

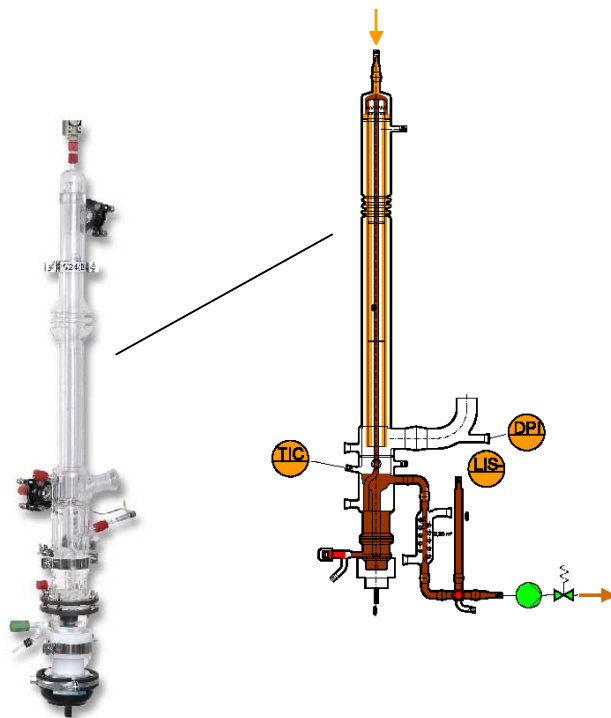
## NORMAG Falling Film Evaporator FFE

- Evaporator Tube in stainless steel or borosilicate glass 3.3
- Equal liquid film thickness and distribution by special structure or roughening of the evaporator tube surface
- Wide operation range due to **NORMAG**-Pump- and apparatus design
- Product sensitive evaporation by optimised residence time and heat stress
- High evaporation rates possible
- Minimised Hold-Up
- Design for high reproducibility as the basis for feasibility studies and scale-up
- Single apparatus or complete systems
- Modular Design
- Options
  - Complete corrosion resistant design
  - Batch or continuous operation
  - Operation with solid content
  - Fractionation of distillate

The **NORMAG**-Falling film evaporator is due to its wide operation range from 0,01 up to 1 bara and the robust and corrosion resistant design ideal for the flexible requirements in laboratories and experimental halls. Due to its modular design the evaporator can be combined e.g. with a condenser or a distillation column. Especially this flexibility, the product sensitive operation and the very good reproducibility of results makes the difference to other evaporators such as electrical heaters.

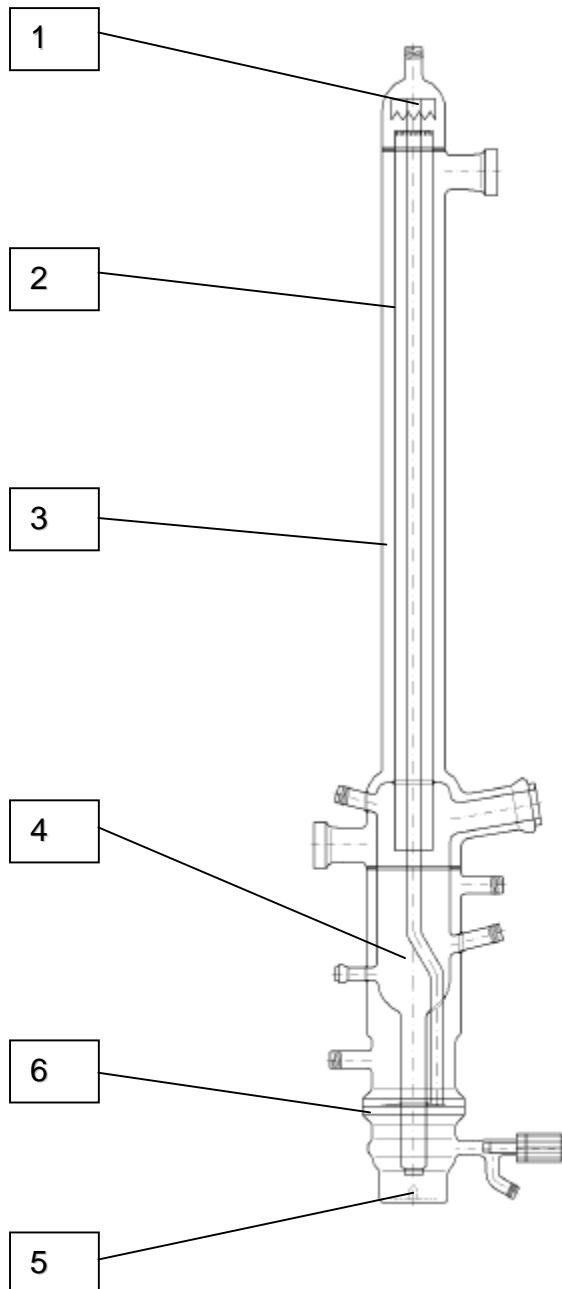
The evaporator itself is – as illustrated – a vertical evaporator tube, heated by oil or steam. At the inner tube of the evaporator rinses – illustrated light brown – a thin and equally distributed liquid film downwards and is partially evaporated. The vapor and remaining liquid flow cocurrent into the sump and will be separated in the vaporous side stream and the – dark brown illustrated – liquid hold-up. The liquid overflow is level controlled. A major part of the hold-up will be redistributed on top of the evaporator by the **NORMAG** magnetic pump and the – dark brown illustrated – inner pump tube for pre-heating of the liquid onto evaporation temperature.

**Falling Film Evaporator with modular flange for a condenser or distillation column**



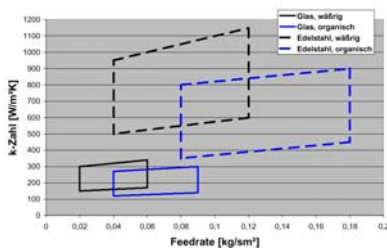
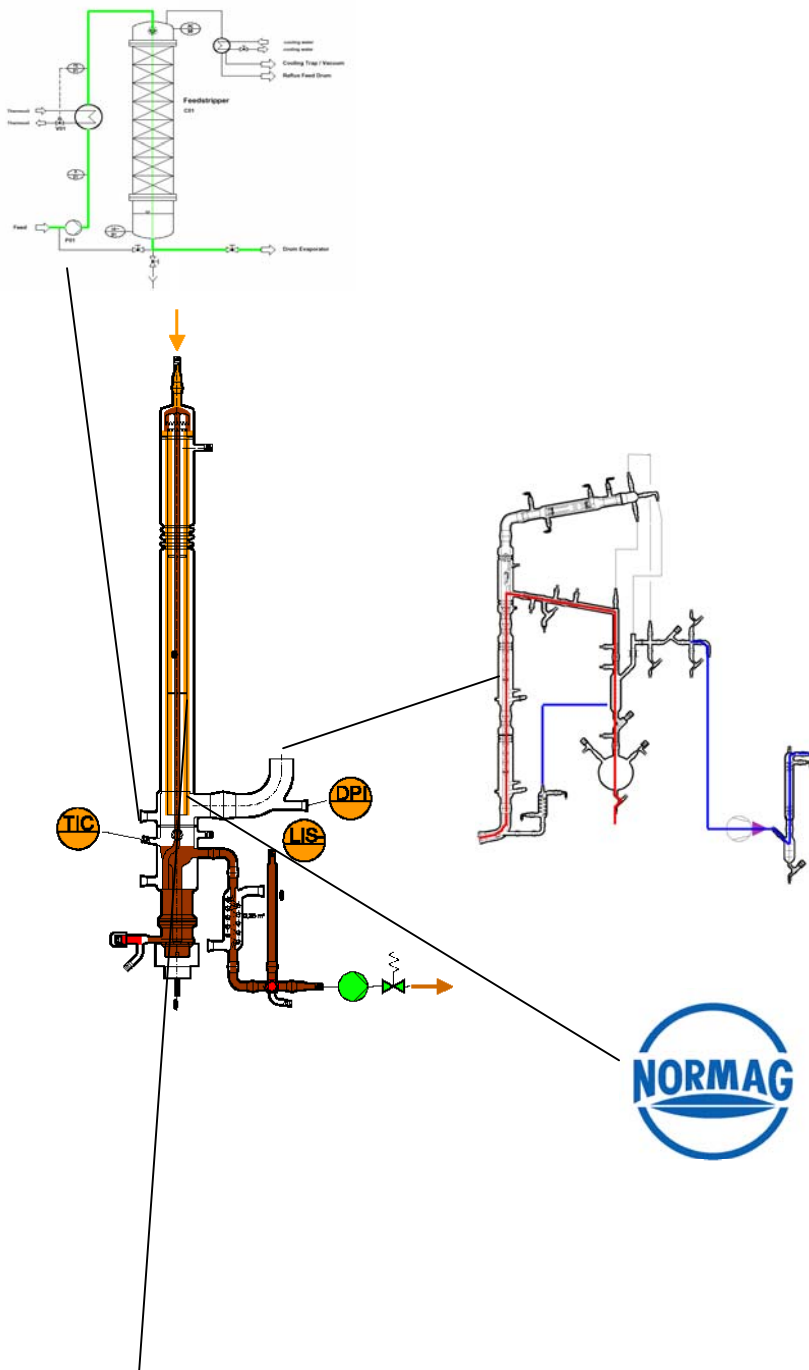


## Characteristics of **NORMAG**-Falling Film Evaporator



- 1 Umbrella distributor and special **NORMAG**-overflow-weir for a highly efficient liquid distribution onto the evaporator tube
- 2 Evaporator tube
  - Boro 3.3, roughened, or
  - stainless steel for high efficient heat transfer
  - structured stainless steel evaporator tubes for very high k-values respectively very small temperature differences for sensitive evaporation
- 3 Heating jacket options
  - themofluid heating with special distribution
  - steam heating
- 4 Bottom vessel
  - minimised hold-up
  - optional complete heating of the jacket for high operation temperatures
- 5 **NORMAG**-sump-pump  
Special magnetic pump, completely corrosion resistant, robust, with extremely low NPSH even for boiling liquids
- 6 Flange zone  
Optimised heating even of the flange zones by use of **NORMAG**-turn backs as an option

## Options



### Feed-Degasser:

In the feed to the evaporator includes are inert gases or air soluted. The content can be determined most times by the pressure and temperature while the feed is in contact with the gas.

For Evaporation processes with a relatively high soluted gas content of the feed and extremely low pressures at moderate pressures is proposed, since this will reduce the rising volume flow of non-condensable gases from the evaporator to the vacuum pump system.

### Modularity:

The evaporator can easily modular adapted with various other modules, in most cases with

- a descending condenser
- a distillation unit as illustrated

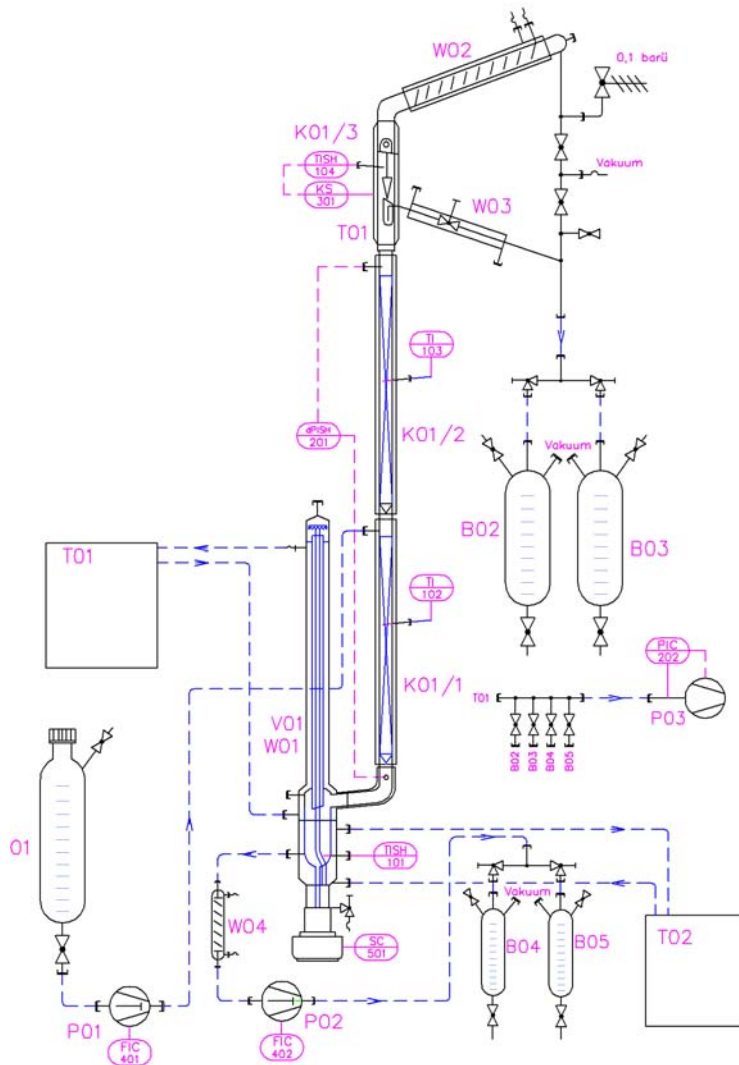
### NORMAG-quality:

The **NORMAG** sign on each glass component ensures reliable components in highest quality due to customer requirements. Specific dimensional & tolerance validation and for complete units functional tests ensure our quality

### Engineering

An application specific support for the evaporator type choice, the calculation of the required heating power and thermal stress can be given by NORMAG. These data are important for a later scale-up. Exemplarily is the illustrated heat transfer, the k-value, depending on various factors, e.g. the feed rate.

## Operation and Applications



### Example distillation:

The feed from the vessel O1 is fed by the pump P01 into the column K01/2 and rinses counter-current to the upstreaming vapor into the falling film evaporator W01. The remaining liquid is collected in the sump of the falling film evaporator, pumped with the NORMAG-pump S01 onto the evaporator tube and is then partially and well controlled evaporated. By this evaporation the column pressure difference is controlled with respect to the sump temperature by thermostat TD2 and thermofluid temperature by TD1 to ensure a sensitive and well reproducible evaporation. The sump product will be drawn by an overflow in the falling film evaporator via cooler W04 and pump P02 in the vessels B04/05. The sump volume is small compared to the column volume. Cause of this the product will be only for comparably short time thermally stressed and, in addition, the column equilibrium is much quicker adjusted.

### Typical applications:

- Lab and Experimental hall
  - for thermally sensitive products
  - for high reproducibility
  - for scale-up
- Production
  - Juice, milk, Aroma recovery, various chemicals & pharmaceuticals

### Technical specification:

Capacity:	0,1 l/h up to 50 l/h
	0,02 m <sup>2</sup> up to 0,5 m <sup>2</sup>
Operation temperature:	Up to 200 °C
Operation pressure:	appr. 10 mbara up to 1 bara
<b>Energy:</b>	
Power:	230/400 VAC, 50/60 Hz
Water:	min. 1 barg