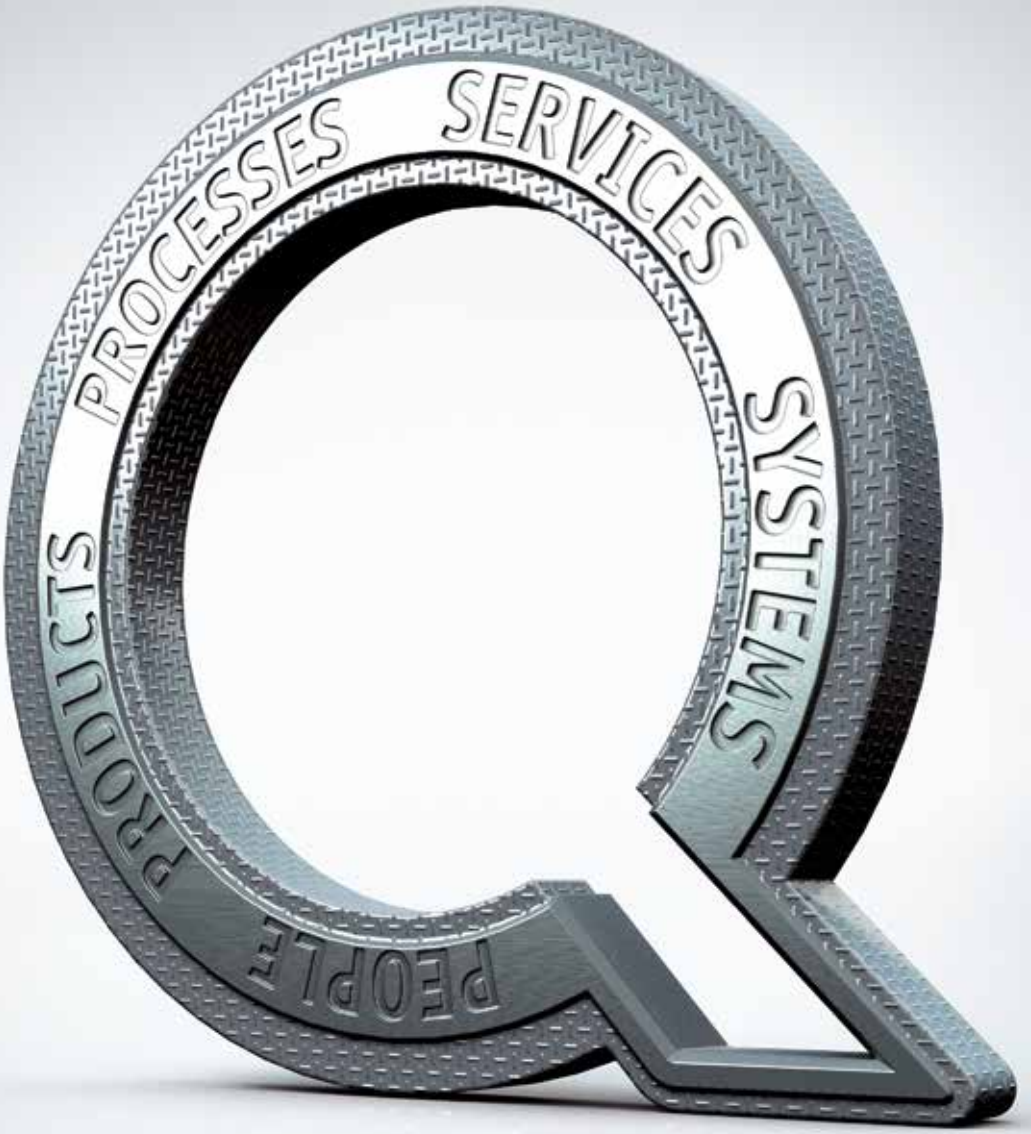


Quality in Action

at HAWE Hydraulik

Solutions for a World under Pressure

HAWE HYDRAULIK

Preface

HAWE Quality in full flow...

... and everybody benefits – the people buying and using our products and, of course, the people at HAWE themselves. We offer top product quality at attractive prices, delivering reliably and on time. All of HAWE's people and units remember our strategic focus in their work. The challenge is for us to strike the right balance between staying agile and being professional, and to act according to that ambition.

To keep this possible, we – Quality, Organization and Personal – assist HAWE's management in creating the right environment in terms of personnel, organization and technology. We believe that we have brought together the right set of skills in our Quality and Organization team. We know that the potential of the technology we have available can only ever be put to its full use with the right people, working in a coherent structural and procedural organization.

Comprehensive quality controlling means that HAWE is always monitoring and recording the effect of this concept, for us to be able to say one day: "HAWE lives quality"

This brochure tells you more about how we live this ambition with all of our people and our business partners.

I hope you will enjoy reading more about quality at HAWE. My team and I are always there to answer your questions at qualitymanagement@hawe.de

Yours
Stefan Schmid
Director of Human Resources, Organization and Quality

Index

Organization
General Information

Headquarters
HAWE Hydraulik SE
Einsteinring 17
85609 Munich
Germany

info@hawe.de
www.hawe.com

Phone: +49 89 379100-1000
Fax: +49 89 379100-91000

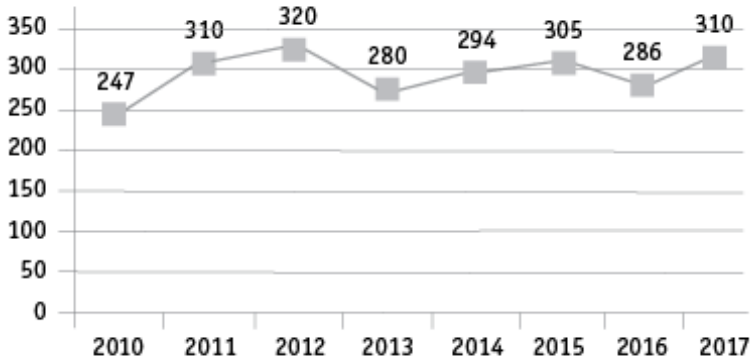
VAT ID: DE180016108
Commercial Register: HRB 174760,
Registry Court Munich

Headquarters in Aschheim/Munich

HAWE offers sustainable hydraulic solutions and makes a contribution to tackling global technological challenges. Our responsible and versatile employees work professionally across a value chain spanning three continents to develop intelligent products for demanding customers. We are able to generate dynamic growth in value-driven market segments.

Key Figures

Annual turnover of the HAWE-Group (in millions of EUR)



Number of subsidiaries	17
Number of production sites	4
Affiliated companies	1

Employees (as of December 2017)

HAWE-Group	2060
HAWE Hydraulik SE	1,587
HAWE Hydraulik SE – Production	72%
HAWE Hydraulik SE – Administration	28%
HAWE Subsidiaries	471

Product liability

(Insurance cover for physical injury and material damage)	€30 million

Executive Board

CEO
Karl Haeusgen

Assistance: Dagmar Sixt
Tel.: +49 89 379100-1274
E-Mail: D.Sixt@hawe.de

CTO
Martin Heusser

Assistance: Hilde Mihulet
Tel.: +49 89 379100-1378
E-Mail: H.Mihulet@hawe.de

CSO
Robert Schullan

Assistance: Dagmar Sixt
Tel.: +49 89 379100-1274
E-Mail: D.Sixt@hawe.de

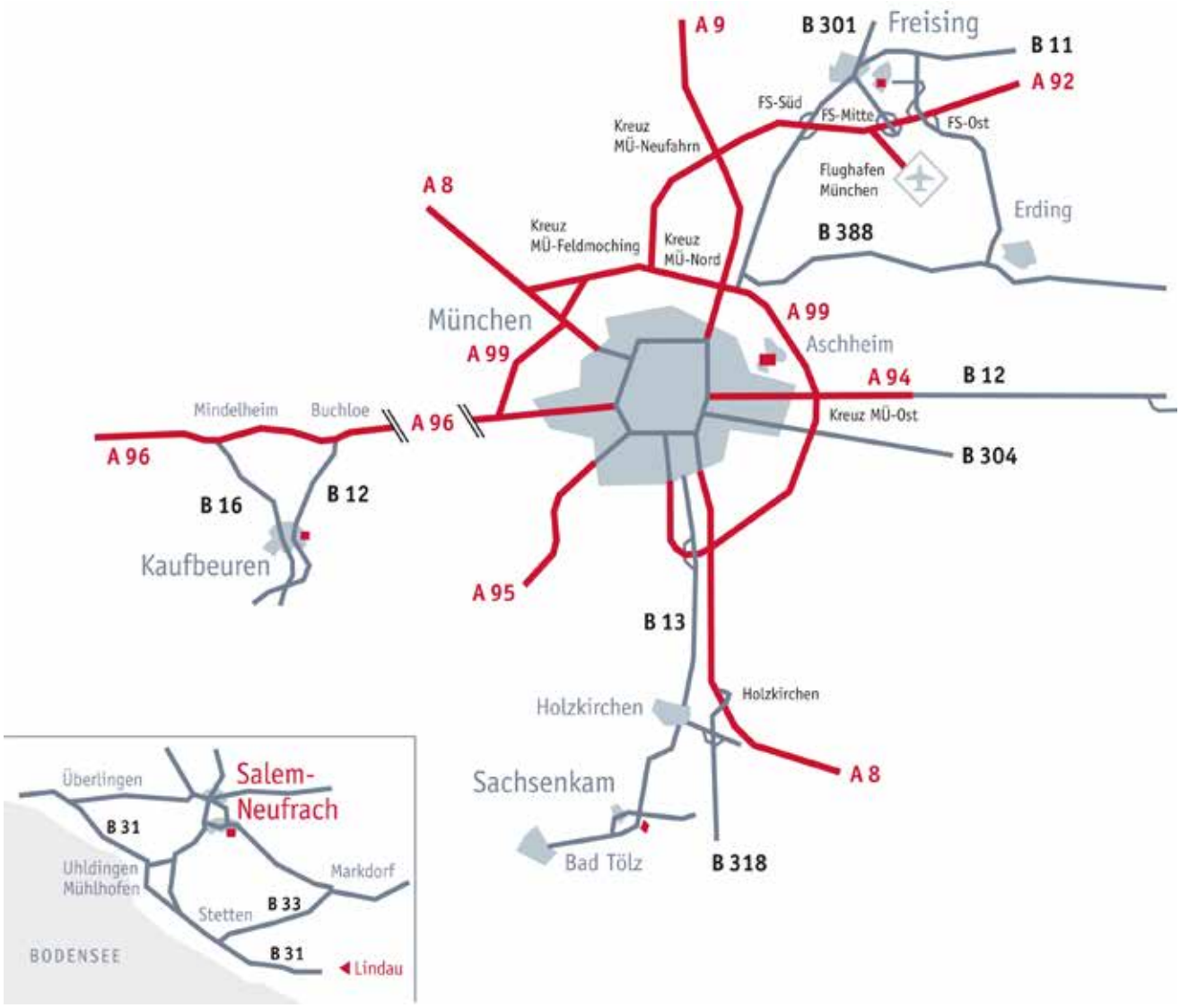
COO
Wolfgang Sochor

Assistance: Marianne Oswald
Tel.: +49 89 379100-1201
E-Mail: M.Oswald@hawe.de

CFO
Markus Unterstein

Assistance: Anna-Maria Keuler
Tel.: +49 89 379100-1441
E-Mail: Am.Keuler@hawe.de

Organization
Premises



Munich/Aschheim (since 1949, moved to Aschheim in 2018)

444 employees
(as of Dec 2017)

Production space: 6,400 m²
(total: 15,400 m²)

Core competencies:
- Research & Development
- Industrial Facility Management
- Industrial Engineering
- Administration
  (Purchasing, HR, etc.)

Freising (since 1965, expanded in 2007/2008)

385 employees
(Dec 2017)

Production space: 13,000 m²
(total: 16,500 m²)

Core competencies:
- Production of valve units
- Production of pump casings
- Production of ground parts
- Logistics hub for all Bavarian sites

Sachsenkam (since 1977, new buildings 2008/2009

225 employees
(Dec 2017)

Production space: 6,000 m²
(total: 7,350 m²)

Core competencies:
- Mass production of lathed parts and ground/sanded parts with automated loading and unloading
- Mass production through deployment of product-specific rotary transfer machines
- Automated assembly (RK / RB valves, pump elements)

Kaufbeuren (since 2011, new buildings 2014)

503 employees
(Dec 2017)

Production space: 30,000 m²
(total: 50,000 m²)

Core competencies:
- Manufacturing of PSL valve banks
- Manufacturing of LHDV valves
- Line production of valve banks and spool valves
- Automated assembly of modules

Schienle Magnettechnik + Elektronik GmbH, Salem/Lake Constance (since 1998)

90 employees
(Dec 2017)

Production space: 3,300 m²
info@schienle.de

Core competencies:
- Developing, manufacturing, and distributing solenoids, sensors, and actuation systems with and without explosion-proofing

Organization
Sales Organization

Subsidiaries – The HAWE-Group

Core competencies:

- Sales/Advice
- 2D and 3D CAD System Design
- Assembly and Performance Tests
- Complete Documentation
- Warehousing and Logistics
- Framework Agreements
- Product Training
- Maintenance and Service

HAWE North America, Inc. (since 1997)
Charlotte, North Carolina, USA (Head Office); Houston, Texas, USA; Portland, Oregon, USA

59 employees
(Dec 2017)

sales@hawehydraulics.com

HAWE-Italiana S.r.l. (since 1973)
Milan, Italy (Head Office); Bologna, Italy

28 employees
(Dec 2017)

info@hawe.it

HAWE Hydraulik France
(since 1977 as HAWE-France S.A.S./2007 Takeover of Otelec SARL)
Tigery, France

22 employees
(Dec 2017)

ventes@hawe.fr

HAWE Hidraúlica S.L.U. (since 1995)
Barcelona, Spain

7 employees
(Dec 2017)

hawe.hidraulica@hawe.es

HAWE-Hydratec AG (since 1996)
Perlen, Switzerland

24 employees
(Dec 2017)

info@hawe-hydratec.ch

HAWE Finland Oy (since 2000)
Espoo, Finland

7 employees
(Dec 2017)

info.finland@hawe.fi

HAWE Hydraulik Sweden (since 2016)
Göteborg, Sweden

4 employees
(Dec 2017)

info@hawe.se

HAWE Österreich GmbH (since 2001)
Gerersdorf, Austria

5 employees
(Dec 2017)

office@hawe.at

HAWE Hidravlika d.o.o (since 2004)
Petrovče, Slovenia

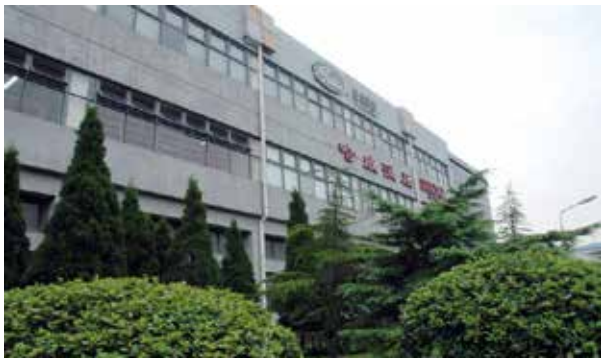
10 employees
(Dec 2017)

office@hawe.si

HAWE Oil-Hydraulic Technology (Shanghai) Co., Ltd. (since 1998)
Shanghai, China (Head Office); Beijing, China

100 employees
(Dec 2017)

info@hawe.com.cn



HAWE Japan Ltd. (since 2007)
Nagoya, Japan (Head Office); Tokyo, Japan; Osaka, Japan

24 employees
(Dec 2017)

info@hawe.co.jp

HAWE Korea Co., Ltd. (since 1995)
Chungnam, South Korea; Busan, South Korea

34 employees
(Dec 2017)

info@hawe.kr

HAWE Hydraulics Australia PTY Ltd. (since 2007)
North Wollongong, Australia

5 employees
(Dec 2017)

info@hawe.com.au

HAWE Hydraulics Pvt. Ltd. (since 2001)
Bangalore, India

47 employees
(Dec 2017)

contactus@haweindia.com

HAWE Hydraulik Singapore Pte. Ltd (since 2012)
Singapore City, Singapore

5 employees
(Dec 2017)

chan.ch@hawe.com.sg

HAWE Representative Office **(seit 2016)**
Moscow, Russia

4 employees
(Dec 2017)

info@hawe.com.ru

Hydra-Fab Fluid Power Inc **(since 1989, acquired by HAWE in 2018)**
Ontario, Canada

30 employees
(Dec 2017)

sales@hydrafab.com

Organization

Sales Organization

Sales Offices in Germany

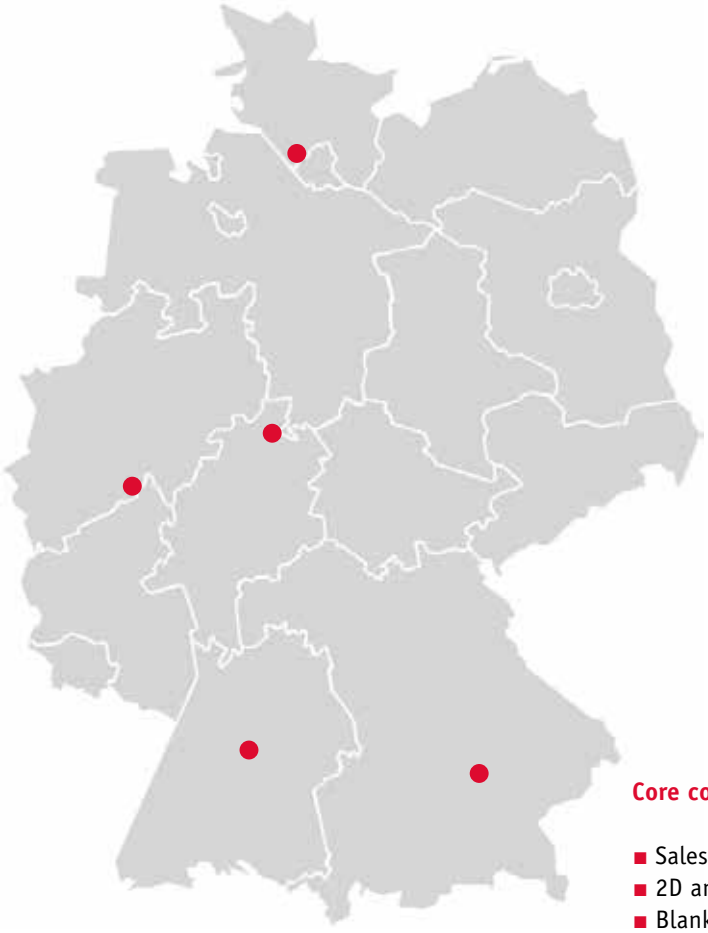
Freising Office
HAWE Hydraulik SE
Kulturstr. 44
D-85356 Freising
Vertrieb-Freising@hawe.de

Filderstadt Office
HAWE Hydraulik SE
Felix-Wankel-Str. 41
D-70794 Filderstadt
Vertrieb-Filderstadt@hawe.de

Hennef Office
HAWE Hydraulik SE
Bonner Str. 12 d
D-53773 Hennef
Vertrieb-Hennef@hawe.de

Kassel Office
HAWE Hydraulik SE
Frankfurter Str. 229 b
D-34134 Kassel
Vertrieb-Kassel@hawe.de

Norderstedt Office
HAWE Hydraulik SE
Werkstr. 6
D-22844 Norderstedt
Vertrieb-Norderstedt@hawe.de



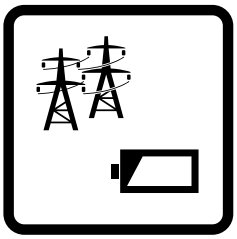
Core competencies:

- Sales and support
- 2D and 3D-CAD system design
- Blanket orders
- Service and maintenance

Sales Partners

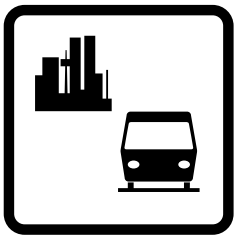
The Americas	Argentina, Brazil, Chile, Ecuador, Panama, Peru
Asia-Pacific	Hong Kong, Malaysia, Taiwan, Thailand, Vietnam
EMEA	Austria, Belgium, Belarus, Bulgaria, Czech Republic, Denmark, Egypt, Finnland, France, Great Britain, Greece, Hungary, Israel, Italy, Luxembourg, Morocco, Netherlands, Norway, Poland, Portugal, Romania, Russia, Saudi Arabia, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Turkey, Ukraine

Industries



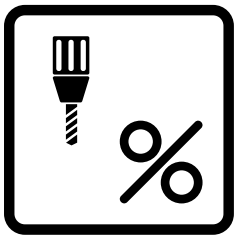
Energy

- Wind power
- Solar power
- Water power
- High voltage distribution



Infrastructure

- Construction equipment
- Municipal & road vehicles
- Civil engineering

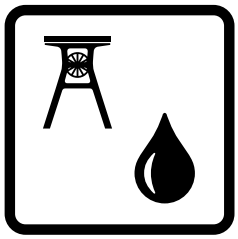


Efficient manufacturing

- Machine tools
- Material testing
- Plastic machinery
- Automotive manufacturing
- Hydraulic tools
- Lubrication
- Power units, manifolds, cylinders

Nutrition & Nature

- Agriculture
- Forestry



Resources

- Oil & gas exploration
- Mining equipment

Product Portfolio

Products – Unique Features

Compact, energy-efficient, and durable products:

- Consistent use of steel
- Components designed for high pressures
- Compact builds (installation space kept to a minimum)
- Zero leakage and/or controlled leakage
- Permission for special usage conditions (e.g. ATEX, KBA, CE)
- Range of products in a modular system
- Customized system solutions

HAWE Hydraulik is contributing toward solving global problems. This approach is reflected in our target markets.

Organization
Product Portfolio

Product Line-Up

Pumps
Hydraulic Pumps & Power Units
- Axial piston pumps and engines
- Radial piston pumps
- Compact hydraulic power units
- Two-stage pumps
- Gear pumps
- Hand pumps
- Air-driven hydraulic pumps




Valves
Pressure Valves
- Proportional pressure limiting and control valves
- Two-stage valves
- Shut-off valves
- Over-center valves




Check Valves
- Check valves with/without hydraulic release
- Pre-fill valves
- Line rupture protection valves
- Shuttle valves
- Clamping cylinders



Directional Control Valves
- Zero-leakage directional seated valves
- Directional spool valves with/without proportional control




Flow Control Valves
- Throttle valves, Restrictors
- Flow control valves
- Proportional flow control valves
- Flow dividers



Accessories & Cylinders
- Pressure switches
- Pressure sensors
- Pressure accumulators
- Clamping cylinders



Electronics
- Electronic amplifiers
- Economy circuits
- Programmable control systems



Quality Organization

In 2011, HAWE combined its quality management, organization management and HR management expertise into one dedicated business unit. As part of this holistic approach, the following activities make a contribution that helps the entire HAWE organization:

- Constant monitoring and further improvement of HAWE's organization
- Systematic training and development of all employees
- Establishment and delivery of central services

Quality Management System

HAWE's Director of Quality, HR & Organization has been formally nominated by the CEO and supervises all quality management (QM) activities at the entire HAWE-Group in line with DIN EN ISO 9001:2015 standards.

The effective functioning and further development of the QM system is guaranteed by the cooperation of the autonomous Quality Representative (QR) of HAWE's international subsidiaries with the on-site Quality Representative of the local production sites and administration units. This system of cooperation is supervised and managed centrally according to a standardized process, qualifying the entire HAWE-Group for a QM matrix certification. Upon successful completion of the certification audit, the QM system will have been officially validated and the Group as a whole and all its subsidiaries will be awarded joint and individual QM certificates.

IMDS (Integrated Management Documentation System) has been put in place as an active online quality management system. This is is maintained and constantly improved by HAWE's Quality Representatives. Several existing systems have been integrated into a single system.

Management assessments function as an umbrella QM review process that combines the regular reviews conducted at HAWE's subsidiaries. The QRs use it to specify which interventions need to be implemented in partnership with the local units. Their completion is monitored and assessed centrally by means of an established set of indicators.

Home of IMDS

The constant validation and improvement of this QM system relies on the use of **QM instruments**, such as an established continuous improvement process (CIP) and dedicated tracking indicators, audits, and reports. Additional controlling indicators are integrated with the self-assessment and monitoring indicators used for

QM purposes and feed into the monthly **Q&O Report** that reviews and visualizes the relevant financial, production, and quality indicators for use by selected management groups. The report has proven itself as a viable tool for executive management and line managers wishing to track the status quo of operations at the company. Selected information is published for HAWE's wider workforce with monthly breakdowns of the data from the Q&O Reports for individual sites.

HAWE's German sites and its international subsidiaries take part in **internal audits**, conducted according to DIN EN ISO 9001 standards by the central QM services. The results of these audits and the activities initiated in response are recorded in a central software system for use in the subsequent screening of the activities' impact and effectiveness in the following year's internal audits.

Corrective and preemptive interventions are selected after analyzing the data: CAQ (Computer-Aided Quality) data is processed into a report to support production management. All production incidents are recorded in the ERP system as additional data for the CIP process. This is further expanded with data from regular stock analyses and assessments and from the review of HAWE's chosen production principles (e.g. lean production, one-piece-flow principle).


ZERTIFIKAT ■ CERTIFICATE ■ 認證證書 ■ СЕРТИФИКАТ ■ CERTIFICADO ■ CERTIFICAT

CERTIFICATE

The Certification Body
of TÜV SÜD Management Service GmbH
certifies that
HAWE - Group

HAWE HYDRAULIK
HAWE Hydraulik SE
85609 Aschheim / Munich
Germany

has established and applies
a Quality Management System for

Development and Sale of
Hydraulic Components and Systems as well as
Corresponding Accessories,
including Manufacturing Plants and Offices
as well as their scope of application as attached.

An audit was performed, Report No. 70003345.
Proof has been furnished that the requirements
according to

ISO 9001:2015

are fulfilled.
The certificate is valid from 2018-01-03 until 2019-11-19.
Certificate Registration No.: 12 100 46656 TMS.

Product Compliance Management
Munich, 2018-03-05

Page 1 of 4

TÜV SÜD Management Service GmbH • Zertifizierungsstelle • Ridlerstraße 65 • 80339 München • Germany
www.tuev-sued.de/certificate-validity-check


Internal production-audit

Production operations are managed on the basis of **CIP indicators** for process controlling, including throughput times, capacities and their utilization, wastage data, quality costs, downtimes, and data from the results-oriented validation of the individual processes.

Customers' warranty claims lead to immediate fault assessments to define the suitable responses in terms of relevant corrective or preventative actions. Technical quality management conducts regular meetings in the operational units to review critical or repeated faults and introduce effective countermeasures to aid the systematic evolution of HAWE's production processes.

HAWE produces a full report on every guarantee or warranty incident, including details on the actions taken on behalf of the customer. Any actions are recorded via the ERP system to ensure the traceability of the incident and the availability of the required spare or replacement parts.

Since 1994, HAWE is certified according to DIN EN ISO 9001.

Quality Organization
Quality Policy

At HAWE, we see quality from two perspectives:

Customer's perspective:
HAWE regards itself as a reliable, agile supplier and engineering partner that pursues the goal of satisfying demanding **customers** over the long term. To this end HAWE provides products of highest quality and durability, guarantees very reliable delivery and offers manifold **services** with short reaction times

Internal perspective:
Our **employees** fulfill customer requests by professionally and transparently managing their **processes**, **products** and **systems**, as well as continually optimizing these. Deadlines, efficiency and results always take center stage.

At HAWE, we are committed to the following principles:

Employees
- A high standard in internal professional training guarantees the availability of qualified skilled workers.
- Our highly talented executives and employees enjoy clearly defined scopes of responsibility to act independently within the framework of assigned duties and agreed targets. KPIs allow the transparent evaluation of these targets and serve as a decision-making basis for measures to be implemented.
- Standardized methods are used to determine and promote the development potential of employees (also as part of the in-house HAWE Academy).
- The employees' expertise and knowledge is a vital success factor for HAWE and is retained within the company through mutual exchanges and a purposeful succession program.

Products & Processes
- Interdisciplinary teams, concurrent development phases and the strategic integration of clients into customer-specific developments, all help to complement and further the standardized product development process.
- The QM system ensures that top quality also remains consistent with large numbers of variants and small batch sizes.
- High-performance and intelligent IT tools (such as CAQ, ERP, Intranet) interlink processes and employees to support the deployment of appropriate quality methods (among others, audits, FMEA). This guarantees preventive error avoidance and continual improvements to products and processes.
- The sustainable and forward-looking selection and development of our suppliers ensures ideal cooperation in line with HAWE's quality standards.
- The systematic selection and forward-looking development of suppliers (among other things by conducting supplier audits, QSVs) ensures collaboration between partners and meets the quality requirements of HAWE.

Services
- Our skilled sales staff support customers in developing bespoke hydraulic solutions..
- Our worldwide service network assists our customers 24/7 and provides them with swift technical support and assistance with skilled local service technicians.
- The service products utilized support our customers in unlocking the full potential of HAWE's products

Systems
- The international reach of our quality management system sets global standards applicable throughout the entire HAWE-Group.
- Independent organizations regularly certify our management systems and products (among others ISO 9001, ISO 14001, ISO 50001, CE0036, KBA).

Quality Organization
Environmental Protection, Energy, Health & Safety Management (EHS)

HAWE is committed to protecting and promoting the occupational health and wellbeing and workplace safety of all of its people.

The Management Board appoints the EHS team leader in writing as the EHS Management Representative. This person is responsible for the EHS management system within HAWE SE in accordance with DIN EN ISO 14001/50001 and OHSAS 18001.

In addition to the protection of our environment and the efficient use of energy, occupational health and industrial safety are integral parts of HAWE's corporate principles. It is the duty of any company to reconcile the demands of ecology and economy. This principle is defined and applied in HAWE's **Industrial Safety and Environmental Policy**.

Derived from the Strategic Goals, EHS management system programs are established each year and communicated to all employees. Annual training on accident prevention for all personnel, regular seminars for the officers in charge, and expert qualification opportunities guarantee the stringent introduction and pursuit of targets with clearly defined responsibilities in the individual sites of the HAWE companies.

SUSTAINABILITY @ HAWE

HAWE has defined fully measurable targets for **environmental protection**, including:
- The reduction of energy consumption and emissions to air and water.
- The reduced consumption of operating materials and hazardous materials.
- The maintenance of an operations- and hazardous substances registers.
- The continuous improvement of resource recycling.

HAWE has defined fully measurable targets for e**nergy efficiency**, including:
- The procurement of energy-efficient machines and equipment.
- The improvement of energy efficiency in terms of site and building services.
- The screening of production processes for energy efficiency.
- The energy-efficient planning and construction of buildings and facilities.

HAWE has defined fully measurable targets for **occupational health and safety**, including:
- The replacement of hazardous materials and substances with less harmful options.
- The improvement of workplace ergonomics.
- The prevention of workplace accidents and absences due to sickness or accident.
- The standardization of personal safety equipment.
- The reduction of harmful noise in production facilities.

The efforts have led to the following certifications:
DIN EN ISO 14001:2015 – HAWE SE (Matrix since 2012)
DIN EN ISO 50001:2011 – HAWE SE (Matrix since 2013)
OHSAS 18001:2007 – HAWE SE (Matrix since 2014)

Industrial Safety and Environmental Policy

HAWE Hydraulik regards health and safety in the workplace, environmental protection, and sensible and efficient use of energy as tasks for every employee.

HAWE therefore commits itself to the following industrial safety and environmental guidelines:

Health and safety at work, and doing business energy-efficient and environmentally-friendly is a key principle at HAWE.

The company regularly examines compliance with all applicable legal requirements on health and safety at work as well those pertaining to energy and the environment.

Alongside market and customer requirements for our products, HAWE monitors the optimal usage of energy and resources and the lowest possible environmental impact. This applies both to the generation and the entire life cycle of our products.

Health and safety, environmental, and energy considerations in our production processes are continuously monitored and evaluated. Activities and processes meriting by alternatives that represent an improvement in terms of technical, ergonomic, environmental and energy factors.. We put great emphasis on creating and maintaining a safe work environment that fosters and promotes health and high achievement. Prior to their implementation, all new activities and processes are analyzed to prevent damage to people and the environment, as well as inappropriate energy consumption.

We define strategic and operative targets, which we monitor using performance indicators. We also define and document responsibilities for attaining these targets. The employees in charge have free access to all the results and measurements. This constant review must result in a permanent improvement in health and safety protection, energy-related metrics at the company and a continual reduction of the impacts on people and the environment.

We define and further develop procedures and methods that contribute through the acquisition of products and tertiary services toward improving health and safety at work, including energy and environmentally related services. We require our suppliers to comply with our industrial safety and environmental policies as well as all applicable legal requirements.

HAWE consistently reinforces its employees' sense of responsibility for corporate health and safety and environmental protection as well as energy efficiency and further develops this via regular information, training and briefings.

We keep our customers, the public and authorities informed about our objectives and activities for health and safety at work, energy and the environment. We want to contribute to an improved mutual understanding of these issues through an objective dialogue. To this end, we continually work with all parties concerned.

Suitable measures are planned and implemented to prevent or minimize the effects caused by malfunctions and accidents that could result in damage to people and the environment.

HAWE commits itself to use resources sparingly and strives to avoid noise and emissions harmful to health and the environment, refuse, waste water and the unnecessary consumption of energy. To achieve this, the company seeks to use the best available state-of-the-art technology. Workplace ergonomics are of great importance for HAWE to maintain and promote the health of our employees.

Our management system provides for the technical and organizational implementation to ensure success of our health and safety and environmental protection policy. This system also serves to identify deviations from the objectives or system. Discrepancies are remedied as swiftly as possible by introducing corrective measures.

Quality Organization
Control of Documents and Records

Standardized, fully documented processes and instructions are used to manage the flow of business-relevant documents and records.

Our quality representative and the specialist personnel ensure that these documents are kept up to date in the IMDS and available where they are needed to achieve a reliable and consistently traceable flow of information to HAWE's employees.

Process documentation in IMDS

Responsibilities and Authorizations

Our employees' responsibilities and areas of oversight are specified in a job or role description, which is updated at least once a year as part of the appraisal interview.

A standardized **potential rating** is a mandatory process for both internal and external applicants for executive positions. The critical requirements of the job in question are simulated in a dedicated **aptitude diagnostics procedure** in line with the DIN 33430 standards, in which the candidates' aptitude is assessed as a set of behavioral criteria. Irrespective of any placement decision, individual development plans are dformulated and adopted for the candidates. After appointment to an executive position, the success of the candidate is monitored with regular performance indicators and a **360° feedback** process.

Skills, Training and Awareness

All executives abide by their shared leadership principles as expressed in practical behavioral terms in the HAWE model of competence.

They are trained to conduct the annual employee reviews by means of dedicated guidelines, turning this joint employee-supervisor meeting into a well-established instrument and forum for mutual feedback. In this process, **annual targets** are defined in line with the general strategic direction of the company. The effect of past **HR development measures** is assessed and new activities are chosen for the next period to match the job requirements defined in the job description.

The **HAWE Academy** provides a selection of HR development opportunities for all HAWE staff. This academy allows easier access to trainings, seminars and autodidactic study formats. It is also a channel for sharing and transferring skills between the people and units of the organization.

Internal training – hydraulic basics

Product Selection & Technical Support
Sales

HAWE operates a network of sales offices for immediate on-site support for its clients.

Most queries and emails can be handled directly by internal services. Defined rules for forwarding calls and replacements during periods of absence are in place to guarantee **constant availability**. We provide top-class customer support by recording all relevant customer data in a central CRM system.

Field service teams are available to process specific questions or functional queries on site at the customers. The technical support team helps with project development and design for specific applications and sectors of industry.

Most of the customer's specifications can be fulfilled with a choice of functionalities from HAWE's modular portfolio. In this case, HAWE will produce a full **quote** within around two working days. Every quote includes details on pricing as well as the product ID and material class. Where required, full hydraulic diagrams or 3D models are included, using different electronic tools.

Order processing is handled by sales offices. The order data is recorded as a single incident in ERP or automatically entered for larger accounts. This helps reduce the margin of error and speeds up the process to enable us to confirm the order within two working days.

The system allows an automatic forecast of **delivery** dates, including details on transport times. HAWE has developed a set of strategically optimized standard delivery times to enable efficient delivery handling as expected by the markets. For regularly recurring requirements, HAWE offers its customers tailor-made solutions for reduced delivery times.

HAWE has introduced effective means to ensure that customers receive the goods they ordered in full and to their specifications (see "Production"). In the unlikely case that this does not happen, the customer can contact our sales or customer service team directly, who will take over the handling of the claims from there.

Product & Application

The Product & Application team oversees the different product classes throughout their product lifecycle and identifies the requirements derived from the diverse customer applications for the products.

Our Product Manager and Key Market Manager have practical expertise on which HAWE hydraulic and electronic components are suitable for particular applications. They are available to offer advice to the sales department and to customers alike.

Our Product Manager and Key Market Manager acquire their knowledge about products, functions and applications by way of:

- Close cooperation with the R&D department at HAWE
- Participation in customer projects
- Involvement in organizations and research projects
- Continual monitoring and analysis of the market

To support sales team and customers, a helpdesk system is used, which assigns tickets to the respective specialists for timely processing.

The Product & Application team keeps the documentation and sales tools up to date, as well as organizing trainings and sales meetings.

Hydraulic requirements vary depending on the target market – whether in energy, infrastructure, efficient production, nutrition and health, or resources. Technical Support therefore has **Key Market Managers** who are experts in specific markets and are familiar with their hydraulic requirements. Using their knowledge, they can work out the right HAWE hydraulic component solution for customers.

The Key Market Managers can also launch projects for new hydraulic technology in **strategic product development**.

HAWE products are subject to European and international guidelines, standards, and laws. The Product & Application team determines the appropriate requirements and observes the changes that may affect the product design. It is involved in various associations and working groups.

Product Selection & Technical Support
Technical Documentation

HAWE supports customers, planners, and users, providing them with technical documentation.

Technical documentation can be directly downloaded from the HAWE website or is available by request.

With these documents, HAWE meets the **legal requirements** for liability, traceability, reproducibility and permanent archiving required by law.

Planners are supported from the product selection stage right through to the detailed technical design:

The following **selection and planning documents** containing information on the entire product life cycle are available to planners:
- Catalogs and product sheets
- Publications (detailed data sheets)
- Spare parts lists and exploded drawings
- 3D models

The technical documentation offers planners support with the following tasks:
- Choosing the right product
- Specifying the product version and the technical features
- Creating a detailed technical design
- Identifying and procuring spare parts
- 3D modelling in machine construction

Supporting users from installation through to maintenance and product disposal:

The technical documentation both informs and instructs the user or fitter and helps them with the product handling.

The **European Machinery Directive** requires manufacturers to supply accompanying documentation.

Assembly instructions are necessary for incomplete machines, such as hydraulic drives. Operating manuals are necessary for complete machines, such as drives combined with moving parts. HAWE takes this obligation very seriously and provides comprehensive assembly and operating manuals, which also include maintenance information.

Users and fitters can thus ensure that they are handling their machine properly, guaranteeing a long service life.

Publication for a proportional directional spool valve

Development

Whenever customers need products for purposes that are still unmet by HAWE's modular portfolio, the right solutions can be developed at the R&D or SYSTEC.

R & D projects are started to suit industry trends as well as market and customer requirements. Control tool here is the product roadmap and product management. SYSTEC projects are dedicated to special customer-specific requirements and combine the HAWE standard components with parts from selected partner companies, creating customized solutions and systems.

A standardized process is used for developing new or optimizing current components and systems, with defined rules for organizing, processing, and documenting such projects. This process serves as a binding guideline for projects throughout the entire development process, which is based on ISO 9001: 2015 and described in the HAWE Process Map.

In the project management system, the projects are software-based and controlled by key figures. Tools such as Stage-Gate processes and agile development methods are used depending on the project and phase.

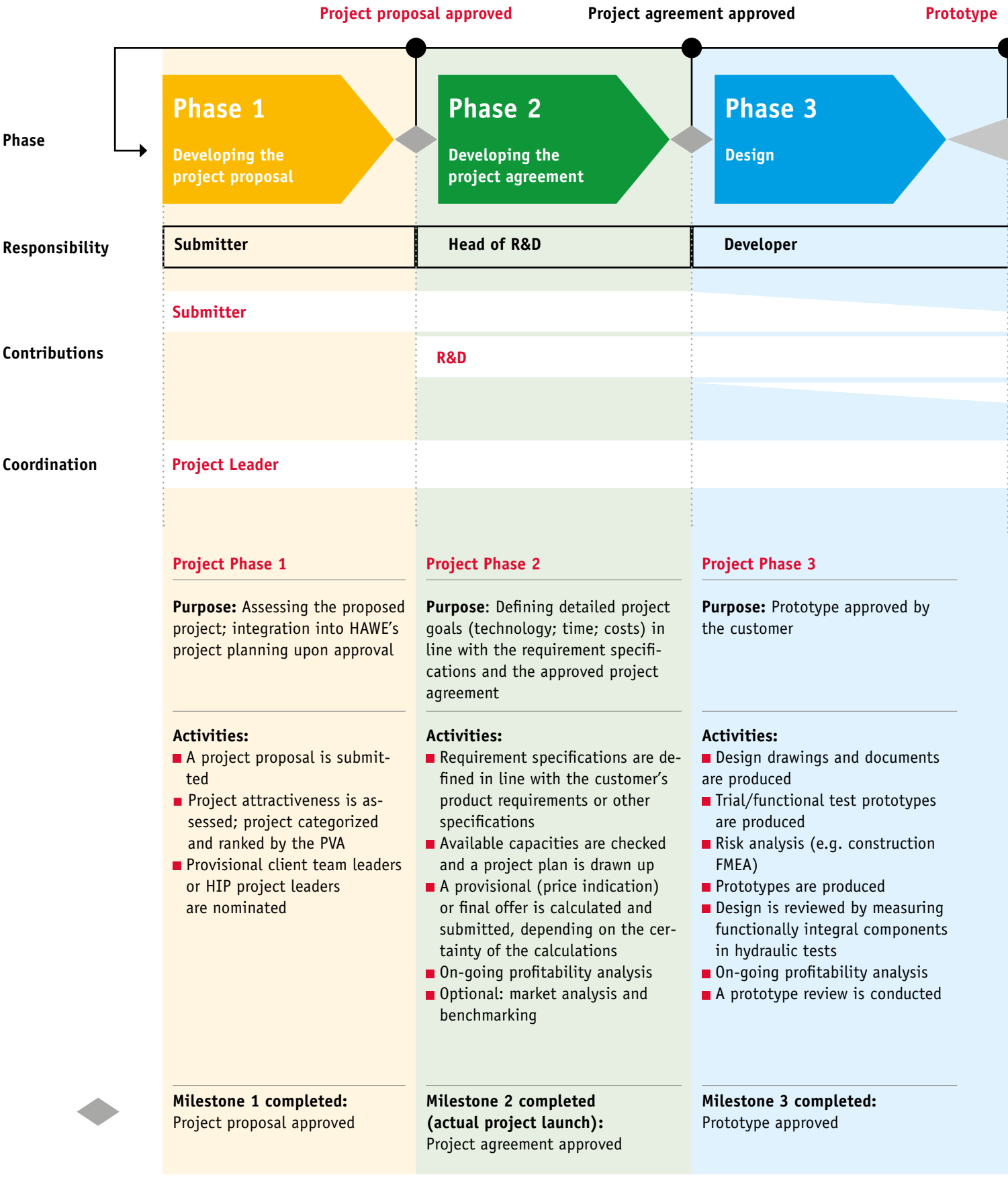
Highly innovative, complex projects can become part of the **HAWE innovation process (HIP)** if certain criteria are in place-namely:

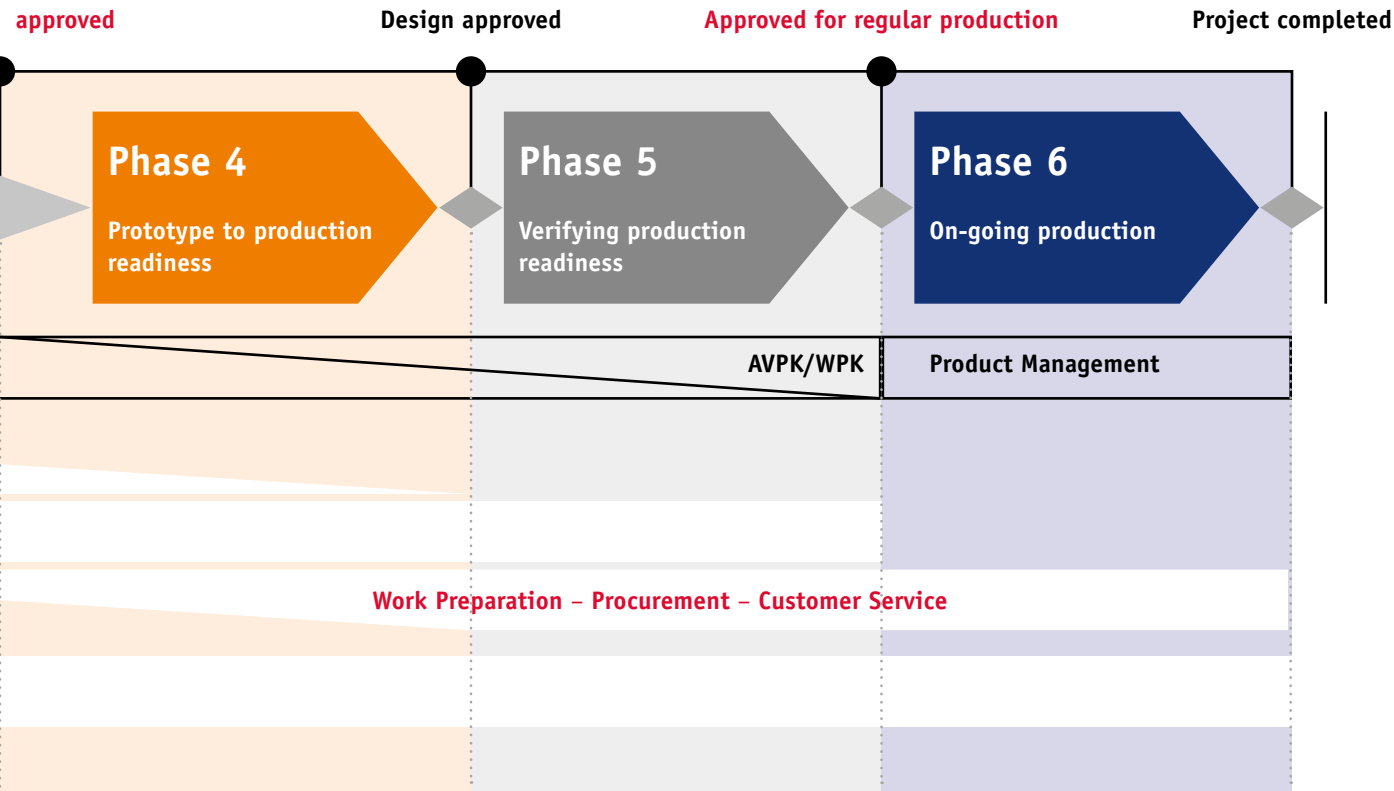
- Complex coordination between multiple departments, units and/or suppliers
- Strategic significance of the product
- Substantial investments

The decision whether and when a project is considered an HIP project is taken at the regular sessions of the executive team and communicated to the departments involved, including the appointment of a HIP project leader.

Development

Project Plans and Schedules in Component Development





Project Phase 4

Purpose: Completed construction documents after the successful production of a pilot batch under regular production conditions

Activities:

- A pilot batch is produced and tested on the basis of the prototype and under regular production conditions
- Process FMEA for production and assembly
- Process feasibility review
- Customer service and logistics concepts are developed
- On-going profitability analysis
- Prototypes tested at the customer
- Completed batch production

Milestone 4 completed:
Design approved for production

Project Phase 5

Purpose: Completed regular production

Activities:

- Initial batch is produced; the viability of the new processes is tested under regular production conditions
- The project's feasibility is confirmed by Production
- Production processes are optimized
- On-going profitability analysis

Milestone 5 completed:
Approved for regular production

Project Phase 6

Purpose: Monitoring on-going production and concluding the project

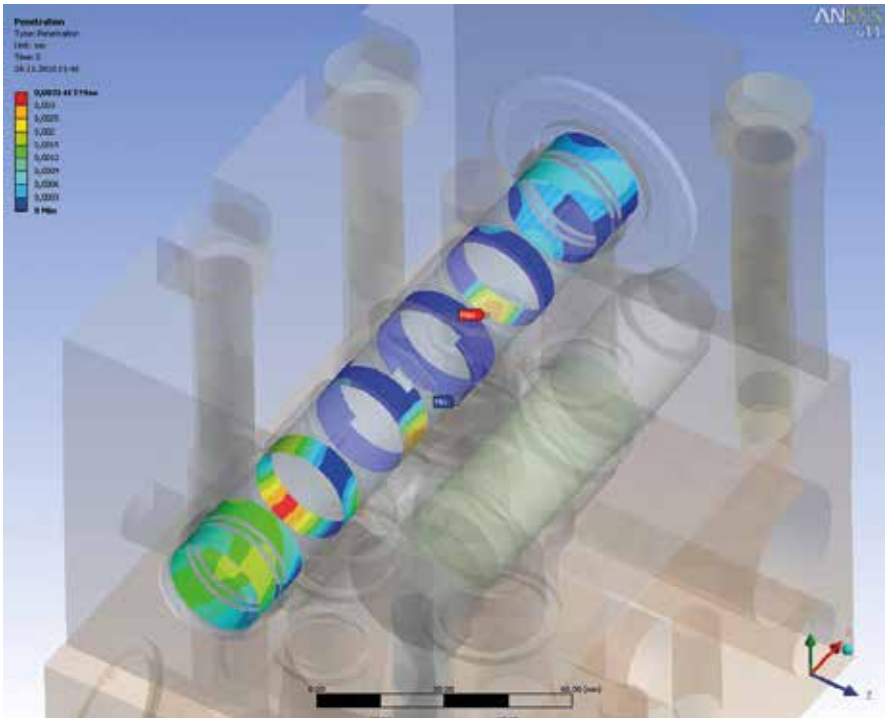
Activities:

- Regular batch production
- The viability of the processes is monitored and verified over 6+ months
- The predicted production volumes are tracked in on-going profitability analyses
- Project review

Milestone 6 completed:
Project completed

Development
Simulation accompanying development

Depending on the product and the task, various simulation tools are used as required in the most varied of development phases. In the conceptual design phase, simulation results are used to test different concept variants and to evaluate them against defined target values. In the further phase of product development, simulation results are used for risk assessment or securing and are included in the FMEA. Ensuring high-quality simulation work requires investment in core topics. These are often carried out in collaboration with local colleges as well as specialized institutes at universities. Fundamental work finds its way into HAWE products.
The simulation team at HAWE is currently divided into four areas of competence, which will be presented below.

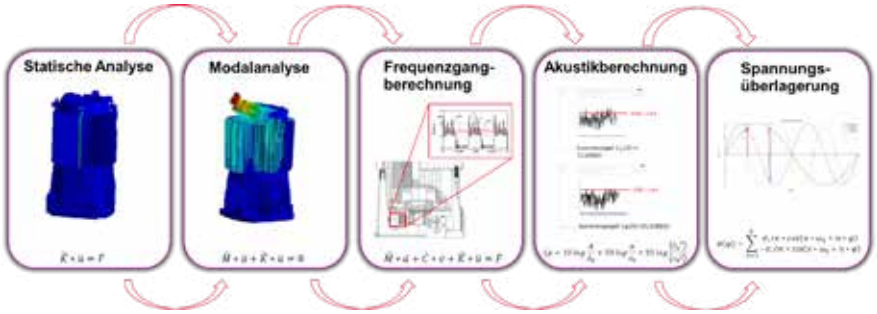


FEM View

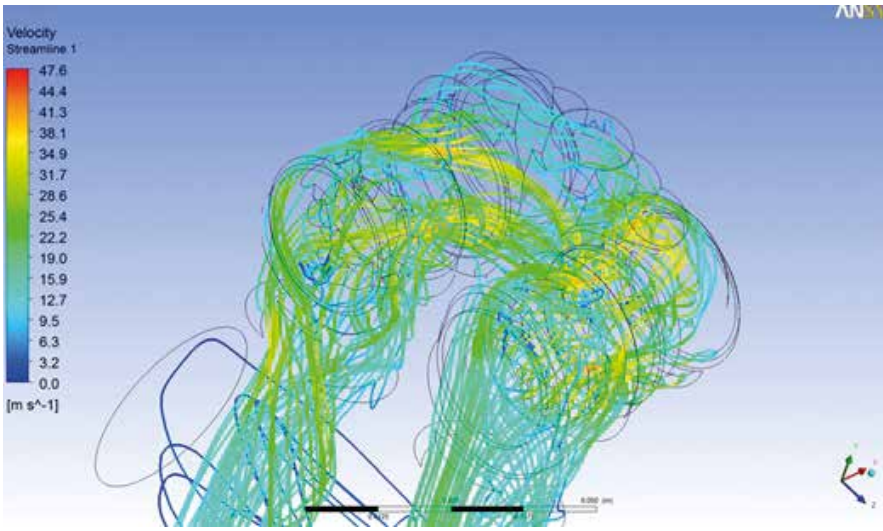
The **Finite Element Method (FEM)** is used in the following areas:

- Identification of critical points with high stresses/ strains depending on the load
- Bolt calculations in accordance with VDI 2230
- Strength analyses
- Design of shafts and fits
- Examination of form tolerances and deformations on flange surfaces, cylinder bores, etc.
- Fatigue rating according to the FKM guideline

In the field of structural dynamics and acoustics transfer functions, eigenfrequencies and structure-borne sound analyses are calculated. Eigenfrequencies (= natural frequencies) are a structure's fingerprint in terms of vibration, and the structure-borne sound behavior in the form of a spectrum can be called the acoustic fingerprint of the same. They stand out for their uniqueness and are therefore calculated and measured as a quality feature for HAWE units and pumps. The particular part can be given harmoniously or by a specific profile. Our ultimate aim is to develop low-noise pumps and power units.



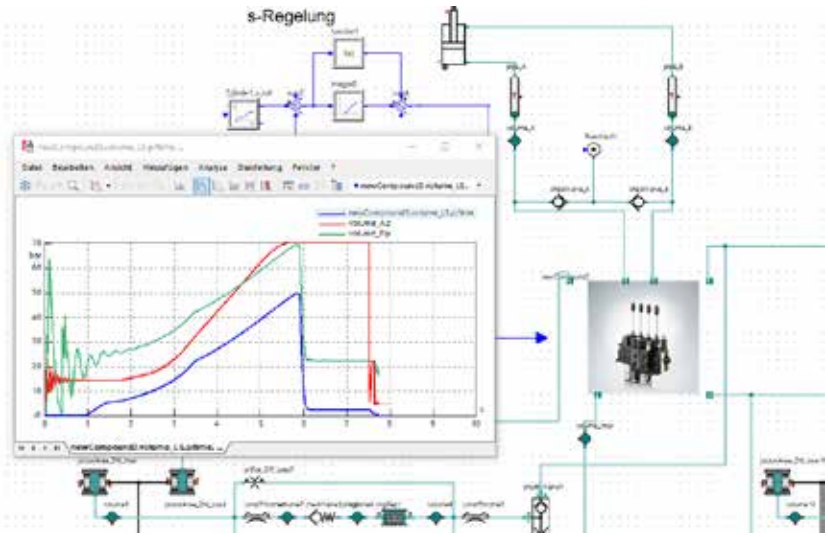
Flow simulation of valves and lines in hydraulic systems is used in the analysis of invisible flow phenomena (e.g. turbulence, cavitation), pressure drops, and flow forces in hydraulic components.



Flow Simulation

Full **system simulation** uses numerical methods to investigate the static and dynamic behavior of complete systems. This includes analysis of the interaction of individual components (pump, lines, valves, actuators) as well as detailed considerations within a single valve. The dynamic component properties are described as mathematical models by ordinary differential equations (DGLn) and combined with those of other components to form a complex DGL system and which is in turn solved. The degree of detail of the modeling is adapted to the problem to ensure the quality of the solution.

Application examples are cross-domain analysis of vibration phenomena or efficiency calculations of hydraulic systems. Furthermore, the thermal behavior can be mapped in mechanical-hydraulic networks.



System simulation

Development
Additional Development Methods

Failure Mode and Effects Analysis (FMEA)

FMEA is used for a systematic exploration of possible weak spots. It covers known and potential faults and identifies potential improvements. HAWE has been using development and process FMEA with success for a number of years and integrated it as a fully established process at the company. FMEA activities help define specific fault-prevention opportunities.

The participating departments execute the action plan produced by FMEA in full. For HIP projects, FMEA is a mandatory part of the process.

Clearance of the action plan from the process-FMEA

Acoustic Development

The demand for low-noise hydraulic systems is steadily growing, in particular for pumps and power packs. HAWE Hydraulik is focusing on reducing noise in development and has set up the first company-wide **acoustic measurement room** at the plant in Kaufbeuren for this purpose. Sound pressure and noise emissions are measured in the acoustic measurement room in accordance with German (DIN) and international (ISO) standards. The room is designed so that compact and systems engineering power packs, as well as radial and axial piston pumps in nearly all versions and sizes, can be measured and compared with each other. The **basic investigations** are used to find out the potential ways of influencing noise emissions.

The measurement room provides almost the exact same physical acoustic properties as for acoustic measurement in an open area. A lower extraneous noise level and free sound radiation are required for this, without reflections, such as from obstacles.

The Fraunhofer Institute has certified the measurement room with **accuracy class 1** in complete compliance with **DIN EN ISO 3745**. The acoustic measurement room is flexibly decoupled from the ground and ensures a lower cutoff frequency for sinusoidal vibrations of 100 Hz. Under consideration of the λ/4 distance, measurements with a cutoff frequency greater than 50 Hz can also be performed in this room.


Acoustic measurement of hydraulic power packs – certified in accordance with DIN EN ISO 3745


Acoustic measurement of hydraulic pumps

R&D Testing

In order to ensure functioning, safe, and durable products, HAWE's testing specialists use a broad range of computer-aided digital metrology techniques, as well as cutting-edge, versatile testbenches.

In addition, modern CAE tools, such as Matlab/Simulink and SimulationX, are used to design and tune hydraulic systems.

HAWE's **testing services** include:

- Measurement of dynamic time courses and quasi-static characteristics to ensure the operation of electrohydraulic components and systems
- Tests to ensure fatigue strength (e.g. burst pressure test up to 6000 bar at 1.5 l/min)
- Designing and peration of complex endurance tests to ensure full service life
- Development of new test methods
- Standardization and automation of tests
- High-precision tightness measurements on valve seats
- Measurement of units and pumps to determine the volumetric efficiency, the total efficiency, the starting current, the power consumption, the maximum pressure as well as the heating and steady-state temperature for a given load profile
- Noise measurements on electrohydraulic machines and systems in the acoustic measuring room
- Temperature and climate tests with climate chamber
- Measurement of springs and actuating solenoids with force-displacement measuring machine from Zwick
- Execution of acceptance tests during the commissioning of complex hydraulic machines and plants according to customer specifications
- Design of special hydraulic test benches, including measurement and control technology (hardware and software

Function test bench with 300 kW electronic drive power

Development
Pilot Production

The Pilot Production department is in charge of prototyping hydraulic solutions to enable HAWE to respond quickly and flexibly to customers' requests.

In this department, the entire machining process (honing, WOB, caulking in the respective specialist departments) takes place in order to discover where components can be optimized and to selectively test and develop ideal production technologies.

HAWE's customers benefit from the excellent skills of the people in charge, the sophisticated facilities, and HAWE's integrated toolmaking section and the custom tools it produces.

The experience, new programs, production processes, metrological insights and inspection data produced here are recorded in detail and made available to the Production for the later full-scale production runs.

Purchasing
Supplier Selection and Development

HAWE's purchasing activities are organized by product groups in central Purchasing. The selection and development of good suppliers is considered as important as questions of sustainability or profitability.

HAWE has concluded **quality assurance agreements (QSV)** with its major suppliers. These form the basis of the quality related cooperation with the definition and documentation of the mutual expectations of the cooperation. Contents are among other things the definition of test plans, adjustment of measuring methods, transmission of measuring / test data, definition of processes such as drawing change management / special releases.

HAWE reviews all the suppliers in its ERP system on an annual basis. This **supplier rating** covers the quality, delivery reliability, and service level of the suppliers, assigning them a category (A, B, or C) depending on their performance. HAWE demands official statements on any incidents or problems and a list of planned or active countermeasures from all B and C-category suppliers, monitoring their responses in full. B and C-category suppliers are also shortlisted for supplier audits.

We use defined plans and standardized methods for our **supplier audits,** while also considering the actual experience of its buyers to allow ad-hoc audits in the case of any relevant incidents. Should these audits give cause for concern in the priority areas of systems, processes, or products, the results are compiled in the audit report with details on the nature of the problem and the deviation from the expectations. HAWE uses these reports when arranging countermeasures with the supplier, the effectiveness of which is tracked in detail and included in the next year's supplier audit.

Whenever **faults** or quality problems are identified, procurement notifies the supplier and files a complaint. A Q-report is also recorded in the ERP system and a formal 8D report is requested from the supplier. The plausibility of the proposed measures is checked as part of HAWE's defined, multi-level complaints procedure. All complaints are included in the supplier ratings.

Purchasing
Verification of Purchased Product

HAWE's purchasing produces an initial sample test report (ISIR) for every new delivery (of defined product groups), including a set of details defined by HAWE's technical documents, such as product drawings or print documents.

When the goods arrive on the HAWE premises, an incoming goods inspection verifies these criteria in line with the supplier's documents and records the inspection results. The Quality/Metrology Representative clears the ISIR for all HAWE sites.

Product testing in the goods receipt office

The fully documented **inspection of incoming goods** is used at all HAWE production sites. After new goods are recorded in the ERP system, the SAP system automatically files an inspection order with details on the order, supplier, and material ID, in addition to defined instructions about the size of the sample and the criteria to be tested. The batches flagged in this manner remain on QM hold and are not released for production until this inspection has been completed.

The inspecting officer records the required data, which is automatically uploaded in the SAP. Whenever faulty parts are identified, an automatic Q-report is generated to initiate fault proceedings. The results of the inspection also form part of the "quality" category of HAWE's supplier management system.

Production

HAWE's products are built with a coherent modular system. The company's sites are specialized for specific product groups, allowing for optimum bundling of technologies and know-how on site.

Production is arranged arranged in processes designed to allow every piece to be produced from start to finish. The **lean production philosophy** is followed in every respect to avoid waste and inefficiency. Order and cleanliness are maintained by applying the **5S method** and the **one-piece flow** system.

Kaufbeuren site

The hallmarks of production at HAWE:

- Standardized material supplies (small containers/ blister packaging/bulk containers)
- 100% inspection integrated in assembly processes
- High degree of automation
- In-house mechanical engineering and machine design
- Cutting edge technology used in the facilities
- Highly skilled personnel

Automatic assembly machine in Sachsenkam

Freising site

Production

Control of Production

HAWE has introduced standard processes for defining and tracking delivery times.

Short, clearly defined lines of communication in the production and assembly units help us to spot any incidents that make it necessary to update delivery plans. The Dispatch team acts the central communications interface with HAWE's sales partners and subsidiaries and keeps our customers informed about the expected delivery of their orders. ERP is used to track and manage these schedules. Additional tools, including dedicated **forecasts, delivery plans, and KANBAN**, are available to manage production, dispatching, and demand planning.

All of HAWE's production sites are integrated in the standardized, **CAQ-based quality assurance** system.

Control of Nonconforming Product

In the case of internal fault notifications, the Quality Representative in charge of the area in question enters a Q-Report.

The fault is then processed by means of the 8D method. The team develops countermeasures to mitigate or prevent the effects of the fault, or preventative measures to avoid a future recurrence of the problem. Faulty parts are marked and removed from the production process and held in separate storage.

In the event of **external customer complaints**, central customer services acts as the interface with the client. The customer service team team works together with technical quality management to the analyzes the fault in questions before handing the incident over for processing according to the 8D method as in the case of internal faults. Again, the team develops either operational mitigating measures or preventative measures to avoid repeat faults. Customer Service is notified about the chosen measures, which it forwards to the customer in a standardized format (8D report). In addition to the 8D process, the standard QM methods used for this purpose include process FMEA and product audits.

Monitoring and Measurement of Product

In-Production Inspections

In-production inspections are conducted by HAWE's production staff in the form of **CAQ-supported operator self-inspection** on dedicated testbench spaces in the production units. These are supplied with the **inspection equipment and CAQ terminals** needed for the purpose. This process is closely **integrated with ERP** to ensure the full traceability of the inspections.

In addition to these self-inspections, dedicated inspection facilities are available for high-precision metrology purposes (e.g. form and position, edge smoothness, dimensions). Like the in-production inspections, these are recorded in the CAQ system.

All data in the CAQ system is available for statistical analysis.

Product identification

Production

Monitoring and Measurement of Product

Final Hydraulic Inspections and Performance Tests

HAWE is committed to optimizing all inspection instructions and processes. For this purpose, most **inspection** results are archived, and every member of staff is required to comply with the established company standards.

The custom, in-house design and construction of hydraulic test benches and their continuous improvement contribute substantially to these efforts. Full 100 percent inspections are conducted for most products, with a specific inspection plan for the random testing of all other products. Regular maintenance of the test benches and verification of the metrological equipment ensure the continued reliability of these processes.

Final hydraulic inspections and performance tests of a valve

Control of Monitoring and Measuring Equipment

HAWE uses **central metrology and testing administration** for all measurement and testing equipment that requires formal calibration. The system monitors the running times of measuring equipment and records all calibrations.

HAWE's in-house calibration laboratories offer calibration services in line with the latest standards, primarily for the calibration of physical lengths. Additional calibration work is conducted on behalf of HAWE by renowned calibration institutes. Our metrology equipment office procures all measurement and testing equipment subject to calibration and is in charge of repair and maintenance orders for all metrology facilities.

Monitoring and measuring equipment is formally inspected on an annual basis at all production sites to ensure its effective management, controlling and use.

Warehousing & Logistics

HAWE stores its goods in three distinct types of storage facilities: high-bay warehousing, manual storage, and automated small-parts storage.

The plant in Freising has an automatic high-bay warehouse with a total of 1,000 parking spaces for Euro pallets. From this, the goods are automatically transported with stacker cranes to the order picker.

In addition, there is a manual high-bay warehouse, with around 700 parking spaces, from which the goods are loaded and unloaded by means of a forklift truck. The automatic small parts warehouse covers around 16,000 parking spaces. These are housed in 3 lanes and 6 high-bay warehouses. Four workstations are used to store and retrieve the goods.

The Sachsenkam site hosts an automatic small parts warehouse is used, with a capacity of around 9,800 parking spaces. In Kaufbeuren is also an automatic small parts warehouse, with 13,600 parking spaces, in operation. At both locations, the goods are stored and retrieved via three workstations.

Automated small-parts storage

All our automated storage are fully sealed to prevent unauthorized access and the entry of dirt or other unwanted foreign matter.. A standardized cleaning procedure is used to ensure that containers are kept clean.

HAWE's seven basic warehousing processes:

- Storage of purchased parts and assembled materials
- Dispatching client orders
- Storing and retrieving assembly orders
- Supplying assembly operations (supplying the dual-container logistics)
- Dispatching assembly orders
- Redefining (freeing up storage capacities via combined storage)
- Ad-hoc retrieval

A special storage software ensures the reliability and availability of the parts. A user logs back all in and out of storage in the system and makes them fully traceable. In ERP, all picking orders are released and transferred to the storage system via an interface. The dispatch lists are printed and verified by scanning the goods barcodes at the point of retrieval. For this purpose, all storage containers and Euro pallets are marked with their own barcodes to track their every movement and their location in the system.

To achieve full and comprehensive traceability in the system, all products, materials, or order parts are stored according to the **FIFO principle** (first in, first out).

Dispatch and Delivery

As a global company, HAWE moves goods around the world – with exports accounting for around 75% of the business.

With its commitment to protecting our environment, HAWE aims to reduce the environmental footprint of its business operations in terms of CO_2 emissions. Packages are sent with the climate-friendly **DHL GoGreen** service. HAWE also bundles its dispatch activities efficiently by cooperating with a general **haulage partner**. It also uses the **lean logistics** concept to uncover waste immediately and find and introduce the right responses to avoid or reduce it.

In September 2012, HAWE was officially listed as a **known consignor** in accordance with the EU security regulations 300/2008. With an internal security section integrated in its dispatch unit, HAWE's compliance with all security-relevant aspects has been certified by the Civil Aviation Authority.

As part of its **compliance management** efforts, HAWE has assessed and introduced all activities and processes for the suppression of terrorist activities required by domestic and international regulations. For this purpose, HAWE has installed an IT system to automatically check for government sanctions and reduce the risk of unwittingly unwittingly supplying listed organizations or persons.

Providing complete reliability with every delivery is one of HAWE's unending ambitions. We work to achieve this, for instance, by ensuring a dependable **supply chain**. Throughput, handling, and transport times are known and allow HAWE to state specific **delivery dates**, achieved by stable, lean, and flexible processes. HAWE's dispatch team is committed to processing and dispatching finished orders on the stated date. By **controlling** processing times, the flow of ready-for-dispatch orders is tracked consistently.

The **container and packaging** section uses small containers and reusable packaging, choosing the right packaging to suit the mode of transport, transport security requirements, and the customer's specifications.

Aftersales & Customer Service

Domestic and international customers can send HAWE products to the Service Center in Kaufbeuren for repairs or modifications.

Dedicated testing facilities are available to check the sent-in products and identify any flaws or faults. Depending on the lifecycle of the product, a range of services can be offered.

Customer Service provides a comprehensive **range of services** for HAWE's products and systems, including:

- Installation, commissioning, maintenance, and repairs as a mobile **on-site service**
- Custom **service and maintenance contracts**
- **Hydraulics seminars** for end customers and subsidiary companies covering the functions, maintenance, and repair of HAWE products
- **In-house services,** including maintenance service, modifications, claims processing, and reviews at HAWE's in-house service center in Munich

HAWE equips its installers and service technicians with cutting-edge technology and instruments, both at the Kaufbeuren service center and via its mobile service teams around the world. HAWE's service experts possess in-depth expertise for hydraulics technology, including specialist applications like offshore technology.

Service mobile

Service technician in field work

Summary
Quality in Action at HAWE Hydraulik

Quality Management

Organization Development

Product Selection, Techn. Support

- Sales
- Technical Support
- Technical Documentation

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Development

- Component development
- HIP: HAWE Innovation Process
- FMEA
- Simulation tools
- Prototype (Pilot Production)
- Pre-assembly
- Acoustic development
- Testing

Purchasing

- Supplier rating
- Supplier audits
- Initial Sample Test Report (ISIR)
- Inspection of incoming goods

Customer

HR Development

Environment, Health & Safety

Production

- Lean production
- 5S method
- One-piece flow system
- Forecasts, delivery plans, KANBAN
- CAQ-based quality assurance
- Internal and external customer complaints
- In-production inspections
- Final hydraulic inspections and performance tests
- Metrology and testing administration

Warehousing, Logistics & Dispatch

- High-bay warehousing
- Manual storage
- Automated small-parts storage
- Stock availability
- Haulage partner
- Lean logistics
- Well-established consignor
- Compliance management

Customer Service

- On-site service
- Service and maintenance contracts
- Hydraulics trainings
- In-house services
- 24h helpline

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P Quality Management 00-EN 05/2018

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