Fire Test Reports for Interpon D Powder Coatings

Explanations and collations of key reports and approvals for the UK market.

September 2023

Index

1. BS476

British Standard 476 refers to fire tests on building materials and structures. The parts of this standard that are of most relevance to powder coatings are Parts 6 and 7.

Part 6 - Fire Propagation
The result of this test is a fire propagation index. It is a measure of the contribution to fire growth made by an essentially flat surface. The results of the test are specific to the test specimen i.e. the product on that particular substrate in the form in which it was tested. Therefore it cannot be used as a method for assessing the product in all situations.

Part 7 - Surface Spread of Flame
This is a method of measuring flame spread along the surface of a specimen. Again the results of the test are specific to the test specimen i.e. the product on that particular substrate in the form in which it was tested. Therefore it cannot be used as a method for assessing the product in all situations.
As defined in the UK Building Regulations 2000 - Fire Safety Approved Document B, the highest product performance classification for wall or ceiling linings is Class 0. This is achieved if a material; (a) Achieves a class 1 rating in BS476 Part 7, and (b) Achieves a fire propagation index of not more than 12 and sub-index of not more than 6 in BS476 Part 6.

Test Results

Interpon D1000 series and D2000 Series have been tested to BS476 Parts 6 and 7 and have met the criteria for Class 0 building regulation approval. The test reports are included in this document.

2. Reaction to Fire Report EN 13501-1

A further classification used in the building industry is given by EN 13501.

This is arrived at by carrying out two tests:

- EN 13823
- EN ISO 1716

The EN ISO 1716 (Calorific value) test determines the potential maximum amount of energy release which can be generated by a product when complete combustion occurs. The test is relevant for classes A1 and A2. Specimens are prepared from each individual component of a product by grinding them into powder. Each component is then tested in an oxygen bomb calorimeter by placing the specimen in a crucible within a stainless steel vessel filled with oxygen and pressure. A spark is then introduced; exploding the mixture and the resultant temperature rise will be used to calculate the calorific value of the specimen.

The classification is split into 3 components.

1. Combustibility. A2 means no contribution to fire

2. Smoke Emission – s1 is best, s3 is worst

3. Release of droplets or particles – d0 is best, d2 is worst

Test Results Interpon D polyester powders have been tested and certified to generically meet EN 13501-1 2007 and achieves a classification of A2-s1, d0 between 60-120 microns. The **average** (not absolute) applied coating film thickness should not exceed 120 microns to ensure this classification is maintained. Some applications may give different results; system manufacturers should offer suitable guidance to powder applicators.

The full test report is included in this document.

3. Fire Reports for Rail

Interpon D1036 and Interpon EC has to be tested for the following:

- Smoke Emission
- Toxic Fume Emission
- Qualitative analysis (what is emitted)
- Quantitative analysis (how much is emitted)
- Flammability
- Fire propagation
- Surface spread of flame

The test reports are appended.

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Direction Sécurité, Structures et Feu
Division Etudes et Essais Feu
Safety, Structures and Fire Department
Fire Studies and Tests Division

RAPPORT DE CLASSEMENT EUROPEEN DE REACTION AU FEU

REACTION TO FIRE EUROPEAN CLASSIFICATION REPORT

N° RA23-0094

Selon l'Arrêté du 21 novembre 2002 modifié relatif à la Réaction au Feu des produits de construction et d'aménagement
Laboratoire pilote agréé par le ministère de l'intérieur (Arrêté du 5 février 1959 modifié)
According to the modified Ordinance dated November 21st, 2002 as regards the Reaction to Fire performance of construction and installation products
Pilot laboratory approved by the Ministry of the Interior (Ordinance of February 5th, 1959 modified)

Valable 5 ans à compter du 04 avril 2023
Valid 5 years from April, 04th, 2023

A la demande de : *Owner:*	**AKZO NOBEL SAS** **Division Powder Coatings** **Zone Industrielle de la Gaudrée** **91410 DOURDAN** **FRANCE**
Marque(s) commerciale(s) : *Commercial brand(s):*	**POLYESTER coatings INTERPON** **série 600, série 800, série D1000, série D2000**
Description sommaire : *Brief description:*	**Peinture appliquée sur support tôle métallique** *Paint applied on metal sheet substrate*
Date du rapport : *Date of issue:*	**19 juin 2023** *June 19th, 2023*

Ce rapport de classement atteste uniquement des caractéristiques de l'objet soumis aux essais et ne préjuge pas des caractéristiques de produits similaires. Il ne constitue pas une certification de produits au sens du code de la consommation. Seul le rapport électronique signé avec un certificat numérique valide fait foi en cas de litige. Ce rapport électronique est conservé au CSTB pendant une durée minimale de 10 ans. La reproduction de ce rapport électronique n'est autorisée que sous sa forme intégrale. Seule la version française fait foi. Il comporte 7 pages.
This classification report certifies only the characteristics of the object submitted for testing but does not prejudge the characteristics of similar products. So it does not constitute a product certification in the sense of the Consumer Code. Only the electronic report signed with a valid digital certificate is taken in the event of litigation. The electronic report is kept at CSTB for a minimum period of 10 years. The reproduction of this electronic report is only authorized in its integral form. Only the French version is authentic. It comprises 7 pages.

CSTB
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Rapport de classement / *Classification report* n° **RA23-0094**

1. Introduction / *Introduction*

Ce rapport de classement définit le classement attribué au(x) produit(s) précité(s) conformément aux procédures données dans la norme NF EN 13501-1:2018.
This classification report defines the classification assigned to the above-mentioned product(s) in accordance with the procedures given in the NF EN 13501-1:2018 standard.

2. Description du produit / *Product description*

Peintures en poudre à base de polyester essayées et appliquées sur une face d'un support tôle d'aluminium classé A1 d'épaisseur 1,0 mm ± 0,2 mm.
Polyester-based powder paints tested and applied to one side of on an A1 class aluminium sheet substrate with a thickness of 1,0 mm ± 0,2 mm.

Nature	Résine polyester et charges minérales *Polyester resin and mineral fillers*
Epaisseurs nominales *Nominal thicknesses*	60 à 120 µm *From 60 to 120 µm*
Densités sèches nominales *Nominal dry densities*	De 1200 à 1700 kg/m^3 (selon le coloris) *From 1200 to 1700 kg/m^3 (according to the colour)*
Coloris / *Colours*	Divers / *Various*
Aspects / *Appearances*	Non métallisé et métallisé *Not metallized and métallized*

La description complète du produit figure dans le(s) rapport(s) d'essais listé(s) au §3.1.
The complete description of the product is in the test report(s) listed in §3.1.

3. Rapports d'essais et résultats d'essais en appui du classement
Test reports and test results in support of classification

3.1 Rapports d'essais / *Test reports*

Nom du laboratoire *Name of laboratory*	Nom du demandeur *Name of sponsor*	Identification de l'essai *Test identification*	N° du rapport d'essai *Test report No.*	Méthode d'essai *Test method*
CSTB	**AKZO NOBEL SAS Division Powder Coatings Zone Industrielle de la Gaudrée 91410 DOURDAN FRANCE**	**22-15288**	**DSSF-22-15288**	NF EN 13823+A1:2022 NF EN ISO 1716:2018
		22-09268	**DSSF-22-09268**	NF EN 13823:2020 NF EN ISO 1716:2018

3.2 Résultats d'essais / *Test results*

Méthode d'essai *Test method*	Produit *Product*	Nombre d'épreuves *Number of tests*	Paramètres *Parameters*	Résultats / *Results*	
				Paramètres continus Moyennes *Continuous parameters Mean values*	Paramètres conformité *Compliance parameters*
NF EN 13823+A1	POLYESTER coatings INTERPON série 600, série 800, série D1000, série D2000 Epaisseur 120 µm Coloris divers Aspect non métallisé *Thickness 120 µm* *Various colours* *Not metallized appearance*	3	$FIGRA_{0,2MJ}$(W/s) $FIGRA_{0,4MJ}$(W/s) LFS THR_{600s}(MJ)	**25,0** **12,5** **-** **0,4**	**-** **-** **Non atteint** *Not reached* **-**
			SMOGRA(m²/s²) TSP_{600s}(m²)	**0,0** **13,7**	**-** **-**
			Gouttelettes ou particules enflammées *Flaming droplets or debris*	**-**	**Aucune** *None*
NF EN 13823	POLYESTER coatings INTERPON série 600, série 800, série D1000, série D2000 Epaisseur 110 µm Coloris divers Aspect métallisé *Thickness 110 µm* *Various colours* *Metallized appearance*	3	$FIGRA_{0,2MJ}$(W/s) $FIGRA_{0,4MJ}$(W/s) LFS THR_{600s}(MJ)	**23,3** **15,4** **-** **2,0**	**-** **-** **Non atteint** *Not reached* **-**
			SMOGRA(m²/s²) TSP_{600s}(m²)	**0,0** **17,9**	**-** **-**
			Gouttelettes ou particules enflammées *Flaming droplets or debris*	**-**	**Aucune** *None*

Le (-) signifie : non applicable / *(-) means: not applicable*

3.3 Epreuve complémentaire / *Additional test*

Méthode d'essai *Test method*	Produit *Product*	Nombre d'épreuves *Number of tests*	Paramètres *Parameters*	Résultats / *Results*	
				Paramètres continus Moyennes *Continuous parameters Mean values*	Paramètres conformité *Compliance parameters*
NF EN 13823+A1	POLYESTER coatings INTERPON série 600, série 800, série D1000, série D2000 Epaisseur 120 µm Coloris noir métallisé *Thickness 120 µm Metallized black colour*	1	$FIGRA_{0,2MJ}$(W/s) $FIGRA_{0,4MJ}$(W/s) LFS THR_{600s}(MJ)	**74,3** **0,0** **-** **0,5**	**-** **-** **Non atteint** ***Not reached*** **-**
			SMOGRA(m^2/s^2) TSP_{600s}(m^2)	**0,0** **11,9**	**-** **-**
			Gouttelettes ou particules enflammées *Flaming droplets or debris*	**-**	**Aucune** ***None***
NF EN 13823	POLYESTER coatings INTERPON série 600, série 800, série D1000, série D2000 Epaisseur 60 µm Coloris noir métallisé *Thickness 60 µm Metallized black colour*	1	$FIGRA_{0,2MJ}$(W/s) $FIGRA_{0,4MJ}$(W/s) LFS THR_{600s}(MJ)	**12,2** **12,2** **-** **1,4**	**-** **-** **Non atteint** ***Not reached*** **-**
			SMOGRA(m^2/s^2) TSP_{600s}(m^2)	**0,0** **20,8**	**-** **-**
			Gouttelettes ou particules enflammées *Flaming droplets or debris*	**-**	**Aucune** ***None***

Le (-) signifie : non applicable / *(-) means: not applicable*

3.4 Résultats d'essais (suite) / *Test results (continuation)*

Méthode d'essai *Test method*	Produit *Product*	Nombre d'épreuves *Number of tests*	Paramètres *Parameters*	Résultats / *Results*	
				Paramètres continus Moyennes *Continuous parameters Mean values*	Paramètres conformité *Compliance parameters*
NF EN ISO 1716	POLYESTER coatings INTERPON série 600, série 800, série D1000, série D2000 (aspect métallisé : cas défavorable) (*metallized appearance: worst case*)	3	Q_{PCS} (MJ/kg) Q_{PCS} (MJ/m²)	**20,718** **3,8**	
	POLYESTER coatings INTERPON série 600, série 800, série D1000, série D2000 (aspect non métallisé : cas défavorable) (*non-metallized appearance: worst case*) Produit dans son intégralité (cas défavorable) *Product on its whole (worst case)*	3	Q_{PCS} (MJ/kg) Q_{PCS} (MJ/m²)	**22,146** **3,7**	-

Le (-) signifie : non applicable / *(-) means: not applicable*

Rapport de classement / *Classification report* n° **RA23-0094**

4. Classement et domaine d'application / *Classification and direct field of application*

4.1 Référence du classement / *Reference of the classification*

Le classement est prononcé suivant la norme NF EN 13501-1:2018.
This classification has been carried out in accordance with the NF EN 13501-1:2018 standard.

4.2 Classement / *Classification*

Comportement au feu *Fire behaviour*		Production de fumées *Smoke production*		Gouttes ou particules enflammées *Flaming droplets or debris*
A2	**-**	**s1**	**,**	**d0**

Classement / *Classification* : A2 - s1, d0

4.3 Domaine d'application / *Field of application*

Le classement est valable pour les paramètres produits suivants :
This classification is valid for the following product parameters:

Nature	Résine polyester et charges minérales *Polyester resin and mineral fillers*
Epaisseurs nominales *Nominal thicknesses*	60 à 120 µm* *From 60 to 120 µm**
Densités sèches nominales *Nominal dry densities*	De 1200 à 1700 kg/m^3 (selon le coloris) *From 1200 to 1700 kg/m^3 (according to the colour)*
Coloris / *Colours*	Divers / *Various*
Aspects / *Appearances*	Non métallisé et métallisé *Not metallized and métallized*

Le classement est valable pour les conditions d'utilisation finales suivantes :
This classification is valid for the following end use conditions:

Support *Substrate*	Le produit appliqué sur tout substrat métallique classé A1 de masse volumique ≥ 2025 kg/m^3 et d'épaisseur ≥ 0,8 mm dont le point de fusion est ≥ 500°C *The product applied on any A1 class metal substrate with a density ≥ 2025 kg/m^3 and with a thickness ≥ 0.8 mm whose melting point is ≥ 500°C*
Lame d'air *Air gap*	Sans / *Without*

5. Limitations / *Limitations*

Le présent document de classement n'est pas une approbation ni une certification de type du produit.
The present document does not represent type approval or certification of the product.

Fait à Champs-sur-Marne, le 19 juin 2023
Prepared at Champs-sur-Marne, June 19th, 2023

Le Référent Technique
Etudes et Essai Feu
Fire Studies and Tests Technical Referent

Signature numérique de Olivier BRAULT
Date : 2023.06.29 12:17:37 +02'00'

Olivier BRAULT

Fin de rapport / *End of the report*

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Direction Sécurité, Structures et Feu
Division Etudes et Essais Feu
Safety, Structures and Fire Department
Fire Studies and Tests Division

RAPPORT DE CLASSEMENT EUROPEEN DE REACTION AU FEU

REACTION TO FIRE EUROPEAN CLASSIFICATION REPORT

N° RA23-0035

Selon l'Arrêté du 21 novembre 2002 modifié relatif à la Réaction au Feu des produits de construction et d'aménagement
Laboratoire pilote agréé par le ministère de l'intérieur (Arrêté du 5 février 1959 modifié)
According to the modified Ordinance dated November 21st, 2002 as regards the Reaction to Fire performance of construction and installation products
Pilot laboratory approved by the Ministry of the Interior (Ordinance of February 5th, 1959 modified)

Valable 5 ans à compter du 23 novembre 2022
Valid 5 years from November 23rd, 2022

A la demande de : *Owner:*	**AKZO NOBEL SAS** **Division Powder Coatings** **Zone Industrielle de la Gaudrée** **91410 DOURDAN** **FRANCE**
Marque commerciale : *Commercial brand:*	**Métal déployé revêtu INTERPON Polyester**
Description sommaire : *Brief description:*	**Panneau en treillis revêtu d'une peinture/revêtement en poudre** *Mesh panel coated with powder coating/paint*
Date du rapport : *Date of issue:*	**03 mars 2023** *March 03rd, 2023*

Ce rapport de classement atteste uniquement des caractéristiques de l'objet soumis aux essais et ne préjuge pas des caractéristiques de produits similaires. Il ne constitue pas une certification de produits au sens du code de la consommation. Seul le rapport électronique signé avec un certificat numérique valide fait foi en cas de litige. Ce rapport électronique est conservé au CSTB pendant une durée minimale de 10 ans. La reproduction de ce rapport électronique n'est autorisée que sous sa forme intégrale. Seule la version française fait foi. Il comporte 6 pages.
This classification report certifies only the characteristics of the object submitted for testing but does not prejudge the characteristics of similar products. So it does not constitute a product certification in the sense of the Consumer Code. Only the electronic report signed with a valid digital certificate is taken in the event of litigation. The electronic report is kept at CSTB for a minimum period of 10 years. The reproduction of this electronic report is only authorized in its integral form. Only the French version is authentic. It comprises 6 pages.

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Rapport de classement / *Classification report* n° **RA23-0035**

1. Introduction / *Introduction*

Ce rapport de classement définit le classement attribué au(x) produit(s) précité(s) conformément aux procédures données dans la norme NF EN 13501-1:2018.
This classification report defines the classification assigned to the above-mentioned product(s) in accordance with the procedures given in the NF EN 13501-1:2018 standard.

2. Description du produit / *Product description*

Panneau en treillis d'aluminium revêtu sur les 2 faces d'une peinture en poudre thermodurcissable à base de résine polyester et de charges minérales. Le panneau en treillis d'aluminium est fixé mécaniquement sur une ossature en aluminium, le tout fixé sur support tôle d'aluminium classé A1, d'épaisseur 1,0 ± 0,2 mm.

Aluminium mesh panel coated on both sides with a thermosetting powder paint based on polyester resin and mineral fillers. The aluminium mesh panel is mechanically fixed on an aluminium frame, the whole fixed on an A1 class aluminium sheet substrate, thickness 1.0 ± 0.2 mm.

Peinture / *Paint*	Nature	Poudre à base de résine polyester *Polyester resin-based powder*
	Densité sèche nominale *Nominal dry density*	1200 à 1700 kg/m^3 (selon le coloris) *From 1200 to 1700 kg/m^3 (depending on the colour)*
	Epaisseur nominale *Nominal thickness*	60 à / *to* 90 µm
	Coloris / *Colours*	Divers / *Various*
Panneau en treillis d'aluminium *Aluminium mesh panel*	Référence / *Reference*	Mesh
	Taux nominal de perforation *Nominal perforation rate*	45 %
	Longue diagonale *Long way design*	115 mm
	Courte diagonale *Short way design*	46 mm
	Largeur de la lanière *Strand width*	15 mm
	Epaisseur nominale de la tôle *Nominal sheet thickness*	3 mm
	Epaisseur mesurée totale *Overall measured thickness*	21,5 mm

La description complète du produit figure dans le(s) rapport(s) d'essais listé(s) au §3.1.
The complete description of the product is in the test report(s) listed in §3.1.

3. Rapports d'essais et résultats d'essais en appui du classement
Test reports and test results in support of classification

3.1 Rapports d'essais / *Test reports*

Nom du laboratoire *Name of laboratory*	Nom du demandeur *Name of sponsor*	Identification de l'essai *Test identification*	N° du rapport d'essai *Test report No.*	Méthode d'essai *Test method*
CSTB	**AKZO NOBEL SAS Division Powder Coatings Zone Industrielle de la Gaudrée 91410 DOURDAN FRANCE**	**22-09966**	DSSF-22-09966	NF EN 13823:2020
			DSSF-22-09966 (rapport d'essais d'extension *extension test report)*	NF EN ISO 1716:2013
		ES541170363	RA18-0083	NF EN ISO 1716:2013

3.2 Résultats d'essais / *Test results*

Méthode d'essai *Test method*	Produit *Product*	Nombre d'épreuves *Number of tests*	Paramètres *Parameters*	Résultats / *Results*	
				Paramètres continus Moyennes *Continuous parameters Mean values*	Paramètres conformité *Compliance parameters*
NF EN 13823	Métal déployé revêtu INTERPON Polyester	3	$FIGRA_{0,2MJ}$(W/s) $FIGRA_{0,4MJ}$(W/s) LFS THR_{600s}(MJ)	**2,8** **2,8** **-** **0,9**	- - **Non atteint** *Not reached* -
			SMOGRA(m²/s²) TSP_{600s}(m²)	**0,0** **4,8**	- -
			Gouttelettes ou particules enflammées *Flaming droplets or debris*	**-**	**Aucune** *None*
NF EN ISO 1716	Peinture / Paint INTERPON Polyester	3	Q_{PCS} (MJ/kg) Q_{PCS} (MJ/m²)	**20,559** **1,445**	-
	Panneau en treillis d'aluminium *Aluminium mesh panel*	-	Q_{PCS} (MJ/kg)	**0,0**	-
	Produit dans son intégralité (Cas défavorable) *Product on its whole (Worst case)*	-	Q_{PCS} (MJ/kg)	**0,6**	-

Le (-) signifie : non applicable / *(-) means: not applicable*

4. Classement et domaine d'application / *Classification and direct field of application*

4.1 Référence du classement / *Reference of the classification*

Le classement est prononcé suivant la norme NF EN 13501-1:2018.
This classification has been carried out in accordance with the NF EN 13501-1:2018 standard.

4.2 Classement / *Classification*

Comportement au feu *Fire behaviour*		Production de fumées *Smoke production*		Gouttes ou particules enflammées *Flaming droplets or debris*
A1	**-**	**Non applicable** *Not applicable*	**,**	**Non applicable** *Not applicable*

Classement / *Classification* : A1

4.3 Domaine d'application / *Field of application*

Le classement est valable pour les paramètres produits suivants :
This classification is valid for the following product parameters:

Peinture / *Paint*	Nature	Poudre à base de résine polyester *Polyester resin-based powder*
	Densité sèche nominale *Nominal dry density*	1200 à 1700 kg/m^3 (selon le coloris) *From 1200 to 1700 kg/m^3 (depending on the colour)*
	Epaisseur nominale *Nominal thickness*	60 à / *to* 90 µm
	Coloris / *Colours*	Divers / *Various*
Panneau en treillis d'aluminium *Aluminium mesh panel*	Référence / *Reference*	Mesh
	Taux nominal de perforation *Nominal perforation rate*	45 %
	Longue diagonale *Long way design*	115 mm
	Courte diagonale *Short way design*	46 mm
	Largeur de la lanière *Strand width*	15 mm
	Epaisseur nominale de la tôle *Nominal sheet thickness*	3 mm
	Epaisseur mesurée totale *Overall measured thickness*	21,5 mm

Le classement est valable pour les conditions d'utilisation finales suivantes :
This classification is valid for the following end use conditions:

Mise en œuvre *Setting up*	Fixé mécaniquement sur une ossature métallique *Mechanically fixed on a metal sustructure.*
Support / *Substrate*	Cette ossature est fixée sur tout substrat métallique classé A1 de masse volumique ≥ 2025 kg/m^3 et d'épaisseur ≥ 0,8 mm dont le point de fusion est ≥ 500°C *This substructure is fixed on any A1 class metal substrate with a density ≥ 2025 kg/m^3 and with a thickness ≥ 0.8 mm whose melting point is ≥ 500°C.*

5. Limitations / *Limitations*

Le présent document de classement n'est pas une approbation ni une certification de type du produit.
The present document does not represent type approval or certification of the product.

Fait à Champs-sur-Marne, le 03 mars 2023
Prepared at Champs-sur-Marne, March 03rd, 2023

Le Référent Technique
Etudes et Essai Feu
Fire Studies and Tests Technical Referent

Signature numérique de Olivier BRAULT
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Olivier BRAULT

Fin de rapport / *End of the report*

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Title:

CLASSIFICATION OF REACTION TO FIRE PERFORMANCE IN ACCORDANCE WITH EN 13501-1:2018

Notified Body No:

0833

Product Name:

"Super Durable PPC Aluminium"

Report No:

WF 419155

Issue No:

2

Prepared for:

AkzoNobel Powder Coatings
Stoneygate Lane,
Felling,
Gateshead,
Tyne and Wear,
NE10 0JY

Date:

22nd October 2019

1. Introduction

This classification report defines the classification assigned to “Super Durable PPC Aluminium”, a powder coated solid aluminium panel, in line with the procedures given in EN 13501-1:2018.

2. Details of classified product

2.1 General

The product, “Super Durable PPC Aluminium”, a powder coated solid aluminium panel, is defined as being suitable for construction applications, excluding flooring and linear pipe thermal insulation.

2.2 Product description

The product, “Super Durable PPC Aluminium”, is fully described below and in the test reports provided in support of classification listed in Clause 3.1.

General description		Powder coated solid aluminium panel
Product reference		“Super Durable PPC Aluminium”
Name of manufacturer		AkzoNobel Powder Coatings
Thickness of composite		1mm (Stated by sponsor) 1.1mm (determined by Warringtonfire)
Density of composite		0.25g/cm^3 (determined by Warringtonfire)
Coating	Generic type	Polyester Powder Coating
	Product reference	“Interpon D2525”
	Name of manufacturer	AkzoNobel Powder Coatings
	Colour reference	“Bronze”
	Number of coats	One
	Thickness	60-90 microns
	Weight per unit area	0.065-0.100kg/m^2
	Density	1.3g/cm^3
	Application method	Automatic electrostatic spray
	Curing process per coat	20 minutes at 200°c
	Flame retardant details	See Note 1 below
Aluminium	Generic type	Aluminium solid panel
	Product reference	No specific product reference assigned
	Detailed description	1050 grade material
	Name of manufacturer	See Note 2 below
	Thickness	1mm
	Weight per unit area	2.7kg/m^2
	Flame retardant details	This component is inherently flame retardant
Mounting and fixing details		A 40mm ventilated cavity was situated between the reverse face of the specimens and the calcium silicate backing board
Brief description of manufacturing process		See Note 3 below

Note 1: The sponsor of the test has confirmed that no flame retardant additives were utilised in the production of the product / component.

Note 2: The sponsor was unable to provide this information.

Note 3: The sponsor was unwilling to provide this information.

3. Test reports & test results in support of classification.

3.1 Test reports.

Name of Laboratory	Name of sponsor	Test reports Nos.	Test method
Warringtonfire	AkzoNobel Powder Coatings	WF 418986-ISSUE 2	EN ISO 1716
Warringtonfire	AkzoNobel Powder Coatings	WF 418985	BS EN 13823

3.2 Test results

Test method & test number	Parameter	No. tests	Results	
			Continuous parameter - Max / Mean (m)	Compliance parameters
BS EN 13823	FIGRA $_{0.2MJ}$	3	0.00 W/s	Compliant
	FIGRA $_{0.4MJ}$		0.00 W/S	Compliant
	THR $_{600s}$		0.38 MJ	Compliant
	SMOGRA		0.00 m^2s^2	Compliant
	TSP_{600s}		34.96 m^2	Compliant
	Lateral Flame Spread to End of Specimen?		None	Compliant
	Fall of Flaming Drop/Particle?		None	Compliant
	Flaming of Fallen Particle Exceeding 10s?		None	Compliant
EN ISO 1716	Coating - PCS (b)	3	2.3051 MJ/m^2	Compliant
	Substrate – PCS (a)	Deemed to satisfy (0.00)		Compliant
	For the product as a whole – PCS (e)	3	0.8233 MJ/kg	Compliant

4. Classification and field of application

4.1 Reference of classification

This classification has been carried out in accordance with clause 8 of EN 13501-1:2018.

4.2 Classification

The product, to "Super durable PPC Aluminium", a Powder coated solid aluminium panel, in relation to its reaction to fire behaviour is classified:

A2

The additional classification in relation to smoke production is:

s1

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

d0

The format of the reaction to fire classification for construction applications, excluding flooring and linear pipe thermal insulation is:

Fire Behaviour		Smoke Production			Flaming Droplets	
A2	-	s	1	,	d	0

i.e. A2 – s1 , d0

Reaction to fire classification: A2 - s1, d0

4.3 Field of application

This classification is valid for the following end use applications:

i) Construction applications with the Aluminium applied over any substrate with a minimum density of 870kg/m^3, having a minimum thickness of 11mm and a fire performance of A2-s1,d0 or better

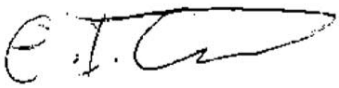
This classification is also valid for the following product parameters:

Aluminium thickness	1mm and above
Coating colour	No variation allowed
Product density	No variation allowed
Product composition	No variation allowed
Product construction	No variation allowed
Coating application rate	Tested value or below allowed
Air gap details	≥0mm allowed

5. Limitations

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

SIGNED



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Euan Gardner
Junior Certification Engineer
Technical Department

APPROVED

……

Matthew Dale
Senior Certification Engineer
Technical Department
On behalf of Warringtonfire

Issue 2: Clarification to field of application & product description at the request of sponsor. No technical changes. E Gardner. 16th November 2020.

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Test Report: ICL/H19/10684

BS 476 Part 6
Fire tests on building materials and structures
Part 6: Method of test for fire propagation for products

Sponsored By

SMU Powder Coatings
AkzoNobel Center
Christian Neefestraat 2
1077 WW Amsterdam
The Netherlands

Test Report: ICL/H19/10684

BS 476 Part 6
Fire tests on building materials and structures
Part 6: Method of test for fire propagation for products

Sponsored By

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1 Purpose of Test

To determine the fire propagation index of the sample specified in Section 2 when subjected to the fire propagation test specified in British Standard 476: Part 6 : 1989 + Amendment Al; 2009.

2 Description of Test Specimen

The description of the specimen given below has been prepared from information provided by the sponsor of the test and Interscience Communications Ltd was not involved in any selection or sampling procedure.

The product was a 1.2mm thick metal sheet coated with a grey paint referenced "Interpon Polyester"

The sponsor of the test did not provide further details relating to the composition of the coating and its rate of application.

3 Conditioning of Test Specimens

The specimens were received on 21st February 2019

The sample was conditioned to constant mass at a temperature of 23±2°C and a relative humidity of 50±10% and maintained in this condition until required for testing.

4 Date of Test

The test was performed on 6th March 2019.

5 Test Procedure

The test was carried out in accordance with BS 476: Part 6+A1:2009, and this report should be read in conjunction with this standard.
Note: This test was subcontracted to another UKAS accredited test laboratory.

6 Test Results

The test results relate only to the burning behaviour of the specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.

The test results relate only to the specimens of the product in the form in which they were tested. Small differences in the composition or thickness of the product may significantly affect the performance during the test and may therefore invalidate the test results.

Table 1 shows the Temperature rise for calibration sheet and specimens
Table 2 shows the Index of performance for each specimen

Temperature Rise -°C			
Calibration	**Specimens**		
Sheet	**a**	**b**	c
12	30	28	29
15	28	30	28
19	26	29	28
22	28	33	31
26	26	34	30
28	31	36	31
58	40	35	39
95	60	34	48
122	86	42	67
146	63	69	65
164	54	58	56
177	50	58	54
192	37	47	46
198	46	59	59
222	27	40	41
230	19	32	33
232	21	38	37
246	12	34	32

t - time in minutes from the time at which the gas jets were ignited.
a, b and c - represent individual specimens giving valid test results.

Table 2: Index of performance

Specimen	s_1	s_2	s_3
a	1.3	3.3	0.1
b	4.9	2.9	0.7
c	3.5	3.3	0.5

7 Observations

No intumescence or deformation of any specimen occurred that affected the required gas input. No melting or slumping occurred that prevented the material from being exposed to the heating conditions. Air flow through the apparatus was not restricted by fallen material or by soot accumulation in the chimney.

8 Conclusion

A sample as described in this report, when tested in accordance with BS 476: Part 6: 1989 Amendment Al ; 2009 , achieved:

Fire propagation index, I = 6.8

sub-indices i_1 = 3.2
i_2 = 3.2
i_3 = 0.4

Prepared by

C. B. Chong
Fire Scientist

Approved by

S. Kumar
Technical Manager

Date of Issue: 28th March 2019.

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Test Report: ICL/H19/10683

BS 476: Part 7 :1997 (2016)
Method for classification of the surface spread of flame of products

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Test Report: ICL/H19/1010683

BS 476: Part 7 :1997 (2016)
Method for classification of the surface spread of flame of products

Sponsored By
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1 Purpose of Test

To determine the surface spread of flame characteristic of a coated metal sheet.

2 Description of Test Specimen

The description of the specimen given below has been prepared from information provided by the sponsor of the test and Interscience Communications Ltd was not involved in any selection or sampling procedure.

The product was a 1.2mm thick metal sheet coated with a grey paint referenced "Interpon Polyester"

The sponsor of the test did not provide further details relating to the composition of the coating and its rate of application.

3 Conditioning of Test Specimens

The specimens were received on 21st February 2019

The sample was conditioned to constant mass at a temperature of 23±2°C and a relative humidity of 50±10% and maintained in this condition until required for testing.

4 Date of Test

The test was performed on 6th March 2019.

5 Test Procedure

The test was carried out in accordance with BS 476: Part 7: 1997 (2016).
The following were recorded:-
a) the time at which the flame front crosses each vertical reference line;
b) the maximum extent of flame spread during the first 1.5 min from the start of the test;
c) the maximum extent of flame spread during the whole test i.e. 10 min or less (if applicable);
d) the time (and distance) at which maximum flame spread is reached.

The flame spread at 1.5min and the final flame spread results were compared with the standard class limits and a classification was assigned.

Note: This test was subcontracted to another UKAS accredited test laboratory.

6 Test Results

The test results relate only to the burning behaviour of the specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.

The test results relate only to the specimens of the product in the form in which they were tested. Small differences in the composition or thickness of the product may significantly affect the performance during the test and may therefore invalidate the test results. The overall uncertainty budget for this test is ±20%

BS 476 Part 7 Surface spread of Flame test results:

Specimen No	Flame spread at 1.5mins (mm)	Maximum flame spread (mm)	Time to reach maximum flame spread (sec)
1	<50	<50	60
2	<50	<50	60
3	<50	<50	60
4	<50	<50	60
5	<50	<50	60
6	<50	<50	60

Specimen No	Time to reach each reference point (mm) in Minutes-sec							
	75	165	215	265	455	710	785	825
1	--	--	--	--	--	--	--	--
2	--	--	--	--	--	--	--	--
3	--	--	--	--	--	--	--	--
4	--	--	--	--	--	--	--	--
5	--	--	--	--	--	--	--	--
6	--	--	--	--	--	--	--	--

Observations

None

7 Requirements

The class limits for flame spread, detailed in BS 476: Part 7: are set out below:

Classification	Flame spread at 1.5mins (mm)	Final flame spread (mm)
1	165 (+25)	165 (+25)
2	215 (+25)	455 (+45)
3	265 (+25)	710 (+75)
4	Exceeding class 3 limits	Exceeding class 3 limits

Note: A definitive classification is based on a sample of six specimens and the figure in brackets gives the tolerance by which one specimen in six may exceed the class limit assigned.

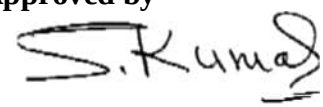
8 Conclusion

The test results show that the product meets the requirements of Class 1

Prepared by

C. B. Chong
Fire Scientist

Approved by



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Date of Issue: 28th March 2019.

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Test Report No: ICL/H19/10687

ISO 5658-2: 2006 / Amd 1:2011
Reaction-to-fire tests – Spread of flame –
Part 2: Lateral spread on building and transport products in vertical configuration

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Test Report No: ICL/H19/10687
ISO 5658-2: 2006 / Amd 1:2011
Reaction-to-fire tests – Spread of flame –
Part 2: Lateral spread on building and transport products in vertical configuration

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1. Purpose of Test

To determine the performance of a specimen of a sheet product when it is subjected to the conditions of test specified in ISO 5658-2: 2006/ Amd 1:2011Reaction-to-fire tests – Spread of flame – Part 2: Lateral spread on building and transport products in vertical configuration.

The results are used to determine compliance with the criteria given in EN 45545-2 Table 5 R 1.

2. Scope of Test

ISO 5658-2: 2006/ Amd 1:2011Reaction-to-fire tests – Spread of flame – Part 2: Lateral spread on building and transport products in vertical configuration, details a test procedure to determine the measurement of lateral spread of flame along the surface of a specimen of a product orientated in the vertical position. It provides data suitable for comparing the performance of essentially flat materials, composites or assemblies that are used primarily as the exposed surfaces of walls in buildings and transport vehicles, such as ships and trains.

3. Description of Test Specimen

The description of the product given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The product was a 1.2mm thick metal sheet coated with a grey coating referenced "Interpon Polyester"

The sponsor of the test has not supplied additional information relating to the paint system and method of application.

The specimens were received on 21st February 2019

4. Conditioning of Test Specimens

The test specimens were conditioned to constant mass at a temperature of 23 ± 2°C and a relative humidity of 50 ± 5%.

5. Date of Test

The test was performed on 8th March 2019.

6. Test Procedure

The test was performed in accordance with the procedure specified in ISO 5658-2: 2006/ Amd 1:2011 and this report should be read in conjunction with that Standard.

7. Conditions of test

One face was exposed to the heating conditions of the test, with an impinging propane pilot flame.

8. Test Results

The test results relate only to the behaviour of the specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.

The test results relate only to the specimens of the product in the form in which they were tested. Small differences in the composition or thickness of the product may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any product, which is supplied or used, is fully represented by the specimens, which were tested. Uncertainty measurement has not been taken into account when presenting the test results.

The average of the three specimens tested is given below:

Derived Fire Characteristics

Critical flux at extinguishment, CFE (kW/m^2):	40.31
Heat of sustained burning Q_{sb} (MJ/m^2):	1.52
Flaming droplets / flaming ash :	None

:

The data recorded in individual tests is given in pages 5.

9 Requirements

The following requirements are given in Table 5 of EN 45545-2 for R1

Test Method	Parameter	Requirements	HL1	HL2	HL3
T02 ISO 5658-2	*CFE* kWm-2	Minimum	20 a	20 a	20 a

a If flaming droplets/particles are reported according to 5.3.7 during the test ISO 5658-2, or for the special case of materials which do not ignite in ISO 5658-2 and are additionally reported as unclassifiable, the following requirements shall be added:
Test to the requirements of EN ISO 11925-2 with 30 s flame application.
The acceptance requirements are:
- flame spread < 150 mm within 60 s;
- no burning droplets/particles.

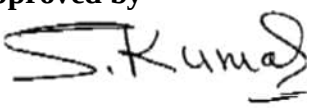
10. Conclusion

The average CFE value of three specimens tested was calculated to be 40.31kW/m^2 and therefore satisfies the CFE requirement given in EN 45545-2 Table 5 R 1for HL1, HL2 and HL 3.

Prepared by

C. B. Chong
Fire Scientist

Approved by



S. Kumar
Technical Manager

Date of Issue: 28th March 2019.

Individual rake data from each specimen run

Table 1

	Run 1	Run 2	Run 3	Average
Time (min, s) to	s	s	s	s
ignition:	43	29	30	34
station 50mm:	53	30	31	38
station 100mm:	63	35	34	44
station 150mm:	0	49	40	30
station 200mm:	0	57	45	34
station 250mm:	0	0	61	20
station 300mm:	0	0	93	31
station 350mm:	0	0	0	0
station 400mm:	0	0	0	0
station 450mm:	0	0	0	0
station 500mm:	0	0	0	0
station 550mm:	0	0	0	0
station 600mm:	0	0	0	0
station 650mm:	0	0	0	0
station 700mm:	0	0	0	0
station 750mm:	0	0	0	0
Flaming out time:	75	92	105	91
Flaming droplets:	0	0	0	0
Final travel (mm)	100	200	300	200
Length of the test (Sec)	675	692	705	691

Table 2

Parameter	Run 1	Run 2	Run 3	Average
Length of test (s)	675	692	705	691
Critical flux at extinguishment, CFE (kW/m^2)	48.50	41.92	30.51	40.31
Heat for sustained burning, Q_{sb} (MJ/m^2)	0.00	2.33	2.22	1.52

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Test Report: ICL/H18/10689

ISO 5659-2: 2012
Plastics - Smoke generation - Part 2:
Determination of optical density by a single-chamber test

Test at 50kW/m^2 without pilot flame

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Test Report: ICL/H19/10689

ISO 5659-2: 2012
Plastics - Smoke generation - Part 2:
Determination of optical density by a single-chamber test

Test at 50kW/m^2 without pilot flame.

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1 Introduction

EN 45545-2 calls up tests in accordance with the procedures specified in ISO 5659-2 at one heat flux specified in EN 45545-2. There is an additional requirement to calculate and report VOF_4 value.

The principle of the test method of ISO 5659-2 is to expose a material to specified thermal conditions of pyrolysis and combustion in a continuous procedure. The change in optical density of the smoke produced when dispersed within a fixed volume of air is recorded throughout the period of test. The resulting smoke density/time curve is used to calculate the smoke index.

The test method provides a means for the comparative assessment of products, however, it does not model a real fire situation and the results cannot therefore be used to describe the fire hazard of materials under actual fire conditions.

2 Description of Test Specimens

The description of the specimens given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The product was a 1.2mm thick metal sheet coated with a grey coating referenced "Interpon Polyester"

The sponsor of the test has not supplied additional information relating to the paint system and method of application.

3 Conditioning of Specimens

The specimens were received on 21st February 2019

The specimens were conditioned to the requirements of ISO 5659-2: 2012, i.e. conditioned to constant mass at 23 ± 3°C and 50 ± 5% RH, before testing.

4 Date of Test

The tests were performed on 14th March 2019.

5 Test Procedure

The test was performed in the non- flaming mode at 50kW/m^2 in accordance with the procedure specified in ISO 5659-2:2012 and this report should be read in conjunction with that Standard.

Specimens were tested at 50kW/m^2 without pilot flame only.

6 Test Results

The test results relate only to the behaviour of the specimens of the product under the particular conditions of test; they are not intended to the sole criterion for assessing the potential smoke hazard of the product in use.

The test results relate only to the specimens of the product in the form in which they were tested. Small differences in the composition or thickness of the product may significantly affect the performance during the test and will therefore invalidate the test results. It is the responsibility of the supplier of the product to ensure that the product, which is supplied, is identical with the specimens, which were tested. Uncertainty measurement has not been taken into account when presenting the test results.

The results of tests carried out can be summarised as follows:-

50kW/m^2 in Non-Flaming Mode				
Parameter	**Test 1**	**Test 2**	**Test 3**	Average
Ds at 1.5 mins	8.22	9.12	10.72	9.36
Ds at 4 mins	**87.08**	**105.50**	**63.32**	**85.30**
Ds Max (in 10mins)	109.24	129.01	65.12	101.12
Ds Max	109.30	129.01	0.00	79.44
Clear beam	64.38	65.42	0.00	43.27
Dsc	25.25	24.33	0.00	16.52
D Max Corrected	84.06	104.69	0.00	62.91
Time to max (Sec)	539.00	544.00	0.00	361.00
VOF4	**144.67**	**154.14**	**122.34**	**140.38**

Ds V time chart is given in Appendix 1.

7 Requirements

The following requirements are given in Table 5 of EN 45545-2 for R1

Test Method	Parameter	Requirements	HL1	HL2	HL3
T10.01 EN ISO 5659-2: 50kWm^{-2}	$D_{s(4)}$ dimensionless	Maximum	600	300	150
T10.02 EN ISO 5659-2: 50kWm^{-2}	VOF_4 min	Maximum	1200	600	300

8 Conclusion

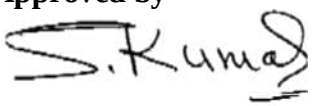
When tested in accordance with the procedure specified in ISO 5659-2 at 50kW/m^2 in the non-flaming mode the material shows a Ds (4) max Value of 85.3 and VOF_4 value of 140.38

The material tested therefore satisfies the smoke emission requirements given iin EN 45545-2 Table 5 R 1for HL1, HL2 and HL3.

Prepared by

C. B. Chong
Fire Scientist

Approved by



S. Kumar
Technical Manager

Date: 28th March 2019.

Appendix 1

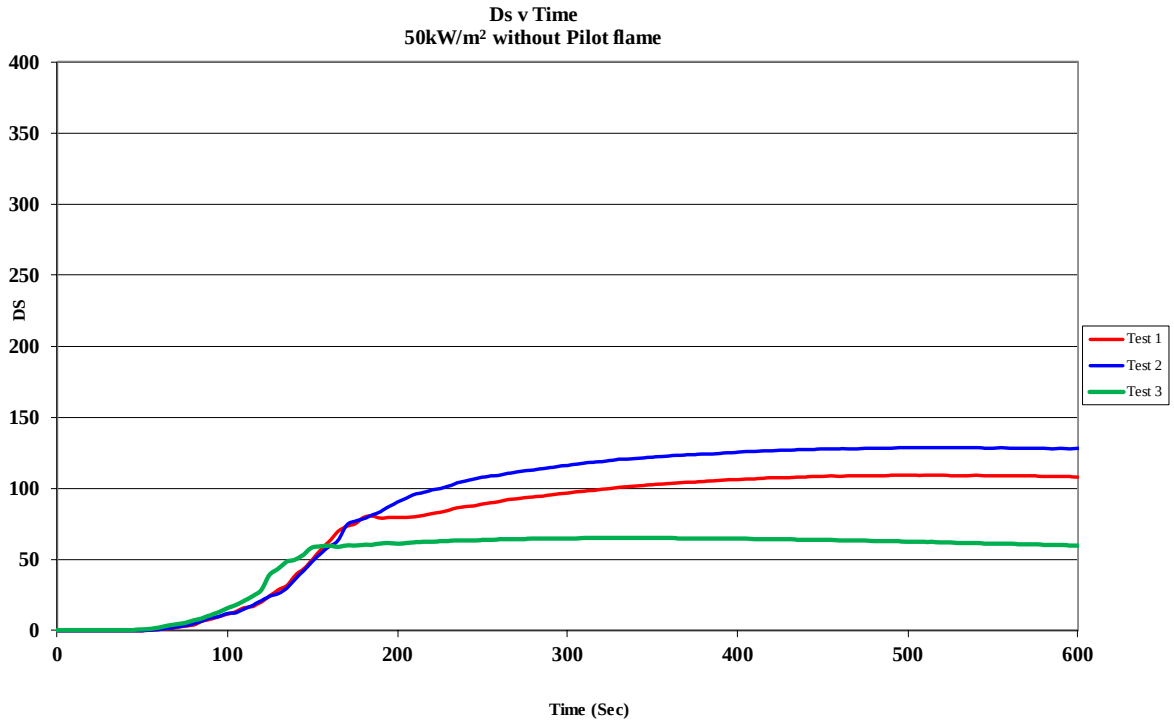


Fig 1: Ds v Time chart

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Test Report: ICL/H19/10690

EN 45545-2
Railway applications— Fire protection on railway vehicles
Part 2: Requirements for fire behaviour of materials and components
Annex C Testing methods for determination of toxic gases from railway products.
Clause C.2 Method 1.

Sponsored By
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Test Report: ICL/H19/10690

EN 45545-2
Railway applications— Fire protection on railway vehicles
Part 2: Requirements for fire behaviour of materials and components
Annex C Testing methods for determination of toxic gases from railway products.
Clause C.2 Method 1.

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1 Introduction

Tests were undertaken at the request of the sponsor on a specimen of a coated panel The test was conducted in accordance with the procedures specified in EN 45545-2 Annex C "Test method for the determination of toxic gases from railway products" Clause 2 Test Method 1.

EN 45545-2 Annex C details a test procedure, the results being expressed as CIT value, for the measurement of toxic fumes generated under the conditions of test carried out in apparatus detailed in ISO 5659-2. The test on seating composite is carried out at 50kW/$m^{2.}$ without pilot flame.

The principle of the test method ISO 5659-2 is to expose a material to specified thermal conditions of pyrolysis and combustion in a continuous procedure. The change in optical density of the smoke produced when dispersed within a fixed volume of air is recorded throughout the period of test. The resulting smoke density/time curve is used to calculate the smoke index.

Fire gas samples are taken at 4 and 8 minutes into the test and quantitative analysis carried out using FTIR.

The test method provides a means for the comparative assessment of products, however, it does not model a real fire situation and the results cannot therefore be used to describe the fire hazard of materials under actual fire conditions.

2 Description Of Test Specimens

The description of the specimens given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The product was a 1.2mm thick metal sheet coated with a grey coating referenced "Interpon Polyester"

The sponsor of the test has not supplied additional information relating to the paint system and method of application.

3 Conditioning Of Specimens

The specimens were received on 21st February 2019

The specimens were conditioned to constant mass in accordance with the requirements of ISO 5659-2 at 23 ± 2°C and 50 ± 5% RH, before testing.

4 Date Of Test

The tests were performed on 14th March 2019.

5 Test Procedure

The tests were carried out in accordance with the procedures specified in EN 45545 -2 Annex C Clause C.2 and this report should be read in conjunction with this standard.

One face was exposed to the heating conditions of the test.

The specimens were tested at 50kW/m^2 without pilot flame.

6 Test Results

The test results relate only to the behaviour of the specimens of the product under the particular conditions of test; they are not intended to the sole criterion for assessing the potential toxicity hazard of the product in use.

The test results relate only to the specimens of the product in the form in which they were tested. Small differences in the composition or thickness of the product may significantly affect the performance during the test and will therefore invalidate the test results. It is the responsibility of the supplier of the product to ensure that the product, which is supplied, is identical with the specimens, which were tested. Uncertainty measurement has not been taken into account when presenting the test results.

The results of tests carried can be summarised as follows:-

Table 1: Toxic gas emission data at 4 minutes.

	Concentration (ppm) 4 mins			
Gas species	**Run 1**	**Run 2**	**Run 3**	**Average**
Carbon dioxide, CO2	5617	5525	5625	5589
Carbon monoxide, CO	74	82	75	77
Oxides of Nitrogen, NOx	ND	ND	ND	-
Sulphur dioxide, SO2	ND	ND	ND	-
Hydrogen Chloride, HCl	ND	ND	ND	-
Hydrogen Bromide, HBr	ND	ND	ND	-
Hydrogen Fluoride, HF	ND	ND	ND	-
Hydrogen Cyanide, HCN	ND	ND	ND	-

Table 2: Toxic gas emission data at 8 minutes.

	Concentration (ppm) 8 mins			
Gas species	**Run 1**	**Run 2**	**Run 3**	**Average**
Carbon dioxide, CO2	5990	5750	5875	5872
Carbon monoxide, CO	72	85	79	79
Oxides of Nitrogen, NOx	ND	ND	ND	-
Sulphur dioxide, SO2	ND	ND	ND	-
Hydrogen Chloride, HCl	ND	ND	ND	-
Hydrogen Bromide, HBr	ND	ND	ND	-
Hydrogen Fluoride, HF	ND	ND	ND	-
Hydrogen Cyanide, HCN	ND	ND	ND	-

Table 3: CIT_G calculations for 4 minutes

Gas species	**ci (mg/m3)**	**Ci (mg/m3)**	**CITG**
Carbon dioxide, CO2	9042.89	72000	0.010
Carbon monoxide, CO	75.83	1380	0.004
Oxides of Nitrogen, NOx	ND	38	0
Sulphur dioxide, SO2	ND	262	0
Hydrogen Chloride, HCl	ND	75	0
Hydrogen Bromide, HBr	ND	99	0
Hydrogen Fluoride, HF	ND	25	0
Hydrogen Cyanide, HCN	ND	55	0
		CIT_G	0.015

Table 4: CIT_G calculations for 8 minutes

Gas species	**ci (mg/m3)**	**Ci (mg/m3)**	**CITG**
Carbon dioxide, CO2	9453.44	72000	0.011
Carbon monoxide, CO	80.61	1380	0.005
Oxides of Nitrogen, NOx	ND	38	0
Sulphur dioxide, SO2	ND	262	0
Hydrogen Chloride, HCl	ND	75	0
Hydrogen Bromide, HBr	ND	99	0
Hydrogen Fluoride, HF	ND	25	0
Hydrogen Cyanide, HCN	ND	55	0
		CIT_G	0.015

7 Requirements

The following requirements are given in Table 5 of EN 45545-2 for R1

Test method reference	Parameter	Requirements for R1 Values are maximum allowed		
		HL1	Hl2	HL3
T11.01 EN ISO 5659-2: 50 kWm-2	*CIT*G dimensionless	1.2	0.9	0.75

8 Conclusion

When tested in accordance with the procedure called un EN 45545-2 Annex C Clause C.2 the sheet product tested satisfies the toxicity requirements given in EN 45545-2 Table 5 R 1for hazard level HL1, HL2 and HL3.

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Approved by

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Date of Issue: 28th March 2019.

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Test Report No: ICL/H19/10686

BS 6853: 1999 Annex B, Clause B.2
Code Of Practice For Fire Precautions
In The Design And Construction Of Passenger Carrying Trains.
Determination of weighted summation of toxic fume, R
B.2 Area based test method.

Sponsored by:

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TEST REPORT NO: ICL/H19/10686
BS 6853: 1999 Annex B, Clause B.2
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In The Design And Construction Of Passenger Carrying Trains.
Determination of weighted summation of toxic fume, R
B.2 Area based test method.
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1. Introduction

Tests were undertaken on a specimen of a seat composite bonded to one face. The test was conducted in accordance with the procedures called up in Annex B.2 of BS 6853: 1999 "Code of practice for fire precautions in the design and construction of passenger carrying trains - Determination of weighted summation of toxic fume, R and this report should be read in conjunction with this test standard.

BS 6853: 1999 Annex B.2 details a test procedure, the results being expressed as R value, for the measurement of toxic fumes generated under the conditions of test carried out in apparatus detailed in BS ISO 5659-2. The test is carried out at 25kW/ m^2 with pilot flame.

A single smoke emission only test was carried out and the time at which 85 % of the peak smoke emission is reached, (or the value at 20 min if no maximum is reached), was determined.

Toxic fume emission testing was then carried out in triplicate. The sampling of evolved gases was undertaken at time at which 85% of Ds max of first specimen was recorded.

The results are used to determine compliance with the criteria given in BS 6853: 1999 Table 1,2,3,4,5,6,9, 10, and 12.

2. Product Description

The description of the specimen given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The product was a 1.2mm thick metal sheet coated with a grey paint referenced “Interpon Polyester"

The sponsor of the test did not provide further details relating to the composition of the coating and its rate of application.

3. Conditioning of Test Specimens

The specimens were received 21st February 2019

The specimens were conditioned at 23 ± 2ºC and a relative humidity of 50 ± 5% in accordance with the requirements given in BS ISO 5659-2.

4. Date of Test

The test was performed on 13th March 2019.

5. Test Procedure

The test was performed in accordance with the procedures called up in BS 6853: 1999 Annex B, Clause B.2. and this report should be read in conjunction with this standard. The coated was exposed to the heating conditions of the test.

6. Test Results

The test results relate only to the behaviour of the specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential toxic gas emission hazard of the product in use.

Table 1: Test results amount detected

Gas	Amount detected (ppm)		
	Run 2	Run 3	Run 4
Carbon dioxide, CO_2	5000	6000	5000
Carbon Monoxide, CO	60	50	60
Hydrogen Fluoride, HF	ND	ND	ND
Hydrogen Chloride, HCl	ND	ND	ND
Hydrogen Bromide, HBr	ND	ND	ND
Hydrogen Cyanide, HCN	ND	ND	ND
Nitrous Fumes, NOx	ND	2	2
Sulphur Dioxide, SO_2	ND	ND	ND

where ND = not detected

Calculation of index:

Individual index ,r = C_x / f_x

Where: C_x is the emission in gm^{-2}

f_x is the reference value in gm^{-2}

r_x is the individual r index

R value,r = $\sum r$

Table 2: BS 6853:1999 reference values

Gas	Reference value, f(gm^{-2})
Carbon Dioxide, CO_2	14000
Carbon Monoxide, CO	280
Hydrogen Fluoride, HF	4.9
Hydrogen Chloride, HCl	15
Hydrogen Bromide, HBr	20
Hydrogen Cyanide, HCN	11
Nitrous Fumes, NO_x	7.6
Sulphur Dioxide	53

Table 3: R value calculation

Gas	**Run 2**		**Run 3**		**Run 4**	
	C_x	**r**	**C_x**	**r**	**C_x**	**r**
Carbon dioxide, CO_2	789.764	0.056	947.717	0.068	789.764	0.056
Carbon Monoxide, CO	6.032	0.022	5.026	0.018	6.032	0.022
Hydrogen Fluoride, HF	0.000	0.000	0.000	0.000	0.000	0.000
Hydrogen Chloride, HCl	0.000	0.000	0.000	0.000	0.000	0.000
Hydrogen Bromide, HBr	0.000	0.000	0.000	0.000	0.000	0.000
Hydrogen Cyanide, HCN	0.000	0.000	0.000	0.000	0.000	0.000
Nitrous Fumes, NOx	0.000	0.000	0.330	0.043	0.330	0.043
Sulphur Dioxide, SO_2	0.000	0.000	0.000	0.000	0.000	0.000
R value		0.078		0.129		0.121

where ND = not detected

Average R value : 0.109

7. Conclusion

The sample described in this report, when tested in accordance with BS 6853: 1999 Annex B.2, achieved an R value of 0.109

Prepared by

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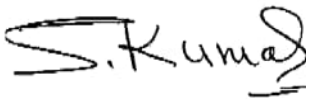
Fire Scientist

Authorised by



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Date of Issue: 28th November 2019.

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Test Report No: ICL/H19/10685

Code of practice for fire precautions in the design and construction of passenger carrying trains BS 6853: 1999 Annex D, Clause D.8.4 Methods For Measuring Smoke Density

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Test Report No: ICL/H19/10685

Code of practice for fire precautions in the design and construction of passenger carrying trains
BS 6853: 1999 Annex D, Clause D.8.4
Methods For Measuring Smoke Density

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1. Purpose of Test

To determine the performance of a specimen of a panel when it is subjected to the conditions of test specified in BS 6853: 1999 "Code of practice for fire precautions in the design and construction of passenger carrying trains" Annex D.8.4" 60^0 Panel test".

2. Scope of Test

BS 6853: 1989 Annex D.8.4 specifies a test procedure, the results being expressed as Ao(on) and Ao(off) values, for the measurement of the density of smoke emitted from a product burning under the defined conditions of test. The results are used to determine compliance with the criteria given in BS 6853: 1999 Table 2,3,5 and 6.

3. Description of Test Specimen

The description of the product given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The product was a 1.2mm thick metal sheet coated with a grey paint referenced "Interpon Polyester"

The sponsor of the test did not provide further details relating to the composition of the coating and its rate of application.

The specimens were received on 21st February 2019

4. Conditioning of Test Specimens

The test specimens were conditioned by maintaining them in indoor ambient conditions for 72 hours and then for a minimum of 16 hours at 23 ± 2°C and a relative humidity of 50 ± 5%.

5. Date of Test

The test was performed on 14th March 2019.

6. Test Procedure

The test was performed in accordance with the procedure specified in BS 6853: 1999 Appendix D, Clause D.8.4 and this report should be read in conjunction with that Standard.

7. Exposed Face

The coated face was exposed to the flame.

8. Test Results

The test results relate only to the behaviour of the specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential smoke hazard of the product in use.

The test results relate only to the specimens of the product in the form in which they were tested. Small differences in the composition or thickness of the product may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any product, which is supplied or used, is fully represented by the specimens, which were tested.

Parameter	Run1	Run 2	Average
Ao(on max)	1.581	1.420	1.501
Ao(on end)	1.495	1.300	1.398
Ao(off)	1.811	1.640	1.726
Ao(off) Corrected	1.897	1.760	1.829

The value of Ao decreased from a maximum value during the ON phase. Ao(off) is corrected by adding the difference between Ao(on max) and Ao(on end) to Ao(off). Thus: Ao(off) = Ao(off end) + Ao(on max) - Ao(on end).

The changes in transmission with time were continuously recorded and Ao v Time graphs are presented in Figures 1 and 2.

9. Requirements

The smoke emission requirements for Interior Vertical services given in table 2 of BS 6853:1999 are as follows:

Parameter	Vehicle category		
	Ia	Ib	II
Ao(on) max	2.6	4.2	9.4
Ao(off) max	3.9	6.3	14.0

10. Conclusion

The panels tested in accordance with BS 6853 Annex D8.4 has achieved Ao(on max) value of 1.50 and Ao(off) Value of 1.73 and therefore satisfies the requirements of Vehicle Category Ib and II.

Prepared by

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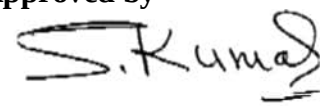
Approved by



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Date of Issue: 28th March 2019.

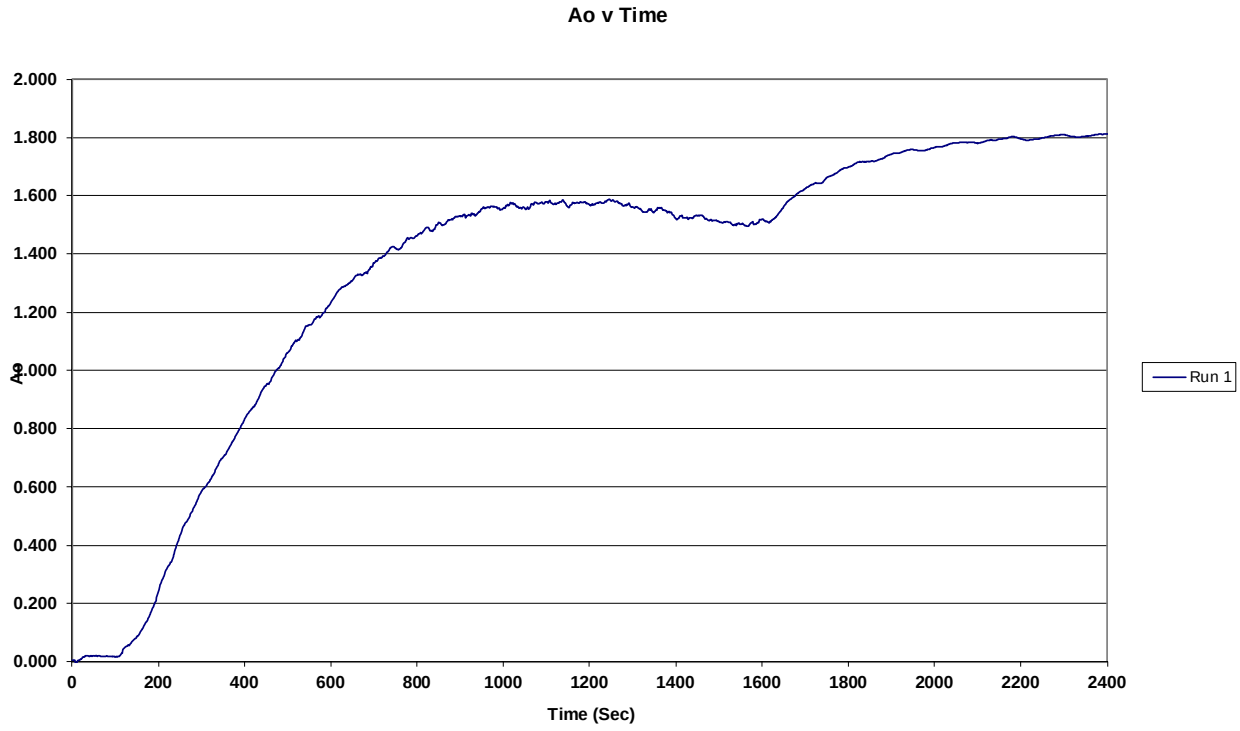

Figure 1 Variation of Absorbance (Ao) with time (Test No 1)

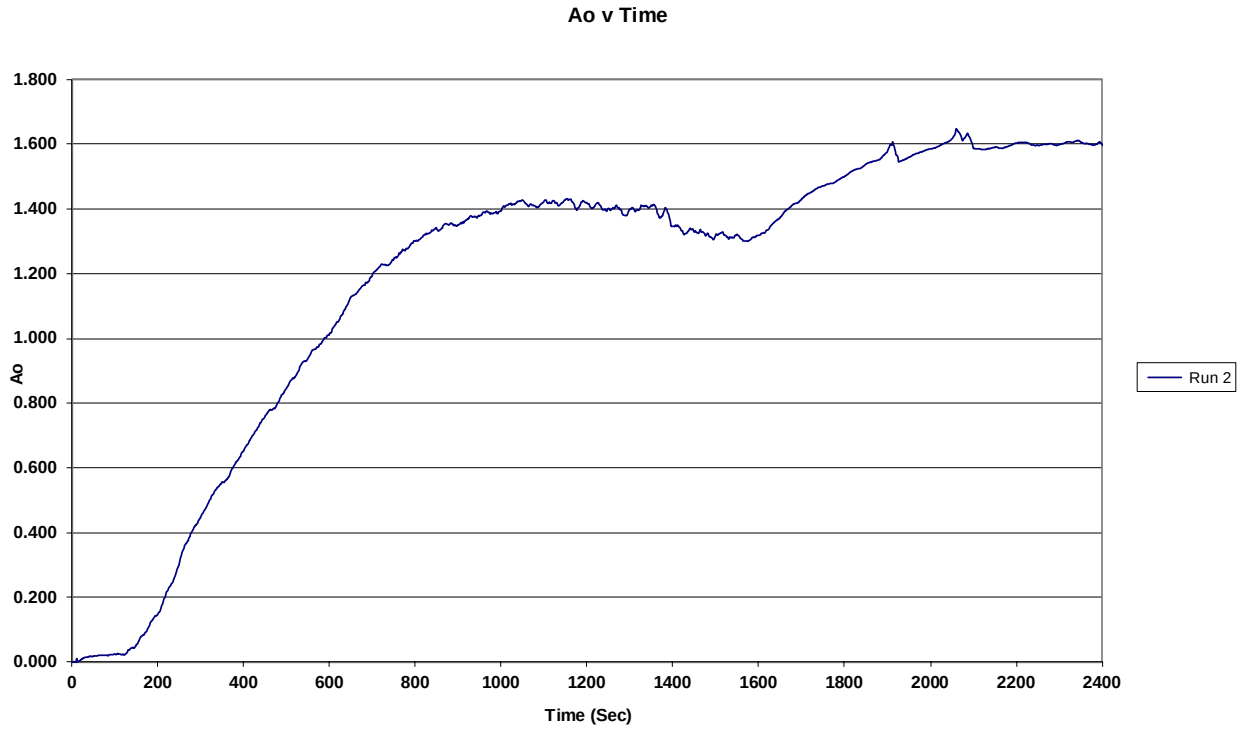

Figure 2 Variation of Absorbance (Ao) with time (Test No: 2)

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Test Report No: ICL/H19/10688

ISO 5660-1: 2015
Reaction-to-fire tests- Heat release, smoke production and mass loss rate- Part 1: Heat release rate (Cone calorimeter method)

Sponsored By

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Test Report No: ICL/H19/10688

ISO 5660-1: 2015
Reaction-to-fire tests- Heat release, smoke production and mass loss rate-
Part 1: Heat release rate (Cone calorimeter method)

Sponsored By
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1. Purpose of Test

To determine the performance of a specimen of a seat composite when it is subjected to the conditions of test specified in ISO 5660-1: 2015 Reaction-to-fire tests- Heat release, smoke production and mass loss rate - Part 1: Heat release rate (Cone calorimeter method).

The results are used to determine compliance with the criteria given in EN 45545-2 Table 5 R 1.

2. Scope of Test

ISO 5660-1: 2015 Reaction-to-fire tests- Heat release, smoke production and mass loss rate- Part 1: Heat release rate (Cone calorimeter method) details a test procedure to determine the rate of heat release, smoke production and mass loss. The heat release values are expressed on area bases and smoke and mass loss values are expressed on mass bases. ARHE values are calculated from the data and MARHE value is reported.

3. Description of Test Specimen

The description of the product given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The product was a 1.2mm thick metal sheet coated with a grey coating referenced "Interpon Polyester"

The sponsor of the test has not supplied additional information relating to the paint system and method of application.

The specimens were received on 21st February 2019

4. Conditioning of Test Specimens

The sample was conditioned to constant mass at a temperature of 23±2°C and a relative humidity of 50±10% in accordance with ISO 554.

5. Date of Test

The test was performed on 26th February 2019.

6. Test Procedure

The test was performed in accordance with the procedure specified in ISO 5660-1 and this report should be read in conjunction with that Standard.

7. Exposed Face

One face was exposed to the heating conditions **(50kW/m^2)** of the test.

8. Test Results

The test results relate only to the behaviour of the specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.

The test results relate only to the specimens of the product in the form in which they were tested. Small differences in the composition or thickness of the product may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any product, which is supplied or used, is fully represented by the specimens, which were tested. Uncertainty measurement has not been taken into account when presenting the test results.

The average of the three specimens tested is given below:

Parameter	**Test 1**	**Test 2**	**Test 3**	**Average**
Specimen thickness (mm)	1.2	1.2	1.2	1.2
Specimen Initial mass (g)	28.13	27.89	28.07	28.0
Time to ignition (s)	49	49	48	48.7
Total heat release (MJ/m²)	3.8	4.6	4.4	4.2
Mass loss between Ign & Ext (g)	1.9	1.9	2.0	1.9
TSR (m²/m²)	104.37	170.51	267.15	180.7
pK HRR (kW/m^2)	132.59	141.27	141.27	138.4
pk Effective heat of combustion (MJ/kg)	75.76	75.61	64.42	71.9
pK Specific ext area (m^2/kg)	4689.01	4538.20	4736.26	4654.5
Average values HRR				
HRR (kW/m^2) over Ign 60 sec from ign	56.68	57.20	66.40	60.1
HRR (kW/m^2) over Ign 120 sec from ign	30.30	30.41	36.44	32.4
HRR (kW/m^2) over Ign 180 sec from ign	19.16	20.49	24.31	21.3
HRR (kW/m^2) over Ign 240 sec from ign	13.38	15.41	18.23	15.7
HRR (kW/m^2) over Ign 300 sec from ign	9.60	12.35	14.58	12.2
HRR (kW/m^2) over Ign 360 sec from ign	7.12	10.45	12.15	9.9

Parameter	Test 1	Test 2	Test 3	Average
Average values EHC (MJ/kg)				
EHC (MJ/kg) over Ign 60 sec from ign	20.31	19.37	19.47	19.7
EHC (MJ/kg) over Ign 120 sec from ign	18.89	20.84	21.48	20.4
EHC (MJ/kg) over Ign 180 sec from ign	17.86	19.33	20.34	19.2
EHC (MJ/kg) over Ign 240 sec from ign	17.09	19.64	20.24	19.0
EHC (MJ/kg) over Ign 300 sec from ign	14.13	19.47	19.65	17.8
EHC (MJ/kg) over Ign 360 sec from ign	12.83	18.79	20.13	17.3
MARHE (kW/m^2)	32.45	33.59	38.34	34.8
Average values Specific ext area (m^2/kg)				
SEA (m^2/kg) over Ign 60 sec from ign	588.74	636.84	636.84	620.8
SEA (m^2/kg) over Ign 120 sec from ign	493.91	676.24	676.24	615.5
SEA (m^2/kg) over Ign 180 sec from ign	439.42	672.46	672.46	594.8
SEA (m^2/kg) over Ign 240 sec from ign	379.76	707.34	707.34	598.1
SEA (m^2/kg) over Ign 300 sec from ign	275.03	720.28	720.28	571.9
SEA (m^2/kg) over Ign 360 sec from ign	207.84	761.88	761.88	577.2

HRR and ARHE charts and given in Appendix 1.

9 Requirements

The following requirements are given in Table 5 of EN 45545-2 for R1

Test Method	Parameter	Requirements	HL1	HL2	HL3
T03.01 ISO 5660-1: 50 kWm-2	*MARHE* kWm-2	Maximum	a -	90	60

a If flaming droplets/particles are reported according to 5.3.7 during the test ISO 5658-2, or for the special case of materials which do not ignite in ISO 5658-2 and are additionally reported as unclassifiable, the following requirements shall be added:
Test to the requirements of EN ISO 11925-2 with 30 s flame application.
The acceptance requirements are:

- flame spread < 150 mm within 60 s;
- no burning droplets/particles.

10. Conclusion

The average MARHE value of three specimens tested with tie wires was calculated to be $34.8kW/m^2$ and therefore satisfies the MARHE requirements given in EN 45545-2 Table 5 R1 for HL2 and HL 3.

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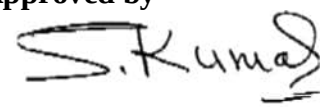

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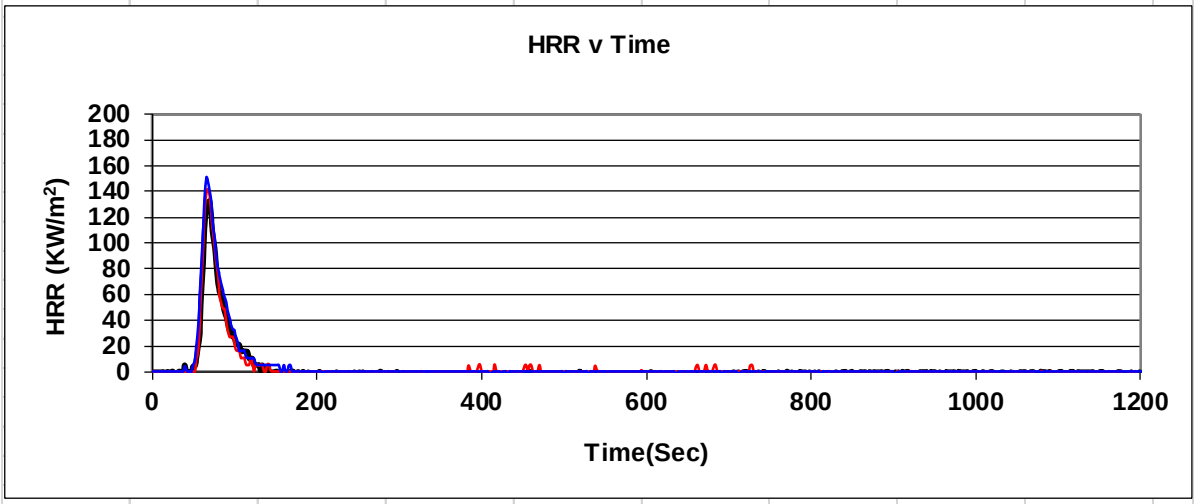
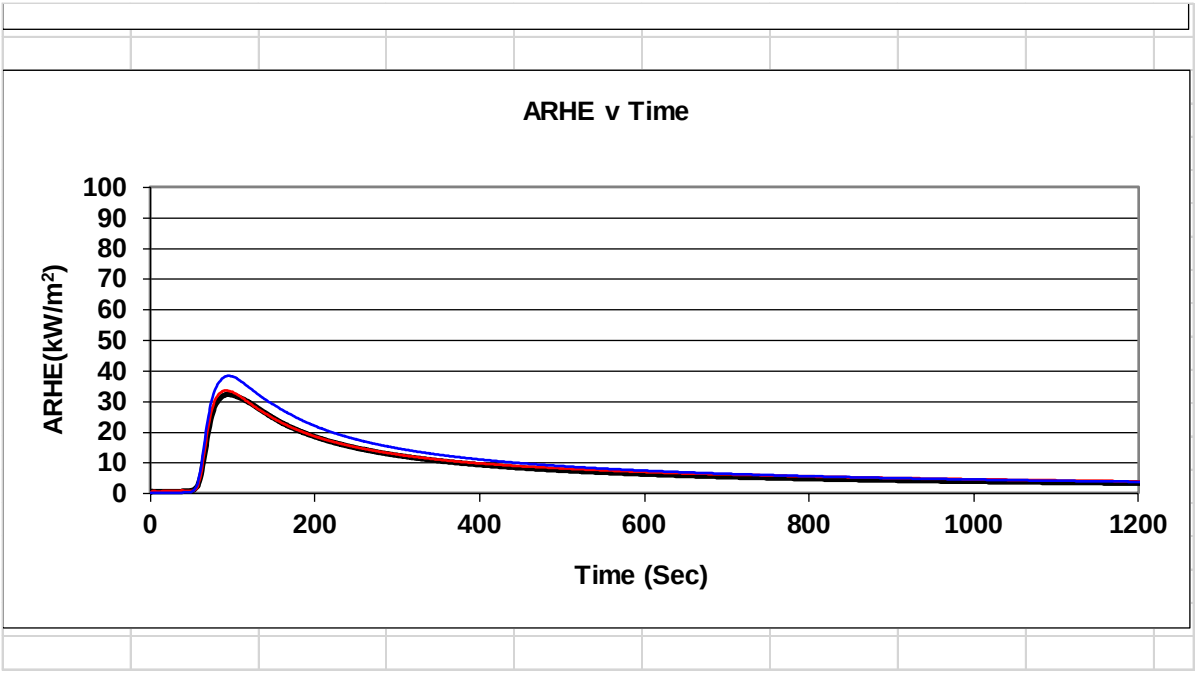
Date of Issue: 28th March 2019.

Appendix 1

Black	Run 1		Red	Run 2		Blue	Run 3





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Test Report: ICL/H19/10676

BS 476 Part 6
Fire tests on building materials and structures
Part 6: Method of test for fire propagation for products

Sponsored By

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AkzoNobel Center
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1077 WW Amsterdam
The Netherlands

Test Report: ICL/H19/10676

BS 476 Part 6
Fire tests on building materials and structures
Part 6: Method of test for fire propagation for products

Sponsored By

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1 Purpose of Test

To determine the fire propagation index of the sample specified in Section 2 when subjected to the fire propagation test specified in British Standard 476: Part 6 : 1989 + Amendment Al; 2009.

2 Description of Test Specimen

The description of the specimen given below has been prepared from information provided by the sponsor of the test and Interscience Communications Ltd was not involved in any selection or sampling procedure.

The test specimens consisted of 1.2mm thick metal sheet coated with a black coating referenced "Interpon Easy Clean (EC)

The sponsor of the test not has supplied additional information relating to the coating its rate and method of application.

3 Conditioning of Test Specimens

The specimens were received on 21st February 2019

The sample was conditioned to constant mass at a temperature of 23±2°C and a relative humidity of 50±10% and maintained in this condition until required for testing.

4 Date of Test

The test was performed on 6th March 2019.

5 Test Procedure

The test was carried out in accordance with BS 476: Part 6+A1:2009, and this report should be read in conjunction with this standard.
Note: This test was subcontracted to another UKAS accredited test laboratory.

6 Test Results

The test results relate only to the burning behaviour of the specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.

The test results relate only to the specimens of the product in the form in which they were tested. Small differences in the composition or thickness of the product may significantly affect the performance during the test and may therefore invalidate the test results.

Table 1 shows the Temperature rise for calibration sheet and specimens
Table 2 shows the Index of performance for each specimen

Temperature Rise -^{o}C			
Calibration	**Specimens**		
Sheet	**a**	**b**	c
19	28	29	21
20	25	28	23
22	25	27	24
24	25	26	26
27	24	25	25
31	24	25	27
60	26	28	23
97	52	54	64
118	44	45	50
143	34	36	42
159	33	37	38
174	28	31	32
197	15	16	22
200	37	37	35
216	27	27	30
226	17	17	20
232	17	18	23
241	15	17	15

t - time in minutes from the time at which the gas jets were ignited.
a, b and c - represent individual specimens giving valid test results.

Table 2: Index of performance

Specimen	s_1	s_2	s_3
a	0.5	1.1	0.0
b	1.3	1.4	0.0
c	0.0	1.6	0.0

7 Observations

No intumescence or deformation of any specimen occurred that affected the required gas input. No melting or slumping occurred that prevented the material from being exposed to the heating conditions. Air flow through the apparatus was not restricted by fallen material or by soot accumulation in the chimney.

8 Conclusion

A sample as described in this report, when tested in accordance with BS 476: Part 6: 1989 Amendment Al ; 2009 , achieved:

Fire propagation index, I = 2.0

sub-indices i_1 = 0.6
i_2 = 1.4
i_3 = 0.0

Prepared by

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Approved by

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Date of Issue: 28th March 2019.

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Test Report: ICL/H19/10675

BS 476: Part 7 :1997 (2016)
Method for classification of the surface spread of flame of products

Sponsored By

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Test Report: ICL/H19/1010675

BS 476: Part 7 :1997 (2016)
Method for classification of the surface spread of flame of products

Sponsored By
SMU Powder Coatings
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1 Purpose of Test

To determine the surface spread of flame characteristic of a coated metal sheet.

2 Description of Test Specimen

The description of the specimen given below has been prepared from information provided by the sponsor of the test and Interscience Communications Ltd was not involved in any selection or sampling procedure.

The test specimens consisted of 1.2mm thick metal sheet coated with a black coating referenced "Interpon Easy Clean (EC)

The sponsor of the test did not provide further details relating to the composition of the coating and its rate of application.

3 Conditioning of Test Specimens

The specimens were received on 21st February 2019

The sample was conditioned to constant mass at a temperature of 23±2°C and a relative humidity of 50±10% and maintained in this condition until required for testing.

4 Date of Test

The test was performed on 6th March 2019.

5 Test Procedure

The test was carried out in accordance with BS 476: Part 7: 1997 (2016).
The following were recorded:-
a) the time at which the flame front crosses each vertical reference line;
b) the maximum extent of flame spread during the first 1.5 min from the start of the test;
c) the maximum extent of flame spread during the whole test i.e. 10 min or less (if applicable);
d) the time (and distance) at which maximum flame spread is reached.

The flame spread at 1.5min and the final flame spread results were compared with the standard class limits and a classification was assigned.

Note: This test was subcontracted to another UKAS accredited test laboratory.

6 Test Results

The test results relate only to the burning behaviour of the specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.

The test results relate only to the specimens of the product in the form in which they were tested. Small differences in the composition or thickness of the product may significantly affect the performance during the test and may therefore invalidate the test results. The overall uncertainty budget for this test is ±20%

BS 476 Part 7 Surface spread of Flame test results:

Specimen No	Flame spread at 1.5mins (mm)	Maximum flame spread (mm)	Time to reach maximum flame spread (sec)
1	170	200	146
2	<50	<50	<50
3	165	170	135
4	170	172	120
5	<50	<50	<50
6	<50	<50	<50

Specimen No	Time to reach each reference point (mm) in Minutes-sec							
	75	165	215	265	455	710	785	825
1	68	88	--	--	--	--	--	--
2	--	--	--	--	--	--	--	--
3	68	84	--	--	--	--	--	--
4	62	87	--	--	--	--	--	--
5	--	--	--	--	--	--	--	--
6	--	--	--	--	--	--	--	--

Observations

None

7 Requirements

The class limits for flame spread, detailed in BS 476: Part 7: are set out below:

Classification	Flame spread at 1.5mins (mm)	Final flame spread (mm)
1	165 (+25)	165 (+25)
2	215 (+25)	455 (+45)
3	265 (+25)	710 (+75)
4	Exceeding class 3 limits	Exceeding class 3 limits

Note: A definitive classification is based on a sample of six specimens and the figure in brackets gives the tolerance by which one specimen in six may exceed the class limit assigned.

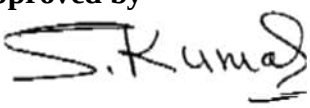
8 Conclusion

The test results show that the product meets the requirements of Class 2

Prepared by

C. B. Chong
Fire Scientist

Approved by



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Date of Issue: 28th March 2019.

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Test Report No: ICL/H19/10679

ISO 5658-2: 2006 / Amd 1:2011
Reaction-to-fire tests – Spread of flame –
Part 2: Lateral spread on building and transport products in vertical configuration

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Test Report No: ICL/H19/10679
ISO 5658-2: 2006 / Amd 1:2011
Reaction-to-fire tests – Spread of flame –
Part 2: Lateral spread on building and transport products in vertical configuration

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1. Purpose of Test

To determine the performance of a specimen of a sheet product when it is subjected to the conditions of test specified in ISO 5658-2: 2006/ Amd 1:2011Reaction-to-fire tests – Spread of flame – Part 2: Lateral spread on building and transport products in vertical configuration.

The results are used to determine compliance with the criteria given in EN 45545-2 Table 5 R 1.

2. Scope of Test

ISO 5658-2: 2006/ Amd 1:2011Reaction-to-fire tests – Spread of flame – Part 2: Lateral spread on building and transport products in vertical configuration, details a test procedure to determine the measurement of lateral spread of flame along the surface of a specimen of a product orientated in the vertical position. It provides data suitable for comparing the performance of essentially flat materials, composites or assemblies that are used primarily as the exposed surfaces of walls in buildings and transport vehicles, such as ships and trains.

3. Description of Test Specimen

The description of the product given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The product was a 1.2mm thick coated metal sheet coated with a black coating referenced "Interpon Easy Clean (EC)"

The sponsor of the test has not supplied additional information relating to the paint system and method of application.

The specimens were received on 21st February 2019

4. Conditioning of Test Specimens

The test specimens were conditioned to constant mass at a temperature of 23 ± 2°C and a relative humidity of 50 ± 5%.

5. Date of Test

The test was performed on 14th March 2019.

6. Test Procedure

The test was performed in accordance with the procedure specified in ISO 5658-2: 2006/ Amd 1:2011 and this report should be read in conjunction with that Standard.

7. Conditions of test

One face was exposed to the heating conditions of the test, with an impinging propane pilot flame.

8. Test Results

The test results relate only to the behaviour of the specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.

The test results relate only to the specimens of the product in the form in which they were tested. Small differences in the composition or thickness of the product may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any product, which is supplied or used, is fully represented by the specimens, which were tested. Uncertainty measurement has not been taken into account when presenting the test results.

The average of the three specimens tested is given below:

Derived Fire Characteristics

Critical flux at extinguishment, CFE (kW/m^2):	30.51
Heat of sustained burning Q_{sb} (MJ/m^2):	7.79
Flaming droplets / flaming ash :	None

:

The data recorded in individual tests is given in pages 5.

9 Requirements

The following requirements are given in Table 5 of EN 45545-2 for R1

Test Method	Parameter	Requirements	HL1	HL2	HL3
T02 ISO 5658-2	*CFE* kWm-2	Minimum	20 a	20 a	20 a

a If flaming droplets/particles are reported according to 5.3.7 during the test ISO 5658-2, or for the special case of materials which do not ignite in ISO 5658-2 and are additionally reported as unclassifiable, the following requirements shall be added:
Test to the requirements of EN ISO 11925-2 with 30 s flame application.
The acceptance requirements are:
- flame spread < 150 mm within 60 s;
- no burning droplets/particles.

10. Conclusion

The average CFE value of three specimens tested was calculated to be 30.51 kW/m^2 and therefore satisfies the CFE requirement given in EN 45545-2 Table 5 R 1for HL1, HL2 and HL 3.

Prepared by

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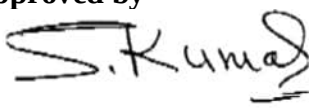
Fire Scientist

Approved by



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Date of Issue: 28th March 2019.

Individual rake data from each specimen run

Table 1

	Run 1	**Run 2**	**Run 3**	**Average**
Time (min, s) to	**s**	**s**	**s**	**s**
ignition:	45	43	35	41
station 50mm:	54	49	65	56
station 100mm:	124	96	121	114
station 150mm:	134	130	144	136
station 200mm:	175	161	170	169
station 250mm:	232	205	212	216
station 300mm:	353	303	296	317
station 350mm:				
station 400mm:				
station 450mm:				
station 500mm:				
station 550mm:				
station 600mm:				
station 650mm:				
station 700mm:				
station 750mm:				
Flaming out time:	2400	2400	2400	2400
Flaming droplets:	0	0	0	0
Final travel (mm)	300	300	300	300
Length of the test (Sec)	3000	3000	3000	3000

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Test Report: ICL/H18/10681

ISO 5659-2: 2012
Plastics - Smoke generation - Part 2:
Determination of optical density by a single-chamber test

Test at 50kW/m^2 without pilot flame

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Test Report: ICL/H19/10681
ISO 5659-2: 2012
Plastics - Smoke generation - Part 2:
Determination of optical density by a single-chamber test

Test at 50kW/m^2 without pilot flame.
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1 Introduction

EN 45545-2 calls up tests in accordance with the procedures specified in ISO 5659-2 at one heat flux specified in EN 45545-2. There is an additional requirement to calculate and report VOF_4 value.

The principle of the test method of ISO 5659-2 is to expose a material to specified thermal conditions of pyrolysis and combustion in a continuous procedure. The change in optical density of the smoke produced when dispersed within a fixed volume of air is recorded throughout the period of test. The resulting smoke density/time curve is used to calculate the smoke index.

The test method provides a means for the comparative assessment of products, however, it does not model a real fire situation and the results cannot therefore be used to describe the fire hazard of materials under actual fire conditions.

2 Description of Test Specimens

The description of the specimens given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The product was a 1.2mm thick coated metal sheet coated with a black coating referenced "Interpon Easy Clean (EC)"

The sponsor of the test has not supplied additional information relating to the paint system and method of application.

The sponsor of the test did not supply further details relating to the composition of the material that was tested.

3 Conditioning of Specimens

The specimens were received on 21st February 2019
The specimens were conditioned to the requirements of ISO 5659-2: 2012, i.e. conditioned to constant mass at 23 ± 3°C and 50 ± 5% RH, before testing.

4 Date of Test

The tests were performed on 14th March 2019.

5 Test Procedure

The test was performed in the non- flaming mode at 50kW/m^2 in accordance with the procedure specified in ISO 5659-2:2012 and this report should be read in conjunction with that Standard.

Specimens were tested at 50kW/m^2 without pilot flame only.

6 Test Results

The test results relate only to the behaviour of the specimens of the product under the particular conditions of test; they are not intended to the sole criterion for assessing the potential smoke hazard of the product in use.

The test results relate only to the specimens of the product in the form in which they were tested. Small differences in the composition or thickness of the product may significantly affect the performance during the test and will therefore invalidate the test results. It is the responsibility of the supplier of the product to ensure that the product, which is supplied, is identical with the specimens, which were tested. Uncertainty measurement has not been taken into account when presenting the test results.

The results of tests carried out can be summarised as follows:-

50kW/m^2 in Non-Flaming Mode				
Parameter	**Test 1**	**Test 2**	**Test 3**	Average
Ds at 1.5 mins	14.56	17.88	26.56	19.67
Ds at 4 mins	**89.48**	**77.61**	**39.70**	**68.93**
Ds Max (in 10mins)	105.70	81.79	44.63	77.37
Ds Max	105.80	81.91	0.00	62.57
Clear beam	83.92	91.65	0.00	58.53
Dsc	10.05	5.00	0.00	5.02
D Max Corrected	95.75	76.91	0.00	57.55
Time to max (Sec)	392.00	331.00	0.00	241.00
VOF4	**151.23**	**145.23**	**87.61**	**128.02**

Ds V time chart is given in Appendix 1.

7 Requirements

The following requirements are given in Table 5 of EN 45545-2 for R1

Test Method	Parameter	Requirements	HL1	HL2	HL3
T10.01 EN ISO 5659-2: 50kWm^{-2}	$D_{s(4)}$ dimensionless	Maximum	600	300	150
T10.02 EN ISO 5659-2: 50kWm^{-2}	VOF_4 min	Maximum	1200	600	300

8 Conclusion

When tested in accordance with the procedure specified in ISO 5659-2 at 50kW/m^2 in the non-flaming mode the material shows a Ds (4) Value of 68.93 and VOF_4 value of 128.02

The material tested therefore satisfies the smoke emission requirements given iin EN 45545-2 Table 5 R 1 for HL1, HL2 and HL3.

Prepared by

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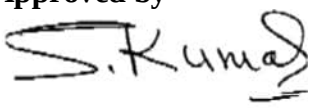
Approved by



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Technical Manager

Date: 28th March 2019.

Appendix 1

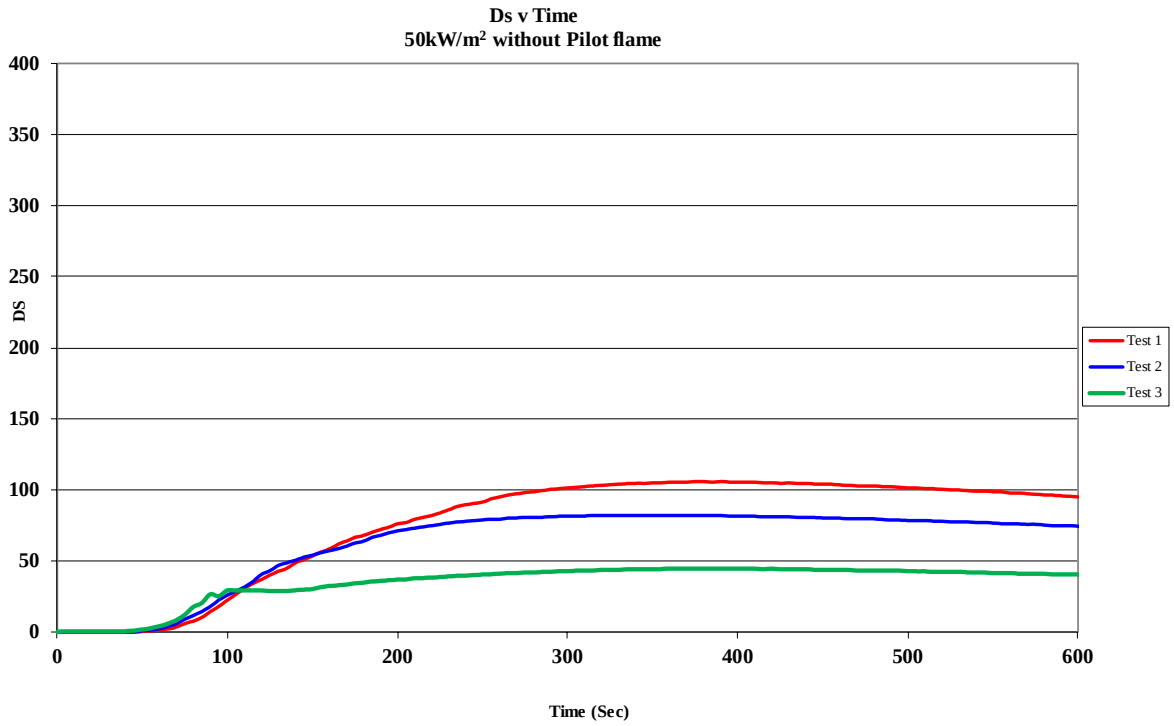

Fig 1: Ds v Time chart

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Test Report: ICL/H19/10682

EN 45545-2
Railway applications— Fire protection on railway vehicles
Part 2: Requirements for fire behaviour of materials and components
Annex C Testing methods for determination of toxic gases from railway products.
Clause C.2 Method 1.

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Test Report: ICL/H19/10682

EN 45545-2
Railway applications— Fire protection on railway vehicles
Part 2: Requirements for fire behaviour of materials and components
Annex C Testing methods for determination of toxic gases from railway products.
Clause C.2 Method 1.

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1 Introduction

Tests were undertaken at the request of the sponsor on a specimen of a coated panel The test was conducted in accordance with the procedures specified in EN 45545-2 Annex C "Test method for the determination of toxic gases from railway products" Clause 2 Test Method 1.

EN 45545-2 Annex C details a test procedure, the results being expressed as CIT value, for the measurement of toxic fumes generated under the conditions of test carried out in apparatus detailed in ISO 5659-2. The test on seating composite is carried out at 50kW/$m^{2.}$ without pilot flame.

The principle of the test method ISO 5659-2 is to expose a material to specified thermal conditions of pyrolysis and combustion in a continuous procedure. The change in optical density of the smoke produced when dispersed within a fixed volume of air is recorded throughout the period of test. The resulting smoke density/time curve is used to calculate the smoke index.

Fire gas samples are taken at 4 and 8 minutes into the test and quantitative analysis carried out using FTIR.

The test method provides a means for the comparative assessment of products, however, it does not model a real fire situation and the results cannot therefore be used to describe the fire hazard of materials under actual fire conditions.

2 Description Of Test Specimens

The description of the specimens given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The product was a 1.2mm thick coated metal sheet coated with a black coating referenced "Interpon Easy Clean (EC)"

The sponsor of the test has not supplied additional information relating to the paint system and method of application.

3 Conditioning Of Specimens

The specimens were received on 21st February 2019

The specimens were conditioned to constant mass in accordance with the requirements of ISO 5659-2 at 23 ± 2°C and 50 ± 5% RH, before testing.

4 Date Of Test

The tests were performed on 14th March 2019.

5 Test Procedure

The tests were carried out in accordance with the procedures specified in EN 45545 -2 Annex C Clause C.2 and this report should be read in conjunction with this standard.

One face was exposed to the heating conditions of the test.

The specimens were tested at 50kW/m^2 without pilot flame.

6 Test Results

The test results relate only to the behaviour of the specimens of the product under the particular conditions of test; they are not intended to the sole criterion for assessing the potential toxicity hazard of the product in use.

The test results relate only to the specimens of the product in the form in which they were tested. Small differences in the composition or thickness of the product may significantly affect the performance during the test and will therefore invalidate the test results. It is the responsibility of the supplier of the product to ensure that the product, which is supplied, is identical with the specimens, which were tested. Uncertainty measurement has not been taken into account when presenting the test results.

The results of tests carried can be summarised as follows:-

Table 1: Toxic gas emission data at 4 minutes.

	Concentration (ppm) 4 mins			
Gas species	**Run 1**	**Run 2**	**Run 3**	Average
Carbon dioxide, CO2	4840	4720	4850	4803
Carbon monoxide, CO	54	57	54	55
Oxides of Nitrogen, NOx	ND	ND	ND	-
Sulphur dioxide, SO2	ND	ND	ND	-
Hydrogen Chloride, HCl	ND	ND	ND	-
Hydrogen Bromide, HBr	ND	ND	ND	-
Hydrogen Fluoride, HF	ND	ND	ND	-
Hydrogen Cyanide, HCN	ND	ND	ND	-

Table 2: Toxic gas emission data at 8 minutes.

	Concentration (ppm) 8 mins			
Gas species	**Run 1**	**Run 2**	**Run 3**	**Average**
Carbon dioxide, CO2	5050	5100	4950	5033
Carbon monoxide, CO	62	57	59	59
Oxides of Nitrogen, NOx	ND	ND	ND	-
Sulphur dioxide, SO2	ND	ND	ND	-
Hydrogen Chloride, HCl	ND	ND	ND	-
Hydrogen Bromide, HBr	ND	ND	ND	-
Hydrogen Fluoride, HF	ND	ND	ND	-
Hydrogen Cyanide, HCN	ND	ND	ND	-

Table 3: CIT_G calculations for 4 minutes

Gas species	ci (mg/m3)	Ci (mg/m3)	CITG
Carbon dioxide, CO2	7792.45	72000	0.009
Carbon monoxide, CO	55.67	1380	0.003
Oxides of Nitrogen, NOx	ND	38	0
Sulphur dioxide, SO2	ND	262	0
Hydrogen Chloride, HCl	ND	75	0
Hydrogen Bromide, HBr	ND	99	0
Hydrogen Fluoride, HF	ND	25	0
Hydrogen Cyanide, HCN	ND	55	0
		CIT_G	0.012

Table 4: CIT_G calculations for 8 minutes

Gas species	ci (mg/m3)	Ci (mg/m3)	CITG
Carbon dioxide, CO2	8103.72	72000	0.009
Carbon monoxide, CO	60.80	1380	0.004
Oxides of Nitrogen, NOx	ND	38	0
Sulphur dioxide, SO2	ND	262	0
Hydrogen Chloride, HCl	ND	75	0
Hydrogen Bromide, HBr	ND	99	0
Hydrogen Fluoride, HF	ND	25	0
Hydrogen Cyanide, HCN	ND	55	0
		CIT_G	0.013

7 Requirements

The following requirements are given in Table 5 of EN 45545-2 for R1

Test method reference	Parameter	Requirements for R1 Values are maximum allowed		
		HL1	Hl2	HL3
T11.01 EN ISO 5659-2: 50 kWm-2	*CIT*G dimensionless	1.2	0.9	0.75

8 Conclusion

When tested in accordance with the procedure called un EN 45545-2 Annex C Clause C.2 the sheet product tested satisfies the toxicity requirements given in EN 45545-2 Table 5 R 1 for hazard level HL1, HL2 and HL3.

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Test Report No: ICL/H19/10678

BS 6853: 1999 Annex B, Clause B.2
Code Of Practice For Fire Precautions
In The Design And Construction Of Passenger Carrying Trains.
Determination of weighted summation of toxic fume, R
B.2 Area based test method.

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TEST REPORT NO: ICL/H19/10678
BS 6853: 1999 Annex B, Clause B.2
Code Of Practice For Fire Precautions
In The Design And Construction Of Passenger Carrying Trains.
Determination of weighted summation of toxic fume, R
B.2 Area based test method.

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1. Introduction

Tests were undertaken on a specimen of a seat composite bonded to one face. The test was conducted in accordance with the procedures called up in Annex B.2 of BS 6853: 1999 "Code of practice for fire precautions in the design and construction of passenger carrying trains - Determination of weighted summation of toxic fume, R and this report should be read in conjunction with this test standard.

BS 6853: 1999 Annex B.2 details a test procedure, the results being expressed as R value, for the measurement of toxic fumes generated under the conditions of test carried out in apparatus detailed in BS ISO 5659-2. The test is carried out at 25kW/ m^2 with pilot flame.

A single smoke emission only test was carried out and the time at which 85 % of the peak smoke emission is reached, (or the value at 20 min if no maximum is reached), was determined.

Toxic fume emission testing was then carried out in triplicate. The sampling of evolved gases was undertaken at time at which 85% of Ds max of first specimen was recorded.

The results are used to determine compliance with the criteria given in BS 6853: 1999 Table 1,2,3,4,5,6,9, 10, and 12.

2. Product Description

The description of the specimen given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The test specimens consisted of 1.2mm thick metal sheet coated with a black coating referenced “Interpon Easy Clean (EC)

The sponsor of the test did not supply further details relating to the composition of the paint its rate and method of application

3. Conditioning of Test Specimens

The specimens were received 21st February 2019

The specimens were conditioned at 23 ± 2°C and a relative humidity of 50 ± 5% in accordance with the requirements given in BS ISO 5659-2.

4. Date of Test

The test was performed on 13th March 2019.

5. Test Procedure

The test was performed in accordance with the procedures called up in BS 6853: 1999 Annex B, Clause B.2. and this report should be read in conjunction with this standard. The coated face was exposed to the heating conditions of the test.

6. Test Results

The test results relate only to the behaviour of the specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential toxic gas emission hazard of the product in use.

Table 1: Test results amount detected

Gas	Amount detected (ppm)		
	Run 2	Run 3	Run 4
Carbon dioxide, CO_2	5000	5000	5000
Carbon Monoxide, CO	60	60	60
Hydrogen Fluoride, HF	ND	ND	ND
Hydrogen Chloride, HCl	ND	ND	ND
Hydrogen Bromide, HBr	ND	ND	ND
Hydrogen Cyanide, HCN	ND	ND	ND
Nitrous Fumes, NOx	ND	2	ND
Sulphur Dioxide, SO_2	ND	ND	ND

where ND = not detected

Calculation of index:

Individual index ,r = C_x / f_x

Where: C_x is the emission in gm^{-2}

f_x is the reference value in gm^{-2}

r_x is the individual r index

R value,r = $\sum r$

Table 2: BS 6853:1999 reference values

Gas	Reference value, f(gm^{-2})
Carbon Dioxide, CO_2	14000
Carbon Monoxide, CO	280
Hydrogen Fluoride, HF	4.9
Hydrogen Chloride, HCl	15
Hydrogen Bromide, HBr	20
Hydrogen Cyanide, HCN	11
Nitrous Fumes, NO_x	7.6
Sulphur Dioxide	53

Table 3: R value calculation

Gas	**Run 2**		**Run 3**		**Run 4**	
	C_x	**r**	**C_x**	**r**	**C_x**	**r**
Carbon dioxide, CO_2	789.764	0.056	789.764	0.056	789.764	0.056
Carbon Monoxide, CO	6.032	0.022	6.032	0.022	6.032	0.022
Hydrogen Fluoride, HF	ND	-	ND	-	ND	-
Hydrogen Chloride, HCl	ND	-	ND	-	ND	-
Hydrogen Bromide, HBr	ND	-	ND	-	ND	0
Hydrogen Cyanide, HCN	ND	-	ND	-	ND	-
Nitrous Fumes, NOx	ND	-	0.330	0.043	ND	-
Sulphur Dioxide, SO_2	ND	-	ND	-	ND	-
R value		**0.078**		**0.121**		**0.078**

where ND = not detected

Average R value : 0.92

7. Conclusion

The sample described in this report, when tested in accordance with BS 6853: 1999 Annex B.2, achieved an R value of 0.092

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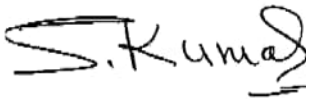
Authorised by



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Test Report No: ICL/H19/10677

Code of practice for fire precautions in the design and construction of passenger carrying trains BS 6853: 1999 Annex D, Clause D.8.4 Methods For Measuring Smoke Density

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Test Report No: ICL/H19/10677

Code of practice for fire precautions in the design and construction of passenger carrying trains
BS 6853: 1999 Annex D, Clause D.8.4
Methods For Measuring Smoke Density

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1. Purpose of Test

To determine the performance of a specimen of a panel when it is subjected to the conditions of test specified in BS 6853: 1999 "Code of practice for fire precautions in the design and construction of passenger carrying trains" Annex D.8.4" 60^0 Panel test".

2. Scope of Test

BS 6853: 1989 Annex D.8.4 specifies a test procedure, the results being expressed as Ao(on) and Ao(off) values, for the measurement of the density of smoke emitted from a product burning under the defined conditions of test. The results are used to determine compliance with the criteria given in BS 6853: 1999 Table 2,3,5 and 6.

3. Description of Test Specimen

The description of the product given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The test specimens consisted of 1.2mm thick metal sheet coated with a black coating referenced "Interpon Easy Clean (EC)

The sponsor of the test did not supply further details relating to the composition of the paint its rate and method of application.

The specimens were received on 21st February 2019

4. Conditioning of Test Specimens

The test specimens were conditioned by maintaining them in indoor ambient conditions for 72 hours and then for a minimum of 16 hours at 23 ± 2ºC and a relative humidity of 50 ± 5%.

5. Date of Test

The test was performed on 6th March 2019

6. Test Procedure

The test was performed in accordance with the procedure specified in BS 6853: 1999 Appendix D, Clause D.8.4 and this report should be read in conjunction with that Standard.

7. Exposed Face

The coated face was exposed to the flame.

8. Test Results

The test results relate only to the behaviour of the specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential smoke hazard of the product in use.

The test results relate only to the specimens of the product in the form in which they were tested. Small differences in the composition or thickness of the product may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any product, which is supplied or used, is fully represented by the specimens, which were tested.

Parameter	Run1	Run 2	Average
Ao(on max)	1.046	1.034	1.040
Ao(on end)	0.982	0.960	0.971
Ao(off)	1.270	1.180	1.225
Ao(off corrected)	1.330	1.25	1.294

The value of Ao decreased from a maximum value during the ON phase. Ao(off) is corrected by adding the difference between Ao(on max) and Ao(on end) to Ao(off). Thus: Ao(off) = Ao(off end) + Ao(on max) - Ao(on end).

The changes in transmission with time were continuously recorded and Ao v Time graphs are presented in Figures 1 and 2.

9. Requirements

The smoke emission requirements for Interior Vertical services given in table 2 of BS 6853:1999 are as follows:

Parameter	Vehicle category		
	Ia	Ib	II
Ao(on) max	2.6	4.2	9.4
Ao(off) max	3.9	6.3	14.0

10. Conclusion

The panels tested in accordance with BS 6853 Annex D8.4 has achieved Ao(on max) value of 1.034 and Ao(off) Value of 1.250 and therefore satisfies the requirements of Vehicle Category Ia, Ib and II.

Prepared by

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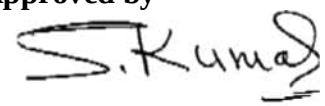
Approved by



S.Kumar
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Date of Issue: 28th March 2019.

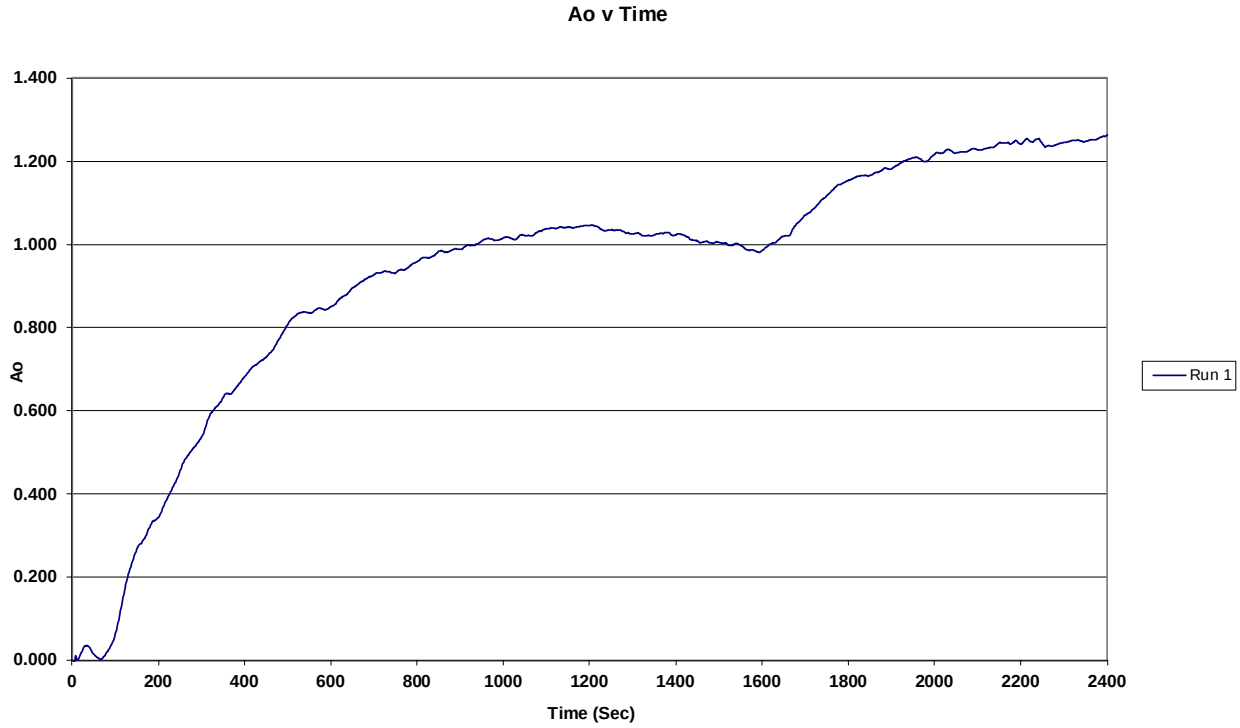

Figure 1 Variation of Absorbance (Ao) with time (Test No 1)

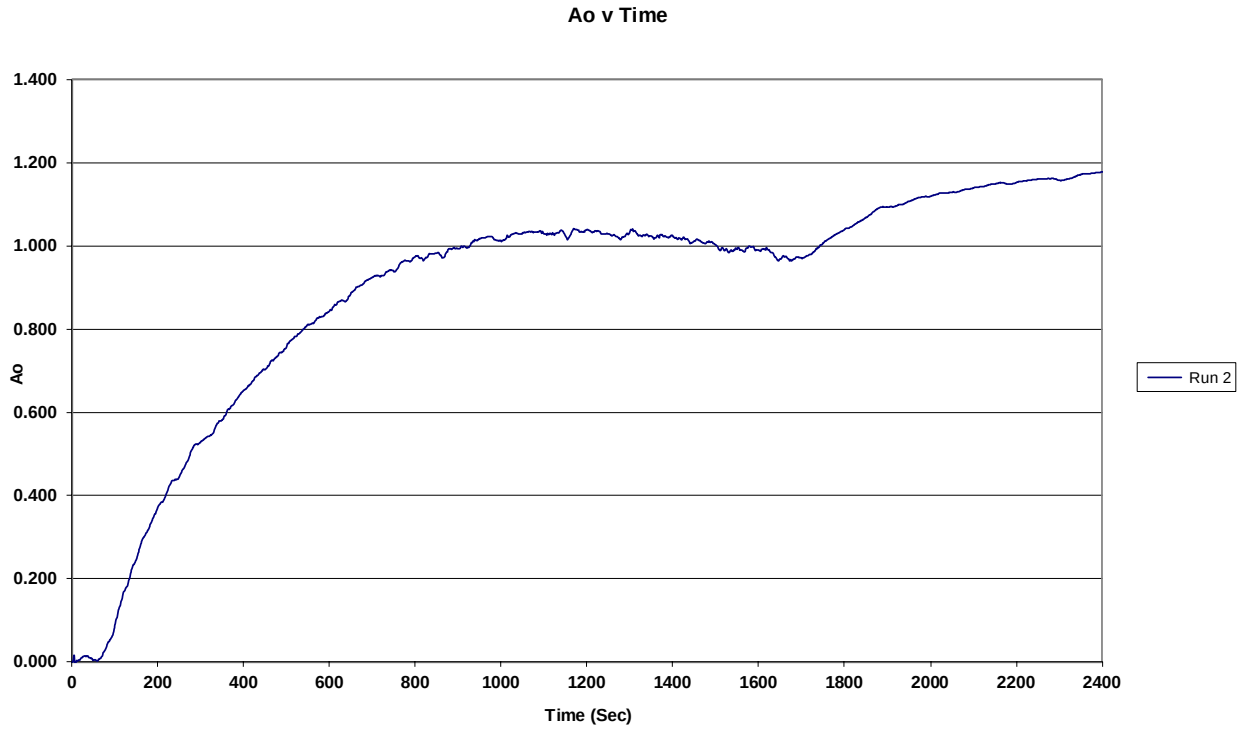

Figure 2 Variation of Absorbance (Ao) with time (Test No. 2)

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Test Report No: ICL/H19/10680

ISO 5660-1: 2015
Reaction-to-fire tests- Heat release, smoke production and mass loss rate- Part 1: Heat release rate (Cone calorimeter method)

Sponsored By

SMU Powder Coatings
AkzoNobel Center
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The Netherlands

Test Report No: ICL/H19/10680

ISO 5660-1: 2015
Reaction-to-fire tests- Heat release, smoke production and mass loss rate-
Part 1: Heat release rate (Cone calorimeter method)

Sponsored By
SMU Powder Coatings
AkzoNobel Center
Christian Neefestraat 2
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1. Purpose of Test

To determine the performance of a specimen of a seat composite when it is subjected to the conditions of test specified in ISO 5660-1: 2015 Reaction-to-fire tests- Heat release, smoke production and mass loss rate - Part 1: Heat release rate (Cone calorimeter method).

The results are used to determine compliance with the criteria given in EN 45545-2 Table 5 R 1.

2. Scope of Test

ISO 5660-1: 2015 Reaction-to-fire tests- Heat release, smoke production and mass loss rate- Part 1: Heat release rate (Cone calorimeter method) details a test procedure to determine the rate of heat release, smoke production and mass loss. The heat release values are expressed on area bases and smoke and mass loss values are expressed on mass bases. ARHE values are calculated from the data and MARHE value is reported.

3. Description of Test Specimen

The description of the product given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The product was a 1.2mm thick coated metal sheet coated with a black coating referenced "Interpon Easy Clean (EC)"

The sponsor of the test has not supplied additional information relating to the paint system and method of application.

The specimens were received on 21st February 2019

4. Conditioning of Test Specimens

The sample was conditioned to constant mass at a temperature of 23±2°C and a relative humidity of 50±10% in accordance with ISO 554.

5. Date of Test

The test was performed on 26th February 2019.

6. Test Procedure

The test was performed in accordance with the procedure specified in ISO 5660-1 and this report should be read in conjunction with that Standard.

7. Exposed Face

One face was exposed to the heating conditions **(50kW/m^2)** of the test..

8. Test Results

The test results relate only to the behaviour of the specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.

The test results relate only to the specimens of the product in the form in which they were tested. Small differences in the composition or thickness of the product may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any product, which is supplied or used, is fully represented by the specimens, which were tested. Uncertainty measurement has not been taken into account when presenting the test results.

The average of the three specimens tested is given below:

Parameter	**Test 1**	**Test 2**	**Test 3**	**Average**
Specimen thickness (mm)	1.2	1.2	1.2	1.2
Specimen Initial mass (g)	27.3	27.21	27.1	27.2
Time to ignition (s)	37	34	36	35.7
Total heat release (MJ/m²)	7.0	7.2	3.1	5.8
Mass loss between Ign & Ext (g)	1.5	1.5	1.3	1.4
TSR (m²/m²)	68.06	118.92	276.13	154.4
pK HRR (kW/m^2)	113.98	98.34	98.34	103.6
pk Effective heat of combustion (MJ/kg)	77.34	65.05	56.10	66.2
pK Specific ext area (m^2/kg)	3082.19	2582.97	3460.65	3041.9
Average values HRR				
HRR (kW/m^2) over Ign 60 sec from ign	60.60	51.52	46.76	53.0
HRR (kW/m^2) over Ign 120 sec from ign	33.85	28.91	24.83	29.2
HRR (kW/m^2) over Ign 180 sec from ign	23.43	20.90	16.60	20.3
HRR (kW/m^2) over Ign 240 sec from ign	17.69	16.08	12.49	15.4
HRR (kW/m^2) over Ign 300 sec from ign	14.74	13.16	10.02	12.6
HRR (kW/m^2) over Ign 360 sec from ign	12.64	11.39	8.37	10.8

Parameter	Test 1	Test 2	Test 3	Average
Average values EHC (MJ/kg)				
EHC (MJ/kg) over Ign 60 sec from ign	23.25	22.08	23.94	23.1
EHC (MJ/kg) over Ign 120 sec from ign	26.28	25.67	24.24	25.4
EHC (MJ/kg) over Ign 180 sec from ign	27.02	25.52	22.70	25.1
EHC (MJ/kg) over Ign 240 sec from ign	25.30	25.80	22.75	24.6
EHC (MJ/kg) over Ign 300 sec from ign	26.40	26.14	21.47	24.7
EHC (MJ/kg) over Ign 360 sec from ign	27.01	26.48	20.29	24.6
MARHE (kW/m^2)	41.47	35.47	31.70	36.2
Average values Specific ext area (m^2/kg)				
SEA (m^2/kg) over Ign 60 sec from ign	338.48	408.03	408.03	384.8
SEA (m^2/kg) over Ign 120 sec from ign	366.25	430.69	430.69	409.2
SEA (m^2/kg) over Ign 180 sec from ign	379.70	448.24	448.24	425.4
SEA (m^2/kg) over Ign 240 sec from ign	346.83	530.23	530.23	469.1
SEA (m^2/kg) over Ign 300 sec from ign	352.66	577.80	577.80	502.8
SEA (m^2/kg) over Ign 360 sec from ign	339.50	620.26	620.26	526.7

HRR and ARHE charts and given in Appendix 1.

9 Requirements

The following requirements are given in Table 5 of EN 45545-2 for R1

Test Method	Parameter	Requirements	HL1	HL2	HL3
T03.01 ISO 5660-1: 50 kWm-2	*MARHE* kWm-2	Maximum	a -	90	60

a If flaming droplets/particles are reported according to 5.3.7 during the test ISO 5658-2, or for the special case of materials which do not ignite in ISO 5658-2 and are additionally reported as unclassifiable, the following requirements shall be added:
Test to the requirements of EN ISO 11925-2 with 30 s flame application.
The acceptance requirements are:

- flame spread < 150 mm within 60 s;
- no burning droplets/particles.

10. Conclusion

The average MARHE value of three specimens tested with tie wires was calculated to be $36.2kW/m^2$ and therefore satisfies the MARHE requirements given in EN 45545-2 Table 5 R1 for HL2 and HL 3.

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Appendix 1

Black	Run 1		Red	Run 2		Blue	Run 3