ANSI/AHRI Standard 711 (SI)

2009 Standard for

Performance Rating of Liquid-Line Driers

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IMPORTANT

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Note:

This standard supersedes ARI Standard 710-2004.
For I-P ratings, see AHRI Standard 710 (I-P)-2009.
Approved by ANSI August 2, 2010. ANS expired August 2, 2020.

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PERFORMANCE RATING OF LIQUID-LINE DRIERS

Section 1. Purpose

1.1 *Purpose.* The purpose of this standard is to establish for Liquid-line Driers: definitions; test requirements; rating requirements; minimum data requirements for Published Ratings; marking and nameplate data; and conformance conditions.

1.1.1 *Intent.* This standard is intended for the guidance of the industry, including manufacturers, engineers, installers, contractors and users.

1.1.2 *Review and Amendment.* This standard is subject to review and amendment as technology advances.

Section 2. Scope

2.1 *Scope.* This standard applies to Liquid-line Driers utilizing solid Desiccants designed for use in the liquid line of all types of refrigeration and air-conditioning systems.

2.2 *Applicability.* This standard applies to Liquid-line Driers for use in refrigerant systems employing the halocarbon refrigerants listed in Table 1, as described in ANSI/ASHRAE Standard 34:

Table 1. Applicable Refrigerant Systems

Refrigerant Number	Chemical Name	Chemical Formula
R-12	dichlorodifluoromethane	$CC1_2F_2$
R-22	monochlorodifluoromethane	$CHC1F_2$
R-134a	1,1,1,2-tetrafluoroethane	CH_2FCF_3
R-245fa	1,1,1,3,3-pentafluoropropane	$CHF_2CH_2CF_3$
R-404A	Refrigerants 125/143a/134a 44.0/52.0/4.0 % wt.	CHF_2CF_3/ CH_3CF_3/ CH_2FCF_3
R-407C	Refrigerants 32/125/134a 23.0/25.0/52.0 % wt.	CH_2F_2/ CHF_2CF_3/ CH_2FCF_3
R-410A	Refrigerants 32/125 50.0/50.0 % wt.	CH_2F_2/ CHF_2CF_3
R-502	Refrigerants 22/115 48.8/51.2 % wt.	$CHC1F_2$/ $CC1F_2CF_3$
R-507A	Refrigerants 125/143a 50.0/50.0 % wt.	CHF_2CF_3/ CH_3CF_3

2.3 *Exclusions*. This standard does not apply to liquid anti-freeze solution Desiccants or driers used in the suction line or low side of refrigeration and air-conditioning systems.

2.4 *Limitations.* This standard provides a means of determining Water Capacity and Refrigerant Flow Capacity of a Liquid-line Drier at specified conditions. This standard does not attempt to reflect the performance of a Liquid-line Drier over the entire range of possible applications. Therefore, acid and particulate removal are not considered here.

2.4.1 *Acid Removal.* It is known that acid in a refrigeration system causes harmful corrosion. Many Liquid-line Driers will remove acids. However, there is no knowledge at the present time as to what concentration of various acids is allowable, nor how to test a liquid-line drier's ability to remove these acids. Therefore, while noting its importance, no consideration of acid removal is given in this standard at this time.

2.4.2 *Particulate Removal.* Although many commercial Liquid-line Driers have filtering media, the subject of filtration is separate and distinct from the considerations of this standard. Therefore, the rating of a Liquid-line Drier is on the premise of a clean Liquid-line Drier and clean refrigerant.

Section 3. Definitions

All terms in this document follow the standard industry definitions in the current edition of *ASHRAE Terminology of Heating, Ventilation, Air Conditioning and Refrigeration* unless otherwise defined in this section.

3.1 *"As Received" Condition.* This specifies the Liquid-line Drier as removed from the manufacturer's packaging, without further reactivation or preparation. (Note: If information is desired with respect to the reactivation of a Liquid-line Drier, the user should consult the manufacturer for recommended reactivation procedure.)

3.2 *Desiccant.* A material that will collect and hold water.

3.3 *Equilibrium Point Dryness (EPD).* The lowest possible water content of liquid refrigerant attainable by a specific Liquid-line Drier. This is achieved at a specific temperature after it has collected a specific quantity of water when the two have been in contact until an equilibrium between the water in the refrigerant and the water in the Liquid-line Drier has been reached. EPD is expressed in parts per million (ppm) by weight.

3.4 *Liquid-line Drier.* A manufactured device for use in the liquid line of refrigeration and air-conditioning systems. The primary purpose is to collect and hold, at its location, water which is in excess of the amount which can be tolerated in the system.

3.5 *Pressure Drop.* The pressure difference between the inlet and the outlet of a Liquid-line Drier, including its connections.

3.6 *Published Rating*. A statement of the assigned values of those performance characteristics, under stated Rating Conditions, by which a unit may be chosen to fit its application. These values apply to all units of like nominal size and type (identification) produced by the same manufacturer. The term Published Rating includes the rating of all performance characteristics shown on the unit or published in specifications, advertising or other literature controlled by the manufacturer, at stated Rating Conditions.

3.6.1 *Application Rating*. A rating based on tests performed at application Rating Conditions (other than Standard Rating Conditions).

3.6.2 *Standard Rating*. A rating based on tests performed at Standard Rating Conditions.

3.7 *Rating Conditions*. Any set of operating conditions under which a single level of performance results and which causes only that level of performance to occur.

3.7.1 *Standard Rating Conditions*. Rating Conditions used as the basis of comparison for performance characteristics.

3.8 *Refrigerant Flow Capacity.* The refrigerating capacity for a flow of liquid refrigerant at specified conditions, which the Liquid-line Drier will pass and not exceed the specified Pressure Drop.

3.9 *"Shall" or "Should".* "Shall" or "should" shall be interpreted as follows:

3.9.1 *Shall.* Where "shall" or "shall not" is used for a provision specified, that provision is mandatory if compliance with the standard is claimed.

3.9.2 *Should.* "Should" is used to indicate provisions which are not mandatory but which are desirable as good practice.

3.10 *Temperature.* The temperature of the liquid refrigerant passing through the Liquid-line Drier, °C.

3.11 *Water Capacity.* The amount of water which a Liquid-line Drier will collect and hold, at each Rating Condition, and still maintain at equilibrium, a water content at or below a given concentration (EPD) in any of the liquid refrigerants. It shall be expressed in drops or in grams on the basis of 20 drops per gram. For the purpose of this standard, 2 drops of water per kilogram of refrigerant is assumed to be equal to 110 ppm.

Section 4. Test Requirements

4.1 *Testing Procedure.* Liquid-line Drier ratings shall be based on tests conducted in accordance with the procedure outlined in ANSI/ASHRAE Standard 63.1.

4.1.1 If alternate test methods are used, the tester assumes the responsibility that results so obtained can be confirmed by ANSI/ASHRAE Standard 63.1.

Section 5. Rating Requirements

5.1 *Rating Requirements.* Liquid-line Driers shall be rated by their Water Capacity, drops, and Refrigerant Flow Capacity at 0.07 Bar Pressure Drop, kW, and shall include their ratings at the Standard Rating Conditions in Table 2.

Table 2. Published Ratings

Refrigerant No.	Standard Rating Conditions	
	Standard Temperature	Water in Refrigerant EPD
	°C	ppm
R-12	24	15
	52	15
R-22	24	60
	52	60
R-134a	24	50
	52	50
R-245fa	24	50
	52	50
R-404A	24	50
	52	50
R-407C	24	50
	52	50
R-410A	24	50
	52	50
R-502	24	30
	52	30
R-507A	24	50
	52	50

5.2 Water Capacity ratings shall be determined in accordance with the rating procedure outlined in 5.2.1 and statistical method outlined in 5.3.

5.2.1 *Rating Procedure.*

5.2.1.1 *Preliminary.* The preliminary Water Capacity of a Liquid-line Drier should be determined by the test procedure outlined in ANSI/ASHRAE Standard 63.1. Two Liquid-line Driers for each Standard Rating Condition should be sufficient for this determination.

5.2.1.2 *Procedure.* Three Liquid-line Driers are then preloaded at this predetermined capacity. Duplicate EPD determinations are made for each Liquid-line Drier. The average EPD for each Liquid-line Drier and the overall average for the six determinations are then calculated. Another set of three Liquid-line Driers is then evaluated at an adjusted capacity, so that the overall average EPD's of the two sets will bracket the Standard EPD. (Figure 1)

5.2.1.2.1 In this procedure, duplicate EPD determinations per Liquid-line Drier are required. This procedure reduces the effect of variations inherent in the method. Most important, it provides a check on the precision of the method. The maximum range for duplicate EPD determinations shall not exceed the values in Table 3.

Table 3. Maximum Range for Duplicate EPD Determinations	
R-12	3 ppm
R-22	6 ppm
R-134a	6 ppm
R-245fa	5 ppm
R-404A	6 ppm
R-407C	6 ppm
R-410A	6 ppm
R-502	6 ppm
R-507A	6 ppm

5.2.1.2.2 If the above range is exceeded, the test data shall be discarded, and the test shall be repeated after the analytical procedure has been reviewed.

5.3. *Statistical Method for Establishing Water Capacity Ratings.* ANSI/ASHRAE Standard 63.1 gives a procedure for determining the Water Capacity of any refrigerant Liquid-line Drier. This sub-section presents a statistical procedure applied to the results from testing sets of samples of production Liquid-line Driers to establish a rating which will be equaled or exceeded by 90% of those produced.

5.3.1 When several determinations of the EPD of a single Liquid-line Drier are made by the procedure of ANSI/ASHRAE Standard 63.1, a series of values will be obtained because of analysis procedure variations. The average of these results is more reliable than any single result. This average also becomes more reliable as more values are used in calculating the average.

5.3.2 When the average EPD of a second Liquid-line Drier is calculated from several determinations, this value may differ from the average of the first Liquid-line Drier because of manufacturing variations. The overall average of the two Liquid-line Driers is more representative of production Liquid-line Driers than is the average of a single Liquid-line Drier. The overall average of several Liquid-line Driers is still more representative.

5.3.3 In order to compensate for these testing and manufacturing variations, a statistical procedure is available for arriving at a rating that will guarantee any percent compliance desired.

5.3.4 This rating procedure is a statistical analysis of results obtained from tests on a group of six Liquid-line Driers, and the rating obtained by this procedure will be such that the average Water Capacity of duplicate tests on any set of six Liquid-line Driers will equal or exceed the rating in 90% of all cases.

5.3.4.1 The two EPD set averages are plotted on a graph, plotting capacity on the vertical axis and EPD on the horizontal axis. A straight line is drawn between these two points. A vertical line is drawn from the Standard EPD to the straight line. A horizontal line is then drawn from the point of intersection to the vertical axis. This point of intersection with the vertical axis gives the "set average" at Standard EPD. (Figure 1)

5.3.4.2 The six individual "duplicate averages" are now plotted on the same graph. The vertical distance of each point from the straight line is determined in units of capacity. The maximum value above the line is added to the maximum value below the line. The sum of these values is called the "range."

5.3.4.3 By using the "set average," the "range", and a multiplication factor of 0.36 taken from statistical tables, the Water Capacity rating is calculated as follows:

Water Capacity rating = A - 0.36 ● r

Where: A = set average

r = range

5.3.4.4 When Liquid-line Driers are preloaded at the rated Water Capacity, it can be guaranteed that at least 90% of averages of sets of six Liquid-line Driers, with duplicate tests for each Liquid-line Drier, will equal or exceed the rating.

5.4 Refrigerant Flow Capacity shall be based on the refrigerant flow rate through the Liquid-line Drier within the specified pressure drop and the refrigerant flow rate per kW of refrigeration at 30°C liquid and -15°C saturated vapor.

5.4.1 The Refrigerant-Flow Capacity Rating is obtained by dividing the refrigerant flow rate expressed in kg/min at a Pressure Drop of 0.07 Bar by the flow rate per refrigerating kW expressed in kg/min/kW as in Table 4 for the refrigerant used**.**

Table 4. Flow Rate per kW of Refrigeration at 30°C Liquid and -15°C Saturated Vapor

Refrigerant No.	kg/min/kW
R-12	0.52
R-22	0.38
R-134a	0.40
R-245fa	0.38
R-404A	0.53
R-407C	0.38
R-410A	0.36
R-502	0.57
R-507A	0.54

5.5 *Tolerances.* To comply with this standard, measured test results shall not be less than 90% of Published Ratings for Refrigerant Flow Capacity and Water Capacity.

Section 6. Minimum Data Requirements for Published Ratings

6.1 *Minimum Data Requirements for Published Ratings.* As a minimum, Published Ratings shall include all Standard Ratings. All claims to ratings within the scope of this standard shall include the statement "Rated in accordance with AHRI Standard 711 (SI)." All claims to ratings outside the scope of this standard shall include the statement "Outside the scope of AHRI Standard 711 (SI)." Wherever Application Ratings are published or printed, they shall include a statement of the conditions at which the ratings apply.

6.2 *Published Ratings.* Capacity ratings published, in accordance with this standard shall, for each refrigerant used, be the following:

6.2.1 *Water Capacity*. Water Capacity ratings for standard Temperatures of 24°C and 52°C shall be published and expressed in drops.

6.2.2 *Refrigerant Flow Capacity*. Refrigerant Flow Capacity ratings for standard Temperatures of 24°C and 52°C shall be published and expressed in kW.

6.3 *"As Received" Ratings.* Published data shall be further qualified by specifying whether a Liquid-line Drier will meet the published capacity ratings in an "As Received" Condition**.** If further activation of the Liquid-line Drier is necessary, published data shall outline the activation procedure.

Section 7. Marking and Nameplate Data

7.1 *Marking and Nameplate Data.* As a minimum, each Liquid-line Drier shall be marked with the following information:

a. The manufacturer's name or trade name
b. Model designation

Section 8. Conformance Conditions

8.1 *Conformance.* While conformance with this standard is voluntary, conformance shall not be claimed or implied for products or equipment within the standard's *Purpose* (Section 1) and *Scope* (Section 2) unless such product claims meet all

of the requirements of the standard and all of the testing and rating requirements are measured and reported in complete compliance with the standard. Any product that has not met all the requirements of the standard shall not reference, state, or acknowledge the standard in any written, oral, or electronic communication.

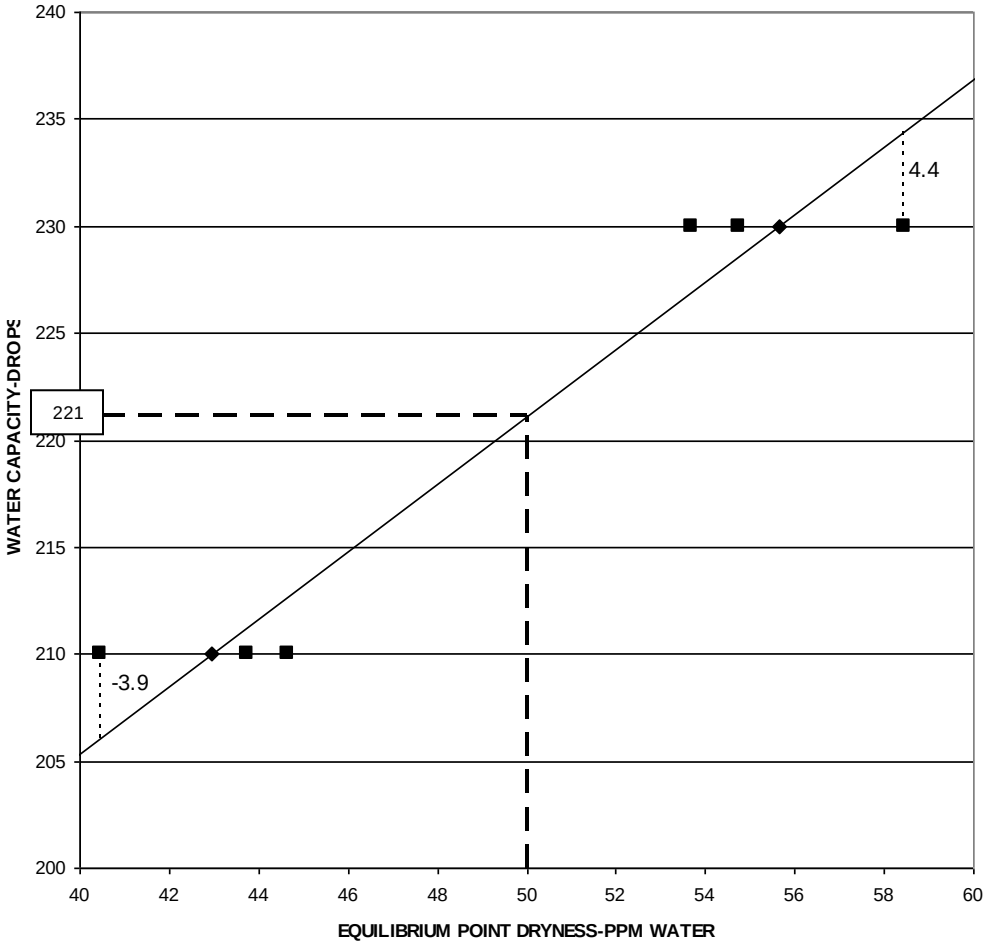

Figure 1. Example of Water Capacity Rating Calculation for Refrigerant 134a at 24°C

EXAMPLE: *Data Collected:*	**210 Drops of Water Added**			**230 Drops of Water Added**		
	Drier No.	EPD (ppm)	Average(ppm)	Drier No.	EPD (ppm)	Average (ppm)
	1	42.8 44.7	43.8	4	57.1 59.8	58.5
	2	38.6 42.3	40.5	5	52.5 54.9	53.7
	3	45.2 44.1	44.7	6	54.2 55.3	54.8
	Average	43.0		Average	55.6	

Determination of Range:

Range = 4.4 + 3.9 = 8.4 Drops

Determination of Set Average:

Enter the chart at EPD of 50 ppm, and read vertically to intersection with capacity line. Proceed horizontally, and read capacity of 221 drops.

Sample Calculations:

Water capacity rating (based on set of six driers) = 221 – 0.36(8.4) = 218 drops

APPENDIX A. REFERENCES – NORMATIVE

A1 Listed here are all standards, handbooks and other publications essential to the formation and implementation of the standard. All references in this appendix are considered as part of this standard.

A1.1 ANSI/ASHRAE Standard 34-2007 with addenda, *Designation and Safety Classification of Refrigerants*, 2007, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., 1791 Tullie Circle N.E., Atlanta, GA 30329, U.S.A.

A1.2 ANSI/ASHRAE Standard 63.1-1995 (RA2001), *Method of Testing Liquid-Line Refrigerant Driers*, 2001, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., 1791 Tullie Circle N.E., Atlanta, GA 30329, U.S.A.

A1.3 *ASHRAE Terminology of Heating, Ventilation, Air Conditioning and Refrigeration*, Second Edition, 1991, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., 1791 Tullie Circle N.E., Atlanta, GA 30329, U.S.A.

APPENDIX B. REFERENCES – INFORMATIVE

B1 Listed here are standards, handbooks and other publications which may provide useful information and background but are not considered essential. References in this appendix are not considered part of the standard.

B1.1 ANSI/ASME Standard B16.22-2001 (RA2005), *Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings*, 2005, American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990, U.S.A.

B1.2 ANSI/SAE Standard J513, *Refrigeration Tube Fittings*, 2000, Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096, U.S.A.

B1.3 Cavestri, R. C. and Schafer, W. R., (2000). "Equilibrium Point Dryness and Water Capacity of Desiccants with Alternative Refrigerants" (ARTI MCLR Final Report DOE/CE/23810-108), 2000, Air-Conditioning and Refrigeration Technology Institute, 2111 Wilson Blvd., Suite 500, Arlington, VA 22201, U.S.A.

B1.4 Lord, E., "The Use of Range in Place of Standard Deviation in the t-Test" *Biometrika*, p. 41, 1947.

B1.5 Proschan and Babcock, "How to Use Short-Cut Statistics" *Chemical Engineering*, September 1954.

APPENDIX C. GUIDE FOR SELECTING A LIQUID-LINE DRIER - INFORMATIVE

C.1 The primary factors in the selection of a Liquid-line Drier for a given application are Refrigerant Flow Capacity, Water Capacity, acid removal capacity and filter capacity. While this standard contains provisions for determining Refrigerant Flow Capacities, and Water Capacities, no attempt has been made to rate acid or particulate removal because there is insufficient data presently available regarding these subjects.

C.2 No relationship has been established between the amount of water entering, or requiring removal from, a given refrigeration system and the refrigerating capacity of that system, since the amount of water in a system is a variable and unknown quantity. Therefore, the drying ability of a Liquid-line Drier cannot be rated dependably in terms of the refrigerating capacity of the system to which it will be connected. Certain assumptions must be made to apply a rated Liquid-line Drier to an existing system wherein the amount of water present is unknown, and for this purpose the following procedure is offered as a guide:

C.2.1 The wetness of the system above the Equilibrium Point Dryness (EPD) is assumed to be 550 ppm (11 drops of water per kilogram of refrigerant charge) for Refrigerant 12 and 990 ppm (20 drops of water per kilogram of refrigerant charge) for all other Refrigerants covered by this standard. The value of 990 ppm was selected to provide for the drying of these refrigerants to a lower relative saturation value than required for Refrigerant 12.

C.2.2 To estimate the refrigerant charge (kg) in a given system that the Liquid-line Drier will maintain in equilibrium for a specified Standard Condition, divide the Water Capacity rating of the Liquid-line Drier (drops of water) by the assumed wetness, drops of water per kilogram of refrigerant charge suggested above in C.1. Conversely, to estimate the Water Capacity of a Liquid-line Drier (drops of water) that is needed for a given system, multiply the total refrigerant charge in the system (kilograms of refrigerant) by the assumed wetness (drops of water per kilogram of refrigerant charge) suggested above in C.1.

C.2.3 The total refrigerant charge and the flow rate in the system should be the basis for selecting a Liquid-line Drier.

C.3 The above suggested procedure is intended merely as a guide, and it is not to be construed as being a part of this standard.

C.4 There is general agreement that systems should be as dry as possible. Therefore, the rating points should not be construed as an allowable level of moisture content but only as an agreed upon parameter that produces a standard measurement that allows comparison between products.