

KASAG



Plant
Apparatus
Pressure vessel
construction

Experts for design, engineering and welding

We meet your requirements **globally**

Swiss precision and quality from the Emmental for the global industrial market

You are part of an environment in which product reliability and impeccable product quality enjoy top priority. You have to put full trust in your partners and put very great demands on them. This is what connects us, because we want customers who set very high standards.

With KASAG Swiss AG as a partner for the design, engineering and construction of apparatuses, vessels, pressure vessels, reactors, filters, heat exchangers, modules and plants for global use, you are on the safe side.

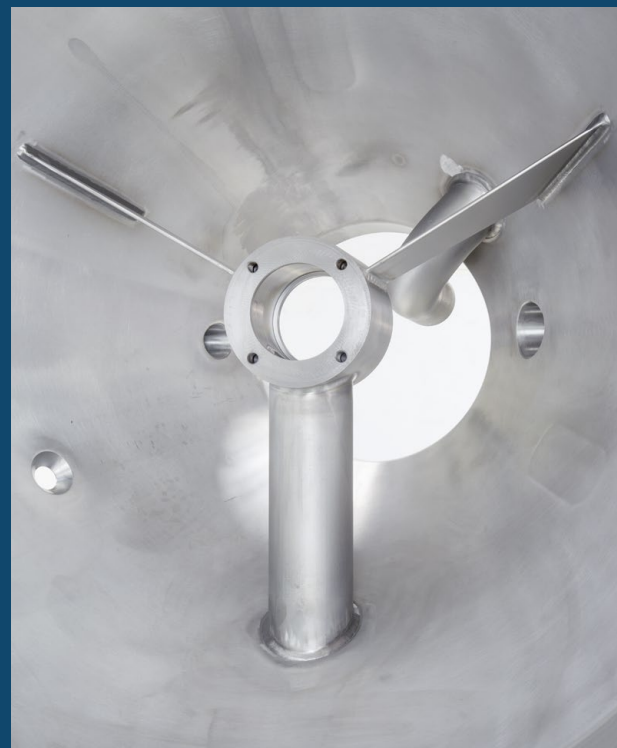
We are the experts for the welding of stainless steel and special materials such as Hastelloy and Duplex.

In close collaboration with our customers, we calculate and design plant components and systems for the chemical and pharmaceutical industry and for the fields of bio and food technology.

Decades of experience, well-founded expert knowledge, and a strong awareness of quality characterize our company as a competent partner.

KASAG is provided with a wide range of manufacturer approvals for the worldwide supply of pressure vessels, process equipment and plants.

Both the origin of the materials processed and the production steps are documented in detail and their traceability is always guaranteed. Furthermore we can offer almost all testing methods required in our organization.





We offer a universal range of services

Product range

Pressure vessels, reactors
Apparatuses, pressure vessels for pharma, biotech
Process vessels, storage tanks
Plants, modules, components, skids, panels
Filtration technology
High-pressure apparatuses and plants
Heat exchangers, evaporators, condensers
Cryogenic vessels, cryogenic technology
Nuclear technology
Vacuum chambers, vacuum apparatuses
Columns
Transportation containers
Welded constructions.

Machinery for object sizes

Vessel diameter	up to Ø 4 m
Object weight	up to 13 t
Object length	up to 16 m

Certifications, manufacturer approvals

ISO 9001 / ISO 3834-2
PED (EN13445 / AD-2000)
ASME (U-Stamp, Code Section VIII Div. 1)
China Stamp (A1), China License
TP TC 032/2013 (EAC), Customs Union
In addition to our existing manufacturing approvals, we are able to perform the respective approval procedures for almost every country around the world (e.g. Singapore, Japan, Malaysia, Canada, etc.)

Engineering

Strength calculation according to regulations
FEM (finite element analysis) calculations
Earthquake, wind loads and nozzle loads
Constructive design, engineering, optimization, choice of material, surfaces
Coordination with regulatory authorities
Constructive implementation and bills of material
CAD systems: Autodesk (AutoCAD 2D, Inventor 3D)

“In collaboration with our ambitious customers, we implement individual and complex projects in business fields ranging from chemicals, pharmaceuticals, biotech, cryogenic technology and nuclear technology with strong passion.”



Additional services

In addition to our existing activities, we design complete modules, components, skids, panels and plants. Furthermore we offer specific services. They include comprehensive engineering on the basis of specifications as well as P&I diagram for your apparatus and pressure vessels in 3D Inventor, including the pipeline routing required.

If required, we'll attend to the purchase management of the purchased parts for you, prepare the electrical and pneumatic wiring including control system, and implement comprehensive testing procedures.

? Do you have any questions?

If you have any general questions regarding offers and the construction of plants, apparatus, pressure vessels, our experts will be glad to assist you:

Phone +41 34 408 58 58
sales@kasag.com

 www.kasag.com/en/plant-apparatus-pressure-vessels-construction



“The KASAG experts are among the global leaders in the fields of process engineering, design, engineering, and the construction of pressure vessels, apparatus and plants for industrial companies.”

Materials

Austenitic, stainless steel (1.4307, 1.4571, ...)
Fully austenitic, stainless steel (1.4539, 1.4828, ...)
Duplex (1.4462, 1.4410, ...)
NiCrFeMo alloys with Ni > 40% (Inconel, Hastelloy, ...)
Al – Mn and Mg alloys (AlMg 4.5 Mn)

Surface treatment

Pickling, passivation, oxygen cleaning
Grinding, brushing
Electrolytic polishing and glass bead blasting (external)

Testing procedures

X-rays RT
Dye penetrant testing PT
Visual inspection VT
Material testing / Positive Material Identification PMI
Helium leakage testing LT
Riboflavin test
Pressure tests of up to max. 1000 bar
Surface roughness testing Ra/Rz
Ferrit measurement Fe
Wall thickness measurement
Video endoscopy
Pressure-loss test (liquid)

Welding

Our certified experts master the procedures of MIG, MAG, TIG, Plasma and Orbital welding. We exclusively use certified filler materials for carrying out our welding operations.



For technical exclusivity worldwide

KASAG Swiss AG
Hohgantweg 4
3550 Langnau / Switzerland
Phone +41 34 408 58 58
Fax +41 34 408 58 59
sales@kasag.com

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www.kasag.com

KASAG

Apparatuses, pressure vessels for the pharma and biotech industry

KASAG Swiss AG has a wide range of experience in the construction of apparatuses, pressure vessels and components for the pharmaceutical and biotech industry. Pharmaceutical and biotech equipment are designed and manufactured in accordance with your requirements and made of stainless steel and special materials. Thereafter, the products are grinded and electro-polished to customer specifications. Finally, comprehensive non-destructive testing is performed. All of the materials, processes and procedures used are documented in a detailed QA documentation and traceability is given at any time. You can rely on KASAG.



The range of services that we provide consists of:

- Apparatuses with agitator, pressure vessels, reactors
- Mobile or stationary process or batch containers
- Storage tanks, WFI (Water for Injection) or CIP (Cleaning in Place) containers
- Fermenters, bioreactors
- Bulk and transport containers
- Sheet metal and welded structures which come into contact with products

The highest manufacturing quality with optimal hygienic cleaning options (CIP cleaning-in-place/SIP sterilization-in-place) come as standard at KASAG.



This includes:

- The correct processing of materials such as 1.4404, 1.4435 BN2 or also in special materials with tested and recorded ferrite content
- Impeccable welding seam quality and documentation
- Tested and recorded surface processing in grinded, highly polished or electro polished versions with a roughness of up to Ra 0.2 μm
- Installation of cleaning equipment within the pressure vessels for optimal cleaning processes and complete discharge in accordance with ASME-BPE
- Extensive test methodology for intermediate testing and final FAT, including: x-ray RT, dye penetrant testing PT, visual inspection VT, material testing / positive material identification PMI, helium leakage testing LT, riboflavin tests, total discharge, pressure testing up to max. 1000 bar, surface roughness testing Ra / Rz, ferrite measurement Fe, wall thickness measurements, video endoscopy and pressure loss testing (liquids)

We use automated and manual welding machinery as well as a modern orbital welding equipment to weld our components.



Apparatuses and pressure vessels for the pharma and biotech industry for worldwide use



Validation / Qualification

We support you with regard to the cGMP guidelines for the validation/qualification of equipment components produced by us for the manufacture of pharmaceutical and biotechnical products (DQ, IQ, OQ, PQ).

In addition to the FAT (final acceptance test) in our factory before delivery and the SAT (site acceptance test) on site, our scope of delivery includes the following areas:

Design Qualification, DQ

Verification to ensure that the quality-relevant, GMP-related requirements were taken into consideration during the design of the equipment:

- Materials
- Dimensioning / design

Installation Qualification, IQ

Documented evidence that critical equipment has been implemented and installed in compliance with customer requirements and statutory provisions:

- Calculation and documentation in accordance with regulations
- Safety equipment, risk analysis
- Accessibility for maintenance and cleaning

Operational Qualification, OQ

Documented evidence that critical equipment operates in compliance with customer requirements within the stipulated limit values throughout the entire work area:

- Leak tightness
- Mechanically moving parts
- Safety equipment
- Operating parameters

Certifications, manufacturer approvals

ISO 9001 / ISO 3834-2

PED (EN13445 / AD-2000)

ASME (U-Stamp, Code Section VIII Div. 1)

China Stamp (A1), China License

TP TC 032/2013 (EAC), Customs Union

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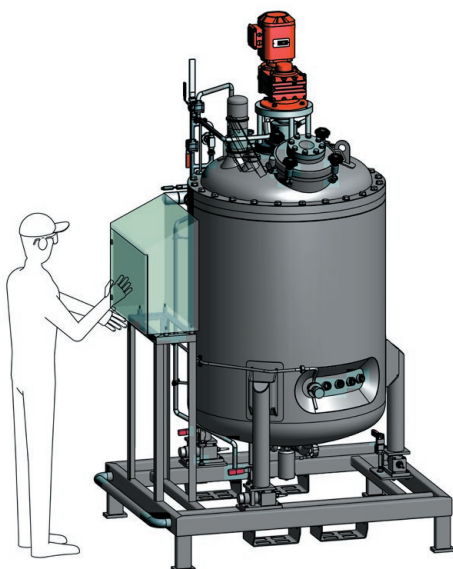


Skids, modules for the pharmaceutical-biotechnological industry

KASAG Swiss AG offers concepts, planning, manufacturing and qualification of customised process technology for the production of medicinal products in compliance with cGMP guidelines. As expert designers of process facilities, automation systems, machinery and containers, we deliver individually designed skids and modules to complement your process line. Delivery from one source, from basic engineering to the commissioning of the plant, including detailed engineering as well as production and assembly. To the perfect solution with KASAG.

Concept development and planning (basic engineering, detailed engineering)

In the concept development and planning stage, the key features of the plant are defined. Documents such as the flow and system layout, diagrams, P+I-diagram, functional descriptions, technical specifications, schedules are developed. The strength calculations for apparatuses, pressure vessels, pipes, etc. are carried out in compliance with the various regulations, and the material availability is checked. Furthermore, the optimum position of the cleaning nozzles, for example, complying with their corresponding use, is defined or a special focus is placed on the selection of the correct piping dimensions, valves, sensors, which we take into consideration for the design. In this way, each design element and each calculation is checked to ensure safe operation of the plant. In this process, we rely on our long-standing practical experience and our comprehensive expertise in this field.



Production processes

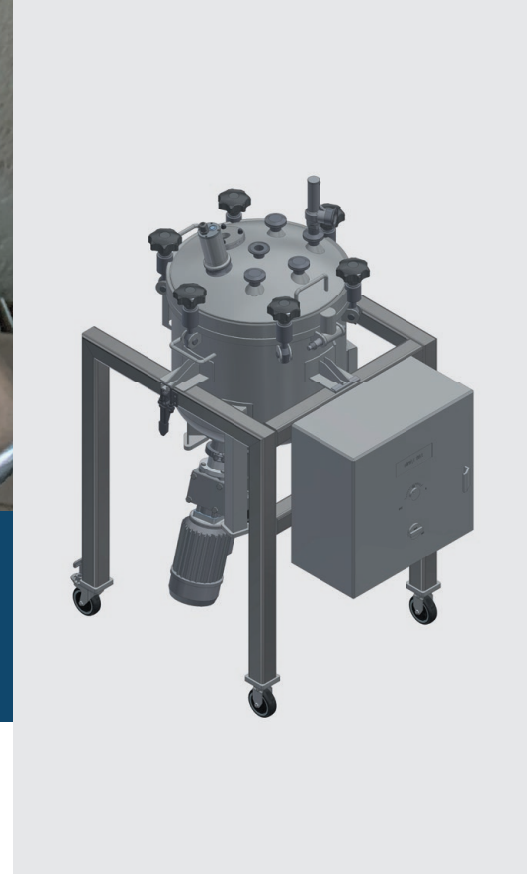
All our apparatuses, pressure vessels and the assembly of skids, modules are produced in our workshops to ensure maximum quality. Benefits of using skids, modules are the detailed pre-qualification during the FAT (final acceptance test) in our factory, the easy on-site assembly and the significantly shorter SAT (site acceptance test) and production start-up time. All this saves you valuable time.

Testing procedures

For testing the plant parts, skids, modules, we offer a wide range of testing procedures such as radiography RT, material testing / positive material identification PMI, helium leak testing LT, Riboflavin test, pressure tests up to max. 1000 bar, surface roughness Ra/Rz, ferrite measurements Fe, video endoscopy, etc.



Skids, modules for global use in the pharmaceutical-biotechnological industry.



Validation / Qualification

The skids, modules are qualified and documented as far as possible in our factory in the course of the FAT. We support you concerning the requirements from the cGMP guidelines in the validation / qualification of the plantparts manufactured by us for the production of pharmaceutical and biotechnological products. In addition to the FAT (final acceptance test) in our plant prior to delivery and the SAT (site acceptance test) on-site, our scope of supply includes the following fields:

Design Qualification, DQ

Verification to ensure that the quality-relevant, GMP-related requirements were taken into consideration during the design of the equipment:

- Materials
- Dimensioning / design

Installation Qualification, IQ

Documented evidence that critical equipment has been implemented and installed in compliance with customer requirements and statutory provisions:

- Calculation and documentation in accordance with regulations
- Safety equipment, risk analysis
- Accessibility for maintenance and cleaning

Operational Qualification, OQ

Documented evidence that critical equipment operates in compliance with customer requirements within the stipulated limit values throughout the entire work area:

- Leak tightness
- Mechanically moving parts
- Safety equipment
- Operating parameters

Support with regard to the cleaning qualification, CQ

- Pre-qualification via Riboflavin test during the FAT
- Support with regard to the inspection of cleaning on-site

Performance Qualification, PQ

- Support regarding the technical aspects of the scope of supply

Risk analysis

- Support with regard to the risk analysis for the operating company. For example in accordance with HAZOP.
- Support with regard to the definition of the explosion-endangered areas and specification of the ATEX requirements of the corresponding plant parts

Our certifications / manufacturer approvals

ISO 9001 / ISO 3834-2

PED (EN13445 / AD-2000)

ASME (U-Stamp, Code Section VIII Div. 1)

China Stamp (A1), China License

TP TC 032/2013 (EAC), Customs Union

In addition to our existing manufacturing approvals, we are able to perform the respective approval procedures for almost every country around the world (e.g. Singapore, Japan, Malaysia, Canada, etc.).

Plants, Modules, Skids

for chemistry, pharma, gas, energy, food technology applications

We are experts in the design, engineering and production of pressure vessels. In addition, KASAG Swiss AG also produces complete skids, modules, assemblies and plants based on your requirements. We offer complete engineering drawings in 3D-Inventor based on your piping and instrumentation diagram (P&ID) as well as your equipment specifications. Our specialist employees then produce your modules, assemblies and plants on this basis. You can rely on KASAG.



Our range of services includes:

- Comprehensive design and engineering of equipment, piping, etc. in 3D-Inventor (piping) on the basis of equipment specifications, P+I diagram and valve and /or instrument lists
- Design and engineering of apparatuses and components
- Support during the procurement of purchased parts in accordance with your specifications
- Acceptance checking of the purchased parts
- Production of complete modules, assemblies, skids, panels, plants
- Electrical, pneumatic wiring including control systems as required
- Performance of non-destructive testing
- Acceptance of modules, assemblies, skids, panels, plants including packaging as required

Testing procedures

- X-rays RT
- Dye penetrant testing PT
- Visual inspection VT
- Material testing / Positive Material Identification PMI
- Helium leakage testing LT
- Riboflavin test
- Pressure tests of up to max. 1000 bar
- Surface roughness testing Ra / Rz
- Ferrit measurement Fe
- Wall thickness measurement
- Video endoscopy
- Pressure-loss test (liquid)

Certifications, manufacturer approvals

- ISO 9001 / ISO 3834-2
 - PED (EN13445/EN13480 / AD-2000)
 - ASME (U-Stamp, Code Section VIII Div. 1)
 - China Stamp (A1), China License
 - TP TC 032/2013 (EAC), Customs Union
- In addition to our existing manufacturing approvals, we are able to perform the respective approval procedures for almost every country around the world (e.g. Singapore, Japan, Malaysia, Canada, etc.).

Special materials

KASAG Swiss AG has many years of experience in the processing and welding of special materials. Based on our knowledge of aluminium and stainless steel, we have continuously expanded our know-how and apply a comprehensive range of welding procedure qualifications and welder certificates in accordance with ISO 3834-2. We are well versed in all MIG, MAG, WIG, Plasma as well as Orbital welding processes, and work exclusively with certified welding materials.



Special materials include both corrosion and heat resistant materials as well as other special alloys with other specific advantages. The examples below illustrate two areas in which special materials are used:

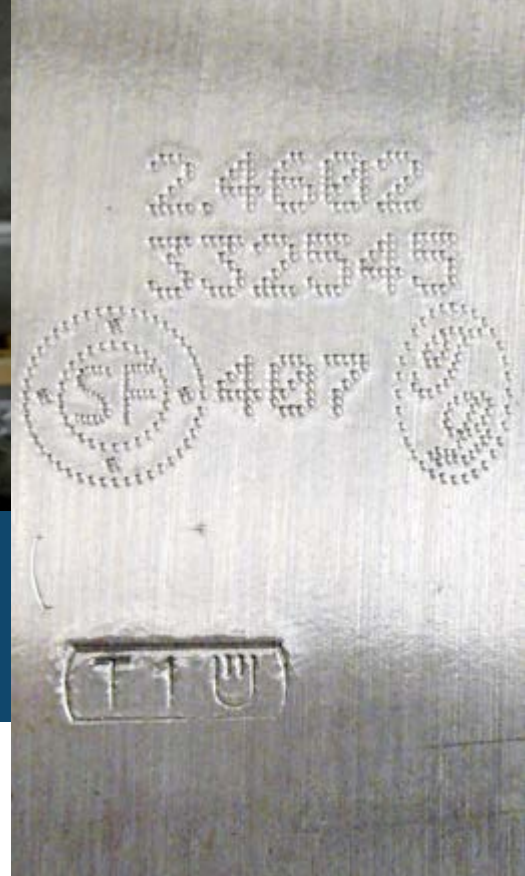
Duplex steels comprise a blend of the characteristics of stainless chrome steels and stainless chrome-nickel steels (austenitic). These have higher strength than stainless chrome-nickel steels, but also greater ductility than stainless chrome steels. Like corrosion-resistant, purely austenitic steels, duplex materials have lower nickel content (approximately 4-8% less), but usually have a significantly higher chrome content.

Nickel-based alloys are materials whose main constituent is nickel, but which have been optimised by means of a smelting process with at least one other chemical element. These alloys offer good corrosion resistance and/or high-temperature performance. Most nickel alloys are classified in accord with international standards.

Processing special materials

The processing stages for special materials can be divided into cutting, mechanical processing, bending, welding and surface treatment. Every special material has specific processing requirements when compared to stainless steel. For example, pipes in 1.4462 cannot be bent in the same radii as stainless steel, or cutting speed when turning C22 are greatly reduced.

When welding special materials, attention must be paid to the various properties and requirements of each individual material, for example lower energy input or high levels of cleanliness.



Design, engineering and welding of special materials

Special material categories

A “Special Materials Overview” with brand names, material numbers, characteristics and areas of application for the following special material categories can be requested from KASAG (non-exhaustive and provided without guarantee):

Corrosion-resistant special alloys:

- Martensite
- Duplex
- Super austenite
- Nickel-based
- Nickel-copper
- Pure nickel

Heat-resistant special alloys:

- Ferrite
- Martensite
- Duplex
- Austenite
- Nickel-based

Special alloys:

- Titanium

Availability

The availability and price of special materials in raw material forms as sheet, pipe, profile, and forging forms are heavily dependent on worldwide demand. When demand is low, there is often no inventory on the procurement market for specific special materials. Because the cost of specialist production would be excessively high, it is not possible to use these special materials.

Area of application

Special materials are mostly used in the offshore, gas and oil industries, the maritime (desalination plants, ship construction), chemical, pharmaceutical and biotech industries, aviation (engine construction, aircraft construction, aerospace), the energy and environmental sectors (reactor construction, turbine construction, waste incineration plants, flue gas desulphurisation), defence technologies, industrial furnace construction and medical technologies

Certifications, manufacturer approvals

ISO 9001 / ISO 3834-2

PED (EN13445 / AD-2000)

ASME (U-Stamp, Code Section VIII Div. 1)

China Stamp (A1), China License

TP TC 032/2013 (EAC), Customs Union

In addition to our existing manufacturing approvals, we are able to perform the respective approval procedures for almost every country around the world (e.g. Singapore, Japan, Malaysia, Canada, etc.).

Nuclear technology

KASAG Swiss AG is a qualified nuclear technology subcontractor, based on our ASME and /or PED (AD2000 or EN13445) manufacturer's approval. We process stainless steel and special materials for you in accordance with nuclear standards relating to complete material traceability and quality documentation. With KASAG as your partner safety comes first.



The manufacture of components for nuclear power plants requires stringent compliance with procedures and places the highest demands on our qualified professionals.

The range of services that we provide consists of:

- Calculations in accordance with regulations, including FEM calculations
- Generation of manufacturing drawings
- Material procurement
- Support for acceptance testing of materials
- Preparation of test sequence plan (Traveller), materials and welded joint lists
- Production
- Performance of non-destructive testing
- Acceptance
- Packaging support and implementation

Additional services

In addition to our existing activities, we design complete modules, components, skids, panels, and plants. Furthermore, we offer specific services. These include comprehensive engineering on the basis of specifications as well as P&I diagram for your apparatuses and pressure vessels in 3D Inventor, including the piping required. We can also take over the comprehensive test procedures according to your requirements.

Materials

Austenitic, stainless steel (1.4307, 1.4571, ...)
Fully austenitic, stainless steel (1.4539, 1.4828, ...)
Duplex (1.4462, 1.4410, ...)
NiCrFeMo alloys with Ni > 40% (Inconel, Hastelloy, ...)
Al – Mn and Mg alloys (AlMg 4.5 Mn)

Surface treatment

Pickling, passivation, oxygen cleaning
Cleaning in accordance with DIN25410
Grinding, brushing



Nuclear technology for use worldwide



Testing procedures

- X-rays RT
- Dye penetrant testing PT
- Visual inspection VT
- Material testing/Positive Material Identification PMI
- Helium leakage testing LT
- Riboflavin test
- Pressure tests of up to max. 1000 bar
- Surface roughness testing Ra / Rz
- Ferrit calculations Fe
- Wall thickness measurement
- Video endoscopy
- Pressure-loss test (liquid)

Welding

Our certified experts are masters of MIG, MAG, TIG, Plasma and Orbital welding procedures. We exclusively use certified filler metals in our welding operations.

Certifications, manufacturer approvals

- ISO 9001 / ISO 3834-2
- PED (EN13445 / AD-2000)
- ASME (U-Stamp, Code Section VIII Div. 1)
- China Stamp (A1), China License
- TP TC 032/2013 (EAC), Customs Union

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Vacuum chambers, vacuum apparatuses

for vacuum technology

KASAG Swiss AG develops and builds customer-specific vacuum chambers and apparatuses which satisfy the highest quality requirements. These are used in the fine vacuum ($> 10^{-3}$ mbar), high vacuum ($> 10^{-7}$ mbar) and even ultra high vacuum ($< 10^{-7}$ mbar to $> 10^{-9}$ mbar) sectors. Pore-free welding and sealing technology comprise the key criteria in the construction of vacuum chambers and apparatuses. Comprehensive in-house testing using helium leak detection guarantee the absolute leak-tightness of your products. With KASAG, you are definitely tight.



Vacuum chambers, vacuum apparatuses

Vacuum chambers and apparatuses usually comprise a welded design made from stainless steel and special materials in order to contain a specific volume. Design and engineering, as well as the leak-tightness of the welded seams and sealing technology pose particular requirements.

Vacuum generation

In order to generate a vacuum in a previously gas filled volume, gas particles must be removed from the volume. This can be achieved using vacuum pumps, for example.

Permeability

The movement of electrical charge carriers in the vacuum is disrupted by the innate magnetism of the adjacent components, and has a negative impact on the intended vacuum. High-technology applications may therefore only use materials which have no innate magnetism and low permeability levels. As stainless steel can be magnetic as well as non-magnetic, material selection is a crucial step in this process. Materials with lower permeability levels include 1.4435 ($\mu \leq 1.1$), or very high alloy materials such as 1.4539 and 1.4529.

During production, particular care must be paid to forming and welding, which increase permeability. Permeability can be reduced again using solution annealing.

Our test procedures for vacuum technology

All vacuum chambers and apparatuses manufactured by KASAG are tested according to the usual test procedures:

- X-ray RT, visual inspection VT
- Dye penetrant testing PT
- Material testing / Positive Material Identification PMI
- Helium leakage testing LT
- Surface roughness testing Ra / Rz
- Ferrite measurement Fe
- Wall thickness measurement, video endoscopy

Certifications, manufacturer approvals

ISO 9001 / ISO 3834-2

PED (EN13445 / AD-2000)

ASME (U-Stamp, Code Section VIII Div. 1)

China Stamp (A1), China License

TP TC 032/2013 (EAC), Customs Union

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Heat exchanger

Heat exchangers, evaporators, condensers

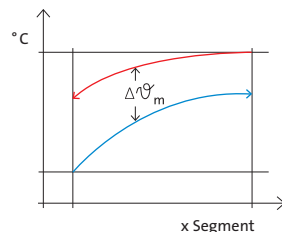
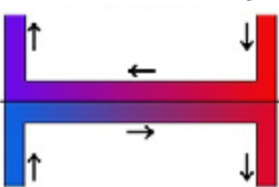
You formulate your requirements and provide your data on medias to KASAG Swiss AG. We then take on the thermal and hydraulic design of the heat exchanger that you want (pipe bundle heat exchangers, double pipe heat exchangers and spiral tube heat exchangers). This is then instructed on the basis of existing drawings or of complete engineering. Our range of materials extends from stainless steel through to special materials. KASAG provides all of the processes necessary, such as the orbital welding process for the manufacture of heat exchangers. With KASAG, you retain permanent flexibility.



Terminology

Colloquially, heat transfer systems also refer to equipment which exchanges or swaps out heat.

Counter-flow heat exchanger



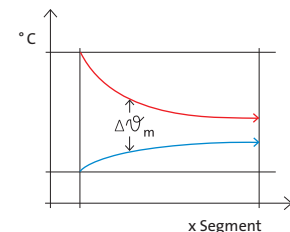
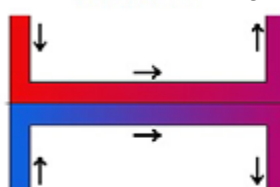
ΔT_m Median temperature difference

In **heat transfer systems**, materials flowing in a counter current flow past each other in an accommodating manner. This enables the exchange of temperatures in the flow mediums so that the originally cold medium absorbs the temperature of the originally hot medium, and vice versa.

Condensers are apparatuses in which a substance is converted from a gaseous state into a liquid.

Evaporators are equipment for converting a liquid into a gas.

Parallel-flow heat exchanger



ΔT_m Median temperature difference

In **parallel flow heat transfer systems**, the substances flow side-by-side, in the same direction. Their temperatures adjust to each other, and their values always lie between the initial temperatures.

Certifications, manufacturer approvals

ISO 9001 / ISO 3834-2

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