嘉鴻關係企業 JIAHON — Creative technology —

氫氟醚 (HFE) 技術白皮書

Hydrofluoroether (HFE) Technical White Paper

引領電子產業清洗與 AI 浸沒式冷卻新世代

Leading a New Era of Electronics Cleaning and AI Immersion Cooling

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執行摘要

Executive Summary

技術革新與市場機遇的交匯點

The Intersection of Technological Innovation and Market Opportunity

隨著全球半導體製程邁向奈米級精度，以及人工智慧（AI）與高效能運算（HPC）對算力需求的爆炸性增長，傳統的精密清洗與散熱技術已面臨效能瓶頸。氫氟醚（Hydrofluoroether, HFE）以其卓越的物理化學特性，正成為應對此雙重挑戰的關鍵解決方案。它不僅是新一代高效、環保的精密清洗劑，更是實現高密度運算浸沒式冷卻的核心介質。

As global semiconductor manufacturing advances toward nanometer-scale precision and the demand for computing power from Artificial Intelligence (AI) and High-Performance Computing (HPC) grows exponentially, traditional precision cleaning and thermal management technologies have reached a performance bottleneck. Hydrofluoroether (HFE), with its outstanding physicochemical properties, is emerging as the key solution to address this dual challenge. It is not only a next-generation, high-efficiency, and eco-friendly precision cleaning agent but also the core medium for enabling high-density computing immersion cooling.

本白皮書旨在深入剖析氫氟醚的技術優勢、多元應用與市場前景。我們將闡明 HFE 在電子產業從傳統清洗到前瞻性 AI 冷卻的演進，並嚴正澄清其與劇毒化學品氫氟酸（HF）的本質區別。更重要的是，我們將展示嘉鴻公司如何憑藉其「**Your Extraordinary is Our Ordinary**」的核心價值，在台灣建立起穩定、合規且具備深度技術支援的在地供應鏈，協助客戶無縫導入 HFE 技術，搶佔市場先機。

*This white paper aims to provide an in-depth analysis of HFE's technical advantages, diverse applications, and market prospects. We will clarify the evolution of HFE in the electronics industry, from traditional cleaning to forward-looking AI cooling, and formally distinguish it from the highly toxic chemical, hydrofluoric acid (HF). More importantly, we will demonstrate how JIAHON Inc., guided by its core value of "**Your Extraordinary is Our Ordinary,**" has established a stable, compliant, and technically robust local supply chain in Taiwan to help clients seamlessly adopt HFE technology and seize market opportunities.*

在全球領導廠商 3M 宣布將於 2025 年底退出全氟及多氟烷基物質（PFAS）生產的背景下，供應鏈的穩定性與可靠性已成為客戶最優先的考量。嘉鴻公司憑藉其多元化的全球採購網絡與在地化服務，正是您應對此變局、確保未來生產無虞的最佳策略夥伴。

Against the backdrop of global leader 3M's announcement to exit Per- and Polyfluoroalkyl Substances (PFAS) manufacturing by the end of 2025, supply chain stability and reliability have become top priorities for customers. With its diversified global sourcing network and localized services, JIAHON Inc. is your ideal strategic partner to navigate this transition and ensure uninterrupted future production.

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1. 導論：新世代的雙重挑戰

1. Introduction: The Dual Challenges of a New Era

當今的科技產業正被兩股強大的力量所驅動：對**極致精密**的追求與對**極限算力**的渴求。一方面，半導體晶片製程已進入 3 奈米甚至更先進的節點，任何微米級的殘留物都可能導致災難性的良率損失。另一方面，AI 模型的複雜度呈指數級增長，驅動 GPU 等運算單元的功率密度屢創新高，傳統風冷散熱已捉襟見肘。

*Today's technology industry is driven by two powerful forces: the pursuit of **ultimate precision** and the thirst for **extreme computing power**. On one hand, semiconductor chip manufacturing has entered the 3-nanometer node and beyond, where any micron-level residue can lead to catastrophic yield loss. On the other hand, the exponential growth in AI model complexity is pushing the power density of computing units like GPUs to new heights, rendering traditional air cooling inadequate.*

挑戰一：精密清洗的極限

Challenge 1: The Limits of Precision Cleaning

- **微縮化結構：** FinFET、GAA 等 3D 結構的複雜縫隙，傳統溶劑難以滲透。
  Miniaturized Structures: *Complex crevices in 3D architectures like FinFET and GAA are difficult for traditional solvents to penetrate.*
- **材料多樣性：** 多種金屬、高分子材料並存，要求清洗劑具備高度的材料兼容性。
  Material Diversity: *The coexistence of various metals and polymers requires cleaning agents with high material compatibility.*
- **良率敏感度：** 高單價零件（如光學鏡頭、MEMS）對表面潔淨度要求極高。
  Yield Sensitivity: *High-value components (e.g., optical lenses, MEMS) demand extremely high levels of surface cleanliness.*

挑戰二：散熱的功耗高牆

Challenge 2: The Thermal Power Wall

- **功率密度激增：** AI 晶片功耗從 300W 攀升至 1000W 以上，單機櫃功率密度可達 250kW。
  Surging Power Density: *AI chip power consumption has climbed from 300W to over 1000W, with single-rack power density reaching up to 250kW.*
- **能源效率瓶頸：** 傳統資料中心 PUE (電力使用效率) 普遍高於 1.4，大量能源消耗於散熱。
  Energy Efficiency Bottleneck: *Traditional data centers typically have a PUE (Power Usage Effectiveness) above 1.4, with significant energy wasted on cooling.*
- **空間與噪音限制：** 風冷系統佔用大量空間且產生巨大噪音，限制了資料中心的部署密度。
  Space and Noise Constraints: *Air cooling systems occupy substantial space and generate immense noise, limiting data center deployment density.*

氫氟醚（HFE）的出現，為同時解決這兩大難題提供了理想的答案。它不僅是卓越的清洗劑，也是高效的冷卻液，成為推動下一代電子產業發展的關鍵賦能技術。

The emergence of Hydrofluoroether (HFE) provides an ideal solution to both challenges simultaneously. It is not only an excellent cleaning agent but also an efficient coolant, making it a key enabling technology for the next generation of the electronics industry.

2. HFE 技術深度解析

2. In-depth Analysis of HFE Technology

2.1 關鍵物理化學特性

2.1 Key Physicochemical Properties

氫氟醚之所以能成為理想的解決方案，源於其獨特的分子結構所賦予的一系列優異特性。下表將 HFE 與其他常用氟化液及傳統溶劑進行了全面比較。

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HFE's suitability as an ideal solution stems from a series of superior properties endowed by its unique molecular structure. The following table provides a comprehensive comparison of HFE with other common fluorinated fluids and traditional solvents.

特性 *Property*	氫氟醚 (HFE) *Hydrofluoroether*	全氟聚醚 (PFPE) *Perfluoropolyether*	全氟烯烴 (PFO) *Perfluoroolefin*	傳統溶劑 (IPA, MEK) *Traditional Solvents*
表面張力 (mN/m) *Surface Tension*	15-20 (極低 / Very Low)	18-22 (低 / Low)	16-20 (極低 / Very Low)	22-25 (高 / High)
沸點 (°C) *Boiling Point*	40-150 (範圍廣 / Wide Range)	150-350 (高 / High)	49-173 (範圍廣 / Wide Range)	82-150
絕緣強度 (kV) *Dielectric Strength*	>35 (極高 / Very High)	>25 (高 / High)	>30 (高 / High)	<10 (低/不絕緣 / Low/Non-insulating)
毒性 *Toxicity*	低 / Low	極低 / Very Low	極低 / Very Low	中等 / Moderate
不燃性 *Non-flammability*	是 / Yes	是 / Yes	是 / Yes	否 (具閃點) / No (Has Flash Point)
臭氧消耗潛值 (ODP) *Ozone Depletion Potential*	0	0	0	0
全球暖化潛值 (GWP) *Global Warming Potential*	55-320 (低 / Low)	>5000 (極高 / Very High)	<10 (極低 / Very Low)	>1000 (高 / High)
材料兼容性 *Material Compatibility*	優異 / Excellent	優異 / Excellent	優異 / Excellent	可能腐蝕塑膠 / May corrode plastics

核心優勢總結：

Summary of Core Advantages:

- **低表面張力與低黏度：** 具備超強的滲透力，能深入微米級縫隙，徹底清除污染物，是精密清洗的關鍵。
  Low Surface Tension & Low Viscosity: *Possesses superior penetration power to enter micron-scale crevices and thoroughly remove contaminants, which is key for precision cleaning.*
- **高絕緣強度與不導電性：** 可直接用於帶電設備的清洗或浸沒式冷卻，無短路風險，保障操作安全。
  High Dielectric Strength & Non-conductivity: *Allows for direct use on energized equipment for cleaning or immersion cooling without risk of short circuits, ensuring operational safety.*
- **優異的熱穩定性：** 在寬廣的溫度範圍內保持穩定，不分解、不變質，適合長期循環使用。
  Excellent Thermal Stability: *Remains stable over a wide temperature range without decomposition or degradation, suitable for long-term recycling.*
- **低毒性與不燃性：** 無閃點，大幅提升工場環境的安全性，降低職業健康風險。
  Low Toxicity & Non-flammability: *No flash point, significantly enhancing workplace safety and reducing occupational health risks.*
- **環保特性：** ODP 為 0，GWP 值遠低於傳統氟化物，符合全球日益嚴格的環保法規，是可持續發展的首選。
  Eco-friendly Properties: *ODP of 0 and a GWP value far lower than traditional fluorochemicals, complying with increasingly stringent global environmental regulations and making it a top choice for sustainable development.*
- **材料兼容性佳：** 對絕大多數金屬、塑膠和彈性體呈惰性，不造成腐蝕或損壞。
  Good Material Compatibility: *Inert to most metals, plastics, and elastomers, causing no corrosion or damage.*

3. 應用領域 (一)：精密清洗

3. Application (I): Precision Cleaning

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3.1 為何 HFE 是高價零件的理想清洗劑？

3.1 Why is HFE the Ideal Cleaning Agent for High-Value Components?

在半導體、光學、醫療設備等高價值領域，一次清洗失誤可能造成數十萬甚至數百萬的損失。HFE 憑藉其物理化學特性，提供了無可比擬的可靠性與效率。

In high-value sectors such as semiconductors, optics, and medical devices, a single cleaning failure can result in losses of hundreds of thousands or even millions of dollars. HFE, with its unique physicochemical properties, offers unparalleled reliability and efficiency.

強滲透力： HFE 的低表面張力使其能輕易滲透至傳統溶劑無法到達的微觀結構，如晶圓上的深刻蝕溝槽、鏡頭模組的精密組件間隙，將隱藏的微粒與有機殘留物「攜帶」出來。

Strong Penetration: *HFE's low surface tension allows it to easily penetrate micro-structures inaccessible to traditional solvents, such as deep etched trenches on wafers and gaps between precision components in lens modules, effectively "carrying out" hidden particulates and organic residues.*

快速乾燥無殘留： HFE 具有適中的沸點與低揮發潛熱，清洗後能快速、均勻地蒸發，不在零件表面留下水痕或溶劑殘留，免除了額外的烘烤或漂洗步驟，顯著縮短製程時間並降低能耗。

Fast, Residue-Free Drying: *With a moderate boiling point and low latent heat of vaporization, HFE evaporates quickly and uniformly after cleaning, leaving no water spots or solvent residue on the component surface. This eliminates the need for extra baking or rinsing steps, significantly shortening process time and reducing energy consumption.*

帶電清洗安全性： 其優異的絕緣性允許在不切斷電源的情況下對敏感電子元件進行清洗，有效避免靜電放電（ESD）對高價晶片的損害。

Safety in Energized Cleaning: *Its excellent dielectric properties permit the cleaning of sensitive electronic components without powering them down, effectively preventing electrostatic discharge (ESD) damage to high-value chips.*

3.2 典型清洗應用場景

3.2 Typical Cleaning Application Scenarios

產業領域 *Industry Sector*	清洗對象 *Cleaning Target*	解決的痛點 *Pain Point Addressed*	HFE 帶來的價值 *Value Delivered by HFE*
半導體製造 ***Semiconductor Mfg.***	蝕刻腔體、FOUPs、測試探針 *Etch chambers, FOUPs, test probes*	金屬離子與有機物殘留導致製程飄移 *Process drift due to metal ion and organic residues*	提升製程穩定性與晶圓良率 *Improves process stability and wafer yield*
顯示器 (LCD/OLED) ***Display Panels***	面板玻璃、驅動 IC *Panel glass, driver ICs*	微塵顆粒導致亮點、暗點等缺陷 *Defects like bright/dark spots caused by micro-particles*	提高面板潔淨度，降低不良率 *Enhances panel cleanliness, reduces defect rate*
光學與通訊 ***Optics & Communications***	光學鏡片、光纖連接器 *Optical lenses, fiber optic connectors*	指紋、油脂影響光學性能 *Fingerprints and oils affecting optical performance*	確保信號傳輸品質與成像清晰度 *Ensures signal quality and imaging clarity*
醫療設備 ***Medical Devices***	精密手術器械、植入式裝置 *Surgical instruments, implantable devices*	生物負載與加工油污殘留 *Bioburden and residual machining oils*	符合嚴格的醫療級潔淨標準 *Meets stringent medical-grade cleanliness standards*
航空航太 ***Aerospace***	航空引擎零件、精密陀螺儀 *Aero-engine parts, precision gyroscopes*	嚴苛環境下的可靠性要求 *Reliability requirements in harsh environments*	延長零件壽命，保障飛行安全 *Extends component life, ensures flight safety*

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4. 應用領域 (二)：AI 浸沒式冷卻

4. Application (II): AI Immersion Cooling

4.1 浸沒式冷卻：突破 AI 算力的散熱瓶頸

4.1 Immersion Cooling: Breaking the Thermal Bottleneck of AI Computing

浸沒式冷卻技術將伺服器、GPU 等發熱元件完全浸泡在不導電的 HFE 冷卻液中，利用液體直接接觸進行熱交換。與傳統風冷相比，這是一場散熱的革命。

Immersion cooling technology involves fully submerging heat-generating components like servers and GPUs in a non-conductive HFE coolant, using direct liquid contact for heat exchange. Compared to traditional air cooling, this is a thermal management revolution.

4.2 浸沒式冷卻 vs. 傳統風冷：全方位比較

4.2 Immersion Cooling vs. Traditional Air Cooling: A Comprehensive Comparison

指標 *Metric*	傳統風冷 *Traditional Air Cooling*	HFE 浸沒式冷卻 *HFE Immersion Cooling*	優勢說明 *Advantage*
最大機櫃功率密度 ***Max Rack Power Density***	~50 kW	250 kW+	支持 5 倍以上的高密度部署 *Supports >5x higher density deployment*
PUE (電力使用效率) ***PUE (Power Usage Effectiveness)***	1.4 - 2.0	1.02 - 1.05	散熱能耗降低 90% 以上 *Reduces cooling energy consumption by >90%*
總體能耗 ***Total Energy Consumption***	高 / High	低 (節省 10-50%) *Low (10-50% savings)*	顯著降低資料中心營運成本 (OPEX) *Significantly lowers data center OPEX*
空間利用率 ***Space Utilization***	低 / Low	高 (節省 2/3 面積) *High (saves 2/3 floor space)*	相同空間容納更多算力 *More computing power in the same footprint*
維護成本 ***Maintenance Cost***	高 (風扇、空調) *High (fans, AC)*	低 (節省 70% 工時) *Low (saves 70% labor)*	機械故障點少，可靠性高 *Fewer mechanical failure points, higher reliability*
噪音 ***Noise***	> 70 dB	< 50 dB (靜音機房) *(Silent data center)*	改善工作環境 *Improves working environment*
可靠性 ***Reliability***	受灰塵、濕度影響 *Affected by dust, humidity*	隔絕環境影響 *Isolated from ambient environment*	延長設備壽命，降低故障率 *Extends equipment lifespan, reduces failure rate*

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HFE 的低沸點（如 Novec 7100 的 61°C）與高蒸發潛熱特性，使其在「兩相浸沒式冷卻」中表現尤為出色。液體在晶片表面沸騰，吸收大量熱量後變為蒸氣，蒸氣上升至冷凝管後變回液體滴落，形成高效的被動式散熱循環。此設計不僅散熱效率極高，且冷卻液回收率高達 95% 以上，可持續使用超過 5 年，兼具效能與經濟性。

HFE's low boiling point (e.g., 61°C for Novec 7100) and high latent heat of vaporization make it particularly effective in "two-phase immersion cooling." The liquid boils on the chip surface, absorbing a large amount of heat and turning into vapor. The vapor rises to a condenser, where it turns back into liquid and drips down, creating a highly efficient passive cooling cycle. This design not only offers extremely high thermal efficiency but also achieves a coolant recovery rate of over 95%, allowing for continuous use for more than 5 years, combining both performance and cost-effectiveness.

5. 市場趨勢與競爭格局

5. Market Trends & Competitive Landscape

5.1 全球市場展望 (2025-2035)

5.1 Global Market Outlook (2025-2035)

全球 HFE 市場正處於高速增長期。根據綜合市場分析，預計市場規模將從 2025 年的約 2.73 億美元，增長至 2033 年的 4.16 億美元，年複合成長率（CAGR）達 5.4% - 8.4%。

The global HFE market is in a high-growth phase. According to composite market analysis, the market size is projected to grow from approximately $273 million in 2025 to $416 million by 2033, with a compound annual growth rate (CAGR) of 5.4% - 8.4%.

主要成長驅動力：

Key Growth Drivers:

- **AI 算力需求：** 浸沒式冷卻成為高階 AI 伺服器的剛性需求，是市場最強勁的成長引擎。
  Demand for AI Computing Power: *Immersion cooling is becoming a mandatory requirement for high-end AI servers, serving as the market's most powerful growth engine.*
- **環保法規趨嚴：** 歐盟 F-Gas 法規等政策加速淘汰高 GWP 值的傳統氟化物，HFE 作為合規替代品需求大增。
  Stricter Environmental Regulations: *Policies like the EU F-Gas Regulation are accelerating the phase-out of high-GWP traditional fluorochemicals, boosting demand for HFE as a compliant alternative.*
- **產業升級：** 半導體、電動車電池、5G 通訊等高端製造業對精密清洗與熱管理的要求不斷提升。
  Industrial Upgrades: *Advanced manufacturing sectors like semiconductors, EV batteries, and 5G communications have ever-increasing requirements for precision cleaning and thermal management.*
- **供應鏈重塑：** 國際大廠 3M 宣布退出 PFAS 生產，為具備穩定供應能力的企業（如嘉鴻）帶來巨大的市場機遇。
  Supply Chain Reshaping: *The announcement by industry giant 3M to exit PFAS production creates a massive market opportunity for companies with stable supply capabilities, such as JIAHON.*

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5.2 競爭格局與嘉鴻的策略定位

5.2 Competitive Landscape and JIAHON's Strategic Positioning

市場變局：3M 退出所帶來的機遇

Market Shift: The Opportunity from 3M's Exit

全球 HFE 市場的領導者 3M 公司已宣布將於 2025 年底前全面停止生產所有 PFAS 相關產品（包括 Novec 系列 HFE）。這一決定源於日益增加的環保訴訟與監管壓力，它將徹底改變全球供應格局。過去依賴 3M 的客戶，如今正迫切尋找可靠、合規且具備長期供應能力的替代夥伴。這為嘉鴻公司提供了前所未有的歷史性機遇，以其穩定的供應鏈和專業的技術服務，承接釋出的市場份額。

3M, the global leader in the HFE market, has announced a complete halt to all PFAS-related production (including the Novec HFE series) by the end of 2025. This decision, driven by mounting environmental litigation and regulatory pressure, will fundamentally reshape the global supply landscape. Customers who previously relied on 3M are now urgently seeking reliable, compliant, and long-term alternative partners. This presents an unprecedented historical opportunity for JIAHON Inc. to capture the vacated market share with its stable supply chain and professional technical services.

目前市場主要參與者包括 Solvay、AGC、Daikin 等國際巨頭，以及巨化股份、新宙邦等快速崛起的中國廠商。在此競爭環境中，嘉鴻的定位並非單純的價格競爭者，而是**高附加價值的解決方案提供商**。

Current major market players include international giants like Solvay, AGC, and Daikin, as well as rapidly emerging Chinese manufacturers such as Juhua Group and Capchem. In this competitive environment, JIAHON is not positioned as a mere price competitor, but as a ***high-value-added solution provider****.*

嘉鴻的策略是利用其在地化優勢，提供快速響應的技術支援、靈活的供應方案以及深度的產業知識，幫助台灣客戶在供應鏈變局中平穩過渡，並藉此機會優化製程、提升競爭力。

JIAHON's strategy is to leverage its local advantage to provide rapid-response technical support, flexible supply solutions, and deep industry knowledge. We aim to help Taiwanese clients navigate the supply chain transition smoothly and use this opportunity to optimize their processes and enhance competitiveness.

6. 安全、環保與法規遵循

6. Safety, Environment & Regulatory Compliance

6.1 嚴正聲明：氫氟醚 (HFE) ≠ 氫氟酸 (HF)

6.1 Formal Clarification: Hydrofluoroether (HFE) ≠ Hydrofluoric Acid (HF)

這是產業中最常見的誤解，也是我們必須嚴正澄清的首要問題。HFE 與 HF 僅名稱相似，其化學性質與安全等級有天壤之別。

This is the most common misconception in the industry and the first issue we must formally clarify. While their names are similar, HFE and HF are worlds apart in terms of chemical properties and safety levels.

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	氫氟醚 (HFE) *Hydrofluoroether*	氫氟酸 (HF) *Hydrofluoric Acid*
化學性質 ***Chemical Properties***	化學性質穩定，呈惰性 *Chemically stable, inert*	高活性，強腐蝕性 *Highly reactive, strongly corrosive*
毒性 ***Toxicity***	低毒性，操作安全 *Low toxicity, safe to handle*	劇毒，高危險化學品 *Acutely toxic, highly hazardous chemical*
燃燒性 ***Flammability***	不可燃，無閃點 *Non-flammable, no flash point*	不可燃 *Non-flammable*
腐蝕性 ***Corrosivity***	不腐蝕金屬、玻璃、塑膠 *Non-corrosive to metals, glass, plastics*	能溶解玻璃、陶瓷、多數金屬 *Dissolves glass, ceramics, most metals*
主要用途 ***Primary Use***	精密清洗劑、冷卻液、溶劑 *Precision cleaner, coolant, solvent*	特殊工業蝕刻（如半導體蝕刻） *Specialty industrial etching (e.g., semiconductor)*

結論：嘉鴻公司提供的所有 HFE 產品均為低毒、穩定、安全的化學品，與高危險性的氫氟酸完全不同，客戶可放心使用。

Conclusion: All HFE products supplied by JIAHON Inc. are low-toxicity, stable, and safe chemicals, completely different from the highly hazardous hydrofluoric acid. Customers can use them with confidence.

6.2 環保合規性 (ODP, GWP, TFA)

6.2 Environmental Compliance (ODP, GWP, TFA)

HFE 的設計初衷即是為了取代對環境有害的傳統氟氯碳化物（CFCs）和氫氟氯碳化物（HCFCs）。

HFEs were originally designed to replace environmentally harmful chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs).

- **ODP (臭氧消耗潛值) = 0**：完全不破壞臭氧層。
  ODP (Ozone Depletion Potential) = 0: *Does not deplete the ozone layer at all.*
- **GWP (全球暖化潛值) 低**：GWP 值介於 55-320 之間，遠低於上一代制冷劑 HFCs（GWP > 1000），符合歐盟 F-Gas 等全球主流法規的減排要求。
  Low GWP (Global Warming Potential): *With GWP values between 55-320, it is far lower than previous-generation refrigerants like HFCs (GWP > 1000), meeting the emission reduction requirements of major global regulations like the EU F-Gas Regulation.*
- **TFA (三氟乙酸) 議題**：雖然 HFE 在大氣中降解可能產生微量的 TFA，但根據世界衛生組織（WHO）等權威機構評估，其在環境中的濃度極低，對生態系統和人類健康的風險可忽略不計。
  TFA (Trifluoroacetic Acid) Issue: *Although atmospheric degradation of HFE may produce trace amounts of TFA, assessments by authoritative bodies like the World Health Organization (WHO) indicate that its environmental concentration is extremely low, posing a negligible risk to ecosystems and human health.*

6.3 安全操作與回收指南

6.3 Safe Handling and Recycling Guidelines

儘管 HFE 安全性高，嘉鴻仍建議遵循標準的工業化學品操作規範（EHS）：

Although HFE has a high safety profile, JIAHON recommends following standard industrial chemical handling practices (EHS):

- **儲存**：於陰涼通風處密封保存，遠離強鹼與高溫。
  Storage: *Store in a cool, well-ventilated area in a sealed container, away from strong alkalis and high temperatures.*
- **處理**：操作時佩戴標準防護手套與護目鏡。
  Handling: *Wear standard protective gloves and safety goggles during operation.*
- **廢棄物管理**：HFE 價值高昂，應優先考慮回收。透過專業的蒸餾或冷凝回收系統，回收率可達 95% 以上，大幅降低總擁有成本（TCO）。嘉鴻可協助客戶評估並導入合適的回收方案，實現經濟效益與環境效益的雙贏。
  Waste Management: *HFE is a high-value material, and recycling should be prioritized. Through professional distillation or condensation recovery systems, recovery rates can exceed 95%, significantly reducing the Total Cost of Ownership (TCO). JIAHON can assist clients in evaluating and implementing suitable recycling solutions to achieve a win-win for both economic and environmental benefits.*

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7. 嘉鴻公司的核心優勢

7. The Core Advantages of JIAHON Inc.

在充滿變數的市場中，選擇一個可靠的合作夥伴至關重要。嘉鴻公司不僅是材料供應商，更是您技術升級與供應鏈安全的策略夥伴。

In a volatile market, choosing a reliable partner is crucial. JIAHON Inc. is not just a material supplier; we are your strategic partner for technological upgrades and supply chain security.

7.1 在地化供應鏈與深度技術整合

7.1 Localized Supply Chain and Deep Technical Integration

嘉鴻憑藉在台灣深耕多年的經驗，建立了涵蓋全球與在地的多元化供應商體系，有效降低單一來源風險。我們的團隊橫跨電子、機械、化工等多個領域，能夠為客戶提供的不僅是產品，更是完整的解決方案。

With years of deep-rooted experience in Taiwan, JIAHON has built a diversified global and local supplier ecosystem, effectively mitigating single-source risks. Our team spans multiple disciplines, including electronics, mechanics, and chemistry, enabling us to provide clients not just with products, but with complete solutions.

服務面向 *Service Aspect*	嘉鴻的專業優勢與解決方案 *JIAHON's Professional Edge & Solution*	客戶獲得的價值 *Value to Client*
採購網絡 ***Sourcing Network***	全球/在地多元供應商生態系，應對 3M 退出變局 *Global/local diversified supplier ecosystem to counter the 3M exit*	供應鏈穩定，避免斷料危機 *Stable supply chain, avoiding line-down crisis*
技術深度 ***Technical Depth***	跨領域專家團隊，提供清洗/冷卻製程優化諮詢 *Cross-disciplinary expert team for cleaning/cooling process optimization consulting*	提升決策品質，加速產品導入 *Better decision-making, faster product adoption*
風險控管 ***Risk Management***	標準化規格驗證、效期管理、合規文件支持 *Standardized spec verification, shelf-life management, compliance documentation support*	降低品質、庫存與法規風險 *Reduces quality, inventory, and regulatory risks*
合作模式 ***Cooperation Model***	提供小量樣品、加速驗證服務包，支持靈活試點 *Offers small samples, accelerated validation packages, supports flexible pilots*	低風險快速驗證，降低導入門檻 *Low-risk, rapid validation, lowering adoption barriers*
永續經營 ***Sustainability***	協助規劃溶劑回收系統，降低 TCO *Assists in planning solvent recovery systems to lower TCO*	提升成本效益與 ESG 表現 *Improves cost-effectiveness and ESG performance*

7.2 成功案例與客戶認可

7.2 Success Stories and Client Recognition

嘉鴻已成功協助多家台灣頂尖企業導入 HFE 解決方案，涵蓋伺服器代工、主機板製造、高等學術研究等多個領域。這些成功案例證明了嘉鴻不僅有能力提供高品質的產品，更有能力協助客戶解決實際的工程問題，是您值得信賴的長期夥伴。

JIAHON has successfully assisted numerous leading Taiwanese enterprises in adopting HFE solutions across various sectors, including server ODMs, motherboard manufacturing, and advanced academic research. These success stories demonstrate that JIAHON not only provides high-quality products but also possesses the capability to help clients solve real-world engineering challenges, making us your trustworthy long-term partner.

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8. 常見問題 (FAQ)

8. Frequently Asked Questions (FAQ)

Q1：氫氟醚會腐蝕我的設備或產品嗎？

Q1: Will HFE corrode my equipment or products?

A：不會。氫氟醚化學性質非常穩定，對絕大多數金屬、玻璃、硬質塑膠都呈惰性。僅有少數特定橡膠材質（如氟橡膠）可能需要選用特殊型號，嘉鴻的技術團隊會協助您進行材料兼容性評估。

A: No. HFE is chemically very stable and inert to the vast majority of metals, glass, and rigid plastics. Only a few specific rubber materials (like fluoroelastomers) may require special grades. JIAHON's technical team will assist you with material compatibility assessment.

Q2：氫氟醚是否有毒或危險？

Q2: Is HFE toxic or dangerous?

A：氫氟醚屬於低毒性、不可燃的液體，與劇毒的氫氟酸完全不同。在正常通風條件下操作非常安全，僅需遵守基本的工業安全防護指引。

A: HFE is a low-toxicity, non-flammable liquid, completely different from the acutely toxic hydrofluoric acid. It is very safe to handle under normal ventilated conditions, requiring only basic industrial safety precautions.

Q3：清洗後是否需要額外的漂洗或烘乾步驟？

Q3: Are extra rinsing or drying steps needed after cleaning?

A：通常不需要。氫氟醚具有優良的揮發特性，能快速乾燥且不留任何殘留物，這也是其作為精密清洗劑的一大優勢，可以簡化製程、節省時間與能源。

A: Usually not. HFE has excellent evaporation properties, allowing it to dry quickly without leaving any residue. This is a major advantage as a precision cleaner, as it simplifies the process, saving time and energy.

Q4：嘉鴻的 HFE 產品是否符合台灣及國際環保法規？

Q4: Do JIAHON's HFE products comply with Taiwanese and international environmental regulations?

A：是的。嘉鴻提供的所有 HFE 產品均已完成台灣環保署的新化學物質標準註冊，並且其 ODP=0、GWP 值低的特性，完全符合歐盟、美國等主要市場的現行環保法規。

A: Yes. All HFE products offered by JIAHON have completed standard registration for new chemical substances with Taiwan's EPA. Furthermore, their characteristics of ODP=0 and low GWP fully comply with current environmental regulations in major markets like the EU and the US.

Q5：面對 3M 停產，嘉鴻的供應是否穩定？

Q5: With 3M's production halt, is JIAHON's supply stable?

A：非常穩定。嘉鴻早已佈局多元化的全球供應商網絡，並與多家國際級 HFE 製造商建立了穩固的合作關係。我們有能力確保長期、穩定、高品質的產品供應，協助客戶平穩度過供應鏈轉型期。

A: Absolutely stable. JIAHON has long established a diversified global supplier network and forged solid partnerships with multiple world-class HFE manufacturers. We are fully capable of ensuring a long-term, stable, and high-quality supply to help our clients navigate the supply chain transition smoothly.

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結論與行動呼籲：立即體驗 HFE 的革新效益

Conclusion & Call to Action: Experience the Revolutionary Benefits of HFE Now

氫氟醚不僅是一項材料的升級，更是推動您的產品走向更高精度、更高性能與更佳環保表現的關鍵引擎。在 AI 浪潮與供應鏈重塑的歷史交匯點，選擇正確的技術與夥伴，將決定您未來的競爭力。

HFE is more than just a material upgrade; it is the key engine driving your products toward higher precision, superior performance, and better environmental credentials. At this historic intersection of the AI wave and supply chain realignment, choosing the right technology and partner will define your future competitiveness.

嘉鴻公司憑藉其深厚的技術實力、穩定的在地供應鏈與客戶至上的服務理念，是您導入 HFE 技術、實現產業升級的最佳夥伴。我們誠摯邀請您立即與我們聯繫，索取免費樣品與技術資料，或預約一次免費的製程評估諮詢。

With our deep technical expertise, stable local supply chain, and customer-first service philosophy, JIAHON Inc. is your ideal partner for adopting HFE technology and achieving industrial upgrading. We cordially invite you to contact us immediately to request free samples and technical data, or to schedule a complimentary process evaluation consultation.

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