行政院及所屬各機關出國報告審核表

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審核意見</td><td colspan="2">□1.依限繳交出國報告
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□5.送本機關參考或研辦
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□7.退回補正，原因：
□不符原核定出國計畫
□以外文撰寫或僅以所蒐集外文資料為內容
□內容空洞簡略
□未依行政院所屬各機關出國報告規格辦理
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說明：

一、出國計畫主辦機關即層轉機關時，不需填寫「層轉機關審核意見」。

二、各機關可依需要自行增列審核項目內容，出國報告審核完畢本表請自行保存。

三、審核作業應於出國報告提交後兩個月內完成。

報告人 ： 單位 總經理

主管 副總經理

行政院及所屬各機關出國報告提要		
出國報告名稱：第 3 期煤輪建造計畫**主機性能測試**		
		頁數 61 含附件■是□否
出國計劃主辦機關/聯絡人/電話 台灣電力公司		
出國人員姓名/服務機關/單位/職稱/電話 鄭永康/台灣電力公司/燃料處船舶建造計畫工程師/23667728		
出國類別：□1 考察□2 進修□3 研究□4 實習■5 其他		
出國期間： 100.01.05--100.01.09	出國地區： 韓國蔚山	
報告日期： 100.3.3		
分類號/目		
關鍵詞：現代重工，性能測試，廠試報告		

內容摘要：(二百至三百字)

1.本公司委由台船公司建造4艘9.3萬載重噸煤輪(電昌五-八號)之主機型號為 WARTSILA RT 6RTflex58T-D Nox Tier2出力 11290kw 98.8RPM，為最新型電子式點火之省油引擎。 因主機為煤輪最重要的裝備，其品質及性能對煤輪未來營運至為重要，為確保主機品質及性能，故須派員參與見證試俥過程與性能。

2.新建 4 艘煤輪預計 100 年 2/5/8/10 月分別交船。第 3 艘定名為電昌七號(台船編號：HNO.985)，其主機係由韓國蔚山現代重工公司（HHI）生產製造，於 100 年 01 月 07-08 日在 HHI 主機廠出廠前性能測試，本次參與現代重工主機廠出廠前測試，有中國驗船中心（CR） 法國驗船協會（BV） 聯合船舶設計中心、台船公司等單位人員，測試項目及結果（如附件 1&6）摘要如下：

(1)主機之各種負載（25%、50%、75%、85%（NOR） 100%及 110%）運轉性能正常及耗油率符合規範之要求。

(2)拆檢吊缸開放檢查良好。

(3)尺寸及間隙檢查正常。

（4）Nox Tier2 零組件使用正確，Nox 排放符合規範。

(5)各種負載測試時無不正常、漏油、異音及高溫等現象。本次在韓國蔚山 HHI 廠測試時，共開出 28 項要求改善事項（如附件 2），將由 HHI 廠負責改正答覆（如附件 3）。

3.參訪韓國釜山 PANASIA 公司，該公司設有研發、製造工廠及 1 座水質測試浮船。該公司所產製船用壓艙水處理系統已獲得 IMO 認證，並大立推廣全球船運公司，其產品相關維修保養作業程序正規劃編撰中，本公司獲得安裝及維護手冊（如附件 7）。

行政院所屬各機關出國報告
（出國類別：洽公）

第 3 期煤輪建造計畫主機性能測試

服務機關：台灣電力公司
出國人 職 稱：燃料處船舶建造計畫工程師
姓 名：鄭永康

出國地區：韓國釜山、蔚山

出國期間：100.01.05--100.01.09

報告日期：100.03.03

目錄

一、前言

1. 本公司第 2/3 期煤輪建造計畫辦理恢復及修正預算作業，於 98.6.17 陳報經濟部轉陳行政院。行政院 98.7.9 院授主孝二字第 0980004304 號函原則同意恢復辦理及一次發包事宜。本公司於 98.7.14 與台船公司完成採購 4 艘 9.3 萬載重噸煤輪議價作業，並於 98.7.17 完成簽約。

   新建之 4 艘約 9.3 萬載重噸級煤輪預計 100 年 2 月、5 月、8 月及 10 月分別交船，投入營運後，加上第 1 期兩艘超巴拿馬型煤輪載運量約 260 萬公噸（年載量係澳洲與印尼各載半年運量計算）合計每年共可載運約 833 萬公噸，自運率約為 28%，尚有大部分進口燃料煤仍需租船載運。

2. 本公司第 3 期煤輪建造計畫，新建 1 艘 9.3 萬載重噸級煤輪，定名為電昌七號，其主機係由韓國蔚山 HHI(現代重工)公司生產製造，型號為 WARTSILA RT 6RT -flex58T-D Nox Tier2 出力 11290kw 98.8RPM，為最新型電子式點火之省油引擎。

3. 主機為煤輪最重要的裝備之一，其品質及性能對煤輪未來營運至為重要，本公司為確保主機品質及性能，有必要於性能測試期間派員參與瞭解製造工藝及見證試俥過程與性能，並於 100 年 01 月 7、8 日參與在 HHI 主機廠出廠前性能測試（shop and official test）。

二、出國行程

本次參加廠試會驗及往返行程共計 5 天（01 月 05 日至 01 月 09 日），如下所列：

1. 01 月 05 日　台北 → 釜山　（中華航空 CI 9036 班機
   轉韓航 KE 1123 班機）
2. 01 月 06 日　釜山　參訪 PANASIA 公司
3. 01 月 07 日　釜山 → 蔚山　電昌七號 主機 SHOP TEST
4. 01 月 08 日　電昌七號　主機開放檢查
5. 01 月 09 日　蔚山 → 台北　（韓航 KE 1602 班機
   轉中華航空 CI 161 班機）

三、電昌七號主機廠試

台電公司在台船公建造之4艘93,300載重噸運煤輪之主機均向韓國現代現代重工業公司(HHI,HYUNDAI HEAVY INDUSTRIES CO., LTD)購進，因此船舶建造裝機前需至該集團蔚山市之主機廠辦理廠試事宜。

(一)名稱與數量

1.名稱：主機（Main Diesel Engine）

2.數量：1（Set/Ship）

3.廠牌：Wartsila, Hyundai

4.型號：Wartsila 6RT-flex58T-D

5.規格：

Max. continuous output	11,290 KW * 98.8 rpm
Normal output(85%)	9,597 KW * 93.6 rpm
Φ 580 mm * 2,416 mm	Stroke * 6 Cyl.

6.機號： AA4162

(二)規範要求

1.適用法規：

Specification for 93,300 DWT Bulk Carrier HNo.983~986, Page G1-2

2.1 Rules and Regulations

China Register of Shipping (CR)with the symbols of 100+E, Bulk Carrier, CMS(CAU)+ and

LR: +100A1, Bulk Carrier, BC-B CSR, Shipright(SCM, CM), LI, ESP, GRAB[20], +LMC, UMS.

2.規格與要求：

Specification for 93,300 DWT Bulk Carrier HNo.983~986, Page M1-5

1.3.1 Main Diesel Engine

Type	Wartsila 6RT-flex58T-D type Marine Diesel Engine

No. of set	One (1)
Max. continuous output	11,290 KW and shaft speed 98.8 rpm
Normal output(85%)	9,597 KW and shaft speed 93.6 rpm
No. of cylinder	6
Cylinder bore	580 mm
Stroke	2,416 mm
Fuel rate	164.1 g/KW.h plus 5% allowance at normal output with lower calorific value of 10,200 kcal/kg at ISO condition.
Direction of rotation	Clockwise looking from aft

Attachment

Governer	Electric	1
Turbo-charger	High efficiency	1 set
Air cooler		1 set
Turning gear	Motor driven type	1 set
Auxiliary blower	Motor driven Centrifugal	2 sets

3.其他要求：

The exhaust gas shall be comply with Nox tier II. Delta tuning to be applied in M/E.

Second order balancer should be provided, if necessary.

(三)供應廠商

1.廠牌：Wartsila

2.供應商：Hyundai

(四)測試時程

1. 07th/Jan./2011 - official shop trial

2. 08th/Jan./2011 - Overhaul Inspection and Final meeting

(五)參與測試單位及人員

(1)HHI

Gyung Won Lee 李慶源 / Quality Management Dep't / Engine and Machinery Division

(2)CSBC Ship Yard

Cheng-Tzu Wei 魏正賜 /台船公司 艤裝工廠副廠長

(3)Taipower

Y.K. Cheng 鄭永康 / 台電燃料處 船舶建造計畫工程師

(4)USDDC

Chao-Jen Hu 胡朝仁 / 聯設中心工程處輪機組組長

(5)Class Society

CR Surveyor Chang, Ming-Hsiung 張明雄 /
中國驗船中心技術處輪機組組長

BV Surveyor Hwan-Geuk Choi / Principal Surveyor

(六)測試方法與程序

出國前需先研讀相關的採購規範、重要機材廠試查核表、船廠和船東審圖意見，並於**測試前**先瞭解測試計畫，包括測試項目、方法與程序等（附件1），相關廠試程序與時程表如下：

1.測試項目：

(1)安全保護裝置測試 (Safety Device Test)

(2)啟動及反轉測試 (Starting and reversing test)

(3)轉動機鎖住測試 (Turning gear interlock test)

(4)主機控制操作及 WECS-9520 功能測試 (Engine control & WECS-9520 function test)

(5)無負荷狀態下倒俥運轉測試 (Astern running test at no load)

(6)最低轉速測試 (Minimum revolution test)

(7)負載測試 (Load Test)

a.轉速量測 (rpm)

b.負荷量測 (KW)

c.燃油消耗量測 (Fuel oil consumption measurement)

d.符合 IMO 氮氣排放測試(IMO Nox compliance test)

(8)調速器測試 (Governor Test)

(9)過速停機 (Over speed trip)

(10)增壓機一部停止運轉測試(One turbo charge cut-off test)

(11)單缸停止運轉測試 (One cylinder cut-off test)

(12)推進器餘裕測試(Propeller margin test, 85% of CMCR with rpm 5%of propeller margin)

2.測試程序：

(1)16:00~18:50 安全保護裝置測試 (Safety Device Test)

(2)18:50~00:40 負載運轉測試 (Load Running Test)

18:50~19:20 25%Load (30 min)

19:20~19:50 50%Load (30 min)

19:50~20:20 75% Load (30 min)

20:20~21:20 85% Load (60 min)

21:20~21:50 85%(pp) propeller margin(30 min)

21:50~22:50 100% Load (60 min)

22:50~23:20 110% Load (30 min)

(3)23:20~23:40 調速器測試及過速停機 (Governor Test & Over speed trip)

(4)23:40~00:00 單缸停止運轉測試 (One cylinder cut-off test)

(5)00:00~00:40 增壓機一部停止運轉測試(One turbo charge cut-off test)

(6)00:40 廠試會議(Meeting)

3.測試方法：

(1)安全保護裝置測試(safety device test)：主機安全保護裝置測試依序執行測試項目如下列所示：

a.O.M.D. function test (Governor MK6)採模擬機訊號測試,

確認是否停機O.M.D.。

b.主滑油進口低壓停機

主滑油壓力設定min 2.9 bar，確認10sec 內是否停機。

c.排氣閥低壓停機

排氣閥壓力設定min 4.5 bar，確認是否停機。

d.增壓機進口低壓停機

增壓機進口壓力設定min 0.6 bar，確認是否停機。

e.缸套冷卻水進口低壓停機

缸套冷卻水進口壓力設定min 2.5 bar，確認60sec內是否停機。

f.活塞冷卻油失效停機

活塞無冷卻油，確認15sec內是否停機。

g.活塞冷卻油壓差停機

活塞冷卻油壓差超過max 0.4 bar，確認15sec內是否停機。

h.推力軸承高溫停機

推力軸承高溫max85℃，確認60sec內是否停機。

i.緊急停機

操作緊急停機手把，確認是否停機。

(2)啟動及反轉測試(Starting and reversing test)：在機側確認主機是否啟動（正轉）和反轉。

(3)轉動機鎖住測試（Turning gear interlock test)：在機側確認轉動機操作桿位置在「engaged」主機是否能啟動，在「disengaged」主機是否無法啟動。

(4)無負荷狀態下倒俥運轉測試（Astern running test at no load)：在無負荷狀態下進行5分鐘的倒俥運，觀查是否有異常現象。

(5)最低轉速測試（Minimum revolution test)：逐漸降低主機轉速至最低轉速（約25分鐘)，確認最低轉速並觀察主機運轉情形。

(6)負載運轉測試（Load Running Test)：主機啟動進行負載運轉測試，測試運轉階段與時間參閱前項廠試時程之內容，各

負載測試情況，各負載測試結果。負載運轉的同時廠方亦配合進行主機燃油消耗量計測及符合主機燃油消耗量計測結果。

(7)調速器測試 (Governor Test)：調速器測試目的在於確定負荷變化情況下主機的反應，測試時，主機以100%負荷運轉，將負荷逐漸下降觀測轉速與負荷值的變化。

(8)過速停機 (Over speed trip)：確認主機轉速超過設定值時是否自動停機，設定值110% at MCR (109 rpm)。

(9)單缸停止運轉測試 (One cylinder cut-off test)：將主機的一缸（第2缸）封閉，進行主機運轉，觀測運轉情形。

(七)測試結果

1.設備規格： 符合核定之廠家送審圖要求

2.測試記錄：

馬力結果符合規模要求，燃油消耗量測結果值169.2g/KWh（規範值：164.1 g/KWh plus 5%）

3.拆缸檢驗（2011-01-08）：

拆缸檢驗決定第2缸，檢驗結果正常，拆檢項目如下；曲軸（Crank shaft)、汽缸套(Cylinder liner)、汽缸蓋(Cylinder cover)、活塞（Piston)、十字頭（Cross head)、過濾器（Strainer）等。

4.廠試檢討及報告

在出發前，須已先準備並研讀相關的採購規範、重要機材廠試查核表、船廠和船東審圖意見。

經過兩天測試與檢驗後，由船廠（台船公司)、本案監造廠商（聯設中心）和本公司共同提出檢驗意見（附件2)，要求主機廠家HHI進行缺失改善，HHI於100年02月01日針對上述意見提出答覆（附件3)。

廠試測試期間各類負載檢錄資料如附件4。

HHI並提供測試各類油料、各項檢測儀器提供原始資料或校正資料如附件5。

電昌七號主機廠試報告如附件6。

三、參訪 PANASIA 公司

本公司新建 4 艘 93,300 載重噸運煤輪亦安裝韓國 PANASIA 公司製造之壓艙水處理系統（Ballast Water Treatment System），本次趁赴韓國辦理「第 3 期煤輪建造計畫主機性能測試」之便，順道安排 1 天轉赴釜山參訪 PANASIA 公司，旨在催促該公司儘速編製壓艙水處理系統之維修保養手冊。

有關 PANASIA 公司及壓艙水處理系統簡介詳如本公司燃料處曾計畫經理之「赴韓國參與主機性能測試及參訪瞭解主機及壓艙水處理設備製造及檢驗過程等相關事務」出國報告之「附件 4 Panasia 公司簡介」及「附件 5 電昌五號安裝之 PANASIA 的壓艙水處理系統簡介」，此處不再贅述。

元月 6 日的 PANASIA 公司訪查，除參訪該公司金海地區工廠生產線外並安排參觀釜山港的駁船上進行的壓艙水處理系統實驗。由於電昌五號及電昌六號已在安裝壓艙水處理系統，故參訪過程與該公司技術人員切磋及交換意見，包括：機器安裝過程宜注意事項（例如維修空間）、建議改善事項（例如各類感應器之安全保護）…等等。該公司為同步助益渠產品推廣全球，告知已編製相關維修保養手冊，將會儘速隨 FINAL DRAWING 寄送台船公司，本報告已取得該公司寄達之安裝及維護手冊「INSTRUCTION MANUAL-Installation and Maintaenance」（如附件 7）。

附件 1：測試計畫

HYUNDAI HEAVY INDUSTRIES CO., LTD.

	Doc. No.: K630-IR10A-3535	Page No: 1 / 4
SHOP TRIAL PLAN FOR MAIN ENGINE	Engine No.	AA4160/61/62/63
	Engine type	6RT-flex58T-D
	Hull No.	CSBC983/4/5/6
	Owner	TPC CORPORATION
	Class	BV+CR:CSBC983/5 LR+CR:CSBC984/6
	Ship yard	CSBC(Taiwan)

CONTENTS

* This procedure is prepared on the basis of the engine specification and technical data.
(Dwg. No. A24-218427-8.1)

QUALITY MANAGEMENT DEPARTMENT
HHI-EMD

Rev.	Prepared	Checked	Approved	Description
2				
1				
0	Y.S.KIM 2010-08-09		Y. M. KIM 2010-08-09	First issue

附件 2：廠試檢討提出改善事項

HYUNDAI HEAVY INDUSTRIES CO., LTD.

APPLICATION FOR INSPECTION & TEST

(ENGINE AND MACHINERY DIVISION)

Insp. Date : 2011-01-08 Messrs: TPC / BV Page: 1 / 2

No.	Ship No Type Project No	Nomenclature Kind of insp	Charge No Item No	Q'ty	Time Location	PIC Extension Mobile	Remarks
1	CSBC985	MAIN ENGINE	1) CRANKSHAFT JOURNAL & MAIN BEARING: # 2	1	15:00	G.W.Lee	
			2) CYL.LINER & CYL.COVER : # 1				
	6RT-flex58T-D	OVERHAUL INSPECTION	3) PISTON COMPLETE : # 1		Assembly Shop(For M/E) 1-1	202-9037	
	AA4162		4) X-HEAD PIN/BEARING & GUIDE SHOE : # 1			010-2769-1933	
			5) CRANK PIN & BEARING : # 6				
			6) CAMSHAFT DRIVING GEAR : ALL				

2ffe Chang. 2011. Jan. 8

C.J. Lee 1-8-2011 OWNER

C-Tae SHIPYARD

(with 3 pages attach)

~~DNV~~ KR V surveyor CLASS

1. Oil leakage was found~~at~~ from No.1 cylinder port side at engine low flat should be rectify.
2. Oil leakage form pipe connection above F.O. high pressure boost pump should be rectify.
3. Engine middle platform (p.s.) No.1 & No.5 cylinder oil leakage.
4. Cable Tray on Top side of middle engine gallery is too low compare with N983/984 please rectify.
5. Open holes for control box or connection should be provided protection seal.
6. Hand rail of middle platform (4 place (p.s.)) should be modify to match pillar position
7. Lifting beam for blower (aft.) is too low to obstruct traffic
8. Exh. gas pipe expention joint, manhole, and all Fuel pipe should be provide good insulation.

HHI EMD QM
G.W.Lee

GENERAL MANAGER
QM, HHI-EMD
S. C. JIN

HYUNDAI HEAVY INDUSTRIES CO., LTD.

APPLICATION FOR INSPECTION & TEST

(ENGINE AND MACHINERY DIVISION)

Insp. Date : 2011-01-07 Messrs: TPC / BV Page: 2 / 2

No.	Ship No / Type / Project No	Nomenclature / Kind of insp	Charge No / Item No	Q'ty	Time / Location	PIC / Extension / Mobile	Remarks
1	CSBC985	MAIN ENGINE	1.SAFETY DEVICE TEST & ETC.	1	16:00	G.W.Lee	
	6RT-flex 58T-D	OFFICIAL SHOP TRIAL	2.LOAD TEST 25% LOAD : 30 (: ~ :)		Assembly Shop(For M/E) 1-1	202-9037	
	AA4162		50% LOAD : 30 (: ~ :)			010-2769-1933	
			75% LOAD : 30 (: ~ :)				
			85% LOAD : 60 (: ~ :)				
			100% LOAD : 60 (: ~ :)				
			110% LOAD : 30 (: ~ :)				
			3.GOVERNOR TEST & OVER SPEED TRIP				

Zhi Cheng. 2011.Jan.8 (with 3 pages attach)

C.F.Wu 1-8-2011 C.-T. Wei

OWNER SHIPYARD CLASS

1. protection cover for all studs should be provided.
2. Oil leakage from No.1/3/4/5 Exh value driving oil pipe should be rectify.
3. Engine Top platform and its handrail with heavy vibration should be rectify.
12. Exh temperature of No.1 cylinder is lower than everage please confirm.
13. Oil leakage from ~~port.~~ P.S. ~~cutter~~ for end, ~~Starboard~~ No 5. cyl. casing (middle) forent (p.s) casing ----
14. C.F.W. inlet temp. gauge please change T type.

GENERAL MANAGER
QM, HHI-EMD S. C. JIN

1/3

YARD(CSBC) REQUEST ITEMS

ITEM	CONTENT	RESULT	REMARK
01	Instruction manul (operation. remote Cont.- etc) To Be supply To CSBC	Noted	
02	immediately (for 983 ~~[illegible]~~) P. side middle ENGINE FLAT's floor and hand rail Viberation Seriously. To Be Reinforce.	Noted	
	and SET screws for Joint missing		
03	middle ENGINE FLAT Ford side Rand rail for step Viberation heavily (Connecting To upper ENGFLAT)	Noted	
04	Lagging for each Fuel VALVE pipes To Be Completely ~~[illegible]~~	Noted	

Y.K. Chong
2011.1.8.

HHI EMD OM
G.W. Lee

C.T. Lee
JAN. 08 2011

2/3

YARD(CSBC) REQUEST ITEMS

ITEM	CONTENT	RESULT	REMARK
05	Jacket C.F.W MAIN PIPE Viberation seriously (FWD near Exh gas manifold)	Noted	
06	hand rail Viberation heavily on upper E/F FWD SIDE and P SIDE	(E/F : ENGINE FLAT) Noted	
07	cyl. cover FWD and after and around the cover's hand rail and FLAT Viberation.	Noted	
08	L.o PIPE for exh. V. acturator heavy Viberation (MID E/F after SIDE)	Noted	
09	~~Exh~~ ~~L.O~~ exh. VALVE Acturator L.O branch PIPE Leakage seriously (1. 3. 4. 5. cy)	Noted	

The chang
S. K. Chang
2011. Sep. 8

HAI-CHID CHI
G.W. Lee

C.T. Wei
JAN. 08. 2011

3/3

YARD(CSBC) REQUEST ITEMS

ITEM	CONTENT	RESULT	REMARK
10	Fuel oil pump and Fuel oil Accumulator's Lagging Missing	Noted	
11	Tracing Steam pipe & insulation missing	Noted	
12	~~Cod~~ Cold and Rot ~~Crack~~ Deflection condition record To be offered	Noted	
13	SERVO oil Service pump Name plate Missing	Noted	
14			

H.H. Cheng
H.H. Cheng
2011. Jan. 8

HHI EMD QM
G.W. Lee
JAN

C.T. Wu
JAN. 08 2011

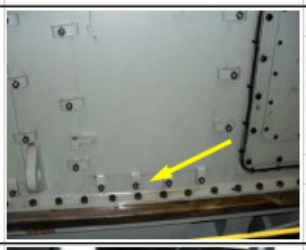
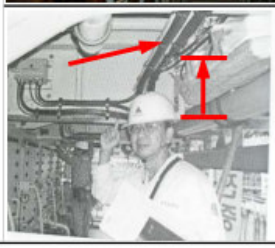
附件 3：HHI 答覆船東意見表

HYUNDAI HEAVY INDUSTRIES CO., LTD.

Ship No	CSBC985	Eng.Type	6RT-flex58T-D
Eng. No	AA4162	Test Date	2011.01.07
Owner	TPC	Delivery	-

Owner's Comment

QM PIC	G.W.Lee	Drawn	Check	Appd
Issued	31			
Completed	26			

No	Picture	Description	Charge/Date		After Management
1		Description Oil leakage was found from No.1 cylinder port side at engine low platform shoud be rectified. Action Completed.	St 1 2 3	Shop Test	BLANK Confirm
2		Description Oil leakage from pipe connection above F.O. high pressure boost pump should be rectified. Action Completed.	St 1 2 3	Shop Test	BLANK Confirm
3		Description Engine middle platform (port side) No.1 and No.5 cylinder oil leakage. Action To be done during installation onboard.	St 1 2 3	Shop Test	Engine is dismantled into three parts and this surface will be assembled again during installation onboard. Confirm
4		Description Cable tray under the upper platform is too low compare with CSBC983/984. Please rectify. Action Completed.	St 1 2 3	Shop Test	 Confirm
		Description Cable tray under the upper platform is too low compare with CSBC983/984. Please rectify. Action Completed.	St 1 2 3	Shop Test	 Confirm
		Description Cable tray under the upper platform is too low compare with CSBC983/984. Please rectify. Action Completed.	St 1 2 3	Shop Test	BLANK Confirm

附件 4：廠試各項紀錄資料表

HYUNDAI HEAVY INDUSTRIES CO.,LTD. Official Shop Test Result For Main Engine																	
HYUNDAI - WARTSILA Load Data Sheet 1																	
Hull No.		CSBC985		Owner		TPC											
Engine No.		AA4162		Class		BV + CR											
Engine Type		6RT-flex58T-D		Test Date		2011.01.07											
Output(MCR)		11[illegible]		Engineer		D.J.HONG											
Speed(MCR)		98.8 rpm		Operator		S.J.JUNG											
PRELIMINARY																	
General Data	Loading power(%) / Check time			%	Time	25%		19:00		50%		19:30		75%		20:00	
	Engine power / speed (theoretical)			kW	rpm	2823		62.2		5645		78.4		8468		89.8	
	Mean eff. pressure design / actual			bar													
	Brake force (indicated)			tonf·m		61.5				98.0				128.5			
	Engine power / speed (measured)			kW	rpm	2823		62.2		5645		78.4		8468		89.8	
	VIT + FQS(IT_G) / inj. begin standard value			∠°		2.8		0.0		-2.0		0.0		-2.8		0.0	
	Fuel oil: Actuator Output	Fcmd		%		25.0		27.2		38.0		41.0		50.0		51.8	
	Consumption absol.			kg/h	g/kWh	515.00		182.46		985.00		174.49		1435.00		169.47	
	Consumption ISO			g/kWh		180.70				172.68				167.82			
	Cyl. Lub. oil: Injection Number			10min/1cyl		198				325				469			
	Total Feed Rate			kg/h		5.9				9.7				14.0			
	Feed Rate			g/bhph	g/kWh	1.54		2.09		1.26		1.72		1.21		1.65	
Scavenge Air	Aux. Blower / Nozzles in operation			on/off	EA	ON		ALL		OFF		ALL		OFF		ALL	
	Barometric pressure / Humidity			hPa	%	1029.0		17.0		1029.0		17.7		1029.0		15.2	
	Ambient temp.			℃		8.0				8.3				8.2			
	Press drop across air cooler			mmAq		35				75				103			
	T/C filter suction pressure			mmAq		10				20				47			
	Pressure after blower			mmHg		230				870				1600			
	Scavenge air pressure			mmHg	bar	280		0.380		850		1.130		1590		2.130	
	Temp. before blower			℃		9.0	15.0	10.0	10.0	10.0	16.0	11.0	11.0	12.0	19.0	12.0	13.0
	Temp. before air cooler			℃		37				92				138			
	Temp. after air cooler			℃		29				32				34			
Exhaust Gas	Turboblower speed			rpm		6233				10789				13549			
	Pressure before turbine			mmHg		180				610				1260			
	Pressure after turbine			mmAq		20				75				175			
	Temp. before turbine			℃		275				320				334			
	Temp. after turbine			℃		229				230				203			
	Temp. after cylinder	Mean		℃		240.0				281.5				296.7			
		1 2 3 4		℃		235	240	245	245	280	280	292	290	285	295	300	305
		5 6		℃		240	235			275	272			295	300		
Cylinder Pressures	Maximum / Compression press.	Mean		bar	bar	85.2		64.0		117.5		75.5		149.7		105.8	
		No, 1		bar	bar	86		64		117		76		150		106	
		No, 2		bar	bar	86		64		117		76		150		106	
		No, 3		bar	bar	86		64		117		76		150		105	
		No, 4		bar	bar	84		64		117		75		149		106	
		No, 5		bar	bar	85		64		118		75		150		106	
		No, 6		bar	bar	84		64		119		75		149		106	
Systems	Air press.: Control air / Valve air spring			bar		6.50		6.50		6.50		6.50		6.50		6.50	
	Lub. oil press. : Bearing / Cross head bearing			bar		4.60		11.50		4.60		11.50		4.60		11.50	
	Servo oil			bar		121				140				158			
	Servo oil pump inlet			bar		4.60				4.60				4.50			
	T/C lub oil inlet			bar		2.60				2.30				2.60			
	Axial detuner driving / free end			Mpa		0.38		0.40		0.37		0.39		0.37		0.39	
	Water press.: Cylinder			bar		4.0				4.0				4.0			
	Lub. oil temp.: Bearing / Turbocharger			℃		44.0				43.0				42.0			
	Crosshead inlet			℃		44.0				43.0				42.0			
	T/C outlet			℃		50				57				68			
	Water temp.: cylinder inlet			℃		50.0				53.0				58.0			
	cylinder outlet	Mean		℃		54.7				59.7				65.8			
		1 2 3 4		℃		54	55	55	54	59	60	60	59	66	66	65	66
		5 6		℃		55	55			60	60			66	66		
	Air cooler inlet			℃		15				13				14			
	Air cooler outlet			℃		16				53				70			
	Fuel: Press. bef / aft retaining valve			bar		8.8		3.8		8.5		3.5		8.5		3.5	
	Press. Engine inlet / Rail			bar	bar	7.5		600		7.5		600		8.0		599	
	Temp. before engine			℃		39.0				40				39			
	Thrust bearing temp.			℃		47				47				47			

附件 5：廠試之油料、儀器校正資料

CERTIFICATE OF QUALITY

HYUNDAI OIL REFINERY CO.LTD.QC SECTION

Ulsan Terminal	Seoul Office
TEL : 052)208-6828	TEL : 02)2004-3000(Exchange)
FAX : 052)266-2866	FAX : 02)2004-3410

Product Name : Bunker-A (0.3%)	Ticket No : 3003505
Tank No. :	Testing Date : 2010.01.01
Customer : H H I	Equip No : 82-1737

Test Items	Test Method	Specification	Results
API Gravity 60°F	ASTM D-1298	Report	23.9
Specific Gravity 15/4℃	ASTM D-1298	Report	0.9100
Density 15℃ kg/㎥	ASTM D-1298	Report	910.0
Flash Point ,PMCC ℃	ASTM D-93	Min 60	73.0
Kinematics Viscosity 50℃ ㎟/sec	ASTM D-445	Max 20	4
Sulfur wt %	ASTM D-4294	Max 0.3	0.210
Pour Point ℃	ASTM D-97	Max -5	-10.0
Water & Sediment vol %	ASTM D-1796	Max 0.3	0.1
Ash wt %	ASTM D-482	Max 0.05	0.01
Conradson Carbon Residue wt%	ASTM D-4530	Max 8	0.6
Calorific Value(Net) Kcal/kg	KS M 2057		10012
Calorific Value(Gross) Kcal/kg	KS M 2057		10633

I certify the above statement of quality to be true and correct.

2011 1 6

kim y . S

ULSAN TERMINAL MANAGER

附件 6：電昌七號主機廠試報告

HYUNDAI HEAVY INDUSTRIES CO., LTD.

		Doc. No.: K630-IR11A-0503
SHOP TEST RESULT FOR MAIN ENGINE	Engine No.	AA4162
	Engine type	6RT-flex58T-D
	Hull No.	CSBC985
	Owner	TPC
	Class	BV + CR
	Ship yard	CHINA SHIPBUILDING CORPORATION

HYUNDAI - WARTSILA

CONTENTS **PAGE No.**

QUALITY MANAGEMENT DEPARTMENT
HHI-EMD

Rev.	Prepared	Checked	Approved	Description
2				
1				
0	G. W. LEE 2011-01-27	Y. M. KIM 2011-01-28	M. H. KIM 2011-01-28	First issue

HYUNDAI HEAVY INDUSTRIES CO., LTD.

Official Shop Test Result For Main Engine

Trial Report

Hull No.	CSBC985	Owner	TPC
Engine No.	AA4162	Class	BV + CR
Engine Type	6RT-flex58T-D	Test Date	2011.01.07
Output(MCR)	11290 kW	Engineer	D.J. HONG
Speed(MCR)	98.8 rpm	Operator	S.J. JUNG

Engine Specification

* Cylinder Bore	580 mm	* Piston Stroke	2416 mm	* Installation	CSBC985	* Direction of Rotaion :
* Engine Builder	HHI - EMD	* No. of Cylinder	6	* M.E.P	17.9 bar	
* Brake Type & Coefficient		CFSR-24 & 1 / 1.35962 (kW base)				Clockwise

Turbocharger Specification

* Type		1 X TPL77B12
* Specification		CV12CT75CA15 TT40TF20TA22
* Maximum RPM/TEMP	nBmax/tBmax	16200 rev/m 520 ℃
	nMmax/tMmax	17040 rev/m 550 ℃
* Serial No.		XH002954
* Manufacturer		HYUNDAI - ABB

Power Take Off (P.T.O) Generator Specification

* Type	
* Serial No.	
* Nominal Power	BLANK
* Nominal Speed	
* Nominal Voltage	

Governor Specification Electric(O) Hydraulic( )

Speed Governor

* Type	AC C20 DGS	* Manufacturer	KONGSBERG MARITIME KOREA

Electric Actuator

* Type	Proact Digital Plus	* Serial No.P/E	17172252 / 17172253 - 1006		
* Manufacturer	WOODWARD LOVELAND,CO.,USA			* Part No.P/E	8404-045

Cylinder Lubricators Specification

* Piston Diameter	- mm	* Gear Ratio	-	* Type	Pulse Feed Cyl.lubricator
* Manufacturer	WILLY VOGELE AG				

Air Cooler Specification

* Part No	A29-179492-5	* MFG No	20003389/30
* Manufacturer	GEA INDUSTRIAL HEAT EXCHANGER SYSTEMS (CHINA) CO.,LTD		

Auxiliary Blower Specification

* Fan	* Type	TBCR-050G-4526	* Serial No.1,2	10B0037-01- 05/06	* Pressure	673	mmAq
	* Manufacturer	TEA-IL BLOWER					
* Elect. Motor	* Type	HM	* Power,Amp	45 kW, 72.1 A	* Voltage	440 V 60 Hz	
	* Serial No.1,2	0F613F12-001/002	* Manufacturer	HYUNDAI HEAVY INDUSTRIES CO. LTD			

Specification of Oil used at Shop Trial

	Fuel Oil	Bearing Oil	Cylinder Oil	T/C Oil
* Grade of Oil	BUNKER-A	MELINA S30	ALEXIA LS	MELINA S30
* Density at 15℃ (g/ml)	0.9100	0.8864	0.9142	0.8864
* Viscosity (㎟/s)	4.00 50℃	103.6 40℃	205.8 40℃	103.6 40℃
* Lower calorific value(kcal/kg)	10012			

HYUNDAI HEAVY INDUSTRIES CO., LTD.

Official Shop Test Result For Main Engine	Hull No.	CSBC985	Owner	TPC
	Engine No.	AA4162	Class	BV + CR
	Engine Type	6RT-flex58T-D	Test Date	2011.01.07
Setting Table A1	Output(MCR)	11290 kW	Engineer	D.J. HONG
	Speed(MCR)	98.8 rpm	Operator	S.J. JUNG

*** Injection control units** Draw. No. : ***2-107.347.582***

Quantity piston stroke : ***80*** [mm] Quantity piston diam. : ***36*** [mm]

*** Fuel rail pressure** : *Fuel quantity and speed dependent (WECS-9520 parameter)*

Safety valve opening pressure : ***1250*** [bar]

Emergency fuel pressure control valve : ***1050*** [bar]

*** Control oil pressure** : - [bar]

*** Injection valves and fuel pressure pipes**

* Nozzle Draw. No. : **A20-218678-6 (EXEC. 208)**

* Needle lift : **1.20** [mm]

* Opening pressure : **375±5bar** [bar]

No. of holes	1	2	3	4	5	BLANK
Hole diam. [mm]	0.600	0.900	0.850	0.825	0.750	
vertical ∠ α°	17	14	11	13	13	
horizontal ∠ β°	-12	9	19	28	38	

* High pressure pipe diameter : to the fuel rail inside **12.0** [mm] outside **30.0** [mm]

to the injection valve inside **6.0** [mm] outside **18.0** [mm]

*** Injection timing** : *Charge air pressure, fuel pressure and speed dependent (WECS-9520 parameter)*

*** Exhaust valve timing** : *Charge air pressure and speed dependent (WECS-9520 parameter)*

*** Exhaust valve control unit** Draw. No. : ***0-107.351.163***

Piston stroke : **57** [mm] Piston diameter : **71** [mm]

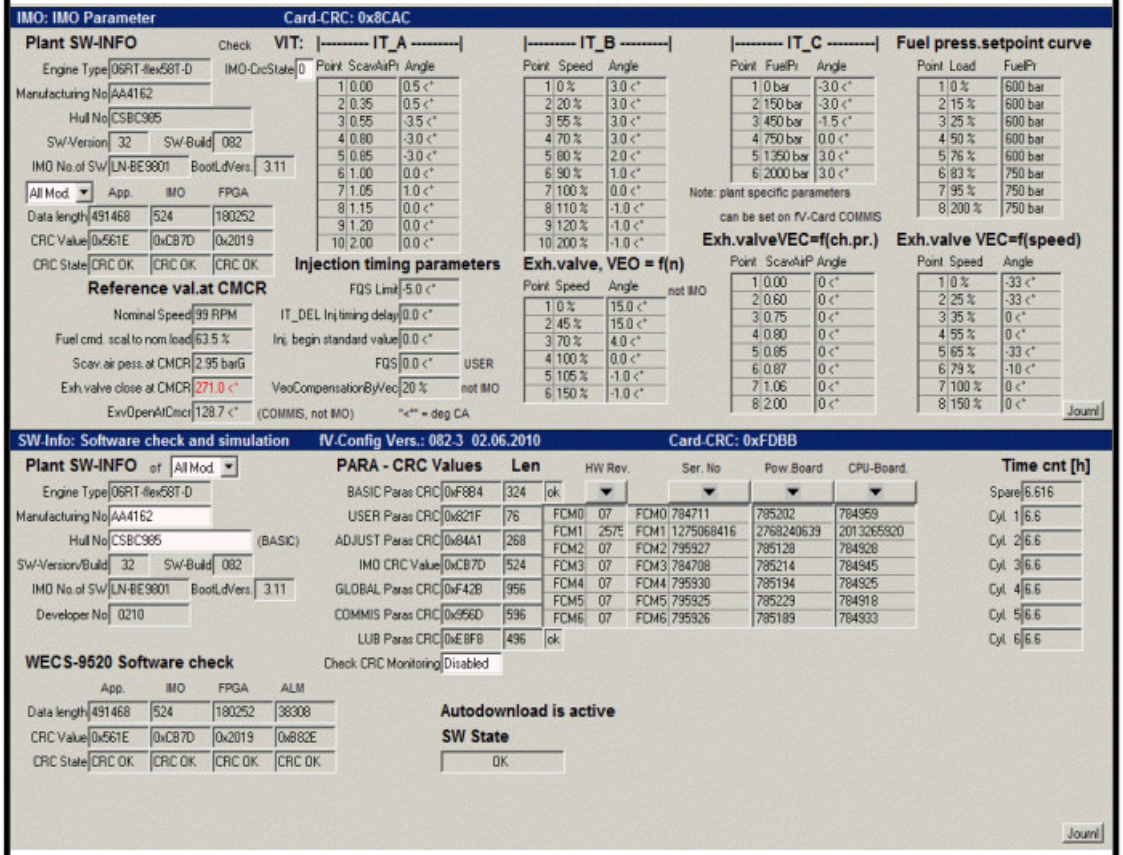
*** Servo oil pressure** : ***100 - 200*** *bar (charge air pressure dependent WECS-9520 parameters)*

*** SW-INFO WECS 9520**

ENGINE TYPE	6RT-flex58T-D	Hull NO.		CSBC985	
SOFTWARE VERSION	32	Build	82	BLV	3.11
APP CRC VALUE	0x561E	IMO SW-NO		LN-BE9801	
IMO CRC VALUE	0xCB7D	IMO DATA LENGTH		524	

HYUNDAI HEAVY INDUSTRIES CO., LTD.

Official Shop Test Result For Main Engine		Hull No.	CSBC985	Owner	TPC
		Engine No.	AA4162	Class	BV + CR
		Engine Type	6RT-flex58T-D	Test Date	2011.01.07
Setting Table A2	fV Data IMO	Output(MCR)	11290 kW	Engineer	D.J. HONG
		Speed(MCR)	98.8 rpm	Operator	S.J. JUNG



HYUNDAI HEAVY INDUSTRIES CO., LTD.

Official Shop Test Result For Main Engine

Setting Table A2 | **fV Data 25%**

Hull No.	CSBC985	Owner	TPC
Engine No.	AA4162	Class	BV + CR
Engine Type	6RT-flex58T-D	Test Date	2011.01.07
Output(MCR)	11290 kW	Engineer	D.J. HONG
Speed(MCR)	98.8 rpm	Operator	S.J. JUNG

INDIC2: RT-flex Indications — fV-Config Vers.: 082-3 02.06.2010 — Card-CRC: 0x1004

Miscellaneous

Est.Power (FuelCmd x n)	27 %	30020
Time Count of Spare	0.84 h	

Engine speed (n)

Engine Speed	62 RPM	
Percentage	62.9 %	

Fuel command (LI)

Used for Injection	27.6 %	30001
FuelCommandPCS	27.2 %	30009
Percent of CMCR	43.3 %	
WECS Fuel Cmd Limiter	Normal	

Scavenge Air Pressure

Mean value	0.36 bar	30003
Sensor 1	0.35 bar	30033
Sensor 2	0.36 bar	30034
Scaled to CMCR	0.34	

Fuel Rail Pressure

Setpoint	600 bar			30018
Actuator outp./Lim./near Lim.	25 %	No	No	30019
Mean value	601 bar			30017
Sensor 1	595 bar	????		30015
Sensor 2	608 bar	????		30016

Servo Oil Pressure

Setpoint reference	121 bar		30014
Mean value	121 bar		30013
Sensor 1	121 bar		30011
Sensor 2	122 bar		30012
Setpoint correction	115 bar		
Deviation	0 bar		

Injection timing

IT_D (VIT)	2.8 <°	30023
VIT + FQS (IT_G)	2.8 <°	30024
Injection begin	2.8 <°	30025
Inj. time, Average val.	26.7 ms	30026
IT_A f(ch/pr)	0.5 <°	
IT_B f(speed)	3.0 <°	
IT_C f(fuel pr.)	-0.7 <°	
VIT on/off	on	

Number of inj. nozzles

Injection with	all nozzles	30008

Exhaust Valve

Opening angle	130.5 <°	30021
Closing angle	244.6 <°	30022
Opening deadtime	18.9 ms	
Closing deadtime	99.3 ms	

Crank Angle

Crank angle 1	0.0 <°	????
Crank angle 2	0.0 <°	????
TDC	Gap	
F.ZeroOrderFrmWECS	NO	

Interlocks

Turning Gear FDM 3	Disengaged
Turning Gear FDM 4	Disengaged
Any Blower running	No
Shutdown on Safety System	No

SW State: OK

Journal

EXHV: Exhaust valve indications — fV-Config Vers.: 082-3 02.06.2010

Cyl.	Open Pos. Sensor 1/2 Sensor 1	Open Pos. Sensor 1/2 Sensor 2	Closed Pos. Sensor 1/2 Sensor 1	Closed Pos. Sensor 1/2 Sensor 2	Exv.A/M Cmd	Deadtime Open.Deadtim	Deadtime Clos.Deadtim	On Time Open / Close OnTime Open	On Time Open / Close OnTime Close
1	7.5 mA	6.4 mA	15.3 mA	14.5 mA	AUTO	19 ms	99 ms	0.9 ms	1.0 ms
2	6.7 mA	7.3 mA	14.9 mA	15.1 mA	AUTO	19 ms	101 ms	0.9 ms	0.9 ms
3	7.6 mA	6.7 mA	15.6 mA	15.0 mA	AUTO	19 ms	96 ms	1.0 ms	1.0 ms
4	6.6 mA	7.0 mA	15.1 mA	14.3 mA	AUTO	19 ms	100 ms	0.9 ms	0.9 ms
5	7.5 mA	7.2 mA	15.3 mA	15.2 mA	AUTO	19 ms	100 ms	0.9 ms	0.9 ms
6	6.6 mA	6.6 mA	14.6 mA	14.6 mA	AUTO	18 ms	97 ms	0.8 ms	0.9 ms

Time count [h]: 0.85

Journal

INJECT: Inj.timing, value, inj.begin & deadtime

Cyl.	Quantity Piston Return	Quantity Piston Inject	Inj. begin Deadtime	Inj. begin Angle	Injection Time	OnTime Railvalve Inject Vlv.1	Vlv.2	Vlv.3	OnTime Railvalve Return Vlv.1	Vlv.2	Vlv.3
1	4.5 mA	8.9 mA	12.1 ms	3.3 <°	27.2 ms	1.0 ms	0.9 ms	0.9 ms	0.9 ms	0.9 ms	0.9 ms
2	4.4 mA	8.9 mA	11.9 ms	3.2 <°	26.6 ms	0.9 ms	1.0 ms	1.0 ms	0.8 ms	0.8 ms	0.9 ms
3	4.5 mA	8.9 mA	12.4 ms	3.4 <°	28.5 ms	0.8 ms	0.9 ms	0.9 ms	0.8 ms	0.8 ms	0.8 ms
4	4.4 mA	8.8 mA	11.9 ms	2.7 <°	26.5 ms	0.8 ms	0.8 ms	0.9 ms	0.8 ms	0.8 ms	0.8 ms
5	4.5 mA	8.9 mA	12.1 ms	2.5 <°	26.9 ms	0.9 ms	0.9 ms	0.9 ms	0.8 ms	0.8 ms	0.8 ms
6	4.5 mA	8.9 mA	12.5 ms	2.4 <°	25.9 ms	0.8 ms	0.9 ms	0.9 ms	0.8 ms	0.8 ms	0.8 ms

Measured Speed: 62.3 RPM

Injection with: all nozzles

Est.Power(FuelCmd x n): 27 %

"<°" = deg CA

Journal

HYUNDAI HEAVY INDUSTRIES CO., LTD.

Official Shop Test Result For Main Engine

Setting Table A2 | **fV Data 50%**

Hull No.	CSBC985	Owner	TPC
Engine No.	AA4162	Class	BV + CR
Engine Type	6RT-flex58T-D	Test Date	2011.01.07
Output(MCR)	11290 kW	Engineer	D.J. HONG
Speed(MCR)	98.8 rpm	Operator	S.J. JUNG

INDIC2: RT-flex Indications — fV-Config Vers.: 082-3 02.06.2010 — Card-CRC: 0x1004

Miscellaneous

Est.Power (FuelCmd x n)	51 %	30020
Time Count of Spare	1.39 h	

Engine speed (n)

Engine Speed	78 RPM	
Percentage	79.3 %	

Fuel command (LI)

Used for Injection	40.3 %	30001
FuelCommandPCS	40.7 %	30009
Percent of CMCR	64.0 %	
WECS Fuel Cmd Limiter	Normal	

Scavenge Air Pressure

Mean value	1.13 bar	30003
Sensor 1	1.12 bar	30033
Sensor 2	1.13 bar	30034
Scaled to CMCR	0.54	

Fuel Rail Pressure

Setpoint	600 bar		30018
Actuator outp./Lim./near Lim.	38 %	No / No	30019
Mean value	599 bar		30017
Sensor 1	593 bar		30015
Sensor 2	606 bar		30016

Servo Oil Pressure

Setpoint reference	140 bar		30014
Mean value	140 bar		30013
Sensor 1	140 bar		30011
Sensor 2	141 bar		30012
Setpoint correction	132 bar		
Deviation	0 bar		

Injection timing

IT_D (VIT)	-2.0 <°	30023
VIT + FQS (IT_G)	-2.0 <°	30024
Injection begin	-2.0 <°	30025
Inj. time, Average val.	33.6 ms	30026
IT_A (ch/pr)	-3.3 <°	
IT_B (speed)	2.1 <°	
IT_C (fuel pr.)	-0.7 <°	
VIT on/off	on	

Number of inj. nozzles

Injection with	all nozzles	30008

Exhaust Valve

Opening angle	129.5 <°	30021
Closing angle	261.2 <°	30022
Opening deadtime	18.3 ms	
Closing deadtime	95.8 ms	

Crank Angle

Crank angle 1	0.0 <°	
Crank angle 2	0.0 <°	
TDC	Gap	
F.ZeroOrderFlmWECS	NO	

Interlocks

Turning Gear FCM 3	Disengaged
Turning Gear FCM 4	Disengaged
Any Blower running	No
Shutdown on Safety System	No

SW State: OK

Journal

EXHV: Exhaust valve indications — fV-Config Vers.: 082-3 02.06.2010

Cyl.	Open Pos. Sensor 1/2 Sensor 1	Open Pos. Sensor 1/2 Sensor2	Closed Pos. Sensor 1/2 Sensor 1	Closed Pos. Sensor 1/2 Sensor 2	Exv.A/M Cmd	Deadtime Open.Deadtim	Deadtime Clos.Deadtim	On Time Open / Close OnTime Open	On Time Open / Close OnTime Close
1	7.4 mA	6.5 mA	15.5 mA	14.4 mA	AUTO	18 ms	95 ms	0.9 ms	1.0 ms
2	6.9 mA	7.3 mA	14.7 mA	15.3 mA	AUTO	18 ms	97 ms	0.9 ms	0.9 ms
3	7.4 mA	7.1 mA	15.7 mA	14.9 mA	AUTO	18 ms	93 ms	1.0 ms	0.9 ms
4	7.1 mA	6.9 mA	15.1 mA	14.4 mA	AUTO	18 ms	96 ms	0.8 ms	0.8 ms
5	7.6 mA	7.4 mA	15.3 mA	15.1 mA	AUTO	18 ms	97 ms	0.9 ms	0.8 ms
6	6.6 mA	6.6 mA	14.6 mA	14.5 mA	AUTO	18 ms	94 ms	0.8 ms	0.8 ms

Time count [h]: 1.39

Journal

INJECT: Inj.timing, value, inj.begin & deadtime

Cyl.	Quantity Piston Return	Quantity Piston Inject	Inj. begin Deadtime	Inj. begin Angle	Injection Time	OnTime Railvalve Inject Vlv.1	Vlv.2	Vlv.3	OnTime Railvalve Return Vlv.1	Vlv.2	Vlv.3
1	4.5 mA	11.0 mA	11.9 ms	-1.4 <°	33.1 ms	0.9 ms	0.9 ms	0.9 ms	0.8 ms	0.8 ms	0.8 ms
2	4.4 mA	10.9 mA	11.7 ms	-1.5 <°	34.3 ms	0.8 ms	0.9 ms	0.9 ms	0.8 ms	0.8 ms	0.8 ms
3	4.5 mA	10.9 mA	12.2 ms	-1.3 <°	34.5 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.7 ms	0.8 ms
4	4.4 mA	10.9 mA	11.6 ms	-2.0 <°	33.8 ms	0.8 ms	0.8 ms	0.9 ms	0.8 ms	0.8 ms	0.8 ms
5	4.5 mA	10.9 mA	11.9 ms	-2.2 <°	32.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms
6	4.5 mA	11.0 mA	12.3 ms	-2.3 <°	34.3 ms	0.8 ms	0.9 ms	0.9 ms	0.8 ms	0.8 ms	0.8 ms

Measured Speed: 78.5 RPM

Injection with: all nozzles

Est.Power(FuelCmd x n): 51 %

"<°" = deg CA

Journal

HYUNDAI HEAVY INDUSTRIES CO., LTD.

Official Shop Test Result For Main Engine

Setting Table A2 | **fV Data 75%**

Hull No.	CSBC985	Owner	TPC
Engine No.	AA4162	Class	BV + CR
Engine Type	6RT-flex58T-D	Test Date	2011.01.07
Output(MCR)	11290 kW	Engineer	D.J. HONG
Speed(MCR)	98.8 rpm	Operator	S.J. JUNG

INDIC2: RT-flex Indications — fV-Config Vers.: 082-3 02.06.2010 — Card-CRC: 0x1004

Miscellaneous

Est.Power (FuelCmd x n)	74 %	30020
Time Count of Spare	1.89 h	

Engine speed (n)

Engine Speed	90 RPM	
Percentage	91.0 %	

Fuel command (LI)

Used for Injection	51.8 %	30001
FuelCommandPCS	51.3 %	30009
Percent of CMCR	81.2 %	
WECS Fuel Cmd Limiter	Normal	

Scavenge Air Pressure

Mean value	2.13 bar	30003
Sensor 1	2.10 bar	30033
Sensor 2	2.13 bar	30034
Scaled to CMCR	0.79	

Fuel Rail Pressure

Setpoint	600 bar		30018
Actuator outp./Lim./near Lim.	50 %	No / No	30019
Mean value	599 bar		30017
Sensor 1	593 bar		30015
Sensor 2	607 bar		30016

Servo Oil Pressure

Setpoint reference	158 bar		30014
Mean value	158 bar		30013
Sensor 1	158 bar		30011
Sensor 2	159 bar		30012
Setpoint correction	150 bar		
Deviation	0 bar		

Injection timing

IT_D (VIT)	-2.9 <°	30023
VIT + FQS (IT_G)	-2.8 <°	30024
Injection begin	-2.8 <°	30025
Inj. time, Average val.	39.5 ms	30026
IT_A f(ch/pr)	-3.0 <°	
IT_B f(speed)	0.9 <°	
IT_C f(fuel pr.)	-0.8 <°	
VIT on/off	on	

Number of inj. nozzles

Injection with	all nozzles	30008

Exhaust Valve

Opening angle	129.1 <°	30021
Closing angle	266.7 <°	30022
Opening deadtime	17.7 ms	
Closing deadtime	93.6 ms	

Crank Angle

Crank angle 1	0.0 <°	
Crank angle 2	0.0 <°	
TDC	Gap	
F ZeroOrderFrmlWECS	NO	

Interlocks

Turning Gear FCM 3	Disengaged
Turning Gear FCM 4	Disengaged
Any Blower running	No
Shutdown on Safety System	No

SW State: OK

Journal

EXHV: Exhaust valve indications — fV-Config Vers.: 082-3 02.06.2010

Cyl.	Open Pos. Sensor 1	Open Pos. Sensor2	Closed Pos. Sensor 1	Closed Pos. Sensor 2	Exv.A/M	Deadtime Open	Deadtime Close	On Time Open	On Time Close
1	7.0 mA	6.6 mA	15.3 mA	14.4 mA	AUTO	18 ms	93 ms	0.8 ms	0.9 ms
2	7.0 mA	7.1 mA	14.6 mA	15.3 mA	AUTO	17 ms	95 ms	0.8 ms	0.8 ms
3	7.7 mA	6.7 mA	15.5 mA	15.1 mA	AUTO	18 ms	91 ms	1.0 ms	0.9 ms
4	6.8 mA	6.9 mA	15.1 mA	14.3 mA	AUTO	18 ms	94 ms	0.8 ms	0.8 ms
5	7.8 mA	7.2 mA	15.4 mA	15.0 mA	AUTO	18 ms	95 ms	0.9 ms	0.8 ms
6	6.5 mA	6.6 mA	14.5 mA	14.6 mA	AUTO	18 ms	92 ms	0.8 ms	0.8 ms

Time count [h]: 1.89

Journal

INJECT: Inj.timing, value, inj.begin & deadtime

Cyl.	Quantity Piston Return	Quantity Piston Inject	Inj. begin Deadtime	Inj. begin Angle	Injection Time	OnTime Railvalve Inject Vlv.1	Vlv.2	Vlv.3	OnTime Railvalve Return Vlv.1	Vlv.2	Vlv.3
1	4.4 mA	12.7 mA	11.4 ms	-2.3 <°	38.8 ms	0.9 ms	0.8 ms	0.9 ms	0.9 ms	0.9 ms	0.8 ms
2	4.4 mA	12.7 mA	11.3 ms	-2.4 <°	39.6 ms	0.8 ms	0.9 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms
3	4.4 mA	12.6 mA	11.7 ms	-2.2 <°	39.4 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms
4	4.4 mA	12.7 mA	11.3 ms	-2.9 <°	44.4 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms
5	4.4 mA	12.7 mA	11.5 ms	-3.1 <°	39.6 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms
6	4.4 mA	12.7 mA	11.9 ms	-3.2 <°	39.4 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms

Measured Speed: 90.0 RPM

Injection with: all nozzles

Est.Power(FuelCmd x n): 73 %

"<°" = deg CA

Journal

HYUNDAI HEAVY INDUSTRIES CO., LTD.

Official Shop Test Result For Main Engine

Setting Table A2 | **fV Data 85%**

Hull No.	CSBC985	Owner	TPC
Engine No.	AA4162	Class	BV + CR
Engine Type	6RT-flex58T-D	Test Date	2011.01.07
Output(MCR)	11290 kW	Engineer	D.J. HONG
Speed(MCR)	98.8 rpm	Operator	S.J. JUNG

INDIC2: RT-flex Indications — fV-Config Vers.: 082-3 02.06.2010 — Card-CRC: 0x1004

Miscellaneous

Est.Power (FuelCmd x n)	82 %	30020
Time Count of Spare	2.85 h	

Engine speed (n)

Engine Speed	94 RPM	
Percentage	94.6 %	

Fuel command (LI)

Used for Injection	55.0 %	30001
FuelCommandPCS	55.0 %	30009
Percent of CMCR	86.6 %	
WECS Fuel Cmd Limiter	Normal	

Scavenge Air Pressure

Mean value	2.51 bar	30003
Sensor 1	2.47 bar	30033
Sensor 2	2.50 bar	30034
Scaled to CMCR	0.89	

Fuel Rail Pressure

Setpoint	732 bar		30018	
Actuator outp./Lim./near Lim.	52 %	No	No	30019
Mean value	732 bar		30017	
Sensor 1	724 bar		30015	
Sensor 2	739 bar		30016	

Servo Oil Pressure

Setpoint reference	171 bar		30014
Mean value	171 bar		30013
Sensor 1	171 bar		30011
Sensor 2	172 bar		30012
Setpoint correction	160 bar		
Deviation	0 bar		

Injection timing

IT_D (VIT)	-1.8 <°	30023
VIT + FQS (IT_G)	-1.8 <°	30024
Injection begin	-1.8 <°	30025
Inj. time, Average val.	38.4 ms	30026
IT_A f(ch/pr)	-2.3 <°	
IT_B f(speed)	0.5 <°	
IT_C f(fuel pr.)	0.0 <°	
VIT on/off	on	

Number of inj. nozzles

Injection with	all nozzles	30008

Exhaust Valve

Opening angle	128.9 <°	30021
Closing angle	268.5 <°	30022
Opening deadtime	16.9 ms	
Closing deadtime	92.4 ms	

Crank Angle

Crank angle 1	0.0 <°	
Crank angle 2	0.0 <°	
TDC	Gap	
F ZeroOrderFrmWECS	NO	

Interlocks

Turning Gear FCM 3	Disengaged
Turning Gear FCM 4	Disengaged
Any Blower running	No
Shutdown on Safety System	No

SW State

OK

Journal

EXHV: Exhaust valve indications — fV-Config Vers.: 082-3 02.06.2010

Cyl.	Open Pos. Sensor 1/2 Sensor 1	Open Pos. Sensor 1/2 Sensor 2	Closed Pos. Sensor 1/2 Sensor 1	Closed Pos. Sensor 1/2 Sensor 2	Exv.A/M Cmd	Deadtime Open.Deadtim	Deadtime Clos.Deadtim	On Time Open / Close OnTime Open	On Time Open / Close OnTime Close
1	7.7 mA	6.2 mA	15.2 mA	14.4 mA	AUTO	17 ms	92 ms	0.8 ms	0.9 ms
2	7.0 mA	7.5 mA	14.8 mA	15.1 mA	AUTO	17 ms	94 ms	0.8 ms	0.8 ms
3	7.6 mA	7.0 mA	15.6 mA	14.8 mA	AUTO	17 ms	90 ms	0.9 ms	0.9 ms
4	7.1 mA	7.0 mA	15.0 mA	14.4 mA	AUTO	17 ms	94 ms	0.8 ms	0.8 ms
5	7.6 mA	7.4 mA	15.2 mA	15.1 mA	AUTO	17 ms	93 ms	0.9 ms	0.8 ms
6	6.6 mA	6.4 mA	14.6 mA	14.4 mA	AUTO	17 ms	92 ms	0.8 ms	0.8 ms

Time count [h]: 2.51

Journal

INJECT: Inj.timing, value, inj.begin & deadtime

Cyl.	Quantity Piston Return	Quantity Piston Inject	Inj. begin Deadtime	Inj. begin Angle	Injection Time	OnTime Railvalve Inject Vlv.1	Vlv.2	Vlv.3	OnTime Railvalve Return Vlv.1	Vlv.2	Vlv.3
1	4.4 mA	13.2 mA	10.9 ms	-1.3 <°	38.0 ms	0.8 ms	0.8 ms	0.9 ms	0.9 ms	0.9 ms	0.8 ms
2	4.4 mA	13.2 mA	10.8 ms	-1.4 <°	38.7 ms	0.8 ms	0.9 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms
3	4.4 mA	13.2 mA	11.2 ms	-1.2 <°	38.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms
4	4.4 mA	13.3 mA	10.7 ms	-1.9 <°	38.3 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms
5	4.4 mA	13.3 mA	11.0 ms	-2.1 <°	42.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms
6	4.4 mA	13.3 mA	11.4 ms	-2.2 <°	38.2 ms	0.8 ms	0.9 ms	0.9 ms	0.8 ms	0.8 ms	0.8 ms

Measured Speed: 93.7 RPM

Injection with: all nozzles

Est.Power(FuelCmd x n): 82 %

"<°" = deg CA

Journal

HYUNDAI HEAVY INDUSTRIES CO., LTD.

Official Shop Test Result For Main Engine

Setting Table A2 | fV Data 100%

Hull No.	CSBC985	Owner	TPC
Engine No.	AA4162	Class	BV + CR
Engine Type	6RT-flex58T-D	Test Date	2011.01.07
Output(MCR)	11290 kW	Engineer	D.J. HONG
Speed(MCR)	98.8 rpm	Operator	S.J. JUNG

INDIC2: RT-flex Indications — fV-Config Vers.: 082-3 02.06.2010 — Card-CRC: 0x1004

Miscellaneous

Est.Power (FuelCmd x n)	100 %	30020
Time Count of Spare	4.44 h	

Engine speed (n)

Engine Speed	99 RPM	
Percentage	99.9 %	

Fuel command (LI)

Used for Injection	64.3 %	30001
FuelCommandPCS	64.4 %	30009
Percent of CMCR	100.6 %	
WECS Fuel Cmd Limiter	Normal	

Scavenge Air Pressure

Mean value	3.16 bar		30003
Sensor 1	3.12 bar		30033
Sensor 2	3.16 bar		30034
Scaled to CMCR	1.05		

Fuel Rail Pressure

Setpoint	750 bar			30018
Actuator outp./Lim./near Lim.	62 %	No	No	30019
Mean value	752 bar			30017
Sensor 1	745 bar			30015
Sensor 2	758 bar			30016

Servo Oil Pressure

Setpoint reference	200 bar		30014
Mean value	200 bar		30013
Sensor 1	200 bar		30011
Sensor 2	201 bar		30012
Setpoint correction	185 bar		
Deviation	0 bar		

Injection timing

IT_D (VIT)	1.0 <°	30023
VIT + FQS (IT_G)	1.0 <°	30024
Injection begin	1.0 <°	30025
Inj. time, Average val.	41.5 ms	30026
IT_A f(ch/pr)	1.0 <°	
IT_B f(speed)	0.0 <°	
IT_C f(fuel pr.)	0.0 <°	
VIT on/off	on	

Number of inj. nozzles

Injection with	all nozzles	30008

Exhaust Valve

Opening angle	128.7 <°	30021
Closing angle	271.0 <°	30022
Opening deadtime	15.6 ms	
Closing deadtime	31.5 ms	

Crank Angle

Crank angle 1	0.0 <°	
Crank angle 2	0.0 <°	
TDC	Gap	
F.ZeroOrderFrmWECS	NO	

Interlocks

Turning Gear FCM 3	Disengaged
Turning Gear FCM 4	Disengaged
Any Blower running	No
Shutdown on Safety System	No

SW State: OK

Journal

EXHV: Exhaust valve indications — fV-Config Vers.: 082-3 02.06.2010

Cyl.	Open Pos. Sensor 1/2: Sensor 1	Open Pos. Sensor 1/2: Sensor2	Closed Pos. Sensor 1/2: Sensor 1	Closed Pos. Sensor 1/2: Sensor 2	Exv.A/M: Cmd	Deadtime: Open.Deadtim	Deadtime: Clos.Deadtim	On Time Open / Close: OnTime Open	On Time Open / Close: OnTime Close
1	7.7 mA	6.5 mA	15.3 mA	14.4 mA	AUTO	16 ms	90 ms	0.8 ms	0.9 ms
2	6.8 mA	7.4 mA	14.7 mA	15.1 mA	AUTO	16 ms	94 ms	0.9 ms	0.8 ms
3	7.8 mA	7.1 mA	15.6 mA	14.9 mA	AUTO	16 ms	89 ms	0.8 ms	0.9 ms
4	7.0 mA	7.1 mA	15.0 mA	14.3 mA	AUTO	16 ms	93 ms	0.8 ms	0.8 ms
5	7.8 mA	7.3 mA	15.3 mA	15.0 mA	AUTO	16 ms	93 ms	0.9 ms	0.8 ms
6	6.9 mA	6.8 mA	14.7 mA	14.3 mA	AUTO	16 ms	90 ms	0.8 ms	0.8 ms

Time count [h]: 4.45

Journal

INJECT: Inj.timing, value, inj.begin & deadtime

Cyl.	Quantity Piston: Return	Quantity Piston: Inject	Inj. begin: Deadtime	Inj. begin: Angle	Injection: Time	OnTime Railvalve Inject: Vlv.1	Vlv.2	Vlv.3	OnTime Railvalve Return: Vlv.1	Vlv.2	Vlv.3
1	4.4 mA	14.7 mA	10.2 ms	1.5 <°	41.2 ms	0.8 ms	0.8 ms	0.8 ms	0.9 ms	0.8 ms	0.9 ms
2	4.4 mA	14.7 mA	10.1 ms	1.4 <°	41.4 ms	0.8 ms	0.9 ms	0.9 ms	0.8 ms	0.8 ms	0.8 ms
3	4.4 mA	14.6 mA	10.6 ms	1.6 <°	41.5 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.7 ms	0.8 ms
4	4.4 mA	14.7 mA	10.1 ms	0.9 <°	41.3 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms
5	4.4 mA	14.7 mA	10.4 ms	0.7 <°	41.3 ms	0.8 ms	0.9 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms
6	4.4 mA	14.7 mA	10.7 ms	0.6 <°	41.5 ms	0.8 ms	0.9 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms

Measured Speed: 98.9 RPM

Injection with: all nozzles

Est.Power(FuelCmd x n): 101 %

"<°" = deg CA

Journal

HYUNDAI HEAVY INDUSTRIES CO., LTD.

Official Shop Test Result For Main Engine		Hull No.	CSBC985	Owner	TPC
		Engine No.	AA4162	Class	BV + CR
		Engine Type	6RT-flex58T-D	Test Date	2011.01.07
Setting Table A2	fV Data 110%	Output(MCR)	11290 kW	Engineer	D.J. HONG
		Speed(MCR)	98.8 rpm	Operator	S.J. JUNG

INDIC2: RT-flex Indications — fV-Config Vers.: 082-3 02.06.2010 — Card-CRC: 0x1004

Miscellaneous
- Est.Power (FuelCmd x n): 110 % (30020)
- Time Count of Spare: 5.42 h

Engine speed (n)
- Engine Speed: 102 RPM
- Percentage: 103.1 %

Fuel command (LI)
- Used for Injection: 68.0 % (30001)
- FuelCommandPCS: 67.8 % (30009)
- Percent of CMCR: 105.9 %
- WECS Fuel Cmd Limiter: Normal

Scavenge Air Pressure
- Mean value: 3.37 bar (30003)
- Sensor 1: 3.34 bar (30033)
- Sensor 2: 3.37 bar (30034)
- Scaled to CMCR: 1.11

Fuel Rail Pressure
- Setpoint: 750 bar (30018)
- Actuator outp./Lim./near Lim.: 66 % No No (30019)
- Mean value: 750 bar (30017)
- Sensor 1: 744 bar (30015)
- Sensor 2: 756 bar (30016)

Servo Oil Pressure
- Setpoint reference: 200 bar (30014)
- Mean value: 200 bar (30013)
- Sensor 1: 200 bar (30011)
- Sensor 2: 201 bar (30012)
- Setpoint correction: 186 bar
- Deviation: 0 bar

Injection timing
- IT_D (VIT): 0.2 <° (30023)
- VIT + FQS (IT_G): 0.2 <° (30024)
- Injection begin: 0.2 <° (30025)
- Inj. time, Average val.: 43.8 ms (30026)
- IT_A f(ch/pr): 0.4 <°
- IT_B f(speed): -0.3 <°
- IT_C f(fuel pr.): 0.0 <°
- VIT on/off: on

Number of inj. nozzles
- Injection with: all nozzles (30008)

Exhaust Valve
- Opening angle: 128.1 <° (30021)
- Closing angle: 271.0 <° (30022)
- Opening deadtime: 16.1 ms
- Closing deadtime: 92.9 ms

Crank Angle
- Crank angle 1: 0.0 <° ????
- Crank angle 2: 0.0 <° ????
- TDC: Gap
- F ZeroOrderFrmWECS: NO

Interlocks
- Turning Gear FCM 3: Disengaged
- Turning Gear FCM 4: Disengaged
- Any Blower running: No
- Shutdown on Safety System: No

SW State
- OK

Journal

EXHV: Exhaust valve indications — fV-Config Vers.: 082-3 02.06.2010

Cyl.	Open Pos. Sensor 1/2: Sensor 1	Open Pos. Sensor 1/2: Sensor2	Closed Pos. Sensor 1/2: Sensor 1	Closed Pos. Sensor 1/2: Sensor 2	Exv.A/M: Cmd	Deadtime: Open.Deadtim	Deadtime: Clos.Deadtim	On Time Open / Close: OnTime Open	On Time Open / Close: OnTime Close
1	7.4 mA	6.4 mA	15.2 mA	14.3 mA	AUTO	16 ms	92 ms	0.8 ms	0.9 ms
2	6.8 mA	7.1 mA	14.9 mA	15.0 mA	AUTO	16 ms	95 ms	0.8 ms	0.8 ms
3	7.6 mA	7.2 mA	15.6 mA	14.8 mA	AUTO	16 ms	89 ms	0.8 ms	1.0 ms
4	6.8 mA	6.9 mA	15.0 mA	14.3 mA	AUTO	16 ms	94 ms	0.8 ms	0.8 ms
5	7.6 mA	7.0 mA	15.3 mA	14.9 mA	AUTO	17 ms	94 ms	0.9 ms	0.8 ms
6	6.7 mA	6.5 mA	14.6 mA	14.3 mA	AUTO	16 ms	91 ms	0.8 ms	0.8 ms

Time count [h]: 5.43

Journal

INJECT: Inj.timing, value, inj.begin & deadtime

Cyl.	Quantity Piston: Return	Quantity Piston: Inject	Inj. begin: Deadtime	Inj. begin: Angle	Injection Time	OnTime Railvalve Inject: Vlv.1	Vlv.2	Vlv.3	OnTime Railvalve Return: Vlv.1	Vlv.2	Vlv.3
1	4.4 mA	15.3 mA	10.3 ms	0.7 <°	43.6 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.9 ms
2	4.4 mA	15.3 mA	10.1 ms	0.6 <°	43.9 ms	0.8 ms	0.9 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms
3	4.4 mA	15.3 mA	10.6 ms	0.8 <°	44.1 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms
4	4.4 mA	15.3 mA	10.1 ms	0.1 <°	44.2 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms
5	4.4 mA	15.4 mA	10.4 ms	-0.1 <°	43.6 ms	0.8 ms	0.9 ms	0.8 ms	0.8 ms	0.8 ms	0.8 ms
6	4.4 mA	15.3 mA	10.7 ms	-0.2 <°	43.8 ms	0.8 ms	0.9 ms	1.0 ms	0.8 ms	0.8 ms	0.8 ms

Measured Speed: 102.1 RPM

Injection with: all nozzles

Est.Power(FuelCmd x n): 110 %

"<°" = deg CA

Journal

HYUNDAI HEAVY INDUSTRIES CO., LTD.

Official Shop Test Result For Main Engine	Hull No.	CSBC985	Owner	TPC
	Engine No.	AA4162	Class	BV + CR
	Engine Type	6RT-flex58T-D	Test Date	2011.01.07
Setting Table B	Output(MCR)	11290 kW	Engineer	D.J. HONG
	Speed(MCR)	98.8 rpm	Operator	S.J. JUNG

Starting Air Pilot Valve

Cylinder No.		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Opens after T.D.C [°]	Ahead	0	0	0	0	0	0								
	Astern	0	0	0	0	0	0		BLANK						
Closes after T.D.C [°]	Ahead	90	90	90	90	90	90								
	Astern	90	90	90	90	90	90								

Cylinder

Cylinder No.		1	2	3	4	5	6		8	9	10	11	12	13	14
On Test Bed	Distance b include Shims mm	23.7	23.9	24.1	24.6	24.2	24.1								
	Compression Shim mm	36	36	36	36	36	36								
	Comp'Pressure at 25%Output Scav. air pressure 0.380 bar	64.0	64.0	64.0	64.0	64.0	64.0		BLANK						
	Combustion Pressure at 100% Output (Fuel command 52.7 %)	152	153	152	151	151	152								
For Delivery	Distance b include Shims mm	23.7	23.9	24.1	24.6	24.2	24.1								
	Compression Shim mm	36	36	36	36	36	36								

* Cylinder Liner Drawing No.	A20-220743-9	* Cylinder Cover Drawing No.	A20-217855-5
		* Piston Head Drawing No.	A20-146854-6

*Distance b is measured between Top surface of Piston and Upper edge of Cyl. Liner (Piston at T.D.C gasket removed)

* Piston ring	Type	No.1 : SCP1CC18	No.2~4 : SCP1RC18
	Manufacturer	GEOTZE	GEOTZE

Special Tests

* Engine speed increase	From 98.8 rpm to 99.9 rpm ΔN= 1.11%
* M/E Overspeed	Safety device stop the Engine at 107.5 rpm, 108.8% of Nominal speed

Set Points	Too low brg.oil & PCO	Exhaust v/v air spring	Piston.C.O non-flow	T/C L.O	Oil mist detector
* Pressure (kg/cm²)	2.90	4.50	ALL TESTED	0.64	ALL TESTED
* Slow down delayed (sec)	10.86	-	-	4.98	-
* Thrust pad temp.sh./down(℃)	84.0				
* Slow down delayed (sec)	59.14 sec				

* Minimun speed	Fuel cmd %	Eng. speed	T/C speed	Power	Eng.Speed(%)	Brake
	11.7	25.0 rpm	2276	414 kW	25.30%	22.5 tonf

HYUNDAI HEAVY INDUSTRIES CO., LTD. Official Shop Test Result For Main Engine				
HYUNDAI - WARTSILA / Load Data Sheet 1	Hull No.	CSBC985	Owner	TPC
	Engine No.	AA4162	Class	BV + CR
	Engine Type	6RT-flex58T-D	Test Date	2011.01.07
	Output(MCR)	11290 kW	Engineer	D.J. HONG
	Speed(MCR)	98.8 rpm	Operator	S.J. JUNG

Section	Item	Detail	Unit		25%				50%				75%			
General Data	Loading power(%) / Check time		%	Time	25%		19:00		50%		19:30		75%		20:00	
	Engine power / speed (theoretical)		kW	rpm	2823		62.2		5645		78.4		8468		89.8	
	Mean eff. pressure design / actual		bar		7.1		7.1		11.3		11.3		14.8		14.8	
	Brake force (indicated)		tonf·m		61.5				98.0				128.5			
	Engine power / speed (measured)		kW	rpm	2823		62.2		5645		78.4		8468		89.8	
	VIT + FQS(IT_G) / inj. begin standard value		∠°		2.8		0.0		-2.0		0.0		-2.8		0.0	
	Fuel oil: Actuator Output	Fcmd	%		25.0		27.2		38.0		41.0		50.0		51.8	
	Consumption absol.		kg/h	g/kWh	515.00		182.46		985.00		174.49		1435.00		169.47	
	Consumption ISO		g/kWh		180.70				172.68				167.82			
	Cyl. Lub. oil: Injection Number		10min/1cyl		198				325				469			
	Total Feed Rate		kg/h		5.9				9.7				14.0			
	Feed Rate		g/bhph	g/kWh	1.54		2.09		1.26		1.72		1.21		1.65	
Scavenge Air	Aux. Blower / Nozzles in operation		on/off	EA	ON		ALL		OFF		ALL		OFF		ALL	
	Barometric pressure / Humidity		hPa	%	1029.0		17.0		1029.0		17.7		1029.0		15.2	
	Ambient temp.		℃		8.0				8.3				8.2			
	Press drop across air cooler		mmAq		35				75				103			
	T/C filter suction pressure		mmAq		10				20				47			
	Pressure after blower		mmHg		230				870				1600			
	Scavenge air pressure		mmHg	bar	280		0.380		850		1.130		1590		2.130	
	Temp. before blower		℃		9.0	15.0	10.0	10.0	10.0	16.0	11.0	11.0	12.0	19.0	12.0	13.0
	Temp. before air cooler		℃		37				92				138			
	Temp. after air cooler		℃		29				32				34			
Exhaust Gas	Turboblower speed		rpm		6233				10789				13549			
	Pressure before turbine		mmHg		180				610				1260			
	Pressure after turbine		mmAq		20				75				175			
	Temp. before turbine		℃		275				320				334			
	Temp. after turbine		℃		229				230				203			
	Temp. after cylinder	Mean	℃		240.0				281.5				296.7			
		1 2 3 4	℃		235	240	245	245	280	280	292	290	285	295	300	305
		5 6	℃		240	235			275	272			295	300		
Cylinder Pressures	Maximum / Compression press.	Mean	bar	bar	85.2		64.0		117.5		75.5		149.7		105.8	
		No, 1	bar	bar	86		64		117		76		150		106	
		No, 2	bar	bar	86		64		117		76		150		106	
		No, 3	bar	bar	86		64		117		76		150		105	
		No, 4	bar	bar	84		64		117		75		149		106	
		No, 5	bar	bar	85		64		118		75		150		106	
		No, 6	bar	bar	84		64		119		75		149		106	
Systems	Air press.: Control air / Valve air spring		bar		6.50		6.50		6.50		6.50		6.50		6.50	
	Lub. oil press. : Bearing / Cross head bearing		bar		4.60		11.50		4.60		11.50		4.60		11.50	
	Servo oil		bar		121				140				158			
	Servo oil pump inlet		bar		4.60				4.60				4.50			
	T/C lub oil inlet		bar		2.60				2.30				2.60			
	Axial detuner driving / free end		Mpa		0.38		0.40		0.37		0.39		0.37		0.39	
	Water press.: Cylinder		bar		4.0				4.0				4.0			
	Lub. oil temp.: Bearing / Turbocharger		℃		44.0				43.0				42.0			
	Crosshead inlet		℃		44.0				43.0				42.0			
	T/C outlet		℃		50				57				68			
	Water temp.: cylinder inlet		℃		50.0				53.0				58.0			
	cylinder outlet	Mean	℃		54.7				59.7				65.8			
		1 2 3 4	℃		54	55	55	54	59	60	60	59	66	66	65	66
		5 6	℃		55	55			60	60			66	66		
	Air cooler inlet		℃		15				13				14			
	Air cooler outlet		℃		16				53				70			
	Fuel: Press. bef / aft retaining valve		bar		8.8		3.8		8.5		3.5		8.5		3.5	
	Press. Engine inlet / Rail		bar	bar	7.5		600		7.5		600		8.0		599	
	Temp. before engine		℃		39.0				40.0				39.0			
	Thrust bearing temp.		℃		47				47				47			

HYUNDAI HEAVY INDUSTRIES CO., LTD. — Official Shop Test Result For Main Engine

HYUNDAI - WARTSILA — Load Data Sheet 2

Hull No.	CSBC985	Owner	TPC
Engine No.	AA4162	Class	BV + CR
Engine Type	6RT-flex58T-D	Test Date	2011.01.07
Output(MCR)	11290 kW	Engineer	D.J. HONG
Speed(MCR)	98.8 rpm	Operator	S.J. JUNG

Group	Item	Detail	Unit	Unit	85%				85%(PP)				100%			
General Data	Loading power(%) / Check time		%	Time	85%		20:30		85%(PP)		21:30		100%		22:30	
	Engine power / speed (theoretical)		kW	rpm	9597		93.6		9597		98.3		11290		98.8	
	Mean eff. pressure design / actual		bar		16.1		16.1		15.3		15.3		17.9		17.9	
	Brake force (indicated)		tonf·m		139.5				133.0				155.5			
	Engine power / speed (measured)		kW	rpm	9597		93.6		9597		98.3		11290		98.8	
	VIT + FQS(IT_G) / inj. begin standard value		∠°		-1.6		0.0		-2.0		0.0		1.0		0.0	
	Fuel oil:	Actuator Output / Fcmd	%		53.0		55.2		53.0		52.7		62.0		64.3	
		Consumption absol.	kg/h	g/kWh	1650.00		171.94		1652.00		172.20		1989.00		176.17	
		Consumption ISO	g/kWh		169.20				169.46				173.37			
	Cyl. Lub. oil:	Injection Number	10min/1cyl		519				519				607			
		Total Feed Rate	kg/h		15.5				15.5				18.1			
		Feed Rate	g/bhph	g/kWh	1.19		1.61		1.19		1.61		1.18		1.60	
Scavenge Air	Aux. Blower / Nozzles in operation		on/off	EA	OFF		ALL		OFF		ALL		OFF		ALL	
	Barometric pressure / Humidity		hPa	%	1029.0		20.1		1029.0		20.3		1028.0		20.6	
	Ambient temp.		℃		8.3				8.2				8.1			
	Press drop across air cooler		mmAq		110				111				120			
	T/C filter suction pressure		mmAq		58				59				78			
	Pressure after blower		mmHg		1900				1900				2370			
	Scavenge air pressure		mmHg	bar	1890		2.580		1870		2.560		2350		3.140	
	Temp. before blower		℃		13.0	20.0	13.0	14.0	13.0	20.0	13.0	14.0	13.0	22.0	13.0	13.0
	Temp. before air cooler		℃		156				157				185			
	Temp. after air cooler		℃		34				34				37			
Exhaust Gas	Turboblower speed		rpm		14450				14460				15770			
	Pressure before turbine		mmHg		1520				1530				1960			
	Pressure after turbine		mmAq		215				220				300			
	Temp. before turbine		℃		352				352				398			
	Temp. after turbine		℃		203				204				230			
	Temp. after cylinder	Mean	℃		311.3				312.0				353.3			
		1, 2, 3, 4	℃		298	310	315	320	300	312	315	320	340	350	360	360
		5, 6	℃		310	315			310	315			355	355		
Cylinder Pressures	Maximum / Compression press.	Mean	bar	bar	151.7		117.5		151.8		117.0		148.3		142.2	
		No, 1	bar	bar	152		118		152		117		148		143	
		No, 2	bar	bar	151		117		153		117		148		143	
		No, 3	bar	bar	151		118		152		117		148		142	
		No, 4	bar	bar	152		118		151		117		148		142	
		No, 5	bar	bar	152		117		151		117		150		142	
		No, 6	bar	bar	152		117		152		117		148		141	
Systems	Air press.:	Control air / Valve air spring	bar		6.50		6.50		6.50		6.50		6.50		6.50	
	Lub. oil press. :	Bearing / Cross head bearing	bar		4.60		11.50		4.50		11.50		4.50		11.50	
		Servo oil	bar		172				172				200			
		Servo oil pump inlet	bar		4.40				4.40				4.30			
		T/C lub oil inlet	bar		2.70				2.70				2.70			
		Axial detuner driving / free end	Mpa		0.37		0.39		0.36		0.38		0.36		0.37	
	Water press.:	Cylinder	bar		4.2				4.3				4.4			
	Lub. oil temp.:	Bearing / Turbocharger	℃		42.0				43.0				44.0			
		Crosshead inlet	℃		42.0				43.0				44.0			
		T/C outlet	℃		74				74				80			
	Water temp.:	cylinder inlet	℃		64.0				68.0				69.0			
		cylinder outlet — Mean	℃		71.7				73.7				78.5			
		1, 2, 3, 4	℃		72	72	71	72	74	74	73	74	78	79	78	79
		5, 6	℃		72	71			74	73			79	78		
		Air cooler inlet	℃		15				16				21			
		Air cooler outlet	℃		73				70				72			
	Fuel:	Press. bef / aft retaining valve	bar		8.4		3.4		8.3		3.3		8.2		3.3	
		Press. Engine inlet / Rail	bar	bar	8.0		744		8.0		745		7.0		750	
		Temp. before engine	℃		38.0				40.0				39.0			
	Thrust bearing temp.		℃		47				47				48			

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HYUNDAI HEAVY INDUSTRIES CO.,LTD.

Official Shop Test Result For Main Engine

HYUNDAI - WARTSILA | **Load Data Sheet 3**

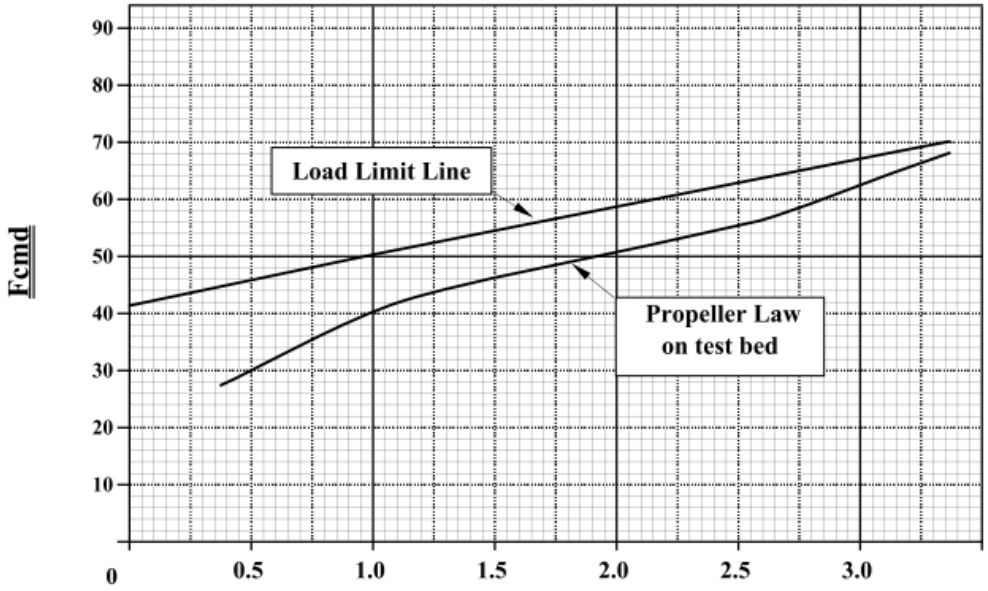
Hull No.	CSBC985	Owner	TPC
Engine No.	AA4162	Class	BV + CR
Engine Type	6RT-flex58T-D	Test Date	2011.01.07
Output(MCR)	11290 kW	Engineer	D.J. HONG
Speed(MCR)	98.8 rpm	Operator	S.J. JUNG

General Data	Loading power(%) / Check time					%	Time	110%		23:30		**Cylinder cut out**				**T/C cut out**		
	Engine power / speed (theoretical)					kW	rpm	12419		102.0		7451		86.0		1129		45.9
	Mean eff. pressure design / actual					bar		19.1		19.1		13.6		13.6		3.9		3.9
	Brake force (indicated)					tonf·m		165.5				118.0				33.5		
	Engine power / speed (measured)					kW	rpm	12416		102.0		7451		86.0		1129		45.9
	VIT + FQS(IT_G) / inj. begin standard value					∠°		0.2		0.0		-1.5		0.0		1.8		0.0
	Fuel oil:	Actuator Output	Fcmd			%		66.0		68.0		-		-		-		-
		Consumption absol.				kg/h	g/kWh	2232.00		179.72		-		-		-		-
		Consumption ISO				g/kWh		177.05				-				-		
	Cyl. Lub. oil:	Injection Number				10min/1cyl		668				430				93		
		Total Feed Rate				kg/h		19.9				12.8				2.8		
		Feed Rate				g/bhph	g/kWh	1.18		1.60		1.27		1.72		1.81		2.46
Scavenge Air	Aux. Blower / Nozzles in operation					on/off	EA	OFF		ALL		OFF		ALL		ON		2 nozzles
	Barometric pressure / Humidity					hPa	%	1028.0		21.0		1028.0		22.0		1028.0		22.0
	Ambient temp.					℃		9.0				8.3				8.3		
	Press drop across air cooler					mmAq		126				95				20		
	T/C filter suction pressure					mmAq		86				50				0		
	Pressure after blower					mmHg		2530				1630				0		
	Scavenge air pressure					mmHg	bar	2510		3.370		1610		2.200		50		0.080
	Temp. before blower					℃		14.0	24.0	13.0	14.0	10.0	20.0	11.0	9.0	-	-	-	-
	Temp. before air cooler					℃		196				142				40		
	Temp. after air cooler					℃		38				38				28		
Exhaust Gas	Turboblower speed					rpm		16400				13590				0		
	Pressure before turbine					mmHg		2100				1280				30		
	Pressure after turbine					mmAq		320				170				15		
	Temp. before turbine					℃		420				350				270		
	Temp. after turbine					℃		245				210				230		
	Temp. after cylinder		Mean			℃		375.0				323.3				225.8		
			1	2	3	4	℃	360	370	380	385	270	120	410	460	210	220	230	230
			5	6			℃	380	375			260	420			230	235		
Cylinder Pressures	Maximum / Compression press.		Mean			bar	bar	158.7		150.0		122.2		112.7		56.5		32.2
			No,	1		bar	bar	157		150		135		117		57		32
			No,	2		bar	bar	158		150		-		108		55		32
			No,	3		bar	bar	159		151		112		110		56		32
			No,	4		bar	bar	159		150		109		107		57		32
			No,	5		bar	bar	159		150		125		119		56		32
			No,	6		bar	bar	160		149		130		115		58		33
Systems	Air press.:	Control air / Valve air spring				bar		6.50		6.50		6.50		6.50		6.50		6.50
	Lub. oil press. :	Bearing / Cross head bearing				bar		4.50		11.50		4.40		11.50		4.40		11.50
		Servo oil				bar		200				174				110		
		Servo oil pump inlet				bar		4.30				4.40				4.40		
		T/C lub oil inlet				bar		2.70				2.70				2.70		
		Axial detuner driving / free end				Mpa		0.36		0.37		0.36		0.37		0.36		0.37
	Water press.:	Cylinder				bar		4.4				3.7				3.7		
	Lub. oil temp.:	Bearing / Turbocharger				℃		44.0				45.0				45.0		
		Crosshead inlet				℃		44.0				45.0				45.0		
		T/C outlet				℃		82				64				46		
	Water temp.:	cylinder inlet				℃		70.0				69.0				69.0		
		cylinder outlet	Mean			℃		79.8				76.8				64.3		
			1	2	3	4	℃	79	80	79	81	73	78	75	80	64	65	64	65
			5	6			℃	81	79			75	80			64	64		
		Air cooler inlet				℃		22				24				20		
		Air cooler outlet				℃		73				45				21		
	Fuel:	Press. bef / aft retaining valve				bar		8.0		3.2		8.2		3.2		8.2		3.2
		Press. Engine inlet / Rail				bar	bar	7.8		750		8.0		780		8.0		600
		Temp. before engine				℃		39.0				40.0				39.0		
	Thrust bearing temp.					℃		49				47				46		

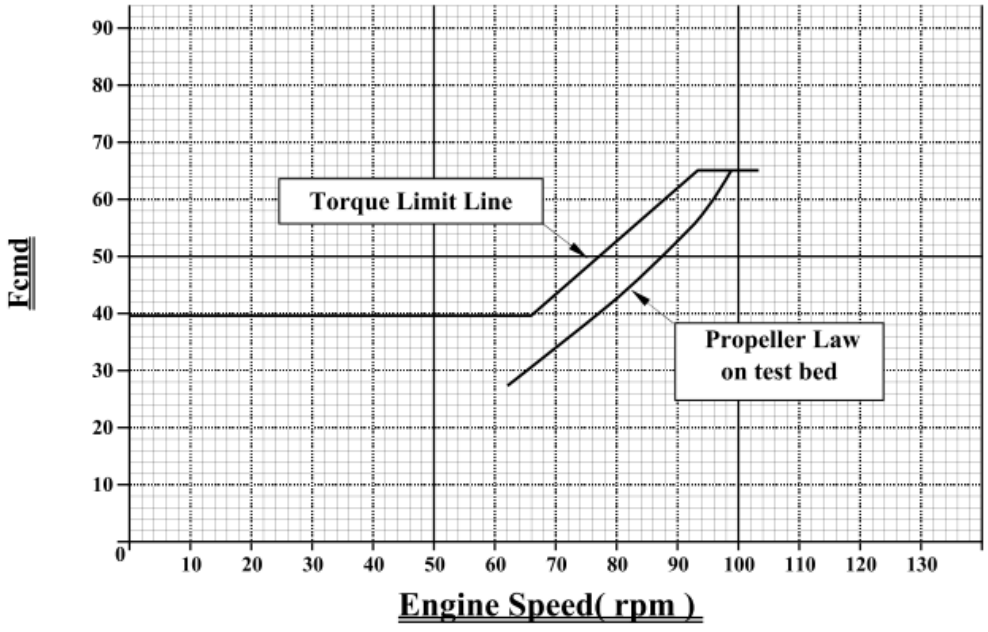
HYUNDAI HEAVY INDUSTRIES CO., LTD.

Official shop test result for Main Engine	Hull No.	CSBC985	Owner	TPC
	Engine No.	AA4162	Class	BV + CR
	Engine Type	6RT-flex58T-D	Test Date	2011.01.07
Load & Torque Limit Diagram	Output(MCR)	11290 kW	Engineer	D.J. HONG
	Speed(MCR)	98.8 rpm	Operator	S.J. JUNG

Load Limit Diagram



Torque Limit Diagram



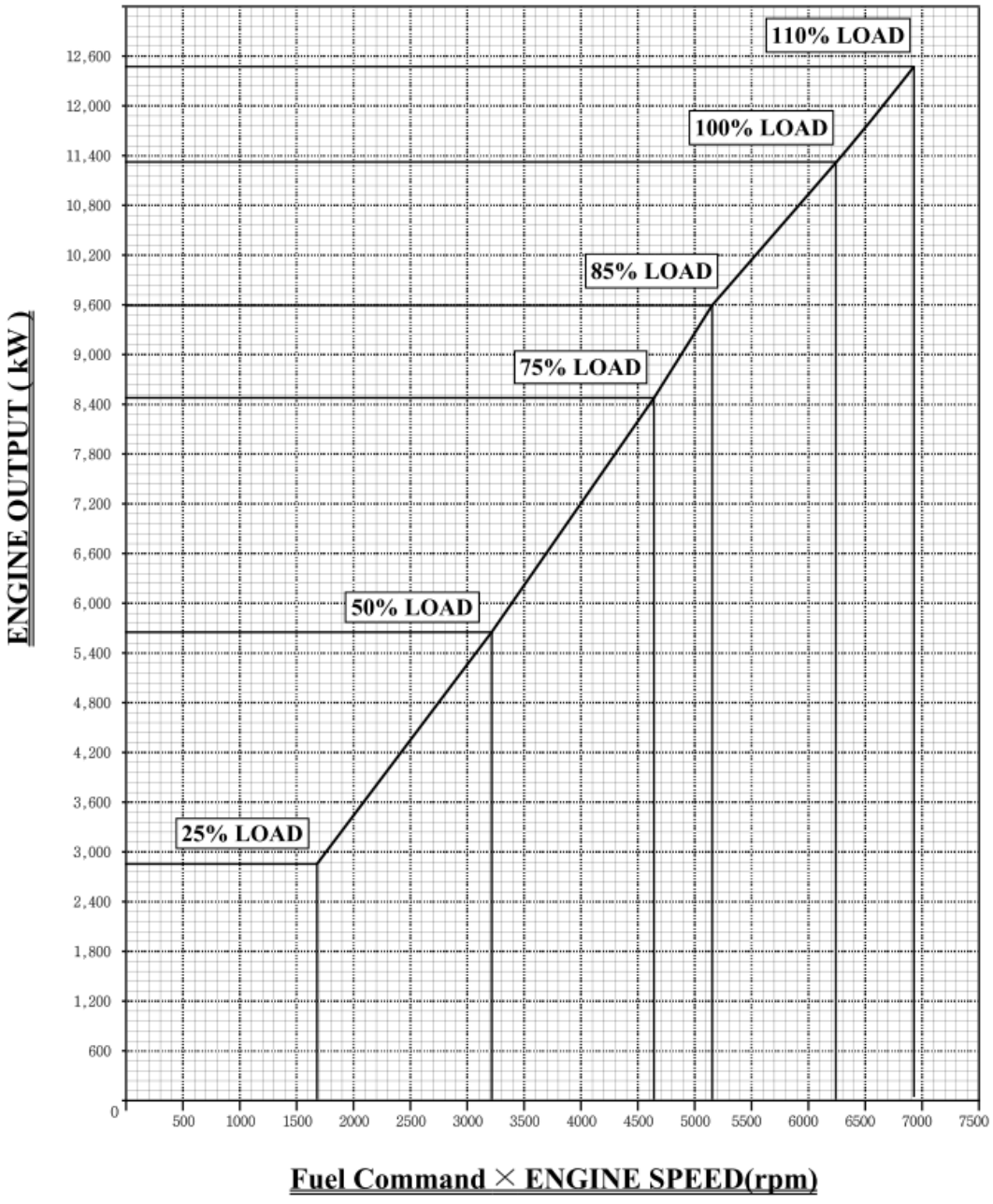
15

HYUNDAI HEAVY INDUSTRIES CO., LTD.

Official Shop Test Result For Main Engine	Hull No.	CSBC985	Owner	TPC
	Engine No.	AA4162	Class	BV + CR
	Engine Type	6RT-flex58T-D	Test Date	2011.01.07
Power Diagram	Output(MCR)	11290 kW	Engineer	D.J. HONG
	Speed(MCR)	98.8 rpm	Operator	S.J. JUNG

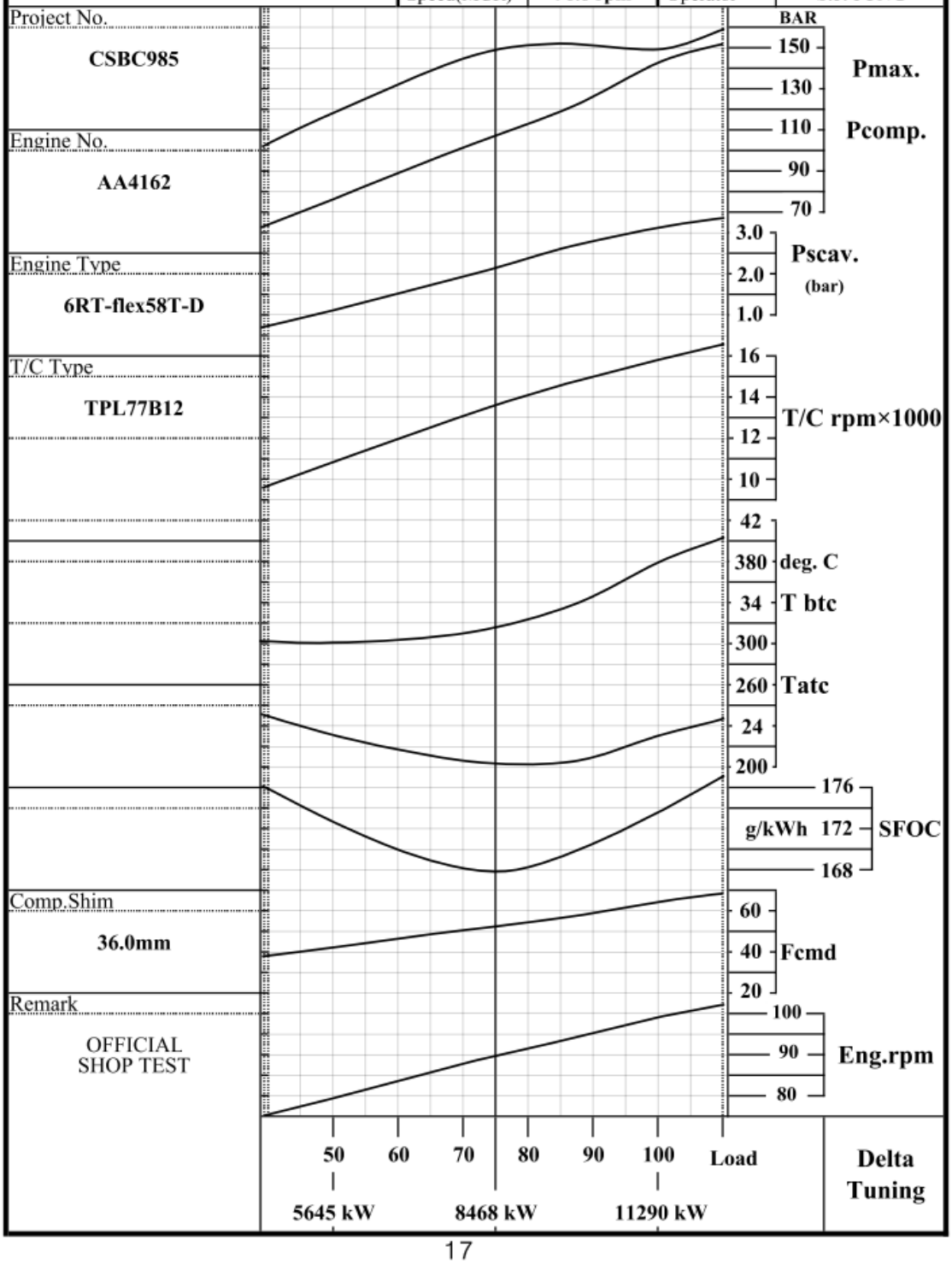
* Fuel oil specific gravity : 0.91 g / ml at 15℃

*Fuel oil Lower Calorific Value: 10012 kcal / kg | * Fuel oil viscosity : 4.00 cst at 50℃



HYUNDAI
HEAVY INDUSTRIES CO., LTD.

Official shop test result for Main Engine	Hull No.	CSBC985	Owner	TPC
	Engine No.	AA4162	Class	BV + CR
	Engine Type	6RT-flex58T-D	Test Date	2011.01.07
Engine performance	Output(MCR)	11290 kW	Engineer	D.J. HONG
	Speed(MCR)	98.8 rpm	Operator	S.J. JUNG



HYUNDAI HEAVY INDUSTRIES CO., LTD.

Official Shop Test Result for Main Engine	Hull No.	CSBC985	Owner	TPC
	Engine No.	AA4162	Class	BV + CR
	Engine type	6RT-flex58T-D	Nomenclature	Bearing
Inspection Report	Output(MCR)	11,290 kW	Kind of insp.	Clearance
	Speed(MCR)	98.8 rpm	Work condition	Before shop test

Unit: 1/100 mm

1. Main Bearing Clearance(position A) Spec.: #1 : 30 ~ 70 / Others : 20 ~ 60

BRG.No.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Clearance	F	E	E	F	F	F	E	F	E	BLANK						
	A	E	E	E	F	E	E	E	E							

E: 45 GO / 50 NOT GO F: 50 GO / 55 NOT GO G: 55 GO / 60 NOT GO (Special feeler gauge was used)

2. Bottom End Bearing Clearance(position B) Spec.: 45 ~ 65

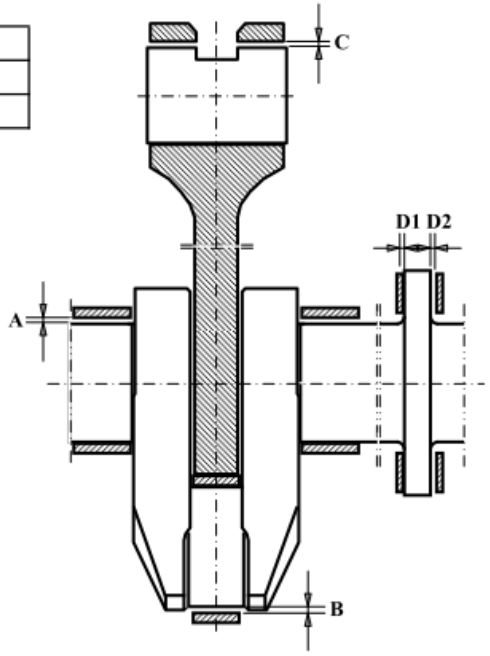
BRG.No.		1	2	3	4	5	6	7	8	9	10	11	12
Clearance	F	50	50	50	55	50	55	BLANK					
	A	55	50	50	55	50	55						

3. Crosshead pin Bearing Clearance(position C) Spec.: 31 ~ 55

BRG.No.		1	2	3	4	5	6	7	8	9	10	11	12
Clearance	F	55	55	55	50	55	55	BLANK					
	A	55	55	55	46	55	55						

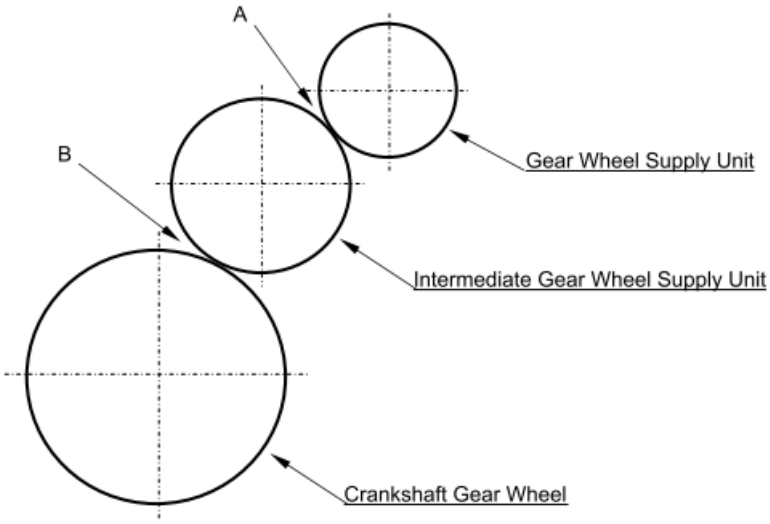
4. Thrust pad Clearance

Position	D1 + D2
Spec.	80 ~ 130
Clearance	93



HYUNDAI HEAVY INDUSTRIES CO., LTD.

Official Shop Test Result for Main Engine	Hull No.	CSBC985	Owner	TPC
	Engine No.	AA4162	Class	BV + CR
	Engine type	6RT-flex58T-D	Nomenclature	Gear Wheel
Inspection Report	Output(MCR)	11,290 kW	Kind of insp.	Backlash
	Speed(MCR)	98.8 rpm	Work condition	Before shop test



(Parallelity A:0.020mm, B:0.026mm)

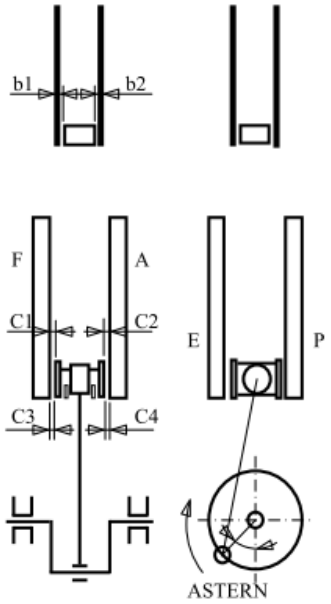
P:Pump Side E:Exh. Side Unit : 1/100mm

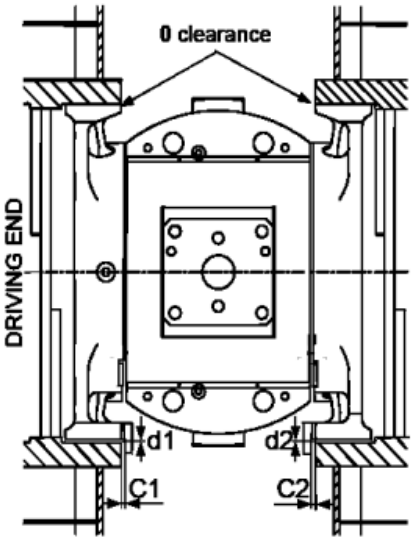
Pos. / Spec.	0°							90°							180°							270°						
	Free		Mid.		Drive		Parallelity	Free		Mid.		Drive		Parallelity	Free		Mid.		Drive		Parallelity	Free		Mid.		Drive		Parallelity
	P	E	P	E	P	E		P	E	P	E	P	E		P	E	P	E	P	E		P	E	P	E	P	E	
A	20	13	20	13	21	13	1	20	13	20	13	18	13	2	22	13	22	12	22	12	1	19	11	19	11	20	12	2
28~40	33		33		34		-	33		33		31		-	35		34		34		-	30		30		32		-
B	24	16	24	16	25	15	0	24	14	24	14	24	15	1	24	14	23	15	23	16	1	21	18	21	18	24	15	0
38~54	40		40		40		-	38		38		39		-	38		38		39		-	39		39		39		-

HYUNDAI HEAVY INDUSTRIES CO., LTD.

Official Shop Test Result for Main Engine	Hull No.	CSBC985	Owner	TPC
	Engine No.	AA4162	Class	BV + CR
	Engine Type	6RT-flex58T-D	Nomenclature	Reciprocating parts
Inspection Report	Output(MCR)	11,290 kW	Kind of Insp.	Alignment
	Speed(MCR)	98.8 rpm	Work Condition	Before shop test

Unit: 1/100 mm





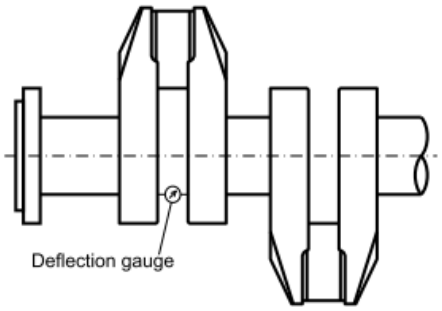
(30° crank angle before BDC)

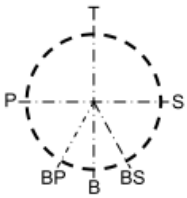
Position \ Cyl.No.		1	2	3	4	5	6	7	8	9	10	11	12
Clearance Piston skirt & liner (Spec.: 80 ~ 117)	b1	55	60	60	50	50	39	BLANK					
	b2	37	36	40	46	46	53						
	b1+b2	92	96	100	96	96	92						
Clearance Guide shoe & Guide bar (Spec.: 20 ~ 90)	d1	70	70	70	65	75	65						
	d2	60	70	70	65	70	70						
	d3	70	80	85	85	80	75						
	d4	65	80	80	80	75	80						
Clearance Guide bar & Guide rail (Spec.: 30 ~ 90 / per side)	C1	76	73	50	33	68	42						
	C2	49	82	70	57	47	78						
	C1+C2	125	155	120	90	115	120						
	C3	66	63	45	33	73	57						
	C4	54	87	80	67	52	78						
	C3+C4	120	150	125	100	125	135						

HYUNDAI HEAVY INDUSTRIES CO., LTD.

Official Shop Test Result for Main Engine	Hull No.	CSBC985	Owner	TPC
	Engine No.	AA4162	Class	BV + CR
	Engine Type	6RT-flex58T-D	Nomenclature	Crankshaft
Inspection Report	Output(MCR)	11,290 kW	Kind of Insp.	Deflection
	Speed(MCR)	98.8 rpm	Work Condition	Before & after

Unit: 1/100 mm





Looking from after

Vertical	
Cyl.1	18 ~ -37
Cyl.2 ~ (n-1)	±18
Cyl.(n)	18 ~ -52
Horizontal	
Cyl.1~(n)	± 8
* n= Cyl. numbers	

Position \ Cyl.No.		1	2	3	4	5	6	7	8	9	10	11	12
After stay bolt tightening	BP	0	0	0	0	0	0						
before shop trial	P	-18	-4	-4	+2	-10	-22						
(without water brake)	T	-17	-2	+3	+12	-15	-44	BLANK					
Date: 2010.12.30	S	-15	-5	-8	+1	-10	-24						
Temp.: -1 ℃	BS	+2	-1	-4	0	+2	-2						
Vertical Deflection	V	-18	-2	+5	+12	-16	-43						
Horizontal Deflection	H	-3	+1	+4	+1	0	+2						
After stay bolt tightening	BP	0	0	0	0	0	0						
after shop trial	P	-29	-7	+2	+3	-12	-24						
(with water brake)	T	-36	-4	+18	+19	-10	-41	BLANK					
Date: 2010.01.07	S	-21	-4	+10	+10	-7	-24						
Temp.: 48 ℃	BS	0	0	+2	+3	+2	-2						
Vertical Deflection	V	-36	-4	+17	+18	-11	-40						
Horizontal Deflection	H	-8	-3	-8	-7	-5	0						

* Remark *

Mark(+): Elongation of distance between Crank web(⎍)

Mark(-): Diminution of distance between Crank web(⎎)

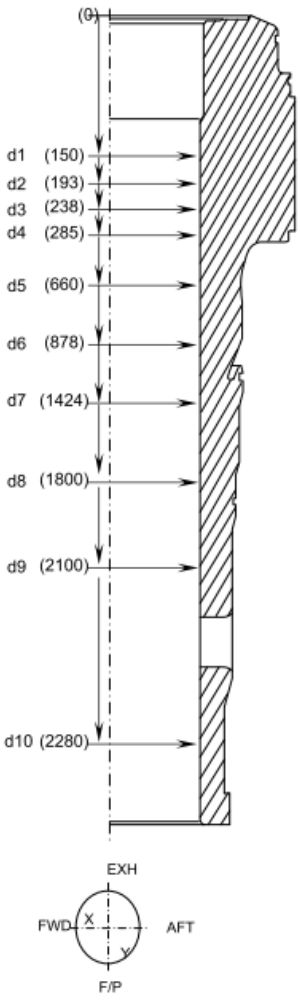
HYUNDAI HEAVY INDUSTRIES CO., LTD.

Official Shop Test Result for Main Engine

Inspection Report

Hull No.	CSBC985	Owner	TPC
Engine No.	AA4162	Class	BV + CR
Engine Type	6RT-flex58T-D	Nomenclature	Cyl. Liner
Output(MCR)	11,290 kW	Kind of Insp.	Dimension
Speed(MCR)	98.8 rpm	Work Condition	Before shop test

Unit: 1/100 mm



Cyl.No	Position		I	II	III	IV	V	VI	VII	VIII	IX	X
	Spec. / Item no.		ø580 +0.175 0									
1	RTX58T -D-921	X	+8	+8	+8	+8	+8	+8	+8	+8	+8	+8
		Y	+8	+8	+8	+8	+8	+8	+8	+7	+7	+7
2	-D-931	X	+11	+11	+11	+11	+10	+11	+10	+10	+10	+10
		Y	+10	+10	+10	+10	+10	+10	+10	+10	+10	+9
3	-D-932	X	+13	+13	+13	+13	+13	+12	+12	+12	+12	+12
		Y	+12	+12	+12	+12	+12	+12	+12	+12	+12	+12
4	-D-933	X	+8	+8	+8	+8	+9	+8	+9	+9	+9	+9
		Y	+8	+8	+8	+8	+8	+8	+8	+8	+8	+8
5	-D-934	X	+10	+10	+9	+9	+9	+9	+9	+9	+9	+9
		Y	+9	+9	+9	+8	+9	+8	+8	+8	+8	+8
6	-D-937	X	+12	+12	+12	+12	+12	+12	+12	+13	+13	+13
		Y	+11	+11	+11	+12	+11	+12	+12	+12	+12	+12
S	-D-938	X	+13	+13	+13	+12	+13	+12	+12	+12	+12	+12
		Y	+12	+12	+12	+12	+12	+12	+12	+12	+12	+11
		X				BLANK						
		Y										
		X										
		Y										
		X										
		Y										
		X										
		Y										
		X										
		Y										
		X										
		Y										
		X										
		Y										

附件 7：PANASIA 公司壓艙水處理系統維護手冊

INSTRUCTION MANUAL

(Installation and Maintenance)

BALLAST WATER MANAGEMENT SYSTEM

GloEn-Patrol™

PROJECT : H983/984/985/986

Doc. No. : PAD-IM-18 (Rev.1)

PANASIA

4 MAINTENANCE

4.1 Filter

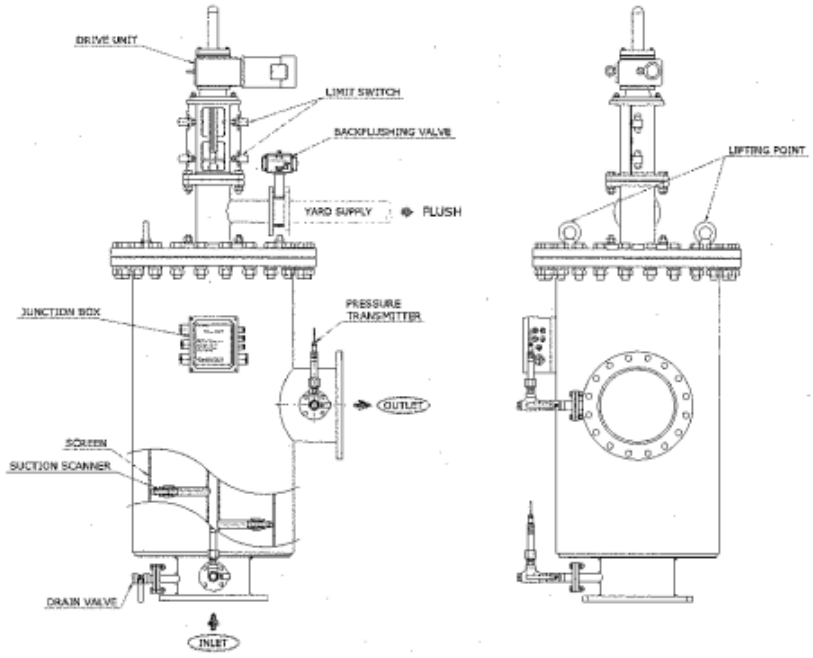
4.1.1 Inspection

(1) General

In order to check the proper operation of the Filter, simulate a pressure differential signal. This will initiate the self-cleaning cycle: Check that the exhaust valve opens, that the scanner moves forward, and when it reaches limit switch "B" verify that the exhaust valve closes.

Weekly maintenance

- Check that the Filter operates properly, following a general inspection.
- Check that there is grease on the drive shaft, and drive bushing. Add grease if necessary.
- Take care of any leakage from the scanner shaft. If necessary, tighten the sealing nut or replace the sealing ropes.



< Fig. 4.1 Filter 'PF250' Model Configuration >

(2) Maintenance prior to long term cessation of filter operation

The following must be done if the Filter will not operate for more than a month.

- Operate flushing cycle (if possible, with fresh water).
- Disconnect the control board from the power.
- Release pressure from the Filter.
- Grease the drive shaft and the drive bushing.

(3) Maintenance prior to re-operation

- Connect the control board to the mains.
- Check proper operation of the Filter.
- Grease the drive shaft and the drive bushing.
- If necessary change the sealing nut internal O-ring.

 Attention	***IMPORTANT!!*** *1) The drive shaft must be lubricated with heavy-duty, water-resistant grease that will not oxidize.*

4.1.2 Dismantling and Assembling the Filter Components

Prior to opening the Filter it is recommended that a flushing cycle is performed by pressing the "CYCLE RUN" push button.

4.1.3 Fine Screen

(1) Dismantling:

- Close the filter inlet and outlet valves and release the pressure.
- Press the "CYCLE RUN" push button and disconnect the power when the scanner is in the middle of its track (When the limit switch disc is half-way between the two limit switches).

4.2 UV Unit

4.2.1 Cleaning the Quartz Sleeves

The quartz sleeves have to be cleaned on a regular basis. The optimum frequency for doing this depends on the liquid and has to be established on the basis on of hands-in experience working with the system.

If the optional cleaning mechanism is used, cleaning can take place while the system is operating.

*** Chemical Cleaning Method:**

If the quartz sleeves become very dirty, chemicals may be added to the medium to dissolve the deposit.

- Turn off the liquid flow and the main switch of the Control Panel.
- Place appropriate chemicals in the disinfection chamber via an external connection.
- Drain the liquid off via the drain plug. Remember to remove the ventilation plug before draining.
- Rinse the disinfection chamber with the normal liquid medium used in the system, and drain once again via the drain hole.
- Replace the drain and ventilation plugs.

4.2.2 Cleaning the UV Sensor and Quartz Window

The UV sensor measures the efficiency of the UV lamps in combination with the level of contamination of the water. A quartz window on the inside of the disinfection chamber covers the measuring surface of the sensor. Contamination may occur on this window and has a negative effect on the UV measurement.

If the system does not have a built-in cleaning mechanism the quartz window should be cleaned chemically as below.

Warning

1) *Turn off the main switch and the circuit breakers in the control panel!*
2) *Turn off the flow and drain the liquid in the disinfection chamber.*

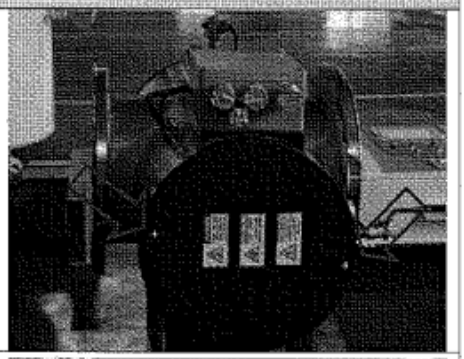
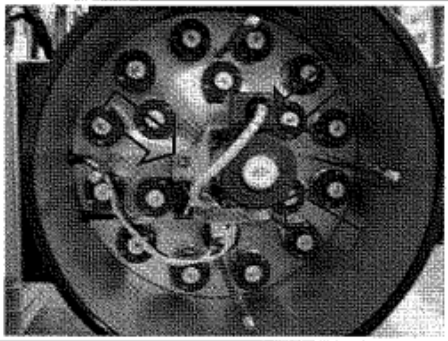
4.2.3 Replacing Lamps and Quartz Sleeves

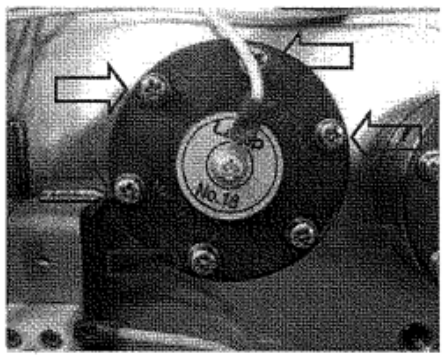
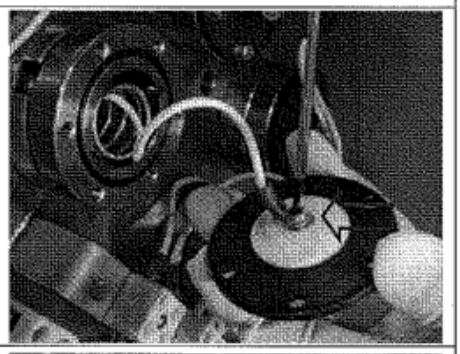
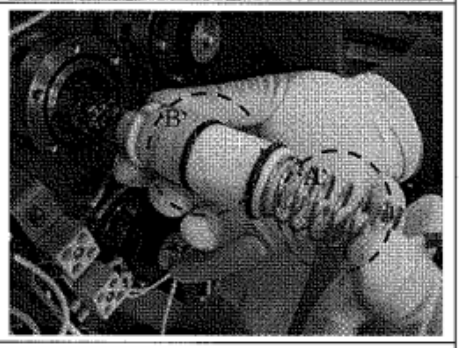
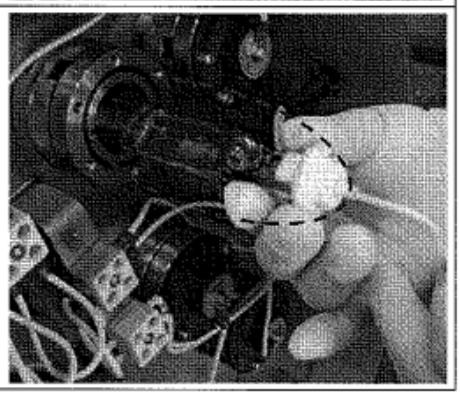
This procedure describes the actions needed to fit initially or replace wire lamps and to clean or replace quartz sleeves.

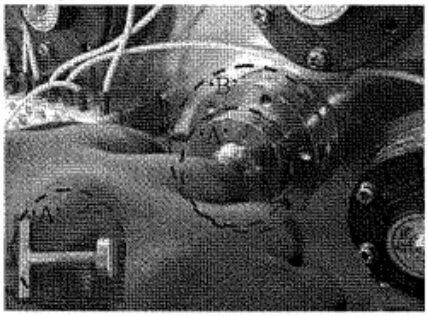
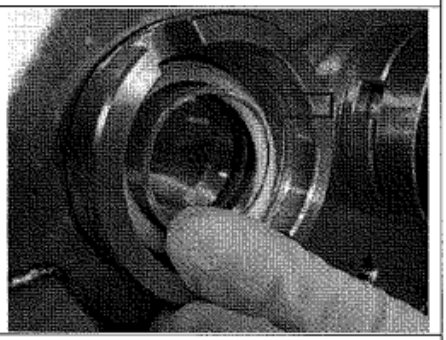
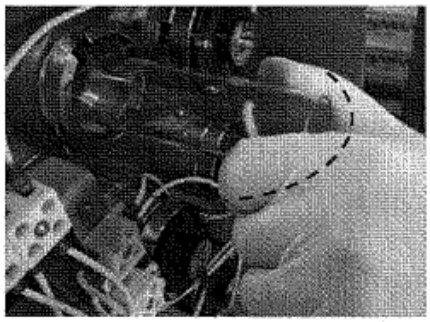
 Warning	*1) Turn off the main switch and disengage the circuit breakers in the control panel!* *2) Turn off the flow and drain the liquid.* *3) Remember that the lamps can be hot!*

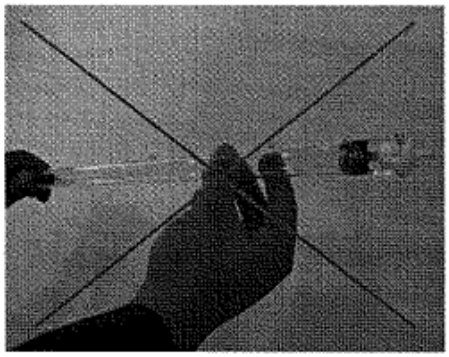
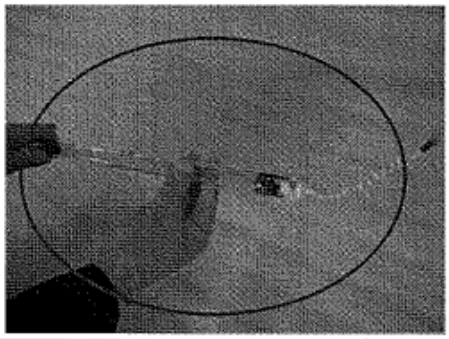
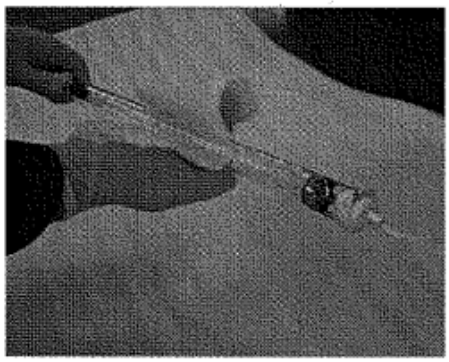
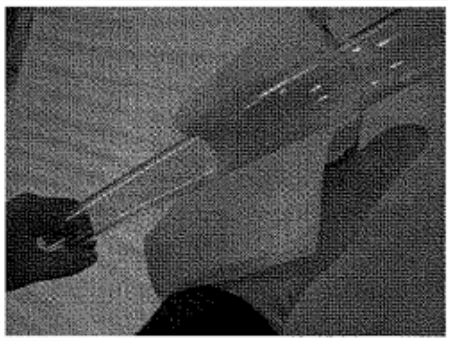
 Attention	*1) Wear clean gloves free of talc powder and grease to avoid damaging the lamps.*

Table 5.2 Replacing Lamps and Quartz Sleeves

STEP	WORKING METHOD	PHOTOGRAPH
1	• Remove the blank cover plate on both sides.	
2	• Remove the three nuts of wiper motor assembly.	

STEP	WORKING METHOD	PHOTOGRAPH
3	• Remove the lamp holder plate (6 x M4 bolts)on both sides	
4	• Loosen the lamp wire on the connector block (both sides).	
5	• Take the spring('A') and Anti vibration stopper out of the quartz sleeve('B').	
6	• Take the old lamp out of the quartz sleeve.	

STEP	WORKING METHOD	PHOTOGRAPH
7	• On both side use the tool('B') to unscrew the isolating T/B body('A') from the chamber end plate.	
8	• Repeat Moving both side quartz sleeve about ten millimeter. • Remove backup ring and O ring	
9	• Remove quartz sleeve.	
10	• New UV lamps are supplied in cardboard packaging.	

STEP	WORKING METHOD	PHOTOGRAPH
11	• Never touch the glass of the lamp with bare hands!	
12	• Wear clean gloves and only hold the lamp by both sides.	
13	• If necessary clean the lamp with a cotton cloth and a little alcohol, but never touch it with bare hands!	
14	• If necessary clean the quartz sleeve with a cotton cloth and a little alcohol, but never touch it with bare hands!	

 Attention	*1) If the lamp located nearest the UV sensor has to be replaced because of a defect, it must be replaced with a lamp that is already being used in the system.* *2) In this way, lamps with differing outputs will least affect the UV measurement.*

 Attention	*1) Used lamps can be returned to PANASIA CO., LTD.* *2) Do not dispose of old lamps as unsorted municipal waste.*

4.2.4 Maintenance of the Automatic Cleaning Mechanism

See below a detailed table of maintenance of the automatic cleaning mechanism

 Warning	*1) Turn off the main switch and disengage the circuit breakers in the control panel!* *2) Turn off the flow and drain the liquid.* *3) Remember that the lamps can be hot!*

 Attention	*1) Wear clean gloves free of talc powder and grease to avoid damaging the lamps.*

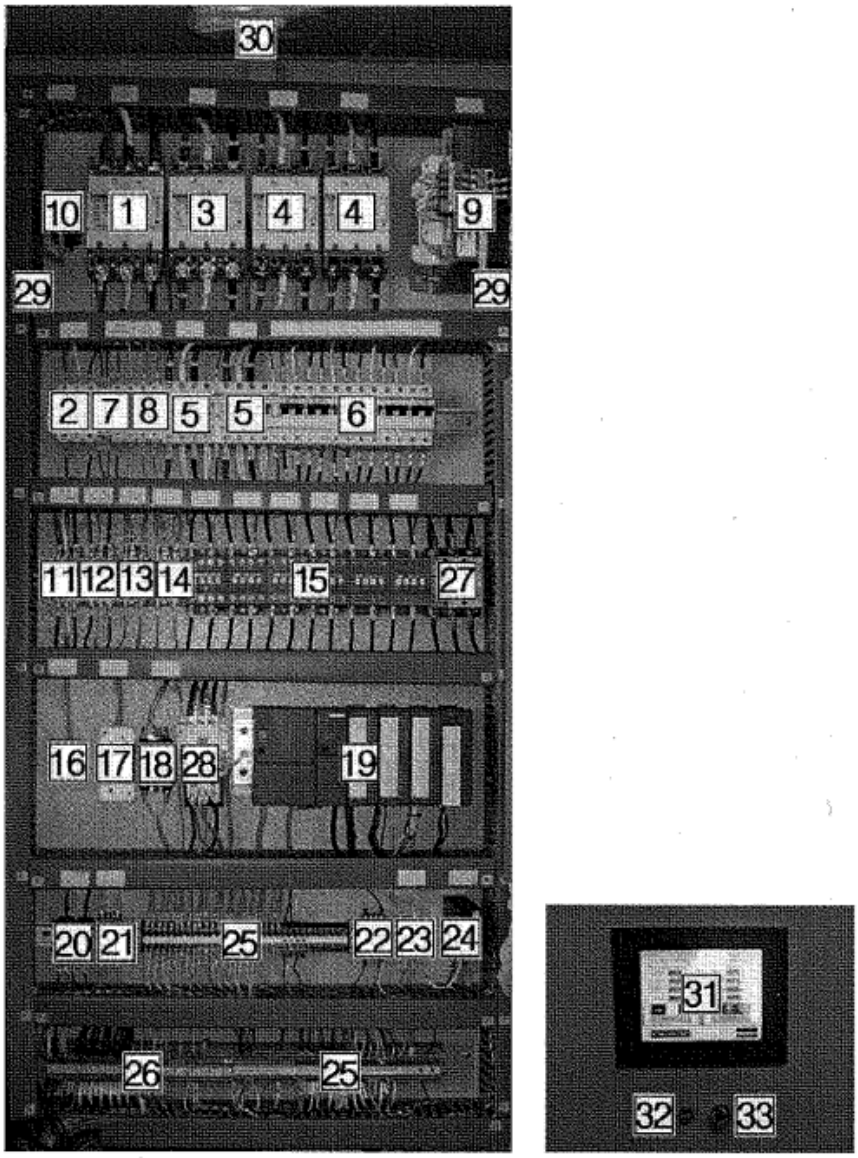
4.2.5 Air fan of the Control Panel

Regularly check and, if necessary, replace the air fan.

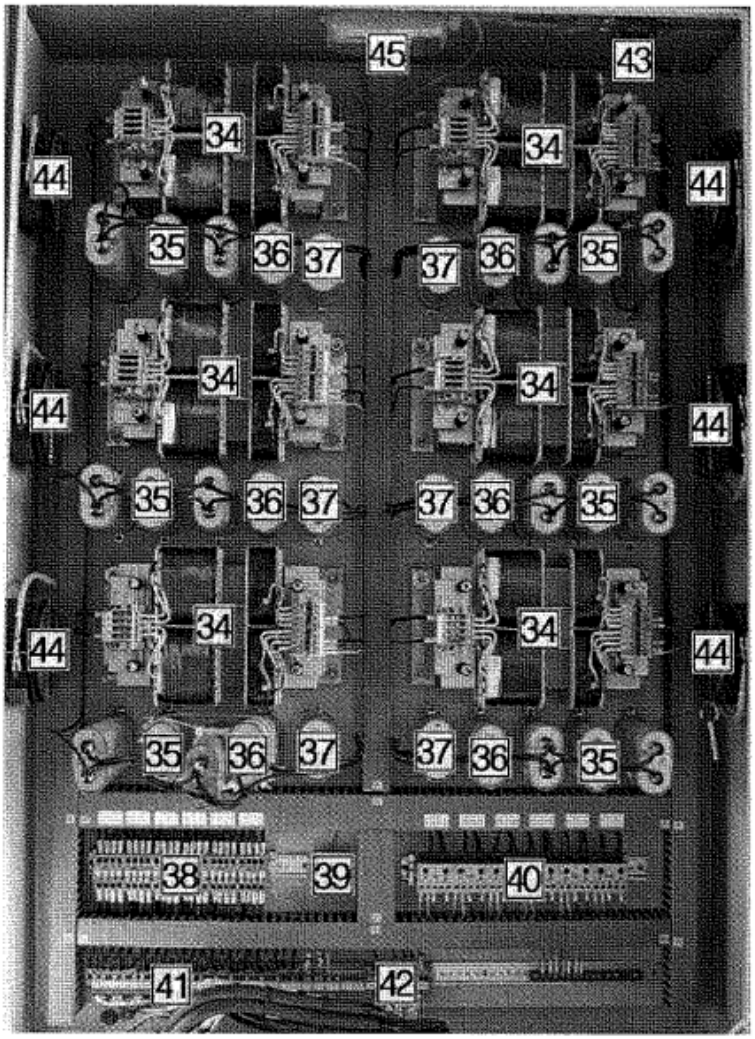
4.2.6 Earth Leakage Circuit Breaker Check

Every month check the Earth Leakage Circuit Breaker (ELCB) to make sure it is working properly by pressing the test button. The system should shut-down immediately.

4.3 Control Panel Part Name and Function



< Fig. 4.2 Control Panel Components >



< Fig. 4.3 Electric Ballast Panel Components >

① CB00: As the main circuit breaker, regulates power for the entire Monitoring System.

② CB10: Regulates power for the Filter System.

③ CB20: Regulates power for the UV Disinfection System.

④ CB21~22: Regulates power for the UV Disinfection System (Auxiliary).

⑤ ELCB1~2: A device to stop the UV System under any abnormal condition by detecting a leakage current, which could be generated in operating an UV Lamp, and each of them controls 6 UV Lamps.

⑥ CB23~28: Regulates power for the UV Lamp, and each of them controls 2 UV Lamps.

⑦ CB30: Regulates power for control circuit at the inlet of transformer (TX7).

⑧ CB31: Regulates power for control circuit like PLC, etc.

⑨ TX7: A transformer to supply power to instruments that are controlled by PLC or 220VAC power (380V//220/24VAC).

⑩ CP: As a surge protector, protects control circuits and driving circuits from switching surges, which are generated at times of controlling the main circuit breaker.

⑪ MCFF: A forward-turn electronic switch of three-phase Motor used for filter flushing.

⑫ MCFR: A reverse-turn electronic switch of three-phase Motor used for filter flushing.

⑬ MCUF: A forward-turn electronic switch of a single-phase motor used in UV Lamp cleaning.

⑭ MCUR: A reverse-turn electronic switch of a single-phase motor used in UV Lamp cleaning.

⑮ MC23~28: Electronic switches for operation control of UV Lamps; each of them controls 2 UV Lamps.

⑯ TS1: A switch to turn on the fluorescent lamp at the control panel.

⑰ PO: An outlet to supply 220V power to outside equipment, etc.

⑱ NF1: A noise filter to stabilize power that is supplied to the power supply of PLC.

⑲ PLC: A controller for the entire monitoring system, and from the left, it is composed of Power Supply, CPU, Digital Input (DI), Digital Output (DO), Analog Input (AI) and Analog Output (AO) Modules.

⑳ EOCR1: A device to stop motor and system under any abnormal condition by detecting overloads of motor; it takes charge of motor of the Filter System.

㉑ AUX1: An electronic relay to regulate solenoid valve used for the Filter System.

㉒ AUX2: An electronic relay to regulate solenoid valve used for the UV Disinfection System.

㉓ NF2: A noise filter to stabilize power that is supplied to SMPS1.

㉔ SMPS1: A power supply used to supply 24VDC to DC control circuits.

㉕ TB2~3: Input/output terminal blocks for cables or wires that are connected to DC power circuit or DC control circuit and various transmitters/sensors.

㉖ TB1: An input/output terminal block for cables or wires that are connected to the main circuit breaker, AC power circuit or AC control circuit.

㉗ CB40: Regulates power for the Filter Back-Flushing System.

㉘ MC13: An electronic switch for operation control of Back-Flushing pump.

㉙ FAN1~2: Cooling fans that discharge the internal air of control panel to outside.

㉚ FL1: A fluorescent lamp for working at the control panel.

㉛ MONITORING UNIT: A graphic panel with touch screen functions for control and monitoring.

㉜ BZ/AL: An alarm device when there is any abnormality in the monitoring system.

㉝ EMG: An emergency switch to shut-down the system manually at times of emergency.

㉞ TX1~6: Electric ballasts for discharging lamps to operate UV Lamps; and each of them controls 2 UV Lamps.

㉟ C1~18: Capacitors for operation of UV Lamps; gets connected to the secondary of electric ballast, and there are three for each ballast.

㊱ C19~24: Capacitors for power control of UV Lamps (Step 1; 88% of Max. power)

㊲ C25~30: Capacitors for power control of UV Lamps (Step 2; 72% of Max. power).

㊳ MC7~12: Electronic switches for power control of UV Lamps.

㊴ TS2: A switch to turn on the fluorescent lamp at the electric ballast panel.

㊵ EUCR1~6: A device to stop the UV System under any abnormal condition by detecting an under current, which could be generated in operating an UV Lamp, and each of them controls 2 UV Lamps.

㊶ TB4: An input/output terminal block for cables or wires that are connected to the electric ballast, AC power circuit or AC control circuit.

㊷ TB5: An input/output terminal block for cables or wires that are connected to DC power circuit or DC control circuit.

㊸ PT: A sensor for detecting temperature of internal ballast panel.

㊹ FAN3~8: Cooling fans that discharge the internal air of electric ballast panel to outside.

㊺ FL2: A fluorescent lamp for working at the electric ballast panel.