

AMERICAN NATIONAL STANDARD/CANADIAN GAS ASSOCIATION STANDARD
FOR
**PERFORMANCE TESTING AND RATING OF
GAS-FIRED, AIR CONDITIONING
AND HEAT PUMP APPLIANCES**



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Documents

AMERICAN NATIONAL STANDARD
ANSI Z21.40.4-1996

CANADIAN GAS ASSOCIATION STANDARD
CGA 2.94-M96

First Edition - 1996

This Standard is a revised edition
of the former

Standards for

PERFORMANCE TESTING AND RATING OF
GAS-FIRED HEAT ACTIVATED AIR
CONDITIONING AND HEAT PUMP APPLIANCES

ANSI Z21.40.4-1994

APPROVED



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***American National Standards Institute, Inc.
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10036***

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The American Gas Association and Canadian Gas Association have co-sponsored national standards programs in the U.S. and Canada, and the creation or harmonization of Canadian and U.S. binational gas equipment standards. International Approval Services (IAS), formed in 1993, has provided the technical and administrative support required by these activities, on behalf of the co-sponsors.

The Canadian Gas Association remains the sponsor of the gas equipment and installation standards programs in Canada. In the U.S. sponsorship, or the Secretariat, was transferred in May 1996 from the American Gas Association to International Approval Services-U.S., Inc. Although IAS-U.S. acts as secretariat of the Z21 Committee, the actions of the committee are independent of ANSI and IAS-U.S.

IAS also operates a design certification program for fuel-fired products covered by the standards, accredited by the American National Standards Institute and the Standards Council of Canada, and accepted by all Canadian inspection authorities. Through the Gas Research Institute (GRI) and the Canadian Gas Research Institute (CGRI), the gas industry helps pursue the improvement of gas equipment and the development of new products. Data from these projects is available to Standards Committees for review and consideration.

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CANADIAN GAS ASSOCIATION

The Canadian Gas Association (CGA), has been accredited by the Standards Council of Canada to prepare National Standards of Canada in the area of equipment for use with natural gas and propane. Founded in 1907, its 320 corporate members span the industry spectrum and include natural gas transmission companies, distributors, manufacturers of other gas appliances and equipment, brokers, marketers and producers.

Committees that write the standards include representation from all interests and are so constituted that no one interest may dominate. The interests represented include consumers, manufacturers, utilities, governmental inspection authorities and certification organizations. Standards are prepared using the consensus principle with effort applied to reconcile differing opinions. Government inspection authorities having jurisdiction also ballot on the standards as

members of the Interprovincial Gas Advisory Council (IGAC).

The CGA Standards Advisory Committee (SAC) reviews committee structures and procedures to determine that the standards meets the criteria of the Standards Council of Canada.

This Standard has been accepted by the Standards Committee, IGAC and SAC.

This Standard is intended to be used within the scope of the standard by the manufacturing sector, by those applying the equipment, or those responsible for its proper application. It is the responsibility of the user to determine in each case that the Standard is suitable for the specific application. The Standards Committee and IGAC normally stipulate an effective date for the Standard.



PREFACE

This publication represents a basic standard for safe operation, substantial and durable construction, and acceptable performance of performance testing and rating of gas-fired, air-conditioning and heat pumping appliances. It is the result of years of experience in the manufacture, testing, installation, maintenance, inspection and research on performance testing and rating of gas-fired, air-conditioning and heat pumping appliances designed for utilization of gas. There are risks of injury to persons inherent in appliances that, if completely eliminated, would defeat the utility of the appliance. The provisions in this standard are intended to help reduce such risks while retaining the normal operation of the appliance.

Nothing in this standard is to be considered in any way as indicating a measure of quality beyond compliance with the provisions it contains. It is designed to allow compliance of performance testing and rating of gas-fired, air-conditioning and heat pumping appliances, the safety construction and performance of which may exceed the various provisions specified herein. In its preparation, recognition has been given to possibilities of improvement through ingenuity of design. As progress takes place, revisions may become necessary. When they are believed desirable, recommendations or suggestions should be forwarded to the Chairman of Accredited Standards Committee Z21, 8501 East Pleasant Valley Road, Cleveland, Ohio 44131, or the Chairman of the Canadian Gas Association Standards Steering Committee on Gas Burning Appliances and Related Accessories, 55 Scarsdale Road, Don Mills, Ontario, Canada, M3B 2R3.

Safe and satisfactory operation of performance testing and rating of gas-fired, air-conditioning and heat pumping appliances depends to a great extent upon its proper installation, use and maintenance. It should be installed, as applicable, in accordance with the *National Fuel Gas Code, ANSI Z223.1*; the *Natural Gas Installation Code, CAN/CGA-B149.1*; the *Propane Installation Code, CAN/CGA-B149.2*; or the manufacturers' installation instructions and local municipal codes.

Users of this American National Standard/Canadian Gas Association Standard are advised that the devices, products and activities within its scope may be subject to regulation at the Federal, Territorial, Provincial, state or local level. Users are strongly urged to investigate this possibility through appropriate channels. In the event of a conflict with this standard, the Federal, Territorial, Provincial, state or local regulation should be followed.

NOTICE TO READER: The Canadian Gas Association (CGA) has been accredited by the Standards Council of Canada to prepare standards in the area of equipment for use with natural gas and propane. Standards are prepared by committees that include representatives from all interests and are so constituted that no one interest may dominate. The interests represented include governmental inspection authorities, certification agencies, manufacturers, utilities, and consumers. Government inspection authorities having jurisdiction review and approve these standards; sitting as the Interprovincial Gas Advisory Council (IGAC).

THIS STANDARD IS INTENDED TO BE USED BY THE MANUFACTURING SECTOR AND BY THOSE APPLYING THE EQUIPMENT AND BY THOSE RESPONSIBLE FOR ITS PROPER INSTALLATION. IT IS THE RESPONSIBILITY OF THESE USERS TO DETERMINE THAT IN EACH CASE THIS STANDARD IS SUITABLE FOR AND APPLICABLE TO THE SPECIFIC USE THEY INTEND.

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EFFECTIVE DATE: An organization using this standard for product evaluation as a part of its certification program will normally establish the date by which all products certified by that organization should comply with this standard. In Canada the Standards Committee and the Interprovincial Gas Advisory Council normally stipulate an effective date for the standard.

HISTORY OF THE DEVELOPMENT OF STANDARD FOR PERFORMANCE TESTING AND RATING OF GAS-FIRED, AIR-CONDITIONING AND HEAT PUMPING APPLIANCES

(This History is informative and is not part of the standard.)

With the onset of the Free Trade Agreement between the United States and Canada on January 2, 1988, significant attention was given to the harmonization of the United States and Canadian safety standards addressing gas-fired equipment for residential, commercial and industrial applications. It was believed that the elimination of the differences between the standards would remove potential trade barriers and provide an atmosphere in which North American manufacturers could market more freely in the United States and Canada. The harmonization of these standards was also seen as a step toward harmonization with international standards.

With the formation of joint subcommittees, a Canadian Gas Association Standards Steering Committee on Gas Burning Appliances and Related Accessories was established to parallel Accredited Standards Committees Z21 and Z83, and to support the formation of joint subcommittees. Operating procedures, in accordance with American National Standards Institute procedures, for joint subcommittees were developed and subsequently approved by ANSI on April 1, 1993.

At its March 1987 meeting, the Z21 air conditioning subcommittee was informed of industry interest in the development of standards coverage for new products which would heat, cool or generate electricity as separate functions or in combination. The subcommittee endorsed the need for such coverage and recommended to Accredited Standards Committee Z21 that the subcommittee's scope be expanded and clarified, to cover preparation of standards for energy conversion equipment utilizing gas fuel to provide: 1) conditioned air, liquid or refrigerant to spaces or equipment; 2) on-site electrical power generation; 3) mechanical power; and 4) any combination of the above. Equipment may include, but is not limited to, heat pumps, fuel cells, gas engines, humidifiers, dehumidifiers and cogenerators.

The subcommittee agreed the preparation of standards coverage under its scope could

include drafting new standards, as well as upgrading existing air conditioning standards. The subcommittee established the Fuel Gas Heat Pump Working Group to review the current air conditioning standards and draft new standard's coverage for product application outlined under the revised scope.

In that there are no Department of Energy (DOE) ratings for gas-fired heat pumps and air conditioners, it was agreed a new standard should be developed to provide gas-fired heat pump/air conditioner manufacturers with the method of testing, efficiency rating, and cost of operation procedures and calculations which are currently available to electric heat pump/air conditioning manufacturers. The proposed standard was to be based on similar steady-state and seasonal efficiency calculations governed by the DOE.

A Z21/CGA Joint Subcommittee on Standards for Gas Air Conditioning Appliances was established, based on memberships of the Z21 Subcommittee on Standards for Gas Air Conditioning Appliances and the CGA 2.9 Committee on Standards for Gas Air Conditioning Appliances. Membership encompasses representatives from the U.S. and Canadian manufacturing industry, gas suppliers, regulatory authorities and general interest with the intent that each country is equally represented.

Based on the efforts of the Fuel Gas Heat Pump Working Group, a proposed Z21.40.4 standard was adopted for distribution for review and comment by the supervising technical joint subcommittee at its February 1992 meeting. The proposed standard was distributed for review and comment in September, 1992. At its February 1993 meeting, the draft standard was reviewed and revised in light of comments received.

Following procedures, the Z21 Committee, at its April 8, 1993 meeting, adopted the proposed standard for performance testing and rating of gas-fired, air conditioning and heat pumping appliances. The first edition of the

performance testing and rating of gas-fired, air conditioning and heat pumping appliances standard, was approved as American National Standard by the American National Standards Institute, Inc., on May 23, 1994.

The joint subcommittee adopted the standard at its May 1994 meeting to be distributed for review and comment as a proposed harmonized standard. The proposed harmonized standard was distributed for review and comment during July 1994. At its November 1994 meeting, the proposed harmonized standard was reviewed and revised in light of comments received.

Following procedures, the Z21 Committee, at its April 6, 1995 meeting, adopted the proposed harmonized standard for performance testing and rating of gas-fired, air-conditioning and heat pumping appliances. The CGA Standards

Steering Committee adopted the proposed harmonized standard for gas-fired, heat activated air conditioning and heat pump appliances by a letter ballot dated May 19, 1995.

The Interprovincial Gas Advisory Council approved the proposed harmonized standard by a letter ballot dated October 20, 1995. This, the first edition of the harmonized performance testing and rating of gas-fired, air-conditioning and heat pumping appliances was approved as American National Standard by the American National Standards Institute, Inc., on July 16, 1996.

The following identifies the designation and year of the harmonized standard:

ANSI Z21.40.4•CGA 2.94 - 1996

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CONTENTS

	Page
SECTION 1: SCOPE	1
SECTION 2: TESTING REQUIRED	
2.1 Gas Input Rates	2
2.2 Air-source (Air-to-air and Air-to-water) Heat Pumps	2
2.3 Water-source (Water-to-air and Water-to-water) Heat Pumps	2
2.4 Ground Water-source (Water-to-air and Water-to-water) Heat Pumps	2
2.5 Water-cooled Air Conditioners and Chillers	3
2.6 Air-cooled Condensing Units	3
2.7 Water-cooled Condensing Units	3
2.8 Desiccant Ventilation-air Dehumidifiers	3
2.9 Optional Tests for Application Ratings	3
SECTION 3: TESTING PROCEDURES	
3.1 All Appliances	8
3.2 Air-source (Air-to-air and Air-to-water) Heat Pumps	8
3.3 Water-to-air and Water-to-water Heat Pumps and Water-cooled Air Conditioners and Chillers	9
3.4 Air-delivery (Air-to-air and Water-to-air) Heat Pumps and Water-cooled Air Conditioners	9
3.5 Water-delivery (Air-to-water and Water-to-water) Heat Pumps and Water-cooled Chillers	10
3.6 Desiccant Ventilation-air Dehumidifiers	10
SECTION 4: TESTING PROCEDURES	
4.1 Cooling Tests	11
4.2 Heating Tests	12
SECTION 5: STEADY-STATE COOLING RATINGS	
5.1 Gross Cooling Values	16
5.2 Net Cooling Capacity Ratings	16
5.3 Net Cooling-mode Gas Input Ratings	16
5.4 Net Cooling-mode Auxiliary Electric Input Ratings	16
5.5 Cooling Capacity Adjustments	16
5.6 Auxiliary Electric Input Adjustments	17
5.7 Rounding of Rating Values	17
SECTION 6: STEADY-STATE HEATIN RATINGS	
6.1 Gross Heating Values	18
6.2 Net Heating Capacity Ratings	18
6.3 Net Heating-mode Gas Input Ratings	18
6.4 Net Heating-mode Auxiliary Electric Input Ratings	18
6.5 Heating Capacity Adjustments	18
6.6 Auxiliary Electric Input Adjustments	18
6.7 Rounding of Rating Values	18

CONTENTS (Continued)

	Page
SECTION 7: COOLING SEASONAL PERFORMANCE PARAMETERS FOR RESIDENTIAL AIR-SOURCE APPLIANCES	
7.1 Limitations	19
7.2 Procedure	19
7.3 Level 1 Gas Input Performance	19
7.4 Level 2 Gas Input Performance	19
7.5 Intermediate Gas Input Performance	19
7.6 Variable Gas Input Performance	19
7.7 Outdoor Temperature Profile	20
7.8 Building Cooling Load	20
7.9 Cooling Load Hours	20
7.10 Cooling Capacity	21
7.11 Cyclic Parameters	21
7.12 Seasonal Totals	22
SECTION 8: HEATING SEASONAL PERFORMANCE PARAMETERS FOR RESIDENTIAL AIR-SOURCE APPLIANCES	
8.1 Limitations	23
8.2 Procedure	23
8.3 Level 1 Gas Input Performance	23
8.4 Level 2 Gas Input Performance	23
8.5 Intermediate Gas Input Performance	23
8.6 Variable Gas Input Performance	24
8.7 Outdoor Temperature Profiles	25
8.8 Building Heating Load	26
8.9 Heating Bin Hours	26
8.10 Heating Capacity	26
8.11 Cyclic Parameters	26
8.12 Seasonal Totals	27
SECTION 9: ANNUAL PERFORMANCE PARAMETERS FOR RESIDENTIAL AIR-SOURCE APPLIANCES	
9.1 Limitations	29
9.2 Required Data	29
9.3 Annual Gas Energy Consumption	29
9.4 Annual Electric Energy Consumption	29
SECTION 10: COOLING INTEGRATED PART LOAD VALUE PARAMETERS FOR COMMERCIAL APPLIANCES	
10.1 Limitations	30
10.2 Procedure	30
10.3 Level 1 Gas Input Performance - Air-source Heat Pumps	30
10.4 Level 2 Gas Input Performance - Air-source Heat Pumps	30
10.5 Intermediate Gas Input Performance - Air-source Heat Pumps	30
10.6 Representative Outdoor Temperatures - Air-source Heat Pumps	31
10.7 Load Factors	31

CONTENTS (Continued)

	Page
10.8 Integrated Part Load Values	31
SECTION 11: OUTDOOR SOUND POWER LEVEL RATINGS FOR AIR-SOURCE APPLIANCES	
11.1 Test Procedure	32
11.2 Test Conditions - Cooling Mode	32
11.3 Test Conditions - Heating Mode	32
SECTION 12: REFERENCES	33
ANNEX A: SAMPLE CALCULATION OF COOLING SEASONAL PERFORMANCE PARAMETERS FOR RESIDENTIAL AIR-SOURCE APPLIANCES	35
ANNEX B: SAMPLE CALCULATION OF HEATING SEASONAL PERFORMANCE PARAMETERS FOR RESIDENTIAL AIR-SOURCE APPLIANCES	42
ANNEX C: SAMPLE CALCULATION OF COOLING INTEGRATED PART LOAD VALUE PARAMETERS FOR COMMERCIAL APPLIANCES	49

NOTE

This standard contains SI (metric) equivalents to the yard/pound quantities, the purpose being to allow the standard to be used in SI (metric) units. (*ASTM E380* is used as a guide in making metric conversions from yard/pound quantities.) If a value for a measurement as given in this standard is followed by an equivalent value in other units, the first stated is to be regarded as the requirement. The given equivalent may be approximate. If a value for a measurement and an equivalent value in other units, are both specified as a quoted marking requirement, the first stated unit, or both shall be provided.

HARMONIZED STANDARD FOR PERFORMANCE TESTING AND RATING OF GAS-FIRED, AIR-CONDITIONING AND HEAT PUMPING APPLIANCES

SECTION 1

SCOPE

This standard establishes methods of testing and rating gas-fired, heat pumps for space-conditioning performance. The procedures apply to factory-made, space-conditioning, unitary heat pumps which utilize gas as the primary fuel. This includes engine-driven heat pumps, absorption-cycle heat pumps, desiccant-type heat pumps, and other gas-fired heat pumps. The heat source/sink for the heat pumps may be outdoor air, ground water, or closed-loop water. The heat pumps provide the functions of year-round space conditioning either by direct heating and cooling of air or indirectly by the production of heated and chilled water.

The heat pump may include other functions. Appropriate portions of this standard can be applied to heat pumps which have a gas input that varies so that the output matches the cooling or heating load, to heat pumps which have a single level gas input which varies as a function of ambient conditions, and to heat pumps which have a constant gas input regardless of load or ambient conditions, and to heat pumps with several discrete levels of gas input. In addition to applying to heat pumps which provide year-round space conditioning, portions of this standard can be applied to heat pumps which provide space cooling only or space heating only. Also, procedures are provided for testing and rating water-cooled air conditioners and water-cooled chillers which reject condenser heat with a cooling tower, air- and water-cooled condensing units, and desiccant ventilation-air dehumidifiers.

Section 2 lists the thermal testing that is required for each class of appliance. The type of test and the levels of gas input are prescribed. For air-source/sink appliances, the outdoor temperature conditions are specified, and for water-source/sink appliances, the entering source/sink water temperatures are specified.

Section 3 identifies additional conditions at which the thermal tests specified in Section 2 are to be conducted. This includes the voltage of auxiliary electric input, indoor air quantities, return air temperatures, water flow rates, and return water temperatures.

Section 4 outlines the procedures to be followed when thermal testing. This includes steady-state tests and cyclic tests for the cooling mode, and steady-state tests, cyclic tests, and frost accumulation tests for the heating mode.

Section 5 covers calculation procedures for determining steady-state capacity and input ratings for the appliance operating in the cooling mode. Appropriate adjustments are made to the input and output values determined by the tests to normalize the impacts of auxiliary electric inputs.

Section 6 covers calculation procedures for determining steady-state capacity and input ratings for the appliance operating in the heating mode. Appropriate adjustments are made to the input and output values determined by the tests to normalize the impacts of auxiliary electric inputs.

The next four sections of the standard cover calculation procedures for determining seasonal and annual performance parameters for residential and commercial applications.

Section 7 covers calculation procedures for determining cooling-mode seasonal output and energy consumption ratings for appliances suitable for installation in residential applications. The steady-state cooling ratings from Section 5 are required as inputs for these determinations. A sample calculation is provided in Annex A.

Section 8 covers calculation procedures for determining heating-mode seasonal output and energy consumption ratings for appliances suitable for installation in residential applications. The steady-state heating ratings from Section 6 are required as inputs for these determinations. A sample calculation is provided in Annex B.

Section 9 covers calculation procedures for determining annual energy consumption for appliances suitable for installation in residential applications. The seasonal energy consumption data determined in Sections 7 and 8 are required as inputs for these calculations.

Section 10 covers calculation procedures for determining cooling-mode average hourly output and energy consumption ratings for appliances suitable for installation in commercial applications. The steady-state cooling ratings from Section 5 are required as inputs for these determinations. A sample calculation is provided in Annex C.

Section 11 covers procedures for determining outdoor sound power level ratings for air-source appliances.

Section 12 lists the references used in developing the standard.

SECTION 2

TESTING REQUIRED

2.1 GAS INPUT RATES.

2.1.1 Level 1. The Level 1 gas input rate for the tests prescribed in this standard is the minimum input level allowed by the appliance controls at the listed corresponding temperature condition.

2.1.2 Level 2. The Level 2 gas input rate for the tests prescribed in this standard is the maximum input level allowed by the appliance controls at the listed corresponding temperature condition.

2.1.3 Intermediate. For appliances with variable gas input rates, the Intermediate gas input rate for the tests prescribed in this standard is determined by:

$$\text{Intermediate gas input rate} = \left(\frac{2}{3}\right)(\text{Level 1 gas input rate}) + \left(\frac{1}{3}\right)(\text{Level 2 gas input rate})$$

Level 1 and Level 2 gas input rates are the levels allowed by the appliance controls at the listed corresponding temperature condition. For appliances with discrete levels of gas input between the Level 1 and Level 2 gas input rates, the Intermediate gas input rate for the tests prescribed in this standard shall be the input rate nearest the value calculated by the above equation. For appliances with only two discrete levels of gas input rate (that is, Level 1 and level 2 only), tests at the temperature condition listed for the Intermediate gas input rate shall be performed at both Level 1 and Level 2 gas input rates and the results averaged to provide equivalent intermediate gas input rate performance data.

2.2 AIR-SOURCE (AIR-TO-AIR AND AIR-TO-WATER) HEAT PUMPS

2.2.1 Cooling performance. Five steady-state, wet-coil, cooling performance tests shall be performed at the conditions listed in Table 2-1 located at the end of this section.

The wet bulb temperature conditions listed in Table 2-1 shall be maintained only for air-to-air heat pumps which reject condensate to the outdoor coil or are evaporatively-cooled.

The determination of cooling seasonal performance parameters for residential heat pumps requires the evaluation of a cooling-mode cyclic degradation coefficient. The coefficient may be established by test in lieu of accepting a default value of 0.25. When the testing option is exercised, the additional cooling performance tests listed in Table 2-2 shall be performed.

2.2.2 Heating performance. Five steady-state heating performance and two frost accumulation tests shall be performed at the conditions listed in Table 2-3.

The determination of heating seasonal performance parameters for residential heat pumps requires the evaluation of a heating-mode cyclic degradation coefficient. The coefficient can be established by test in lieu of accepting a default value of 0.25. When the testing option is exercised, the additional heating performance test listed in Table 2-4 shall be performed.

2.3 WATER-SOURCE (WATER-TO-AIR AND WATER-TO-WATER) HEAT PUMPS

2.3.1 Cooling performance. Two steady-state cooling performance tests shall be performed at the conditions listed in Table 2-5.

2.3.2 Heating performance. Two steady-state heating performance tests shall be performed at the conditions listed in Table 2-6.

2.4 GROUND WATER-SOURCE (WATER-TO-AIR AND WATER-TO-WATER) HEAT PUMPS

2.4.1 Cooling performance. Four steady-state cooling performance tests shall be performed at the conditions listed in Table 2-7.

2.4.2 Heating performance. Four steady-state heating performance tests shall be performed at the conditions listed in Table 2-8.

2.5 WATER-COOLED AIR CONDITIONERS AND CHILLERS

2.5.1 Cooling performance. Three steady-state cooling performance tests shall be performed for water-cooled air conditioners and chillers which reject condenser heat with a cooling tower at the conditions listed in Table 2-9.

2.6 AIR-COOLED CONDENSING UNITS

2.6.1 Cooling performance. Four steady-state, cooling performance tests shall be performed at the conditions listed in Table 2-10.

The wet bulb temperature conditions listed in Table 2-10 shall be maintained only for evaporatively-cooled condensing units.

2.7 WATER-COOLED CONDENSING UNITS

2.7.1 Cooling performance. Four steady-state, cooling performance tests shall be performed at the conditions listed in Table 2-11.

2.8 DESICCANT VENTILATION-AIR DEHUMIDIFIERS

2.8.1 Dehumidifying performance. Steady-state, dehumidifying performance test(s) shall be performed at one or both of the conditions listed in Table 2-12.

2.9 OPTIONAL TESTS FOR APPLICATION RATINGS.

2.9.1 Additional optional steady-state cooling and heating performance tests may be run at gas input rates, entering air temperatures, and entering water temperatures other than those listed in this section to establish application performance ratings.

Table 2-1

STEADY-STATE TESTS, COOLING - AIR-SOURCE HEAT PUMPS

Identifying Notation	Type of Test	Gas Input Rate	Outdoor Temperature
$ss^{k=2(95)}$	Steady-state	Level 2	95°F (35°C) db, 75°F (23.8°C) wb
$ss^{k=2(82)}$	Steady-state	Level 2	82°F (27.8°C) db, 65°F (18.3°C) wb
$ss^{k=i(87)*}$	Steady-state	Intermediate	87°F (30.6°C) db, 69°F (20.6°C) wb
$ss^{k=1(82)*}$	Steady-state	Level 1	82°F (27.8°C) db, 65°F (18.3°C) wb
$ss^{k=1(67)*}$	Steady-state	Level 1	67°F (19.4°C) db, 53.5°F (11.9°C) wb
* Test not required when Level 1 equals Level 2.			

Table 2-2

OPTIONAL TESTS TO ESTABLISH CYCLIC PARAMETERS, COOLING- AIR-SOURCE HEAT PUMPS

Identifying Notation	Type of Test	Gas Input Rate	Outdoor Temperature
$cyc^{k=1(72)}$	Cyclic (dry coil for air-to-air HPs)	Level 1	72°F (22.2°C) db
$ssd^{k=1(72)}$	Steady-state (dry coil for air-to-air HPs)	Level 1	72°F (22.2°C) db

Table 2-3

**STEADY-STATE AND FROST ACCUMULATION TESTS,
HEATING- AIR-SOURCE HEAT PUMPS**

Identifying Notation	Type of Test	Gas Input Rate	Outdoor Temperature
$\text{def}^{k=2(35)*}$	Frost accumulation	Level 2	35°F (1.7°C) db, 33°F (0.6°C) wb
$\text{ss}^{k=2(17)*}$	Steady-state	Level 2	17°F (8.3°C) db, 15°F (-9.4°C) wb
$\text{ss}^{k=2(7)*}$	Steady-state	Level 2	7°F (-13.9°C) db, 5.5°F (-14.7°C) wb
$\text{ss}^{k=i(17)*}$	Steady-state	Intermediate	17°F (-8.3°C) db, 15°F (-9.4°C) wb
$\text{ss}^{k=1(47)}$	Steady-state	Level 1	47°F (8.3°C) db, 43°F (6.1°C) wb
$\text{def}^{k=1(35)}$	Frost accumulation	Level 1	35°F (1.7°C) db, 33°F (0.6°C) wb
$\text{ss}^{k=1(17)}$	Steady-state	Level 1	17°F (-8.3°C) db, 15°F (-9.4°C) wb
* Test not required when Level 1 equals Level 2.			

Table 2-4

**OPTIONAL TEST TO ESTABLISH CYCLIC PARAMETERS,
HEATING- AIR-SOURCE HEAT PUMPS**

Identifying Notation	Type of Test	Gas Input Rate	Outdoor Temperature
$\text{cyc}^{k=1(47)}$	Cyclic	Level 1	47°F (8.3°C) db, 43°F (6.1°C) wb

Table 2-5

STEADY-STATE TESTS, COOLING - WATER-SOURCE HEAT PUMPS

Identifying Notation	Type of Test	Gas Input Rate	Entering Water-Sink Temperature
$\text{ssc}^{k=2(85)}$	Steady-state/cooling	Level 2	85°F (29.4°C)
$\text{ssc}^{k=1(85)*}$	Steady-state/cooling	Level 1	85°F (29.4°C)
* Test not required when Level 1 equals Level 2.			

Table 2-6

STEADY-STATE TESTS, HEATING - WATER-SOURCE HEAT PUMPS

Identifying Notation	Type of Test	Gas Input Rate	Entering Water-Source Temperature
$ssh^{k=2(70)}$ $ssh^{k=1(70)*}$	Steady-state/heating Steady-state/heating	Level 2 Level 1	70°F (21.1°C) 70°F (21.1°C)
* Test not required when Level 1 equals Level 2.			

Table 2-7

STEADY-STATE TESTS, COOLING - GROUND WATER-SOURCE HEAT PUMPS

Identifying Notation	Type of Test	Gas Input Rate	Entering Water-Sink Temperature
$ssc^{k=2(70)}$ $ssc^{k=2(50)}$ $ssc^{k=1(70)*}$ $ssc^{k=1(50)*}$	Steady-state/cooling Steady-state/cooling Steady-state/cooling Steady-state/cooling	Level 2 Level 2 Level 1 Level 1	70°F (21.1°C) 50°F (10°C) 70°F (21.1°C) 50°F (10°C)
* Test not required when Level 1 equals Level 2.			

Table 2-8

STEADY-STATE TESTS, HEATING - GROUND WATER-SOURCE HEAT PUMPS

Identifying Notation	Type of Test	Gas Input Rate	Entering Water-Source Temperature
$ssh^{k=2(70)}$ $ssh^{k=2(50)}$ $ssh^{k=1(70)*}$ $ssh^{k=1(50)*}$	Steady-state/heating Steady-state/heating *Steady-state/heating Steady-state/heating	Level 2 Level 2 Level 1 Level 1	70°F (21.1°C) 50°F (10°C) 70°F (21.1°C) 50°F (10°C)
* Test not required when Level 1 equals Level 2.			

Table 2-9

**STEADY-STATE TESTS, COOLING - WATER-COOLED AIR CONDITIONERS
AND CHILLERS**

Identifying Notation	Type of Test	Gas Input Rate	Entering Condenser-Water Temperature
$ss^{k=2}(T_2)$ $ss^{k=i}(T_i)^*$ $ss^{k=1}(T_1)^*$	Steady-state/cooling Steady-state/cooling Steady-state/cooling	Level 2 Intermediate Level 1	$(T_2)^\circ\text{F}$ $(T_2)^\circ\text{C}$ $(T_i)^\circ\text{F}$ $(T_i)^\circ\text{C}$ $(T_1)^\circ\text{F}$ $(T_1)^\circ\text{C}$
* Test not required when Level 1 equals Level 2.			

where:

$$\begin{aligned}
 T_2^\circ\text{F} &= 85 \\
 T_2^\circ\text{C} &= 29.4 \\
 T_i^\circ\text{F} &= 60 + 25 \times (\text{Intermediate gas input rate/Level 2 gas input rate}) \\
 T_i^\circ\text{C} &= 15.6 + 13.9 \times (\text{Intermediate gas input rate/Level 2 gas input rate}) \\
 T_1^\circ\text{F} &= 60 + 25 \times (\text{Level 1 gas input rate/Level 2 gas input rate}) \\
 T_1^\circ\text{C} &= 15.6 + 13.9 \times (\text{Level 1 gas input rate/Level 2 gas input rate})
 \end{aligned}$$

Table 2-10

STEADY-STATE TESTS, COOLING - AIR-COOLED CONDENSING UNITS

Identifying Notation	Type of Test	Gas Input Rate	Outdoor Temperature	Entering Suction Temperature	
				Saturated	Actual
$ss^{k=2}(95,50)$	Steady-state	Level 2	95°F (35°C) db, 75°F (23.8°C) wb	50°F (10°C)	65°F (18.3°C)
$ss^{k=2}(95,40)$	Steady-state	Level 2	95°F (35°C) db, 75°F (23.8°C) wb	40°F (4.4°C)	55°F (12.8°C)
$ss^{k=2}(80,50)$	Steady-state	Level 2	80°F (26.7°C) db, 67°F (19.4°C) wb	50°F (10°C)	65°F (18.3°C)
$ss^{k=2}(80,40)$	Steady-state	Level 2	80°F (26.7°C) db, 67°F (19.4°C) wb	40°F (4.4°C)	55°F (12.8°C)

Table 2-11

STEADY-STATE TESTS, COOLING - WATER-COOLED CONDENSING UNITS

Identifying Notation	Type of Test	Gas Input Rate	Entering Condenser-Water Temperature	Entering Suction Temperature	
				Saturated	Actual
$ss^{k=2}(85,50)$	Steady-state	Level 2	85°F (29.4°C)	50°F (10°C)	65°F (18.3°C)
$ss^{k=2}(85,40)$	Steady-state	Level 2	85°F (29.4°C)	40°F (4.4°C)	55°F (12.8°C)
$ss^{k=2}(75,50)$	Steady-state	Level 2	75°F (23.8°C)	50°F (10°C)	65°F (18.3°C)
$ss^{k=2}(75,40)$	Steady-state	Level 2	75°F (23.8°C)	40°F (4.4°C)	55°F (12.8°C)

Table 2-12

STEADY-STATE TESTS, DEHUMIDIFYING - DESICCANT DEHUMIDIFIERS

Identifying Notation	Type of Test	Gas Input Rate	Entering Temperatures	
			Ventilation Air	Reactivation Air
$ss^{k=2}(95,95)$	Steady-state	Level 2	95°F (35°C) db, 75°F (23.8°C) wb	95°F (35°C) db, 75°F (23.8°C) wb
$ss^{k=2}(95,80)$	Steady-state	Level 2	95°F (35°C) db, 75°F (23.8°C) wb	80°F (26.7°C) db, 67°F (19.4°C) wb

SECTION 3

TESTING CONDITIONS

3.1 ALL APPLIANCES

3.1.1 Test Room and Appliance Installation. The test room requirements and appliance installation procedures are as specified in Standard *ANSI/ASHRAE 37 Standard (ASHRAE 14 for condensing units)*.

3.1.2 Auxiliary Electric Voltages. The nameplate voltage for the auxiliary electric input shall be one of the following:

<u>Single-Phase - 60 Hertz</u>	<u>Three-Phase - 60 Hertz</u>
115	208
208	208/230
208/230	230
230	460
265	575

Standard rating tests shall be performed at the nameplate voltage, phase, and frequency. Appliances with dual nameplate voltages and with a maximum rated cooling capacity less than 65,000 Btu/hr (19 050 W) (or maximum rated heating capacity less than 65,000 Btu/hr (19 050 W) for heating-only heat pumps) shall be tested at the higher of the two voltages only.

Maximum rated cooling capacity for air-source (air-to-air and air-to-water) heat pumps is defined as the cooling capacity at Level 2 gas input in a 95°F (35°C) outdoor ambient temperature. Maximum rated cooling capacity for ground water-source heat pumps is defined as the cooling capacity at Level 2 gas input with a 50°F (10°C) water sink temperature. Maximum rated cooling capacity for water-source heat pumps, and water-cooled air-conditioners and chillers which reject condenser heat with a cooling tower is defined as the cooling capacity at Level 2 gas input with an 85°F (29.4°C) entering water temperature. Maximum rated heating capacity for air-source (air-to-air and air-to-water) heat pumps is defined as the heating capacity at Level 2 gas input in a 17°F (-8.3°C) outdoor ambient temperature. Maximum rated heating capacity for ground water-source heat pumps and water-source heat pumps is defined as the heating capacity at Level 2 gas input with a 70°F (21.1°C) water source temperature.

For dual-nameplate appliances with a maximum rated cooling capacity of 65,000 Btu/hr (19 050 W) or greater (or maximum rated heating capacity of 65,000 Btu/hr (19 050 W) or greater for heating only heat pumps), the standard rating tests shall be performed at either the lower of the two voltages or at both voltages if ratings for both voltages are desired.

3.1.3 Split Systems. All standard ratings for appliances in which an outdoor section is separated from an indoor section shall be determined with at least 25 feet (7.62 m) of each interconnecting tube of the sizes recommended by the manufacturer. Appliances furnished with interconnecting tubing that is not recommended for cutting to length shall be tested with the complete length of tubing furnished, or with 25 feet (7.62 m) of tubing, whichever is greater. At least 10 feet (3.05 m) of all tubing runs shall be exposed to the outside conditions. Tubing insulation and other details of the installation in the test facility shall be in accordance with the manufacturer's published installation procedures.

3.1.4 Domestic Water Heating. If the appliance has provision for heating domestic water, there shall be no domestic water circulated through the unit and there shall be no hot water draws during the performance tests.

3.2 AIR-SOURCE (AIR-TO-AIR AND AIR-TO-WATER) HEAT PUMPS

3.2.1 Outdoor Air Quantity. All standard ratings shall be determined at the outdoor-air quantity specified by the manufacturer where the outdoor fan drive is adjustable. Where the outdoor-air fan drive is not adjustable, the ratings shall be determined at the outdoor-air quantity inherent in the appliance when operated with all of the airflow resistance elements associated with inlets, louvers, and any duct work considered by the manufacturer as normal installation practice in place. Once established, the outdoor air circuit of the appliance shall remain unchanged throughout all tests.

3.2.2 Outdoor Ambient Temperatures. The temperature of the air surrounding units or sections