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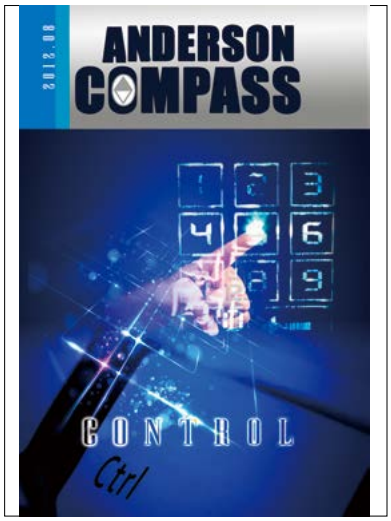

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總編輯的話 Editor's Note

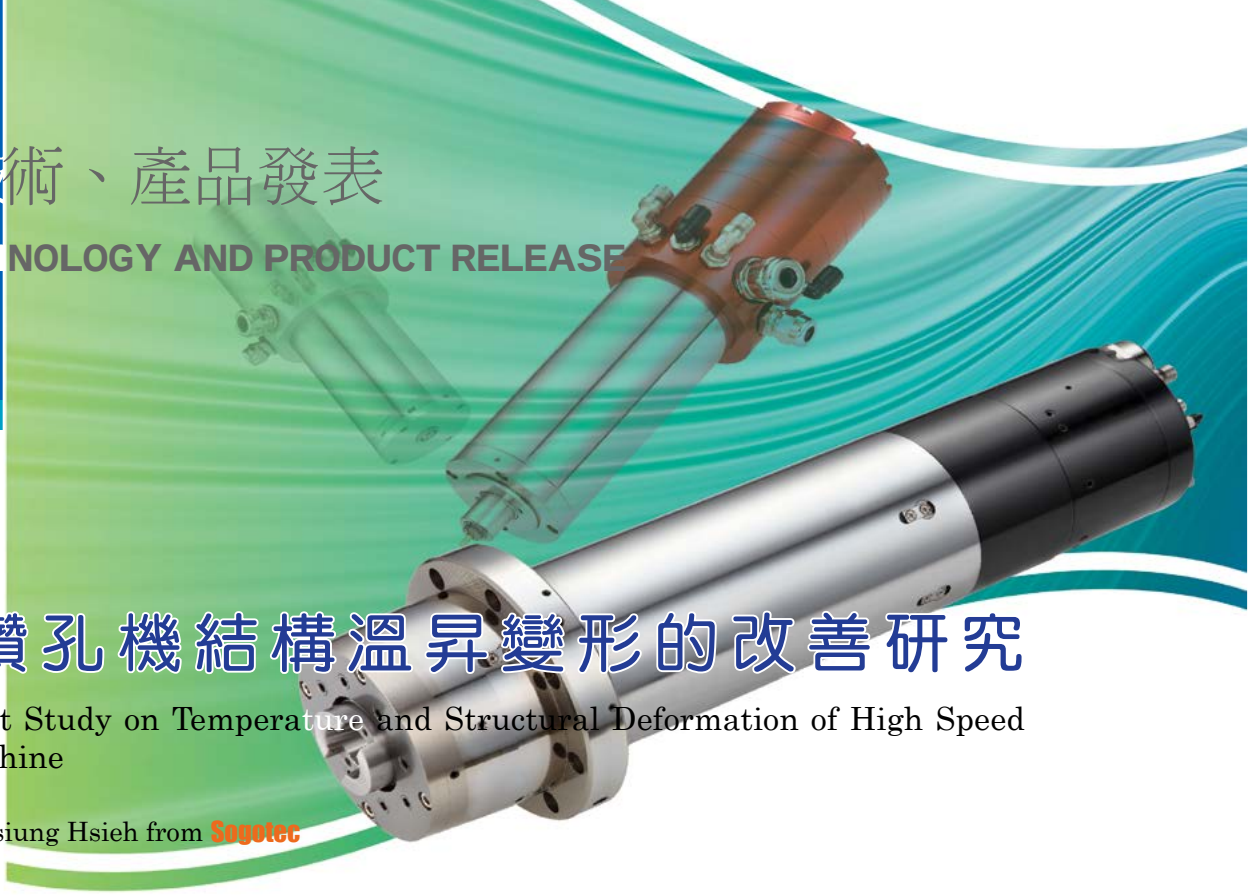
從福建的世界文化遺產－福建土樓，到引領科技風潮Apple的新研發大樓－Apple Campus，雖然圓形外型有類似的巧合，但從管理與控制的觀察，其實有著不同的內涵。福建土樓樓主藉由圓樓的厚實結構與單一出入的實質控制，提供族人安全的居住空間。Apple規劃中的新圓形研發大樓，引用人性的管理，結合自然的舒適環境，提供自由的創作空間；吸引世界一流的人才，窮其一生在裡面貢獻其智慧，這象徵性的圓形枷鎖，已經昇華為無形的心靈控制。這個結果，不得不令人折服於Apple管理控制的最高境界。

From the world culture heritage of Fujian – Fujian Tulou to the new R&D building of technology trend leader Apple - Apple Campus, though there is a similar coincidence of the round shape, their connotation is different through the observation of management and control. The host of Fujian Tulou provides its clansmen a safe living space by a strong structure of round building and effective control of single entry. The new round R&D building planned by Apple is to adopt the humanized management combining a natural comfortable environment to provide a free space for creation. It attracts world-class talents to devote their wisdom inside that building for their whole lives. This symbolic round shackle has become an invisible mind control. The result leaves us no choice but to be convinced to the highest level of management control of Apple.




相較於人類管理內涵的進化，其實機械設備控制原理的演進，也不遑多讓。數值控制在機械設備的發展，已有40年以上的歷史，從單純控制位置開始，到今天的CNC控制系統，控制的意義，已今非昔比；今日的CNC機械，高精度、高速度的要求已是標準的規格，市場對設備的需求已轉向自動化、智能化，機械的控制一詞，同樣也進化成更寬廣的控制含意。恩德有感於新控制理念的轉變，近年來在人機的操作介面、軟體的控制應用、機電整合等各方面，不斷的投入新的資源，以期在未來產品的競爭，注入更多的活力。本期有多篇文章，深入探討各種生產自動化的概念，和提出新的操作人機，期待更多有志一同的同仁，一起來探索未來機械控制的新領域－人性化與智能化。

Comparing to the evolution of management connotation of human, there is also not enough time to concede for the development of control principle of mechanical equipment. The history of development of numerical control in mechanical equipment is more than 40 years. From the simple position control to the CNC control system, the present meaning of control cannot compare with the past. For today's CNC machine, the requirements of high precision and high speed have been considered as standard specification. The requirements for equipment nowadays are upon automation and intelligentization. The term of mechanical control has evolved into a broader meaning of control. On the feeling of the change of new control concept, Anderson continuously invests new resources in human-machine operation interface, control application of software and mechanical and electronic integration to infuse more vital energies into the competition of future products. There are many articles in this issue probing into the concept of each production automation deeply and providing new human-machine operation. We expect more colleagues of the same mind together to explore the new field of future mechanical control - humanization and intelligentization.



高速鑽孔機結構溫昇變形的改善研究

Improvement Study on Temperature and Structural Deformation of High Speed Drilling Machine

謝銘雄 Ming-Hsiung Hsieh from Sogotec

PCB 高速鑽孔機在整個 PCB 製程是屬於第一道關卡，所以一台穩定的機器對鑽孔的定位精度是相當重要的，而且此設備一般都是 24 小時在加工，結構的穩定是首要考量。為了能夠符合產業高產能的需求，PCB 鑽孔機的速度也從每分鐘 25 米提升至 60 ~ 80 米，然而在高速化的過程中，溫度的變化對於鑽孔精度有很大的影響，在高速鑽孔過程中，機台內外部的熱源會使機台產生溫度變化，進而造成結構熱漲冷縮的效應，使得鑽針中心與實際鑽孔座標的位置產生相對的偏移， 假使鑽孔孔位偏移過大則會造成工件報廢，所以對 PCB 鑽孔機提供一個穩定的環境及好的冷卻回路系統是很重要的。

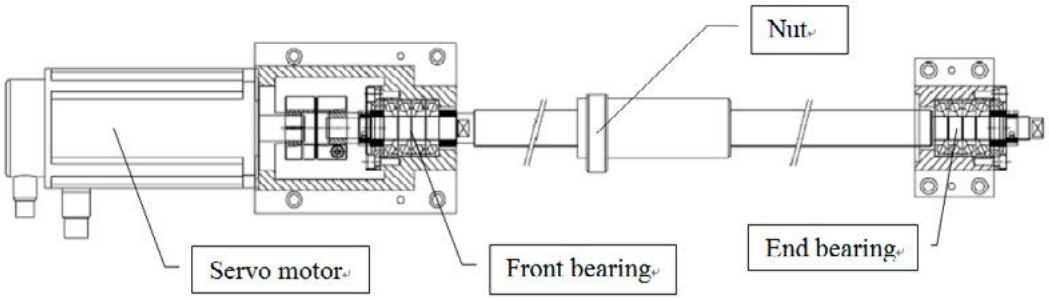
機台熱源分布的分析

PCB 鑽孔機的熱源大概有伺服馬達、線性馬達及氣靜壓高速主軸馬達等產生的熱量，滾珠軸承、滾珠螺桿及氣靜壓高速主軸的氣靜壓軸承等的摩擦熱量，機台配件如冷卻機、空氣乾燥機等造成環境溫度的變化，最後為廠房本身的環境溫度變化，以上熱源皆會使機台結構產生變形量或光學尺變位而造成鑽孔孔位的偏差。

PCB high speed drilling machine is considered as the first step of the entire PCB process. Therefore, a stable machine plays a very important role for the positioning precision of drilling. Moreover, such equipment generally runs for 24 hours a day, so a stable structure is the prime consideration. In order to conform to the requirement of high throughput, the speed of PCB drilling machine has been raised from 25m/m to 60~80m/m. However, during the high speed process, the temperature variation has a great effect upon the drilling precision. In the process of high speed drilling, the interior and exterior heat sources will cause a temperature variation on the machine and then further cause an effect of thermal expansion and cool contraction on structure, which may make an opposite offset on the positions of drilling center and actual drilling coordinates. In case a drilling offset is big, that workpiece will be considered as no longer usable. Therefore, it is very important to provide a stable environment and good cooling circuit system for PCB drilling machine.

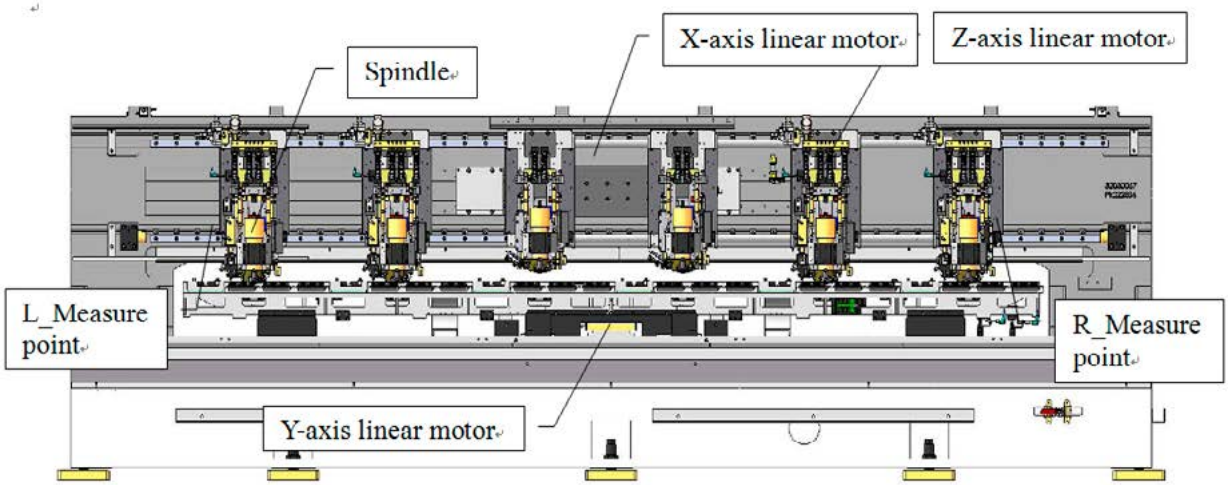
Distribution Analysis of Heat Sources of Machine

The heat sources of PCB drilling machine come from the heat generated servo motor, linear and aerostatic spindle motor, the friction heat of the ball bearing, ball screw and aerostatic bearing of aerostatic spindle, the temperature variationscaused by cooler and air dryer,



圖一 滾珠螺桿組發熱源圖示

Figure 1 Diagram of Heat Sources of Ball Screw Uni



圖二 線性馬達及主軸發熱源圖示

Figure 2 Diagram of Heat Sources of Linear Motor and Spindle

and the environmental temperature variation of the factory itself. All of the above mentioned heat sources will cause the deformation or displacement of linear scale of the machine structure and further cause a deviation of the drilling hole position.

機台熱源量測的實驗設計

Experimental Design of Heat Source Measurement of Machine

PCB 鑽孔機的熱源對於結構變形的影響主要為X軸方向的，因為此方向的結構變形會造成各軸的變形量不一致，且距離機台中心越遠的軸熱變形量越大，所以我們會進行量測X軸鞍座兩側的變形量，主分成兩種方式：(1).X、Y軸不動，Z軸移動與主軸轉動，(2).X、Y、Z軸移動與主軸轉動，方式(1)使用千分錶進行量測，如圖三所示，方式(2)使用雷射干涉儀進行量測，如圖四所示。The main effect caused by the heat sources of the PCB drilling machine on structure deformation is mostly to the direction of X axle, as the structure deformation of such direction will cause different amounts of deformation for each axle. The farther away the axle is from the machine center , the greater its thermal deformation will be. Therefore, we will measure the bilateral amounts of deformation of saddle of the X axle. There are two manners: (1) X and Y axles remain fixed but Z axle moves and spindle rotates; (2) X, and Y and Z axles move and spindle rotates. Manner (1) measures by using a dial gauge, as shown in figure 3; manner (2) measures by using a laser interferometer, as shown in figure 4.

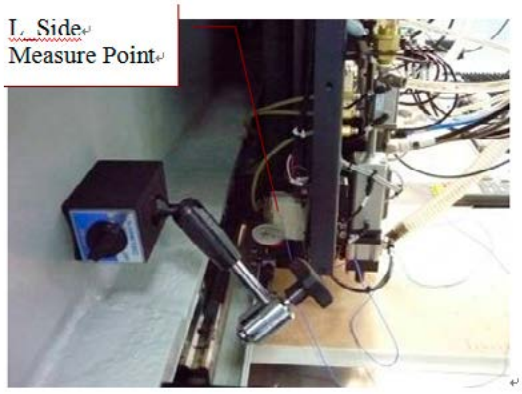
熱源排除的方式
Manner of Heat Sources Elimination

熱脹冷縮為大多數金屬材料對溫度之特性，而以鋼或鑄鐵為結構材料的切削機台對溫度的反應也不例外。進行切削加工時，各項內外熱源（馬達、氣靜壓主軸、螺桿螺帽與螺桿軸承組的摩擦…等）會使機台結構生溫度上的變化，造成結構熱脹冷縮的效應，如果此熱脹冷縮的現象使得鑽針與鑽孔孔位的相對位置發生變化，則會引起鑽孔孔位的偏差[1]。除此，由於各項內外熱源常會隨時間而變化，因此鑽孔孔位的偏差量也往往難以掌握，這表示溫度效應會影響鑽孔機精度的穩定性。對於熱變形的改善方式約有：變形的補償、溫度的控制、結構的設計、改善熱傳、移除熱源等方向著手[2]。就鑽孔機而言，比較適合的方式為：1. 改善熱傳：利用絕熱或低熱傳導係數的材料加裝在馬達與結構之間，以減少溫度變化造成結構的變形，2. 移除熱源：利用好的冷卻系統及足夠的流量或加裝一道冷卻板在熱源與馬達之間，以減少熱的傳遞，3. 溫度的控制：提供一個穩定的空調環境及合適的冷卻溫度。

Thermal expansion and cool contraction are characteristic of temperature for most metal materials and there is no exception to the cutting machine made by steel or cast iron. During the cutting process, the temperature variation of machine structure may be caused by both interior and exterior heat sources (such as the frictions of the motor, aerostatic spindle, screw and nut, screw bearing unit, etc.) and an effect of thermal expansion and cool contraction on structure may further happen. If there is a change happening to the opposite positions of the drill and drilling hole position because of the phenomenon of thermal expansion and cool contraction, a deviation [1] of drilling hole position may be caused. In addition to this, since both interior and exterior heat sources may change according to time, it is usually hard to master the deviation of the drilling hole position, which means the temperature effect will influence the stability and precision of the drilling machine. The improvement approaches for thermal deformation are: deformation compensation, temperature control, structural design, improvement of heat-transfer, removal of heat sources and so on [2]. As for a drilling machine, the better approaches are: 1. Improvement of heat-transfer: to decrease the structural deformation caused by temperature variation by using the material of heat insulation or low heat transfer coefficient between the motor and structure. 2. Removal of heat sources: to decrease the heat transfer by using a good cooling system and sufficient flow or retrofitting one cooling plate between the heat source and motor. 3. Temperature control: to provide a stable air conditioning environment and suitable cooling temperature.

實驗結果與分析
Experimental Result and Analysis

首先針對不同的冷卻溫度設定 16℃、18℃、20℃進行熱變形測量，機台的作動條件為 H18、Z12、S175，鑽孔數約 480Hit/min，機器運轉時間為 20 分鐘及機器停止 20 分鐘，結果如圖五所示，在冷卻水溫度越低，最大熱變形量也越低，但是機台的發熱量實在太高，因此機台熱變形量已經超出



圖三 鞍座側邊變形量量測 (1)

Figure 3 Measurement of Bilateral Amounts of Deformation of Saddle (1)

圖四 鞍座側邊變形量量測(2)

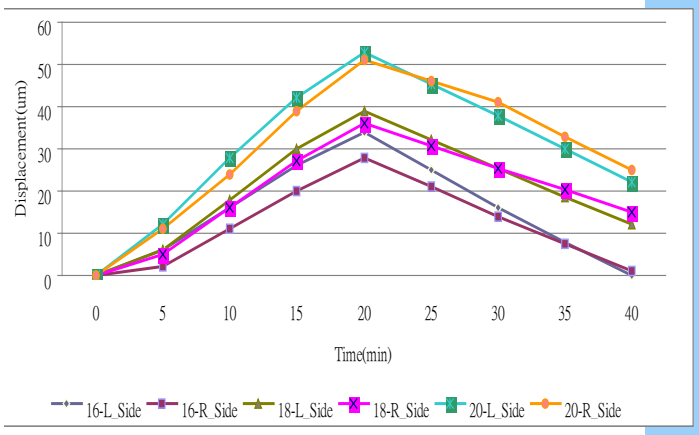
Figure 4 Measurement of Bilateral Amounts of Deformation of Saddle (2)

鑽孔精度的公差範圍，所以我們先從增加冷卻水管路管徑，以增加Z軸線馬的冷卻水流量後再進行測試。在設定冷卻溫度18℃且條件與之前相同的情況下進行量測，機器運轉時間為45分鐘及機器停止45分鐘結果，如圖六所示，在量測第20分鐘時的變形量20um有比圖五的第20分鐘時的變形量34um小一些，而且溫昇變形量也從第25分鐘後趨於緩和，在第45分鐘時變形量為31um，所以可發現增加冷卻水流量可減少機台的溫昇，但在這裡我們發現機台的冰水機溫度與室溫有差異時，容易造成機台過冷導致機台結構收縮，在這種情況下進行鑽孔時，同樣會造成鑽孔孔偏過大。

First of all, measure the thermal deformation respectively to different cooling temperatures: 16 ℃, 18 ℃ and 20 ℃. The operating conditions for the machine were H18, Z12 and S175 and the number of drilling holes was 480Hit/min. The machine operated for 20 minutes and then stopped for 20 minutes. The result is shown in Figure 5. The lower the temperature of the cooling water was, the lower the thermal deformation was caused. However, since the heat release of the machine was truly too high, the thermal deformation of the machine has gone beyond the tolerance range of drilling precision. Therefore, the first thing we did was to increase the pipe diameter of cooling water pipe in order to increase the flow of cooling water of the motor of Z axle and then test. We carried out a measurement under a cooling temperature of 18 ℃,with the same conditions as before and the machine operated for 45 minutes and then stopped for 45 minutes. The result is shown in Figure 6, in which the deformation of 20um in the 20th minute was less than the deformation of 34um in the 20th minute in Figure 5. Meanwhile, the deformation of temperature rise fell after the 25th minute. The deformation in the 45th minute was 31um, so we found increasing the flow of cooling water can reduce temperature rise of the machine. However, we also find that once the temperature of the chiller is different to the room temperature, the machine structure may contract due to overcooling. If a drilling is carried out under such condition, the drilling deviation may be too big

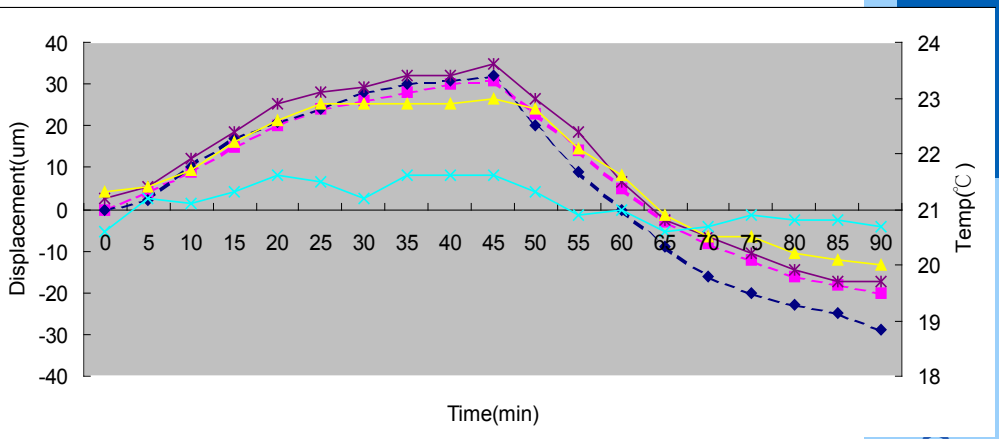
所以我們決定機台於待機時冷卻水溫度設定20~22℃，當機台進行高速鑽孔時冷卻水溫度設定16~18℃，為了減少Z軸線性馬達的熱量傳遞到結構而產生熱變形，

所以我們在線性馬達與結構之間加裝一片玻璃纖維板，以減少熱量的傳遞，我重新設計兩種測試條件，A：機台待機溫度為21℃，機台運轉溫度為



圖五 不同冷卻溫度的變形量

Figure 5 .Amount of Deformation upon Different Cooling Temperature



圖六 增加冷卻水流量後的變形量與溫度變化

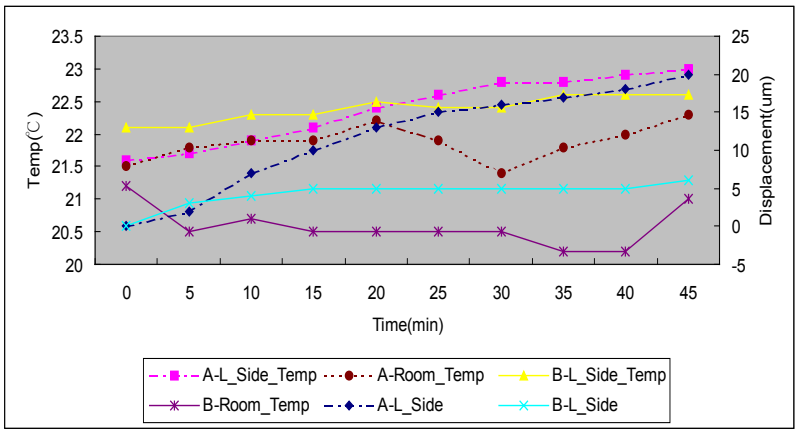
Figure 6. Amount of Deformation and Temperature Variation After Increasing the Cooling Water Flow

17℃，B：機台待機溫度為22℃，機台運轉溫度為16℃，進行比較不同溫度設定對熱變形量的影響，如圖七所示，由結果可知測試條件A，量測點的起始溫度為21.6℃與室溫相接近，但是隨著時間的增加，量測點的溫度也一直增加到最後達23℃，總溫度變化為1.4℃，總變形量也達到20um，測試條件B，量測點的起始溫度為22℃比室溫約高1℃，但是隨著時間的增加，量測點的溫度也一直增加到最後達22.5℃，總溫度變化為0.5℃，總變形量也達到6um，從結果顯示測試條件B是比較有效的數據，但是待機與運轉時的溫度差異達6℃，對機台在鑽孔過

程中若有異常問題或是環境濕度變化很大時，容易使機台產生結露現象而造成機台生鏽或 CBD 檢測異常。雖然使用玻璃纖維板做為隔熱的介質，似忽有明顯的效果，但是也必須搭配合適的溫度控制，才能使機台保持穩定的尺寸。Therefore, we decided to set up the temperature of cooling water at 20~22℃ while idling and at 16~18℃ when the high speed drilling was carrying out. In order to decrease the thermal deformation caused by the heat of linear motor of Z axle transferred to the structure, we retrofitted one fiberglass plate between the linear motor and structure in order to decrease the heat transfer. In order to compare the effects on thermal deformation based on different temperatures, I redesigned two test conditions: A: The idling temperature of machine was 21 ℃ and the operating temperature of the machine was 17℃. B: The idling temperature of machine was 22 ℃ and the operating temperature of machine was 16℃. The result is as shown in Figure 7 and we know that for the test condition A, the initial temperature of measure point was 21.6℃ which was close to the room temperature, but as time went by, the temperature of measure point kept rising to 23 ℃. The total temperature variation was 1.4 ℃ and the total amount of deformation reached 20um. For the test condition B, the initial temperature of measure point was 21.6℃ which was 1 ℃ higher than the room temperature, but as time went by, the temperature of measure point kept rising to 22.5℃. The total temperature variation was 0.5℃ and the total amount of deformation reached 6um. We can therefore know that the test condition B is more effective, but the temperature difference between idling and operating is 6 ℃. This may cause a condensation phenomenon on machine if there is an abnormal problem or the variation of the ambient humidity is big during the drilling process and may further cause the machine to become rusty or having CBD detect abnormal. Though it seems to have an obvious effect by using a fiberglass plate as a medium of heat insulation, a suitable temperature control shall be made to enable the machine to remain stable.

為了解玻璃纖維板為何無法達到我們期望的目標，因此對 Z 軸線性馬達在高速位移時線性馬達表面的溫度進行量測，量測點為線性馬達的下方，此時冷卻水溫度設定為 20℃，其他條件與之前的設定皆相同，結果如圖八所示，線性馬達在測試時間內的溫度變化為 21℃到 36℃，溫度差高達 15℃，所以玻璃纖維板的厚度 10mm 不足以完全隔絕溫度的傳遞，加上溫升 15℃的輻射熱也加深周遭結構的熱變形。In order to understand why a fiberglass plate can not reach our expected goal, we carried out a measurement for the surface temperature of linear motor when the linear motor of Z axle was on high speed displacement. The measure point was under the linear motor and for the time being the temperature of cooling water was set up at 20 ℃ and the other conditions were the same as before. The result is shown in Figure 8. The temperature variation of linear motor during the test time was from 21 ℃ to 36 ℃; the temperature difference was up to 15℃. The thickness of fiberglass plate of 10mm was unable to insulate the heat transfer completely and the temperature rise of 15 ℃ has also reinforced the thermal deformation of surrounding structure.

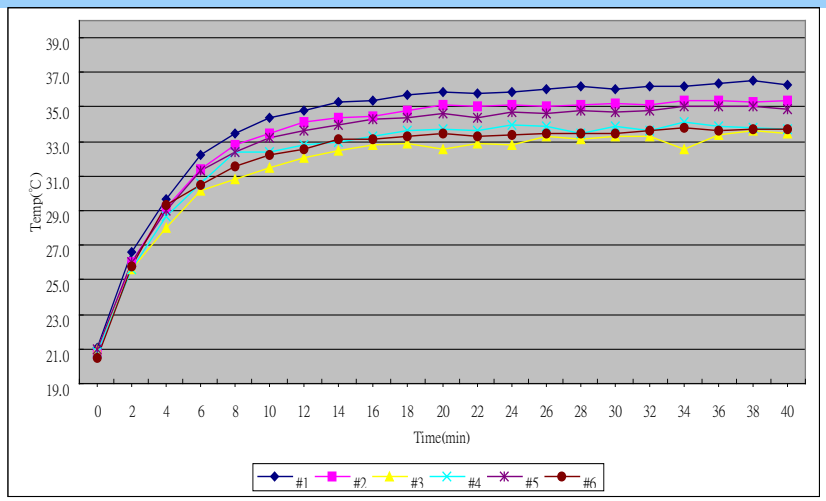
為了使結構變形能夠有效的控制下來，所以將玻璃纖維板改為具有冷卻效果的鋁板，依據之前的測試條件進行量測，待機時溫度設定為 20℃，機台運轉時溫度設定為 18℃，結果如圖九所示，從圖中可以發現具有冷卻效果的鋁板加上玻璃纖維板，可以有效的控制溫度在一定的範圍內；接著我們擴大實驗，進行 X、Y、Z 軸同動的測試，機台的作動條件為 H8、Z3、S175，鑽孔數約 420 ~ 460Hit/min，X、Y 軸的位移



圖七 使用玻璃纖維板做為隔熱的量測與溫度變化

Figure 7 Measurement and Temperature Variation upon Using Fiberglass Plate for Heat Insulation

量為 1.27mm，位移量的檢知是利用雷射干涉儀進行量測，如圖四所示，此項測試分為 90 分鐘及 180 分鐘，因為 X、Y、Z 軸同動鑽孔測試，所以 Z 軸的熱量產生也與之前測試狀況不一樣，測試結果如圖十所示，從

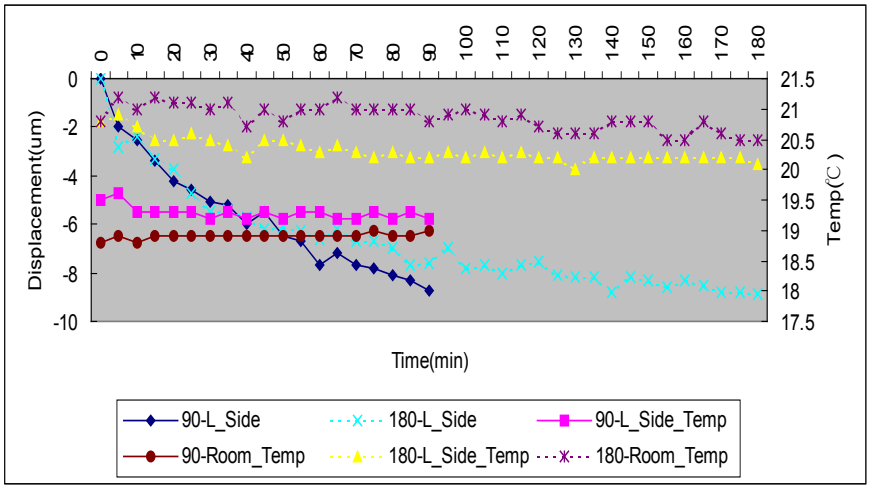


圖八 Z 軸線性馬達外部溫度量測

Figure 8 Measurement of External Temperature of Linear Motor of Z Axle

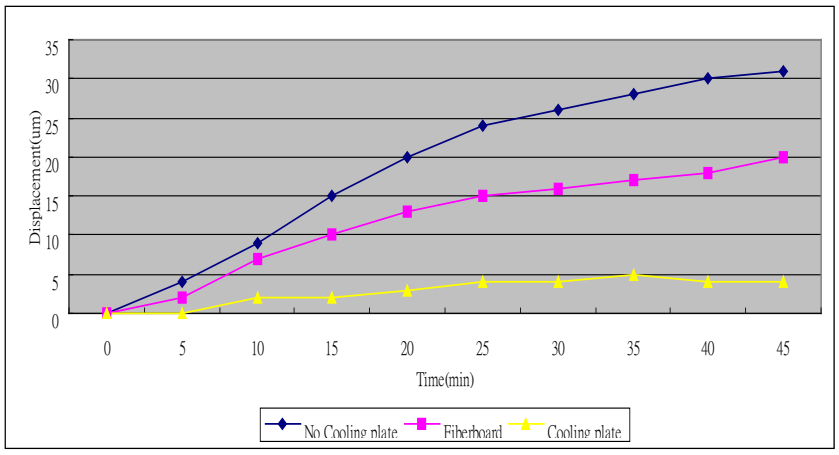
圖中可以發現機台都是呈現負向的變化，這表示機台結構是在一種過冷的狀態，而且在 90 分鐘的測試中溫室平均在 19℃，結構的熱變形量約在 45 分鐘之後持續的收縮，最大熱變形量為 -9um，而在 180 分鐘的測試中溫室平均在 21.7℃，結構的熱變形量約在 45 分鐘之後持續緩和收縮，最大熱變形量為-9um，所以不同的室溫會影響到結構的熱變形量。

In order to control the structural deformation effectively, a fiberglass plate has been changed to an aluminum plate possessing the cooling effect. We measured according to previous test conditions and set up the idling temperature at 20℃ and operating temperature at 18℃ , the result is shown in Figure 9. We can find that the temperature can be controlled within a certain range if we use an aluminum plate possessing the cooling effect and a fiberglass plate together. Afterwards, we expanded the experiment to carry out a synchronous test of X, Y and Z axles. The operating conditions for machine were H18, Z3 and S175 and the number of drilling holes was 420 ~ 460Hit/min. The amount of displacement of X and Y axles was 1.27mm and the amount of displacement was measured by a laser interferometer, as shown in Figure 4. This test was based on 90 minutes and 180 minutes. Since this was a synchronous drilling test of X, Y and Z axles, the heat of Z axle was different to previous test and the test result is shown in Figure 10. We can find that the machine was always under a negative variation through the figure, which means that the machine structure was under an overcooling condition. Moreover, in the test based on 90 minutes, the room temperature was 19℃ in average and the amount of thermal deformation of structure kept contracting after 45 minutes and the maximum amount of thermal deformation was -9um. In the test based on 180 minutes, the room temperature was 21.7℃ in average and the amount of thermal deformation of structure kept contracting after 45 minutes and the maximum amount of thermal deformation was -9um. Therefore, the amount of thermal deformation may be influenced by different room temperature.



圖九 不同隔熱板材質的變形量

Figure 9 Amount of Deformation upon Different Plate Material of Heat Insulation



圖十 不同的室溫對結構變形量的影響

Figure 10 Effect on Amount of Structural Deformation upon Different Room Temperature

結論
Conclusion

從本研究可以發現高速化的過程，傳動系統的熱能和主軸的熱能急遽上升，因此加速熱源傳遞到機台各處；從各項的實驗中發現熱量在影響機台精度的地方，一定需優先將熱量移除，以減少結構的熱變形，並且依熱量的多寡與成本的高低來決定使用哪一種方法；另外對於機台冷卻回路流量與溫度控制，必須依照環境溫度而做不同的調整，這是相當重要的，不然容易使結構處於過冷或過熱的狀態，換言之這些溫度控制不當時，當機台在運轉或待機的兩種狀態時，就可能會使結構產生很大的熱變形量，這是一般我們不會考慮的到地方。

Through this research we find that during the high speed process, since the thermal energy of transmission system and spindle are going up rapidly, the heat sources are delivered througout of the machine quickly. Through each experiment, we see that once the machine precision is influenced by the heat energies, the thermal energy should be removed in priority to decrease the thermal deformation of structure and the manner shall be applied according to the amount of heat energies and the cost. It is fairly important to adjust the flow of cooling circuit of machine and the temperature control according to the ambient temperature or the structure may be in the condition of overcooling or overheating. In other words, once these temperatures are not controlled properly, a large amount of thermal deformation of structure may be caused while operating or idling, which is often ignored.

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高智能的整合設備 ThruFeed
High Intelligence Ingration Device ThruFeed

李東昇 Tung-Sheng Li From AIC

前言
Introduction

科學技術不斷地向前發展，使得人們的需求更加豐富，從以前只求有觀念，拓展至目前客制化的獨特性及精緻性的需求等要點，於是與日常生活息息相關的傢俱更加重要。所以許多系統傢俱製造商推出「到府丈量，7日交貨」等服務。且設計師可將設計結果在電腦中利用3D模擬軟體充分呈現產品樣貌，一旦與客戶達成共識，就立即開單製作。所以，此次發展電腦輔助智慧化系統傢俱製造設備，就是針對此種快速且須高度整合的產業進行開發。

As the science technology has been developed continuously, it has richened the requirement of people. From the previous concept of requiring "to have" to the current requirements of uniqueness and delicacy of customization, the furniture related to the daily life has become more important. Therefore, many system furniture manufacturers provide the service of "door-to-door measurement; delivery in 7 days". Moreover, the designer can present the full product appearance of design result by 3D simulation software. Once reaching a common understanding with customer, it can be produced instantly. Therefore, such manufacturing device of intelligent system furniture assisted by computer is being developed based on such industry requiring high speed and high integration.

智能化設備發展趨勢
Development Trend ofen

科學技術不斷地向前發展，使得新技術和材料及工藝不斷地出現新的契機。且在機械、電子、雷射及自動控制等創新技術發展下，帶給木工機械更佳的自動化、彈性化、智能化及創新等特點，讓木工機械注入新的活血，使得木工機械的產品不斷提升技術水準、創新技術與安全性及方便性。其設備的發展趨勢有以下幾個方面：(1) 提高生產及經濟效益。(2) 提升加工精度。(3) 提高板材應用使用率。(4) 提升智能化及創新技術。(5) 提升自動化設備。(6) 提升CAM/CAD功能完整性。

As the science technology has been developed continuously, the chances of new technology, material and technology have come out continuously. Moreover, under the development of innovative technology of machinery, electronics, laser and automatic control, it brings optimum automation, flexibility,

intelligence and innovation to woodworking machinery to infuse fresh blood into woodworking machinery. It further enables the technology standard, innovation technology, safety and convenience of woodworking machinery to be improved continuously. The development trends of device are: (1) to increase the productive and economic benefits, (2) to improve the processing precision, (3) to increase the application rate of plate material, (4) to increase the intelligence and innovative technology, (5) to improve the automotive device and (6) to increase the completion of CAM/CAD function.

智能化設備的要素
Key Elements of Intelligent Device

智能化系統傢俱製造設備的開發，所具備的要素需要有自動化設備、人性化考量、智能化操作介面和創新技術應用等。智能化設備製造已成為必備之技術能力，尤其是精密加工技術更影響製造業的成敗，而其加工技術的達成也需依賴高精度高穩定性之設備。
The essential key elements for the development of manufacturing device of intelligent system furniture are automotive device, human-based consideration, intelligent operation interface and application of innovative technology. The intelligent device manufacturing has become one necessary technical capability. Especially for the precision processing technology, it further affects the success or failure of manufacturing industry. The achievement of its processing technology also relies on a device with high precision and high stability.

設備 (ThruFeed) 機構及功能介紹
Mechanism and Functional Introduction otelligent Device (ThruFeed)

此設備在硬體上提供獨特的夾持系統和自動定位系統及雷射量測系統。在伺服系統中，提供 4 伺服軸 (X、Y、Z、U) 設計，其中 X 軸具有讓水平側鑽或鏤銑做前後微動設計。在整體加工模組 (圖 1) 提供了一組排鑽組機構 (7x6 共 12 支的垂直鑽、2 組 X 方向及 1 組 Y 方向的水平鑽)、鋸片機構及鏤銑機構，此加工模組足以取代傳統手工鑽孔機、刻溝機及鏤銑機。在軟體方面上提供自行研發的對話式 CAD/CAM 軟體系統 (圖 2)，讓使用者很直覺繪製想要的加工圖形。

Such device provides unique clamping system, auto positioning system and laser measurement system as its hardware. In servo system, it further provides a design of four servo axles (X, Y, Z and U), in which X axle is a design for front-to-back micro movement of horizontal sidetracking or routing. For the entire processing module (see Figure 1), a unit of row drill mechanism (12pcs of 7x6 vertical drills, 2 sets of X direction and 1 set of Y direction horizontal drills), saw blade mechanism and routing mechanism are provided. Such processing module is able to replace traditional manual drilling machine, grooving machine and router. For the software, self-developed dialogue type CAD/CAM software system (see Figure 2) is provided to enable the user to draw a processing drawing intuitively.

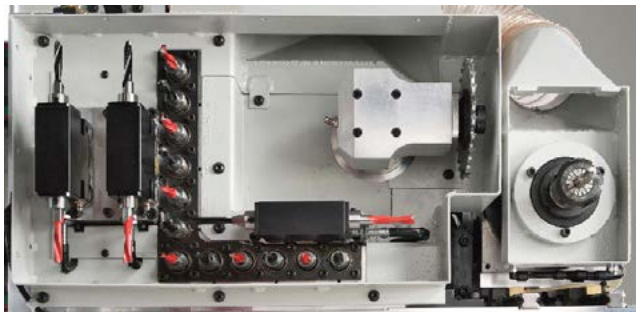


圖 1 主軸頭本體

Figure 1 Body of Spindle Head

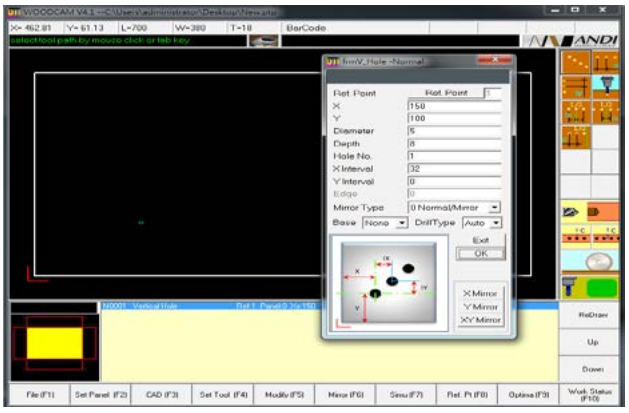


圖 2 CAD/CAM 軟體系統

Figure 2 CAD/CAM Software System

在操作方面，搭配了自行研發的虛擬面板軟體 (圖 3)，讓操作人員利用直觀圖示進行機械的操控，且虛擬面板提供前所未有診斷機械動作功能，這可讓操作人員進一步了解目前機械的狀況。
For the operation, equipping with self-developed virtual panel software (see Figure 3) enables the operator to control machinery based on a pictorial drawing. Moreover, virtual panel provides an unprecedented

function to diagnose mechanical action which enables the operator to further understand the current condition of machinery.

另外，此設備利用獨有的夾持系統及自動板材定位系統，讓操作人員在更換不同尺寸的板材加工時，不須因板材重新定位，而導致加工時間的浪費，達到板材定位零設定（圖4）；夾持系統可讓加工件自動進退料，且讓加工件在最大加工範圍內任意變化，不用擔心工件固定及加工基準點的問題，如此可避免人為操作的誤差及減少操作時間。
In addition, with an unique clamping system and auto positioning system of plate material this equipment operator doesn't have to reposition the plate material and further lead to a waste of processing time while changing to different sized plate material. There is no setting required for positioning the plate material (see Figure 4). The clamping system allows automatic infeed and outfeed of workpiece. The workpiece may be changed arbitrarily within the maximum processing range. There is no need to worry about the fixation of workpiece and norming point of processing. Therefore, the error resulted from manual operation and operation time can be both reduced.

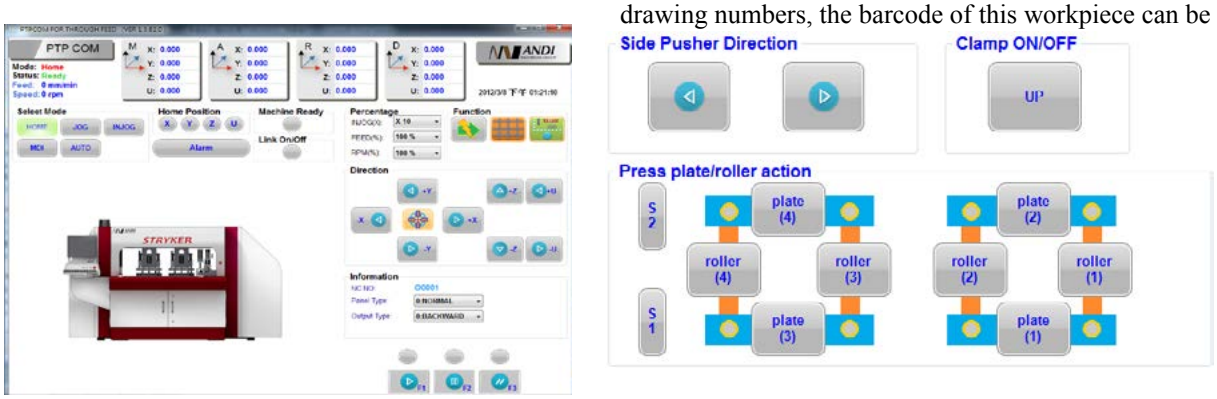


圖 3 虛擬面板軟體 Figure 3 Virtual Panel Software

除此之外，此設備另一個利器就是雷射量測系統，利用雷射量測系統進行板材前後偵測後，自動將加工孔位進行有效的校正，大大提升孔位準確度。
In addition, the other advantage of such device is laser measurement system. After a plate material is completed detecting by laser measurement system, the processing hole position will be calibrated effectively and automatically, so the accuracy of hole position will be raised up significantly.

在軟體方面，使用自行研發的 CAD/CAM 系統，且系統內建許多加工模組提供使用者多樣的加工選擇與組合；此 CAD/CAM 還內建了自定變數功能（圖5），讓使用者利用自定變數的功能自行設計程式，在搭配不同板材尺寸自行產生多樣變化，達到自給自足方式；另外，還可以利用CAD/CAM 內的條碼系統（圖6）進行自動化生產管理，依先前存入加工圖檔編號進行條碼解析後，利用條碼掃瞄器讀取加工件上的條碼進行最佳化加工，如此可減少不必要操作及撰寫程式的錯誤；此外該軟體還提供工作清單功能（圖7），讓客戶更有效在產能管理及物料追蹤上增添了便利性。
For the software, self-developed CAD/CAM system is applied and many built-in processing modules of the system provide the user multiple processing options and combinations. Such CAD/CAM further provide a function of self-designed variation (see Figure 5) which enables the user himself to design the program. In order to reach a manner of self-sufficiency, users can use different sized plate materials to create different variations. In addition, a barcode system inside CAD/CAM (see Figure 6) can also be used for automated production management. After carrying out a barcode analysis according to previous loading processing drawing numbers, the barcode of this workpiece can be read by a barcode scanner for an optimum processing. This method can reduce an unnecessary operation and error while writing program. In addition, the software also provides a function of to-do list (see Figure 7) ,which enables the customer to provide more effective convenience on capacity management and material tracing

圖 4 板材定位零設定 Figure 4 None Setting Required for Positioning Plate Material

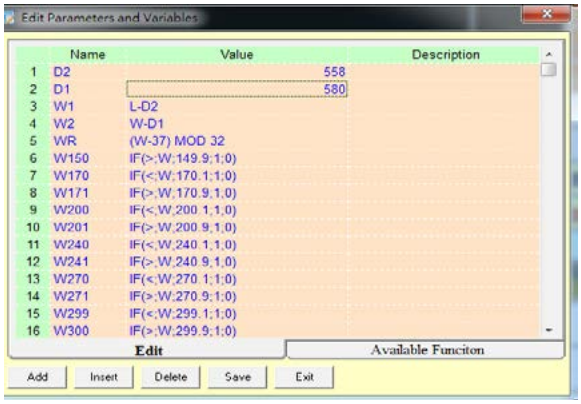


圖 5 自定變數功能

Figure 5 Function of Self-Designed Variation

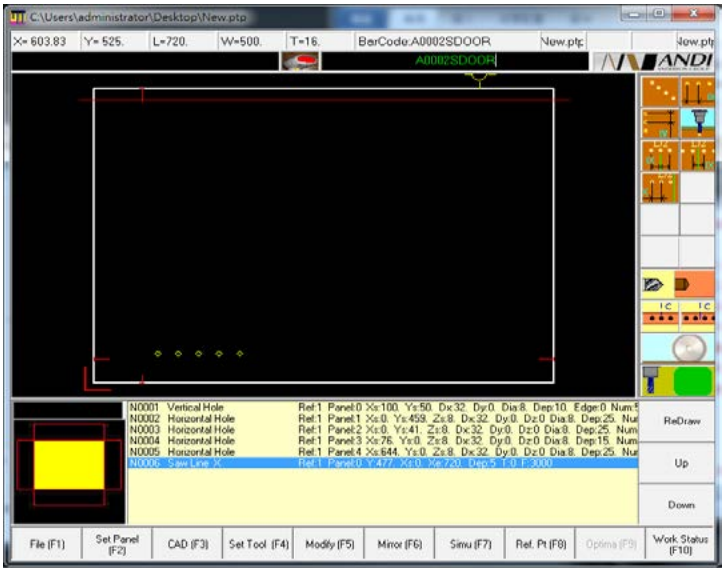


圖 6 條碼系統功能

Figure 6 Function of Barcode System

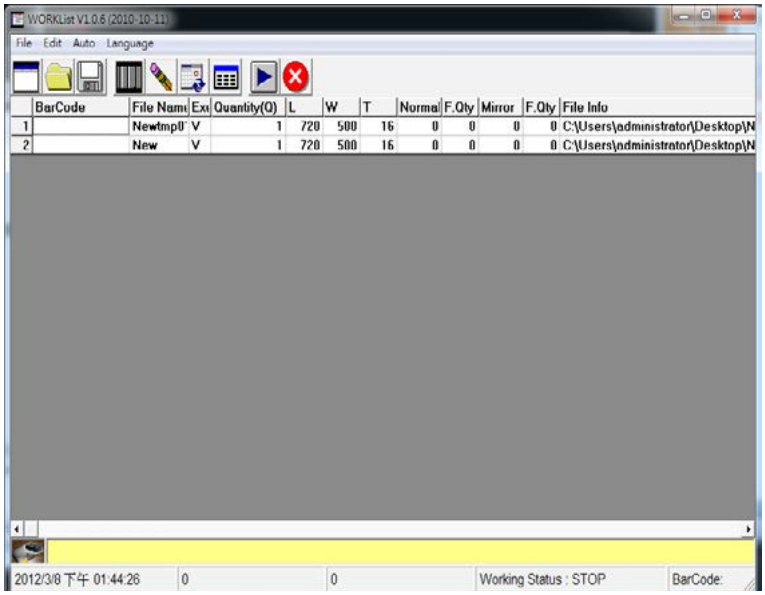


圖 7 工作清單功能

Figure 7 Function of To-do List

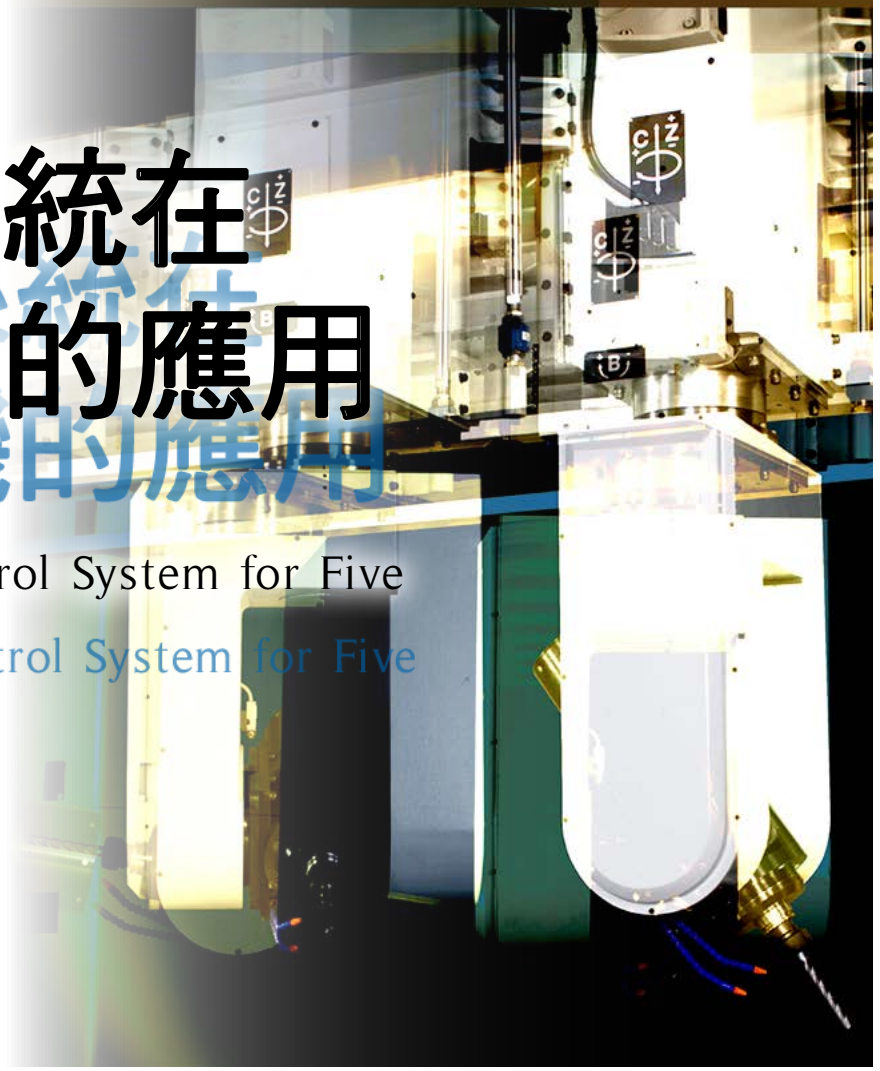
未來產品發展方向
Development Direction of Future Products

未來產品發展朝向整線設計，從裁板機出來之板材，貼上生產加工條碼後，利用輸送帶運行到智能化系統傢俱製造設備後，利用條碼器讀取加工件上的條碼，並再利用 CAD/CAM 內的條碼系統進行解析自動產生加工碼進行加工；然後，將加工完成的工件利用輸送帶運行到完成板件加工區後，再利用大型雷射條碼掃瞄器進行板件分類，達到全自動化生產之目標。
The development direction of future products will be of integral design. After sticking a production and processing barcode on the plate material coming out from cutting machine, the plate material is delivered to the manufacturing device of intelligent system furniture by a conveyor belt. The barcode of the workpiece will be read by a barcode scanner and analyzed by a barcode system inside CAD/CAM for automatic processing. Afterwards, the finished workpiece will be delivered to the processing zone of finished plate material by a conveyor belt and then sorted by a large laser barcode scanner to achieve the goal of fully automatic production.

結論
Conclusion

智能化系統傢俱製造設備的開發，對於市場上一般的傳統鑽孔、刻溝及鏤銑等加工應用更具有創新的突破理念；且在研發技術上更具有創新及先進，使得在板材加工應用的領域上更佳彈性應用。在現代講求效率的文化中，將最前端的客戶需求與後端的製造整合起來，利用資訊傳遞的方式進行溝通，大大減少人為操作錯誤，進而達到機械最大的產能及工作效益。
Comparing to general processing applications in the market, such as traditional drilling, grooving and routing, the concept of manufacturing device development of intelligent system furniture is more innovative. Moreover, as its development technology is more innovative and advanced, this enables a more flexible application for plate material processing. Upon the current culture of efficiency seeking, to integrate the front-end customer's requirement and back-end production and to communicate upon a manner of information transmission will decrease the error resulted from manual operation to achieve the maximum production capacity and working efficiency of machinery.

新代控制系統在五軸機的應用



Application of SYNTEC Control System for Five Axle Processing Machine

李明哲 Tommy Lee from AIC

前言 Introduction

原本五軸加工技術主要應用於航太產業，此技術之應用，必須整合機械的機構設計、控制器技術以及3D高階CAD/CAM軟體，一直是進入門檻很高的領域。但隨著各項配套技術越來越成熟，以及具CNC加工經驗的人才增多，五軸加工應用逐漸在各行各業擴散，成為一項製造業中時常聽聞的技術。

The five axle preocessing technology was mainly applied in the aerospace industry. The application of such technology must integrate the mechanical design of machinery, controller technology and 3D high-level CAD/CAM software, which is always a domain of high barrier to enter. However, as each matching technology is more and more mature and the talents with CNC processing experience are more and more available, the application of five axle processing has been spread to all trades and professionals gradually and become one well known technology in the manufacturing industry.

概觀來說，五軸加工設備相較於傳統三軸加工設備，由於增加機台的旋轉自由度，所以可大幅降低工件裝夾次數；而加工死角減少及曲面加工能力擴展也大大縮短後製手工時間，所以五軸加工也是一高效率的加工方法。

Generally speaking, comparing a five axle processing equipment with a traditional three axle processing equipment, since the degree-of-freedom rotary is increased, the clamping number of workpiece can be reduced significantly. Moreover, due to the decrement of processing dead end and extension of processing capability of curved surface, the post-production time can be shortened greatly. Therefore, the five axle processing is also one high efficiency processing method.

更由於現今產品均講究少量多樣，五軸加工技術是一符合未來趨勢的加工方法。本文將針對五軸控制器的重要功能做一概略的介紹，並就恩德目前使用新代控制系統做導覽，以期使用者對SYNTEC控制器應用於五軸加工機有更多的了解。

As current products always stress on small amount but large variety, the five axle processing technology can be considered as one processing method conforming to the future trend. This paper will briefly introduce the important functions of a five axle controller and further describe the SYNTEC control system used by Anderson now to asist the users in having a better understanding about SYNTEC control system applied to five axle processing machine.

五軸機控制系統介紹
Introduction of Control System of Five Axle Processing Machine

市面上常見的五軸控制器廠商有FANUC、SIEMENS、HEIDENHAIN等，這些控制器原本來說均屬於專用封閉系統控制器，也就是說其控制器OS均採自家產品與外界溝通不易。但由於電腦工業的蓬勃發展，CPU運行速度不斷加快及周邊相關零件完善，WINDOW Based操作系統日漸風行，上述各家廠商均推出相對應產品。

The well known vendors of five axle controller on the market are FANUC, SIEMENS, HEIDENHAIN and so on. These controllers originally belong to specialized closed system controllers, which means the OS of their controllers all adopt their own products and are hard to communicate with the external world. However, due to the flourishing development of computer industry, the continuous acceleration of CPU operating speed, the completion of related parts and the growing popularity of WINDOW Based operating system, the above mentioned vendors all launch their own corresponding products.

而SYNTEC亦在此波技術浪潮中為採WINDOW CE操作系統之PC Based控制器。其系統具有開放性、客製化能力強等特色，更易符合各種不同產業的特殊加工需求。

SYNTEC is also involved in this wave of technology, adopting a PC Based controller of WINDOW CE operating system. The systwm features open-end and strong customization which is easier to meet any special processing requiremrnt of any different industry.

五軸控制系統特有功能介紹
Introduction of Specialized Functions of Five Axle Control System

◆ 刀尖控制功能
(Rotate Tool Center Point, RTCP)Tool Tip Control Function (Rotate Tool Center Point, RTCP)

刀尖控制功能是指，所下的移動指令或進給指令皆參考刀尖點為基準點作控制。控制器會依據刀具長度作自動補償，當程式控制旋轉軸運動，刀尖會沿著加工路徑前進，而控制器自行調整X、Y、Z軸的運動位置。

The tool tip control function means that the given moving instruction or feeding instruction both refer to tool tip point as standard point for control. The controller will do self-compensation according to the tool length. When the program control the movement of rotating shaft, the tool tip may go forward along the processing path and the controller will adjust the movement location of X, Y and Z axle automatically

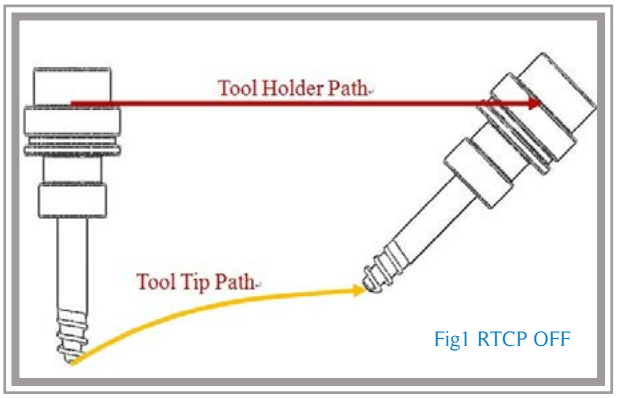


Fig1 RTCP OFF

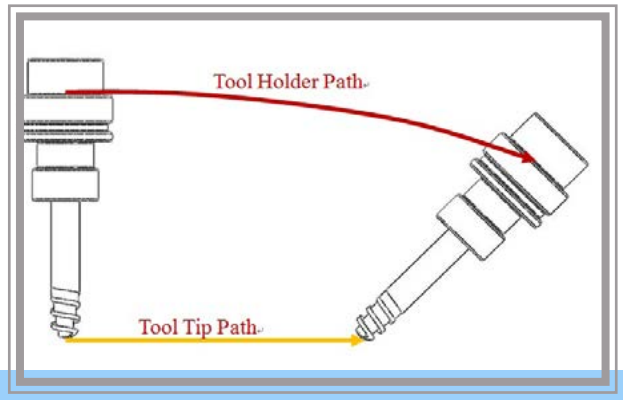


Fig2 RTCP ON

◆斜平面加工功能 (Feature Coordinate)Oblique Surface Processing Function (Feature Coordinate)

斜平面採用 Euler angle 作定義。使用者可透過程式指令能將正規平面 (X-Y)，自動轉換成傾斜的工件基準面，然後控制刀具軸方向與傾斜加工面垂直。如此操作者就可以很快速的，將原本使用於正規平面的程式，移植至斜平面上加工。而「斜平面座標系」是架構在「工件座標系 G54」上定義。二者之間的關係如下圖所示：

The oblique surface takes Euler angle as definition. Thw user can change a regular surface (X-Y) to oblique workpiece standard surface automatically through program instruction, then can control the direction of tool shaft to be vertical with oblique processing surface. In such case, operator can transplant the program originally used in regular surface to oblique surface for processing. ”Coordinate system of oblique surface” is defined against coordinate system of workpiece G54”. The relation between both is shown as below drawing:

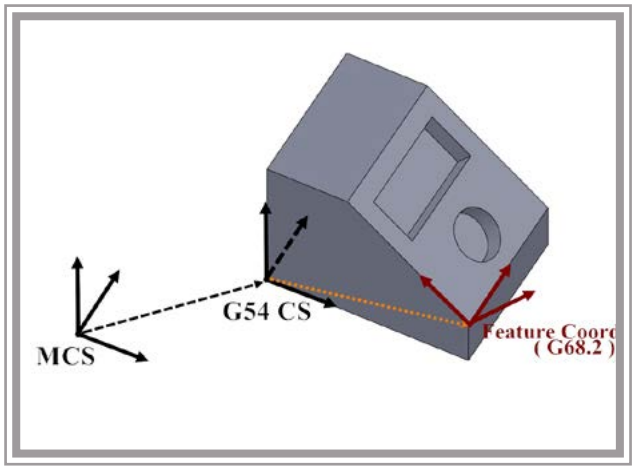


Fig 3

SYNTEC 五軸控制系統手動同動功能介紹 Introduction of Manual/Synchronous Functions of SYNTEC Five Axle Control System

由於現今社會許多零件均是塑膠製成，當所需的量並無法達到塑膠射出方式的經濟規模時，模具費用變成一極高成本。此時若使用吸塑成型法，即可大幅降低模具成本，再配合五軸加工機，可使成品精度穩定準確。

Since now many parts are made by plastic, the mold fee has become a high cost when the required quantity can not reach the economic scale of plastic injection. If now a vacuum forming method is used, the mold cost will be reduced greatly. And if further going with five axle processing machine, the accuracy of product can be stable and accurate.

其加工程式通常並不是加工一個空間曲面而是只沿空間中的曲線將材料做切斷的動作。所以若使用於3D CAD/CAM 五軸軟體，其操作上常常是較為複雜，需由特別受過訓練的技術人員才能勝任，且軟體的售價不菲。

The processing program does not usually process a spatial curved surface but cut the material along the curve in the space. Therefore, if a 3D CAD/CAM five axle sofeware is applied, the operation is more complicated and a trained technician is required to handle this and the cost of software is expensive.

所以對機器進行教導學習的逆向工程方法（以已存在的模型為依據，直接量測模型上的加工路徑點座標，產生加工路徑），對客戶而言，是最方便及直觀生產加工方法。

Therefore, a reversed engineering method applied for a machine (based on existed model, a processing path is created by measuring the processing path coordinates on model directly) is the most convenient and direct production processing method for customers.

為了讓進行逆向工程量測功能順暢流利，SYNTEC 控制器開發了五軸手動同動功能，其中包含有斜平面座標教導功能及五軸手動進給功能。

In order to smooth the reversed engineering measurement, manual and synchronous functions of five axle has been developed for SYNTEC controller, in which a instruction function of oblique surface coordinates and manual feeding function of five axle are included.

◆ 斜平面座標教導功能 Instruction Function of Oblique Surface Coordinates

斜平面座標教導功能乃因應五軸傾斜平面加工功能，所開發之人機座標教導功能。使用者直接以刀具姿態或3點成面概念等方式，配合人機介面執行座標教導，快速定義斜平面的原點與軸向，執行傾斜面加工。

The instruction function of oblique surface coordinates is a human-machine coordinates instruction function developed for five axle processing function of oblique surface. User can define the origin and axle direction quickly by using the cutter orientation and concept of three-point plane directly going with the instruction of human-machine interface to operate a processing of oblique surface.

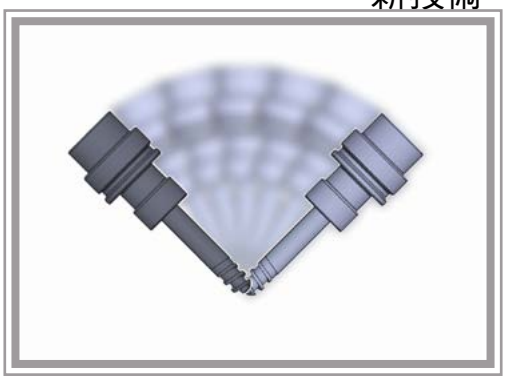


Fig 4 RTCP ON and Rotating B or C axis manually

◆五軸手動進給功能
Manual Feeding Function of Five Axle

五軸手動進給功能透過人機介面按鈕，可快速開啟與刀具現有姿態垂直之斜平面座標系設定，當操作者對線性軸(X、Y、Z)手動位移時，機械自動進行座標系運算，沿刀具座標系之線性軸(X、Y、Z)移動；也可由人機介面按鈕啟動RTCP功能，Fig 4即為開啟RTCP功能後，JOG旋轉軸之示意圖。即RTCP開啟後，移動旋轉軸時，刀尖會固定在定點，方便操作者選擇最好的加工角度來加工工件。

The manual feeding function of five axle can open the setting of oblique surface coordinate system being vertical with cutter orientation through the button of human-machine interface. When operator manually moves the linear axles of X, Y and Z, the machine may proceed with a computation of coordinate system, moving along linear axles X, Y and Z of tool coordinate system; RTCP function can be started through the button of human-machine interface, in whicn Fig 4 is the diagram of JOG rotating shaft after RTCP function is started. The tool tip will fix in a fixed point after RTCP is started and rotating shaft is moving to enable the operator to select the best processing angle for workpiece processing.

Fig 5 Teaching process

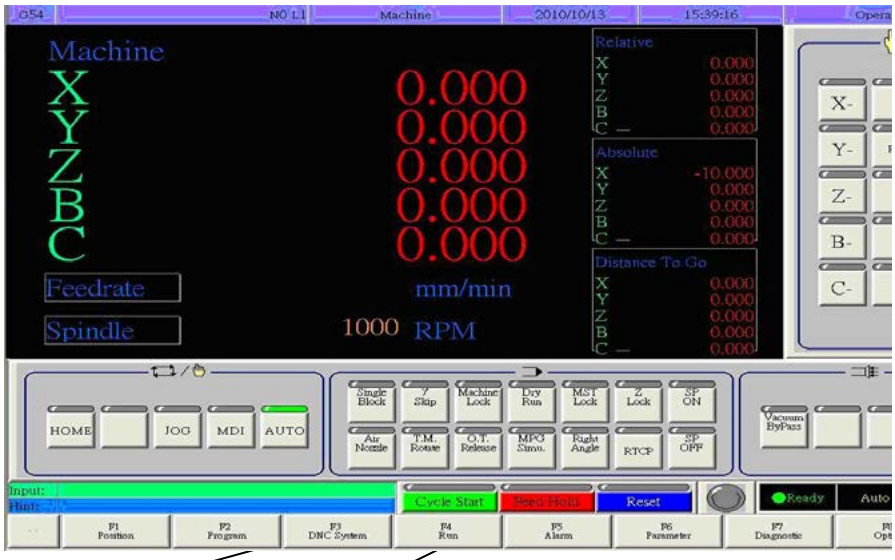


Fig6 SYNTEC HMI

結論
Conclusion

目前恩德科技公司將SYNTEC 控制器用於輕切削五軸加工機上。如搭配HSK32E 40000RPM 主軸，專門使用於塑膠3D 部件銑削的MAXXIS 系列，以及箱型雙區加工五軸機系列。

Now Anderson Industrial Corp. has applied SYNTEC controller for light cutting five axle processing machine such as, MAXXIS series equipped with HSK32E 40000RPM spindle, which is specially used in plastic 3D parts cutting and five axle processing machine series of box type dual-zone processing.

我們期待透過軟體及人機介面的充份整合，可提供客戶更方便使用及高價性比的設備。當然，在未來恩德也會本著不斷精益求精及為客戶提供最佳生產設備的精神，不斷挑戰自我推出更好的產品。

We expect to fully integrate the software and human-machine interface to provide our customers the equipments of more convenience and higher performance price ratio. Of course, Anderson will constantly improve itself and uphold a spirit of providing its customers the best production equipments to challenge itself to launch better products in the future.

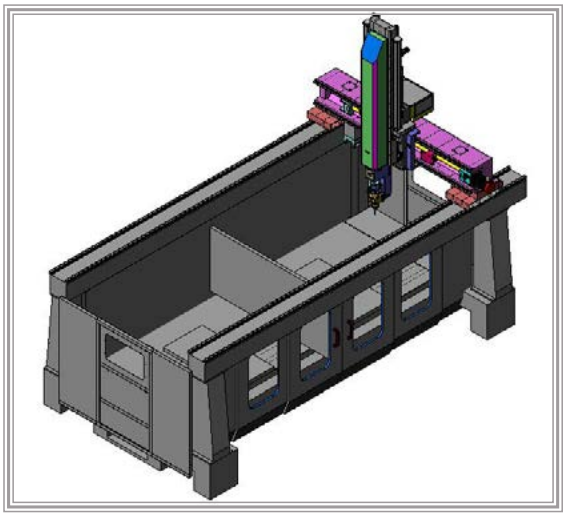


Fig 8 Box Type

Fig 7 AXXIOM 1618IP

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LI YEN-HUI, LIU HSIN-HUNG The Market Opportunities for Taiwanese Five Axle Processing Machine Center Machinery Industry No. 334 2011.01

2.SYNTEC 技術手冊SYNTEC Technical Manual

3.FANUC 技術手冊FANUC Technical Manual

4.SIEMENS 技術手冊SIEMENS Technical Manual

3D 立體噴繪介紹
Introduction of 3D Inkjet Printing

葉斯文 Awen Ye From CNT

噴繪運用的發展
Development of Inkjet Application

數位噴繪是充份結合光電科技、數值控制、化學工業的技術結晶。若以噴墨結構類型來區分，噴繪機可區分為水性墨水、溶劑墨水、及UV墨水型三種。基於各種墨水結構特性不同，產品的適用範圍也有所不同；如水性墨水適合戶內寫真、精美海報、相片、照相館等相關產品，溶劑墨水用於戶外廣告、大型廣告牌、燈布、車貼，UV墨水在玻璃裝飾、標誌工程、各式建材、工藝品等則有廣泛的應用，各墨水均有其特點及領域。恩德集團於2006年開始積極投入，並先後推出CoJet及AJet兩款UV數位噴繪機，正式跨足工業用噴繪機市場，將原本主要以廣告業觀點的UV噴墨應用技術，應用到恩德集團專業深厚的傢俱、建材市場，以期融合出嶄新的應用技術並進而創造全新的市場。

Digital printing is the full combination of optoelectronic technology, numerical control, and the chemical industry technology. From the structures, the inkjet printers can be divided into three types: water-based ink, solvent ink and UV ink. Based on the different structural properties of the ink, the scope of application is different. For example, the water based ink is suitable for studio shots, posters, photos, photo store and other related products. The solvent ink is for outdoor advertising, billboards, light cloth, car stickers. And UV ink is widely used on glass decoration, signs, engineering, all kinds of building materials, and handicrafts, etc. Each ink has its own characteristics and field. Anderson Group has focused on it in 2006, and has introduced two types of UV digital inkjet printers, CoJet and AJet, formally stepped into the market of industrial inkjet printers. It uses the technology of UV inkjet applications which was mainly for advertisement on Anderson Group specializing scope including furniture, building materials market. It is expected to create a new technique integration and develop a new market.

3D 立體噴繪的運用
Application of 3D Inkjet Printing

3D立體噴繪工藝即是指利用UV墨水在固化後可產生一定膜厚(2μm~10μm)的特性，並藉由UV數位噴繪機可數值化設定的功能下，使噴墨頭可在一次程序中進行UV墨水的重複堆疊固化來

產生浮雕圖像效果，如此的噴印方式，可以產生油畫、實木紋及一些逼真的仿真紋路效果。
3D inkjet printing means to use the features of UV ink which will produce a certain thickness (2μm to 10μm) of film after curing. Meanwhile, with the function that UV digital inkjet printers can be set digitally, the inkjet head can repeat stacking and curing of UV ink to produce relief effects in one processing, so the inkjet can produce effects like oil painting, wood grain and simulating texture.

3D立體噴繪功能加上UV墨水原有可印在各種不同材質的承印物，及其環保、耐候性強的優點等，可運用的產品類別非常廣泛。3D立體噴繪與傳統的平面圖案產品相較，主要差異在於增加了產品觸感及視覺上的立體感，以下是一些產品運用介紹：

With the original UV inks, 3D inkjet printing can print on a variety of material substrates. The advantages of environmental and strong weather resistant provide a very wide range of product categories. In comparison with traditional flat pattern, the main difference is that it increases the tactile and visual three-dimensional feelings. The following are introductions of some product applications:

實木貼面傢俱
Wood veneer furniture

噴繪方式取代珍貴的實木貼皮或是在實木上局部噴繪拼花效果，並可縮短生產週期及減少傳統貼皮的複雜工序所需之各種設備及大量人工。應用材質：實木、密度板。（圖01~03)

Use inkjet printing to replace the precious wooden skin or make parquet effect printing on partly solid wood, it can also shorten the production cycle and reduce the complex processes of the traditional veneer which requires a variety of equipment and a lot of artificial. Materials of application: wood, MDF. (Fig. 01 ~ 03)

辦公傢俱
Office Furniture

桌面板噴繪裝飾，提供簡單的工序完成多樣的產品別。應用材質：實木、夾板、密度板、水泥板、UV板。（圖04~07）

For the inkjet decoration of table boards, provide a simple process to complete a variety of products. Materials of application: solid wood, plywood, MDF, cement board, UV board.(Fig. 04~07)

圖 01 Fig. 01

圖 02 Fig. 02

圖 03 Fig. 03

圖 04 Fig. 04

圖 06 07 Fig. 06 07

圖 05 Fig. 05

櫥櫃傢俱
Cabinet Furniture

提供少量多樣產品，加強櫃體上的裝飾花紋效果，提升附加價值。應用材質：：密度板、PVC 貼面。(圖 08-09)

Provide a small amount of diverse products to enhance the decorative pattern effect on the cabinets to increase the added value. Materials of application: MDF, PVC veneer. (Fig08-09)

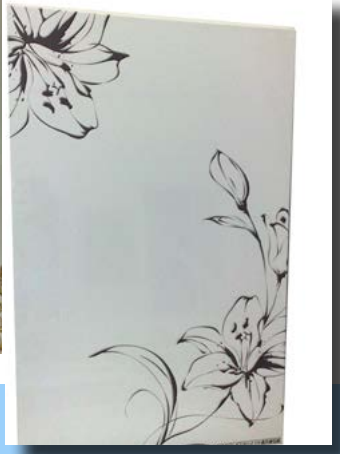


圖 08 09 Fig. 08 09

門業
Door Industry

免漆門、實木門的局部或全覆蓋的裝飾花紋或拼花效果，用以增加附加價值及產品多樣化。應用材質：實木、密度板、PVC 貼面。(圖 10~14)

Use partial or complete coverage of decorative pattern or mosaic effect on paint-free doors, solid wood doors to increase the added value and product diversification. Materials of application: solid wood, MDF, PVC veneer. (Fig. 10~14)

圖 10-14/ Fig. 10-14

圖 09 /Fig. 09

地板業
Flooring Industry

防滑地板、拼花地板的局部或全覆蓋噴繪。應用材質：實木、密度板。（圖015~017）

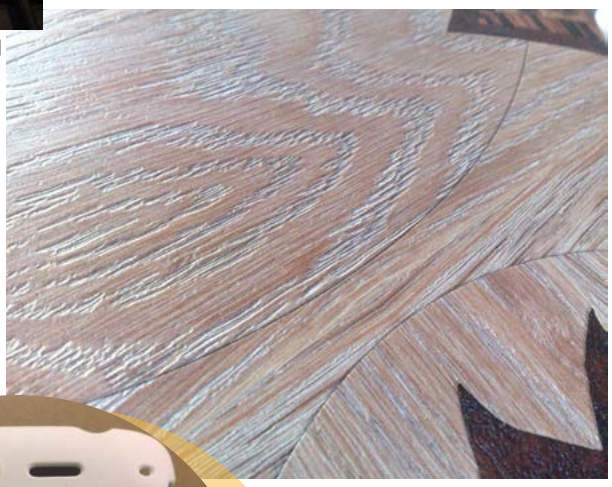
Apply inkjet printing on part of the slip-proof floor and parquet floor or in full-coverage. Materials of application: solid wood, MDF. (Fig. 015~017)

禮品業
Gift Industry

個性化訂製產品完全有別於傳統的平面轉印及絲印產品，擁有更好的設計空間並同時兼具優良的保存壽命。應用材質：壓克力、玻璃、磁磚、木材、密度板、石材、金屬.....等等。（圖18~24）

Personalized custom products are completely different from the conventional planar transferring or screen printing products, which have a better design space and the excellent life preservation at the same time. Materials of application: acrylic, glass, tile, wood, MDF, stone, metal, ...etc. (Fig.18~27)

圖 15-17/ Fig. 15-17



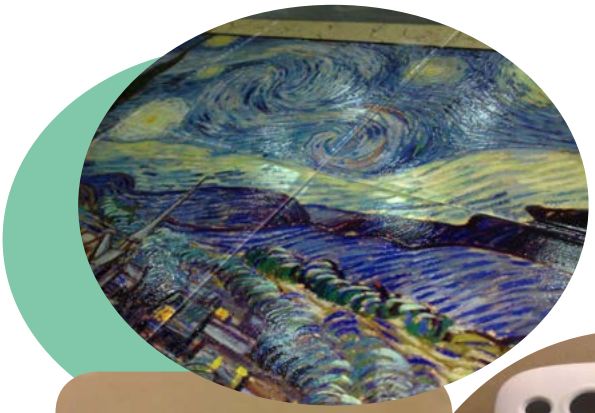


圖 18-24/Fig. 18-24

建材業
Building Materials Industry

在板材上製作裝飾花紋效果，如消音板、背景牆、移門、裝飾玻璃、隔斷...等，用以增加附加價值及產品訂製化的可能性。應用材質：密度板、鋁塑板、玻璃、石材、實木、磁磚...等等。（圖25~26）

Produce effects of decorative pattern on the plates such as silencers board, backdrop, sliding doors, decorative glass, cut off, ...etc., and increase the added value and the possibility of customization. Materials of application: MDF, aluminum molded panels, glass, stone, solid wood, tile, ... and so on. (Fig. 25~26)

圖 25~26/ Fig. 25-26

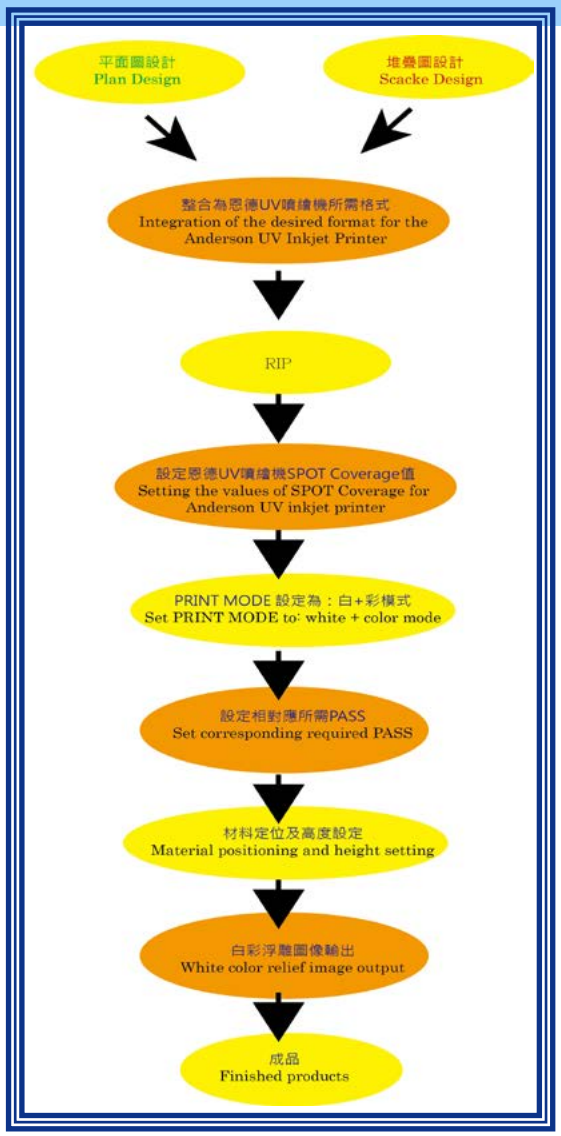
複製畫
Painting Reproduction

主要是以油畫複製為主，可以仿真原著作油畫的筆觸及顏料堆積的凹凸感。應用材質：油畫布。（圖27）

Mainly for oil painting reproduction, it is available to simulate the brush strokes and the concavity from pigment accumulation of the original paintings. Materials of application: canvas.(Fig. 27)

高效率 3D 立體噴繪的發展
Development of High Efficiency 3D Inkjet Printing

目前的3D立體噴繪最主要的發展障礙不外乎是成本及產能兩大因素，目前市場上的UV墨水相較於已發展相當成熟普及的水性墨水及溶劑墨水，UV墨水的價格昂貴許多，由於3D立體噴繪需要大量的墨水進行重複固化堆疊，依據需要的效果其耗墨量會達到平面噴繪的墨水耗量的6~10倍以上，使得3D立體噴繪的應用產品中墨水成本佔了很重的比例。此外重複固化堆疊墨水需要更多的機械動作來完成噴繪，也使得產能會下降到原來平面噴繪產能的12%~33%之



浮雕噴繪的流程　Relief Inkjet Printing Process

間，如此噴繪的墨水成本大幅升高，同時生產速度也降低許多。目前3D立體噴繪的發展，需要能開發出擁有在單位噴繪面積中產生較高利潤的產品，才能發揮出市場價值。

The current main obstacles of developing 3D printing are nothing more than the two factors of the cost and capacity. Compared to water-based ink and solvent ink on the market, which have been developing quite some time and well-spread, the UV ink is much more expensive. Since the 3D inkjet printing needs a lot of ink for curing and stacking repetition, the amount of ink consumption will reach 6 to 10 times more than the plane printer according to required effects, the ink cost accounts for a very heavy proportion of the application of 3D printing products. In addition, to repeat ink curing and stacking takes more mechanical actions to complete the printing, the production will drop to 12% to 33% of the capacity by original plane inkjet printers. Thus, the ink cost rises sharply, while the producing speed reduces a lot. The current 3D printing needs to develop a product with higher profits per unit area to have a market value..

為了提升3D立體噴繪的發展潛力，當務之急必先披荊斬棘排除目前的發展阻礙，我們需要能掌握高品質且優惠高的墨水，我們也需要不斷提升噴繪機的生產速度及優化噴印程序，並持續精進研究產品應用及教育客戶的應用能力，以此三個方向為目標，最終協助客戶獲得最大的使用利益。

In order to enhance the development potential of the 3D inkjet printing, it is the most imperative to rule out all obstacles hindering the current development. We need to control the high quality and favorable ink, and also to continuously upgrade the producing speed of inkjet printers and optimize the printing process. Besides, we must continue research of product applications and educate the customers for it. Take the three as our targets and ultimately help customers maximize their using benefits.

結論

Conclusion

3D立體噴繪只是一種噴繪功能，要如何發揮在各產品領域之中，則需要許多產品開發的創意及不斷改善的演進。為了加速產品及應用的推廣，恩德特別成立了應用教育部門，期能集思廣益，致力於研究開發並深入瞭解客戶所需、學習客戶所需、教育客戶所需，以對此全新應用的市場投下創新的元素。

3D inkjet printing is just a printing function. To play among the various product areas, it is necessary to have creative product development and continuous evolution of the improvement. In order to accelerate the promotion of products and applications, Anderson has set up the application education sector, and hope the collective wisdom can absorb great ideas on research and development to understand, learn and educate customers for what they need, and to put innovative elements on the whole new market of application.

高速永磁同步馬達之探討

A Probe on High Speed Permanent Magnet Synchronous Motor(PMSM)

高速永磁同步馬達之探討
A Probe on High Speed Permanent Magnet Synchronous Motor(PMSM)

蔣繼緯 Chi-Wei Chiang From AIC

前言

Foreword

在工具母機中，主軸最主要功用在於傳遞能量，藉由帶動刀具來進行加工動作，可說是工具機的核心之一，主軸傳送動力的方式主要分為皮帶式、直結式與內藏式。這三種如圖一所示，在高轉速應用領域中，以內藏式主軸為主流；對於內藏式主軸來說，馬達為主要的動力來源，可視為主軸的心臟。假使能夠更深入了解馬達設計這塊領域，在市場競爭中將會有更多的優勢，因此本文將針對應用於高速主軸的馬達來探討其設計概要。

The major function of the spindle in a machine tool is passing energy and activating the cutting tools to perform processing task, and can be said to be one of the cores of the machine tool. The spindle's method of power transportation can mainly be divided into three types: leather belt type, direct-drive type and built-in type, as shown in Figure 1. In the field of high speed application, the main stream is built-in spindles. For built-in spindles, the motor is the primary force provider and is like the heart of the spindle. With further understanding in the field of motor design, more advantage can be gained in market competition. Therefore, this report will focus on motors used in high speed spindles and probe into its designing essentials.

高速主軸馬達發展的沿革

The Course of Development of High Speed Spindle Motor

以往高速內藏式主軸工具機用之馬達以交流感應馬達(AC Induction Motor)為主，如圖二所示，由於感應馬達構造簡單、轉子較為堅固(高轉速不易飛脫)、造價便宜且維修容易，至今仍備受業界喜愛，由於感應馬達轉子本身需要激磁，因此會有較高的轉子損失，導致效率較低且容易產生熱，導致主軸溫度較高。此外，感應馬達的功率體積比較小，亦即相同體積下產生的功率會比較小。

Past high speed built-in spindle machine tools have mainly used AC induction motors . As shown in Figure 2, as induction motors have simple structures, stable rotors (which do not go out of position when operated at high speed), are manufactured at low cost and are easy to maintained, they are still a favorite in the industry nowadays. However, as the induction motor's rotors need to be magnetized, there is a higher rotor loss leading to low efficiency, and it gets hot easily, so the spindle might have a higher temperature. Also, induction motors have a smaller power to volume ratio, meaning they produce less power at the same volume.

近年來隨著國內外政府積極提倡節能省碳，高效率產品現在成為主要議題，因此「效率」也會是目前設計馬達的訴求之一，感應馬達主要缺點就是效率低，因此主軸製

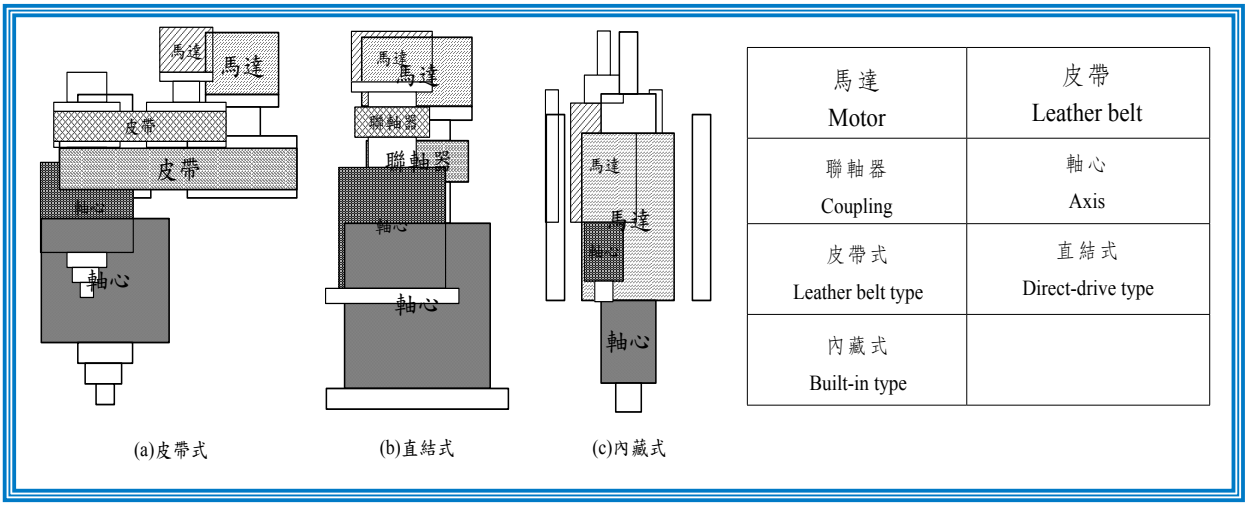


圖1 主軸系統示意圖 Figure 1 Diagram of Spindle System

造商開始漸漸轉向使用永磁同步馬達(Permanent Magnet Synchronous Motor)作為主軸的動力來源，如圖三所示。

In recent years, as governments domestic and abroad,became promoting energy conservation and carbon reduction, products with high efficiency have become the main issue. As a result "efficiency" will be one of the demands in motor design. The main disadvantage of induction motors is their low efficiency. Therefore spindle manufacturers have turned to PMSM as the main power source of spindles, as shown in Figure 3.

由於永磁同步馬達不需要轉子激磁，因此比起感應馬達擁有較高效率(一般效率大於90%)，且轉子的溫升也較低。此外永磁同步馬達擁有較高氣隙磁通密度分布及功率體積比，因此相同體積下永磁同步馬達會比感應馬達產生更高的功率；由於永磁同步馬達擁有較低的轉動慣量，因此在加減速的時間上會有很明顯的優勢；此外，永磁馬達在轉速較低時，即可以提供額定輸出轉矩，表示其轉速操作範圍較廣。

As there is no need for a magnergized rotor for permanent magnet synchronous motors(PMSM), they have higher efficiency (generally over 90%) when compared to induction motors and the rotor's rise in temperature is a lower. PMSM also have higher air-gap flux density distribution and power-volume ratio, they can produce more power than induction motors with the same volume. PMSM have a lower moment of inertia, so they have a clear edge when it comes to time spent on acceleration and deceleration. Also, PMSM can offer rated output torque at lower speeds, indicating they have a wider working range of speeds.

相對地永磁同步馬達也有一些缺點，例如高轉速時離心力會導致轉子磁石飛脫問題、造價方面較為昂貴、驅動器也較為昂貴等…。永磁同步馬達與感應馬達的優缺點比較如表一、二所示。

On the other hand, PMSM also have some demerits such as, dislodging rotor, magnets, due to centrifugal force when operated at high speed, higher manufacturing cost and more expensive drivers. The merits and demerits of PMSM and induction motors are compared in Table 1 and Table 2.

馬達分類說明

Description of Types of Motors

一般應用於工具機產業的馬達我們可以簡稱為伺服馬達，近年來由於無刷式伺服馬達(brushless servo motor)製造與控制技術的急速發展，再加上大型積體電路與半導體功率元件的進步，使其商品化產品日益增多，在高性能伺服應用場合如電腦控制數值工具機、工業機器人等，均已逐漸取代了傳統式的有電刷的直流伺服馬達(dc servo motor)。無刷式伺服馬達主要可分為兩大類(圖二)：(1)無刷式直流伺服馬達(brushless DC servo motor)，一般亦稱之為永磁式同步馬達(PMSM)或永磁式交流伺服馬達(PM AC servo

motor)，(2)感應式交流伺服馬達(induction AC servo motor)。Motors generally used in machine tool industries are abbreviated servo motors. Recently, due to the manufacturing of brushless servo motors and the rapid development of controlling technology, in addition to the advances of large scale integrations and semiconductor power devices, market products increase by the day and have replaced traditional DC servo motors with brushes in high performance servo applications such as computer controlled value machine tools and industrial robots. There are two major types of brushless servo motors (see Figure 2): (1) Brushless DC servo motors, also called PMSM or PM AC servo motors and (2) Induction AC servo motors.

優點 Merit	缺點 Demerit
構造簡單 Simple Struture	效率低 Low efficienccy
造價便宜 Low manufacturing cost	轉子溫升高 Temperature rise of rotor
維修容易 Easy maintenance	功率體積比低 Low power-volume ratio
	控制響應慢 Slow control response

表一、感應馬達優缺點比較表 Table 1: Merits and Demerits of Induction Motors

優點 Merit	缺點 Demerit
效率高 High efficienccy	造價昂貴 High manufacturing cost
功率體積比低 High power-volume ratio	
溫升低 Low rise in temperature	
控制響應快 Fast control response	
轉速操作範圍廣 Wide range of operating speed	

表二、永磁同步馬達優缺點比較表 Table 2: Merits and Demerits of PMSM

無刷式直流伺服馬達採用內裝式之霍爾效應(Hall-effect)感測元件來偵測轉子的絕對位置，以決定功率元件的觸發時序。其效用有如將直流伺服馬達的機械式電刷換相(mechanical commutation)，改為電子式換相(electronic commutation)，因而去除了直流伺服馬達因電刷所帶來的限制。目前一般永磁式交流伺服馬達之回接元件多採用解角器(resolver)或光電解編碼器(photo encoder)，前者可量測轉子絕對位置，後者則只能測得轉子旋轉之相對位置，電子換相功能則設計於驅動器內。

Brushless DC servo motors are equipped with built-in Hall effect detective elements to detect the absolute position of the rotor and decide the trigger timing of power devices. Its effects are like converting the mechanical commutation in the DC servo motor into electronic commutation. Thus, the limitations brought by electric brushes in DC servo motors are removed. Currently, PMAC servo motors generally are equipped with resolvers or photo encoders as their reconnecting elements. The former can measure the rotor's absolute position and the latter can only measure the rotor's relative position by its rotation. The electronic commutation function is designed within the driver.

永磁同步馬達的工作原理

The Working Principles of PMSM

這邊將針對永磁同步馬達的工作原理說明，馬達的工作原理可以「弗萊明左手定則」來說明，弗萊明左手定則可用來判斷一根通有電流的導線置於磁場中時其受力的方向。若以左手之食指表示磁場方向，中指表示電流方向，則大姆指表示此導線受力的方向，如圖3所示之電流方向，則環狀線圈受磁場之作

用，將順正時鐘方向旋轉，產生之扭矩T可以下式表示 This part explains the working principles of PMSM. The principles can be explained by “Fleming’s left hand rule”, which can be used to tell the direction of force of a leading wire with electricity when put in a magnetic field. Use the index finger of the left hand to represent the direction of the magnetic field and the middle finger to represent the direction of the current, and the thumb represents the direction of force . For the direction of current shown in Figure 3, the ring-shaped coil will rotate clockwise due to the effect from the magnetic field, and the resulting torque T can be presented by formula below:

$$T = KIB \quad [\text{N.m}] \qquad (1)$$

其中K為比例常數，I 為流經線圈之電流，B 為永久磁鐵所造成之磁場強度。where, K is a constant I is the current passing through the coil, and B is the strength of the magnetic field formed by the permanent magnet.

永磁式交流伺服馬達的工作原理可以圖4說明，由電晶體三相換流器(inverter)經由脈寬調變(pulse width modulation)在馬達之定子造成一旋轉磁場，它與轉子永久磁鐵所造成之磁場相互作用而產生旋轉扭矩。電子換相器(electronic commutator)之目的即在於使定子所產生之磁場方向與轉子永久磁鐵之磁場方向保持垂直，而產生最大之扭矩，為了達到這個目的可藉由解角器來回授轉子位置，由電子換相器來達成。The working principle of PM AC servo motors can be explained with Figure 4. Form a revolving magnetic field at the stator of the motor with the transistor three phase inverter through pulse width modulation, it will form a rotary torque through interaction with the magnetic field formed by the rotor’s permanent magnet. The purpose of the electric commutator is to keep the magnetic field of the stator perpendicular to that of the permanent magnet, and forming the largest torque. This goal can be reached by using the resolver to determine the location of the rotor and using the electronic commutator to complete the task.

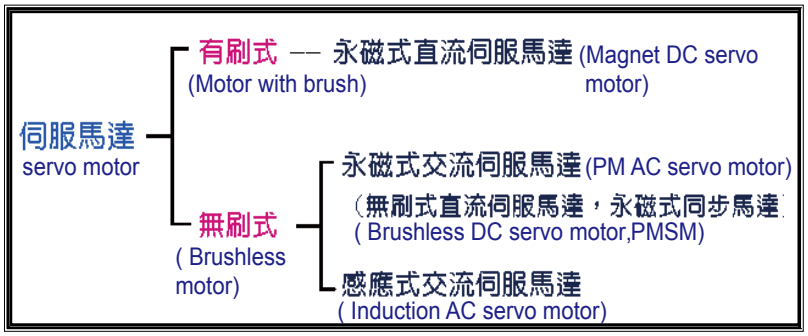


圖2 伺服馬達分類 Figure 2 Classification of Servo Motor

在解角器之初級線圈施以90相位差的交流電壓 $V_m \sin\omega_e t$ 與 $V_m \cos\omega_e t$（如圖4所示），則在次級線圈隨轉子旋轉之角度θ，由變壓器效應產生 $V_m \sin(\omega_e t + \theta)$ 之交流電壓，此交流電壓經由回授，由相位同步器將三相參考電壓 $\sin\omega_e t$ 、 $\sin(\omega_e t + 2/3\pi)$ 、 $\sin(\omega_e t + 4/3\pi)$，轉換為 $V_m \sin\theta$ 、 $V_m \sin(\theta + 2/3\pi)$ 、 $V_m \sin(\theta + 4/3\pi)$，其中Vm為激磁電壓之最大值，ωe為交流電壓之角頻率。$V_m \sin\theta$ 、 $V_m \sin(\theta + 2/3\pi)$ 、 $V_m \sin(\theta + 4/3\pi)$ 即為三相換流器之調變信號(modulation signals)，換流器將相位差120之三相交流電壓施於馬達之定子，如圖4所示A、B、C三相之電流分別以IA、 IB、IC表示，其最大值為Im，各相電流(phase current)可表示為 When AC voltage with a 90 phase difference $V_m \sin\omega_e t$ and $V_m \cos\omega_e t$ are applied at the primary coil of the resolver (as shown in Figure 4), an AC voltage of $V_m \sin(\omega_e t + \theta)$ will form due to transformer action on the secondary coil following the rotating angle θ of the rotor. This voltage goes through feedback and the three-phase reference voltages of $\sin\omega_e t$, $\sin(\omega_e t + 2/3\pi)$, and $\sin(\omega_e t + 4/3\pi)$ will be converted into $V_m \sin\theta$, $V_m \sin(\theta + 2/3\pi)$, and $V_m \sin(\theta + 4/3\pi)$ by the phase synchronizer, with V_m being the largest value of energizing voltage and ω_e the angular frequency of the AC voltage. $V_m \sin\theta$, $V_m \sin(\theta + 2/3\pi)$, and $V_m \sin(\theta + 4/3\pi)$ are modulation signals of the three phase inverter, which applies a three phase AC voltage with the phase difference of 120 on the stator of the motor as seen in Figure 4. The currents of A, B, and C are represented by I_A 、 I_B 、

I_C, the maximum is I_m and the phase currents can be shown as

$$I_A = I_m \sin\theta \quad (2)$$

$$I_B = I_m \sin\left(\theta + \frac{2}{3}\pi\right) \quad (3)$$

$$I_C = I_m \sin\left(\theta + \frac{4}{3}\pi\right) \quad (4)$$

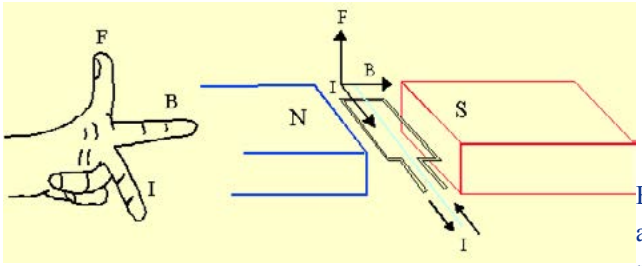


圖3 弗萊明左手定則

Figure 3: Fleming's Left Hand Rule

設Bm為轉子永久磁鐵所造磁場強度之最大值，其與馬達定子各相之電樞線圈正交磁場強度為 BA、BB、BC，根據轉子角度可表示為

Set Bm as the maximum strength of the magnetic field formed by the rotor permanent magnet, the crossed magnetic field strength of armature coil with each phase of motor stator are BA, BB, and BC and can be presented depending on the rotor's angle as:

$$B_A = B_m \sin\theta \quad (5)$$

$$B_B = B_m \sin\left(\theta + \frac{2}{3}\pi\right) \quad (6)$$

$$B_C = B_m \sin\left(\theta + \frac{4}{3}\pi\right) \quad (7)$$

各相電樞線圈電流IA、IB、IC與其所承受之磁場強度BA、BB、BC分別產生之旋轉扭矩T_A、T_B、T_C可表示為

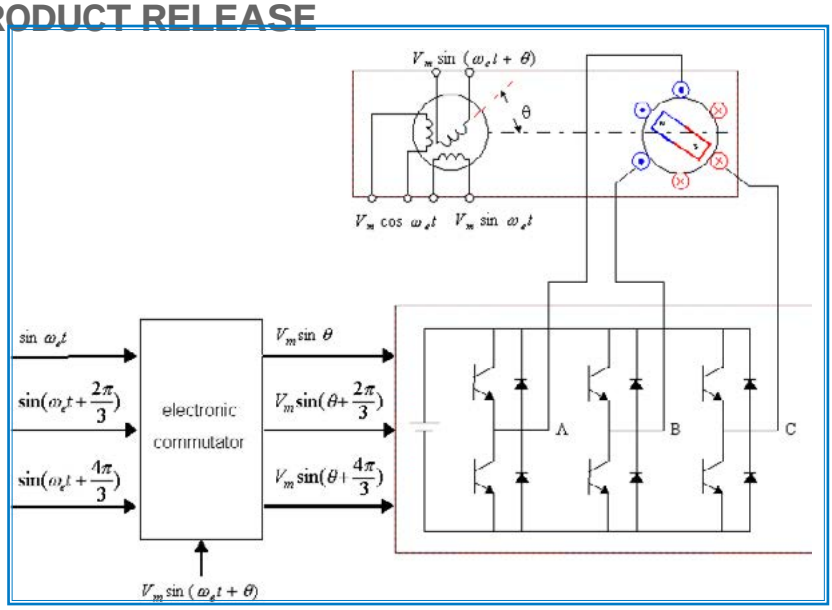


圖4 永磁同步馬達控制方塊圖

Figure 4: Block Diagram for Control of PMSM

The magnetic field strength B_A, B_B, and B_C received by armature coil current of each phase I_A, I_B, and I_C and the rotary torque T_A, T_B, and T_C can be shown as:

(8) $T_A = K_A B_A = K_m B_m \sin$

(9) $T_B = K_B B_B = K_m B_m \sin^2\left(\theta + \frac{2}{3}\pi\right)$

(10) $T_C = K_C B_C = K_m B_m \sin^2\left(\theta + \frac{4}{3}\pi\right)$

其中K為比例常數。TA、TB與TC分別為三相之電流與轉子之永久磁鐵所產生之扭矩，其合成扭矩T可表示為

Where, K is a constant, and T_A, T_B, and T_C are torques formed by the currents of the three phases and the permanent magnet of rotor. The composite torque T can be represented as:

(11) $$T = T_A + T_B + T_C = \frac{3}{2} K_m B_m$$

各相電流(phase current)、電樞線圈所受之磁場大小、產生之轉矩、與馬達之相對位置可參考圖5。由(11)式可得知，如果經由相位同步器(phase synchronizer)使得相電流(如$I_A = I_m \sin\theta$)與相對應之磁場(如$B_A = B_m \sin\theta$)保持同步，則合成扭矩T與轉子之角度θ無關。由(11)式可知K為定值，Bm為轉子永久磁鐵之磁場強度亦為定值，因此T正比於各相電流之振幅Im，由此可知，控制Im的大小，即可控制馬達所產生之扭矩。

Figure 5 can be referred to phase currents, size of magnetic fields on the armature coil, torque generated, and relative position to the motor. From formula (11), it can be found that if phase currents (such as $I_A = I_m \sin\theta$) and its corresponding magnetic fields (such as $B_A = B_m \sin\theta$) are synchronized by a phase synchronizer, the composite torque T does not relate to the angle of the rotor θ. It is also found from the same formula that as K and B_m, the strength of the magnetic field of the rotor's permanent magnet, are both constants, T is in positive correlation with the amplitude of vibration I_m. As is seen the torque formed by the motor can be controlled by cintrolling Im.

高速永磁同步馬達的設計概要

The Designing Principles of High Speed PMSM

介紹完永磁同步馬達的動作原理後，這邊要來談一下高速永磁同步馬達的設計概要，永磁同步馬達主要是由兩部分組成：定子及轉子，定子通常是由矽鋼片和三相線圈組成，轉子是由稀土類磁石組成，因此永磁同步馬達轉子沒有銅損，由於稀土類磁石具有高能量，所以永磁同步馬達具有高功率密度及轉矩。

After introducing the working princioles of PMSM, the designing principles of high speed PMSM will be discussed in this part. PMSM is mainly formed by two parts: stator and rotor. The stator is usually composed of silicon steel sheets and three phase winding; the rotor is made of RE magnets, so there is no copper loss for rotor of PMSM. As RE magnets contain high energy, therefore PMSM has high power density and torque.

一般來說，應用在主軸的高速永磁同步馬達需要的是高功率，因此在繞線上跟一般馬達會有點不同，最主要的差異在於電流密度，就馬達定子繞線方面，主要的熱能來源就是電流密度，假使電流密度越高，就會產生越高的熱能，一旦熱能帶不走就會導致溫升過高，由於主軸永磁馬達的電流密度都很高，因此一定要加裝水冷系統以帶走熱能。

Generally speaking, what is needed in high speed PMSM spindles is high power, so there will be more differences in winding than normal motors. The main difference is in the density of the current for winding in the motor stator, the main heat energy source is the density of the current. If the density gets higher, more heat energy will be generated, and if this energy cannot be carried away it will lead to overheating. As the current densities for PMSM in spindles are all very high, installation of water cooling systems are essential to take away the heat energy.

高速主軸通常應用轉速都很高，根據公式 $n=120f/p$，轉速n是和頻率f跟極數p有關，因此轉速要越快頻率就要跟著變高；根據(12)式來看，頻率和鐵損是成正比的，一旦頻率變高鐵損也會跟著變高進而導致效率變低，因此為了防止鐵損過大，選用矽鋼片時最好選取35mm等級以下的鈔鋼片。

High speed spindles are usually operated at high speed According to the formula $n=120f/p$. The speed n relates with the frequency f and pole number p. In order to get higher speed, the frequency needs to be raised. Based on formula (12), the frequency is in positive correlation with iron loss, therefore higher frequencies result in greater iron loss which lowers the efficiency. To prevent excessive iron loss, it is better to choose silicon steel sheets of the 35mm level or below when purchasing silicon steel sheets.

(12)

對於永磁同步馬達來說，在

$$P_{iron}=\left[k_h B_m^2 f+\frac{\pi^2\sigma d^2}{6}(B_m f)^2+k_e(B_m f)^{3/2}\times 8.76\right]k_f\times\frac{1}{v}$$

高轉速的應用下會有一個很大的問題：磁石飛脫問題，這是設計者必須要克服的，為了克服磁石飛脫，解決辦法就是在使用套管(sleeve)包覆在磁石表面，增加其機械應力。套管的選擇除了考慮其成本以外，不同的套管材料也要考慮其導電率所造成的磁場變化和渦流損，這會影響轉子的溫升並且造成熱伸長和效率降低。

The magnet flying off is a huge problem for PMSM and an obstacle for the designer to overcome. To prevent the magnet from flying off, the motor isoften retained within sleeves.When choosing sleeves, besides cost consideration, the change of magnetic fields and eddy current loss caused by the conductivity of different materials for sleeves also needs to be taken into account. These factors can affect the temperature rise of the rotor and create thermal expansion and lower the efficiency.

低震動與低噪音是主軸馬達主要訴求之一，因此如何降低馬達本身的震動與噪音，也是馬達電機設計者必須要考慮的一環；對馬達來說，會造成馬達震動的原因有很多種，其中很重要的一個就是頓轉轉矩(cogging torque)；當永磁馬達沒有通入電時，欲轉動馬達會感受到一波波突兀的 順暢轉矩，此現象稱為頓轉轉矩。頓轉轉矩產生之主因為永久磁石與定子齒部間的吸引，因此設計應用於主軸的永磁同步馬達，低頓轉轉矩是必要的條件，至於怎麼降低頓轉轉矩就要看設計者的想法，可以藉由選配槽極數或是將磁石斜型等…方法來降低頓轉轉矩。

The main demand for spindle motors are low vibration and low

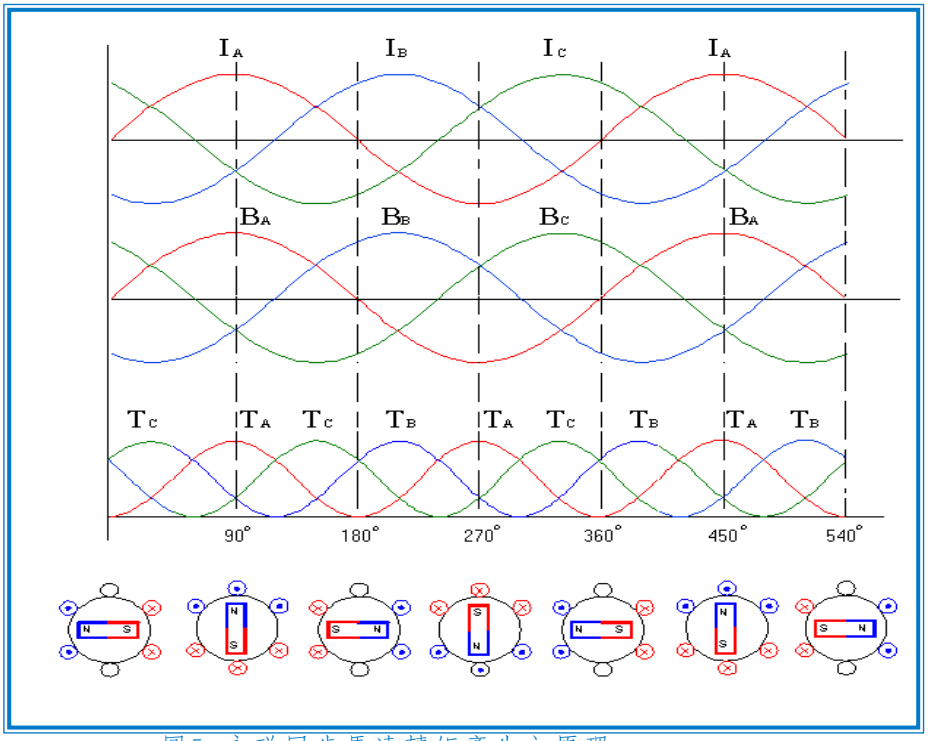


圖5 永磁同步馬達轉矩產生之原理

Figure 5 The Theory of Torque Forming in PMSM

noise. Therefore, eliminating the vibration and nose of the motor itself is a point of concern for motor designers. There are several causes which lead to motor vibration and amongst them. If the PM motor is set in motion without input current the periodic waves of rough torques can be felt, and this type of torque is called cogging torque. The main reason for cogging torques is due to the interaction between the permanent magnet and the stator's teeth. Thus lowering cogging torques is a necessary condition when designing PMSM. How to lower cogging torques depends on the designer ; it can be lowered with methods like choosing the number of slots and poles or skewing the magnet, etc.

恩德永磁同步馬達的發展與未來

The Development and Future of Anderson's PMSM

目前國內生產和研發高速主軸用永磁馬達的廠商少之又少，為了因應市場需求，恩德決定自己開發永磁同步馬達，目前已經針對PCB和玻璃磨削產業應用開發出六萬轉高速永磁馬達，圖6為此高速永磁同步馬達的外觀圖，其詳細馬達規格如表三所示。新開發的永磁同步馬達跟廠內現有的六萬轉感應馬達比較起來，在相同馬達外徑下，永磁同步馬達所產生的功率(2.7 kW)是感應馬達(1.2 kW)的兩倍多，證明了永磁馬達具有更高的功率體積比。

At present there are very few manufacturers who produce and develop PM motors for high speed spindles. To respond to market demands, Anderson has decided to develop PMSM on its own. 60,000 rpm high speed PM motors have already been developed for PCB and glass cutting industries. Figure 6 is the outward appearance of the high speed PMSM, and its specifications are shown in Table 3. When compared to existing 60,000 rpm induction motors, the newly developed PMSM can produce more than double the power (2.7 kW) of the existing models (1.2 kW) with the same outer motor diameter. It proves that PMSM has a higher power-volume ratio.

搭載此高速永磁同步馬達的主軸具有較高的扭力和更好的控制響應，因此只要再搭配編碼器(encoder)，主軸就可以進行剛性攻牙，此外，由於永磁馬達具有較短的加減速時間，對於換刀頻繁的加工場合來講，整體加工時效上會更有效率。

Spindles with this high speed PMSM have higher torque and better control response, thus the spindle with can perform rigid tapping. As PM motors have shorter acceleration and deceleration time, it can have a better

efficiency in processing time as a whole for processing works that require frequent changes of blades.
此高速永磁同步馬達是恩德首次投入馬達電機領域，可以算是一個新的里程碑，未來會針對其他產業別需求開發所使用的馬達，以達到機械、電機上下垂直整合，使得恩德產品更具有競爭力。
This model of high speed PMSM is Anderson's first step into the field of motor and a new milestone for the company. In the future more motors will be developed for industrial needs . It will reach the perpendicular integration of machinery and electrical machinery, and make the products from Anderson Group more competitive.

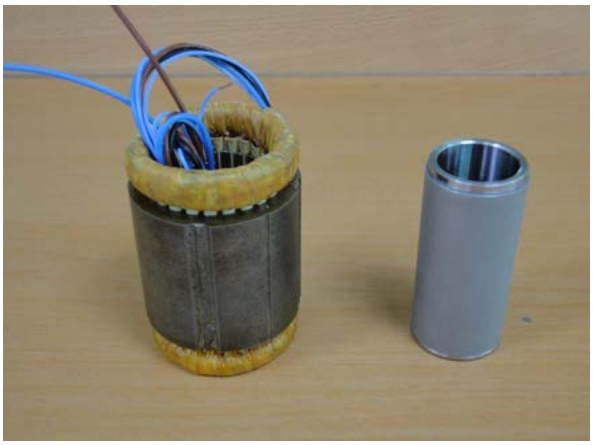


圖6 高速永磁同步馬達外觀
Figure 6 Appearance of PMSM

馬達參數 Motor parameters	尺寸 Size
驅動電壓 Drive voltage	184 V
驅動電流 Drive current	11 A
額定功率 Rated power	2.7 kW
額定轉速 Rated rotation speed	60000 rpm
冷卻方式 Cooling method	Water cooling
馬達外徑 Motor outer diameter	48 mm

表三 高速永磁同步馬達規格表
Table 3: Specifications of High Speed PMSM

淺談雷射機在導光板模仁的新運用

An Overview on New Applications of Laser Machinery on Light Guide Panel Cores

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一、前言
1. Forewords

雷射產業按國際慣用的分類方法，將雷射產品分為雷射加工、醫療、印刷、光存儲，測距、檢測、文教娛樂中的各種雷射儀器和設備，雷射元件和通信用雷射組件，以及雷射用材料和零件等11類。雷射產業可說是光電產業的核心技術，雷射技術的應用領域，如雷射醫療及雷射檢測方面美國占首位，美國也是最早將高功率雷射引入汽車工業的國家，在雷射材料加工設備方面，德國則走在世界先端。

The international laser industry categorizes laser products into eleven fields which include laser processing, medical, printing, light storage, measuring, testing, educational and entertainment laser instruments and equipment, laser components and communication laser parts, and laser materials and parts. The laser industry is the core of the electro-optic technology. The United States lead the field of laser technology application, such as laser medical treatment and laser measuring, and where the first to implement high power laser into the motor industry. Meanwhile, Germany leads the way when it comes to laser material processing equipments.

雷射技術應用可分為雷射能量應用及雷射信號應用二部份，而在雷射能量應用中也以中功率之CO2、Nd-YAG雷射為主要光源，以雷射光為工做製程之基礎研究及製程發展。在工業上之應用除了 傳統工業外也擴展到微電子、微光學及微系統等範疇。工作範圍從基礎研究、加工程序、設計之最佳化乃至於製程設備之裝配及操作。而在雷射訊號應用方面之發展重點為工業通訊及醫療上之應用。而恩德集團的雷射技術應用著重在雷射能量運用，也就是運用CO2、Nd-YAG雷射光為載具去做光路的設計及產品製程的發展研究，目前所應用的雷射機台，有壓克力板雷射切割機，太陽能設備的劃線機(LASER SCRIBING)，LCD導光板模仁雷射打點機，軟性電路板雷射切割成型機等，未來還會運用在觸控玻璃基板的切割及陶瓷基板的鑽孔等設備。

The application of laser technology can be divided into laser energy applications and laser signal applications. In laser energy applications, mid power CO2 and Nd-YAG lasers are used as the primary light source and laser light

is used as the tool in fundamental research and processing development in manufacturing processing. Industrial laser application have broadened from traditional use to microelectronics, micro-optics, and micro systems. The works range from fundamental research, processing procedure, optimizing design to installation and operation of manufacturing processing equipment. On the other hand, laser signal applications are mainly in industrial communication and medical usage. The laser technology of Anderson Group focuses on laser energy application, which is using CO2 and Nd-YAG laser lights as vehicles to design optical paths and research for manufacturing processing development. Currently, laser have been used in machines such as acrylic board laser cutters, solar equipped laser scribing, LCD light guide panel core drilling machines, and laser cutting and forming machines for flexible printed circuit board. There are future plans for applying laser technology in cutting of glass touch substrates and drilling of ceramic substrates.

二、導光板之應用及發展趨勢

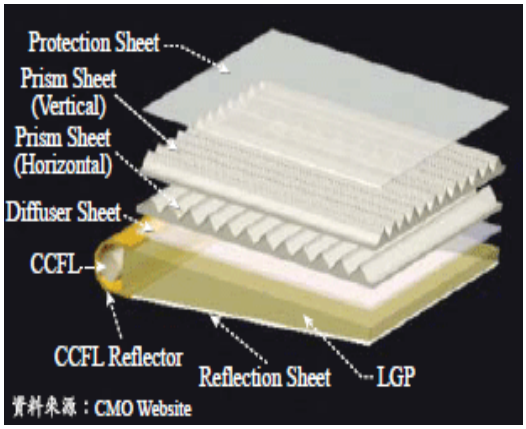
2. The Application of Light Guide Panels and Developing Trends

導光板(Light Guide Panel)為背光模組的關鍵零組件，目的在於導引光線方向成為平面出光，以達到高輝度與高均齊性。隨著平面顯示器的輕薄化與對亮度與解析度的提升，導光板微結構的尺寸要求到微米等級，造成模仁加工的困難，由於LCD之使用量日增，其影響顯像品質甚鉅之背光模組也就顯得更加重要。高亮度是TFT-LCD非常決定性的要求項目。近兩年來，由於液晶顯示器及行動通訊的大量需求，使大尺寸TFT-LCD及中小尺寸平板電腦面板製程技術不斷被引進台灣。背光模組主要負責LCD顯示器中的光源射出功能，由導光板及燈管等零組件結合而成，背光模組加上控制光線的LCD面板後，即可組成一個LCD顯示器。背光模組中，又以導光板最重要，因為它是控制光線是否能均勻發散出去的關鍵。國內目前超過三十多家廠商先後投入背光模組相關元件的製造，是所有關鍵零組件中自給率最高的。側光式LED背光模組於液晶面板背面設置導光板，LED之光線由導光板的端面入射至導光板內，均勻擴散後再從導光板表面射出。由於LED光源亮度大幅提高及導光板加工技術的進步，目前側光式LED背光模組如圖一所示，儼然已經成為市場主流。[1]

Light guide panels are key components of LCD back light modules. They are used to guide the direction of light into plane luminescence, achieving high brightness and homogeneity. As flat panel displays decrease in thickness and increase in brightness and resolution, the demand for the size of light guide panel microstructures has reached the micrometer level and the difficulty of core processing has risen. As the usage of LCD increases by the day, back light module, which plays a key role in resolution quality, proves to be very important. High brightness is a critical demand for TFT-LCD. In the recent two years, due to the mass demand of LCD and mobile communication, manufacturing technologies of large sized TFT-LCD and medium to small sized computer tablet PC panels have been continuously introduced to Taiwan. The light guide panel is the most important in back light module, as it is a key to controlling the balance of light emission. More than 30 manufacturers are engaged in producing back light module related parts and these parts show the highest degree of self-sufficiency of all key parts. Light guide panels are installed at the back of the LCD panels on edge-lit LED back light modules. The light of the LED shoots into the light guide panel from its end plan, spreading evenly then shooting out from the surface of the light guide board. As the brightness of LED light source has vastly increased and the processing technology of light guide panels has improved, edge-lit LED back light modules have become the main stream of the market, as shown in figure 1. [1]

現行導光板大多利用塑膠射出成型的方式來製作，結構上大概為2.0~0.6mm的壓克力板，當背光技術趨勢逐漸朝向利用LED作為背光源的時候，相對的導光板生產技術也隨之困難。因為當背光源體積縮小，在顯示產品有可能變得更輕薄的機會下，導光板自然也要跟著變薄，才能達到輕薄的目的。目前，能夠實現低成本、且符合現在與未來規格之極超薄導光板的生產製造技術陸續發表出來，過去這項技術是利用透過微鏡片和透明樹脂材料所組成的射出成型技術來實現。目前包括韓國三星、壽喜精密、日本宮川、日本歐姆龍、荷蘭Modilis等業者開始利用新技術，如噴墨或熱壓印成型

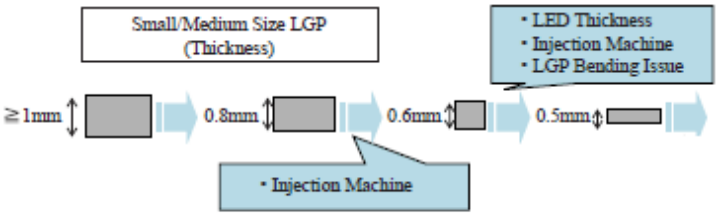
的方式，生產新一代的薄型導光板，但是不管是材料還是技術都面臨諸多問題尚未解決。現有一般中型尺寸導光板厚度約為2.0~1.0mm左右，但隨著市場趨勢與技術的要求，導光板厚度已經逐漸薄化達到0.8~0.6mm。未來隨著LED背光源模組日益成熟，依應用尺寸與產品之需求，導光板厚度可薄到0.5~0.1mm，甚至可稱之為導光膜，導光板之厚度演化趨勢(如圖二)。由於厚度突然變薄，這在導光板成型方面將會出現一些問題，若期望以傳統的射出成型技術完成薄型導光板，那麼在設備上就必須改用高射速的射出成型機才行，而且其成型的厚度也有極限，依目前的射出成型而言，十多吋的導光板0.5mm已經接近極限



圖一 側入光式背光模組示意圖
Figure 1: A diagram of an edge-lit back light module

值。所以，對於背光模組業者就必須不斷地追求更新的導光板製作技術，來生產可量產低成本、且符合現在與未來規格的導光板。[2]

Currently most of the light guide panels are made by plastic injection molding, and the structure mainly consists of acrylic boards of 2.0~0.6mm. As back light technology tends to use LED as its back light source, the manufacturing of light guide panels becomes more difficult. This is because when the size of the back light source decreases



資料來源：光電科技協會

圖二 側光式導光板之厚度演化趨勢圖
Figure 2: The evolution of thickness of edge-lit light guide panels

to display the product's ability to decrease in thickness, the light guide panel has to also decrease in thickness to reach the goal of the whole product. However, as manufacturing technologies of ultrathin light guide panels that are low in cost and meets current and future standards can indicate, this type of technology has been using injection molding of micro-lens and transparent resin. Some manufacturers, such as Samsung of Korea, Kotobuki(壽喜精密), Miyakawa, and OMRON of Japan, Modilis of Netherlands have started using new technologies such as inkjet or heat press molding to produce new thin light guide panels, but there are many unsolved problems in both material and technology. The current thickness of a medium-sized light guide panel is about 2.0~1.0mm, but the thickness of light guide panels has degreased to 0.8~0.6mm as a result of market trends and demands in technology. As manufacturing of LED back light modules develops, the applicable and demanded future size of light guide panels can go down to 0.5~0.1mm and can even learn them the name light guide coating. The evolution of thickness of edge-lit light guide panels is shown in figure 2. Due to the sudden decrease in thickness, some problems will arise in light guide panel molding. If we wish to make thin light guide panels with traditional injection molding, we need to be equipped with an injection molding machine of high injection speed; even so, there is a limit to the thickness of its products. Currently, 0.5mm is close to the thinnest that can be made from injection molding for a light guide panel of over 10 inches. Therefore, back light module manufacturers have to continue in pursue of new light guide panel manufacturing technologies to produce cost efficient and standard meeting light guide panels. [2]

三、導光板模仁雷射加工機規格要求
3. Specification Demands for Light Guide Panel Core Processing Machines

導光板射出用高定位精度金屬模仁的製造技術主流有二，一為精密光蝕刻技術(LIGA)，另一為精密電鑄技術(Galvanoformung)。新近發展之微結構V-CUT加工技術由於難度和精度過高，目前還是以中小尺寸(10吋以下)面板之應用為主，大尺寸(10吋以上)應用部份則尚未成熟。而目前恩德集團所生產的雷射加工機應用於導光板加工的有中小尺寸(22吋以下)及大尺寸(65吋)的導光板模仁加工，特別著重於鋼板模仁加工，模仁加工的重點在孔形、孔徑、深度及網格均勻性的控制。

There are two main streams for high location accuracy metal cores for light guide panel injection. One is LIGA and the other is Galvanoformung. The newly developed micro structure V-CUT technology is very difficult and too high in accuracy, and are therefore mainly used for medium to small sized panels (below 10 inches) and not deemed mature for use in large sized panels (10 inches or larger). The laser processing machines produced by Anderson Group are currently used for light guide panel processing of medium to small sized panels (below 22 inches) and large sized panels (65 inches) with a focus on steel sheet core processing. The main points of core processing is the shape, diameter and depth of the holes and the control of structure balance.

導光板模仁雷射打點機台加工鋼板性能規格有以下幾點要求：

The following are required for specifications of steel sheets used on light guide panel core laser drilling machines:

1. 雷射打點鋼板不可有接圖痕跡及掉點現象，再由射出或熱滾壓導光板模組點燈判定，打點區塊不能有亮暗不均。

The steel sheet for laser drilling cannot contain machined traces or dripping and shall be judged by lighting injection or heated-rolled light guide panel module. The brightness needs to be balanced for the area to be drilled.

2. 有效打點行程必需大於65吋，16：9(1440 x 810mm)；16：10(1400 x 875mm)；21：10(1440 x 685mm))。

Effective drilling procedures have to be larger than 65 inches, 16：9(1440 x 810mm)；16：10(1400 x 875mm)；21：10(1440 x 685mm)).

3. 使用65吋以上鋼板，將鋼板分割標示成二十五點，此二十五點為測試雷射打點DOT直徑(包含火山口部分)及深度。

Use steel sheets of 65 inches or above, divide and mark 25 points on the sheet. These 25 points are for testing the DOT diameters (including crater) and depth for laser drilling.

4. 測量二十五點雷射打點DOT直徑及深度，以直徑為50um與深度為5um當做基準，其直徑誤差在平均值±5um之內，深度誤差在平均值±0.5um之內為合格(25點中有1點NG為容許範圍)。

Test the laser drilling DOT diameters and depth for the 25 points with the standard diameter of 50 um and depth of 5um. It is qualified if the inaccuracy is within ±5um for the diameter and ±0.5um for the depth. (1 failure out of 25 points is within acceptable range.)

5. 在同一試片加工的相對定位精度須在±5um之內為合格。

The relative location accuracy on the same test sheet needs to be within ±5um.

6. 兩片鋼板於不同天打樣，相同雷射參數，圖檔及打點條件，必滿足上述條件(4及5)

If two sheets are tested on different days with same laser parameters, image and drilling conditions, the above requirements (4, 5, and 6) need to be met.

7. 雷射打點持續作動時間至少能維持三天，因為佈點圖檔約7200萬點，且加工後需滿足上述條件(4、5、6)

The laser drilling procedure needs to be able to continue for at least three days as a dot image contains around 72 million dots. Also, the above requirements (4, 5, and 6) need to be met after processing.

8. 雷射打點過程中，鋼板不加膠帶固定時，不能有位移及吸力不足的情況發生，且鋼板經由雷射打點後背面不得有變形現象發生。

During the laser drilling process, if the steel sheet is not fixed with tape, there cannot be occurrences of shifting or lack of suction, and the back of the sheet cannot be bent through the process.

9. 鋼板尺寸為1462x844x0.3mm，材質為SUS304，雷射打點機台平面精度需要在±25u之內為合格。

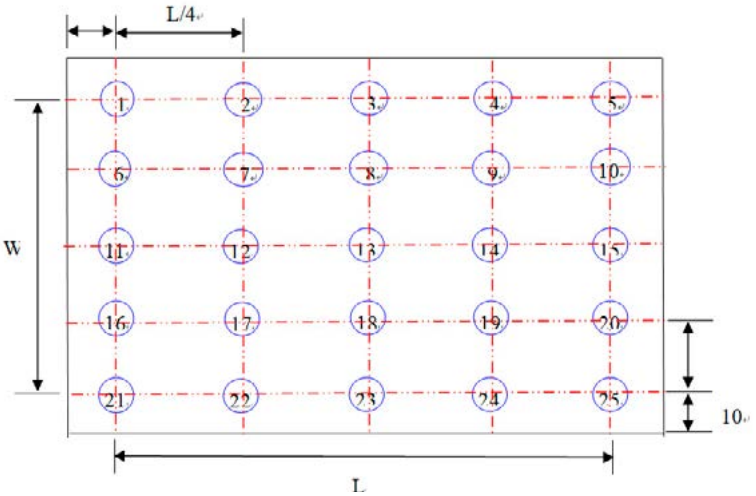
9. The size of steel sheet made of SUS304 is 1462x844x0.3mm. The qualified plane precision of LCD light guide panel core drilling machines shall be at ± 25u.

四、導光板模仁雷射機加工方式
4. Processing Method or Light Guide Panel Core Laser Machines

導光板模仁雷射機加工步驟為，首先由客戶提供佈點圖檔(通常由客戶光學設計部門提供)，佈點設計是為使導光板所導引的光產生散射以致能平均地透射出導光板表面。然後經由轉檔程式讀檔，並將雷射打點的圖檔作參數設定並轉檔(會有一個txt檔索引檔，其他則是dxf檔案，如附圖四)，開　主程式先讓機台作歸零動作(如附圖五)，然後將要打的鋼板放入加工台面吸真空固定(需將鋼板放於承靠邊)，讀入txt索引檔並試打，依照紅光調整位置作CCD定位，然後雷射enable，雷射經由光路及掃描鏡(laser scanner)，依循步驟開始作鋼板打點(如附圖六)。加工後其中1/25的孔型、孔徑、深度如附圖七所示。

孔徑約為52.01um，深度約為5.17um。(符合客戶規格要求)

The procedure of processing for light guide panel core laser machines is as following: First, the client offers the dot image (usually made by the optical design department of the client). The design of the dot distribution is to spread the light guided by the light guide panel so it can shoot out of the surface of the light guide panel evenly. Then read the file with the file converting program, set the parameters for the image for laser drilling, and convert the file (there will be one index txt file and the rest will be dxf files, as in figure 4). Open the main program and first set the machine back to origin (as in figure 5), and insert the steel sheet to be drilled onto the processing platform and fix position by vacuum (the sheet needs to be placed against the edge). Read the txt index file and perform trial drills, adjust the position according to the red light for CCD positioning, then enable laser. The laser will pass through the optical path and the laser scanner and begin drilling the steel sheet following the procedures (as in figure 6). After the processing, the shape, diameter, and depth for 1/25 of the total holes will be shown as in figure 7. The diameter is about 52.01um whereas the depth is about 5.17um (meeting the client's requirements).and depth of drilled holes



圖三　鋼板測試示意圖
Figure 3: Diagram for steel sheet testing

五、導光板模仁雷射加工機的推廣
5. Promoting Light Guide Panel Core Laser Machines

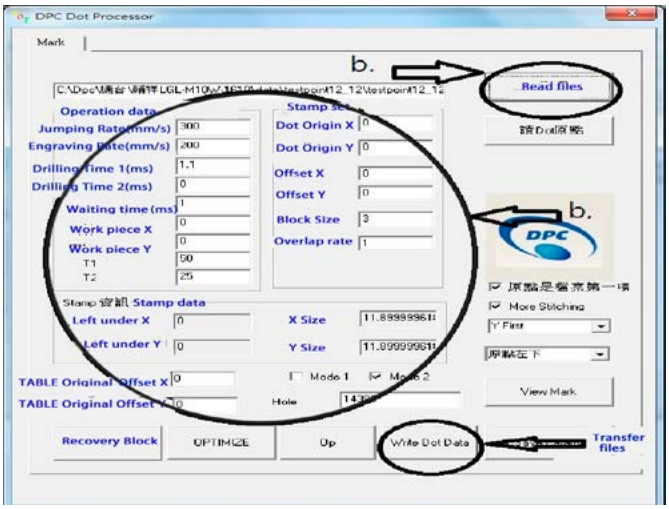
全球導光板廠來看前五大廠市占率約66%，除奇美實業為台廠外，其餘四家為日系廠，其中在LED TV導光板方面，Mitsubishi Rayon為日系TV廠的主要供應商。

The top five manufacturers currently hold 66% of the global light guide panel market share. Chi Mei Corp. is Taiwan based and the other four are Japanese, with Mitsubishi Rayon being the main supporter for Japanese TV factories.

而在台系廠布局方面，除了奇美實業外，輔祥具導光板設計能力，且轉投資輔德高分子已開始量產光學級塑膠粒PMMA，有助於其降低導光板之原料成本，但其生產之導光板為自用，故不會顯現在營收上。華宏2010年新增側光LED TV導光板產品線，由輔祥設計，華宏負責導光板裁切、拋光、印刷，預估此產品線可占其今年營收比重4%[3]。目前恩德集團所生產的導光板雷射加工打點機，屬於較新的製程，需配合後段熱滾壓機做滾壓使形成導光板，目前已成功的切入中小尺寸LED導光板廠如羚洋及大尺寸TV導光板廠如輔祥等(如圖八所示

)，展望未來此類設備還是需要和大廠來做結合，配合他們的生產製程做機台修正，並了解製程的應用，使此設備結合製程參數，將其機器性能發揮到最佳狀態，然後再將其設備放大推廣到其他生產導光板廠商，這樣才能將機台的效益發揮到最大。

As for Taiwanese makers, besides Chi Mei Corp., Forhouse has the ability of designing light guide panels, and its investment Evonik Forhouse Optical Polymers Corporation has started producing PMMA which helps reducing the material cost of light guide panels. However their light guide panels are made only for their own usage so it will not reflect in their revenue. Wahhong has introduced its product line for edge-lit LED TV light guide panels with Forhouse designing and Wahhong cutting, polishing, and printing the panels. This product line is estimated to take up 4% of the year's earning.[3] The light guide panel processing drilling machine produced by Anderson Group is a new manufacturing process and has to operate in coordination with heated rolling machines for molding. These machines have successfully made their ways into medium to small sized LED light guide panel factories such as LEDyoung and large sized TV light guide panel factories like Forhouse(as in figure 8). In the future, these types of equipments needs to combine with large manufacturers and make adjustments in accordance to their manufacturing processes, understand the application of the manufacturing processes so that the machine binds well with parameters of the manufacturing and can carry



圖四　轉檔程式　Figure 4: File converting program

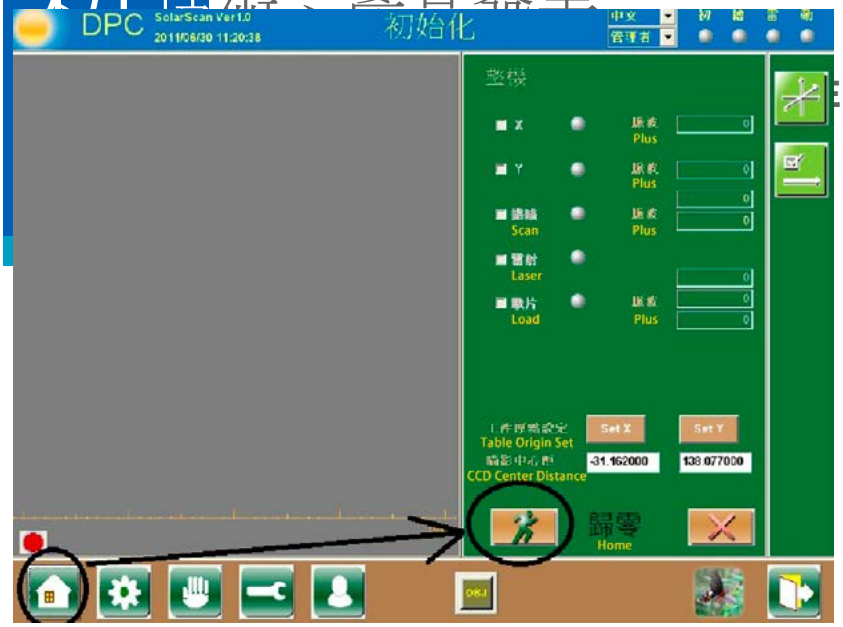
out its functions to the largest possible extent. Then elaborate the equipments and promote them to other makers of light guide panels and further maximize the benefits the machines can bring.

六、結論
6. Conclusion

液晶面板的光源來自於背光系統，背光模組功能在提供模組光源，其性能的好壞會直接影響液晶面板的顯像品質，其價值及重要性僅次於彩色濾光片。在減輕重量、降低模組厚度與降低成本的多重目標下，背光模組業界多極力發展一體化導光板的設計、製作技術，將擴散片，稜鏡片等的功能整合到導光板之中；亦即在導光板上、下兩面均製作微結構，使光能均勻地自導光板表面射出，且具有適當程度的方向性，在不降低亮度要求下，將模組構造簡化，精簡光學膜數，提供正面輝度[4]。

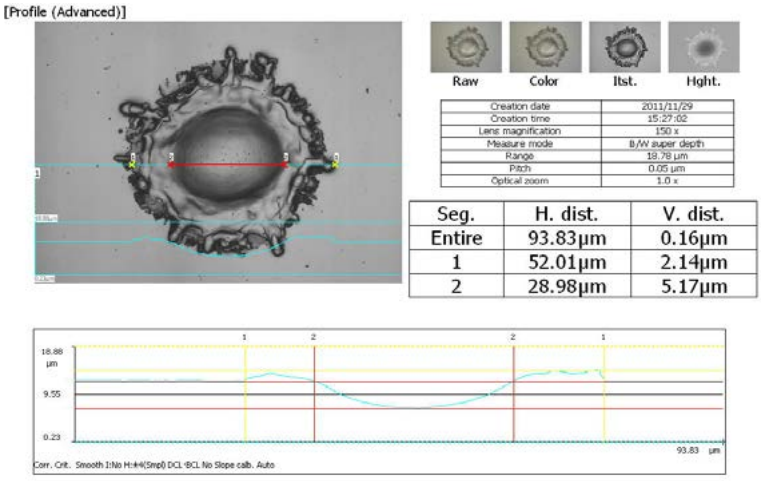
The light support for LCD panels comes from back light systems. As a back light system supplies light sources for modules, its quality can directly affect the resolution quality of LCD panels, and its value and importance are next to the color filter. Under the multiple pressure of losing weight, decreasing thickness, and lowering cost, most parts of the back light module industry are putting effort into developing design and manufacturing skills of integrated light guide panels, integrating functions of diffusers and prisms into light guide panels. In other words, making microstructures on both sides of the light guide panel to ensure light shoots out evenly from the surface of the panel with accurate direction. The aim is to simplify the structure of the module without lowering brightness and to provide front brightness with as few optical coatings as possible.

在提高正面輝度之訴求下，目前導光板的製作技術以非印刷式為主流，其係以蝕刻 (Etching)、電鑄薄板 (Stamper) 與微溝加工 (Slot-cut) 等方式在精密模具上形成圓點陣列或長溝形陣列微結構，再利用射出成形製程製造出符合光學設計特性的導光板。但目前上述的技術都各有其優缺點，包括會造成在製作模具時鑽石刀具容



圖五　機台歸零 Figure 5: Setting the machine back to origin

圖六　讀檔開始打點　Figure 6: Drilling begins for the opened file



圖七　孔型、孔徑、深度量測圖　Figure 7: The measurement for the shape, diameter,

易在過程中斷裂，且利用光罩設計模具時，會使模具的費用變的相當昂貴且費時，且不易多樣化及大尺寸生產。所以目前利用雷射打點加工，藉由雷射特性及光路的設計，可調整雷射的功率、頻率、速度及打點網格大小，去控制雷射打點的孔型、孔徑，深度及網點密度。藉由光學之不同佈點設計，可使鋼板經由雷射打點熱轉印及點燈後，在正面輝度與提高光均勻度的表現較為理想，且可以多樣化及做大尺寸面板的生產，通常據客戶所提供的資料，一片鋼板可以熱轉印約 1 萬片左右，進而降低生產成本。故此新製程目前正在被導入及生產中，若能藉由控制雷射特性及光學佈點密度的大小，減少導光板內之光折射損失，提高光利用率，使利用雷射加工製作的導光板產品產生差異化，若能如此，此新製程及設備後續的效益是可預期的。

Under the command of raising front brightness, the current main stream of light guide penal producing technology is the non-printing type, using etching, stamping, and slot-cutting to form microstructures with patterns of dots or channels on precise modules, then utilize the injection molding method to produce light guide panels which fit the characteristics of optical design. All above techniques are with merits and demerits, including diamond cutters snapping when making the module, and the use of TMA to design modules making the process costly and time consuming, along with the difficulties of variety and large sized production. Therefore the processing method using laser drilling can take advantage of the special features of laser and the design of light routs and adjust the power, frequency, speed of the laser and the size of grids when drilling, and

中小尺寸(工作行程:450x550 mm)Medium to small size(Work procedure: 450x550mm)

大尺寸(工作行程:1600x1000 mm)
Large size (Work procedure: 1600x1000mm)

圖八 機台外觀圖 Figure 8: The exterior of the machines

control the shape, diameter, depth, and density of holes. Using different dot distributions of optics, the steel sheet can perform optimal front brightness and light balance after laser drilling, heated rolling, and lighting. Varieties and large sized manufacturing also become possible and the cost can be lowered as based on information offered by clients, one steel sheet can be heated rolled into 10,000 pieces. Thus, this new manufacturing process is being introduced and operating. If the light lost in reflection within the light guide panel can be reduced by controlling the characteristics of laser and the density of optical dot distribution, and the light usage rate can be raised, a difference can be made by these light guide panels manufactured by laser processing. If this can be achieved, future benefits of this new manufacturing process and its equipments can be anticipated.

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板類市場在亞洲的崛起和恩德的機會
The Rise of Furniture Board Market in Asia and Opportunity of Anderson

近年來製作家具的材料由傳統的實木變成夾板、木心板、密底板、塑合板或 OSB 板，就如同房子由以前的平房變成樓房到高樓大廈，是無法避免的事實，除非人口大幅減少或者可居住 / 耕種土地大量增加又或者樹木成材的樹齡大幅減短（通常可做家具之樹木樹齡至少需 30 年以上）。

In recent years, the major material used to manufacture furniture changes from solid wood to plyboard, lumber core plyboard, medium density fiber board (MDF), particle board or oriented standard board (OSB). It is just like the building changes from a single-story house to a skyscraper, which is an unstoppable trend unless human population decreases dramatically, livable/cultivable land increases hugely or the time a tree for a useful timber is reduced greatly. (Ordinarily, it takes more than 30 years for a tree to grow big enough for furniture making.)

但這好像都是痴人說夢，唯一比較可行的是”小樹就可以做家具，其方法為將樹木打碎做成塑合板 (particle board) 或切成細條做成 OSB 板 (oriented standard board)，然後再做成家具，所以板類家具的崛起，將成為不可違逆的事實。特別是：可指定功能、尺寸、配色並於現場組裝之客製化系統櫥櫃，必然漸漸成為市場主流。

Nevertheless, these are unrealistic. The alternative idea “using small trees to make furniture” sounds more feasible. In this case, a tree is broken into pieces to make a particle board or shredded into strands to make an OSB, and then we use this board to make furniture. Therefore, the rise of board furniture will be an unavoidable reality. Especially, a piece of custom furniture system which has custom function, size and color and can be assembled on site will become the mainstream.

說明 :Explanation:

1. 塑合板之原料通常是以實木家具剩餘之木屑或不再產膠之老橡膠木，或雜木林及人造針葉林木為主。

1. The materials used to make particle board usually are the chips left from making solid wood furniture, old oak trees which stop producing resin, mixed forest or artificial coniferous forest.

2. 定向粒片板 (OSB):oriented standard board
是將樹齡 3~5 年以上之樹木切成長條細片，再交叉編織貼合作成，板材結構承重效果佳，但表面粗糙；目前市面上較少使用，IKEA 有推出此類家具。

2. Oriented standard board (OSB): The over 3~5 year old trees are shredded into strands first, and these strands

can be crisscrossed and bound to form an OSB. The weight-bearing ability of OSB is good, but its surface is rough. It is rarely used in the market. IKEA has this kind of furniture made of it.

板類產品運用的主要領域
Major Applications of Furniture Board

板類家具顧名思義為，以板材為材料所製成的家具，目前市面上較常使用作為家具之板材有：木心板、夾板、密底板、塑合板、空心板、定向塑合(OSB)板、蜂巢板、發泡板..等，運用領域大約可分類為：

Board furniture, as implied by the name, is made of board. In the current market, the most used boards in furniture includes lumber core plyboard, plyboard, medium density fiber board (MDF), particle board, hollow slab, oriented standard board (OSB), honeycomb board, foaming board and so on. The applications can be categorized as:

原始森林 Virgin forest

A. 傳統板類家具
Conventional Board Furniture

於傳統噴漆家俱中亦使用大量之板材，通常以夾板貼合實木皮使用，但在低價的家具則以塑合板貼實木皮或MDF直接打型噴漆使用

Boards are commonly used in conventional lacquered furniture. The plyboards are usually bound with polly wood. But for low price furniture, the particle board bound with polly wood or MDF directly punched and spray painted are used.

銷售管道：銷售時通常均已組裝完成，以家具店為主要銷售管道。

Distribution channels: When it is put on sale, it has usually already been assembled. The main distribution channel is a furniture store.

B. 單元家具 / Furniture Units

通常以塑合板或空心板貼合PVC皮或紙皮為主要板料，再製作成酒櫃、鞋櫃、電視櫃、衣櫃、書桌、五斗櫃、書櫃…等單元家具。

Particle boards or hollow slabs bound with PVC veneer or paper skin are used as major boards to make furniture units like alcohol cabinets, shoe cabinets, TV cabinets, cloth cabinets, desks, 5 drawer cabinets, book cabinets, etc.

主要銷售通路：郵(網)購、大賣場，銷售時通常未組裝，由客戶自行載運並組裝，故亦稱為DIY單元家具。此類家具通常具有輕質、易搬運及價格大眾化之優點。

人造針葉速豐林
Artificial fast-growing coniferous forest

Distribution Channels: Mail order, online shopping and shopping mall. When being put for sale, it usually has not been assembled yet. The customers need to deliver it and assemble it by themselves. So, it is also called DIY furniture units. This kind of furniture usually has the advantages like light weight, being easy to deliver and bargain price.

另亦有單元系統櫃，其作法用料均與系統櫃相同，是系統櫃業者或家具公司設計整系列之家具，以現品模式銷售。

There is a system furniture unit as well. Its manufacturing and material are the same as system furniture. It belongs to a series of furniture designed by system furniture manufacturers or furniture companies and is sold in merchandise-in-stock mode.

以上單元家具均以批量製造生產，製造成本可控制。

Batch production is used to make the furniture units aforementioned, so the cost is controllable.

說明：Explanation:

空心板： 空心板通常以塑合板條為框架，作成日/目字形框架並於要鑽孔處再以框條補強，內部填充以保麗龍或蜂巢蕊填充(有時無填充)上下再貼合表面有貼合PVC或紙之3mm夾板製成。

Hollow slab：The hollow slab is usually made based on particle board trim outlined as 日/目 frame, using the frame trim to reinforce the drill holes. The inside space will be bound with Styrofoam or honeycomb core (sometimes without any of these fillings), sticking 3mm plyboards covered with PVC veneer or paper on both sides of it.

蜂巢板： 通常以已固化之蜂巢蕊上下貼合8mm之MFC板做成

Honeycombed Board：It is usually made of solid honeycomb cores with 8mm or MFC board binding on both sides of it.

MFC板：melamine face chip board 即以塑合板上下貼合美耐皿之板材

MFC Board：Melamine face particle board is the particle board with Melamine board binding on both sides of it.

C. 訂製系統櫥櫃

Order for System Furniture

通常以MFC板及蜂巢板為主要材料，銷售模式為：設計師到府丈量，並依客戶實際需要搭配各式櫃型及功能五金及外觀顏色，並產生3D效果圖，由客戶確認後，再交由工廠依圖製造生產，生產完成後，再到客戶處組合安裝，故系統櫥櫃是最具功能實用及方便性之家具。且因其可充分利用空間，故近年來市場成長頗為快速。

The main materials for making the system furniture are MFC board and honeycombed board. The following is the marketing model. First, the interior designer will come to client's place for measurement, selecting cupboard types, colors, and functions according to client's needs. And after the 3D illustration is generated and confirmed by the client, it will be sent to the factory for production. When the production is finished, the cupboard components will be sent to the client's place for installation. This is why system furniture is the most functional and convenient furniture.

And because system furniture can have full-use of the space, the demand from the market is growing fast in recent years.

板類生產的模式與設備介紹
Board ProductionMode and Equipment Introduction

通常市面上所稱之板類家具，均指不需使用傳統噴漆工藝所製造生產之家具，故於此只介紹依製造/生產方式可分：批量生產(計劃生產)及接單生產。

The term board furniture in the market is usually referring to the furniture manufactured without using traditional spray painting process. Here we only introduce you board furniture according to different production types, such as

以系統家具裝潢之更衣室
The dressing room decorated with system furniture
(相片來源:綠的家具網站)
(Picture source：Website of Green Furniture)

以系統家具裝潢之
The bedroom deco
system furniture
(相片來源:綠的家具網站)
(Picture source：Website o

DIY 電視櫃
DIY TV cabinet
相片來源:美傢家具網站
(Picture source：Website of Meicha Furniture)

DIY 四斗
DIY Four drawe
相片來源:美傢家
(Picture source：Website o

batch production (planed production) and make-to-order production.

批量生產(計劃生產)：通常使用於單元櫃製作或大型系統櫃連鎖店生產工廠

Batch production(planed production)：It is usually used to make modular cabinet or used by the factory of large-scale system furniture chain store.

優點：可大幅降低加工成本及可能提升板材利用率

Advantage：It can strongly lower the processing cost and increase the utilization rate of the board.

缺點：需有倉庫以置放成品庫存及有呆料之危險。

Disadvantage：It requires storehouses to store the stocks and there are risks of idle materials.

接單生產：即接到訂單才製造/生產

Make-to-order production：It means that suppliers manufacture/produce by orders.

板類家具不論批量或接單生產其主要生產流程均為：

Either batch production or make-to-order production, the manufacturing procedure of board furniture is as follows：

{設計/接單} {拆單/排版/備料} {裁板} [{定寸修邊/切溝} {貼邊}] {鑽孔} {清點/包裝/出貨}

{Design/order taking }à{order splitting /layout/material preparation }à{board cutting}à[{sizing and edge trimming /groove cutting}à{edge banding}]à{drilling}à{inventory /packaging/shipping}

說明 / Explanation：

拆單：將需生產之櫥櫃設計圖或手繪圖轉換成生產用材料清單，並計算出訂單所需之各式板材、五金配件、及各式功能配件之數量。

Order Splitting：This means to transfer the cabinet design or freehand drawing into the material inventory for production, and to calculate the amount of boards, hardware accessories, and other functional accessories that required in the order.

批量生產：因拆單次數少，且均為制式產品故不論以人工拆單或電腦拆單均無太大問題。當然以廚櫃軟體拆單可提升拆單效率及降低人為疏失。

Batch Production：It rarely requires order splitting, and the products are all standardized. Therefore, there should be no problem when using manual order splitting or computer order splitting. And, of course, using cupboard software to do order splitting can increase order splitting efficiency and lower the human error rate.

接單生產：因每張訂單所需製作之櫥櫃，尺寸、顏色、功能、數量均不相同，故如以人工拆單將浪費大量人力，且容易出錯。故以廚櫃軟體(如AutoWork)拆單將是最好選擇。

Make-to-order Production：Because of the differences in cabinet size, color, function and number from different orders, using manual order splitting will waste lots of human resources with errors occurring. Therefore, using cupboard software such as AutoWork to do the order splitting is the best choice.

排版：將拆單所得之需加工板材清單依板材顏色、厚度規畫出適合之裁版圖樣，並計算出大板材需求數量。

Layout: Map out suitable cutting pattern for process-needed board list from split order by the color and

臥室
orated with
f Green Furniture)

以系統家具裝潢之書房
The study room decorated with system furniture
(相片來源:綠的家具網站)
(Picture source：Website of Green Furniture)

櫃
er cabinet
家具網站
f Meicha Furniture)

DIY 書櫃
DIY Bookcase
相片來源:美傢家具網站
(Picture source：Website of Meicha Furniture)

thickness of board and calculate the required quantity of large boards.

批量生產：通常主要需求是裁板效率高，故最多只做2~3次(轉板次數)裁切之排版比較適當，以優化軟體排版(如G plan)並計算出大板材之需求數量，當然是最佳選擇。

Batch production: Due to the major main requirement of board cutting's high efficiency, it is more appropriate and of course the best choice to make layout with only 2 or 3 times (turning frequency of board) cutting top to optimize the software layout (such as G plan) and calculate the demand of large boards.

接單生產：因每張訂單之生產量很少，故可能需在一片大板材上裁切出所有尺寸之材料，故轉板4~5次裁切，亦屬正常。在需兼顧板材利用率下排出複雜之裁切圖樣，並算出大板材需求片數，對排版人員將是一大考驗，故利用排版軟體(如G plan)將是最佳選擇。

Make-to-Order Production: Due to the small amount of production of each order, all sizes may be needed to cut out from a large board; therefore, it is normal to turn the board for 4 to 5 times to cut. With consideration of board utilization rate, complex patterns of cutting pattern as well as calculation of the required number of large board are big challenges to layout personnel. Thus, the use of layout software(such as G plan) will be the best choice.

備料：依排版後所計算出之大板材數量，以人工或自動方式將板材準備完成，並送到機械加工區。18mmMFC板之標準包裝2800mm*2070mm*18mm*28pcs，如是批量生產，每次使用量應都大於28pcs，故以堆高機或自動傳送設備將板材由庫存區送至裁板區均無大問題。

Material Preparation: The large board amount calculated after layout should be prepared manually or automatically and sent to the mechanical processing area. The 18mmMFC board's standard packaging is 2800mm * 2070mm * 18mm * 28pcs. Each usage must be greater than 28pcs if it is batch production. Boards can be sent from the inventory area to board cutting area by forklift or automatic transmission equipment with no problem.

但如是接單生產每次使用單一顏色板材可能只需1~5片，那將整疊之板材送到裁板區，再將未用完之板材送回庫存區，將會非常無效率，故以優化排版軟體(如GPlan)算出板材需求數量，再以自動備料系統(如G handing)自動依需求數量按裁板順序，事先取料並疊成一落，或直接將單一板材送到裁切區裁切，將是不錯的選擇。

However, if only 1 to 5 pieces of single color board needed in a make-to-order production, it will be very inefficient to send the entire stack of boards to board cutting area, then send the unused portion of board pile back to the inventory area. Therefore, layout software(such as GPlan) should be adopted to calculate the required amount of boards and plan the order of board cutting according to demanded amount by auto material preparation system (such as G handing) automatically to take boards and make a pile first or directly send the single color board to board cutting area for cutting. They will both be nice choices.

裁板：將大板材裁切成需求尺寸

Board Cutting: Cut large board into the size required

因MCF板係以高溫高壓壓合，故其密度比重較高，通常標準尺寸2800*2070*18mm之板材重量約70~75Kg，於生產時以人工將板材搬上裁板機對操作人員體力將是一大考驗，特別是批量生產時每次裁板數量多，故使用有輔助上料系統之裁板機(如Giben prisma SPTorIcon2機械)。

MCF boards are pressed with high temperature and pressure for higher proportion of density. Normally board of standard size 2800 * 2070 * 18mm weighs about 70 to 75kg. It will always be a big challenge to operators physically when moving the board up to the board cutting machine manually in production, especially when there is large amount of board cutting in batch production. Therefore board cutting machine with assistant feed-in system (such as Giben prisma SPTorIcon2 machinery) should be adopted.

另裁板機因鋸片材質因素，裁切速度與裁切板厚會受到限制，如需提高產能只能從上/下料及備料方法改善。

And, due to the blade material of board cutting machine, cutting speed and thickness will be limited. If more capacity is needed, it can only be improved by feed-in/out and material preparation.

既然上/下料及裁切轉板次數會影響裁切效率，針對接單生產的生產模式，就因需多次上下料及轉板之裁切方式，使得生產非常沒有無效率。所

以只需一次上下料，即可完成貼條碼標籤、垂直鑽孔、裁板、切溝、打結合卡榫之CNC Router (如Selexx)，將是接單生產另一種不錯的選擇。

Frequencies of feed-in/out and board turning while cutting would affect the efficiency of production. For make-to-order production model, since repeatedly feed-in/out and cutting method with board turning are needed, it leads to inefficient production.

So CNC Router (such as Selexx) that needs feed-in/out for only one time to complete barcode label pasting, vertical drilling, board cutting, groove cutting and place locking clamp will be another good choice for make-to-order production.

裁板機裁切：Cut Boards with Board cutting machine:

優點 Advantages

1. 可量產即多片板材同時裁切

1. Mass production by board cutting machine means simultaneously cutting many pieces of boards.

2. 切斷面平整，如貼薄邊材時貼合面較平順

2. The cutting plane is flat and neat, making a smoother binding face if attached with thin sapwood.

缺點 Disadvantages

1. 裁切時因破壞內聚力，裁斷面越長板材彎曲越明顯

1. Due to the destruction of cohesion while cutting,longer cutting plane makes boards bending more.

2. 有劃線鋸(scoring saw)痕跡

2.There are traces of scoring saw.

3. 需多次上下料及轉板可能碰傷板材

3. Boards may be bumped for the sake of multiple feed-in/out and board turning.

CNC Router 排版裁切：以CSV檔案匯入排版軟體，直接進行排版並依已定義之鑽孔模式產生鑽孔孔位，進行加工。

CNC Router Layout and Cutting: The layout software is imported as a CSV file to directly process layout, and accordingly a defined drilling mode will start drilling holes for preparation of processing.

優點 Advantages

1. 未完整切斷整片板材，內聚力變形量少，尺寸精度較佳。

1. Incomplete board cutting reduces the deformation of cohesion to make more accurate measurements.

2. 無劃線鋸痕跡。

2. There are no traces of scoring saw.

3. 一次上料可完成多樣工作(裁板-定寸-修邊-切溝-鑽垂直孔)，人工需求少。

3.One feed-in can complete multiple tasks (board cutting-sizing-edge trimming-groove cutting-vertical drilling) in less requirement of human power.

缺點：Disadvantages：

1. 無法多片板材同時裁切，產能固定。

Because the machine can't do the job to cut multiple boards at the same time, it only makes a fixed production capacity.

2. 一台機械做多樣工作，影響產能。

One machinery does multiple tasks that might influence the production capacity.

3. 需使用鎢鋼螺旋刀，刀具費用較高。

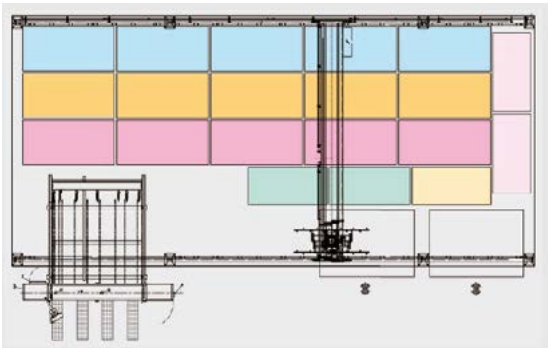
Tungsten steel spiral cutters are needed, which leads to higher cost of tools.

4. 切斷面較粗躁，貼較薄邊材時貼合面可能會有印痕。

Print may be marked on the binding face when a rough cutting plane is bound to the thin sapwood.

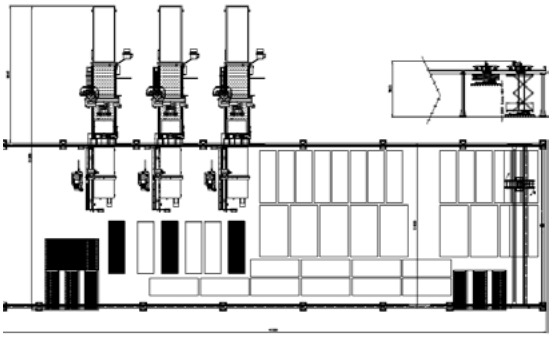
5. 需使用MDF 墊板增加費用。

MDF pads are needed, which costs higher.



裁板機搭配自動備料/上料系統圖例

Illustration: Board cutting machine working with auto material preparation / feed-In system

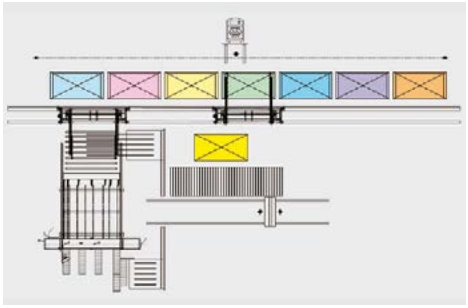


CNC 複合機(ANDI SELEXX)搭配自動上料系統圖例

Illustration: CNC complex machine (ANDI SELEXX) working with auto feed-In system

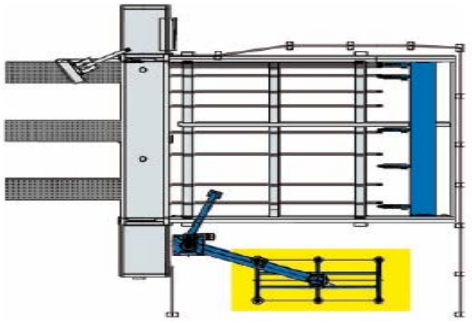
新技術、產品發表

NEW TECHNOLOGY AND PRODUCT RELEASE



裁板機搭配自動備料/上料系統圖例

Illustration: Board cutting machine working with auto material preparation / feed-in system



裁板機搭配自動備料/上料系統圖例

Illustration: Board cutting machine working with auto material preparation / feed-in system

定寸/修邊/切溝/貼邊：因板材裁切時因內聚力遭到破壞，造成裁切邊彎曲(俗稱香蕉彎)，如未將之修平會影響貼邊品質及鑽孔位置精度，及成品之組裝精度，同時亦修齊板材邊緣的劃線鋸痕跡，以提升貼邊。Sizing/Edge Trimming/Groove Cutting/Edge Banding：Cohesion damage during board cutting will result in a bend on the cutting edge (commonly known as “Banana Bend”). If this problem is not fixed, it will decrease the quality of edge banding and the position accuracy of drilling holes, and the assembly precision of finished products. Meanwhile, it is necessary to trim the edges of boards with neat scoring saw traces for better quality of edge banding.

通常批量生產時可選用組合機械(雙端做榫機+雙邊貼邊機)可同時完成定寸/修邊/切溝/貼邊等工作，加工速度快且品質佳。但少量生產時，因組合機械功能多，機械調整耗時，所以並不適用。Usually, a combination machinery can be chosen (Double End Tenoner + Double-sided Edge Banding Machine) during the batch production to simultaneously do the jobs like sizing/edge trimming/groove cutting/edge banding for fast processing and excellent quality. However, it is not applicable to small-batch production since the combination machinery takes a lot of time for adjustment based on its complex mechanical functions.

所以1+1/2(雙端做榫機+單邊貼邊機)是最適當的機械，但目前此型機械造價太高，不符投資效益，故甚少工廠選用；故具修邊/貼邊/切溝功能且可自動調整定位之機械(如Giben KE03/KE04)是目前市場主流(只需更換適合厚度及顏色之邊材及貼邊程式，不需做機械調整) Therefore, 1+1/2 (Double End Tenoner + Double-sided Edge Banding Machine) is the best machinery. However, building this kind of machinery cost too much, it’s difficult to make profits in terms of investment returns. Most of manufacturers don’t choose this one, even it is the best . Alternatively, the machinery with the functions of edge trimming/edge banding/groove cutting and auto position adjustment (such as Giben KE03/KE04) is the most popular model in the market (only changing thickness and color of sapwood, and edge banding program without any mechanical adjustment).

◆鑽孔：批量生產使用排鑽機是適當的選擇，但因其調機及更換鑽頭較麻煩故並不適用於少量生產，反而CNC鑽孔/打型/切溝複合機如(ANDI PTP or STRYKER)將是較適當的選擇。

Drilling：The line boring machine is a good choice for batch production. Nevertheless, moving the machine and replacing drills make a lot of trouble. Obviously line boring machine is not applicable to small-batch production; on the contrary, CNC drilling/punching/groove cutting complex machine, such as ANDI PTP or STRYKER, is a better choice.

◆整理/清點/包裝/出貨：

Sorting/Inventory/Packaging/Shipping：

恩德智能化的整合系統 Anderson Intelligent Integration System

因訂製系統櫥櫃，每一案件均須重複：丈量設計-拆圖-排版取料-裁板-定寸/修邊/切溝/貼邊-鑽孔等生產加工程序，人工及錯誤生產之費用極高，是訂製系統櫃生產須克服之瓶頸，恩德為此提出完整之解決方案：To customize a system furniture, every case is a repetition of these production & processing procedures: Measurement & design – drawing breakdown – layout & material taking – board cutting - sizing/edge trimming/groove cutting/edge banding – drilling. High labor cost and expenses

from errors during production are the choke points of the custom system furniture production that must be conquered during custom production. Thus,Anderson provides you with integrated solutions as follows:

◆丈量設計：室內設計師到客戶處丈量後以AUTOWORK繪製3D室內空間圖形，再依客戶需要以有定義之櫥櫃擺置配色，以近似櫥櫃施工完成後之3D模擬效果圖，經由客戶確認/訂購。

Measuring & Designing: The interior designer visits the client's site for measuring, and draws a 3D interior space graphics by AUTOWORK according to measurements. Next, appropriate arrangement and color combination for the defined cabinets must be made in compliance with client's needs. Then, a 3D rendering of simulation will be issued for client's confirmation/ordering when the cabinet construction is going to be finished.

◆拆圖：以工廠端之AUTOWORK軟體將訂單設計圖分解，分解時會產生多份EXCEL料單如：需加工板材料單、五金配件料單、外製品料單…等，依工廠需要而定，亦可產生整合料單以方便出貨時清點配件。

Drawing Breakdown: The AUTOWORK software from the factory side breakdowns the design of the orders and generates multiple EXCEL lists of materials such as: List of processing required boards, list of metal accessories, list of outsourced products, and so on. Integrated material lists can be issued for easier inventory of accessories during the shipment.

◆裁板：接收自至G plan之裁板圖樣以Giben裁板機進行裁板，或接收來至CAMPRO Nesting軟體之NC程式，以ANDI SELEXX機械進行切板

Board Cutting: The Giben board cutting machine receives cutting pattern from G plan to do the job of board cutting, or receives the NC program from CAMPRO Nesting software to use the ANDI SELEXX machinery operating board cutting.

A. 將EXCEL板材清單匯入Gplan軟體，由Gplan軟體依指定模式(可接受轉板次數)進行分類排版，並計算需求大板材數量及產生裁板圖樣。並將需求板材數量資料送至G handing系統進行備料或人工備料或直接將板材送至裁板機裁板

A. EXCEL Lists of boards are imported into Gplan software, which will layout and classify boards according to a specified mode (acceptable turning frequency of board), figure out required quantity of large boards, and produce board cutting pattern. The data of required quantity of boards will be sent to the G handing system for material preparation, manual material preparation or directly sent to the board cutting machine for cutting.

B. 或將EXCEL板材清單匯入CAMPRO Nesting軟體，進行排版並依事先定義之鑽孔模式進行配孔，並產生NC程式。再將程式傳到SELEXX機械進行切板/鑽孔加工

Or, EXCEL Lists of boards are imported into the CAMPRO Nesting software, which will process layout and hole matching according to the pre-defined drilling mode to generate the NC program. Next, the NC program will be sent to the SELEXX machinery to process board cutting/drilling.

◆貼邊：以GIBEN自動調整貼邊機進行貼邊

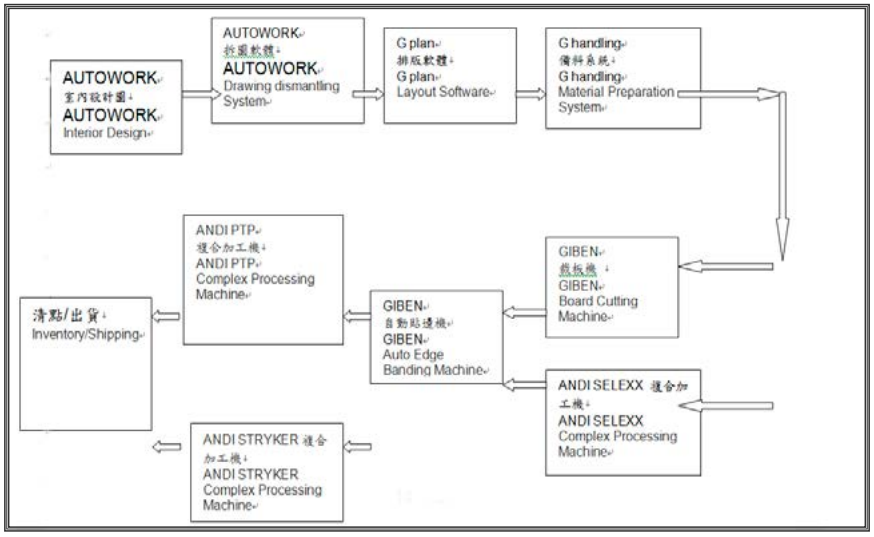
Edge Banding: Use the GIBEN automatic edge banding machine to do the edge banding job.

◆鑽孔：由PTP or STRYKER鑽孔機接收/啟動以AUTOWORK軟體所產生之鑽孔程式進行加工，或以已定義之變數鑽孔模式以條碼機或自行選擇程式進行自動配孔並產生鑽孔程式進行加工

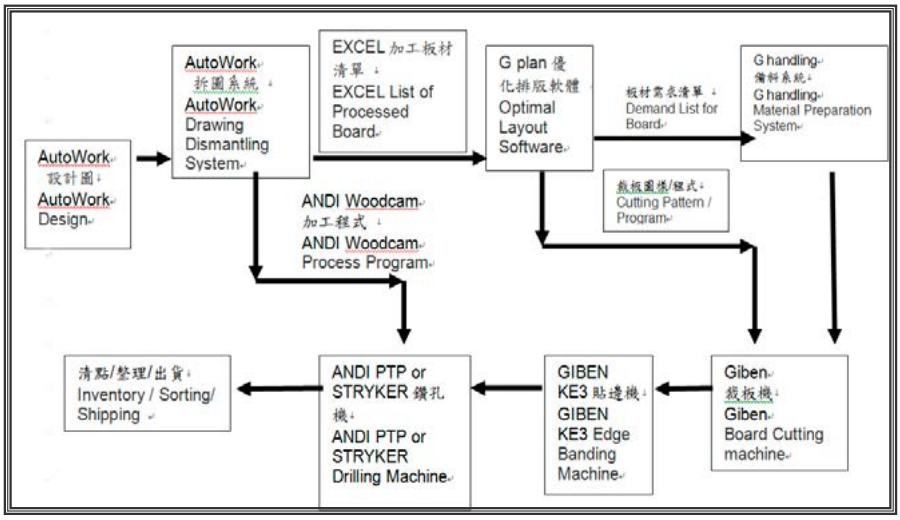
Drilling: Use PTP or STRYKER drilling machine to receive/activate the drilling program generated by AUTOWORK software for processing, or use a defined variable drilling mode to let barcode machine or automatic selection of program perform automatic hole matching and generate drilling program for processing.

◆整理/清點/包裝/出貨：以AUTOWORK產生之整合料單進行整理/清點/包裝/出貨

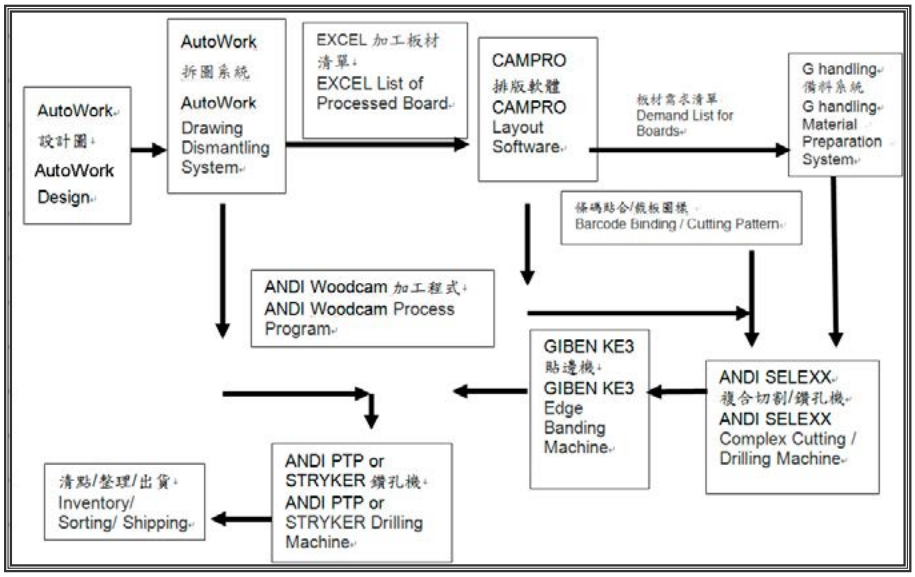
Sorting/Inventory /Packaging/Shipping: Do the sorting/inventory/packaging/shipping jobs using the total material lists made by AUTOWORK.



作業流程圖
Operating Procedure



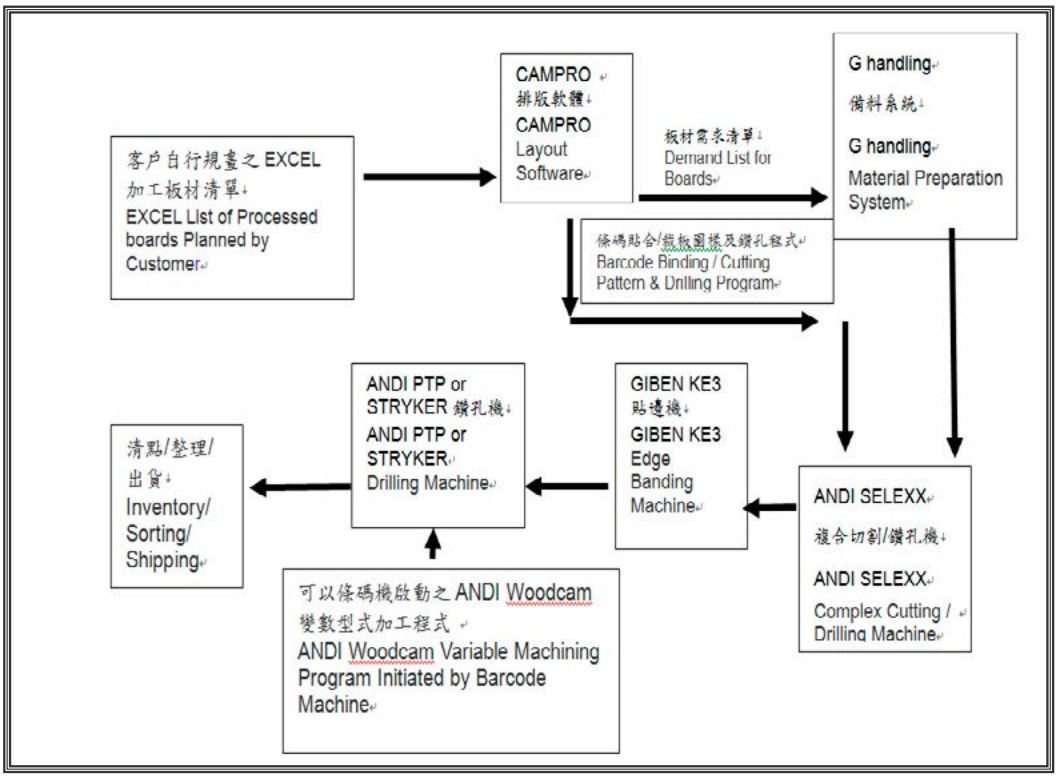
可能作業流程1:
Possible Operating Procedure 1:



可能作業流程2:
Possible Operating Procedure 2:

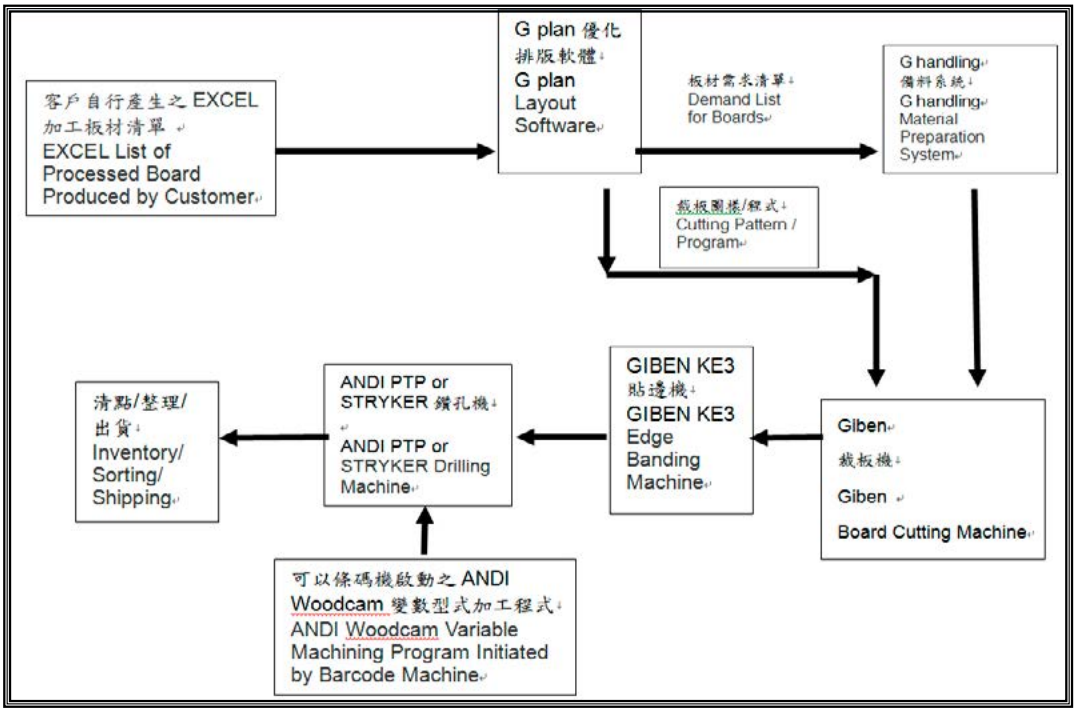
說明: ANDI SELEXX 複合切割只做板材裁切不做鑽孔可提高產能

Explanation: ANDI SELEXX complex cutting is only for the purpose of board cutting instead of drilling to increase the production capacity.



可能作業流程3:

Possible Operating Procedure 3:



可能作業流程4

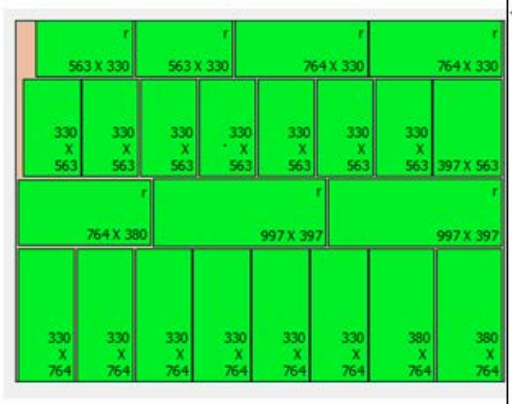
Possible Operating Procedure 4

以AUTOWORK產生之3D模擬彩現圖
3D colorful virtual diagram made by AUTOWORK

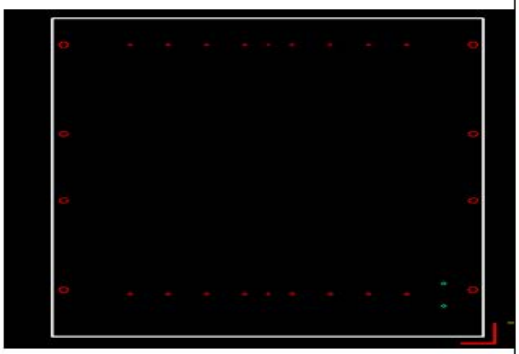
以AUTOWORK產生之3D室內設計圖
3D interior design made by AUTOWORK

desc piece	color	前封邊材	qty	width	depth	thickness	裁板寬度
右側板	871	ABS	10	566	380	18	566
左側板	871	ABS	10	566	380	18	566
底板	871	ABS	10	764	380	18	764
頂板	871	ABS	10	764	380	18	764
右門板	871	ABS	10	563	397	18	563
左門板	871	ABS	10	563	397	18	563
右側板	871	ABS	10	563	330	18	563
左側板	871	ABS	10	563	330	18	563
底板	871	ABS	10	764	330	18	764
頂板	871	ABS	10	764	330	18	764
右門板	871	ABS	10	997	397	18	997
左門板	871	ABS	10	997	397	18	997

以AUTOWORK產生之加工板材清單範例
Example list of processed boards made by AUTOWORK



以Gplan產生之優化排版範例
Example of optimal layout made by Gplan



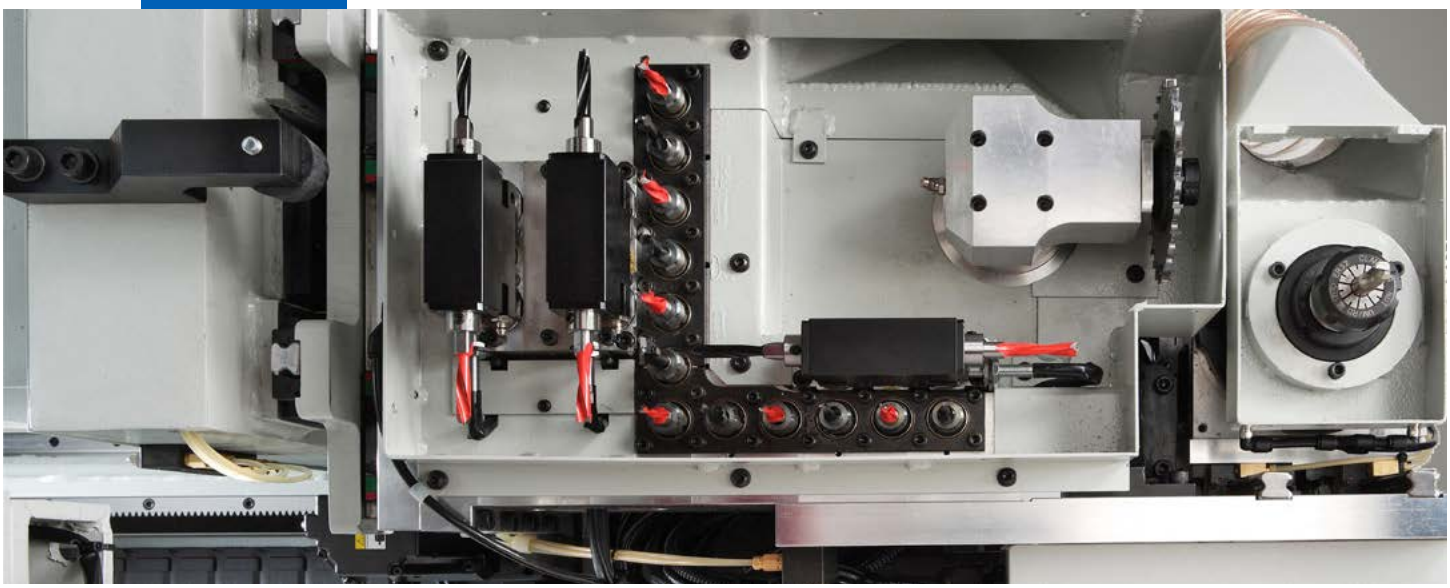
以變數產生之woodcam鑽孔程式範例
Example of WOODCAM drilling program founded on the basis of variables

以變數建立WOODCAM程式範例
Example of WOODCAM program founded on the basis of variables

結論
Conclusions

因人口越來越多且房價越來越高，每人可擁有之住房面積越來越小，為充分利用空間，及使家具擺設更具實用性及合理/美觀，故訂製系統家具將會更加流行。因訂製系統家具生產製造過程較為繁瑣，所以；如果你找不到聰明、勤奮、負責的員工，那你就需要一套聰明且穩定的軟體和機械設備，恩德智能化的整合系統將為你提供完整的解決方案。

Increasingly larger population and higher house prices, the housing area everyone owns is getting smaller and smaller. To fully utilize the space, and arrange furniture more practical in use and artistic in exterior, custom system furniture will be getting more and more popular. Owing to the production of custom system furniture involving really complicated procedures, a whole set of software and mechanical equipment with stability and wisdom are necessary if you can't hire smart, diligent and responsible employees. Knowing your needs, Anderson, with our real strength, provides you with intelligent integration system as a complete solution.

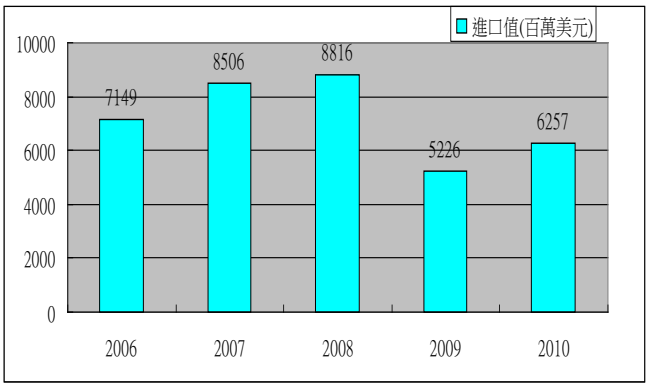


低價木工機械的趨勢
Trends of Low-cost Woodworking Machinery

黃華泰 Ward Huang From AIC

近年來由於經濟不景氣的影響，全球的木工機械進口總額在2009 年時大幅下滑，從2008 年的88.16 億美元下跌到52.26 億美元，跌幅達40.7%，到了2010 年才微幅上升，相較於2009 年上升了19.7%，如（圖一）。

Due to the low economy in recent years, the total global amount of imported woodworking machinery took a large decline in 2009, dropping from US$8.816 billion to US$5.226 billion, a decline of 40.7%. The amount then took a small incline in 2010, up 19.7% from 2009, as shown in Figure 1.policy study and trend analysis



圖一 2006~2010 年全球木工機械貿易統計
Figure 1: Statistics of Global Woodworking Machinery Commerce from 2006~2010
資料來源：傳統產業加值創新科技關懷計畫－產業發展策研究與趨勢分析
Information source: Value-added traditional industrial and innovation technology care plan – Industrial developing

在這些因素影響下，許多顧客在選購設備也趨於保守，不願再花較多的金額去購買性能好、精度較準確且耐用度高的機種，反而開始尋找價位相較低廉，但機械耐用度和性能都依舊在可接受範圍內的機型。此時低價木工機械的優勢就出現了，雖然在精度上比起高價機種來的稍差，但是還在需求範圍之內，而在成本方面卻降低了許多。除了品質和成本，顧客在購買機台考慮的因素，交期是否滿足也是他們考慮的重點，在這方面上低價木工機械也有很大的優勢，因為其結構相較簡單，所需組立時間也較短，容易達成量產規劃，相較於其他高價位機型，交機的時間也縮短許多。

Under the influences of these causes, many customers become conservative in terms of choosing and purchasing equipments and are no longer willing to spend more money buying machines with higher performance, accuracy and durability. Instead, they look for models that are cheaper and have acceptable performance and durability. This is when the advantages of low-cost woodworking machinery comes in. Although these machines have slightly lower accuracy than higher priced ones, their performance is within an acceptable range, at a considerably lower cost. Besides the quality and cost, when purchasing machines, the customers also put heavy consideration on meeting delivery deadlines. The low-cost woodworking machines are also advantageous in this aspect as they have simpler structures and require less assembly time, making them easier to reach production plants and take a lot less shipping time when compared to other models .

不只在顧客選購上的考量，機械業者在採取低價木工機械也有其策略。一台性價比（性能與價錢比）高的低價木工機械，較容易打入一個新的市場，畢竟在一個尚未涉足的新市場，品牌形象也還沒建立之前，一台性能可以接受但價錢相對便宜的機台，是比較容易讓人有嘗試的意願。

Aside from customer purchasing considerations, machine manufacturers have their own strategies with low-cost woodworking machinery. A low-cost woodworking machinery with higher capability/price ratio can make its way into a new market more easily. In a new market where no prior entries were made and corporate images are yet to be established, a machine with a lower price and acceptable performance can more easily raise the willingness of buyers to give it a try.

低價位木工機械的性能
Performances of Low-cost Woodworking Machinery

一台機台除了要達到所需求的基本精度外，機械結構上的剛性、生產品質的穩定和機台加工的速度等都很重要。低價位木工機械雖然價位低廉，但也都必須具備上述所列的各種基本性能，並不是所謂的低價就和削價競爭、品質低劣畫上等號；而是將一般複合性的機台改成功能較單一化，或是只有一至二項的主要功能，以達到簡化機台適合量產模式的生產。

In addition of meeting basic accuracy requirements, the rigidity of its structure, the consistency of manufacturing quality and speed of processing are also important factor. Despite being sold at lower prices, low-cost woodworking machinery has to contain all the above basic functions, not solely equaling to lowering the price for competition and sacrificing the quality. Instead, these models aim at simplifying normally complex functions or having only one or two primary functions to make them easier and adequate for mass production.

一般木工機械跟金屬切削的工具機性能需求上不同，工具機加工的是金屬，機械精度要求極高，所以機械組立製程需要精細管控，一般零件精度不易一次到位，需有經驗師父耐心調整，量產難度高；木工機械則相反，可利用容許的精度範圍下，管控好零件精度，讓製程標準化、簡單化，達到量產生產效益；而低價位木工機因為更簡易與輕量化的機構，使低價木工機更有機化達到量產的經濟效益。

Needs for functions are different between woodworking machinery and general metal cutting machine tools. Machine tools process metal and have extremely high demands in accuracy, so the assembling of the machine needs detailed care. It is not easy to make sure all accuracies of general parts are put into place at one time and there needs to be experienced technicians to make adjustments, making it difficult to mass produce these machine tools. Woodworking machinery show the contrary as accuracies of parts can be controlled within an acceptable range, making the processsing standardized and simple, and the benefit of mass production can be achieved. The simple and light structures of low-cost woodworking machinery make them further organized for better economical benefits of mass production.

雖然低價位木工機功能較少，但若搭配自動上下料、簡易自動換刀系統和自動排版功能等，可以減少人力的成本及機械操作的工安意外。同時機械因具備簡單明確的人機操作介面、對話視窗和直覺式的步驟，縮短了板材設定及上下料的時間，大幅減少了加工時間，提升機台生產效率；也省去人員培訓的時間，消費者在購買機台後，不需另外花費大量時間培養機台操作者，大幅減少購買新機台時，所耗費的接軌時間。讓客戶在生產方面更加快速及便利。

Although low-cost woodworking machines have less functions, if they are collocated with automatic loading and unloading of materials, simplified automatic cutter changing systems and automatic typesetting, human labor costs can be lowered and operating safety accidents can be decreased. Meanwhile, as the machines provide simple and clear man-machine operating interfaces, dialogue windows and intuitional steps, the time for sheet material setting, loading and unloading can be reduced, saving great amounts of processing time and increasing the productivity of the machine. It also saves personnel training time as the consumers do not need to spend excess time in training operators so the adjusting time after acquisition of new machines can be vastly decresased. The clients can produce with better speed and convenience.

恩德低價木工機械的規格

Specifications of Anderson's Low-cost Woodworking Machinery

THRU-FEED PTP TECHNICAL DATA	WIBJ-5		
CLAMP PIECE DIMENSIONS	LxWxT MAX	3000x1000x50	MM
	L MIN	> 250	MM
	WxT MIN	50x10	MM
WORK DIMENSIONS (FULL COVER)	XxYx Z	∞ x 800 x 50	MM
MAX. FEED SPEED	X AXIS	50	M/MIN
	Y AXIS	50	M/MIN
	Z AXIS	15	M/MIN
NO.1 MULTI-DRILL	DRILL ROTATION SPEED	4800	RPM
X * Y -> 7*6	SHANK OF DRILL	$ 10	MM
X -> 2+2+SAW	GROOVING SAW ROTATION SPEED	4200	RPM
Y -> 1+1	GROOVING SAW I.D.	$ 30	MM
	GROOVING SAW MAX. O.D.	$ 120	MM
	GROOVING SAW MAX. THK	5	MM
NO.2 ROUTER	SPEED	1000~18000	RPM
	ROUTER NOSE	ER32	
POWER	NO.1 MULTI-DRILL	1.5	KW
	NO.2 ROUTER	3.75	KW
	TOTAL POWER	(380V/60HZ/26A) 15	KW
AIR PRESSURE	HOSE: 3/4"	6	KG/CM^2
	CONSUMPTION	330	L/MIN
NC CONTROLER		SYNTEC	
DIMENSIONS	FLOOR AREA (WxD)	4100x4000	MM
	HEIGHT	1800	MM
	WEIGHT	1800	KG

a. THRU FEED

THRU-FEED 主要訴求就是以快速換料作為其目的，所以機台可以縮短一開始的板材定位及加工過程所耗費的時間，以達到快速完成加工的需求。在安全需求方面，我們在進出料兩端都各別設置了緊急停止開關按鈕和電眼，確實的保護加工者在使用機台時的安全。其他重要特性如下：

The main purpose of THRU-FEED is fast material exchange. The machines minimize the time for material positioning and processing and meet the need for fast processing. Regarding safety, emergency stop buttons and electric eyes are installed for both material feeding and outputting, providing true protection of the user. Other important features are as follows:

1. 快速板材

1. 定位及零準備時間/ Quick sheet material fixing and zero preparation time

操作者在更換不同尺寸板材時，不需重新設定可以減少時間的浪費。

When the operator switches between different sized sheet materials, time can be saves as there is no need to reconfigure .

2. 高性能的排鑽模組 / High performance multi-drill module

排鑽組其結構具有高剛性及高精度，可長時間進行加工且不會產生誤差。

The structure of the multi-drill module has high rigidity and accuracy, can process for long periods of time ,while decreasing

3. 雙系統架構，使用PC 人機操作介面，更易於操作 / Dual-system structure with PC man-machine operating interface for easy operation

結合網路連結雙系統架構，配合恩德自行研發之軟體woodcam 與PTPcom，使得操作者更容易上手。

The dual-system structure combined with an internet connection works in coordination with Anderson developed Woodcam and PTPcom software making it easy for operators to get familiar with the system.

4. 配置安全裝置 / Safety features

在機台兩側各別設置緊急停止按鈕和電眼，以確保在任何突發狀況下，機台均可馬上停止，避免使用者在機台操作時發生意外。

Emergency stop buttons and electric eyes are installed for both sides of the machine to ensure the machine can immediately stop in case of emergency, decreasing accidents to users.

5. 簡易上手的軟體介面 / Easy to use software interface

Woodcam 是恩德專為鑽孔機設計之軟體，不僅畫圖方便也可模擬孔路徑，且直覺式的視窗、對話式對話框與可輸入參數式的數據，使得操作者更為簡便。除此之外工作清單與自動回歸原點的功能，更符合人性化的操作訴求。

Woodcam is a software designed by Anderson especially for drillers. It offers a convenient drawing function and drilling route simulation, and the intuitional windows, dialogue boxes and parameter setting statistics make the system easy for operators. Also, the work menu and automatic home function further meets the user-friendly operating demands.

6. 可讀取barcode 及遠端監控 / Barcode scanning and remote monitoring

機台支援讀取barcode 功能，可讓使用者快速載入圖檔。遠端監控功能提供遠距離維修服務，以減少客戶維修成本並縮短服務時程。

The machine supports barcode scanning which enables users to quickly load programes. The remote monitoring function offers remote maintenance services, lowering the clients' maintenance costs and shortensing the service time

b. OWEN (SPECTRA)

OWEN 系列根據不同需求有三種尺寸的加工台面可供選購，分別為S48(2500x1300mm)、S510(3,100x1,600mm) 以及S612(3,700x1,900mm)。機台的主要特色分別敘述如下：

The OWEN series offers processing platforms in three sizes depending on demand: S48(2500x1300mm), S510(3,100x1,600mm), and S612(3,700x1,900mm). The main features of the machines are as follows:

1. 自動換刀系統 / Automatic Cutter Changing System

S48 刀庫6 把刀，S510 跟S612 刀庫皆為8 把刀，自動換刀系統可節省人力換刀所需之時間，增加生產效率並且減少操作人員換刀發生的意外。

The cutter magazine on the S48 consists of 6 cutters and the cutter magazine on the S510 and S612 include 8 cutters. The automatic cutter changing system saves time from manual cutter changing, increases productivity and eliminates accidents that might occur to operators during cutter changes.

2. 刀長量測系統 / Cutter Length Measuring System

可精確量測刀長，避免人員輸入錯誤，毀損加工工件。

Accurately measures the length of cutters to avoid input errors which can damage manufacturing work pieces.

MODEL	S 48	S 510	S 612
X AXIS STROKE	2,500mm	3,100mm	3,700mm
YAXIS STROKE	1,600mm	1,900mm	2,200mm
Z AXIS STROKE	200mm		
TABLE SIZE	2500x1300mm x1	3,100x1,600mm	3,700x1,900mm
X AXIS FEED SPEED	50m/min		
Y AXIS FEED SPEED	50m/min		
Z AXIS FEED SPEED	10m/min		
SPINDLE RPM	1,000~18,000rpm		
SPINDLE TAPER	SK30		
SPINDLE POWER	5.5KWx1		
MULTI-DRILL	6*1		
DRILL ROTATION SPEED	4,800rpm		
SHANK OF DRILL	φ10 mm		
POWER	1.5KWx1		
NC CONTROLLER	SYNTEC		
FLOOR AREA OF MACHINE	3,400mmx4,600mm	3,900x5,400mm	5,000x6,000mm
HEIGHT OF MACHINE	2,400mm		
WEIGHT OF MACHINE	2,100kg	2,800kg	3,000kg

3. 簡易的NC人機介面 / Simple NC User Machine Interface

簡易的介面有助於操作者快速學習操作機械，搭配上恩德自行研發之軟體，可模擬刀具加工路徑，方便操作者加工前的準備作業。

The simple interface helps users to quickly learn machine operation. With the addition of software developed by Anderson, the cutter routes during processing can be simulated, making the preparation before processing easier .

4. 採用伺服馬達驅動 / Servomotor Drive

採用同高等級機械的交流伺服馬達配合齒排機構，維持NC機台的基本精準需求，以領先同業低價產品的品質水準。

This models use an AC servomotor drive equal to machines of high levels paired with a rack structure to maintain the basic accuracy demands for NC machines and lead in quality levels in the low-cost products field of trades.

5. 自動上下料 / Automatic Loading and Unloading of Materials

可因應客戶需求加購自動上下料，以減少人力上下料的作業時間與降低工業安全意外發生的機率。

A automatic loading and unloading can be added by request to cut the time for manual loading and unloading, and lower the chance of industrial accidents.

恩德低價木工機械的製程規劃

Process Planning for Low-cost Woodworking Machinery

製程規劃的意義指公司在其有限的內部資源及外在因素等限制下，從事生產過程的規劃，俾達到以最低的成本及最有效率的方法，來生產出令顧客滿意的產品。低價木工機械的製程主要可依照幾個方向來看。

Processs planning means the enterprise plans its manufacturing procedures under limited internal resources and external causes to derive a most efficient way to produce products that satisfy customers at a lowest cost. The processs of low-cost woodworking machinery can be viewed from several aspects.

首先在設計上，大量的選用標準件，或是與其他機型相通的共用件來做設計，這不只降低設計上所需的時間，在備料上的便利性、庫存數量控管及空間使用上也大大提升；此外設計也需要對管線做一個最佳化的設計，使得管線耗材的使用上達到最精簡；最後，設計也須考量組裝的便利性，減少現場組立的工時，以達到節省人力成本的效果。

First, use great amounts of standard parts or parts that interlink with other models when designing. This reduces the time needed for design and raises the convenience in material preparation, inventory control and space usage. Also, an optimal design for the pipeline to minimize the use of pipeline consumables. Finally, the design needs to concern the convenience of assembling, decrease the work time of on-site assembling and achieve the effect of saving human labor cost.

第二：開發組裝模具，主要目的在減少組立時定位及校正的時間，並且降低組立人員的技術門檻，這也可解釋為增加組立人員的共用性，彼此可以互相支援，提昇人員間的調度性。

Secondly, develop assembling modules to decrease time spent on positioning and adjusting when assembling and

lowering the skill threshold for assembling personnel. This can also be interpreted as increasing the versatility of assembling personnel, as they are able to perform multiple tasks and support each other, achieving better flexibility for labor use.

第三：簡化調校步驟，利用零件公差規範讓組立快速順暢，以減少製程沒必要的量測調整工作，並製作出一套製程組裝的SOP 流程，做為現場組立人員組立依據。

Thirdly, simplify the checking and adjusting procedures, make the assembling fast and smooth by the parts tolerance standard to cut down unnecessary measuring and adjusting works. In addition, create an SOP procedure for process and assembly as the reference for on-site assembling personnel.

第四：耗材管理，依據在設計時已經先規劃好的管線，來做管線耗材備料的動作；所有耗材精確管控，以達到最精簡的耗材使用。由以上的說明我們將製程規劃的重點與功效整理如下：

The forth aspect is management of consumables. Prepare pipeline consumables according to the pipeline planned during design. All the consumables need to be accurately controlled for the most simplified use. Based on the above details, the main points and effects of processsing planning are sorted as follows:

1. 批量化生產 / Mass Production
- 降低零件物料採購成本 Lower cost in purchasing parts and materials
- 減少人員備料找料時間 Decrease labor time in preparation and finding of materials
- 減少人員找工具時間 Decrease labor time in finding tools

2. 組裝模具開發 / Assembly Module Developments
- 減少零組件定位時間 Decrease time in part positioning
- 減少零組件校正時間 Decrease time in part checking and adjusting
- 新手可以上線（無須專業組裝技術） Friendly to new users (no professional assembling skill needed)

3. SOP 工作流程 / SOP Work Procedure
- 防止錯誤發生 Prevent errors
- 提高組裝品質 Raise assembling quality
- 縮短組裝工時 Shorten assembling time

4. 降低耗材浪費 / Lower Consumable Material Waste
- 一些消耗性線材管類長度事先規劃 Plan the length of consumable pipelines in advance
- 一定長度以上之管線耗材回收 Recycle consumable pipeline which exceed a certain length

結論 Conclusion

恩德低價位木工機械，是將不常用的功能去除和利用功能單一化的規劃，滿足符合安全的操作使用要件，配合製程的簡化與量產機制等各種專業製程的管控下，所達到低價的基本訴求。相較於高單價機械的製作，其所考慮的方向雖有不同，但絕對不是簡易取巧的工作，製程的難處其實不遑多讓。這也說明了恩德低價位機種，並不是如坊間削價競爭下的低劣產物，而是集結設計、組立、採購等多元智慧的產物。

Anderson's low-cost woodworking machinery meets the demands of offering low costs through several professional processsing managements, such as removing functions not commonly used and utilizing function simplifying plans, meeting operating safety requirements, simplifying the processsing and introducing a mass production system. It has a different direction of consideration when compared to the manufacturing higher priced machines, but it is not taking a short cut. The process itself is actually pretty difficult. This explains why Anderson's low-cost models are not of the low-quality products , but a product that combines intelligences of design, assembly, and purchasing.

相較於其他競爭者的低價位機種，恩德低價位機械仍然維持有恩德產品家族特有的品質與精度。未來恩德仍然會秉持提供客戶最大經濟效益為職志，持續開發超低價位的機種，提供給各種階層族群更寬廣的選擇，這些客戶不會再因自己有限的資源，只能選擇掉進低劣品質機械的深淵，而懊悔終身。

Compared to low-cost models of other competitors, Anderson's low-cost machines keep the group's characteristic quality and accuracy. The Anderson Group will continue to develop models at super low cost to offer its customers the greatest economical benefits and provide a wider choice for consumers at all levels. Customers with limited resources will no longer have to settle on models of lower quality .

DieJet 1212 – 工業技術 DTP 印刷應用軟性刀模製作之精密噴墨繪圖機

DieJet 1212 – Industrial technical DTP print application
Precision DTP (Direct To Plate) inkjet plotter for flexible die production.

Alfred Könemann from
AEC

目標市場

軟性刀模製作，常用於美術印刷業，專用於自粘商標、薄膜的觸切與斷切（切至斬板）加工、所有的感壓性複合材料、薄紙板盒材和發泡膜、多種的編織布以及需要專用製作方式的特殊材質。

滾筒式印刷業之精密軟性刀模

精密軟性刀模製作之專用鋼板。要做進一步加工的鋼板必須完全無油脂。進行製程中，DieJet 1212 會在鋼板上直接噴繪出所需的圖型。因採用特殊紫外線硬化噴墨並結合紫外線於「移動中」直接硬化式製程，產出高品質的噴印效果，使得本產品成為尖端科技精密軟性刀模的最佳首選（步驟如下簡略圖）。

步驟 1：顯示無油脂的市售鋼板。DieJet 會在鋼板表面噴印出UV 線硬化型墨水。RIP 軟體製成的印刷檔案可經網路或 USB 來提供。

Target market

The production of flexible dies, which are used by the graphical industry, the supply market of self-adhesive labels, the kiss-cutting and cutting through (down to the anvil) of foils, all kinds of pressure-sensitive composites, thin cardboard boxes and foam foils as well as an array of woven fabrics and special materials require a dedicated production solution.

Precision flexible dies for the rotary printing industry

Dedicated steel rule sheets are used for the production of precision flexible dies. These sheets of steel needs to be provided for the further manufacturing process totally oil and grease free. During the ongoing process, the DieJet 1212 prints direct the required contours on the surface of the steel sheet. The high quality printing result combined by the use of our specifically kind of UV light curable ink and the ‘on the fly’ direct UV light curing process makes this application to the first choice for a state of the art production for precision flexible dies.

Step1: Shows an oil and grease free supplied steel sheet. The DieJet prints the UV cured ink direct on the surface of the sheet. The print file, prepared by a RIP software, is provided by network or USB.

步驟 2：鋼板上 DieJet 噴墨沒有覆蓋著的部位，可用專門的蝕刻製程以氯化鐵溶液將之蝕刻掉。

步驟 3：GVM (Anderson Europe GmbH 出品) 是種高精密 CNC 控制的雕刻機械。蝕刻製程後所留下的圖型，既粗又鈍，無法當作刀模的切刀使用。GVM 機械以我們特殊設計的雕刻銑刀與優化的 CNC 程式把刀模的刀刃加工成銳利的刀刃。

步驟 4：顯示已安裝於滾筒式磁性滾筒上的軟性刀模。要滾切的材料，例如標籤：是由印刷機的磁性滾筒與斬板中間拉出來。目的就僅只是要切斷標籤材料而非底紙，以免撕壞了捲材。因此，刀模務必要製做出高優質的刀鋒，且模切面積高達 1000 x 800mm 時，公差仍在 3 微米以下。

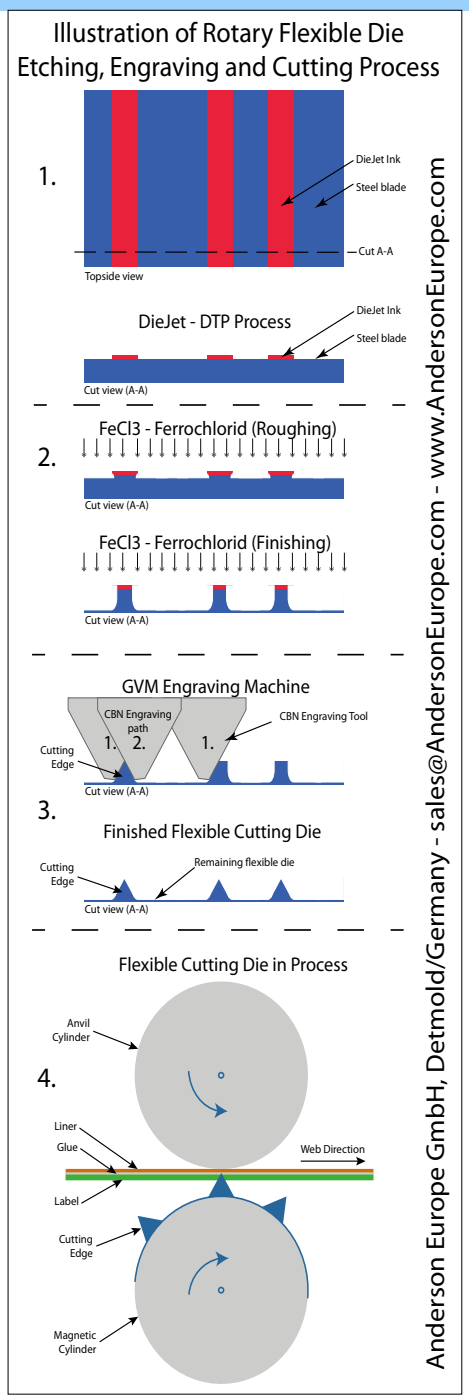
DieJet 1212 配備

- 真空吸附式工作臺
- 兩個獨立精密定位銷對位系統，提供刀模對位
- 8 個噴印頭
- 2 個紫外線燈，以7 段式的工作流程控制光照強度
- 龍門式驅動配合全密式精密回授系統
- 內建微軟 Windows 作業系統，具網路與 USB 支援功能
- 經特殊工作流程優化之使用介 面

初始情況、需求與改善動機

精密軟性刀模一直以來主要都用抗紫外線的光阻劑來做蝕刻製程。此種製程現已因專用的光阻材料被禁用而面臨產業威脅。此外，這種傳統方法不僅效率低，且技術精確度也不足，其缺點包括：

1. 所需裝備 （雙輥式的熱壓合、熱穩定性、大版面的繪圖機、紫外線曝光機、剝膜機等等） 的投



滾筒式軟性刀模／蝕刻、雕刻製版及模切製程圖示（簡略圖）
Illustration of Rotary Flexible Die / Etching, Engraving and Cutting Process (simplified schema):

Step2: A dedicated etching process removes by the use of liquid ferrochlorid, the areas on the sheet which are not covered by the DieJet ink.

Step3: The GVM (product of the Anderson Europe GmbH) is a high precision CNC controlled engraving machine. The contours, which are remained by the etching process, are rough and not sharp in the meaning of a cutting knife. The GVM machine sharps the contours by the use of our specifically designed engraving tools and optimized CNC programs.

Step4 :Shows the flexible cutting die fixed on a rotary magnetic cylinder. The material, which needs to be cut, e.g. labels will be pulled by a printing machine between the magnetic cylinder and an anvil. The target is to cut just the labels and not the liner, to avoid a tear of the web material. Therefore, it is absolutely necessary to produce height optimized cutting edges within tolerances down to 3 microns on a die dimension up to 1000 x 800 mm.

The DieJet 1212 is e.g. equipped with:

- a vacuum operated working table
- 2 independent precision pinning point systems for referencing the dies
- 8 printing heads
- 2 UV lights, intensity controlled by the workflow in 7 independent levels
- full independently controlled gantry drive with precision linear feedback systems
- Microsoft Windows Embedded operating systems, with

資額很高
2. 需要有熟練合格的作業員
3. 因需要蝕刻製程以製作鋼版，所以最少要有 50 分鐘長以上的製作工時
4. 大版面精密軟性刀模在製作上對無扭曲變形的要求越來越嚴格
5. 高耗材性（壓膜中僅有5% 能用，其餘 95% 的材料均將成為廢棄物棄置）
6. 所需的能源量大約要 25 kVA
7. 最小的生產場地都要大約 200 平方公尺的面積
8. 生產場地中大部分製作都要有感光室的要求（紫外線光罩設備）

DTP 方案的優點

「DieJet」，是 Anderson Europe 提出的「直接製版」法。只要採用 DieJet，就能以正確的製版法消除上述所有的缺點並有更正面的效果。

DieJet 是工業用大版面平台式精密噴墨印刷機，能以特殊的媒介噴印；蝕刻製程所需的幾何圖形都會直接的噴印到鋼板上面。DieJet 在鋼板上的全部區域均可做精密直接噴印製程的概念，是以特定應用的專業知識加入我們多年的經驗以及客戶的要求而來的，故 DieJet 在實用上具有了下列特點：

1. 無扭曲變形又具高精密度的製作，縱使在大版面製版時亦然
2. 僅需大約 4kVA 的低耗能量
3. 無需專業合格的作業員
4. 製作蝕刻製程用的鋼版僅需大約短暫的 20 分鐘製作工時
5. 每刀模模板的耗材量低（大約 4 毫升的印墨）
6. 投資額低
7. 僅需約 15 平方公尺的小地坪面積
8. 製作場地無需特殊的準備（像是感光室）

機器用途

採用我們的DieJet 就是使用一種經濟式的軟性刀模製程，該製程不論是現今或將來都是一項具有高效工作流程的安全投資。關於需求方面，Anderson Europe GmbH 的 DieJet DTP 機器，是專門製作滾筒式及平台式印刷與模切業用的軟式刀模。其標準的應用性適用於全世界所有的軟性刀模的製造商。

Network and USB support
- specifically workflow optimized user interface

Initial situation, needs and motivation

Precision flexible dies are being prepared mainly by the use of a UV light resistant laminate for the etching process. The medium-term continuation of this process is currently threatened by the discontinuation of the availability of dedicated photo-resistant materials.
In addition, this conventional method is inefficient and the technology no longer sufficiently accurate, including in terms of:

1. the high investment for the necessary equipment (double roll hot lamination, thermal stability, large-format plotter, UV exposure machine, stripper)
2. the necessary availability of highly qualified operators
3. the high production time of min. 50 minutes regarding the required etching process of preparing the steel plates
4. the strongly increasing requirements regarding a distortion-free production of large format precision flexible dies
5. the high material consumption (just 5% of the laminate can be used, the remaining 95% are considered to be disposed as waste)
6. the necessary energy demand of approx. 25 kVA
7. the minimum production area of approx. 200 m²
8. the preparation of most production area concerning photo lab room requirements (UV light shielding)

Advantages of the DTP solution

With the „DieJet“, Anderson Europe offers a „Direct to Plate“ solution.
By using the DieJet, all the above negative features are

技術規格
Technical Specification

DTP – 平台式噴墨印刷機 DTP - FLATBED INKJET PRINTER			
機型 MODEL	DieJet 1212	控制器 Controller	DieJet 之 DPC 噴墨控制系統，微軟 Windows CE 作業系統， 包括 RIP-Software Onyx 或 PhotoPrint 的噴印機驅動 (DPC DieJet 版本) DPC Inkjet control system for DieJet, Microsoft Windows CE operation system Including Printer Drive (DPC DieJet Edition) for RIP-Software Onyx or PhotoPrint
	適用於精密軟性刀模的製作 Applied for the production of precision flexible dies	真空系統 Vacuum system	支援選配的真空泵浦，並以數位感測器監控 supported by an optional vacuum pump, controlled and monitored by a digital sensor
工作臺 Working table	X 1200 x Y 1200 mm	環境要求 Environment Required	地坪面積 (長乘寬)： 3500 mm x 4000 mmFloor area (LxW)
	工作臺材料為具溝槽的CPL材質 Material of the working table is made by a CPL material with grooves	機器高度 Machine heigh	2500 mm
	平台系統有精密的龍門式伺服驅動定位功能、電氣系統控制之監控型獨立真空吸著區 Flatbed system with precision gantry servo drive positioning, monitored independent suction zones controlled by an electro pneumatic system	機器重量 Machine weight	2000 kg
最大版材厚度 Maximum thickness of workpiece	15 mm	壓縮空氣要求 Compressed Air requirement	6 bar (-10%), 10 l/min
噴印面積 Printing are	寬度 = 1200 mm/長度 = 1200 mm Width = 1200 mm/ Length = 1200 mm	建議環境溫度 Recommended environmental tem	攝氏 21 度、+/- 1 度 21 degree Celsius, +/- 1 degree
噴印解析度 Printing resolution	720 x 720 dpi	電源要求Electrical power requirement	220V~575V, 50/60 Hz, 18A, 3 相 220V~575V, 50/60 Hz, 18A, 3Phase
噴印速度 Printing Speed	一車 720 x 720 dpi 最高可達 6'15" 等於 28 平方公尺/小時 /720 x 720 dpi up to 6'15" one table equivalent to 28 m2/hr The Printing Speed may differ to different printing sizes	其他事項 Miscellaneou	基準點位於右前角 Reference point on the front right hand corner
	噴印速度會因噴印尺寸的不同而異 The Printing Speed may differ to different printing sizes		特殊設計可獨立操作 之氣控式定位銷系統，可將版片定位至工作臺頂端 Specifically designed and independent operable pneumatic controlled pinning system for referencing the blades on top of the working table
噴頭 Print Heads:	電壓控制液滴式噴墨頭：512 噴嘴/ Piezo Drop-On-Demand Inkjet head; 512 nozzles		機器顏色：藍白色 Machine color: white and blue
	墨滴量Drop volume：14pl		清潔噴印頭之沖洗功能 Flush function for cleaning the print heads
	8 個噴頭包括標準配置 /8 heads included with standard arrangement		緊急停機功能 Emergency stop function
	噴墨種類：紫外線硬化型/UV curable 噴墨顏色配置：黑色 /Ink color arrangement: Black		信號燈與蜂鳴器 Signal lamp and buzzer

implemented an appropriate solution for removal and / or positive compensation.

The DieJet is an Industrial Large-format Precision Flatbed Inkjet Printer which allows printing via a special medium; the necessary geometries for the etching process will be applied directly onto the steel sheet. Thus conceived of the DieJet is in all areas for a precision direct printing process on sheet metal is, we put our experience as well as the needs of our customers by the given application knowledge, makes the DieJet accessible for those application by the following features:

1. a distortion-free and high precision productivity, even on large workpieces
2. the low energy consumption of just approx. 4KVA
3. no professional qualified operators are required
4. the shorten production time of approximately 20 minutes for the preparation of a steel plate for the etching process
5. the low consumption of material per cutting plate (approximately 4 milliliters of ink)
6. low required investment
7. a small floor space of approximately 15 square meters
8. no special preparation of the production area (like as a photo lab)

本圖示顯示採用了「創新 DieJet 製程」，比起傳統製程，其所需製作的步驟就大幅的減少了。

Machine purpose

With the use of DieJet we offer an economic production of flexible dies, which features now and for the future an efficient workflow by a secure investment.

傳統製程 Conventional process:

創新 DieJet 製程 Innovative DieJet Process:

Concerning these requirements the DieJet DTP machine of Anderson Europe GmbH is specifically performed for producing flexible dies for the rotary and flatbed printing and cutting industry. This typical application is worldwide capable by all manufacturer of flexible dies.

This illustration shows that by the implementation of the 'Innovative DieJet Process' necessary production steps are substantial reduced - compared to the conventional process.

Simplify your production - Use the state of the art

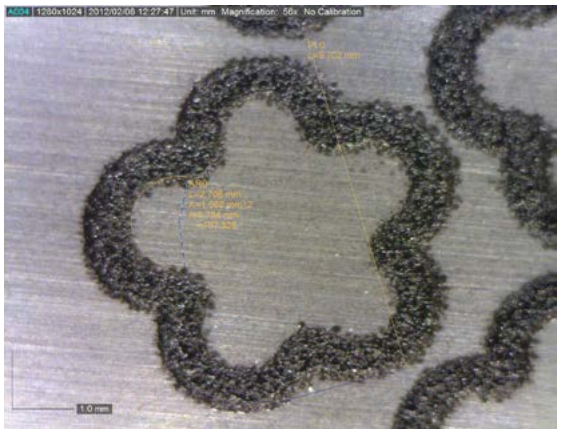
Conclusion

DieJet DTP solution, to be `up to date` and ready for the requirements of your customers. The DieJet 1212 features the demands for a cost sensitive and workflow optimized production.

About the Author:

Alfred Könemann is with the Anderson Group since 2001. At Anderson Groups subsidiary Anderson Europe GmbH located in Detmold / Germany, he is responsible for the branch management, sales and development.

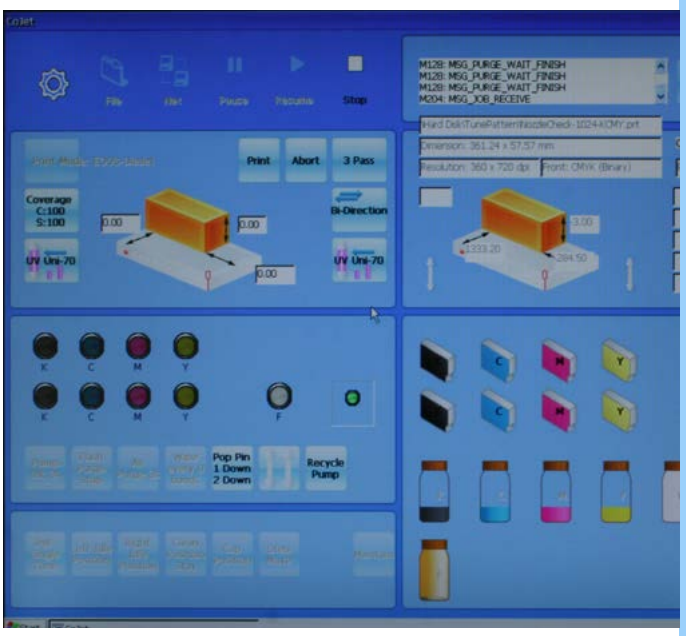
DieJet_Shape_Etched



DieJet_Shape_Printed

總結

製作簡易化 — 使用最尖端科技之 DieJet DTP 法，以便跟上時代並滿足您的客戶需求。DieJet 1212 具有滿足成本敏感性與優化工作流程製作的特性。



作者簡介:

Alfred Könemann 自 2001 年起即任職於 Anderson Group。於德國 Detmold Anderson Groups 的子公司 Anderson Europe GmbH 工作，主要負責分公司經營管理、業務與開發。

主軸大批量急單供給作業探索

Discussion of Urgent Single-supply for Large Quantity of Spindles

張郁仁 James Yu-Ren Chang From AIC

前言 Foreword

度過金融海嘯危機後，2011 年景氣回升急遽又快速，訂單大批量的湧入，所有的行業幾乎同時開始動工，大量的採購原物料和大規模的聘雇人員，可以感受到社會的繁榮和經濟的成長。更多的工作人員投入生產現場，接受新的工作教導與訓練，不停地配合公司加班，期望產品能快速地出貨至客戶。但是，許多原物料的供應均呈現塞車且有交貨遲緩的現象，很難滿足製造廠快速成長的訂單。

Going through the financial tsunami, the economy in 2011 goes up again dramatically and quickly. Orders emerge in large quantities and almost all industries start working simultaneously. Huge procurement of raw material and large-scale hiring show the social prosperity and the economic growth. More staff works in the production site. They take new training courses, work overtime in the factories, and hope the products can be quickly shipped to the customers. However, lots of material supplies are delayed and there are difficulties to meet the fast-growing orders from manufacturers.

原物料的品質與供應的順暢度、產品的品質與設計規格的延伸、製造成本的調節控制、人力增補的作業與訓練、、工作人員持續加班的配合度、維持客戶的滿意度等等，考驗著主管的管理能力與領導魅力。主軸部門面臨此人、事、時、地、物等各方面的挑戰，是如何完成此艱鉅任務並達到目標？研擬四個作業面來說明：工作流程的分解、物料供應的管制、標準作業的訂定和品質變異的控制。

The material quality, the smoothness of supply, the extension of product quality and specification designs, the adjustment and control of manufacturing cost, the operations for hiring and training of man power, the employees' cooperation of working overtime, and the persistence in customer satisfaction are testing the management ability and leadership of administrators. Facing the challenges from people, events, places, and objects, how can the spindle department complete this arduous task and reach the goal? Here are four points of perspectives: workflow decomposition, material supplies management, setting of operation standards and quality variation control.

工作流程的分解
Decomposition of Workflow

將小單元組裝所需要使用的零件、工具(量具或治具)、設備、耗材等等,準備於工作桌上,儘量避免人員的走動。組裝時按部就班進行,完成後立即檢測是否合格,並且登記所需要花費的時間,以及將所有物件的料號(或設備編號)、規格、名稱、數量詳細記錄,並衡量組裝使用空間需□□□□

Prepare the following on the working table, including the required parts, tools (measures or fixtures), equipments, supplies, etc., which need to be used for the assembly of small units, and try to avoid moving around of personnel. Assemble step by step, inspect the quality immediately after completion, and write down the time spent. Record the details of item numbers of all objects (or the device numbers), specifications, item names and quantity, and measure the requiring assembling space.

依據上述的方法,逐一地進行每個小單元組裝,並且登記所需要花費的時間。此時間統計完成後,將進行工作流程分解,構思有那些小單元可以同步作業或者離線作業和每個單元的優先順序,以及生產多少數量,目前人員編制,場所使用大小,搬運儲存方式,期望使流程優化和產能最大化。

According to the above method, assemble each small unit one by one and write down the time spent. When the statistics of the time is done, start the workflow decomposition to check what small units can be assembled simultaneously or worked offline, the producing sequence and quantity for each unit, in order to optimize the process and maximize the capacity with the current staffing, workplace size, handling storage methods.

舉例單元組裝說明如下:Sample unit assembling instructions are as following:

-工作項目:主軸本體和前軸座組裝

Work items: The spindle body and the front axle seat assembly

零件:盤形彈簧、O 形環、軸承、快速接頭、電纜固定接頭、氣壓缸、逼緊螺帽、前軸承座、本體、軸心。

Parts: Disc spring, O-rings, bearings, quick connectors, cable fixing joints, pneumatic cylinder, tight nut, front bearing holder, and shaft.

工具:L 型板手、T 型板手、2 點板手、勾板手、套筒板手、熱風槍、組裝製具、銼刀、游標卡尺、木槌、雕刻筆、氣槍、切換閥、SENSOR 治具。

Tools: L-type wrench, T-type wrench, 2-point wrench, hook spanner wrench, hot air gun, assembly fixtures, rasp, vernier caliper, mallet, engraving pen, air guns, switching valve, and SENSOR fixtures.

設備:高度規、車床。

Equipment: Height gauges and lathes.

耗材:止付螺絲、內六角螺絲、酒精、紅膠、藍膠、銅棒。

Consumables: Set screw, hex socket cap screws, alcohol, red glue, blue glue, and copper rod.

時間:120 分

Time: 120 minutes

-工作項目:測試主軸

Work project: Spindle testing

零件:盤形彈簧、快速接頭、拉刀桿、夾頭

Parts: Disc spring, quick joint, drawbar shaft, and collet.

工具:開口板手、T 型板手、套筒板手、千分錶、震動計、噪音計、扭力板手、2 點板手、偏擺計、偏擺標準棒。

Tools: Open wrench, T-plate wrench, socket wrench, dial indicator, vibration meter, noise meter, torque wrench, 2-point wrench, run out meter, and deflection standard pin.

設備:變頻器、冰水機。

Equipment: inverter and water cooler.

耗材:酒精、紅色黏膠、藍色黏膠、潤滑劑。

Consumables: Alcohol, red glue, blue glue, and lubricants.

時間:90 分 Time: 90 minutes

工作流程分解圖

Work process decomposition diagram

		零件 Parts	站 Station	分解 decomposition	流程 Process	項目 Description	時間 Time
53301715	54300858	54901398			前置 Preparing	清洗料件 Clean the material parts	60
	54300858	56300166			前置 Preparing	軸心黏合 Axis shaft bonding	30
					前置 Preparing	培林公差配合 Set bearing tolerance	20
		53101883			前置 Preparing	填充金屬填補膠 Fill the plastic glue to metal	60
41002037	41002321	41107683			前置 Preparing	氣壓缸座水接頭組裝 Assemble the air cylinder and water joint	30
		51803355			前置 Preparing	測量前軸承座高度 Measure the height of front bearing holder	5
	53101883	56300165			前置 Preparing	本體組裝定子 Assemble the stator on main body	30
		53101883	1	245	前置 Preparing	本體試漏 Test for body leakage	10
	40803897	40803948			前置 Preparing	培林清洗及填加 Clean the bearing and add grease	40
	54300858	56300166			動平衡 Motion Balance	軸心動平衡 Shaft motion balance	80
					動平衡 Motion Balance	更換動平衡機承靠座 Change motion balancing machine holder	
	51502954	51502977	2	220	動平衡 Motion Balance	前後逼緊螺帽動平衡 Check the motion balance for front and rear tight nut	100
56300166	54901398	60610322			組裝 Assemble	本體和前軸座組裝 Assemble the body and front bearing holder	120
					組裝 Assemble	本體和氣壓缸組裝 Assemble the body and air cylinder	130
			3	250	組裝 Assemble	裝設感應器於氣壓缸座 Install the sensors on the air cylinder base	
	41085026	41085027			跑合 Running	線路焊接 Circuit soldiering	120
			4	240	跑合 Running	跑合機台測試 Test machine running	240
	40501034	53301714	5	210	測試 Test	測試主軸 Test spindle	90
					後置 Post-production	電印主軸本體序號 Use electrochemical marking for the serial number on the spindle body	
					後置 Post-production	清潔主軸和上防銹潤滑油 Clean the spindle and put on anti-rust lubricant	
					後置 Post-production	包裝主軸於箱子內 Pack the spindle in the box	60

物料供應的管制
FMaterial Supplies Management

由工作流程分解圖得知，工作流程分解為5 個工作站，4 個人分派於不同的工作站，依工作流程同步生產6 支，每日可生產12 支，每周5 日可產出60 支，每月4 周產出將供應240 支，但物料供應是否能如計劃順序執行嗎？怎麼樣才能做到？

Through decomposition map we can learn that the workflow is broken down into five workstations. Four people are assigned to different stations to produce 6pcs at the same time. The daily capacity is 12pcs, and the output of 5 days a week is 60pcs, and 240pcs per 4 weeks. But the supply of material can be performed as planned order? How can we do this?

物料供應的時間和數量要達到此生產進度，有些多道製程交期長的關鍵性零件是無法做到的，所以積極尋找及培養

第二家供應來源，而進行評估供應商的主要重點是公司的規模大小、技術人員的數量、成本的競爭優勢、加工技術的能力、經營和管理。綜合觀察評估結果後，請新廠商估價，進行打樣試作，量測精準度與測試可靠度，提出必須改善和注意的事項，再次進行第二次試作，同樣的量測精準度與測試可靠度，若無缺失即進入量產與交貨期的控制。

It is not possible for supplying of some key parts with multi-production with longer delivery time to achieve the time and quantity as production schedule. Therefore, it is necessary to find alternative sources actively. The key factors to evaluate suppliers are the company scale, number of technical personnels, the competitive advantage of cost efficiency, processing ability, operation, and management. After the overall evaluation, request price list and samples from the new supplier and check the accuracy and reliability with sample trial. Propose the disadvantages to be improved and noticed, then proceed with the second trial with the same testing for accuracy and reliability. If there is no mistake, carry out the large production and control of delivery.

因應2011 年大批量的急單效應，幾乎所有供應商產能暴滿，如何能順利取得物料供應至生產線上，除了運用公司ERP 和B2B 系統作業外，採購外包人員還要不停地電話催促與確認，甚至不定時的親自前往供應商察看物料進度是否符合交期，惟恐物料供應短缺，造成生產線上的停工待料，間接影響團隊士氣低落。縱使一切安排妥當，但市場瞬息萬變，意想不到的狀況仍然接踵而至，如：上游原料被壟斷、歐洲火山爆發航運中斷、日本的大地震等等，都先後造成物料的嚴重短缺。物流供應的順暢度，直接地影響生產節奏，也嚴重的影響出貨，部分客戶因此取消訂單；所以不斷的調整生產以符合物料的供應狀態，仍然是每日必須查核追蹤的要事。

In response to the 2011 large quantities of rush orders, almost all supplier capacities are overcrowded. To successfully have the material supplied for the production line, besides using ERP and B2B systems, the merchandiser must keep calling to push and confirm the procurement outsourcing, even go to the supplier to look at material progress from time to time to make sure the delivery is on time. In case of a supply shortage , it may result in the production downtime and indirectly cause low morale of the team. Even if all the arrangements are in place, the market is constantly changing and unexpected problems still follow. For example, raw material were monopolized, the volcano eruption in Europe caused shipping interruption, and the earthquake in Japan has caused severe shortages of material. The smoothness of material supply directly affects the production tempo and the delivery and customers might cancel their orders. So constant production adjustment to meet the material supplying state is still a very important job to be checked and followed every day.

標準作業的訂定
Setting of Operation Standards

透過工作步驟分解，了解每項工作進行所須具備的知識、技術或能力等，並進而有計畫性的執行相關訓練。藉由資深員工豐富的實務經驗與專業技能，將其工作知識與技能以工作流程分解依序教導，並且在實際工作現場中進行一對一的新進人員訓練，使得訓練與工作的進行結合融入在一起，並能檢視成效及適切性，新進人員藉由「做中學」的訓練，確實掌握每項工作的核心知識，透過此訓練模式將工作的專業技術（核心能力）快速傳承與發展。

To understand the knowledge, technology or capacity for each work to be possessed through the work step decomposition, and thus plan and carry out the relevant training. With practical experiences and expertise of senior staff, their knowledge and skills can be taught to new staff in sequence according to the workflow decomposition. In addition, the operation training on site integrates training into their work and enables a review of the effects and appropriateness. New staff learns by practicing to get the core knowledge of each job. This training mode passes and develops professional technology (core ability) rapidly.

工作分解技巧的步驟與思考程序：

The steps and the thinking process of work skill decomposition:

A 步驟：分析某一項工作所進行的順序時，以常識觀點分割出主要的動作。

A Step: Separate the main action with common sense when analyzing a work sequence.

思考程序：工作是否告一段落，我做了甚麼動作，這個動作是不是一個主要步驟。

Thinking process: Does the work come to an end? What action have I taken? Is this action a major step?

B 要點：正確執行每一步驟的關鍵（品質、安全、易做）。

B points: Correctly perform the key point of each step (quality, safety, and easy to do).

思考程序：找出一個可能要點，如果不這樣做會怎樣？符合哪一個條件，它是不是一個要點。

Thinking process: Find a possible element to consider the consequences if not doing it; which quality it meets and whether it is a key point or not.

C 理由：知識養成學習判斷，避免錯誤的發生。

C reasons: Learn the knowledge with judgment to avoid making mistakes.

思考程序：這樣做的目的，這樣做的好處，為什麼這樣做？不這樣做的後果？

Thinking process: The purpose of doing so, and the benefits of doing so. Why do so? What is the result of not doing so?

舉例：清洗料件作業標準

Example: Operation standards of cleaning material and parts

次序 sequence	步驟 Process	要點 Key Points	理由 Reasons
1	清點 Count	清洗前要先清點零件種類及數量 Inventory the type and quantity of parts before cleaning	避免短缺 Avoid shortages
2	檢查 Check	檢查零件狀況是否有缺陷 Check defection of any parts	避免事後再拆卸重工動作 Avoid double actions of demolition after the process
3	打開 Open	開啟抽風機和窗戶 Turn on the exhaust fan and open the windows	保持室內空氣清新 Keep indoor air clean
4	清洗 Clean	零件擺在容器裡清洗時要排列整齊 Place the parts in the container coordinately when cleaning	避免碰撞影響組裝精度 Avoid collisions to affect the assembly precision
5	使用 Use	毛刷和洗劑清洗零件要乾淨 Use brush and detergent to clean the parts	殘留的污垢毛邊會影響精度 Residual dirt flash will affect the accuracy
6	風乾 Dry	氣槍先吹乾淨電風扇再吹乾淨 Blow with the air gun then with the electric fan	避免洗劑殘留零件 Avoid the lotion residue on parts

品質變異的控制
Quality Variation Control

a) 落實每日的執行/ Thorough Execution of Daily Practice

自主檢查由作業人員進行，每日依據原物料、半成品或成品的特性，規格要求的標準、上限、下限進行自主檢查，也可能運用查檢表。檢驗頻率有：首件、抽檢、全檢、點檢，檢驗方式有：量測、目視、化驗。系統查偵由主管和品保人員進行，可能運用查檢表，檢驗頻率有：首件、巡檢、抽檢、全檢、確認、點檢，檢驗方式有：量測、目視、化驗。

Independent inspection is done by the operator. Carry out the daily independent examination base on the characteristics of raw material, semi-finished or finished products, the specification standard, upper limit and lower limit;The checklist may also be used. Inspection frequency can be first piece or sampling, full inspection. The test methods are by measuring, visual and chemical examination. The system is detected and checked by the supervisor and quality control personnel, and a checklist may be used. The inspection frequencies are for first piece, sampling inspection, full inspection, confirmation, and point inspection. The test methods are by measuring, visual and chemical examination.

b) 追查每週的內部不良/ Weekly Follow-up of Internal Defects

製程上運用防呆手法概念，設計規劃出工具使用或特殊量具測量，使製造過程不會因為人員疏忽而發生錯誤，以零錯誤為製程目標。將不良半成品或成品退回前段製程重做，盡可能降低重工成本。再根據不良半成品或成品的問題狀況，進行製程調整以吻合品質標準，等完成所有的製程矯正，品檢的頻度就可以減少，不必作過度查偵。

With the concept of foolproof for process design, use tools or special measuring tools and avoid man-made errors during producing process due to staff negligence. Zero error is the goal of the process. Return the bad semi-finished or finished products to the previous station for re-production and minimize the cost of double-operation. Adjust the producing process to meet the quality standards. After completing all the process correction, the frequency of the QC can be reduced. No need to have excessive check and detection.

C) 檢討每季的產出結果/ Review Results of Quarterly Output

每季檢討衡量整體流程是否做好，例如：品質、成本、交期、滿意度等等。建立產品規格標準的系統查偵，並且每季檢討。利用每季的製程能力分析和客訴回饋分析，整理出必須改善和下一階段產品提升的重點，並修訂到製程作業程序。

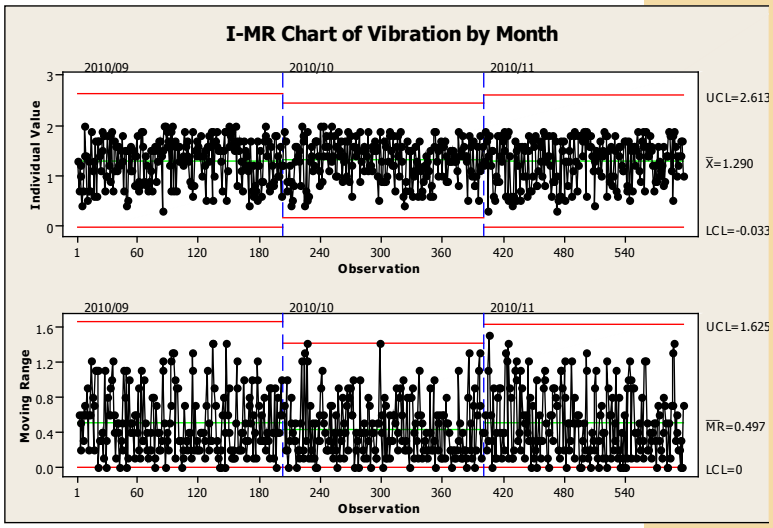
Quarterly review whether the overall process is done correctly, such as quality, cost, delivery, satisfaction, and so on. Establish the checking and detecting system for the product specifications, and review quarterly. Use the analysis of quarterly process capability and customer feedback to sort out the points to improve and enhance in the next phase, and revise the operating process.

茲以振動值管制圖說明如下：

The following is a description with control chart of vibration value:

由製程資訊化管理系統，歸類整理收集自變數，進行統計資料分析，由管制圖上可以了解製程是否穩定和立即反應製程上有無發生變化。管制圖最大的用途，是彌補自主查偵與系統查偵的不足，眼睛和量測只能看到個數，整體來看，自變數有沒有發生變化，看不出來，所以需要管制圖，用統計的觀點來看自變數是否有變異，發現問題馬上解決。技術人員於振動值管制圖上可以看出每月製程進行的改善是否有進步和穩定與趨勢，提供管理者正確的專業判斷。

Classify by a process information management system to collect the independent variables for statistical data analysis. From the control chart, we can understand the process stability and see changes on the process immediately. The main purpose of the control chart is to make up for the shortage of independent investigation and system detection. The visual check and measuring can only show the number of independent variables. Overall speaking, the change of independent variables cannot be seen. Therefore, the control chart is necessary. Check for any change of independent variables with statistical perspective and solve the problem immediately when it is found. Technical staff can see from the control chart of vibration values that the monthly process is improved and stable, and the trends can also be seen. The result can provide the information for administrators to make right and professional decision.



振動值管制圖

Control chart of vibration value

結論 Conclusion

感謝主軸廠同仁們致力於製程資訊化管理系統的執行和生產製程的改善，漸進地將流程優化和產能加大化，並且獲得歷年來最亮麗的成績，在此生產改善的過程中，許多不合理的地方，迫使我們重新認真地思考，我們要做什麼？怎麼做？並重新關注：產銷的節拍、物料的流動、製程的品質等等，經由大家的腦力激盪與努力，一一提出具體可以執行的方案，並有效的持續力行，才共同完成這些艱巨的任務。今後主軸廠將繼續秉持追求盡善盡美的精神，讓恩德也成為向世界一流的主軸公司。

Thanks to the colleagues in the spindle factory for the implementation of the process information management systems and the improvement of the production process, the process is optimized and the capacity is increased gradually and obtains the most brilliant results over the years. During the improvement of the production process, many unreasonable factors have made us re-consider seriously. What will we do? How to do it? And thus let us refocus on the tempo of production and sales, the flow of material, process quality, etc.. By the brainstorming and hard work of us all, the specific solutions are figured out one by one, and carried out continuously and effectively so that we can complete the arduous task. From now on, the Spindle Factory will continue to uphold the spirit of the pursuit of perfection, and also allow Anderson Group to become one of the world-class spindle manufacturers.

恩德集團美國分公司 2012 年經銷商銷售研討會

ANDERSON GROUP AMERICA host's the AGA DEALER SALES SEMINAR JANUARY 2012

Raymond G. Ward from AGA

2012 年 1 月 11 日至 13 日，恩德集團美國分公司在北卡羅萊納州夏洛特市，舉辦銷售暨資訊研討會。

美國經濟於2008 遭逢「金融風暴」後，境內經銷商網絡整體架構發生劇烈變化。而恩德與我們許多的銷售夥伴也一樣經歷了非常戲劇化的變遷，這些銷售夥伴多年來都是公司銷售網絡的中流砥柱。

機器製造商和進口商盡力維持在美營運的當下，但也並沒有忽視一個事實，就是數以千計持有、使用ANDI 產品的顧客，仍然仰賴技術支援和零件供應，以維持其生產作業。而我們的美國銷售夥伴也盡全力幫助他們維持營運，並且和他們各自負責的市場、區域裡的顧客群保持良好、友善的關係。

公司所面臨的嚴峻改變和挑戰，教導我們這些熬過金融風暴的人要「活在新世界」，而且要學習以往從未接觸過的生存技巧。

恩德集團美國分公司可以維持在美國的營運而毋須進行大幅度的組織異動，同時也對穩定成長、復甦中的美國經濟局勢做好準備，並且能夠將資金投入由母公司台灣恩德集團決定、批准的投資案。

我們已預期未來在美加地區及中美洲市場的成長及市佔率，並且據以進行規劃，此時銷售夥伴的奧援自然是不可或缺的；再者，過去一年裡，我們的首要任務是組織、維護及支持一個專業銷售團隊，以服務專用機的經銷商。這些

From January 11th to January 13th 2012 Anderson Group America (AGA) hosted a Sales and Information Seminar in Charlotte, North Carolina.

Having experienced the <Great Recession> the US economy underwent starting in 2008, the overall landscape of the US dealer network also changed dramatically and Anderson as well as many of our sales partners, who for many years were the backbone of the company's sales network in the United States lived through dramatic transformations.

As machine builders and importers struggled to maintain their operations in the USA, not wanting to lose sight of the fact, that thousands of customers, owning and operating ANDI products, still depended on the technical support and parts availability to maintain their manufacturing operations, also our American sales partners underwent challenges to maintain their operations and stay loyal to their customer base in their individual market areas and territories.

These drastic changes and challenges to the company taught all who survived this recession to <live in a new world> and learn survival skills not previously experienced.

Anderson Group America was able to sustain its US operations without making major changes to their organization and was able to prepare for an economic

專家連同美國恩德銷售團隊，形成我們提升市場滲透率、覆蓋率的核心主力，他們將致力於恩德、Omnitech、恩德DPC 產品在北美、中美洲的專業行銷。

對於恩德集團美國分公司而言，重點在於提供知識庫、必要產品資訊給我們的銷售夥伴，使他們的專業工作得以順利進行，同時向市場宣示恩德已經從金融風暴中蛻變成一個更強大、更有組織的 CNC 鏤銑機和數位噴繪機供應商。

2011 年 11 月我們決定舉辦 2012 年初經銷商銷售暨產品研討會，且已寄發邀請函給超過 50 家近年來和美國恩德有合作關係的註冊銷售夥伴。這些銷售夥伴同時代表著恩德（ANDI）、Omnitech（SELEXX 系列）、恩德/DPC 印刷的專家。

美國恩德也想到一個獨特的方法來寄發邀請函，並獲得銷售夥伴們的注意。我們準備一份「個人 DVD 邀請函」給各受邀單位，這部影片大約 5 分鐘長。對於觀看 DVD 接收邀請函的「初體驗」，每個接收單位的反應都很良好，大部分的受邀經銷商都認為這是個獨到又聰明的點子。

為了準備這次活動，我們將議程重點安排在「產品發表」上，展示美國恩德豐富多樣的CNC 鏤銑機和數位噴繪機產品。

我們要求公司所有的業務經理都要準備詳細的產品簡報，包括他們現階段負責的產品，以及他們熟稔的各項產品，跟大家分享他們多年來向廣大、特性分歧的顧客銷售恩德及Omnitech 產品的經驗。

我們對業務人員的要求就是要讓顧客瞭解，我們各種功能強大的產品獨到之處為何。同時，讓銷售夥伴有機會學習、深入體會我們對品質的關注，藉此讓他們成為全球CNC 技術領導品牌之一的優秀零售商。

除了我們自己的專業簡報，還有幾個提供高品質產品和專業技術的「關鍵供應商」也協助本次活動的進行。供應商代表之中，例如提供高品質、高可靠度刀軸給我們 CNC 加工中心的德國 ATEMAG 、CNC 控制器領導品牌 Fanuc、提供尖端軟體的 PLANIT，和其他專業供應商的幫助使本次活動圓滿完成。

研討會的「高潮」之一是美國恩德Raymond G. Ward 邀請加拿大籍 Paul Demchuk 的演講，講題內容是他在「太平洋山道」的徒步歷險。這次徒步行程長2000 英里，從英屬哥倫比亞、加拿大，到墨西哥邊境，Paul 以四個半月的時間完成，其間他走過北美，甚至可能是全世界最荒涼的地方。他的簡報大意是「如何在危險的環境中生存」，他面臨的挑戰包括：瀕死、失溫、挨餓、碰到 9 頭熊、不計其數的蚊子和各種昆蟲，還有學會如何閃避森林大火。Paul 從中聯想到：商場上，領導人如何在充滿危機的商業環境中謀生圖存。而能讓自己的感受更敏銳、求生意志堅強

recovery in the USA, which is now underway and poised to grow and capitalize on the investments made and approved by the parent company, Anderson Industrial Corporation, Taiwan.

As we prepared for and also envisioned our future growth and market share in the United States of America, Canada and Central America, we of course cannot do this without the support of our valued sales partners and for us the first priority will be, as in years past, to organize, maintain and support a professional Sales Team of dedicated Machinery Dealers. These professionals, together with the AGA sales team, form the core of our market penetration and coverage and will contribute to the Anderson, Omnitech and Anderson/DPC products being professionally marketed and promoted throughout North and Central America.

Important to Anderson Group America was to provide these sales partners the knowledge base and product information necessary to enable them their professional work and also show the market that Anderson has emerged from the recession a stronger company, well organized and with a solid product offering in CNC Routers and Digital Printer products.

It was decided in October 2011 to host a Dealer Sales and Product Seminar in early 2012 and invitations were sent to 50 plus registered sales partners who in recent years had an association with AGA. These sales partners represent both Anderson (ANDI), Omnitech (SELEXX series) and Anderson/DPC print specialists.

AGA also thought of a unique way to send our invitations and receive the attention of our sales partners, by providing for a <personal invitation by DVD> to each invited party. This video was about 5 minutes long and was well received by all recipients, as this was “a first experience “ to receive an invitation by having to review a DVD. The majority of invited dealers thought this to be a unique and clever idea and it was well received.

In preparation for this event, the main focus of course was to arrange and organize for <Product Presentations> on AGA’s expansive product offering in both the CNC Router as well as the Digital Print products offered.

All Sales Managers of the company were asked to prepare and execute a detailed presentation of the product range they are responsible for and which they know very well, bringing many years of experience in selling the Anderson and Omnitech products to a large and very diverse clientele.

The mandate given to our Sales Staff was to establish what makes our products unique and versatile and provide our sales partners the opportunity to learn and better understand our attention to quality and allow them in turn to become successful retailers of one of the

營運與管理
OPERATION AND MANAGEMENT

的人，將會凌駕於他人之上。他的簡報令人印象深刻、難以忘懷。

接下來的重要活動是一場在美國恩德舉行的公開招待會，大約有 40 位訪客參與，我們展示8 項 ANDI CNC 產品，包含 5 軸工具機、ANDIMAXX 重切削 CNC 鏤銑機、新款STRYKER 穿越進給式工具機、UV 數位噴繪機 COJET 和 AJET、2 款 SELEXX 的產品。

附帶一提，兩位來自母公司的貴賓－楊惟仁先生和李明哲先生，他們遠從台灣加入我們的行列，而且協助我們讓活動順利進行。大家都也從中獲得許多經驗。

我要感謝所有參加本次活動的訪客、贊助者，當然也感謝恩德集團美國分公司的專業團隊，讓我們擁有精彩豐富的體驗，並且也要感謝他們的努力與執著，讓我們向市場、銷售網路、競爭對手宣示恩德的強大實力，以及未來攻取優勢市佔率的決心。

leading brands in CNC technology worldwide.

In addition to our own professional presentations, we were supported by some of our <key vendors> who support AGA with their quality products and know-how. Representatives of ATEMAG, Germany who provide for high quality and dependable aggregates for our CNC Machining Centers, FANUC, the world's leader in CNC controllers, PLANIT who offers state-of-the-art software products and other professional suppliers contributed substantially to the success of the event.

A "highlight" was the presentation given by Mr. Paul Demchuk of Canada, who was invited by Raymond G. Ward, of AGA to speak about his adventures of hiking the "Pacific Crest Trail" from British Columbia, Canada to the boarder of Mexico. A 2000 mile hike that took Paul 4.5 month to complete and took him through some of the most remote parts of North America, if not the world. The tenor of his presentation was < How to survive in a hostile environment > and with the challenges he faced, from near death situations, hypothermia and starvation to having encountered 9 bears, millions of mosquitoes and other insects and learning how to evade forest fires. Paul associated this with what business leaders encounter living through hostile business environments. Ones senses become keener and the desire to survive overrides all else. A truly remarkable and memorable presentation.

A further key event for our approximate 40 visitors was the Open House at AGA, where we were able to show and demonstrate 8 ANDI CNC Products, to include a 5 axis machine, an ANDIMAXX heavy duty CNC Router, the new STRYKER Through feed machine as well as our UV Digital Printers COJET and AJET and 2 SELEXX models.

We also wish to mention the attendance of two honored guests to this key event, Mr. Wei-Jen Yang and Mr. Tommy Lee of our parent company, who joined us from Taiwan and were able to assist and contribute to the success. It was a learning experience for all.

I wish to thank all participants who joined us as visitors, contributors and of course the professional staff of Anderson Group America for an outstanding experience and for the work and efforts made to show our market, our sales network and our competitors that Anderson is strong and will develop major market share in the years ahead.

銷售的核心 - 服務與品質

Sales Core - Service and Quality

顏昌耀 Aber Yen From CNT

CNC 綜合加工中心在目前的木工及非鐵金屬或塑料切割業，已是不可或缺的重要機械設備之一，無論是生產製造KD組合傢俱、廚櫃、音箱、相框、模具、餐桌倚、電視櫃、門板及板式傢俱等的木器廠，無論規模大小，幾乎都已在使用CNC 綜合加工中心。

CNC machining center has been one of the indispensable and important mechanical equipments for current woodworking and nonferrous metal or plastic cutting industries. No matter what the wood furniture factories manufacture, such as KD combination furniture, kitchen cabinet, sound box, photo frame, mold, dining chair, TV cabinet, door plank, and panel furniture, or no matter the scale is big or small, most of them have already been using the CNC machining center.

由於此種設備包含有鑽、鋸及銑(或是刨)的功能，再配合電器、電腦(控制器)及機械架構的搭配，可將所需加工的產品一次性加工完成，因此設備價格較高，售後服務的快速性往往較一般傳統機械更為重要。客戶在使用加工中心時，一旦產生故障，往往是與電腦或是機械甚至於電器零件彼此間相互關連，若是沒有經過專業訓練的人員，即一般的電工或機械維修工，往往很難在最短的時間內將問題查出並與以解決。

Since such equipment consists of the functions of drilling, sawing and milling (or planning) and is further fitted for electric appliance, computer (controller) and mechanistic structure, the product requiring machining can be machined completely at a time. Therefore, the

price of such equipment is higher and the rapidity of after-sales service is usually more important than traditional machinery. Once a failure happens while the customer is operating the machining center, it is usually related to the correlation among computer, machinery and even part of electric appliance. If the person is not professionally trained, i.e. a general electrician or machinery maintenance staff usually can not find the problem and solve it within a short time.

在中國，所有的客戶都希望在問題發生的當下，就能立即予以解決，由於大陸幅員廣闊，維修工程師往往都先利用電話的溝通來判斷問題所在，因此，經驗與技術的累積更相形重要。

In China, all customers wish to solve the problem instantly when it happens. As the territory of China is broad, maintenance staffs usually communicate by phone to find the problem. Therefore, the accumulation of experiences and technology are even more important.

早先加工中心都是使用日本FANUC 或是德國Siemens的控制器等較為知名且穩定性高的控制器，因此，大部份

市場行銷展望
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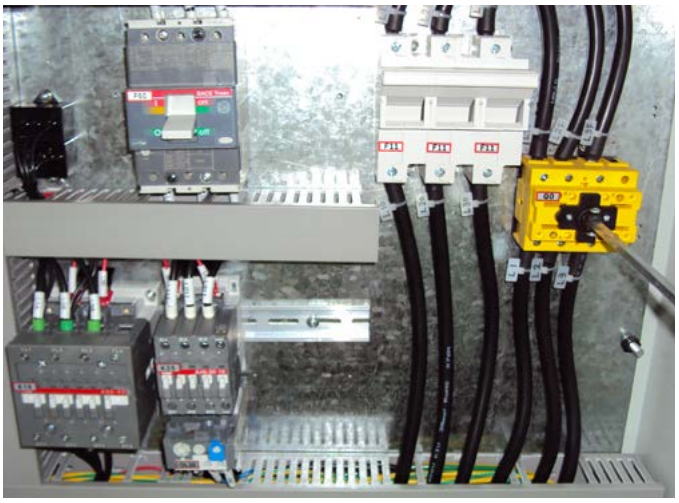
的設備所會產生的問題幾乎都是以電器零件的損壞或是軸承的問題較多；但是近年來，為了使得機械設備的性價比能更加符合客戶的需求，許多的CNC 設備是採用所謂的PC 級控制器，雖然操作畫面似乎較為簡易，但是常常會因為作業環境的不良，或是本身內部電子零件或是軟件的問題，產生不明原因的當機或是無法與硬體相聯結，這時若要找出到底是機械，或是電子零件，或是控制器的問題，再加上若是有專業言語上的溝通不良，就更是難上加難。如果還有零件供應上的不夠便捷，那麼常會造成停機待修過久的事情發生，這都會直接造成客戶生產上的損失。有鑒於此，CNC 的專業服務團隊以及在中國國內是否有生產製造基地的製造商，都是許多客戶的最優先選擇。

In the past, the controllers used in most machining centers were FANUC from Japan and Siemens from Germany, which are more famous and with high stability. Therefore, the problem happened to equipments were mostly related to the damaged parts of electric appliance or bearing. However, in recent years, in order to have a cost performance closer to clients' expectation, many CNC equipments have adopted the so-called PC-grade controller. Though the operation screen seems to be simpler, a crash caused by unknown reason or hardware unable to be connected may happen because of the poor operation environment or the problem of its inner electric part or software. It is all more difficult to find out whether it is the problem of machine, electric part, or controller when there is a communication problem with terminology. If there is even an inconvenience of part supply, it will result into a longer downtime and cause production loss of the clients directly. In view of this, the manufacture who owns a CNC professional service team and production base inside the territory of China will be a top priority of most customers.

恩德早已在1993 年起就在上海開始佈局，分別在北京、上海及廣東設有服務團隊及消耗性的零件庫存，更於1997 年起在上海設廠，也是所有目前國際知名CNC 加工中心製造商中，第一家於中國設立生產及製造基地，以確保能服務及維修恩德所有的機械設備，而且，每台機械都附有符合CE 及ISO 標準的隨機資料

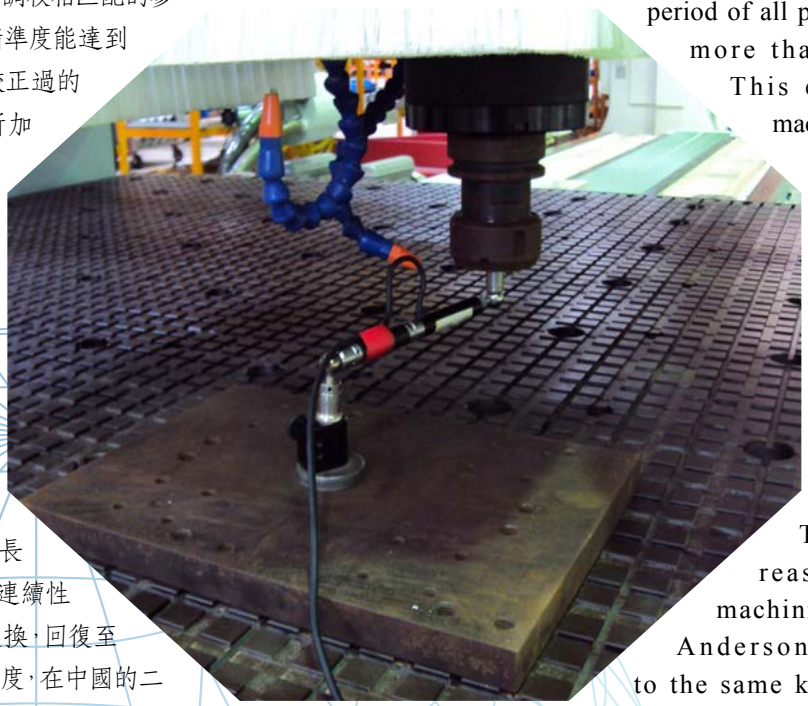
Anderson has started its layout in Shanghai since 1993 and built a service team and stock of consuming parts in Beijing, Shanghai and Guangdong. Anderson set up its factory in Shanghai in 1997. It is the first manufacturer of all international famous manufactures of CNC machining center to set up its production base in China to ensure the service and reparation of all machineries and equipments of Anderson. Moreover, each machine is attached with data complying with CE and ISO standard.

除此以外，在CNC 設備的電氣配備及電路的接頭是否有明顯的號碼標示也是非常重要的，因為可以從廠商所隨機附送的線路圖資料，再配合線路的號碼，往往可以在第一時間內先查看機械的故障原因，或是因操作不當所引起。因此，客戶在機械驗收時，除了機械要能正常操作並瞭解簡易保養維護的方式外，更要檢查是否有隨機附送的機械操作說明書、機械零件結構圖、電器零件表、電路圖、氣壓圖、控制器維修操作手冊等，是確保往後設備能繼續正常使用的重要條件之一。



In addition, it is also very important if there is an obvious number mark for electric appliance of CNC equipment and joint of circuit. This is because the reason of machine failure may be looked up in the very beginning to see if it is caused by a poor operation through the circuit diagram enclosed with the machinery and the number of circuit. Therefore, upon an acceptance check of machine, customer not only needs to see if the machinery can be operated normally and learn some simple maintenance and reparation methods, but also has to check if there are an operation manual, parts structural drawing, parts list of electric appliance, circuit diagram, air pressure diagram, controller maintenance operation manual, etc. enclosed. This is one of the important conditions to ensure this equipment can be operated normally in the future.

另外，加工中心在製造過程，是否有經過所謂的Ball bar 循圓測試，以確保機械的X 軸及Y 軸的同步移動，也是對於機械的精準度好壞，至為重要的因素之一；關於此項數據，可藉由循圓測試儀以調校相匹配的參數，以使機械的穩定性及精準度能達到最佳化。沒有經過此儀器校正過的設備，往往在使用初期，所加工的產品還能符合最終客戶的需求，但是在機械使用一段時間，產生零件的磨耗後，無論怎樣更換零配件及維修，已無法回復機械的原始最佳狀況。恩德的加工中心，在出廠前，全部經過循圓測試儀反複的測試，以確保機械的加工品質。在經過客戶的長期甚至接近每天24 小時的連續性使用後，仍可經由零件的更換，回復至接近新機出廠時的標準精度，在中國的二手機市場上，最搶手且單價較高的加工中心也幾乎都是恩德的設備，由此不難看出恩德機械品質的端倪。



Furthermore, it is also one of the important factors for the precision of machinery if a machining center has been carried out a ball bar circular test to ensure the synchronous motion of X axle and Y axle. With regard to this data, the parameters matched can be adjusted by circular test to enable the stability and precision of machinery can be optimum. Any equipment which has not been adjusted by this device may usually be able to meet the requirement of end users. However, once the parts have been worn and torn, the machinery can not recover to its original optimum condition even though the parts have been replaced or repaired. All the machining centers of Anderson have been tested repeatedly by circular test before leaving the factory to ensure the machining quality of machinery. After continuous operating for a long term or even 24 hours per day, the standard precision still can be recovered almost like new machinery by replacing the parts. In the second-hand machinery market of China, the most popular and expensive machining centers mostly come from Anderson. This can be deemed as a clue for the quality of Anderson machinery.

恩德也完善的保存所有的機械資料，所有零件的可追溯期至少在20 年以上，使得客戶所購買的恩德的加工中心，即使在任何的國家，都可經由當地的代理或是經銷商，或是恩德派遣的工程師，迅速的維修。這也是為何恩德的加中工心，在同類型的產品中，能被多數客戶所認可及購買，儼然成為亞洲精密機械製造的第一品牌。

Anderson also conserves all the machineries data perfectly. The retroactive period of all parts is at least more than 20 years. This enables any machining centers purchased by customers in any country to be repaired rapidly by local agent or distributor or engineer dispatched by Anderson. This is the reason why the machining center of Anderson comparing to the same kind products are approved and purchased by most customers. Anderson dignified the first brand of precision machinery manufacture in Asia.

恩德集團美國分公司 2012年的挑戰與展望

ANDERSON GROUP AMERICA Challenges and Outlook 2012

作者：Raymond G. Ward

美國是全球最大經濟體，北臨加拿大、南鄰墨西哥。美、加約有 5 億人口居住在這遼闊的地理區域裡，而據估計，這裡是世界上平均每人所得最高的區域之一。

墨西哥具有豐富的資源和極為實惠的人力成本，其通往美國市場的運輸距離很短，在當地生產製造的投資機會非常有利，對恩德及 Omnitech 擅長的機器銷售業務，是個深具潛力的優良市場。

因為 2007 年末期到2011 年底的「金融風暴」重創了美國和部分的世界經濟，恩德集團美國分公司和其他所有的資本設備銷售業者一樣都受到嚴重影響。

當中詳情就是 － 美國的GDP（國內生產毛額）縮減到 1970 年代以來首見的低點。大約是整個勞動人口10% 的幾百萬人，都陷入失業的狀態。恩德集團美國分公司過往在木工市場 CNC 銷售的主要獲利來源－房市，已經完全崩潰，成了一灘死水。銀行凍結所有放款業務，而消費者也停止支出。美國汽車工業嚴重衰退，後來得到美國政府 5 仟億美元的扶困金。許多家庭不僅失去工作，畢生積蓄也因無力承擔房貸而消耗殆盡，結果有 3 百萬戶遭到查封。股市則在短短幾天內重挫了 50%。這是一場美國前所未見的經濟災難。根據2007 － 2011 年的財產損失總計，以及對於國內和全世界的影響程度，專家們相信「金融風暴」的衝擊更甚於 1930 年代的「大蕭條」。

恩德集團美國分公司通過了這場世界末日般的考驗。同時，由於獲得台灣高階主管的支持和理解，我們得以維持

The United States of America represents the largest economy in the world. Boarded by Canada to the north and Mexico to the south this huge geographical area represents a total of approx. 500 million people with the USA and Canada also accounting for some of the highest per capita income in the world.

Mexico has huge resources and very affordable labor costs and with short transportation distances to access the US market, has extremely favorable investment opportunities for local manufacturing, a good market for potential machinery sales in which Anderson and Omnitech traditionally have done well.

Due to the “Great Recession” which crippled the US and partially the world economy from late 2007 to the end of 2011, AGA was, as all other companies involved in capital equipment sales, severely affected.

Put into context – The US GDP (Gross Domestic Product) shrank to levels last seen in the 1970’s. Millions of people, approx. 10% of the available work force went into unemployment. The housing market, which in the past provided for most of AGA’s revenue in CNC sales to the woodworking market came to a standstill, as the this market collapsed completely. Banks froze all lending and consumers stopped spending.

The US automotive industry went into a severe recession and was bailed out by the US government in the amount of ½ trillion US$.3 Million home’s went into foreclosure, as families having lost their

現有的商業模式，並且因應大家對美國經濟會大幅好轉、復甦的期望來預作準備。大家都感受到經濟已開始復甦。帶動美國經濟成長的汽車工業正重振雄風，所有的美國汽車公司，以及海外製造商的美國子公司又再次成長。失業率逐步下降。股市幾乎恢復到金融風暴前的水準，銀行也慢慢願意放款給私人和公司行號。即便是房市，也確實看到春燕來臨，而恩德集團美國分公司現有顧客群的 80% 和木工產業相關，因此我們也格外受到鼓舞。

恩德集團美國分公司正「蓄勢待發」。因為我們已在最艱難的時刻通過考驗，我們的信念是：隨著經濟的復甦，我們會恢復過往的銷售業績和服務活動，再次成為恩德集團中的典範，過去幾年讓恩德集團美國分公司重新思考和發掘我們的強項，並且逐步消除及改善我們的弱點，而 ANDI 的名號顯然在我們所佔有的市場中仍代表著高品質、高性能的標竿。

因為客戶相信我們製造 CNC 鏤銑機的技術力、恩德集團美國分公司滿足顧客需求的服務能力，恩德在北美的裝機量已超過 3000 台，這是它在市場中重獲應有地位的堅實基礎，也是「關鍵廠商」、「業界佼佼者」的表徵。

我們的目光已經更上層樓，轉移到別的地方。我們曾經以木工產業為主要市場，如今這部分的市場日漸萎縮，且流失了約 25% 的顧客群。目前恩德集團美國分公司已朝向航太、高階複合材料、塑料、非鐵金屬市場尋求成長。這些市場不但再次快速成長，而且這些產業的資本投資力道都相當強勁，因為市場對於已加工產品、購買機械設備的需求都持續增加中。

jobs and having spent their savings could no longer afford to meet their mortgage obligations. The stock market lost 50% of its value in only a few days.

An economical disaster the USA had not yet seen. Experts believe that the <Great Recession> had more impact that the <Great Depression> of the 1930's due to the amount of accumulated wealth lost from 2007 – 2011 and the overall effects on the nation and the world.

Anderson Group America prevailed throughout this apocalyptic time and with the support and understanding of our senior management in Taiwan was able to sustain its business model and prepare for what all believe will be a major recovery and comeback of the US economy. The recovery has started and is being felt by all. The automotive industry, being a catalyst for growth in America is doing very well again. All US automotive companies, as well as the US subsidiaries of oversea manufacturers are growing again. The unemployment levels are falling. The stock market has almost recovered to pre – recession levels and the Banks are slowly but surely willing to make loans to both private and business enterprises.

Even the housing market is showing some solid signs of recovery, which for AGA is encouraging as 80% of our current customer base is related to

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具有 35 年 CNC 鏤銑機經驗的恩德必然會成功。當市場從「由業務驅動的企業」轉變為「由工程解決方案驅動的企業」，憑藉包含嫻熟的技術人員、經驗豐富的業務管理團隊之人力資源，與北卡夏洛特市展示間的頂尖設備，恩德集團美國分公司必定會達成公司所設定的目標。

我們的展示間配備了最新的 ANDI CNC 技術，這是我們在美國營運的關鍵項目，因此這個展示間可說是西半球的 ANDI 技術「旗艦店」。經驗告訴我們，當顧客參訪我們的展示間，看過任何產品的專業展示，並且瞭解我們的業務和技術團隊的專業程度後，我們敲下訂單的機率就會急遽上升。

恩德集團美國分公司維持主軸維修站（我們可以在此維修氣冷式和水冷式 ANDI 主軸）的能力是迎向成功的另一個要素。我們在主軸報修後的快速、高效率完修時間，顧客給予高度評價。這當然是一項非常值得的投資，也得到了顧客的肯定和重視。

恩德集團美國分公司現在的體質十分強壯！！！作為一家公司企業，我們的員工樂於在此工作，並面對詭譎多變的市場裡各式挑戰。無論如何，我們的目標是成為北美CNC鏤銑機市場的關鍵廠商，為達成顧客和管理階層的期望，我們的產品、多角化經營、專業方法終將帶領我們向勝利邁進。

the woodworking industry.

AGA is <Open for Business> and as we prevailed through the hardest of times, our belief is that with a recovery in the economy, we will once again be a poster child for the Anderson Group as we regain our sales and service activities.

These past years have allowed AGA to rethink and rediscover our abilities and strength as well as to take steps to eliminate or improve on our weaknesses and it is a clear and unequivocal comment that the name ANDI still standards for quality and performance in the market area we cover.

Based on this trust in our abilities as a CNC Router manufacturer and AGA's ability to service and support the needs of our customers, Anderson with its installation base in North America of over 3000 machines, has a solid foundation to regain its rightful position in the market, that is of a "key player" and "top contender".

Our focus has shifted. Once dominated by the woodworking industry, which has shrunk and having lost about 25% of our existing customer base, AGA has now engaged in seeking growth in markets such as the aerospace, high end composites, plastics and NE metals. These markets are growing fast again and capital investments in these industries is strong, as both market demand for machined products and available capital to finance the acquisition of machine equipment is increasing.

Anderson with 35 years of CNC Router experience is predestined to be successful and as the market has shifted from a <sales driven enterprise> to an <engineered solution driven enterprise>, AGA with its human resources in skilled technicians and highly experienced sales management and a state-of –the-art show room facility in Charlotte, NC will meet the demands set in our company.

Our show-room is equipped with the latest in ANDI CNC technology is the center piece of our US operation and could be described as the <Flagship Store> of ANDI technology in the Western hemisphere. Experience has proven that when customers visit our show room they receive a professional demonstration on any of our products and combined with the professionalism of our sales and technical team, our chances of closing an order exponentially increases.

AGA abilities to maintain a Spindle Repair Shop in which we can repair both air cooled and water cooled ANDI spindles is a further denominator for our future success and our customers appreciate the fast and efficient turnaround of a requested spindle repair. Certainly a worthwhile investment into our market and highly respected and appreciated by our customers.

The state of Anderson Group America is strong!!! As a company and as an enterprise in which our staff enjoys to work and accept the challenges presented in a still volatile market. However, as we have set our course to become a key player in the North America CNC Router market, our products, our diversification and our professional approach to meet our customer's, our management's expectations will prevail.

夏初北海道記行

EARLY SUMMER TRIP IN HOKKAIDO

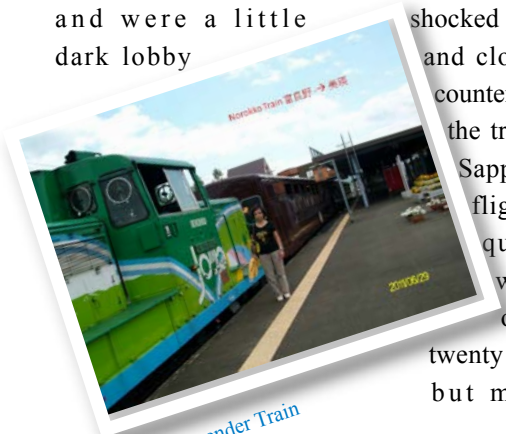
楊月華 Tammy Yang from Anderson Group

這次6/28，自成田機場進日本，移民官開了3個窗口給外國人通關，但是，進日本的外國人，10根手指頭伸出來還有剩，咻一下就0kay了。從空橋下來、通關、領行李，再走路到國內線報到櫃枱，總共只花了40分鐘，這還包括我們走錯路。

For this trip we entered Japan from Narita Airport on June 28th. The Immigration official opened three windows for customs clearance of foreign visitors but there were fewer than ten visitors on this day and we went through customs in seconds. We could finish counting the visitors by less than ten fingers this day. It only took us a total of 40 minutes to pass the jetway, clear customs, get our luggage and check in to the domestic check-in counter, and this includes getting lost on the way.

原本直直走就好了，我們卻往2樓走去，被國際出境大廳昏暗的燈光、關閉的報到櫃枱給嚇了一跳，以為關門大吉了；還有原本以為轉札幌國內線班機空檔僅有1小時20分，會不會太趕，結果竟然還有40分的空檔。在上廁所與等待gate開放期間空調沒開，好熱！

We should have gone straight but went upstairs instead, and were a little shocked upon seeing a dark lobby and closed check-in counters. We thought the transfer time to Sapporo domestic flights would be quite a rush – we will have one hour and twenty minutes only, but much to our surprise, when we were done, there were 40 minutes left. However it was hot as the air conditioner was not working when we went to the washrooms and waited for the gates to open.



Lavender Train

第2天 6/29，到富良野，如果不是富良野花季就別去富良野吧！老式的小車站，得提著行李上下樓梯，救人ㄡ！階梯很多，我帶了個搭飛機可以手提的小行李，已算是經驗老道了，但心裡還是忍不住〇〇╳╳，暗罵了一聲。

Day two was June 29th and we visited Furano. If it weren't for the flower seasons, this place could not be recommended. An old station where we had to drag the luggage up and down stairs almost killed us. Can someone help? I pleaded for help in my heart! And there were tons of stairs. I was of the more experienced travelers and brought a small briefcase, but still cussed a bit in my heart.

富良野 Rope Way

行李寄放車站置物櫃，馬上轉搭Norokko Train觀景慢車自富良野到美瑛，雖然出發前就已知還不到薰衣草開花的時節，但總該有別的花田吧？ㄘㄟˇ，沒有就是沒有，一路上除了綠，還是綠，坐1小時的木頭椅座位，屁股痛啊！

Recycle House

After depositing our luggage in the luggage storage of the station, we took the Norokko train, a slow trip from Furano to Biei. We knew lavender wasn't in season before setting off, but we still kept wondering if we would be in anticipation of other blossoms along the way; and what a pity, there were none. We had more than one hour of watching nothing but green and sitting on wooden seats with painful rear ends.

隔天，搭Twinkle Bus 遊富良野，4 個小時，車上只有12 個遊客，Bus 小姐哇啦哇啦一直說、一直說，行程是到電影拍攝場景與Cheese 工廠等吃吃喝喝的地點，只要與吃喝有關，還難不倒我，一切順利愉快。

The next day we took the Twinkle Bus to tour Furano; there were only 12 tourists during the four hour tour and we had a very enthusiastic and professional tour guide who never felt tired of introducing Furano. The tour included visits to movie shooting sites and cheese factories and I had no problem with eating related trips. Everything just went smoothly and pleasantly.

我們自己又去搭Rope Way，到山頂上看風景。僅我跟月玲2 位，專車ㄟ，好樂，想坐哪裡，隨你高興，月玲擺了一個大字。到達後，發現山上只有我們2 個阿西，靜悄悄的，外面下著小雨，好冷！霧霧的，什麼山也看不清，只好原車折返，回程站務員與去程同一位。就可以知道我們停留的時間多短。

Afterwards we took the Rope Way (cable car) to the mountain top. Yue-Ling and I were the only passengers and it felt like a chartered ride. We were both very excited and Yue-Ling even did some stretching. After reaching the mountain top it was still the two of us with the silence and some rain drops. It was cold and foggy and we could not see anything clearly, so we decided to head back. We had the same cable car operator on the ride back and this shows just how short our stay was.

站務員想必暗笑在心裡：唉，兩個歐巴桑，人家這是要去滑雪的纜車，山上又沒雪，上來幹嘛，還擺什麼Pose 嘛！可是，不上去，又怎麼知道上面沒啥搞頭。

I believe the operator must be laughing at us: What are these silly ladies doing on a cable car for skiing when there's no snow on the mountain top, and why were they posing back there? Well, how could we know that there's nothing up there if we didn't go up there?

第4 天7/1，到帶廣、十勝川溫泉，吃到元祖好讚的肉排飯、六花亭甜點。車站內有電扶梯，經過富良野車站的一番折騰，趕快給帶廣車站一個讚。這次入住的十勝川豆陽亭，太棒了！住得好，吃的更棒，晚餐鮪魚、鯛魚、櫻花甜蝦Sashimi，沒在怕你吃，無限供應，有誠意極了。座位旁邊的日本太太不計形像的拿了3 趟，吃了一堆，我也不管會不會皮膚過敏，也給它撩下去了，事後證明，東西新鮮，一點事也沒有，還好，明智的決定。

July 1st was the fourth day and we headed to the hot springs of Obihiru and Tokachigawa.

六花亭

帶廣元祖肉排飯

We had great pork chop rice and Rokkatei deserts. The station was equipped with escalators and it was a great relief after the mess we had at Furano Station. We immediately gave Obihiru Station a big hand. The hotel was Toyotei and it was fantastic. Much to our delight, the lodging was great and the food even better. We had unlimited tuna, bream and Sakura Ebi shrimp sashimi serving with great hospitality in a dinner buffet. The Japanese guest at the next table took three trips to grab food, filling her stomach with a pile of seafood. And I shook off the fear of allergies and ate a lot of seafood. Results told us, if the food is fresh, nothing will happen. I was satisfied with my decision.

丹頂鶴

十勝川的金鞭草溫泉，是日本有名的美人湯之一，泡了會年輕10歲，但只限十勝川，出了十勝川就不掛保證了，搭機回台肯定被打回原形，殘念！泡過無數個日本溫泉，給嬉野、湯布院、下呂，十勝川真是一整個讚，滑潤滑潤，超推薦的

The Moor hot spring of Tokachigawa is a famous beauty hot spring and it makes you ten years younger by just dipping in it. However I know this is Tokachigawa limited and I would return to my old self by the time I get back to Taiwan. That's too bad. I've been in countless Japanese hot springs and the moisturizing hot springs of Ureshino, Yufuin, Gero and Tokachigawa are my favorites. They deserved a big hand and ambitious recommendation from me.

第5天 7/2 到釧路。因為tour Bus 會停在飯店前，提著行李去參加14:00 發車的遊阿寒濕原一周的巴士local tour。反正3 點前到飯店也沒用，只能乾等浪費時間而已。這次巴士只有8 位遊客，一個人坐一排，輕鬆愉快。

On July 2nd, the 5th day, we were off to Kushiro. The tour bus stopped right in front of the hotel and we left for the local tour around Akan Marshland at 14:00. There's no use to get to the hotel and waste time there before 3 anyway. The bus had only eight passengers and each of us got one row of seats for our comfort.

4 個小時的行程中，Bus 小姐，依舊哇拉哇拉的一直說、一直說，Oops！這次慘了，踢到鐵板了，99% 鴨子聽雷，有聽沒有到，1% 是用猜的，喔…現在，在講濕原的形成，當初是海水，後來慢慢變成…？傻了！喔，在講丹頂鶴，出選擇題1、2、3，要我們選，為了共襄盛舉，選錯反正又不罰錢，隨便給它舉手選一個。小姐，你嘛幫幫忙，明知車上有2 個來自台灣的歐巴桑，說些簡單點來聽聽，不然也英文註解一下嘛，真是太難了！但是，好玩極了。

The four hour ride was filled by the endless introduction of the Japanese guide. We had no idea about 99% of the speech and had to guess the 1% left. Okay, now she's talking about the forming of the marshland… it was first ocean and then… forget it. Dizzy…Oh and now she's talking about red crowned cranes… she offered one, two, three choices… We don't get fined for guessing wrong, right? Come on miss, you know there are two Taiwanese women on board, would you give us some help in English explanation? Everything is too difficult! But we could see it was fun.

到濕原需要爬到好高的山上（比美青青草原好漢坡的樓梯），要爬一條筆直通天的樓梯令人傻眼，爬上去，走個上坡，轉個彎，又是樓梯！沿路一直想放棄，不想爬了，累死了，我要回家！可是，Bus 小姐與司機先生一前一後把大夥夾在中間，想落跑，門兒都沒有！本著為台灣人增光的想法，既已被夾住，落跑不成，輸人不輸陣，牙一咬，拼了！

Then we had to climb up to the mountain to see the marshland, and the stairs seemed to go all the way up to the clouds(I can see it's not easier than the Hero Hill Trail in Evergreen Grassland, Taiwan). After a long string of stairs we reach a flat turning point, take a turn and face another endless string of stairs. We wanted to give up and head back but the tour guide and the bus

丹頂鶴自然公園/ 弊舞橋

釧路濕原

driver made sure that didn't happen, walking in front/back of us. As we couldn't run away, I grinded my teeth and kept going, thinking I would bring pride to Taiwan by doing so. Go!

上到展望台，鳥瞰濕原，哇塞！美呆了！一切辛苦，值得了！有Joe 的360 度相機，美景會更加分！Bus 小姐最後唱了一首有關釧路的歌，歌喉真好，人又可愛，幫她照了一張相片，以後萬一成名了，我可以炫耀一下！

After we finally reached the observation balcony I immediately realized that it was worth all the climbing to see this great scenery of the marshland. With Joe's panorama camera, it even gets better. Finally our guide sang us a song about Kushiro. She was a great singer and a cute girl. We took a picture with her and claimed bragging right if she becomes a famous singer in the future.

第6 天 7/3，星期天，下午要搭機回台灣，去找了Bus 小姐推薦和商市場的海鮮蓋飯（勝手井），結果沒開，丹頂市場的螃蟹，也沒開，沿路商店都關門，找不到可以吃中餐的地方。還好，MOO shopping center 樓上屋台的拉麵店還有營業。

July 3rd, Sunday, was the sixth day and we were leaving for Taiwan in the afternoon. We looked for the seafood and rice in bowl (Kattedon) in Kushiro Washo Market recommended by the tour guide but it wasn't open; the crab market wasn't open in Tancho market; all the shops weren't open. We couldn't find a place for lunch. Fortunately the Ramen restaurant in upstairs of MOO shopping center was open.

在羽田出關回台灣，自15 度的釧路來到35 度的東京，熱斃了！在機場轉運的shutter bus 上遇到一團旅行團，大嗓門，吵死了！一大箱、一大箱的行李，唉！回到人間了！

We left for Taiwan from Tokyo Haneda AirPort. It was so killing hot to leave Kushiro of 15 degrees for Tokyo of 35 degrees! And we had to deal with the noises from the tour group on our airport shuttle bus and cases and cases of luggage! We could feel that we were not in heaven any more.

這趟日本行，感覺日本好冷清，太寂靜了，是我到早了嗎？這幾日只遇到來自台灣的3 口胖胖家族與一對來自新加坡年青夫妻，不見歐美人士！怕地震？怕海嘯？怕輻射？所以不敢來日本玩？

On this trip, I wondered if I came Japan too early as there were no tourists. I only met a family of three members and a young couple from Singapore; no European or American tourists appeared. Is everyone scared of the earthquake, of the tsunami, or the radiation? Do people not dare to come to Japan?

你愛日本嗎？你喜歡日本嗎？趕快去消費吧！硬骨子的日本人，他們應該不需要捐款，他們需要大家活絡經濟。不過，日本人也真是的，也不會因為business slow 改改標價，硬邦邦的死豬價，也不變通一下。

Do you like Japan? Do you love Japan? Take a trip over there! I don't think these hard spine Japanese want donations, all they want is a cheerful economy to come back. But they are too stubborn to reduce the high prices even when business is slow.

此番經驗到3 點前到達溫泉旅館，櫃檯會優雅的告訴你3 點後才有房間，讓你在沒有空調昏暗的大廳等待，沒人招呼你，賣店close，連杯冰水也沒有，只能乾等！3 點開工了，燈打亮了，空調開了，招呼聲有了！也許節約人事、節約能源、節約費用，節約、再節約，就是他們的因應策略，但服務質量是不打折！

We experienced that if you arrive at your hotel before three o'clock the clerk would politely tell you that the room will be available after three, and make you wait in the lobby where the air conditioner's off, the shop's closed and not even a cup of water is offered. All you can do is wait. And then when it's three o'clock, the lights were on, the AC was on, and people started greeting us. This is their way of dealing with the effect of disaster by saving on everything: personnel costs and energy source, save, save and save. But it was easy to see that they still offer great service.

6 天5 夜的日本行，突然想念起台中的Massage，7/4 一早醒來，管他一屋子的零亂，先去按摩，恢復元氣（旅遊還是會累的），來一個Happy Ending 圓滿完成！

After staying six days and 5 nights in Japan, I suddenly missed the massage in Taichung. On the morning of July 4th, I ignored my messy room and went for a massage to take off all the tiredness from the trip and get my energy back (after all, sometimes traveling is also tiresome). And that's the happy ending of my story.

竹東蕭如松藝術園區散游

A WALK IN HSIAO JU SUNG ART MUSEUM, ZHUDONG

陳慧玲 Hui-Ling Chen from AIC

今年溼冷又漫長的九天年假中，原想宅在家裡，不想被塞在車陣中或到處去人擠人。但真的好不容易天氣放晴時，卻又不想待在家中發霉，趕緊拎起家中二隻小蘿蔔頭出遊去囉！

It was wet and cold during the nine-day Chinese New Year vacation. I thought about staying at home, not wanting to be in a crowd or stuck in traffic. But when the sun finally came out, I didn't want to rot at home any more. So I took my two kids and headed out.

既然想輕鬆出遊，當然就不能選擇路程太遠與熱門的景點，想起日前曾在網路上看到的資料，但卻仍無緣一訪，就決定前往短短半小時車程近在竹東的蕭如松藝術園區。

To have an easy and comfortable trip, I didn't want to go too far or to popular places filled with people. I remembered seeing the introduction of Hsiao Ju Sung Art Museum, Zhudong on the internet where we haven't had a chance to visit, so I decided to take the half hour drive there.

進入竹東市區後，跟著 GPS 的指示在狹窄的巷道中繞行了好一會，當 GPS 告知已抵達目的地時，心想藝術園區怎可能位在如此狹小的巷弄之內，經詢問在地人，方才確認沒找錯地方。

After arriving in Zhudong, I circled around in narrow streets following GPS instructions. When my GPS told me I have reached my destination, I couldn't believe that an art museum could be in such a small street. I asked a local and finally confirmed that it was the right place.

一進入園區發現腹地並未如想像地大，但對二個得以放風的小傢伙而言卻已足夠了，二個小傢伙立刻滿場飛奔！園區不大其實也有好處，因為大人可以悠哉遊哉地慢慢逛，放心地讓小孩到處跑，也不需擔心小孩走失，因為過一下子這些到處鑽來鑽去的皮小孩時又會在你的眼前出現。

As I entered, I found out that the interior wasn't as large as I thought; but it was more than enough for my two little kids to run around, which was what they did immediately! This is the good thing about the outdoor area not being too large, as adults can take their time and let the children run and roam not having to worry about them getting lost. Just wait for a little while and the kids eventually would appear again.

藝術園區是原任教新竹地區美術老師的蕭如松老師故居，蕭如松老師是台灣美術史上一位重要的水彩畫家。在蕭老師過世後，其故居因長期無人管理、閒置，以致幾成廢墟，實為可惜！後經新竹文化局長達四年修復，始復原為目前所見的園區。園區共由五棟日式房舍及庭園所構成，仍保有相當完整的日據時代建築特色與庭園風貌。其中充滿綠意的日式庭園造景相當自然不造做，據說有不少新人至此拍攝婚紗，是個相當棒的攝影取景好去處！若喜好攝影者至此，「記憶體」應會被謀殺不少吧！

The museum was the past residence of former Hsinchu art teacher Ju-Sung Hsiao. Mr. Hsiao was a water color artist who played an important role in the Taiwanese art history. After his death his residence was vacant and lacked maintenance for a long time, almost turning into ruins. The Hsinchu Cultural Affairs Bureau took four

years to repair it and turned it into the museum that we see today. It consists of five Japanese style houses aand keeps the characteristics of architecture and garden from the Japanese era . The Japanese garden is full of green and word is that many couples choose it for their wedding photo shoot. It is a great place for photography. If you are a photography enthusiast, I am sure this place would use a lot of your “memory space.”

既然叫做藝術園區，怎可少了藝術這個元素呢？當然也就少不了蕭如松老師畫作的展示，園區利用修復完成的房舍作為展覽室，將老屋再利用做了最好示範。日式木造房舍中可隱約聞到木頭的芳香，置身其中賞畫，真是一大享受呢！若運氣不錯，尚可遇到志工，志工可以為來訪者解說蕭老師畫作，剛好可趁機好好補上一堂美術課喔~

As it is called an art museum, the art component of this place cannot be missed. Mr. Hsiao’s paintings are on display in the rebuilt houses, making this an excellent example of reusing old buildings. The distinct scent of wood can be experienced in Japanese wooden house and it is a true enjoyment to view the paintings in such surroundings. If you are lucky you might even meet volunteer guides who explain Mr. Hsiao’s paintings to the visitors. It’s a great chance for a live art lesson!

園區中另一棟建築成為展示蕭老師生前的生活型態的博物館，將蕭老師使用過的器具、文物、文件等，模擬成蕭老師當時生活空間，可以讓年輕一輩感受當時的人生活之氛圍。但這間展示間可不是每天都有開放的唷，我們到訪的當天好像剛好有長官先行至此視察環境，所以才有機會趁著短暫開啟的時間進去參觀，運氣真的很不錯！

Another building in the area puts the lifestyle of Mr. Hsiao on display. A living space like in the past was created with actual tools, documents and other items used by Mr. Hsiao, which provides a taste this era to newer generations. However this display area is not open every day. On the day of our visit, there happened to be a government official visiting and we had a chance to take a look inside during the special, short opening time. How lucky we were!

園區裡也利用修復完成的房舍規劃為「藝術家咖啡廳」，營造成具有戶外景觀的庭園式咖啡廳，也規劃了戶外的露天咖啡座。在這兒點杯咖啡、帶本書，就可以在悠閒地度過一個美好的午後時光。

A rebuilt building was planned as the “Artist’s Cafe” and was made into a coffee lounge with outdoor view. Bring a book and get a cup of coffee, and you can have a beautiful, relaxing afternoon.

如果您不想在假日時到處人擠人，如果您是喜歡老房子的人，如果您想找一個環境幽雅的好所在好好放鬆，這裡應該就是您要找的地方。另外，附帶一提，這兒可是免費開放參觀的喔！

If you don't want to be with a crowd on your vacation, if you like old buildings, or if you want a quiet, relaxing place, then this is the right place for you. Oh, by the way, it is free admission tas well!

HIGH SPEED SPINDLE

【PR玻璃磨削主軸】 【HSK25E】 【HSK32E】 【HSK40E】 【ISO25】 【ISO30】

Spindle type	PR	HSK25E	HSK32E	HSK40E	ISO25	ISO30
轉速範圍(rpm)	60000	50000	40000	30000	30000	24000
夾頭形式	collect	HSK25E	HSK32E	HSK40E	ISO25	ISO30
偏擺精度	<10um (16mm)	<0.02mm (200mm)	<0.02mm (200mm)	<0.02mm (200mm	<0.02mm (200mm)	<0.02mm (200mm)
馬達功率(Kw)	1.2	5	8.1	9	5	15
主軸外徑(mm)	62	100	100	100	100	120
溫度控制系統	PTC	PTC	PTC	PTC	PTC	PTC
轉速回饋訊號	3 wires sensor	NO	NO	NO	NO	NO
冷卻方式	Water	Water	Water	Water	Water	Water

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