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Testing of Industrial Doors

1 Test object

Panels for vertically moving Industrial doors tested together with FlexiForce hardware. The size of the doors was 4000 mm daylight width and 3500 mm daylight height for testing of wind load, air permeability and water penetration in an air chamber. The tests were performed in accordance with EN 13241-1 annex ZA.3 Initial type testing.

2 Date of testing

The testing was performed from 2005-02-29 to 2005-07-26. The panels were selected by the client without assistance from SP. The test result shown in this report refers only to the tested sample.

3 Testing

Following tests were performed: Resistance to wind load, determination of air permeability, determination of resistance to water penetration, dangerous substances and thermal resistance.

3.1 Resistance to wind load

3.1.1 Testing of fully assembled door

The door was fitted in the opening of an airtight chamber, with its exterior facing inwards towards the chamber and tested in accordance with *EN 12444 Resistance to wind load – testing and calculation*. Before the test steps were taken to eliminate air leakage in the door and its supporting construction. An inner air pressure was increased in steps in accordance with the different classes given in *EN 12424 Resistance to wind load – classification*. The air pressure was then increased until the door ruptured. The test was performed at ambient temperature.

3.1.2 Testing of door panels

Door panels were subjected to four-point bending tests in accordance with *EN 12444 Resistance to wind load – testing and calculation*. The loading points were symmetrical positioned in the test set-up. The distance between the loading points was half of the distance between the points of support. The applied load was increased in steps in accordance with the different classes given in *prEN 12424 Resistance to wind load – classification*. After each step the deflection of the door panels was measured. The test was performed at ambient temperature.

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3.2 Determination of air permeability

The door was fitted in the opening of an airtight chamber, with its exterior facing inwards towards the chamber and tested in accordance with *EN 12427 Air permeability – test method*. The air leakage was measured at a positive air pressure of 50 Pa.

3.3 Resistance to water penetration

The door was fitted in the opening of an airtight chamber, with its exterior facing inwards towards the chamber and tested in accordance with *EN 12489 Resistance to water penetration – test method*. Water was supplied through three horizontal rows of nozzles with ten nozzles in each.

3.4 Dangerous substances

The different doors were examined in accordance with the requirements of the Construction Products Directive, CPD, (89/106/EEC). The interpretative Document Essential Requirements No 3 related to the CPD identifies aspects where hygiene, health and the environment may be concerned. Technical specifications are required to define release of pollutants to indoor air, outdoor air, soil and water, taking account of the concentration of pollutants in the products.

3.5 Thermal resistance

Calculation of the U-values of the door sections was performed using the FRAM 5.1 program. The tests were performed in heat-flow meter apparatus HFM2000 single specimen symmetrical configuration with double heat-flow meters.

4 Test result

4.1 Resistance to wind load

4.1.1 Test of fully assembled door

The inner pressure in the air chamber was increased in steps.

Table 1 Fully Assembled doors

Door (panel) type	Width [m]	Height [m]	Wind load class	Maximum pressure [Pa]
Tecsedo covered t=40 mm	4.00	3.50	3	

4.1.1.1 Measurement uncertainty wind load

The total calculated measurement uncertainty is for the wind load < 1.5% and for the deformations < 1.5%. Reported uncertainty corresponds to an approximate 95 % confidence interval around the measured value. The interval has been calculated in accordance with GUM (The ISO guide to the expression of uncertainty in measurements), which is normally accomplished by quadratic addition of the actual standard uncertainties and multiplication of the resulting combined standard uncertainty by the coverage factor $k=2$.

4.1.2 Bending test of door panels

The door panels were subjected to four-point bending tests in accordance with *prEN 12444 Resistance to wind load – testing and calculation*. The panels were supported and the load was applied as shown in Figure 1. The loading points were symmetrical positioned in the test set-up.

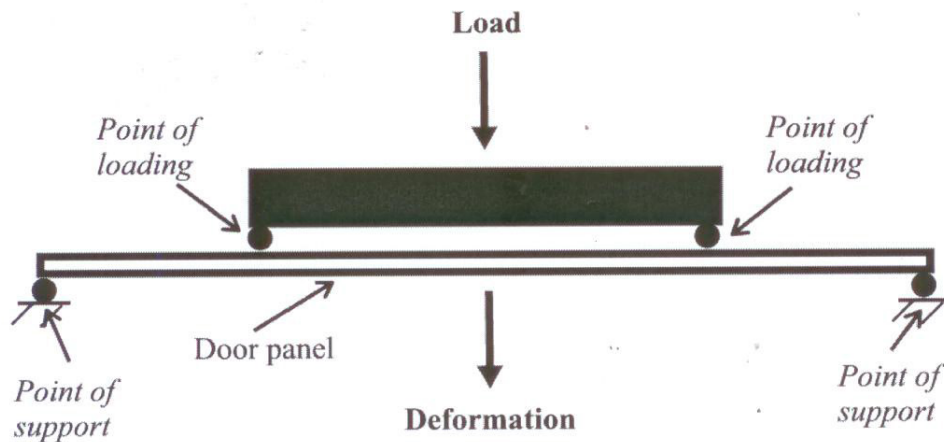


Figure 1 Schematic figure of test set-up

4.1.3 Results from four point bending test

Table 2 Description of Tecsedo door panels

Tecsedo a	4040*610*40
Tecsedo b	4000*610*40, 4 windows
Tecsedo c	6000*610*40
Tecsedo d	6000*610*40, 6 windows
Tecsedo e	7500*610*40, reinforcement profile 65S
Tecsedo f	8500*610*40, reinforcement profile 110S
Tecsedo g	7500*610*40, 7 windows, reinforcement profile 65S
Tecsedo h	8525*610*40, 8 windows, reinforcement profile 110S

Table 3 Summary of Tecsedo test results of resistance to wind load

Door panel	Wind load class		Maximum pressure [Pa]	Remarks/Fracture
		[Pa]		
Tecsedo a	5	1020	1403	BoP at loading point
Tecsedo b	2	-	819	BoP at windows 1 and 3
Tecsedo c	2	-	623	BoP at loading point
Tecsedo d	0	-	404	BoP at window 3
Tecsedo e	2	-	810	BoP at loading point
Tecsedo f	3	-	1018	BoP at loading points
Tecsedo g	1	-	560	BoP at both edges of window 3
Tecsedo h	2	-	829	BoP and delamination at inner edge of window 4

BoP = Buckling of the panel

4.1.2.1 Measurement uncertainty bend test

The total calculated measurement uncertainty is for the wind load $< 1.5\%$ and for the deformations $< 1.5\%$. Reported uncertainty corresponds to an approximate 95 % confidence interval around the measured value. The interval has been calculated in accordance with GUM (The ISO guide to the expression of uncertainty in measurements), which is normally accomplished by quadratic addition of the actual standard uncertainties and multiplication of the resulting combined standard uncertainty by the coverage factor $k=2$.

4.2 Determination of air permeability

Table 4 Summary determination of air permeability

Door type	Width [m]	Height [m]	Air permeability class
Tecsedo covered t=40 mm	4.00	3.50	3

4.3 Resistance to water penetration

Table 5 Summary resistance to water penetration

Door type	Width [m]	Height [m]	Water penetration class
Tecsedo covered t=40 mm	4.00	3,50	1

4.6 Dangerous substances

Door components described in this report are made of material that complies with the Construction Products Directive (89/106/EEC).

3.7 Thermal resistance

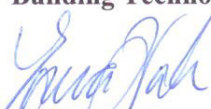
Calculations with an industrial door with width (W) = 8.50 m and height (H) 7.00 m;


Table 6 Thermal resistance

Type of panels	Thermal transmittance, W/(m ² K)					
	p	pw	pd	pwd	g	gd
Tecsedo	0.8	0.9	1.0	1.0	-	-

- p = Door with covered panels only
 pw = covered panels with windows
 pd = covered panels with a pass door
 pwd = covered panels with windows and a pass door
 g = fully glazed door
 gd = glazed door with a pass door

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