ALTERNATIVE SOLUTION REPORT
Oeko Tube

Holmes Farsight

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Written By:	Reviewed by:
	
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1 PURPOSE

The purpose of this document is to provide expert advice with regards to the installation of an Oeko Tube electrostatic, micro dust filter, (referred to hereafter as Oeko Tube), to flues attached to inbuilt and free-standing solid fuel burning appliances <40kW, within the scope of AS2918: 2018.

The purpose of the Oeko tube is to to electrostatically charge the uppermost section of the flue to attract fine particulate emissions, as opposed to allowing them to freely discharge into the atmosphere. Over time the majority of this particulate matter will build up to a point where it falls back down the flue to be re-combusted with a small percentage making its way to the outside.

It is understood that this advice may be used to form part of a Building Consent application for the installation of an Oeko Tube to both new and existing appliances. Should the Oeko Tube be installed to an existing appliance it is required that either a new flue be installed to meet B2, (durability) or the existing flue be inspected and certified as being fit for purpose by a member of the NZ Home Heating Association (NZHHA).

2 INTRODUCTION

An alternative solution is a solution that differs, in part or wholly, from the solutions offered by the Acceptable Solutions or Verification Methods but achieves compliance with the performance requirements of the Building Code to the extent required by the Building Act. The term alternative solutions is defined as such in the Building Control Handbook: -

- ***Alternative solution*** *means a solution that is compliant with the Building Code but is not part of the Compliance Document.*

The Role of Alternative Solutions in a Performance Based Regulatory System

There may be a number of reasons for the use of an alternative solution, (see examples below), and they play a critical role in the evolution of the "deemed to comply route" as; they are the systems mechanism of recognising the "importance of allowing for continuing innovation in methods of building design and construction", (s4(2)(c) BA04) and also act to fill in the many blanks left by the acceptable solutions and verification methods

- There may not be an Acceptable Solution or Verification Method for the work proposed**
- The building work may incorporate unusual or innovative design features that is not accounted for in the "deemed to comply route" **
- The Acceptable Solution or Verification Method may require features that do not meet the building owner's expectations. **
- The Acceptable Solution or Verification Method may not recognise new technologies, or current best practice. **
- The Acceptable Solution or Verification Method may propose design solutions that are in excess of the minimum requirements. **
- The Acceptable Solution or Verification Method may propose design solutions that do not achieve a level of risk management that is acceptable to the building owner.
- The building owner may want something that looks different, performs better, is more cost effective or overcomes specific site issues that are not addressed in a compliance document. **

**applicable to this report

Whatever the reason for using an alternative solution, the Building Code, being performance based, allows for innovation and applicants have the freedom to propose an innovative solution.

Roles and Responsibilities in the Context of the Approval process of an Alternative Solution

A Designer is responsible for:-

- ensuring that the plans and specifications are sufficient to result in the building work complying with the building code" (BA04s14D(2); and
- Identifying the building code clauses relevant to the proposal, (BFR2004 Form 2)
- Identifying their means of compliance relative to the applicable building code clauses and the plans and specifications, (BFR2004 Form 2)

A BCA is responsible for checking to ensure that it —

- Documents reasonable grounds to establish how an application for a building consent complies with the building code (BA04s14F(a)(i); and
- Grants and issues building consents (BA04s14F(b); and

Therefore, whilst Acceptable Solutions and Verification Methods are the predominant route to compliance the Building Act is clear that both the designer and BCA are responsible for demonstrating and documenting compliance benchmarked against the building code. The system therefore requires: -

- The Designer to identify and justify their alternative solution: and
- The BCA to benchmark this information against the building code in order to document reasonable grounds in ascertaining compliance, "to the extent required"

3 THE PROPOSAL

The Building

The scope of this advice is ringfenced to NZS2918 scoped appliances connected to flues modified to include an Oeko Tube associated with buildings falling within the scope of the table below: -

Intended Use	Classified Use	Use	Importance levels
Dwelling houses Sheds, workshops, sleep outs and the like associated with dwelling houses.	Housing: • Detached dwellings • Multi-unit dwellings • Group dwellings Outbuildings.	SH, SR	1 and 2

2.0 HOUSING

2.0.1 Applies to buildings or use where there is self-care and service (internal management). There are three types:

2.0.2 Detached Dwellings

- Applies to a building or use where a group of people live as a single household or family. Examples: a holiday cottage, boarding house accommodating fewer than 6 people, dwelling or hut.

2.0.3 Multi-unit Dwelling

- Applies to a building or use which contains more than one separate household or family. Examples: an attached dwelling, flat or multi-unit apartment.

2.0.4 Group Dwelling

- Applies to a building or use where groups of people live as one large extended family. Examples: within a commune or marae.

7.0 OUTBUILDINGS

7.0.1 Applies to a building or use which may be included within each classified use but are not intended for human habitation and are accessory to the principal use of associated buildings. Examples: a carport, farm building, garage, greenhouse, machinery room, private swimming pool, public toilet, or shed.

4 THE RELEVANT PERFORMANCE CRITERIA

This report has been prepared based on the applicability of the following Building Code Performance Criteria in relation to the proposal (note take account of building code obligations and limits in application)

PERFORMANCE

B1.3.3 Account shall be taken of all physical conditions likely to affect the stability of buildings, building elements and sitework, including:

(a) Self-weight
(h) Wind,

B1.3.4 Due allowance shall be made for:

(a) The consequences of failure,
(b) The intended use of the building,
(d) Variation in the properties of materials and the characteristics of the site

CLAUSE B2—DURABILITY

PERFORMANCE

B2.3.1 Building elements must, with only normal maintenance, continue to satisfy the performance requirements of this code for the lesser of the specified intended life of the building, if stated, or:

(b) 15 years if:
  i. Those building elements (including in-built chimneys and flues) are moderately difficult to access or replace, or
  ii. Failure of those building elements to comply with the building code would go undetected during normal use of the building, but would be easily detected during normal maintenance.

(c) 5 years if:
   i. The building elements (including freestanding appliances/ flues) are easy to access and replace, and
   ii. Failure of those building elements to comply with the building code would be easily detected during normal use of the building.

C1—OBJECTIVES OF CLAUSES C2 TO C6 (PROTECTION FROM FIRE)

PERFORMANCE

C2.2 The maximum surface temperature of combustible building materials close to fixed appliances using controlled combustion and other fixed equipment when operating at their design level must not exceed 90°C.

C2.3 Fixed appliances using controlled combustion and other fixed equipment must be designed, constructed and installed so that there is a low probability of explosive or hazardous conditions occurring within any spaces in or around the building that contains the appliances.

CLAUSE E2—EXTERNAL MOISTURE

PERFORMANCE

E2.3.2 Roofs and exterior walls must prevent the penetration of water that could cause undue dampness, damage to building elements, or both.

E2.3.7 Building elements must be constructed in a way that makes due allowance for the following:

(a) the consequences of failure:
(b) the effects of uncertainties resulting from construction or from the sequence in which different aspects of construction occur:
(c) variation in the properties of materials and in the characteristics of the site.

CLAUSE F2—HAZARDOUS BUILDING MATERIALS

PERFORMANCE

F2.3.1 The quantities of gas, liquid, radiation or solid particles emitted by materials used in the construction of buildings, shall not give rise to harmful concentrations at the surface of the material where the material is exposed, or in the atmosphere of any space.

CLAUSE G9—ELECTRICITY

PERFORMANCE

G9.3.1 The electrical installation shall incorporate systems to:

(a) Protect people from contact with parts of the installation which are live during normal operation, and to prevent parts of the installation or other building elements becoming live during fault conditions,
(b) Permit the safe isolation of the installation and of electrical fittings and appliances,

(c) Safeguard people from excessive temperatures resulting from either normal operation of electrical equipment, or from currents which could exceed the installation rating,
(d) Safeguard people from injury which may result from electromechanical stress in electrical components caused by currents in excess of the installation rating,
(e) Protect building elements from risk of ignition, impairment of their physical or mechanical properties, or function, due to temperature increases resulting from heat transfer or electric arc,
(f) Operate safely in its intended environment, and
(g) Safeguard against ignition of the surrounding atmosphere where it is potentially flammable or explosive.

G9.3.3 An electrical installation connected to an electrical supply system, shall contain safeguards which protect the safety features of the external supply.

5 THE EVIDENCE

Comparison to compliance documents

BUILDING CODE CLAUSE B1, (STRUCTURE)	
Verification Method Requirements	Alternative Solution

Please refer to the Santosh Ankale, (CPEng 1161253), of Cheal engineers report for flues fitted with an Oeko Tube.
This justification is relevant to flues fitted with an Oeko Tube within the following scope:-
• Wind zones A1-A7 and W
• Wind pressures
  • 3.53 kPa ULS
  • 2.72 kPa, SLS
• To a maximum flue height (incl building)not exceeding 10m, measured in accordance with NZS3604, excluding hill, ridge and escarpments
• Up to importance level 2 buildings
• With a design life/ durability of 15 years
• Buildings situated on soil class D/E
• With a maximum height of flue 1.5m, measured from the roofline
	Past consideration of adverse effects on a buildings structure B1 structure is seldom considered within the context of the approval of a building consent for a solid fuel appliance and associated flue. In the context of an alternative solution I note the following: -
	• The Oeko Tube weighs approximately 6kg.
	• A standard 150mm diameter stainless steel flue weighs approximately 2.1kg per lineal meter
	• A 150mm diameter twin walled flue weighs approximately 5.7kg per lineal meter
	• Fig 4.8 NZS2918 identifies the need to continue the twin walled flue above the roofline between a minimum of 600mm and a maximum of approximately 2.9m, (roof pitch and flue positioning dependent)
	• When nearby structures are considered adherence to fig 4.8 could result in a flue approaching in excess of 4m from the roofline
	• The degree of tolerance relative to the weight of flue above the roofline is therefore 19.4kg.
	• As such a flue fitted with an Oeko Tube extending 2.35mm above the roofline is arguably within the scope of weight generally accepted in the consenting and certification process without question.
	• Little guidance exists for flue braces, but common rule of thumb dictates flues exceeding 1.5m above the roofline are required to be braced and should the flue exceed 2.9m specific design is required.

BUILDING CODE CLAUSE B2, (DURABILITY)	
Acceptable Solution Requirements	Alternative Solution
B2/AS1 simply requires durability periods of 5 years, (freestanding), and 15 years, (inbuilt), giving further guidance on whether building elements are difficult- easy to access and replace, maintenance. B2/VM1 provides further guidance outlining aspects such as in-service history, testing and differential materials but is of little value to this assessment. In general terms durability is often built into other "deemed to comply" routes. Tables 20-22, E2/AS1 is a prime example. In this instance durability is inherent within the limitations of the test parameters outlined in NZS2918.	B2 is not a standalone building code clause and so must be considered in conjunction with a stand-alone building code clause to which durability is applicable. B2/E2, B2/B1 etc. In this instance durability is relevant in consideration of B1, C2, (E2, G9, not subject to an alternative solution). COMMONLY ASKED QUESTIONS **Creosote build up** Creosote buildup is to some extent dealt with in NZS2918 as there is a general assumption outlined in B7, (fuel test), that requires untreated Pinus radiata with a moisture content, (MC) of between 10-15% be used as the fuel source. Parameters for coal are also specified with a volatile content, (VC) of no less than 30% and a calorific value, (CV) of not less than 22MJ/kg, wet. In this respect questions are sometimes raised regarding unregulated local markets in terms of MC, VC and CV, for example claims that Canterbury predominantly burns "wet wood" are often cited. This considered, any solid fuel burning appliance, and associated flue, burning fuel other than assumed by way of B7, NZS2918, falls outside the test parameters of the standard, and so would need to be treated as an untested appliance. This, regardless of whether the flue is fitted with an Oeko Tube. It is therefore important to consider the limitations of the standard and regulate consistently accepting the premise that a person using the correct fuel will experience creosote buildup in accordance with the assumptions of the standard. Conversely a person using a fuel source outside of this assumption will regardless of the flue experience creosote buildup other than that assumed but similarly across the board. **Particulate build up** Given that the purpose of the Oeko Tube is to retain/ recycle the products of combustion within the flue it is reasonable to assume that a flue fitted with an Oeko Tube will have a more onerous cleaning regime than a traditional flued appliance. In this respect I note the following: - • NZS2918 has requirements to facilitate the cleaning of the inner surface of the entire flue without dismantling, (other than would be normal when carried out by a chimney sweep) but does not stipulate the frequency of cleaning, leaving it to

BUILDING CODE CLAUSE B2, (DURABILITY)	
	the owner to decide based on external influences such as insurers requirements and personal preference, etc; and • The purpose of the Oeko Tube is to capture particulates in the flue, of which approximately 90% will fall back down the flue to be re-combusted or cleaned out leaving the remainder to discharge to the air/ fall to the roof/ ground; and • The Oeko Tube has stringent maintenance requirements, (imposed by way of the Ecan Resource Consent), where an accredited person is contractually obliged to clean the flue, in accordance with the manufacturer's requirements on an annual basis. Given the purpose of the Oeko Tube we must accept that the flue will have a permanent buildup of particulates, greater than would normally be expected for a traditional flue. This said the particulate build up is finite to the extent that it will reach a maximum thickness before either falling back down to the appliance or making its way to the outside. We must also accept that a person using the correct fuel source will not experience excessive creosote buildup and a person not using the correct fuel source should be treated equally across the board. In consideration of the above it is reasonable to conclude that the manufacturer has more stringent requirements than NZS2918 in respect to cleaning, (as 2918 has none), and the mandatory cleaning regime is contextually "normal", in consideration of B2.3.1, such that the nominal 5/ 15 year durability required by way of B2 will be achieved when compared and contrasted against a traditional flue. **More onerous cleaning and maintenance requirements of the firebox and flue** Durability in this context is a C2.2/B2 issue. In this respect NZS2918 assures compliance to C2.2, C2.3/ B2 and as noted above the standard facilitates provision for cleaning of the flue only. In respect to the cleaning of the firebox NZS2918 assumes that the firebox and flue will be cleaned on an as and when basis by the homeowner. Sections, 1.4, 1.5 and 6.1 of the manufacturer's installation manual make clear the contractual maintenance obligations of the certified expert clearly outlining their certification/ qualification requirements. **Particulate matter landing and adhering to the roof associated with the flue** Please refer to appendix B for a comprehensive assessment. **Particulate matter landing and adhering to other locations surrounding the chimney and dwelling**

BUILDING CODE CLAUSE B2, (DURABILITY)	
	In this respect we must draw a limit to the assessment based on building code obligations and limitations. For example, a B2/E2 assessment must be limited to the obligations prescribed in E2.3.1 and E2.3.2, i.e. the roof. Other locations surrounding the building is not within the limitations of a BCA assessment in a E2/B2 context. We could however consider C2.3…. around the building…. but as noted above compliance in this respect can be taken from P Sparrows opinion and compliance to fig 4 NZS2918 and durability relative to C2.3 is arguably not applicable in this context. **Potential adverse effects of soot flakes on the roof and surrounding property.** Again, this is largely a E2/B2 issue as addressed above. In addition, C2.3 controls hazardous conditions in and around the *building* containing the appliance. In this context sootfall would have to be considered instrumental to hazardous conditions around the property to the extent that the conditions are detrimental to people's health, (arguably the intent of C2.3). In this respect please be aware that the purpose of the Oeko Tube is to dramatically reduce "sootfall" and so in this respect a flue fitted with an Oeko Tube outperforms its counterpart by a significant margin, as outlined in appendix B, essentially improving the situation quite significantly when contrasted against a traditional flue. **Additional maintenance requirements** As referenced above the Resource Consent process has conditioned a mandatory 10-year maintenance plan where the flue and appliance will be professionally cleaned on an annual basis by a certified expert. Sections, 1.4, 1.5 and 6.1 of the manufacturer's installation manual make clear the contractual maintenance obligations and certification/ qualification requirements of the certified expert. **Oeko Tube safety features.** The electrical component of the Oeko Tube has built in safety features such that:- • Should an unauthorized person attempt to access the flue the system will automatically be disabled; and • Should a fault occur the system will be disabled, and the owner alerted leaving the flue to continue to operate as normal, but for the retention of particulate matter within the flue allowing it to discharge to the atmosphere; and

BUILDING CODE CLAUSE B2, (DURABILITY)	
	• Untoward actions such as vigorous cleaning of the firebox, (whilst the appliance is in use, leading to excessive particulate matter entering the flue), would at worst lead to the Oeko Tubes safety features coming into play, disabling the system and displaying a fault. The fault would be brought to the attention of the homeowner and subsequently addressed under the mandatory maintenance regime. Again, in the meantime the flue would continue to act in direct accordance with NZS2918.

BUILDING CODE CLAUSE C2, (PREVENTION OF FIRE OCCURRING)	
Verification Method Requirements	Alternative Solution
Compliance to C2.2 and C2.3 is generally satisfied by way of NZS2918. NZS2918 however covers more than just C2.2 and C2.3 with crossovers into B1 implied as well as B2 in a C2.2 context.	COMMONLY ASKED QUESTIONS **Appliance modifications** Section 5, NZS2918 addresses appliance modifications and variations whilst section 1 outlines definitions. Admittedly, the Oeko Tube modifies the flue, (as defined), not the appliance, (as defined), and so strictly speaking flue modifications fall outside the scope of section 5. This said, this is more an irregularity as opposed to a conscious omission, as the authors of NZS2918 simply didn't consider modifications to the flue, only modifications such as air intakes, air control systems, catalytic combustors, water jackets etc to the appliance. When this issue is considered holistically, i.e. in consideration of the totality of the system, appliance and flue, P Sparrow of Spectrum Laboratories, an IANZ accredited lab validates compliance to C2. in line with the intent of section 5. In Mr. Sparrows professional opinion working within the parameters of an accredited organisation, as outlined in appendix A, he concludes that:- • a flue fitted with an Oeko Tube electrostatic filter does not affect the combustion process, does not affect the draw of gas through the flue system, such that if the appliance were to be retested with an Oeko Tube it will not significantly alter the heat output or efficiency of the appliance. **Re-entrainment of particulate matter.** Re-entrainment is an atmospheric event that occurs when contaminants that are exhausted in a plume from a stack are mixed back into the original volume of air. This issue is tenuously linked to C2.3, i.e. a low probability of hazardous conditions

BUILDING CODE CLAUSE C2, (PREVENTION OF FIRE OCCURRING)	
	occurring around the building… In this respect C2.3 does not incur durability requirements and this issue has been addressed by P Sparrow of Spectrum Laboratories, i.e. ….” does not affect the draw of gas through the system” …. This comment in conjunction with fig 4.8 NZS2918 for example, satisfies the issue of re-entrainment as long as the flue is installed in accordance with fig 4.8 NZS2918

BUILDING CODE CLAUSE E2, (EXTERNAL MOISTURE)	
Acceptable Solution Requirements	Alternative Solution
E2/AS1 figs 21, 29, 53, 54, 60 etc all outline acceptable methods of dealing with penetrations relative to the flue and associated electrical work.	N/A to this assessment as compliance to E2/AS1 can be easily achieved.

BUILDING CODE CLAUSE F2, (HAZARDOUS BUILDING MATERIALS)	
Acceptable Solution Requirements	Alternative Solution
F2/AS1 provides no guidance in the respect of the installation of solid fuel burning appliances/ flues and any subsequent modifications.	F2 is comparable in application to B2, in so much that F2 is applicable to all building elements but must be applied in conjunction with another building code clause. In this instance B1/F2, C2/F2, E2/F2, etc. F2.3.1 lays out the requirements for the components used within the construction of the appliance, flue and Oeko Tube requiring that quantities of gas, liquid, radiation or solid particles emitted by the associated materials shall not give rise to harmful concentrations at the surface of the material where the material is exposed, or in the atmosphere of any space. In this respect all materials used in the construction of the Oeko Tube are either located externally or in the uppermost section of the flue and regardless are inert to the extent that F2 compliance can be assured.

BUILDING CODE CLAUSE G9, (ELECTRICITY)	
Verification Method Requirements	Alternative Solution
The installation of an Oeko Tube includes electrical work such that is prescribed under sec 2, Electrical Act 1992, and is therefore deemed *energy work* with compliance established via sec19(e), BA04. The energy works certificate, (CoC), shall be presented to the BCA with the application for code compliance certificate under sec92(4).	N/A to this assessment as compliance to G9/VM1, (NZS3000), shall achieved and documented in accordance with the BA04.

Appendix A

SPECTRUM LABORATORIES
1/25 Highbrook Drive, East Tamaki, Auckland
PO Box 259-182 Greenmount, Auckland, 1730
Telephone +64 9 271 1616, Fax +64 9 271 1615

Monday, August 10, 2020

RE: OekoTube effect on solid fuel burner installations

Client:

Attention:	Dr. Rene Haeberli.
Company:	Envirosolve Limited.
Make / Model:	OekoTube / OT-2
Address:	Ohakune Road, RD3, Raetihi, Wanganui, New Zealand.
Phone:	+64 6 385 4871.

Instructions:

The client requested an opinion regarding the installation and use of the OT-2 OekoTube electrostatic filter on a solid fuel wood burning appliance, specifically the effect on the particulate emissions, efficiency, power output and safe clearance distances.

Opinion:

Operation of the device:
The OekoTube electrostatic filter does not affect the combustion process of the fuel, the OekoTube provides a post combustion treatment that using an electrostatic field prevents the particulates from entering the atmosphere by trapping them in the flue pipe. This does not affect the draw of gas through the flue system so therefore has no effect on the combustion itself.

Safety Clearance:
It is the opinion of Spectrum laboratories that as the OekoTube will not affect the combustion process an existing installation would remain unaffected by its operation.

Clause 5.2 'Appliance Variation' of the AS/NZS 2918 'Domestic solid fuel burning appliances - Installation' standard requires that any modification made to an appliance from its as-tested configuration have an opinion from the Laboratory that originally tested the appliance or an IANZ or NATA accredited laboratory confirming that the modification would change the installation requirements. In this particular situation the OekoTube is intended to be deployed onto any solid fuel burning appliance so an opinion for every model is not practical. This opinion covers the safe installation onto any solid fuel burning appliance.

Efficiency and Emission:
It is the opinion of Spectrum laboratories that this modification would not decrease the efficiency or increase the emissions results of a tested solid fuel burning appliance.

Clause 8.5 of AS/NZS 4012 and Clause 9.2 of AS/NZS 4013 require that any modification to a fire will still comply via retest exemption if a NATA or IANZ accredited laboratory issues an opinion stating that the modification will not significantly alter the heat output or efficiency of the tested appliance nor shall it increase the particulate emissions.

Appendix B

	Flue with Oeko Tube	Traditional Flue
Small Particle Assessment. **Emissions, at a particle size of 8nm**	10% of small particles emitted through the flue. 90% make their way back through the flue to be re-combusted.	Conservative assumption of 95% of small particles emitted through the flue.
Roof coverage area	Weather condition dependent, conservatively assume that 20% of the small particles emitted through the flue settle onto the roof 80% discharge into the atmosphere.	
Estimated % of small particle size on the roof.	0.2x0.1=0.02, or **2%**	0.2x0.95=0.19, or **19%**
Able to visually detect	Coverage dependent, may be able to detect a thin film if concentrations high	
Surface area coverage	Comparatively high. The smaller the particle the higher the combined surface area, estimated at 100% of the estimated roof coverage area.	
Conclusion Both flues omit extremely small particles with potential coverage areas for large parts of the roof but with the particle size under consideration a large amount will be borne into the atmosphere and the remainder onto the roof. If we assume a 80/20 split, i.e. 80% into the atmosphere and 20% onto the roof, with an 70% assumed roof coverage area, a flue fitted with an Oeko tube has the potential to reduce small particle coverage on the roof up to **89%.** Given the competitively large surface area of the particles under consideration this is a significant improvement.		
	Flue with Oeko Tube	**Traditional Flue**
Large Particle Assessment. **Emissions, particle size 1600000nm/ 1.6mm**	2-5% estimated based on the testing undertaken. For the purpose of this assessment assume a worst-case scenario of 10% of total emissions result in large particle discharge. Large particles either discharged directly through the	Without significant testing it's hard to estimate. For the purposes of this assessment we will conservatively assume 1% of total emissions result in large particle coverage.

	combustion process or indirectly through the adhesion and subsequent dislodgement of small particles drawn from within the flue by atmospheric conditions.	
Roof coverage area	Large particles will likely fall within a 1m radius of the flue, (weather dependent). If we therefore assume a 170m² roof area large particle coverage is limited to around 1.8% of the total roof area. Of that likely catchment area large particle coverage will be sparse and the surface area comparatively small with an estimated surface area coverage of 5% of the likely coverage area.	
Estimated % of large particle size on the roof.	0.1x0.1=0.01 x0.05 =0.0005, or **0.05%**	0.01x0.95=0.0095x0.05=0.00047 or **0.0475%**
Able to visually detect	Yes. Particles are relatively large at 1.6mm and are able to be visually inspected as a sparse coverage when compared to the thin film of the small particles.	

Conclusion

A flue fitted with an Oeko Tube discharges 89% less small particles onto the roof, but we also need to factor in the discharge large particles. As these particles are competitively large, they are more likely to fall, and do so near the flue. We also need to consider that the amount of large particles omitted is largely dependent on the total percentage of emissions. When we factor this in it is evident that a flue fitted with an Oeko Tube flue is comparable to its counterpart. (note assuming an absolute worst case scenario for the Oeko Tube and absolute best case scenario for a traditional flue).

The coverage area and total surface area must however be considered as large particles have a relatively low footprint due to their comparatively small surface and coverage area.

Using the above as reference point we see that a flue fitted with an Oeko Tube:-

- Reduces overall emissions by up to 95%, (not a building code issue); and
- Reduces likely small particle emission onto the roof by approximately 89%; and

- Is comparable relative to large particle emission onto the roof, (assuming an absolute worst-case scenario for the Oeko Tube and absolute best case scenario for a traditional flue); and
- When considered holistically reduces the combined particle emission onto the roof by in excess of 89%

I therefore conclude that as a flue fitted with an Oeko Tube, when considered holistically, reduces the combined particle emission onto the roof and as such complies to a better extent, relative to E2/B2 compliance, in respect of particulate matter landing and adhering to the roof below the flue.