

REPORT No. 12_03894-a

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PURPOSE	Resistance to artificial weathering, Charpy impact and colour differences
TESTED MATERIAL	PVC profile
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1. TEST SPECIMENS

PVC profile samples belonging to the company “**PIMAS PLASTIK INSAAT MALZEMELERI A.S.**” was received at Fundation Tecnalia R&I on October 2th of 2013 with the following reference:

- PIMAPEN RAL-A 213 S TS 5358/1171166

2. TESTS REQUESTED

The requested tests are the following:

- ◆ Determination of the resistance to artificial weathering according to UNE-EN 513:2000

After aging are evaluated the following properties:

- ◆ Determination of Charpy impact properties, non-instrumented impact test according to UNE-EN ISO 179-1:2011
- ◆ Colour differences according to ISO 7724-3:1984

3. CARRIED OUT TESTS

- ◆ **Determination of the resistance to artificial weathering according to UNE-EN 513:2000**

The test consists in subjecting the test specimens to the radiation of a xenon-arc luminous source for a specific period. Test specimens are attached to the mobile carousel that turns around the lamp with a particular system of filters suitable for outdoor exposure:

The xenon arc source provides a spectral irradiance $(550 \pm 55) \text{ W/m}^2$ between 300-800 nm and $(60 \pm 12) \text{ W/m}^2$ between 300-400 nm.

The test was carried out under the conditions described in Method 2 of this standard that simulates severe weather, and they are:

- Black plate temperature is $(65 \pm 2)^\circ\text{C}$.
- The spray cycle: 6 minutes spray and 114 minutes dry period
- The relative humidity during the dry period is $(65 \pm 5)\%$.
- Test time 6000 hours for 12 GJ/m^2 .

◆ **Determination of Charpy impact properties, non-instrumented impact test according to UNE-EN ISO 179-1:2011**

Is determined the Charpy impact strength of two series of samples, one aging according to the procedure described above and another unaged.

The test specimens have the following dimensions:

- Length: (50 ± 1) mm
- Width: (6 ± 0,2) mm
- Thickness: Equal to the profile wall

In the center of the sample there are two notches aligned with groove bottom radius of 0.25 mm always leaving a remaining with of 3 mm.

The impact strength is determined as energy / remaining section (kJ/m²).

◆ **Colour differences according to ISO 7724-3:1984**

The CIELAB chromatic system has been used to take the measurements. It transforms the optical stimuli into a series of quantifiable L*, a*, b* coordinates, where:

- L* corresponds to luminosity or clarity.
- The a* and b* coordinates form a plane where the deviation of the achromatic point corresponds to the L luminosity, where:

A +a* deviation implies a change in colour to red

A -a* deviation turns colour to green

A +b* deviation implies a change in colour to yellow

A -b* deviation -b* is a change in colour to blue

Based on a colour comparison, the L*, a*, b* coordinates in the tested sample are deducted from the L*, a*, b* coordinates of the reference colour, thus obtaining the deviation values of the three coordinates:

$\Delta L^* = L^* \text{ test} - L^* \text{ reference}$

$\Delta a^* = a^* \text{ test} - a^* \text{ reference}$

$\Delta b^* = b^* \text{ test} - b^* \text{ reference}$

- so:
- if ΔL^* is positive the sample shall be clearer than the reference
 - if ΔL^* is negative the sample is darker than the reference
 - if Δa^* is positive the sample will have a higher red component reference
 - if Δa^* is negative a sample will have a green component that increased referrals
 - if Δa^* is positive a sample will have a green component that increased referrals
 - if Δa^* is negative a sample will have a blue component that increased referrals

The difference in total colour ΔE^* will be:

$$\Delta E^* = \sqrt{(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2}$$

The color comparison method used has been used as a reference ten individual measurements in each case.

4. RESULTS

- ◆ Determination of Charpy impact properties, non-instrumented impact test according to UNE-EN ISO 179-1:2011

In the following table the obtained results are showed:

Table I

Sample	Impact resistance after aging (KJ/m ²)	Impact resistance unaged samples (KJ/m ²)
1	82.0	84.9
2	76.2	81.4
3	84.7	80.9
4	83.0	84.4
5	85.6	87.1
6	79.5	78.3
Average	81.8	82.8
Standard deviation	3.5	3.2

Impact resistance difference between the aged and unaged samples	Specification	Assessment
1.2 %	≤40%	Satisfactory

◆ **Colour differences according to ISO 7724-3:1984**

The obtained results for the colour differences are showed in the following table:

Table II

ΔL^*	Δa^*	Δb^*	ΔE^*
-0.43	0.09	0.25	0.50

Result		Specification		Assessment	
ΔE^*	Δb^*	ΔE^*	Δb^*	ΔE^*	Δb^*
0.50	0.25	≤ 5	≤ 3	Satisfactory	Satisfactory