2021-03-01

Fredric Wenger
Technical Manager Heat Pump/Cooling
PoD / Process & Technical dep.
Stockholm Exergi

1 SUPPORTING DOCUMENTATION FOR NON-DEFAULT M_R VALUES.

1.1 Background

Since refrigerant's negative impacts on the environment have been noted, for example the impact on the ozone layer and greenhouse effect, the requirements for handling refrigerants have been tightening. In doing so, the requirements on the equipment being used during refrigerant handling, has also increased.
For Stockholm Exergi this means that, for example equipment for continuous monitoring of refrigerant emissions to the air and water has been installed and advanced equipment for emptying the refrigerant-bearing plants has been constructed.

1.2 Question at issue

How far is it possible to drain refrigerants from the refrigerant-bearing equipment at Stockholm Exergi's facilities, for example when dismantling a heat pump or chiller at the end of its life?

1.3 Method

In order to determine exactly how much of a refrigerant charge that can be withdrawn when draining equipment, it is required to first fill a new plant with a certain amount of refrigerant and then empty it before it is put into operation. This because a certain portion of the refrigerant will be bound in the plant's oil system during operation. The problem with this procedure is mainly that we do not have any new plants to fill/empty.

However, you can make an accurate assessment by analyzing the emptying process of a plant section. Then you can establish that a certain pressure drop corresponds to a certain amount of refrigerant and thus it´s possible to make a qualified estimate of the remaining refrigerant.

1.5   Example

Below is an example of an executed refrigerant discharge of a heat pump at Stockholm Exergi's plant in Värtaverket in Stockholm.
Emptying of VP26 in Rn1&2, Värtaverket 2009.08.29.

Date/time	Heat pump pressure (Bar(A))	Refrigerant tank pressure (Bar(A))	Refrigerant tank weight (kg)	Comment
2009.08.29				
09.00	8.9	10.1	4,730	Start emptying liquid
10.00	10.4	7.4	13,000	
11.00	9.5	8.1	19,600	
12.00	8.9	9.2	19,900	Emptying gas phase
13.00	5.9	12.2	20,400	
14.00	3.9	11.9	21,000	
15.00	2.6	11.5	21,400	
16.00	1.5	10.6	21,800	
17.00	1.1	10.4	21,900	
18.00	0.9	10.1	22,000	
2009.08.30				Interruption nightime
09.00	0.9	9.5	22,100	
10.00	0.6	9.7	22,200	
11.00	0.3	9.6	22,250	
12.00	0.1	9.6	22,290	
13.00	0.05	9.5	22,320	
14.00	0.02	9.5	22,350	
15.00	0.005	9.6	22,370	Emptying finished

The same principle applies to all cooling machines and heat pumps regardless location.

1.7 Conclusion

If one analyzes the emptying process in the table above it can be concluded that the residual amount of refrigerant after discharge is very small. In order to estimate the remaining amount you can look at the table´s last two lines where it appears that a pressure drop from 20 mBar to 5 mBar corresponds to a refrigerant amount of 20 kg (22,370-22,350). It follows that the residual amount of refrigerant (from 5 mBar to absolute vacuum) is less than 20 kg. The reason why we do not drain to an absolute vacuum is that the equipment of refrigerant management set a limit at ~5 mBar.

The conclusion of the above is that we comfortably can empty a refrigerant-bearing plant to less than 1 % of the fill volume. In the example above with a heat pump containing ~20 tons of refrigerant 1 % is 200 kg.

Fredric Wenger

Verified by

Christer Boberg
Stockholm Exergi
Market developer

_____

Stockholm Exergi AB   Postadress: 115 77 Stockholm   Besöksadress: Jägmästargatan 2   Telefon: 020-31 31 51
www.stockholmexergi.se   E-postadress: kundservice@stockholmexergi.se   Säte: Stockholm   Organisationsnummer: 556016-9095