American National Standard for

ANSI/IIAR 3-2012

Ammonia Refrigeration Valves

Approved by
the American National
Standards Institute
May 16, 2012

Supersedes
ANSI/IIAR 3-2005

iiar®
International Institute of
Ammonia Refrigeration

Notes on the Standard Text

Metric Policy

This document employs the common English engineering unit system (the "inch-pound" system) as primary units of measure and the International System of Units (SI), as defined in the United States National Institute of Standards and Technology Special Publication 330 "The International System of Units" for secondary units. In this Standard common metric (CGS) units are included in some cases for convenient reference. Conversions are approximate.

Normative/Informative Elements

Most standards include both required and advisory information. In keeping with typical standards-writing practice, this document uses the term *informative* to identify advisory text and the term *normative* to identify requirements. Informative material shall never be regarded as a requirement. Certain elements of a standard are traditionally regarded as informative and may not be labeled as such. These elements include the Foreword and any Notes that appear in the main body.

Notice

The information contained in this Standard has been obtained from sources believed to be reliable. However, it should not be assumed that all acceptable methods or procedures are contained in this document, or that additional measures may not be required under certain circumstances or conditions.

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Foreword (Informative)

This document is intended to be a safety standard to ensure the product integrity of ammonia refrigeration valves and strainers. Its provisions represent minimum requirements for those areas addressed. However, more stringent requirements may be necessary because of particular circumstances, project specifications or other jurisdictional considerations. Note that this standard does not constitute a design manual and should not be used as such. Suitable safeguards must be used for all design validation and production tests required by this standard which involve internal pressurization of the device(s) under evaluation.

The IIAR 3 American National Standard for Ammonia Refrigeration Valves was originally published by the International Institute of Ammonia Refrigeration (IIAR) in October 1999. It was subsequently approved as an American National Standard by the American National Standards Institute (ANSI) in September 2005. This milestone concluded the work of the IIAR Valve Committee which had developed the document from its inception. The IIAR Valve Committee was therefore disbanded and the task of ongoing maintenance of ANSI/IIAR 3 Ammonia Refrigeration Valves was assumed by the IIAR Standards Committee. ANSI requires reaffirmation of existing standards every five years. Work began on the re-affirmation of this standard in 2009, and completed in May, 2012.

This Standard was prepared using the ANSI consensus method whereby organizations and individuals recognized as having interest in the subject of the standard were contacted to be members of a consensus body, whose vote to approve the Standard is required in addition to the public review process. This Standard was prepared and approved by for submittal to ANSI by the IIAR Standards Committee and the IIAR Board of Directors.

At the time of the publication of this revision of the Standard, the IIAR Standards Review Committee had the following members:

Robert J. Czarnecki, Chair - Campbell Soup Company
Don Faust, Vice Chair – Gartner Refrigeration & Mfg., Inc.
Eric Brown - ALTA Refrigeration, Inc.
Dennis R. Carroll – Johnson Controls
Jim Caylor – Jacobs Engineering
Wayne D. Davis - M & M Refrigeration, Inc.
Eric Johnston – ConAgra
Gregory P. Klidonas – GEA Refrigeration North America, Inc.
Thomas A. Leighty - Refrigeration Systems Company
Brian Marriott – Johnson Controls
Rich Merrill – Retired, EVAPCO, Inc.
Ron Worley – Nestlé USA

The task group working on this standard had the following members at the time of publication:

Brian Marriott – Johnson Controls

Table of Contents

Section 1

Purpose

The purpose of this standard is to specify criteria for materials, design parameters, marking and testing for valves and strainers used in closed circuit ammonia refrigerating systems.

Section 2

Scope

2.1 This standard shall apply to shut-off valves, control valves and strainers designed and manufactured for use in closed circuit mechanical refrigerating systems utilizing ammonia as the refrigerant.

2.2 This standard includes criteria for materials of construction, pressure-containing envelope, seat leakage, quality assurance, marking and production testing applicable to finished products as delivered by the original manufacturer.

2.3 This standard applies to actuator elements which form a part of the pressure-containing envelope on valves.

2.4 This standard applies to valves incorporating a mechanical actuating float or other mechanism exposed to the refrigerant.

2.5 Compliance with this standard shall not be required for products manufactured prior to the publication date of the document.

2.5.1 Where a manufacturer has established, through long standing provision, the safety and applicability for ammonia refrigeration service of valves and strainers which have been continuously offered and manufactured to a consistent standard. Such valves or strainers shall be permitted for the application(s) specified by the manufacturer provided they can be identified, and they have been documented, as suitable for ammonia refrigeration service.

2.6 This standard shall not apply to valves wholly contained within the pressure-containing envelope of other equipment.

Example: Slide valves in screw compressor casings.

2.7 This standard shall not apply to strainer baskets wholly contained within the pressure-containing envelope of other equipment.

Example: Strainers in compressor casings.

2.8 This standard shall not apply to safety relief valves within the scope of Section VIII of the ASME Boiler and Pressure Vessel Code {4.2.1} and hydrostatic relief valves.

2.9 This standard shall not apply to float switches.

2.10 This standard shall not apply to liquid level transmitters.

2.11 This standard shall not apply to valves intended for service at temperatures below –76 ºF [–60 ºC].

Section 3

Definitions

Refer to ANSI/IIAR 1-2011 for Definitions.

Section 4

References

4.1 Normative References

4.1.1 ANSI/IIAR 1, Latest edition, Definitions and Terminology used in ANSI/IIAR Standards.

4.1.2 ANSI/IIAR 2, Latest edition, Equipment, Design and Installation of Ammonia Mechanical Refrigerating Systems - Section on Materials {10.1/10.5}.

4.1.3 ASME/ANSI B16.5, Latest edition, Pipe Flanges and Flanged Fittings -Section 2, Pressure-Temperature Ratings {10.2/10.1}.

4.2 Informative References

4.2.1 ASME Section VIII, Division 1, Governing edition, ASME Boiler and Pressure Vessel Code - Pressure Vessels {10.2}.

4.2.2 ASTM Volumes 1.01, 1.02, 1.04, 1.05 and 2.02, Latest edition {10.3}.

4.2.3 FCI-70-2, Latest edition, Tolerable Seat Leak Classifications {10.4}.

Section 5

General Requirements

5.1 A valve shall perform its designated function over the range specified by the manufacturer.

5.2 All shut off valves shall incorporate a back-seat feature such that the stem (spindle) seal can be serviced with the valve under pressure.

EXCEPTION:
Quarter-turn valves (example: ball and butterfly valves); gate valves; and uni-body valves.

5.3 Flow Direction

5.3.1 The manufacturer's literature shall identify valves designed to also permit fluid flow opposite the flow direction marking on the valve.

5.3.2 Where a manually seated valve will tolerate a MSSPD that exceeds the pressure differential against which the actuator mechanism will support opening of the valve, the manufacturer shall specify the maximum permissible opening pressure differential. The manufacturer shall mark the valve to indicate the direction of pressure difference for which the actuator will support opening of the valve at or above the MSSPD.

5.4 Control valve MOPD and reverse flow MSSPD shall be specified by the manufacturer. Note that the MOPD may be less than the MAWP if the valve is so marked.

5.5 Multi-function valves shall comply with the requirements of each functionally incorporated valve type.

5.6 The action of actuators designed specifically or otherwise selected for attachment to, or incorporation into, valves shall not compromise the MAWP of those valves.

5.7 Valve internal configurations which may incidentally capture fluid within an internal cavity (example: ball valves as a function of actuation) shall incorporate equalizing to prevent hydrostatic pressure rise within the cavity.

5.8 The applicable assembly and installation procedures for the valve bonnet, flanges and other pressure-containing attachments to the valve shall be specified by the manufacturer and made available on request.

5.9 Valve design and construction shall prevent unintentional extraction of the valve stem (spindle) or loosening/removal of the bonnet through actuation of the valve.

5.10 The permissible seat leakage for control valves that are not designed to functionally stop flow shall be made available by the manufacturer on request.

5.11 Seal Caps

5.11.1 Seal caps shall be designed such that the attachment mechanism (example: screw threads) permits gradual removal of the cap allowing for venting of any pressure contained within the cap before the cap is disengaged from the valve.

5.11.2 Pressure-containing seal caps shall be identified in the manufacturer's literature and by marking the cap.

5.12 The manufacturer shall make available on request product documentation containing at least the relevant specifications, performance and marking information required by this Standard.

Section 6

Materials of Construction

6.1 All valves and strainers subject to this standard shall be manufactured using only those materials that comply with the requirements of the "Materials" sub-section of ANSI/IIAR 2, latest edition {4.1.2}.

6.2 Mating (companion) flanges and flange hardware used on flange mounted valves and strainers shall be suitable for the manufacturer's specified pressure/temperature range of the valve.

6.2.1 Mating (companion) flanges intended for installation by welding shall be manufactured from carbon steel or stainless steel material compatible with the material specification of the pipe to which the flange is welded.

EXCEPTION:
Aluminum flanges welded to aluminum connections on manufactured equipment are permitted.

6.2.2 Mating (companion) flanges intended for installation on the pipe by screw thread joint shall be manufactured from carbon steel, stainless steel or ductile iron material.

Section 7

Pressure Envelope Requirements

7.1 Pressure/Temperature Range

The design of the valve pressure-envelope shall meet minimum criteria as follows:

7.1.1 All valves shall contain 300 psig [2068 kPa gauge](20.7 bar gauge) over the temperature range –20 °F [–28.9 °C] through 240 °F [115.6 °C].

EXCEPTION:
ANSI class 150 flange mounted valves used within the application parameters for the pressure-temperature rating specified in ASME/ANSI B16.5, provided they comply with all other applicable requirements of this standard {4.1.3}.

7.1.2 The upper and lower pressure and temperature limits shall be specified by the manufacturer for valve designs which exceed the requirements of 7.1.1.

The pressure-containing envelope shall maintain its integrity over the range within the specified limits.

Valves intended for service outside the temperature range –20 °F [–28.9 °C] through 240 °F [115.6 °C] shall meet or exceed the following MAWP requirements:

a. 75 psig [517 kPa gauge](5.17 bar gauge) MAWP over the temperature range below –50 °F [–45.4 °C] through –76 °F [–60 °C];

b. 120 psig [827 kPa gauge](8.27 bar gauge) MAWP over the temperature range below –20 °F [–28.9 °C] through –50 °F [–45.4 °C];

c. 300 psig [2068 kPa gauge](20.7 bar gauge) MAWP in the temperature range above +240 °F [116 °C] up to the temperature specified by the manufacturer.

7.1.3 Flange mounted valves shall have the flange faces of the valve and mating flange(s) limited to captive gasket style or raised face style to ensure retention of the sealing gaskets between the mating faces.

7.2 Design Validation

The manufacturer shall retain a permanent record of each proof test procedure and results.

Test apparatus or restraints applied to the shut off valve, control valve or strainer to perform the proof test(s) shall not adversely influence the test validity.

The valve design shall be validated through the applicable proof test(s) on a production sample(s) as follows:

7.2.1 Pressure Envelope – Shut-off valves, control valves and strainers, including field mounted control valve sub-assemblies and pressure-containing seal cap(s) where applicable:

a. PRESSURE ENVELOPE PROOF TEST – At room temperature (60 °F [15.6 °C] to 100 °F [37.8 °C]) :
   i) sustain 2.2 times MAWP for one minute without visible leakage;
   ii) withstand 5 times MAWP for one minute without bursting.

b. PRESSURE ENVELOPE VACUUM TEST: Exhibit not more than 150 microns pressure rise over 24 hours at room temperature after evacuation to a maximum pressure of 1500 microns absolute and isolation from the vacuum source.

These tests shall separately validate the stem (spindle) packing and where applicable, the pressure-containing seal cap(s).

7.2.2 Shut-off valves –

a. DESTRUCTIVE STEM (SPINDLE) TORQUE TEST(S) – At room temperature(60 °F [15.6 °C] to 100 °F [37.8 °C]) the valve assembly, as delivered by the original manufacturer, shall be tested under conditions of stem (spindle) failure to verify the integrity of:
   i) pressure containment at room temperature MAWP;
   ii) the disc, seat and back seat mechanisms against failure;
   iii) MSSPD containment on top of the seat at full forward (in) stem (spindle) position.

Tests i) and ii) shall be conducted at stem (spindle) positions of : full forward (in); and full backward (out).

b. SEAT SEAL TEST AT THE SPECIFIED UPPER AND LOWER TEMPERATURE LIMIT MAWP – The valve assembly, as delivered by the original manufacturer, shall be tested to validate that the seat maintains a bubble tight seal to atmosphere for sixty minutes:
   i) in both directions of flow;
   OR
   ii) only in the designated direction of flow when the valve is so marked, provided the reverse flow MSSPD is also specified and documented by the manufacturer.

c. SEAT OPENING TEST AT ROOM TEMPERATURE (60 °F [15.6 °C] to 100 °F [37.8 °C]) – The valve assembly, as delivered by the original manufacturer, shall be tested at the pressure difference between room temperature MAWP and atmosphere, to validate that the valve can be opened:
   i) with the pressure respectively under and above the seat;
   OR
   ii) with the pressure only in the designated direction of flow when so specified by the manufacturer and marked on the valve.

   EXCEPTION:
   A lower MSSPD may be used for this test provided this value is specified by the manufacturer and marked on the valve.

7.2.3 Control valves – Control valves shall be proof tested for maximum seat leakage as a percentage of rated Cv [Kv] at the MAWP applied as a pressure difference {4.2.3}.

Control valves additionally designed to functionally stop flow with zero seat leakage:

a. SEAT SEAL TEST AT THE SPECIFIED UPPER AND LOWER TEMPERATURE LIMIT MAWP – The valve assembly, as delivered by the original manufacturer, shall be tested to validate that the seat maintains a bubble tight seal to atmosphere for sixty minutes:
   i) in both directions of flow;
   OR
   ii) only in the designated direction of flow when so specified by the manufacturer and marked on the valve.

7.2.4 Stem Sealing System – All valves equipped with stem (spindle) sealing system:

a. PACKING TIGHTNESS TEST AT THE ROOM TEMPERATURE MAWP (60 °F [15.6 °C] to 100 °F [37.8 °C]) – The valve assembly, as delivered by the original manufacturer, shall be tested to validate at room temperature that the packing maintains a bubble tight seal to atmosphere for sixty minutes in the following stem (spindle) positions:
   i) full forward (in);
   ii) full backward (out);
   iii) mid-stroke.

b. PACKING TIGHTNESS TEST AT THE SPECIFIED UPPER AND LOWER TEMPERATURE LIMIT MAWP – The valve assembly, as delivered by the original manufacturer, shall be tested to validate that the packing maintains a bubble tight seal to atmosphere for sixty minutes in the following stem (spindle) positions:
   i) full forward (in);
   ii) full backward (out);
   iii) mid-stroke.

7.2.5 Life cycle rating claims shall be validated through testing.

Section 8

Marking

Marking shall not be obscured by paint or other finish applied by the manufacturer.

8.1 Shut-off Valves

All shut-off valves shall carry the following markings:

a. Manufacturer's name or unique symbol permanently marked on the body

b. Specific direction of flow if the valve is so designed

c. Model number

d. Size, nominal

e. The application range or limits of the shut-off valve shall be identifiable through the model number or other unique marking

8.2 Control Valves and Strainers

All control valves shall carry the following markings:

a. Manufacturer's name or unique symbol permanently marked on the body

b. Specific direction of flow if the valve is so designed

c. Model number

d. Port size, nominal

e. The application range or limits of the control valve or strainer shall be identifiable through the model number or other unique marking

8.3 Pressure-Containing Seal Caps

All pressure-containing seal caps shall carry the following markings:

a. Manufacturer's name or unique symbol permanently marked on the cap

b. MAWP

8.4 Omission of Markings

Valves or strainers with size or shape limits that inhibit placement of body tags or marking plates may have the following markings omitted in the order shown:

a. Unique marking identifying the application range or limit

b. Size, or port size (nominal)

8.5 Optional Markings

Where space permits, the following optional markings may be used:

a. Date code

b. Cv [or Kv] rating

c. Serial number

d. Materials, which shall be shown using the industry standardized material designation. **Example:** ASTM {4.2.2}.

EXCEPTION:
A valve manufacturer may use an abbreviation for material designation but this abbreviation shall be defined in that manufacturer's literature, which shall be available on request.

8.6 Test Laboratory Marking

The mark of a testing laboratory recognized by the authority having jurisdiction shall be applied when the valve product has been so tested and approved.

8.7 Special Cases

8.7.1 Hand-operated flow regulating valves designed to interrupt flow, with leakage permitted across the seat when fully closed, shall carry a permanent marking in the form of two circumferential grooves (nominally 1/16" [1.6 mm] wide x 0.025" [0.6 mm] deep at 3/16" [4.8 mm] centers) machined into the stem (spindle). These grooves shall be located so as to be clearly visible in all positions of the stem (spindle).

8.7.2 Pressure-sensitive components rated for an MAWP lower than the valve pressure envelope rating shall have those components clearly marked.

8.7.3 Should a shut off valve, control valve or strainer be shipped with a holding charge other than air at atmospheric pressure, that condition shall be clearly indicated on a tag appended to the device such that the device cannot be installed or functionally used without the removal of the tag.

Section 9

Production Testing

9.1 The manufacturer shall perform the necessary production control, inspection, tests and rework to ensure continued compliance to this standard.

9.2 Production testing shall validate performance expectations and verify the in-plant quality assurance program.

9.3 Complete valves; valve assemblies; welded assemblies of two or more shut-off valves and/or control valves and/or strainers; which fall within the scope of this standard shall be tested in conformance with this section.

EXCEPTION:

a. Uni-body valves shall be subjected through sampling to all the relevant production tests that may be applied. The sampling method and sample size shall be sufficient to statistically validate the integrity of the product.

b. Pressure-containing seal caps shall be subjected through sampling to all the relevant production tests which may be applied. The sampling method and sample size shall be sufficient to statistically validate the integrity of the product.

9.4 Test Requirements

All testing shall be carried out at MAWP at room temperature (60 °F [15.6 °C] to 100 °F [37.8 °C]) except as otherwise specified.

All exterior openings shall be capped or plugged with test closures such that the entire pressure-containing envelope is tested. The test closures shall not intrude into the shut off valve, control valve or strainer any further than is necessary to ensure sealing. Test apparatus or restraints applied to the device to perform the test(s) shall not adversely influence the test validity.

Test fluid may be dry air, inert gas, or suitable liquid.

Where air or gas is employed, the device under pressure shall be submersed in water or other suitable low surface tension liquid and contained in a tank designed to provide a safe testing environment.

Table 1 specifies the minimum leakage test duration for each respective valve size grouping.

Table 1. Minimum Leakage Test Duration

Valve Size	Test Duration – Seconds
Up to 2" [50mm]	15
2½" to 8" [65 to 200mm]	30
10" [250mm] and larger	60

9.4.1 All shut off valves, control valves and strainers

a. ENVELOPE TEST TO VERIFY ZERO LEAKAGE OVER THE TEST DURATION - Where applicable, the valve shall be unseated, but not back seated. The manufacturer's testing process shall incorporate sufficient time submersed to allow any air bubbles trapped on exterior surfaces or in cavities to escape or be removed before initiating the leakage test duration {Table 1}.

9.4.2 All hand shut-off valves -

a. SEAT TEST TO VERIFY ZERO LEAKAGE OVER THE TEST DURATION - This test shall be conducted with the valve closed and the pressure applied under the disc.

EXCEPTION:
On quarter turn valves this test shall be conducted in both directions of flow, unless the valve is designed and marked for only one direction of flow.

9.4.3 All control valves – All control valves shall be tested with the pressure applied in the direction for which the valve is designed to interrupt flow:

a. Control valves designed to interrupt flow with permissible leakage - SEAT TEST TO VERIFY LEAKAGE IS LESS THAN 1% OF THE RATED CV [KV] of the same valve body when equipped with its maximum flow capacity internals:
   i) at minimum 100 psig [689 kPa gauge] (6.89 bar gauge) for the high pressure test;
   ii) and at 15 psig [103 kPa gauge](1.03 bar gauge) for the low pressure test.

b. Control valves designed to interrupt flow with zero leakage - SEAT TEST TO VERIFY ZERO LEAKAGE OVER THE TEST DURATION.

EXCEPTION:
On specialty control valves which cannot be tested by these methods the manufacturer shall establish a test for seat leakage using methodology appropriate to the intent of the design.

9.5 All test fluid shall be drained or purged from the shut-off valve and/or control valve and/or strainer after testing so as to preclude contamination of the shut-off valve and/or control valve and/or strainer or the system into which it is installed.

9.6 Alternate methods of production leak detection may be employed provided the selected alternate is of equal or greater sensitivity than the method described in this Section.

9.7 Any valve or strainer failing any production test may be reworked by replacement or suitable repair of the faulty component(s). Weld repair of cast steel components shall be performed by a certified welder. Reworked valves shall be subjected to all required production tests.

Section 10

Sources of References (Informative)

10.1 American National Standards Institute (ANSI)
25 West 43rd Street, 4th Floor
New York, NY 10036, USA

10.2 American Society of Mechanical Engineers (ASME)
ASME International
3 Park Avenue
New York, NY 10016-5990, USA

10.3 American Society for Testing and Materials (ASTM)
100 Barr Harbor Drive
P.O. Box C700
West Conshohocken, PA 19428-2949, USA

10.4 Fluid Controls Institute, Inc. (FCI)
1300 Sumner Avenue
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10.5 International Institute of Ammonia Refrigeration (IIAR)
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