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**Table of instructions & guidelines for engine alignment**

**List of parts of instructions and guidelines for engine alignment of direct-coupled Wärtsilä 2-stroke marine propulsion engines provided in design group (DG) 9709, H-drawing 107.404.952:**

<b>Table 1</b>			
<b>List of documents for design group 9709 “Engine alignment”</b>			
<b>Part #</b>	<b>Material ID</b>	<b>Sub title</b>	<b>Drawing ID</b>
<b>001</b>	PAAD128841	Introduction	DAAD040460
<b>002</b>	PAAD128842	Alignment in brief	DAAD040461
<b>003</b>	PAAD128843	Bearing arrangement & layout calculation	DAAD040462
<b>004</b>	PAAD128844	Equivalent two-dimensional crankshaft model	DAAD040463
<b>005</b>	PAAD128845	Procedure & measurements at shipyard	DAAD040464
<b>006</b>	PAAD128846	Measurements during normal ship service	DAAD040465
<b>007</b>	PAAD128847	Crankweb deflections - limits	DAAD040466
<b>008</b>	PAAD128848	Main bearing loads – recommendations & limits	DAAD040467
<b>009</b>	PAAD128849	Guidelines for measurements	DAAD040468

**Abbreviations**


The following abbreviations are used in this document:

H-drawing    main drawing (Wärtsilä drawing set structure)

DG            design group (Wärtsilä drawing set structure)

FCV#        crankshaft execution variant

FE            finite element

Substitute for:										PC	Q-Code	X	X	X	X	X
Modif	Number	Drawn Date	Number	Drawn Date	Number	Drawn Date	Number	Drawn Date	Number	Drawn Date						
		Product <b>W-2S</b>			Engine Alignment Introduction											
Made	14.10.2013	J.Bergande		Main Drw.	Page	1 / 4					Material ID	<b>PAAD128841</b>				
Chkd	18.10.2013	W. Schiffer		Design Group	9709		Drawing ID	<b>DAAD040460</b>				Rev				
Appd	21.10.2013	B.Haag														

# 1 Introduction

## 1.1 Aim of alignment

The purpose of alignment is to meet the following basic demands at all normal ship service conditions<sup>1</sup>:

- 1 **All bearings<sup>2</sup> need to have a positive static load.**
- 2 All crankweb deflections – engine stopped – need to be within the service limits.

The static bearing loads and the crankweb deflections vary due to the influence of elastic ship hull bending as well as service forces and temperatures.

In order to ensure that the above mentioned demands are met, the following three principles have to be considered:

- It is crucial that the shaft bearings are arranged at optimum long distances in order to limit the variations of the static bearing loads and of the crankweb deflections.
- The bearing offset changes which are expected to occur between installation condition and any normal ship service condition need to be considered by an appropriate pre-compensation.
- A careful levelling of main engine bedplate by means of all jacking screws (or alignment wedges resp.) during installation is crucial for achieving proper static main bearing loads and crankweb deflections.

## 1.2 Preface

The instructions and guidelines provided in DG9709 “Engine alignment” aim to facilitate the complete topic of engine alignment from the design stage of shafting arrangement to the final normal ship’s service operation condition.

The objective is an easy and trouble-free alignment by guiding through this process. The final goal is a safe and trouble-free propulsion system operation over the complete ship’s lifetime.


The instruction contains different kinds of information:

- general information
- guidelines and guidance values, guiding through the alignment process
- alignment limits which have to be kept in order to ensure a safe operation of the propulsion system.

## 1.3 Validity of instructions and guidelines in DG9709 “Engine alignment”

The instructions and guidelines provided in DG9709 “Engine alignment” are valid for direct-coupled Wärtsilä two-stroke engines i.e. W-X, RT-flex and RTA type under the conditions mentioned in the following.

- 1 Ship draught and trim within normal limits.
- 2 All shaft line bearings and all engine main bearings.

Substitute for:										PC	Q-Code	X	X	X	X	X
Modif	Number	Drawn Date	Number	Drawn Date	Number	Drawn Date	Number	Drawn Date	Number	Drawn Date						
		Product <b>W-2S</b>			<b>Engine Alignment</b> <b>Introduction</b>											
Made	14.10.2013	J.Bergande		Main Drw.	Page	Material ID					<b>PAAD128841</b>					
Chkd	18.10.2013	W. Schiffer		Design Group	2 / 4											
Appd	21.10.2013	B.Haag		<b>9709</b>	Drawing ID	<b>DAAD040460</b>					Rev					

**All data mentioned in this instruction are only valid for *standard installations* of the mentioned Wärtsilä two-stroke engines on board of seagoing vessels.** The term *standard installations* means:

- the intermediate bearing(s) is (are) arranged at optimum long shaft bearing distance(s) as defined in DG9709 - "Engine alignment – Bearing arrangement & layout calculation", section "Shaft bearing arrangement / Optimum bearing distances".
- no additional heavy masses like shaft generators are installed on the propulsion shaft line.

**In case of non-standard installations it is strongly recommended to contact Wärtsilä. Case-specific guidance values will be defined according to the basic approach of this instruction.** However, even for standard installations it is not possible to cover all possible installation variants and their characteristics, as there are various ship designs and an ongoing development.

Therefore, the given guidance values can only provide strong indication whether the alignment is acceptable or needs to be improved. **In some special cases the guidance values might be exceeded, while the alignment is acceptable, and vice versa.** In case of any doubts, **Wärtsilä can provide case-specific support. Wärtsilä case-specific instructions supersede the general values provided in this document.**

All engine type-specific data provided in this instruction are valid for all crankshaft executions, e.g. FCV1, FCV2, and FCV3.


#### 1.4 Responsibilities

It is the shipyard's responsibility to guarantee that finally, after ship delivery all bearings are statically loaded and the crankweb deflections do not exceed the admissible limits (= aim of alignment, as explained in previous section 1.1 ) under all normal operation conditions.

- The referred main bearing load limits are provided in DG9709 - "Engine alignment – Main bearing loads – recommendations & limits", section "Minimum limits for normal ship service".
- The referred crankweb deflection limits are provided in DG9709 - "Engine alignment – Crankweb deflections - limits", section "Limits for crankweb deflection - ship service".

Guidelines about how these requirements can be fulfilled are given in DG9709 "Engine alignment". However, Wärtsilä does not take any responsibility for the correctness of these guidance values.

As long as Wärtsilä is not involved as direct contractual partner, Wärtsilä will just provide technical support and issue comments if requested, e.g. whether an alignment condition meets Wärtsilä's expectations or not. Therefore, Wärtsilä only provides guidelines and proposals for the complete alignment process, but will not specify the exact way of working, as this remains within shipyard's responsibility.

Substitute for:								PC	Q-Code	X	X	X	X	X
Modif	Number	Drawn Date	Number	Drawn Date	Number	Drawn Date	Number	Drawn Date						
		Product <b>W-2S</b>			Engine Alignment Introduction									
Made	14.10.2013	J.Bergande	Main Drw.	Page	3 / 4	Material ID	<b>PAAD128841</b>							
Chkd	18.10.2013	W. Schiffer	Design Group	9709		Drawing ID	<b>DAAD040460</b>					Rev		
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## 1.5 Wäertsilä alignment services

Wäertsilä provides various services concerning the engine and shafting alignment of direct-coupled two-stroke marine diesel engines. Certain services, e.g. the review of the shafting arrangement during design stage, are free of charge, whereas other services, e.g. complete shafting alignment calculations, will be charged to the purchaser, except when otherwise stipulated.


### 1.5.1 Wäertsilä's alignment calculation program "EnDyn"

**Wäertsilä offers a special alignment calculation program named "EnDyn" on request and free of charge to licensees and shipyards installing a Wäertsilä engine.**

It is strongly recommended to use the EnDyn calculation program for alignment layout calculations of Wäertsilä two-stroke diesel engines, as it provides accurate and detailed results. The program incorporates the full three-dimensional FE based models of all actual portfolio engines, i.e. W-X, RT-flex and RTA type. Just the correct crankshaft type needs to be selected as input for the complete crankshaft, incl. running gears and main bearings.

For additional information, ordering alignment layout calculation, any kind of alignment review or requesting the EnDyn alignment program<sup>3</sup>, please contact Wäertsilä, e.g. by email to: [application.engineering.ch@wartsila.com](mailto:application.engineering.ch@wartsila.com). Onsite support for alignment execution can be ordered from Wäertsilä field service: [fieldservice.ch@wartsila.com](mailto:fieldservice.ch@wartsila.com) or by contacting the local Wäertsilä office.

<sup>3</sup> It is recommended to ask for EnDyn program up-dates regularly e.g. when starting a new project. Up-dates take place about every 6 months. Wäertsilä agrees to use this program also for other alignment projects, e.g. four-stroke installations, different engine brands, etc. The program is suitable for such tasks. In connection with Wäertsilä products the full advantage of the program can be utilised as more detailed information can be provided.

Substitute for:								PC	Q-Code	X	X	X	X	X
Modif	Number	Drawn Date	Number	Drawn Date	Number	Drawn Date	Number	Drawn Date						
		Product <b>W-2S</b>			<b>Engine Alignment Introduction</b>									
Made	14.10.2013	J.Bergande	Main Drw.	Page	4 / 4	Material ID	<b>PAAD128841</b>							
Chkd	18.10.2013	W. Schiffer	Design Group	<b>9709</b>		Drawing ID <b>DAAD040460</b>	Rev							
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## WinGD-2S - Alignment - introduction

### TRACK CHANGES

DATE	SUBJECT	DESCRIPTION
2016-10-25	DOCUMENT	First web upload

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