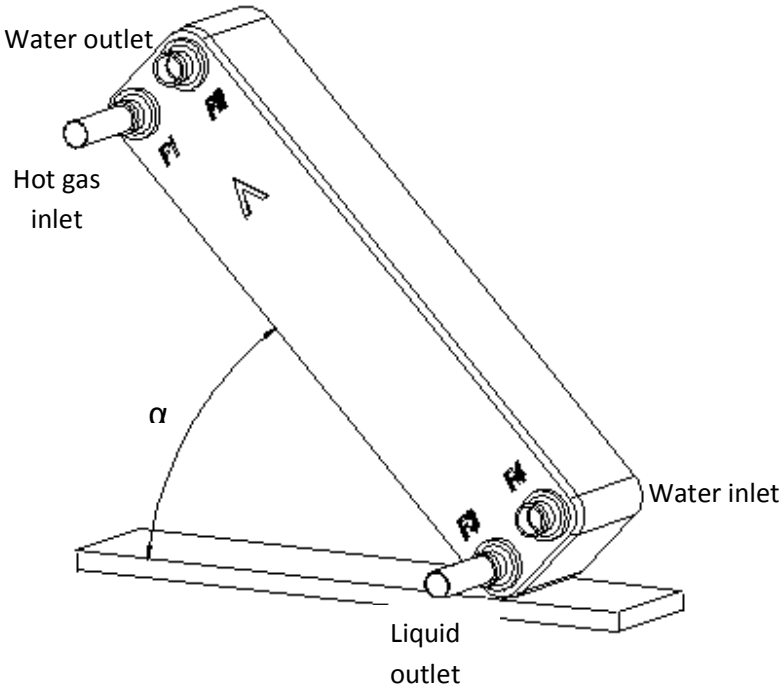
Condenser performance of tilted BPHE

Background

The BPHE condenser is normally used standing up in a vertical position. The refrigerant gas is fed in the top and the subcooled liquid leaves at the bottom of the heat exchanger. Space restrictions in some applications have raised the question of impact of horizontal installation angles. Performance tests have been made in the lab at SWEP in Landskrona where the condenser has been tilted sideways from the up-right position. The purpose was to determine how the installation angle affects the performance of a BPHE used as a condenser during normal running conditions.

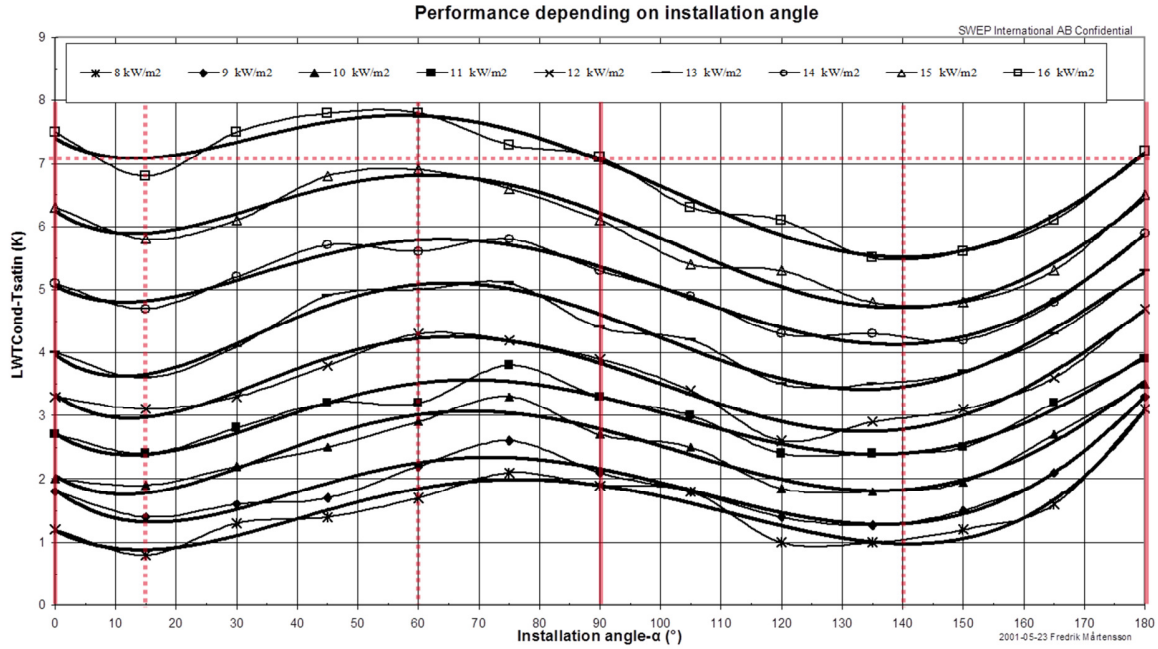
Method

Condenser performance test of a B28x40 was done in 13 different installation angels in the range from 0° to 180°. Where α is defined as the angle between the horizontal and the left side of the condenser. α = 90° corresponds to a normal installation.



Result

In the graph below the B28 condenser performance expressed in temperature approach is plotted as a function of installation angel. The test result indicates a performance peak at 15° and an even better at 140°. Worst performance dip was seen at 60°.



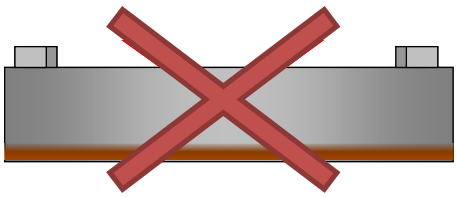
Even if the optimum installation angles from performance point of view seem to be around 140°, for this specific BPHE, it is not very practical from a mounting point of view. The more reasonable installation angles are the standard 90° and the alternatives 0° and 180°. The performance for those three angels is almost the same according to the test of B28.

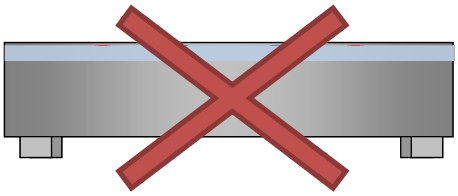
Pros and cons

Comparing the two options of tilting the BPHE 0° or 180° the choice with 0° is preferred based on fact that the refrigerant connection then being positioned in the lower part which should facilitate condensate drainage. The disadvantage with that setup would be the slight risk of dirt possibly could sediment and accumulate in the lower part of the BPHE, but with good flow and clean water that shouldn't be an issue. The option with 180° tilt would instead have a risk of air getting trapped in the top, if system not properly vented, since water connections are positioned in the lower part.

Other positions

Tilting the heat exchanger in the other direction causing the BPHE laying completely on the back or front is not recommendable. Main reason for this is that it could cause mal-distribution on the refrigerant side. On water side there are other drawbacks like; if on back dirt could possibly sediment and accumulate in the last (bottom) channel, or if on full front residual air could get trapped and causing an air pocket in the last (top) channel if system not vented correctly.





Conclusion

The up-right installation angle is the recommended one but when necessary horizontal is a plausible option. The predicted performance in SSP is valid for the vertical position and the performance impact of placing it horizontal could differ dependent on BPHE dimensions but is estimated to ±0,5K in temperature approach.

The test showed that other angles (non vertical or horizontal) might give a better performance for B28. However it is not possible to make a general statement valid for all BPHE models and operating conditions. Neither could the negative impact of other factors like air and particles be predicted if other angles are used.

The content above is written in good faith and should be considered best practice based on knowledge available at SWEP today.