出國報告（出國類別：其他）

「臺灣桃園國際機場第三航站區旅客空橋（含預冷式機艙空調、400Hz 地面電源裝置）系統工程」PCA 及 GPU 設備廠驗報告

服務機關：桃園國際機場股份有限公司

姓名職稱：孫宏彬副總經理

羅子鈞工程師

派赴國家/地區：丹麥/歐登塞

出國期間：112 年 9 月 30 日至 10 月 8 日

報告日期：112 年 12 月 6 日

摘要

隨著世界各地航空客貨運量持續成長，桃園國際機場原有之第一航廈，及第二航廈容量已逐漸不敷使用，且即將面臨更新、改善等需求，為提升桃園國際機場整體服務品質，桃園國際機場股份有限公司(下稱本公司)依「臺灣桃園國際機場第三航站區建設計畫」辦理各項工程設計、發包等作業。而「第三航站區旅客空橋(含預冷式機艙空調及 400Hz 地面電源裝置)系統工程」(下稱本工程)係屬前揭建設計畫之子項工程，主要提供第三航站區各機坪之旅客上下機接駁靠橋服務，並供給航機停靠於機坪時所須之運轉電力與機艙內空調。

目前世界各地機場航機停靠機坪時之電源供應大致以下三類：(1)航機自身輔助動力裝置(APU—Auxiliary Power Unit)、(2)移動式電源供應車、(3)將機場所供電力轉換為航機可用之 400Hz 電力(附掛於登機空橋下或座落地面)；另機艙內空調之供應方式大致亦下三類：(1)航機自身 APU 運轉以啟動空橋系統、(2)移動式電源供應車、(3)固定式空調設備(附掛於登機空橋下或座落地面)。

然以航機自身 APU 或移動式電源車/氣源供應車，多數仍以燃油方式驅動，在現代環保意識提升，並須改善桃園國際機場機坪作業環境前提下，本工程係採用橋掛式機艙空調機(PCA)與橋掛式 400Hz 地面電源裝置(GPU)，以有效降低空氣及噪音污染，並減少作業車輛，進而提升機場服務品質與競爭力。

目錄

壹、目的

「第三航站區旅客空橋(含預冷式機艙空調及 400Hz 地面電源裝置)系統工程」採最有利標之評選方式決標於 ShinMaywa(Asia) Pte. Ltd.(新加坡商新明和亞洲有限公司)，其中「登機空橋(PBB)」部分，已於本國屏東縣新園鄉鋼構廠進行製造及組立等作業，而「預冷式機艙空調(PCA)」，及「400Hz 地面電源裝置(GPU)」係採用 ITW GSE 公司生產之 PCA 3500-Series，及 GPU 90kVA 2400 Power Coil，爰本公司按相關工程實際進度，並依契約規定辦理第二級工程品質管理作業。

本次廠驗係前往丹麥—歐登塞 ITW GSE 公司辦理抽查驗「預冷式機艙空調(PCA)」及「400Hz 地面電源裝置(GPU)」，以瞭解 PCA 及 GPU 設備實際製造流程、進度，及品質(含外觀及性能)等，並確認工廠製造及檢試驗程序符合規範規定，爰依契約規定，按本工程廠商提送之設備廠驗計畫辦理本次作業，藉由抽驗方式實施細部規格與功能現場測試，以落實執行本工程品質管理制度，並確保相關設備品質符合本公司需求。

貳、過程

一、廠驗行程

日期	行程紀要	夜宿地點
112/9/30 (星期六) 至 112/10/1 (星期日)	去程： 自桃園機場搭乘航班 EK367 班機至杜拜轉機 轉搭 EK151 班機前往丹麥哥本哈根機場	夜宿機上
112/10/2 (星期一) 至 112/10/6 (星期五)	自哥本哈根前往 ITW GSE 歐登塞工廠辦理廠驗 進行公司發展歷程、設備產品及產線介紹 文書作業檢核、測試儀器檢核 400HZ 地面電源裝置 GPU 抽驗 90 噸預冷式機艙空調 PCA 抽驗 試驗成果紀錄及檢討會議	丹麥 歐登塞
112/10/7 (星期六) 至 112/10/8 (星期日)	回程： 自哥本哈根機場搭乘 EK152 班機至杜拜轉機 轉搭 EK366 班機返抵臺灣桃園國際機場	夜宿機上

二、廠驗人員名單

服務單位	職稱	姓名
桃園國際機場股份有限公司(主辦單位)	副總經理	孫宏彬
桃園國際機場股份有限公司(主辦單位)	工程師	羅子鈞
桃園國際機場第三航站區總顧問(專案管理單位)	專案經理	鍾慧萍
台灣世曦工程顧問股份有限公司(設計監造單位)	監造主任	湯正浩
新加坡商新明和亞洲有限公司(承攬廠商)	專案經理	張魁義
新加坡商新明和亞洲有限公司(承攬廠商)	專案經理	劉公權

三、ITW GSE 公司簡介

ITW—Illinois Tool Works(伊利諾伊州工具公司)成立於 1912 年，並於 2000 年成立 ITW GSE Ground Services division，GSE 代表其地面支援系統部門，自此陸續匯集並收購 Hobart、AXA Power、Houchin、Trilectron Industries、J&B Aviation、ITW Military GSE 及 Air-a-Plane 等公司(將 850 個獨立事業單位，陸續統整為 80 個部門)，並自 2018 年起，整合所有傳統品牌之空調裝置、地面動力設備，及相關配件(如供電電纜、空調軟管)等，採以單一品牌 ITW GSE 銷售，其企業宗旨為提供航空相關產業最清潔、最可靠，和最具成本效益的地面支援設備系統。

圖 3-1 ITW GSE 集團歷程

本次前往之廠驗地點，前身為 AXA Power，此品牌成立於 1924 年，即將於 2024 年邁向百年歷史，其公司團隊由敬業的人員組成，而該獨特的企業文化，讓許多專業人士從業多年，進而確保該公司擁有豐富的專業知識及生產技術，且不間斷地在航空相關產業進行創新，展現其在該領域的領先地位，進而創造生態環境永續，本公司亦可藉由本次設備的導入，使桃園機場加速往綠機場境界邁進。

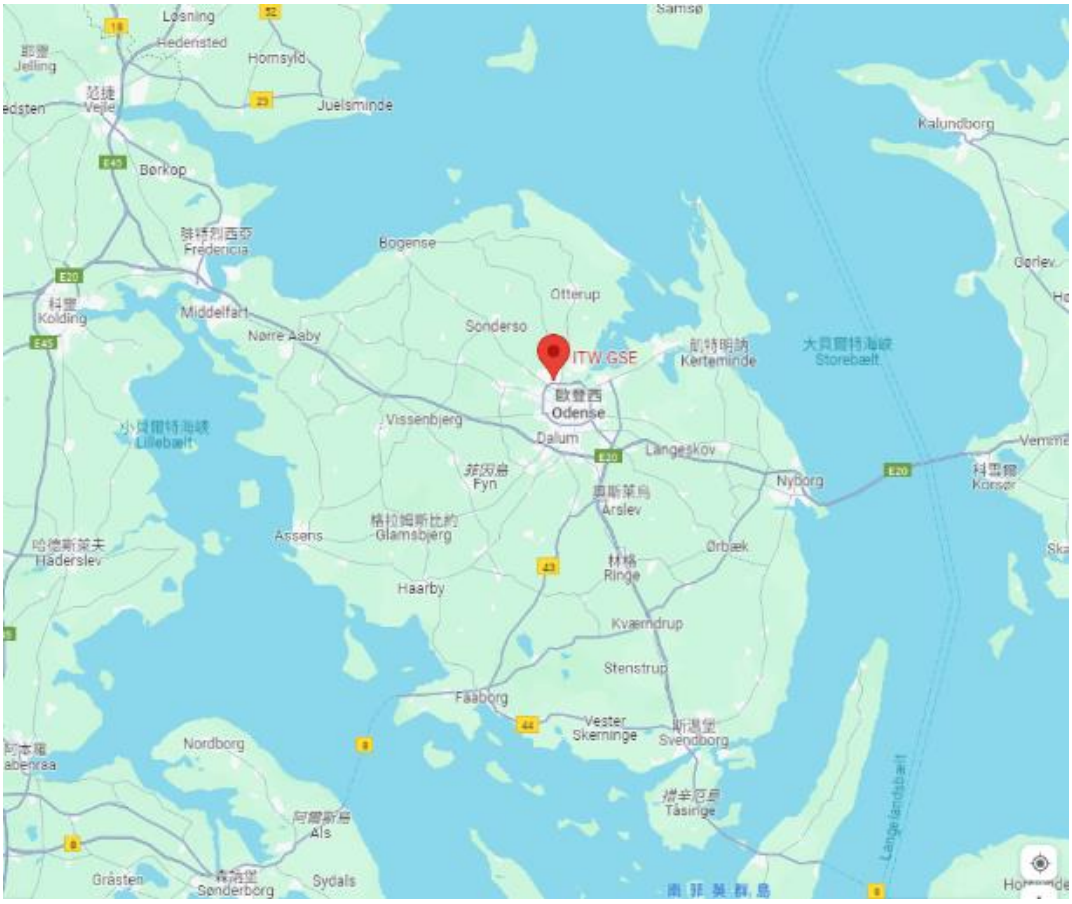


圖 3-2 ITW GSE 位於丹麥 Odense 地理位置

圖 3-3 廠驗團隊及 ITW GSE 公司代表於工廠前合影

圖 3-4 ITW GSE 公司介紹(一)-工廠大門

圖 3-5 ITW GSE 公司介紹(二)-工廠環境介紹

圖 3-6 ITW GSE 公司介紹(三)-生產排程表介紹

圖 3-7 ITW GSE 公司介紹(四)-生產排程表介紹

圖 3-8 ITW GSE 公司介紹(五)-辦公室環境

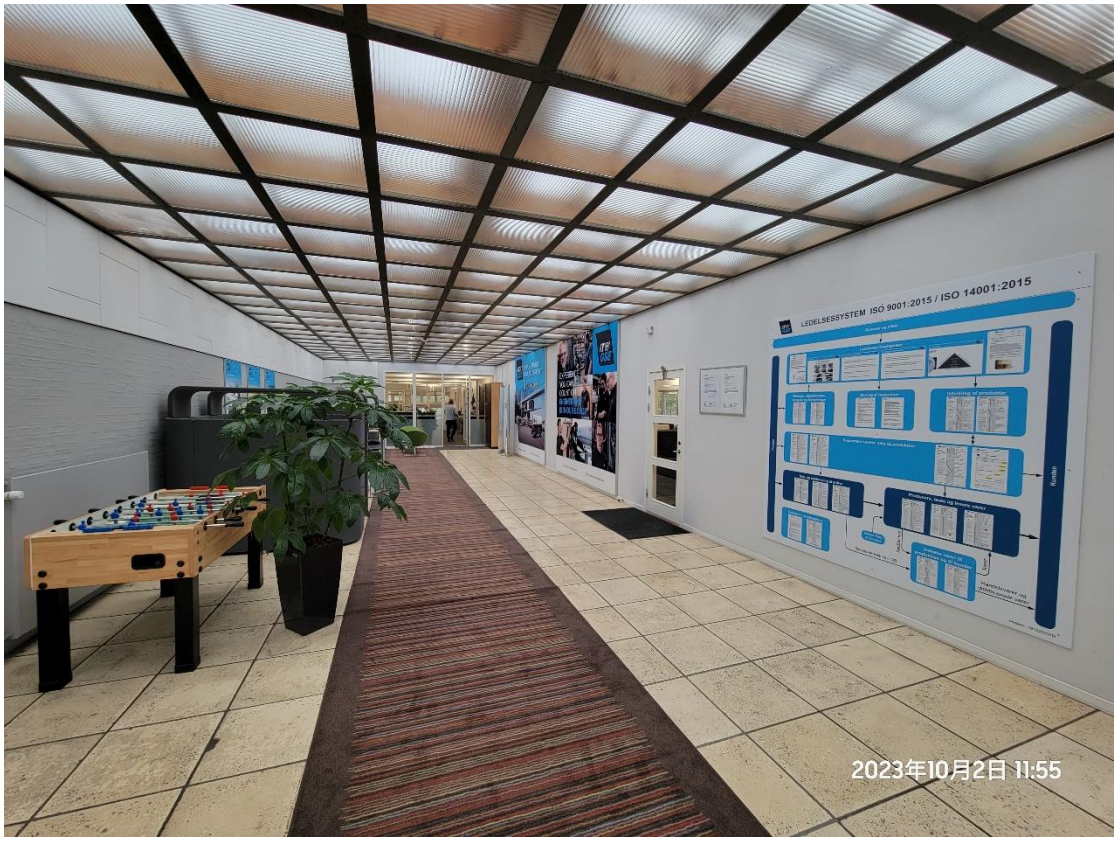


圖 3-9 ITW GSE 公司介紹(六)-公司形象牆及 ISO 制度

四、本次採購產品型號及規格

(一) 本工程預冷式機艙空調設備(PCA)，規格如下：

1. 設備型號：ITW GSE 3500 PCA。
2. 輸入電壓：3 相 400 V±10%。
3. 輸入電流：275 A。
4. 輸入頻率：50/60 Hz。
5. 功率因數：100% load＞0.97。
6. 壓縮機容量：90 tons。
7. 冷氣出風流量：210 kg/min。
8. 設備尺寸(不含風管及回收器)：約 4.7m × 2.23m × 1.73m。
9. 設備重量(不含風管及回收器)：約 4,000 kg。
10. 防水等級：IP54(電器部件)。

(二) 本工程 400Hz 地面電源裝置(GPU)，規格如下：

1. 設備型號：ITW GSE 2400 power Coil。
2. 輸入電壓：3 相 400 V。
3. 輸入電流：140 A
4. 輸入頻率：50/60 Hz。
5. 輸出電壓：200 V。
6. 輸出電流：260 A
7. 輸出頻率：400 Hz。
8. 輸出容量：90kVA。
9. 設備尺寸：約 1.53m × 0.87m × 0.9m。
10. 設備重量：約 700 kg。
11. 防水等級：IP55。

五、ITW GSE 工廠測試

(一)測試行程前說明

1. 前置會議：介紹公司歷程及相關產品簡介，並確認本次廠驗行程、與原廠人員核對本次查證項目與內容。
2. 進產線前安全宣導：宣導工作環境危害因素，及安全衛生注意事項。
3. 設備產線介紹：原廠人員於產線各站進行預冷式機艙調(PCA)，及 400Hz 地面電源裝置(GPU)介紹。
4. 檢測儀器校正：檢測前檢視所有測試儀器之校正有效期，以確保測試結果之有效性。

圖 5-1 廠驗行程說明(公司歷程/產品簡介與核對抽驗項目)

圖 5-2 廠驗行程說明(PCA 產線介紹)

圖 5-3 廠驗行程說明(PCA 風箱)

圖 5-4 廠驗行程說明(PCA 濾網)

圖 5-5 廠驗行程說明(PCA 模組化設計)

圖 5-6 廠驗行程說明(PCA 鼓風機)

圖 5-7 廠驗行程說明(PCA 風扇)

圖 5-8 廠驗行程說明(GPU 產線介紹)

圖 5-9 廠驗行程說明(GPU 自主檢查介紹)

圖 5-10 廠驗行程說明(GPU 組立站)

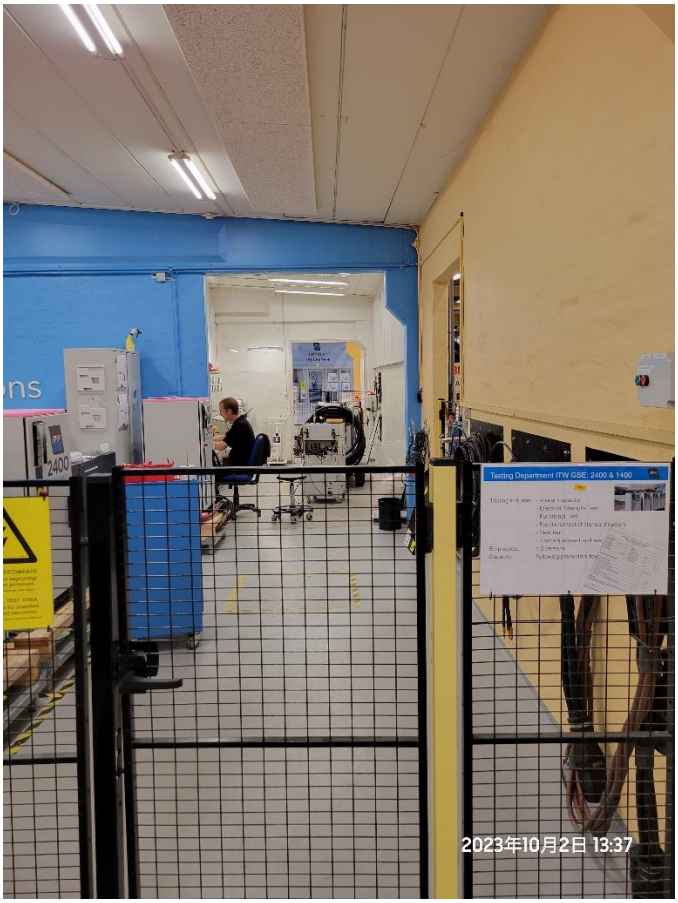


圖 5-11 廠驗行程說明(GPU 自主檢查部門)

圖 5-12 廠驗行程說明(GPU 電纜捲軸模組)

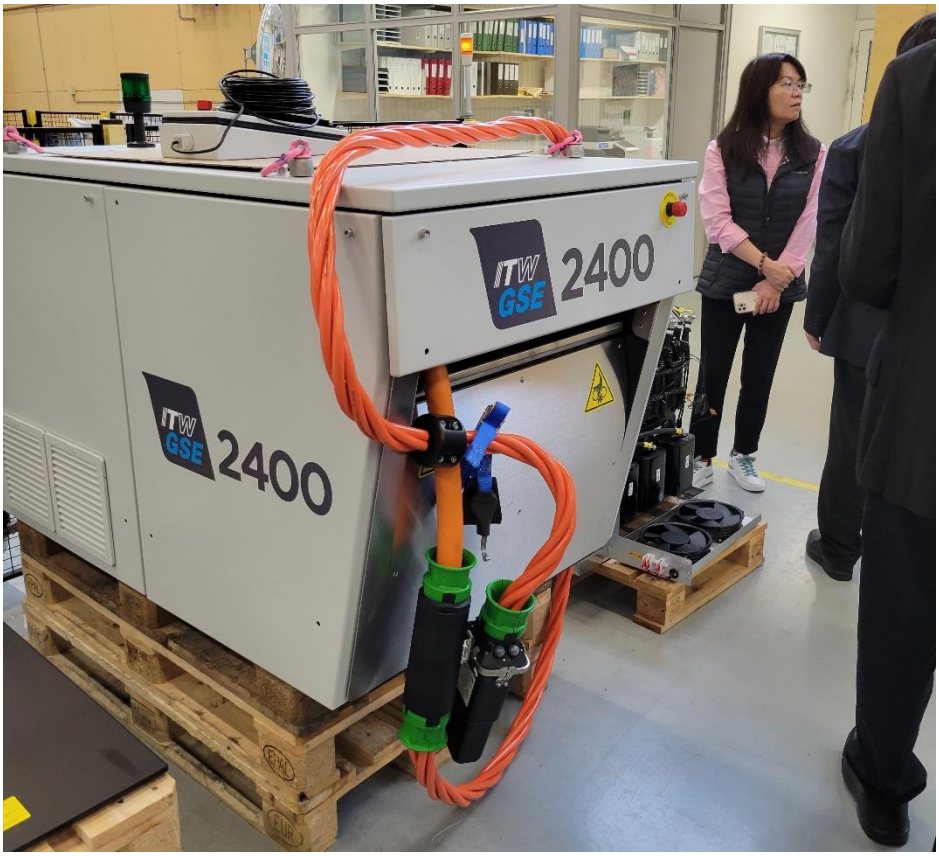


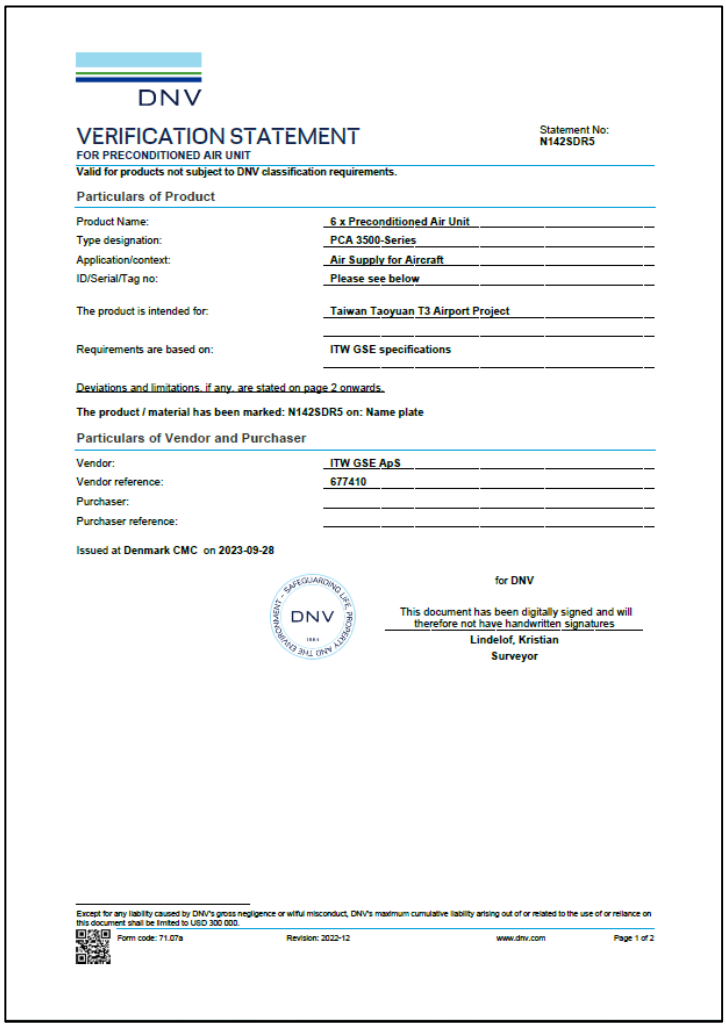
圖 5-13 廠驗行程說明(GPU 電纜及供電插座)

(二)執行情形及測試結果

本次廠驗作業係依據契約施工規範、廠商資格文件及核定之廠驗計畫書辦理檢查及檢測，廠驗期間依規定會同廠商、設計及監造單位、專案管理及第三方公證機構辦理，本次檢查及檢測項目臚列如下：

1. 進行檢視第三方公證檢測報告：

(1) 預冷式機艙空調(PCA)第三方公證檢測報告



DNV

VERIFICATION STATEMENT

FOR PRECONDITIONED AIR UNIT

Statement No: N142SDR5

Valid for products not subject to DNV classification requirements.

Particulars of Product

Product Name:	6 x Preconditioned Air Unit
Type designation:	PCA 3500-Series
Application/context:	Air Supply for Aircraft
ID/Serial/Tag no:	Please see below
The product is intended for:	Taiwan Taoyuan T3 Airport Project
Requirements are based on:	ITW GSE specifications

Deviations and limitations, if any, are stated on page 2 onwards.

The product / material has been marked: N142SDR5 on: Name plate

Particulars of Vendor and Purchaser

Vendor:	ITW GSE ApS
Vendor reference:	677410
Purchaser:	
Purchaser reference:	

Issued at Denmark CMC on 2023-09-28

for DNV

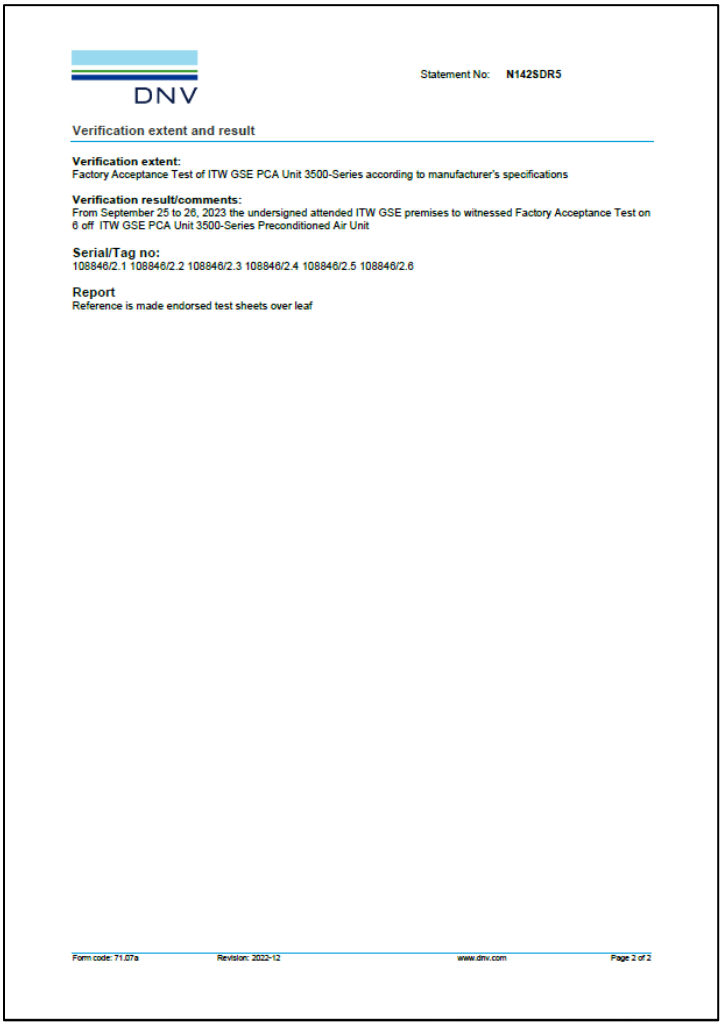
This document has been digitally signed and will therefore not have handwritten signatures

Lindelof, Kristian

Surveyor

Except for any liability caused by DNV's gross negligence or wilful misconduct, DNV's maximum cumulative liability arising out of or related to the use of or reliance on this document shall be limited to USD 300 000.

Form code: 71.07a Revision: 2022-12 www.dnv.com Page 1 of 2



DNV

Statement No: N142SDR5

Verification extent and result

Verification extent:
Factory Acceptance Test of ITW GSE PCA Unit 3500-Series according to manufacturer's specifications

Verification result/comments:
From September 25 to 26, 2023 the undersigned attended ITW GSE premises to witnessed Factory Acceptance Test on 6 off ITW GSE PCA Unit 3500-Series Preconditioned Air Unit

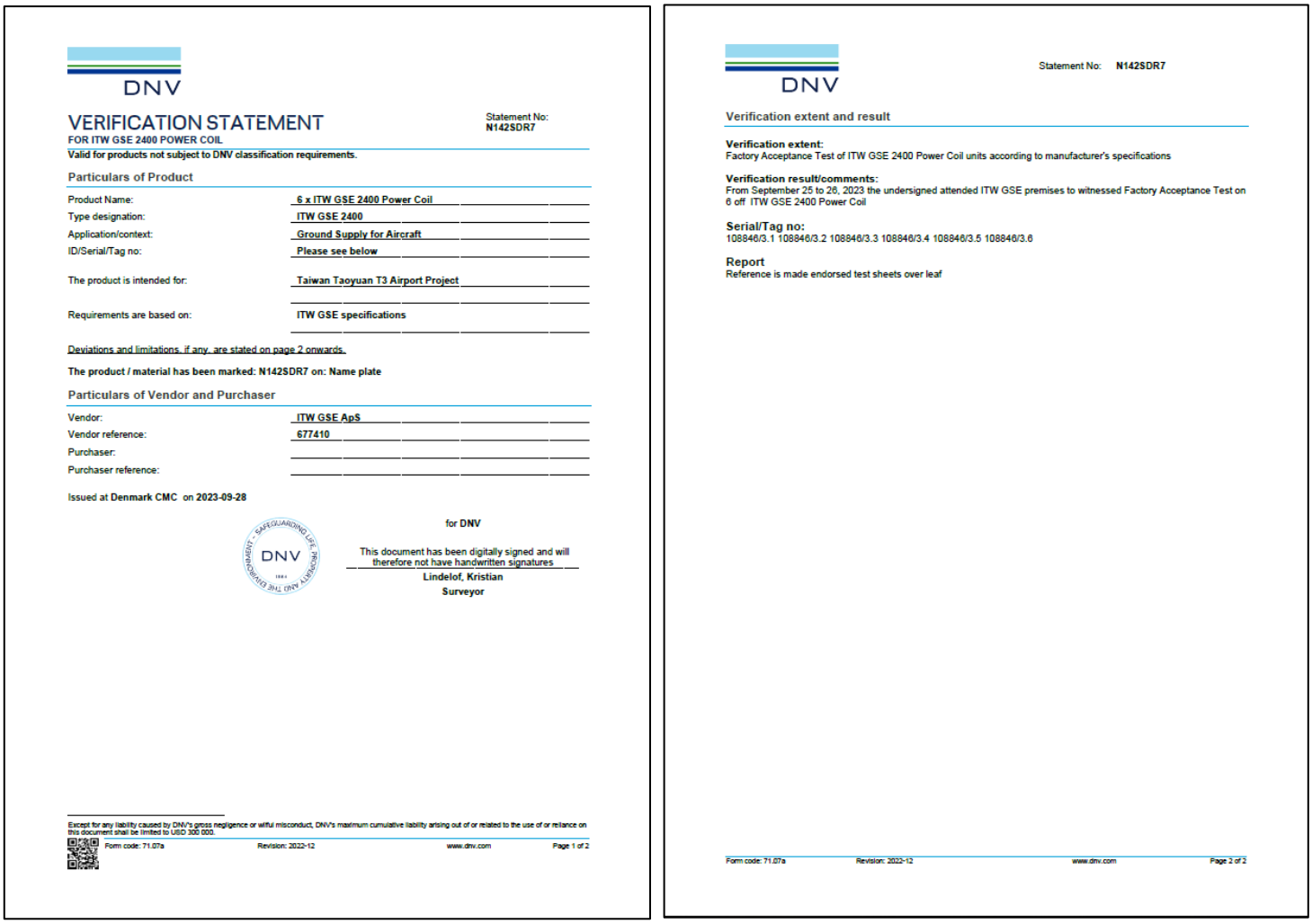
Serial/Tag no:
108846/2.1 108846/2.2 108846/2.3 108846/2.4 108846/2.5 108846/2.6

Report
Reference is made endorsed test sheets over leaf

Form code: 71.07a Revision: 2022-12 www.dnv.com Page 2 of 2

圖 5-14 PCA 第三方公證單位檢測報告

(2) 400Hz 地面電源裝置(GPU)第三方公證檢測報告



DNV

VERIFICATION STATEMENT

Statement No: N142SDR7

FOR ITW GSE 2400 POWER COIL

Valid for products not subject to DNV classification requirements.

Particulars of Product

Product Name:	6 x ITW GSE 2400 Power Coil
Type designation:	ITW GSE 2400
Application/context:	Ground Supply for Aircraft
ID/Serial/Tag no:	Please see below
The product is intended for:	Taiwan Taoyuan T3 Airport Project
Requirements are based on:	ITW GSE specifications

Deviations and limitations, if any, are stated on page 2 onwards.

The product / material has been marked: N142SDR7 on: Name plate

Particulars of Vendor and Purchaser

Vendor:	ITW GSE ApS
Vendor reference:	677410
Purchaser:	
Purchaser reference:	

Issued at **Denmark CMC** on **2023-09-28**

for DNV

This document has been digitally signed and will therefore not have handwritten signatures

Lindelof, Kristian

Surveyor

Except for any liability caused by DNV's gross negligence or wilful misconduct, DNV's maximum cumulative liability arising out of or related to the use of or reliance on this document shall be limited to USD 300 000.

Form code: 71.07a Revision: 2022-12 www.dnv.com Page 1 of 2

DNV

Statement No: N142SDR7

Verification extent and result

Verification extent:
Factory Acceptance Test of ITW GSE 2400 Power Coil units according to manufacturer's specifications

Verification result/comments:
From September 25 to 26, 2023 the undersigned attended ITW GSE premises to witnessed Factory Acceptance Test on 6 off ITW GSE 2400 Power Coil

Serial/Tag no:
108846/3.1 108846/3.2 108846/3.3 108846/3.4 108846/3.5 108846/3.6

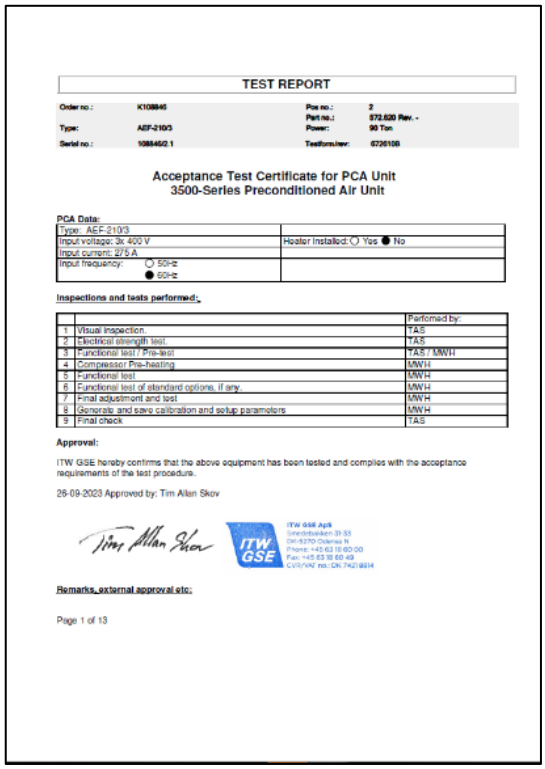
Report
Reference is made endorsed test sheets over leaf

Form code: 71.07a Revision: 2022-12 www.dnv.com Page 2 of 2

圖 5-15 GPU 第三方公證單位檢測報告

2. 出廠測試報告

(1) 預冷式機艙空調(PCA)出廠測試報告



TEST REPORT

Order no.: K108846 Pos no.: 2
Part no.: 572.620 Rev. -
Type: AEF-210/3 Power: 90 Ton
Serial no.: 108846/2.1 Testform/rev: 672610B

Acceptance Test Certificate for PCA Unit
3500-Series Preconditioned Air Unit

PCA Data:

Type: AEF-210/3	
Input voltage: 3x 400 V	Heater Installed: ○ Yes ● No
Input current: 275 A	
Input frequency: ○ 50Hz ● 60Hz	

Inspections and tests performed:

		Performed by:
1	Visual inspection.	TAS
2	Electrical strength test.	TAS
3	Functional test / Pre-test	TAS / MWH
4	Compressor Pre-heating	MWH
5	Functional test	MWH
6	Functional test of standard options, if any.	MWH
7	Final adjustment and test	MWH
8	Generate and save calibration and setup parameters	MWH
9	Final check	TAS

Approval:

ITW GSE hereby confirms that the above equipment has been tested and complies with the acceptance requirements of the test procedure.

26-09-2023 Approved by: Tim Allan Skov

ITW GSE ApS Smedebakken 31-33 DK-5270 Odense N Phone: +45 63 18 60 00 Fax: +45 63 18 60 49 CVR/VAT no.: DK 7421 8814

Remarks, external approval etc:

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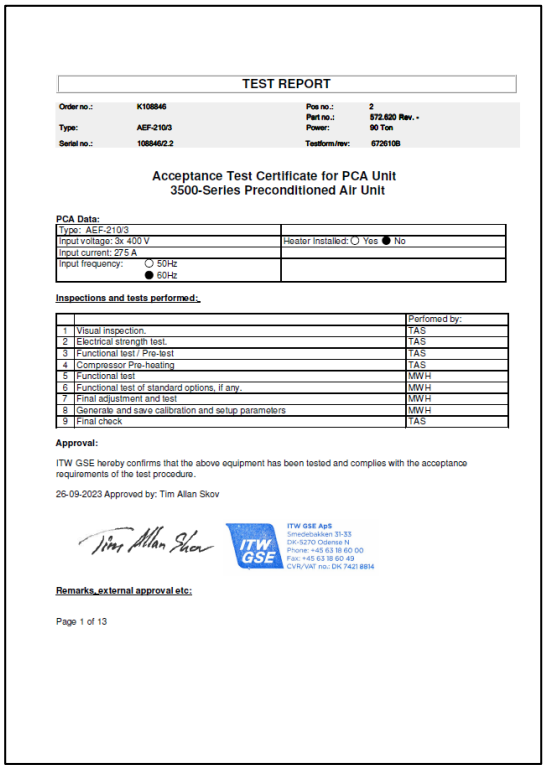

TEST REPORT

Order no.: K108846 Pos no.: 2
Part no.: 572.620 Rev. -
Type: AEF-210/3 Power: 90 Ton
Serial no.: 108846/2.2 Testform/rev: 672610B

Acceptance Test Certificate for PCA Unit
3500-Series Preconditioned Air Unit

PCA Data:

Type: AEF-210/3	
Input voltage: 3x 400 V	Heater Installed: ○ Yes ● No
Input current: 275 A	
Input frequency: ○ 50Hz ● 60Hz	

Inspections and tests performed:

		Performed by:
1	Visual inspection.	TAS
2	Electrical strength test.	TAS
3	Functional test / Pre-test	TAS
4	Compressor Pre-heating	TAS
5	Functional test	MWH
6	Functional test of standard options, if any.	MWH
7	Final adjustment and test	MWH
8	Generate and save calibration and setup parameters	MWH
9	Final check	TAS

Approval:

ITW GSE hereby confirms that the above equipment has been tested and complies with the acceptance requirements of the test procedure.

26-09-2023 Approved by: Tim Allan Skov

ITW GSE ApS Smedebakken 31-33 DK-5270 Odense N Phone: +45 63 18 60 00 Fax: +45 63 18 60 49 CVR/VAT no.: DK 7421 8814

Remarks, external approval etc:

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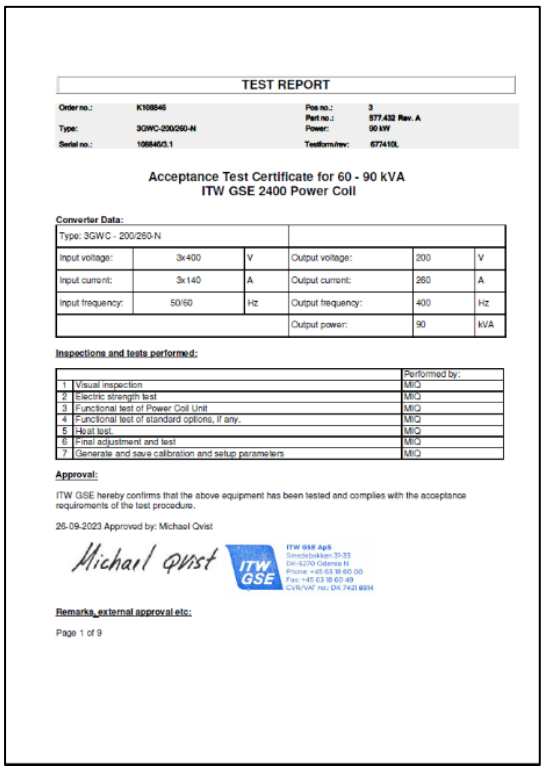
圖 5-16 PCA 出廠測試報告

(2) 400Hz 地面電源裝置(GPU)出廠測試報告



TEST REPORT

Order no.: K108846 Pos no.: 3
Part no.: 577.432 Rev. A
Type: 3GWC-200/260-N Power: 90 kW
Serial no.: 108846/3.1 Testform/rev: 677410L

Acceptance Test Certificate for 60 - 90 kVA
ITW GSE 2400 Power Coil

Converter Data:

Type: 3GWC - 200/260-N					
Input voltage:	3x400	V	Output voltage:	200	V
Input current:	3x140	A	Output current:	260	A
Input frequency:	50/60	Hz	Output frequency:	400	Hz
			Output power:	90	kVA

Inspections and tests performed:

		Performed by:
1	Visual inspection	MIQ
2	Electric strength test	MIQ
3	Functional test of Power Coil Unit	MIQ
4	Functional test of standard options, if any.	MIQ
5	Heat test.	MIQ
6	Final adjustment and test	MIQ
7	Generate and save calibration and setup parameters	MIQ

Approval:

ITW GSE hereby confirms that the above equipment has been tested and complies with the acceptance requirements of the test procedure.

26-09-2023 Approved by: Michael Qvist

ITW GSE ApS Smedebakken 31-33 DK-5270 Odense N Phone: +45 63 18 60 00 Fax: +45 63 18 60 49 CVR/VAT no.: DK 7421 8814

Remarks, external approval etc:

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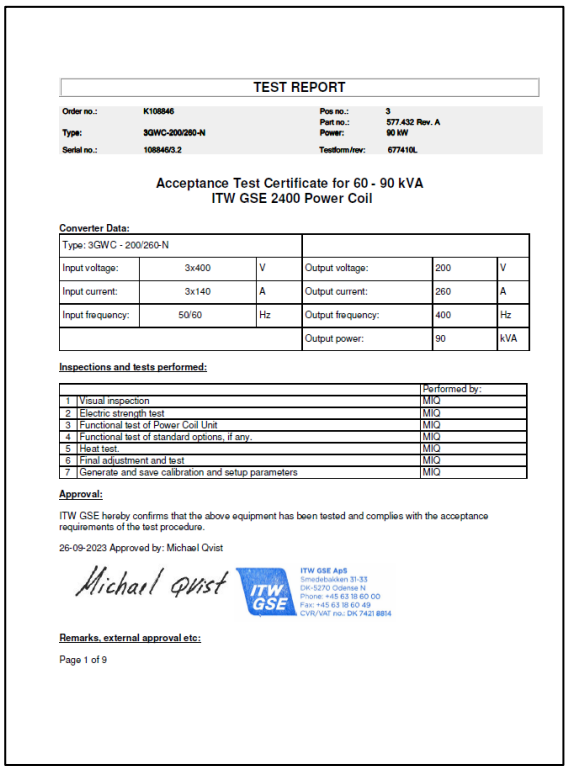

TEST REPORT

Order no.: K108846 Pos no.: 3
Part no.: 577.432 Rev. A
Type: 3GWC-200/260-N Power: 90 kW
Serial no.: 108846/3.2 Testform/rev: 677410L

Acceptance Test Certificate for 60 - 90 kVA
ITW GSE 2400 Power Coil

Converter Data:

Type: 3GWC - 200/260-N					
Input voltage:	3x400	V	Output voltage:	200	V
Input current:	3x140	A	Output current:	260	A
Input frequency:	50/60	Hz	Output frequency:	400	Hz
			Output power:	90	kVA

Inspections and tests performed:

		Performed by:
1	Visual inspection	MIQ
2	Electric strength test	MIQ
3	Functional test of Power Coil Unit	MIQ
4	Functional test of standard options, if any.	MIQ
5	Heat test.	MIQ
6	Final adjustment and test	MIQ
7	Generate and save calibration and setup parameters	MIQ

Approval:

ITW GSE hereby confirms that the above equipment has been tested and complies with the acceptance requirements of the test procedure.

26-09-2023 Approved by: Michael Qvist

ITW GSE ApS Smedebakken 31-33 DK-5270 Odense N Phone: +45 63 18 60 00 Fax: +45 63 18 60 49 CVR/VAT no.: DK 7421 8814

Remarks, external approval etc:

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圖 5-17 GPU 出廠測試報告

3. 廠驗測試

本工程規定測試項目於其試驗區進行測試，查驗其產品品質，及最終功能檢測是否符合契約規範要求，主要檢驗內容及過程摘述如下：

(1) 預冷式機艙空調(PCA)測試過程：

i. 確認外觀，並據零件清單檢查指定標籤。

ii. 檢查組件、電線和電纜是否依據進行圖表編號。

iii. 檢視彈簧墊圈、螺栓，及螺釘連接情形。

iv. 檢查測試項目是否依相應的 PCA 測試控制表規定進行。

v. 檢查油漆塗裝品質，並測試膜厚。

vi. 進行電氣強度測試。

vii. 進行壓縮機預熱測試。

viii. 進行功能測試。

ix. 進行最終調整/測試。

x. 確認所有檢查項目是否完程，並確認設備功能正常。

(1)-1 預冷式機艙空調測試紀錄表

Test Record Form for PCA Unit 3XXX Series Preconditioned Air Unit
PCA 機組 3XXX 系列預冷式機艙空調機組測試紀錄表

PCA Data：
PCA 數據：

Type：AEF- 2101 3 - / 類型：ADF- /	Serial no.：序列號：108846/2.4
Input voltage: 輸入電壓：3 x 400 V	Heater Installed: 加熱器安裝：Yes ☐ No ☒
Input current: 輸入電流：275 A	
Input frequency: 輸入頻率：60 Hz	

Inspections and tests performed:
進行的檢查和測試：

Item 項次	Content 內容	Signature 簽章
1	Visual inspection 外觀檢查	CFH
2	Electrical strength test 電氣強度測試	CFH
3	Functional test / Pre-test 功能測試/預測試	CFH
4	Compressor Pre-heating 壓縮機預熱	CFH
5	Functional test 功能測試	CFH
6	Final adjustment and test 最後調整和測試	CFH
7	Final Check 終檢	CFH

Approval 批准：

ITW GSE hereby confirms that the above equipment has been tested and complies with the acceptancerequirements of the test procedure.
ITW GSE 特此確認上述設備已經過測試並符合測試程序的驗收要求。

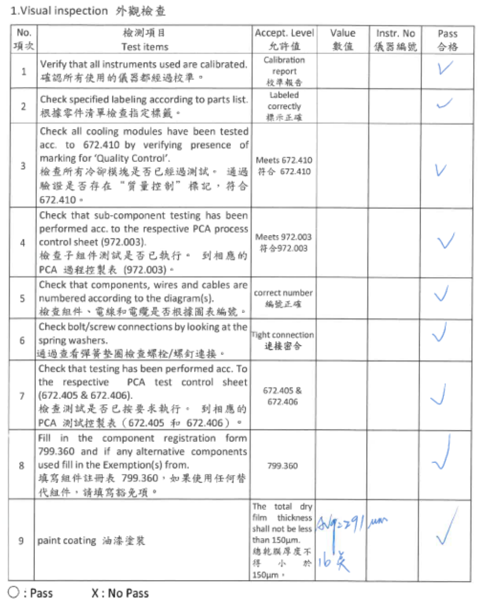
4-10-2023
Date

Signature

Remarks, external approval etc 備註、外部批准等

P.5-2

圖 5-18 預冷式機艙空調測試紀錄表 1



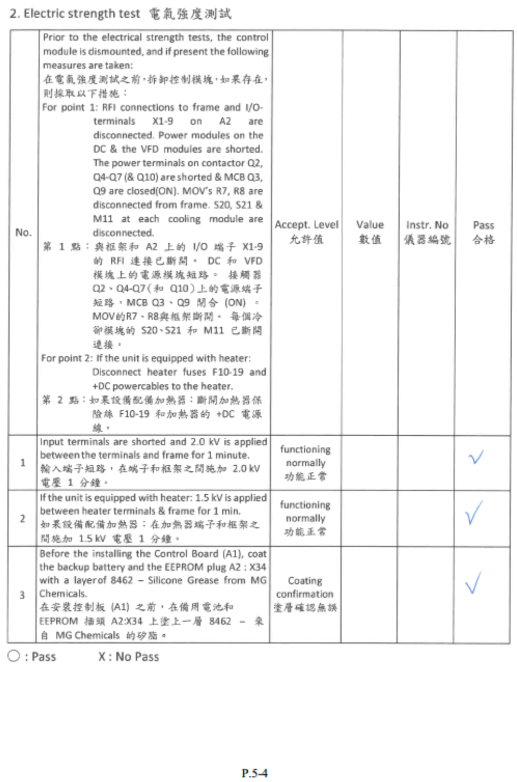
1.Visual inspection 外觀檢查

No. 項次	檢測項目 Test items	Accept. Level 允許值	Value 數值	Instr. No 儀器編號	Pass 合格
1	Verify that all instruments used are calibrated. 確認所有使用的儀器都經過校準。	Calibration report 校準報告			✓
2	Check specified labeling according to parts list. 根據零件清單檢查指定標籤。	Labeled correctly 標示正確			✓
3	Check all cooling modules have been tested acc. to 672.410 by verifying presence of marking for 'Quality Control'. 檢查所有冷卻模塊是否已經過測試。通過驗證是否存在"質量控制"標記，符合 672.410。	Meets 672.410 符合 672.410			✓
4	Check that sub-component testing has been performed acc. to the respective PCA process control sheet (972.003). 檢查子組件測試是否已執行。到相應的 PCA 過程控製表 (972.003)。	Meets 972.003 符合972.003			✓
5	Check that components, wires and cables are numbered according to the diagram(s). 檢查組件、電線和電纜是否根據圖表編號。	correct number 編號正確			✓
6	Check bolt/screw connections by looking at the spring washers. 通過查看彈簧墊圈檢查螺栓/螺釘連接。	Tight connection 連接密合			✓
7	Check that testing has been performed acc. To the respective PCA test control sheet (672.405 & 672.406). 檢查測試是否已按要求執行。到相應的 PCA 測試控製表（672.405 和 672.406）。	672.405 & 672.406			✓
8	Fill in the component registration form 799.360 and if any alternative components used fill in the Exemption(s) from. 填寫組件註冊表 799.360，如果使用任何替代組件，請填寫豁免項。	799.360			✓
9	paint coating 油漆塗裝	The total dry film thickness shall not be less than 150μm. 總乾膜厚度不得小於 150μm。	349.2791 μm	16 [illegible]	✓

○：Pass X：No Pass

P.5-3

圖 5-19 預冷式機艙空調測試紀錄表 2



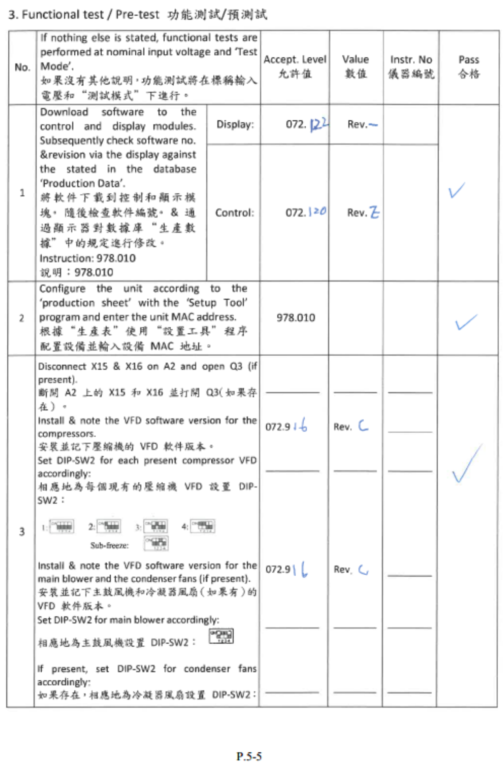
2. Electric strength test 電氣強度測試

No.	Prior to the electrical strength tests, the control module is dismounted, and if present the following measures are taken: 在電氣強度測試之前，拆卸控制模塊，如果存在，則採取以下措施：For point 1: RFI connections to frame and I/O-terminals X1-9 on A2 are disconnected. Power modules on the DC & the VFD modules are shorted. The power terminals on contactor Q2, Q4-Q7 (& Q10) are shorted & MCB Q3, Q9 are closed(ON). MOV's R7, R8 are disconnected from frame. S20, S21 & M11 at each cooling module are disconnected. 第 1 點：與框架和 A2 上的 I/O 端子 X1-9 的 RFI 連接已斷開。DC 和 VFD 模塊上的電源模塊短路。接觸器 Q2、Q4-Q7（和 Q10）上的電源端子短路，MCB Q3、Q9 閉合 (ON)。MOV的R7、R8與框架斷開。每個冷卻模塊的 S20、S21 和 M11 已斷開連接。For point 2: If the unit is equipped with heater: Disconnect heater fuses F10-19 and +DC powercables to the heater. 第 2 點：如果設備配備加熱器：斷開加熱器保險絲 F10-19 和加熱器的 +DC 電源線。	Accept. Level 允許值	Value 數值	Instr. No 儀器編號	Pass 合格
1	Input terminals are shorted and 2.0 kV is applied between the terminals and frame for 1 minute. 輸入端子短路，在端子和框架之間施加 2.0 kV 電壓 1 分鐘。	functioning normally 功能正常			✓
2	If the unit is equipped with heater: 1.5 kV is applied between heater terminals & frame for 1 min. 如果設備配備加熱器：在加熱器端子和框架之間施加 1.5 kV 電壓 1 分鐘。	functioning normally 功能正常			✓
3	Before the installing the Control Board (A1), coat the backup battery and the EEPROM plug A2 : X34 with a layer of 8462 – Silicone Grease from MG Chemicals. 在安裝控制板 (A1) 之前，在備用電池和 EEPROM 插頭 A2:X34 上塗上一層 8462 – 來自 MG Chemicals 的矽脂。	Coating confirmation 塗層確認無誤			✓

○：Pass X：No Pass

P.5-4

圖 5-20 預冷式機艙空調測試紀錄表 3



3. Functional test / Pre-test 功能測試/預測試

No.	If nothing else is stated, functional tests are performed at nominal input voltage and 'Test Mode'. 如果沒有其他說明，功能測試將在標稱輸入電壓和"測試模式"下進行。		Accept. Level 允許值	Value 數值	Instr. No 儀器編號	Pass 合格
1	Download software to the control and display modules. Subsequently check software no. &revision via the display against the stated in the database 'Production Data'. 將軟件下載到控制和顯示模塊。隨後檢查軟件編號。& 通過顯示器對數據庫"生產數據"中的規定進行修改。Instruction: 978.010 說明：978.010	Display:	072.122	Rev. –		✓
		Control:	072.120	Rev. Z		
2	Configure the unit according to the 'production sheet' with the 'Setup Tool' program and enter the unit MAC address. 根據"生產表"使用"設置工具"程序配置設備並輸入設備 MAC 地址。		978.010			✓
3	Disconnect X15 & X16 on A2 and open Q3 (if present). 斷開 A2 上的 X15 和 X16 並打開 Q3(如果存在）。		____	____	____	✓
	Install & note the VFD software version for the compressors. 安裝並記下壓縮機的 VFD 軟件版本。		072.916	Rev. C	____	
	Set DIP-SW2 for each present compressor VFD accordingly: 相應地為每個現有的壓縮機 VFD 設置 DIP-SW2：1: 2: 3: 4: Sub-freeze:		____	____	____	
	Install & note the VFD software version for the main blower and the condenser fans (if present). 安裝並記下主鼓風機和冷凝器風扇（如果有）的 VFD 軟件版本。		072.916	Rev. C	____	
	Set DIP-SW2 for main blower accordingly: 相應地為主鼓風機設置 DIP-SW2：		____	____	____	
	If present, set DIP-SW2 for condenser fans accordingly: 如果存在，相應地為冷凝器風扇設置 DIP-SW2：		____	____	____	

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圖 5-21 預冷式機艙空調測試紀錄表 4

(1)-2 預冷式機艙空調測試照片

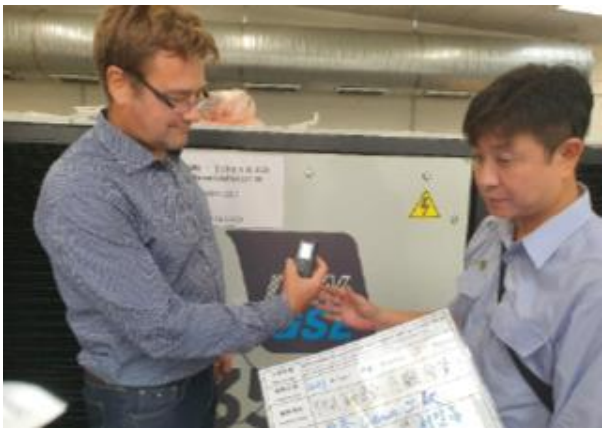
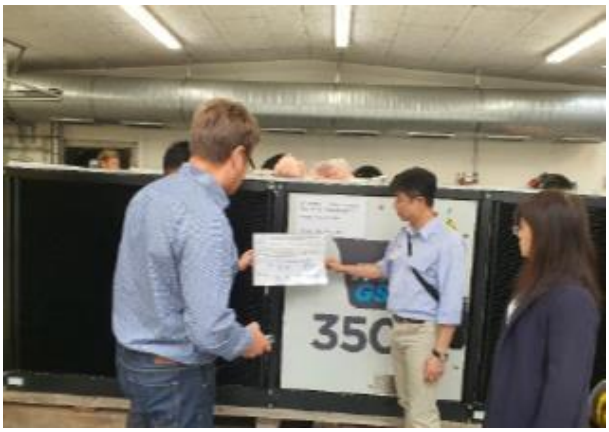
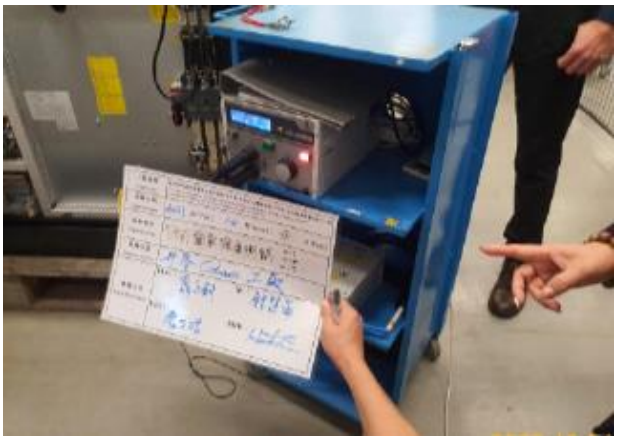
	

圖 5-22 檢查標籤及外觀	圖 5-23 檢查外殼油漆膜厚
	
圖 5-24 檢查膜厚，平均模厚 291μm	圖 5-25 電氣強度測試

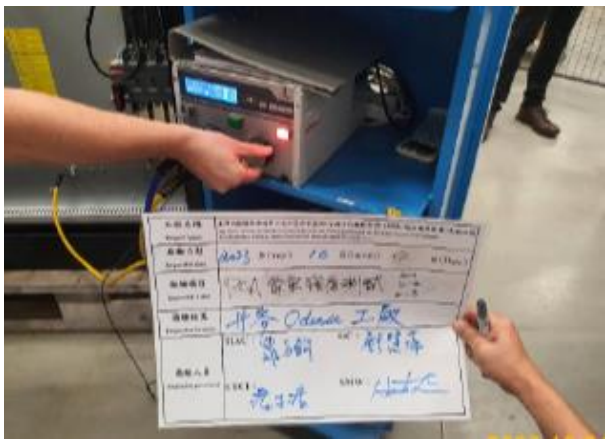



圖 5-26 電氣強度測試—使輸入端子短路，在端子和框架之間施加 2.0 kV 電壓 1 分鐘	圖 5-27 確認備用電池和 EEPROM 插頭上塗有矽脂(在安裝控制板前)

(1)-2 預冷式機艙空調測試照片(續)

圖 5-28 調整數據庫資料，以認控制器作動是否正常。

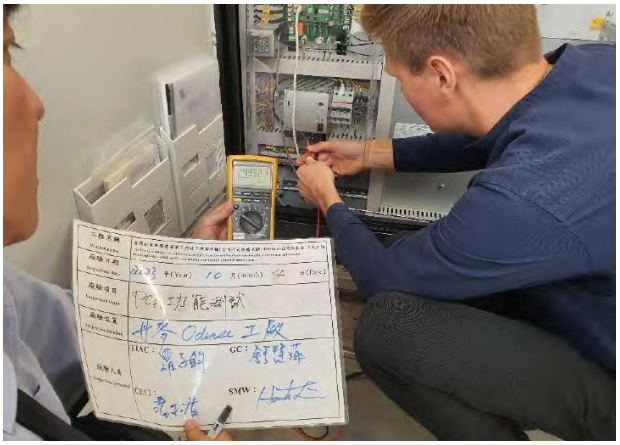


圖 5-29 調整輸出端電壓驗，以證設備功能

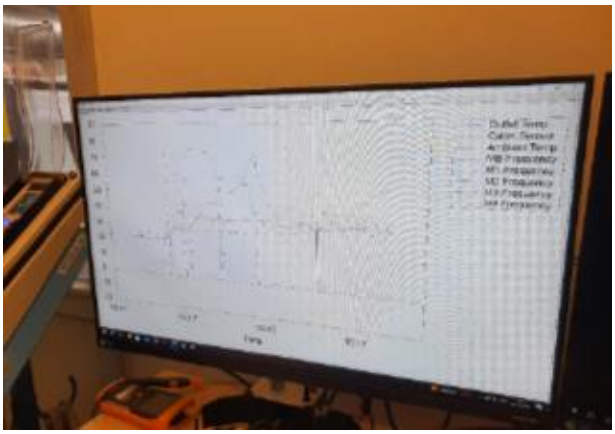
圖 5-30 驗證顯示幕中所示環境溫度是否等於實際環境溫度

圖 5-31 驗證顯示幕中所示環境溫度是否等於實際環境溫度

圖 5-32 驗證顯示屏中所示排/吸入壓力是否與實際環境相同。

圖 5-33 功能正常

(1)-2 預冷式機艙空調測試照片(續)

	
圖 5-34 進行測試前暖機(壓縮機必須預熱至少 16 小時，方可啟動 PCA 並繼續進行功能測試)。	圖 5-35 環境實驗室數值監控
	
圖 5-36 驗證直流散熱器風扇，及主鼓風機和的功能是否正常。	圖 5-37 確認 PCA 排風作動正常
	
圖 5-38 拆下過濾器外蓋，阻塞 90%的過濾器，並驗證堵塞開關的功能是否正常。	圖 5-39 功能正常

(2) 400Hz 地面電源裝置(GPU)測試測試過程：

i. 驗證儀器是否校準，並確認功率分析儀設置符合測試設定。

ii. 驗證銘牌數據。

iii. 驗證手冊和圖表資料是否齊全。

iv. 依零件清單檢查指定的標籤是否正確。

v. 檢查測試項目是否依相應的 GPU 測試控制表規定進行。

vi. 檢查外殼油漆狀況，與膜厚測量。

vii. 檢查組件、電線和電纜是否依據圖表編號標示。

viii. 檢視彈簧墊圈、螺栓，及螺釘連接情形。

ix. 進行電氣強度測試。

x. 進行功能測試。

xi. 進行熱測試。

xii. 確認所有檢查項目是否完成，並確認設備功能正常。

(2)-1 400Hz 地面電源裝置測試紀錄表

Test Record Form for 60 - 90 kVA
ITW GSE 2400 Power Coil
60 - 90 kVA 測試紀錄表
ITW GSE 2400 電源線圈

Converter Data :

Type 類型 : 3GWC-200/ 260 -N		Serial no. 序號 : 108846/3.5	
Input voltage 輸入電壓 :	3X400 V	Output voltage 輸出電壓 :	200 V
Input current 輸入電流 :	140 A	Output current 輸出電流 :	260 A
Input frequency 輸入頻率:	50/60 Hz	Output frequency 輸出頻率 :	400 Hz
		Output power 輸出功率 :	90 kVA

Inspections and tests performed 執行的檢查和測試：

		Signature 簽章
1	Visual inspection 外觀檢查	CFH
2	Electric strength test 電氣強度測試	CFH
3	Functional test of Power Coil Unit 功率線圈單元的功能測試	CFH
4	Heat test. 熱測試	CFH
5	Final adjustment and test. 最終調整和測試	CFH
		CFH

Approval 批准 :

ITW GSE hereby confirms that the above equipment has been tested and complies with the acceptancerequirements of the test procedure.
ITW GSE 特此確認上述設備已經過測試並符合測試程序的驗收要求。

3-10-2023
Date

Signature

Remarks, external approval etc 備註、外部批准等

P.5-46

圖 5-40 地面電源裝置測試紀錄表 1

1.Visual inspection 外觀檢查

No. 項次	檢測項目 Test items	Accept. Level 允許值	Value 數值	Instr. No 儀器編號	Pass 合格
1	Verify that all used instruments are calibrated and the Power Analyzer settings are according to instruction 978.030 驗證所有使用的儀器都經過校準並且功率分析儀設置符合指令 978.030	978.030			✓
2	Verify rating plate data. 驗證銘牌數據	Model: POWER COIL 2400 型號:POWER COIL 2400 Capacity: 90KVA 容量: 90KVA			✓
3	Verify presence of manual and diagram. 驗證手冊和圖表的存在	Attached 已檢附			✓
4	Check specified labeling according to parts list. 根據零件清單檢查指定的標籤	Labels are correct 標籤正確無誤			✓
5	Check that sub-component testing has been performed acc. to the respective GPU process control sheets (977.019~020). 檢查子組件測試是否已執行， 到各自的 GPU 過程控製表(977.019~020)	Executed 已執行			✓
6	Check enclosure painting. 檢查外殼油漆。	Dry film thickness above 120µm (inclusive) 乾膜厚度 120µm (含) 以上		15 point Ave. >90µm	✓
7	Check that components, wires and cables are numberedaccording to the diagram(s). 檢查組件,電線和電纜是否根據圖表編號。	correct number 編號正確			✓
8	Check bolt/screw connections by looking at the spring washers. 通過查看彈簧墊圈檢查螺栓/螺釘連接	right connection 連接密合			✓

○ : Pass X : No Pass

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圖 5-41 地面電源裝置測試紀錄表 2

2. Electric strength test 電氣強度測試

NO. 項次		Accept. Level 允許值	Value 數值	Instr. No 儀器編號	Pass 合格
	Prior to the electrical strength tests, the control module is dismounted. 在電氣強度測試之前，控制模塊被拆卸。 For point 2-3: RFI & 400 Hz N connections to frame and I/O-terminals X1-4 on A2 are disconnected. SW4 jumper on A2 is removed. Power modules are shorted & MOV's R2, R3 are disconnected from frame. Disconnect the Mains input wires on the VFD. Remove the EMC screw & the VAR screw on the side of the VFD. (Install only the EMC screw again after test). Remove wire 13 in K1:A2-. 對於第2-3點：RFI 和 400 Hz N 與框架和 A2 上的 I/O 端子 X1-4 的連接已斷開。 A2 上的 SW4 跳線已移除。 電源模塊短路 & MOV 的 R2、R3 與框架斷開。 斷開 VFD 上的電源輸入線。 拆掉機身側面的 EMC 螺絲和 VAR 螺絲變頻器。（測試後僅重新安裝 EMC 螺釘）。 拆下 K1:A2- 中的 13 號線 For point 4-5: X1-4 on A2 are installed again. Remove SW3 +/- jumper on A2. Remove wire 29 and 210 in X5 and remove X10. 對於第4-5點：再次安裝 A2 上的 X1-4， 清除A2 上的 SW3 +/- 跳線。 拆下 X5 中的 29 號和 210 號電線，並拆下 X10。	Accept. Level 允許值	Value 數值	Instr. No 儀器編號	Pass 合格
1	Verify that the high voltage tester is daily verified according to the instruction before the Electric strength test is continued. 在繼續進行電氣強度測試之前，確認高壓測試儀每天都按照說明進行校驗。	978.031 & 978.032	—		✓
2	Output terminals are shorted to frame and 2.0 kV is applied between input terminals and frame for 1 minute. 輸出端子與框架短路，在輸入端子和框架之間施加 2.0 kV 電壓 1 分鐘。	Max. 75 mA		12.05mA	✓
3	Input terminals are shorted to frame and 2.0 kV is applied between output terminals and frame for 1 minute. 輸入端子與框架短路，在輸出端子和框架之間施加 2.0 kV 電壓 1 分鐘。	Max. 75 mA		6.5mA	✓

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圖 5-42 地面電源裝置測試紀錄表 3

NO. 項次		Accept. Level 允許值	Value 數值	Instr. No 儀器編號	Pass 合格
	Prior to the electrical strength tests, the control module is dismounted. 在電氣強度測試之前，控制模塊被拆卸。 For point 2-3: RFI & 400 Hz N connections to frame and I/O-terminals X1-4 on A2 are disconnected. SW4 jumper on A2 is removed. Power modules are shorted & MOV's R2, R3 are disconnected from frame. Disconnect the Mains input wires on the VFD. Remove the EMC screw & the VAR screw on the side of the VFD. (Install only the EMC screw again after test). Remove wire 13 in K1:A2-. 對於第2-3點：RFI 和 400 Hz N 與框架和 A2 上的 I/O 端子 X1-4 的連接已斷開。 A2 上的 SW4 跳線已移除。 電源模塊短路 & MOV 的 R2、R3 與框架斷開。 斷開 VFD 上的電源輸入線。 拆掉機身側面的 EMC 螺絲和 VAR 螺絲變頻器。（測試後僅重新安裝 EMC 螺釘）。 拆下 K1:A2- 中的 13 號線 For point 4-5: X1-4 on A2 are installed again. Remove SW3 +/- jumper on A2. Remove wire 29 and 210 in X5 and remove X10. 對於第4-5點：再次安裝 A2 上的 X1-4， 清除A2 上的 SW3 +/- 跳線。 拆下 X5 中的 29 號和 210 號電線，並拆下 X10。	Accept. Level 允許值	Value 數值	Instr. No 儀器編號	Pass 合格
4	I/O-terminals (exempting wire no. 1, 6, 7, 8, 9, 10, 11, 12, 17) on X10 are shorted and 500 VDC is applied between the terminals & frame for 1 min. X10 上的 I/O 端子（豁免線號 1、6、7、8、9、10、11、12、17）短路，並在端子和框架之間施加 500 VDC 1 分鐘。	normal functioning 功能正常	OK	AXA-537	✓
5	I/O-terminals (exempting +/-) on X7 are shorted and 500 VDC is applied between the terminals & frame for 1 min. X7 上的 I/O 端子（免除 +/-）短路，並在端子和框架之間施加 500 VDC 1 分鐘。	normal functioning 功能正常	OK	AXA-537	✓
6	Before the installing the Control Board, coat the backup battery and the EEPROM plug X34 with a layer of 8462 – Silicone Grease from MG Chemicals.	Execution completed 執行完成			✓

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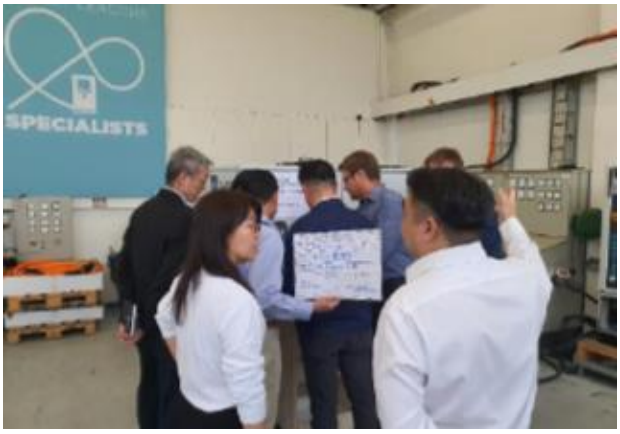
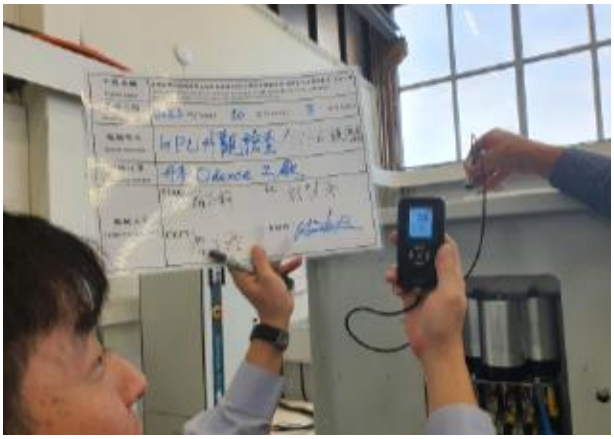
圖 5-43 地面電源裝置測試紀錄表 4

(2)-2 地面電源裝置測試照片

<table>
<tr><td> 
</td><td>  </td></tr>
<tr><td>圖 5-44 驗證銘牌數據</td><td>圖 5-45 驗證手冊和圖表資料</td></tr>
<tr><td> 
</td><td>  </td></tr>
<tr><td>圖 5-46 依零件清單檢查指定的標籤</td><td>圖 5-47 檢查外殼油漆膜厚</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>圖 5-48 平均膜厚：294µm</td><td>圖 5-49 檢查組件、電線和電纜及圖表編號</td></tr>
</table>

(2)-2 地面電源裝置測試照片(續)

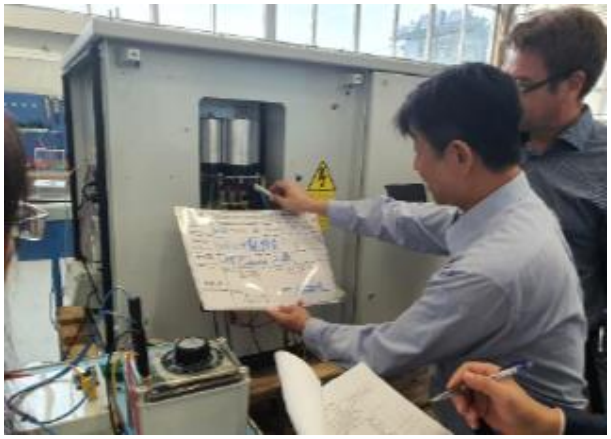


圖 5-50 檢查彈簧墊圈/螺栓/螺釘連接	圖 5-51 電氣強度測試

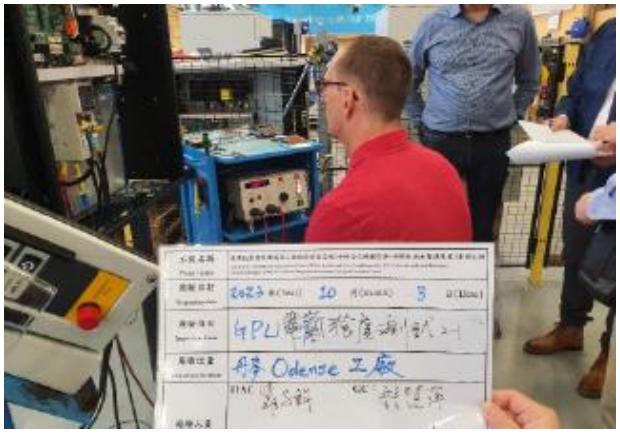



圖 5-52 確認高壓測試儀是否校驗完成	圖 5-53 電氣強度測試(輸入端子與框架短路，在輸出端子和框架之間施加 2.0 kV 電壓 1 分鐘)

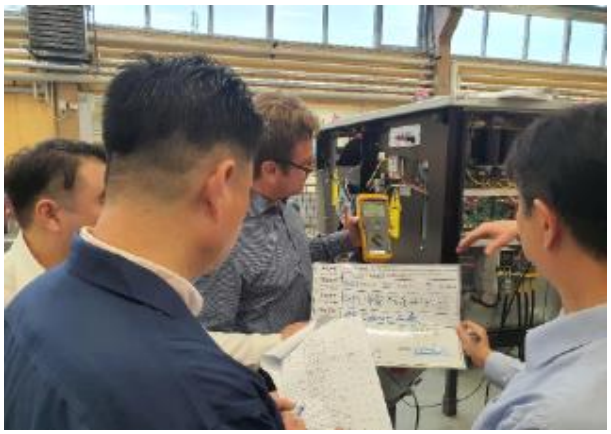
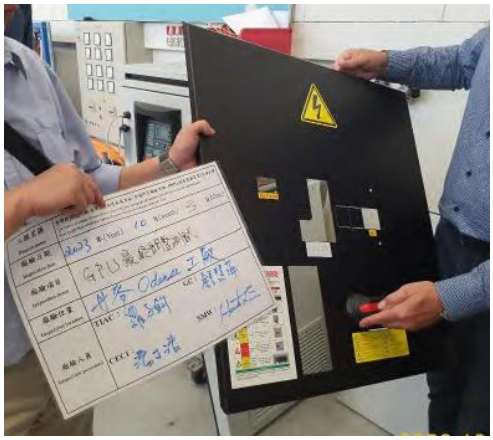
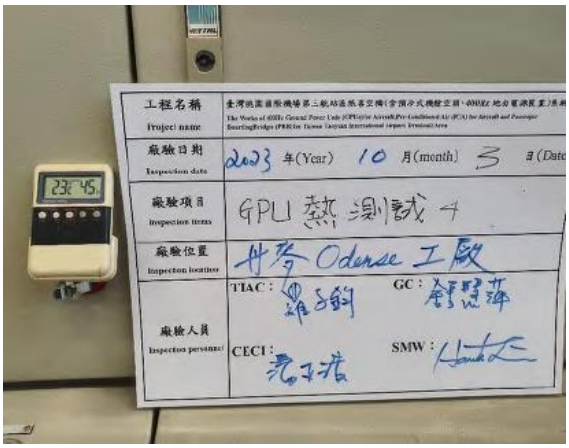



圖 5-54 電氣強度測試(使 I/O 端子短路，並在端子和框架之間施加 500 VDC 1 分鐘)	圖 5-55 驗證隨插即用功能是否正常

(2)-2 地面電源裝置測試照片(續)

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>圖 5-56 確認操作面板功能是否正常。</td><td>圖 5-57 電氣功能測試。</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>圖 5-58 驗證設備接地，及保護外蓋。</td><td>圖 5-59 GPU 熱測試。</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>圖 5-60 驗證電纜捲軸運行功能。</td><td>圖 5-61 驗證操作手冊、圖表等。</td></tr>
</table>

(3)測試儀器校正報告

element Metech

Element Metech A/S
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CALIBRATION CERTIFICATE
Issued by an Accredited Calibration Laboratory

Certificate number	Date of issue	Page (of)
1232925	2023-06-08	1 (9)

Calibrated by: Laust Kruse Pedersen
Approved by: Kjeld Jensen

CUSTOMER:	**ITW GSE APS** SMEDEBAKKEN 31-33 5270 ODENSE N
DEVICE UNDER TEST:	**POWER ANALYZER, VOLTECH, PM3000** Serial No.: 3125 ID No.: AXA-239 METECH No.: 370988 (MIO No.:)
COMMISSION:	Accredited Calibration
EXTENT OF CALIBRATION:	Element Metech Calibration Instruction P102-006 and specifications from former certifikat.
STATUS:	No adjustment or repair has been made.
RESULT OF CALIBRATION:	**Pass (P)** – All measured results are within the acceptance limits
DATE OF CALIBRATION:	2023-06-08 (yyyy-mm-dd)
DATE OF RECEIPT:	2023-06-07 (yyyy-mm-dd)
LOCATION OF CALIBRATION:	Electrical Laboratory, Lab. 265, 7470 Karup
AMBIENT CONDITIONS:	Temperature: (23 ± 3) °C, Humidity: (50 ± 25) %rh
TRACEABILITY:	The calibration is performed with equipment directly or indirectly traceable to the laboratory reference standards. The reference standards are traceable to national or international standards.

This calibration certificate documents the metrological traceability to national or international standards, which realize the units of measurement according to the International System of Units (SI).
The applied quality management system is certified to DS/EN ISO 9001:2015 and the laboratory activities meet the requirements in DS/EN ISO/IEC 17025:2017.
The measurement management system is in compliance with DS/EN ISO 10012:2003.
Element Metech A/S with accreditation number 333 is accredited by Danish Accreditation and Metrology Fund (DANAK) for calibration according to DS/EN ISO/IEC 17025:2017.
The Danish Accreditation and Metrology Fund (DANAK) is signatory to the multilateral agreements of the European co-operation for Accreditation (EA) and of the International Laboratory Accreditation Cooperation (ILAC) for the mutual recognition of calibration certificates.
This calibration certificate may not be reproduced other than in full except with the permission of the issuing laboratory. Calibration certificates without signature are not valid.

Test template: TES_PM3000_001_102

Element Metech A/S, Herningvej 30, 7470 Karup J, Denmark
Registered office: Karup, CVR-nr. / VAT No: DK 21 49 79 32

All work and services carried out by Element Metech A/S are subject to, and conducted in accordance with, the Element Metech A/S Standard Terms and Conditions, which are available at www.elementmetech.com/terms or upon request.

ilac-MRA DANAK CAL Reg. No. 333

P.6-1

圖 5-62 功率分析儀校正報告 1

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CALIBRATION CERTIFICATE
Issued by an Accredited Calibration Laboratory

Certificate number 1232925 Page (of) 2 (9)

REFERENCE EQUIPMENT	ID NO.	CAL. DUE
AC/DC Multifunction Calibrator, Fluke 5522A	D1685	2024-02-17
Frequency Standard Reciever, Rohde & Schwarz DCF77	D0153	NCR

MEASUREMENT UNCERTAINTY

The reported expanded measurement uncertainty is stated as the standard measurement uncertainty multiplied by the coverage factor k such that the coverage probability corresponds to approximately 95 %. If not otherwise stated the coverage factor is k=2, which for a normal distribution corresponds to a coverage probability of approximately 95 %, for the reported expanded measurement uncertainty.

The measurement uncertainty is determined in accordance with EA Publication EA-4/02 M: 2013 *Evaluation of the Uncertainty of Measurement in Calibration* and the measurement uncertainty is stated in accordance with ILAC publication ILAC-P14:09/2020 *ILAC Policy for Measurement Uncertainty in Calibration.*

The calibration and measurement procedures and measuring equipment used have been selected to provide a measurement uncertainty of less than a third of the specification of the device under test, i.e. a Test Uncertainty Ratio (TUR) > 3, where possible. The reported measurement uncertainty applies only to the measured value and do not imply anything regarding the long-term stability of the device under test.

Remarks:
Setting PM3000: AUTO, AVERAGING DEPTH = 16.

Measurements marked by [*] are not part of DANAK accreditation no. 333.

P.6-2

圖 5-63 功率分析儀校正報告 2

element Metech

CALIBRATION CERTIFICATE
Issued by an Accredited Calibration Laboratory

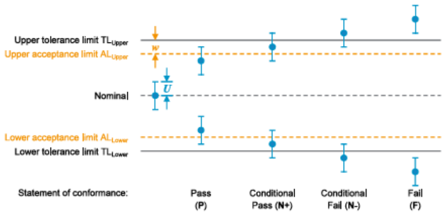
Certificate number 1232925 Page (of) 3 (9)

STATEMENT OF CONFORMITY WITH TOLERANCE / SPECIFICATION

The statement of conformity with tolerance / specification is determined in accordance with ILAC publication ILAC G8:09/2019 *Guidelines on Decision Rules and Statements of Conformity* using the decision rule with a non-binary statement with guard band equal to the expanded measurement uncertainty (w=U). The statement of conformity is based on a 95 % coverage probability for the expanded measurement uncertainty and is only valid for the device under test at the tested points.

The statement of conformity with tolerance / specification is reported as:

P	Pass – The measured result is within in the acceptance limits
N+	Conditional Pass – The measured result is inside the guard band, i.e. within the tolerance limits but outside the acceptance limits
N-	Conditional Fail – The measured result is outside the tolerance limits but with less than the guard band
F	Fail – The measured result is outside the tolerance limits with more than the guard band
NE	Not Evaluated: Test Uncertainty Ratio is not sufficient (U > TL) to evaluate compliance with tolerances.



TL	Tolerance Limit / Specification Limit (TL_{Upper}, TL_{Lower})
AL	Acceptance Limit ($AL_{Upper} = TL_{Upper} - w$, $AL_{Lower} = TL_{Lower} + w$)
w	Guard band equal to expanded uncertainty (w = U)
U	Expanded measurement uncertainty (U)

The statement of conformity with tolerance / specification is based on the decision rule above and the final judgement, if the device under test is compliant and fit for purpose for its intended use (metrological confirmation), has to be made by the customer.

Other terms that may be used:

NT	Not Tested, the measured point is not measured (and not tested for conformity with specification)
NS	Not Specified, the measured point is measured but has no tolerance / specification limits
NA	Not Available
UUT	Unit Under Test
DUT	Device Under Test
ppm	parts per million
TUR	Test Uncertainty Ratio (TL / U)
NCR	No Calibration Required
MPE	Maximum Permissible Error

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圖 5-64 功率分析儀校正報告 3

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CALIBRATION CERTIFICATE
Issued by an Accredited Calibration Laboratory

Certificate number 1232925 Page (of) 4 (9)

Results:

Function : AC Voltage CH1

Range	Nominal	Measured	Deviation	Uncertainty	Spec. [±]	
0,5 V range @ 60 Hz	0,1980 V	0,1959 V	–0,0021 ±	0,00058 V	0,0207 V	P
0,5 V range @ 1000 Hz	0,1980 V	0,1961 V	–0,0019 ±	0,00058 V	0,0210 V	P
1 V range @ 60 Hz	0,3500 V	0,3526 V	0,0026 ±	0,00058 V	0,0214 V	P
1 V range @ 1000 Hz	0,3500 V	0,3532 V	0,0032 ±	0,00058 V	0,0219 V	P
2 V range @ 60 Hz	0,7000 V	0,7043 V	0,0043 ±	0,00015 V	0,0227 V	P
2 V range @ 1000 Hz	0,7000 V	0,7046 V	0,0046 ±	0,00015 V	0,0238 V	P
5 V range @ 60 Hz	1,700 V	1,7069 V	0,0069 ±	0,00029 V	0,0267 V	P
5 V range @ 1000 Hz	1,700 V	1,7072 V	0,0072 ±	0,00029 V	0,0293 V	P
10 V range @ 60 Hz	3,500 V	3,512 V	0,012 ±	0,0011 V	0,034 V	P
10 V range @ 1000 Hz	3,500 V	3,511 V	0,011 ±	0,0011 V	0,039 V	P
20 V range @ 60 Hz	7,000 V	7,024 V	0,024 ±	0,0016 V	0,047 V	P
20 V range @ 1000 Hz	7,000 V	7,024 V	0,024 ±	0,0016 V	0,058 V	P
50 V range @ 60 Hz	17,000 V	17,019 V	0,019 ±	0,0030 V	0,087 V	P
50 V range @ 1000 Hz	17,000 V	17,019 V	0,019 ±	0,0030 V	0,113 V	P
50 V range @ 50000 Hz	17,000 V	16,885 V	–0,115 ±	0,0057 V	0,526 V	P
100 V range @ 60 Hz	35,00 V	35,05 V	0,05 ±	0,0096 V	0,16 V	P
100 V range @ 1000 Hz	35,00 V	35,05 V	0,05 ±	0,012 V	0,21 V	P
200 V range @ 60 Hz	70,00 V	70,08 V	0,08 ±	0,015 V	0,29 V	P
200 V range @ 1000 Hz	70,00 V	70,09 V	0,09 ±	0,018 V	0,40 V	P
500 V range @ 60 Hz	170,0 V	170,18 V	0,18 ±	0,033 V	0,69 V	P
500 V range @ 400 Hz	115,0 V	115,14 V	0,14 ±	0,023 V	0,81 V	P
500 V range @ 1000 Hz	170,0 V	170,12 V	0,12 ±	0,037 V	0,95 V	P
1000 V range @ 60 Hz	350,0 V	350,3 V	0,3 ±	0,11 V	1,4 V	P
1000 V range @ 1000 Hz	350,0 V	350,3 V	0,3 ±	0,11 V	1,9 V	P
2000 V range @ 60 Hz	700,0 V	700,6 V	0,6 ±	0,18 V	2,7 V	P
2000 V range @ 1000 Hz	700,0 V	700,3 V	0,3 ±	0,18 V	3,8 V	P

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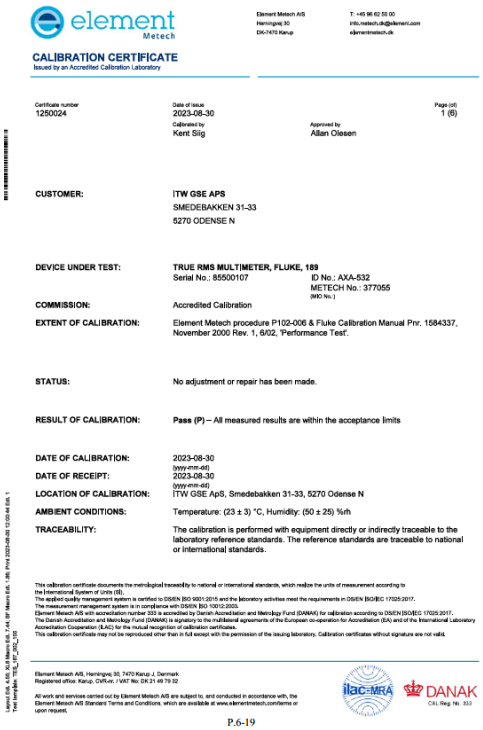
圖 5-65 功率分析儀校正報告 4

(3)測試儀器校正報告(續)



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CALIBRATION CERTIFICATE
Issued by an Accredited Calibration Laboratory

Certificate number	Date of issue	Page (of)
1250024	2023-08-30	1 (6)

Calibrated by: Kent Silg
Approved by: Allan Olesen

CUSTOMER: ITW GSE APS
SMEDEBAKKEN 31-33
5270 ODENSE N

DEVICE UNDER TEST: TRUE RMS MULTIMETER, FLUKE, 189
Serial No.: 85500107
ID No.: AXA-532
METECH No.: 377055
(MIO No.)

COMMISSION: Accredited Calibration

EXTENT OF CALIBRATION: Element Metech procedure P102-006 & Fluke Calibration Manual Pnr. 1584337, November 2000 Rev. 1, 6/02, 'Performance Test'.

STATUS: No adjustment or repair has been made.

RESULT OF CALIBRATION: **Pass (P)** – All measured results are within the acceptance limits

DATE OF CALIBRATION: 2023-08-30 (yyyy-mm-dd)
DATE OF RECEIPT: 2023-08-30 (yyyy-mm-dd)
LOCATION OF CALIBRATION: ITW GSE ApS, Smedebakken 31-33, 5270 Odense N
AMBIENT CONDITIONS: Temperature: (23 ± 3) °C, Humidity: (50 ± 25) %rh
TRACEABILITY: The calibration is performed with equipment directly or indirectly traceable to the laboratory reference standards. The reference standards are traceable to national or international standards.

This calibration certificate documents the metrological traceability to national or international standards, which realize the units of measurement according to the International System of Units (SI).
The applied quality management system is certified to DS/EN ISO 9001:2015 and the laboratory activities meet the requirements in DS/EN ISO/IEC 17025:2017.
The measurement management system is in compliance with DS/EN ISO 10012:2003.
Element Metech A/S with accreditation number 333 is accredited by Danish Accreditation and Metrology Fund (DANAK) for calibration according to DS/EN ISO/IEC 17025:2017.
The Danish Accreditation and Metrology Fund (DANAK) is signatory to the multilateral agreements of the European co-operation for Accreditation (EA) and of the International Laboratory Accreditation Cooperation (ILAC) for the mutual recognition of calibration certificates.
This calibration certificate may not be reproduced other than in full except with the permission of the issuing laboratory. Calibration certificates without signature are not valid.

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Registered office: Karup, CVR-no. / VAT No. DK 21 49 79 52

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ilac-MRA DANAK CAL Reg. No. 333

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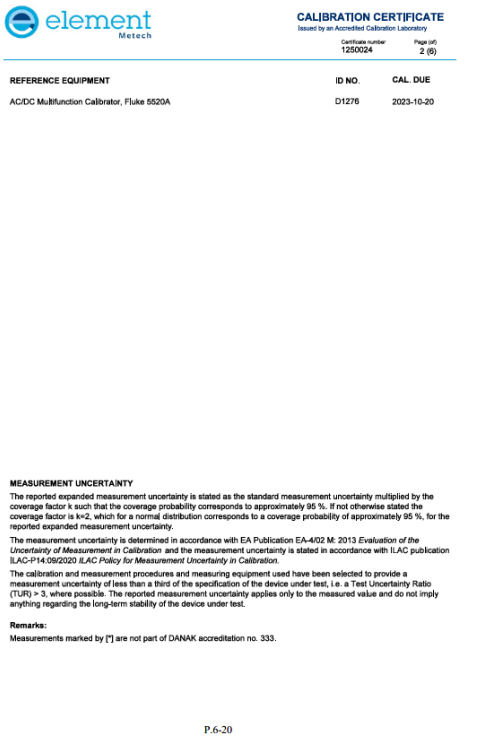
圖 5-66 萬用電錶校正報告 1



element Metech

CALIBRATION CERTIFICATE
Issued by an Accredited Calibration Laboratory

Certificate number: 1250024 Page (of): 2 (6)

REFERENCE EQUIPMENT	ID NO.	CAL. DUE
AC/DC Multifunction Calibrator, Fluke 5520A	D1276	2023-10-20

MEASUREMENT UNCERTAINTY

The reported expanded measurement uncertainty is stated as the standard measurement uncertainty multiplied by the coverage factor k such that the coverage probability corresponds to approximately 95 %. If not otherwise stated the coverage factor is k=2, which for a normal distribution corresponds to a coverage probability of approximately 95 %, for the reported expanded measurement uncertainty.

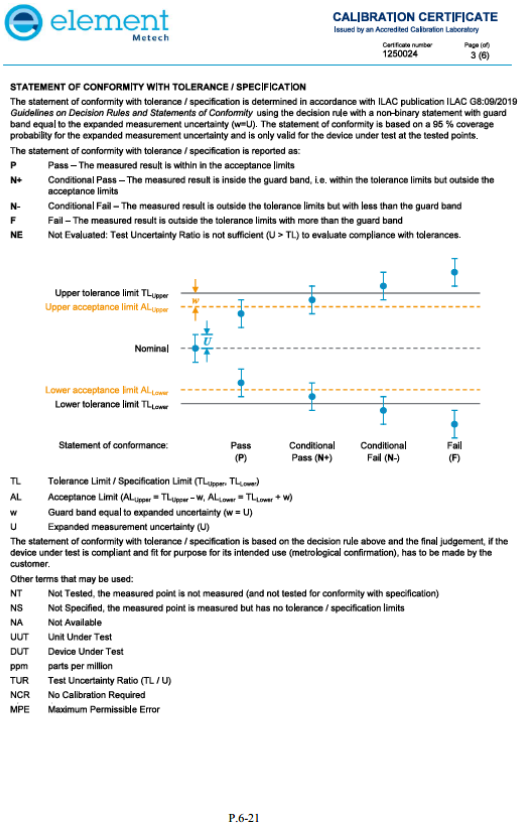
The measurement uncertainty is determined in accordance with EA Publication EA-4/02 M: 2013 *Evaluation of the Uncertainty of Measurement in Calibration* and the measurement uncertainty is stated in accordance with ILAC publication ILAC-P14:09/2020 *ILAC Policy for Measurement Uncertainty in Calibration*.

The calibration and measurement procedures and measuring equipment used have been selected to provide a measurement uncertainty of less than a third of the specification of the device under test, i.e. a Test Uncertainty Ratio (TUR) > 3, where possible. The reported measurement uncertainty applies only to the measured value and do not imply anything regarding the long-term stability of the device under test.

Remarks:
Measurements marked by [*] are not part of DANAK accreditation no. 333.

P.6-20

圖 5-67 萬用電錶校正報告 2



element Metech

CALIBRATION CERTIFICATE
Issued by an Accredited Calibration Laboratory

Certificate number: 1250024 Page (of): 3 (6)

STATEMENT OF CONFORMITY WITH TOLERANCE / SPECIFICATION

The statement of conformity with tolerance / specification is determined in accordance with ILAC publication ILAC G8:09/2019 *Guidelines on Decision Rules and Statements of Conformity* using the decision rule with a non-binary statement with guard band equal to the expanded measurement uncertainty (w=U). The statement of conformity is based on a 95 % coverage probability for the expanded measurement uncertainty and is only valid for the device under test at the tested points.

The statement of conformity with tolerance / specification is reported as:

P	Pass – The measured result is within in the acceptance limits
N+	Conditional Pass – The measured result is inside the guard band, i.e. within the tolerance limits but outside the acceptance limits
N-	Conditional Fail – The measured result is outside the tolerance limits but with less than the guard band
F	Fail – The measured result is outside the tolerance limits with more than the guard band
NE	Not Evaluated: Test Uncertainty Ratio is not sufficient (U > TL) to evaluate compliance with tolerances.

TL	Tolerance Limit / Specification Limit (TL_{Upper}, TL_{Lower})
AL	Acceptance Limit ($AL_{Upper} = TL_{Upper} - w$, $AL_{Lower} = TL_{Lower} + w$)
w	Guard band equal to expanded uncertainty (w = U)
U	Expanded measurement uncertainty (U)

The statement of conformity with tolerance / specification is based on the decision rule above and the final judgement, if the device under test is compliant and fit for purpose for its intended use (metrological confirmation), has to be made by the customer.

Other terms that may be used:

NT	Not Tested, the measured point is not measured (and not tested for conformity with specification)
NS	Not Specified, the measured point is measured but has no tolerance / specification limits
NA	Not Available
UUT	Unit Under Test
DUT	Device Under Test
ppm	parts per million
TUR	Test Uncertainty Ratio (TL / U)
NCR	No Calibration Required
MPE	Maximum Permissible Error

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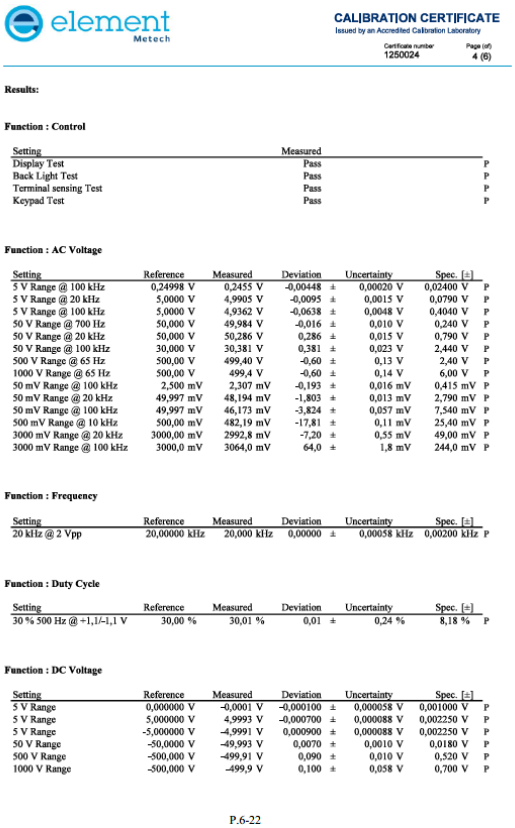
圖 5-68 萬用電錶校正報告 3



element Metech

CALIBRATION CERTIFICATE
Issued by an Accredited Calibration Laboratory

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Results:

Function : Control

Setting	Measured	
Display Test	Pass	P
Back Light Test	Pass	P
Terminal sensing Test	Pass	P
Keypad Test	Pass	P

Function : AC Voltage

Setting	Reference	Measured	Deviation		Uncertainty	Spec. [±]	
5 V Range @ 100 kHz	0,24998 V	0,2455 V	-0,00448	±	0,00020 V	0,02400 V	P
5 V Range @ 20 kHz	5,0000 V	4,9905 V	-0,0095	±	0,0015 V	0,0790 V	P
5 V Range @ 100 kHz	5,0000 V	4,9362 V	-0,0638	±	0,0048 V	0,4040 V	P
50 V Range @ 700 Hz	50,000 V	49,984 V	-0,016	±	0,010 V	0,240 V	P
50 V Range @ 20 kHz	50,000 V	50,286 V	0,286	±	0,015 V	0,790 V	P
50 V Range @ 100 kHz	30,000 V	30,381 V	0,381	±	0,023 V	2,440 V	P
500 V Range @ 65 Hz	500,00 V	499,40 V	-0,60	±	0,13 V	2,40 V	P
1000 V Range @ 65 Hz	500,00 V	499,4 V	-0,60	±	0,14 V	6,00 V	P
50 mV Range @ 100 kHz	2,500 mV	2,307 mV	-0,193	±	0,016 mV	0,415 mV	P
50 mV Range @ 20 kHz	49,997 mV	48,194 mV	-1,803	±	0,013 mV	2,790 mV	P
50 mV Range @ 100 kHz	49,997 mV	46,173 mV	-3,824	±	0,057 mV	7,540 mV	P
500 mV Range @ 10 kHz	500,00 mV	482,19 mV	-17,81	±	0,11 mV	25,40 mV	P
3000 mV Range @ 20 kHz	3000,00 mV	2992,8 mV	-7,20	±	0,55 mV	49,00 mV	P
3000 mV Range @ 100 kHz	3000,0 mV	3064,0 mV	64,0	±	1,8 mV	244,0 mV	P

Function : Frequency

Setting	Reference	Measured	Deviation		Uncertainty	Spec. [±]	
20 kHz @ 2 Vpp	20,00000 kHz	20,000 kHz	0,00000	±	0,00058 kHz	0,00200 kHz	P

Function : Duty Cycle

Setting	Reference	Measured	Deviation		Uncertainty	Spec. [±]	
30 % 500 Hz @ +1,1/-1,1 V	30,00 %	30,01 %	0,01	±	0,24 %	8,18 %	P

Function : DC Voltage

Setting	Reference	Measured	Deviation		Uncertainty	Spec. [±]	
5 V Range	0,000000 V	-0,0001 V	-0,000100	±	0,000058 V	0,001000 V	P
5 V Range	5,000000 V	4,9993 V	-0,000700	±	0,000088 V	0,002250 V	P
5 V Range	-5,000000 V	-4,9991 V	0,000900	±	0,000088 V	0,002250 V	P
50 V Range	-50,0000 V	-49,993 V	0,0070	±	0,0010 V	0,0180 V	P
500 V Range	-500,000 V	-499,91 V	0,090	±	0,010 V	0,520 V	P
1000 V Range	-500,000 V	-499,9 V	0,100	±	0,058 V	0,700 V	P

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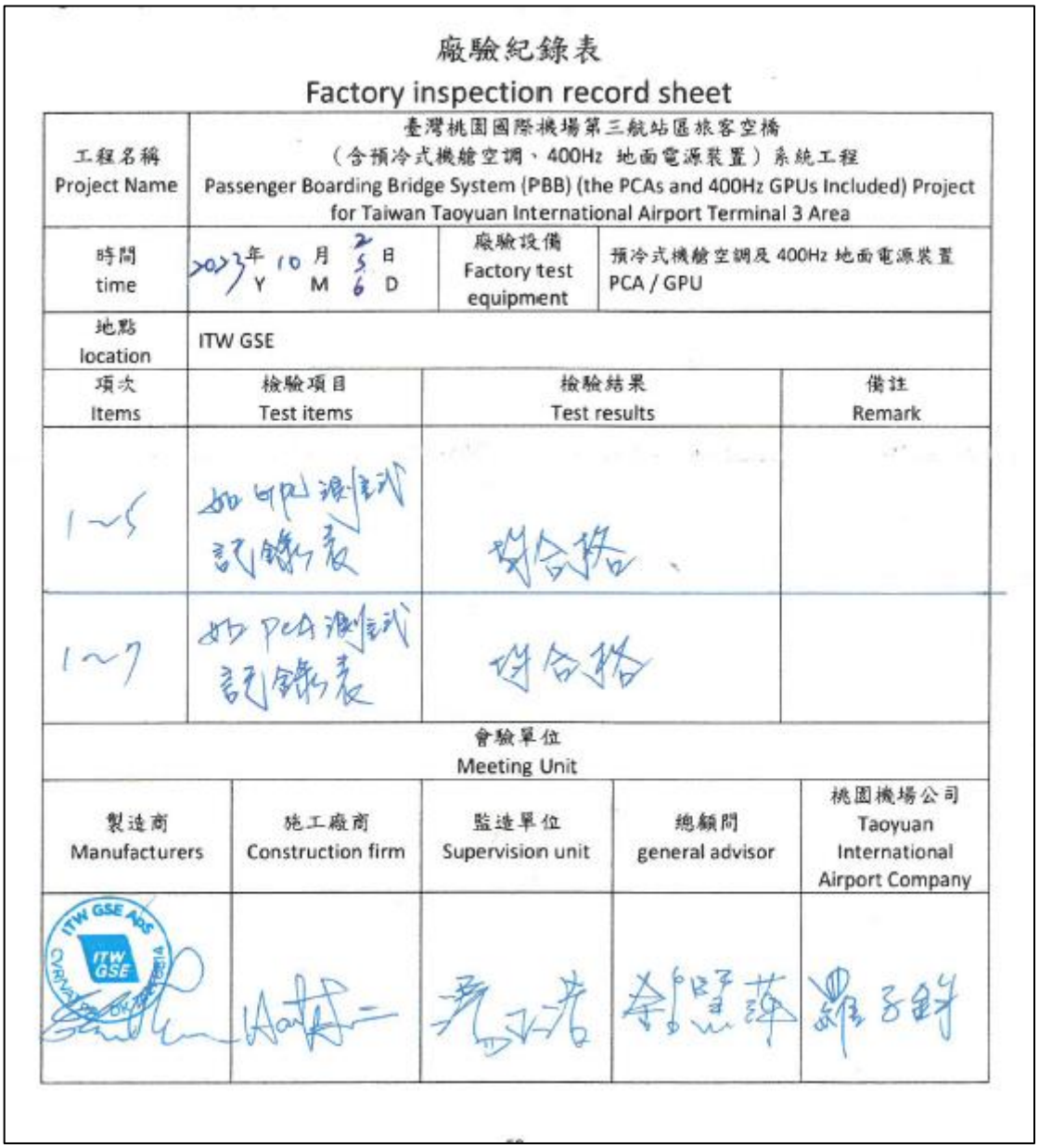
4. 工廠測試結果：

   (1) 預冷式機艙空調：經檢驗確認外觀，根據零件清單檢查指定標籤、檢查組件、電線和電纜是否根據圖表編號、通過查看彈簧墊圈檢查螺栓/螺釘連接、電器強度測試、功能測試，及最終調整測試等，皆符合規定，試驗結果合格。

   (2) 400Hz 地面電源裝置：經驗證銘牌數據，驗證手冊和圖表的存在、根據零件清單檢查指定的標籤、檢查外殼油漆與厚度、檢查組件、電線和電纜是否根據圖表編號、確認彈簧墊圈檢查螺栓/螺釘連接、進行電氣強度測試、功能測試及熱測試等，皆符合規定，試驗結果合格。

5. 檢討會議：根據工廠測試結果，本案預冷式機艙空調(PCA)，及 400Hz 地面電源裝置(GPU)，於廠內測試皆符合契約規定。



廠驗紀錄表

Factory inspection record sheet

工程名稱 Project Name	臺灣桃園國際機場第三航站區旅客空橋 （含預冷式機艙空調、400Hz 地面電源裝置）系統工程 Passenger Boarding Bridge System (PBB) (the PCAs and 400Hz GPUs Included) Project for Taiwan Taoyuan International Airport Terminal 3 Area		
時間 time	2023年 10月 25日 Y M 6 D	廠驗設備 Factory test equipment	預冷式機艙空調及 400Hz 地面電源裝置 PCA / GPU
地點 location	ITW GSE		

項次 Items	檢驗項目 Test items	檢驗結果 Test results	備註 Remark
1~5	如PCA測試記錄表	好合格	
1~7	如PCA測試記錄表	好合格	

會驗單位

Meeting Unit

製造商 Manufacturers	施工廠商 Construction firm	監造單位 Supervision unit	總顧問 general advisor	桃園機場公司 Taoyuan International Airport Company
ITW GSE ApS				

圖 5-70 預冷式機艙空調及 400Hz 地面電源裝置廠驗紀錄表均合格

參、心得及建議

ITW GSE 創立迄今已有百年歷史，該公司向來以提供高品質、高可靠度之航空業地面支援設備聞名，並受世界各地民用，及軍用機場所採用，除本公司此次採購之橋掛式 PCA 及 GPU 外，該公司亦生產移動式電源供應車、橋掛式 PCA 之軟管捲收器等設備，近期更進一步推廣機坪智慧供電管理系統(IPM—Intelligent Power Management)，而經由本次出國廠驗行程，所得心得及建議如下：

一、根據 ITW GSE 調查全球機場上千個設備建置項目，發現大多數供電及供氣系統之設計，提供之功率均超過一般最高須求(多數系統運作剩餘功率可能超過 30%)，而該公司推廣之機坪智慧供電管理系統(IPM)，可直接減少各機坪分電箱數量，即可以單一電源管理系統供應電力予機坪上所需設備，除 PCA、GPU 外，亦可供給電力予電動車/移動式電源車之充電樁，且該系統可依據各設備即時電力需求，自行分配輸出功率，進而減少能源浪費，示意圖如下：

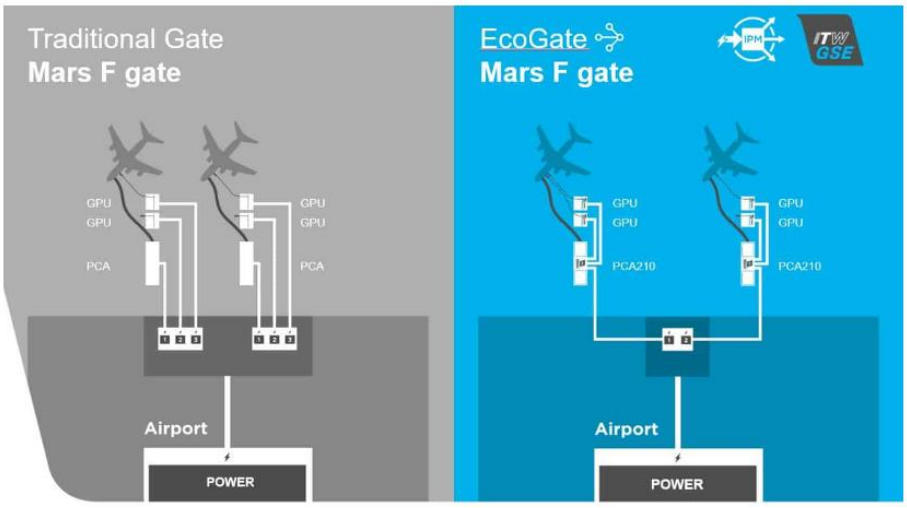


圖 6-1 ITW GSE Intelligent Power Management 示意圖

二、承上，在持續推動碳管理及能源管理制度，以降低溫室氣體排放量的國際政策下，且一併改善桃園機場機坪之作業環境(包含後續第三航廈遠端機坪，及未來衛星廊廳各機坪)，均可將此公司所產相關設備納入採購規劃，除可避免再使用燃油驅動之供電/供氣設備外，若採用該公司推行之 IPM 系統，在本機場機坪持續擴充情境下，更能降低機場整體能源之耗費。

三、實地廠驗作業後得知，即使人員貼近 PCA 及 GPU 設備旁，其運作時噪音，仍低於航機運轉噪音，為更積極改善機坪噪音及空氣汙染，應鼓勵航空公司多加使用本公司所提供之基礎服務設施。

四、經參觀 ITW GSE 工廠辦公空間，及產線作業環境，多方面均有考量人體工學，及安衛措施(可多向調整之辦公桌/椅、產線之省力裝置、不同工項之阻隔設施、人員防護具等)，且提供舒適、清潔之環境與福利(員工餐廳、休憩區、淋浴間、且鼓勵員工養成運動習慣等)，若公司陸續將相關概念參考導入，亦可有效改善工作環境，並提升員工之向心力。

五、丹麥有 82%以上電力來自於低碳能源(風力、太陽能，及生質燃料)，而臺灣多數能源均須採進口方式，且桃園機場為 24 小時營運，所耗能源龐大，應在不影響機場營運情形下，新設綠能相關設施，並進一步推廣能源管理系統，陸續汰換舊有耗能設備，以讓桃園機場更往綠機場境界邁進。