Graphite Heat Exchangers and Components

- Annular-groove Condenser NB/HB/KB
- cGMP Annular-groove Condenser NB/GMP / HB/GMP
- Annular-groove Vent Condenser GN/GH
- Annular-groove Heat Exchanger G1
- Annular-groove Heat Exchanger R/WA
- Annular-groove Dilution Cooler R-K
- Wavy-groove Heat Exchanger W
- Annular-groove Evaporator UB/FB
- Conti-Reactor
- Block Heat Exchanger
- Annular-groove Absorber
- Quench
- Reactor / Agitated Vessel
- Column Internals
- Other Components
For more than 40 years GAB Neumann have designed and manufactured heat exchangers, equipment and components for applications in the chemical, pharmaceutical, steel coating and environmental industries.

Providing the highest quality and maintaining a strong customer focus are the foundation of our organisation. This is demonstrated by the longevity of more than 15,000 units that have been delivered to a loyal customer base. Our staff are our key, they are highly skilled, well experienced and dedicated, ensuring the success of our products and our company.

Across the world, our staff and agents develop solutions with our clients for their specific applications to optimise overall performance and cost.

Our experienced staff assist in thermal and physical sizing of units using customised software (e.g. finite element analysis) which is translated into the automated manufacturing process to ensure continuity throughout the chain.
The Material: Graphite

The critical success factors for high quality graphite processing are: an homogeneous texture, a uniform grain structure, a perfect graphite impregnation process and consistent mechanical and thermal processing. Providing these, ensures that our products meet the most demanding requirements (e.g. cGMP capabilities).

Graphite is characterised by its wide ranging and high level of corrosion resistance. It resists nearly all acids, solvents, chlorides and other halogen compounds as well as their corresponding alloys.

Graphite’s thermal conductivity is much greater than most comparable corrosion resistant materials.

A very low tendency to foul compliments and helps qualify the material for use in onerous applications.

Duties as extreme as quenching flue gas at 1,300°C can be accommodated with graphite as it is capable of withstanding wall temperatures within the range of -60°C to +200°C.

Diverse processes can be accommodated with the large available pressure envelope -1 bar to +16 bar.

Different raw material manufacturing processes provide for differing graphite grades, i.e. mechanical strengths, allowable operating temperatures and chemical resistance.

| G16-5-180 |
| G18-5-180 resp. G18-8-200 |
| G20-5-180 resp. G20-8-200 |

The main criteria for the quality are the texture, the grain structure, the impregnation resin and the impregnation process.

Providing the highest corrosion resistance against acids, solvents, chlorides and other halogenated compounds.

Excellent thermal conductivity

Graphite is non-adhesive

A maximum temperature range of -60°C to +200°C allows process temperature of up to 1,300°C.

A maximum pressure envelope of -1 bar to +16 bar.

We have 3 graphite qualities serving different requirements.
This unique design developed by GAB Neumann enables us to adapt the heat exchanger to the specific needs of the customer’s operating requirements.

The geometry and design provides high turbulence, resulting in low fouling, automatic cleaning and high heat transfer.

Potential leak paths and cross contamination is minimised by eliminating or reducing gasketed joints.

Highly turbulent forced flow provides excellent automatic cleaning

Minimum fouling and high thermal conductivity provides best heat transfer

Leak paths minimised with no or few gaskets
The combination of high performance graphite material and our unique annular-groove design provides a heat exchanger that meets perfectly the needs of our customers specialised and multipurpose units.

The annular groove heat exchanger combines an outstanding thermal performance with a small overall size. More than $20 \text{ m}^2$ transfer area per $\text{ m}^3$ volume can be easily achieved.

The material and design permit the operation of our units under cGMP conditions. This model complies with the challenging requirements of API (active pharmaceutical ingredients) manufacturing in hundreds of cGMP plants worldwide.

Compared with other corrosion resistant materials our heat exchangers are characterised by their low cost price, their low maintenance requirements and therefore their low lifetime costs leading to higher profitability.

**The Result**

- Technically perfect
- Use in single or multipurpose plants
- High thermal performance
- Small overall size
- cGMP-compliant / qualified for API-production
- Long lifetime

**Economically outstanding**

- Low cost price
- Short delivery time
- Low operating expenses
Annular-groove Condenser NB/HB/KB

- Condensers for highly corrosive applications with high heat transfer
- Corrosion resistant on both service and product side
- Vertical or horizontal installation
- Dephlegmation applications possible
- Carbon fibre reinforcement (optional)
- Detachable header and bottom for mechanical cleaning of product side (optional)

Applications (Examples)
- Condensing of chlorinated solvents and acidic chlorides in pharmaceutical, agrochemical or dyestuff industries
- Condensing vapours in inorganic processes (e.g. sulphuric-acidic vapours, hydrochloridic vapours)

Special Features
- Both flow cross-sections are variable, thus resulting in high heat transfer rates and self-cleaning
- No gaskets and therefore no risk of leakage
- No critical swelling stress caused by the use of organic solvents

Benefits
- High operational safety
- High operational availability
- Minimised maintenance needs
- Small heat transfer area requirements
- Small special needs

Annular-groove Heat Exchanger G1

- Heat exchanger for highly corrosive applications
- For direct vertical installation in columns
- Corrosion resistant both on the service and product side
- cGMP design (optional)

Applications (examples)
- Use as a dephlegmator in the partial condensation of solvents
- Heat input into a column (e.g. as an evaporator “Robert” type)
- Application as a head condenser in a column with reflux separator

Special Features
- Direct access to product grooves
- Extremely small overall height

Benefits
- Easy to clean on the product side
- Small required space in column
cGMP Annular-groove condenser NB/GMP / HB/GMP

- Condenser for cGMP applications (e.g. in pharmaceuticals synthesis)
- For highly corrosive applications at a high thermal efficiency
- Corrosion resistant both, service and product side
- Vertical or horizontal installation
- For applications where FDA or other special food processing requirements need to be met
- Carbon fibre reinforcement (optional)

Applications (examples):
- Condensing of solvents in synthesis plants, especially in multi-purpose plants in the pharmaceutical and speciality chemical industry
- Condensing duties within the production of APIs (active pharmaceutical ingredients)
- Use within the production of food and food ingredients (i.e. flavours and fragrances)

Special Features
- Detachable header and bottom
- Rotating cleaning device (PTFE)
- No gaps, crevices and dead corners
- Bonded construction without gaskets between product and service media
- Inspection glass

Benefits
- Cleaning in Place (CIP) and mechanical cleaning possible
- Completely drainable
- In situ inspection with access for endoscopes and swab testing
- No batch or cross contamination
- No black particles due to special mechanical processing and cleaning
Annular-groove Vent Condenser GN/GH

- Condenser for highly corrosive applications
- Corrosion resistant both, service and product side
- Vertical or horizontal installation
- Dephlegmation applications possible
- Inclusion of demister possible
- Carbon fibre reinforcement (optional)

Applications (examples):
- Vent cooling of exhaust gas or vent condensing of corrosive vapours, e.g. for complying with VOC regulations (volatile organic compounds)
- Condensing and separation of corrosive vapours at the inlet or outlet of vacuum pumps

Special Features
- Large flow cross section
- cGMP design (optional)

Benefits
- Excellent separation efficiency, e.g. for complying with exit air regulations
- Small required space
- Completely drainable
- No batch or cross-contamination risk

Annular-groove Heat Exchanger R/WA

- Heat exchanger for heating or cooling of highly corrosive media
- Corrosion resistant one side: R series
- Corrosion resistant both sides: WA series
- Carbon fibre reinforcement (optionally)

Applications (examples):
- Heating or cooling of hydrochloric or sulphuric acids and solvents
- Heat transfer between two corrosive media
- Use as feed preheater for sump of column

Special Features
- Both flow cross-sections are variable, thus resulting in high heat transfer rates and self-cleaning
- No gaskets and therefore no risk of leakage
- Small overall height

Benefits
- Excellent heat transfer performance
- Self cleaning
- No cross-contamination
- Low maintenance cost
- High plant availability
**Annular-groove Dilution Cooler R·K**

- Dilution and cooling unit for the dilution of sulphuric acid
- Separate inlets for concentrated acid and dilution water
- Inlet of acid through PTFE tube
- Carbon fibre reinforcement (optional)

**Applications (examples)**
- Production of battery acid
- Dilution of concentrated acids in chemical production plants or fertiliser production
- Sulphate production for water treatment

**Benefits**
- Achieving final dilution and final temperature in one single process
- High efficiency

**Special Features**
- Dilution and cooling combined in one unit
- Dilution directly in the cooled segments
- Continuous dilution and mixing process

**Wavy-groove Heat Exchanger W**

- Special groove design for the application of annular-groove heat exchangers of R and WA series (single or both sides corrosion resistant)
- Qualified for media with a high fouling tendency
- Carbon fibre reinforcement (optional)

**Applications (examples)**
- Cooling of process media in the bio-fuel production process
- Heating and cooling applications in the production of synthetic fibres

**Special Features**
- Special groove design for achieving maximum turbulent flow

**Benefits**
- Extremely low fouling risk
- Excellent automatic cleaning properties
- Very low maintenance needs
- Highest plant availability
Annular-groove Evaporator UB/FB

- Evaporator with forced or thermosiphon circulation: UB series
- Falling film evaporator with special distribution disc design: FB series
- Corrosion resistant on both service and product side
- Carbon fibre reinforcement (standard)
- Detachable header and bottom for mechanical cleaning of product side (optional)
- cGMP design (optional)

Applications (examples)
- Evaporating organic media in continuous and batch processes (e.g. distillation, fractionation)
- Concentration of diluted sulphuric or hydrochloric acids
- Desorption of hydrochloric acid

Conti-Reactor

- Mixing, heating and cooling of two or more process media reacting exothermically or endothermically within one continuous process
- Multiple heating and cooling circuits possible
- Maximum dwell time / reaction time depending on size of unit and volume flow (e.g. 15 min at 0,7 m³/hr)
- All circuits are corrosion resistant

Applications (examples)
- Synthesis of active ingredients in agro-chemical industry by three separate, individually controlled steps
- Continuous chlorination (Cl₂+HCl+Educt)
### Block Heat Exchanger

- All-purpose unit for cooling, heating, condensing and evaporating duties
- Vertical or horizontal installation

#### Applications (examples)
- Heating pickling baths in steel industry
- Cooling of galvanising baths in steel finishing processes
- Condensing and cooling of hydrochloric acid in adiabatic absorption operations
- Evaporation of organic solvents

### Special Features
- Single or double-row borings at the product side
- Robust construction
- Modular design
- Easy to disassemble

### Benefits
- Large transfer areas and comparatively low pressure drop on the product side
- High operational safety
- Mechanical cleanability

### Annular-groove Absorber

- For absorbing HCl and other halogenated-hydrogen based gases
- Use in scrubbing applications
- Co or counter current flow options
- Design for small, medium and large inert gas content
- Capacity for 40 kg/hr to 1,000 kg/hr HCl gas at 100 % concentration

#### Applications (examples)
- Production of high purity hydrochloric acid

### Special Features
- Cross sectional flow corresponding to decreasing gas volume

### Benefits
- Wide load area at highest absorption
- High performance
- Great operational safety
Quenching duties

- Quench with spray lances
- For gases up to 15,000 m³/hr volumetric flow
- For gases up to 1,300°C inlet temperature
- Suitable for gases with halogens (e.g. CL₂, Br₂) and NOX

Applications (examples)
- Quenching of exhaust gas containing HCl, HBr and CL₂ within organic polymer production
- Quenching in ore refining processes with approx. 15 kg/hr of solids content
- Quenching of CFC vent gas containing PTFE dust

Special Features
Two or more spray lances
Excellent cooling due to continuous water film on wall surfaces and the cooling grooves in the wall

Benefits
Suitable even with large gas volume variations
Treatment of highly oxidising gases

Reactor / Agitated Vessel

- Vessel volumes from 5 L to 1,000 L
- Design pressures from -1 bar to +6 bar
- Heated or cooled vessel walls
- Carbon fibre reinforcement (optional)

Applications (examples)
- Heating and reacting of thermally sensitive materials
- Storage of highly corrosive liquids

Special Features
Extremely good heat transfer

Benefits
Minimised heating and cooling times
Excellent heat transfer at low agitation power
Efficient and low cost alternative to small and medium sized glass lined or exotic alloyed vessels
Column Internals

Based on customer’s drawings and requirements we manufacture
- distribution trays
- sieve trays
- bubble-cap plates
- cascades
- supporting trays
- hold-down plates

On request, or if necessary we perform strength calculations (e.g. finite element analysis).

Applications (examples)
- distribution trays for column
  (Ø400 mm - Ø600 mm)
- supporting and hold-down trays for packing
  (Ø600 mm)

Other Components

Based on customer’s drawings and requirements we manufacture
- jet nozzles
- steam and water jets
- thermowells
- wiper blades (for thin film evaporators)
- inlet pipes for liquids, gases and vapours

On request, or if necessary, we perform strength calculations (e.g. finite element analysis).

Applications (examples)
- jet nozzles for corrosion resistant vacuum jet pump (e.g. Δ38
- overflow cartridge for distribution tray (e.g. Δ92 x 115mm)
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Please ask us for special designs and applications.
We have successfully delivered to:

- Ajinomoto Omninchem
- BASF
- Bayer
- Boehringer Ingelheim
- Clariant
- Ciba
- Degussa
- DSM
- Egis
- Glaxo Smithkline
- Hindustan Insecticides
- H.C. Starck
- IFF
- Lanxess/Saltigo
- Merck
- Roche
- Sanofi-Aventis/Chinoin
- Symrise
- Syngenta
- Wacker Chemie

Please ask us for detailed references

Details on corrosion resistance, materials, designs and products can be found in our product information, work standards and SPOTs on the internet.

www.gab-neumann.de