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Summary of Structural Calculations for MASTERTENT

1 Project Description

This description represents only a summary of the structural analysis. Detailed calculations are retained by ZINGERLEMETAL and can be made available, if there is a legitimate need.

The maximum allowable wind forces and the maximum allowable area loads on the tent structure are computed for both, the "35" and the "50" profiles.

2 Applicable Standards

CNR-UNI 10011 CNR 10012-85 CNR 10022-84 CNR 10024-86
 DIN 18800

3 Methodology

The symmetric tent structure is analyzed longitudinally and in cross section. The scaffold is considered as a flat structure and the resulting forces are considered to act perpendicular on a plane surface. For simplicity reasons, the perpendicular force has been substituted by three individual forces acting on three locations.

The vertical forces transmitted down through the struts are considered as weights acting on the base plates. Calculations were performed for two different load values on the base plates, 30 kg and 7 kg. These two values were used to calculate the maximum wind speed the tent can be exposed to (longitudinally and across), before the tent starts to move. The allowable maximum value is based on the worst case scenario. Calculations are also carried out to check stress levels and structural stability.

Material properties and geometric parameters were provided by the ZINGERLEMETAL. Any deviation from these properties and parameters will render this calculation invalid.

4 Materials

Aluminum: F12: $R=120\text{N/mm}^2$
 Maximum allowable stress: $R_{\text{allow}}: 60\text{N/mm}^2$ DIN 18800 Load Case HZ

5 Load Computation

Wind Load according to Chapter 5.1.3 ff CNR 10012-85

5.1 Wind Pressure

$$W = p \times G \times C$$

W.. Wind Pressure p.. kinetic Wind Pressure G.. Gust Factor C.. Force Factor

$$W = v_z^2 / 1,6 \times G \times C$$

$$\Rightarrow W = 1,167 \times v^2$$

$$\Rightarrow v = \sqrt{W / 1,167}$$

5.2 Force Calculation

$$F_{Bymin} = -300\text{N} \quad [\text{for base plate with 30kg load}]$$

$$F_{Bymin} = -70\text{N} \quad [\text{for base plate with 7kg load}]$$

a) Vertical Forces

$$\Sigma M_B = 0$$

$$\Sigma F_y = 0 \quad F_{AY} + F_{BY} - 2F_{V1} - F_{V2} = 0$$

$$\Sigma F_x = 0 \quad F_{AX} - F_{BX} = F_{h1} + F_{h2} + F_{h3}$$

$$\Sigma M_x = 0$$

$$M_I = F_{AX} \times X$$

$$M_{II} = F_{BX} \times S - (F_{V1} \times X - F_{By}) \times X - F_{h3} \times h - 2F_{V1} \times (X - a)$$



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b) Supplementary Energy

$$U^* = 1/(2EJ_1) \int M_I^2 dx + 1/(2EJ_2) \int M_{II}^2 dx$$

$$\delta U^*/\delta F_{AX} = 0 \quad 1/(2EJ_1) \int M_I^2 \delta M_I / \delta F_{AX} dx + 1/(2EJ_2) \int M_{II}^2 \delta M_{II} / \delta F_{AX} dx = 0$$

$$F_{AX} = 2a(F_{h1} s + F_{h2} s + F_{h3} s - F_{v1} a + F_{By} a + F_{h3} h) / (s^2 J_2 / 3J_1 + 2as)$$

For "30" Profiles: $F_{AX} = 2a(F_{h1} s + F_{h2} s + F_{h3} s - F_{v1} a + F_{By} a + F_{h3} h) / (0,1415 s^2 + 2as)$
 $F_{BX} = F_{AX} - F_{h1} - F_{h2} - F_{h3}$

For "40" Profiles: $F_{AX} = 2a(F_{h1} s + F_{h2} s + F_{h3} s - F_{v1} a + F_{By} a + F_{h3} h) / (0,0567 s^2 + 2as)$
 $F_{BX} = F_{AX} - F_{h1} - F_{h2} - F_{h3}$

Approximation: $F_{AXmax} = 2a(F_{h1} s + F_{h2} s + F_{h3} s - F_{v1} a + F_{h3} h) / (2as)$

Profile Values		B	H	B	h	Jy
50 Profile	J	43x43x2,5	43 mm	43 mm	38 mm	73.365 mm ⁴
35 Profile	J	33x33x2	33 mm	33 mm	29 mm	29.419 mm ⁴
Scissors	J _s	30x15x2	15 mm	30 mm	11 mm	6.245 mm ⁴

5.3 Stress Analysis

Location I

$$\sum F_x = 0 \quad F_{h2} + S_{1x} = 0$$

$$\Rightarrow S_{1x} \quad \Rightarrow S_1 = S_{1x} / \sin \alpha$$

$$R_{max} = S_{1/A}$$

Location II

$$\sum F_y = 0 \quad F_{v2}/2 + S_{2y} = 0$$

$$\Rightarrow S_{2y} \quad \Rightarrow S_2 = S_{2y} / \cos \alpha$$

$$R_{max} = S_{II/A}$$

5.4 Stability Check

$$Pk = p^2 E J_1 / l_k^2$$

6 **Results**

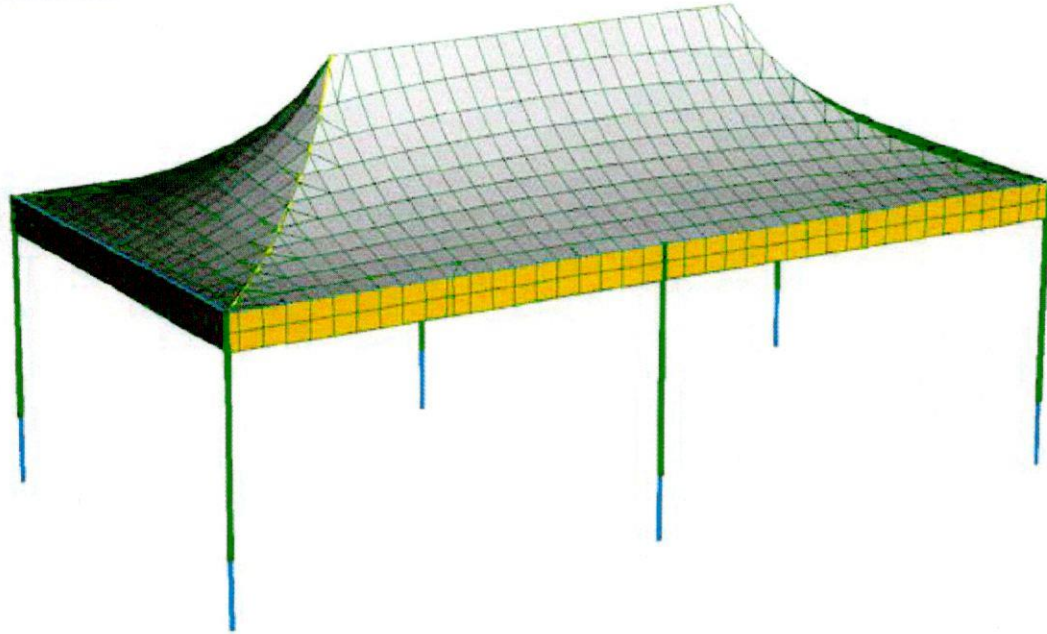
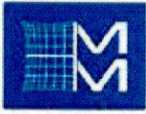
Allowable **Wind Speeds** and maximum allowable **Vertical Loads** for all tent types are determined from the equations shown above under utilization of the following tabulations.

Base Plate=>	30kg	7kg
Tent Type	V[km/h]	V[km/h]
8x4(50)	42,9	25,4
4x4(50)	42,9	25,4
4x2 (50)	28,7	25,4
6x3(50)	48,2	25,4
6x4(50)	45,0	25,4
4,5x3(50)	43,7	25,4
3x3(50)	48,1	25,4
6x3	48,1	25,4
4,5x3 (35)	43,7	25,4
3x3 (35)	48,2	25,4
1,5x3 (35)	30,7	25,4
1,5x1,5 (35)	30,7	25,4

Maximum load on structure for "35" and "50" profiles:

$$120N/m^2 = 12kg/m^2$$

Calculations performed by:
 Ing. Norbert Gruber



Structures: **Tent 8x4m, 6x4m, 4x4m, 6x3m, 4,5x3m, 3x3m, 3x2m, 2x2m, 5x5m**
valid also for tents with awning

Object: **Structural report**

Type: **Temporary structure**

Project and manufacture:

ZINGERLEMETAL



Structural design:

Dr. Ing. Massimo Maffei Profession legally qualified and register in Engineer Order in Vicenza (ITALY) with position n° 1989

ZNG-050-RP1015	0	14-09-10 1	(15-09-2010)		
Report n°	Pag. n°D	ata	Revision n°	Check	Data

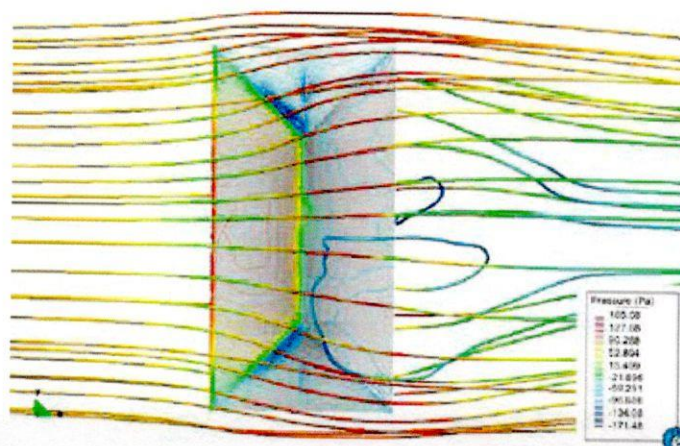
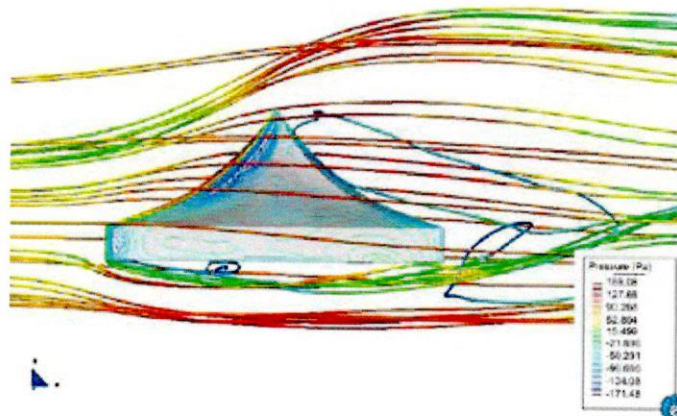


Massimo Maffei
Engineering and Consulting

6 CONCLUSION

Here below it is possible to find some important points that summarize the analysis:

- The structure is a temporary tent, so in according with UNI EN 13782 snow load is not considered and the base velocity can be reduced as specified;
- The structure without belts lateral elements can support a wind that has a fundamental speed of 16 m/s (57.6km/h)
- The structure with belt lateral elements can support a wind that has a fundamental speed of 20 m/s (72km/h). In this case the helical pickets have a length of 43.5cm.
- The structure with belt lateral elements can support a wind that has a fundamental speed of 30 m/s (108km/h). In this case the pickets have diameter of Ø30mm and a length of 80cm.



Eigenschaften Aluminium LEGA 6060

Chemische Zusammensetzung in %

Legierung	Cu	Fe	Mg	Si	Mn	Zn	Ti	Cr	Al
6060	max	max			max	max	max	max	
Theoretische Werte	- 0,10	- 0,35	0,45 0,38-0,5	0,45 0,38-0,5	- 0,1	- 0,1	0,10	0,10	Rest

Physikalische Eigenschaften

<p>Dichte: 2,70 kg/dm³</p> <p>Schmelztemperatur: 600 °C</p> <p>Spezifische Hitze bei 100 °C: 0,22 cal/g·°C⁻¹</p> <p>Wärmeleitfähigkeit bei 20 °C</p> <p>O: 0,42 cal/sec cm °C</p> <p>IDEAL ZUM ELOXIEREN</p>	<p>Koeffizient für lineare Expansion:</p> <p>20 bis 100 °C 23 · 10⁻⁶ °C⁻¹</p> <p>20 bis 200 °C 24 · 10⁻⁶ °C⁻¹</p> <p>20 bis 300 °C 25 · 10⁻⁶ °C⁻¹</p> <p>Spezifischer elektrischer Widerstand bei 20 °C: T6:3,25 μ Ω cm</p> <p>Elastizitätsmodul: 6700 Kg/mm²</p>
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ZINGERLEMETAL®

Technical data sheet / Technisches Datenblatt

“OXFORD 500”

POLYESTER FABRIC / GEWEBE 500 x 500 D

Producer/Hersteller	Cetate Production
Finishing/Beschichtung:	PD, WR, PU colour 3x, F/R, ANTI-UV
Coating side/beschichtete Seite:	
- Main material/Hauptmaterial:	Aromatic urethane Polymer: 60%
- Fire retardant material/feuerfestes Material:	Decabromo diphenyl Oxides: 20%
	Antimony Trioxide: 20%
Front site/Frontseite:	
- Water repellency/wasserabweisend:	Perfluoro Alkyl Copolymer: 10%
Yarn/Garn:	100% Polyester 500x500D
Density/Webdichte:	46 (Warp) x 36 (Weft) per inch ²
Weight/Gewicht:	220 gr/m ²
Width/Breite:	155 cm
Colorant/Farbstoff:	Bagacrone – India
Highest traction and extension/Höchstzugkraft und –dehnung:	ISO 13934-1:1999 – Mittelwert aus je 5 Streifen
	Highest traction – warp
	Höchstzugkraft – Kette : 2.030 N
	Highest traction - shot
	Höchstzugkraft – Schuß : 1.577 N
	Highest extension - warp
	Höchstzugkraftdehnung – Kette : 26,6 %
	Highest extension - shot
	Höchstzugkraftdehnung – Schuß : 27,1%
Water purity/Wasserechtheit	ISO 105 E01:1994
	colour change/Änderung der Farbe : 5
	Anbluten der Begleitgewebe-Polyester : 5
	Anbluten der Begleitgewebe – Baumwolle: 5
	ISO 105 E05:1997
	Water/Wasser : 5
	Acetic acid/Essigsäure : 5
	Sulfuric acid/Schwefelsäure : 4
	ISO 105 B02: 1999
Light-fastness/Lichtechtheit	Light-fastness/Lichtechtheitsnote : ≥ 6 (Mittelwerte)
	ISO 811: 1981 – Water-column-test/Wassersäuletest
	Average/Mittelwert : > 161 cm
	Highest value/Höchster Wert : > 200 cm
	Lowest value/Niedrigster Wert : 161 cm
Water-proofing/Wasserdichtheit	



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CLASSIFICATION

CLASSIFICATION OF REACTION TO FIRE PERFORMANCE IN ACCORDANCE WITH EN 13501-1:2007+A1:2009

Classification no.	2013-Efectis-R0497f
Sponsor	Zingerle Metal GmbH Förche 7 39040 Natz/Schabs Italy
Product name	Fabric LKR056400 - Polyester Oxford 500x500D
Prepared by	Efectis Nederland BV
Notified body no.	1234
Author(s)	C.C.M. Steinhage B.Sc. A.J. Lock
Project number	2013497
Date of issue	November 2013
Number of pages	5

1. INTRODUCTION

This classification report defines the classification assigned to fabric, type **LKR056400 - Polyester Oxford 500x500D** in accordance with the procedures given in EN 13501-1:2007+A1:2009.

2. DETAILS OF CLASSIFIED PRODUCT

2.1. GENERAL

The product, fabric, type **LKR056400 - Polyester Oxford 500x500D**, will be used as fabric for tents.

2.2. PRODUCT DESCRIPTION

The product is composed of:
Polyester fabric, FR grade, designated *LKR056400 - Polyester Oxford 500x500D*
Surface density approx. 0.225 kg/m².

2.3. MANUFACTURER/IMPORTER

Zingerle Metal GmbH
Industriezone 103
39040 Natz/Schabs
Italy

3. STANDARDS, REPORTS, RESULTS AND CRITERIA IN SUPPORT OF THIS CLASSIFICATION

3.1. REPORTS

Name of Laboratories	Name of sponsor	Report ref. no.	Test method
Efectis Nederland BV The Netherlands	Zingerle Metal GmbH Italy	2013-Efectis-R0497d 2013-Efectis-R0497e	EN ISO 11925-2:2010 EN 13823:2010



Efectis Nederland Report
2013-Efectis-R0497f
November 2013
Zingerle Metal GmbH

CLASSIFICATION

3.2. TEST RESULTS

Test method and test number	Parameter	No. tests	Results	
			Continuous parameter - mean (m)	Compliance with parameters
EN-ISO 11925-2				
surface flame impingement	$F_s \leq 150$ mm	6	25	-
	Ignition of filter paper		-	Compliant
Edge flame impingement	$F_s \leq 150$ mm	6	25	-
	Ignition of filter paper		-	Compliant
EN 13823				
	FIGRA0.2MJ [W/s]	3	0.0	-
	FIGRA0.4MJ [W/s]		0.0	-
	THR600s [MJ]		0.6	-
	LFS < edge		-	Compliant
	SMOGRA [m ² /s ²]		7	-
	TSP600s [m ²]		83	-
	Flaming debris - flaming ≤ 10 s - flaming > 10 s		-	Compliant Compliant

3.3. CLASSIFICATION CRITERIA

Fire classification of construction products and building elements Excluding floorings and linear pipe thermal insulation products			
Classification criteria			
Class	B	C	D
Test method(s)			
EN 13823	FIGRA ≤ 120 W/s LFS < edge of specimen THR _{600s} $\leq 7,5$ MJ	FIGRA ≤ 250 W/s LFS < edge of specimen THR _{600s} ≤ 15 MJ	FIGRA ≤ 750 W/s
EN ISO 11925-2 Exposure = 30 s	$F_s \leq 150$ mm within 60 s Ignition of the paper in EN ISO 11925-2 results in a d2 classification.		
Additional classification			
Smoke production	s1 = SMOGRA ≤ 30 m ² /s ² and TSP _{600s} ≤ 50 m ² ; s2 = SMOGRA ≤ 180 m ² /s ² and TSP _{600s} ≤ 200 m ² ; s3 = not s1 or s2		
Flaming Droplets/particles	d0 = no flaming droplets/particles in EN 13823 within 600 s; d1 = no flaming droplets/particles persisting longer than 10 s in EN 13823 within 600 s; d2 = not d0 or d1.		

4. CLASSIFICATION AND FIELD OF APPLICATION

4.1. REFERENCE OF CLASSIFICATION

This classification has been carried out in accordance with clause 11 of EN 13501-1:2007+A1:2009.

4.2. CLASSIFICATION

The product, **fabric, type LKR056400 - Polyester Oxford 500x500D**, in relation to its reaction to fire behaviour is classified:

B

The additional classification in relation to smoke production is:

s2

The additional classification in relation to flaming droplets / particles is:

d0

Reaction to fire classification: B - s2, d0

4.3. FIELD OF APPLICATION

This classification is valid for the following product parameters:

Surface density 0.225 kg/m²

Other properties FR grade

This classification is valid for the following end use applications:

Substrate Not applicable

Air gap Free standing

Methods and means of fixing Not applicable

Joints No joints

Other aspects of end use
conditions Used for tents

4.4. DURATION OF THE VALIDITY OF THIS CLASSIFICATION REPORT

There are no limitations in time on the validity of this report.



Efectis Nederland Report
2013-Efectis-R0497f
November 2013
Zingerle Metal GmbH

CLASSIFICATION

5. LIMITATIONS

This classification document does not represent type approval or certification of the product.

C.C.M. Steinhage B.Sc.
Project leader reaction to fire

A.J. Lock
Project leader reaction to fire



CLASSIFICATION OF REACTION TO FIRE PERFORMANCE IN ACCORDANCE WITH EN 13501-1:2007+A1:2009

Sponsor	Zingerlemetal AG Förche 7 I-39040 Natz / Schabs (BZ) Italy
Prepared by	Efectis Nederland BV Lange Kleiweg 5 P.O. Box 1090 NL-2280 CB RIJSWIJK The Netherlands
Notified Body no.	1234
Product name	PVC fabric
Classification report no	2012-Efectis-R9353c
Issue number	1
Date of issue	August 2012
Project number	2012353

This classification report consists of four pages and may only be used in its entirety.

1. Introduction

This classification report defines the classification assigned to **PVC fabric** in accordance with the procedures given in EN 13501-1:2007+A1:2009.

2. Details of classified product

2.1 General

The product, **PVC fabric**, will be used for tents.

2.2 Product description

The product is composed of:

Material: PVC fabric, laminated 400 gr/m²
 Specifications: PES 250x250D, 22x23 / sq.inch
 Treatment: UV + F/R
 Width: 190cm
 Colour: white

The product has a total thickness of 0.3 mm and a mass per unit area of approx. 400 kg/m².

2.3 Manufacturer/Importer

Wonpoong
 South Korea

3. Standards, reports, results and criteria in support of this classification

3.1 Reports

Name of Laboratories	Name of sponsor	Report ref. no.	Test method
Efectis Nederland BV The Netherlands	Zingerlemetal AG Italy	2012-Efectis-R9353a 2012-Efectis-R9353b	EN ISO 11925-2:2010 EN 13823:2010

3.2 Test results

Test method and test number	Parameter	No. tests	Results	
			Continuous parameter – mean (m)	Compliance with parameters
EN-ISO 11925-2				
surface flame impingement	Fs ≤150 mm [mm]	6	95	-
	Ignition of filter paper		-	Compliant
edge flame impingement	Fs ≤150 mm [mm]	6	86	-
	Ignition of filter paper		-	Compliant
EN 13823				
PVC fabric	FIGRA _{0,2MJ} [W/s]	3	14	-
	FIGRA _{0,4MJ} [W/s]		0	-
	THR _{600s} [MJ]		0,5	-
	LFS < edge		-	Compliant
	SMOGRA [m ² /s ²]		123	-
	TSP _{600s} [m ²]		142	-
	Flaming debris - flaming ≤ 10 s - flaming > 10 s		-	Compliant Compliant

3.3 Classification criteria

Classification criteria of the Single Burning Item (SBI) test			
Class	Fire	Class	Smoke
A2	FIGRA _{0,2 MJ} ≤ 120 W/s LFS < edge of the long wing specimen THR _{600s} ≤ 7,5 MJ	s1	SMOGRA ≤ 30 m ² /s ² TSP _{600s} ≤ 50 m ²
B	FIGRA _{0,2 MJ} ≤ 120 W/s LFS < edge of the long wing specimen THR _{600s} ≤ 7,5 MJ	s2	SMOGRA ≤ 180 m ² /s ² TSP _{600s} ≤ 200 m ²
C	FIGRA _{0,4 MJ} ≤ 250 W/s LFS < edge of the long wing specimen THR _{600s} ≤ 15 MJ	Class	Droplets
		d0	No flaming droplets/particles
D	FIGRA ≤ 750 W/s	d1	Flaming droplets/particles < 10 s
		d2	Not d0 or d1

4. Classification and field of application

4.1 Reference of classification

This classification has been carried out in accordance with clause 11 of EN 13501-1:2007+ A1:2009.

4.2 Classification

The product, **PVC fabric**, in relation to its reaction to fire behaviour is classified:

B

The additional classification in relation to smoke production is:

s2

The additional classification in relation to flaming droplets / particles is:

d0

Reaction to fire classification: B - s2, d0

4.3 Field of application

This classification is valid for the following product parameters:

- | | |
|--------------------|----------------------|
| - Thickness | 0.3 mm |
| - Surface density | 400 g/m ² |
| - Other properties | laminated |

This classification is valid for the following end use applications:


- | | |
|--|----------------|
| - Substrate | not applicable |
| - Air gap | free standing |
| - Methods and means of fixing | not applicable |
| - Joints | no joints |
| - Other aspects of
end use conditions | used for tents |


4.4 Duration of the validity of this classification report

There are no limitations in time on the validity of this report.

5. Limitations

This classification document does not represent type approval or certification of the product.


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Project leader reaction to fire


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