ZÖLLNER
ENERGY SYSTEMS

Omega 5400 S3

Project Guide

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1 Scope and purpose

This document defines the scope, objectives, and intended use of the Hydraulic Dynamometer Project Guide for the **Omega 5400 S3**. It serves as a foundational resource for all stakeholders involved in the planning, design, procurement, implementation, and commissioning of hydraulic dynamometer systems across various industrial applications, including but not limited to engine testing, powertrain validation, and mechanical performance evaluation.

1.1 Purpose

The primary purpose of this development package is to establish a standardized framework that facilitates the successful integration of hydraulic dynamometer into a test bench. Drawing on proven practices from other sectors and other high-performance test environments, this document aims to:

- Establish technical and operational specifications for hydraulic dynamometer systems.
- Support alignment between project owners, developers, equipment suppliers, engineering teams, and system integrators.
- Ensure interface clarification for hydraulic dynamometer conceptual integration.

1.2 Scope

This project guide focuses the pre-order phase of a hydraulic dynamometer project, from early-stage feasibility assessment through system integration and test bench scope evaluation. It covers the technical specification & design by means of functional requirements, interface standards, instrumentation, hydraulic system design, control systems, and automation integration.

1.3 Target Audience

This document is intended for a multidisciplinary audience, including:

- Engineering consultants and design teams for test facilities developments
- Engine manufacturers

2 Related documents

Description
Performance Diagram
Water Requirements
Outline Drawing

Table 1 Related documents

3 Terms and abbreviations

Table 2 shows the terms and abbreviations used in this document.

Term / Abbreviation	Explanation
HD	Hydraulic Dynamometer
UUT	Unit Under Test
EMI	Electromagnetic interference
TWS	Testbed workstation
DLC	Dynamometer Load Controller
LSE	Leistungsstufeneinheit (valve actuator control unit)

Table 2: List of abbreviations

4 Technical data

Table 3 provides and overview of the key technical parameters.

Power at ΔT = 25 K	5400 kW
Maximum permissible torque	60 kNm
Maximum speed	2200 rpm
Minimum water fill level for control stability	>1%
Weight	9000 kg

Table 3 Key technical parameters

Note: The selection of a HD type cannot be done only with the operational limits. Contact Zollner Energy Systems customer communication for support in the selection of the HD type selection.

5 Performance diagram

The power and torque diagram serves as a critical reference tool in the early stages of hydraulic dynamometer system selection and design. It provides a graphical representation of the operational envelope of various dynamometer types in relation to the performance characteristics of the test specimen, typically internal combustion engines, electric motors, or hybrid powertrains.

This chapter is intended to guide users in selecting the most appropriate dynamometer configuration by comparing the required test parameters—such as maximum torque, rotational speed, and power output—against the capabilities of the dynamometer Omega 5400 S3. By ensuring proper alignment between the UUT and the dynamometer system, this process supports accurate performance evaluation, protects system components from overload, and optimizes test bench efficiency.

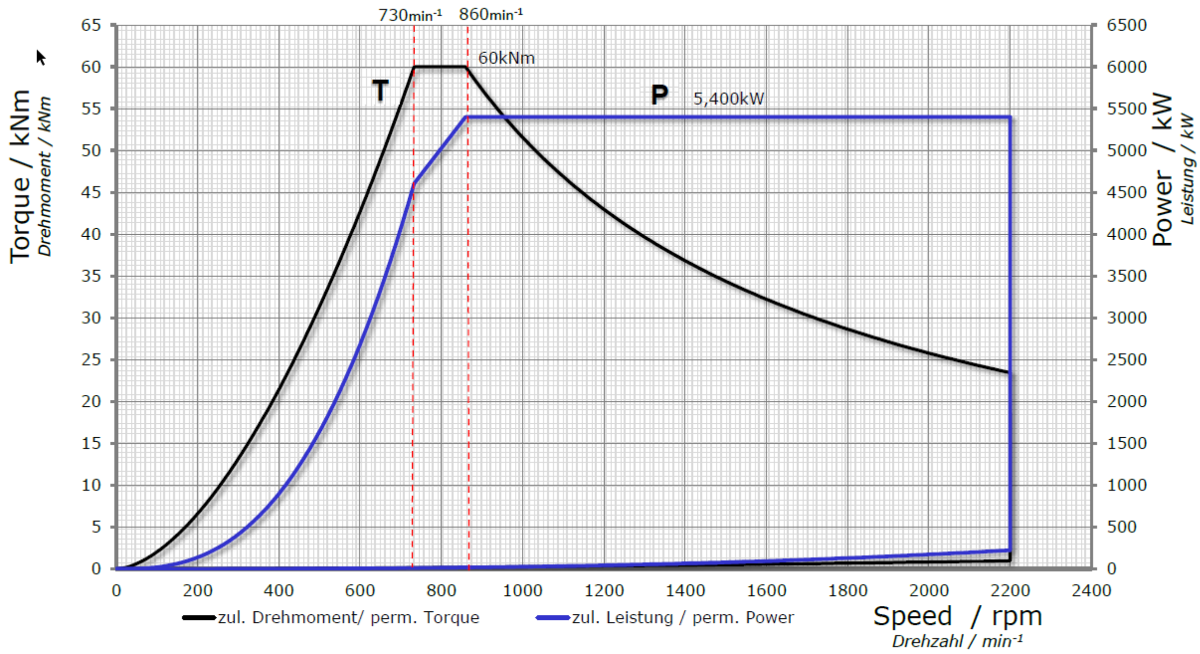

Figure 1 Performance diagram Omega 5400 S3 according to Error! Reference source not found.

6 Dimensions and interfaces

This chapter provides key information on the weights, interfaces, and physical dimensions of the Omega 5400 S3 and its associated components. Understanding these parameters is critical for proper facility layout, structural planning, and handling procedures during installation and commissioning.

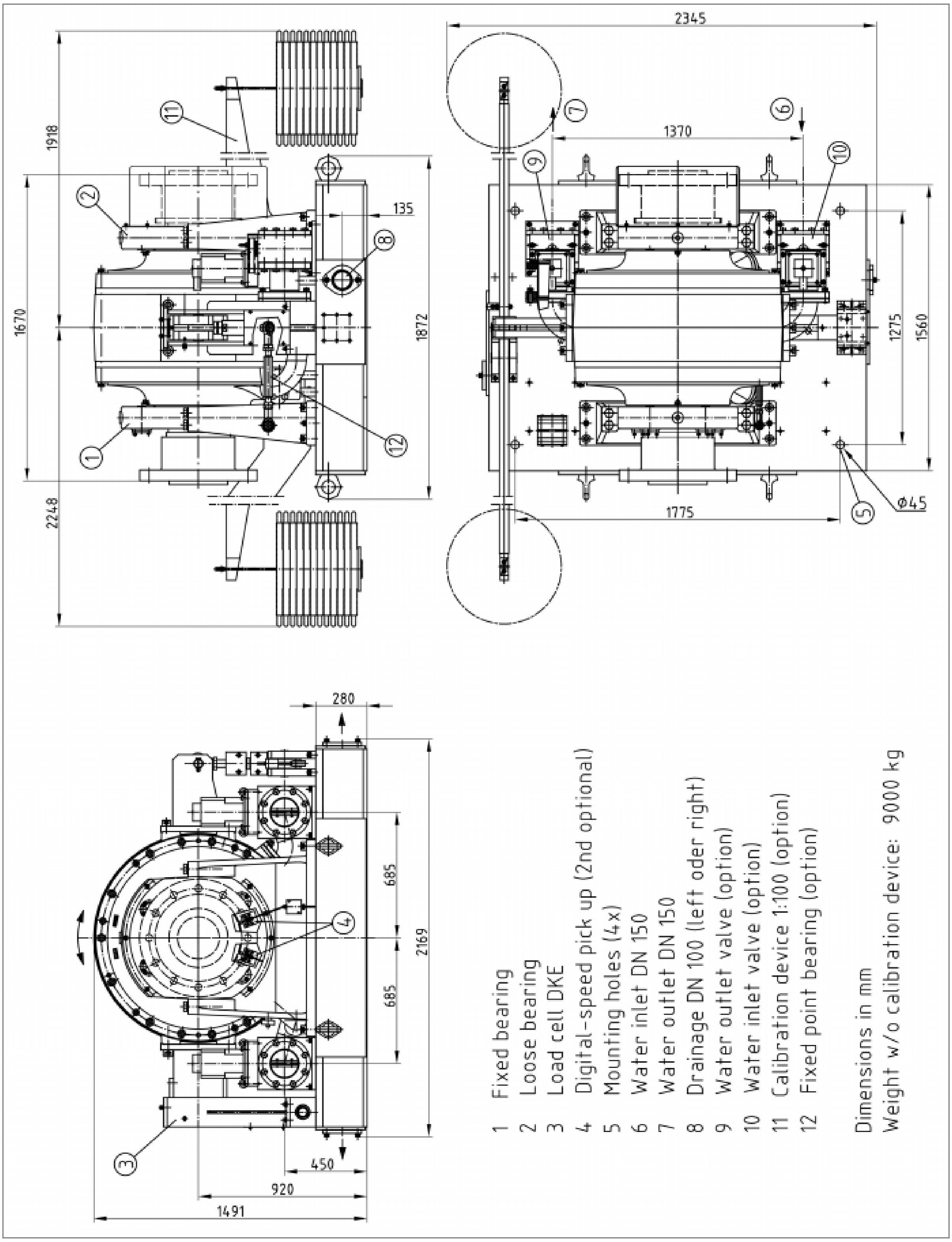

Figure 2 Outline and interface drawing according to Error! Reference source not found.

7 Water requirement

HD dissipate absorbed mechanical power as heat through water cooling. This chapter specifies the required water flow conditions to safely and effectively manage this thermal load. Key parameters include water flow rate, inlet temperature, pressure range, outlet temperature limits, and water quality guidelines.

To assist with system sizing and integration, this chapter also provides a standardized equation to calculate the required water volume flow rate (Q) based on the absorbed mechanical power (P) and the permissible temperature rise (ΔT) of the cooling water. The calculation assumes steady-state conditions and typical values for water density and specific heat capacity:

$$Q_W = 0.86 * \frac{P}{\Delta T}$$

Q_W	required water flow rate	$[\frac{m^3}{h}]$
P	absorbed mechanical power	$[kW]$
ΔT	temperature difference between inlet and outlet ($\Delta T = T_O - T_I$)	$[K]$
T_I	water inlet temperature	$[°C]$
T_O	water outlet temperature	$[°C]$

Dieser Zusammenhang ist im folgenden Diagramm dargestellt:

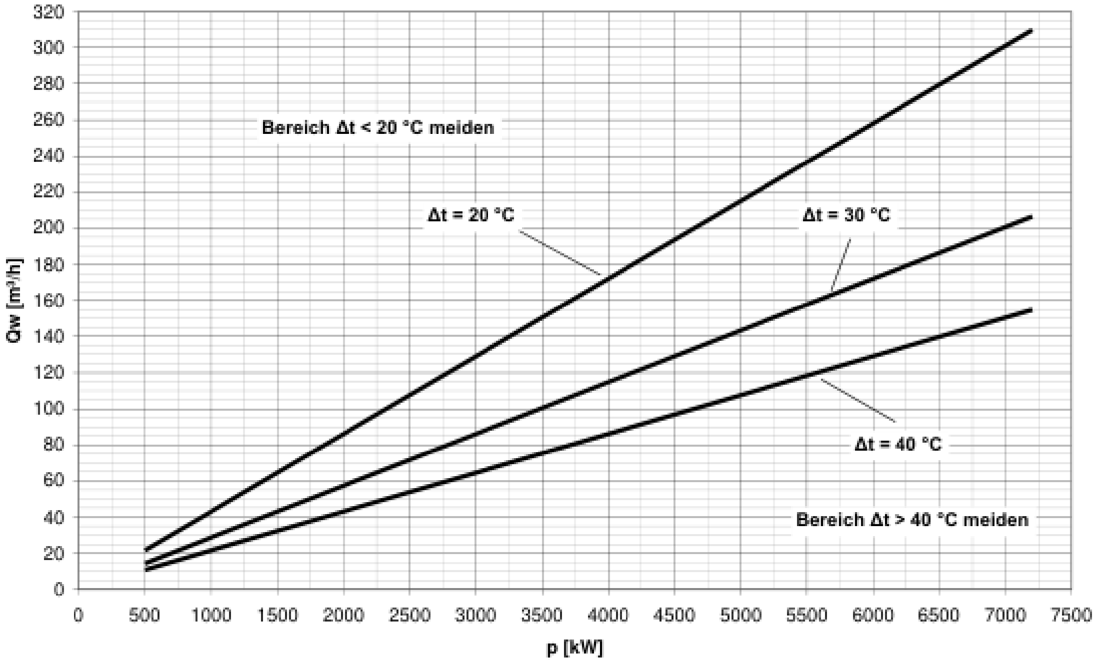

Figure 3 Water flow rate for different temperature differences according to Error! Reference source not found.

7.1 Cooling water and supply requirements

- **Pressure range (min – max)**: 1.5–2.5 bar, with a constant tolerance of ±0.1 bar
- **Inlet temperature**: No specific requirement, but must be >0 °C
- **Outlet temperature**: ≤60 °C
- **Recommended temperature difference (ΔT)**: 20 to 40 K
- **Particle size (contamination)**: ≤0.5 mm
- **Corrosion / frost protection**: No additives

8 Electrical system interfaces interface

This chapter provides an overview of the electrical and control system requirements for the Omega 5400 S3 dynamometer. It outlines the necessary power supply specifications (8.2), communication interfaces (8.3), control devices, and physical dimensions of key components (8.1) to ensure safe, reliable, and seamless integration with the test facility.

8.1 Components, dimensions, and weights

	Dimensions (W x H x D)	**Weight**
Power Cabinet (LSE) – 1 to 4 Valves	600 mm x 600 mm x 350 mm	39 - 43 kg

Table 4 Dimensions and weights of the electrical equipment

8.2 Electrical Power Supply

	Single-phase / N / PE (TN-S system)	**Three-phase / N / PE (TN-S system)**
Voltage	115 VAC ±10% / 230 VAC ±10%	3 x 400 VAC to 480 VAC ±10%
Frequency	50±2 Hz / 60±2 Hz	50±2 Hz / 60±2 Hz
Power consumption	max. 2 kVA	10 – 15 – 20 kVA
Minimum cable cross-section	3 x 2.5 mm²	5 x 2.5 mm²
Cable entry		From below
Maximum residual current	0 mA	240 mA
Maximum EMI	According to EN 61800-3 and EN 61000-2-4	
Foundation grounding conductor	According to DIN VDE 0100-540	

Table 5 Requirements for the electrical power supply

8.3 Communication Interfaces *(optional)*

Host Communication

- **Analog/Digital Signals**: Hybrid interface

Signal Outputs via Hybrid Interface

- **Speed**: ±10 V / 0–20 mA / 4–20 mA
- **Torque**: ±10 V / 0–20 mA / 4–20 mA
- **Power**: ±10 V / 0–20 mA / 4–20 mA

Alarms

- Volt-free (potential-free) contacts

9 Environmental requirements

To ensure reliable operation, longevity, and accuracy of the Omega 5400 S3, it is essential to maintain specific environmental conditions within the test facility. Table 6 defines the permissible ambient conditions under which the dynamometer and its auxiliary systems are designed to operate.

	Control Room	**Test Cell and Technical Floor**
Temperature range:	0 °C to +45 °C	5 °C to +40 °C
Relative humidity:	<75%, non-condensing	<90%, non-condensing

Table 6 Ambient conditions for HD operation