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INCH POUND

MIL-PRF-83990A(USAF)
24 February 1997
SUPERSEDING
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PERFORMANCE SPECIFICATION
OVEN, THERMAL DRYING, ELECTRIC

This specification is approved for use by the Department of the Air Force and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE.

1.1 Scope. This specification covers general purpose, electrically heated thermal drying ovens for use in various heating, drying, and baking operations.

1.2 Classification. The ovens will be of the following types, classes and styles as specified (see 6.2).

1.2.1 Types.

Type I Gravity/convection air circulation
Type II Forced air circulation

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: WR-ALC/LKJE, 460 2ND STREET, STE 221, Robins AFB, GA 31098-1640 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 4430

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1.2.2 Classes. The oven will be classified by maximum operating temperature as follows:

Class 1	As specified in Ordering Data (see 6.2)
Class 2	500 °F
Class 3	650 °F

1.2.3. Style.

Style 1	Single door
Style 2	Double door

1.3. Size. Oven size will be considered to be the free and clear dimensions within the oven, wall to wall (width), door to back (depth), and, floor to ceiling (height) as specified in 6.2.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of the documents not listed in the DoDISS are the issues of the documents cited in the solicitation. (see 6.2)

NATIONAL FIRE PROTECTION ASSOCIATION STANDARDS

NFPA 86D	Industrial Furnaces using Vacuum as an Atmosphere
NFPA 70	National Electrical Code

(Application for copies should be addressed to the National Fire Protection Association, 1 Batterymarch Park, Quincy, MA, 02269-9101).

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article inspection. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.2.

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3.2 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the materials meet or exceed the operational and maintenance requirements, and promote economically advantageous life cycle costs.

3.3 Design. The oven shall be an upright, fully insulated, electrically heated, automatically controlled, completely self-contained design of the type, class, style and size as specified in 6.2 and shall conform to the requirements of NFPA 86D, Class A. Heavy duty and/or industrial grade components and materials are required with the objective of ensuring long service life under shop or laboratory service conditions.

3.3.1 Safety. The oven shall be provided with safety features and devices for the protection of personnel, equipment and the work being processed. Parts which are hazardous to personnel shall be guarded. Equipment and components shall be selected and applied which are “fail-safe”, when possible.

3.3.2 Materials. All materials used in the fabrication of the oven and related equipment shall be of a quality necessary to produce an oven to meet the requirements herein and shall not deteriorate, corrode, rust, or fail when exposed to conditions likely to occur during service usage.

3.3.3 Lubrication. Provisions shall be made for the lubrication of all moving parts except sealed bearings, to reduce wear and maintain efficiency. Lubrication points shall be readily accessible.

3.3.4 Accessibility. All parts subject to wear or breakage and all parts which require periodic maintenance shall be readily accessible for adjustment and replacement.

3.3.5 Interchangeability. All parts shall be manufactured to standards which permit replacement without modification of parts or equipment.

3.4 Construction. The oven shall be constructed of parts which are free of harmful defects and repairs. All surfaces shall be clean and free of harmful or extraneous materials. All edges shall be either rounded or beveled unless sharpness is required to perform a necessary function. The structure shall be capable of withstanding, without damage, normal forces encountered during transportation, delivery, and operation of the oven at its maximum capacity.

3.5 Components, systems, and performance.

3.5.1 Air circulation.

3.5.1.1 Type I. Air shall circulate by gravity/convection in patterns which shall promote even heat distribution throughout the working chamber.

3.5.1.2 Type II. A forced air circulating system shall provide air movement within the oven to promote even heat distribution throughout the working chamber and provide means for accurate temperature control. The temperature variation between any two points within the oven shall be no greater than 10 degrees F.

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3.5.2 Cabinet. The minimum outside dimensions of the cabinet shall be consistent with the required thickness of the thermal insulation to ensure minimal heat loss. The cabinet shall provide space for all wiring, heating elements, controls and for Type II ovens, a forced air circulating system.

3.5.3 Structural. The entire oven shall provide a rigid structure even with the door(s) open. The bottom of walk-in ovens shall withstand at least 150 pounds per square foot. Oven bottoms, other than walk-in ovens, shall be of sufficient strength to withstand a concentrated 50 pound load anywhere on the oven bottom.

3.5.4 Ventilation. For Type II ovens, ventilators or openings shall be provided in the walls or top of the cabinet for the entrance and exit of fresh air. The location, size and design shall provide for a minimum of one complete air change per minute in the oven, except when otherwise specified in 6.2. The ventilators shall be adjustable, manually controlled from the outside of the oven. Provisions shall be made for connection of the exhaust ventilator opening to an exhaust duct. The oven ventilation system shall conform to NFPA 86D requirements.

3.5.5 Instrument opening. Unless specified otherwise in 6.2, there shall be an opening through a wall of the cabinet near the top for the insertion inside the oven of temperature sensing element(s), other than those which are part of the normal oven instrumentation. Provisions are required to seal the opening when it is not in use.

3.5.6 Shelf supports. Shelf supports shall be attached to the right and left walls of the interior of the oven. The supports shall permit shelves to be spaced at vertical intervals which are adjustable from top to bottom in accordance with the requirements specified in 6.2. Unloaded shelves shall remain horizontal when withdrawn approximately one-half the depth of the cabinet chamber.

3.5.7 Shelves. Shelves for other than walk-in ovens shall approximate the width and depth of the oven working chamber. The number required shall be as specified in 6.2. When shelves or partial shelves are required for walk-in ovens, the type, size, number and location shall be as specified in 6.2. Shelves shall be easily removable from the oven. The shelves shall be capable of supporting a 50 pound load without deflecting more than one fourth inch or sustaining any permanent deformation.

3.5.8 Forklift supports. Unless otherwise specified in 6.2, the cabinet shall be constructed in such a manner as to permit forklift use during installation or subsequent movement. The supports shall be of sufficient strength to support the oven assembly and the work load.

3.5.9 Doors. The oven shall have a side hinged single door (Style 1) or double doors (Style 2) as specified in 6.2. Door(s) shall permit full width and height access to the working area when open. The door(s) when shut shall be close fitting within the door opening to minimize heat loss and shall seat tightly against a suitably resilient seal around the edge to prevent air leakage. Walk-in ovens shall have door(s) which open safely and easily from both the outside and the inside. Latches shall provide positive latching and fast release of the closed door(s).

3.5.10 Thermal insulation. Thermal insulation shall be heat-resisting material which is non-combustible, non-hygroscopic, non-powdering, and which will not settle. Insulation shall contain no Class 1 ozone depleting chemicals nor any EPA-17 chemicals. The insulation shall be sufficient

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to limit the heat loss of the oven to no more than 0.050 kW (171 BTU) per hour per square foot of oven interior surface at maximum operating temperature.

3.5.11 Temperature indicator. The oven shall be equipped with a digital or analog temperature indicator. The instrument shall be graduated in degrees F and shall be positioned to be read easily. The temperature indicator may be an individual unit or combined with the thermostat.

3.5.12 Thermostat. The oven temperature adjustment shall be by means of a thermostat control. The thermostat shall be capable of automatically maintaining the oven temperature as set to within ± 10 degrees F. The thermostat control shall be located on the outside of the oven and shall be fully enclosed to protect the instrument against dust, dirt, moisture or corrosive media. The thermostat sensing element shall be suitably located inside the oven to ensure sensitivity to overall oven temperature fluctuations.

3.5.13 Heating units. The oven heating units shall be located in such a manner as to preclude direct radiant energy to the oven work space. The number and size of the elements shall be sufficient to raise and stabilize the oven temperature from ambient level to maximum operating temperature in fifty minutes. The heaters shall conform to the requirements of NFPA 86D.

3.5.14 Excess temperature cut-out. An excess temperature cut-out shall be provided which is adjustable over a minimum range of 150 degrees F below to 50 degrees F above the maximum operating temperature of the oven. The cut-out shall function to remove power from the oven when the set over-temperature point is reached. The power shall remain off until manually reset and shall comply with NFPA 86D requirements.

3.5.15 Over-current protection. Over-current protection for each major element in the heater circuit(s) shall be in compliance with NFPA 70, National Electrical Code.

3.5.16 Cut-out switch. The oven shall have a cut-out switch that disconnects power from the heating units when one or both doors are opened and reconnects power when the door(s) are securely closed.

3.5.17 Indicator light. The oven shall be equipped with an indicator light which shall function when the oven heaters are energized. The indicator light shall be located near the door(s) and be visible when facing the door(s).

3.6 Electrical Requirements.

3.6.1 Electrical system. The oven electrical system shall comply with the requirements of the National Electrical Code and NFPA 86D.

3.6.2 Power supply. The oven shall operate on a 230 volt, 60 Hertz, 3 phase power supply, unless otherwise specified in 6.2.

3.6.3 Wiring. The oven wiring shall be completely enclosed in easily accessible control and wiring compartment(s) integral with the cabinet. Any wiring exposed to high temperatures shall be suitably protected.

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3.6.4 Forced Air Circulating System. The oven shall have a forced air circulating system to circulate air within the Type II oven. The motor for the system shall have adequate thermal and over-current protection. The assembly shall be statically and dynamically balanced.

3.6.5 Dielectric strength. The electrical system insulation, excluding control and recording instruments, shall be capable of withstanding without damage an impressed voltage of 1,000 volts plus twice the rated voltage without breaking down and shall register a resistance value of not less than one megohm at 500 volts DC. The dielectric strength shall apply between all insulated circuits and external oven parts.

3.6.6 Undervoltage protection. Undervoltage protection shall be provided in accordance with NFPA 86D to remove power from the oven in the event of power failure. The oven shall not restart until it is manually reset.

3.6.7 Lock-out tag-out protection. Walk-in type ovens shall have provisions to isolate and lock out all sources of hazardous energy to ensure the safety of maintenance personnel.

3.7 Nameplate. A corrosion and weather resistant nameplate shall be securely attached to the oven. The nameplate shall include:

Contract number
National stock number
Manufacturer's name
Manufacturer's model
Manufacturer's serial number
Power input characteristics
Maximum operating temperature, °F

4. VERIFICATION

4.1 Classification of Inspections. The inspection requirements specified herein are classified as follows:

a. First article inspection (see 4.2).

b. Quality Conformance inspection (see 4.3).

4.2 First article test. Unless otherwise specified (see 6.2), one oven shall be subjected to first article testing. Testing shall consist of the examination in paragraph 4.4 and the testing in paragraph 4.5. Failure of the first article test oven to pass any examination or test shall be cause for rejection.

4.3 Quality conformance inspection. Quality conformance inspection shall be performed on each item prior to being offered for acceptance under the contract. Quality conformance inspection shall consist of the examinations in 4.4 and the tests in 4.5 as specified by the procuring activity (see 6.2). Failure of the oven to pass the examination or any specified test shall be cause for rejection.

4.4 Examination. The oven shall be examined to verify the following:

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Requirements paragraphs	Examination to be conducted
1.2.1 Type	Check Type I or Type II as specified
1.2.2 Class	Check maximum operating temperature
1.2.3 Style	Check number of doors
1.3 Size	Check oven cavity dimensions
3.3.3 Lubrication	Check lubrication points and accessibility
3.3.4 Accessibility	Check accessibility of repairable assemblies
3.5.4 Ventilation	Check adjustable ventilation devices
3.5.6 Shelf supports	Check placement of supports
3.5.7 Shelves	Check the number and the size(s)
3.5.8 Forklift supports	Check for forklift slots (if applicable)
3.5.9 Doors	Check the number of doors, fit, clearance, and latch
3.5.11 Temperature indicator	Check for °F units and for readability ease
3.5.12 Thermostat	Check to ensure thermostat is protected
3.5.13 Heating units	Check to ensure work space is not directly exposed to heating units
3.5.17 Indicator light	Check indicator light location
3.6.2 Power supply	Check voltage, hertz, phase
3.6.3 Wiring	Check by visual inspection
3.6.7 Lock-out, tag-out	Check by engaging device
3.7. Nameplate	Check nameplate for requirements

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4.5 Tests. The oven shall be in compliance with all tests. Failure to comply with all tests shall be cause for rejection. The following table provides a cross-reference of the Section 3 requirements tested or verified in the paragraphs below.

Requirements Cross-Reference Matrix

REQUIREMENT	VERIFICATION
3.3 and 3.3.1	4.5.1
3.5.1.2	4.5.4
3.5.3	4.5.2.2
3.5.7	4.5.2.1
3.5.10	4.5.5
3.5.12	4.5.3
3.5.13	4.5.1.1
3.5.14	4.5.7
3.5.16	4.5.6
3.6.5	4.5.9
3.6.6	4.5.8

4.5.1 Durability/operational test. The oven shall successfully complete at least 50 cycles.. A complete cycle shall consist of heating the oven from ambient temperature to the maximum specified temperature and cooling it back down to ambient temperature. All safety items and safety interlocks shall be checked for proper operation by simulating failure of key components such as fans, sticking thermostat, sticking main contactor and/or by purposely mis-operating the oven controls to whatever extent that might be inadvertently possible during normal use.

4.5.1.1 Heating Units. Heating unit performance shall be monitored during the tests of 4.5.1. Failure to reach the maximum temperature within the allowable 50 minutes time frame shall be cause for rejection.

4.5.2 Deflection and rigidity tests.

4.5.2.1 Shelf deflection test. A shelf shall be supported in the same manner as it is supported in the oven and shall have a load of 50 pounds placed at its center for a period of five minutes and then removed. The shelf shall not deflect more than ¼-inch or receive any permanent deformation.

4.5.2.2 Bottom deflection test. For walk-in ovens, a person weighing at least 200 pounds shall walk randomly around and about the oven floor for five minutes. The oven bottom shall not buckle or receive any permanent deformation or damage. The floor/bottom of an oven not large enough for or classified as walk-in, shall be tested by placing a 50 pound load, of no more than 30 square inches bearing area, at a minimum of five locations about the floor. The load shall remain in place at each location for at least three minutes. No permanent deformation or damage to the floor shall result.

4.5.3 Thermostat accuracy test. A calibrated thermocouple shall be placed near the center of the oven to determine the thermostat accuracy. The thermostat shall be set to the maximum

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operating temperature and the oven allowed to heat up and stabilize. The thermocouple reading and the thermostat reading shall be recorded. The thermostat reading shall be within ±10°F of the thermocouple reading. The process shall be repeated at a temperature approximately 50 percent of the maximum operating temperature and the thermostat reading verified to be within +/- 10 degrees F of the thermocouple reading.

4.5.4 Temperature variance test. (Type II ovens only) Four accurately calibrated thermocouples shall be placed near the corners of the oven to determine the overall temperature variation. The temperature variation between any two points within the oven shall not be greater than 10°F. The test shall be conducted at approximately 150 degrees F and at maximum operating temperature of the furnace.

4.5.5 Heat loss test. The oven shall be operated for a period of time sufficient to allow complete thermal stability at maximum operating temperature. Then, without altering any controls or settings, the oven power shall be accurately measured for one hour. The power consumption so measured and reflected in kW/hour shall not exceed 0.050 kW (171 BTU) per hour per square foot of oven interior surface.

4.5.6 Cut-out switch test. The oven door(s) shall be closed and the heating elements energized. The door(s) shall then be alternately opened and closed 20 times. The oven shall cut-off when the door(s) is/are opened and re-energized when the door(s) is/are closed.

4.5.7 Excess temperature cut-out test. The excess temperature cut out shall be tested by setting the cut-out at 150 degrees below the maximum operating temperature of the furnace. The thermostat shall then be disabled to simulate thermostat failure in the closed position and the furnace operated. Power to the furnace shall be interrupted by the cut-out at the appropriate setting within +/- 10 degrees F. The test shall be repeated with the cut-out set at 50 degrees above the maximum operating temperature.

4.5.8 Undervoltage protection test. The oven shall be in operating mode to conduct the undervoltage protection test. Electricity to the oven shall be interrupted by manually tripping the circuit breaker. The circuit breaker shall then be reset to the “ON” position. The oven shall not restart until manually reset.

4.5.9 Dielectric and Insulation resistance test. The circuits of the electrical system excluding control or recording instruments shall withstand, without damage, for a period of one minute, an impressed voltage of 1000 volts plus twice the rated voltage. The impressed voltage shall be applied between all insulated circuits and insulated circuits and the frame. The insulation shall then be subjected to an electrical resistance test. The resistance between all insulated circuits and the oven frame shall be not less than one megohm at 500 volts DC.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point’s packaging activity within the Military Department or Defense Agency, or within the Military Department’s System Command. Packaging data retrieval is available from the managing Military

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Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature which may be helpful, but is not mandatory.)

6.1 Intended use. These ovens are intended for use in heating, drying, baking, or curing various products, components and end items in shops and laboratories.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of this specification.
b. Issue of the DoDISS to be cited in the solicitation, and if required, the specific issue of individual document referenced (see 2.2).
c. Type required (see 1.2.1).
d. Class required. Specify maximum operating temperature if Class 1 (see 1.2.2)
e. Style required (see 1.2.3).
f. Size of minimum, clear, interior dimensions required (see 1.3).
g. First article if required (see 3.1 and 4.3).
h. Ventilation required (see 3.5.4)
i. Instrument opening, specify if not required (see 3.5.5)
j. Number and position of shelf supports (see 3.5.6).
k. Type, size, number and location of shelves (see 3.5.7).
l. Forklift requirements (see 3.5.8)
m. Operating power supply (see 3.6.2).
n. Quality Conformance testing requirements (see 4.3).
o. Packaging requirements (see 5.1).

6.3 Subject term (key word) listing.

Electric oven
Thermal drying, baking, or curing
Gravity/convection air
Forced air

6.4 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

Custodian:
Air Force - 99

Preparing Activity:
Air Force - 84

(Project 4440-F025)

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
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NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-83990A	2. DOCUMENT DATE (YYMMDD)

3. DOCUMENT TITLE
Oven, Thermal Drying, Electric

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*	b. Organization	
c. ADDRESS *(Include zip code)*	d. TELEPHONE *(Include Area Code)* (1) Commercial (2) DSN *(if applicable)*	7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME	b. TELEPHONE *(Include Area Code)*	
WR-ALC/LKJE	(1) Commercial 912-926-6630	(2) DSN 468-6630
c. ADDRESS *(Include Zip Code)* 460 2ND ST STE 221 ROBINS AFB GA 31098-1640	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 DSN 289-2340	