

THE LINDE GROUP

*Linde*

# Cryogenic Standard Tanks LITS 2





# Introduction.

To an increasing extent, industrial gases such as oxygen, nitrogen and argon are delivered to customers in liquid form at cryogenic temperatures and stored by the customer in tanks before further use.

The pressure ratings and sizes of these tanks have been standardised in accordance with the requirements of distribution logistics and economical series production.

# Standard vacuum insulated tanks.

The vacuum-insulated double wall tanks consist of two concentric vessels, an austenitic steel inner tank and an outer jacket in carbon steel with an anti-corrosion primer and a special environmentally friendly top coat. The interspace between inner and outer tank is evacuated and filled with insulating powder (perlite). An adsorbent is also added to maintain the vacuum in the insulation interspace.

The standard tanks come in gross nominal water capacities from 3,160 litre to 61,620 litre. The maximum allowable working pressure for the inner vessels is 18, 22 or 36 bar gauge for design temperatures ranking from -196°C up to 20°C. All standard tanks have vertical configuration, requiring little space for installation.

The pressure vessels are manufactured and tested in accordance with the Pressure Equipment Directive EU 97/23/EC and EN 13458. These codes are internationally accepted. Consequently, it will be much easier than before to install and use these tanks in and outside of the European Union.

The Linde quality management system satisfies all elements of the ISO 9001 program. All produced tanks are subjected to inspection and quality control under supervision of independent inspection bodies.

The operating pressure may be set up to 90 % of the maximum allowable working pressure and is automatically maintained constant by the regulator and pressure building coil fitted to the tank.

Each tank can also be equipped with a tank mounted (clip-on) air-heated vaporiser to supply product in gaseous form at ambient temperatures and flow rates up to 120 Nm<sup>3</sup>/h. Standard tank features are various fittings for transportation and installation. Vaporisers up to 1,000 Nm<sup>3</sup>/h are installed separately.

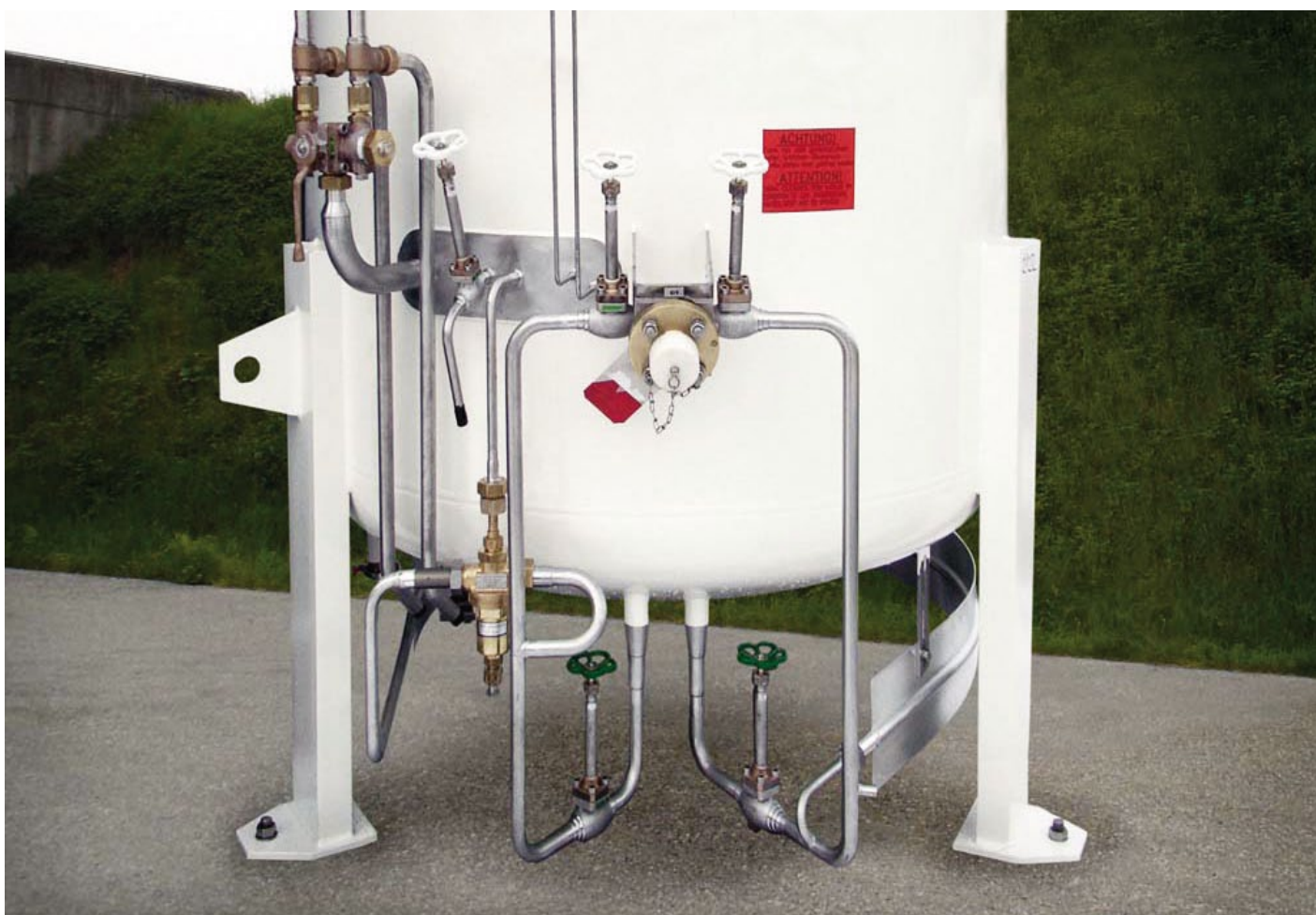
Based on the standard design, Linde offers additional features depending on client's requirements.

Standard carbon dioxide tanks are very similar to the tanks for air gases. As a function of the application and customer's request you have here the choice between an inner vessel either manufactured from a low temperature resistant austenitic steel or a fine grain carbon steel. The insulation system is equal to the system which is used for the air gas tanks.

CO<sub>2</sub>-tanks, equipped with an inner vessel made out of a low temperature resistant austenitic steel can therefore also be used as multi-purpose storage for other industrial gases.

Linde owns long standing experience in handling other liquefied gases such as for example LNG and hydrogen. Tanks for these gases are engineered and manufactured according to customers specifications, therefore quotations will be elaborated from case to case.

[Arrangements of valves, pipes and instrumentation](#)





# Quality standards for cryogenic tanks.

Quality management and inspection is based on the following guiding principles:  
Quality management and inspection is an indispensable part of our corporate strategy and therefore a managerial responsibility carried out at all levels of the company. We consider the improvement of our product quality and the continued development of our quality management system as a permanent challenge.

The Schalchen Plant is certified according to:

- EN ISO 9001/2000
- ASME (U, U2, R-Stamp)
- Manufacture license of special equipment People's Republic of China and others

Acceptance inspection is carried out by the experts of the Notified Body acc. to the valid (international) laws and further by Linde's own specialists.



## Optional standards for enhanced quality

Depending on customer requirements the tanks are available in two enhanced quality degrees:

Quality degree	Technical detail	Applications
<b>HQ</b> Degree for media with purity >5.0	<ul style="list-style-type: none"> <li>– Inner vessel stainless steel</li> <li>– Inner vessel and pipes pickled</li> <li>– Stainless steel cryogenic valves below sealed</li> </ul>	High demands in semiconductor industry and research
<b>IQ</b> Degree for corrosive industrial environment	<ul style="list-style-type: none"> <li>– Inner vessel stainless steel</li> <li>– Stainless steel cryogenic valves with stuffing box</li> </ul>	Corrosive environment

# Technical data - tanks for air gases LIN, LOX, LAR.

Size		30	60	110	200	300	490	610	800
Max. allowable working pressure	air gases: 18 bar, 36 bar								for LIN only
Gross capacity	approx. litre	3,160	6,365	11,535	20,355	30,205	49,020	61,620	80,360
Net capacity	approx. litre								
	18 bar	3,000	6,050	10,960	19,340	28,700	46,570	58,540	76,340
	36 bar	2,840	5,730	10,380	18,320	27,180	44,120	55,460	
Pressure stage									
18 bar,	kg LIN	2,425	4,890	8,855	15,630	23,190	37,630	47,300	61,680
filling ratio 95 %, 1 bar	kg LOX	3,425	6,910	12,530	22,090	32,885	53,180	66,850	
	kg LAR	4,185	8,440	15,290	26,980	40,040	64,965	81,660	
36 bar,	kg LIN	2,300	4,630	8,390	14,800	21,970	35,650	44,810	
filling ratio 90 %, 1 bar	kg LOX	3,250	6,540	11,850	20,920	31,050	50,390	63,340	
	kg LAR	3,970	7,990	14,480	25,560	37,920	61,550	77,370	
Boil-off rate	%/d LIN	0.67	0.58	0.44	0.31	0.30	0.21	0.20	0.19
1 bar, 15°C A.T.	%/d LOX	0.42	0.37	0.29	0.20	0.19	0.13	0.12	
referred to total capacity	%/d LAR	0.46	0.40	0.32	0.21	0.21	0.15	0.14	
vacuum < 2 x 10 <sup>-2</sup> mbar									
Discharge capacity with standard pressure building									
coil at 0,7 x MAWP and 8 hours operating time									
pressure stage									
18 bar	m <sup>3</sup> /h (1 bar, 15°C) LIN	150		300	300	600	600		600
	m <sup>3</sup> /h (1 bar, 15°C) LOX	190		380	380	750	750		
	m <sup>3</sup> /h (1 bar, 15°C) LAR	190		380	380	750	750		
36 bar	m <sup>3</sup> /h (1 bar, 15°C) LIN	140		140	140	280	280		
	m <sup>3</sup> /h (1 bar, 15°C) LOX	180		180	180	360	360		
	m <sup>3</sup> /h (1 bar, 15°C) LAR	180		180	180	360	360		
Capacity of one safety valve at 1.1 x MAWP/cold condition									
pressure stage									
18 bar	kg/h LIN				1,090				1,070
	kg/h LOX				1,010				
	kg/h LAR				1,240				
36 bar	kg/h LIN				5,610				
	kg/h LOX				2,260				
	kg/h LAR				2,850				
Insulation	insulating powder (perlite), vacuum < 5 x 10 <sup>-2</sup> mbar (tank in operation), status of delivery: 5 mbar								
Main material	inner vessel: low temperature resistant austenitic steel outer vessel: carbon steel								
Main dimensions	overall diameter	1,600	1,600	2,000	2,400	2,400	3,000	3,000	3,000
	overall height	4,150	7,150	7,350	8,350	11,550	11,550	14,150	18,050
Weight empty, kg	18 bar type	2,510	4,910	5,940	9,840	13,920	19,300	23,370	29,650
	36 bar type	2,600	5,220	7,180	12,310	17,090	24,570	30,260	

LIN = liquid nitrogen; LOX = liquid oxygen; LAR = liquid argon

# Technical data - tanks for carbon dioxide.

Size		30	60	110	200	300	490	610
Max. allowable working pressure	CO <sub>2</sub> : 22 bar							
Gross capacity	approx. litre	3,160	6,365	11,535	20,355	30,205	49,020	61,620
Net capacity	approx. litre	2,940	5,920	10,730	18,930	28,090	45,590	57,310
Filling ratio 93 %, 1 bar	kg CO <sub>2</sub>	3,120	6,280	11,370	20,065	29,780	48,330	60,740
Boil-off rate 1 bar, 15°C A.T. referred to total capacity vacuum < 2 x 10 <sup>-2</sup> mbar	%/d CO <sub>2</sub>	0.22	0.19	0.14	0.10	0.10	0.07	0.06
Discharge capacity with standard pressure building coil at 0.7 x MAWP and 8 hours operating time								
pressure stage 22 bar	kg/h (1 bar, 15°C) CO <sub>2</sub>	70		140	140	280	280	
Capacity of one safety valve at 1.1 x MAWP/cold condition								
pressure stage 22 bar	kg/h, CO <sub>2</sub>				975			
Insulation	insulating powder (perlite), vacuum < 5 x 10 <sup>-2</sup> mbar (tank in operation) status of delivery: 5 mbar							
Main material	inner vessel: low temp. resistant austenitic steel outer vessel: carbon steel							
Main dimensions	overall diameter overall height	1,600 4,150	1,600 7,150	2,000 7,350	2,400 8,350	2,400 11,550	3,000 11,550	3,000 14,150
Weight empty, kg	22 bar Type	2,510	4,910	6,300	10,250	14,500	20,500	24,800

# Features.

## Highly effective operation

Two service valves provide an exchange possibility for the filling valves even if the tank is filled.

Integrated pressure building coil for standard discharge capacities (service valves see flow diagrams: valve 2 pressure building and valve 13 gas shut-off). The tank also has an optimized design to reduce ice formation.



## Safety

In case that the safety valves will release product, the medium will be blown off to a safe place.

## Easy operation

All valves required for operation are set in one line







### Ergonomical position of controls and instruments

The tank controls and instruments are set in two lines.

- **Operation line:**  
Operation controls and instruments
- **Service line:**  
Service controls and instruments
- Weather protection for instruments

The operation controls and instruments can be operated by the user. A white handwheel is fixed on top of this instruments and will be used for filling or extraction.

The service controls and instruments will be used by trained employees of the gas supplier only. These valves are marked with a green handwheel.

### Non-corroding transport and lifting devices

Stainless steel transport legs

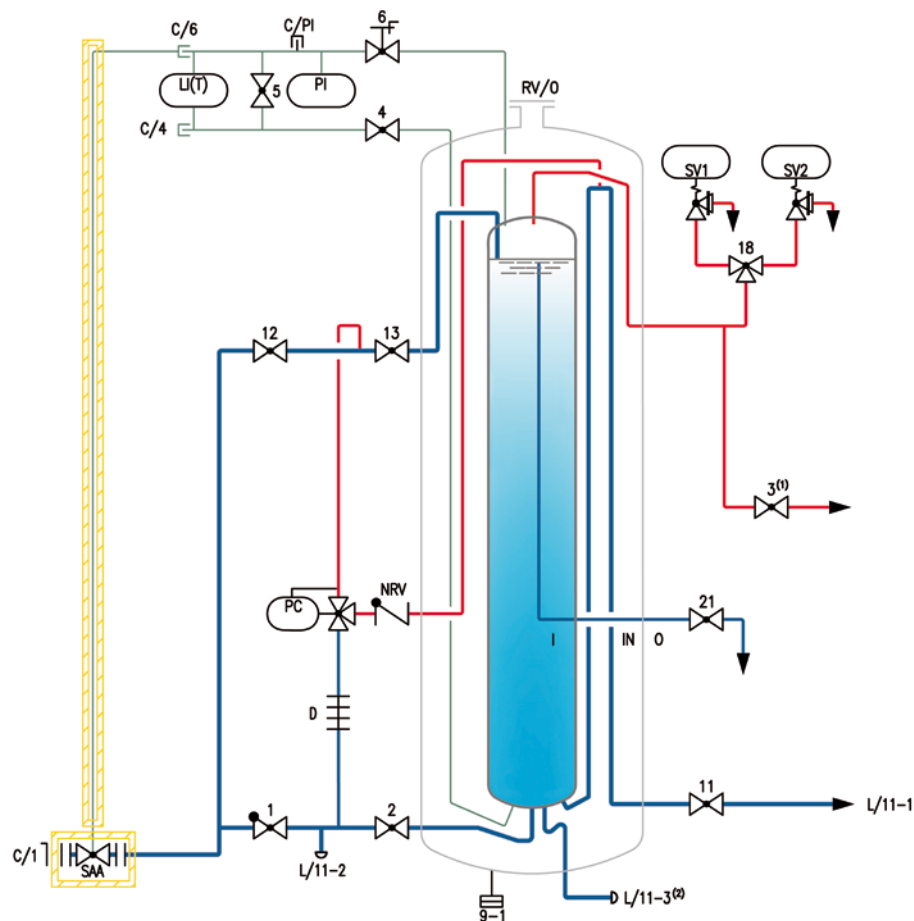


Additional vent valve (for T.. V110 - T.. V610)



Lifting lugs with stainless steel inlay





## Flow diagram - tanks for nitrogen, oxygen, argon.

### Instrumentation and equipment, standard

C/1	Fill coupling
C/4, C/6	Connection add. transmitter
C/PI	Test connection pressure indicator
D	Pressure building coil
I	Inner vessel
IN	Insulation
LI	Level indicator
L/11-1	Pipeline discharge
L/11-2	Pipeline discharge (plugged)
L/11-3	Pipeline discharge (plugged)
NRV	Non return valve
O	Outer vessel
PC	Pressure controller
PI	Pressure indicator
RV/O	Relief valve-outer vessel
SV1, SV2	Safety valve

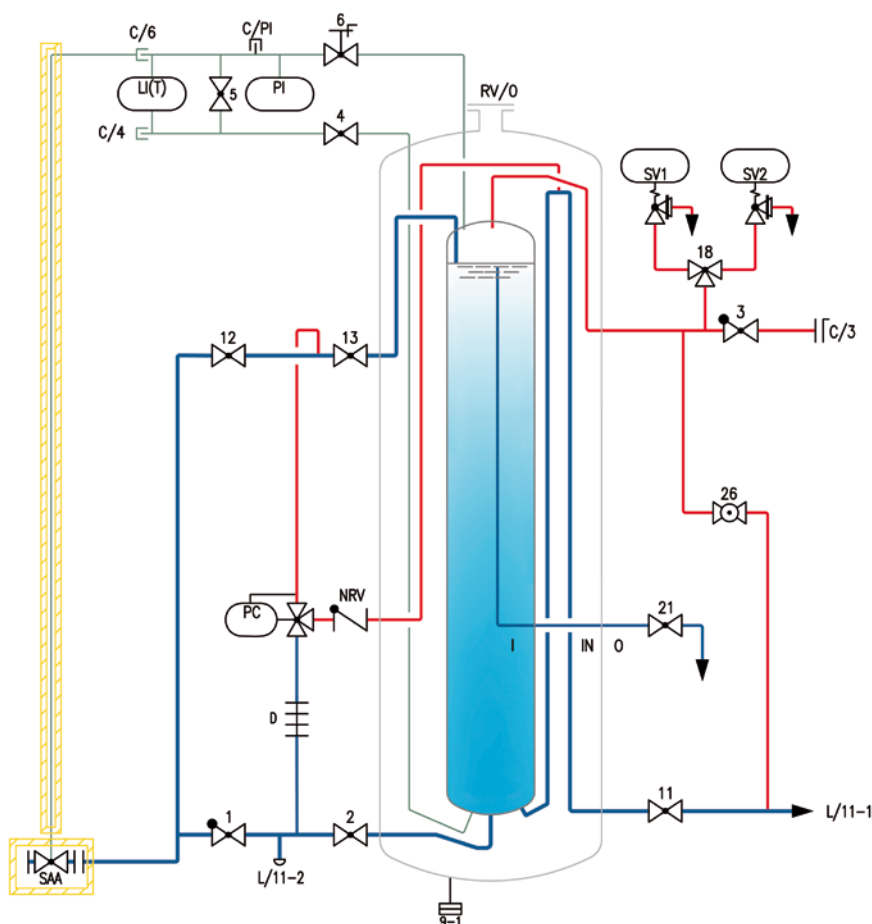
Valves, standard

1	Filling
2	Pressure building valve
3	Vent valve
4	Bottom gauge (+)
5	Gauge bypass
6	Top gauge (-)
9-1	Evacuation connection
11	Discharge
12	Top filling
13	Gas shut-off
18	Change over
21	Trycock

## Options

SAA	Safety shut-off valve, control line for SAA
LI(T)	Level indicator Samson Media 6 incl. instrument panel and standard programming, extra programming of Samson Media 6 acc. to customer requirements
LI(T)	Level indicator WIKA with transmitter output 4 - 20 mA

- (1) only T ... V110 - T ... V800
- (2) only T18 V200 - T18 V800



## Flow diagramm - tanks for carbon dioxide.

### Instrumentation and equipment, standard

C/3	Vent coupling
C/4, C/6	Connection add. transmitter
C/PI	Test connection pressure indicator
D	Pressure building coil
I	Inner vessel
IN	Insulation
LI(T)	Level indicator
L/11-1	Pipeline discharge
L/11-2	Pipeline discharge (plugged)
NRV	Non return valve
O	Outer vessel
PC	Pressure controller
PI	Pressure indicator
RV/O	Relief valve-outer vessel
SV1, SV2	Safety valve

### Valves, standard

1	Filling
2	Pressure building valve
3	Vent
4	Bottom gauge (+)
5	Gauge bypass
6	Top gauge (-)
9-1	Evacuation connection
11	Discharge
12	Top filling
13	Gas shut-off
18	Change over
21	Trycock
26	Pressuring

### Options

SAA	Safety shut-off valve, control line for SAA
LI(T)	Level indicator Samson Media 6 incl. instrument panel and standard programming, extra programming of Samson Media 6 acc. to customer requirements
LI(T)	Level indicator WIKA with transmitter output 4 - 20 mA

# Clip-on standard design.

## Special VAP - Quality for specific use.

The vaporisers are suitable for a design overpressure = max. allowable working pressure (PS) of 40 bar and an allowable operating temperature range (TS) of -269°C/+50°C.

Design and testing was carried out in accordance with the directive 97/23/EC concerning pressure equipment, AD 2000-Merkblätter and DIN EN.

The Linde finned tubes and connecting flanges are made of aluminium alloy and the seals are formed according to Linde Standards.

Clip-on standard design means the vaporiser without frame. Upon customer request, a mounting kit for installation on a cryo-tank is available.

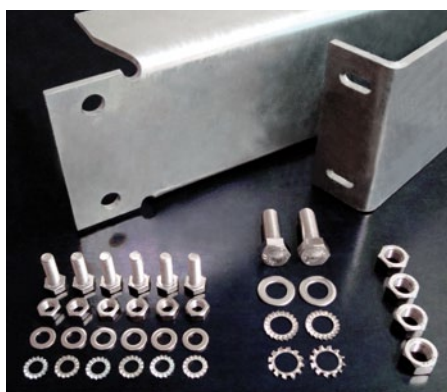
### Explanation of type designation:

- L = air heated
- 40 = max. permissible working overpressure: 40 bar
- 8 F = number of Finned tubes: 8
- 2,5 = length of single finned tube: 2,5 m

Type L 40 - 4 F 2,5

Mounting kit

Type L 40 - 2 F 2,5



vaporiser type	dimensions approx.			weight empty [kg]	nominal capacity*) N <sub>2</sub> [Nm <sup>3</sup> /h]	connections (inlet/outlet)	Linde ident-no.
	depth [m]	width [m]	height [m]			[mm]	
L 40 - 8 F 2,5	1,67	0,516	2,733	140	120	screwed: M40 x 2 pipe: DN 15 (21,3 x 1,5) socket welding end: ø18,2 material: stainless steel	J34895
L 40 - 4 F 2,5	1,67	0,276	2,733	74	60		I32740
L 40 - 2 F 2,5	0,69	0,276	2,709	37	30		I32631

\*) The capacity is based on an ambient temperature of 20°C, 70 % rel. humidity, 15°C temperature difference between ambient and gas outlet temperature at a continuous 8-hours-operation





# SHEQ - safety, health, environment and quality police.



At the Engineering Division, we do not want to harm people or the environment. We will comply with all applicable legal, regulatory, internal and industry requirements.

We strive to be leading in SHEQ to meet safe, secure and healthy working conditions and supplying safe, compliant and environmentally responsible products and services for our customers.

SHEQ is a key part of The Linde Group's overall strategy and we will also require our contractors and partners to manage in line with this policy.

To achieve this vision,  
SHEQ is 100 % of our  
behaviour,  
100 % of the time.

# Service and guarantee.

## Welcome to the Engineering Division

The Linde Schalchen Plant is located 100 km east of Munich, Germany. 700 engineers and skilled workers design and manufacture components and complete modules for the application in process plants.

Backed up by more than 100 years of production know-how, highly developed plant modules are manufactured. Our innovative technologies and our competitiveness open the door to participation in prestigious plant projects worldwide.

Linde provides complete services on field installation and operation. A specialised service crew is available for immediate and professional repair services.

**Do you need further and more detailed information?**  
Just ask us – we will be pleased to help you.

### Linde AG

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### Production area of standardised equipment:

- Advice and sale  
Phone: +49.8621.85-6777
- After sales service, guarantee, spare parts  
Phone: +49.8621.85-6279

### Other products by production area

#### of standardised equipment:

- Static vacuum insulated cryogenic vessels
- Spiral welded pipes



# Designing processes – constructing plants.

Linde's Engineering Division continuously develops extensive process engineering know-how in the planning, project management and construction of turnkey industrial plants.

## The range of products comprises:

- Petrochemical plants
- LNG and natural gas processing plants
- Synthesis gas plants
- Hydrogen plants
- Gas processing plants
- Adsorption plants
- Air separation plants
- Cryogenic plants
- Biotechnology plants
- Furnaces for petrochemical plants and refineries

More than 4,000 plants worldwide document the leading position of the Engineering Division in international plant construction.

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## Production facilities.

At Linde Engineering Schalchen Plant over 700 skilled engineers and workers design and manufacture components and complete modules for numerous applications in process plants such as ethylene plants, hydrogen and synthesis gas plants, LNG plants and air separation plants. Production capacity totals approx. 1.3 million hours per year.

In addition, the plant offers services for field installation and advice on operation. A specialised service crew is available for immediate and professional repair services.

## Product range.

- Aluminium plate-fin heat exchangers as single units or as manifolded assemblies
- Cold boxes with aluminium plate-fin heat exchangers, columns and vessels
- Coil-wound heat exchangers and isothermal reactors for chemical and petrochemical plants
- Columns and pressure vessels in aluminium for cryogenic plants
- Spiral-welded pipes in aluminium
- Storage tanks for liquefied gases
- Steam-heated waterbath vaporisers as well as air-heated vaporisers for liquefied gases

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