substrate material for film-coating remains possible:

B) Three (3) months of natural ageing over the summer (15 June - 15 September) must take place for each colour defined by its colorimetric characteristics.

The samples are sent under the responsibility of the applicant to the ageing station; they will then be sent by and under the responsibility of the applicant to CSTB.

The natural ageing station(2) where the profiles are exposed must fulfil all the following conditions(3):

- Ensure annual radiation amounts of 6.6 ± 0.5 GJ/m^{-2};
- Receive 2950 ± 150 hours of sunshine annually.

The profiles are exposed according to standard NF EN ISO 877-1 at an exposure angle of 45°. The generatrix of the specimen is positioned horizontally.

Cleaning with unpressurised water is permitted on samples in case of pollution by sand or ash dust outside rainy periods.

A sample of the control profile is kept out of the light, on which the exposed surface and the unexposed surface are identified.

(2) Independent site accredited in accordance with NF EN 17025 and recognised by CSTB.
(3) On the date this reference system was written (September 2017). The SEVAR station in Bandol and ATLAS station in Sanary-sur-Mer met these conditions.

Once this three-month ageing period is over, the appearance is verified and a visual assessment is carried out by members of the Durability Committee.

	standards	***requirement***	***specific measures***
Grey scale*	NF EN ISO 20105-A02	≥ 3	-

**between the control profile and aged profile*

On the unexposed side of the profile, the density, Vicat needle test point temperature and colorimetry characteristics will be verified in order to ensure they conform to the specifications supplied by the applicant (exposed profile extruded using the vinyl compound covered by the application).
On an experimental basis, the colorimetry characteristics are measured on the exposed side.