FuranFlex25 RWV Red liner

To BS EN 1443:2003

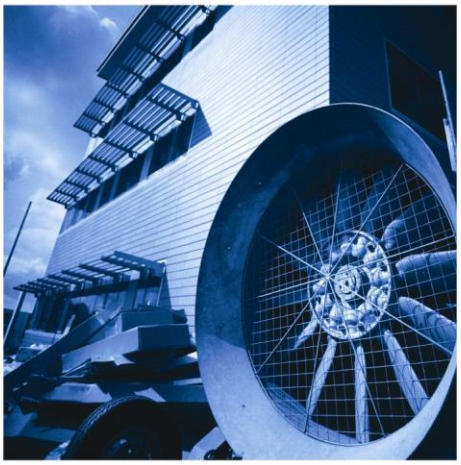
Report 55942/1 Edition 3

This report supersedes Report 55942/1 Edition 2 dated 23 August 2012

Carried out for
Kompozit'All UK Ltd.

By Dave Butler

21 June 2016



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Carried out for:
Kompozit'All UK Ltd.
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Contract: **Report 55942/1 Edition 3**

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Date: **21 June 2016**

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1 PREFACE

This report supersedes BSRIA Report No.55942/1 dated 8 June 2012.

- Front page and headings, at the client's request the product name has been changed throughout the report from Furenflex RWV flue liner to FuranFlex25 RWV Red.
- Front page, at the client's request the company name has been changed from KOMPOZITOR Ltd. to Kompozit'All UK Ltd.
- Front page, at the client's request the company address has been changed from H-2220 Vecsés, Széchenyi út 60, Hungary.

These changes do not affect the overall results or conclusions of the report as originally issued.

CONTENTS

TABLES

APPENDICES

2 INTRODUCTION

A FuranFlex25 RWV Red advanced liner manufactured by Kompozitor Ltd. was installed at BSRIA on the 14 March 2012 for thermal performance tests.

The FuranFlex25 RWV Red advanced liner material is designed for use with wood and solid fuels. Corrosion resistance classes are given in Table 2 of EN 1443:2003.

Corrosion resistance class 3 can be used with the following fuels.

1. Gas
2. Natural gas L + H
3. Oil with sulphur content > 0.2 mass %
4. Kerosene with sulphur content ≥ 50 mg/m^2
5. Wood in open fire places
6. Wood in closed stoves
7. Coal
8. Peat

The thermal performance testing was carried out to the general requirements of BS EN 1443:2003 and using the test methods contained in BS EN 1859:2009. A typical installation is shown in Appendix B on page 15.

This report refers only to the equipment tested.

3 TEST ITEMS

The test chimney components were supplied and installed by BSRIA prior to the client arranging the installation of the FuranFlex25 RWV Red advanced liner.

For the purposes of the test a tee and tee cap arrangement was used to connect the calibration ring to the combustion appliance.

Table 1 Test items

Date of Receipt	Test Engineer Initials	Full Description of Test Items	Reference Number
01/03/12	DB	Support structure for test chimney installation, supplied and constructed by BSRIA	55942A31DB
28/02/12	DB	Test chimney for installation of composite material, supplied and constructed by BSRIA (Concrete flue liners 200 mm x 200 mm internal dimensions)	55942A1DB to 55942A26DB
14/03/12	DB	FuranFlex25 RWV Red advanced liner including calibration ring, installed by the client	55942A28DB
21/03/12	DB	Replacement tee cap supplied and fitted by BSRIA	55942A29DB
27/03/12	DB	New tee with cap supplied and fitted by the client	55942A30DB

4 TEST CHIMNEY

In order to test the composite material a concrete chimney liner was erected with at a height of 6 m with an open section at the bottom to allow access for the installation of the FuranFlex25 RWV Red advanced liner and for attachment to the test equipment. A 90^{o} tee was attached to the calibration ring at the bottom of the installed liner to allow connection to the combustion equipment.

Thermocouples were placed on the wooden support structure with fire retardant board between the concrete flue liner and the wooden structure on only one side.

During the test surface temperatures were recorded on the external surfaces of the concrete flue liners not protected by the fire retardant board.

The construction of the test chimney is shown in Appendix B on page 16.

5 TEST SEQUENCE

The testing sequence is given below.

1. Initial gas tightness test of liner prior to commencement of testing, including 90° tee.
2. First thermal performance test at normal operating conditions for a duration of 240 minutes, test temperature of 552°C at end of test period.
3. Gas tightness test of liner, including 90^{o} tee.
4. Thermal shock test for 30 minutes, test temperature of 994°C at end of test period.
5. Gas tightness test of liner, including 90° tee.
6. Second thermal performance test at normal operating conditions for duration of 240 minutes, test temperature of 550°C at end of test period.
7. Gas tightness test of liner, including 90^{o} tee.
8. The 90^{o} tee was removed to allow access to calibrating ring.
9. Gas tightness test of liner as per standard installation, without tee attached.

Note:- The designation for the tests is EN1443 - T450 - N1 - D - 3 - G.

For the thermal performance test at normal operating conditions the required temperature is 550°C +5 % as specified in clause 4.5.3.1 of EN 1859:2009.

For the thermal shock test the required temperature is 1000^{o}C -20/+50°C as specified in clause 4.5.3.2 of EN 1859:2009.

6 TEST RESULTS

Table 2 Findings of examination for compliance with BS EN 1443:2003

BS EN 1443:2003 clauses	Description	Complies? Yes/No	
4.1 – 4.7	Classification	Yes	(1)
4.10	Resistance to fire	Yes	(2)
6.3.1	Heat resistance	Yes	(3)
6.3.2	Sootfire resistance	Yes	(4)
6.4.1	Gas tightness	Yes	(5)
6.7.5	Flow resistance	Yes	(6)
4.11	Designation	Yes	(7)

1. Classification

Testing was carried out against the classifications below.

Temperature class	T450
Pressure class	N1
Condensate class	D
Corrosion resistance class	3
Sootfire resistance class	G

2. Resistance to fire

The FuranFlex25 RWV Red advanced liner adheres to the surface of the existing chimney and therefore no distance to combustibles is required and the resistance to fire internal to external is G.

Following the thermal performance tests the gas tightness class was N1. See gas tightness results in Appendix A pages 9, 11 & 13.

3. Heat resistance

The results of the thermal performance tests are given in Appendix A on page 9, 10, 13 & 14.

4. Sootfire resistance

The results of the sootfire resistance test are given in Appendix A on page 11.

5. Gas tightness

The gas tightness results following each thermal performance test are given in Appendix A on pages 9, 11 & 13.

6. Flow resistance

For this report the mean roughness has been assumed to be similar to clay ceramic flue liners.
Using the typical roughness values from EN 13384-1:2002+A2:2008, the mean roughness *r* would be 0.0015.

Note:- The flue liner when installed is cleaned using nylon or non-metallic brush.

7. Designation

The product designation's' is as follows;

Standard	Temperature class	Pressure class	Resistance to condensate class	Corrosion resistance class	Sootfire resistance class
BSEN 1443:2003	T450	N1	D	3	G

APPENDIX: A THERMAL PERFORMANCE TEST RESULTS

Tests 1 – First heat stress test at normal operating conditions

Pre-test conditions

Air velocity	Zone A	0.04	m/s
	Zone B	0.02	m/s
	Zone C	0	m/s

Humidity		44	%

Ambient temperatures	Zone A	12.63	12.63	°C
	Zone B	14.24	14.28	°C
	Zone C	14.57	14.92	°C

Test conditions

Test period	240	min
Flue velocity	3.60	m/s
CO/CO_2 ratio	0.0657	
Flue gas temperature at end of test period	552.4	°C

Summary of surface temperatures on the test chimney are given on page 10.

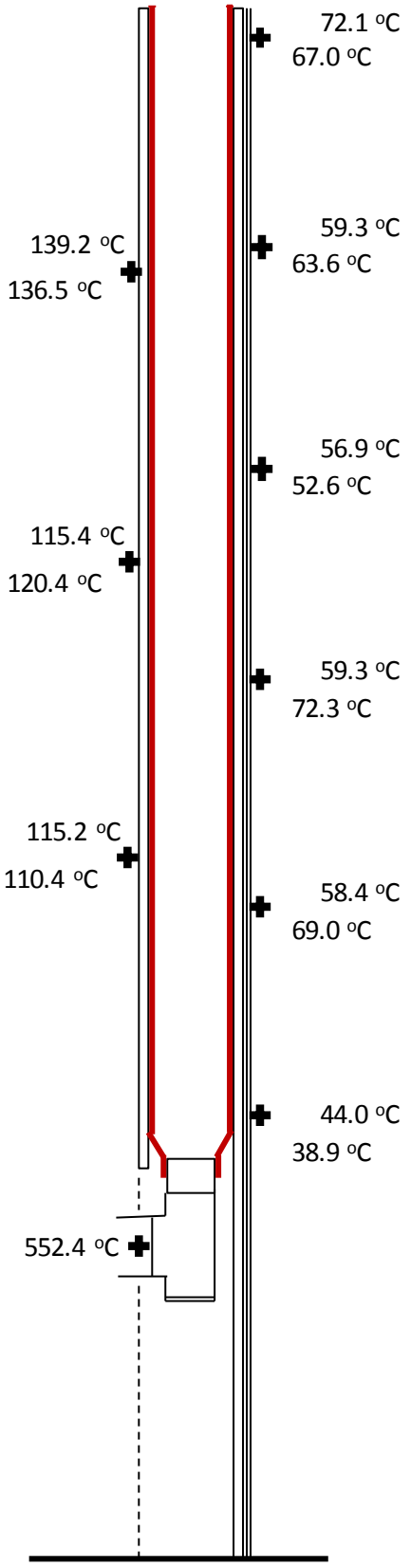
Gas tightness before test 1

Pressure class	N1	
Pressure required	40	Pa
Leakage rate	0.249	$l/s/m^2$

Gas tightness after test 1

Pressure class	N1	
Pressure required	40	Pa
Leakage rate	0.149	$l/s/m^2$

Summary of surface temperatures on the test chimney



Tests 2 – Sootfire resistance test

Pre-test conditions

Air velocity	Zone A	0.01	m/s
	Zone B	0.01	m/s
	Zone C	0	m/s
Humidity		47	%

Ambient temperatures	Zone A	13.97	14.00	°C
	Zone B	15.25	15.20	°C
	Zone C	15.76	16.20	°C

Test conditions

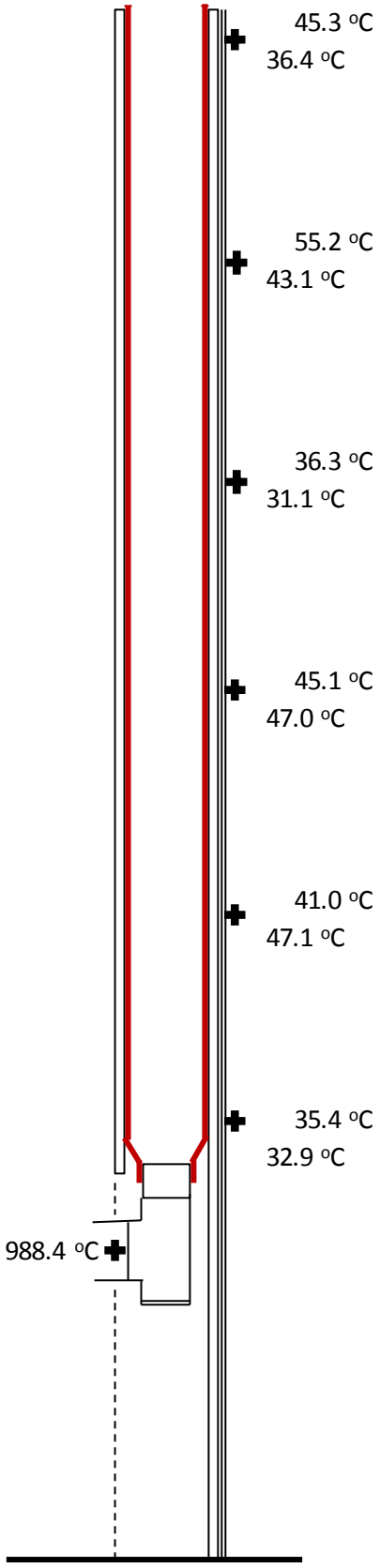
Test period	30	min
Flue velocity	5.41	m/s
CO/CO_2 ratio	0.0657	
Flue gas temperature at end of test period	988.4	°C

Summary of surface temperatures on the test chimney are given on page 12.

Gas tightness following test 2

Pressure class	N1	
Pressure required	40	Pa
Leakage rate	0.387	$l/s/m^2$

Summary of surface temperatures on the test chimney



Tests 3 – Second heat stress test at normal operating conditions

Pre-test conditions

Air velocity	Zone A	0.01	m/s
	Zone B	0.01	m/s
	Zone C	0.04	m/s
Humidity		47	%

Ambient temperatures	Zone A	17.13	17.57	°C
	Zone B	19.05	18.79	°C
	Zone C	17.83	18.14	°C

Test conditions

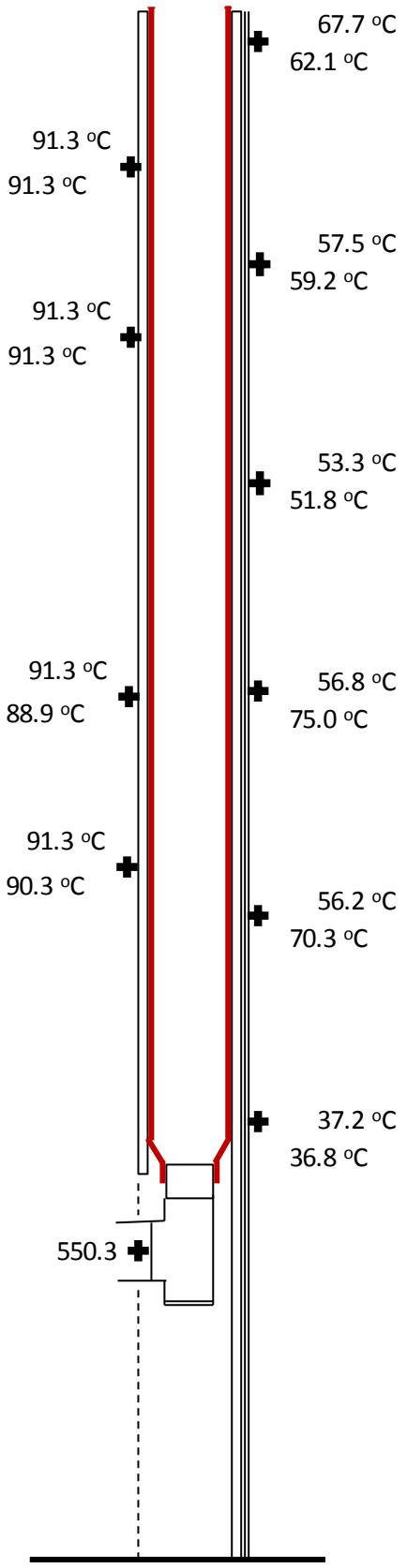
Test period	240	min
Flue velocity	3.66	m/s
CO/CO_2 ratio	0.0659	
Flue gas temperature at end of test period	550.3	°C

Summary of surface temperatures on the test chimney are given on page 14.

Gas tightness following test 3

Pressure class	N1	
Pressure required	40	Pa
Leakage rate	0.113	$l/s/m^2$

Summary of surface temperatures on the test chimney



APPENDIX: B DRAWINGS

Figure 1 - Typical installation

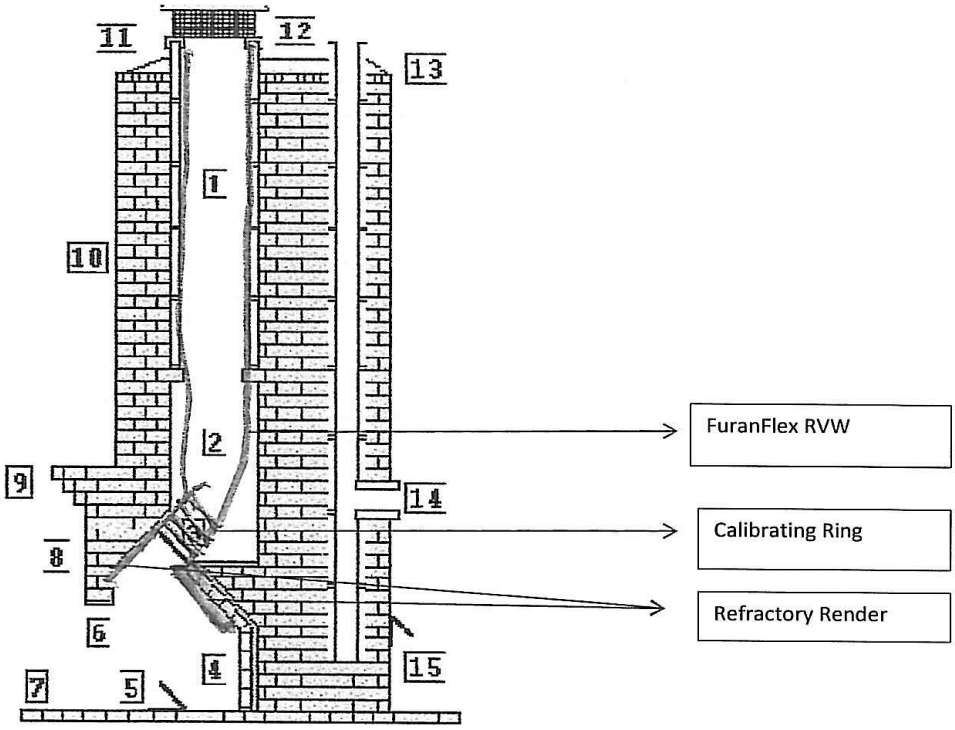
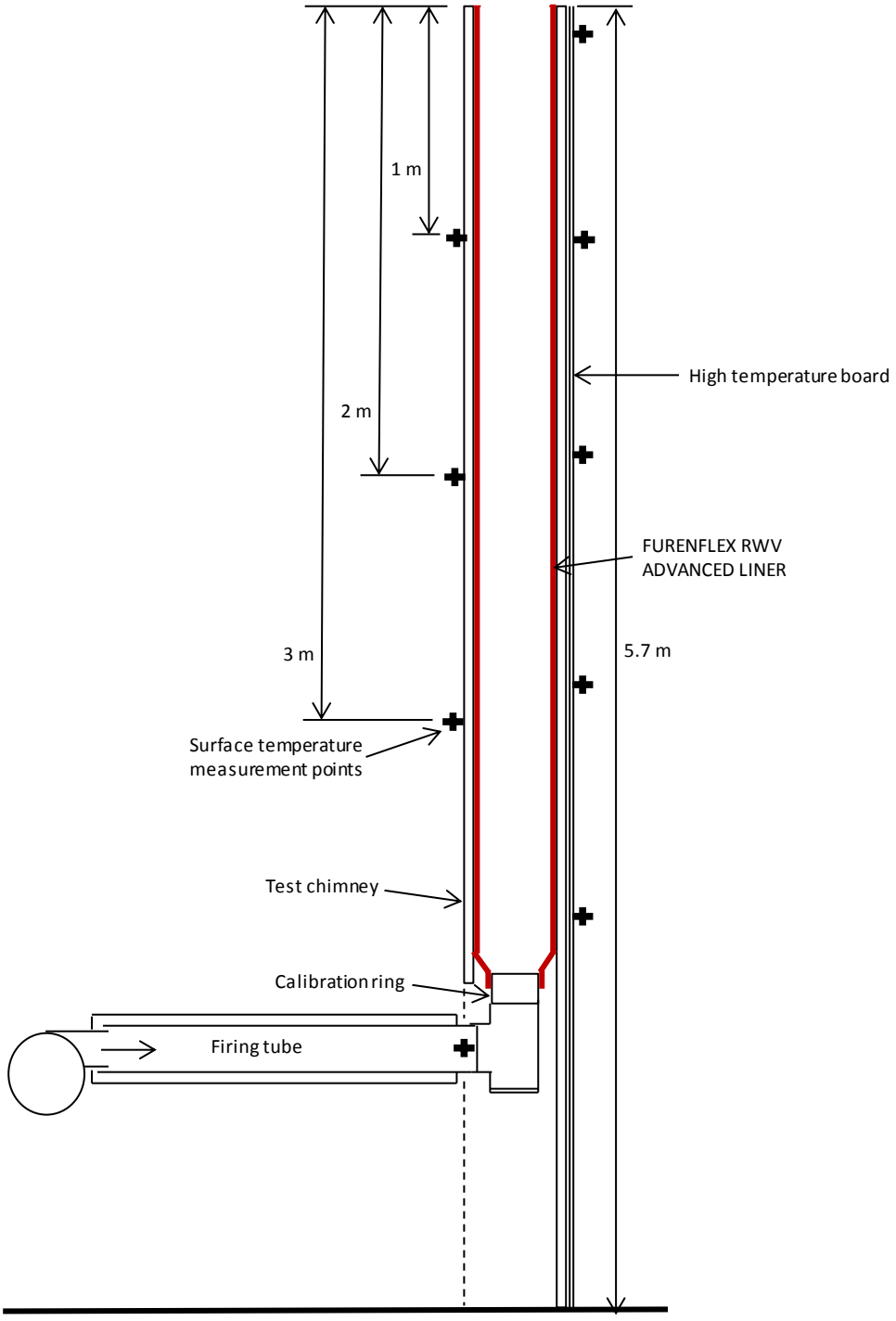


Figure 2 – Construction of test chimney



Test chimney construction

Photograph 1 (Lower section including tee piece)

Photograph 2 (Tee connection for gas tightness test)

Photograph 3 (Top section after installation of liner, to be cut off level with test chimney)

APPENDIX: C INSTALLATION INSTRUCTIONS

FuranFlex® RWV

New material and technology for chimney lining for wood-burning and solid fuel.

KOMPOZITOR Ltd., May 2012.

Adaptation area:

FuranFlex RWV is a lining material and technology for heat resistant flue-gas and ventilation systems, developed by Kompozitor. Explanation of designation:

„R" = (Resist) For 30 minutes it resists the temperature up to 1000 °C of flue gas. The colour of the material is red, though the traditional FuranFlex is black.

„W" = (Wood) Suitable for wood fuel.

„V" = (Ventilation) Suitable for ventilating ducts.

This description can only be applied to wood fuelled flue-gas systems.

Denomination for **chimney**: EN 1443 T450 N1 D 3 G

- Adaptable up to a maximum temperature of 450 °C flue-gas.
- Operates with natural draft boilers
- Suitable for dry operation under normal working circumstances (no condensation allowed in chimney)
- Fuel: wood and wood derivatives (in case of heating)
- Soot fire resistant system

The material of FuranFlex

Glass-fiber textile: same reinforcement used for FuranFlex.
Resins: modified resin mix, red colour, less fluent, slower hardening. Emits liquid at hardening.
External textile: white colour, fabric textile, reinforced with Kevlar filaments.

FuranFlex RWV is not combustible (A2).

Behaviour of FuranFlex-RWV on various temperatures.

Between 200-700°C – transition process in the material, tube should not be moved.
At 500-800 °C there is some smoke noticeable.
At the temperature of 1000 °C flue-gas it stays stable.
FuranFlex RWV does not burn, even on 1000°C cannot be ignite.

Corrosion resistance of FuranFlex RWV

The FuranFlex RWV cannot be used for any solid fuel, because in this category different type of coal, peat and other junk materials appear as well. At the burning of these materials dangerous acids (ex.: Sulphuric acid) are generated.

The corrosion of FuranFlex RWV is weaker than the standard FuranFlex's. RWV can be applied in dry mode for wood applications.

Building technology

Main differences compared to standard FuranFlex technology:

- Storage
- Different order of layers (see also separate point), so the thickness off walls are major
- Harder bending (more tense), maximum degree of pulling is 30°C
- Hardening procedure is slower
- Applied pressure is lower
- Develop of boiler wiring

Used pressure is the same as applied at the standard lining. The external glassfiber textile is still sensitive, even with the Kevlar reinforcement, it requires sensitive treatment.

Storage

During storage, care must be taken to avoid damage of the packaging. In case of damaged package, the storage life of FuranFlex RWV is shorter.

Storage duration of FuranFlex RWV:

20-25 °C	2 weeks
15-20 °C	4 weeks
8-15 °C	8 weeks

Layers

Structure of FuranFlex RWV is the same as the standard FuranFlex Lining Tube.

1. Inner foil tube
2. Lining material developed of composite (glass-fibre-resin)
3. External textile

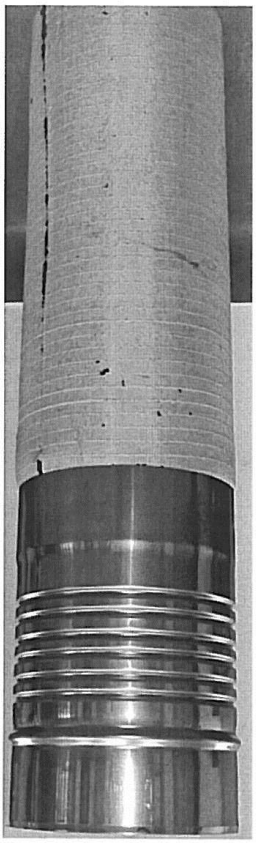
The inner foil tube has to be removed from the hardened FuranFlex RWV Tube.
The lining material is a 4-layer, glassfiber strengthened composite layer.
The external outer textile provides the nominal dimension of the lining tube.

Connecting flue pipe to FuranFlex RWV

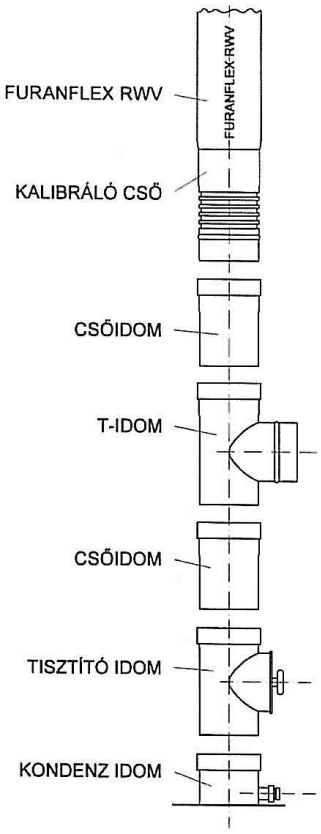
Connection to the flue liner of FuranFlex RWV is different than the standard FuranFlex system. The connection between the FuranFlex tube and the stainless steel element can secured by a larger calibrating tube.

Building of the calibration tube: FuranFlex RWV must be placed in to the chimney through the calibration tube, then inflate with air and harden with steam. After hardening FuranFlex, cut off two ends must be at the stainless steel calibration tube, similar to the adapter ring. Inside of the calibration tube and the lining tube have to be daubed with 1200 °C heat-resistant silicone paste. The

calibration tube has to contain at least one mangled (ring). The more located on the tube, the stronger is the mechanical connection between the FuranFlex RWV and the stainless steel element. It is significant that the diameter at the lower end of the calibration tube match the used stainless steel elements. The steel elements have to hit its material quality to FuranFlex (EN 1443 T450 N1 D 3 G).



Calibration ring needed connecting the steel elements



Steel elements connected to FuranFlex

T-element

FuranFlex RWV cannot be placed through the T-element! T-element has to be connected to the calibrating tube.

Cleaning slot

The connecting section between the T-element and the cleaning slot has to be connected with steel element that meets the requirements of the local regulations. The steel elements have to match in its material quality to FuranFlex (EN 1443 T450 N1 D 3 G).

Vertical (fireplace) connection

Gatherer steel element is needed have installation the soot fire. At least 1000 mm distance need to be ensured between the flames emerging during firing and the FuranFlex RWV calibration ring. If this distance cannot be ensured, then steel liner elements have to be installed between the FuranFlex RWV and the umbel.

Maintenance

FuranFlex RWV needs professional examination twice a year. The examination can be done by chimney sweeper or a person with FuranFlex diploma.

Cleaning only with (plastic / synthetic) brushes.

The service must be recorded for possible guarantee validation.

Sootfire

In case of soot fire the FuranFlex RWV does not melt, nor bend, nor strain. In case of stronger surface damage the chimney must be lined with FuranFlex RWV material. Attention! Soot-fire is not normal working condition.

Environment and health protection

The chemical build-up of FuranFlex RWV is similar as the standard FuranFlex Lining Tube. No harmful material pollutes when build-in. Some non-toxic smoke starts up above 500°C, in case of fire.

The material of FuranFlex RWV is glass fibre reinforced resin. A significant amount of dust appear when cutting the lining tube, therefore dust mask must be worn.

Sizing / measerment

Sizes of the FuranFlex RWV lining material that can be ordered (diameters)

Diameter (mm): 100, 110, 130, 150, 160, 180, 200, 225, 250, 275, 300,

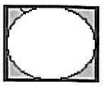
For special order

(325, 350, 375, 400, 450, 500, 550, 600, 650, 700, 750, 800, 850, 900, 950, 1000)

The diameters (cross-section) of the FuranFlex RWV have to be determined after measurement, in knowledge of the combustion and flue-gas system.

FuranFlex-RWV can be used only in dry operating circumstances. It must be checked by EN 13384.

Important! Appropriate diameters have to be chosen, so that the hardened lining tube affects the wall of the chimney at least on two vertical line, or on a wide space.



Guarantee

Kompozitor Ltd. has 10 years of guarantee for the FuranFlex RWV lining material, as follows:

- Observant of the national permit by contractor before, after and during the lining process.
- The contractor has to have the certificate of the knowledge of FuranFlex technology, which is filled by Kompozitor Ltd. or his partner.
- For industrial installation individual planning is needed.
- Guarantee valid only, if the guarantee card was sent back to Kompozitor Ltd., before the guarantee claim.
- Guarantee includes only the repair of the lining tube, not valid for other direct or indirect damage.
- Guarantee is valid with the regular yearly check and service (ask for local chimney industry)

Guarantee not valid:

- if any non-official repair was made on the boiler
- Annual check was not accomplished
- If any unrequited change was made on the chimney0
- If installation was not made by national licence or technological description
- Operation is not accorded to the permitted rating.
- No guarantee in case of soot fire.
- Questioner about guarantee claim should be filled.

APPENDIX: D PHOTOS OF LINER FOLLOWING THERMAL PERFORMANCE TESTS

Note:- The test chimney was dismantled and two 1.2 m sections of the liner material were removed for inspection.

Photograph 3

Photograph 4

Photograph 5

Photograph 6