

經濟部暨所屬機關因公出國人員報告書
(出國類別：洽公)

M9401 煉製事業部大林廠汽柴油品質
提昇投資計畫赴反應器設備製
造廠監辦

出國人：服務機關：中油公司興建工程處
職務：一般工程師、設備檢查員
姓名：莊志誠、柯裕民

出國地點：韓國

出國期間：98年7月22日至7月31日

報告日期：98年9月29日

摘要

無論在煉製或石化工場各種固定設備中，製程的反應器都是這些設備中的核心要角，因此在製造的過程中，相關的檢查規範亦較為嚴謹。大林廠柴油加氫脫硫工場係採用丹麥的 Topsoe 公司的製程，其中的 R-1001 反應器係本公司透過採購方式招標購置，由韓國 Sedae 公司得標承製，本座反應器除要求承攬商須依照 ASME SEC.VIII Div.2 設計，取得 ASME U2 stamp，並須依據 Topsoe Standard(Unfired Pressure Vessel No4-1361/E, Rev.7)、中油公司工程標準 DS-1-1-01-0(Engineering Specification for Pressure Vessel)及 DS-1001-01-0(Engineering Specification for High Temperature Service Pressure Vessel)，其檢查與測試程序計劃 (ITP)必須依照 API RP934(Material and Fabrication Requirements for 2-1/4Cr-1Mo and 3Cr-1Mo Steel Heavy Wall Pressure for High Temperature, High Pressure Hydrogen Service)。

本次公務出國之主要目的，係赴韓國製造廠 Sedae 公司實際查驗其 NDT 執行情況及 TOFD(Time of Flight Diffraction)超音波檢測之實際執行情形，及目前反應器製造進度是否能於 11 月 30 前運抵工地，以免耽誤大林廠柴油加氫脫硫統包工程之進度。在實際驗證 TOFD 超音波檢測參考規塊時，依照其檢測程序及參數設定，都能檢出內部的人工瑕疵，在驗證其實際銲道檢測時，亦能有效顯示銲道情況(查驗圓周銲道及縱向銲道)；另本次公務出國亦順道參訪 KHE(Korea Heat Exchanger Ind. Co. Ltd)公司瞭解韓國石化相關 Air Cooler 設備製造能力。

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壹、目的

早期國內設備製商受限於製造技術及捲製能力，對於超過 100mm 厚度之反應器並無承製能力，因此常以外購方式由歐美日等先進國家取得；所幸目前已有各家國內製造廠商，勇於突破各項製造瓶頸，也擠身反應器製造供應之林，是一可喜現象。

唯市場總是競爭的，所以國內製造廠商雖佔地利優勢，但卻不是取得訂單之保證，所以本案訂單即是由韓國 Seade 公司取得。而本公司對外購反應器製造過程中之檢驗，以往在製造期間都有派人駐廠檢驗，本次則是於反應器製造中期介入，旨在瞭解廠商有否依契約規定及其 ITP 所訂，落實各項 NDT 工作之執行及見證其 TOFD 超音波檢測之執行情形，由於本案反應器之厚度達 146mm，如使用射線檢測技術(RT)來評估銲道瑕疵，須使用高能量射源，且底片靈敏度不佳，Seade 公司為有效且快速檢測銲道瑕疵，目前新發展且成熟的檢測技術為 TOFD(Time of Flight Diffraction)超音波檢測技術，且 ASME 有相關規範可引用 (ASME code case 2235-6)，因此，本次行程亦在驗證廠商執行 TOFD 超音波檢測技術之能力。

空氣冷卻器(air cooler)亦是煉製工廠中不可或缺的設備，民國九〇年代初期，本公司桃園煉油廠低硫燃油工場就曾因空冷氣爆炸，使公司蒙受重大損失，當時該空冷器即是外購取得，韓商供貨。參訪 KHE 公司目的在瞭解其 Air Cooler 製造能力，及就其與本國同級設備製廠間之差異性作一比較。

貳、過程

一、行程安排

日期	詳細工作內容
7月22日 星期三	啓程前往韓國首爾（Seoul）。
7月23日 星期四	前往 KHE 公司參訪。
7月24日 星期五	轉赴釜山（Busan）。
7月25日 星期六	“至 Sedae 公司監辦”行前準備事宜：相關資料查閱。
7月26日 星期日	“至 Sedae 公司監辦”行前準備事宜：相關資料查閱。
7月27日 星期一	赴 Sedae 公司討論反應器製造檢查事宜。
7月28日 星期二	TOFD 超音波檢測實際操作。
7月29日 星期三	工作討論並取回已執行部分各項 NDT 報告
7月30日 星期四	由釜山返回首爾並整理各項查驗資料。
7月31日 星期五	搭機至桃園機場，轉返高雄。

二、出國紀要

98年7月22日(星期三)

啓程由高雄小港機場直飛韓國，3小時後抵達仁川機場，出關後轉搭短程巴士至首爾，已是夜間十時許，至飯店整理妥當，便作歇息。

98年7月23日(星期四)

KHE 公司參訪

KHE 公司係一頗具規模的 Air Cooler 專業製造公司(韓國排名前二名的 Air Cooler 製造公司)，工廠佔地甚廣，國內主要製造 Air cooler 之主要兩家廠商聚熱與世鴻公司，可能尙無製廠規模能出其右，且廠房內機具、器材與製造中設備，皆置放整齊，走道暢通、動線明朗，令人印象深刻。

國內 Air Cooler 製商，與本公司有業務往來者有兩家，皆在彰化縣；一是位於鹿港鎮的聚熱公司，另一則是位於彰濱工業區的世鴻公司。

由於本公司與 KHE 公司現行並無契約關係，故無從得知其製造品質。但仍可由以下數點，與國內二製商之差異性座做一比較：

1. Air Cooler 使用的 Fin Tube 均係自行捲製(與國內公司相同)。
2. 參觀其 Air Cooler 製程與檢驗過程，與國內二製商無分軒輊。
3. 但其設備製作完成後之噴砂、塗裝程序皆係在其廠內施作，採自動化方式，於密閉空間作業，可徹底解決空污問題，值得國內製商參考。

98年7月24日(星期五)

搭韓國高鐵 (KTX) 赴釜山。

經由二次轉車抵達釜山已是下午五點，至旅館 check in 後結束當天行程。

98年7月25、26日(星期六、日)

本次公務出國主要行程”至反應器設備廠 Sedae 公司監辦”行前準備事宜：相關資料查閱。

98年7月27、28、29日(星期一、二、三)

工作前討論

在本次公務出國前，已先訂定本次的工作主題並事先請 Sedae 公司準備，在抵達 Sedae 公司後，立即就工作主題討論，並達成決議(如附件一)，內容主要與 Sedae 公司討論反應器製作進度、運送相關事宜、製造檢查事項及查驗 TOFD 超音波檢測過程，為查驗各項 NDT 工作的落實，並取回已執行部分 NDT 報告。包含：

1. TOFD 超音波檢測報告(含圓周鐳道與縱向鐳道，如附件二)
2. PT 液滲檢測報告(Overlay PT check，如附件三)

3. PMI 檢測報告(反應器殼板 SA387-22 CL2，如附件四)
4. RT 檢測報告(管嘴對銲，如附件五)
5. FERRITE TEST 檢測報告(Overlay 後肥粒鐵含量測試，如附件六)

TOFD 超音波檢測

在過去，針對設備銲道最常用的檢測方式是射線檢測(RT)，但隨著鋼板厚度的增加，射線照相呈現的影像會越見模糊；當鋼板厚度達到 100 mm 以上時，不但須高能量的射源(如高能鈷六十 RT 檢測設備，國內僅台塑重工有此設備)，而且檢測時間長，一張底片可能需長達數小時成像時間，靈敏度尚可但清晰度不佳，瑕疵不容易判讀。

這是 TOFD 超音波檢測技術被採用的原因之一；它既可輕易穿透厚板，可在螢幕上立即得知檢測結果，而且判讀容易，不須像傳統超音波檢測，須由具較多檢測經驗的檢測人員來判讀，可立即得知檢測結果，並可解決射線檢測實施時，可能造成的輻射傷害及日後底片銷毀時產生的環境污染問題。

本次實際見證其操作，以缺陷模擬試片作校正，由波束的顯示中，証實該項檢測技術的可信度。並於實際施行檢測動作時，在執行及判讀上的動作均已顯現得相當純熟，且當時檢測執行係由高級檢測師 (Level III) 操刀。

參、心得及建議

一、心得

(一) 工作環境

參訪的二家韓國設備製商都相當注重工作環境之整潔，工廠內走道相當暢通，連工廠內的洗手間都是乾淨明亮，顯示公司對廠內工作人員的尊重，針對這點，與國內類似設備製廠相較，著實令人汗顏，通常國內的製造廠大多是地面髒亂，洗手間非常簡陋。最常見的是“路都不好走”；更進一步說，若工廠廠房發生事故，可能連前往事故現場的援救人員都很難到達事故現場，人員尚且如此，如需設備援救時，進入時程必然大受耽擱。這點值得我們深思。

(二) TOFD 超音波檢測

這項技術對於新製厚壁設備的檢查，在國外已使用的很廣泛，但由於代檢機構對於銲道檢測仍習慣於以 RT 底片的方式來認定，本案是首次 TOFD 技術應用於新製設備的銲道檢測，目前國內的新製厚壁設備，如本案的 R-1002 反應器(厚度 87mm，銘榮元公司承製)、D-1003 筒槽(厚度 95mm，

俊鼎公司承製)，都是以傳統的射線檢測(RT)來確認銲道品質，並沒有採用 TOFD 超音波檢測。據瞭解，國內的檢測公司，除工研院及少數 1、2 家公司有此設備及檢測能力，因此，提昇國內 TOFD 超音波檢測能力及製造廠家接受度還須努力。

- (三) 韓國在最近這幾年急起直追，整個國家的國力展現令人刮目相看，一進入韓國市區，看到的都是滿街跑的韓國車，想要找一部進口車都不容易；拿起在網路上印出來的韓國地圖，Sedae 公司的人員還特地指正地圖錯誤，韓國與日本之間的海是韓國海不是日本海，他們的國家意識之強令人震驚，這也是身處在島國的臺灣無法想像的。

二、建議

- (一) 目前的財務採購或工程採購案，如果是內購設備，我們尚可依採購契約，與供應商訂定查驗點，約束供應商落實各項必要的 NDT 檢測，並對其查驗；但對外購設備，則往往只能做“進庫檢驗”。依契約規定檢點各項應做的檢驗，及確認各項檢測報告是否都已到位。這是現實亦是無奈，只能就供應商檢附的各項報告，消極的採取相信態度，但卻不能保證報告的內容確已落實執行。萬一檢驗動作未落實執行，設備經短暫使用即可能衍生工安事故，桃廠低硫燃工廠空冷器爆炸即是一例。該空冷器爆炸原因事後追查，係 Nozzle 未開槽做全滲透銲接，致強度不足所導致。因此，對於重要的外購設備(如反應器等)，我們應該依循過去方式，派駐人員駐廠檢驗，這樣對於銲接品質的管控才能有所掌握。
- (二) 現在新建工程大多採統包方式發包，得標之統包商雖可完全主導設計、採購、裝建工作，但統包商通常是利潤導向，會先找價格最低的下包商，甚至是大陸、韓國等國家的製造商或供應商，因此如何約束統包商，在尋找設備供應商時，若國內製廠亦有承製能力，則宜優先選用，不可一味只是價格取向，以保障國內產業及設備品質。

肆、附錄

一、參訪 KHE 公司照片



KHE 公司前合影(KHE 公司大林 RFCC 案經理)



整齊、明潔的廠房



設備置放情況



設備製作開槽與銲接作業



製作完成之鰭管(Fin tube)



廠內之噴砂與噴漆設備

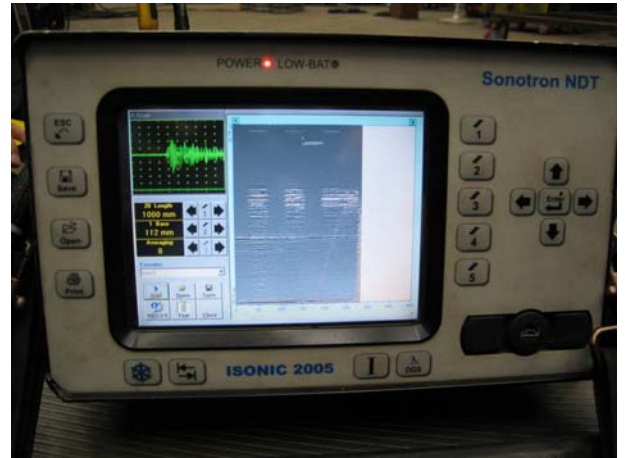
二、Sedae 公司 TOFD 超音波檢測實作查驗照片



三種厚度之參考規塊與 TOFD 超音波探頭



檢測前校正作業 一



校正作業 二(螢幕上為檢測到參考規塊之人工瑕疵)



校正作業 三(檢測人員解說檢測道之人工瑕疵)



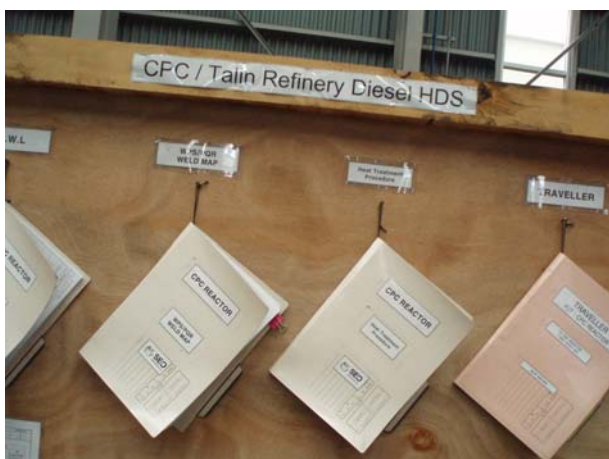
圓周銲道 TOFD 檢測情形



縱向銲道 TOFD 檢測情形



檢測中之工作討論情形



本案各項作業程序書置現場供隨時翻閱



Overlay 銲接施作情形



參與檢驗全體人員合影

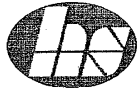
MEETING AGENDA

Proect: CPC/Talin Refinery Disel HDS R-1001 Reactor

Date: July 27,2009

NO	AGENDA	Reply from Sedae
1	Overall introduction of Inspection Test Procedure about R-1001 Reactor	Please see the approved inspection and test procedure.
2	Detailed schedule of R-1001 Reactor please show the updated schedule of R-1001 Reactor, and show the task not on schedule.	Please see the updated fabrication schedule.
3	NDT report and TOFD report please show the detailed NDT reports and TOFD reports have been done. including TOFD system verification record and calibration/reference block.	Before inspection, ToFD equipment is calibration through reference Block. After NDT inspection, We review NDT Report.
4	Any TOFD inspection and NDT Inspection can be witnessed. especially the TOFD calibration procedure should be witnessed.	For completed weld seam, You can watch the demonstration whenever you want.
5	NDT personnel records in this project	SEC has NDT personal Records & Procedure.
6	How do you do to satisfy ASME code case 2235-6 according to Code Case 2235-6, under what conditions and limitations may TOFD inspection be used in lieu of radiography in this project	1) The inspection time: TOFD inspection would be examined after welding the MAIN and before welding OVERLAY 2) The temperature of the inspection: Inspection must be examined after 48 hours after finishing the welding (include the B.P.<before P.W.H.T>), the temperature is the same temperature on normal temperature with the calibration block. 3) The condition of the surface: the inspection would be examined after removing a foreign substances like scale that have an effect on the inspection. 4) Overcoming of the inspection limitation: We would separate the inspection part with 3 zones to minimize the part that is not inspected. We would test offset scan especially for the bottom part.. We would test MT(magnetic test) inspection on the inside and outside of the welding part to inspect the surface defects.
7	Can the TOFD reference block be given with the Reactor? Because the request of my government's AI, Can the TOFD reference block be given with the Reactor?	Not yet decided. Because we spent the plates material for shell & head.

초음파 탐상 검사 보고서 (ToFD) REPORT OF ULTRASONIC EXAMINATION (Time of Flight Diffraction Method)



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보고서번호 HSTOFD-RC07-80-D003-090403-01

Report No.

보고일자

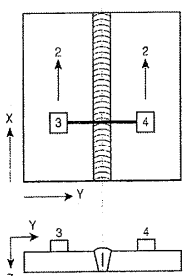
2009. 04. 03

Date of Report

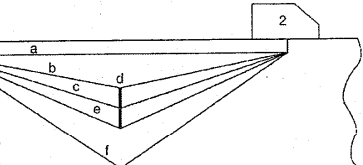
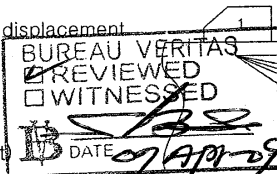
주문주/발주선 Owner/Customer CPC CORPORATION, TAIWAN	공사명 Project Name(No.) CPC/Talin Refinery Diesel Hds M9401
제품명 Item Name(No.) R-1001 HDS REACTOR	도면번호 Drawing No. SEC-RC07-80-D003 Rev.2
제품재질 Material SA387-22 CL.2	제품두께 Thickness 146 <input checked="" type="checkbox"/> mm <input type="checkbox"/> inch
제품종류 Item Type <input checked="" type="checkbox"/> 용접 Welding <input type="checkbox"/> 압연 Rolling <input type="checkbox"/> 단조 Forging <input type="checkbox"/> Other	표면조건 Surface Condition <input checked="" type="checkbox"/> 사상 As Ground <input type="checkbox"/> Other <input type="checkbox"/> 기계가공 As Machined
용접방법 Welding process <input type="checkbox"/> SMAW <input checked="" type="checkbox"/> SAW <input type="checkbox"/> FCAW <input type="checkbox"/> GTAW <input type="checkbox"/> GMAW <input type="checkbox"/> Other	검사 시기 Examination Time <input checked="" type="checkbox"/> Before PWHT <input type="checkbox"/> After PWHT <input type="checkbox"/> After Hydro-test <input type="checkbox"/> Other
용접개선현상 Grove Type <input type="checkbox"/> V <input checked="" type="checkbox"/> X <input type="checkbox"/> K <input type="checkbox"/> Other	리젝션 Rejection <input type="checkbox"/> On <input checked="" type="checkbox"/> Off Level 0
장비 Equipment 제조사 Maker : Sonotron NDT 모델 Model : ISONIC 2005 고유번호 Serial No. : 804500610251 교정날짜 Due Date : 2010. 02. 25 교정기록번호 Calibration record No. : HS-UT-01-0032	주사 Scanning 스캐너 종류 Scanner Type : Vantage VANPIRE 스캐너 번호 Scanner Serial No. : CE VPR 0105 주사속도 Scanning speed : Max. 150 mm/sec 케이블 형태 Cable Type : LEMO 케이블 길이 Cable Length : 5 m
교정시험편 Calibration Block Serial No. : HSC-TOFD-005 Thickness : 146 mm	온도차 Temp. Diff. 0 C° (Block: 15 C° / Exam.: 15 C°)
접촉매질 Couplant <input type="checkbox"/> 기름 Oil <input type="checkbox"/> 글리세린 Glycerin <input type="checkbox"/> Other <input type="checkbox"/> 전분 C.M.C <input checked="" type="checkbox"/> 물 Water	검사수행시간 Examination Date & Time Start : 2009. 04. 03 9:00 Finish : 2009. 04. 03 10:00
프로그램 Computerized Program ISONIC Office 2005 Multi-Functional Package	절차서 번호 Procedure No. HS-WP/TOFD-101E Rev. No. <0>
합격기준 Acceptance Standard ASME Code Case 2235-6 (2004Ed)	참고규격 Reference Standard ASME Sec.V, Art.4 / ASME Sec.VIII, Div.2 (2004Ed+2006ADD)

적용방법 Technique No.	탐촉자 Transducer						탐촉자간격 Probe Center Separation	감도 Sensitivity
	제조사 Maker	모델 Model	식별번호 Serial No.	각도 Angle	주파수 Frequency	크기 Size		
Tec. 1	TKS	5C6N	NFAA25,26	60 Deg.	5 Mhz	6 mm	112 mm	50 dB
Tec. 2	TKS	5C6N	NFBA25,26	45 Deg.	5 Mhz	6 mm	162 mm	50 dB
Tec. 3	TKS	5C6N	NCEA25,26	40 Deg.	5 Mhz	6 mm	218 mm	50 dB

Scanning Method



- 1 Reference line
- 2 Direction of probe displacement (x-direction)
- 3 Transmitter
- 4 Receiver
- 5 Transit time (through wall extent)
- 6 Lateral wave
- 7 Imperfection upper tip
- 8 Imperfection lower tip
- 9 Backwall reflection



- 1 transmitter
- 2 Receiver
- a lateral wave
- b Upper tip
- c Included angle
- d Imperfection
- e lower tip
- f Back wall reflection

시험자 Examiner 김동우 D.W.KIM 2009. 04. 03 LEVEL II	임회자 Witnessed by QAD: H.S. KSA DATE: 2009. 04. 03
판독자 Interpreter 전병일 B.I.JOHN 2009. 04. 03 LEVEL III	검토자 Reviewed by HSECI W.I. Bae/Date
승인자 Approver 전병일 B.I.JOHN 2009. 04. 03 LEVEL III	



초음파탐상검사보고서(ToF) REPORT OF ULTRASONIC EXAMINATION (Time of Flight Diffraction Method)

ASME



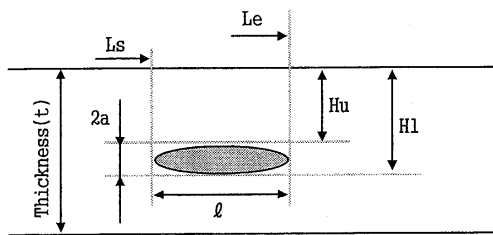
한솔검사엔지니어링(주)
HANSOL INSPECTION ENGINEERING CO., LTD.
주소 : 서울시 구로구 구로동 197-33
전화 : 02) 6330-2233 FAX : 02) 6330-2236

보고서번호 HSTOFD-RC07-80-D003-090403-01
Report No.
보고일자 2009. 04. 03
Date of Report

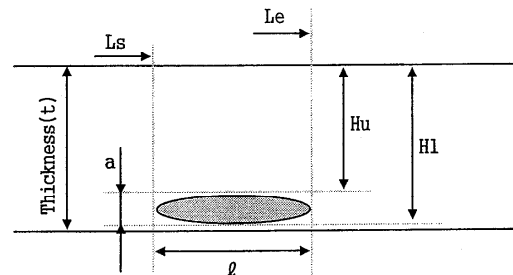
확인번호 Identification No.		위치 Location(mm)		길이 Length (mm) l	깊이 Depth(mm)		높이 Height (mm) a or $2a$	결정의종류 Type of Flaw	a / l	a / t	평가 Evaluati on	검사방법 Technique
Joint No.	Ind. No.	Start Ls	End Le		Upper Hu	lower Hl						
LWL-17-1	1	253.1	289.1	36	73.2	75.2	2.0	Subsurface	0.02778	0.00685		Tec. 1,2,3
LWL-17-2		No Recordable Indication										Tec. 1,2,3
LWL-18-1		No Recordable Indication										Tec. 1,2,3
LWL-18-2		No Recordable Indication										Tec. 1,2,3
- B L A N K -												

	<input checked="" type="checkbox"/> Witnessed By
	<input checked="" type="checkbox"/> Reviewed By
QAD:	<i>H. S. KIM</i>
DATE:	<i>2009. 04. 03</i>

1. Indication Marking (Subsurface Indication)



2. Indication Marking (Surface Indication)



초음파탐상검사보고서(ToF)
REPORT OF ULTRASONIC EXAMINATION
(Time of Flight Diffraction Method)

ASME

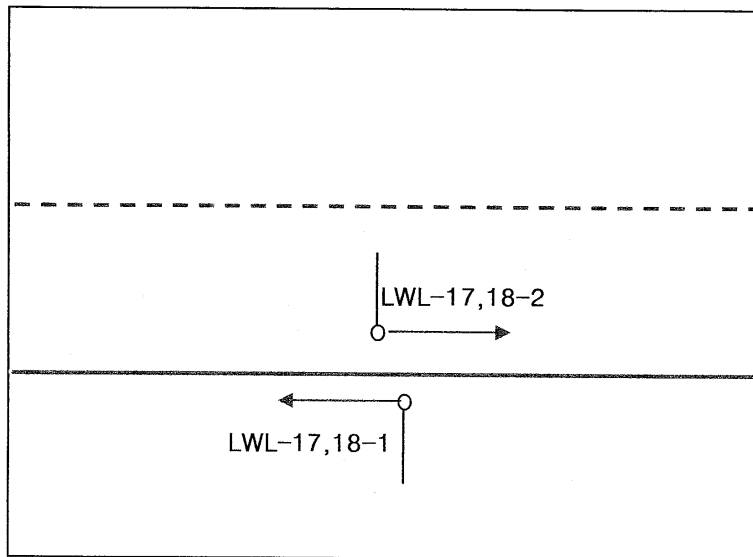


한솔검사엔지니어링(주)
 HANSOL INSPECTION ENGINEERING CO., LTD.
 주 소 : 서울시 구로구 구로동 197-33
 전 화 : (02) 6330-2233 FAX : (02) 6330-2236

보고서번호 HSTOFD-RC07-80-D003-090403-01
 Report No.
 보고일자 2009. 04. 03
 Date of Report

Location Marking

R-1001 HDS REACTOR
 SEC-RC07-80-D003




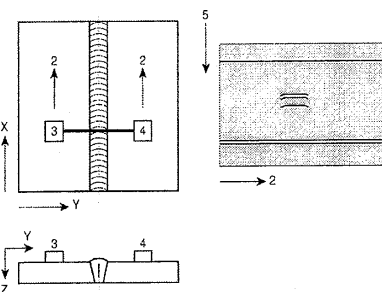
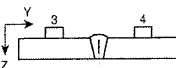
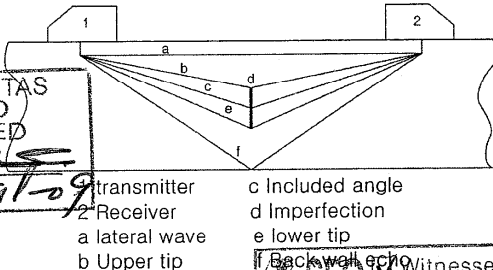
OUT SIDE SCANNING

	<input checked="" type="checkbox"/> Witnessed By
	<input checked="" type="checkbox"/> Reviewed By
QAD:	<i>H. S. KSM</i>
DATE:	<i>2009. 04. 03</i>



ASME

초음파탐상검사보고서(ToFD)
 REPORT OF ULTRASONIC EXAMINATION
 (Time of Flight Diffraction Method)

 한솔검사엔지니어링(주) HANSOL INSPECTION ENGINEERING CO., LTD. 72 Shincheon-dong changwon-city Gyeongsangnam-do korea TEL : 055) 266-8815 FAX : 055) 266-8815		보고서번호 HSTOFD-RC07-80-D003-090526-01 Report No. 보고일자 2009. 05. 26 Date of Report							
주문주/발주선 Owner/Customer CPC CORPORATION, TAIWAN		공사명 Project Name(No.) CPC/Talin Refinery Diesel Hds M9401							
제품명 Item Name(No.) R-1001 HDS REACTOR		도면번호 Drawing No. SEC-RC07-80-D003 Rev.3							
제품재질 Material SA387-22 CL.2		제품두께 Thickness 146 <input checked="" type="checkbox"/> mm <input type="checkbox"/> inch							
제품종류 Item Type <input checked="" type="checkbox"/> 용접 Welding <input type="checkbox"/> 압연 Rolling <input type="checkbox"/> 단조 Forging <input type="checkbox"/> Other		표면조건 Surface Condition <input checked="" type="checkbox"/> 사상 As Ground <input type="checkbox"/> Other <input type="checkbox"/> 기계가공 As Machined							
용접방법 Welding process <input type="checkbox"/> SMAW <input checked="" type="checkbox"/> SAW <input type="checkbox"/> FCAW <input type="checkbox"/> GTAW <input type="checkbox"/> GMAW <input type="checkbox"/> Other		검사시기 Examination Time <input checked="" type="checkbox"/> Before PWHT <input type="checkbox"/> After PWHT <input type="checkbox"/> After Hydro-test <input type="checkbox"/> Other							
용접개선휘상 Groove Type <input type="checkbox"/> V <input checked="" type="checkbox"/> X <input type="checkbox"/> K <input type="checkbox"/> Other		리젝션 Rejection <input type="checkbox"/> On <input checked="" type="checkbox"/> Off Level 0							
검사기 Equipment 제조사 Maker : Sonotron NDT 모델 Model : ISONIC 2005 고유번호 Serial No. : 804500610251 교정날짜 Due Date : 2010. 02. 25 교정기록번호 Calibration record No. : HS-UT-01-0032		주사 Scanning 스캐너 종류 Scanner Type : Vantage VANPIRE 스캐너 번호 Scanner Serial No. : CE VPR 0105 주사속도 Scanning speed : Max. 150 mm/sec 케이블 형태 Cable Type : LEMO 케이블 길이 Cable Length : 5 m							
교정시험편 Calibration Block Serial No. : HSC-TOFD-005 Thickness : 146 mm		온도차 Temp. Diff. 0 C° (Block: 25 C° / Exam.: 25 C°)							
접촉매질 Couplant <input type="checkbox"/> 기름 Oil <input type="checkbox"/> 글리세린 Glycerin <input type="checkbox"/> Other <input type="checkbox"/> 전분 C.M.C <input checked="" type="checkbox"/> 물 Water		검사수행시간 Examination Date & Time Start : 2009. 05. 26 14:00 Finish : 2009. 05. 26 17:30							
프로그램 Computerized Program Version ISONIC Office 2005 Multi-Functional Package		절차서 번호 Procedure No. Rev. No. HS-WP/TOFD-101E <0>							
합격기준 Acceptance Standard ASME Code Case 2235-6 (2004Ed)		참고규격 Reference Standard ASME Sec.V, Art.4 / ASME Sec.VIII, Div.2 (2004Ed+2006ADD)							
적용방법	탐촉자 Transducer						탐촉자간격	감도	
Technique No.	제조사 Maker	모델 Model	식별번호 Serial No.	각도 Angle	주파수 Frequency	크기 Size	Probe Center Separation	Sensitivity	
Tec. 1	TKS	5C6N	NFAA25,26	60 Deg.	5 Mhz	6 mm	112 mm	50 dB	
Tec. 2	TKS	5C6N	NFBA25,26	45 Deg.	5 Mhz	6 mm	162 mm	50 dB	
Tec. 3	TKS	5C6N	NCEA25,26	40 Deg.	5 Mhz	6 mm	218 mm	50 dB	
Scanning Method									
									
1 Reference line 2 Direction of probe displacement (x-direction) 3 Transmitter 4 Receiver 5 Transit time (through wall extent) 6 Lateral wave 7 Imperfection upper tip 8 Imperfection lower tip 9 Backwall reflection			1 transmitter 2 Receiver a lateral wave b Upper tip			c Included angle d Imperfection e lower tip			
시험자 Examiner 김동우 D.W.KIM 2009. 05. 26 LEVEL II				임회자 Witnessed by				Backwash Echo Witnessed By <input checked="" type="checkbox"/>	Reviewed By <input checked="" type="checkbox"/>
판독자 Interpreter 전병일 B.I.JOUN 2009. 05. 26 LEVEL III				검토자 Reviewed by				QAD: H.S. K21 DATE: 2009. 05. 26	Rev / Wit / App
승인자 Approver 전병일 B.I.JOUN 2009. 05. 26 LEVEL III				HSBCT W. I. Bae/Date					



초음파탐상검사보고서(ToF)
REPORT OF ULTRASONIC EXAMINATION
(Time of Flight Diffraction Method)



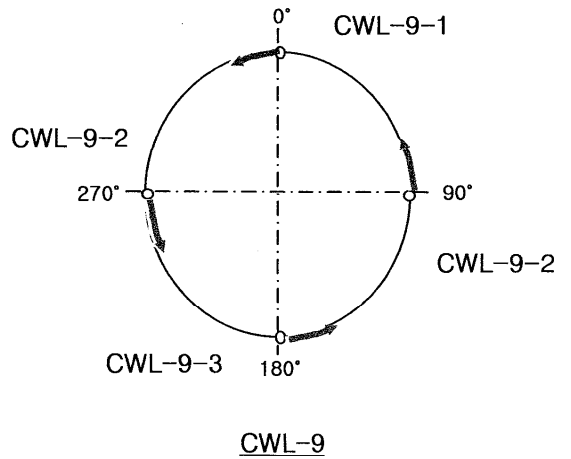
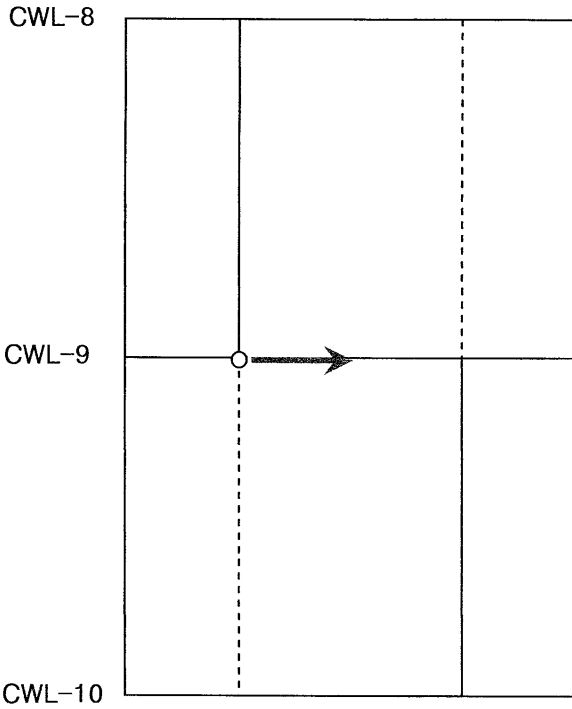
한솔검사엔지니어링(주)
 HANSOL INSPECTION ENGINEERING CO., LTD.
 72 Shincheon-dong changwon-city Gyeongsangnam-do korea
 TEL : 055) 266-8815 FAX : 055) 266-8815

보고서번호 HSTOFD-RC07-80-D003-090526-01
 Report No.
 보고일자 2009. 05. 26
 Date of Report

Location Marking

R-1001 HDS REACTOR

SEC-RC07-80-D003




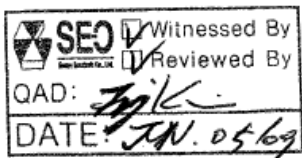
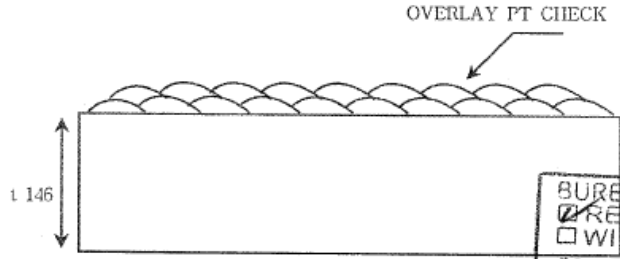
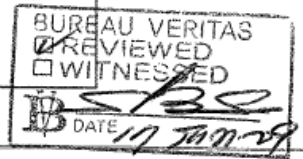
OUT SIDE SCANNING

	<input checked="" type="checkbox"/> Witnessed By
	<input checked="" type="checkbox"/> Reviewed By
QAD:	<i>H. S. KIM</i>
DATE:	<i>2009. 05. 26</i>



REPORT OF LIQUID PENETRANT EXAMINATION


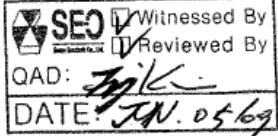
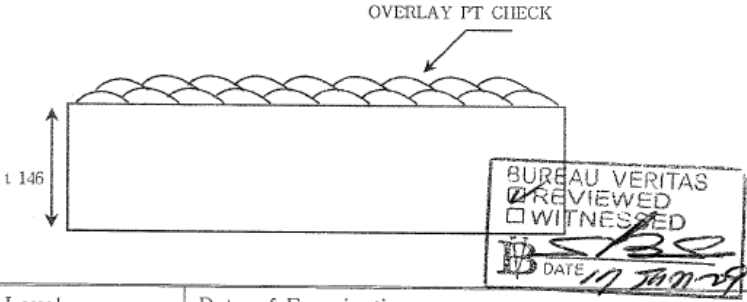
액체 침투 탐상 시험 보고서

 케이엔디티앤아이(주) Korea Nondestructive Testing & Internet Co., Ltd. 서울시 구로구 구로동 170-5 우림 e-Biz센터 805호 TEL : (02) 852-2223~4 FAX : (02) 861-1298		Report No. KNDT-CW-SEC3-P091207 보고서번호		
		Page No. 1 of 1 페이지번호		
Project Name 공사명 M9401 / CPC/TALIN REFINERY DIESEL HDS	M/O No.(job No.)발주서번호 96k601 (SEC-RC07-80)	Owner/Customer주문주/고객 CPC CORPORATION, TAIWAN / SEDA ENEERTECH CO., LTD.		
Item Name 제품명 R-1001 HDS REACTOR	Procedure/Code Rev. No. 절차서/규격 KNDT-NDEP-PT-CPC-001 ASME SEC.VIII Div.2 APP.9-2 ('04ED. '06ADD.)	Dwg No.도면번호 SEC-RC07-80-D003		
Item No. 제품번호 LWL-3.4	Surface Condition 표면상태 AS WELDED	Material 재질 E347		
Penetrant/Applying 침투제/적용 P-2 NAWOO TECH. / N03NPP01	Dwell Time 침투시간 7min	Penetrant Type 침투제 종류 <input checked="" type="checkbox"/> Visible Dye <input type="checkbox"/> Fluorescent		
Developer/Applying 현상제/적용 D-4 NAWOO TECH / 03NPD03	Developing Time 현상시간 10min	Surface Temperature 표면온도 18℃		
Remover 세척제 R-1,3 NAWOO TECH / 03NPR03	Removal Technique 세척방법 <input type="checkbox"/> Water <input checked="" type="checkbox"/> Solvent	Local Heating 국부가열 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Procee of PT 침투탐상공정 B-3	Method of removing excess penetrant 과잉침투제 제거 방법/ Wiping With Cloth	Post examination Cleaning 후처리 방법 Solvent Removal		
Time of between step 공정사이의 시간	Drying after preparation Min. 3 minute	After removal penetrants Max. 15 minutes		
Light Source / Lux Meter 조명등 / 조도계 일련번호 Nam Young 100W / TES 1330A / 040106691		Light Source to Object Distance/LUX 조명거리/광도 50 cm / 1200 Lux		
Black Light / UV Meter S/No. 자외선등 / 자외선 강도계 N/A		Black Light Source-to-Object Distance 자외선등조명거리/강도 N/A cm / μW/cm ²		
Identification No. 확인 번호	Accept 합격	Reject 불합격	Interpretation 판독	Remarks 비고
SHELL (LWL-3.4)	V		NO RECORDABLE INDICATION	
			-BLANK-	
*PT CHECK POSITION .all surface (overlay welded part)				
				
				
Examined by 시험자	KIM, DAE-MIN	Level 레벨 II	Date of Examination JUN. 05, 2009	
Interpreted by 판독자	KIM, DAE-MIN	Level 레벨 II	Owner/Customer 주문주/고객감독관	
Approved by 승인자	SAM SURK, HUR	Level 레벨 III	<input type="checkbox"/> Third Party Inspector 공인검사관 <input type="checkbox"/> ANI / AI	



REPORT OF LIQUID PENETRANT EXAMINATION

액체 침투 탐상 시험 보고서

 케이엔디티앤아이(주) Korea Nondestructive Testing & Internet Co., Ltd. 서울시 구로구 구로동 170-5 우림 e-Biz센터 805호 TEL : (02) 852-2223~4 FAX : (02) 861-1298		Report No. KNDT-CW-SEC3-P091207 보고서번호 Page No. 1 of 1 페이지번호		
Project Name 공사명 M9401 / CPC/TALIN REFINERY DIESEL HDS	M/O No.(job No.)발주서번호 96k6이 (SEC-RC07-80)	Owner/Customer주문주/고객 CPC CORPORATION, TAIWAN / SEDAE ENERTECH CO., LTD.		
Item Name 제품명 R-1001 HDS REACTOR	Procedure/Code Rev. No. 절차서/규격 KNDT-NDEP-PT-CPC-001 ASME SEC.VIII Div.2 APP.9-2 ('04ED, '06ADD.)	Dwg No.도면번호 SEC-RC07-80-D003		
Item No. 제품번호 LWL-3.4	Surface Condition 표면상태 AS WELDED	Material 재질 E347		
Penetrant/Applying 침투제/적용 P-2 NAWOO TECH. / N03NPP01	Dwell Time 침투시간 7min	Penetrant Type 침투제 종류 <input checked="" type="checkbox"/> Visible Dye <input type="checkbox"/> Fluorescent		
Developer/Applying 현상제/적용 D-4 NAWOO TECH / 03NPD03	Developing Time 현상시간 10min	Surface Temperature 표면온도 18℃		
Remove 세척제 R-1.3 NAWOO TECH / 03NPR03	Removal Technique 세척방법 <input type="checkbox"/> Water <input checked="" type="checkbox"/> Solvent	Local Heating 국부가열 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Procee of PT 침투탐상공정 B-3	Method of removing excess penetrant 과잉침투제 제거 방법/ Wiping With Cloth	Post examination Cleaning 후처리 방법 Solvent Removal		
Time of between step 공정사이의 시간	Drying after preparation Min. 3 minute	After removal penetrants Max. 15 minutes		
Light Source / Lux Meter 조명등 / 조도계 일련번호 Nam Young 100W / TES 1330A / 040106691	Light Source to Object Distance/LUX 조명거리/광도 50 cm / 1200 Lux			
Black Light / UV Meter S/No. 자외선등 / 자외선 강도계 N/A	Black Light Source-to-Object Distance 자외선등조명거리/강도 N/A cm / μW/cm ²			
Identification No. 확인 번호	Accept 합격	Reject 불합격	Interpretation 판독	Remarks 비고
SHELL (LWL-3.4)	V		NO RECORDABLE INDICATION	
			-BLANK-	
*PT CHECK POSITION .all surface (overlay welded part)				
				
Examined by 시험자	KIM, DAE-MIN	Level 레벨	II	Date of Examination JUN. 05, 2009
Interpreted by 판독자	KIM, DAE-MIN	Level 레벨	II	Owner/Customer 주문주/고객감독관
Approved by 승인자	SAM SURK, HUR	Level 레벨	III	<input type="checkbox"/> Third Party Inspector 공인검사관 <input type="checkbox"/> ANI / AI



INSPECTION REPORT OF POSITIVE MATERIAL IDENTIFICATION



Report No. : KNDT-CW-PMI-SEC3-CPC-09001 (1 of 2)

Client	CPC CORPORATION, TAIWAN / SEDAE ENERTECH CO., LTD.	We Certify That Statements in This Report are Correct	
Project	M9401 CPC/TALIN REFINERY DIESEL HDS		
(M/O No.) PO No.	(SEC-RC07-80) 96k601	Spec. No.	ASME SEC II Part A
Item Name	R-1001 HDS REACTOR	Proc. No.	KNDT-NDEP-PMI-003 Rev.2
Item No.	PLATE	Dwg. No.	SEC-RC07-80-D003
Examination Equipment	NITON XLI-818 ALLOY ANALYZER	Examination Scope	<input type="checkbox"/> Deposit Metal <input checked="" type="checkbox"/> Base Metal
* Material Specification(Base Metal)			
SA387-22 CL2			
* Acceptance Chemical Range			
Cr : 1.88 ~ 2.62 % , Mo : 0.85 ~ 1.15 % , Mn : 0.25 ~ 0.66 %			

Part Name.	Verified Element									Result	Date of Examination	Remark
	Base Metal											
	Cr	Mo	Mn	-	-	-	-	-	-			
79t × 3050 × 6700 (Heat No.: 327437) (Rolled Plate No.: 89909-01)	2.21	0.97	0.27	-	-	-	-	-	-	Accept	JAN. 21. 2009	
79t × 3050 × 7200 Heat No.: 327437, Rolled Plate No.: 89895-01	2.24	0.98	0.30	-	-	-	-	-	-	Accept	JAN. 21. 2009	
79t × 2750 × 6400 Heat No.: 327437, Rolled Plate No.: 89903-01	2.18	0.98	0.50	-	-	-	-	-	-	Accept	JAN. 21. 2009	
79t × 2750 × 7000 Heat No.: 327437, Rolled Plate No.: 89892-01	2.22	0.99	0.62	-	-	-	-	-	-	Accept	JAN. 21. 2009	
146t × 3200 × 7610 (Heat No.: 323499) (Rolled Plate No.: 19209-01)	2.55	1.02	0.51	-	-	-	-	-	-	Accept	JAN. 21. 2009	

Witnessed By
Reviewed By
 QAD: H. S. KSA
 DATE: 2009.01.21

Examined by 시험자 KIM,DAE-MIN <u>(Signature)</u>	Date of Examination <p style="text-align: center;">JAN. 21. 2009</p> Owner/Customer <input type="checkbox"/> Third Party Inspector <input type="checkbox"/> ANI/AI (Authorized Nuclear Inspector)
Approved by 승인자 KIM,DAE-MIN <u>(Signature)</u>	<div style="border: 1px solid black; padding: 5px; text-align: center;"> BUREAU VERITAS <input checked="" type="checkbox"/> REVIEWED <input type="checkbox"/> WITNESSED <u>(Signature)</u> </div>



INSPECTION REPORT OF POSITIVE MATERIAL IDENTIFICATION

Report No. : KNDT-CW-PMI-SEC3-CPC-09001 (2 of 2)

Client	CPC CORPORATION, TAIWAN / SEDAE ENERTECH CO., LTD.	We Certify That Statements in This Report are Correct	
Project	M9401 CPC/TALIN REFINERY DIESEL HDS		
(M/O No.) PD No.	(SEC-RC07-80) 96k601	Spec. No.	ASME SEC II Part A
Item Name	R-1001 HDS REACTOR	Proc. No.	KNDT-NDEP-PMI-003 Rev.2
Item No.	PLATE	Dwg. No.	SEC-RC07-80-D003
Examination Equipment	NITON XLI-818 ALLOY ANALYZER	Examination Scope	<input type="checkbox"/> Deposit Metal <input checked="" type="checkbox"/> Base Metal

Part Name.	Verified Element									Result	Date of Examination	Remark
	Base Metal											
	Cr	Mo	Mn	-	-	-	-	-	-			
146t × 3200 × 7610 (Heat No.: 323499) (Rolled Plate No.: 19210-01)	1.99	0.90	0.61	-	-	-	-	-	-	Accept	JAN. 21. 2009	
146t × 3200 × 7610 (Heat No.: 326431) (Rolled Plate No.: 60468-01)	2.06	1.10	0.55	-	-	-	-	-	-	Accept	JAN. 21. 2009	
146t × 3200 × 7610 (Heat No.: 327076) (Rolled Plate No.: 58115-01)	2.31	0.94	0.38	-	-	-	-	-	-	Accept	JAN. 21. 2009	
146t × 3200 × 7610 (Heat No.: 327076) (Rolled Plate No.: 58151-01)	1.95	0.89	0.45	-	-	-	-	-	-	Accept	JAN. 21. 2009	
146t × 3200 × 7610 (Heat No.: 327076) (Rolled Plate No.: 58152-01)	2.26	0.94	0.61	-	-	-	-	-	-	Accept	JAN. 21. 2009	
146t × 3200 × 7610 (Heat No.: 327392) (Rolled Plate No.: 82326-01)	2.38	1.03	0.39	-	-	-	-	-	-	Accept	JAN. 21. 2009	
146t × 3200 × 7610 (Heat No.: 327392) (Rolled Plate No.: 82327-01)	2.51	1.10	0.54	-	-	-	-	-	-	Accept	JAN. 21. 2009	
146t × 3200 × 7610 (Heat No.: 327392) (Rolled Plate No.: 82328-01)	1.90	0.97	0.45	-	-	-	-	-	-	Accept	JAN. 21. 2009	
60t × 1950 × 7380 (Heat No.: 327437) (Rolled Plate No.: 89912-01)	2.60	1.10	0.61	-	-	-	-	-	-	Accept	JAN. 21. 2009	
				B	L	A	N	K	-			

	<input checked="" type="checkbox"/> Witnessed By <input checked="" type="checkbox"/> Reviewed By QAD: <u>H. S. KIM</u> DATE: <u>2009. 01. 21</u>
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REPORT OF RADIOGRAPHIC EXAMINATION

방사선 투과 검사 보고서

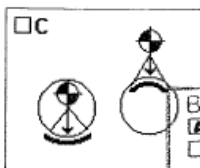
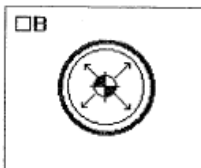
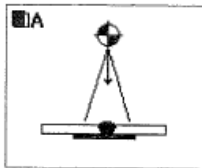


케이엔디티엔아이(주)
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 서울特別市 구로구 구로동 170-5 우림e-Biz 805
 電話 : (02) 852-2223~4 FAX : (02) 861-1298

Report No. 보고서 번호
 KNDT-CW-SEC3-R091094
 Page No. 페이지 번호
 1 OF 2

Customer(발주처) CPC CORPORATION, TAIWAN / SEDAE ENERTECH CO., LTD.		Project No./Name(공사번호/명) M9401 / CPC/TALIN REFINERY DIESEL HDS	
Item No./Name(제품번호/명) R-1001 HDS REACTOR		Part No./Name(부품번호/명) NOZZLE No.:B (NECK PIPE)	
DWG No. SEC-RC07-80-D005	Revision Rev.	Operation No.	Procedure No./Code(절차서/코드) KNDT-NDEP-RT-CPC-001 ASME SEC.VII Div.2 APP.8 ('04ED. '06ADD.)
X-ray Generator X선 발생장치	S/No.		S/No. N090632
	Voltage	Kvp	Source Type <input checked="" type="checkbox"/> Ir-192 <input type="checkbox"/> Co-60
	Current	mA	Intensity 30 Ci
	Focal Size	mm	Focal Size 3.0×2.0 mm
	Expose Time	Hr Min Sec	Expose Time Hr 2 Min 30 Sec
Material Type(재질) SA387-22 CL2		Mat'l Thickness(두께) 22.2mm	Weld Thickness / Reinforcement 24.2mm / 2mm
Penetration Thickness(투과두께) 24.2mm		Shim Thickness(심두께) N/A	Penetrameter(투과도계) <input checked="" type="checkbox"/> S.Side ASME #1B <input type="checkbox"/> F.Side
Contrastmeter(계조계) <input type="checkbox"/> With <input checked="" type="checkbox"/> Without		Min. SOD / Max. OFD 400mm / 25mm	Film Brand/Type(필름 제조사/종류) Fuji#100 / ASTM Class Type II
Density(농도) 2.0 - 4.0		Sensitivity(감도) 0.51mm (9th Wire)	Developing Condition(현상조건) 21 °C 5 Min
Film Viewing(필름관찰) <input checked="" type="checkbox"/> Single Wall <input type="checkbox"/> Double Wall		Screen(스크린) <input checked="" type="checkbox"/> Front 0.127 mm <input checked="" type="checkbox"/> Back 0.127 mm	Remarks(비고) TOTAL : 10 SHEETS
Number of Film(카세트당 필름수) 1 Sheet		Number of Exposure(촬영횟수) 10 Exposure	

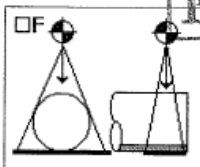
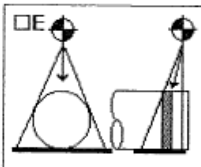
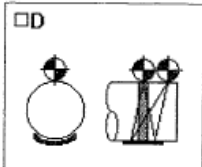
Remarks (Shooting Sketch)



G

JOINT No. : C-2, C-3, C-4

BUREAU VERITAS
 REVIEWED
 WITNESSED
 DATE: 09 Jul-09



SEO Witnessed By
 Reviewed By
 QAD: H.S. KSA
 DATE: 2009.07.01

Examined by
 시험자 KIM, DAE MIN Level II
 Interpreted by
 판독자 KIM, DAE MIN Level II
 Approved by
 승인자 SAM SURK, HUR Level III

Date of Examination 검사일자
 2009. 07. 01

Owner/Customer 주문주/고객 감독관

Third Party Inspector 공인 검사관
 ANI/AI

REPORT OF RADIOGRAPHIC EXAMINATION

방사선투과검사보고서



케이엔디타엔아이(주)
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Report No. 보고서 번호
 KNDT-CW-SEC3-R091094
 Page No. 페이지 번호
 2 OF 2

Project No./Name(공사번호/명) M9401 / CPC/TALIN REFINERY DIESEL HDS
 Item No./Name(제품번호/명) CPC CORPORATION, TAIWAN / SEDAE ENERTECH CO., LTD.

Film Identification No. 필름 확인번호	Acc. 합격	Rej. 불합격	Grade 등급	Interpretation 판정	Film Size 필름 크기	Welder ID 용접사번호	Remark 비고
C-2 0-1	✓			P	114×305	ESC	09' 07 01
" 1-2	✓			N	"	"	"
" 2-3	✓			N	"	"	"
C-2 3-E	✓			N	"	ESC	"
C-3 0-1	✓			N	"	ESI	"
" 1-2	✓			P	"	"	"
C-3 2-E	✓			P	"	ESI	"
C-4 0-1	✓			P	"	ESC	"
" 1-2	✓			N	"	"	"
C-4 2-E	✓			N	114×305	ESC	09' 07 01
				-BLANK-			

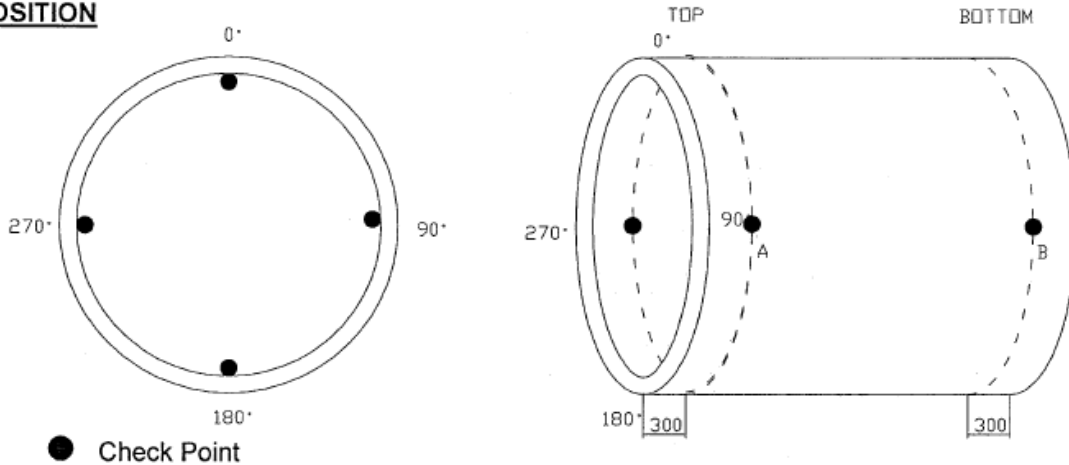
Witnessed By
 Reviewed By
 QAD: *M.S. KSA*
 DATE: *2009.07.01*

- ☞ Interpretation (판정 설명)**
- ① [N] No defect (무결함)
 - ② [IP] Incomplete Penetration (용입 부족)
 - ③ [LF] Lack of Fusion (용합불량)
 - ④ [S] Slag Inclusion (슬래그 개재)
 - ⑤ [P] Porosity (기공)
 - ⑥ [UC] Under Cut (언더컷)
 - ⑦ [BT] Burn Through (용락)
 - ⑧ [T] Tungsten Inclusion (텅스텐 개재)
 - ⑨ [SD] Surface Defect (표면 결함)
 - ⑩ [CP] Crater Pit (크레이터 피트)
 - ⑪ [RC] Root Concavity (루트면 오목함)
 - ⑫ [CR] Crack (크랙, 티짐)

FERRITE TEST REPORT (AFTER OVERLAY)

CUSTOMER	CPC CORPORATION, TAIWAN	DOC. No.	SEC-R001-FTR-01
PROJECT NAME	CPC/Tain Refinery Disel HDS	P/O No.	96K601
ITEM NAME	R-1001 HDS REACTOR	DRAWING No.	SEC-RC07-80-D003
ITEM No.	LWL-1,LWL-2	PAGE No.	1 OF 1

1. TEST POSITION



2. TEST RESULTS

POINT	VALUE (%)			REMARK
0°-A	6.5	6.2	6.7	
0°-B	7.4	6.5	6.9	
90°-A	6.4	6.4	7.1	
90°-B	6.9	7.2	6.5	
180°-A	7.3	7.2	6.8	
180°-B	6.5	6.6	7.1	
270°-A	6.4	7.3	7.1	
270°-B	6.9	6.6	6.9	

3. ACCEPTANCE CRITERIA

Test Value : Engineering Specification, DS-103-0002-0, 7.1.5 (Ferrite Range : Max. 10%)

4. USED INSTRUMENT

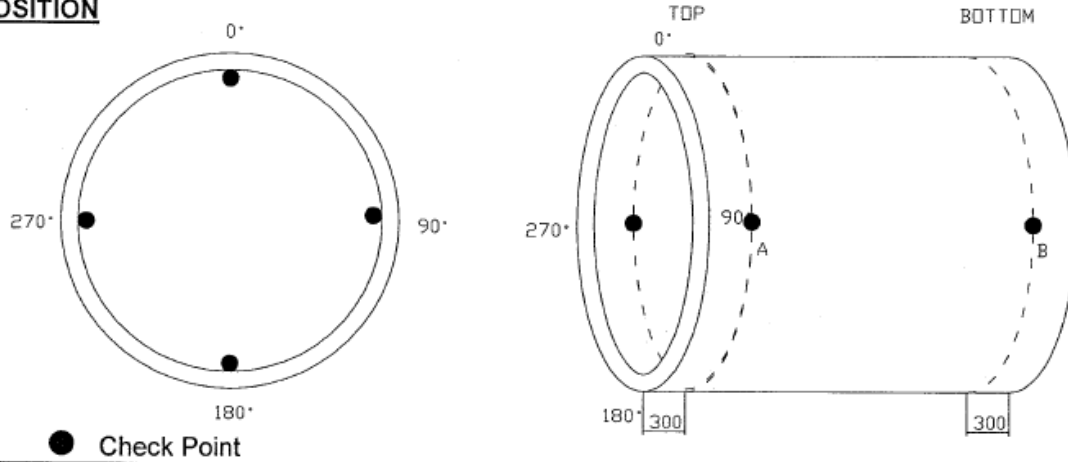
Ferrite Tester : FERITSCOPE MP30E-S, Serial No. : SN080003269

<input type="checkbox"/> WITNESSED BY <input type="checkbox"/> REVIEWED BY	RESULT	<input checked="" type="checkbox"/> ACCEPTABLE <input type="checkbox"/> UNACCEPTABLE
	REVIEWED / APPROVED BY	<i>H. S. KZM Jun 12. '09</i>
	INSPECTED BY	<i>LiKC Jun 12 '09</i>

FERRITE TEST REPORT (AFTER OVERLAY)

CUSTOMER	CPC CORPORATION, TAIWAN	DOC. No.	SEC-R001-FTR-02
PROJECT NAME	CPC/Talin Refinery Disel HDS	P/O No.	96K601
ITEM NAME	R-1001 HDS REACTOR	DRAWING No.	SEC-RC07-80-D003
ITEM No.	LWL-3,LWL-4	PAGE No.	1 OF 1

1. TEST POSITION



2. TEST RESULTS

POINT	VALUE (%)			REMARK
0°-A	6.7	7.2	6.6	
0°-B	6.7	6.6	7.0	
90°-A	6.5	7.5	7.1	
90°-B	7.1	7.0	6.7	
180°-A	7.8	7.1	6.6	
180°-B	6.6	6.6	6.5	
270°-A	6.7	7.3	7.0	
270°-B	7.1	6.6	6.4	

3. ACCEPTANCE CRITERIA

Test Value : Engineering Specification, DS-103-0002-0, 7.1.5 (Ferrite Range : Max. 10%)

4. USED INSTRUMENT

Ferrite Tester : FERITSCOPE MP30E-S, Serial No. : SN080003269

<input type="checkbox"/> WITNESSED BY <input type="checkbox"/> REVIEWED BY	RESULT	<input checked="" type="checkbox"/> ACCEPTABLE <input type="checkbox"/> UNACCEPTABLE
	REVIEWED / APPROVED BY	<i>H. P. KJA Jun 05 '09</i>
	INSPECTED BY	<i>hikc June 05/09</i>