行政院所屬機關因公出國人員出國報告

（出國類別：開會）

煉製事業部低硫燃油工場 E2002 A/B/C 換熱器工程設計及購料製作監辦工程連繫

服務機關：台灣中油公司煉製事業部高雄煉油廠

姓名職稱：許東益、紀煌順 機械工程師

派赴國家：義大利

出國期間：98 年 12 月 15 日至 98 年 12 月 21 日

報告日期：99 年 1 月 26 日

摘　要

本次出國爲本部高雄煉油廠辦理低硫燃油工場 E-2002A/B/C 換熱器 BLC 型式（BREECH-LOCK CLOSURE TYPE），俗稱槍膛式換熱器。由世鴻公司承攬（請購案號:C3I97A162），換熱器設備由義大利 KOCH 公司製造。此次派遣出國辦理本案開工事宜、工程聯繫、設計規範研討、製造監辦等工作。

本案使用年度出國計畫第 21 項：參加加熱爐、裂解爐維修，石化工場修護技術研討會及工廠參訪計畫。

本次主要與世鴻公司、KOCH 公司設計人員三方舉行 KICK OFF MEETING 就採購規範供應範圍及澄清事項，設計要求及圖件討論，對材料規格審查及討論，製造時程、品質檢驗和交貨日期、交貨準備等事宜。並赴本案設備器身、浮頭端板供應廠家 MATALCAM、高雄廠氣體純化工場七座反應器製造廠 SICES、桃廠重型反應器製造廠 NUOVO PIGNONE 工廠參觀。

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壹、 出國目的：

一、藉由與代理商世鴻公司、製造廠家 KOCH 公司設計人員三方舉行 KICK OFF MEETING，瞭解製造廠家設備設計能力、製造與檢驗測試之程序，確保設備品質。

二、確定採購規範供應範圍及澄清事項，設計要求及圖件討論，對材料規格審查及討論。

三、瞭解設備製造進度，確保符合工期。。

四、與製造廠家研討技術規範及意見交換。

五、提升本公司技術人員及操作人員對此類設備之規劃、設計、審查、監造、檢驗、性能試驗之能力。

貳、 過程內容：

一、 行程略述如下：

1）98 年 12 月 15 日由高雄啓程至義大利米蘭。

2）98 年 12 月 16 日與代理商世鴻公司、製造廠家 KOCH 公司設計人員三方舉行 KICK OFF MEETING，就採購規範供應範圍及澄清事項，設計要求及圖件討論，對材料規格審查及討論，製造時程、品質檢驗和交貨日期、交貨準備等事宜。

3）98 年 12 月 17 日至本案設備器身、浮頭端板供應廠家 MATALCAM 工廠參觀。

4) 98 年 12 月 18、19 日至高雄廠氣體純化工場七座反應器製造廠 SICES 及桃廠重型反應器製造廠 NUOVO PIGNONE 工廠參觀。

5) 98 年 12 月 20 日由羅馬返程回高雄，於 98 年 12 月 21 日抵達。

二、開會過程：代理商世鴻公司、製造廠家 KOCH 公司設計人員三方舉行

KICK OFF MEETING，AGENDA 如下：

1)Introduction of Companies and Attendees

2) Communication Lines

3) Review of Purchase Order and Scope of Supply

4) Design Requirements and Discussion of GA drawing

5) Review and Discussion of Material Requisition Sheets

6) Review of Supplier Data Schedule（documents list/ Schedule and turnaround）

7) Procurement of raw materials

8) Manufacturing - Review of fabrication Data Schedule

9) QC Requirements – Shop inspection and Release

10) Final documentation

11) Preparation for shipment （packing and marking）

12) Administration issues：Invoicing – Bank Guarantees-Letter of Credit

13) Reporting （Monthly Progress Report）

14) Shop Tour

三、討論及決議：

1) Introduction of Companies and Attendees：

介紹三方參加人員。

2) Communication Lines：

將來 KOCH 公司(KHT)連繫窗口爲：Giuseppe Riccardi，世鴻公司（Worfin）爲莊炎榮先生（Wint Selby），中油公司（CPC）方面僅對世鴻公司作連繫。

3) Review of Purchase Order and Scope of Supply：

就 98 年 6 月 9 日於高雄廠三方人員作合約規範附錄 1 rev.1 要求作討論，此次再作須澄清部份作確認。

KHT 確認鍛鋼部份抽樣檢查依合約附錄 1 rev.1 執行。

KHT 確認三座換熱器於製造廠內各別試壓及運輸。

KHT 告知若中油要求，由 KHT 提供 E-2002A&B 支撐鞍座、連結噴嘴焊接焊材，由世鴻於工廠內焊接試壓、運輸，則可節省約 13~15 天工期。

CPC/Worfin 於 2010 年 1 月底前提供油漆規範予 KHT。

KHT 確認 UT Phase Array 非其供應範圍。

KHT 允諾於管板內增加兩道溝槽以利脹管。

4) Design Requirements and Discussion of GA drawing：

KHT 提交圖件 GA2322-01 Rev.0（附件 2）。

KHT 確認新製換熱器與現有者能互換使用，KHT 也確認其製作包括焊接，將依照 KHT 實際製作標準及技術。

GA drawing 已再次審查，KHT 確認新製換熱器所有尺寸與原有設備相同。但是 KHT 要求 CPC/Worfin 需證明所有資料，包括舊設備圖件須正確且新、舊製換熱器前後一致性。

CPC 提供舊設備之基礎負載資料，以供核對。

KHT 要求 CPC/Worfin 於 2010 年 1 月 8 日前確認 GA drawing 與基礎負載資料。

5) Review and Discussion of Material Requisition Sheets：

Material Requisition Sheets MRS 2322 rev. 0 已討論。

CPC/Worfin 要求在 MRS 內須詳細記載每支 TP321 無縫管子在彎管後作固熔化處理並試壓。

MRS 已作修正及加註意見。

KHT 要求修改 MRS 內 SA-387 Gr.22 鋼板，爲了反應鋼板於室內之化學成份變化。

MRS 已作修正及加入對氫和氮含量之要求。

MRS 2322 重新修正 rev.1，由 Worfin 於會議上作核對及確認（附件 3）。

6) Review of Supplier Data Schedule（documents list/ Schedule and turnaround）：

KHT 提交供應確認時程日期（附件 4）。

提交文件於 15 天內由 CPC/Worfin 作確認。

KHT 確認三座換熱器之各文件皆有效的，除了 ITPs 和最後製作數據書將每座各別提出。

KHT 提供製作數據書索引供 Worfin 作確認。

7) Procurement of raw materials：

KHT 提交下游供應商之採購明細單（附件 5）。

KHT 確認所有 Pos 主要素材（鍛鋼、管子、鋼板）已訂購，並期待他們能準時交貨以符合製作時程。

8) Manufacturing - Review of fabrication Data Schedule：

KHT 提交製作時程表，顯示該合約於 2010 年 5 月 20 日 EXW 交貨（附件 6）。

CPC/Worfin 要求 KHT 核對有否再提前交貨可能性。

KHT 確認合約交期及說明可能提前取決於製造能有重大進展。

9) QC Requirements - Shop inspection and Release：

KHT 提交 ITP 樣本顯示製作過程中檢查細節及標準。

KHT 說明檢查表與製作步驟是前後一致的。

10) Final documentation：

KHT 顯示一製造數據書樣本，爲工作結束交貨給業主之最後文件。

11) Preparation for shipment （packing and marking）：

KHT 確認裝船包裝含木製鞍座組成及氮氣充填和記號噴漆。

12) Administration issues：Invoicing - Bank Guarantees-Letter of Credit：

KHT 和 CPC/Worfin 討論及同意，對附款階段協商要求文件。

Worfin 同意信用狀修改。

13) Reporting（Monthly Progress Report）：

KHT 確認將提供 Worfin 每月情況報表，內容將包括下列文件：

.文件表/狀況（SDS）

.次目表/狀況

.製造進度

14) Shop Tour：

工廠觀摩已進行中（MATALCAM 工廠參觀）。

四、工廠觀摩簡介：

1) K.H.T.(全名 KOCH Heat Transfer companies) 工廠參觀

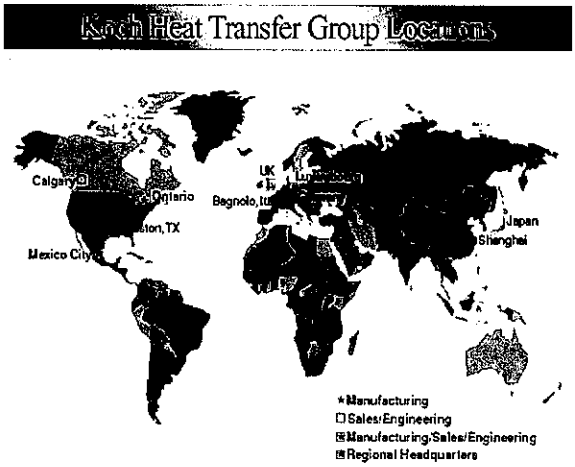
KOCH 熱傳公司，長久以來是一家兼具有設計及製造各種換熱器的全球性公司。且不斷地提供管式換熱器產品的創新技術。

該公司除取得有 ISO 9001 認證，尚有 ABS、BS、Lloyds，內部有品管部門和研發部門，依據顧客要求設備，從設計、採購、製作至交貨，作一序列階段品質控制。

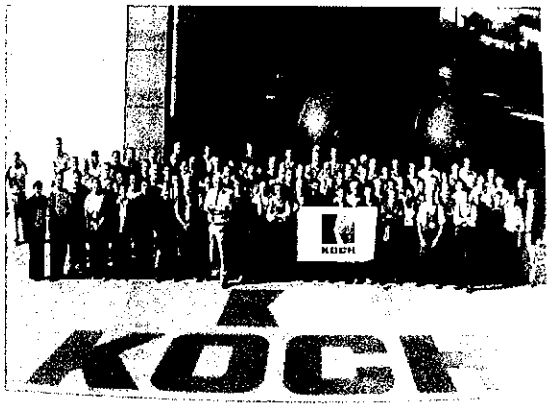
本案代理商爲國內世鴻公司、製造廠家爲位於義大利米蘭工業區的 KOCH 公司，藉由三方舉行 KICK OFF MEETING，同時實地觀摩該製造廠之各種設備。

該公司工廠有各類機械，並生產螺旋狀管子增加其傳導面積，其現場有不同大小熱處理爐，自動焊接機具，各種檢查設備，廠房排列十分整潔，亦非常注重工安及環保問題，爲一現代化工廠。

KOCH 全球的公司



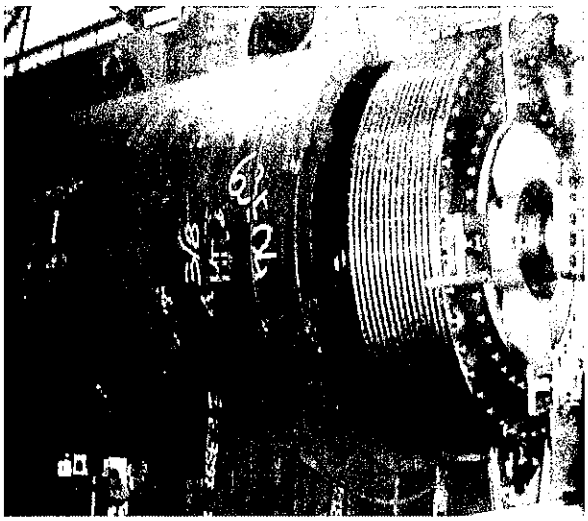
KOCH 義大利米蘭的製造廠

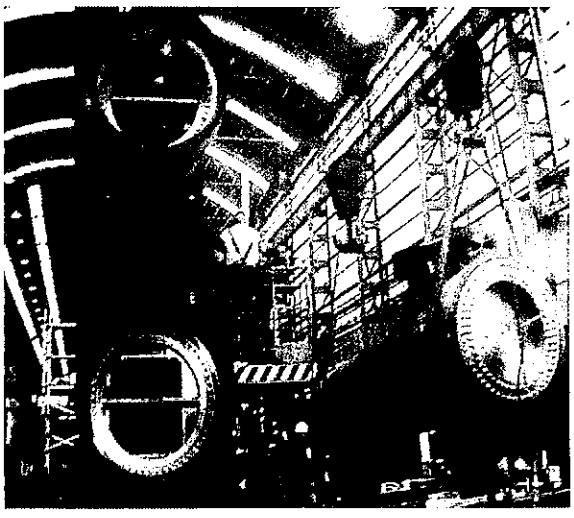


Bagnolo Cremasco, Italy

中油、世鴻、KOCH 三方人員舉行 KICK OFF MEETING

KOCH 義大利製造廠 BLC 型式換熱器現場組裝情形





2) MATALCAM 工廠參觀：

MATALCAM 公司是一家提供世界各國各種鍛造設備的公司，已具有數十年（1907 成立）經驗在鋼、鍛件，熱冶金和用機器製造的產業，在其非常專業的人員及技術下，已供應全世界各種各樣的碳鋼、合金鋼、高合金鋼高品質的鍛件，尤以其不銹鋼鍛造最大產品重量可達 30 噸，可見其工廠規模之大。該公司除有 ISO 9000 認證，尚有 ABS、BS、Lloyds，內部有品管部門和廢鐵件溶化、合金原料之調配至交貨作階段品質控制。

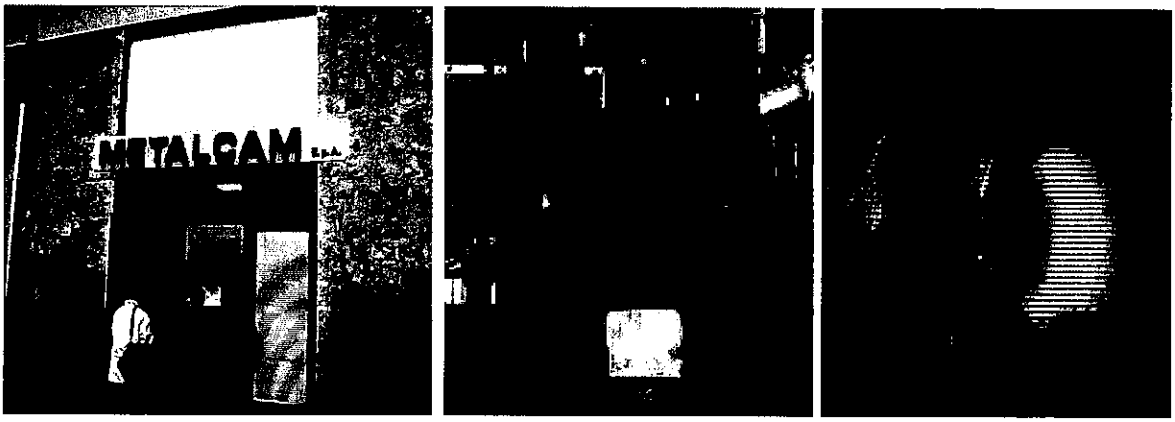
MATALCAM 公司工廠規模大，從廢鐵原料進入電解爐熔融，依據各種不同材質要求，加入各類合金成份，熔融過程中取樣做化學成份分析，再調整合金成份，直到符合材質規範要求。其除了數量大分批次澆注模型外，儘可能以一次澆注完成（3~35 噸）steel mill，以達到產品一致性。然後將尚處高溫狀態下之 steel mil 迅速鍛造或擠壓成所須各種毛胚（詳圖片）。

MATALCAM 公司鍛造廠房有半自動油壓機 6300 噸及 3500 噸，5 座加熱爐，不同載重夾具機，最大可處理 40 噸之鍛造件。

其鍛造品有氣體及蒸汽渦輪機、水力、電力、風力發電機傳動軸。材質有高、低合金鋼、不繡鋼和 ESR 鋼等。

MATALCAM 公司除了發電工業製造外，尚有鍋爐、Extrusion、機械加工、造船等工業製品。

MATALCAM 公司鍛造設備及鍛造工件



本案所屬已完成待車製的鍛造設備(器身)

3) SICES 工廠：

SICES Group 成立於 1958 年，其服務對象爲油（Oil）、天然氣（Gas）、石化（Petrochemical）、化學（Chemical）和 Power Generation 等工業工廠設備製造、安裝和維護。該集團可完全供應統包（Turn Key）工廠設備，對壓力容器（Pressure Vessels）、反應器（Reactor）、塔槽（Tower）、容器（Drum）、儲槽（Storage Tank）、換熱器（Shell and Tube Heater Exchanger）、鍋爐（Boiler）等

製造、安裝和維護。

SICES Group 目前亦積極發展節能及綠能生態研發。

SICES Group 工廠規模非常大，除鍛造鋼材原料委外加工，其餘大多由自己加工、成型、焊接組裝，檢驗試壓等。該公司除有 ISO 9001 認證，尚有 ABS、BS、Lloyds，內部有品管部門和依據工作型態從購物至交貨作階段品質控制。本部高雄廠氣體純化工場七座反應器即由該公司製造供應，其依循規範製作、檢查、試壓及文件整理提供，雖製作過程中本廠未派員作檢驗，但交貨後本廠提出其製作、檢查、試壓等文件與勞檢機關複查而順利取得使用合格證。

SICES Group 已獲得在國際市場上可信賴性的好評，因應市場連續性演變要求，提供其客戶經營發展特殊之支援，提供技術和財務，將經驗和資源作結合。有一寬廣彈性在人力和技術資源穩固投資和其他一流公司有效合作，使團隊成爲一可信賴的供應者及企業合夥人。

SICES Group 客戶遍及世界各國，直接供應或透過代理商供應。目前該公司線上有韓國、法國、及沙烏地阿拉伯之設備製作。

4) NUOVO PIGNONE 工廠：

NUOVO PIGNONE 成立已超過 40 年，其 Massa 工廠位於佛羅倫斯之 Marina di Carrara 海港，因此服務對象無大型設備製造及運輸之限制。

其主要製品爲壓力容器（Pressure Vessels）、反應器（Reactor）、換熱器（Exchanger）、空氣冷卻器（Air Cooler）、球閥（Ball Valve）及世界各地石化工業工廠設備製造等製造、安裝。

該公司持續更新工廠設備及研發新技術，在考量製造經驗，工廠設備及市場情況，Nnovo Pignone 全力於複雜及大型設備之發展。其對較特別設備如：

（1） high thickness reactors

（2） other reactors of large size in Cr, Mo steel

（3） plat-former reactors

（4） tubular reactors

（5） HP shell and tube heater exchanger

（6） large size exchanger

（7） exchanger and Vessels for very low temperature service

（8） special equipment for fertilizer plants

該公司有嚴格之品管制度，主要遵循 ISO 9001、BS5750、UNI EN29001，其 Q.A. 制度經 LLRR 認證，Massa 工廠被 ASME Stamps S,U,U2 所認證並授與 3 級 NDT 人員資格。Nnovo Pignone 技術實驗室可作各種材質之物理性質測試及化學成份分析。各類 NDT 檢查執行包括最先進方法，如自動超音波檢測 TOFD 應用於厚板焊道之檢查。

進年來該公司全力於複雜及大型設備之發展，其製作設備也現代化及大型，如不同大小熱處理爐，最大可容納 9M 直徑，32M 長，重量 1400 噸。重要設備尚有：

（1） several tandem wire welding systems for welding high thickness

（2） special heavy rollers and devices for handling of very heavy pieces

（3） hydraulic presses and plate rolling machine

（4） special systems for weld overlay deposits

（5） positions for handling and welding of large casing and reactors heads

（6） compressor impeller automatic welding systems

（7） very modern large size machine tools

（8） automatic machine for tubes to tube sheet welding

NUOVO PIGNONE 公司尚有製造加油站用加油機，據稱本公司營業處多處加油站使用該公司產品。

NUOVO PIGNONE 公司目前正承製桃廠重型反應器製造

參、心得與建議

1) 心得：

本次出國爲本部高雄煉油廠辦理低硫燃油工場 E-2002A/B/C 換熱器 BLC 型式（BREECH-LOCK CLOSURE TYPE），俗稱槍膛式換熱器。由世鴻公司承攬，換熱器設備由義大利 KOCH 公司製造。此次派遣出國辦理本案開工事宜、工程聯繫、設計規範研討、製造監辦等工作。

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KOCH 熱傳公司，長久以來是一家兼具有設計及製造各種換熱器的全球性公司。且不斷地提供管式換熱器產品的創新技術，同時實地觀摩該製造廠之各種設備。該公司工廠有各類機械，並生產螺旋狀管子增加其傳導面積，其現場有不同大小熱處理爐，自動焊接機具，各種檢查設備，廠房排列十分整潔，亦非常注重工安及環保問題，爲一現代化工廠。

MATALCAM 公司是一家提供世界各國各種鍛造設備的公司，已具有數十年（1907 成立）經驗在鋼、鍛件，熱冶金和用機器製造的產業，在其非常專業的人員及技術下，已供應全世界各種各樣的碳鋼、合金鋼、高合金鋼高品質的鍛件，尤以其不銹鋼鍛造最大產品重量可達 30 噸之多，可見其工廠規模之大。

藉由此次工廠參觀進一步深入了解各公司製造、檢驗、組裝、測試流程，也見識到國外廠家對品管要求之嚴格，在與設計人員討論，除可增加我們對標準規範的了解，亦更見到義大利重工業之發達及擴大視野。另一方面當今世界各地環境污染防治，政府環境保護法規亦趨嚴格，科技進步帶動汙染防治技術及監測和分析器材日新月異，工程人員積極吸收新技術及知識，爲環保盡一份心力，也逐漸研發節能及綠能生態工業。

此次能到歐洲國家，見識到歐洲之生活習慣、環境、交通、氣候及民族特性，亦感覺氣候之變化，更盛逢歐洲大風雪，雖然僅七天時間，實際扣除飛航時間餘四天，此趟雖感到勞累但也感受到不同異國風味。但總歸一句感覺還是我們這裡好。

2) 建議：

有幸參與本案購規範供應範圍及澄清事項，設計要求及圖件討論，對材料規格審查及討論，製造時程、品質檢驗和交貨日期、交貨準備等事宜。藉以見識到先進國家之工業技術與發展，在與製造廠家設計人員溝通討論及意見交流，對工程人員之專業知識提升有所助益。專業工程人員養成非一朝一夕可及，希望公司能有多元出國計畫來提升工程人員技術能力及增加視野。

肆、 附錄 ：

附件 1、KICK OFF MEETING 會議紀錄

附件 2、E-2002A/B/C 換熱器 BLC 型式組成圖件 GA2322-01 Rev.0

附件 3、MRS 2322 重新修正 rev.1

附件 4、供應確認時程日期

附件 5、下游供應商之採購明細單

附件 6、製作時程表

附件 1

KOCH
HEAT TRANSFER COMPANY, SRL *A Koch Chemical Technology Group, LLC Company*
UNIPERSONALE

Minutes of meeting

Subject: KICK OFF MEETING
Our Reference: Job 2322- Worfin

Date of Meeting:	16.12.2009	**Chaired by:**	Loris Scirea
Time:	0900-1600	**Minutes by:**	Giuseppe Riccardi
Location:	Koch Heat Transfer Company Bagnolo	**Issue date:**	17.12.2009
Participants:	Mr.Dong-Yie Hsu- CPC Corp. Mr.Huang-Shun Chi – CPC Corp. Mr. Tai-Feng Van – Worfin Eng. Mr. Wint Selby – Worfin Eng.	Koch: Mr. Riccardo Borelli - MD Mr. Scirea Loris - PM Mr. Giuseppe Riccardi – PM Mr. Francesco Valdameri - OpM Mr. Doriano Esposito – QC M Mrs. Nora Peletti – Contract Mgr Mrs. Paola Ferrari Adminstration	Copy to: Mr.Byron Black

Current	Previous	Description	Resp.	Date
		Agenda: 1) Introduction of Companies and Attendees 2) Communication lines 3) Review of Purchase Order and Scope of Supply 4) Design requirements and discussion of GA drawings 5) Review and discussion of Material Requisition Sheets 6) Review of Supplier Data Schedule (documents list/schedule and turnaround) 7) Procurement of raw materials 8) Manufacturing – Review of fabrication schedule 9) QC requirements – Shop Inspection and Release 10) Final documentation 11) Preparation for shipment (packing and marking) 12) Administration issues: Invoicing – Bank Guarantees – Letter of Credit 13) Reporting (Monthly Progress Report) 14) Shop Tour		
		1) KHT welcome CPC/Worfin, introduced the Company and the attendees		

Current	Previous	Description	Resp.	D
		3) The scope of supply has been reviewed with reference to Appendix 1 rev.1 to contract and MOM with CPC of June 9,2009. KHT confirmed that the random inspection of forgings will be carried out as per Appendix 1 rev.1 to contract. KHT confirmed that the exchangers will be individually hydotested in the shop and will be shipped as single unit. KHT informed that, if requested by the Client, they can make an offer for staking, welding of interconnecting nozzles, hydrotesting and delivery in staked position of items E-2002 A&B. In KHT opinion this could save from 13 to 15 days during installation of the exchangers at the plant. CPC/Worlin will provide within the end of January 2010 the specification for the finish paint. KHT confirmed that UT Phase Array are not in the scope of supply. KHT confirmed that two grooves in the tubesheet will be provided for tube expansion.		
		4) KHT handed over copy of drawing GA2322-01 rev.0 (see attachment nr. 1) KHT confirmed that the new exchangers will be fully interchangeble with the existing ones. KHT also confirmed that fabrication, including welding, will be in accordance to the actual KHT manufacturing standards and technology. The GA drawing has been reviewed. KHT confirmed that overall dimensions of the exchangers are the same of the existing equipment. Nevertheless, KHT requested CPC/Worlin to verify that all information included in the drawing are correct and consintent for repalcement of the old equipment with the new exchangers. CPC informed that they intend to verify the foundation loads data. KHT requested approval of the GA drawings as well as of the foudation loads calculations within January 8, 2010		
		5) Material Requisition Sheets nr. MRS 2322 rev.0 have been discussed. CPC/Worlin requested to specify in the MRS of the TP321 seamless tube that each individual tube will be hydrotested after U bending and solution annealing. The MRS has been revised to incoporate the comment. KHT asked to revise the MRS of the SA 387 Gr.22 plates in order to reflect the chemical composition of the plate that is in house. The MRS has been revised to incorporate the new requirements for Hydrogen and Nitrogen content. The MRS 2322 have been reissued in rev.1, checked		

Current	Previous	Description	Resp.	Date
		and approved by Worfin during the meeting (see attachment nr. 2)		
		6) KHT handed over the Supplier Data Schedule with correct dates (see attachment nr. 3). The turnaround for review of the documents by CPC/Worfin will be 15 days. KHT confirmed that each document will be valid for the three exchangers except for the ITPs and final manufacturing data books that will be issued for each individual exchanger. KHT will submit to Worfin the Manufacturing Data Book Index for approval.		
		7) KHT handed over list the purchase orders to subsuppliers (see attachment nr. 4) KHT confirmed that all POs for the main raw materials (forgings, tubes, plates) have been placed and they are expecting on time delivery to support the fabrication schedule		
		8) KHT handed over the Manufacturing schedule showing the contract delivery of May 20, 2010 EXW (see attachment nr. 5) CPC/Worfin asked KHT to check for possible improvement of the delivery. KHT confirmed the contract delivery and explained that possible improvements can be evaluated only when the fabrication has reached a significant progress.		
		9) KHT handed over a sample of the ITP to show the level of detail of the inspection during the fabrication. KHT explained the inspections are listed to be consistent with the manufacturing sequence.		
		10) KHT showed an example of Manufacturing Data Book to give evidence of the final documentation that will be delivered to the Client at the end of the job.		
		11) KHT confirmed that the packing will be consisting of wooden saddles only and preparation for shipment will be consisting of nitrogen purging and painting of shipping marks.		
		12) KHT and CPC/Worfin discussed and agreed the documents required for the negotiation of the milestone payments (see attachment nr. 6) Worfin will revise the Letter of Credit to incorporate the agreed changes.		
		13) KHT confirmed they will provide to Worfin a Monthly Status Report that will include the following documents: ▪ Documents List/Status (SDS) ▪ Suppliers List/Status ▪ Manufacturing Schedule		
		14) A shop tour has been carried out		

附件 2

附件 3

KOCH
HEAT TRANSFER COMPANY, SRL
A Koch Chemical Technology Group, LLC Company
Strada Paullese, 2 – 26010 Bagnolo Cremasco (CR) – Italia – Tel. +39 0373 237611 – Fax +39 0373 648550 –
http:/ / www.kochheattransfer.com

JOB N° :	2322 E
CLIENT :	Worlin Engineering Co Ltd
P.O. No. :	P-0477
ITEM No. :	E-2002A/B/C
DOCUMENT TITLE :	MATERIAL REQUISITION SHEET
DOCUMENT No. :	MRS-2322
SHOP No. :	5384 ; 5385 ; 5386

APPROVED
Worlin Engineering Co., Ltd.
12/16/09

SHEET 1 OF 19

REV.	DATE	DESCRIPTION	WRITTEN	CHECKED	APPROVED
9					
8					
7					
6					
5					
4					
3					
2					
1	16/12/2009	ISSUED FOR APPROVAL	A.O.	C.D. (MECH. ENG. MNG.)	C.D. (MECH. ENG. MNG.)
0	04/12/2009	ISSUED FOR APPROVAL	A.O.	C.D. (MECH. ENG. MNG.)	C.D. (MECH. ENG. MNG.)

MATERIAL REQUISITION SHEET

MRS-2322-FOR-01 Rev.1

TYPE OF MATERIAL: Low Alloy (2¼Cr-1Mo) Pressure Retaining Steel

PRODUCT	*SPECIFICATION*	*GRADE*	*CLASS*	*SUPPLY CONDITIONS*
Forgings (Applicable to items: main barrels, tubesheets, Breech-lock™ Threaded Ring & Cover)	SA 336M/ SA 336 SA 182M/ SA 182	F22	3 3	Q+T

1. SCOPE	This MRS specifies the selected options in the referred specifications and specifies the additional requirements which shall be added to the requirements of the referred specifications. Any conflict between referred specifications shall be solved adopting the most stringent requirement. The forging material specified in this document are to be used for the design and the manufacturing of a heat exchanger in accordance with ASME Section VIII Div.1. *("U" Stamp is required)*
2. APPLICABLE CODE & SPEC.S	**- ASME SECT.II - PART A 2007 Ed. + Add. A08 (Metric Units)** **- SA 336M, SA 182M, SA 370M, SA 388M, SA 788M** **- ASME SECT.VIII Div.1 & Div.2 2007 Ed. + Add. A08 (Metric Units)** ***Supplementary Requirements:*** - **SA 336M-S2 (transverse tension test)** - **SA 336M-S8 (forging requirements)** - **SA 788M-S14.1.2 (FATT test)** - **SA 788M- S16 (Grain Size)** ◇1
3a. STEEL MAKING PRACTICE & SUPPLY CONDITIONS ◇1	The steel shall be made by a process which include ***vacuum degassing while molten*** and ***fine grain practice.*** The material shall be forged as close as practicable to the specified size and shape. **The forging ratio shall be not less than 1:4** The supply conditions are : **Q+T.** **Minimum tempering Temperature:+20°C above PWHT TEMP.TURE**
3b. CHEMICAL COMPOSITION	The following chemistry shall be obtained (heat analysis) in addition to referred specifications requirements : $J_{factor} = (Si + Mn) \times (P+Sn) \times 10^4 \leq 120$ (element concentrations weight %) $X_{factor} = (10P+4Sn+5Sb+As) / 100 \leq 15$ (element concentrations weight ppm) **Ni ≤ 0.30 % ; Cu ≤ 0.20 %**
4-CHARPY-V IMPACT TESTING	As per relevant material specification and Code. Impact Testing temperature: **-18°C (coincident with MDMT)** Minimum absorbed energy (for a set of three full size specimens): **55J(40ft-lbf) ave& 48J (35ft-lbf) min.** ◇1 **Only test piece per set with impact energy lesser than 55 J is acceptable.** Impact Testing shall be performed on specimens subjected to the following simulated PWHT : **1) MIN. SPWHT** **The % ductile fracture and lateral expansion in mils to be reported.**

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MATERIAL REQUISITION SHEET

MRS-2322-FOR-01 Rev.1

TYPE OF MATERIAL: Low Alloy (2¼Cr-1Mo) Pressure Retaining Steel

PRODUCT	*SPECIFICATION*	*GRADE*	*CLASS*	*SUPPLY CONDITIONS*
Forgings (Applicable to items: main barrels, tubesheets, Breech-lock™ Threaded Ring & Cover)	SA 336M/ SA 336 SA 182M/ SA 182	F22	3 3	Q+T

5. EXTENT & LOCATION OF CHARPY-V IMPACT TESTING	As per relevant material Specifications and Codes of para. 2, ***in particular according to para.8.2.2 of SA 336 and para. 8.3 of SA 182 as applicable and, for thick and complex forgings, to paragraph 3.10.4.2 of ASME Sect.VIII Div.2.*** Additionally, test specimens shall be taken at ½ T from the prolongation thickness and transversely to the max working direction of the forging – see (S2) of SA 336.
6. ROOM TENSILE TESTING	As per relevant material Specification & Code. Tensile Testing shall be performed on specimens subjected to the following simulated PWHT : **ii) MAX. SPWHT**
7. EXTENT & LOCATION OF ROOM TENSILE TESTING	As per relevant material Specifications and Codes of para. 2, ***in particular according to para.8.2.2 of SA 336 and para. 8.3 of SA 182 as applicable and, for thick and complex forgings, to paragraph 3.10.4.2 of ASME Sect.VIII Div.2.*** Additionally, test specimens shall be taken at ½ T from the prolongation thickness and transversely to the max working direction of the forging – see (S2) of SA 336.
8.HIGH TEMPERATURE TENSILE TESTING	N/A
9.EXTENT & LOCATION OF HIGH TEMPERATURE TENSILE TESTING	

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KOCH
HEAT TRANSFER COMPANY, SRL

ALLOY

MATERIAL REQUISITION SHEET — MRS-2322-FOR-01 Rev.1

TYPE OF MATERIAL: Low Alloy (2¼Cr-1Mo) Pressure Retaining Steel — **Page 3 of 6**

PRODUCT	*SPECIFICATION*	*GRADE*	*CLASS*	*SUPPLY CONDITIONS*
Forgings (Applicable to items: main barrels, tubesheets, Breech-lock™ Threaded Ring & Cover)	SA 336M/ SA 336 SA 182M/ SA 182	F22	3 3	Q+T

10. HARDNESS TESTING & GRAIN SIZE	Max hardness : 215 BHN. The test shall be performed on the tensile specimens having been subjected to the following simulated PWHT : I) MIN SPWHT ◇1 **(S15) Grain size shall be determined according to SA 788M-S15 to be ≥ 6 (at least on 75% of surveyed area).**
11. EXTENT & LOCATION OF MECHANICAL TESTING & GRAIN SIZE DETERMINATION	As per relevant material Specifications & Codes of para. 2.
12. ADDITIONAL CHARPY-V IMPACT TESTING (TRANSITION CURVES)	***FATT curve to be determined according to SA788M-S14 and SA 370.***
13. EXTENT & LOCATION OF ADDITIONAL CHARPY-V IMPACT TESTING (TRANSITION CURVES)	As per relevant material Specifications & Codes at para. 2, but at least per heat basis. ***Supplier shall submit for approval to the Purchaser (Quality Dept.) a plan for withdrawal of specimens with location, orientation of withdrawal and numbers of specimens prior to proceeding of tests.***

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MATERIAL REQUISITION SHEET

MRS-2322-FOR-01 Rev.1

TYPE OF MATERIAL: Low Alloy (2¼Cr-1Mo) Pressure Retaining Steel

PRODUCT	*SPECIFICATION*	*GRADE*	*CLASS*	*SUPPLY CONDITIONS*
Forgings (Applicable to items: main barrels, tubesheets, Breechlock™ Threaded Ring & Cover)	SA 336M/ SA 336	F22	3	Q+T
	SA 182M/ SA 182		3	

14. FATT RESULTS ACCEPTANCE CRITERIA	**FATT Transition Temperature ≤ -10 °C**
15. NON DESTRUCTIVE EXAMINATIONS	- **100 % UT** examination in accordance with **SA 388** and **ASME SECTION VIII Div.2** para. **3.3.4.** Acceptance criteria shall be in accordance with **ASME SECTION VIII Div.2** paras. **3.3.4.3 & 4.** - **100% MP** examination in accordance with **ASME SECTION VIII Div.2 – paragraph 7.5.6.1 with acceptance criteria to para. 7.5.6.2 on all finished surfaces.** Alternatively, **100% PT examination** and acceptance criteria may be applied in lieu of MT in accordance with **ASME SECTION VIII Div.1 – Appendix 8** on all finished **surfaces.** **(to be performed by KHT after machining).**

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MATERIAL REQUISITION SHEET — MRS-2322-FOR-01 Rev.1

TYPE OF MATERIAL: Low Alloy (2¼Cr-1Mo) Pressure Retaining Steel				Page 5 of 6
PRODUCT	*SPECIFICATION*	*GRADE*	*CLASS*	*SUPPLY CONDITIONS*
Forgings (Applicable to items: main barrels, tubesheets, Breech-lock™ Threaded Ring & Cover)	SA 336M/ SA 336 SA 182M/ SA 182	F22	3 3	Q+T

16. REPAIR OF DEFECTS	Weld repair of base material is not acceptable unless specifically approved by the Purchaser. Imperfections on finish surface, such as forging witness marks, non metallic inclusion, micro voids, can be removed by grinding if not impair all tolerances and the minimum thickness required. Linear indications such as cracking are not acceptable. In such an event, the supplier shall provide a repair procedure to be pre-approved for minor repair by welding.
17. DIMENSIONAL TOLERANCES	As per relevant material Specification & Code at para. 2 , except that the required thicknesses are minima (underthickness not permitted).
18. MARKING	Marking with "low stress" stamps shall be carried out as stated in **SA 336 / SA 182** when applicable. Additionally the following data shall be legible stencilled (only if requested by the purchase suborder) : - **P.O. number** - **Dimensions** - **Item number**
19. CERTIFICATION	**EN 10204 Type 3.2 (English Language).** Heat treatment temperature, soaking time and cooling medium should be stated in the certificate. Mill certificate of source material shall be added.
20. MIN SPWHT	**Min simulated PWHT** : Heating rate : **50 °C/h (90 °F/Hr)** Holding temperature : **690 °C (±10°C) (1274 °F +/- 18°F)** Holding time : **10 h** Cooling rate : **50 °C/h (90 °F/Hr)**
21. MAX SPWHT	**Max simulated PWHT** : Heating rate : **50 °C/h (90 °F/Hr)** Holding temperature : **690 °C (±10°C) (1274 °F +/- 18°F)** Holding time : **40 h** Cooling rate : **50 °C/h (90 °F/Hr)**

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KOCH HEAT TRANSFER COMPANY, SRL

MATERIAL REQUISITION SHEET — MRS-2322-FOR-01 Rev.1

TYPE OF MATERIAL: Low Alloy (2¼Cr-1Mo) Pressure Retaining Steel — Page 6 of 6

PRODUCT	*SPECIFICATION*	*GRADE*	*CLASS*	*SUPPLY CONDITIONS*
Forgings (Applicable to Items: main barrels, tubesheets, Breech-lock™ Threaded Ring & Cover)	SA 336M/ SA 336 SA 182M/ SA 182	F22	3 3	Q+T

22. FINAL DOCUMENTATION (prior to or at shipping)	The Supplier shall provide the following documents along with shipping of deliverables: - **certified material test report (CMTR)** indicating all test data, heat treatment and PWHT specified in this Material requisition for each heat of material - **UT Report for all forgings** – the test report shall at least contain the full list of scanned surfaces
23. PRE-FABRICATION DOCUMENTATION (option)	Upon request, the Supplier shall provide prior to commencement of any fabrication activities the following documents: - **quality control plan** - **UT examination procedure** - **Heat treatment specification** - **Specimens withdrawal plan for determination of FATT curve**
NOTE	*The (S *) indicate the supplementary requirements stated by ASME relevant material specifications.*

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KOCH
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MATERIAL REQUISITION SHEET				MRS-2322-FOR-02 Rev.0
TYPE OF MATERIAL: Austenitic Pressure Retaining Steel				Page 1 of 3
PRODUCT	SPECIFICATION	GRADE	CLASS /UNS No.	SUPPLY CONDITIONS
Forging (Breech-lock™ internal parts – tubeside)	SA 965/965M	F321	S32100	SOLUTION ANNEALED

1.SCOPE	This MRS specifies the selected options in the referred specifications and specifies the additional requirements which shall be added to the requirements of the referred specifications. Any conflict between referred specifications shall be solved adopting the most stringent requirement. The forging material specified in this document are to be used for the design and the manufacturing of a heat exchanger in accordance with Applicable Code & Standards as herein mentioned. *("U" Stamp is required)*
2. APPLICABLE CODE & SPEC.S	**- ASME SECT.II PART A 2007 Ed. + Add. A08 (Metric Units)** **- SA 336M, SA 965M** **- ASME SECT. VIII DIV.1 & DIV.2 2007 Ed.+Add. A08 (Metric Units)** ***Supplementary requirements:***
3a. STEEL MAKING PRACTICE & SUPPLY CONDITIONS	The material shall be forged as close as practicable to the specified size and shape. Fibers must follow external shape. Use of piece obtained by machining from flat disk is prohibited. The forging ratio shall be 1:4 minimum. **The supply conditions are : Solution Annealed** The material shall be furnished degreased, free from oil and pickled , passivated and free of scale.
3b. CHEMICAL COMPOSITION	As per relevant material Specifications & Codes at para.2.
4.CHARPY-V IMPACT TESTING	N/A - ***exempted according to para. UHA-51(d)(1)*** of applicable ASME Code.
5. EXTENT & LOCATION OF CHARPY-V IMPACT TESTING	N/A
6. ROOM TENSILE TESTING	As per relevant material Specifications & Codes at para.2.
7. EXTENT & LOCATION OF ROOM TENSILE TESTING	As per relevant material Specifications & Codes at para.2.
8.HIGH TEMPERATURE TENSILE TESTING	N/A
9.EXTENT & LOCATION OF HIGH TEMPERATURE TENSILE TESTING	N/A

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REV.	DATE	ISSUED by	CHECKED by	APPROVED by

MATERIAL REQUISITION SHEET				MRS-2322-FOR-02 Rev.0
TYPE OF MATERIAL: Austenitic Pressure Retaining Steel				Page 2 of 3
PRODUCT	*SPECIFICATION*	*GRADE*	*CLASS /UNS No.*	*SUPPLY CONDITIONS*
Forging (Breech-lock™ internal parts – tubeside)	SA 965/965M	F321	S32100	SOLUTION ANNEALED

10. HARDNESS TESTING & GRAIN SIZE	Max hardness : as per relevant material Specifications & Codes at para.2. ***(recommended limit : 22 HRC)***
11. EXTENT & LOCATION OF MECHANICAL TESTING & GRAIN SIZE DETERMINATION	As per relevant material Specifications & Codes at para.2.
12. STABILIZING HEAT TREATMENT	N/A
13. NON DESTRUCTIVE EXAMINATIONS	- **100 %** UT examination and acceptance criteria in accordance with **ASME SECTION VIII Div.2** para. **3.3.4** . Acceptance criteria shall be in accordance with **ASME SECTION VIII Div.2** paras. **3.3.4.3 & 4** . - 100 % LP examinations shall be performed in accordance with **ASTM PRACTICE E 165** . Acceptance criteria per **ASME VIII DIV.2 subpara. 7.5.7.2 (after machining).**
16..REPAIR OF DEFECTS	Weld repair of base material is, in principle, not acceptable. Imperfections on finish surface, such as forging witness marks, non metallic inclusion, micro voids, can be removed by grinding if not impair all tolerances and the minimum thickness required. Linear indications such as cracking are not acceptable.
15. DIMENSIONAL TOLERANCES	As per relevant material Specification & Code , except that the required thicknesses are minima (underthicknesses not permitted).
16. MARKING	Marking with "low stress" stamps shall be carried out as stated in **SA 965 (or SA 965M as referenced in this material requisition)** as applicable. Additionally the following data shall be legible stencilled : - **P.O. number** - **Dimensions** - **Item number**
17.CERTIFICATION	**EN 10204 Type 3.1 (English Language).** Heat treatment temperature, soaking time and cooling medium should be stated in the certificate. Mill certificate of source material shall be added.

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REV.	DATE	ISSUED by	CHECKED by	APPROVED by

MATERIAL REQUISITION SHEET

MRS-2322-FOR-02 Rev.0

TYPE OF MATERIAL: Austenitic Pressure Retaining Steel

PRODUCT	*SPECIFICATION*	*GRADE*	*CLASS /UNS No.*	*SUPPLY CONDITIONS*
Forging (Breech-lock™ internal parts – tubeside)	SA 965/965M	F321	S32100	SOLUTION ANNEALED

18. FINAL DOCUMENTATION *(prior to or at shipping)*	The Supplier shall provide the following documents along with shipping of deliverables: - **certified material test report (CMTR)** indicating all test data, heat treatment and PWHT specified in this Material Requisition for each heat of material - **UT Report for non-standard forgings** – the test report shall at least contain the list of scanned surfaces
19. PRE-FABRICATION DOCUMENTATION *(option)*	Upon request, the Supplier shall provide prior to commencement of any fabrication activities the following documents: - **quality control plan** - **UT examination procedure** - **Heat treatment specification**
NOTE	**The (S *) indicate the supplementary requirements stated by ASME relevant material specifications.**

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REV.	DATE	ISSUED by	CHECKED by	APPROVED by

KOCH
HEAT TRANSFER COMPANY, SRL

Strada Paullese 2 - 26010 Bagnolo Cremasco (CR) - Italia - Tel. +39 0373 237 11 - Fax +39 0373 645 50 - http: www.kochheattransfer.com

MATERIAL REQUISITION SHEET

MRS-2322-PLA-01 Rev.2

TYPE OF MATERIAL: Low Alloy Pressure Retaining Steel — Page 1 of 4

PRODUCT	*SPECIFICATION*	*GRADE*	*CLASS*	*SUPPLY CONDITIONS*
Plates (Applicable to items : shell&dr heads)	**SA 387/387M**	**22**	**2**	**Q+T**

1.SCOPE	This MRS specifies the selected options in the referred specifications and specifies the additional requirements which shall be added to the requirements of the referred specifications. Any conflict between referred specifications shall be solved adopting the most stringent requirement. The plate material specified in this document are to be used for the design and the manufacturing of a heat exchanger in accordance with Applicable Code & Standards as herein mentioned in accordance ASME Section VIII Div.1. *("U" Stamp is required)*
2. APPLICABLE CODE & SPEC.S	**- ASME SECT.II PART A 2007 Ed. + Add. A08 (Metric Units)** **- SA 387M-S1 & S3, SA 578M , SA 20M & SA 370M** **- ASME SECT. VIII DIV.1 2007 Ed. + Add. A08(Metric Units)**
3a. STEEL MAKING PRACTICE & SUPPLY CONDITIONS	The steel shall be made by a process which include vacuum degassing while molten, fully aluminium killed steel,manufactured to fine grain practice. The supply conditions are : **Q+T** **Minimum tempering Temperature:+20°C (36 °F) above PWHT TEMPERATURE**
3b. CHEMICAL COMPOSITION	The following chemistry shall be obtained (heat analysis) in addition to referred specifications requirements : J_{factor} = **(Si +Mn) x (P+Sn) x 10^4 ≤ 120** (element concentrations weight %) X_{factor} = **(10P+4Sn+5Sb+As) / 100 ≤ 15** (element concentrations weight ppm) **Ni ≤ 0,30 % ; Cu ≤ 0.20 %** 2 Hydrogen content ≤ 1.5 ppm Oxigen ≤ 45 ppm Nitrogen ≤ 65 ppm
4.CHARPY-V IMPACT TESTING	As per relevant material specification and Code. Impact Testing temperature:**-18°C. (coincident with MDMT)** Minimum absorbed energy (for a set of three full size specimens): **55J (40ft-lbf) ave& 48J (35ft-lbf) min .** Impact Testing shall be performed on specimens subjected to the following simulated PWHT : **i) MIN. SPWHT** **The % ductile fracture and lateral expansion in mils shall be reported.**
5. EXTENT & LOCATION OF CHARPY-V IMPACT TESTING	As per relevant material Specification and Code , but at least per heat basis. The test specimens shall be taken at ½ T (and at ¼ T according to **SA-20**) of the material thickness of each plate and shall be oriented transversely to the rolling direction.
6. ROOM TENSILE TESTING	As per relevant material Specifications & Codes of para.2. **(S3)** Tensile Testing shall be performed on specimens subjected to the following simulated PWHT : - **ii) MAX. SPWHT**

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0	22/06/09	AO	CD	CD

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MATERIAL REQUISITION SHEET

MRS-2322-PLA-01 Rev.2

TYPE OF MATERIAL: Low Alloy Pressure Retaining Steel — Page 2 of 4

PRODUCT	*SPECIFICATION*	*GRADE*	*CLASS*	*SUPPLY CONDITIONS*
Plates (Applicable to items : shell/ele heads)	SA 387/387M	22	2	Q+T

7. EXTENT & LOCATION OF ROOM TENSILE TESTING	As per relevant material Specifications & Codes of para. 2. Additionally, the test specimens shall be taken at ½ T (and at ¼ T according to **SA 20**) of the material thickness of each plate and shall be oriented transversely to the rolling direction.
8.HIGH TEMPERATURE TENSILE TESTING	N/A
9.EXTENT & LOCATION OF HIGH TEMPERATURE TENSILE TESTING	
10. HARDNESS TESTING & GRAIN SIZE	Max hardness : **215 HB.** The test shall be performed on the tensile specimens having been subjected to the following simulated PWHT : **II) MIN SPWHT**
11. EXTENT & LOCATION OF MECHANICAL TESTING & GRAIN SIZE DETERMINATION	As per relevant material Specifications & Codes of para. 2.
12a ADDITIONAL CHARPY-V IMPACT TESTING (TRANSITION CURVES)	***FATT curve to be determined according to SA 370.***

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MATERIAL REQUISITION SHEET MRS-2322-PLA-01 Rev.2

TYPE OF MATERIAL: Low Alloy Pressure Retaining Steel

PRODUCT	*SPECIFICATION*	*GRADE*	*CLASS*	*SUPPLY CONDITIONS*
Plates (Applicable to items : shellside heads)	SA 387/387M	22	2	Q+T

12b. EXTENT & LOCATION OF ADDITIONAL CHARPY-V IMPACT TESTING (TRANSITION CURVES)	As per relevant material Specifications & Codes at para. 2, but at least per heat basis. ***Supplier shall submit for approval to the Purchaser (Quality Dept.) a plan for withdrawal of specimens with location, orientation of withdrawal and numbers of specimens prior to proceeding of tests.***
13.FATT RESULTS ACCEPTANCE CRITERIA	**FATT Transition Temperature ≤ -10 °C**
14a. MIN SPWHT	**Min simulated PWHT :** Heating rate : **56 °C/h (100 °F/h)** Holding temperature : **690 °C(-10; +10°C) (1245 °F +/- 18 °F)** Holding time : **10 h** Cooling rate : **56 °C/h (100 °F/h)**
14b. MAX SPWHT	**Max simulated PWHT :** Heating rate : **56 °C/h (100 °F/h)** Holding temperature : **690 °C(-10; +10°C) (1245 °F +/- 18 °F)** Holding time : **40 h** Cooling rate : **56 °C/h (100 °F/h)**

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MATERIAL REQUISITION SHEET

MRS-2322-PLA-01 Rev.2

TYPE OF MATERIAL: Low Alloy Pressure Retaining Steel

PRODUCT	*SPECIFICATION*	*GRADE*	*CLASS*	*SUPPLY CONDITIONS*
Plates (Applicable to items : shell/side heads)	SA 387/387M	22	2	Q+T

15. NON DESTRUCTIVE EXAMINATIONS	- **100 % UT** examination and acceptance criteria in accordance with **SA 578-S1 - acceptance Level C.** - **100% MP** examination and acceptance criteria in accordance with **ASME SECTION VIII Div.2 para. 7.5.6** with acceptance criteria according to **ASME SECTION VIII Div.2 para. 7.5.6.2 on all surfaces after forming and on machined bevels.** Alternatively, **100% PT examination** may be applied in lieu of MT in with **ASME SECTION VIII Div.2 para. 7.5.7** with acceptance criteria according to **ASME SECTION VIII Div.2 para. 7.5.7.2 on all surfaces after forming and on machined bevels.**
16. WELD REPAIR	Weld repair of base material is, in principle, not acceptable. Imperfections on finish surface, such as rolling witness marks, non metallic inclusion, micro voids, can be removed by grinding if not impair all tolerances and the minimum thickness required. Linear indications such as cracking are not acceptable.
17. DIMENSIONAL TOLERANCES	As per relevant material Specification & Codes of para. 2 , except that the required thicknesses are minima (underthicknesses not permitted).
18. MARKING	Marking with "low stress" stamps shall be carried out as stated in **SA 387 (or SA 387M as referenced in this material requisition)** as applicable. Additionally the following data shall be legible stencilled : - **P.O. number** - **Dimensions** - **Item / plate number**
19. CERTIFICATION	**EN 10204 Type 3.1 (English Language).** Heat treatment temperature, soaking time and cooling medium should be stated in the certificate. Mill certificate of source material shall be added.
20. FINAL DOCUMENTATION (prior to or at shipping)	The Supplier shall provide the following documents along with shipping of deliverables: - **certified material test report (CMTR)** indicating all test data, heat treatment and PWHT specified in this Material requisition for each heat of material - **UT Report for all plates** – the test report shall contain diagrams of the scanned surfaces
21. PRE-FABRICATION DOCUMENTATION (option)	Upon request, the Supplier shall provide prior to commencement of any fabrication activities the following documents: - **quality control plan** - **UT examination procedure** - **Heat treatment specification**
NOTE	**The (S *) indicate the supplementary requirements stated by ASME relevant material specifications.**

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MATERIAL REQUISITION SHEET

MRS-2322-TUB-01 rev.1

TYPE OF MATERIAL: Austenitic Pressure Retaining Steel Tubing

PRODUCT	*SPECIFICATION*	*GRADE*	*UNS #*	*SUPPLY CONDITIONS*
Seamless Tubes	SA 213 / 213M	TP321	S32100	SOLUTION ANNEALED

1. SCOPE	This MRS specifies the selected options in the referred specifications and specifies the additional requirements which shall be added to the requirements of the referred specifications. Any conflict between referred specifications shall be solved adopting the most stringent requirement. The tube material specified in this document are to be used for the design and the manufacturing of a heat exchanger in accordance with Applicable Code & Standards as herein mentioned ***("U" Stamp is required).***
2. APPLICABLE CODE & SPECS:	**- ASME SECT.II PART A 2007 Ed. + A08 (Metric Units)** **- SA 213M & SA 450M** **- ASME SECT. VIII Div.1 2007 Ed. + A08 (Metric Units)**
3a. STEEL MAKING PRACTICE & SUPPLY CONDITIONS	The tubes shall be made ,preferably, by a cold-finished process. Heat-treatment supply conditions : **solution-annealed** The material shall be suitable to be "U" bent , locally solution annealed ,pickled and passivated , expanded & welded. The material shall be furnished degreased, free from oil and pickled free of scale.
3. CHEMICAL COMPOSITION	As per relevant material Specification & Code of para.2.
4.CHARPY-V IMPACT TESTING	N/A (exempted according to UHA-51)
5. EXTENT & LOCATION OF CHARPY-V IMPACT TESTING	N/A
6. ROOM TENSILE TESTING	As per relevant material Specification & Code of para.2.
7. EXTENT & LOCATION OF ROOM TENSILE TESTING	As per relevant material Specification & Code of para.2 .

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MATERIAL REQUISITION SHEET

MRS-2322-TUB-01 rev.1

TYPE OF MATERIAL: Austenitic Pressure Retaining Steel Tubing

PRODUCT	*SPECIFICATION*	*GRADE*	*UNS n°*	*SUPPLY CONDITIONS*
Seamless Tubes	SA 213 / 213M	TP321	S32100	SOLUTION ANNEALED

8.HIGH TEMPERATURE TENSILE TESTING	N/A
9.EXTENT & LOCATION OF HIGH TEMPERATURE TENSILE TESTING	N/A
10. HARDNESS TESTING	Max hardness as per referenced specifications & code of para.2. ***(recommended limit : 90 HRB)*** 1
11.MECHANICAL TESTING & GRAIN SIZE DETERMINATION	As per relevant material Specification & Code of para.2
12. EXTENT & LOCATION OF MECHANICAL TESTING & GRAIN SIZE DETERMINATION	As per relevant material Specification & Code of para.2.
13. INTERGRANULAR CORROSION TEST	N/A
14.EXTENT OF INTERGRANULAR CORROSION TEST	N/A
15.STABILIZING HEAT TREATMENT	N/A
16. HYDROSTATIC TEST	As per relevant material Specifications & Code of para.2 ***on each individual tube after bending and local solution annealing of U-bends.*** 1

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MATERIAL REQUISITION SHEET — MRS-2322-TUB-01 rev.1

TYPE OF MATERIAL: Austenitic Pressure Retaining Steel Tubing — Page 3 of 3

PRODUCT	*SPECIFICATION*	*GRADE*	*UNS n°*	*SUPPLY CONDITIONS*
Seamless Tubes	SA 213 / 213M	TP321	S32100	SOLUTION ANNEALED

17. NON DESTRUCTIVE EXAMINATIONS	Eddy Current Test according to **SA 450 or SA 450M as referenced in this material requisition.**
18. REPAIR OF DEFECTS	Repair by welding is not permitted.
19. DIMENSIONAL TOLERANCES	As per relevant material Specification & Code . The thickness shall be **minimum wall** with specified tolerance : **-0% / +20%.**
20. MARKING	Marking shall be carried out in accordance with **SA 450 or SA 450M as referenced in this material requisition (by means of Ink-jet).** Additionally the following data shall be shown (only if requested by relevant purchase suborder) : • **P.O. number** • **Dimensions** • **Item number** Low stress stamp is not permitted.
21. CERTIFICATION	**EN 10204 Type 3.1 (English Language)** Heat treatment temperature, soaking time and cooling medium should be stated in the certificate. Mill certificate of starting material should be added.
NOTE	**The (S *) indicate the supplementary requirements stated by ASME relevant material specifications.**

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MATERIAL REQUISITION SHEET	MRS-2322-Bol-01 Rev.0
TYPE OF MATERIAL: High Alloy Stainless Steel Miscellaneous parts (Bolts & Nuts)	Page 1 of 1

MATERIAL : SA 453M Gr.660 Cl.B

Applicable to item tags: ***Internal Flange Set Bolts of Breech-Lock™ Closure***

1. For bolts dimensions and sizes see separate list.

2. Material Certificates acc. to EN 10204 type 3.1.

3. Material shall be in accordance with ASME SECT. II part A 2007 Ed.+Add. A08 (Metric Units).
   Any Code requirement shall be complied with in addition to the requirements of this "Material Requisition Sheet.

4. Material shall fulfil all requirements of ASME SA 453M GR.660 Cl. B bolting (design temperatures not exceeding 427 °C).

5. The Stud Bolts shall be supplied with Class 2A threads and tapped holes/Nuts shall have Class 2B threads in accordance with ANSI B1.1 ,Unified Inch Screw Threads (UN or UNC Thread Form).

6. The hardness of the bolting material shall be as lowest as possible but in fully accordance with Specifications as mentioned at para. 3 above.

7. All bolts , studs and nuts over 2 inch (50 mm) nominal bolt size shall be examined by liquid penetrant method in accordance with Appendix 7 of ASME SECTION VIII Div.1. This examination shall be performed on the finished component after threading . Linear nonaxial indications are unacceptable. Linear axial indications greater than 1 inch (25 mm) in length are unacceptable.

8. The bolt materials specified in this document are to be used for the design and the manufacturing of heat exchangers in accordance with ASME Section VIII Div.1 Code 2007 Ed. +Add. A08(Metric Units) – *"U" stamp required.*

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ALLOY

MATERIAL REQUISITION SHEET	MRS-2322-Bol-02 Rev.0
TYPE OF MATERIAL: Low Alloy Steel Miscellaneous parts (Bolts & Nuts)	Page 1 of 1

MATERIAL: SA 193M Gr.B16 / SA 194M Gr.4

(EXTERNAL BOLTING)

Applicable to Item tags: (Set Bolts of Breech-Lock™ Lock Rings)

1. For bolts dimensions and sizes see separate list.

2. Material Certificates acc. to EN 10204 type 3.1.

3. Material shall be in accordance with ASME SECT. II part A 2007 Ed.+Add. A08 (Metric Units)
   Any Code requirement shall be adhered to, in addition to the requirements of this "Material Requisition Sheet".

4. The Stud Bolts shall be supplied with Class 2A threads and tapped holes/Nuts shall have Class 2B threads in accordance with ANSI B1.1 ,Unified inch Screw Threads (UN or UNC Thread Form) .

5. The hardness of the bolting material shall be as lowest as possible.

6. All bolts , studs and nuts of 2 inch (50 mm) nominal size and above shall be examined by magnetic particle method in accordance with Appendix 6 of ASME SECTION VIII Div.1 or by liquid penetrant method in accordance with Appendix 7 of ASME SECTION VIII Div.1 . This examination shall be performed on the finished component after threading . Linear nonaxial indications are unacceptable. Linear axial indications greater than 1 inch (25 mm) in length are unacceptable.

7. The bolt materials specified in this document are to be used for the design and the manufacturing of heat exchangers in accordance with ASME Section VIII Div.1 Code 2007 Ed. + Add. A08 (Metric Units) – *"U" stamp required.*

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附件 4

SUPPLIER DATA SCHEDULE (SDS)

KOCH

Date	03-06-2009
Revision	0
Project	Martin Engineering Co Jaw
Tunnel POC	

ITEM NO.	Doc Code Number / Reference Number	S	Supplier Document Title	No.	Level 1					Level 2					Level 3					Level 4					Level 5				
					Number	Title	Issue date	Actual issue	Code	Due date	Title	Issue date	Actual issue	Code	Due date	Title	Issue date	Actual issue	Code	Due date	Title	Issue date	Actual issue	Code	Due date	Title	Issue date	Actual issue	Code
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附件 5

PO #	Business Partner	PO Date	Item Description	Material	Planned Receipt Date
POI001152	Metalcam SPA	16/11/2009	Shell barrel	SA336 F22 CL3	29/01/2010
POI001152	Metalcam SPA	16/11/2009	Shell barrel	SA336 F22 CL3	05/02/2010
POI001152	Metalcam SPA	16/11/2009	Shell barrel	SA336 F22 CL3	05/02/2010
POI001152	Metalcam SPA	16/11/2009	Shell barrel	SA336 F22 CL3	13/02/2010
POI001152	Metalcam SPA	16/11/2009	/CONF. ORDINE		13/02/2010
POI001160	Asfo SPA	16/11/2009	Flanged nozzle	SA182 F22 CL3	05/02/2010
POI001160	Asfo SPA	16/11/2009	Flanged nozzle	SA182 F22 CL3	05/02/2010
POI001160	Asfo SPA	16/11/2009	Flanged nozzle	SA182 F22 CL3	05/02/2010
POI001160	Asfo SPA	16/11/2009	Flanged nozzle	SA182 F22 CL3	05/02/2010
POI001160	Asfo SPA	16/11/2009	Flanged nozzle	SA182 F22 CL3	05/02/2010
POI001160	Asfo SPA	16/11/2009	Flanged nozzle	SA182 F22 CL3	05/02/2010
POI001160	Asfo SPA	16/11/2009	Flanged nozzle	SA182 F22 CL3	05/02/2010
POI001160	Asfo SPA	16/11/2009	Flanged nozzle	SA182 F22 CL3	05/02/2010
POI001160	Asfo SPA	16/11/2009	Flanged nozzle	SA182 F22 CL3	05/02/2010
POI001160	Asfo SPA	16/11/2009	Flanged nozzle	SA182 F22 CL3	05/02/2010
POI001160	Asfo SPA	16/11/2009	Flanged nozzle	SA182 F22 CL3	05/02/2010
POI001160	Asfo SPA	16/11/2009	Block forgings	SA182 F22 CL3	05/02/2010
POI001160	Asfo SPA	16/11/2009	Block forgings	SA182 F22 CL3	05/02/2010
POI001160	Asfo SPA	16/11/2009	Block forgings	SA182 F22 CL3	05/02/2010
POI001160	Asfo SPA	16/11/2009	Block forgings	SA182 F22 CL3	05/02/2010
POI001160	Asfo SPA	16/11/2009	Breech lock channel cover	SA336 F22 CL3	05/02/2010
POI001160	Asfo SPA	16/11/2009	Breech lock tubesheet	SA336 F22 CL3	05/02/2010
POI001160	Asfo SPA	16/11/2009	Breech lock ring	SA336 F22 CL3	05/02/2010
POI001160	Asfo SPA	16/11/2009	Breech lock ring	SA336 F22 CL3	05/02/2010
POI001160	Asfo SPA	16/11/2009	Breech lock ring	SA336 F22 CL3	05/02/2010
POI001160	Asfo SPA	16/11/2009	Breech lock ring	SA965 F321	05/02/2010
POI001160	Asfo SPA	16/11/2009	Breech lock ring	SA965 F321	05/02/2010
POI001160	Asfo SPA	16/11/2009	Breech lock ring	SA965 F321	05/02/2010
POI001160	Asfo SPA	16/11/2009	Breech lock ring	SA965 F321	05/02/2010
POI001160	Asfo SPA	16/11/2009	Breech lock ring	SA965 F321	05/02/2010
POI001160	Asfo SPA	16/11/2009	Breech lock partition box flg.	SA965 F321	05/02/2010
POI001160	Asfo SPA	16/11/2009	/CONF. ORDINE		05/02/2010
POI001163	Forges SPA	16/11/2009	Breech lock channel	SA336 F22 CL3	22/01/2010
POI001163	Forges SPA	16/11/2009	Breech lock channel	SA336 F22 CL3	29/01/2010

POI001163	Forges SPA	16/11/2009	Breech lock channel	SA336 F22 Cl 3	05/02/2010
POI001163	Forges SPA	16/11/2009	/CONF. ORDINE		29/01/2010
POI001205	Sandvik Italia SPA	24/11/2009	Tubes 19,05dia x 1,65 thk Mil	SA213 TP321	12/03/2010
POI001205	Sandvik Italia SPA	24/11/2009	Tubes 19,05dia x 1,65 thk Mil	SA213 TP321	12/03/2010
POI001205	Sandvik Italia SPA	24/11/2009	Tubes 19,05dia x 1,65 thk Mil	SA213 TP321	12/03/2010
POI001205	Sandvik Italia SPA	24/11/2009	Tubes 19,05dia x 1,65 thk Mil	SA213 TP321	12/03/2010
POI001205	Sandvik Italia SPA	24/11/2009	Tubes 19,05dia x 1,65 thk Mil	SA213 TP321	12/03/2010
POI001205	Sandvik Italia SPA	24/11/2009	Tubes 19,05dia x 1,65 thk Mil	SA213 TP321	12/03/2010
POI001205	Sandvik Italia SPA	24/11/2009	Tubes 19,05dia x 1,65 thk Mil	SA213 TP321	12/03/2010
POI001205	Sandvik Italia SPA	24/11/2009	Tubes 19,05dia x 1,65 thk Mil	SA213 TP321	12/03/2010
POI001205	Sandvik Italia SPA	24/11/2009	Tubes 19,05dia x 1,65 thk Mil	SA213 TP321	12/03/2010
POI001205	Sandvik Italia SPA	24/11/2009	Tubes 19,05dia x 1,65 thk Mil	SA213 TP321	12/03/2010
POI001205	Sandvik Italia SPA	24/11/2009	Tubes 19,05dia x 1,65 thk Mil	SA213 TP321	12/03/2010
POI001205	Sandvik Italia SPA	24/11/2009	Tubes 19,05dia x 1,65 thk Mil	SA213 TP321	12/03/2010
POI001205	Sandvik Italia SPA	24/11/2009	Tubes 19,05dia x 1,65 thk Mil	SA213 TP321	12/03/2010
POI001205	Sandvik Italia SPA	24/11/2009	Tubes 19,05dia x 1,65 thk Mil	SA213 TP321	12/03/2010
POI001205	Sandvik Italia SPA	24/11/2009	Spacers 19,05dia	SA213 TP321	12/03/2010
POI001205	Sandvik Italia SPA	24/11/2009	/CONF. ORDINE		12/03/2010
POI001233	Fad Flange Acciaio e Derivati SPA	27/11/2009	Flange 1.1/2" 2500 BF RJ	SA182 F22 CL3	29/01/2010
POI001233	Fad Flange Acciaio e Derivati SPA	27/11/2009	Services - Quality/Testing		29/01/2010
POI001233	Fad Flange Acciaio e Derivati SPA	27/11/2009	Services - Quality/Testing		29/01/2010
POI001233	Fad Flange Acciaio e Derivati SPA	27/11/2009	/CONF. ORDINE		29/01/2010
POI001234	Outokumpu SPA	27/11/2009	Plate Thk 10mm	SA240 321	12/12/2009
POI001234	Outokumpu SPA	27/11/2009	Plate Thk 45mm	SA240 321	29/01/2010
POI001234	Outokumpu SPA	27/11/2009	/CONF. ORDINE		29/01/2010
POI001235	Industeel Belgium SA	27/11/2009	Plate Thk 20mm	SA387 Gr22 CL2	26/02/2010
POI001235	Industeel Belgium SA	27/11/2009	Plate Thk 30mm	SA387 Gr22 CL2	26/02/2010
POI001235	Industeel Belgium SA	27/11/2009	/CONF. ORDINE		26/02/2010
POI001238	Centro Servizi Metalli SPA	27/11/2009	Plate Thk 20mm	SA240 321	11/12/2009
POI001238	Centro Servizi Metalli SPA	27/11/2009	/CONF. ORDINE		11/12/2009
POI001303	Metalcam SPA	11/12/2009	Test Plate PTP-A-105 mm		29/01/2010
POI001303	Metalcam SPA	11/12/2009	Test Plate PTP-B-105 mm		29/01/2010
POI001303	Metalcam SPA	11/12/2009	Test Plate PTP-C-105 mm		29/01/2010
POI001303	Metalcam SPA	11/12/2009	/CONF. ORDINE		29/01/2010
POI001313	Forges SPA	14/12/2009	Services - Forging		22/01/2010
POI001313	Forges SPA	14/12/2009	/CONF. ORDINE		22/01/2010

附件 6

Koch Heat Transfer Company
C2322 Worfin
Production schedule

ID	Name attività	Start	Finish
1	Order placed	Thu 12/11/09	Thu 12/11/09
2	Eng nearing activities	Thu 12/11/09	Thu 11/02/10
3	Drawings approval	Mon 14/12/09	Sat 30/01/10
4	Subcoders placement	Mon 16/11/09	Thu 10/12/09
5	**Materials procurement**	**Thu 10/12/09**	**Fri 16/04/10**
6	Plates	Thu 10/12/09	Fri 26/02/10
7	Forgings	Thu 10/12/09	Fri 05/02/10
8	Tubes	Thu 10/12/09	Fri 16/04/10
9	Others	Thu 10/12/09	Mon 22/03/10
10	**Fabrication**	**Fri 05/02/10**	**Thu 20/05/10**
11	**Channel**	**Fri 05/02/10**	**Fri 09/04/10**
12	Machining of forgings	Fri 05/02/10	Tue 16/02/10
13	Weld overlay deposit	Tue 16/02/10	Mon 08/03/10
14	Nozzles ass y and welding	Tue 09/03/10	Wed 31/03/10
15	Final machining	Wed 31/03/10	Fri 09/04/10
16	**Shell**	**Fri 05/02/10**	**Fri 02/04/10**
17	Machining of forgings	Fri 05/02/10	Thu 18/02/10
18	Heads forming	Sat 27/02/10	Wed 24/03/10
19	Shell ass y and welding	Thu 18/02/10	Wed 10/03/10
20	Nozzles welding to shell	Thu 11/03/10	Fri 02/04/10
21	**Tube bundle**	**Fri 05/02/10**	**Fri 16/04/10**
22	Machining of forgings	Fri 05/02/10	Sat 20/02/10
23	Tubesheet drilling	Mon 22/02/10	Thu 18/03/10
24	Baffles drilling	Sat 27/02/10	Fri 19/03/10
25	Tubes bending	Fri 19/03/10	Wed 07/04/10
26	Cage ass y and tubes insertion	Fri 19/03/10	Tue 30/03/10
27	Tube to tubesheet welding	Tue 30/03/10	Fri 16/04/10

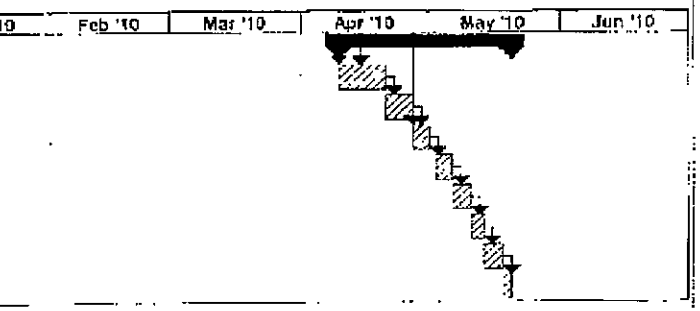
Nov '09 | Dec '09 | Jan '10 | Feb '10 | Mar '10 | Apr '10 | May '10 | Jun '10

Task | Progress | Summary
Critical Task | Milestone

Items: 30
Date: 15/12/2009
Rev: Preliminary

Koch Heat Transfer Company
C2322 Worfin
Production schedule

ID	Nome attività	Start	Finish
28	Final	Sat 10/04/10	Thu 20/05/10
29	Channel welding to shell	Sat 10/04/10	Tue 20/04/10
30	PWHT	Wed 21/04/10	Tue 27/04/10
31	Bundle insertion into shell	Tue 27/04/10	Sat 01/05/10
32	Shellside hydrotest	Mon 03/05/10	Thu 06/05/10
33	Final assy	Fri 07/05/10	Tue 11/05/10
34	Final hydrotest	Tue 11/05/10	Fri 14/05/10
35	Sandblasting and painting	Fri 14/05/10	Tue 18/05/10
36	Ex works delivery	Wed 19/05/10	Thu 20/05/10



Date: 15/12/2009
Revisione immagini

Task
Progress
Summary
Critical Task
Milestone