DIN EN 328:2014-11 (E)

Heat exchangers - Forced convection unit air coolers for refrigeration - Test procedures for establishing the performance

Contents

Page

Foreword 4

Introduction 5

1 Scope 6

2 Normative references 6

3 Terms and definitions 6

4 Symbols 11

5 Standard capacity 13
5.1 Basis of standard capacity data 13
5.2 Standard conditions for the cooling capacity 14
5.2.1 General 14
5.2.2 Refrigerants 14
5.2.3 Liquids 15
5.3 Conditions for the nominal air flow rate 15
5.4 Conditions for nominal fan power 15

6 Manufacturer's data 15

7 Measurements 16
7.1 Uncertainty of measurements 16
7.2 Measurement criteria 17
7.2.1 Pipe side temperature measurement 17
7.2.2 Superheating temperature 18
7.2.3 Temperature at expansion device inlet 18
7.2.4 Liquid temperatures 18
7.2.5 Water temperatures (balancing air heater) 18
7.2.6 Air temperature measurement 18
7.2.7 Pressure measuring points 19
7.2.8 Flow rates 19
7.2.9 Oil content 19
7.2.10 Non azeotropic refrigerant 19

8 Testing methods and equipment 20
8.1 Testing methods 20
8.1.1 Capacity 20
8.1.2 Air flow 20
8.1.3 Heat exchange with the ambient 20
8.2 Equipment 20
8.2.1 Calorimeter room 20
8.2.2 Refrigerant / liquid pipes 22
8.2.3 Expansion device 22
8.2.4 Flashgas 22
8.2.5 Air flow measurement 22
8.2.6 Liquid receiver 22

9 Test procedures 23

9.1 General ... 23
9.2 Calibration of the calorimeter room ... 23
9.3 Measurement of the cooling capacity ... 24
9.3.1 Air humidity ... 24
9.3.2 Subcooled refrigerant temperature ... 24
9.3.3 Steady-state conditions ... 24
9.3.4 Test duration ... 24
9.3.5 Conducting the test ... 25
9.3.6 Air inlet temperature ... 26
9.3.7 Data to be recorded ... 26
9.4 Measuring the fan performance ... 26

10 Calculating the cooling capacity ... 27
10.1 Heat loss factor ... 27
10.2 Cooling capacity ... 27
10.2.1 From the air side energy input ... 27
10.2.2 From flow rate of refrigerant ... 27
10.2.3 From the flow rate of liquid ... 27
10.2.4 Measured capacity ... 28

11 Conversion to standard conditions ... 28
11.1 Cooling capacity ... 28
11.1.1 General correction for atmospheric pressure ... 28
11.1.2 Refrigerants with direct expansion operation ... 28
11.1.3 Refrigerants - operation with liquid overfeed by pump circulation ... 29
11.1.4 Liquids ... 29
11.2 Calculating the standard liquid side pressure drop ... 30
11.2.1 General ... 30
11.2.2 Single Test ... 30
11.2.3 Duplicate Tests ... 30
11.3 Nominal air flow ... 31
11.4 Nominal fan power ... 31

12 Test report ... 31

Annex A (informative) Bubble point temperature ... 32

A.1 Diagram bubble point temperature ... 32

Annex B (normative) Test installation for direct expansion operation ... 33

Annex C (normative) Test installation for liquids ... 35

Annex D (informative) Superheating and capacity ... 36

Annex E (normative) Test arrangement ... 37

Annex F (normative) Operation with liquid overfeed by pump circulation ... 38

F.1 Scope ... 38
F.2 Standard conditions ... 38
F.3 Measurements ... 39
F.4 Testing methods and equipment ... 39
F.5 Test procedures ... 40
F.6 Capacity calculations ... 41
F.7 Conversion to standard conditions ... 42

Annex G (informative) Procedure to measure the oil content ... 45

Bibliography ... 46