

出國報告（出國類別：考察）

智慧航安監控船舶「航港 1 號」主機廠試 考察報告

服務機關：交通部航港局

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派赴國家/地區：丹麥/斐特烈港

出國期間：112 年 2 月 12 日至 112 年 2 月 18 日

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關 鍵 詞：智慧航安監控船舶「航港1號」主機廠試

內容摘要：

交通部航港局辦理「智慧航安監控船舶建造案」採購案，委由中信造船股份有限公司（下稱中信）進行承造，智慧航安監控船舶於111年8月31日開工，同年12月1日安放龍骨，並預定於113年3月交船，經中信通知，主機於112年2月在丹麥斐特烈港MAN柴油機檢驗廠進行廠試，考量主機屬船舶重要裝備，爰由船東、智慧航安監控船舶監造廠商及本船入級之驗船機構赴丹麥參與廠試，經確認所有廠試程序及測試結果均符合「智慧航安監控船舶建造案」採購案規範書以及驗船機構規定要求。

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壹、考察目的

交通部航港局為延伸海上公權力，規劃建造具衛星通訊寬頻網路資訊系統之智慧航安監控船舶如圖1（船名為「航港1號」），依航路標識條例蒐證離岸風場海域違規事項，增強應對海上突發航安違章處理，善盡國際公約及離岸風場航行安全管理之責任，以及通報反應風場海域內緊急海難事件，回傳事故現場資訊供應變中心瞭解現場情況，以利其進行相關決策，加速海難事件的應變能力，並掌握海難殘骸移除或污染處置作業之進度。

「智慧航安監控船舶建造計畫」於109年7月6日奉行政院核定同意辦理，設計圖說、建造規範等文件於110年10月22日完成，「智慧航安監控船舶建造案」採購案於111年4月28日決標，由中信得標，採購金額為2億5,000萬元，查智慧航安監控船舶（下稱航港1號）於111年8月31日開工，同年12月1日安放龍骨，後續中信於111年12月8日通知(如附件1、附件2、附件3)，航港1號主機將於112年2月14日至16日於丹麥檢驗廠進行廠試，考量主機屬船舶極重要裝備，其性能將影響船舶速度及動力，爰由交通部航港局及航港1號規劃、設計、監造廠商「財團法人船舶暨海洋產業研發中心」（下稱船舶中心）與航港1號入級之驗船機構「財團法人中國驗船中心」（下稱CR）派員赴丹麥參與廠試。



圖 1.航港 1 號示意圖

貳、行程

日期	主要行程
2月12日	由桃園機場搭機前往荷蘭阿姆斯特丹史基浦轉機
2月13日	由荷蘭阿姆斯特丹史基浦機場搭機前往丹麥奧爾堡機場 搭乘火車轉巴士前往斐特烈港
2月14日	第一臺主機廠試(FAT)
2月15日	參觀MAN工廠同型柴油機組裝產線
2月16日	第二臺主機廠試(FAT)
2月17日	搭乘巴士前往丹麥奧爾堡機場 由丹麥奧爾堡機場搭機前往荷蘭阿姆斯特丹史基浦機場
2月18日	由荷蘭阿姆斯特丹史基浦機場搭機前往桃園機場
2月19日	抵達桃園機場

參、考察內容

一、背景

鑒於航港 1 號任務性質，多為監控離岸風場船舶有無確實遵守彰化風場航道航行指南，以及巡視風場航路標識運作情形，另臺灣周遭海域發生海難時，提供現場影像及資訊給應變中心瞭解現場情況，故規劃船舶主要尺寸(如表 1)在試航狀況下船速不小於 21 節，並按照 110 年 9 月 8 日委託臺灣大學船模水槽實驗室進行之船模試驗¹結果，及考量風力 3 級海況、10%航海餘裕與 12%附屬物阻力推估，航港 1 號船速 21 節時，於試航船況預估所需總馬力約為 3,553.6 kW(如表 2)，遂要求本船採 2 部主機配置，每部額定最大輸出馬力不得小於 2,000 kW。

表 1.航港 1 號主要尺寸

全長(不包括碰墊)	約 40.0m
模寬	約 7.8m
最大吃水(含附屬物)	超過 2.7m
最大船速(試航狀況下)	不小於 21 節
巡航距離(15 節)	不小於 1,300 浬

表 2.航港 1 號於試航船況下，船速與主機馬力預估結果

Vs(節)	EHP(kW)	η_o	η_H	η_R	BHP (kW)
7	39.2	0.6563	0.992	0.992	63.2
10	138.1	0.6454	0.991	0.992	226.6
13	366.2	0.6305	0.991	0.992	615.4
15	651.6	0.6164	0.990	0.992	1120.4
17	1137.7	0.5963	0.990	0.992	2022.4
19	1577.5	0.5972	0.990	0.992	2800.5
21	2021.6	0.6032	0.990	0.992	3553.6
23	2440.5	0.6125	0.990	0.992	4225.8
25	2872.6	0.6215	0.990	0.992	4902.4

*符號說明：

η_o ：螺槳單獨試驗中的推進效率

η_H ：船殼效率

η_R ：相對轉動效率

η_{shaft} ：軸效率=0.98

η_{gear} ：減速機效率=0.98

BHP：制動馬力

EHP：有效馬力

¹ 註：本船之試航船況須在空船重量加上 50%的載重量之情況下實施，吃水 1.87 米。

規劃航港 1 號主機及主機廠試相關規範如下：

(一)主機規範(摘自「智慧航安監控船舶建造案」規範書 4.1.3.1. 輪機主要裝備表，如表 3)：

表 3.航港 1 號主機規格

設備名稱	數量	規格
主機	2	<p>型式: V 型、單轉向四行程、排氣渦輪增壓、海水冷卻、缸套為淡水冷卻、船用柴油機、濕式排煙，免維護式蓄電瓶啟動，附彈性底座及彈性軸聯結器。</p> <p>最大輸出：在空氣 45°C，海水溫度 32°C 情況下，每部最大輸出 不低於 2,000 kW。</p> <p>轉速：1,600~2,100 rpm。</p> <p>燃油：船用輕柴油。</p> <p>引擎排煙須符合 IMO Tier II 標準。</p>

(二)主機廠試(摘自「智慧航安監控船舶建造案」規範書 4.1.4.1.製造廠廠試)：

主機在製造廠(Manufacturer's Shop)或船東認可場所中完成下列項目之測試，並檢附廠試紀錄：

1.主機

(1)運轉測試 (含燃油消耗率之量測與紀錄)：柴油機各負載馬力運轉測試時間如表 4 所示。

表 4.主機運轉測試時間

最大馬力測試	25%	50%	75%	85%	100%
運轉時間	1/2 hr	1/2 hr	1/2 hr	1/2 hr	2 hr

(2)安全保護裝置測試 (Safety Device Test)

(3)緊急跳脫測試 (Emergency Trip Device Test)

(4)調速器測試 (Governor Test)

(5)啟動測試 (Starting Test)

(6)最低轉速測試(Minimum Speed Test)

(7)噪音強度測試² (ABN Measurement)

(8)馬力負荷限制測試(Governor Control Line Test)

註：廠試後，主機排煙排放符合 IMO MARPOL Tier II 標準之合格證書，應提供給參與測試之船東代表確認。

經考量規範要求及調查市場供貨狀況，航港 1 號決定採用 MAN 12V175D-MM 型柴油機，中信通知，廠試日期為 112 年 2 月 14 日至 2 月 16 日，由交通部航港局劉嘉洪組長、張瀨之技士、船舶中心謝銘信副處長及 CR 趙邑驗船師赴丹麥參與廠試。

二、廠試

(一)廠試前會議

為確保廠試過程順利，航港局與船舶中心於 112 年 2 月 8 日召開主機廠試前視訊會議(如圖 2、圖 3)，請船舶中心說明規範書要求、廠試程序書審查情形及測試項目內容說明，規範書要求已於前開背景章節敘明，主機廠家資料表如表 5，廠試程序書審查情形及測試項目內容說明如下：



圖 2 及圖 3.廠試前會議

表 5. 主機廠家資料表

廠牌及型號	MAN 12V175D
序號	8351487、8351488
數量	2 部
最大輸出馬力 (kW)	2,220
轉速 (rpm)	1,900
燃油消耗率 (g/kWh)	195.0
排煙標準	IMO Tier II
起動方式	電瓶起動

² 噪音強度測試僅執行首臺主機量測，並須記錄量測值

1.廠試程序書審查情形

(1)Information about shop test, Output [kW]: MCR1 2,200 kW , 應修正為 2,220 kW 。

廠家(MAN)回復：will update while FAT test.

(2)Load Test (依船舶規範書，如表 4)：

A.運轉測試期間，需執行燃油消耗率之量測與記錄。

B.100%負載測試，主機噪音需低於 110 dB(A)以下。應先提供測試方式及標準(僅執行首臺主機)。

廠家回復：

A.Will record while FAT.

B.Provide reference record.

(3)安全保護裝置測試 (Safety Device Test) 須加入下列功能測試：

A.緊急跳脫功能, Control of EMP function

B.互鎖保護功能, Control of interlock function

C.燃油洩漏警報, Fuel system leakage alarm

D.高溫冷卻水膨脹櫃低水位警報, HTCW Expansion Tank low level alarm

E.冷卻海水低壓警報, Sea water low pressure alarm

F.排煙高溫警報須包含各缸排煙

G.啟動電瓶低電壓警報, Battery low voltage alarm

廠家回復：

A.test while FAT via put emergency button.

B.test on board.

C.test on board by break the switch

D.test on board.

E.test on board.

F.test on board.

G.yard monitors the batteries.

(4)負載限制測試(Load limit test)程序書說明“**The measurements will not be in the FAT report**”。依規範廠試應執行此項目，並提供測試結果。

廠家回復：will provide separately from FAT report.

(5)廠試前應檢送文件：Before shop trial, MAN should submit following documents to Owner's attendant:

A.The Fuel oil analysis (including F.O. density, low calorific value) which is used for the shop test should be submitted to Owner's attendant for review.

B.The calibration sheet for each test-equipment should be submitted to Owner's attendant for review

廠家回復：

A.The FO sampling will be taken while FAT and need to send to lab as third-party to do analysis. This normally will take one to three months, it depends on the lab busy or not.

B.The calibration report will go with the FAT final report only not for review but MAN guarantee all the measuring tools are in the valid condition for testbed.

2.測試項目內容

- (1)外觀及規格檢驗：檢查主機銘牌所述之機型、型號及額定容量是否有誤。
- (2)啟動測試：依 CR 鋼船建造與入級規範連續啟動 3 次，以確認本機啟動及停止功能。
- (3)安全保護裝置測試：檢視各項溫度、壓力等各項安全保護裝置及監控儀表的警報、顯示功能及停俾或減俾反應動作。
- (4)緊急跳脫測試：確認緊急停機按鈕之停機功能。
- (5)負載運轉測試(含燃油消耗率之量測與記錄)：分別進行 25%、50%、75%、85%、100%的負載運轉測試，測試期間同步觀測並記錄主機各項顯示數據及燃油耗油量計測。
- (6)調速器測試：主機在全負載運轉下瞬間卸除負載，瞬間轉速提高，隨即回復穩定的轉速，確認最高轉速不超過額定速率之 15%。(CR 規範 2022,第 IV 篇第 3 章 3.4.8)
- (7)馬力負荷限制測試：依據主機馬力特性曲線挑選定點，確認對應設定之負載限制曲線的正确性。
- (8)最低轉速測試：主機處於負載的情況下調整引擎至最低轉速 600rpm，觀測主機運轉的穩定性。
- (9)噪音量測：於 100%負載下及指定位置進行噪音計量，不大於 110 dB(A)。
- (10)運轉後開放檢查：停機後，拆卸下滑油過濾器檢查濾網內的情況、拆卸曲軸箱及進排氣閥外蓋檢查內部有無異狀。

(二)主機廠試：

1.測試項目(如附件 4、附件 5)

- (1)外觀及尺寸規格檢驗 (Visual & Dimension Inspection)
- (2)啟動測試 (Starting Test)
- (3)安全保護裝置測試 (Safety Device Test)
- (4)啟動互鎖測試 (Start Inter-Locking Test)：確認轉俾機之啟動互鎖功能。
- (5)負載運轉測試 (Load Running Test)
- (6)燃油消耗量計測 (Fuel Oil Consumption Measurement)
- (7)噪音強度測試 (ABN Measurement)
- (8)滑油過濾器濾芯清潔檢查 (L.O. Filter opened for cleaning inspection)
- (9)調速器測試 (Governor Test)
- (10)馬力負荷限制測試(Governor Control Line Test)
- (11)最低轉速測試 (Minimum Speed Test)
- (12)運轉後開放檢驗 (Overhaul Inspection)

2.測試程序



圖 4.第一臺主機廠試運轉

- (1)07:30~08:00 廠試前確認會議(如圖 4)
- (2)08:00~08:15 外觀及尺寸規格檢驗
- (3)08:15~08:20 啟動測試
- (4)08:20~09:30 安全保護裝置測試
- (5)08:40~08:45 啟動互鎖測試
- (6)09:34~13:51 負載運轉測試(含燃油消耗量及噪音強度計測)

(2)啟動測試：符合，如圖 6。



圖 6. 啟動測試情形

(3)安全保護裝置測試：符合，如圖 7、圖 8。



圖 7、圖 8.滑油過濾器壓差警報測試

(4)啟動互鎖測試：合格，如圖 9、圖 10。



圖 9、圖 10.啟動互鎖測試

(5)緊急跳脫測試：符合，如圖 11、圖 12。

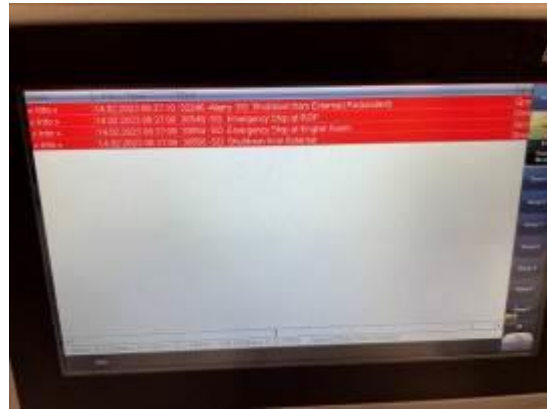


圖 11、圖 12.緊急跳脫測試

(6)負載運轉測試(含燃油消耗率之量測與記錄)：本機各項負載運轉正常、性能穩定，如圖 13、圖 14。



圖 13、圖 14. 主機 75%及 85%負載運轉測試

(7)滑油過濾器濾芯清潔檢查：過濾器濾芯無異狀，如圖 15。



圖 15. 滑油過濾器濾芯

(8)調速器測試：滿載 1,900rpm 情況下卸除負載，最高升到 1,994 rpm，最終穩定於 1,900 rpm，瞬間轉速變動率為 $4.9\% (1,994-1,900) \div 1,900=4.9\%$ ，屬於可接受範圍，如圖 16。



圖 16. 調速器測試引擎轉速結果

(9)馬力負荷限制測試：合格，如圖 17、圖 18。



圖.17、圖 18.1500rpm 測試結果、1800rpm 測試結果

(10)最低轉速測試：合格。

(11)噪音量測：量測結果如附件 7，量測值為 108dB(A)，合格，如圖 19、圖 20。



圖.19、圖 20.噪音量測

(12)運轉後開放檢查：拆卸 B5 曲軸箱外蓋及 A5 進排氣閥外蓋檢查，無異狀，如圖 21、圖 22、圖 23。



圖.21、圖 22、圖 23. 運轉後檢查主機有無異狀

有關 112 年 2 月 16 日第二臺主機廠試結果如附件 8，說明如下：

(1)外觀及規格檢驗：廠牌、型號、序號及額定容量均符合，如圖 24。



圖 24. 第二臺主機銘牌

(2)啟動測試：符合，如圖 25。



圖 25. 啟動測試情形

(1)啟動互鎖測試：合格，如圖 26、圖 27。

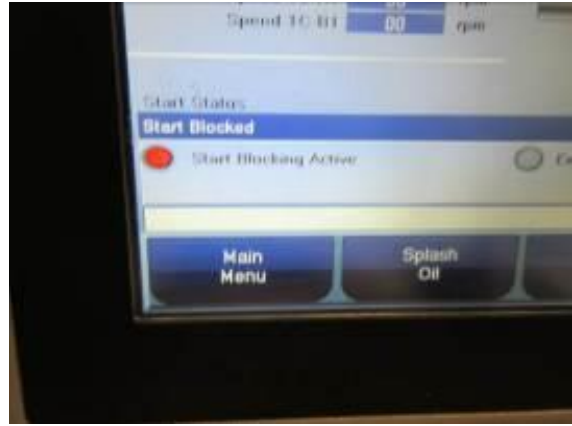


圖 26、圖 27.啟動互鎖測試

(2)安全保護裝置測試：符合，如圖 28、圖 29。



圖 28、圖 29.超速測試、滑油低位警報測試

(3)緊急跳脫測試：符合，如圖 30、圖 31。



圖 30、圖 31.緊急跳脫測試

(4)運轉測試(含燃油消耗率之量測與記錄)：本機各項負載運轉正常、性能穩定，如圖 32、圖 33。



圖 32、圖 33. 25%最大馬力測試結果、50%最大馬力測試結果

(5)滑油過濾器濾芯清潔檢查：滑油過濾器拆開檢視後，發現有金屬碎屑，要求廠家需進行內視鏡檢查，經檢查後無異狀，如圖 34。



圖 34. 滑油過濾器濾芯

(6)調速器測試：滿載 1,900rpm 情況下卸除負載，最高升到 1,958rpm，最終穩定於 1,900 rpm，瞬間轉速變動率為 $3.05\% (1,958-1,900) \div 1,900=3.05\%$ ，屬於可接受範圍，如圖 35。

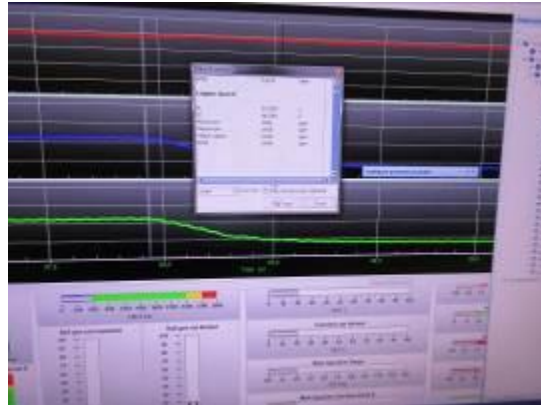


圖 35. 引擎轉速結果

(7)馬力負荷限制測試：合格，如圖 36、圖 37。



圖 36、圖 37.主機於 900rpm 及 1,900rpm 測試結果

(8)最低轉速測試：合格，如圖 38。



圖 38. 最低轉速測試結果

(9)運轉後開放檢查：拆卸 B5 曲軸箱外蓋及 A4 進排氣閥外蓋進行內部檢查，無異狀，如圖 39、圖 40、圖 41。



圖 39、圖 40、圖 41.運轉後檢查主機狀況

肆、心得及建議

一、心得

航港 1 號為交通部航港局第一艘自行主辦規劃、設計、建造及監造自有船舶，為了解機器相關廠試流程及應注意事項，確保主機性能正常並如期如質順利抵達中信造船廠，爰本局與船舶中心於廠試前召開說明會議，請船舶中心說明廠試流程及測試項目。

除參與廠試，丹麥 MAN 檢驗廠商尚有帶領本局、船舶中心、CR 及 MAN 德國設計師參觀廠區生產線及機器，為確保進入廠區內人員安全，丹麥 MAN 檢驗廠區於進入前，需配戴安全帽、穿著訪客背心及鋼頭工作鞋，廠區內逃生路線、滅火器、警示牌等安全標示清楚明瞭，廠區內地板乾淨，未見雜物、油漬、垃圾等情形，備品及物料建立編碼機制，名稱標示清楚，擺放整齊，生產線動線順暢，於廠區內行走時，需行走在劃設行人區域內，以確保行人安全。

本次航港 1 號主機廠試，深深體會在丹麥外郊的斐特烈港地區人口雖然不多，但卻是一個高度國際化的城市，僅僅製造 MAN 175D 的種類機型，可以發展成一套精準的製程、量測設備及程序，是本次赴丹麥參加廠試的另一種體驗，很值得學習。

本次廠試均按規範內規定項目執行，主機負載運轉性能及各項安全裝置功能測試的結果正常，符合規範要求，廠試後提供儀器校正資料如附件 9。

二、建議

- (一)主機為船舶重要之設備，對船舶性能及航行安全至關重要，如何選擇安全、可靠、性能優異的主機需要了解柴油機的專長，此項學能又與船舶檢查員(FSI)及港口國管制檢查員(PSCO)的業務相關，交通部航港局應持續訓練與管考 FSI/PSCO 對於船舶輪機的專業知識。
- (二)出國前的準備工作及規劃事宜極為重要，關係出國執行業務的成績，本次在出國規劃、行前準備聯繫上應有充分落實，並召開行前準備及業務會議蒐集資料，得以順利完成任務。

伍、附件

附件 1.主機廠試船廠請驗通知

APPLICATION

(檢驗申請書)

Date : 112.01.13

To : SHIP AND OCEAN INDUSTRIES R&D CENTER

(致：財團法人船舶暨海洋產業研發中心)

Tel : 台北(02)2808-5899 , 高雄(07)223-9822

Fax : 台北(02)2808-5866 , 高雄(07) 224-8247

Item of Inspection & Test :

(檢驗與測試項目)

J412 交通部航港局智慧航安監控船舶主機廠試日期**更改**如附件,
敬請派員蒞臨指導。(詳細請參考附件)

後補：1.邀請函、2.測試程序書、3.日程表

Date & Time of Inspection :

(檢驗日期與時間)

112 年 02 月 **14** 日 ~ 112 年 02 月 **16** 日

Place of Inspection :

(檢驗地點)

丹麥

Telephone :

(電話)

Applicant :

(申請廠商)

中信造船股份有限公司

Incharge Staff :

(主辦人) 轉通知 林碧霞/品保部

Telephone :

(電話) 07-579000 轉 276

Faxmile :

(傳真) 07-5711721

附件 2.主機廠試廠家邀請函

MAN Energy Solutions



Invitation Letter

Dear Hsieh, Ming-Hsin,

We would like to invite you to visit our testbed in FRH Demark for the project, MOTC Smart Ship, engines FAT (Factory Acceptance Test). The date will be conducted in 14th Feb 2023 and 16th Feb 2023.

The attendance numbers of people is limited with 3 (three) person due to COVID-19, in case you might have more people to attend, please let us know in advance.

The address is below:

MAN Energy Solutions
MAN PrimeServ Denmark
Niels Juels Vej 15
9900 Frederikshavn

Contact person is Mr. Kevin Hsu in case you have any query; M +886 905 050 397;
kevin.hsu@man-es.com

Yours faithfully
MAN Energy Solutions Taiwan Ltd.

A handwritten signature in black ink, appearing to read "Adam Green".

Adam Green
Managing Director

A handwritten signature in black ink, appearing to read "Kevin Hsu".

Kevin Hsu
Sales Manager



附件 3. 廠商通知廠試行程安排

MAN Energy Solutions



Information about shop test

FRH, the 14-02-2023

FAT date: 14-02-2023

Testbed No. 3

Meetingroom no. _____
TCF

Customer: MOTC Hull J412
Classification society: LR+CR
Emission-Certification: Member engine IMO Tier II

Engine type: 12V175D-MM Engine no.: 8351487
Output [kW]: MCR1 2220 Speed [rpm]: 1900

Application: Marine main engine Fuel: MGO

Person in charge: Mr. J. Nørgaard Phone: 4662

Load points:

No.	estimated time	Output		Speed rpm	Remarks
		%	kW		
1	08:20	Warming up engine			
2	08:30	Test of safety system. See point 3 and 4 on page 2.			
3	09:15	Start Load test/Run in (exhaust back pressure @100% 50mbar)			
4	09:15	25	555	1197	
5	09:45	50	1110	1508	
6	10:15	75	1665	1726	
7	10:45	85	1887	1800	
8	11:15	90	1998	1834	
9	11:30	100	2220	1900	ABN measurement
10	12:30	100	2220	1900	
11	13:30	110	2442	1961	
12	13:45	Shut down engine for inspection of L.O. filter			
13	14:45	Mounting of new L.O. filters, and start engine again			
14	15:00	Governor test (load throw off 100% --> 0%)			
15	15:15	Load limit test from 600 to 1900rpm			
16	16:15	Idle 600 rpm			
17	16:30	Engine stop			
18	17:00	Inspection of engine			
19	18:00	End			



Information about shop test

FRH, the 16-02-2023

FAT date: 16-02-2023

Testbed No. 3

Meetingroom no. _____

TCF

Customer: MOTC Hull J412

Classification society: LR+CR

Emission-Certification: Member engine IMO Tier II

Engine type: 12V175D-MM Engine no.: 8351488

Output [kW]: MCR1 2220 Speed [rpm]: 1900

Application: Marine main engine Fuel: MGO

Person in charge: Mr. J. Nørgaard Phone: 4662

Load points:

No.	estimated time	Output		Speed rpm	Remarks
		%	kW		
1	08:20	Warming up engine			
2	08:30	Test of safety system. See point 3 and 4 on page 2.			
3	09:15	Start Load test/Run in (exhaust back pressure @100% 50mbar)			
4	09:15	25	555	1197	
5	09:45	50	1110	1508	
6	10:15	75	1665	1726	
7	10:45	85	1887	1800	
8	11:15	90	1998	1834	
9	11:30	100	2220	1900	
10	12:30	100	2220	1900	
11	13:30	110	2442	1961	
12	13:45	Shut down engine for inspection of L.O. filter			
13	14:45	Mounting of new L.O. filters, and start engine again			
14	15:00	Governor test (load throw off 100% --> 0%)			
15	15:15	Load limit test from 600 to 1900rpm			
16	16:15	Idle 600 rpm			
17	16:30	Engine stop			
18	17:00	Inspection of engine			
19	18:00	End			

附件 4.第一臺主機廠試測試程序書

MAN Energy Solutions



1 Load Tests

The engine is started at the time indicated in the program.

The load will be increased to the percentage and at the time indicated in the schedule without any announcement.

For each step all relevant data for the engine will be recorded when the condition is constant.

Exhaust back pressure @ 100% 50mbar.

ABN measurement at 100% load.

The measurements will be taken 1m from the engine, at several locations on the engine.

Measurements will only be taken at 100% load.

02 Governor Test

The governor test is carried out to demonstrate the load response of the engine in the following way:

1. The engine is running with full load (100%) of engine power and is suddenly thrown off.

Engine must be within $\pm 15\%$ of nominal speed and steady state after 5 seconds.

Will be recorded and included in the final test protocol.

03 Safety system test: Control of alarm and shutdown

Interlock and EMP:

Test of interlock and EMP function

Over speed:

For demonstration of the over speed a simulation is made in the engine control system by lowering the set point.

Low lube oil pressure:

For demonstration of the "Low lube oil pressure" stop, the lube. Oil is simulated in engine control system with engine operating at idle speed (600rpm)

Low HT cooling water pressure:

For demonstration of the "Low HT cooling water pressure" the cooling water pressure is simulated in engine control system with engine operating at idle speed (600rpm)

Low HT cooling water High temperature:

For demonstration of the "Low HT cooling water temperature" the cooling water temperature is simulated in engine control system with engine operating at idle speed (600rpm)

Crankcase pressure high:

For demonstration of the "Crankcase pressure high" the crankcase pressure is simulated in engine control system with engine operating at idle speed (600rpm)

Exhaust Gas Temp Cylinder Outlet High:

For demonstration of the "Exhaust gas high temperature" the Exhaust gas temperature is simulated in engine control system with engine operating at idle speed (600rpm)

Charge air high temperature:

For demonstration of the "Charge air high temperature" the Charge air temperature is simulated in engine control system with engine operating at idle speed (600rpm)

Lube oil high temperature:

For demonstration of the "Lube oil high temperature" the Lube oil temperature is simulated in engine control system with engine operating at idle speed (600rpm)

L.O. filter differential pressure:

For demonstration of the "L.O. filter differential pressure" the Valve after the oil differential pressure sensor will be closed. engine operating at idle speed (600rpm)



F.O. filter differential pressure:

For demonstration of the "F.O. filter differential pressure" the plug for the sensor will be removed, and there will be an alarm on high differential pressure. engine operating at idle speed (600rpm)

Fuel leakage:

Demonstration of fuel leakage function. Engine operating at idle speed (600rpm)

04 Test of start/stop function

Local Start:

For demonstration of local start the engine is started from Local Operator Panel (LOP).

Local Stop:

For demonstration of local stop the engine is stopped from Local Operator Panel (LOP).

05 Load limit test

Run the engine at load limit, between 600 and 1900rpm. With 300 rpm interval (600-900-1200-1500-1800-1900 rpm)
(The measurements will not be in the final FAT report)

06 Inspection

Standard engine inspection (High speed Engine): Visual check of rocker arms by removal of one rocker arm cover.
Crankcase cover, by removal of one crankcase cover, no further dismantling of parts.

07 Acceptance Test Protocol

All the records from the different tests and measurements are collected in an acceptance test protocol for the engine.
The preliminary protocol is handed over to the participants after the acceptance test.

附件 5.第二臺主機廠試測試程序書

MAN Energy Solutions



1 Load Tests

The engine is started at the time indicated in the program.

The load will be increased to the percentage and at the time indicated in the schedule without any announcement.

For each step all relevant data for the engine will be recorded when the condition is constant.

Exhaust back pressure @ 100% 50mbar.

02 Governor Test

The governor test is carried out to demonstrate the load response of the engine in the following way:

1. The engine is running with full load (100%) of engine power and is suddenly thrown off.

Engine must be within $\pm 15\%$ of nominal speed and steady state after 5 seconds.

Will be recorded and included in the final test protocol.

03 Safety system test: Control of alarm and shutdown

Interlock and EMP:

Test of interlock and EMP function

Over speed:

For demonstration of the over speed a simulation is made in the engine control system by lowering the set point.

Low lube oil pressure:

For demonstration of the "Low lube oil pressure" stop, the lube. Oil is simulated in engine control system with engine operating at idle speed (600rpm)

Low HT cooling water pressure:

For demonstration of the "Low HT cooling water pressure" the cooling water pressure is simulated in engine control system with engine operating at idle speed (600rpm)

Low HT cooling water High temperature:

For demonstration of the "Low HT cooling water temperature" the cooling water temperature is simulated in engine control system with engine operating at idle speed (600rpm)

Crankcase pressure high:

For demonstration of the "Crankcase pressure high" the crankcase pressure is simulated in engine control system with engine operating at idle speed (600rpm)

Exhaust Gas Temp Cylinder Outlet High:

For demonstration of the "Exhaust gas high temperature" the Exhaust gas temperature is simulated in engine control system with engine operating at idle speed (600rpm)

Charge air high temperature:

For demonstration of the "Charge air high temperature" the Charge air temperature is simulated in engine control system with engine operating at idle speed (600rpm)

Lube oil high temperature:

For demonstration of the "Lube oil high temperature" the Lube oil temperature is simulated in engine control system with engine operating at idle speed (600rpm)

L.O. filter differential pressure:

For demonstration of the "L.O. filter differential pressure" the Valve after the oil differential pressure sensor will be closed. engine operating at idle speed (600rpm)



F.O. filter differential pressure:

For demonstration of the "F.O. filter differential pressure" the plug for the sensor will be removed, and there will be an alarm on high differential pressure. engine operating at idle speed (600rpm)

Fuel leakage:

Demonstration of fuel leakage function. Engine operating at idle speed (600rpm)

04 Test of start/stop function

Local Start:

For demonstration of local start the engine is started from Local Operator Panel (LOP).

Local Stop:

For demonstration of local stop the engine is stopped from Local Operator Panel (LOP).

05 Load limit test

Run the engine at load limit, between 600 and 1900rpm. With 300 rpm interval (600-900-1200-1500-1800-1900 rpm)
(The measurements will not be in the final FAT report)

06 Inspection

Standard engine inspection (High speed Engine): Visual check of rocker arms by removal of one rocker arm cover.
Crankcase cover, by removal of one crankcase cover, no further dismantling of parts.

07 Acceptance Test Protocol

All the records from the different tests and measurements are collected in an acceptance test protocol for the engine.
The preliminary protocol is handed over to the participants after the acceptance test.



PRELIMINARY

Shop test protocol

Engine type	12V175DMM	Building standard A10
Number of cylinders	12	in vee angle
Bore	175	mm
Stroke	215	mm
Engine number	8351487	
Feature ident	A10-MFAA2C109A	
Engine output	2.220	kW
Engine speed	1.900	rpm
Engine rotation direction	Counter clockwise	
Firing order	A1 - B2 - A2 - B4 - A4 - B6 - A6 - B5 - A5 - B3 - A3 - B1	
Application	4 - stroke Marine main engine FPP: Fixed pitch propeller	

All tests are carried out according to ISO 3046-1, -3 and ISO 15550.

Classification society	LR+CR
Emission-Certification	NOx-Emission according IMO-Regulation 13 revised MARPOL Annex VI 2008 IMO-Tier II-Certification engine group (member)

Emission test cycle E3

Classification Engine	LR: CPN2330045-2 CR: 876-23-015
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Customer	MOTC
Place / Country	Taiwan

Place / Country	Frederikshavn / Denmark
Date	14-02-2023



Engine type 12V175DMM

Engine no. 8351487

Representatives

Name	Company
Søren Sørensen	LR
Rasmus Bang Ingvarsen	MAN Energy Solutions SE
Jonas Nørgaard	MAN Energy Solutions SE
CHAO, YI	CR
HSIEH MING HSIN	Representative of Owner (SOIC)
LIU CHIAHUNG	Owner MOTC

Certification

This is to certify that the shop test for the above mentioned engine has been carried out according to the enclosed recordings and performance data.



Representative of classification society

Søren Sørensen
Søren Sørensen

Representative of classification society

CHAO, YI
CHAO, YI

Representative of MOTC owner

LIU CHIAHUNG
LIU CHIAHUNG

Representative of owner (SOIC)

HSIEH MING HSIN
HSIEH MING HSIN

Representative of MAN Energy Solutions SE

Rasmus Bang Ingvarsen
Rasmus Bang Ingvarsen

Representative of MAN Energy Solutions SE

Jonas Nørgaard
Jonas Nørgaard



Place, date

Frederikshavn, 14-02-2023

measurement-no: 9
FAT_25%

Performance Data



25,1 %

14-02-2023, 09:34

engine type	12V175D-MM	atmospheric pressure	1.030	mbar
engine no.	8351487	ambient temperature	12,7	°C
turbocharger type	TCR12-43052	abs. ambient humidity	4,18	g/kg
turbocharger no.	1342-55/-56	relative humidity	47	%
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40	
testbed no.	3	fuel oil spec.	MGO	
water brake type	Froude F0631	LHV fuel	42.966 kJ/kg	

Power		Fuel	
engine power	557,8 kW	fuel temp. HP pump inlet	29 °C
engine speed	1.196 rpm	fuel press. HP pump inlet	7,5 bar
mean eff. press.	9,0 bar	fuel mass flow 1	112,7 kg/h
		s.f.o.c (42700kJ/kg,ISO)	204,4 g/kWh

Common Rail			
fuel index	42,8	%	
current feed duration A MV	1,2	ms	current feed duration B MV 1,2 ms
current feed timing A MV	4,8	°KW	current feed timing B MV 4,8 °KW

Charge Air			
charge air temp. A	39,8	°C	air temp. compr. inlet B 18,7 °C
			charge air temp. B 39,0 °C
			charge air press. B 580 mbar

Exhaust Gas								
	MV	cyl.	1	2	3	4	5	6
temp. cylinder outlet (A)	396,5 °C	A	367,0	387,0	418,0	405,0	400,0	402,0
temp. cylinder outlet (B)	396,2 °C	B	384,5	391,0	388,0	420,8	401,0	392,0
exh. gas temp. turb inlet A	457,0 °C	exh. gas temp. turb inlet B	461,0 °C					
exh. gas press. turb. outlet A	4 mbar	exh. gas press. turb. outlet B	4 mbar					
TC. speed A	31.540 rpm	TC. speed B	31.470 rpm					
wastegate position A	0 %	wastegate position B	0 %					

Lubricating Oil			
lub. oil press. engine inlet	4,2	bar	
lub. oil temp. engine inlet	84	°C	

Cooling Water		LT	
HT		cw. press. IC LT inlet	0,81 bar
cw. press. engine inlet	0,93 bar	SW	
cw. temp. engine outlet	86,4 °C	sea water press. pump outlet	1,82 bar
		sea water temp. pump inlet	25,7 °C

Bearing											
	MV	No.	supp. CS	1	2	3	4	5	6	7	supp. CCS
main bearing temperature	93,8 °C	°C	88,3	93,2	94,1	94,6	92,6	94,2	93,9	94,0	82,7
splash oil temperature	93,0 °C	°C		93,2	93,1	93,8	92,5	92,2	93,4		



14-02-2023
SKEVXVE

press. crankcase -1 mbar smoke AVL - -

optional values shown as "" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:

measurement-no: 10
FAT_50%

Performance Data



50,2 %

14-02-2023, 10:06

engine type	12V175D-MM	atmospheric pressure	1.030	mbar
engine no.	8351487	ambient temperature	13,6	°C
turbocharger type	TCR12-43052	abs. ambient humidity	4,17	g/kg
turbocharger no.	1342-55/-56	relative humidity	44	%
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40	
testbed no.	3	fuel oil spec.	MGO	
water brake type	Froude F0631	LHV fuel	42.966	kJ/kg

Power		Fuel		
engine power	1.113,5	kW	fuel temp. HP pump inlet	28
engine speed	1.508	rpm	fuel press. HP pump inlet	7,8
mean eff. press.	14,3	bar	fuel mass flow 1	215,5
			s.f.o.c (42700kJ/kg,ISO)	195,8
				g/kWh

Common Rail				
fuel index	61,0	%	current feed duration B MV	1,3
current feed duration A MV	1,3	ms	current feed timing B MV	8,0
current feed timing A MV	8,0	°KW		

Charge Air				
charge air temp. A	36,6	°C	air temp. compr. inlet B	19,9
			charge air temp. B	36,0
			charge air press. B	1.770
				mbar

Exhaust Gas											
	MV		cyl.	1	2	3	4	5	6		
temp. cylinder outlet (A)	412,8	°C	A	387,0	401,0	433,0	424,0	417,1	414,6		
temp. cylinder outlet (B)	409,1	°C	B	402,5	398,0	410,0	430,0	408,0	406,0		
exh. gas temp. turb inlet A	446,0	°C	exh. gas temp. turb inlet B							449,0	°C
exh. gas press. turb. outlet A	19	mbar	exh. gas press. turb. outlet B							19	mbar
TC. speed A	49.720	rpm	TC. speed B							49.700	rpm
wastegate position A	0	%	wastegate position B							0	%

Lubricating Oil				
lub. oil press. engine inlet	4,7	bar		
lub. oil temp. engine inlet	84	°C		

Cooling Water				
			LT	
HT			cw. press. IC LT inlet	1,17
HT			SW	
cw. press. engine inlet	1,18	bar	sea water press. pump outlet	2,49
cw. temp. engine outlet	86,5	°C	sea water temp. pump inlet	25,4
				°C

Bearing												
	MV		No.	supp. CS	1	2	3	4	5	6	7	supp. CCS
main bearing temperature	99,6	°C	°C	90,1	98,0	100,8	101,6	97,2	100,5	100,5	98,6	84,0
splash oil temperature	96,0	°C	°C		95,3	95,8	97,2	95,6	95,5	96,2		



14-02-2023

SKEVXVE

press. crankcase	-4	mbar	smoke AVL	-	-
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optional values shown as "" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:

measurement-no: 11
FAT_75%

Performance Data



75,2 %

14-02-2023, 10:36

engine type	12V175D-MM	atmospheric pressure	1.031 mbar
engine no.	8351487	ambient temperature	14,4 °C
turbocharger type	TCR12-43052	abs. ambient humidity	4,24 g/kg
turbocharger no.	1342-55/-56	relative humidity	43 %
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40
testbed no.	3	fuel oil spec.	MGO
water brake type	Froude F0631	LHV fuel	42.966 kJ/kg

Power		Fuel	
engine power	1.668,5 kW	fuel temp.HP pump inlet	27 °C
engine speed	1.727 rpm	fuel press.HP pump inlet	7,8 bar
mean eff.press.	18,7 bar	fuel mass flow 1	337,1 kg/h
		s.f.o.c (42700kJ/kg,ISO)	204,3 g/kWh

Common Rail			
fuel index	81,1 %	current feed duration B MV	1,6 ms
current feed duration A MV	1,6 ms	current feed timing B MV	7,3 °KW
current feed timing A MV	7,3 °KW		

Charge Air			
charge air temp. A	38,4 °C	air temp.compr.inlet B	20,1 °C
		charge air temp. B	37,8 °C
		charge air press. B	2.630 mbar

Exhaust Gas			
	MV		
temp. cylinder outlet (A)	505,0 °C	cyl. 1	497,0
temp. cylinder outlet (B)	503,2 °C	2	497,0
		3	517,0
		4	511,0
		5	502,0
		6	506,0
exh.gas temp.turb inlet A	530,0 °C	exh.gas temp.turb inlet B	530,0 °C
exh.gas press.turb.outlet A	42 mbar	exh.gas press.turb.outlet B	42 mbar
TC.speed A	58.450 rpm	TC.speed B	58.380 rpm
wastegate position A	19 %	wastegate position B	19 %

Lubricating Oil			
lub.oil press.engine inlet	4,7 bar		
lub.oil temp.engine inlet	84 °C		

Cooling Water			
		LT	
HT		cw.press.IC LT inlet	1,57 bar
cw.press.engine inlet	1,38 bar	SW	
cw.temp.engine outlet	86,7 °C	sea water press.pump outlet	3,06 bar
		sea water temp.pump inlet	25,2 °C

Bearing			
	MV		
main bearing temperature	104,3 °C	No.	1
splash oil temperature	98,2 °C	supp. CS	91,2
		1	101,8
		2	106,3
		3	107,5
		4	100,7
		5	105,3
		6	105,6
		7	103,4
		supp. CCS	84,7



14-02-2023

SKEVXVE

press.crankcase	-8 mbar	smoke AVL	-
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optional values shown as "" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:

measurement-no: 12
FAT_85%

Performance Data



85,2 %

14-02-2023, 11:08

engine type	12V175D-MM	atmospheric pressure	1.030 mbar
engine no.	8351487	ambient temperature	14,9 °C
turbocharger type	TCR12-43052	abs. ambient humidity	4,27 g/kg
turbocharger no.	1342-55/-56	relative humidity	42 %
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40
testbed no.	3	fuel oil spec.	MGO
water brake type	Froude F0631	LHV fuel	42.966 kJ/kg

Power		Fuel	
engine power	1.890,6 kW	fuel temp.HP pump inlet	25 °C
engine speed	1.802 rpm	fuel press.HP pump inlet	7,8 bar
mean eff.press.	20,3 bar	fuel mass flow 1	379,0 kg/h
		s.f.o.c (42700kJ/kg,ISO)	202,5 g/kWh

Common Rail			
fuel index	88,0 %	current feed duration B MV	1,7 ms
current feed duration A MV	1,7 ms	current feed timing B MV	10,7 °KW
current feed timing A MV	10,7 °KW		

Charge Air			
charge air temp. A	39,1 °C	air temp.compr.inlet B	21,4 °C
		charge air temp. B	38,5 °C
		charge air press. B	2.740 mbar

Exhaust Gas										
	MV		cyl.	1	2	3	4	5	6	
temp. cylinder outlet (A)	535,0 °C	A	527,2	526,0	547,0	540,0	533,0	537,0		
temp. cylinder outlet (B)	533,4 °C	B	530,0	528,0	537,0	543,0	526,6	536,0		
exh.gas temp.turb inlet A	560,0 °C	exh.gas temp.turb inlet B								559,0 °C
exh.gas press.turb.outlet A	48 mbar	exh.gas press.turb.outlet B								48 mbar
TC.speed A	59.970 rpm	TC.speed B								59.830 rpm
wastegate position A	23 %	wastegate position B								23 %

Lubricating Oil			
lub.oil press.engine inlet	4,7 bar		
lub.oil temp.engine inlet	84 °C		

Cooling Water			
		LT	
HT		cw.press.IC LT inlet	1,67 bar
cw.press.engine inlet	1,45 bar	SW	
cw.temp.engine outlet	86,8 °C	sea water press.pump outlet	3,29 bar
		sea water temp.pump inlet	24,9 °C

Bearing											
	MV	No.	supp. CS	1	2	3	4	5	6	7	supp. CCS
main bearing temperature	106,1 °C	°C	91,8	103,1	108,2	109,8	102,0	107,1	107,5	105,2	85,2
splash oil temperature	99,7 °C	°C		97,3	99,7	101,2	99,7	99,4	100,6		



14-02-2023

SKEVXVE

press.crankcase	-8 mbar	smoke AVL	-
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optional values shown as "" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:

measurement-no: 13
FAT_90%

Performance Data



14-02-2023, 11:34

90,2 %

engine type	12V175D-MM	atmospheric pressure	1.030	mbar
engine no.	8351487	ambient temperature	15,6	°C
turbocharger type	TCR12-43052	abs. ambient humidity	4,34	g/kg
turbocharger no.	1342-55/-56	relative humidity	40	%
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40	
testbed no.	3	fuel oil spec.	MGO	
water brake type	Froude F0631	LHV fuel	42.966	kJ/kg

Power		Fuel		
engine power	2.001,6	kW	fuel temp. HP pump inlet	25
engine speed	1.835	rpm	fuel press. HP pump inlet	7,9
mean eff. press.	21,1	bar	fuel mass flow 1	401,0
			s.f.o.c (42700kJ/kg, ISO)	202,3
				g/kWh

Common Rail				
fuel index	91,8	%	current feed duration B MV	1,8
current feed duration A MV	1,8	ms	current feed timing B MV	11,7
current feed timing A MV	11,7	°KW		

Charge Air				
charge air temp. A	39,8	°C	air temp. compr. inlet B	22,1
			charge air temp. B	39,1
			charge air press. B	2.800
				mbar

Exhaust Gas											
		MV	cyl.	1	2	3	4	5	6		
temp. cylinder outlet (A)	551,8	°C	A	543,0	541,7	562,0	558,0	550,0	556,0		
temp. cylinder outlet (B)	548,2	°C	B	543,0	542,0	553,0	557,0	542,0	552,0		
exh. gas temp. turb inlet A	577,0	°C	exh. gas temp. turb inlet B							578,0	°C
exh. gas press. turb. outlet A	49	mbar	exh. gas press. turb. outlet B							49	mbar
TC. speed A	60.830	rpm	TC. speed B							60.670	rpm
wastegate position A	26	%	wastegate position B							25	%

Lubricating Oil				
lub. oil press. engine inlet	4,6	bar		
lub. oil temp. engine inlet	84	°C		

Cooling Water				
			LT	
HT			cw. press. IC LT inlet	1,71
cw. press. engine inlet	1,48	bar	SW	
cw. temp. engine outlet	86,8	°C	sea water press. pump outlet	3,41
			sea water temp. pump inlet	25,1
				°C

Bearing												
		MV	No.	supp. CS	1	2	3	4	5	6	7	supp. CCS
main bearing temperature	106,9	°C	°C	92,1	103,9	109,1	111,0	102,6	107,8	108,3	105,8	85,4
splash oil temperature	100,4	°C	°C		97,5	100,5	102,1	100,6	100,1	101,5		



14-02-2023

SKEVXVE

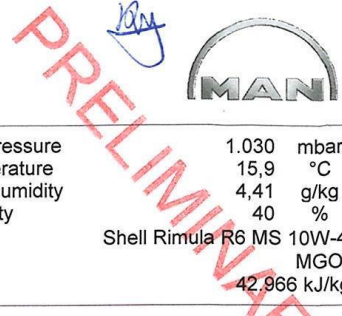
press. crankcase -8 mbar smoke AVL - -

optional values shown as "" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:

measurement-no: 14
FAT_100%-1

Performance Data



100,2 %

14-02-2023, 12:10

engine type	12V175D-MM	atmospheric pressure	1.030 mbar
engine no.	8351487	ambient temperature	15,9 °C
turbocharger type	TCR12-43052	abs. ambient humidity	4,41 g/kg
turbocharger no.	1342-55/-56	relative humidity	40 %
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40
testbed no.	3	fuel oil spec.	MGO
water brake type	Froude F0631	LHV fuel	42.966 kJ/kg

Power		Fuel	
engine power	2.225,2 kW	fuel temp.HP pump inlet	27 °C
engine speed	1.901 rpm	fuel press.HP pump inlet	7,8 bar
mean eff.press.	22,6 bar	fuel mass flow 1	448,2 kg/h
		s.f.o.c (42700kJ/kg,ISO)	203,3 g/kWh

Common Rail			
fuel index	99,2 %		
current feed duration A MV	1,7 ms	current feed duration B MV	1,7 ms
current feed timing A MV	11,7 °KW	current feed timing B MV	11,7 °KW

Charge Air			
charge air temp. A	41,3 °C	air temp.compr.inlet B	22,7 °C
		charge air temp. B	40,7 °C
		charge air press. B	2.895 mbar

Exhaust Gas			
	MV		
temp. cylinder outlet (A)	585,7 °C	cyl. 1	575,9
temp. cylinder outlet (B)	583,2 °C	cyl. 2	580,0
		cyl. 3	597,5
		cyl. 4	592,0
		cyl. 5	581,0
		cyl. 6	588,0
exh.gas temp.turb inlet A	619,0 °C	exh.gas temp.turb inlet B	619,0 °C
exh.gas press.turb.outlet A	53 mbar	exh.gas press.turb.outlet B	53 mbar
TC.speed A	62.310 rpm	TC.speed B	62.060 rpm
wastegate position A	30 %	wastegate position B	30 %

Lubricating Oil			
lub.oil press.engine inlet	4,5 bar		
lub.oil temp.engine inlet	84 °C		

Cooling Water			
		LT	
HT		cw.press.IC LT inlet	1,81 bar
cw.press.engine inlet	1,55 bar	SW	
cw.temp.engine outlet	87,2 °C	sea water press.pump outlet	3,62 bar
		sea water temp.pump inlet	26,0 °C

Bearing			
	MV		
main bearing temperature	108,6 °C	No.	92,8
splash oil temperature	102,0 °C	supp. CCS	105,4
		1	110,9
		2	113,1
		3	104,1
		4	109,3
		5	109,9
		6	107,5
		7	85,5
		supp. CCS	
		1	98,6
		2	102,1
		3	104,0
		4	102,3
		5	101,6
		6	103,2



14-02-2023

SKEVXVE

press.crankcase	-8 mbar	smoke AVL	-
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optional values shown as "" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:

measurement-no: 15
FAT_100%-2

Performance Data

100,4 %



14-02-2023, 13:06

engine type	12V175D-MM	atmospheric pressure	1.030	mbar
engine no.	8351487	ambient temperature	16,5	°C
turbocharger type	TCR12-43052	abs. ambient humidity	4,51	g/kg
turbocharger no.	1342-55/-56	relative humidity	40	%
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40	
testbed no.	3	fuel oil spec.	MGO	
water brake type	Froude F0631	LHV fuel	42,966 kJ/kg	

Power			Fuel		
engine power	2.228,2	kW	fuel temp. HP pump inlet	27	°C
engine speed	1.901	rpm	fuel press. HP pump inlet	7,8	bar
mean eff. press.	22,7	bar	fuel mass flow 1	448,4	kg/h
			s.f.o.c (42700kJ/kg,ISO)	203,1	g/kWh

Common Rail					
fuel index	99,3	%	current feed duration B MV	1,8	ms
current feed duration A MV	1,8	ms	current feed timing B MV	11,7	°KW
current feed timing A MV	11,7	°KW			

Charge Air					
charge air temp. A	40,7	°C	air temp. compr. inlet B	23,1	°C
			charge air temp. B	40,1	°C
			charge air press. B	2.890	mbar

Exhaust Gas											
	MV		cyl.	1	2	3	4	5	6		
temp. cylinder outlet (A)	585,7	°C	A	573,0	579,8	598,6	592,0	583,5	587,0		
temp. cylinder outlet (B)	582,0	°C	B	573,7	576,0	587,0	594,0	576,0	585,0		
exh.gas temp.turb inlet A	617,0	°C	exh.gas temp.turb inlet B							619,0	°C
exh.gas press.turb.outlet A	53	mbar	exh.gas press.turb.outlet B							53	mbar
TC.speed A	62.390	rpm	TC.speed B							62.240	rpm
wastegate position A	29	%	wastegate position B							29	%

Lubricating Oil					
lub.oil press.engine inlet	4,5	bar			
lub.oil temp.engine inlet	84	°C			

Cooling Water					
HT			LT		
cw.press.engine inlet	1,54	bar	cw.press.IC LT inlet	1,80	bar
cw.temp.engine outlet	87,0	°C	SW		
			sea water press.pump outlet	3,66	bar
			sea water temp.pump inlet	25,2	°C

Bearing												
	MV		No.	supp. CCS	1	2	3	4	5	6	7	supp. CCS
main bearing temperature	108,5	°C	°C	92,7	105,3	110,8	113,0	104,0	109,2	109,8	107,5	85,5
splash oil temperature	101,8	°C	°C		98,4	101,8	103,9	102,1	101,4	103,0		



14-02-2023

SKEVXVE

press.crankcase	-9	mbar	smoke AVL	-	-
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optional values shown as "-" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:

measurement-no: 16
FAT_110%

Performance Data



110,2 %

14-02-2023, 13:51

engine type	12V175D-MM	atmospheric pressure	1.030 mbar
engine no.	8351487	ambient temperature	18,4 °C
turbocharger type	TCR12-43052	abs. ambient humidity	4,68 g/kg
turbocharger no.	1342-55/-56	relative humidity	36 %
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40
testbed no.	3	fuel oil spec.	MGO
water brake type	Froude F0631	LHV fuel	42.966 kJ/kg

Power		Fuel	
engine power	2.445,5 kW	fuel temp.HP pump inlet	27 °C
engine speed	1.963 rpm	fuel press.HP pump inlet	7,8 bar
mean eff.press.	24,1 bar	fuel mass flow 1	501,4 kg/h
		s.f.o.c (42700kJ/kg,ISO)	206,7 g/kWh

Common Rail			
fuel index	108,4 %	current feed duration B MV	1,9 ms
current feed duration A MV	1,9 ms	current feed timing B MV	12,8 °KW
current feed timing A MV	12,8 °KW		

Charge Air			
charge air temp. A	41,1 °C	air temp.compr.inlet B	24,8 °C
		charge air temp. B	40,5 °C
		charge air press. B	2.900 mbar

Exhaust Gas									
	MV	cyl.	1	2	3	4	5	6	
temp. cylinder outlet (A)	641,9 °C	A	630,0	637,5	657,0	648,5	637,3	641,0	
temp. cylinder outlet (B)	638,8 °C	B	629,0	631,0	645,0	653,0	635,0	640,0	
exh.gas temp.turb inlet A	682,0 °C	exh.gas temp.turb inlet B	684,0 °C						
exh.gas press.turb.outlet A	60 mbar	exh.gas press.turb.outlet B	60 mbar						
TC.speed A	63.010 rpm	TC.speed B	62.800 rpm						
wastegate position A	38 %	wastegate position B	38 %						

Lubricating Oil			
lub.oil press.engine inlet	4,5 bar		
lub.oil temp.engine inlet	84 °C		

Cooling Water			
HT		LT	
cw.press.engine inlet	1,60 bar	cw.press.IC LT inlet	1,89 bar
cw.temp.engine outlet	87,5 °C	SW	
		sea water press.pump outlet	3,86 bar
		sea water temp.pump inlet	25,3 °C

Bearing											
	MV	No.	supp. CS	1	2	3	4	5	6	7	supp. CCS
main bearing temperature	109,9 °C	°C	93,4	106,4	112,7	114,7	105,1	110,4	111,3	108,8	86,1
splash oil temperature	103,3 °C	°C		99,9	103,5	105,5	103,5	102,9	104,3		



14-02-2023

SKEVXVE

press.crankcase	-9 mbar	smoke AVL	-
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optional values shown as "" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:

measurement-no: 17
Load limit_600rpm

Performance Data



9,1 %

14-02-2023, 14:52

engine type	12V175D-MM	atmospheric pressure	1.029 mbar
engine no.	8351487	ambient temperature	15,9 °C
turbocharger type	TCR12-43052	abs. ambient humidity	4,20 g/kg
turbocharger no.	1342-55/-56	relative humidity	38 %
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40
testbed no.	3	fuel oil spec.	MGO
water brake type	Froude F0631	LHV fuel	42.966 kJ/kg

Power		Fuel	
engine power	201,3 kW	fuel temp. HP pump inlet	29 °C
engine speed	600 rpm	fuel press. HP pump inlet	7,7 bar
mean eff. press.	6,5 bar	fuel mass flow 1	41,7 kg/h
		s.f.o.c (42700kJ/kg, ISO)	208,1 g/kWh

Common Rail			
fuel index	36,4 %	current feed duration B MV	1,2 ms
current feed duration A MV	1,2 ms	current feed timing B MV	4,3 °KW
current feed timing A MV	4,3 °KW		

Charge Air			
charge air temp. A	39,5 °C	air temp. compr. inlet B	36,0 °C
		charge air temp. B	38,3 °C
		charge air press. B	60 mbar

Exhaust Gas									
	MV	cyl.	1	2	3	4	5	6	
temp. cylinder outlet (A)	329,9 °C	A	310,9	325,6	347,6	334,4	329,9	331,1	
temp. cylinder outlet (B)	328,4 °C	B	319,7	334,7	328,5	342,2	328,8	316,5	
exh. gas temp. turb inlet A	378,2 °C	exh. gas temp. turb inlet B	379,1 °C						
exh. gas press. turb. outlet A	-1 mbar	exh. gas press. turb. outlet B	-1 mbar						
TC. speed A	12.060 rpm	TC. speed B	12.040 rpm						
wastegate position A	0 %	wastegate position B	0 %						

Lubricating Oil			
lub. oil press. engine inlet	1,7 bar		
lub. oil temp. engine inlet	84 °C		

Cooling Water			
		LT	
		cw. press. IC LT inlet	0,56 bar
HT		SW	
cw. press. engine inlet	0,60 bar	sea water press. pump outlet	0,88 bar
cw. temp. engine outlet	87,5 °C	sea water temp. pump inlet	22,7 °C

Bearing											
	MV	No.	supp. CS	1	2	3	4	5	6	7	supp. CCS
main bearing temperature	92,2 °C	°C	87,3	91,1	92,7	92,7	91,2	92,8	92,8	91,9	82,1
splash oil temperature	92,5 °C	°C		92,9	93,2	93,5	91,5	91,3	92,9		

press. crankcase 0 mbar smoke AVL - -

optional values shown as "" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:

measurement-no: 18
Load limit_900rpm

Performance Data



20,8 %

14-02-2023, 15:00

engine type	12V175D-MM	atmospheric pressure	1.029	mbar
engine no.	8351487	ambient temperature	15,0	°C
turbocharger type	TCR12-43052	abs. ambient humidity	4,18	g/kg
turbocharger no.	1342-55/-56	relative humidity	40	%
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40	
testbed no.	3	fuel oil spec.	MGO	
water brake type	Froude F0631	LHV fuel	42.966	kJ/kg

Power		Fuel	
engine power	462,2 kW	fuel temp. HP pump inlet	30 °C
engine speed	898 rpm	fuel press. HP pump inlet	7,2 bar
mean eff.press.	9,9 bar	fuel mass flow 1	94,0 kg/h
		s.f.o.c (42700kJ/kg,ISO)	204,6 g/kWh

Common Rail			
fuel index	49,7	%	
current feed duration A MV	1,3	ms	current feed duration B MV 1,3 ms
current feed timing A MV	4,3	°KW	current feed timing B MV 4,3 °KW

Charge Air			
charge air temp. A	40,4	°C	air temp.compr.inlet B 28,9 °C
			charge air temp. B 39,4 °C
			charge air press. B 270 mbar

Exhaust Gas		MV						
		cyl.	1	2	3	4	5	6
temp. cylinder outlet (A)	468,7 °C	A	433,7	462,0	494,8	472,0	476,6	472,9
temp. cylinder outlet (B)	462,7 °C	B	444,8	464,6	461,4	489,2	471,4	444,6
exh.gas temp.turb inlet A	520,3 °C							exh.gas temp.turb inlet B 523,2 °C
exh.gas press.turb.outlet A	0 mbar							exh.gas press.turb.outlet B 0 mbar
TC.speed A	22.540 rpm							TC.speed B 22.490 rpm
wastegate position A	0 %							wastegate position B 0 %

Lubricating Oil			
lub.oil press.engine inlet	2,9	bar	
lub.oil temp.engine inlet	83	°C	

Cooling Water		LT	
		LT	0,66 bar
		sw	
HT		sw	
cw.press.engine inlet	0,73	bar	sea water press.pump outlet 1,30 bar
cw.temp.engine outlet	86,9	°C	sea water temp.pump inlet 26,5 °C

Bearing		MV									
		No.	supp. CS	1	2	3	4	5	6	7	supp. CCS
main bearing temperature	90,8 °C	°C	87,0	90,0	91,2	91,3	90,0	91,4	91,0	90,8	81,5
splash oil temperature	93,3 °C	°C		93,7	93,8	94,3	92,4	92,1	93,7		

press.crankcase 0 mbar smoke AVL - -

optional values shown as "" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:

measurement-no: 19
Load limit_1200rpm

Performance Data



51,9 %

14-02-2023, 15:04

engine type	12V175D-MM	atmospheric pressure	1.029 mbar
engine no.	8351487	ambient temperature	15,0 °C
turbocharger type	TCR12-43052	abs. ambient humidity	4,23 g/kg
turbocharger no.	1342-55/-56	relative humidity	41 %
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40
testbed no.	3	fuel oil spec.	MGO
water brake type	Froude F0631	LHV fuel	42.966 kJ/kg

Power

engine power	1.151,0 kW
engine speed	1.199 rpm
mean eff.press.	18,6 bar

Fuel

fuel temp.HP pump inlet	29 °C
fuel press.HP pump inlet	7,3 bar
fuel mass flow 1	217,0 kg/h
s.f.o.c (42700kJ/kg,ISO)	190,3 g/kWh

Common Rail

fuel index	76,5 %	current feed duration B MV	1,7 ms
current feed duration A MV	1,7 ms	current feed timing B MV	6,3 °KW
current feed timing A MV	6,3 °KW		

Charge Air

charge air temp. A	40,7 °C	air temp.compr.inlet B	22,2 °C
		charge air temp. B	39,8 °C
		charge air press. B	1.550 mbar

Exhaust Gas

	MV	cyl.	1	2	3	4	5	6	
temp. cylinder outlet (A)	476,5 °C	A	459,0	476,0	489,9	487,0	477,0	470,0	
temp. cylinder outlet (B)	475,2 °C	B	463,0	468,0	474,4	495,0	480,0	471,0	
exh.gas temp.turb inlet A	545,0 °C								548,0 °C
exh.gas press.turb.outlet A	11 mbar								11 mbar
TC.speed A	46.700 rpm								46.700 rpm
wastegate position A	0 %								0 %

Lubricating Oil

lub.oil press.engine inlet	4,1 bar
lub.oil temp.engine inlet	84 °C

Cooling Water

HT		LT	
cw.press.engine inlet	0,92 bar	cw.press.IC LT inlet	0,84 bar
cw.temp.engine outlet	87,3 °C	SW	
		sea water press.pump outlet	1,86 bar
		sea water temp.pump inlet	27,1 °C

Bearing

	MV	No.	supp. CCS	1	2	3	4	5	6	7	supp. CCS
main bearing temperature	94,1 °C	°C	87,9	92,8	95,2	95,3	92,5	94,8	94,8	93,3	82,2
splash oil temperature	95,9 °C	°C		96,0	95,7	96,8	95,4	95,2	96,2		

press.crankcase -2 mbar smoke AVL - -

optional values shown as "" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:

measurement-no: 20
Load limit_1500rpm

Performance Data



80,4 %

14-02-2023, 15:09

engine type	12V175D-MM	atmospheric pressure	1.029 mbar
engine no.	8351487	ambient temperature	15,2 °C
turbocharger type	TCR12-43052	abs. ambient humidity	4,31 g/kg
turbocharger no.	1342-55/-56	relative humidity	41 %
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40
testbed no.	3	fuel oil spec.	MGO
water brake type	Froude F0631	LHV fuel	42.966 kJ/kg

Power		Fuel	
engine power	1.785,8 kW	fuel temp.HP pump inlet	27 °C
engine speed	1.500 rpm	fuel press.HP pump inlet	7,5 bar
mean eff.press.	23,0 bar	fuel mass flow 1	336,0 kg/h
		s.f.o.c (42700kJ/kg,ISO)	190,1 g/kWh

Common Rail			
fuel index	94,6 %	current feed duration B MV	1,9 ms
current feed duration A MV	1,9 ms	current feed timing B MV	9,2 °KW
current feed timing A MV	9,2 °KW		

Charge Air			
charge air temp. A	38,7 °C	air temp.compr.inlet B	21,3 °C
		charge air temp. B	37,7 °C
		charge air press. B	2.640 mbar

Exhaust Gas									
	MV	cyl.	1	2	3	4	5	6	
temp. cylinder outlet (A)	498,0 °C	A	485,0	492,0	513,0	505,0	499,0	494,0	
temp. cylinder outlet (B)	496,5 °C	B	489,0	485,0	504,0	508,0	496,0	497,0	
exh.gas temp.turb inlet A	537,0 °C	exh.gas temp.turb inlet B	538,0 °C						
exh.gas press.turb.outlet A	32 mbar	exh.gas press.turb.outlet B	32 mbar						
TC.speed A	57.750 rpm	TC.speed B	57.820 rpm						
wastegate position A	14 %	wastegate position B	14 %						

Lubricating Oil			
lub.oil press.engine inlet	4,6 bar		
lub.oil temp.engine inlet	84 °C		

Cooling Water			
		LT	
HT		cw.press.IC LT inlet	1,30 bar
HT		SW	
cw.press.engine inlet	1,14 bar	sea water press.pump outlet	2,56 bar
cw.temp.engine outlet	87,5 °C	sea water temp.pump inlet	25,8 °C

Bearing											
	MV	No.	supp. CS	1	2	3	4	5	6	7	supp. CCS
main bearing temperature	100,0 °C	°C	89,5	97,8	102,0	102,8	97,5	100,8	101,5	97,7	83,4
splash oil temperature	98,2 °C	°C		96,7	98,3	99,5	98,1	98,0	98,7		

press.crankcase -6 mbar smoke AVL - -

optional values shown as "" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:

measurement-no: 21
Load limit_1800rpm

Performance Data



99,5 %

14-02-2023, 15:14

engine type	12V175D-MM	atmospheric pressure	1.029 mbar
engine no.	8351487	ambient temperature	15,5 °C
turbocharger type	TCR12-43052	abs. ambient humidity	4,37 g/kg
turbocharger no.	1342-55/-56	relative humidity	41 %
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40
testbed no.	3	fuel oil spec.	MGO
water brake type	Froude F0631	LHV fuel	42.966 kJ/kg

Power		Fuel	
engine power	2.208,2 kW	fuel temp. HP pump inlet	26 °C
engine speed	1.802 rpm	fuel press. HP pump inlet	7,7 bar
mean eff. press.	23,7 bar	fuel mass flow 1	439,5 kg/h
		s.f.o.c (42700kJ/kg,ISO)	200,9 g/kWh

Common Rail			
fuel index	102,8 %	current feed duration B MV	1,9 ms
current feed duration A MV	1,9 ms	current feed timing B MV	10,4 °KW
current feed timing A MV	10,4 °KW		

Charge Air			
charge air temp. A	41,0 °C	air temp.compr.inlet B	21,5 °C
		charge air temp. B	40,4 °C
		charge air press. B	2.890 mbar

Exhaust Gas		MV						
		cyl.	1	2	3	4	5	6
temp. cylinder outlet (A)	583,7 °C	A	574,0	576,0	599,0	592,0	578,0	583,0
temp. cylinder outlet (B)	580,8 °C	B	574,6	572,0	588,0	594,0	575,0	581,0
exh.gas temp.turb inlet A	616,0 °C	exh.gas temp.turb inlet B	618,0 °C					
exh.gas press.turb.outlet A	50 mbar	exh.gas press.turb.outlet B	50 mbar					
TC.speed A	61.350 rpm	TC.speed B	61.350 rpm					
wastegate position A	32 %	wastegate position B	32 %					

Lubricating Oil			
lub.oil press.engine inlet	4,6 bar		
lub.oil temp.engine inlet	84 °C		

Cooling Water			
HT		LT	
cw.press.engine inlet	1,44 bar	cw.press.IC LT inlet	1,67 bar
cw.temp.engine outlet	87,6 °C	SW	
		sea water press.pump outlet	3,40 bar
		sea water temp.pump inlet	26,1 °C

Bearing		MV									
		No.	supp. CCS	1	2	3	4	5	6	7	supp. CCS
main bearing temperature	105,2 °C	°C	90,8	101,9	107,8	109,3	101,4	106,0	106,9	103,0	84,4
splash oil temperature	100,9 °C	°C		98,5	101,0	102,4	100,9	100,5	101,8		

press.crankcase -9 mbar smoke AVL - -

optional values shown as "" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:

measurement-no: 22
Load limit_1900rpm

Performance Data



99,9 %

14-02-2023, 15:18

engine type	12V175D-MM	atmospheric pressure	1.029 mbar
engine no.	8351487	ambient temperature	15,7 °C
turbocharger type	TCR12-43052	abs. ambient humidity	4,42 g/kg
turbocharger no.	1342-55/-56	relative humidity	41 %
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40
testbed no.	3	fuel oil spec.	MGO
water brake type	Froude F0631	LHV fuel	42.966 kJ/kg

Power		Fuel	
engine power	2.217,2 kW	fuel temp.HP pump inlet	27 °C
engine speed	1.901 rpm	fuel press.HP pump inlet	7,8 bar
mean eff.press.	22,6 bar	fuel mass flow 1	444,9 kg/h
		s.f.o.c (42700kJ/kg,ISO)	202,6 g/kWh

Common Rail			
fuel index	98,3 %	current feed duration B MV	1,7 ms
current feed duration A MV	1,7 ms	current feed timing B MV	11,7 °KW
current feed timing A MV	11,7 °KW		

Charge Air			
charge air temp. A	39,4 °C	air temp.compr.inlet B	21,6 °C
		charge air temp. B	38,8 °C
		charge air press. B	2.890 mbar

Exhaust Gas											
	MV		cyl.	1	2	3	4	5	6		
temp. cylinder outlet (A)	579,3 °C		A	568,0	573,7	592,0	585,9	576,0	580,0		
temp. cylinder outlet (B)	576,3 °C		B	569,0	570,0	581,0	587,0	571,0	579,6		
exh.gas temp.turb inlet A	609,0 °C									exh.gas temp.turb inlet B	611,0 °C
exh.gas press.turb.outlet A	53 mbar									exh.gas press.turb.outlet B	53 mbar
TC.speed A	62.230 rpm									TC.speed B	62.160 rpm
wastegate position A	30 %									wastegate position B	30 %

Lubricating Oil			
lub.oil press.engine inlet	4,5 bar		
lub.oil temp.engine inlet	84 °C		

Cooling Water			
		LT	
HT		cw.press.IC LT inlet	1,80 bar
cw.press.engine inlet	1,55 bar	SW	
cw.temp.engine outlet	86,7 °C	sea water press.pump outlet	3,70 bar
		sea water temp.pump inlet	23,6 °C

Bearing												
	MV		No.	supp. CS	1	2	3	4	5	6	7	supp. CCS
main bearing temperature	107,5 °C		°C	91,7	104,3	109,9	111,9	103,2	108,2	108,9	105,9	84,9
splash oil temperature	101,6 °C		°C		99,0	101,6	103,7	101,7	101,2	102,6		

press.crankcase -9 mbar smoke AVL - -

optional values shown as "" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:



Engine type 12V175DMM

Engine no. 8351487

Software and display versions

Versions / Date / Type				
Marine Application				
Hours [h]	4	-CM-	-GM.G-Safety-	CM-
Hours In Overload [h]	0	-SafSys-	-SafSys-	E.C. AISys-
Software Version		1.02.04.	1.02.04.	1.02.04.
Parameter Setting		23-02-08	70-01-01	23-02-08
EC Fuel Injection IM 1-				
Software Version (-IM-)		1170		
Parameter Setting (-IM-)		23-02-08		
Software Version:	3.01.13	Legend:		E.C.
Type:	12 Cyl.	175D_V12CR	CM = Control Module	AISys- Engine Control System
Engine no.:	8351487	GM = Gateway Module	IM = Injection Module	Alarm/propic-Unit

Parameters / Emission-Identifier

Parameters	Emission-Identifier
	1_/_2 00 00 00 00 0 0000 00
	2_/_2 0000 0000
-0,25 °Crank Delivery Begin Offset	F0D2C90D AEFF0048
Engine n°: 8351487	>>



Remark: Actual running hours after FAT may differ from the value above.

附件 7.第一臺主機噪音測試結果



MAN Energy Solutions

AIRBORNE NOISE - REPORT

Sound pressure level at 1 m distance to engine (ref: 20µPa)

The values may change depending on the acoustical properties of the environment.

Engine type: 12V175D **Engine number:** 8351487

Measuring conditions

Engine load:	100%MCR	Turbo charger-side:	MID
Output:	2220kW	Measuring time:	15s
Speed:	1900rpm	Measuring points:	18
Measuring site:	FRH5	Measuring date:	14.02.2023
Mounting:	resilient/ conical mounts	Turbo charger:	TCR12
Operating mode:	MGO	Measured by:	S. Sørensen/ EERDH

Measuring equipment

Manufacturer:	Brüel & Kjaer	Calibrator type:	B&K 4231
Analyzer type:	Hand-held Analyzer 2270	Diameter windshield:	90mm
Microphone:	B&K 4189		

Measuring points

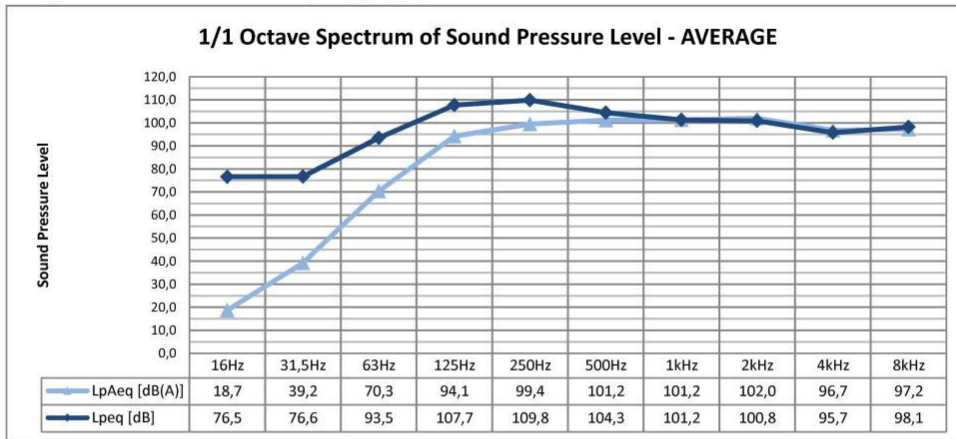
Depending on the size of the engine, measuring points are positioned according to ISO 6798 on a square around the engine at a distance of 1 m. The points are positioned evenly around the engine.

Comments

Exhaust gas noise is not included. No room correction is performed.

Results

Averaged Sound Pressure Level LpAeq [dB(A)]: 108,0



Department: EERPM **Date:** 21.02.2023

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MAN Energy Solutions
Future in the making



PRELIMINARY

Shop test protocol

Engine type	12V175DMM	Building standard A10
Number of cylinders	12	in vee angle
Bore	175	mm
Stroke	215	mm
Engine number	8351488	
Feature ident	A10-MFAA2C109A	
Engine output	2.220	kW
Engine speed	1.900	rpm
Engine rotation direction	Counter clockwise	
Firing order	A1 - B2 - A2 - B4 - A4 - B6 - A6 - B5 - A5 - B3 - A3 - B1	
Application	4 - stroke Marine main engine FPP: Fixed pitch propeller	

All tests are carried out according to ISO 3046-1, -3 and ISO 15550.

Classification society	CR + LR
Emission-Certification	NOx-Emission according IMO-Regulation 13 revised MARPOL Annex VI 2008 IMO-Tier II-Certification engine group (member)

Emission test cycle E3

Classification Engine	LR: CPN2330045-4 CR: 876-23-016
-----------------------	---------------------------------

Customer	MOTC
Place / Country	Taiwan

Place / Country	Frederikshavn / Denmark
Date	16-02-2023



Engine type 12V175DMM

Engine no. 8351488

Representatives

Name	Company
Søren Sørensen	LR
Rasmus Bang Ingvartsen	MAN Energy Solutions SE
Jonas Nørgaard	MAN Energy Solutions SE
CHAO, YI	CR
HSIEH MING HSIN	Representative of Owner (SOIC)
LIU CHIAHUNG	Owner MOTC

Certification

This is to certify that the shop test for the above mentioned engine has been carried out according to the enclosed recordings and performance data.



Representative of classification society

Søren Sørensen
Søren Sørensen
Copenhagen Office
Søren Sørensen

Representative of classification society

CHAO, YI
CHAO, YI

Representative of MOTC owner

LIU CHIAHUNG
LIU CHIAHUNG

Representative of owner (SOIC)

HSIEH MING HSIN
HSIEH MING HSIN

Representative of MAN Energy Solutions SE

Rasmus Bang Ingvartsen
Rasmus Bang Ingvartsen

Representative of MAN Energy Solutions SE

Jonas Nørgaard
Jonas Nørgaard



Place, date

Frederikshavn, 16-02-2023

measurement-no: 9
FAT_25%

Performance Data



16-02-2023, 08:52

25,1 %

engine type	12V175D-MM	atmospheric pressure	1.011 mbar
engine no.	8351488	ambient temperature	14,0 °C
turbocharger type	TCR12-43052	abs. ambient humidity	5,37 g/kg
turbocharger no.	1342-75/-76	relative humidity	54 %
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40
testbed no.	3	fuel oil spec.	MGO
water brake type	Froude F0631	LHV fuel	42.966 kJ/kg

Power		Fuel	
engine power	557,8 kW	fuel temp. HP pump inlet	29 °C
engine speed	1.196 rpm	fuel press. HP pump inlet	7,5 bar
mean eff. press.	9,0 bar	fuel mass flow 1	113,0 kg/h
		s.f.o.c (42700kJ/kg,ISO)	204,6 g/kWh

Common Rail			
fuel index	42,9 %	current feed duration B MV	1,2 ms
current feed duration A MV	1,2 ms	current feed timing B MV	4,8 °KW
current feed timing A MV	4,8 °KW		

Charge Air			
charge air temp. A	39,3 °C	air temp. compr. inlet B	20,0 °C
		charge air temp. B	38,6 °C
		charge air press. B	570 mbar

Exhaust Gas									
	MV	cyl.	1	2	3	4	5	6	
temp. cylinder outlet (A)	402,0 °C	A	405,0	418,0	412,0	400,0	395,0	382,0	
temp. cylinder outlet (B)	407,3 °C	B	412,8	403,0	397,6	425,3	399,0	406,0	
exh. gas temp. turb inlet A	467,0 °C	exh. gas temp. turb inlet B	464,0 °C						
exh. gas press. turb. outlet A	4 mbar	exh. gas press. turb. outlet B	4 mbar						
TC. speed A	31.860 rpm	TC. speed B	31.680 rpm						
wastegate position A	0 %	wastegate position B	0 %						

Lubricating Oil			
lub. oil press. engine inlet	4,3 bar		
lub. oil temp. engine inlet	84 °C		

Cooling Water			
		LT	
HT		cw. press. IC LT inlet	0,81 bar
cw. press. engine inlet	0,94 bar	SW	
cw. temp. engine outlet	86,5 °C	sea water press. pump outlet	1,84 bar
		sea water temp. pump inlet	25,6 °C

Bearing											
	MV	No.	supp. CS	1	2	3	4	5	6	7	supp. CCS
main bearing temperature	94,0 °C	°C	87,5	93,4	94,2	94,6	93,3	94,5	93,9	94,4	82,6
splash oil temperature	93,1 °C	°C		93,7	93,1	93,5	92,5	92,0	93,8		



16-02-2023

SKEVXVE

press.crankcase -1 mbar smoke AVL - -

optional values shown as "" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:

measurement-no: 10
FAT_50%

Performance Data



50,1 %

16-02-2023, 09:24

engine type	12V175D-MM	atmospheric pressure	1,011 mbar
engine no.	8351488	ambient temperature	15,1 °C
turbocharger type	TCR12-43052	abs. ambient humidity	5,49 g/kg
turbocharger no.	1342-75/-76	relative humidity	52 %
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40
testbed no.	3	fuel oil spec.	MGO
water brake type	Froude F0631	LHV fuel	42,966 kJ/kg

Power

engine power	1.112,5 kW
engine speed	1.508 rpm
mean eff.press.	14,3 bar

Fuel

fuel temp.HP pump inlet	28 °C
fuel press.HP pump inlet	7,7 bar
fuel mass flow 1	215,8 kg/h
s.f.o.c (42700kJ/kg,ISO)	195,7 g/kWh

Common Rail

fuel index	61,1 %	current feed duration B MV	1,3 ms
current feed duration A MV	1,3 ms	current feed timing B MV	8,0 °KW
current feed timing A MV	8,0 °KW		

Charge Air

charge air temp. A	36,8 °C	air temp.compr.inlet B	21,6 °C
		charge air temp. B	36,2 °C
		charge air press. B	1.740 mbar

Exhaust Gas

	MV	cyl.	1	2	3	4	5	6	
temp. cylinder outlet (A)	417,9 °C	A	421,2	426,0	432,0	416,0	412,0	400,0	
temp. cylinder outlet (B)	420,6 °C	B	427,2	413,4	418,0	436,0	410,0	419,0	
exh.gas temp.turb inlet A	456,0 °C								454,0 °C
exh.gas press.turb.outlet A	16 mbar								16 mbar
TC.speed A	50.330 rpm								50.070 rpm
wastegate position A	0 %								0 %

Lubricating Oil

lub.oil press.engine inlet	4,5 bar
lub.oil temp.engine inlet	84 °C

Cooling Water

HT		LT	
cw.press.engine inlet	1,19 bar	cw.press.IC LT inlet	1,19 bar
cw.temp.engine outlet	86,4 °C	SW	
		sea water press.pump outlet	2,54 bar
		sea water temp.pump inlet	26,0 °C

Bearing

	MV	No.	supp. CCS	1	2	3	4	5	6	7	supp. CCS
main bearing temperature	100,1 °C	°C	89,6	98,5	101,3	101,8	98,5	100,8	100,6	99,2	83,9
splash oil temperature	96,8 °C	°C		97,0	96,3	97,8	96,7	95,7	97,1		



16-02-2023

SKEVXVE

press.crankcase -4 mbar smoke AVL - -

optional values shown as "" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:

measurement-no: 11
FAT_75%

Performance Data



16-02-2023, 09:53

75,2 %

engine type	12V175D-MM	atmospheric pressure	1,011 mbar
engine no.	8351488	ambient temperature	15,8 °C
turbocharger type	TCR12-43052	abs. ambient humidity	5,46 g/kg
turbocharger no.	1342-75/-76	relative humidity	49 %
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40
testbed no.	3	fuel oil spec.	MGO
water brake type	Froude F0631	LHV fuel	42,966 kJ/kg

Power

engine power	1.668,7 kW
engine speed	1.727 rpm
mean eff.press.	18,7 bar

Fuel

fuel temp.HP pump inlet	27 °C
fuel press.HP pump inlet	7,7 bar
fuel mass flow 1	338,5 kg/h
s.f.o.c (42700kJ/kg,ISO)	204,5 g/kWh

Common Rail

fuel index	81,7 %	current feed duration B MV	1,6 ms
current feed duration A MV	1,6 ms	current feed timing B MV	7,3 °KW
current feed timing A MV	7,3 °KW		

Charge Air

charge air temp. A	38,3 °C	air temp.compr.inlet B	22,9 °C
		charge air temp. B	37,9 °C
		charge air press. B	2.640 mbar

Exhaust Gas

	MV							
temp. cylinder outlet (A)	509,7 °C	cyl.	1	2	3	4	5	6
temp. cylinder outlet (B)	513,0 °C	A	510,0	504,0	519,0	515,0	507,0	503,0
		B	510,0	500,0	519,0	531,0	506,0	512,0
exh.gas temp.turb inlet A	537,0 °C	exh.gas temp.turb inlet B	533,0 °C					
exh.gas press.turb.outlet A	37 mbar	exh.gas press.turb.outlet B	37 mbar					
TC.speed A	59.630 rpm	TC.speed B	59.390 rpm					
wastegate position A	17 %	wastegate position B	17 %					

Lubricating Oil

lub.oil press.engine inlet	4,5 bar
lub.oil temp.engine inlet	84 °C

Cooling Water

HT		LT	
cw.press.engine inlet	1,39 bar	cw.press.IC LT inlet	1,59 bar
cw.temp.engine outlet	86,8 °C	SW	
		sea water press.pump outlet	3,13 bar
		sea water temp.pump inlet	25,2 °C

Bearing

	MV										
main bearing temperature	105,1 °C	No.	supp. CCS	1	2	3	4	5	6	7	supp. CCS
splash oil temperature	99,0 °C	°C	90,7	102,7	107,1	107,9	102,4	105,8	106,0	103,9	84,6
		°C		96,9	98,4	100,6	99,5	98,3	100,1		



16-02-2023

SKEVXE

press.crankcase -8 mbar smoke AVL - -

optional values shown as "" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:

measurement-no: 12
FAT_85%

Performance Data



85,3 %

16-02-2023, 10:24

engine type	12V175D-MM	atmospheric pressure	1,011 mbar
engine no.	8351488	ambient temperature	16,5 °C
turbocharger type	TCR12-43052	abs. ambient humidity	5,46 g/kg
turbocharger no.	1342-75/-76	relative humidity	47 %
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40
testbed no.	3	fuel oil spec.	MGO
water brake type	Froude F0631	LHV fuel	42.966 kJ/kg

Power		Fuel	
engine power	1.892,5 kW	fuel temp. HP pump inlet	25 °C
engine speed	1.802 rpm	fuel press. HP pump inlet	7,8 bar
mean eff. press.	20,3 bar	fuel mass flow 1	380,7 kg/h
		s.f.o.c (42700kJ/kg,ISO)	202,7 g/kWh

Common Rail			
fuel index	88,7 %	current feed duration B MV	1,8 ms
current feed duration A MV	1,8 ms	current feed timing B MV	10,8 °KW
current feed timing A MV	10,8 °KW		

Charge Air			
charge air temp. A	39,1 °C	air temp. compr. inlet B	24,1 °C
		charge air temp. B	38,8 °C
		charge air press. B	2.740 mbar

Exhaust Gas									
	MV	cyl.	1	2	3	4	5	6	
temp. cylinder outlet (A)	542,0 °C	A	541,0	535,0	551,0	547,0	541,0	537,0	
temp. cylinder outlet (B)	545,0 °C	B	543,0	533,6	553,0	561,6	536,0	543,0	
exh. gas temp. turb inlet A	568,0 °C	exh. gas temp. turb inlet B	565,0 °C						
exh. gas press. turb. outlet A	43 mbar	exh. gas press. turb. outlet B	43 mbar						
TC. speed A	61.130 rpm	TC. speed B	60.830 rpm						
wastegate position A	21 %	wastegate position B	21 %						

Lubricating Oil			
lub. oil press. engine inlet	4,5 bar		
lub. oil temp. engine inlet	84 °C		

Cooling Water			
HT		LT	
cw. press. engine inlet	1,45 bar	cw. press. IC LT inlet	1,68 bar
cw. temp. engine outlet	86,9 °C	SW	
		sea water press. pump outlet	3,36 bar
		sea water temp. pump inlet	25,1 °C

Bearing											
	MV	No.	supp. CCS	1	2	3	4	5	6	7	supp. CCS
main bearing temperature	106,7 °C	°C	91,3	103,8	108,9	110,2	103,4	107,4	107,9	105,6	84,8
splash oil temperature	100,2 °C	°C		97,3	99,8	102,1	100,9	99,5	101,7		



16-02-2023

SKEVXVE

press.crankcase -9 mbar smoke AVL - -

optional values shown as "" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:

measurement-no: 13
FAT_90%

Performance Data



90,2 %

16-02-2023, 10:47

engine type	12V175D-MM	atmospheric pressure	1.011 mbar
engine no.	8351488	ambient temperature	16,8 °C
turbocharger type	TCR12-43052	abs. ambient humidity	5,45 g/kg
turbocharger no.	1342-75/-76	relative humidity	46 %
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40
testbed no.	3	fuel oil spec.	MGO
water brake type	Froude F0631	LHV fuel	42.966 kJ/kg

Power

engine power	2.001,5 kW
engine speed	1.835 rpm
mean eff.press.	21,1 bar

Fuel

fuel temp.HP pump inlet	25 °C
fuel press.HP pump inlet	7,8 bar
fuel mass flow 1	402,7 kg/h
s.f.o.c (42700kJ/kg,ISO)	202,7 g/kWh

Common Rail

fuel index	92,3 %	current feed duration B MV	1,8 ms
current feed duration A MV	1,8 ms	current feed timing B MV	11,7 °KW
current feed timing A MV	11,7 °KW		

Charge Air

charge air temp. A	39,4 °C	air temp.compr.inlet B	24,4 °C
		charge air temp. B	39,1 °C
		charge air press. B	2.810 mbar

Exhaust Gas

	MV	cyl.	1	2	3	4	5	6	
temp. cylinder outlet (A)	558,4 °C	A	557,0	551,0	567,0	566,3	557,0	552,0	
temp. cylinder outlet (B)	561,1 °C	B	557,5	551,0	570,0	577,0	553,0	558,0	
exh.gas temp.turb inlet A	586,0 °C								583,0 °C
exh.gas press.turb.outlet A	46 mbar								46 mbar
TC.speed A	61.930 rpm								61.660 rpm
wastegate position A	23 %								23 %

Lubricating Oil

lub.oil press.engine inlet	4,5 bar
lub.oil temp.engine inlet	84 °C

Cooling Water

HT		LT	
cw.press.engine inlet	1,48 bar	cw.press.IC LT inlet	1,72 bar
cw.temp.engine outlet	87,1 °C	SW	
		sea water press.pump outlet	3,47 bar
		sea water temp.pump inlet	24,9 °C

Bearing

	MV	No.	supp. CCS	1	2	3	4	5	6	7	supp. CCS
main bearing temperature	107,7 °C	°C	91,6	104,7	110,0	111,3	104,2	108,3	108,8	106,4	85,1
splash oil temperature	101,1 °C	°C		98,2	100,7	103,0	101,9	100,3	102,6		

16-02-2023

SKEVXVE



press.crankcase -9 mbar smoke AVL - -

optional values shown as "" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:

measurement-no: 14
FAT_100%-1

Performance Data

100,2 %



16-02-2023, 11:24

engine type	12V175D-MM	atmospheric pressure	1.011 mbar
engine no.	8351488	ambient temperature	17,6 °C
turbocharger type	TCR12-43052	abs. ambient humidity	5,56 g/kg
turbocharger no.	1342-75/-76	relative humidity	45 %
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40
testbed no.	3	fuel oil spec.	MGO
water brake type	Froude F0631	LHV fuel	42.966 kJ/kg

Power		Fuel	
engine power	2.224,5 kW	fuel temp. HP pump inlet	26 °C
engine speed	1.902 rpm	fuel press. HP pump inlet	7,7 bar
mean eff. press.	22,6 bar	fuel mass flow 1	450,1 kg/h
		s.f.o.c (42700kJ/kg,ISO)	203,8 g/kWh

Common Rail			
fuel index	100,0 %	current feed duration B MV	1,8 ms
current feed duration A MV	1,8 ms	current feed timing B MV	11,7 °KW
current feed timing A MV	11,7 °KW		

Charge Air			
charge air temp. A	39,8 °C	air temp. compr. inlet B	25,3 °C
		charge air temp. B	39,6 °C
		charge air press. B	2.890 mbar

Exhaust Gas										
	MV		cyl.	1	2	3	4	5	6	
temp. cylinder outlet (A)	592,6 °C		A	589,6	585,0	601,0	601,0	593,0	586,0	
temp. cylinder outlet (B)	596,4 °C		B	590,5	584,5	606,0	615,8	590,0	591,5	
exh.gas temp.turb inlet A	629,0 °C									625,0 °C
exh.gas press.turb.outlet A	53 mbar									53 mbar
TC.speed A	63.640 rpm									63.260 rpm
wastegate position A	27 %									27 %

Lubricating Oil			
lub.oil press.engine inlet	4,5 bar		
lub.oil temp.engine inlet	84 °C		

Cooling Water			
			LT
HT			cw.press.IC LT inlet
HT			1,82 bar
HT			SW
HT			sea water press.pump outlet
HT	1,55 bar		3,71 bar
HT	87,1 °C		sea water temp.pump inlet
HT			24,2 °C

Bearing												
	MV		No.	supp. CS	1	2	3	4	5	6	7	supp. CCS
main bearing temperature	109,2 °C		°C	92,2	106,2	111,8	113,2	105,6	109,6	110,4	108,0	85,1
splash oil temperature	102,5 °C		°C		99,4	102,1	104,5	103,1	101,5	104,1		



16-02-2023

SKENVVE

press.crankcase	-9 mbar	smoke AVL	-	-
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optional values shown as "" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:

measurement-no: 15
FAT_100%-2

Performance Data

30



100,2 %

16-02-2023, 12:26

engine type	12V175D-MM	atmospheric pressure	1.011 mbar
engine no.	8351488	ambient temperature	18,4 °C
turbocharger type	TCR12-43052	abs. ambient humidity	5,61 g/kg
turbocharger no.	1342-75/-76	relative humidity	43 %
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40
testbed no.	3	fuel oil spec.	MGO
water brake type	Froude F0631	LHV fuel	42.966 kJ/kg

Power

engine power	2.225,1 kW
engine speed	1.902 rpm
mean eff.press.	22,6 bar

Fuel

fuel temp.HP pump inlet	27 °C
fuel press.HP pump inlet	7,7 bar
fuel mass flow 1	450,0 kg/h
s.f.o.c (42700kJ/kg,ISO)	203,5 g/kWh

Common Rail

fuel index	100,0 %	current feed duration B MV	1,8 ms
current feed duration A MV	1,8 ms	current feed timing B MV	11,7 °KW
current feed timing A MV	11,7 °KW		

Charge Air

charge air temp. A	40,5 °C	air temp.compr.inlet B	26,3 °C
		charge air temp. B	40,4 °C
		charge air press. B	2.900 mbar

Exhaust Gas

	MV		cyl.	1	2	3	4	5	6	
temp. cylinder outlet (A)	593,2 °C		A	591,0	586,0	603,0	602,0	591,0	586,0	
temp. cylinder outlet (B)	597,3 °C		B	592,0	584,3	607,0	617,4	591,0	592,0	
exh.gas temp.turb inlet A	630,0 °C									625,0 °C
exh.gas press.turb.outlet A	53 mbar									53 mbar
TC.speed A	63.670 rpm									63.330 rpm
wastegate position A	27 %									27 %

Lubricating Oil

lub.oil press.engine inlet	4,4 bar
lub.oil temp.engine inlet	84 °C

Cooling Water

HT		LT	
HT		cw.press.IC LT inlet	1,81 bar
cw.press.engine inlet	1,56 bar	SW	
cw.temp.engine outlet	87,1 °C	sea water press.pump outlet	3,72 bar
		sea water temp.pump inlet	25,2 °C

Bearing

	MV	No.	supp. CS	1	2	3	4	5	6	7	supp. CCS
main bearing temperature	109,1 °C	°C	92,0	106,0	111,6	113,0	105,6	109,5	110,2	107,9	85,1
splash oil temperature	102,4 °C	°C		99,4	102,0	104,4	103,0	101,4	104,0		



16-02-2023

SKEVXVE

press.crankcase	-9 mbar	smoke AVL	-	-
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optional values shown as "" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:

measurement-no: 16
FAT_110%

Performance Data

110,1 %



16-02-2023, 13:03

engine type	12V175D-MM	atmospheric pressure	1.011 mbar
engine no.	8351488	ambient temperature	18,8 °C
turbocharger type	TCR12-43052	abs. ambient humidity	5,59 g/kg
turbocharger no.	1342-75/-76	relative humidity	41 %
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40
testbed no.	3	fuel oil spec.	MGO
water brake type	Froude F0631	LHV fuel	42,966 kJ/kg

Power		Fuel	
engine power	2.444,2 kW	fuel temp.HP pump inlet	27 °C
engine speed	1.963 rpm	fuel press.HP pump inlet	7,6 bar
mean eff.press.	24,1 bar	fuel mass flow 1	504,3 kg/h
		s.f.o.c (42700kJ/kg,ISO)	207,6 g/kWh

Common Rail			
fuel index	109,2 %	current feed duration B MV	1,9 ms
current feed duration A MV	1,9 ms	current feed timing B MV	12,8 °KW
current feed timing A MV	12,8 °KW		

Charge Air			
charge air temp. A	40,7 °C	air temp.compr.inlet B	27,0 °C
		charge air temp. B	40,6 °C
		charge air press. B	2.900 mbar

Exhaust Gas											
	MV		cyl.	1	2	3	4	5	6		
temp. cylinder outlet (A)	650,5 °C		A	648,0	642,5	663,0	660,0	648,0	641,6		
temp. cylinder outlet (B)	655,9 °C		B	648,8	643,0	666,4	680,0	650,0	647,5		
exh.gas temp.turb inlet A	698,0 °C									exh.gas temp.turb inlet B	693,0 °C
exh.gas press.turb.outlet A	60 mbar									exh.gas press.turb.outlet B	60 mbar
TC.speed A	64.170 rpm									TC.speed B	63.820 rpm
wastegate position A	36 %									wastegate position B	36 %

Lubricating Oil			
lub.oil press.engine inlet	4,4 bar		
lub.oil temp.engine inlet	84 °C		

Cooling Water				
			LT	
HT			cw.press.IC LT inlet	1,89 bar
cw.press.engine inlet	1,62 bar		SW	
cw.temp.engine outlet	87,6 °C		sea water press.pump outlet	3,92 bar
			sea water temp.pump inlet	25,2 °C

Bearing												
	MV		No.	supp. CS	1	2	3	4	5	6	7	supp. CCS
main bearing temperature	110,4 °C		°C	92,5	107,1	113,3	114,5	106,7	110,6	111,6	109,2	85,4
splash oil temperature	104,1 °C		°C		101,6	103,6	106,2	104,6	102,9	105,8		



16-02-2023

SKEVXVE

press.crankcase	-10 mbar	smoke AVL	-	-
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optional values shown as "—" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:

measurement-no: 17
Load limit_600rpm

Performance Data



9,1 %

16-02-2023, 14:12

engine type	12V175D-MM	atmospheric pressure	1.011 mbar
engine no.	8351488	ambient temperature	17,4 °C
turbocharger type	TCR12-43052	abs. ambient humidity	5,20 g/kg
turbocharger no.	1342-75/-76	relative humidity	42 %
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40
testbed no.	3	fuel oil spec.	MGO
water brake type	Froude F0631	LHV fuel	42.966 kJ/kg

Power		Fuel	
engine power	201,0 kW	fuel temp.HP pump inlet	30 °C
engine speed	600 rpm	fuel press.HP pump inlet	7,5 bar
mean eff.press.	6,5 bar	fuel mass flow 1	42,3 kg/h
		s.f.o.c (42700kJ/kg,ISO)	210,9 g/kWh

Common Rail			
fuel index	36,8 %	current feed duration B MV	1,2 ms
current feed duration A MV	1,2 ms	current feed timing B MV	4,3 °KW
current feed timing A MV	4,3 °KW		

Charge Air			
charge air temp. A	40,3 °C	air temp.compr.inlet B	34,8 °C
		charge air temp. B	39,0 °C
		charge air press. B	50 mbar

Exhaust Gas									
	MV	cyl.	1	2	3	4	5	6	
temp. cylinder outlet (A)	332,8 °C	A	331,9	352,6	340,3	330,2	329,6	312,0	
temp. cylinder outlet (B)	332,3 °C	B	334,3	333,0	325,7	341,8	325,1	333,6	
exh.gas temp.turb inlet A	366,8 °C	exh.gas temp.turb inlet B	367,8 °C						
exh.gas press.turb.outlet A	-1 mbar	exh.gas press.turb.outlet B	-1 mbar						
TC.speed A	12.050 rpm	TC.speed B	12.060 rpm						
wastegate position A	0 %	wastegate position B	0 %						

Lubricating Oil			
lub.oil press.engine inlet	1,7 bar		
lub.oil temp.engine inlet	85 °C		

Cooling Water			
		LT	
HT		cw.press.IC LT inlet	0,54 bar
cw.press.engine inlet	0,61 bar	SW	
cw.temp.engine outlet	87,8 °C	sea water press.pump outlet	0,87 bar
		sea water temp.pump inlet	24,5 °C

Bearing											
	MV	No.	supp. CS	1	2	3	4	5	6	7	supp. CCS
main bearing temperature	91,5 °C	°C	87,1	90,4	91,7	91,9	91,1	92,1	91,8	91,3	82,2
splash oil temperature	92,6 °C	°C		93,4	93,3	92,9	91,6	91,1	93,2		

press.crankcase 0 mbar smoke AVL - -

optional values shown as "" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:

measurement-no: 18
Load limit_900rpm

Performance Data



16-02-2023, 14:16

20,8

%

engine type	12V175D-MM	atmospheric pressure	1.011 mbar
engine no.	8351488	ambient temperature	17,1 °C
turbocharger type	TCR12-43052	abs. ambient humidity	5,23 g/kg
turbocharger no.	1342-75/-76	relative humidity	43 %
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40
testbed no.	3	fuel oil spec.	MGO
water brake type	Froude F0631	LHV fuel	42.966 kJ/kg

Power

engine power	462,7 kW
engine speed	898 rpm
mean eff.press.	10,0 bar

Fuel

fuel temp.HP pump inlet	31 °C
fuel press.HP pump inlet	7,1 bar
fuel mass flow 1	94,8 kg/h
s.f.o.c (42700kJ/kg,ISO)	205,9 g/kWh

Common Rail

fuel index	50,1 %	current feed duration B MV	1,3 ms
current feed duration A MV	1,3 ms	current feed timing B MV	4,3 °KW
current feed timing A MV	4,3 °KW		

Charge Air

charge air temp. A	39,9 °C	air temp.compr.inlet B	30,6 °C
		charge air temp. B	38,9 °C
		charge air press. B	250 mbar

Exhaust Gas

	MV		cyl.	1	2	3	4	5	6	
temp. cylinder outlet (A)	473,1 °C		A	464,8	497,5	486,8	469,3	476,0	444,1	
temp. cylinder outlet (B)	475,2 °C		B	477,4	471,2	460,4	502,2	467,4	472,5	
exh.gas temp.turb inlet A	521,0 °C									519,9 °C
exh.gas press.turb.outlet A	0 mbar									0 mbar
TC.speed A	22.530 rpm									22.400 rpm
wastegate position A	0 %									0 %

Lubricating Oil

lub.oil press.engine inlet	2,9 bar
lub.oil temp.engine inlet	84 °C

Cooling Water

HT		LT	
cw.press.engine inlet	0,74 bar	cw.press.IC LT inlet	0,65 bar
cw.temp.engine outlet	87,5 °C	SW	
		sea water press.pump outlet	1,32 bar
		sea water temp.pump inlet	28,0 °C

Bearing

	MV	No.	supp. CCS	1	2	3	4	5	6	7	supp. CCS
main bearing temperature	90,8 °C	°C	86,4	89,8	91,1	91,2	90,3	91,5	90,9	90,6	81,4
splash oil temperature	93,3 °C	°C		94,3	93,8	93,7	92,3	91,7	94,1		

press.crankcase 0 mbar smoke AVL - -

optional values shown as "" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:

measurement-no: 19
Load limit_1200rpm

Performance Data



51,9 %

16-02-2023, 14:19

engine type	12V175D-MM	atmospheric pressure	1.011	mbar
engine no.	8351488	ambient temperature	17,0	°C
turbocharger type	TCR12-43052	abs. ambient humidity	5,26	g/kg
turbocharger no.	1342-75/-76	relative humidity	44	%
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40	
testbed no.	3	fuel oil spec.	MGO	
water brake type	Froude F0631	LHV fuel	42.966	kJ/kg

Power

engine power	1.152,4	kW
engine speed	1.199	rpm
mean eff.press.	18,6	bar

Fuel

fuel temp.HP pump inlet	30	°C
fuel press.HP pump inlet	7,4	bar
fuel mass flow 1	218,4	kg/h
s.f.o.c (42700kJ/kg,ISO)	190,9	g/kWh

Common Rail

fuel index	77,1	%	current feed duration B MV	1,7	ms
current feed duration A MV	1,7	ms	current feed timing B MV	6,3	°KW
current feed timing A MV	6,3	°KW			

Charge Air

charge air temp. A	41,3	°C	air temp.compr.inlet B	24,0	°C
			charge air temp. B	40,5	°C
			charge air press. B	1.530	mbar

Exhaust Gas

	MV		cyl.	1	2	3	4	5	6	
temp. cylinder outlet (A)	485,5	°C	A	476,0	491,0	500,0	495,0	484,0	467,0	
temp. cylinder outlet (B)	489,2	°C	B	479,0	479,0	493,0	510,0	491,0	483,0	
exh.gas temp.turb inlet A	556,0	°C	exh.gas temp.turb inlet B	553,0	°C					
exh.gas press.turb.outlet A	11	mbar	exh.gas press.turb.outlet B	11	mbar					
TC.speed A	47.160	rpm	TC.speed B	46.980	rpm					
wastegate position A	0	%	wastegate position B	0	%					

Lubricating Oil

lub.oil press.engine inlet	4,1	bar
lub.oil temp.engine inlet	84	°C

Cooling Water

HT			LT		
cw.press.engine inlet	0,93	bar	cw.press.IC LT inlet	0,83	bar
cw.temp.engine outlet	87,6	°C	SW		
			sea water press.pump outlet	1,87	bar
			sea water temp.pump inlet	27,6	°C

Bearing

	MV		No.	supp. CS	1	2	3	4	5	6	7	supp. CCS
main bearing temperature	93,4	°C	°C	87,0	92,3	94,4	94,2	92,4	94,1	93,5	92,8	81,9
splash oil temperature	96,0	°C	°C		96,6	95,6	96,5	95,6	94,9	96,7		

press.crankcase -1 mbar smoke AVL - -

optional values shown as "-" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:

measurement-no: 20
Load limit_1500rpm

Performance Data



80,6 %

16-02-2023, 14:22

engine type	12V175D-MM	atmospheric pressure	1.011 mbar
engine no.	8351488	ambient temperature	17,2 °C
turbocharger type	TCR12-43052	abs. ambient humidity	5,38 g/kg
turbocharger no.	1342-75/-76	relative humidity	44 %
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40
testbed no.	3	fuel oil spec.	MGO
water brake type	Froude F0631	LHV fuel	42.966 kJ/kg

Power

engine power	1.789,2 kW
engine speed	1.500 rpm
mean eff.press.	23,1 bar

Fuel

fuel temp.HP pump inlet	28 °C
fuel press.HP pump inlet	7,5 bar
fuel mass flow 1	336,8 kg/h
s.f.o.c (42700kJ/kg,ISO)	189,7 g/kWh

Common Rail

fuel index	95,3 %	current feed duration B MV	1,9 ms
current feed duration A MV	2,0 ms	current feed timing B MV	9,2 °KW
current feed timing A MV	9,2 °KW		

Charge Air

charge air temp. A	39,4 °C	air temp.compr.inlet B	24,0 °C
		charge air temp. B	38,7 °C
		charge air press. B	2.650 mbar

Exhaust Gas

	MV		cyl.	1	2	3	4	5	6	
temp. cylinder outlet (A)	503,5 °C		A	498,0	500,0	517,0	511,0	505,0	490,0	
temp. cylinder outlet (B)	506,3 °C		B	502,0	494,0	515,0	524,0	503,0	500,0	
exh.gas temp.turb inlet A	545,0 °C									541,0 °C
exh.gas press.turb.outlet A	32 mbar									32 mbar
TC.speed A	58.760 rpm									58.590 rpm
wastegate position A	13 %									13 %

Lubricating Oil

lub.oil press.engine inlet	4,5 bar
lub.oil temp.engine inlet	84 °C

Cooling Water

HT		LT	
cw.press.engine inlet	1,16 bar	cw.press.IC LT inlet	1,30 bar
cw.temp.engine outlet	87,6 °C	SW	
		sea water press.pump outlet	2,56 bar
		sea water temp.pump inlet	27,5 °C

Bearing

	MV	No.	supp. CS	1	2	3	4	5	6	7	supp. CCS
main bearing temperature	98,1 °C	°C	87,7	96,3	100,1	100,0	96,5	98,8	98,9	96,2	82,6
splash oil temperature	98,7 °C	°C		98,7	98,0	99,8	98,9	97,7	99,2		

press.crankcase -6 mbar smoke AVL - -

optional values shown as "" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:

measurement-no: 21
Load limit_1800rpm

Performance Data



16-02-2023, 14:25

99,5 %

engine type	12V175D-MM	atmospheric pressure	1.011 mbar
engine no.	8351488	ambient temperature	17,4 °C
turbocharger type	TCR12-43052	abs. ambient humidity	5,48 g/kg
turbocharger no.	1342-75/-76	relative humidity	44 %
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40
testbed no.	3	fuel oil spec.	MGO
water brake type	Froude F0631	LHV fuel	42.966 kJ/kg

Power

engine power	2.209,2 kW
engine speed	1.801 rpm
mean eff.press.	23,7 bar

Fuel

fuel temp.HP pump inlet	27 °C
fuel press.HP pump inlet	7,6 bar
fuel mass flow 1	441,7 kg/h
s.f.o.c (42700kJ/kg,ISO)	201,3 g/kWh

Common Rail

fuel index	103,3 %	current feed duration B MV	1,9 ms
current feed duration A MV	1,9 ms	current feed timing B MV	10,4 °KW
current feed timing A MV	10,4 °KW		

Charge Air

charge air temp. A	41,2 °C	air temp.compr.inlet B	24,8 °C
		charge air temp. B	40,8 °C
		charge air press. B	2.890 mbar

Exhaust Gas

	MV		cyl.	1	2	3	4	5	6	
temp. cylinder outlet (A)	587,8 °C		A	584,6	582,6	601,0	597,0	584,7	577,0	
temp. cylinder outlet (B)	592,5 °C		B	587,0	579,0	600,6	613,8	587,0	587,7	
exh.gas temp.turb inlet A	622,9 °C									618,6 °C
exh.gas press.turb.outlet A	48 mbar									48 mbar
TC.speed A	62.540 rpm									62.250 rpm
wastegate position A	30 %									30 %

Lubricating Oil

lub.oil press.engine inlet	4,5 bar
lub.oil temp.engine inlet	84 °C

Cooling Water

HT		LT	
cw.press.engine inlet	1,44 bar	cw.press.IC LT inlet	1,67 bar
cw.temp.engine outlet	87,6 °C	SW	
		sea water press.pump outlet	3,39 bar
		sea water temp.pump inlet	27,1 °C

Bearing

	MV	No.	supp. CCS	1	2	3	4	5	6	7	supp. CCS
main bearing temperature	102,9 °C	°C	88,8	100,2	105,7	106,0	100,6	103,4	103,9	100,5	83,4
splash oil temperature	100,5 °C	°C		97,4	100,0	102,4	101,5	99,8	102,1		

press.crankcase -9 mbar smoke AVL - -

optional values shown as "" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:

measurement-no: 22
Load limit_1900rpm

Performance Data



99,6 %

16-02-2023, 14:27

engine type	12V175D-MM	atmospheric pressure	1.011 mbar
engine no.	8351488	ambient temperature	17,6 °C
turbocharger type	TCR12-43052	abs. ambient humidity	5,58 g/kg
turbocharger no.	1342-75/-76	relative humidity	45 %
attached pumps	5 -	lube oil spec.	Shell Rimula R6 MS 10W-40
testbed no.	3	fuel oil spec.	MGO
water brake type	Froude F0631	LHV fuel	42.966 kJ/kg

Power		Fuel	
engine power	2.210,7 kW	fuel temp. HP pump inlet	27 °C
engine speed	1.902 rpm	fuel press. HP pump inlet	7,8 bar
mean eff. press.	22,5 bar	fuel mass flow 1	445,9 kg/h
		s.f.o.c (42700kJ/kg,ISO)	203,1 g/kWh

Common Rail			
fuel index	98,6 %	current feed duration B MV	1,7 ms
current feed duration A MV	1,7 ms	current feed timing B MV	11,7 °KW
current feed timing A MV	11,7 °KW		

Charge Air			
charge air temp. A	40,7 °C	air temp. compr. inlet B	24,8 °C
		charge air temp. B	40,5 °C
		charge air press. B	2.895 mbar

Exhaust Gas		MV						
		cyl.	1	2	3	4	5	6
temp. cylinder outlet (A)	587,0 °C	A	585,0	580,0	597,0	596,0	584,0	580,0
temp. cylinder outlet (B)	591,3 °C	B	586,0	581,0	599,0	611,0	585,0	586,0
exh. gas temp. turb inlet A	622,0 °C	exh. gas temp. turb inlet B	617,0 °C					
exh. gas press. turb. outlet A	52 mbar	exh. gas press. turb. outlet B	52 mbar					
TC. speed A	63.360 rpm	TC. speed B	63.160 rpm					
wastegate position A	28 %	wastegate position B	28 %					

Lubricating Oil			
lub. oil press. engine inlet	4,5 bar		
lub. oil temp. engine inlet	84 °C		

Cooling Water		LT	
HT		cw. press. IC LT inlet	1,81 bar
cw. press. engine inlet	1,56 bar	SW	
cw. temp. engine outlet	86,9 °C	sea water press. pump outlet	3,72 bar
		sea water temp. pump inlet	25,6 °C

Bearing		MV									
		No.	supp. CS	1	2	3	4	5	6	7	supp. CCS
main bearing temperature	106,3 °C	°C	89,9	103,4	109,2	110,1	103,5	106,7	107,4	104,2	84,0
splash oil temperature	101,7 °C	°C		98,8	101,2	103,8	102,4	100,7	103,4		

press. crankcase -10 mbar smoke AVL - -

optional values shown as "" pressure values above atmosphere A / B = cylinder bank LT / HT = low / high temp. MV = mean value IC = intercooler

Remarks:



Engine type 12V175DMM

Engine no. 8351488

Software and display versions

		Versions / Date / Type			
		Marine Application			
Overload [h]	3	-CM-	-GM.G-Safety-	-CM-	-GM G-Alarm-
on	0	-SafSys-	-SafSys-	E.C. AISys	E.C. AISys
Setting		1.02.04.	1.02.04.	1.02.04.	1.02.04.
Setting		23-02-16	70-01-01	23-02-16	23-02-16
Injection		-IM.1-			
Injection (-IM-)		1170			
Setting (-IM-)		23-02-16			
Version:	3.01.13	Legend:			
12 Cyl.	175D_V12CR	SafSys: Safety System			
8351488		CM = Control Module			
		GM = Gateway Module			
		IM = Injection Module			
		E.C. AISys: Engine Control System Alarmprocessor-Unit			

Parameters / Emission-Identifier

Parameters	Emission-Identifier
	1./_2 00 00 00 00 0 0000 00
	2./_2 0000 0000
-0,25 °Crank Delivery Begin Offset	F0D2C90D - AEFF0048
Engine n°: 8351488	



16/Feb/2023

Remark: Actual running hours after FAT may differ from the value above.

附件 9. 廠試儀器校正資料

3F064



Hottinger Brüel & Kjaer GmbH
 Im Tiefen See 45 · DE - 64293 Darmstadt
 Tel. +49 / (0)6151 / 803-436 · E-Mail: DAkkScal@hbkworl.com

Akkreditiertes Kalibrierlaboratorium nach
 Accredited calibration laboratory according to
 DIN EN ISO/IEC 17025:2018

Mitglied im
 Member of

Deutschen Kalibrierdienst



Deutsche
 Akkreditierungsstelle
 D-K-12029-01-00

Kalibrierschein
 Calibration certificate

Kalibrierzeichen
 Calibration mark

99081
D-K- 12029-01-00
2021-10

Gegenstand Object	Drehmomentaufnehmer Torque Transducer
Hersteller Manufacturer	Hottinger Baldwin Messtechnik GmbH, DE - Darmstadt
Typ Type	T40FM/50 kN·m
Serien-Nr. (Prüfmittel-Nr.) Serial number (Test equipment no.)	153212007
Eigentümer Owner	MAN Energy Solutions SE; DK - 9900 Frederikshavn
Auftragsnummer Order No.	440048917
Anzahl der Seiten des Kalibrierscheines Number of pages of the certificate	9
Datum der Kalibrierung Date of calibration	2021-10-21

Dieser Kalibrierschein dokumentiert die metrologische Rückführung auf nationale Normale zur Darstellung der Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI). Die DAkkS ist Unterzeichner der multilateralen Übereinkommen der European co-operation for Accreditation (EA) und der International Laboratory Accreditation Cooperation (ILAC) zur gegenseitigen Anerkennung der Kalibrierscheine. Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.

This calibration certificate documents the metrological traceability to national standards, which realize the units of measurement according to the International System of Units (SI). The DAkkS is signatory to the mutual agreements of the European co-operation for Accreditation (EA) and of the International Laboratory Accreditation Cooperation (ILAC) for the multilateral recognition of calibration certificates. The user is obliged to have the object recalibrated at appropriate intervals.

Dieser Kalibrierschein darf nur vollständig und unverändert weiterverbreitet werden. Auszüge oder Änderungen bedürfen der Genehmigung des ausstellenden Kalibrierlaboratoriums. Kalibrierscheine ohne Unterschrift haben keine Gültigkeit.
 This calibration certificate may not be reproduced other than in full except with the permission of the issuing laboratory. Calibration certificates without signature are not valid.

HBK classification: Confidential - External
Rev. 2.137

Stempel Seal	Datum Date	Stellv. Leiter des Kalibrierlaboratoriums Deputy Head of the calibration laboratory	Bearbeiter Person in charge
	2021-10-25		
		Meckel	Zournatzidis

Zertifiziert nach ISO 9001 und ISO 14001 (DQS-000001) Akkreditiert als EMV-Prüflab. (Reg.-Nr. D-PL-12029-01) Seite / Page **1(9)**
 Certified according to ISO 9001 and ISO 14001 by DQS Accredited as EMC testing laboratory by DAkkS

99081
D-K- 12029-01-00
2021-10

Kalibriereinrichtung

Torque reference standard

25 kN·m Drehmoment-BNME (s. DAkkS-Akkreditierungsurkunde vom 2020-09-09)
(see DAkkS accreditation certificate dated 2020-09-09)

Anschlussmessunsicherheit: **bis 20 kN·m <= 0,008 %; von 25 kN·m bis 25 kN·m <= 0,01 %**
Best measurement capability up to 20 kN·m <= 0,008 %; from 25 kN·m to 25 kN·m <= 0,01 %

der eingestellten Drehmomentstufe
of the torque step selected

Kalibrierbedingungen

Calibration conditions

Umgebungstemperatur: Anfang / Begin: **(22,1 ± 1) °C** Ende / End: **(22,2 ± 1) °C**

Ambient temperature

Umgebungsfeuchte: **(47 ± 2) % rel.**

Environmental humidity

Die Kalibrierung ist nur gültig bei Verwendung des unten beschriebenen Ausgeber-Typs.

The calibration is only valid if a signal conditioner of the same type as described below is used.

Angaben zum Aufnehmer

Transducer data

Stator; Serien-Nr.: **T40FM-Stator; 253770040**

Stator; serial number

Statorversorgung: ********

Stator supply

Nullsignal (ausgebaut): **59983,8 Hz**

Zero signal (unmounted)

Einbauteile der Kalibrierung:

Mounting parts for calibration

DAkkS-Standard

DAkkS-standard

Angaben zum Kabel:

Cable data

Laboreig. Anschlusskabel 6 m

Owned by the laboratory: connection cable 6 m

Aufnehmersversorgung:

Transducer supply voltage

5 V; DC

Angaben zum Ausgeber und Anzeiger

Signal conditioner and indicator data

Grundgerät: <i>System</i>	HBM-MGCplus	(Eigentum des Kalibrierlaboratoriums) <i>(owned by the calibration laboratory)</i>
Identifizierung: <i>Identification</i>	2310-30786	
Verstärkertyp: <i>Amplifier type</i>	HBM-ML60B	(Eigentum des Kalibrierlaboratoriums) <i>(owned by the calibration laboratory)</i>
Identifizierung: <i>Identification</i>	DKD118	
Firmware-Version: <i>Firmware version</i>	P5.50	
Messkanal: <i>Measuring channel</i>	3	
Messbereich: <i>Measuring range</i>	200000,0 Hz	
Filter: <i>Filter</i>	0,1 Hz Bessel	
Kalibriersignal: <i>Calibration signal</i>	13052,9 Hz	
Anschlussart: <i>Type of connection</i>	Standard	
Anzeigertyp: <i>Indicator type</i>	PC	(Eigentum des Kalibrierlaboratoriums) <i>(owned by the calibration laboratory)</i>
Identifizierung: <i>Identification</i>	PR1396	
Software: <i>Software</i>	****	
Anzeigeranpassung: <i>Indicator adaptation</i>	****	

Sonstiges

Other data

Gemessen im Teilbereich bis 25 kN·m.

Measured in the subrange up to 25 kN·m.

Kalibrierverfahren / Calibration procedure

Die Kalibrierung wurde gemäß der Norm DIN 51309:2005 durchgeführt:

- 1) 3-malige Vorbelastung vor Kalibrierung in der jeweiligen Drehmomentrichtung mit 100% des Kalibrierbereichsendwertes (diese Vorbelastung ist vor jeder Benutzung zu wiederholen!)
- 2) Die Belastungsrichtungen und Einbaustellungen sind in der Tabelle der Messdaten angegeben.
- 3) Einbaustellungen: 3 x 120°
- 4) Drehmomentvektor: horizontal

Alle Messwerte und berechneten Werte sind um die jeweilige Nullanzeige reduziert. Die Ergebnisse sind in der letzten Stelle gerundet.

"AE" = Anzeigeeinheiten.

Korrekturen laut Akkreditierung sind berücksichtigt.

Die Kalibrierung erfolgt im Anlieferungszustand (as found), relevante Informationen oder davon abweichende Bedingungen sind auf Seite 3 unter Sonstiges, bzw. Anzeigeranpassung dokumentiert.

The calibration was performed according to the standard DIN 51309:2005:

- 1) *3 times preloading with 100% calibration torque in the respective torque direction prior to calibration (this kind of loading has to be repeated each time the transducer is used!)*
- 2) *Load direction and mounting positions are listed in the table measuring data.*
- 3) *Mounting positions: 3 x 120°*
- 4) *Torque vector: horizontal*

All measured values and calculated results have been reduced by the indication at zero load.

"AE" = Indication units.

Corrections according to accreditation included.

The calibration is carried out as found, relevant information or conditions deviating from this are documented on page 3 under Other data or Indicator adaption.

Messunsicherheit / Measurement uncertainty

Angegeben ist die erweiterte Messunsicherheit, die sich aus der Standardmessunsicherheit durch Multiplikation mit dem Erweiterungsfaktor $k=2$ ergibt. Sie wurde gemäß EA-4/02 M: 2013 und DIN 51309:2005 Anhang C bestimmt. Der Wert der Messgröße liegt mit einer Wahrscheinlichkeit von 95% im zugeordneten Werteintervall.

Ein Anteil für die Langzeitstabilität des Kalibriergegenstandes ist nicht enthalten.

The uncertainties shown are the expanded uncertainties ($k=2$), which are calculated according to EA-4/02 M: 2013 and DIN 51309:2005 appendix C. The results of the calibration are within a confidence level of 95%. A statement about long-term stability of the calibration object is not made.

Konformität / Statement of conformity

Die Konformitätsaussage für den auf Seite 1 benannten Kalibriergegenstand bezieht sich auf die in der Norm DIN 51309:2005 definierten Klassifizierungen.

Zusätzlich erfolgt auf der letzten Seite eine Bestätigung, dass der Kalibriergegenstand für die dort abgedruckten, im Rahmen der Kalibrierung ermittelten Merkmale, die vom Hersteller veröffentlichten bzw. vertraglich vereinbarten Spezifikationen, einhält.

The statement of conformity for the calibration device named on page 1 applies to the classification specified in the standard DIN 51309:2005.

In addition a statement on the last page shows that the calibration device meets the specifications published by the manufacturer or agreed by contract that were tested within the scope of the calibration.

1 Kalibrierergebnis / Calibration results (Erweiterungsfaktor / coverage factor **k = 2**)

Drehmoment torque M_K in kN·m	Signal signal Y in Hz	Fall / case (I)		Fall / case (II)	
		rel. Messunsicherheit / rel. uncertainty Ausgleichsfunktion / interpolation kubisch / cubic, in %	linear, in %	Signal signal Y_n in Hz	rel. Uns.-intervall rel. uncert. interval linear, in %
Rechtsdrehmoment / clockwise torque					
0	0,0			0,1	
3	1799,7	0,020	0,039	1799,9	0,041
5	2999,8	0,015	0,022	3000,1	0,029
7	4199,4	0,014	0,031	4199,9	0,034
10	5999,5	0,012	0,020	6000,0	0,023
12	7199,5	0,013	0,019	7199,9	0,024
15	9000,0	0,011	0,011	9000,4	0,018
20	12000,1	0,011	0,011	12000,4	0,013
25	15000,7	0,010	0,013	15000,7	0,012
Linksdrehmoment / anticlockwise torque					
0	0,0			0,1	
-3	-1800,1	0,021	0,021	-1800,3	0,048
-5	-3000,0	0,017	0,019	-3000,4	0,038
-7	-4200,0	0,016	0,018	-4200,4	0,030
-10	-6000,0	0,012	0,017	-6000,5	0,021
-12	-7200,2	0,011	0,012	-7200,6	0,018
-15	-9000,5	0,011	0,011	-9000,8	0,017
-20	-12000,5	0,011	0,011	-12000,7	0,015
-25	-15001,2	0,010	0,012	-15001,2	0,011

2 Klasseneinstufung nach DIN 51309 / Classification according to DIN 51309

Klasse Class	Fall / case (I)		Fall / case (II)	
	kubische Ausgleichsfunktion cubic interpolation von - bis / from - to, in kN·m	lineare Ausgleichsfunktion linear interpolation von - bis / from - to, in kN·m	lineare Ausgleichsfunktion linear interpolation von - bis / from - to, in kN·m	
Rechtsdrehmoment / clockwise torque				
0,05	3 25	3 25	3 25	3 25
0,1				
0,2				
0,5				
1				
2				
5				
Linksdrehmoment / anticlockwise torque				
0,05	-3 -25	-3 -25	-3 -25	-3 -25
0,1				
0,2				
0,5				
1				
2				
5				

3 Interpolationsgleichungen / Interpolation equations S in Hz M in kN·m

Die Interpolationsgleichungen wurden nach der Methode der kleinsten Fehlerquadrate aus den Mittelwerten aller Einbaulagen ermittelt.

The interpolation equation was calculated using the least square method and is based on the average values of all mounting positions.

3.1 Fall (I), Kubische Interpolationsgleichung / Case (I), Cubic interpolation equation

3.1.1 Rechtsdrehmoment / clockwise torque

$$\begin{aligned} S_{ai} &= 599,881 \cdot M_i + 0,0086 \cdot M_i^2 + -0,000108 \cdot M_i^3 \\ M_{ai} &= 0,0016667 \cdot S_i + -4E-011 \cdot S_i^2 + 8,3E-016 \cdot S_i^3 \end{aligned}$$

3.1.2 Linksdrehmoment / anticlockwise torque

$$\begin{aligned} S_{ai} &= 600,013 \cdot M_i + 0,0012 \cdot M_i^2 + 0,000102 \cdot M_i^3 \\ M_{ai} &= 0,00166663 \cdot S_i + -5E-012 \cdot S_i^2 + -7,8E-016 \cdot S_i^3 \end{aligned}$$

3.2 Fall (I), Lineare Interpolationsgleichung / Case (I), Linear interpolation equation

3.2.1 Rechtsdrehmoment
clockwise torque

$$\begin{aligned} S_{ai} &= 600,001 \cdot M_i \\ M_{ai} &= 0,00166666 \cdot S_i \end{aligned}$$

3.2.2 Linksdrehmoment
anticlockwise torque

$$\begin{aligned} S_{ai} &= 600,032 \cdot M_i \\ M_{ai} &= 0,00166658 \cdot S_i \end{aligned}$$

3.2.3 Rechts- und Linksdrehmoment
clockwise and anticlockwise torque

$$\begin{aligned} S_{ai} &= 600,017 \cdot M_i \\ M_{ai} &= 0,00166662 \cdot S_i \end{aligned}$$

3.3 Fall (II), Lineare Interpolationsgleichung / Case (II), Linear interpolation equation

3.3.1 Rechtsdrehmoment
clockwise torque

$$\begin{aligned} S_{ai} &= 600,018 \cdot M_i \\ M_{ai} &= 0,00166662 \cdot S_i \end{aligned}$$

3.3.2 Linksdrehmoment
anticlockwise torque

$$\begin{aligned} S_{ai} &= 600,048 \cdot M_i \\ M_{ai} &= 0,00166653 \cdot S_i \end{aligned}$$

3.3.3 Rechts- und Linksdrehmoment
clockwise and anticlockwise torque

$$\begin{aligned} S_{ai} &= 600,033 \cdot M_i \\ M_{ai} &= 0,00166658 \cdot S_i \end{aligned}$$

4 Kenngrößen nach DIN 51309 / Classification criteria according to DIN 51309

M_K in kN·m	Fall / case (I)					Fall / case (II)					r in kN·m
	b' Y in %	b Y in %	f_0 Y in %	$f_{a,cub}$ Y in %	$f_{a,lin}$ Y in %	b' Y _h in %	b Y _h in %	f_0 Y _h in %	h Y _h in %	$f_{a,lin}$ Y _h in %	
25	0,001	0,002	-	0,000	0,004	0,001	0,002	-	-	0,002	0,00017
20	0,001	0,006	-	-0,001	0,001	0,001	0,006	-	0,005	0,000	0,00017
15	0,002	0,008	-	0,002	-0,001	0,002	0,008	-	0,011	0,001	0,00017
12	0,003	0,013	-	-0,002	-0,007	0,003	0,013	-	0,014	-0,004	0,00017
10	0,007	0,007	-	0,000	-0,008	0,007	0,007	-	0,017	-0,003	0,00017
7	0,010	0,014	-	-0,003	-0,014	0,010	0,014	-	0,029	-0,006	0,00017
5	0,010	0,017	-	0,005	-0,008	0,010	0,017	-	0,027	0,000	0,00017
3	0,006	0,028	-	-0,001	-0,017	0,006	0,028	-	0,028	-0,008	0,00017
0	-	-	0,002	-	-	-	-	0,002	-	-	-
0	-	-	-0,001	-	-	-	-	-0,001	-	-	-
-3	0,011	0,028	-	0,006	0,002	0,011	0,028	-	0,033	0,011	0,00017
-5	0,003	0,023	-	-0,001	-0,004	0,003	0,023	-	0,030	0,006	0,00017
-7	0,002	0,021	-	-0,001	-0,005	0,002	0,021	-	0,024	0,002	0,00017
-10	0,002	0,010	-	-0,003	-0,006	0,002	0,010	-	0,017	0,000	0,00017
-12	0,001	0,007	-	0,000	-0,003	0,001	0,007	-	0,012	0,001	0,00017
-15	0,004	0,006	-	0,002	0,000	0,004	0,006	-	0,010	0,001	0,00017
-20	0,001	0,006	-	-0,001	-0,001	0,001	0,006	-	0,005	-0,002	0,00017
-25	0,001	0,005	-	0,000	0,003	0,001	0,005	-	-	0,000	0,00017

1) Die Bestimmung der linearen Interpolationsgleichung für Rechts- und Linksdrehmoment ist nicht identisch mit einem Kalibrierergebnis für Wechseldrehmoment. Sie ermöglicht es, mit nur einem Kalibrierfaktor das Anzeigergerät optimal für Rechts- und Linksdrehmoment anzupassen.

The linear interpolation equation for clockwise torque and anticlockwise torque can't be used as a calibration result for alternating torque. It only can be used to adjust the indicator optimally for clockwise torque and anticlockwise torque with a single calibration factor.

5 Messdaten / Measuring data in Hz ↓ = inc; ↑ = dec

Rechtsdrehmoment / clockwise torque						
kN·m	1. Vorbel. preloading	2. Vorbel. preloading	3. Vorbel. preloading	0° / 1 ↓	0° / 1 ↑	0° / 2 ↓
0	59994,4	60002,1	60002,3	60002,3	60002,2	60002,3
3	-	-	-	61801,8	61802,3	61801,7
5	-	-	-	63001,8	63002,6	63002,1
7	-	-	-	64201,6	64202,4	64202,0
10	-	-	-	66001,7	66002,5	66002,1
12	-	-	-	67201,5	67202,5	67201,7
15	-	-	-	69002,0	69003,0	69002,2
20	-	-	-	72002,1	72002,6	72002,2
25	75002,6	75002,8	75002,8	75002,8	75002,8	75003,0

kN·m	Vorbel. preloading	120° ↓	120° ↑	Vorbel. preloading	240° ↓	240° ↑
0	60001,9	60002,0	60002,1	59999,8	59999,4	59999,7
3	-	61801,6	61802,0	-	61799,4	61799,8
5	-	63001,8	63002,2	-	62999,4	63000,1
7	-	64201,2	64202,4	-	64199,2	64199,9
10	-	66001,4	66002,4	-	65999,2	66000,1
12	-	67201,2	67202,2	-	67199,5	67200,0
15	-	69001,8	69002,4	-	68999,8	69000,5
20	-	72002,0	72002,6	-	71999,9	72000,3
25	75002,6	75002,8	75002,8	75000,4	75000,2	75000,2

Linksdrehmoment / anticlockwise torque						
kN·m	1. Vorbel. preloading	2. Vorbel. preloading	3. Vorbel. preloading	0° / 1 ↓	0° / 1 ↑	0° / 2 ↓
0	60002,4	59997,8	59997,7	59997,5	59997,6	59997,6
-3	-	-	-	58197,4	58196,8	58197,3
-5	-	-	-	56997,5	56996,6	56997,5
-7	-	-	-	55797,3	55796,5	55797,3
-10	-	-	-	53997,4	53996,5	53997,4
-12	-	-	-	52797,2	52796,4	52797,2
-15	-	-	-	50997,1	50996,2	50996,8
-20	-	-	-	47997,0	47996,4	47997,0
-25	44996,4	44996,6	44996,4	44996,1	44996,1	44996,1

kN·m	Vorbel. preloading	120° ↓	120° ↑	Vorbel. preloading	240° ↓	240° ↑
0	59997,0	59997,1	59997,2	59994,9	59994,6	59994,8
-3	-	58196,7	58196,4	-	58194,7	58194,4
-5	-	56996,7	56996,2	-	56994,9	56994,0
-7	-	55796,7	55796,1	-	55795,1	55794,1
-10	-	53996,9	53995,9	-	53995,0	53994,0
-12	-	52796,7	52795,8	-	52794,7	52793,9
-15	-	50996,3	50995,9	-	50994,3	50993,8
-20	-	47996,3	47995,7	-	47994,5	47994,1
-25	44995,7	44995,6	44995,6	44993,6	44993,8	44993,8

6 Kurzzeitkriechen / short-term creep

Vor der ersten Messreihe der Nullgrad-Einbaustellung wurde die Signaländerung während einer dreiminütigen Wartepause registriert. Die auf den zugehörigen Endwert bezogene Änderung ist das Kurzzeitkriechen.

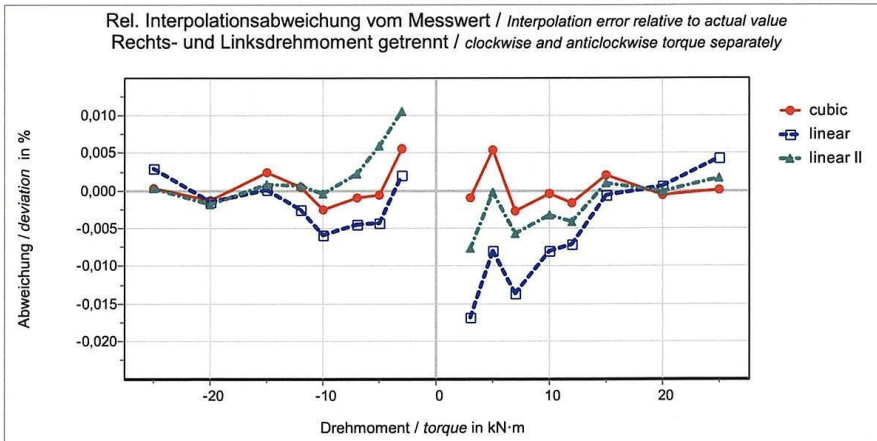
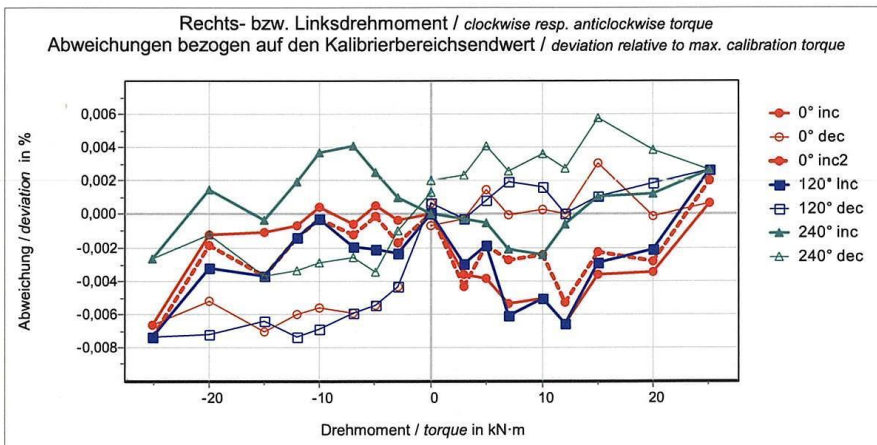
The signal variation during a three-minute waiting interval was recorded before the first series of the zero degree mounting position. The short-term creep is the variation related to the corresponding full-scale value.

Rechtsdrehmoment / clockwise torque: 0,000 %

Linksdrehmoment / anticlockwise torque: 0,000 %

7 Darstellung der Ergebnisse in Diagrammen / Results in diagrams

Bezugswert / reference value: 15000,4 Hz



8 Kubische Interpolationswerte ohne Bezug zur Messunsicherheit
Cubic interpol. values without reference to uncertainty

Rechtsdrehmoment nach 3.1.1 / *clockwise torque acc. to 3.1.1* in Hz

kN·m	0	0,25	0,5	0,75	1	1,25	1,5	1,75	2	2,25
0										
2,5			1799,7	1949,7	2099,7	2249,7	2399,7	2549,6	2699,6	2849,6
5	2999,6	3149,6	3299,6	3449,6	3599,6	3749,6	3899,6	4049,6	4199,6	4349,5
7,5	4499,5	4649,5	4799,5	4949,5	5099,5	5249,5	5399,5	5549,5	5699,6	5849,6
10	5999,6	6149,6	6299,6	6449,6	6599,6	6749,6	6899,6	7049,6	7199,6	7349,6
12,5	7499,6	7649,7	7799,7	7949,7	8099,7	8249,7	8399,7	8549,7	8699,8	8849,8
15	8999,8	9149,8	9299,8	9449,8	9599,9	9749,9	9899,9	10049,9	10199,9	10350,0
17,5	10500,0	10650,0	10800,0	10950,0	11100,1	11250,1	11400,1	11550,1	11700,1	11850,2
20	12000,2	12150,2	12300,2	12450,3	12600,3	12750,3	12900,3	13050,4	13200,4	13350,4
22,5	13500,4	13650,5	13800,5	13950,5	14100,6	14250,6	14400,6	14550,6	14700,7	14850,7
25	15000,7									

Linksdrehmoment nach 3.1.2 / *anticlockwise torque acc. to 3.1.2* in Hz

kN·m	0	-0,25	-0,5	-0,75	-1	-1,25	-1,5	-1,75	-2	-2,25
0										
-2,5			-1800,0	-1950,0	-2100,0	-2250,0	-2400,0	-2550,0	-2700,0	-2850,0
-5	-3000,0	-3150,0	-3300,1	-3450,1	-3600,1	-3750,1	-3900,1	-4050,1	-4200,1	-4350,1
-7,5	-4500,1	-4650,1	-4800,1	-4950,1	-5100,1	-5250,1	-5400,1	-5550,1	-5700,1	-5850,1
-10	-6000,1	-6150,1	-6300,1	-6450,1	-6600,1	-6750,1	-6900,1	-7050,2	-7200,2	-7350,2
-12,5	-7500,2	-7650,2	-7800,2	-7950,2	-8100,2	-8250,2	-8400,2	-8550,2	-8700,2	-8850,3
-15	-9000,3	-9150,3	-9300,3	-9450,3	-9600,3	-9750,3	-9900,3	-10050,4	-10200,4	-10350,4
-17,5	-10500,4	-10650,4	-10800,4	-10950,5	-11100,5	-11250,5	-11400,5	-11550,5	-11700,6	-11850,6
-20	-12000,6	-12150,6	-12300,6	-12450,7	-12600,7	-12750,7	-12900,7	-13050,8	-13200,8	-13350,8
-22,5	-13500,8	-13650,9	-13800,9	-13950,9	-14101,0	-14251,0	-14401,0	-14551,1	-14701,1	-14851,1
-25	-15001,2									

9 Überprüfung der Einhaltung der Herstellerspezifikation anhand der Kalibrierergebnisse
Verification of compliance with manufacturer specification based on calibration results

Merkmal <i>Property</i>	Richtung <i>Direction</i>	Zulässiger Wert <i>Admissible value</i>	Berechneter Wert <i>Value determined</i>	Ergebnis <i>Result</i>
Linearitätsabweichung einschließlich Hysterese d_{lh} in % von M_{nom} <i>Linearity deviation including hysteresis d_{lh} in % of M_{nom}</i>	Rechtsdrehmoment <i>clockwise torque</i>	0,1	0,003	ok
	Linksdrehmoment <i>anticlockwise torque</i>	0,1	-0,002	ok

Ende des Kalibrierscheins / *End of calibration certificate*

Calibration Certificate

Certificate Number: 20221005_31434

Position ID: 31434

Printed: 10/5/2022 3:38:42 PM
Printed by: Chris Præstegaard
CMX Version: 2.11.514.0 (2.11)

Position

Name ambient temperature
Location TCF C1-7
Plant Ambient temperature sensors/

Device

Device ID 31434
Serial Number H7003014176
Manufacturer E+H TST-434
Rangeability 0-60 DEC

Function

Name Temperature Transmitter (tt)
Transfer Function Linear

Calibration Event

Calibration time 10/5/2022 2:58:28 PM
Environment 21.6 °C
Environment Humidity 54 %
Environment 99.98 kPa

Calibrators

Input Calibrator FB150 : B7A604 Due Date: 1/26/2024
Output Calibrator MC6 : 605608 Due Date: 1/26/2024

Calibrators Internal Numbers

Beamex Oy Ab FB150 3I500
Beamex Oy Ab MC6 3K400

Calibration Procedure

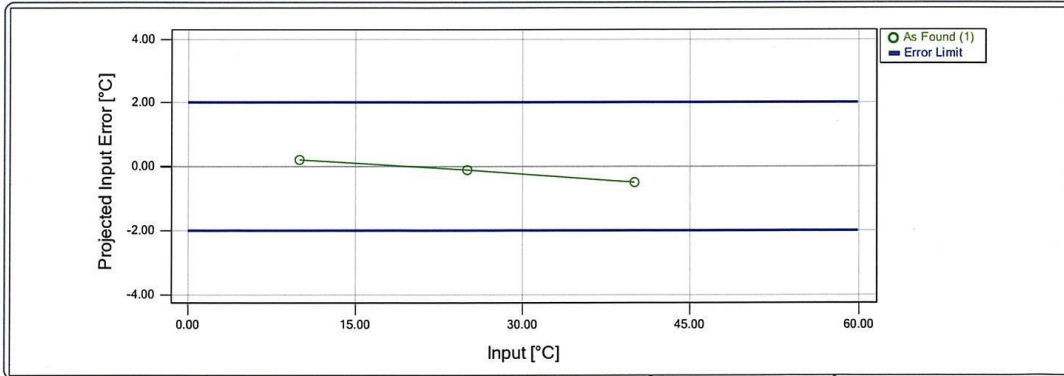
Due Date 3 Months After Activation
Reject If Error > 2 °C

1. As Found

PASSED

Maximum Error: -0.5 °C

Nominal Input [°C]	Actual Input [°C]	Nominal Output [mA]	Actual Output [mA]	Found Error [°C]
10	10.00	10	10.22	0.2
25	25.00	25	24.87	-0.1
40	40.00	40	39.55	-0.5



Calibrated by: *Simon Sørensen*
Simon Sørensen
10/5/2022 2:58:28 PM

Approved: *Chris Præstegaard*
Chris Præstegaard, Measuring Technician
10/5/2022 3:37:23 PM

Calibration Certificate

Certificate Number: 20221005_31472

Position ID: 31472

Printed: 10/5/2022 3:39:55 PM
Printed by: Chris Præstegaard
CMX Version: 2.11.514.0 (2.11)

Position

Name ambient pressure
Location TCF
Plant Ambient Pressure sensors/

Device

Device ID 31472
Serial Number F203F001129
Manufacturer E+H PMP51-13704/115
Rangeability 900-1200 mbar abs.

Function

Name Pressure Transmitter (pt)
Transfer Function Linear

Calibration Event

Calibration time 10/5/2022 3:15:14 PM
Environment 21.6 °C
Environment Humidity 54 %
Environment 100.01 kPa

Calibrators

Input Calibrator MC6 : 605608 Due Date: 1/28/2024
Output Calibrator MC6 : 605608 Due Date: 1/28/2024

Calibrators Internal Numbers

Beamex Oy Ab MC6 3K400
Beamex Oy Ab MC6 3K400

Calibration Procedure

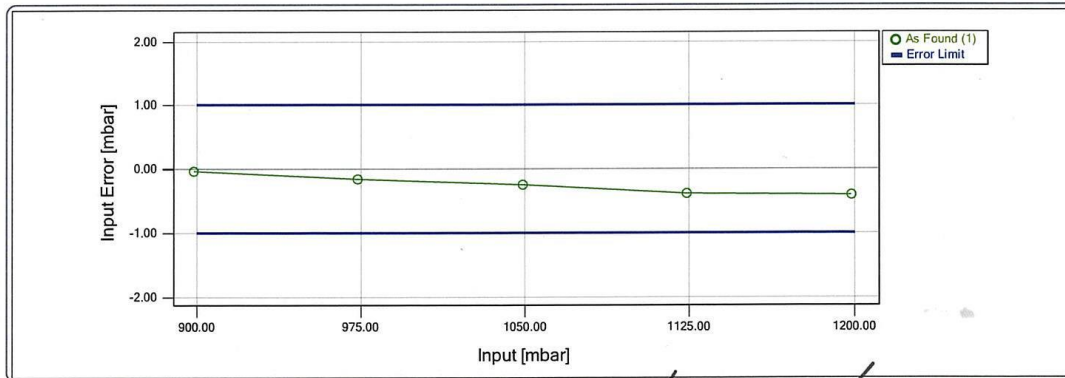
Due Date 3 Months After Activation
Reject If Error > 1 mbar


1. As Found

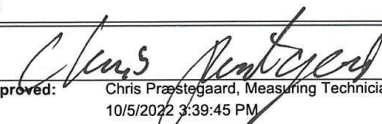
PASSED

Maximum Error: -0.40 mbar

Nominal Input [mbar]	Actual Input [mbar]	Nominal Output [mA]	Actual Output [mA]	Found Error [mbar]
900.0	898.75	900.0	898.79	-0.04
975.0	973.78	975.0	973.94	-0.16
1050.0	1048.82	1050.0	1049.06	-0.24
1125.0	1123.83	1125.0	1124.21	-0.38
1200.0	1198.91	1200.0	1199.31	-0.40



Calibrated by: 
Simon Sørensen
10/5/2022 3:15:14 PM

Approved: 
Chris Præstegaard, Measuring Technician
10/5/2022 3:39:45 PM



HC2 61226886 AutoCal Certificate

Date (YYYY-MM-DD): 2023-01-17
 Time (HH:MM:SS): 11:28:55

Probe Under Test: HC2
 Serial No.: 61226886

Reference: HygroClip2
 Serial No.: 61329823
 Reference Calibration Standard:

Reference Last Calibration Date: 2022-05-24
 Reference Next Calibration Date: 2023-05-24
 Comment on Reference:

Reference Parameter & Calculation:
 The reference provided uncorrected Relative Humidity and Temperature measurements.
 HygroGen2 ID: 914813267

AutoCal Program Number: 1
 Descriptor: ACal Profile 1

Autocal Program Structure:

Step:	Temperature SP (°C):	Humidity SP (%):	Step Duration (HH:MM):	Adjust Temperature:	Adjust Humidity:
1	25.0	15.0	02:00	No	Yes
2	25.0	35.0	00:15	No	Yes
3	25.0	55.0	00:15	No	Yes
4	25.0	85.0	00:15	No	Yes

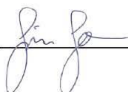
Tolerance to Set Point at which step duration timing will occur (zero = no tolerance applied).

SP Temperature Tolerance (°C): 0.1
 SP Relative Humidity Tolerance (%): 0.1

Probe Actions Recorded:

Step:	Action:	Serial No.:	Date:	Time:	Probe Temp. (°C):	Probe RH (%):	Ref. Temp. (°C):	Ref. RH (%):	Temp. Correction:	RH Correction:
1	Read	61226886	2023-01-17	10:21:16	24.99	15.05	24.99	15.00	0.00	-0.05
1	Read	61226886	2023-01-17	10:23:17	25.00	15.05	25.00	14.98	0.00	-0.07
1	Read	61226886	2023-01-17	10:25:13	24.99	15.03	24.98	14.96	-0.01	-0.07
1	Read	61226886	2023-01-17	10:27:09	24.99	15.05	25.00	15.00	0.01	-0.05
1	Read	61226886	2023-01-17	10:28:43	25.00	15.09	25.04	15.02	0.04	-0.07
1	Delete	61226886	2023-01-17	10:29:04	25.00	15.09	24.99	15.00	-0.01	-0.09
1	Save RH	61226886	2023-01-17	10:29:14	25.01	15.09	25.02	15.00	0.01	-0.09
2	Read	61226886	2023-01-17	10:39:53	25.00	35.15	25.03	35.03	0.03	-0.12
2	Read	61226886	2023-01-17	10:41:54	25.01	35.15	24.98	35.00	-0.03	-0.15
2	Read	61226886	2023-01-17	10:43:54	25.00	35.17	25.01	35.00	0.01	-0.17
2	Read	61226886	2023-01-17	10:45:55	25.01	35.20	25.00	35.00	-0.01	-0.20
2	Read	61226886	2023-01-17	10:47:24	25.01	35.20	25.00	35.03	-0.01	-0.17
2	Save RH	61226886	2023-01-17	10:47:24	25.01	35.20	25.00	35.03	-0.01	-0.17
3	Read	61226886	2023-01-17	10:59:18	25.03	55.16	25.01	54.98	-0.02	-0.18
3	Read	61226886	2023-01-17	11:01:19	25.01	55.21	25.01	55.03	0.00	-0.18
3	Read	61226886	2023-01-17	11:03:20	25.01	55.21	24.98	55.01	-0.03	-0.20
3	Read	61226886	2023-01-17	11:05:20	25.01	55.28	24.99	55.03	-0.02	-0.25
3	Read	61226886	2023-01-17	11:06:49	25.01	55.23	24.96	55.01	-0.05	-0.22
3	Save RH	61226886	2023-01-17	11:06:49	25.01	55.23	24.96	55.01	-0.05	-0.22
4	Read	61226886	2023-01-17	11:20:34	25.02	85.26	24.98	85.04	-0.04	-0.22
4	Read	61226886	2023-01-17	11:22:35	25.05	85.26	24.97	84.99	-0.08	-0.27
4	Read	61226886	2023-01-17	11:24:35	25.03	85.26	25.02	84.99	-0.01	-0.27
4	Read	61226886	2023-01-17	11:26:36	25.02	85.28	24.99	84.99	-0.03	-0.29
4	Read	61226886	2023-01-17	11:28:05	25.03	85.30	25.00	84.99	-0.03	-0.31
4	Save RH	61226886	2023-01-17	11:28:05	25.03	85.30	25.00	84.99	-0.03	-0.31
4	Adjust RH	61226886	2023-01-17	11:28:16	25.03	85.28	25.02	84.99	-0.01	-0.29

Operator: Simon Soerensen

Operator Signature:  Date: 17/01-2023
 Operator Comment:
 Calibration manager

Contact Details:
 MAN Energy Solutions
 Niels Juels Vej 15
 9900 Frederikshavn
 Denmark



Telephone: +4596204005
 Email: Simon.Soerensen@man-es.com

Calibration Certificate

Certificate Number: 20221212_3K1186
Position ID: 3K1186

Printed: 12/12/2022 7:49:59 PM
Printed by: Johnni Sørensen
CMX Version: 2.11.514.0 (2.11)

Position

Name Exhaust Back Pressure
Location TCF C3
Plant Exhaust backpressure/

Device

Device ID 3K1186
Serial Number HC032101129
Manufacturer E+H PMP51-13704/115
Rangeability 900-1200 mbar abs.

Function

Name Pressure Transmitter (pt)
Transfer Function Linear

Calibration Event

Calibration time 12/12/2022 6:20:26 PM
Environment 17 °C
Environment Humidity 25 %
Environment 101.10 kPa

Calibrators

Input Calibrator MC6 : 605608 Due Date: 1/28/2024
Output Value form Scada

Calibrators Internal Numbers

Beamex Oy Ab MC6 3K400

Calibration Procedure

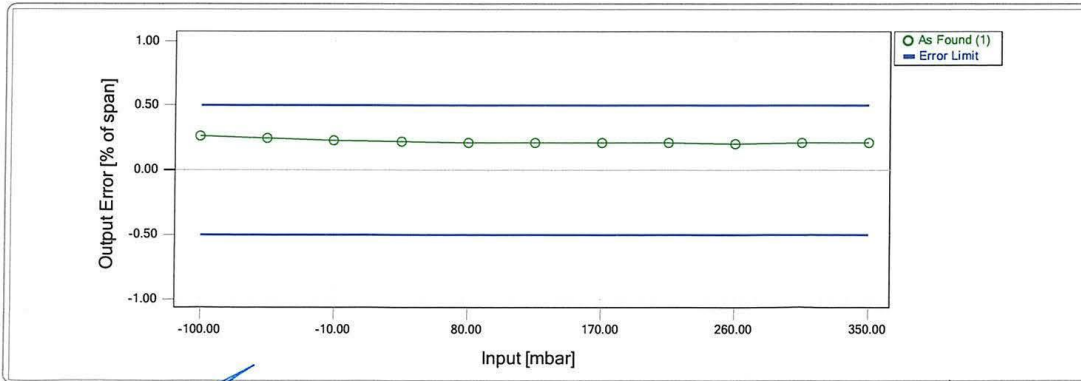
Due Date 3 Months After Activation
Reject If Error > 0.5 % of span

1. As Found

PASSED

Maximum Error: 0.26 % of span

Nominal Input [mbar]	Actual Input [mbar]	Nominal Output [mbar]	Actual Output [mbar]	Found Error [% of span]
-100.0	-100.17	-100.0	-99.00	0.26
-55.000	-55.11	-55.000	-54.00	0.25
-10.000	-10.04	-10.000	-9.00	0.23
35.00	35.01	35.00	36.00	0.22
80.0	80.04	80.0	81.00	0.21
125.00	125.06	125.00	126.00	0.21
170.00	170.05	170.00	171.00	0.21
215.00	215.07	215.00	216.00	0.21
260.0	260.09	260.0	261.00	0.20
305.0	305.06	305.0	306.00	0.21
350.00	350.06	350.00	351.00	0.21



Calibrated by: Johnni Sørensen
12/12/2022 6:20:26 PM

Approved: Chris Præstegaard, Measuring Technician
12/12/2022 7:43:45 PM



Certificate no.: 20230119_3N025

Calibration Certificate

Instrument Designation: Fuel oil system Ser. No.: H712F302000
Instrument Manufacture: Endress+Hauser ID-no.: 3N025
Instrument Model: Promas 83F15 Afd-no.: EERDH

The calibration has been performed with the following equipment:

Calibration Equipment no.: 3N029



Certificate reference for Calibration Equipment: 9.6-120-23532.01.01

Results of the Calibration:

Nominal Measure [Kg/h]	Actual Measure [Kg/h]
114,21	114,51
191,54	191,83
309,12	309,43
389,73	390,10
498,37	498,74
608,18	608,76
693,45	694,03
807,28	807,77
918,37	918,81
1107,14	1107,56
Maximum deviation: 0,58 Kg	Max allowed deviation: +/- 2 %

Date of Calibration: 2023-01-19

Calibration performed and approved by:

Simon Sørensen  & Chris Præstegaard 
Test Engineer Quality Engineer

Date of Issue: 2023-01-19

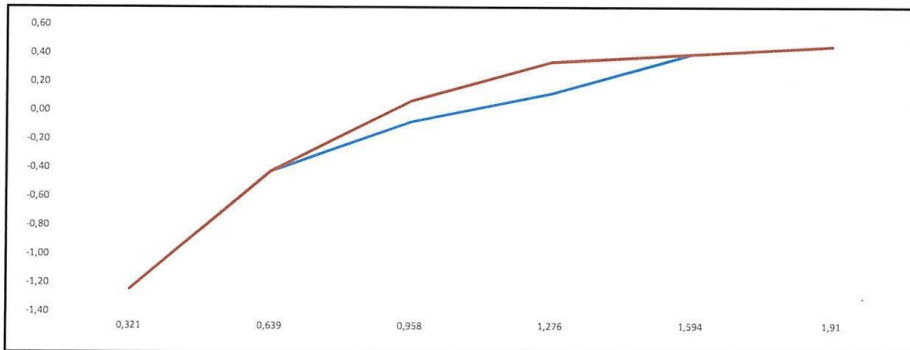
The calibration certificate is only to be reproduced with the formal acknowledgement of MAN Diesel & Turbo

Calibration Certificate

Waterbrake C3
Certificate No.: 20230104_3Q061

Manufacturer:	Froude	Certificate no.:	20230104_3Q061
Type:	F0631	ID. No.:	3Q061
		Machin. No.	NA

Calibration equipment:			Torque ring serial No.: 12004 ID. No.: 3F054							
			Certificate No.: 427556							
Check arm load [mm]	Corrected indication acc. to certificate 865575 [kNm]	Corrected according to arm 0.9144m [kNm]	Loading				Unloading			Total Average Deviation [%]
			Actual indicator reading							
			Reading	[kNm]	Average Deviation [%]	Reading	[kNm]	Average Deviation [%]		
			<i>I</i>	<i>II</i>		<i>I</i>	<i>II</i>			
0	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
0,321	5,00	4,57	4,51	4,52	-1,25	4,51	4,52	-1,25	-1,25	
0,639	10,00	9,14	9,10	9,11	-0,43	9,11	9,10	-0,43	-0,43	
0,958	15,00	13,72	13,70	13,71	-0,08	13,71	13,74	0,07	-0,01	
1,276	20,00	18,29	18,30	18,32	0,12	18,35	18,35	0,34	0,23	
1,594	25,00	22,86	22,94	22,96	0,39	22,94	22,96	0,39	0,39	
1,91	30,00	27,43	27,55	27,56	0,45	27,55	27,56	0,45	0,45	
Remark: Permissible deviation +/- 2% (ISO 3046-1)						Max Average deviation:		-1,25		





 Calibrated by: Simon Sørensen, Operator



 Approved by: Chris Præstegaard, Quality department

Kalibreringer C1-C7.xlsx - Excel

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Kalibreringsoversigt Celle 3

[Link til ATLAS Kalibreringsoversigt](#)

Funktion --> Se under fane	TAG	Qnr.	Aktiveret	Næste kalibrering efter Aktivering	Dage til kal.	Noter
Fuelflow --> Flowmålere	FT1FO	3N025	19-01-2023	18-07-2023	160	
Weight tank --> Forbrugsvægte	FOWT	3N024	IKKE AKTIV	KUN AKTIV VED KØRSEL MED VEJSCELLE		
Water brake --> Vandbremser		3Q061	04-01-2023	04-04-2023	55	
Cell temperature --> Termometre	TT1CA	3I434	12-12-2022	12-03-2023	32	
Ambient pressure --> Barometre	PT1CA	3I472	12-12-2022	12-03-2023	32	
Exhaust backpressure --> Trykmålere	PT2EX	3K1186	12-12-2022	12-03-2023	32	
Relative humidity --> Hygrometre	HuT1CA	3I475	08-02-2023	10-03-2023	30	
Momentflange --> Moment		3F064	02-04-2022	28-03-2023	48	
Flange på kobling tilspændt	XXX	XXX	14-11-2022	12-02-2023	4	
Kalibreringsintervaller efter Aktivering	Måneder	= Dage			Date	08-02-2023
Fuelflow	6	180				
Weight tank	6	180				
Water brake	3	90				
Cell temperature	3	90				

Referenceintervaller MEXA

Sheet1 Kalibreringsintervaller ...

22:59 DAN 08-02-2023