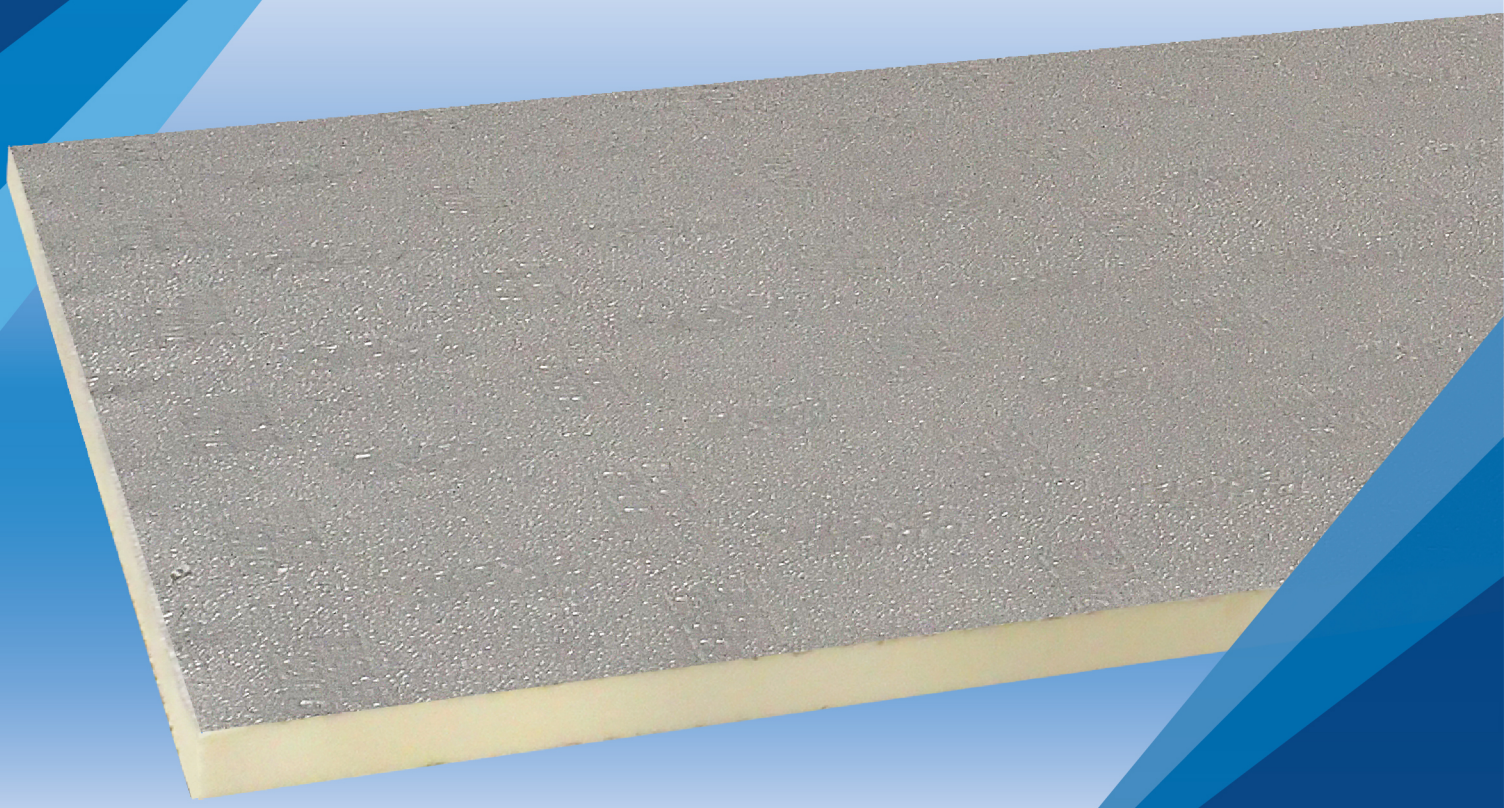
DUCT® EXCEL
Always Excellent!



DUCT EXCEL
PRE - INSULATED DUCT PANEL

Clean Technology, Clean Living

ISO 9001 : 2015

ASTM INTERNATIONAL

Exova Warringtonfire

URS

UKAS QUALITY MANAGEMENT

www.ductexcel.co.th

PRE-INSULATED DUCT PANEL

DUCT EXCEL® Always Excellent!

HVAC System

Aiming for better health

Heating, Ventilation and Air Conditioning (HVAC), Sick Building Syndrome, Indoor Air Quality and Green building concept have become of major concerns to human health in recent years.

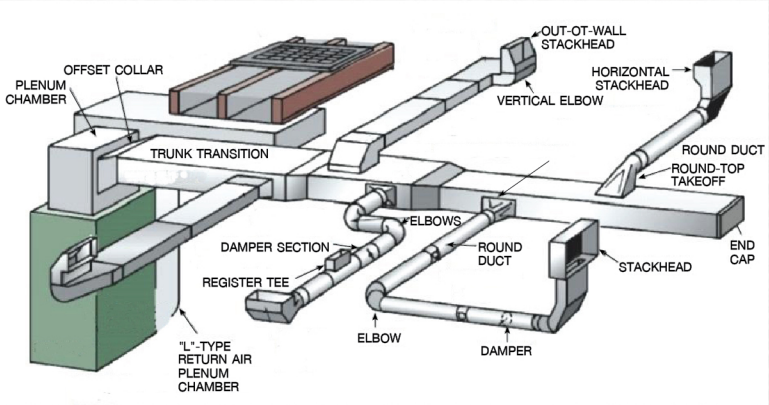
HVAC industry has gone through dynamic changes to keep pace with the remarkable environment development.

Air Ducting is the skeleton of HVAC system where the techniques have been, internationally, accepted in view of the fact that it is fulfilling the demand for better, cleaner and faster air ducting system.

New Technology for Clean Air

Above features classify pre-insulated ducting system eligible for Green Buildings.

Air duct system fabricated with **Pre-Insulated Duct panels** guarantees excellent air quality, increasing ducting system efficiency, which improves living environment.



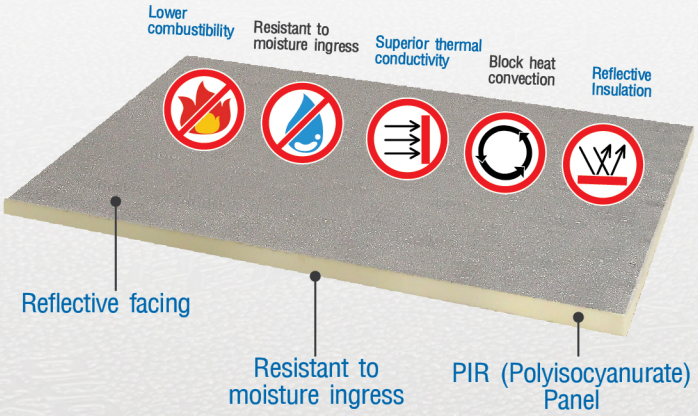
The American Society of Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE) Standard 62.1, Ventilation for Acceptable Indoor Air Quality, lists strategies for improving IAQ through mold and microbial growth prevention.

DUCT EXCEL PID PANEL

Product

Pre-Insulated Duct Panel (PID Panel)

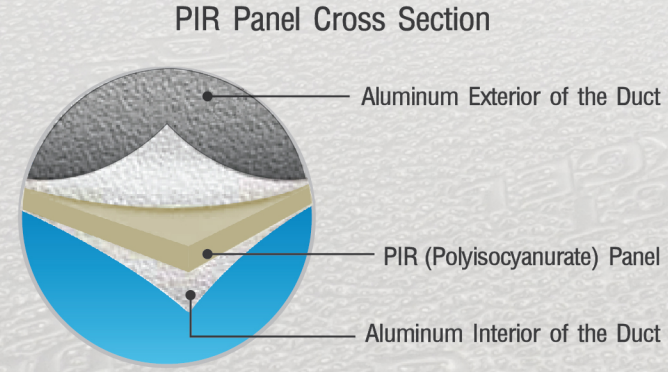
DUCT EXCEL Pre-Insulated Duct Panel is your best solution of proper and suitable Air Duct System for clean air environment of Heat Ventilation and Air Conditioning (HVAC) System – 100% fiber free.

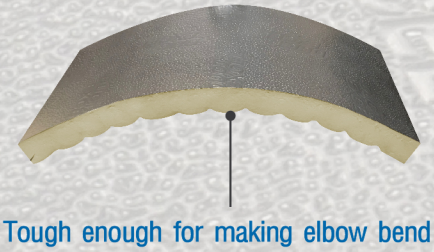


In comparison of traditional Air Duct System, there are many advantages of PID Duct Panel covering of lower initial cost, lower weight of duct & support, saving installation cost and time, long life span, and reduction of operating costs.

Through innovation of PID Duct Panel, its properties can protect many factors including:

- Excellent Fire Performance- 'Class 0' by British Standard 476 (BS476 Part 6 & 7)
- No leakage from duct connection
- Corrosion resistant
- Saving energy from excellent thermal conductivity
- A bit difference of air pressure from beginning to ending
- Resistant to Moisture Ingress, low water absorption, low humidity, and Fungi-free
- Tough enough for making elbow bend
- Saving maintenance cost.
- Eco-friendly
- Economical





DUCT EXCEL PID PANEL

Pre-Insulated Duct Panel
Imported Machinery, Technology and Raw Materials

Imported Production Machinery and Technology

Through more than 18 years of Pre-Insulated Duct Panel manufacturing experiences from SAKE Co., Ltd. – South Korea* who has accumulated its own skills and knowledge in the PIR industry, we have imported their production machine and technology for local production.

Production Machinery is not only modern technology, energy saving but also environmentally friendliness. Our machine produces technologically innovative and high quality PID panels accurately and on a timely basis. The technique, quality and practical values of SAKE MACHINERY are leading in PID insulation industry, which is one of the best PID panel machineries in the world.

This superior technology particularly related to 100% water based PIR system and fire retardant foam with cutting edge technology. Our clean technology provides you high standard of clean living area.

Furthermore our raw materials have been imported for complete manufacturing solutions including of chemical ingredients and chemical formulas.

Therefore, **Duct Excel PID Panel** is high quality, proper functionality and weather resistant product.

*SAKE Co., Ltd. is the largest pre-insulated duct system and PIR insulation panel manufacturer in South Korea.

Factory in Nakornnayok Province, 45 km. from Bangkok

DUCT EXCEL PID PANEL

Advantages

Pre-insulated panels consist of sandwich structure of Aluminium – Poly-isocyanurate foam – Aluminium layers. Internationally recognized manufacturers presented this panel and accepted by ASHRAE as the perfect thermal insulator.

Pre-insulated panels are the first of decades of research and development around the world.

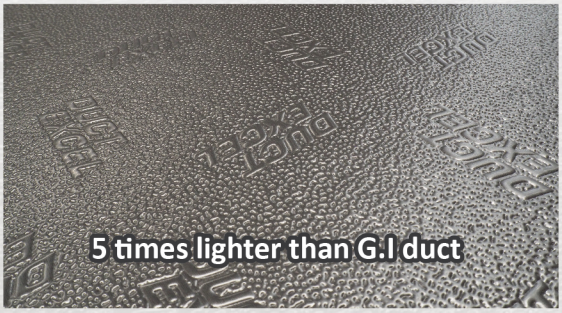
Visually pleasant : It is neat product and looks stylish with surroundings by all means.

Anti-microbial : Pre-insulated ducting system is very much hygienic and less extent to be contaminated by germs and microbes.

Lightweight : The weight of the pre-insulated panels is much lighter than other ducting method. No need for any additional insulation.

Easy to install : This system is simple, fast and easy to fabricate and also in maintenance phase.

"Easy Installation
Corrosion Resistant
Economical
Anti-microbial"



Light of weight! but Strong!!

Neat product and looks stylish

DUCT EXCEL PID PANEL

Technical Specifications

MODEL	APA-L (LEED V4 & V4.1 BETA)	APA	APAX	SPA	SAPA
ALUMINIUM FOIL					
Surface (Thickness - Microns)	**Both Sides :** *Embossed Aluminium Foil (80)*	**Both Sides :** *Embossed Aluminium Foil (80)*	**Outer Face :** *Embossed Aluminium Foil with Antibacterial Coating (80)* **Inner Face :** *Embossed Aluminium Foil (80)*	**Outer Face :** *Metal Sheet or G.I. sheet (200)* **Inner Face :** *Embossed Aluminium Foil (80)*	**Outer Face :** *Embossed Aluminium Foil (80)* **Inner Face :** *Smooth Aluminium Foil (180)*
Color Reference	Silver	Silver	Green / Silver	Gray / Silver	Silver
Weight per Unit Area	0.25 kg/m^2				
Thermal Conductivity	0.021 W/m-k				
Flexural Strength	954 kPa				
Compression Strength	283 kPa				
Water Absorption	0.28 %				
PIR FOAM					
Thickness	20 mm.- 25 mm.				
Density	50±2 kg/m^3				
Generic Type	Polyisocyanurate (PIR)				
Product Reference	Pre-insulated Duct Panel (PID)				
Color Reference	Beige				

DUCT EXCEL PID PANEL

List of Test Reports and Certifications

Description	Test Result	Test Method	Institution
PID PANELS			
Thermal Conductivity	0.021 W/m-k	ASTM C518-15	SGS
Density	51.02 kg/m^3	ASTM D1622	Department of Science Service
Flexural Strength	954 kPa	ASTM D203-05a	Exova, Canada
Compression Strength	283 kPa	ASTM D1621-16	Exova, Canada
Water Absorption	0.28 %	ASTM C209	Exova, Canada
Toxicity Index	2.75	NES 713	Interscience Fire Laboratory, UK
Vertical Flammability	V-0	UL94v	Interscience Fire Laboratory, UK
Horizontal Burning Foam Material	HF-1	UL94H	Department of Science Service
Fire Propagation Index	Class 0 (Index: 3.2)	BS 476 Part 6 1989+A1: 2009	Exova Warrrington fire, UK
Spread of Flame	Class 1 (Index: <50 mm.)	BS 476 Part 7: 1997	Exova Warrrington fire, UK
Fire Classification	Class 0	BS 476 Part 6 & 7	Exova Warrrington fire, UK
Surface Burning Characteristics	Class A	ASTM E84-09c	Exova Warrrington fire, Canada
Burning Test	0 sec.	UL181.11-2013	AWTA Limited
Aluminium Foil Anti-Bacterial Coating	Reduction 99.98% / 99.96%	ATCC 6538P / 8739	SGS
PVC FLANGES			
Vertical Flammability	V-0	UL 94V	Department of Science Service

Ignition | After 5 min Temp measuring | After 10 min | After 20 min | After 30 min

DUCT EXCEL PID PANEL

Comparison Chart & Data sheet

Comparison Chart

	Steel Duct	Duct Excel PID Panel	Remark
Insulation	Insulation needed additionally	Self-insulation (0.022-0.024 w/m-k)	G/W 40T effect without extra insulation
Weight	0.8T:7.0 kg/m^2 (G/W 24K 25T) 1.0T:8.3 kg/m^2 (G/W 24K 25T)	1.38 – 1.44 kg/m^2	Only 1/5 weight of– steel duct
Noise	Noise generation and transfer	Excellent noise reducing effect	
Antibacterial	Easily contaminated	Antibacterial Function (Model APAX)	Epoxy coating (Antibacterial Ceramic – Zeolite contained)
Corrosion	Corrosion by humidity in air	No corrosion	Epoxy coating
Chemicals	Rapid corrosion by chemical reaction in air	Strong chemical resistance	Epoxy coating
Permissible Pressure	High pressure possible	Maximum 150 mmAg	
Permissible Velocity	High pressure possible	Below 15m/sec	
Leakage		Excellent	
Installation	Hard to cut, bend, and install Extra insulation needed	Easy to cut and light weight, able to bend No extra insulation needed	Low cost and save time
Exterior	Extra painting needed	Various colors	
Maintenance	Hard	Easy	
Durability	About 10 years	Semi-permanent	
Price	High	Reasonable	

Data sheet

Dimension	4,000 x 1,200 x 20 mm. or 2,400 x 1,200 x 20 mm.
Density	48-50 kg/m^3
Thickness of Aluminium Foil	80 micron
Weight	1.4 kg/m^2
Thermal Conductivity	0.022-0.024 w/m-k
Water Absorption	0.28 %
Temperature Range	-170°C to +140°C

Duct Excel Co., Ltd.

Head office address : 1622/1 Suthisan-vinitchai Road, Huaykwang, Bangkok 10310, Thailand.
Tel : 02-277-8186, 02-693-0247
Mobile : 086-490 3437, 086-334-1487
Fax : 02-693-0869
Email : center@ductexcel.co.th

Factory address :
193 Moo 3, Rangsit-Nakornnayok Road, Tambol Klongyai, Ampur Ongkarak, Nakornnayok 26120, Thailand.

DUCT EXCEL
Always Excellent!

PID Accessories & Tools

ACF - 1001

ACF - 1002

ACF - 1003

ACF - 1004

ACF - 1005

ACF - 1006

ACF - 1008

ACS - 1001

ACS - 1002

ACS - 1003

ACS - 1004

ACS - 1006

ACS - 1007

ACC - 1002

ACK - 1006

ACK - 1007

ACT - 1001

ACA - 1001

ALUMINIUM TAPE

กาวทา PID

ซิลิโคน A - 700

List of Test Reports and Certifications	1.Thermal Conductivity ASTM C518-17
	2.Density ASTM D1622
	3.Toxicity Index NES713
	4.Vertical Flammability UL94v
	5.Horizontal Burning Foam Material UL94H
	6.Fire Propagation Index BS 476 Part 6 1989+1:2009
	7.Spread of Flame BS 476 Part 7:1997
	8.Fire Classification BS 476 Class 0 Summary PID
	9.Smoke Development ASTM E84
	10.Burning Test UL181.11-2013
	11.Aluminium Foil Anti-Bacterial Coating ATCC 6538P,8739
	12.PVC Flanges_Duct Excel UL 94V
	13.MIT (Made in Thailand)

No. 0307/ 16715

To Duct Excel Co., Ltd.

The Department of Science Service presents the test report for the sample named "PID PANEL" Laboratory No. L64/08586.1 as the total of 1 sample with reference to the request No. L64/08586 dated 9 November 2021.

Enclosed herewith the following result avails for your acknowledgement.

Department of Science Service

26 November 2021

Division of Engineering Materials
Tel. 0 2201 7130
Fax 0 2201 7127
E-mail : physics@dss.go.th

TEST REPORT

Sample's name	Mark / Brand	Laboratory No.
PID PANEL	DUCT EXCEL	L64/08586.1

Test Result

Thermal conductivity at mean temperature of (24±1) °C, W/m-K	0.02118

Customer's name	Duct Excel Co., Ltd.
Customer's address	1622/1 Sutthisan Winitchai Road, Huay Kwang, Bangkok 10310
Sample's description	Silver color solid
Test date	16-19 November 2021
Test method	ASTM C 518-17

Approved by
(Mr. Anon Pomprasit)
Scientist, Senior Professional Level

Reported by
(Mr. Kritsada Suttipan)
Scientist, Senior Professional Level

No. 0307/ 3825

To Duct Excel Co., Ltd.

The Department of Science Service presents the test report for the sample named "PIR Foam Panel" Laboratory No. L65/00812.1 as the total of 1 sample with reference to the request No. L65/00812 dated 31 January 2022.

Enclosed herewith the following result avails for your acknowledgement.

กรมวิทยาศาสตร์บริการ
DEPARTMENT OF SCIENCE SERVICE

Department of Science Service

8 March 2022

Division of Engineering Materials
Tel. 0 2201 7130
Fax 0 2201 7127
E-mail : physics@dss.go.th

TEST REPORT

Sample's name	Mark / Brand	Laboratory No.
PIR Foam Panel	Duct Excel	L65/00812.1

Test Result

Density, kg/m^3	51.02

Customer's name	Duct Excel Co., Ltd.
Customer's address	1622/1 Sutthisan Winitchai Road, Huay Kwang, Bangkok 10310
Sample's description	White - yellow solid
Test date	23 - 25 February 2022
Test method	ASTM D1622/D1622M-14

Approved by

(Mr. Anon Pomprasit)

Scientist, Senior Professional Level

Reported by

(Mr. Kritsada Suttipan)

Scientist, Senior Professional Level

Interscience Fire Laboratory
Building 63
Haslar Marine Technology Park
Haslar Road, Gosport
Hampshire PO12 2AG
United Kingdom
Tel. : +44 (0) 20 8692 5050
Fax.: +44 (0) 20 8692 5155
Email: firetesting@intersciencecomms.co.uk

Test Report: ICL/H18/9587 Rev 1

Defence Standard 02-713 Issue 3.
Determination of the Toxicity Index of Products of combustion from Small Specimens of Materials

Sponsored By
Duct Excel Co., Ltd.
1622/1 Suthisan-Vinitchai Road, Huaykwang
Bangkok, Thailand 10310

Test Report: ICL/H18/9587 Rev 1

Defence Standard 02-713 Issue 3.
Determination of the Toxicity Index of Products of combustion from Small Specimens of Materials

Sponsored By
Duct Excel Co., Ltd.
1622/1 Suthisan-Vinitchai Road, Huaykwang
Bangkok, Thailand 10310

1 Purpose of Test

To assess the performance of a material when it is tested in accordance with the procedures specified in Defence Standard 02-713 Issue 3 "Determination of the Toxicity Index of Products of Combustion from Small Specimens of Materials".

2 Description of Test Specimen

The description of the specimen given above 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 nominally 13mm thick Polyisocyanurate (PIR) Rigid Foam.

The sponsor of the test did not provide further details relating to the composition of the material.

3 Conditioning of Test Specimens

The specimens were received on 25th June 2018

The test specimens were conditioned to constant mass at 23 ± 2°C and 50 ± 10% relative humidity for a minimum period of 24 hours prior to testing.

4 Date of Test

The test was performed on .

5 Test Procedure

Test was carried out in accordance with the procedure specified Defence Standard 02-713 Issue 3 "Determination of the Toxicity Index of Products of Combustion from Small Specimens of Materials".

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 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. Uncertainty measurement has not been taken into account when presenting the test results.

Average Specimen mass (g)	1.0020	**Volume of the test chamber m^3**			0.75
Average Burn time (sec)		60			
Gas	**Chemical formula**	**Concentration in chamber (ppm)**	**C_{Θ} (ppm)**	**Cf**	**C_{Θ}/Cf**
Carbon monoxide	CO	5	224.55	4000	0.06
Carbon dioxide	CO_2	5000	149701	100000	1.50
Nitrogen oxides	NO_X	6	299.40	250	1.20
Formaldehyde	HCHO	0	0.00	500	0.00
Ammonia	NH_3	0	0	750	0.00
Acrylonitrile	CH_2CHCN	0	0	400	0.00
Hydrogen cyanide	HCN	0	0.00	150	0.00
Phenol	C_6H_5OH	0	0	250	0.00
Sulphur dioxide	SO_2	0	0.00	400	0.00
Hydrogen sulphide	H_2S	0	0	750	0.00
Hydrogen chloride	HCl	0	0.00	500	0.00
Hydrogen bromide	HBr	0	0.00	150	0.00
Hydrogen fluoride	HF	0	0	100	0.00
				Toxicity Index	2.75

Note : "0" Indicates below the limit of detection.

7 Observations

No significant phenomena was observed.

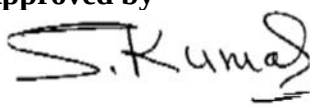
8 Conclusion

When tested in accordance with the procedure specified in Defence Standard 02-713 Issue 3 the material shows a Toxicity index value of 2.75per 100 grammes of product.

Prepared by

C. B. Chong
Fire Scientist

Approved by



S. Kumar
Technical Manager

Date of Issue: 19th July 2018

Date of issue Revision 1: 5th October 2018.

Test No 1					
Specimen mass (g)	1.0023	**Volume of the test chamber m^3**			0.75
Burn time (sec)	60				
Gas	**Chemical formula**	**Concentration in chamber (ppm)**	**C_Θ (ppm)**	**Cf**	**C_Θ/Cf**
Carbon monoxide	CO	5	224.48	4000	0.06
Carbon dioxide	CO_2	5000	149656	100000	1.50
Nitrogen oxides	NO_X	6	299.31	250	1.20
Formaldehyde	HCHO	0	0.00	500	0.00
Ammonia	NH_3	0	0	750	0.00
Acrylonitrile	CH_2CHCN	0	0.00	400	0.00
Hydrogen cyanide	HCN	0	0.00	150	0.00
Phenol	C_6H_5OH	0	0	250	0.00
Sulphur dioxide	SO_2	0	0.00	400	0.00
Hydrogen sulphide	H_2S	0	0	750	0.00
Hydrogen chloride	HCl	0	0.00	500	0.00
Hydrogen bromide	HBr	0	0	150	0.00
Hydrogen fluoride	HF	0	0	100	0.00
				Toxicity Index	2.75

Table 1a

Background concentration (ppm)		
CO	CO_2	NO_X
2	3000	2

1. "0" stands for not detected. Concentration was below the limit of detection of the individual colorimetric tubes.
2. Concentration in the chamber values given in the Table 1 for CO, CO_2 and NO_x are inclusive of background values given in Table 1a.

Test No 2					
Specimen mass (g)	1.0017	**Volume of the test chamber m^3**			0.75
Burn time (sec)	60				
Gas	**Chemical formula**	**Concentration in chamber (ppm)**	**C_Θ (ppm)**	**Cf**	**C_Θ/Cf**
Carbon monoxide	CO	5	224.62	4000	0.06
Carbon dioxide	CO_2	5000	149745	100000	1.50
Nitrogen oxides	NO_X	6	299.49	250	1.20
Formaldehyde	HCHO	0	0.00	500	0.00
Ammonia	NH_3	0	0	750	0.00
Acrylonitrile	CH_2CHCN	0	0	400	0.00
Hydrogen cyanide	HCN	0	0.00	150	0.00
Phenol	C_6H_5OH	0	0	250	0.00
Sulphur dioxide	SO_2	0	0.00	400	0.00
Hydrogen sulphide	H_2S	0	0	750	0.00
Hydrogen chloride	HCl	0	0.00	500	0.00
Hydrogen bromide	HBr	0	0	150	0.00
Hydrogen fluoride	HF	0	0	100	0.00
				Toxicity Index	2.75

Table 2a

Background concentration (ppm)		
CO	CO_2	NO_X
2	3000	2

1. "0" stands for not detected. Concentration was below the limit of detection of the individual colorimetric tubes.
2. Concentration in the chamber values given in the Table 2 for CO, CO_2 and NO_x are inclusive of background values given in Table 2a.

Interscience Fire Laboratory
Building 63
Haslar Marine Technology Park
Haslar Road, Gosport
Hampshire PO12 2AG
United Kingdom
Tel. : +44 (0) 20 8692 5050
Fax.: +44 (0) 20 8692 5155
Email: firetesting@intersciencecomms.co.uk

Test Report: ICL/H18/9586 Rev 1
Test for flammability of Plastic Materials For Parts in Devices and Appliances UL 94 Standard for safety Section 8: Vertical burning test; V-0, V-1, or V-2

Sponsored By
Duct Excel Co., Ltd.
1622/1 Suthisan-Vinitchai Road, Huaykwang
Bangkok, Thailand 10310

Test Report: ICL/H18/9586 Rev 1
Test for flammability of Plastic Materials
For Parts in Devices and Appliances
UL 94 Standard for safety
Section 8: Vertical burning test;
V-0, V-1, or V-2

Sponsored By
Duct Excel Co., Ltd.
1622/1 Suthisan-Vinitchai Road, Huaykwang
Bangkok, Thailand 10310

1 Purpose of Test

To assess the performance of specimens cut from a polymeric sheet when tested in accordance with the procedure specified in UL 94 Section 8 "Vertical burning test" for V-0, V-1, or V-2 rating.

2 Description of Test Specimens

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. All values quoted are nominal, unless tolerances are given. All values quoted are nominal, unless tolerances are given.

The product was a nominally 13mm thick Polyisocyanurate (PIR) Rigid Foam.

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 25th June 2018

The first set of 10 specimens were conditioned for a minimum of 48 hours prior to testing at 23 ± 2°C and 50 ± 5% RH, before testing. A second set were conditioned for a minimum of 168 hours at 70 ± 1°C before being placed into a drying desiccator for 1 hour at ambient temperature, before testing.

4 Date of Test

The test was performed on 16th July 2018

5 Test Procedure

The test was performed in accordance with the procedures specified in UL 94 Section 8 Sub section 8.2 to 8.6 and this report should be read in conjunction with that Standard.

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 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.

The results for specimens conditioned at 23 ± 2 °C and 50 ± 5 % relative humidity for 48 hours are given in table 1:

Table 1

Observation	Specimen No				
	1	2	3	4	5
After flame time (sec) for each individual specimen, t_1	6	8	7	6	6
After flame time (sec) for each individual specimen, t_2	-	-	-	-	-
Afterglow time (sec) after second flame application, t_3	-	-	-	-	-
After flame or afterglow of any specimen up to the holding clamp	-	-	-	-	-
Cotton indicator ignited by flaming particles or droplets	No	No	No	No	No

The results for specimens conditioned at 70 ± 1 °C for 168 hours are given in table 2:

Table 2

Observation	Specimen No				
	1	2	3	4	5
After flame time (sec) for each individual specimen, t_1	5	7	8	8	7
After flame time (sec) for each individual specimen, t_2	-	-	-	-	-
Afterglow time (sec) after second flame application, t_3	-	-	-	-	-
After flame or afterglow of any specimen up to the holding clamp	-	-	-	-	-
Cotton indicator ignited by flaming particles or droplets	No	No	No	No	No

7 Requirements to meet UL classifications are given in the table below:

Observations	Classification requirements		
	V0	V1	V2
Total after flame time (sec) for each individual specimen t_1 or t_2	≤ 10	≤ 30	≤ 30
Total after flame time (sec) for all specimens subjected to test(t_1+ t_2 for 5 samples)	≤ 50	≤ 250	≤ 250
Afterglow time (sec) after second flame application for each individual specimen	≤ 30	≤ 60	≤ 60
After flame or afterglow of any specimen up to the holding clamp	No	No	No
Cotton indicator ignited by flaming particles or droplets	No	No	Yes

8 Conclusion

The specimens tested satisfies the requirements given for a UL 94 rating V0, V1 and V2.

Prepared by

C. B. Chong
Fire Scientist

Approved by

S. Kumar
Technical Manager

Date of Issue: 19th July 2018
Date of Issue revision 1: 5th October 2018.

No. 0307/ 2304

To Duct Excel Co., Ltd.

The Department of Science Service presents the test report for the sample named "Polyisocyanurate (PIR) Foam" Laboratory No. L63/00695.1 as the total of 1 sample with reference to the request No. L63/00695 dated 23 January 2020.

Enclosed herewith the following result avails for your acknowledgement.

Department of Science Service

14 February 2020

Division of Engineering Materials
Tel. 0 2201 7130
Fax 0 2201 7127
E-mail : physics@dss.go.th

TEST REPORT

Sample's name	Mark / Brand	Laboratory No.
Polyisocyanurate (PIR) Foam	Duct Excel	L63/00695.1

Test Results

Flammability	
- Flame class	The material identified in this report meets the criteria to qualify for HF-1 classification.
- Average linear burning rate, mm/min	0

Laboratory No. L63/00695.1

Test item	Flame class			Results									
	HF-1	HF-2	HBF	Preconditioned at 23 °C, 50 % RH for 48 h					Preconditioned at 70 °C for 168 h				
- Specimen No.				1	2	3	4	5	1	2	3	4	5
- Thickness, mm				13.08	13.34	12.78	13.29	12.79	12.77	12.80	13.07	13.19	13.15
1.The duration of burning (t_b) between the 25 mm to the 125 mm mark ,sec	-	-	-	0	0	0	0	0	0	0	0	0	0
2.The distance the specimen burned (L_b) ,mm, between the 25 mm to the 125 mm mark	-	-	-	0	0	0	0	0	0	0	0	0	0
3.The burning rate , mm/min, over a 100 mm span, **or**	-	-	≤ 40 mm/min	0	0	0	0	0	0	0	0	0	0
4.Each specimen cease to burn before flaming or glowing reaches the 125 mm gauge mark	-	-	< 125 mm	25.0	28.0	23.0	22.0	28.5	28.0	29.5	27.5	23.0	25.0
5.Afterflame time, sec	4/5 is ≤ 2 s 1/5 is ≤10 s	4/5 is ≤2 s 1/5 is ≤10 s	-	0	6.5	0	0.5	0	4.5	0	0	0	0
6.Afterglow time for each individual specime, sec	≤ 30 s	≤ 30 s	-	0	0	0	0	0	0	0	0	0	0
7.Cotton indicator ignited by flaming particles or drops	No	Yes	-	No	No	No	No	No	No	No	No	No	No
8.Damaged length for each individual specimen, mm	< 60 mm	< 60 mm	-	25.0	28.0	23.0	22.0	28.5	28.0	29.5	27.5	23.0	25.0

Note : 1. Each specimen is 150 mm long and 50 mm wide.
2. 4/5 means four out of a set of five specimens.
3. 1/5 means one out of a set of five specimens.

Laboratory No. L63/00695.1

Customer's name	Duct Excel Co., Ltd.
Customer's address	1622/1 Sutthisan – Vinitchai Road, Huai Khwang, Hui Khwang, Bangkok 10310
Sample's description	White foam sheet with metal foil in one side
Test date	24 January 2020 – 3 February 2020
Test method	UL 94 Clause 12 Horizontal burning foamed material test

Approved by
(Mr. Anon Pomprasit)
Scientist, Senior Professional Level

Reported by
(Mr. Pongpiput Slangsing)
Scientist, Professional Level

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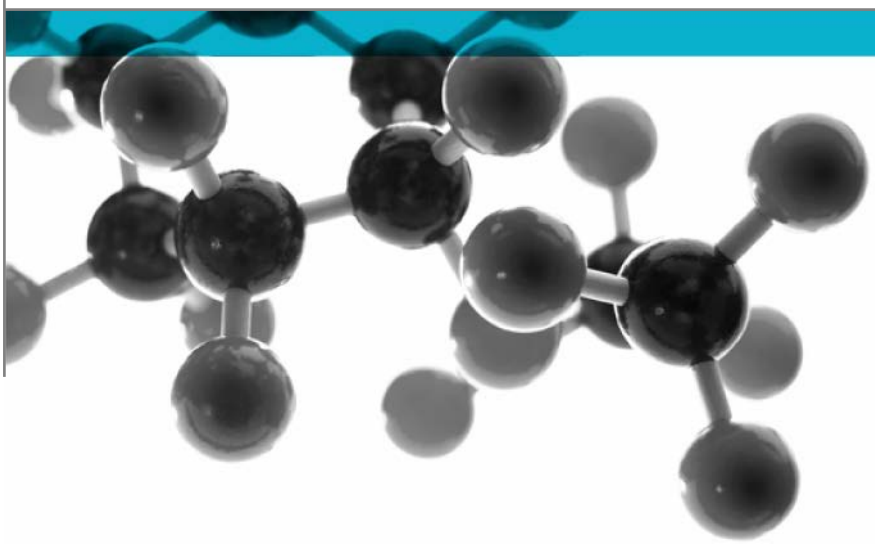
BS 476: Part 6: 1989+A1:2009



Method Of Test For
Fire Propagation For Products

A Report To: Duct Excel Co., Ltd.

Document Reference: 398053

Date: 8th May 2018

Issue No.: 1

Testing
Advising
Assuring

UKAS TESTING
0249

Executive Summary

Objective To determine the performance of the following product when tested in accordance with BS 476: Part 6: 1989+A1: 2009.

Generic Description	Product reference	Thickness	Weight per unit area or density
Rigid polyisocyanurate (PIR) foam panel faced on both sides with embossed aluminium	"PID Panel: APA, APAX and SPA"	20mm	50kg/m^3
Individual components used to manufacture composite:			
Embossed aluminium foil	Not stated	80 microns	0.25kg/m^2
PIR foam	"SAKEPOL S-200"	20mm	50kg/m^3
Embossed aluminium foil	Not stated	80 microns	0.25kg/m^2
Please see page 5 of this test report for the full description of the product tested			

Test Sponsor Duct Excel Co., Ltd., 1622/1 Suthisan Road, Huaykwang, Bangkok, Thailand, 10310

Test Results:

Fire propagation index, I = 3.2

Sub index, i_1 = 1.4

Sub index, i_2 = 0.9

Sub index, i_3 = 0.9

An uncertainty of measurement estimation has been conducted in relation to the fire propagation index, I and the sub index, i_1. The findings are as detailed in Annex A of this report.

Date of Test 27th & 30th April 2018

Signatories

Responsible Officer
T. Mort *
Senior Technical Officer

Authorised
S. Deeming *
Business Unit Head

* For and on behalf of **Exova Warringtonfire**.

Report Issued: 8th May 2018

CONTENTS **PAGE NO.**

Test Details

Purpose of test

To determine the performance of a product when it is subjected to the conditions of the test specified in BS 476: Part 6: 1989+A1: 2009, "Fire tests on building materials and structures, method for fire propagation for products".

The test was performed in accordance with the procedure specified in BS 476: Part 6: 1989+A1: 2009, and this report should be read in conjunction with that British Standard.

Scope of test

BS 476: Part 6: 1989+A1: 2009 specifies a method of test, the result being expressed as a fire propagation index, that provides a comparative measure of the contribution to the growth of fire made by an essentially flat material, composite or assembly. It is primarily intended for the assessment of the performance of internal wall and ceiling linings.

Fire test study group/EGOLF

Certain aspects of some fire test specifications are open to different interpretations. The Fire Test Study Group and EGOLF have identified a number of such areas and have agreed Resolutions which define common agreement of interpretations between fire test laboratories which are members of the Groups. Where such Resolutions are applicable to this test they have been followed.

Instruction to test

The test was conducted on the 27th & 30th April 2018 at the request of Duct Excel Co., Ltd., the sponsor of the test.

Provision of test specimens

The specimens were supplied by the sponsor of the test. **Exova Warringtonfire** was not involved in any selection or sampling procedure.

Conditioning of specimens

The specimens for testing to BS 476: Part 6: 1989+A1: 2009 together with the specimens for testing to BS 476: Part 7: 1997 were received on the 16th April 2018.

Prior to the tests, all of the specimens were conditioned to constant mass at a temperature of 23 ± 2°C and a relative humidity of 50 ± 5%. One specimen from the total sample submitted for test was selected for constant mass verification.

Form in which the specimens were tested

Composite - Combination of materials which are generally recognised in building constructions as discrete entities e.g. coated or laminated materials.

Exposed face

One of two identical faces of the specimens was exposed to the heating conditions of the test.

Description of Test Specimens

The description of the specimens given below has been prepared from information provided by the sponsor of the test. This information has not been independently verified by **Exova Warringtonfire.**

All values quoted are nominal, unless tolerances are given.

General description		Rigid polyisocyanurate (PIR) foam panel faced on both sides with embossed aluminium
Product reference		"PID Panel: APA, APAX and SPA"
Name of manufacturer		Duct Excel Co., Ltd
Thickness		20mm (stated by sponsor) 20.4mm (determined by **Exova Warringtonfire**)
Density		50kg/m^3 (stated by sponsor) 72kg/m^3 (determined by **Exova Warringtonfire**)
Foil	Generic type	Embossed aluminium
	Product reference	**See Note 1 below**
	Detailed description / composition details	**See Note 1 below**
	Name of manufacturer	**See Note 1 below**
	Thickness	80 microns
	Weight per unit area	0.25kg/m^2
	Colour reference	"Silver"
	Flame retardant details	**See Note 2 below**
Adhesive	The foil was auto-adhesively bonded to the foam during the manufacturing process	
Foam	Generic type	Polyisocyanurate (PIR) foam
	Product reference	"SAKEPOL S-200"
	Name of manufacturer	SAKE Co., Ltd. - Korea
	Thickness	20mm.
	Density	50kg/m^3
	Colour reference	"Light-Yellow"
	Flame retardant details	**See Note 1 below**
Adhesive	The foil was auto-adhesively bonded to the foam during the manufacturing process	
Foil	Generic type	Embossed aluminium
	Product reference	**See Note 1 below**
	Detailed description / composition details	**See Note 1 below**
	Name of manufacturer	**See Note 1 below**
	Thickness	80 microns
	Weight per unit area	0.25kg/m^2
	Colour reference	"Silver"
	Flame retardant details	**See Note 2 below**
Brief description of manufacturing process		Foaming polyisocyanurate (PIR) between embossed aluminium in continuous laminating machine

Note 1. The sponsor of the test was unwilling to provide this information.

Note 2. The sponsor of the test has confirmed that no flame retardant additives were utilised in the production of the component.

Test Results

Results

A total of three specimens were tested. The laboratory record sheet relating to each of the test specimens is appended to this report (refer to Tables 1, 2 and 3).

Throughout the test on each specimen careful observation was made of the product's behaviour within the apparatus and special note was taken of any of the phenomena listed in clause 9.2 of the Standard. None of the listed phenomena was observed and the test results on all three specimens tested were valid.

The following test results were obtained for the product.

Fire propagation index, I	**=**	**3.2**
Sub index, i_1	**=**	**1.4**
Sub index, i_2	**=**	**0.9**
Sub index, i_3	**=**	**0.9**

An uncertainty of measurement estimation has been conducted in relation to the fire propagation index, I and the sub index, i_1. The findings are as detailed in Annex A of this report.

NOTE: If a suffix 'R' is included in the above fire propagation index, I, then this indicates that the results should be treated with caution.

Applicability of test result

The test results relate only to the behaviour of the test 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.

Validity

The specification and interpretation of fire test methods are the subject of ongoing development and refinement. Changes in associated legislation may also occur. For these reasons it is recommended that the relevance of test reports over five years old should be considered by the user. The laboratory that issued the report will be able to offer, on behalf of the legal owner, a review of the procedures adopted for a particular test to ensure that they are consistent with current practices, and if required may endorse the test report.

Table 1

Laboratory Record Sheet

FIRE PROPAGATION TEST - BS476:PART 6:1989+A1:2009

Specimen No. : 1 **Date : 27-Apr-18**

Time mins t	Specimen Temperature Deg C Ts	Calibration Temperature Deg C Tc	Ts-Tc/10t	Sub Index Of Performance
0.50	14	13	0.20	
1.00	21	19	0.20	
1.50	27	24	0.20	
2.00	33	28	0.25	
2.50	36	32	0.16	
3.00	41	36	0.17	1.18
4.00	66	68	0.00	
5.00	104	102	0.04	
6.00	137	132	0.08	
7.00	175	156	0.27	
8.00	197	174	0.29	
9.00	235	188	0.52	
10.00	246	198	0.48	1.68
12.00	253	207	0.38	
14.00	246	228	0.13	
16.00	246	236	0.06	
18.00	244	243	0.01	
20.00	240	249	0.00	0.58
Total Index of Performance S			**=**	**3.44**

SubIndex s1 **1.18**

SubIndex s2 **1.68**

SubIndex s3 **0.58**

Index of Performance S **3.44**

Table 2

Laboratory Record Sheet

FIRE PROPAGATION TEST - BS476:PART 6:1989+A1:2009

Specimen No. : 2 **Date : 27-Apr-18**

Time mins t	Specimen Temperature Deg C Ts	Calibration Temperature Deg C Tc	Ts-Tc/10t	Sub Index Of Performance
0.50	16	13	0.60	
1.00	21	19	0.20	
1.50	27	24	0.20	
2.00	32	28	0.20	
2.50	36	32	0.16	
3.00	40	36	0.13	1.49
4.00	71	68	0.08	
5.00	107	102	0.10	
6.00	136	132	0.07	
7.00	157	156	0.01	
8.00	180	174	0.08	
9.00	190	188	0.02	
10.00	205	198	0.07	0.42
12.00	250	207	0.36	
14.00	288	228	0.43	
16.00	282	236	0.29	
18.00	256	243	0.07	
20.00	245	249	0.00	1.15
Total Index of Performance S			**=**	**3.06**

SubIndex s1 **1.49**

SubIndex s2 **0.42**

SubIndex s3 **1.15**

Index of Performance S **3.06**

Table 3

Laboratory Record Sheet

FIRE PROPAGATION TEST - BS476:PART 6:1989+A1:2009

Specimen No. : 3 **Date : 30-Apr-18**

Time mins t	Specimen Temperature Deg C Ts	Calibration Temperature Deg C Tc	Ts-Tc/10t	Sub Index Of Performance
0.50	16	13	0.60	
1.00	23	19	0.40	
1.50	27	25	0.13	
2.00	33	31	0.10	
2.50	37	35	0.08	
3.00	45	39	0.20	1.51
4.00	83	78	0.13	
5.00	121	110	0.22	
6.00	150	144	0.10	
7.00	165	163	0.03	
8.00	183	182	0.01	
9.00	191	193	0.00	
10.00	207	205	0.02	0.51
12.00	254	221	0.28	
14.00	305	234	0.51	
16.00	285	244	0.26	
18.00	259	250	0.05	
20.00	249	256	0.00	1.09
Total Index of Performance S			**=**	**3.11**

SubIndex s1 **1.51**

SubIndex s2 **0.51**

SubIndex s3 **1.09**

Index of Performance S **3.11**

Annex A

Uncertainty of measurement

Specimen No.	1	2	3	Average
Fire propagation index, I	±0.77	±0.77	±0.77	±0.77
Sub index i_1	±0.76	±0.76	±0.76	±0.76

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

Revision History

Issue No :	Re-issue Date:
Revised By:	Approved By:
Reason for Revision:	

Issue No :	Re-issue Date:
Revised By:	Approved By:
Reason for Revision:	

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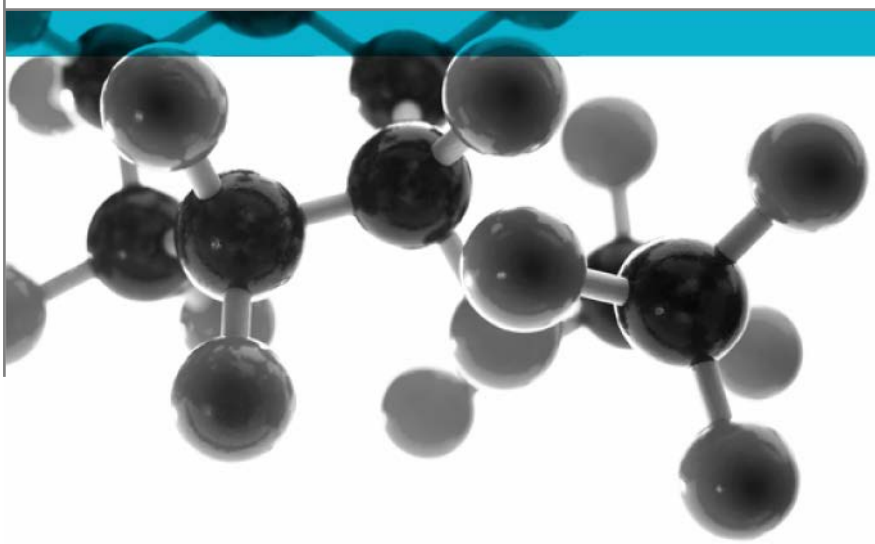
BS 476: Part 7: 1997



Method For Classification Of The Surface Spread Of Flame Of Products

A Report To: Duct Excel Co., Ltd.

Document Reference: 398052

Date: 30th April 2018

Issue No.: 1

Testing
Advising
Assuring

UKAS TESTING
0249

Executive Summary

Objective To determine the surface spread of flame classification of the following product when tested in accordance with BS 476: Part 7: 1997.

Generic Description	Product reference	Thickness	Weight per unit area or density
Rigid polyisocyanurate (PIR) foam panel faced on both sides with embossed aluminium	"PID Panel: APA, APAX and SPA"	20mm	50kg/m^3
Individual components used to manufacture composite:			
Embossed aluminium foil	Not stated	80 microns	0.25kg/m^2
PIR foam	"SAKEPOL S-200"	20mm	50kg/m^3
Embossed aluminium foil	Not stated	80 microns	0.25kg/m^2
Please see page 5 of this test report for the full description of the product tested			

Test Sponsor Duct Excel Co., Ltd., 1622/1 Suthisan Road, Huaykwang, Bangkok, Thailand, 10310

Test Results: **Class 1**

An uncertainty of measurement estimation has been conducted in relation to the distance travelled by the flame front and the findings are as detailed on page 8.

Date of Test 24th April 2018

Signatories

Responsible Officer T. Mort * Senior Technical Officer	Authorised S. Deeming* Business Unit Head

* For and on behalf of **Exova Warringtonfire**.

Report Issued: 30th April 2018

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CONTENTS **PAGE NO.**

Test Details

Purpose of test

To determine the performance of a product when it is subjected to the conditions of the test specified in BS 476: Part 7: 1997, "Fire tests on building materials and structures, method for classification of the surface spread of flame of products". This test was therefore performed in accordance with the procedure specified in BS 476: Part 7: 1997 and this report should be read in conjunction with that British Standard.

Scope of test

BS 476: Part 7: 1997 specifies a method of test for measuring the lateral spread of flame along the surface of a specimen of a product orientated in the vertical position, and a classification system based on the rate and extent of flame spread. It provides data suitable for comparing the performances of essentially flat materials, composites, or assemblies, which are used primarily as the exposed surfaces of walls or ceilings.

Fire test study group/EGOLF

Certain aspects of some fire test specifications are open to different interpretations. The Fire Test Study Group and EGOLF have identified a number of such areas and have agreed Resolutions which define common agreement of interpretations between fire test laboratories which are members of the Groups. Where such Resolutions are applicable to this test they have been followed.

Instruction to test

The test was conducted on the 24th April 2018 at the request of Duct Excel Co., Ltd., the sponsor of the test.

Provision of test specimens

The specimens were supplied by the sponsor of the test. **Exova Warringtonfire** was not involved in any selection or sampling procedure.

Conditioning of specimens

The specimens for testing to BS 476: Part 6: 1989+A1: 2009 together with the specimens for testing to BS 476: Part 7: 1997 were received on the 16th April 2018.

Prior to the tests, all of the specimens were conditioned to constant mass at a temperature of 23 ± 2°C and a relative humidity of 50 ± 5%. One specimen from the total sample submitted for test was selected for constant mass verification.

Form in which the specimens were tested

Composite - Combination of materials which are generally recognised in building constructions as discrete entities e.g. coated or laminated materials. Each specimen was tested in direct contact with a nominally 12mm thick non-combustible backing board.

Exposed face

One of two identical faces of the specimens was exposed to the heating conditions of the test.

Description of Test Specimens

The description of the specimens given below has been prepared from information provided by the sponsor of the test. This information has not been independently verified by **Exova Warringtonfire.**

All values quoted are nominal, unless tolerances are given.

General description		Rigid polyisocyanurate (PIR) foam panel faced on both sides with embossed aluminium
Product reference		"PID Panel: APA, APAX and SPA"
Name of manufacturer		Duct Excel Co., Ltd
Thickness		20mm (stated by sponsor) 20.4mm (determined by **Exova Warringtonfire**)
Density		50kg/m^3 (stated by sponsor) 72kg/m^3 (determined by **Exova Warringtonfire**)
Foil	Generic type	Embossed aluminium
	Product reference	**See Note 1 below**
	Detailed description / composition details	**See Note 1 below**
	Name of manufacturer	**See Note 1 below**
	Thickness	80 microns
	Weight per unit area	0.25kg/m^2
	Colour reference	"Silver"
	Flame retardant details	**See Note 2 below**
Adhesive	The foil was auto-adhesively bonded to the foam during the manufacturing process	
Foam	Generic type	Polyisocyanurate (PIR) foam
	Product reference	"SAKEPOL S-200"
	Name of manufacturer	SAKE Co., Ltd. - Korea
	Thickness	20mm.
	Density	50kg/m^3
	Colour reference	"Light-Yellow"
	Flame retardant details	**See Note 1 below**
Adhesive	The foil was auto-adhesively bonded to the foam during the manufacturing process	
Foil	Generic type	Embossed aluminium
	Product reference	**See Note 1 below**
	Detailed description / composition details	**See Note 1 below**
	Name of manufacturer	**See Note 1 below**
	Thickness	80 microns
	Weight per unit area	0.25kg/m^2
	Colour reference	"Silver"
	Flame retardant details	**See Note 2 below**
Brief description of manufacturing process		Foaming polyisocyanurate (PIR) between embossed aluminium in continuous laminating machine

Note 1. The sponsor of the test was unwilling to provide this information.

Note 2. The sponsor of the test has confirmed that no flame retardant additives were utilised in the production of the component.

Test Results

Results and observations

The test results for the individual specimens, together with observations made during the test and comments on any difficulties encountered during the test are given in Appendix 1.

Classification

In accordance with the class definitions given in BS 476: Part 7: 1997; the specimens tested are classified as Class 1.

An uncertainty of measurement estimation has been conducted in relation to the distance travelled by the flame front and the findings are as detailed on page 8.

Criteria for classification

If the prefix 'D' or suffix 'R' or 'Y' is included in the classification, this indicates that the results should be treated with caution. An explanation of the reason for the prefix and suffixes is given in Appendix 2, together with the classification limits specified in the Standard.

Applicability of test result

The test results relate only to the behaviour of the test 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.

Validity

The specification and interpretation of fire test methods are the subject of ongoing development and refinement. Changes in associated legislation may also occur. For these reasons it is recommended that the relevance of test reports over five years old should be considered by the user. The laboratory that issued the report will be able to offer, on behalf of the legal owner, a review of the procedures adopted for a particular test to ensure that they are consistent with current practices, and if required may endorse the test report.

Appendix 1 – Test Results

SPECIMEN No.	1	2	3	4	5	6
Maximum distance travelled at 1.5 minutes (mm)	<50	<50	50	50	50	50
Distance (mm)	Time to travel to indicated distance (minutes : seconds)					
75						
165						
190						
215						
240						
265						
290						
375						
455						
500						
525						
600						
675						
710						
750						
785						
825						
Time to reach maximum distance travelled	1:00	1:00	1:00	1:00	1:00	1:00
Maximum distance travelled in 10 minutes (mm)	<50	<50	50	50	50	50

Note: Six specimens are usually tested. If the test on any specimen is deemed to be invalid, as defined in the Standard, it is permissible for up to a maximum of nine specimens to be tested in order to obtain the six valid test results.

Observations made during test and comments on any difficulties encountered during the test:

In the case of each specimen tested, blistering of the surface was observed, extending up to a maximum distance of 240mm.

Uncertainty of measurement

Specimen No.	1	2	3	4	5	6
Maximum distance travelled at 1.5 minutes (mm)	±0	±0	±3	±3	±3	±3
Maximum distance travelled in 10 minutes (mm)	±0	±0	±3	±3	±3	±3

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

Appendix 2 – Classification Criteria

Classification of spread of flame

Classification	Spread of Flame at 1.5 min		Final Spread of Flame	
	Limit (mm)	Limit for one specimen (mm)	Limit (mm)	Limit for one specimen (mm)
Class 1	165	165 + 25	165	165 + 25
Class 2	215	215 + 25	455	455 + 45
Class 3	265	265 + 25	710	710 + 75
Class 4	Exceeding the limits for class 3			

Explanation of prefix and suffixes which may be added to the classification

1. A suffix R is added to the classification if more than six specimens are required in order to obtain six valid test results (e.g. class 2R).

2. A prefix D is added to the classification of any product which does not comply with the surface characteristics specified in the Standard and has therefore been tested in a modified form (e.g. class D3).

3. A suffix Y is added to the classification if any softening and/or other behaviour that may affect the flame spread occurs (e.g. class 3Y).

For example, a classification of D3RY could be achieved indicating (a) a modified surface has been used; (b) a class 3 result has been obtained; (c) additional specimens have been used to obtain 6 valid results and; (d) softening and/or other behaviour has occurred which is considered to have affected the test result.

Revision History

Issue No :	Re-issue Date:
Revised By:	Approved By:
Reason for Revision:	

Issue No :	Re-issue Date:
Revised By:	Approved By:
Reason for Revision:	

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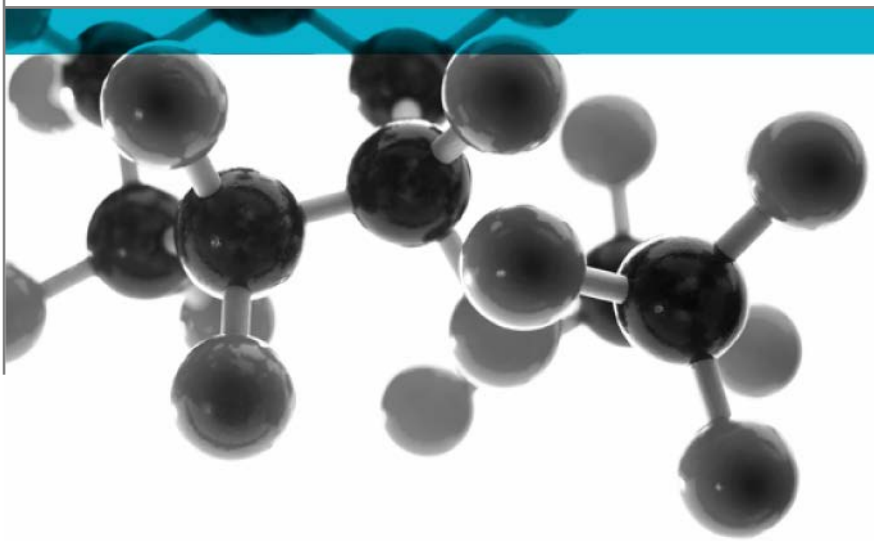
Class 0 Summary Report



Including Opinion Of Compliance With The Requirements For A Class 0 Surface As Defined In Paragraph A13(b) Of Approved Document B (Volumes 1 & 2), (2006 Edition) 'Fire Safety' To The Building Regulations 2000

A Report To: Duct Excel Co., Ltd.

Document Reference: 398052 & 398053

Date: 8th May 2018

Issue No.: 1

Testing
Advising
Assuring

Executive Summary

Objective

To assess the results of tests to BS 476:Part 6:1989+A1: 2009 and BS 476:Part 7:1997, obtained on specimens of the following product and to provide an opinion of compliance with the requirements for a Class 0 surface, as defined in Approved Document B to the Building Regulations 2000.

Generic Description	Product reference	Thickness	Weight per unit area or density
Rigid polyisocyanurate (PIR) foam panel faced on both sides with embossed aluminium	"PID Panel: APA, APAX and SPA"	20mm	50kg/m^3
Individual components used to manufacture composite:			
Embossed aluminium foil	Not stated	80 microns	0.25kg/m^2
PIR foam	"SAKEPOL S-200"	20mm	50kg/m^3
Embossed aluminium foil	Not stated	80 microns	0.25kg/m^2
Rigid polyisocyanurate (PIR) foam panel faced on both sides with embossed aluminium			

Test Sponsor

Duct Excel Co., Ltd., 1622/1 Suthisan Road, Huaykwang, Bangkok, Thailand, 10310

Opinion:

We consider the results of the tests to BS 476:Part 6:1989+A1: 2009 and BS 476:Part 7: 1997, demonstrate that the product, as tested, complies with the requirements for Class 0, as defined in paragraph A13(b) of Approved Document B, `Fire Safety', to the Building Regulations 2000.

Date of Test

24th, 27th & 30th April 2018

Signatories

Responsible Officer T. Mort* Senior Technical Officer	Authorised S. Deeming * Business Unit Head

* For and on behalf of **Exova Warringtonfire**.

Report Issued: 8th May 2018

CONTENTS **PAGE NO.**

Test Details

Terms Of Reference

To assess the results of tests to BS 476:Part 6:1989+A1: 2009 and BS 476:Part 7:1997, obtained on specimens of a product and to provide an opinion of compliance with the requirements for a Class 0 surface, as defined in Approved Document B to the Building Regulations 2000.

Introduction

Specimens of a product have been tested in accordance with the test methods specified in BS 476: Part 6: 1989+A1: 2009 'Method of test for fire propagation for products' and BS 476: Part 7: 1997 'Method of test to determine the classification of the surface spread of flame of products'. The results of the tests are fully reported in the **Exova Warringtonfire** test reports No's. 398052 and 398053.

This summary test report has been prepared at the request of the sponsor and relates the results of the tests to the requirements for a Class 0 surface of a material or composite product, as defined in paragraph A13(b) of Approved Document B, `Fire Safety', to the Building Regulations 2000.

This summary should be read in conjunction with, and not accepted as a substitute for, the **Exova Warringtonfire** test reports No's. 398052 and 398053. Those test reports may include additional information which may be relevant to the assessment of the potential fire hazard of the product.

Face subjected to tests

The specimens were mounted in the test positions such that one of two identical faces was exposed to the heating conditions of the tests.

Results of test

The following results were obtained for the specimens, which were tested.

BS 476: Part 6: 1989+A1: 2009

Fire propagation index, I	=	3.2
subindex, i_1	=	1.4
subindex, i_2	=	0.9
subindex, i_3	=	0.9

BS 476: Part 7: 1997

Class 1 surface spread of flame

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

Description of Test Specimens

The description of the specimens given below has been prepared from information provided by the sponsor of the test. This information has not been independently verified by **Exova Warringtonfire.** All values quoted are nominal, unless tolerances are given.

General description		Rigid polyisocyanurate (PIR) foam panel faced on both sides with embossed aluminium
Product reference		"PID Panel: APA, APAX and SPA"
Name of manufacturer		Duct Excel Co., Ltd
Thickness		20mm (stated by sponsor) 20.4mm (determined by **Exova Warringtonfire**)
Density		50kg/m^3 (stated by sponsor) 72kg/m^3 (determined by **Exova Warringtonfire**)
Foil	Generic type	Embossed aluminium
	Product reference	**See Note 1 below**
	Detailed description / composition details	**See Note 1 below**
	Name of manufacturer	**See Note 1 below**
	Thickness	80 microns
	Weight per unit area	0.25kg/m^2
	Colour reference	"Silver"
	Flame retardant details	**See Note 2 below**
Adhesive	The foil was auto-adhesively bonded to the foam during the manufacturing process	
Foam	Generic type	Polyisocyanurate (PIR) foam
	Product reference	"SAKEPOL S-200"
	Name of manufacturer	SAKE Co., Ltd. - Korea
	Thickness	20mm.
	Density	50kg/m^3
	Colour reference	"Light-Yellow"
	Flame retardant details	**See Note 1 below**
Adhesive	The foil was auto-adhesively bonded to the foam during the manufacturing process	
Foil	Generic type	Embossed aluminium
	Product reference	**See Note 1 below**
	Detailed description / composition details	**See Note 1 below**
	Name of manufacturer	**See Note 1 below**
	Thickness	80 microns
	Weight per unit area	0.25kg/m^2
	Colour reference	"Silver"
	Flame retardant details	**See Note 2 below**
Brief description of manufacturing process		Foaming polyisocyanurate (PIR) between embossed aluminium in continuous laminating machine

Note 1. The sponsor of the test was unwilling to provide this information.

Note 2. The sponsor of the test has confirmed that no flame retardant additives were utilised in the production of the component.

Classification

Opinion

We consider the results of the tests detailed above demonstrate that the product, as tested, complies with the requirements for Class 0, as defined in paragraph A13(b) of Approved Document B, `Fire Safety', to the Building Regulations 2000.

Validity of opinion

This opinion is based on the requirements of the Building Regulations at the date of this report. If the Building Regulations are revised or amended in any way subsequent to that date, care must be taken to ensure that this opinion is not invalidated by those revisions or amendments.

The opinion has been formulated on the assumption that the specimens are representative of the product in practice. **Exova Warringtonfire** was not involved in any sampling or selection procedures which would confirm this or in any audit testing which would provide confidence in the consistency of the product in the tests.

Revision History

Issue No :	Re-issue Date:
Revised By:	Approved By:
Reason for Revision:	

Issue No :	Re-issue Date:
Revised By:	Approved By:
Reason for Revision:	

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info.toronto.fire@element.com
element.com

ASTM E 84 Surface Burning Characteristics of "PID Panel (Pre-Insulated Duct Panel)"

A Report To:	**Duct Excel Co., Ltd.** 1622/1 Suthisan-Vinijchai Road Huaykwang, Bangkok 10310 Thailand
Phone:	+1 66632244996
Attention: E-mail:	Trinnatee Chotimongkol trinnatee@ductexcel.co.th
Submitted by:	Element Fire Testing
Report No.	22-002-270(Revision 1) 4 Pages
Date:	July 12, 2022

1.0 ACCREDITATION

ISO/IEC 17025 for a defined Scope of Testing by the American Association for Laboratory Accreditation (A2LA)

2.0 SPECIFICATIONS OF ORDER

Determine the Flame Spread and Smoke Developed Indices based upon a single test conducted in accordance with ASTM E 84-22, as per Element Quotation No. 22-002-363045 dated June 15, 2022.

2.1 History of Revision

This report supersedes Element Test Report No. 22-002-270, originally issued on July 11, 2022. It is revised to amend the reported sample thickness in Section 5.0.

3.0 SAMPLE IDENTIFICATION (Element sample identification number 22-002-S0270)

Faced, insulated panel system described as, "Polyisocyanurate Foam (PIR)", and identified as:
"PID Panel (Pre-Insulated Duct Panel)"

4.0 TEST PROCEDURE

The method, designated as ASTM E 84-22 "*Standard Method of Test for Surface Burning Characteristics of Building Materials*", is designed to determine the relative surface burning characteristics of materials under specific test conditions, where the material under test is mounted so that it forms the ceiling of a horizontal fire tunnel. A specified airflow is introduced through the tunnel and a specified flame is applied to one end. Observations are then made regarding the rate of flame spread along the specimen. Results are expressed in terms of Flame Spread Index (FSI) and Smoke Developed Index (SDI). There is no established relationship between those two values.

Although the procedure is applicable to materials, products and assemblies used in building construction for development of comparative surface spread of flame data, the test results may not reflect the relative surface burning characteristics of tested materials under all building fire conditions.

5.0 SAMPLE PREPARATION

The test specimen consisted of a total of five sections of material, each approximately 0.787 inches (20 mm) in total thickness by 21 inches (533 mm) in width by 58 inches (1473 mm) in length. The sections were butted together to create the specimen length. The integrated aluminum end flanges were left in-place during testing. Prior to testing, the specimen was conditioned to constant weight at a temperature of 73 ± 5°F (23 ± 3°C) and a relative humidity of 50 ± 5%. During testing, the metal facer surface was exposed to the test flame, as marked.

The testing was performed on: 2022-07-11

6.0 SUMMARY OF TEST PROCEDURE

The tunnel is preheated to 150 ± 5°F (66 ± 2.8°C), as measured by the floor-embedded thermocouple located 23.25 feet (7087 mm) downstream of the burner ports, and is allowed to cool to 105 ± 5°F (40.5 ± 2.8°C), as measured by the floor-embedded thermocouple located 13 feet (3962 mm) from the burners. The tunnel lid is then raised and the test specimen is placed along the ledges of the tunnel so as to form a continuous ceiling 24 feet (7315 mm) long, approximately 12 inches (305 mm) above the floor. Three 8 foot (2438 mm) sections of 0.25 inch (6 mm) cement board are then placed on the back side of the specimen and the lid is then lowered into place.

Upon ignition of the gas burners, the flame spread distance is observed and recorded every second. Flame spread distance versus time is plotted. Calculations ignore all flame front recessions and Flame Spread Index (FSI) is determined by calculating the total area under the curve for the test sample. If the area under the curve (A) is less than or equal to 97.5 min·ft, then FSI = 0.515·A; if greater, FSI = 4900/(195-A). FSI is then rounded to the nearest multiple of 5.

Smoke Developed Index (SDI) is determined by dividing the total area under the obscuration curve by that established for liquid heptane, and multiplying by 100. SDI is then rounded to the nearest multiple of 5 if less than 200. SDI values over 200 are rounded to the nearest multiple of 50.

7.0 TEST RESULTS

SAMPLE: "PID Panel (Pre-Insulated Duct Panel)"

Approx. Time to Ignition (s)	Maximum Flame Front Distance	Time to Maximum Flame Front (s)	Flame Spread Index (FSI)	Smoke Developed Index (SDI)
69	(ft.): 5.1 (m): 1.55	293	**20**	**250**

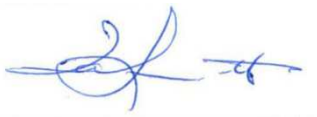
7.1 Observations of Burning Characteristics

The material ignited approximately 69 seconds after exposure to the test flame. The metal facing material was observed to split at approximately 45 seconds.

8.0 INTERPRETATION OF RESULTS

Industry documents such as the International Building Code (IBC) or NFPA 101 Life Safety Code refer to ASTM E 84 (UL 723, NFPA 255) test results using the following material classification categories:

	Flame-Spread Index (FSI)	Smoke Developed Index (SDI)
Class 1 or Class A	0 - 25	450 Maximum
Class 2 or Class B	26 - 75	450 Maximum
Class 3 or Class C	76 - 200	450 Maximum
Results Classification (if applicable):		**Class 1 or Class A**



Francis Williams,
Technician.

Ian Smith,
Technical Manager.

Notes: This report is related only to the sample identified and shall not be reproduced, except in full, without approval. It is covered under Element Materials Technology Canada Inc. Standard Terms and Conditions of Contract, which are accessible at www.element.com, or by calling 1-866-263-9268. ASTM E 84 is a well-established test method that reports data in the form of indices. As such, MU cannot be calculated. In the reporting instructions, calculated values are rounded to the nearest multiple of 5 for FSI, and 5 or 50 for SDI, depending on the result. Since the rounding ranges establish precision and include potential uncertainty, by following the reporting instructions, the lab is considered to have satisfied the MU reporting requirements of ISO/IEC 17025.

9.0 TEST CHARTS **ASTM E 84-22**

Sample: "PID Panel (Pre-Insulated Duct Panel)"

Chart 1. FLAME SPREAD

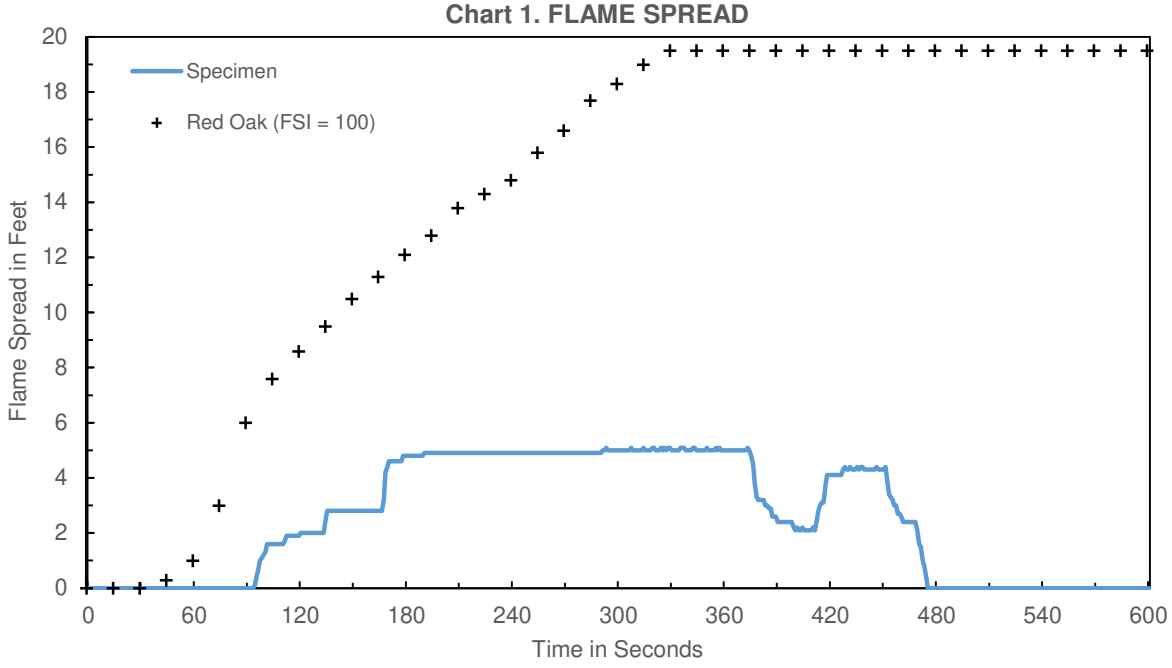
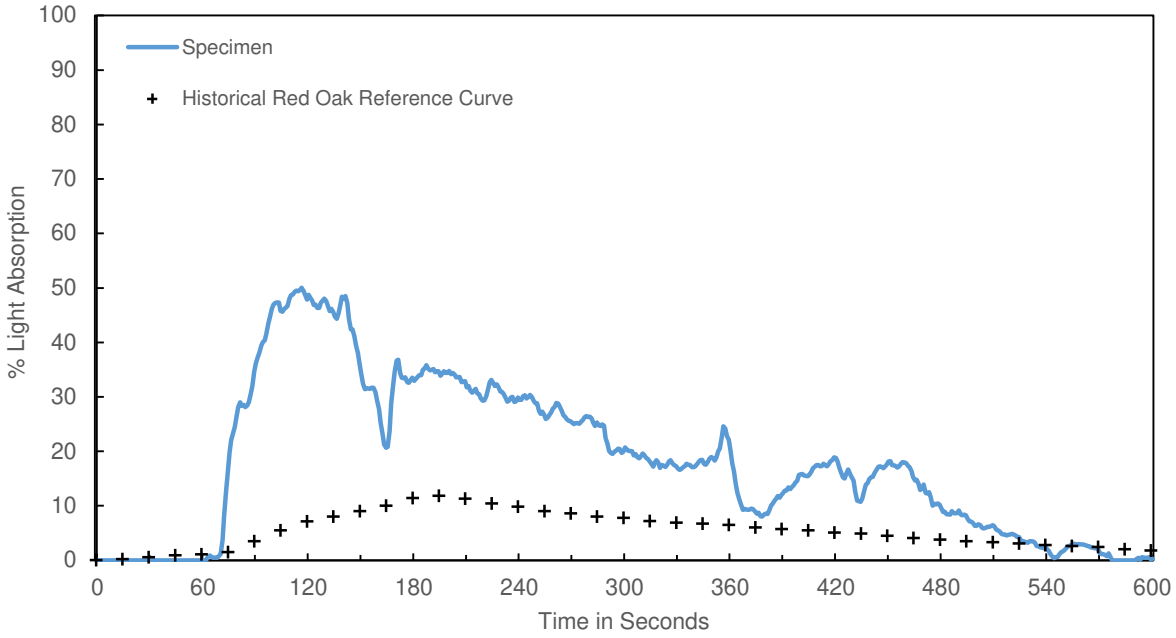


Chart 2. SMOKE DEVELOPED



Calculated Flame Spread (CFS)	Rounded Flame Spread Index (**FSI**)	Calculated Smoke Developed (CSD)	Rounded Smoke Developed Index (**SDI**)	Maximum 23' Air Temperature (°F)
20.1	**20**	262.3	**250**	481

AWTA PRODUCT TESTING

Australian Wool Testing Authority Ltd - trading as AWTA Product Testing
A.B.N 43 006 014 106

1st Floor, 191 Racecourse Road, Flemington, Victoria 3031
P.O Box 240, North Melbourne, Victoria 3051
Phone (03) 9371 2400

TEST REPORT

Client : Duct Excel Co.,Ltd
1622/1 Sutthisan-Vinitchai Road
Huai Khwang,Huai Khwang
Bangkok 10310 Thailand

Test Number : 20-004810
Issue Date : 1/10/2020
Print Date : 1/10/2020

Sample Description
Clients Ref : "Pre-Insulated PIR Duct Panel"
Rigid Ducting
Colour : Silver
End Use : Ducting

UL 181.11-2013 **Burning Test - Air Duct**

Date of Testing			01/10/2020	
Sample Tested			Assembly	
External	Vertical	45 deg	Horizontal	
1st after flame time	0	0	0	sec
1st after glow time	0	0	0	sec
2nd after flame time	0	0	0	sec
2nd after glow time	0	0	0	sec
Did flaming or glowing travel full length of specimen ?	No	No	No	
Did flaming droplets ignite cotton ?	N/A	No	No	
Internal	Vertical	45 deg	Horizontal	
1st after flame time	0	0	0	sec
1st after glow time	0	0	0	sec
2nd after flame time	0	0	0	sec
2nd after glow time	0	0	0	sec
Did flaming or glowing travel full length of specimen ?	No	No	No	

216338 46743

Accredited for compliance with ISO/IEC 17025 - Testing

APPROVED SIGNATORY

MICHAEL A. JACKSON B.Sc.(Hons)
MANAGING DIRECTOR

0204/11/06

Test Report 4681859 Date : 17-Aug-2020

Client : DUCT EXCEL CO.,LTD
1622/1 Suthisarn-Vinitchai Road, Huaykwang, Huaykwang, Bangkok 10310 Thailand

The following sample(s) was/were submitted and identified by client as:

Sample Name : Aluminium Foil
Sample Description : Antibacterial Coating

The following sample(s) was/were identified by SGS as:

SGS Sample No. : 4843657
Sample Condition : Sample is contained in a plastic bag.
Quantity Submitted : 12 pcs

Date Received : 4-Aug-2020 Date Commenced : 5-Aug-2020

Signed for and on behalf of
SGS (Thailand) Limited

Jirapan Vilaipol
Microbiological Lab Manager

TEST RESULTS

Test Required : Antibacterial activity and efficacy (Quantitative) - Staphylococcus aureus ATCC 6538P (and)
- Escherichia coli ATCC 8739

Test Method : Based on JIS Z 2801:2010

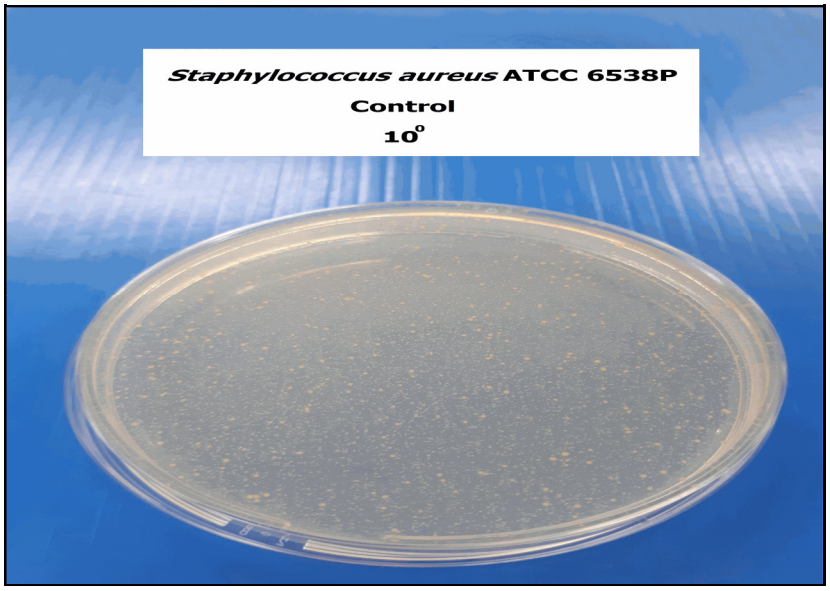
Tested microorganism	Concentration of bacteria (CFU/ml)	Initial inoculum concentration (CFU/piece of samples)	The number of bacteria recovered from control at 0 hr. contact time(CFU/piece of samples)	The number of bacteria recovered from control at 24 hrs. contact time(CFU/piece of samples)	The number of bacteria recovered from tested sample at 24 hrs. contact time(CFU/piece of samples)	Value of antimicrobial activity(R)	%Reduction
Staphylococcus aureus ATCC 6538P	720,000	290,000 (5.5 log)	270,000 (5.4 log)	350,000 (5.5 log)	50 (1.7 log)	3.8	99.98
Escherichia coli ATCC 8739	300,000	120,000 (5.1 log)	100,000 (5.0 log)	6,000,000 (6.8 log)	40 (1.6 log)	5.2	99.96

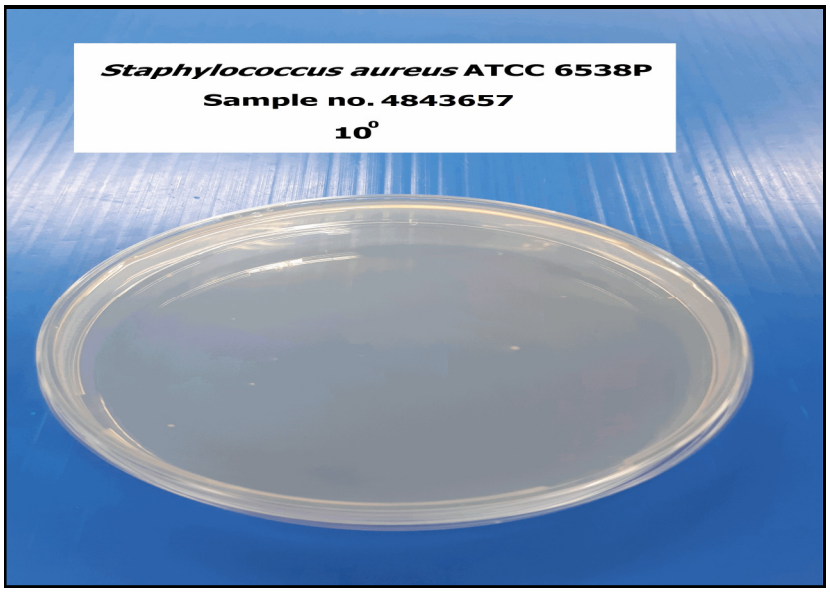
Remark
1. The % Reduction is calculated based on customer's requirement.
2. % Reduction = (A-B)/A * 100
   where,
   A = The number of bacteria recovered from control at 0 hrs. contact time(CFU/piece of samples)
   B = The number of bacteria recovered from tested sample at 24 hrs. contact time(CFU/piece of samples)
3. R = (Ut - Uo)- (At - Uo) = Ut - At

Where, R : antibacterial activity
Uo : average of logarithm numbers of viable bacteria immediately after inoculation on untreated test piece
Ut : average of logarithm numbers of viable bacteria after inoculation on untreated test piece after 24 h
At : average of logarithm numbers of viable bacteria after inoculation on antibacterial test piece after 24 h

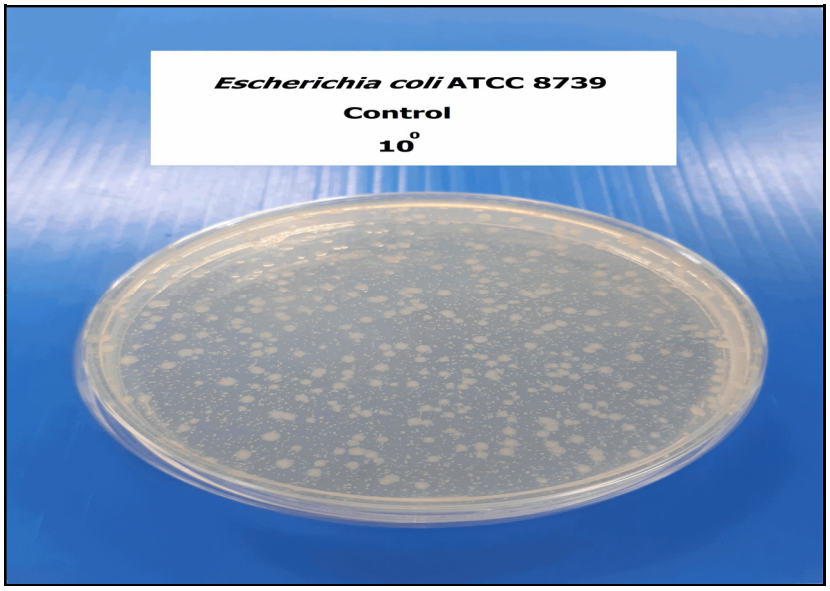
Criteria : The value of antimicrobial activity obtained by the testing methods of this standard shall not be less than 2.0

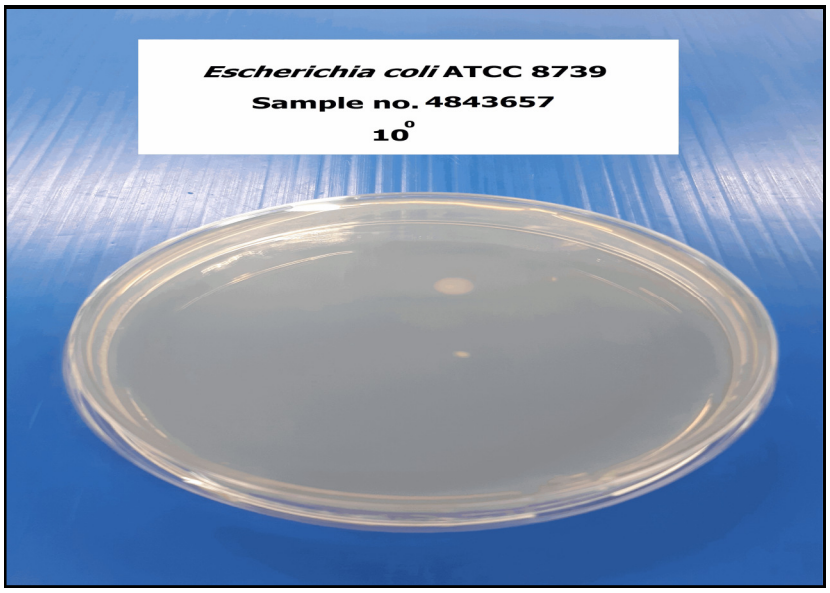
SAMPLE/ATTACHMENT PICTURE





SAMPLE/ATTACHMENT PICTURE





SAMPLE/ATTACHMENT PICTURE

********** End of Report **********

No. 0307/ **6449**

To Duct Excel Co., Ltd.

The Department of Science Service presents the test report for the sample named "PVC Flanges for Pre-insulated Duct Panel (PID) Accessories" Laboratory No. L67/03080.1 as the total of 1 sample with reference to the request No. L67/03080 dated 4 April 2024.

Enclosed herewith the following results avail for your acknowledgement.

กรมวิทยาศาสตร์บริการ
Department of Science Service
1 May 2024
DEPARTMENT OF SCIENCE SERVICE

Division of Engineering Materials
Tel. 0 2201 7130
Fax 0 2201 7127
E-mail : physics@dss.go.th

TEST REPORT

Sample's name	Mark / Brand	Laboratory No.
PVC Flanges for Pre-insulated Duct Panel (PID) Accessories	Duct Excel	L67/03080.1

Test Results

Flammability test	
Flame class	The material identified in this report meets the criteria to qualify for V-0 classification.

Test item	Flame class			Results									
	V-0	V-1	V-2	Preconditioned at 23 °C, 50% RH for 48 hours					Preconditioned at 70 °C for 168 hours				
- Specimen No.				1	2	3	4	5	1	2	3	4	5
- Thickness, mm				1.79	1.78	1.80	1.78	1.80	1.80	1.82	1.77	1.79	1.80
1. Afterflame time after first flame application for each individual specimen t_1 , s	≤ 10	≤ 30	≤ 30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2. Afterflame time after second flame application for each individual specimen t_2 , s	≤ 10	≤ 30	≤ 30	0.5	0.0	4.0	0.5	6.5	2.0	5.5	4.5	4.0	1.5
3. Afterglow time after second flame application for each individual specimen t_3 , s	-	-	-	0.0	1.5	0.5	0.0	0.5	0.5	0.0	0.0	0.0	0.0
4. Total afterflame time for any condition set (t_1 + t_2 for the 5 specimens), s	≤ 50	≤ 250	≤ 250	11.5					17.5				
5. Afterflame plus afterglow time for each individual specimen after the second flame application (t_2 + t_3), s	≤ 30	≤ 60	≤ 60	0.5	1.5	4.5	0.5	7.0	2.5	5.5	4.5	4.0	1.5
6. Afterflame or afterglow of any specimen up to the holding clamp	No	No	No	No	No	No	No	No	No	No	No	No	No
7. Cotton indicator ignited by flaming particles or drops	No	No	Yes	No	No	No	No	No	No	No	No	No	No

Laboratory No. L67/03080.1

Customer's name	Duct Excel Co., Ltd.
Customer's address	1622/1 Suthisarn vinijchai Rd, Huai Khwang, Huai Khwang, Bangkok Thailand 10310
Sample's description	Grey rigid sheet
Test date	17 - 24 April 2024
Test method	UL 94 Clause 8 ((20 mm) Vertical Burning Test ; V-0, V-1 or V-2)

Approved by

(Mr. Jaroon Junsomboon)

Scientist, Senior Professional Level

Reported by

(Mr. Pongpiput Slangsing)

Scientist, Professional Level

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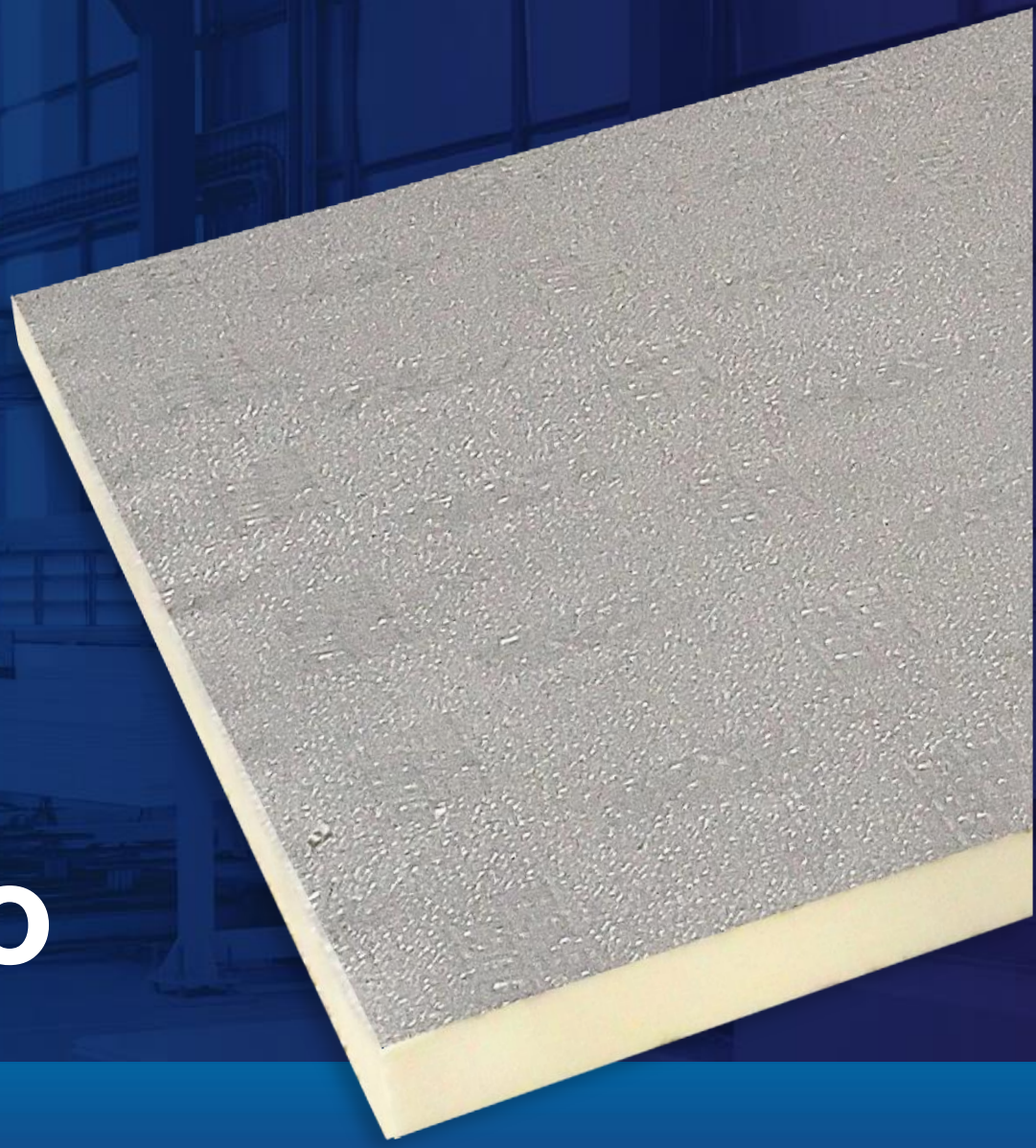
PID PANEL Portfolio



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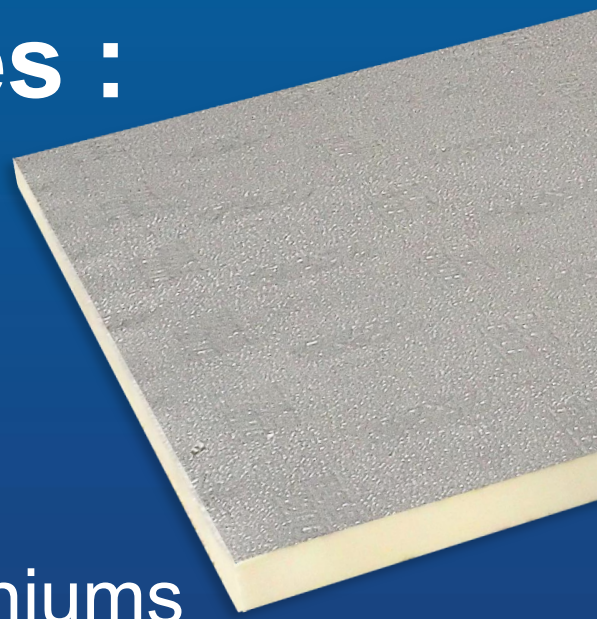
Project References :



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- เดอะมอลล์ บางแค
- SIAM PARAGON (Renovate)
- KING POWER รางน้ำ
- POWER BUY โรบินสันลาดกระบัง
- FOOD COURT โรบินสันลาดกระบัง
- FOOD COURT แฟชั่นไอส์แลนด์
- SUPER SPORT เซ็นทรัลสุวรรณภูมิ
- ADIDAS เซ็นทรัลลาดกระบัง
- POWER BUY โรบินสัน – สุพรรณบุรี
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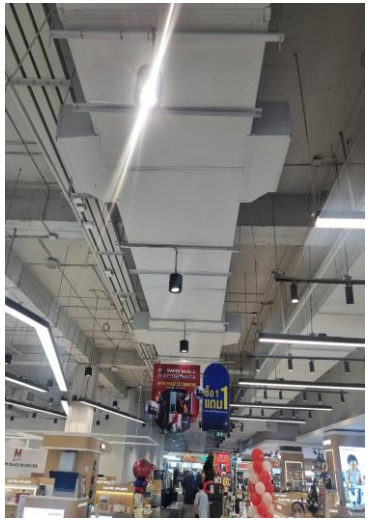

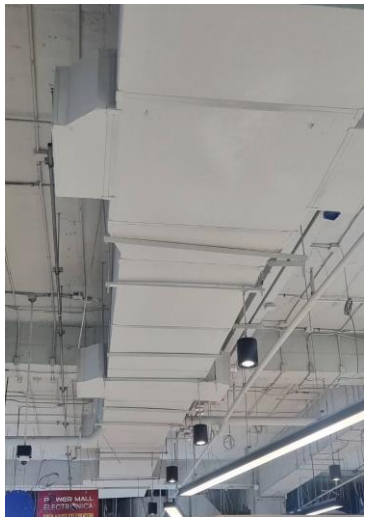

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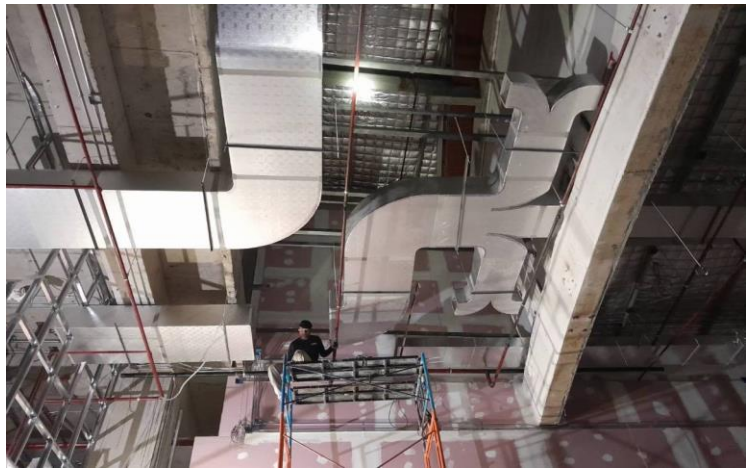

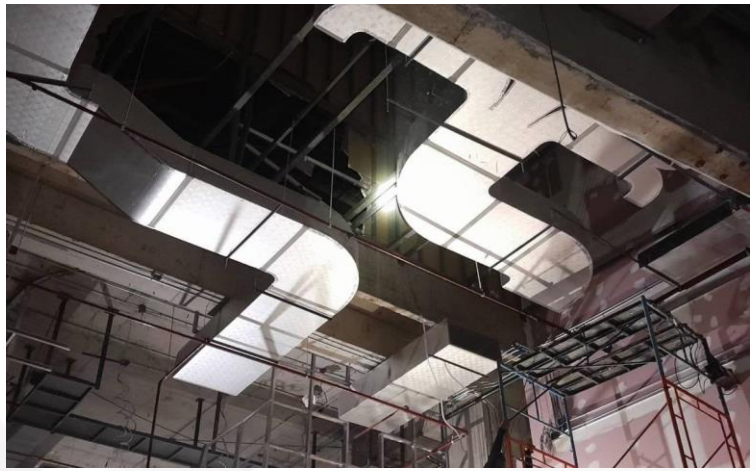

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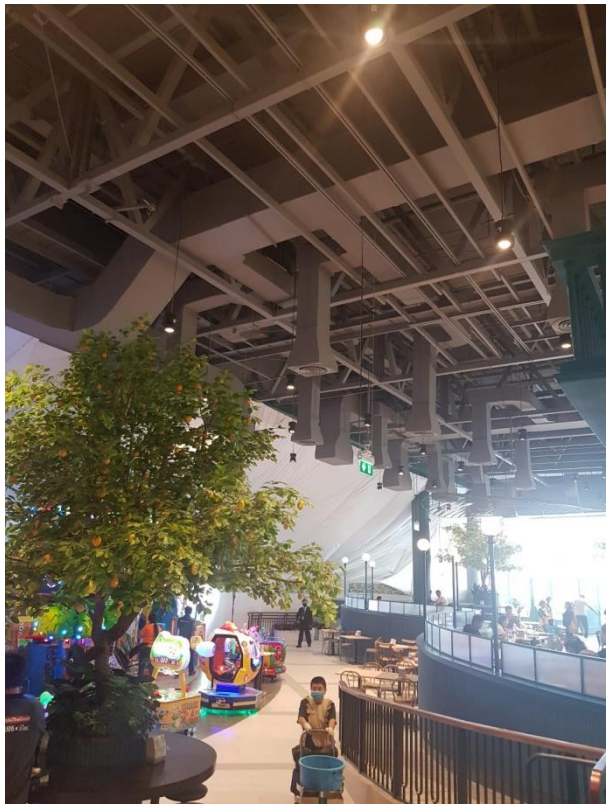
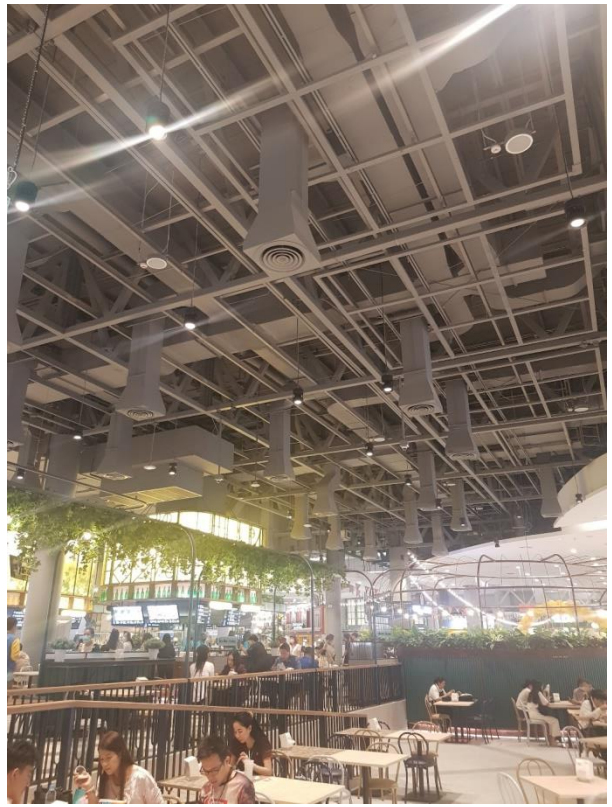
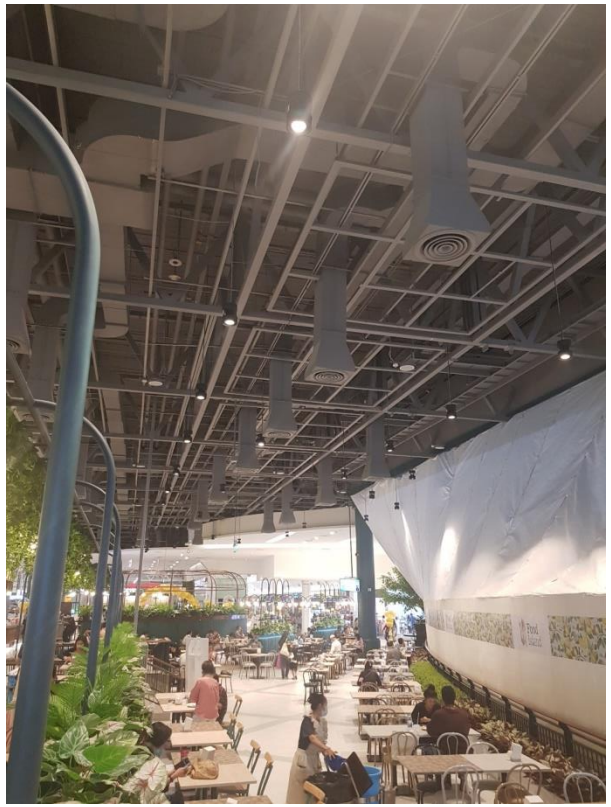
FOOD COURT แฟชั่นไอส์แลนด์







โดย บริษัท

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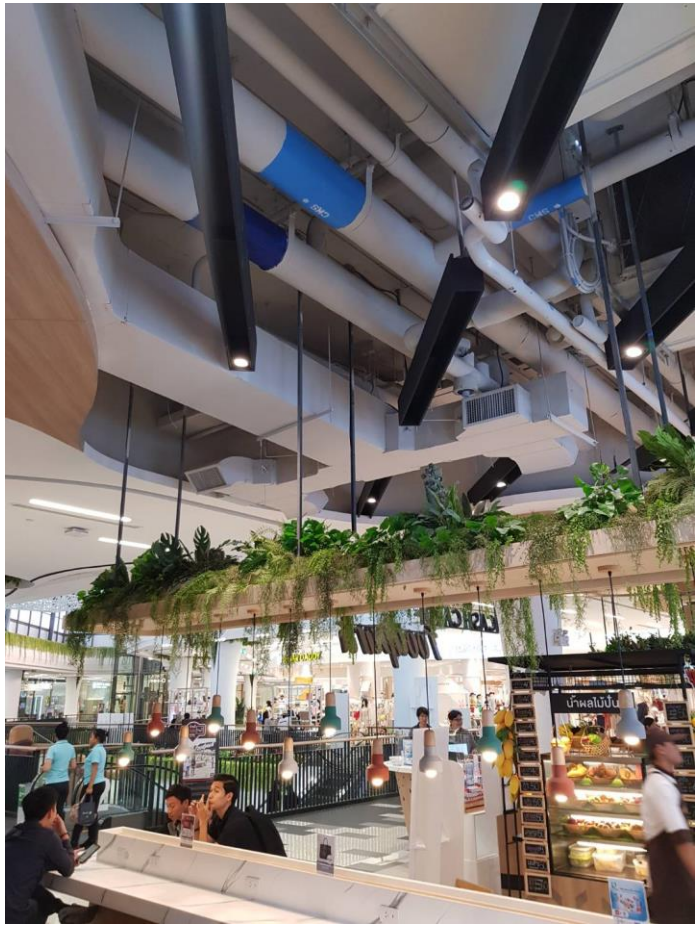
FOOD COURT โรบินสันลาดกระบัง - กรุงเทพ



DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Factories :

- KCE ELECTRONICS HUB – ลาดกระบัง
- JASPER- บางพลี
- LUMENTUM – นวนคร ปทุมธานี
- เบสซี่ คลอง 8 – ปทุมธานี
- NEO FACTORY – คลอง 13 ปทุมธานี
- OHLINS ADVANCED SUSPENSION TECHNOLOGY – ชลบุรี
- PPN MARKETING – บางปะกง
- ไทยรวมสินพัฒนาอุตสาหกรรม – สมุทรสาคร

DUCT EXCEL®
Always Excellent!

ISO 9001 : 2015

Factories

เบสซี่ แอรอน - ลำลูกกา

โดย บริษัท วีเค แอ็พพลาย

DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Factories

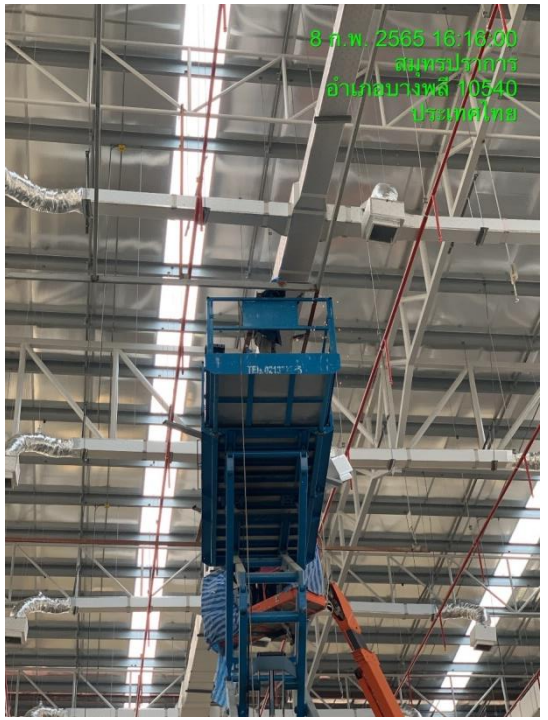
โรงงาน NEO FACTORY – คลอง 13 ปทุมธานี

DUCT EXCEL®
Always Excellent!

ISO 9001 : 2015

Factories

JASPER - บางพลี

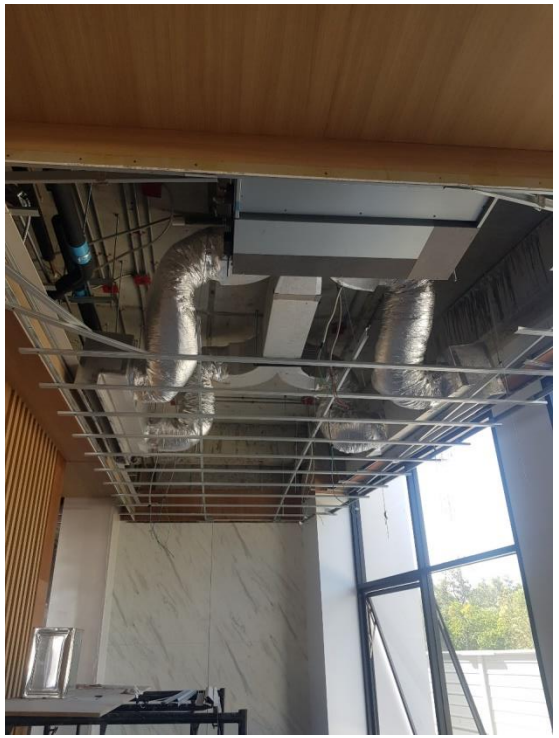


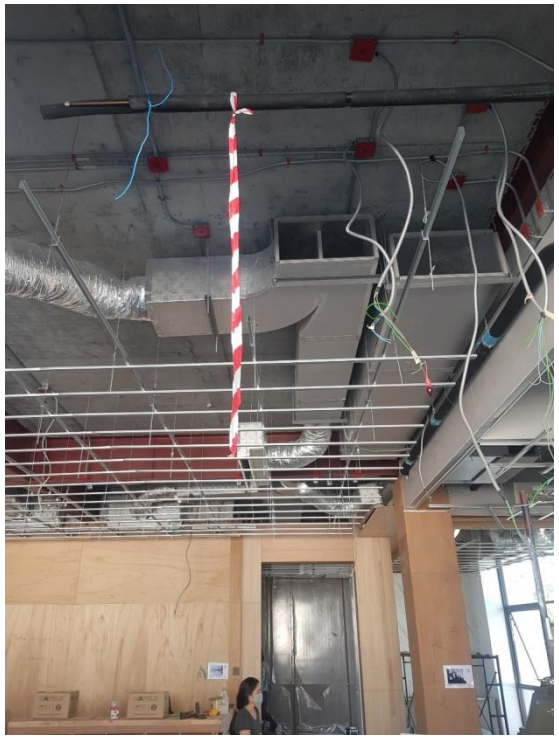
DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Factories

โรงงาน PPN MARKETING - บางปะกง ฉะเชิงเทรา





DUCT EXCEL®
Always Excellent!

ISO 9001 : 2015

Factories

OHLINS ADVANCED SUSPENSION TECHNOLOGY - ชลบุรี

DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Office Buildings :

- สำนักงานใหญ่ ไทยน้ำทิพย์ นอร์ทปาร์ค
- สำนักงานกองทุนเพื่อการศึกษา – ตึก IBM พหลโยธิน
- Mitsubishi Electric Kang Yong Wattana
- กรมศุลกากร
- บริษัท ดีเคเอสเอช (ประเทศไทย) จำกัด
- ธนาคารยูโอบี – สุขุมวิท
- อาคารพหลโยธินเพลส (ส่วนปรุงปรุง)
- อาคารธนบุรีพานิช – บางพลัด กรุงเทพ
- บริษัท แกร็บแท็กซี่ (ประเทศไทย) จำกัด – พระราม 4
- บริษัท เอ็นอาร์ที เซลส์ แอนด์ เซอรวิส จำกัด – ปทุมธานี
- บริษัท กมลพิศาลกระจกนิรภัย จำกัด – นครศรีธรรมราช

DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Office Buildings

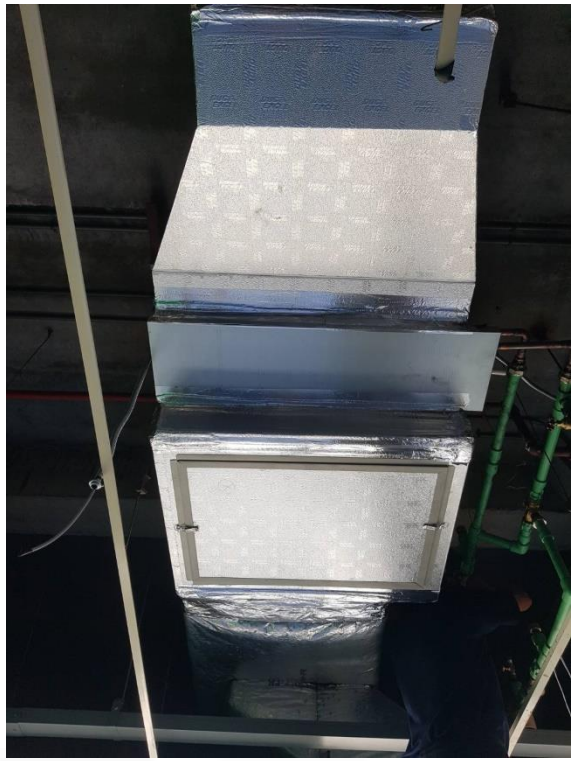
สำนักงานใหญ่ ไทยน้ำทิพย์ นอร์ทปาร์ค

DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Office Buildings

กรมศุลกากร - กรุงเทพ



โดย บริษัท เอส เอส อัลลายแอนซ์

DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Office Buildings

อาคารพหลโยธินเพลส

โดย บริษัท เอสดักท์ เอ็นจิเนียริ่ง

DUCT EXCEL®
Always Excellent!

ISO 9001 : 2015

Office Buildings

บริษัท ดีเคเอสเอช (ประเทศไทย) จำกัด - กรุงเทพ

DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Office Buildings

ธนาคารยูโอบี – สุขุมวิท กรุงเทพ

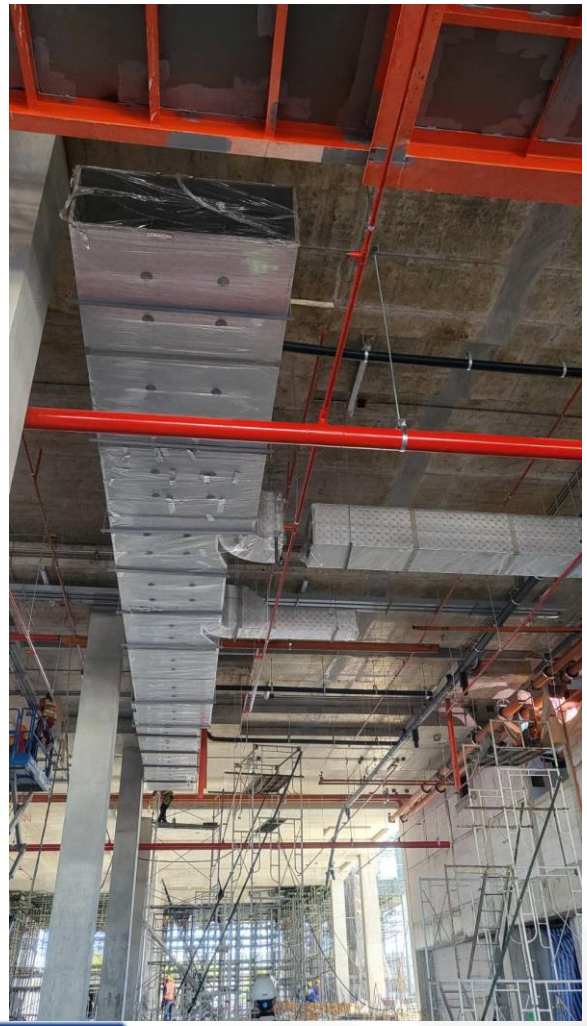
โดย บริษัท พาส409 เอ็นจิเนียริ่ง

DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Office Buildings

บริษัท เอ็นอาร์ที เซลส์ แอนด์ เซอรวิส จำกัด - ปทุมธานี

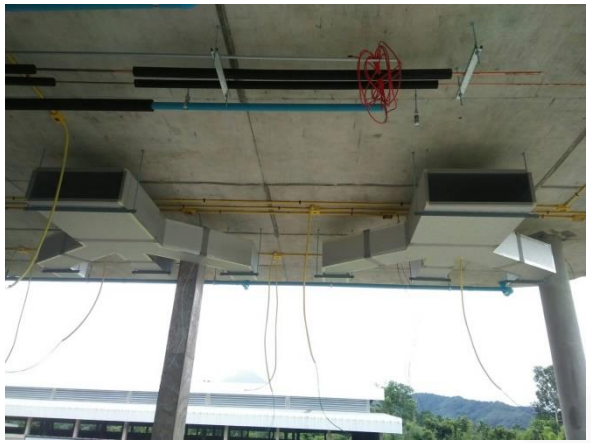


DUCT EXCEL®
Always Excellent!

ISO 9001 : 2015

Office Buildings

บริษัท กมลพิศาลกระจกนิรภัย จำกัด - นครศรีธรรมราช



DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Hospitals :

- โรงพยาบาลวิภาวดี
- โรงพยาบาลลาดพร้าว
- โรงพยาบาลตำรวจ
- สถาบันโรคผิวหนัง อนุเสาวรีย์
- โรงพยาบาลนวเวช – นวมินทร์
- โรงพยาบาลอินทรารัตน์ – รามอินทรา
- โรงพยาบาลบางโพ
- อาคารคลีนิคความงาม แยกพระราม 9
- โรงพยาบาลสินแพทย์ ลำลูกกา
- โรงพยาบาลสินแพทย์ ห้องผ่าตัด - นครปฐม (SPA)
- โรงพยาบาลบางบัวทอง

DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Hospitals :

- โรงพยาบาลนครพิงค์ – เชียงใหม่
- โรงพยาบาลมหาราชนครเชียงใหม่
- โรงพยาบาลท่าสองยาง – ตาก
- โรงพยาบาลมหาสารคาม ห้องคลีนรูม
- โรงพยาบาลรวมแพทย์ – ฉะเชิงเทรา
- โรงพยาบาลอภัยภูเบศร - ปราจีนบุรี
- โรงพยาบาลมหาราช – นครราชสีมา
- โรงพยาบาลอุตรดิตถ์ ห้องแรงดันลบ Covid-19
- โรงพยาบาลปัตตานี
- รพ.บันนังสตา - ยะลา

DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Hospitals :

- โรงพยาบาลตำรวจ อาคารรักษาพยาบาลและฟื้นฟูข้าราชการตำรวจ แยกราชประสงค์
- โรงพยาบาลจุฬาลงกรณ์ คลนิกผู้ป่วยนอก อาคาร ภปร.

DUCT EXCEL®
Always Excellent!

ISO 9001 : 2015

Hospitals

โรงพยาบาลลาดพร้าว - กรุงเทพ

DUCT EXCEL®
Always Excellent!

ISO 9001 : 2015

Hospitals

โรงพยาบาลตำรวจ - กรุงเทพ

Hospital

โรงพยาบาลนครพิงค์ - เชียงใหม่

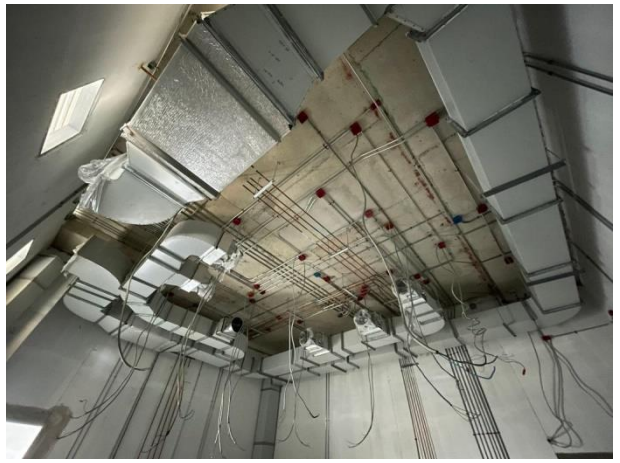
โดย เอสซีเจ แอร์ดักท์

DUCT EXCEL®
Always Excellent!

ISO 9001 : 2015

Hospitals

โรงพยาบาลสินแพทย์ ห้องผ่าตัด - นครปฐม (SPA)



DUCT EXCEL®
Always Excellent!

ISO 9001 : 2015

Hospitals

โรงพยาบาลบางบัวทอง – นนทบุรี

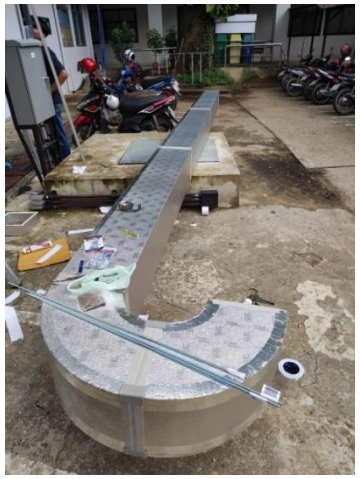
โดย บริษัท วีเค แอ็พพพลาย

DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Hospitals

โรงพยาบาลอุตรดิตถ์ - ห้องแรงดันลบ Covid-19



DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Hospitals

โรงพยาบาลมหาราชนครเชียงใหม่- เชียงใหม่

โดย บริษัท แม่ริม เอ็นจิเนียริ่ง

DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Hotels & Condominiums :

- CENTARA อยุธยา
- Santiburi The Residences รามอินทรา
- บางกอก บูเลอวาร์ด รามอินทรา
- โรงแรมแมนดาริน บางรัก
- Dusit D2S Samyan
- Sand Dunes Chaolao Beach Resort – จันทบุรี
- Andaz Pattaya Jomtien Beach-พัทยา
- คีรีมายา เรสซิเดนส์ เขาใหญ่

DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Hotels & Condominiums

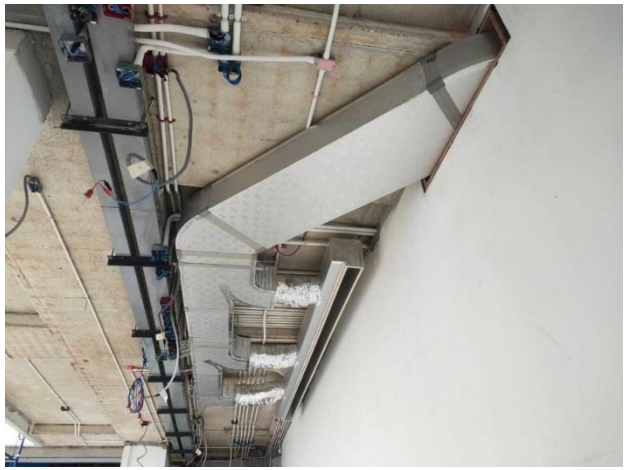
CENTARA อยุธยา

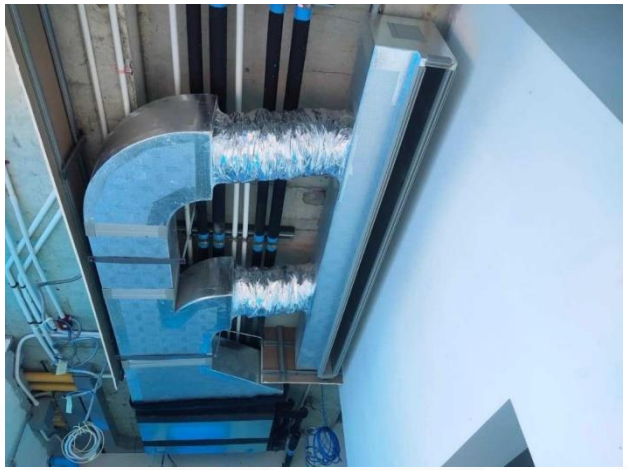
DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Hotels & Condominiums

โครงการ Santiburi The Residences - กรุงเทพ





โดย บริษัท นีโอ727

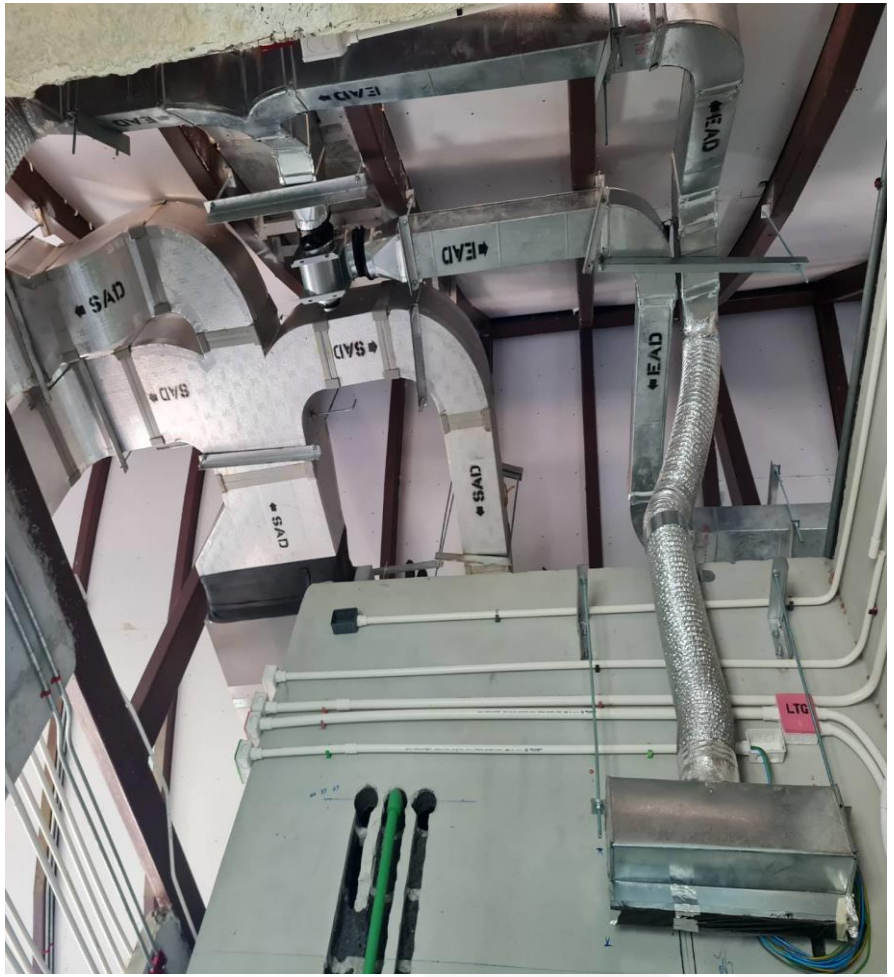
DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Hotels & Condominiums

Andaz Pattaya Jomtien Beach

โดย บริษัท 101 เอ็นจิเนียริ่ง

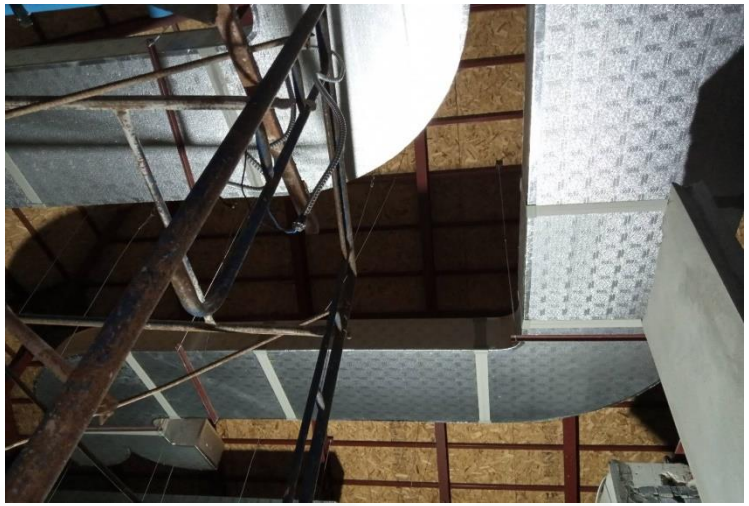


DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Hotels & Condominiums

คีรีมายา เรสซิเดนส์ เขาใหญ่



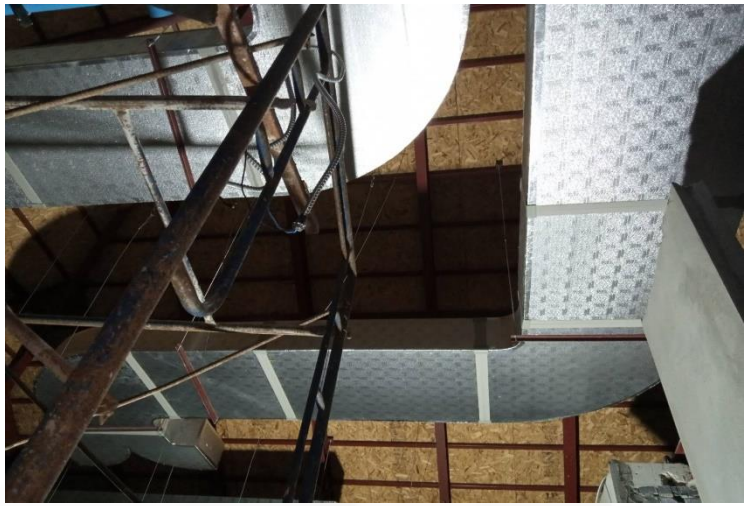
โดย บริษัท เอ็มอีพี ซิสเต็ม

DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Hotels & Condominiums

Dusit D2 Samyan



โดย บริษัท เอ็มไลน์ เอ็จิเนียริ่ง แอนด์ คอนสตรัคชั่น

DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Hotels & Condominiums

Sand Dunes Chaolao Beach Resort - จันทบุรี

DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Other Projects :

- พิพิธภัณฑ์พระรามเก้า
- พิพิธภัณฑ์บ้านปาร์ค นายเลิศ
- วัดมัชฌันติการาม
- บ้านพักเอกอัครราชทูตอเมริกา
- สนามยิงปืน การกีฬาแห่งประเทศไทย
- โรงเรียนมาแตร์เดอีวิทยาลัย
- ร้านอาหาร KING KONG - สายไหม 53
- La Chapelle Bangkok (สตูดิโอและสถานที่จัดงาน)-บางเขน
- STARBUCK – เซียร์รังสิต

DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Other Projects :

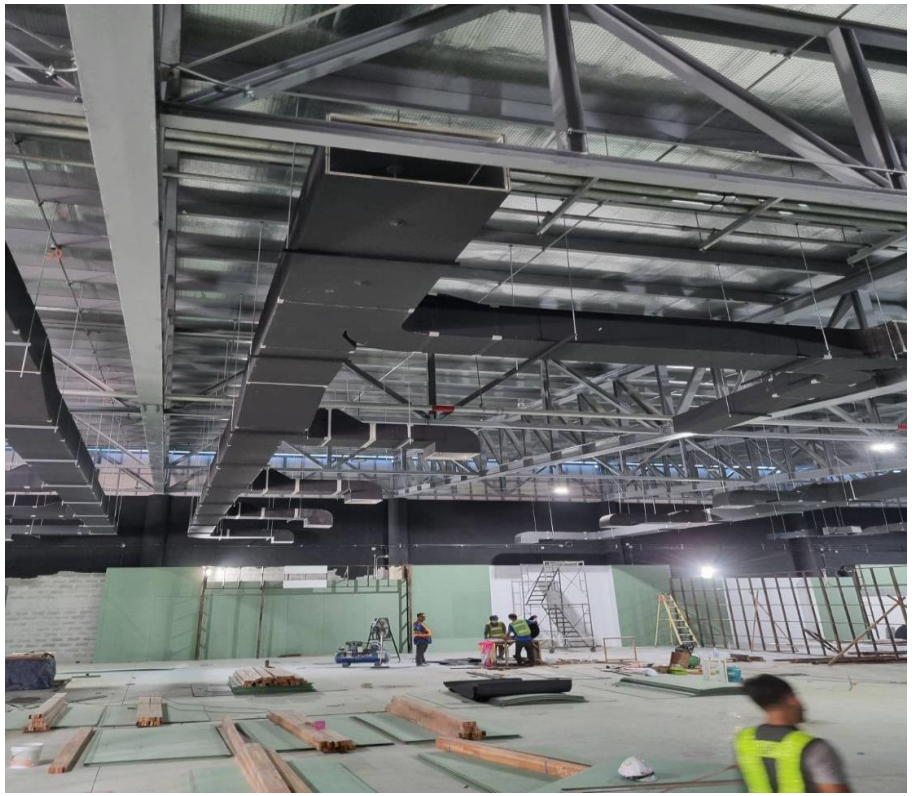
- โบสถ์คริสต์ – นครปฐม
- ร้านปั้นคำหอม – ราชบุรี
- ร้านปั้นคำหอม – กาญจนบุรี
- วัดธารทหาร จ.นครสวรรค์

DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Other Projects

พิพิธภัณฑ์พระราม9 - กรุงเทพ



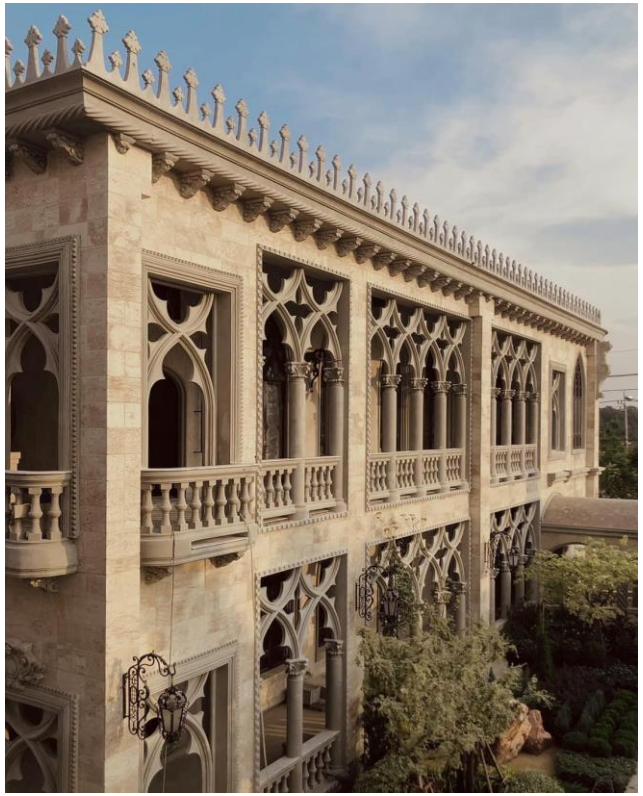
โดย บริษัท เจ แอนด์ เจ แอร์ เทคโนโลยี

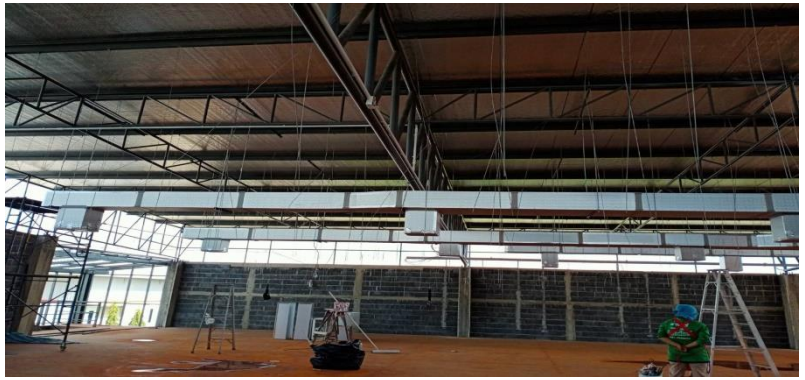
DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Other Projects

Studio - La Chapelle Bangkok





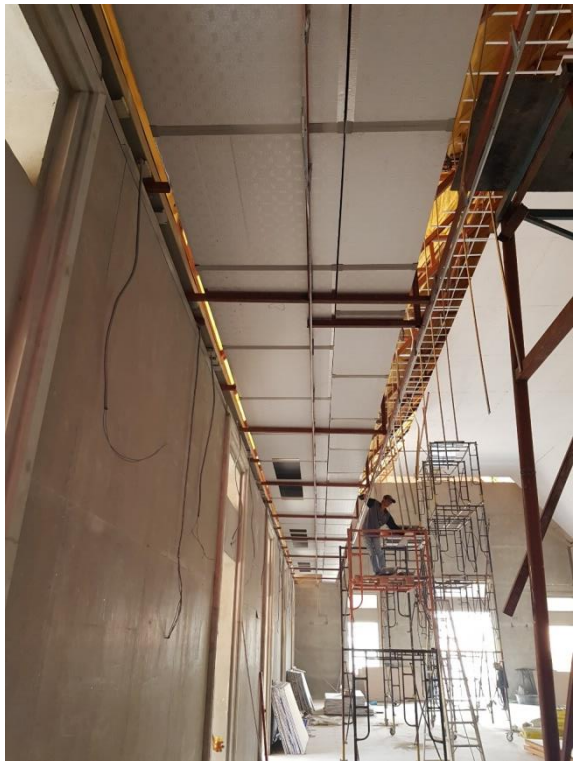
โดย หจก. พีแอร์ กรุ๊ป

DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Other Projects

วัดมัชฌันติการาม - กรุงเทพ

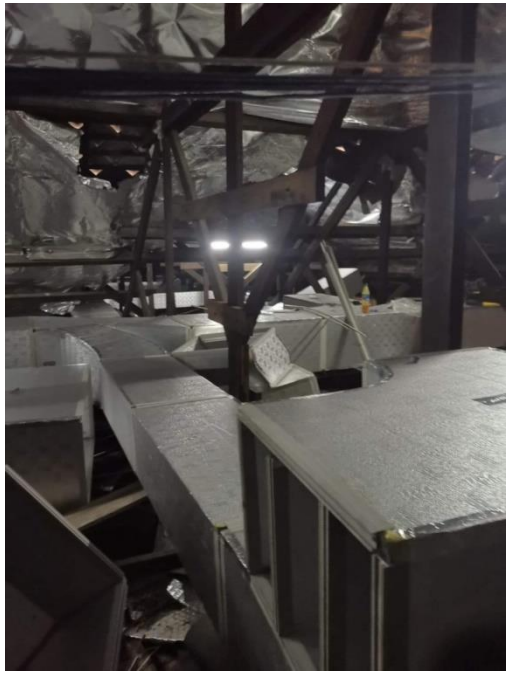


DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Other Projects

บ้านพักเอกอัครราชทูตอเมริกา - กรุงเทพ



โดย บริษัท ซัน ซิสเท็ม

DUCT EXCEL
Always Excellent!

ISO 9001 : 2015

Other Projects

โรงเรียนมาแตร์เดอีวิทยาลัย - กรุงเทพ