



EUROPEAN ASSESSMENT DOCUMENT

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Tubular daylighting devices  
(TDD)

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## 1 SCOPE OF THE EAD

### 1.1 Description of the construction product

The tubular device direct daylight from the roof via a reflecting light pipe, into a room. The tubular daylighting devices consists of several elements:

- A light collector, which is a roof module with a transparent cover
- A flexible or rigid light pipe, which can be supplied with bends and telescopic features for extension. The flexible pipe is made of light-reflecting flexible material, the rigid pipe is made of light-reflecting aluminium.
- A light Diffuser kit, including insulating diffuser and ceiling trim. The light diffuser is made of transparent polymer

The kit also includes various accessories, such as sealing tapes, fasteners etc.

The kit may comprise moving parts, which are not assessed in the framework of this ETA, but such components needs to comply with directives 2006/42/EC (Machinery directive) and 2006/95/EC (Low voltage directive).

See Annex A for drawings of the kit, and section 1.3 for a description of the components.

The product is not covered by a harmonised European standard (hEN 1873 and hEN 14351-1). EN 1873 and hEN 14351-1 only cover the top part of the kit in the roof surface. They do not cover the distinguishing part of the kit, which is the light guidance capability. EN 1873 is relevant for kits for flat roofs and EN 14351-1 is relevant for kits for sloped roofs.

Concerning product packaging, transport, storage, maintenance, replacement and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on the transport, storage, maintenance, replacement and repair of the product as he considers necessary.

It is assumed that the product will be installed according to the manufacturer's instructions or (in absence of such instructions) according to the usual practice of the building professionals.

Relevant manufacturer's stipulations having influence on the performance of the product covered by this European Assessment Document, shall be considered for the determination of the performance and detailed in the ETA.

### 1.2 Information on the intended use(s) of the construction product

#### 1.2.1 Intended use(s)

The tubular daylighting devices is intended to transmit natural daylight into rooms.

The tubular daylighting devices may be intended to transverse through both warm and cold rooms.

The tubular daylighting devices is not intended to have a load bearing, load transferring or stiffening function.

The tubular daylight guidance system is not intended to transmit natural daylight into cold storage rooms and cold storage buildings.

#### 1.2.2 Working life/Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer's request to take into account a working life of the sun tunnel kit for the intended use of 25 years when installed in the. These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works<sup>1</sup>.

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA when drafting this EAD nor by the Technical Assessment Body issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

### **1.3 Specific terms used in this EAD**

#### **1.3.1 Light collector**

Component consisting of a fixed (non-openable) roof light or roof window with one or more curved or flat transparent sheet(s) made of any suitable material and with devices, e.g. flashings of various materials and shapes, for proper installation into the roof and for connection with the light pipe (see below)

#### **1.3.2 Light pipe**

Flexible or rigid component connecting the light collector and the light diffuser made of any suitable material with light reflecting layer inside and with rigid extension sections and joints

#### **1.3.3 Light diffuser**

Component made of any suitable translucent material and with devices, e.g. trim ring(s) for proper installation into the ceiling and devices for connection with the light pipe (see above)

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<sup>1</sup> The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than referred above.

## 2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

### 2.1 Essential characteristics of the product

Table 1 shows how the performance of sun tunnel kits is established in relation to the essential characteristics. Some performance characteristics apply to the assembled kit others apply to the components. This is described in the relevant paragraphs below.

**Table 1 Essential characteristics of the product and methods and criteria for assessing the performance of the product in relation to those essential characteristics**

Nr	Essential characteristic	Assessment method	Type of expression of product performance (level, class, description)
<b>Basic Works Requirement 2: Safety in case of fire</b>			
1	Reaction to fire	2.2.1	Class
2	Resistance to fire	2.2.2	Class
3	External fire performance of roofs	2.2.3	Class
<b>Basic Works Requirement 3: Hygiene, health and the environment</b>			
4	Water tightness	2.2.4	Level
5	Content, emission and/or release of dangerous substances	2.2.5	Description
<b>Basic Works Requirement 4: Safety in use</b>			
6	Resistance to upward and downward load or wind load	2.2.6	Level
7	Resistance to impact	2.2.7	Level
<b>Basic Works Requirement 5: Protection against noise</b>			
8	Airborne sound insulation	2.2.8	Level
<b>Basic Works Requirement 6: Energy economy and heat retention</b>			
9	Air permeability	2.2.9	Level
10	Solar energy transmittance	2.2.10	Level
11	Light transmittance of the assembled system	2.2.11	Level
12	Light properties of the light collector, light pipe and light diffuser	2.2.12	Level
13	Thermal transmittance of the assembled system	2.2.13	Level
14	Thermal transmittance of the light diffuser	2.2.14	Level
15	Loss in light due to bending of the light pipe	2.2.15	Level
16	Durability	2.2.16	Level

## **2.2 Methods and criteria for assessing the performance of the product in relation to essential characteristics of the product**

Concerning the characteristics of the assembled system and for the components where relevant, methods of verification and assessment criteria, which are relevant for the assessment of sun tunnel kits for the intended use are described below.

For cases where the specific geometry of the assembled kit has influence on the characteristic, a reference geometry can be defined regarding length of the light pipe and (where applicable) the slope of the light collector. The reference geometry shall be realistic with respect to a typical end-use condition.

The effects of deviations from this reference geometry on the characteristics may be described by tabulated values, determined by the appropriate methods described in this document.

### **2.2.1 Reaction to fire of the light collector, the light diffuser and the light pipe**

The light collector, the light diffuser and the light pipe shall be tested, using the test method(s) relevant for the corresponding reaction to fire class, in order to be classified according to EN 13501-1.

or

The light collector, the light diffuser and the light pipe is considered to satisfy the requirements for performance class A1 of the characteristic reaction to fire, in accordance with the provisions of EC decision 96/603/EC (as amended) without the need for testing on the basis of its listing in that decision.

The light collector, the light diffuser and the light pipe covered by this EAD shall be classified according to EN 13501-1 taking into account to EC Decision 96/603/EC, amended by EC Decision 2000/605/EC.

### **2.2.2 Resistance to fire of light collector, light diffuser, light pipe or assembled kit**

The light collector, light diffuser, light pipe or assembled sun tunnel kit shall be tested in its end use condition, using the test method relevant for the corresponding fire resistance class, in order to be classified according to the appropriate part of EN 13501-2.

The light collector, light diffuser, light collector or assembled sun tunnels kit shall be classified according to the appropriate part of EN 13501-2.

### **2.2.3 External fire performance of the light collector**

The light collector as described in section 1.1 shall be tested using the test method relevant for the corresponding external fire performance roof class, in order to be classified according to EN 13501-5.

The light collector shall be classified according to EN 13501-5.

#### **2.2.4 Water tightness of the assembled kit**

The water tightness of the assembled kit shall be determined in accordance with clause 4.5 of EN 14351-1 for kits for sloped roofs and in accordance with clause 5.3 and 6.4 of EN 1873 for kits for flat roofs.

The expressed performance of the tested sample shall be done as described in the applied standard

#### **2.2.5 Content, emission and/or release of dangerous substances**

The performance of the product related to the emissions and/or release and, where appropriate, the content of dangerous substances will be assessed on the basis of the information provided by the manufacturer using the methods and criteria described in EOTA TR 034.

#### **2.2.6 Upward and downward load resistance of the light collector**

For use on flat roofs the load resistance of the light collector to upward loads shall for kits be determined in accordance with clause 5.4.1 and 6.5.1.4 of EN 1873.

For use on flat roofs the resistance of the light collector to downward loads shall for kits be determined in accordance with clause 5.4.2 and 6.5.1.4 of EN 1873.

For use on sloped roofs the resistance of the light collector to wind loads shall for kits be determined in accordance with clause 4.2 of EN 14351-1.

The performance of tested sample shall be expressed in accordance with clause 6.5.1.2 and 6.5.1.3 in EN 1873 or clause 4.2 of EN 14351-1.

#### **2.2.7 Resistance to impact of the light collector**

For use on flat roofs the impact resistance of the light collector to both small hard body impacts and large soft body impacts shall be determined in accordance with clause 5.4.3 and 6.5.2 of EN 1873.

For use on sloped roofs the impact resistance of the light collector shall be determined in accordance with clause 4.7 of EN 14351-1.

The performance of the tested sample shall be expressed in accordance with clause 6.5.2 in EN 1873 (hard body impact) and in accordance with clause 5.4.3.2 in EN 1873 (soft body) or clause 4.7 of EN 14351-1.

#### **2.2.8 Direct airborne sound insulation of the assembled system**

The airborne sound insulation performance of the kit shall be verified by laboratory tests according to the relevant parts of EN ISO 10140-1. The rating of airborne sound insulation shall be undertaken according to EN ISO 717-1.

Indicative field testing of an assembly within a manufacturer's range may be possible, as part of the assessment process. However, National Regulations in some Member States may require field testing of the completed building in each case.

The airborne sound insulation between exterior environment and rooms shall be expressed, as element normalized level difference  $D_{n,e,w}$  or as weighted apparent sound reduction index  $R'w$ , according to EN ISO 717-1.

Other designations mentioned in EN ISO 717-1 may be added in the assessment, to agree with the verification methods according to national building regulations based on such designations.

#### **2.2.9 Air permeability of the light diffuser**

The air permeability of the light diffuser shall be determined in accordance with clause 5.8 of EN 1873 for kits for flat roofs and in accordance with clause 4.14 of EN 14351-1 for kits for sloped roofs.

The air permeability of the light diffuser shall be expressed in accordance with clause 5.8 of EN 1873 and clause 4.14 of EN 14351-1 respectively.



### 2.2.10 Solar energy transmittance of the assembled system

The total solar energy transmittance is defined as in EN 410 - The sum of direct solar radiation  $\tau_e$  and the secondary heat transfer factor  $q_i$  towards the inside. The latter originates from solar radiation absorbed in the glazing and subsequently transferred to the inside.

$$g = \tau_e + q_i$$

As no standardized method has been identified, the total solar energy transmittance of the assembled system is based on the physics of the assembled system:

First, the light passes through the float glass of the light collector. Next, the light is transferred through the light pipe by direct transmission and reflections in the silver-based reflective coating. Finally, the light is transmitted through the translucent polymeric diffuser.

As none of these materials exhibit significant spectral selectivity, the spectral distribution of the short-wave radiation entering the room is considered similar to that of solar radiation. As the diffuser is made from polymeric material, the solar absorbance in the diffuser can be considered as negligible and therefore there is no secondary heat transfer from the diffuser to the inside. Similarly, the solar radiation absorbed by the float glass in the light collector as well as in the light pipe can be considered as having negligible influence on the secondary heat transfer to the inside.

For the assembled kit, the g-value is therefore considered equal to the direct solar transmittance  $\tau_e$ . Due to the absence of spectral selective materials described above,  $\tau_e$  equals the light transmittance  $\tau_v$  and

$$g \sim \tau_v$$

The solar energy transmittance of the assembled system shall be expressed in accordance with clause 6 of EN 410.

### 2.2.11 Light transmittance of the assembled system

The light transmittance of the assembled system shall be determined and expressed in accordance with Section 3 of CIE 173.

### 2.2.12 Light properties of the light collector, light pipe and light diffuser

The light transmittance of the individual components light collector and light diffuser shall be determined in accordance clause 5.2 of EN 410. The light reflectance of the light pipe material shall be determined in accordance with clause 5.3 of EN 410

The light properties of the light collector and the light diffuser shall be expressed in accordance with clause 6 of EN 410

### 2.2.13 Thermal transmittance of the assembled system

The French Règles Th-Bât, Fascicule 3/5, § 2.2.7 shall be used for determining a set of tabulated values for the thermal transmittance of the assembled system

Thermal transmittance values for the assembled system shall be expressed as the total thermal transmittance  $W/m^2K$ .

When significant thermal bridges are present, the thermal transmittance, in addition to the normal thermal transmittance  $U$ , shall be expressed in units of  $W/m^2K$ . If relevant, the potential surface condensation risk due to these thermal bridges shall be stated in the ETA.

### 2.2.14 Thermal transmittance of the light diffuser

The thermal transmittance (U-value) of the light diffuser shall be determined in accordance with EN 673, EN ISO 10077-1 and EN ISO 10077-2 if the value is determined by calculation or in accordance with EN ISO 12567-1 or EN ISO 12567-2 if the value is determined by testing.

Thermal resistance values for the light diffuser shall be expressed as the thermal transmittance  $W/m^2K$ .

### **2.2.15 Loss in light due to bending of the light pipe**

The loss in light due to bending of the light pipe shall be determined in accordance with Section 3 of CIE 173.

The loss in light as a function of the bending angles of the pipe shall be stated in the ETA declared.

### **2.2.16 Durability**

When assessing the durability of materials and components in the kit it should be born in mind that durability is normally best ensured by good design measures and good site practice.

Excessive moisture content should primarily be prevented by adequate construction details.

The most important aspect related to the durability of sun tunnel kits is the corrosion of metal. Exposure classes are given in EN ISO 12944-5. In general the rules given for the execution of steel structures given in EN 1090-2+A1 shall be taken into account. The corrosion protection of steel structures shall be carried out according to EN ISO 12944-7.

The durability of materials and components in the kit is sufficiently proved if these materials and components comply with the relevant EN-, ETAG- or ISO standards.

When the Eurocode is used for calculations, the materials and components shall comply with the requirements of the Eurocode and in particular with the material and components standards named in the Eurocode.

The durability of the light collector shall for kits for use on flat roofs be determined in accordance with clause 6.3 (sub-clauses 6.3.1.1, 6.3.1.2, 6.3.3, 6.3.4 and 6.3.5) of EN 1873.

For use on sloped roofs the durability of the light collector shall be determined in accordance with clause 4.15 of EN 14351-1. After completion of the ageing procedure, light transmission of the light collector shall be maintained at a minimum level of 85% of the original value. The yellowness index shall not vary by more than 20% and the relevant mechanical properties (for reinforced and non-reinforced materials) shall be given before and after ageing.

### 3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

#### 3.1 System(s) of assessment and verification of constancy of performance to be applied

For the products covered by this EAD the applicable European legal act is: Decision 1998/436/EC as amended by decision 2001/596/EC

The system is: 3

#### 3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the sun tunnel kits in the procedure of assessment and verification of constancy of performance are laid down in Table 2.

#### 3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body in the procedure of assessment and verification of constancy of performance for the sun tunnel kits are laid down in Table 3.

**Table 2 Control plan for the manufacturer; cornerstones**

No	Subject/type of control (product, raw/constituent material, component - indicating characteristic concerned)	Test or control method	Minimum frequency of control
<b>Factory production control (FPC)</b>			
1	Instructions on for example : <ul style="list-style-type: none"> <li>- type and quality of all materials and components incorporated in the elements</li> <li>- overall dimensions of prefabricated elements</li> <li>- tolerances of geometry</li> <li>- surface treatments when relevant</li> <li>- markings for correct position and installation in the works</li> <li>- packaging and transport protection</li> </ul>	Compliance with original	Every delivery
2	The light collector shall be subject to the provisions described clause 7.3 of EN 14351 for kits for sloped roofs and in accordance with clause 7.3 of EN 1873 for kits for flat roofs	According to EN 14351 and 1873 respectively	
3	Reaction to fire	Compliance with original	Once a Year
4	Design specifications	Compliance with original	Every Delivery

**Table 3 Control plan for the notified body; cornerstones**

No	Subject/type of control <i>(product, raw/constituent material, component - indicating characteristic concerned)</i>	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
1	According to R 568/2014 Notified bodies undertaking tasks under Systems 3 shall consider the European Technical Assessment issued for the construction product in question as the assessment of the performance of that product. Notified bodies and manufacturers shall therefore <b>not</b> undertake the tasks referred to in point 1.4.(b) of the Regulation (assess the performance on the basis of testing (based on sampling carried out by the manufacturer), calculation, tabulated values or descriptive documentation of the construction product.)				

## 4 REFERENCE DOCUMENTS

As far as no edition date is given in the list of standards thereafter, the standard in its current version at the time of issuing the European Technical Assessment, is of relevance.

EN 13501-2:2007+A1::2009	Fire classification of construction products and building elements - Part 2: Classification using data from fire resistance tests, excluding ventilation services
EN 10140-1:2010	Acoustics - Laboratory measurement of sound insulation of building elements - Part 1: Application rules for specific products
EN 717-1:2006	Acoustics - Rating of sound insulation in buildings and of building elements - Part 1: Airborne sound insulation - Amendment 1: Rounding rules related to single number ratings and single number quantities
EN 1873:2014	Prefabricated accessories for roofing - Individual roof lights of plastics - Product specification and test
EN 14351:2006 + A1:2010	Windows and doors - Product standard, performance characteristics - Part 1: Windows and external pedestrian doorsets without resistance to fire and/or smoke leakage characteristics
EN 410:2011	Glass in building - Determination of luminous and solar characteristics of glazing
EN ISO 12944-5:2007	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 5: Protective paint systems
EN ISO 12944-7:2000	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 7: Execution and supervision of paint work
EN 1090-2+A1:2011	Execution of steel structures and aluminium structures - Part 2: Technical requirements for steel structures
EN 13501-1:2007+A1:2009	Fire classification of construction products and building elements - Part 1: Classification using test data from fire reaction to fire tests
EN 13501-5:2007+A1:2009	Fire classification of construction products and building elements - Part 5: Classification using data from external fire exposure to roofs tests
NFRC 100-2010[E0A4]	Procedure for determining fenestration product U-factors, National Fenestration Rating Council 2010. Can be downloaded from <a href="http://www.nfrc.org">www.nfrc.org</a>
NFRC 102-2010[E0A2]	Procedure for measuring the Steady-State Thermal Transmittance of Fenestration Systems, National Fenestration Rating Council 2010. Can be downloaded from <a href="http://www.nfrc.org">www.nfrc.org</a>
EN ISO 10077-1	Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 1: General
EN ISO 10077-2	Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 2: Numerical method for frames
EN ISO 12567-2	Thermal performance of windows and doors - Determination of thermal transmittance by hot box method - Part 2: Roof windows and other projecting windows
EN 673:2011	Glass in building - Determination of thermal transmittance (U value) - Calculation method Règles Th-Bât 2012, Fascicule 3/5
CIE 173:2006	Technical Report «Tubular daylight guidance systems», ISBN 3 901 906 49 5" from the International Commission on Illumination
EOTA TR 034	General Checklist for EADs/ETAs – Content, emission and/or release of dangerous substances in products

**ANNEX A DESCRIPTION OF THE CONSTRUCTION PRODUCT**



Kit for flat roofs:



Kit for sloped roofs:



## ANNEX B TEST FOR REACTION TO FIRE TESTING

### 1. Testing according to EN 13823 (SBI)

Equivalent to the test proposal for linear pipe thermal insulation products a number of pipes shall be mounted alongside the short and the long wing of the test apparatus as shown in Figure 1 below.

The distance between the plastic pipes and between plastic pipe and backing board shall be 10 mm. The corner configuration shall be comparable to the configuration as given in EN 15715 but with a distance of 10 mm between the pipes instead of 25 mm.

At first, pipes with the smallest outer diameter  $d$  shall be tested with the minimum and maximum wall thickness. Following this, pipes with the greatest outer diameter shall be tested with the minimum and maximum wall thickness. The test configuration having delivered the most onerous results shall then be subjected to two further SBI tests.

### 2. Validity of test results

A tested outer diameter of 190 mm with the corresponding maximum possible wall thickness in the test setup also covers for greater outer diameters and greater wall thickness in actual applications.

Figure 1: Schematic drawing of the test configuration

