31 July 1969

Materiel Test Procedure 10-2-146
General Equipment Test Activity

U. S. ARMY TEST AND EVALUATION COMMAND
COMMODITY ENGINEERING TEST PROCEDURE

ICE MAKING MACHINES

1. OBJECTIVE

This document provides test methods and techniques necessary to determine the technical performance and safety characteristics of ice making machines as described in Qualitative Materiel Requirements (QMR's), Small Development Requirements (SDR's), or Technical Characteristics (TC's), and to determine the item's suitability for service tests.

2. BACKGROUND

There exists a need for automatic air- or water cooled, electric motor driven, self-contained, mechanically refrigerated, ice making machines to make and store "cube" or "flake" ice for use in military dining halls, hospitals, laboratories, and other facilities. (See Glossary for a definition of terms used.) The insulated ice-storage bin may be built integral with the ice making machine, or it may be contained in a separate cabinet, with a suitable ice conveyer installed between it and the ice maker. The ice is usually conveyed to the storage bin by gravity, and the storage bin is usually large enough to hold at least half of a day's production of ice. A detailed description of types and capabilities of ice makers will be found in Appendix A.

3. REQUIRED EQUIPMENT

a. Measuring Tape and Ruler.
b. Flashlight.
c. Camera, Film, Flashbulbs.
d. Suitable Weighing Scales for bulk items accurate to ±1.0%.
e. Weighing Balance, reading up to 5 pounds for testing ice "quality", and reading in tenths, hundreths, and thousandths of a pound.
f. Quart Thermos Bottle with a wide mouth opening not less than 2 1/2 inches I.D. for use in measuring ice quality. No bottle caps are needed.
g. Wire basket large enough to catch and hold about 0.6 lb. of ice cubes or flakes at the point where they are discharged into the ice bin or the conveyer chute.
h. Plastic Stirring Rod for stirring the ice inside the thermos bottle.
i. Stop Watch, reading in hours, minutes and seconds.
j. Marking Inks, Colored Crayons.
k. Wrenches, Pliers, Screwdrivers.
l. Liquid-in-Glass Thermometers, 0°F to 150°F. accurate to ±0.5°F.
m. Wet Bulb Thermometer, max. 100°F accurate to ±0.5°F.
n. Voltmeter, Ammeter, Wattmeter, Watt-Hour Meter accurate to ±2.0%.
o. Vibration Testing Machine.
p. Lifting and Moving Device for moving the test item, meeting the

requirements specified by the test item manufacturer.

q. Sound Level Measuring Equipment meeting the requirements specified in reference 4U2 and 4U4.

r. Temperature-Altitude Test Chamber.

s. Mercury Type Barometer.

t. Wire Basket, of established weight, large enough to catch and hold all of the ice harvested in any one harvesting cycle on batch type machines.

u. Two Wire Baskets, of established weight, to catch and hold all of the ice discharged into the storage bin during a 15 minute period on continuous type machines.

v. A Test Room of sufficient volume and of suitable rectangular shape to accomodate the ice maker and its associated external ice storage bin (when one is used), including adjustable heating and cooling means, air circulating fan(s) and auxiliary means, to maintain the average temperature of this room within 2°F. of the specified value. Six thermocouples shall be mounted in this test room (Thermocouples shall be shielded from heat radiation and moisture).

w. A Water Storage Tank or other suitable water source, of sufficient capacity and pipe or hose connections between it and the ice maker, with heating and cooling means to maintain the temperature of the water entering the ice maker within 2°F. of the specified value throughout the duration of any specified test.

x. Suitable Means and Materials to add specified amounts of salts and/or minerals to the water supply to the ice maker so as to simulate the most severe kind of water "hardness", to be encountered in the field, from a water system clogging standpoint.

y. A Suitable Test Room, maintained at an average ambient air temperature of 80°F., in which the "quality" of the ice is tested.

z. Water Flow Meter reading in gallons, to be inserted in the make-up water line, at, or near, the make-up connection to the ice maker, and a similar water flow meter to be inserted in the condenser cooling water line, when the test item uses a water-cooled condenser.

aa. Humidity-Temperature Chamber.

ab. Equipment and Facilities as specified in referenced MTP's.

4. REFERENCES

A. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
B. USATECOM Regulation 700-1, Value Engineering.
C. USATECOM Regulation 705-4, Equipment Performance Report.
D. USAMC Regulation 385-12, Verification of Safety of Materiel from Development through Testing and Supply to Disposition.
E. USAMC Regulation 385-224, AMC Safety Manual.
F. MIL-P-116, Preservation, Methods of.
G. MIL-STD-129, Marking for Shipment and Storage.
H. MIL-STD-461, Electromagnetic Interference Characteristics Requirements for Equipment.
I. MIL-STD-810B, Environmental Test Methods.
J. MIL-STD-814, Requirements for Tiedown, Suspension and Provisions on Military Materiel for Air Drop.
K. MIL-STD-1186, Cushioning, Anchoring, Bracing, Blocking, and

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Waterproofing with Appropriate Test Methods.

L. MIL-R-3593, Refrigeration and Cooling Equipment (Excluding Household Refrigerators), Packaging of.
M. Federal Specification BB-F-1421, Fluorocarbon Refrigerants.
N. FED STD 101B, Methods 5007, 5019, Preservation, Packaging, and Packing Materials Test Procedures.
O. HEL-STD-S-1-63B, Maximum Noise Level for AMC Equipment.
P. National Sanitation Foundation Standard No. 12, Automatic Ice-Making Equipment.
Q. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. ASHRAE Standard 29-63. Methods of Testing and Rating Ice Makers.
R. Underwriters' Laboratories, Inc. UL 563-1966, Standards for Safety, Ice Makers.
S. Underwriters' Laboratories, Inc. UL 207(c) 1967. Standards for Safety, Refrigeratant-Containing Components.
T. Air Conditioning and Refrigeration Institute Standard 210-66 Unitary Air-Conditioning Equipment.
U. USA Standards Institute:

1) B 9.1-1964, Safety Code for Mechanical Regrigeration.
2) S1.4, General Purpose Sound Level Meters.
3) S1.6, Preferred Frequencies for Acoustical Measurement.
4) Z24.10, Octave Band Filter Set for Analysis of Noise and other Sounds.

V. USAGETA Document, Human Factors Evaluation Data for General Equipment (HEDGE).
W. MTP 10-2-500, Physical Characteristics.
X. MTP 10-2-501, Operator Training and Familiarization.
Y. MTP 10-2-503, Transportability (General Supplies and Equipment).
Z. MTP 10-2-505, Human Factors Evaluation.
AA. MTP 10-2-507, Maintenance Evaluation.

5. SCOPE

5.1 SUMMARY

This document describes the following engineering inspections and tests to be made in evaluating ice making equipment:

a. Preparation for Test - A visual inspection of the as-received condition of the test item and accessories, and measurement of the weight and overall physical dimensions of the test item and accessory equipment and operator training and familiarization procedures.

b. Functional Performance - An evaluation to determine the ice quality and ice making capacity of the test item under various environmental conditions, length of time required for "pull down", heat insulation efficiency, and "start-up freeze" (for flake ice makers only).

c. Defrosting - A determination of the ease of defrosting the test item.

d. Electromagnetic Compatibility - An evaluation of the amount of conducted, induced or radiated electrical distrubance generated by the test item during operation.

e. Environmental Tests - An evaluation of the ability of the test item to withstand storage temperature extremes, high altitude, fungus and salt fog.

f. Effects of Water Quality - An evaluation to determine the effects of impurities in the water, on the performance of the test item.

g. Transportability - An evaluation to determine the ability of the test item, and its accessories, to be transported by land, sea and air without damage.

h. Maintenance Evalaution - That portion of the test which is concerned with the following: verification and appraisal of failures; determination and appraisal of maintenace requirements; appraisal of design-for-maintenance; appraisal of the maintenance test package; and, calculation of indicators which express the effects of the preceding aspects.

i. Safety - An evaluation to determine whether the test item contains any safety hazards.

j. Human Factors Evaluation - An evaluation of the man-item relationship during operation, maintenance and transport of the test item, including the noise level generated, and design deficiencies which affect operability.

k. Value Analysis - An evaluation to determine whether the test item contains unneccessary, costly or "nice-to-have" features which could be eliminated without affecting technical performance or safety.

5.2 LIMITATIONS

These procedures are limited to overall performance tests on air, or water-cooled, self-contained, automatic, electric-powered, ice makers having a maximum rating, under standard conditions, of 3000 pounds of cube or flake ice in 24 hours, and using one of the flourocarbon refrigerants (Freons) covered by Federal specification BB-F-1421.

6. PROCEDURES

NOTE: 1. The techniques used in the installation, operation and use of the test item, and the associated test equipment and measuring and recording devices, will be those described in the applicable manufacturer's instruction manual, or draft technical manual. Any change or deviation from these techniques will be recorded in the test item log book.

2. The following safety precautions shall be observed at all times during the use and handling of the test item:

a) Disconnect the electrical power supplied to the test item before performing maintenance or wiring of electrical components. Failure to observe this warning may result in serious injury or death.

b) Avoid bodily contact with liquid refrigerant, and avoid inhaling refrigerant vapor. If refrigerant

vapor is inhaled, immediately inhale fresh air. Be especially careful that refrigerant does not contact the eyes.

c) In case of refrigerant leaks, ventilate the area immediately.

d) Do not do any brazing or soldering, and do not use a halide torch for refrigerant leak testing, if there is the slightest possibility that hot copper, or a torch flame, will come in contact with large quantities of fluorocarbon refrigerant vapors, such as R-12, R-22, R-500, or R-502 refrigerant vapors, because under these conditions, phosgene gas is formed. This gas is a DEADLY POISON. Always pump down the unit, or open up that portion of the refrigerant system which is being worked on, and purge it of refrigerant, before brazing or soldering.

e) Unless permitted in the manufacturer's instructions, do not use a forklift to lift or move the test item, unless it is mounted on a raised base platform. Failure to observe this precaution may cause the test item frame to buckle and cause it to overturn.

f) Be certain that, when lifting the test item, the capacity of the lifting device is adequate. Do not allow the test item to swing while suspended from a lifting device. Failure to observe this warning may result in injury to personnel and damage to the test item.

g) Never start the refrigeration unit before making certain that all service valves are open in accordance with operating instructions.

6.1 PREPARATION FOR TEST

6.1.1 Initial Inspection

Upon receipt of the test item at the test site, the test item shall be subjected to the following:

a. Visually inspect the test item package(s) and record the following:

1) Evidence of packaging damage or deterioration
2) Identification markings, including:

a) Name of contractor
b) Date of manufacture
c) Other markings pertaining to the test item

b. Weigh and measure the individual package(s) of the test item and its accessories and record the following:

1) For each shipping package:

a) Contents
b) Weight
c) Length, width and height
d) Cubage

2) For the entire test item:

a) Weight
b) Cubage

c. Unpack the test item, visually inspect it, and record the following, as applicable:

NOTE: Make use of photographs, diagrams and narration to indicate the condition of the test item and its accessories, as applicable.

1) Evidence of defects in:

a) Manufacturing
b) Material
c) Workmanship

2) Evidence of damage.
3) Evidence of wear.
4) Evidence of refrigerant leakage, using an electronic leak detector.

d. Observe and record the presence of instruction plates, and their adequacy, including:

1) Identification, name and serial number.
2) Caution instructions.
3) Installation and service instructions.
4) Refrigerant identification number (R-12, R-22, etc.) and refrigerant charge in pounds.
5) Horsepower rating of the refrigerant compressor and the water pump.
6) Electrical rating.
7) Maximum allowable ambient air and supply water temperatures.

e. Observe and record the presence of descriptive technical literature.
f. Observe and record whether those requirements of the following standards, which can be verified by visual inspection, are met:

Test Item	Standard
Refrigeration unit	ARI Standard 1110 and UL 207
Ice Maker	ASHRAE Standard 29-63 & UL 563-1966

g. Observe and record the condition of all test unit controls and indicators.

h. Rotate the condenser cooling fan and record any lack of freedom of movement.

6.1.2 Physical Characteristics

Determine the physical characteristics of the test item as described in the applicable sections of MTP 10-2-500, including the following:

a. For externally-mounted ice storage bins, if applicable.

1) Weight
2) Overall length, width, and height
3) Cubage

b. Diameter or width and height, and length of ice-conveyer ducts, if applicable.

6.1.3 Operator Training and Familiarization

Test personnel shall receive training and familiarization in accordance with applicable sections of MTP 10-2-501 and the following:

a. All members of the test team shall be instructed in the safety precautions to be followed in the installation, operation and maintenance of the test item. Copies of all technical manuals and safety instructions shall be issued, and the purpose and methods of testing will be described.

b. Record the adequacy of the manuals for training purposes.

c. Record personnel data as required by MTP 10-2-501 and the amount of time and type of training or familiarization required for each member of the test team.

6.1.4 Installation and Pre-Operational Inspection

Install the test item as directed in the draft technical manuals and perform the following:

a. Be certain that suitable drainage, through piping, to building plumbing or sump has been installed to take care of all condenser and make-up water discharge.

b. Verify that the test item is mounted in a vertical position on a floor or foundation which is out of horizontal not more than 5 degrees, unless otherwise specified. If the flooring is uneven, it may be necessary to shim the test item at support points. Use mounting pads or vibration eliminators when necessary.

c. Verify that all condenser cooling air discharge plenums and ductwork connections are air tight.

d. Check condenser cooling fan belt tension and alignment, and adjust as required.

e. Verify that all electrical wiring to the test unit meets the requirements of the National Electric Code.

f. Verify that all tools, rags, etc. have been removed from the unit.

g. Verify that all liquid line valves in the refrigerant circuit are open.

h. Verify that the oil level can be seen in the sight glass of the compressor crankcase.

i. Verify that the make-up water discharge piping meets all plumbing codes, and that there is no possibility that make-up water will "back-siphon" to the supply source in case the make-up water to flood over the sump pan level, if the water pump continues running.

j. Make certain that the strainer is used at the entrance to the machine to keep foreign particles in the supply lines from interfering with the operation of the water regulating valve.

k. Verify that a clearly legible permanent type of instruction plate or label is affixed to the test item, outlining the manufacturer's recommended procedures for cleaning and sanitizing. This plate or label shall be located in a place which is convenient to the person servicing the unit.

l. Verify that none of the nozzles which are used to distribute make-up water over the evaporator surfaces are clogged. An inadequate supply of make-up water to any portion of the evaporator surface may cause that portion of the surface to build up an excessive layer of ice, which could eventually cause complete main evaporator freeze-up.

m. Verify that duct work to and from the condenser, when specified, is installed according to manufacturer's specifications.

n. Verify that the "full-ice-bin" controls are functioning properly.

o. Record all discrepancies observed and measures taken to correct these discrepancies.

6.2 TEST CONDUCT

NOTE: Report all equipment failures in accordance with USATECOM Regulation 705-4.

6.2.1 Functional Performance - Batch Type Machines

6.2.1.1 Preparation for Test

a. Install all components of the test item in accordance with the manufacturer's instructions:

NOTE: Any water line filters, storage bin or hopper doors, access panels or doors, ice chutes or pipes, storage bin thermostats or other means for shutting down the test item when the bin is full, and other regularly-furnished components and equipment shall be used during the test.

b. Verify that the test item is mounted on a surface having an inclimation of not more than 5 degrees from the horizontal, unless otherwise specified.

c. Install water flow meters to measure the following:

1) Flow in the make-up water line
2) Flow in the condenser water line, if applicable

d. Install voltmeter, ammeter, wattmeter and watt-hour meter in the test item electric power supply.

e. Spin the fan blade on air-cooled models to see that it spins freely.

6.2.1.2 Standard Rating Evaluation

NOTE: Throughout this test, the supply water temperature shall be 70°F., and the ambient air conditions, including condenser inlet air on air-cooled units, shall be 90°F. Dry Bulb and 75°F. Wet Bulb. The barometric pressure shall be 29.92 ± 1.0 inches Hg. The test item shall be exposed to these conditions for a minimum period of 2 hours before starting the test. Unless otherwise specified, the potential at the connections to the supply circuit shall be at rated voltage and frequency.

6.2.1.2.1 Initial Run - Perform the following:

a. Set the controls at the settings specified by the manufacturer to produce the largest size of ice cubes which the test item is designed to produce and start up the test item.

b. Check that proper liquid flow appears in the refrigerant sight glass.

c. Allow the test item to run for two complete ice-making and ice harvesting cycles, including blow-down, after the last test item adjustments have been made.

NOTE: This procedure, which will hereinafter be referred to as the "initial run" period, shall terminate at the start of the third ice-making cycle.

d. Measure and record the following:

1) Length of initial run
2) Operating voltage and amperage

6.2.1.2.2 Test Run - Perform the following:

a. Record the following at the start of the third ice-making cycle:

NOTE: The start of the third ice-making cycle will hereinafter be referred to as the start of the test period.

1) Time at start of run
2) Watt-hour meter reading
3) Water meter reading(s) for:

a) Make-up water system
b) Condenser cooling water system, if applicable

b. Run the test item for a period of not less than four complete ice-making and ice-harvesting cycles. During this test period, perform the following:

1) Place the large-sized wire basket directly below the ice discharge opening leading to the storage bin, and catch the entire amount of ice discharged during one complete ice harvesting period.
2) Weigh the wire basket and its contents, and determine and record the weight of the ice by subtracting the predetermined weight of the wire basket.
3) Measure, observe and record the shape, clarity and the overall dimensions of an ice cube selected from the ice harvested.
4) At the end of this test period observe and record the following:

a) Time at the end of the run
b) Watt-hour meter reading
c) Water meter reading(s) for:

(1) Make-up water system
(2) Condenser cooling water system, if applicable

c. Measure and record the BTU per pound quality of the ice harvested from each ice-making cycle as follows:

1) Measure and record the ambient room temperature at the start of the test and designate it as T_R.

NOTE: Room temperature shall be maintained at a constant ambient temperature of approximately 80°F.

2) Take an approximately 1.000 lb. sample of water from a receptacle containing water maintained at a temperature of approximately 115°F and pour it into the thermos bottle. Measure and record the weight and temperature of this water, and designate them as W_1 and T_1, respectively, in pounds and degrees F.

NOTE: The weight of the water and ice shall be weighed to the nearest one-thousandths of a pound.

3) Remove a sample of ice from the first ice-harvest cycle using the small wire basket and add approximately 0.600 lb. of ice to the water in the thermos bottle.

NOTE: The thermos bottle cap is not to be used during the test.

4) Weigh and record the combined weight of the water and ice, and designate this combined weight as W_2, in pounds.

5) Stir the water-and-ice mixture vigorously with a plastic rod until all of the ice has completely melted. Measure and record the lowest temperature reached, and designate this temperature as T_2 in degrees F.
6) Determine and record the temperature difference between T_1 and T_R, in degrees F., and designate this temperature difference as $\triangle$ 1.
7) Determine and record the temperature difference between T_R and T_2, in degrees F., and designate this temperature difference as $\triangle$ 2.
8) If the values of $\triangle$ 1 and $\triangle$ 2 differ by more than 10°F., repeat steps 1) through 7), using different weights of ice, (W_1) until the values of $\triangle$ 1 and $\triangle$ 2 differ by no more than 5°F. to 10°F. When this condition occurs, designate it as the calibration condition test.
9) Repeat steps 1) through 8) on two successive ice harvests (a total of three tests to be made).

d. Repeat step a through c with the controls set to produce the smallest size of ice cube for which the test item is designed.

e. At the end of the test described under step d stop the ice maker and inspect the make-up water circuit inside the test item, including the water sump pan. Record any evidence of salt or mineral deposits on any evaporator, water sump, or water discharge surfaces.

f. With the ice-making controls set in the OFF position, set the controls to the manual flushing position and observe and record whether the make-up water pump flushing system operates properly.

6.2.1.3 High Temperature Rating Evaluation

Repeat the procedures of paragraphs 6.2.1.2.1 and 6.2.1.2.2 steps a through c under the following conditions, unless otherwise specified:

a.	Air temperature surrounding unit	115°F. D.B., 95°F. wet bulb
b.	Water temperature entering unit (make-up water and/or condenser)	80°F.

6.2.1.4 Low Temperature Rating Evaluation

Repeat the procedures of paragraphs 6.2.1.2.1 and 6.2.1.2.2 steps a through c under the following conditions unless otherwise specified:

a.	Air temperature surrounding unit	45°F. D.B.
b.	Water temperature entering unit (make-up and/or condenser)	40°F.

6.2.1.5 "Pull Down" Test

NOTE: Throughout this test, the supply water temperature shall be 80°F., the condenser water outlet temperature (on water-cooled units) shall be 100°F. and the ambient air temperature shall be 104°F., unless otherwise specified.

a. Expose the test item to the specified ambient air temperature for 12 hours in its unoperating condition.

b. Start up the test item with the controls set to produce the largest size ice cube for which it is designed, and record the starting time.

c. During the test run, measure and record the following at 15 minute intervals:

1) Water temperature of:

a) Make-up water
b) Condenser water, if applicable at:

(1) Inlet
(2) Outlet

2) Ambient air temperature:

a) Dry bulb
b) Wet bulb

d. Using a wire basket, collect the ice produced in each ice-harvesting cycle and perform the following:

1) Measure and record the weight of ice produced
2) Determine and record the BTU per pound quality of the ice using the procedures of step c of paragraph 6.2.1.2.2.

e. Run the test item until it starts discharging the largest size ice cube and the weight of the ice-harvest cycle equals that produced during step b of paragraph 6.2.1.2.2 and also has the same BTU quality. Record the time required before this happens.

NOTE: Unless otherwise specified the time for "pull down" shall not exceed 4 hours.

6.2.1.6 Heat Insulation Efficiency

NOTE: Throughout this test, the supply water temperature shall be 60°F., the condenser water outlet temperature (on water-cooled units) shall be 80°F., and the ambient air temperature shall be 80°F. D.B., 75°F. W.B.

a. Start up the test item with the controls set to produce the

largest size ice cube for which it is designed, and record the starting time.

b. Run the test item continuously for 4 hours, and note and record whether any condensed water drips, runs, or blows off from the unit casing and/or the ice storage bin.

6.2.1.7 High Altitude

NOTE: This test shall be performed only on those test items which are equipped with controls having operating point settings which are sensitive to variations in barometric pressure.

a. Repeat the procedures of paragraph 6.2.1.2 at a reduced barometric pressure of 24.90 Hg (This is the standard barometric pressure which exists at an altitude of 5000 feet above sea-level).

b. Observe and record any change(s) required in the operating settings of the controls.

c. Record changes observed in the test item performance.

6.2.2 Functional Performance - Continuous Type Machines

6.2.2.1 Preparation for Test

Prepare the item for test as described in 6.2.1.1.

6.2.2.2 Standard Rating Evaluation

NOTE: See NOTE of paragraph 6.2.1.2 for environmental conditions.

a. Set the controls as specified by the manufacturer and start up the test item.

b. Allow the test item to run for 2 hours after the last test item adjustments have been made. Measure and record the exact duration of this "initial run".

c. At the begining of the test period which begins immediately after the "initial run" period, place one of the large wire baskets directly below the ice discharge opening leading to the storage bin.

d. Observe and record the following at the begining of the test period:

1) Time at start of run
2) Watt-hour meter reading
3) Water meter reading(s) for:

a) Make-up water
b) Condenser cooling water, if applicable

e. Run the test item for exactly 2 hours and during this 2 hour test period, catch the ice discharged during a 15 minute period until 8 weighings have been made. Have an empty wire basket ready to be put in place immediately after a full wire basket is removed, taking care not to lose any of the ice being discharged during the basket transfer.

f. Weigh each wire basket and its contents, and determine and record the weight of the ice by subtracting the predetermined weight of the wire basket.

g. At the end of the 2 hour test period, observe and record:

1) Time at end of run
2) The watt-hour meter reading
3) Water meter reading(s) for:

a) Make-up water
b) Condenser cooling water system, if applicable

h. Determine the BTU per pound quality of samples of ice taken from any three 15 minute catching intervals by performing the procedures of step c of paragraph 6.2.1.2.2.

i. At the end of the two hour test period stop the ice maker, inspect it and perform the manual flushing test as described in steps e and f of paragraph 6.2.1.2.2.

6.2.2.3 High Temperature Rating Evaluation

Repeat the procedures of paragraph 6.2.2.2 under the following conditions unless otherwise specified:

a.	Air temperature surrounding unit	115°F. D.B.
b.	Water temperature entering unit (Make-up and/or condenser water)	80°F.

6.2.2.4 Low Temperature Rating Evaluation

Repeat the procedures of paragraph 6.2.2.2 under the following conditions unless otherwise specified:

a.	Air temperature surrounding unit	45°F.
b.	Water temperature entering unit (Make-up and/or condenser water)	40°F.

6.2.2.5 "Pull Down" Test

a. Expose the test item for 12 hours in its unoperating condition to an ambient air temperature of 104°F.

NOTE: See NOTE of paragraph 6.2.1.5 for test conditions to be used.

b. Start up the test item and record the start time.
c. Observe and record the following at 15 minute intervals.

1) Water temperature of:

a) Make-up water
b) Condenser water, if applicable at:

(1) Inlet
(2) Outlet

2) Ambient air temperature:

a) Dry bulb
b) Wet bulb

d. Using a wire basket, collect the ice produced in a 15 minute period and perform the following:

1) Measure and record the weight of the ice produced.
2) Determine and record the BTU per pound quality of the ice using the procedures of step c of paragraph 6.2.1.2.2.

e. Run the test item until the ice produced per 15 minute interval equals that produced during the test procedures of paragraph 6.2.2.2 and also has the same BTU quality. Record the time required before this happens.

6.2.2.6 Heat Insulation Efficiency Test

Subject the test item to the procedures of paragraph 6.2.1.6.

6.2.2.7 High Altitude Test

NOTE: This test shall be performed only on those test items which are equipped with controls having operating point settings which are sensitive to variations in barometric pressure.

a. Repeat the procedures of paragraph 6.2.2.2 at a reduced barometric pressure of 24.90 Hg.
b. Observe and record any change(s) required in the operating settings of the controls.
c. Record changes observed in the performance of the test item.

6.2.2.8 "Start-up Freeze"

a. Perform the Initial Run test described in 6.2.2.2 steps a and b.
b. After the initial run test, allow the test item to run until the storage bin is full. Observe and record whether the test item shuts down automatically when this happens.
c. Remove a large amount of ice from the storage bin, and observe and record whether the test item jams up upon start up.

6.2.3 Defrosting

At the completion of the functional performance test defrost the test item and record defrosting difficulties, if any.

6.2.4 Electromagnetic Compatibility

Determine the electromagnetic compatibility of the test item with other equipment by subjecting it to the test procedures for type IIB equipment as described in MIL-STD-461, except that the need for radio interference measurements may be varied if the following conditions exist:

a. All motors in the test item are squirrel-cage type induction electric motors.
b. The electrical switching transients can be exempted as short-duration interference.

6.2.5 Environmental Tests

6.2.5.1 Altitude Test

a. Subject the test item to the high altitude exposure prescribed by Procedure II, Method 500 of MIL-STD-810B.
b. At the completion of the exposure period perform the following:

1) Visually inspect the test item and record any evidence of damage.
2) Determine if there is any leakage of the refrigerant.
3) Repeat the procedures of the Standard Rating Evaluation (paragraph 6.2.1.2 or 6.2.2.2 as applicable) and record any changes in the test item operating characteristics.

6.2.5.2 High Temperature Test

a. Subject the test item to the high temperature exposure prescribed by Procedure I, Method 501 of MIL-STD-810B.
b. Repeat step b of paragraph 6.2.5.

6.2.5.3 Low Temperature Test

a. Subject the test item to the low temperature exposure prescribed in Procedure I, Method 502 of MIL-STD-810B.
b. Repeat step b of paragraph 6.2.5.1.

6.2.5.4 Humidity Test

a. Subject the test item to the humidity exposure prescribed by Procedure I, Method 507 of MIL-STD-810B.
b. Inspect the test item and record evidence of corrosion.
c. Repeat step b of paragraph 6.2.5.1.

6.2.5.5 Fungus Test

a. Subject the test item to the conditions of the fungus test prescribed in Method 508 of MIL-STD-810B.

b. At the completion of the exposure period, perform the following:

1) Visually inspect the test item and record evidence of fungus growths.
2) Repeat the procedures of the Standard Rating Evaluation (paragraph 6.2.1.2 or 6.2.2.2, as applicable) after cleaning the test item, and record changes in the test item operating characteristics, if any.

6.2.5.6 Salt Fog Test

a. Subject the test item to the conditions of the salt fog test as described in Method 509 of MIL-STD-810B.

b. Inspect the test item and record evidence of corrosion.

c. Repeat step b of paragraph 6.2.5.1.

6.2.6 Effects of Water Quality

a. At the discretion of the test director, subject the test item to extended operation using water to which salts, minerals, and/or gases have been added to simulate the most severe kind of water "hardness" (corrosiveness) to be encountered in the field.

NOTE: Common impurities found in water, include $CaSO_4$, $CaCO_3$, $MgCl_2$, $MgSO4$, $CaCl_2$, $MgCO_3$, NaCl, CO_2, and O_2.

b. During the test periodically inspect the test item for evidence of corrosion or scale formation, as applicable.

c. Record the following:

1) Composition of impurities in the water being used
2) Temperature of input water
3) Evidence of corrosion or scale formation, as applicable

6.2.7 Transportability

a. Prepare the test item for transport as directed in the draft technical manual and subject it to the applicable sections of MTP 10-2-503.

b. Upon completion of each phase of testing perform the following:

1) Inspect the test item and record evidence of damage, mechanical binding or looseness and leaks in the refrigerator system.
2) Repeat the procedures of the Standard Rating Evaluation (paragraph 6.2.1.2 or 6.2.2.2, as applicable) and record changes in the test item operating characteristics, if any.

6.2.8 Maintainability and Reliability Evaluation

Evaluate the maintenance-related factors of the test item as described in MTP 10-2-507 with emphasis on the following:

a. Organizational, Direct Support (DS), and General Support (GS) Maintenance requirements.
b. Operator through General Support Maintenance Literature.
c. Repair parts.
d. Tools.
e. Test and handling equipment.
f. Calibration and maintenance facilities.
g. Personnel skill requirements.
h. Maintainability.
i. Reliability.
j. Availability.

6.2.9 Safety

a. Test personnel will observe the proper safety precautions during testing, and will record any condition that might present a safety hazard, the cause of the hazard, and steps taken to alleviate the hazard.
b. Test personnel shall observe and record the absence of any of the following safety features:

1) Electrical parts shall be so located, or enclosed, that suitable protection against accidental contact with uninsulated energized circuits is provided.
2) All internal wiring shall be protected against heat and contact with moving parts.
3) Where connections are made to internal wiring, a barrier-type terminal board, or equivalent, shall be used to secure lead attachment, and to give protection against accidental contact of leads attached adjacent to each other.
4) Where line cords are used, they shall be of sufficient current-carrying capacity, shall be protected against rubbing at access ports by insulated bushings, and shall be sufficiently strain-relieved to withstand approximately five pounds of pull.
5) Where line fuses are used, they shall be of a value consistent with the requirements of the test item.
6) Where switches are used, they shall be of sufficient current capacity, and mounted so as not to allow movement.
7) All metal parts shall be electrically-bonded and grounded, to prevent static electricity build-up.
8) The materials used in the motors shall be inherently non-flammable and non-explosive.
9) Where the normal operating temperature of the motor(s) is such that a burn may be caused on physical contact, the motor shall have a plate attached to it, stating this fact.
10) All moving parts of the test item shall be enclosed to

prevent accidental contact with them when the test item is in its operating position.

11) All propellers or impellers shall be securely attached to the motor shafts.
12) All external surfaces, and all internal surfaces exposed during maintenance, shall have no sharp edges.
13) Where a thermal overload is provided for a motor, it shall be tested for operation, and the method of reset (manual or automatic) shall be verified.
14) The blades of impellers, and shafting, shall be sufficiently strong, and designed with adequate clearance, to prevent contact with casings, or to prevent distortion under conditions of deposit loading or other factors.
15) When the test item is to be installed in areas containing explosive vapors, all rotating fan structures shall be made of non-ferrous, or other non-sparking materials, and all arcing electrical devices such as contactors shall be mounted inside vapor-proof housings.
16) Where capacitors are used, they shall be housed in a suitable enclosure, which will provide protection, and which will also prevent the emmission of flame or molten material, in the event of a failure.
17) Where the test item is equipped with internal heaters, they shall be protected against overheating in the event of an air flow failure.
18) The refrigeration system shall be equipped with pressure safety valves, particulary on the high side of the compressor.
19) Condensation cooling surfaces shall be non-corrosive.
20) The means of collecting, storing, or disposing of condensate shall be such that its function is unimpeded by other internal elements.
21) Note whether the test contains provisions to detect excessively-low temperatures, and to stop compressor operation when this occurs, thereby preventing complete freeze-up of the evaporator coil.

c. Check that there are no ground currents in the frame, ducting, etc.

6.2.10 Human Factors Evaluation

Throughout the test evaluate the effectiveness and characteristics of the man-item interaction as related to human factors by performing the applicable sections of MTP 10-2-505 and the following:

6.2.10.1 General Considerations

a. Prepare task/item checklists to evaluate the human factors characteristics using the criteria of Human Factors Evaluation Data for General Equipment (HEDGE) Class III C equipment and including the following considerations:

1) Operability

a) Controls and indicators - location (easy to operate or read), markings (clearly marked for function), sufficient to maintain proper control of the test item.
b) Ease of controlling and adjusting the test item when installed and operating.

2) Maintainability:

a) Detection of malfunction and determination of cause
b) Access to defective component
c) Replacement and/or repair of defective part
d) Adjustment and routine maintenance of test item

3) Transportability:

a) Test item supplied with handles or other lifting attachments for movement.
b) Removal of internal and external components required prior to transport.

b. Evaluation of the tasks of step a shall include but not be limited to the following:

1) Title of task
2) Adequacy of instructions and tools to perform task
3) Ease of performing task
4) Design of test item as it affects the task
5) Time required to perform task
6) Personnel required for task

6.2.10.2 Noise Evaluation

Following the procedures of HEL-STD S-1-63B use a sound level meter and octave band filter set to measure and record the noise level in each band at measuring stations located at approximately 20° intervals in a horizontal plane with a radius of 3 feet and the test item at the center as follows:

NOTE: 1. No measurements shall be taken at those locations facing the case surface which are within 30° on each side of a line drawn perpendicular to the case surface.
2. Noise measurements may be made while the test item is in the test set-up of paragraph 6.2.1, or 6.2.2 as applicable, if ambient noise levels are sufficiently low. If the test item is normally used without ducting, it may be tested in a reverberant or semi-reverberant room. The room may also be used for a test item which normally has ducting, if the assemblage can be fitted into the room. In any case, the location of the test will be dictated by the requirements of the test item and the ambient noise conditions. When a room is used, the test item should be mounted on a non-resonant stand in the geometric center of the room, at least six feet from any sound relecting

surfaces. Where possible, as with a room, the measuring equipment should be remotely located.

a) With the test item operating
b) Without the test item operating (ambient noise level)

6.2.11 Value Analysis

During the conduct of all tests, the test personnel will observe and record any unnecessary, costly, or nice-to-have features of the test item which can be eliminated without adversely affecting performance, safety or durability.

6.3 TEST DATA

6.3.1 Preparation for Test

6.3.1.1 Initial Inspection

Record the following:

a. Evidence of package damage or deterioration
b. Identification markings

1) Name of contractor
2) Date of manufacture
3) Other pertinent markings

c. For each package record the following:

1) Weight in pounds
2) Length, width, and height in feet
3) Cubage in ft^3
4) Package contents

d. For the entire test item:

1) Weight in pounds
2) Cubage in ft^3

e. For the unpackage test item:

1) Evidence of defects in:

a) Manufacturing
b) Materials
c) Workmanship

2) Evidence of damage
3) Evidence of wear
4) Evidence of refrigerant leakage

f. Presence of instruction plates and their adequacy, including:

1) Identification, name and serial number.
2) Caution instructions.
3) Installation and service instructions.
4) Refrigerant identification number (R-12, R-22, etc.) and refrigerant charge in pounds.
5) Horsepower rating of the refrigerant compressor and the water pump.
6) Electrical rating.
7) Maximum allowable ambient air and supply water temperatures.

g. Presence of descriptive technical literature
h. Whether standards were met
i. Condition of all test unit controls and indicators
j. Any lack of freedom in movement of condenser cooling fan

6.3.1.2 Physical Characteristics

Record the following:

a. Data required by MTP 10-2-500
b. For any externally mounted ice storage bin, if applicable:

1) Weight in pounds.
2) Overall lenth, width, and height, in feet.
3) Cubage in ft^3.
4) Diameter, or width and height and length of ice conveyor, in inches ducts.

6.3.1.3 Operator Training and Familiarization

Record the following:

a. Adequacy of the manuals for training purposes
b. Personnel data as required by MTP 10-2-501

6.3.1.4 Installation and Pre-Operational Inspection

Record the following:

a. Descrepancies in the operational condition of the test item components.
b. Measures taken to correct descrepancies.

6.3.2 Test Conduct

6.3.2.1 Functional Perfomance - Batch Type Machines

6.3.2.1.1 Standard Rating Evaluation -

Record the following:

a. Ambient room conditions:

1) Barometric pressure in inches of Hg
2) Dry bulb temperature in °F
3) Wet bulb temperature in °F

b. Temperature of supply water in °F.
c. Duration of temperature conditioning period in hours.
d. Length of "initial run" in minutes.
e. Setting of all refrigerant flow and ice making controls at the beginning of the test run (large or small cube, etc.).
f. Operating voltage in volts.
g. Operating Amperage in amps.
h. Instrument readings at the start and completion of the test run:

1) Time
2) Watt-hours
3) Water meter in gallons for:

a) Make-up water
b) Condenser water, if applicable

i. For each ice harvest cycle:

1) Weight of ice produced
2) Shape, clarity and dimensions of ice samples

j. For BTU quality of the ice:

1) Ambient room temperature of test room in °F
2) For water in thermos:

a) Weight in pounds
b) Temperature in °F

3) Weight of ice sample in pounds
4) Temperature of water after ice has melted in °F

k. Any evidence of salt or mineral deposits on evaporator, water sump or other make-up water system surfaces.
l. Effectiveness of the manual flush system.

6.3.2.1.2 High Temperature Rating Evaluation -

Record data as described in paragraphs 6.2.1.2.1 and 6.2.1.2.2 steps a through c.

6.3.2.1.3 Low Temperature Rating Evaluation -

Record data as described in paragraphs 6.2.1.2.1 and 6.2.1.2.2, steps a through c.

6.3.2.1.4 "Pull Down" Test -

Record the following:

a. Length of temperature conditioning period in hours.
b. Test item control settings.
c. Test conditions (measured at 15 minutes intervals):

1) Water temperature in °F:

a) Make-up water
b) Condenser water, if applicable at:

(1) Inlet
(2) Outlet

2) Ambient air temperature in °F:

a) Dry bulb
b) Wet bulb

d. For each ice-harvest cycle:

1) Weight of ice produced in pounds
2) BTU quality as described in step c of paragraph 6.2.1.2.2

e. Time required for test item to start producing ice of the quality generated in the Standard Rating Test of paragraph 6.2.1.2.2 in hours.

6.3.2.1.5 Heat Insulation Efficiency Test -

Record the following:

a. Control settings of the test item
b. Length of the test run in hours
c. Whether any condensed water drips, runs, or blows off from the test item casing, and/or the ice storage bin.

6.3.2.1.6 High Altitude Test -

Record the following:

a. Test item control settings
b. Barometric pressure in inches of Hg
c. Operation data as described in paragraph 6.2.1.2
d. Changes required in test item control setting, if any
e. Changes observed in the test item performance

6.3.2.2 Functional Performance - Continuous Type Machines

6.3.2.2.1 Standard Rate Evaluation -

Record the following:

a. Ambient room conditions.

1) Barometric pressure in inches of Hg
2) Dry bulb temperature in °F
3) Wet bulb temperature in °F

b. Temperature of supply water in °F.
c. Duration of temperature conditioning period in hours.
d. Length of "initial run" in hours.
e. Setting of all refrigerant flow and ice making-controls at the end of the "control run".
f. Operating voltage in volts.
g. Operating amperage in amps.
h. Instrument readings at the start and completion of the test run:

1) Time
2) Watt-hours
3) Water meter in gallons for:

a) Make-up water
b) Condenser water, if applicable

i. Weight of ice collected in each 15 minute interval in pounds.
j. For BTU quality of the ice:

1) Ambient room temperature of the test room in °F
2) For water in thermos:

a) Weight in pounds
b) Temperature in °F

3) Weight of ice sample in pounds
4) Temperature of water after ice has melted in °F

k. Evidence of salt a mineral deposits on evaporator, water sump or other make-up water system surfaces.
l. Effectiveness of the manual flush system.

6.3.2.2.2 High Temperature Rating Evaluation -

Record data as described in paragraph 6.2.2.2

6.3.2.2.3 Low Temperature Rating Evaluation

Record data as described in paragraph 6.2.2.2

6.3.2.2.4 "Pull Down" Test

Record the following:

a. Length of temperature conditioning period in hours.
b. Test item control setting.
c. Test conditions (measured at 15 minute intervals):

1) Make-up water
2) Condenser water, if applicable at:

a) Inlet
b) Outlet

d. For ice produced in a 15 minute period:

1) Weight in pounds.
2) BTU quality as described in step c of paragraph 6.2.1.2.2

e. Time required for test item to start producing ice of the quality produced in the Standard Rating Test of paragraph 6.2.2.2 in hours.

6.3.2.2.5 Heat Insulation Efficiency Test -

Record data as described in paragraph 6.2.1.6

6.3.2.2.6 High Altitude Test -

Record the following:

a. Test item control settings
b. Barometric pressure in inches of Hg
c. Operation data as described in paragraph 6.2.2.2
d. Changes required in the test item control settings, if any
e. Changes observed in the test item performed

6.3.2.7 "Start-up Freeze"

Record the following:

a. Test item control settings
b. Malfunction of shut down control, if any
c. Jamming of test item upon start up, if any

6.3.2.3 Defrosting

Record difficulties in defrosting, if any

6.3.2.4 Electromagnetic Compatibility

Record data as required by MIL-STD-461, for type II B equipment

6.3.2.5 Environmental Tests

Record the following:

a. For all tests:

1) Environmental test being performed (Altitude, high temperature, low temperature, humidity, fungus or salt fog).
2) Visable evidence of damage, if any.
3) Data collected or described in paragraph 6.2.1.2 or 6.2.2.2, as applicable.
4) Changes observed in the test item performance.

b. Evidence of refrigerant leakage (for altitude, high temperature, low temperature, humidity, and salt fog tests.
c. Evidence of corrosion (for humidity and salt fog tests).
d. Evidence of fungus growths (for fungus test).

6.3.2.6 Effects of Water Quality

Record the following:

a. Composition of impurities in the water being used
b. Temperature of input water
c. Evidence of corrosion or scale formation, as applicable

6.3.2.7 Transportability

Record data as required by MTP 10-2-503 and the following:

a. Evidence of damage, mechanical binding or looseness.
b. Data collected as described in paragraph 6.2.1.2 or 6.2.2.2 as applicable.

6.3.2.8 Maintainability and Reliability Evaluation

Record data as described in MTP 10-2-507

6.3.2.9 Safety

Record the following:

a. Absence of any required safety features
b. Evidence of ground currents in the frame, ducting, etc.

6.3.2.10 Human Factors Evaluation

a. Record the following:

1) Data as described in the applicable sections of MTP 10-2-505
2) For noise level measurements:

a) Operating condition of the test item (operating not operating).
b) Location of measurement.
c) Noise level in each band.

b. Retain completed HEDGE checklist

6.3.2.11 Value Analysis

Record any features or components of the test item which could be eliminated without compromising the safety, performance, or durability of the test item.

6.4 DATA REDUCTION AND PRESENTATION

6.4.1 General

Summarize all data using tabulations and/or charts, as applicable. The data will be analyzed to determine the extent the test item and maintenance package meet the requirements of the QMR's, SDR's, and TC's for the test item. All photographs should be properly identified.

A Safety Release Recommendation shall be submitted in accordance with USATECOM Regulation 385-6 based on the data collected related to safety.

6.4.2 Ice Quality Evaluation

Determine the quality of the ice Q in BTU per pound as follows:

$$Q = 32 + \frac{W_1 T_1 - W_2 T_2}{W_2 - W_1}$$

where:

W_1 = weight of water sample prior to the addition of the ice.

W_2 = Combined weight of water sample and ice.

T_1 = temperature of water sample prior to the addition of the ice.

T_2 = lowest temperature of water after adding ice.

6.4.3 Ice Making Capacity Under Standard Conditions

6.4.3.1 Batch Type Machines

a. Determine the average duration of one cycle T_b, in minutes as follows:

$$T_b = \frac{\text{Total test period in minutes}}{\text{Number of cycles}}$$

b. Determine the total number of cycles per day N_b as follows:

$$N_b = \frac{1440}{T_b}$$

c. Determine the average weight of ice produced per cycle W_b by determining the arithmetical average of the three ice weighings.

d. Determine the pounds of ice made in a 24 hour day as follows:

Weight of ice produced per day = $N_b \times W_b$

6.4.3.2 Continuous Type Machines

a. Obtain the arithmetic average weight W_c in pounds, of the eight 15 minute ice weighings.

b. Multiply W_c, so obtained, by 96 to determine the pounds of ice made in a 24 hour day.

GLOSSARY

Operation Cycle	On batch-type machines, one complete ice-making (freezing) and subsequent ice-harvesting interval.
Calibration Condition	The ambient air temperature T_R, initial water temperature T_1 and W_1 (without ice), and the minimum water temperature T_2 (with fully melted ice) which exists when $\Delta 1$ $(T_1 - T_R) = \Delta 2$ $(T_R - T_2)$ within 5° to 10°F.
Batch Type Machine	A machine that makes ice cubes intermittently (in batches) until the storage bin is full.
Continuous Type Machine	A machine that makes ice flakes continuously until the storage bin is full.
Cube Ice	Small pieces of ice, regular in shape, each piece having the same average weight. The shape can be cubical, cylindrical, half-round, crescent, hour-glass, or any other geometric variation, depending on the design of the evaporator. The weight ranges from as low as 1/10 to 1 1/4 ounce per piece.
Flake Ice	Small pieces of ice, irregular in form, of various weights and thicknesses. The thickness can vary from paper-thin to as thick as 1/16 inch. The pieces are also frequently compacted to various degrees of hardness.
Make-Up Water	The potable water from which the ice cubes or ice flakes are made. This water is also used during "blow-down" or manually-controlled flushing.
Blow-down	The automatic flushing of the make-up water system at preset intervals.
Ice Quality	The heat-absorbing ability, in BTU per pound, possessed by the ice until it is completely melted.

APPENDIX A

All automatic ice-makers utilize: (1) a refrigeration system, (2) a water system for ice making, (3) a water system or an air system for cooling the refrigerant flowing through the condenser, and (4) an electrical system for driving the compressor motor and for operating the automatic controls. The refrigeration system is conventional, employing a condenser which is water-, or air-cooled. When water cooled, the source of water for cooling the condenser is usually the same as the source from which the "make-up" water is taken. The evaporator is the most distinctive part of the machine. It must be so designed and assembled that the ice which forms on it can be easily removed by the ice-harvesting means employed. This ice removal, or harvesting, may be accomplished either by applying heat to the ice at or near the evaporator surfaces in batch type machines, or by mechanical means such as craping, wedging or flexing in continuous type machines.

Batch type machines are generally used to make ice cubes. These ice cubes are mainly intended for use in beverages, or in similar applications where ice clarity is important. Clear ice is obtained by freezing the water relatively slowly, and by mechanically agitating the water while it is slowly freezing. This procedure causes most of the salts and minerals dissolved in the water to separate out before ice is formed, and to be deposited onto the inner surfaces of the make-up water system. The make-up water system must consequently be flushed or blown-down at periodic intervals to prevent clogging. If the mineral or salt content of the make-up water is high, (i.e., if the water is very "hard"), it may be necessary to blow-down the make-up water system during each ice harvesting interval.

The clarity of flake ice is usually not important, since it is generally used as a packing, or display medium for foods or other temperature sensitive items. Flake ice is usually made in continuous type machines, and it is white or translucent in appearance because it is frozen quite rapidly as it is sprayed onto the evaporator surface. This causes the air intermixed with the water to be entrapped in the water as it freezes, giving it a white or translucent appearance. This rapid freezing also prevents any minerals or salts which may be dissolved in the water from settling out. Continuous type machines making flake ice therefore do not usually require automatic means to periodically blow-down the make-up water system.

Manual controls are provided to clean-out the make-up water system at periodic intervals for sanitary reasons. Such "cleaning" is usually accomplished by pouring cleaning fluid into the make-up water, pumping it through the make-up water system, and then flushing the system throughly with clear make-up water.

The maximum operating temperatures which may be encountered in the field are the same as those to which air conditioners may be subjected. These temperatures are as follows:

1. Air temperature surrounding unit - 115°F. dry bulb
   95°F. wet bulb

2. Water temperature entering ice maker - 80°F.

NOTE: The above temperatures are equivalent to those specified in ARI Standard 210-66 for Unitary Air Conditioning Equipment. (See reference 4D).

Ice making machines may be required to operate at elevations up to 5000 feet above sea level. The ice making capacity is affected by the barometric reading, and it may be increased by 0.8% for each inch of barometric reading below the standard barometric test pressure of 29.92 inch. Other things being equal, the ice making capacity will be approximately 4% higher at an altitude of 5000 feet than it is at sea level.

The quality, of BTU per pound, is an important characteristic of the ice produced by an ice making machine. For example, slush ice may have a cooling capacity of only 84 BTU per pound, and sub-cooled ice may have a cooling capacity greater than the 144 BTU per pound which is obtained with "standard" ice at 32°F.

Typical heat-removing capacities of 32°F. ice obtainable from ice making machines are as follows:

ICE SHAPE	"QUALITY" (BTU PER POUND)
"Cube"	135
"Flake"	115
Compacted "Flake"	120