HB Products WE INCREASE UPTIME, SAFETY AND EFFICIENCY







# HBX Vapor Quality Sensors

## Energy efficient evaporator control, compressor protection and ammonia carbamate protection

# Efficient control and compressor protection

## The Vapor Quality Sensors can be used for

- **Simple efficient DX systems**
  Eliminate superheat and control your expansion valve directly
- **Overfeed systems**
  Control your circulation rate and make your system more efficient at any load
- **Ammonia carbamate detection**
  Leak alarm for $CO_2$ into ammonia for cascade systems at an early stage before the system gets damaged
- **Compressor protection**
  Detect liquid in the suction line and prevent liquid hammering


### Features:

- Energy savings for DX systems ensures semi-flooded operation and eliminates superheat
- Low charge - high efficiency DX plants are possible also for ammonia
- Optimized evaporation control for both DX and overfeed systems
- Direct control of an electric expansion valve or a liquid valve in overfeed systems - No PLC is needed

### Functionalities:

- Measures the content of liquid in a refrigerant gas
- Instant measurement
- No moving parts
- Suited for most common refrigerants and pipes dimensions from ½" to DN300

**Increase capacity** | **Save energy** | **Reduce $CO_2$**

## BENEFITS AND OPPORTUNITIES

- The sensor provides an instant signal without delay which is ideal for controlling the evaporation process in a refrigeration plant. The conventional thermo valve reacts significantly slower and a significant superheating of the gas is needed.
- The sensor has no moving mechanical parts and no service is needed. The mechanical part is made from stainless steel and a few plastic parts all approved for most common refrigerants including ammonia.
- The vapor quality sensors are mounted in straight pipes or in an elbow normally used for strainers. This secures a precise positioning of the sensor element and repeatable results.

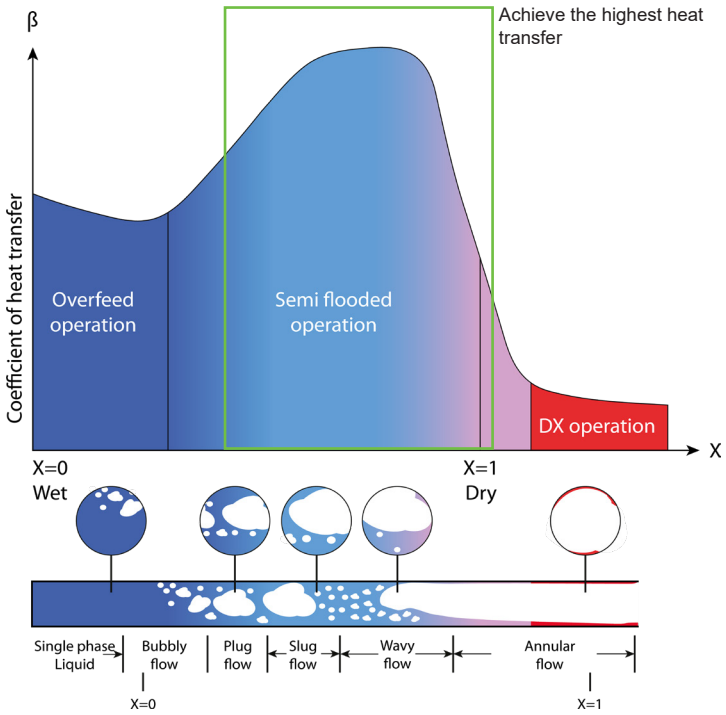
### New innovative technology

The Vapor Quality Sensors have a new innovative technology which makes it possible to measure the mix between gas and liquid in a refrigerant from 0% gas to 100 % gas - a measurement no other sensor can provide. It consists of a tube, with metal inserts, where the mix of two phases pass through. The sensor measures the dielectric constant of the fluid, and as two different phases (liquid/gas) has different dielectric constant, the mix between the two, can be calculated. The output of the sensor is the “X” value which has a linear relation to the Volume % of liquid in the gas.

### Optimize the evaporator

The evaporator efficiency depends on the liquid content of the substance and the flow rate. The figure shows that the efficiency depending on the vapor quality from X=0 wet to X=1 dry gas The highest efficiency is achieved in the semi flooded operation area from a X value 0.5 to 0.9. In this area the substance is a mix between a small amount of liquid and a lot of gas.

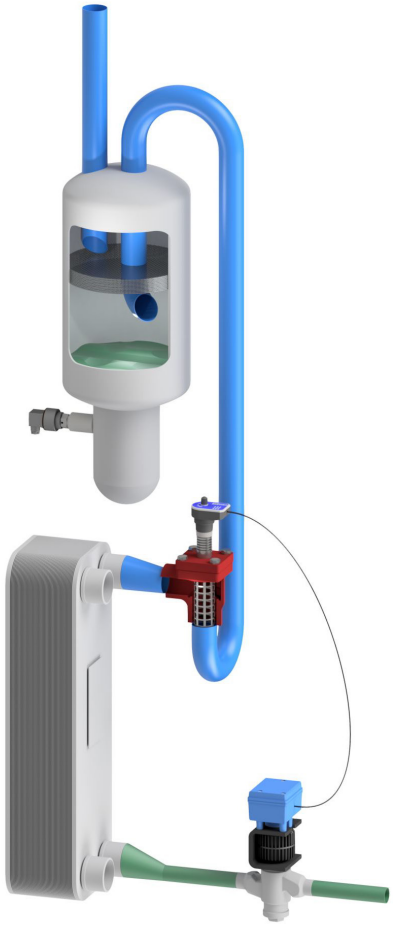
As soon as the gas becomes dry beyond 0.9 the efficiency drops dramatically and at the same time the gas is superheated. In a conventionally DX (direct expansion) system the gas is heated up to 5-10 K superheat and that creates a loss in efficiency in the evaporator as 20-30 % of the area is used for superheating. At the same time superheating is a waste of energy and should be avoided.



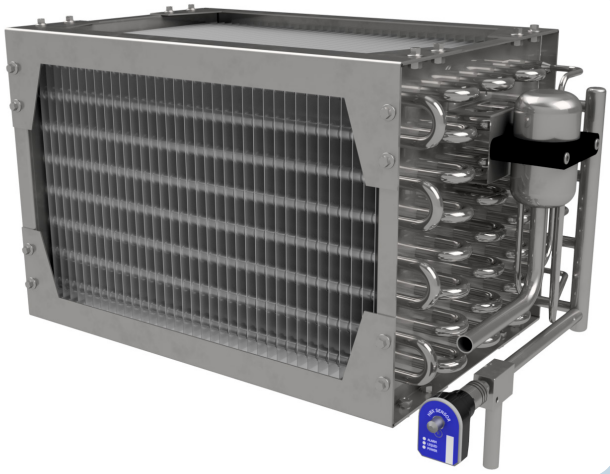
# Eliminate superheat in DX systems

In DX systems the Vapor Quality Sensor can control an electronic expansion valve directly, which secures an optimum evaporator control. Superheat can be eliminated, and evaporator capacity can be increased using semi-flooded operation.

At the same time the installation cost is reduced as the PLC is not needed, and the cabling is simpler. With the right evaporator design the suction pressure can be significantly increased and the COP improved. Energy efficient systems are normally constructed as overfeed systems with circulated refrigerant which is the normal way to eliminate superheat - but with a vapor quality sensor you can get even better efficiency at a lower cost and with a significant lower refrigerant charge.



A Vapor Quality Sensor and a separator vessel make it possible to drain oil and operate a DX system without superheat, even with some amount of water in the system.



Ammonia has a bad reputation in connection with DX systems. This is mainly due to the challenges such as poor liquid distribution, high latent heat, water content and oil accumulation, which can occur in a DX ammonia system.

These challenges can be met by installing an optimal DX evaporator, which has a parallel flow and a distributer that makes sure the liquid is distributed evenly and secures the oil transport.

# Achieve balanced circulation rate in flooded systems

In flooded systems the Vapor Quality Sensor can detect the liquid content and adjust the liquid feed maintaining a balanced circulation rate. The sensor can control the liquid valve directly without the use of a PLC.

By using the vapor quality sensor in the evaporator outlet and using it for controlling the refrigerant feed, it is possible to reduce the pressure drops. This makes the system significantly more energy efficient even in part load operation.

Improved heat transfer in evaporators and plate heat exchangers increases the capacity and makes it possible to reduce the needed refrigerant charge. When using the Vapor Quality Sensor for controlling the liquid feed it is possible to maintain a stable flow, even in risers, with a low pressure drop.

Thermosiphon system with both a Vapor Quality Sensor in the evaporator outlet and a level sensor in the separator.

When the Vapor Quality Sensor is combined with a Level Sensor in the separator vessel it is possible to control the level in the separator and adjust the capacity of the evaporator. This functionality is needed for batch freezers, plate freezers and similar systems, where the capacity change during the cycle.


Level Sensor, HBLT-A2

# The Vapor Quality Family

The Vapor Quality sensor comes in a straight pipe version and two angle versions to match different system designs. They all have the same functionality and are optimized for the most common refrigerants.

## Inline Sensor

The straight version called in-line is available from 1” to 2” and the sensor accepts flow in both directions. The sensor can be mounted both horizontal and vertical position and is made only in stainless steel. The sensor can be butt welded (TIG) into the system.

## Angle Rod Sensor

The angle rod sensor is made in stainless steel from 3/8” to 7/8” and the sensor accepts flow in both directions. The outer pipe has a larger diameter than the system pipe diameter to make room for the sensor element and avoid pressure drops. To make the sensor fit to the pipework in the system pipe reductions are part of the delivery and these will be different depending of the refrigerant. The sensor can be brazed or butt welded into the system.

## Angle Strainer Sensor

The largest versions are built into strainer houses made from carbon steel available from DN20 to DN300 or in stainless steel from DN20 to DN65. The strainer houses do not include a strainer, but it can be mounted in some of the versions; please contact HB Products if this is needed.

The flow direction is limited to one direction and it has to be mounted with the lid and electronic part upwards to secure refrigerant drainage, when the system is stopped. The angle strainer houses from DN40 and sizes below have an additional pipe welded on to create sufficient room for the sensor element.

| Power supply | | Mechanical specifications | |
|---|---|---|---|
| Voltage | 24 V AC/DC | Connection | Welding or brazing |
| Current consumption | Max 250 mA | Mechanical parts | AISI 304 / PEEK |
| Electronic connection | M12 - 5 pins | Material – electronic parts | GF BLK, Nylon 6 (PA) |
| **Output** | | **Approvals** | |
| Analog signal | 4-20 mA | EMC test | EN 61000-2 |
| Control | Stepper motor valve, modulating valve, motor valve | **Cable** | |
| **Environmental conditions** | | 5 m cable with. M12 plug | HBxC-M12/5 |
| Refrigerants | Applicable to HFO/ HFC, R717 (Ammonia), R744 | Cable specifications | PUR -5 x 0,34mm2 |
| Ambient temperature | -40...+50°C | **Indication** | |
| Refrigerant temperature | -55...+50°C | LED indication | LED (green, yellow and red) |
| Max. Working pressure | 52 bar g (754 psi g) | | |
| Degree of protection | IP65 | **Configurations** | |
| Vibrations | IEC 68-2-6 (4g) | Configuration | With PC tool |

**Please note** that a USB programming cable is not included and must be ordered separately. The cable can be used for all sensors from HB Products. Ordering code: HBxC-USB.

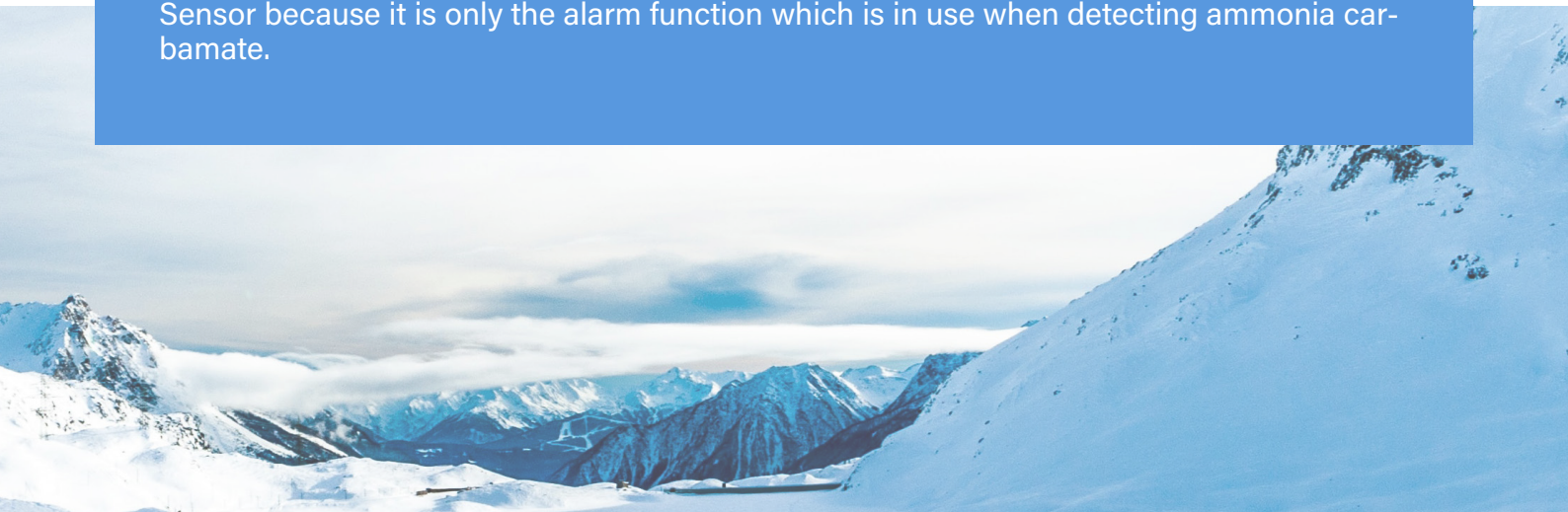
## SPECIAL APPLICATIONS

- **Compressor protection**

  The Vapor Quality Sensor can also be used for compressor protection when mounted in the compressor suction line. Here it detects liquid and can prevent liquid hammering.

- **Leak detection of ammonia carbamate and vapor quality at the same time**

  The sensor can be used for detecting CO2 leaking into an ammonia cascade system creating ammonia carbamate. At the same time the sensor can also be used as a Vapor Quality Sensor because it is only the alarm function which is in use when detecting ammonia carbamate.

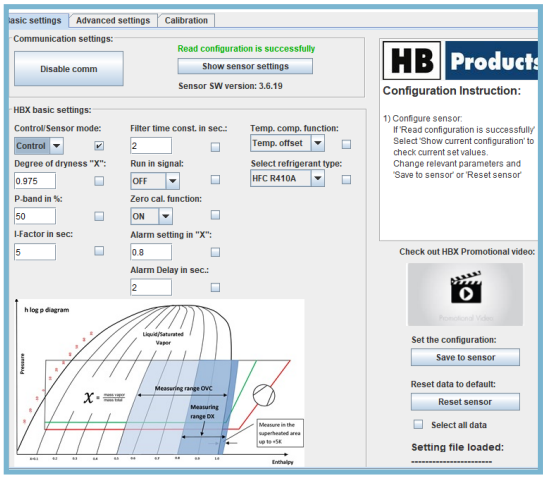


# Use and configuration

## Download our free HB Tool

On our website you have free access to the HB Tool, which is a software you can use for setting up and calibrating the sensors. The Tool can be installed on a PC running MS Windows. Both sensors with a M12 - 5 pin connector and a DIN 43650 - 4 pin can be connected using an USB cable.

The HB Tool can detect the connected sensor and shows all the parameters you can set for the sensor. The data can be stored on the sensor like you store data on a USB stick.
The tool can also be used for calibration and for troubleshooting in the system.

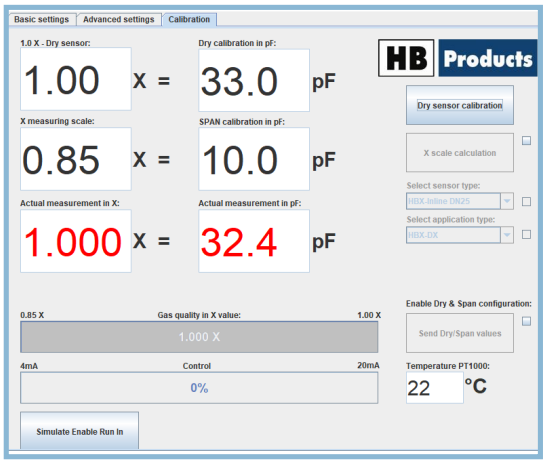



## Sensor interface

The sensors from HB Products typically deliver an analog 4-20 mA signal as measurement result. The signal can be wired over a long distance without compromising the accuracy.

The signal is typically used as input in a PLC for controlling the system. Some sensors have a digital output to be used in a relay, or they have an output cable which can control a valve directly.

Some of the sensors has a LED output for showing power supply, an alarm or other simple output




## CONTACT US


HB Products
Bøgekildevej 21, 8361 Hasselager

87 47 62 00

sales@hbproducts.dk
info@hbproducts.dk

www.hbproducts.dk