NATIONAL BUREAU OF STANDARDS REPORT

2559

PERFORMANCE OF TWO ELECTRIC
DRINKING WATER COOLERS

manufactured by
Sunroc Company

by

C. W. Phillips
Henry Karger
P. R. Achenbach

NBS

U. S. DEPARTMENT OF COMMERCE
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C. W. Phillips
Henry Karger
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Heating and Air Conditioning Section
Building Technology Division

to

Headquarters,
United States Marine Corps
Washington, D. C.

NBS

PERFORMANCE OF TWO ELECTRIC DRINKING WATER COOLERS

ABSTRACT

Two electric drinking water coolers were tested for the United States Marine Corps to determine their compliance with the purchase specification and its addenda issued with U. S. Marine Corps Invitation for Bids #832. Both specimens failed to meet certain performance requirements and were returned to the manufacturer for modifications. After resubmission of the specimens, all of the tests were repeated on one of the coolers, and certain of the tests were repeated on the other cooler. Inspections and material analyses were made of both coolers. The results obtained show that one cooler essentially met all the performance requirements and all but two of the construction requirements of the purchase specification. The second cooler met all the performance requirements with the exception of the Peak Draw Test, the Water Regulator Test, and the Overload Test. It met the majority of the construction requirements of the purchase specification.

I. INTRODUCTION

In accordance with a request from the Headquarters, United States Marine Corps, in a letter dated May 26, 1952, tests and inspections of two electric drinking water coolers of different models manufactured by Sunroc Refrigeration Company, Glen Riddle, Pennsylvania, were made to determine compliance with the purchase specification and its addenda attached to the U. S. Marine Corps Invitation for Bids #832, dated February 29, 1952, and contract NOM-62695, dated May 1, 1952, issued by Headquarters, United States Marine Corps. One cooler of each of the two models was submitted by the manufacturer for tests. Both coolers were returned to the manufacturer when it became apparent during the tests that they did not comply with certain of the specification requirements, and were subsequently resubmitted by the manufacturer after certain modifications were made.

The performance of the two specimens was determined by direct tests as required by the purchase specification and its addenda. Conclusions about compliance of the specimens with regard to materials, construction, and durability were drawn from the results of inspections, plating tests, and other physical and chemical determinations. The tests required such detailed dismantling and sampling of construction materials of both coolers that it was impracticable to attempt reassembly.

II. DESCRIPTION OF TEST SPECIMENS

Thw two water cooler specimens submitted for tests were identified as follows:

NBS Test Specimen 88-52, Specification Type I, Size 10
NBS Test Specimen 97-52 (when resubmitted)
Sunroc Company Model NM2B
Serial Number 220117
Code Number MOD 1-10AH1
Identified in this report as specimen S-10

NBS Test Specimen 89-52, Specification Type III, Size 30
NBS Test Specimen 99-52 (when resubmitted)
Sunroc Company Model A-2520
Serial Number 220306
Code Number 3-30AH1
Identified in this report as specimen S-30

Specimen S-10 was housed in a formed, one-piece steel enclosure which constituted the back and the sides of the cooler. This housing enclosed the condensing unit compartment and evaporator section and provided structural support for the unit. The solid front panel could be removed, after loosening a screw at the bottom of the panel, by pulling the panel away from the cooler at the bottom and down from the recess formed by the top of the cooler. All of the controls and electric connections were accessible from the front side after the front panel was removed.

A front view of the specimen S-10 is shown in Fig. 1. Fig. 2 shows a rear view of the cooler, and the machine compartment is shown in Fig. 3 after removal of the front panel.

Specimen S-30 was housed in a formed, sheet steel enclosure, which completely enclosed the cooling unit housing and also constituted the sides of the machine compartment. The condenser occupied all of the back side of the machine compartment. The sheet-steel-mesh front cover of the machine compartment could be removed after loosening four screws, and all electric controls were accessible from the front of the machine compartment. The cooler was supported on four adjustable steel legs.

A front view of specimen S-30 is shown in Fig. 4. Fig. 5 shows a rear view of the cooler, and the machine compartment is shown in Fig. 6. When the cooler was returned for modification after it failed to comply with certain requirements of the purchase specification, the manufacturer removed the receiver and the automatic expansion valve, and a capillary tube was substituted as the refrigerant flow control. The machine compartment of specimen S-30 after this modification is shown in Fig. 7.

The dimensions of the two coolers were as follows:

	S-10	S-30
Height, in.	41-1/2	55
Width, in.	15-1/2	25-1/2
Depth of cabinet, in.	15-1/2	25-1/4
Depth of cooler (incl. draintray), in.	15-1/2	33-1/2
Weight, lbs. (approx.)	140	350

III. TEST PROCEDURE

The laboratory investigation of the specimens made to determine compliance with the purchase specification and the three addenda attached thereto was divided into two main parts. First, tests were made to determine compliance with the performance requirements of the specification, as follows:

Specification Paragraph No.	Type of Test
(1) E-1, F-3c	Capacity Test
(2) E-2, F-3f	Peak Draw Test
(3) E-3, F-3d	Maximum Operating Test
(4) E-4, F-3e	Overload Test
(5) E-5, F-3g	Automatic Temperature Control Test
(6) E-6, F-3h	Motor Overload Protective Device Test
(7) E-7, F-3j	Water Regulator Test
(8) E-8, F-3i	Freezing Test
(9) F-3a, F-3k	Hydrostatic Test

Secondly, tests and/or inspections were made to determine compliance with other applicable paragraphs relative to materials of construction, composition of materials, arrangement of components, etc.

All performance tests listed above were conducted in a temperature-controlled room under the general conditions set forth in paragraph F-3b of the purchase specification. Temperatures were measured by means of calibrated thermocouples using an electronic, constant-balance type of potentiometer. Accuracy of this instrument was checked at intervals during the tests by means of ice-bath references. Inlet and outlet drinking-water temperatures were measured by thermocouples in thin-walled, stainless steel wells four inches long, mounted so that the thermocouples junctions were approximately in the plane of the exterior surface of the cooler cabinet. Water-flow rates were determined in a manner that did not interfere with the flow of cooled water wasted through the precooler. Supply water temperatures and pressures were controlled by close-differential mechanical devices.

IV. PERFORMANCE TEST RESULTS

When specimen S-10 was placed on the testing stand and connected to the water supply, it was found that the bubbler would not pass more than a trickle of water when opened. Inspection disclosed that some foreign material had lodged on the screen of the bubbler, as shown in Fig. 8. The bubbler was replaced by the manufacturer before the tests began. With the exception of the water regulator test and the automatic temperature control test, all test results reported herein on specimen S-10 were obtained on the original sample as first submitted. The water regulator test and the automatic temperature control test were repeated on specimen S-10 after it was resubmitted and the results reported are those obtained on the resubmitted specimen.

The specimen S-30 developed a refrigerant leak after six of the nine tests outlined in the section under Test Procedure were finished. The cooler had met the requirements of the capacity test, the maximum operating test, and the automatic temperature control test. however failed to meet the requirements of the peak draw test, the water regulator and valve test, and the motor overload protective tests. During the test of the Motor Overload Protective device, this device failed to operate after several cycles. In order to prevent a burnout of the compressor motor, it was disconnected manually. The temperature of the running winding of the compressor motor at that time was 521°F. The temperature of the winding at the last cutout of the protective element before its failure was 421°F. The specification requires that the protective elements function before winding temperatures exceed 257°F. The failure occurred during the test made with the starting winding of the compressor motor disconnected to simulate failure of the starting mechanism.

The day after the above test was made a refrigerant leak was discovered at the place where the suction line entered the hermetic compressor shell. The cause of this leak was not determined.

The cooler was returned to the manufacturer, and all tests were repeated on the resubmitted sample. These are the test results enumerated below.

The following paragraphs show the results obtained on specimens S-10 and S-30 during the performance tests listed under the section on Test Procedure.

(1) Capacity Test (Paragraphs E-1, F-3c)

Table 1, which follows, summarizes the results obtained during the capacity tests on specimen S-10 and specimen S-30 and compares the observed performance with the specification requirements.

The entry entitled "Drinking Water Flow Rate at 30°F Temperature Difference, Gallons per Hour" gives the calculated water flow rate for a 30°F difference between supply and outlet water temperature when the actual difference during the test was not exactly 30°F.

Table 1 shows that the observed capacity of both cooler specimens exceeded the respective required capacity.

TABLE 1. CAPACITY TESTS OF SPECIMENS S-10 AND S-30

Performance Characteristic	Required Performance	Observed Performance	
		S-10	S-30
Ambient Temperature, °F	90	90.3	89.9
Electric Power Input, watts	-	-	1284
Terminal Voltage	115	115	115
Total Current, amps	-	3.8	14.6
Drinking Water, Inlet Temp., °F	80	80.6	79.6
Drinking Water, Outlet Temp., °F	50	50.0	49.7
Drinking Water, Temp. Diff., °F	30	30.6	29.9
Spill through precooler for S-10, %	60	59.8	--
Drinking Water Flow rate, observed, gal./hr.	--	11.8	30.8
Drinking Water Flow rate, corrected for a 30°F temp.diff., gph, for specimen S-10	9.5 (minimum)	12.0	--
Drinking Water Flow rate, corrected for a 30°F temp. diff., gph, for specimen S-30	28.5 (minimum)	-	30.7

(2) Peak Draw Test (Paragraphs E-2, F-3f)

For the cooler type and size of specimen S-10, the specification required that 37-1/2% of the required hourly capacity shall be drawn off in 15 minutes. The water must be drawn off in either 30 or 60 equal intervals, at a flow rate of 1/2 gallon per minute, and with 60% spill through the precooler. During the peak draw test, the outlet drinking water temperature should not exceed 60°F at any time. For this test, cooler specimen S-10 was equipped with a self-closing, hand-operated valve adjusted to permit water to flow at a rate of 1/2 gallon per minute when opened. Water was drawn from the cooler in 60 equal samples, each consisting of a 40% portion, drawn first, and a 60% portion, drawn second. The 40%

portion was poured into a container for subsequent weighing. It simulated water consumed and did not pass through the precooler. The 60% portion was poured into a vessel of low thermal mass immediately prior to each subsequent draw. This vessel allowed the 60% portion to flow through the precooler during the time required for the entire subsequent draw.

During the peak draw test made with cooler specimen S-10, the highest outlet drinking water temperature observed was 55.8°F, hence the cooler complied with the requirements of the specification.

For the cooler type and size of specimen S-30, the specification required that 65% of the required hourly capacity be drawn off in 15 minutes. The water must be drawn off in either 30 or 60 equal intervals, at a flow rate of 4-1/2 gallons per minute for the case of specimen S-30. During the peak draw test, the outlet drinking water temperature should not exceed 55°F at any time.

The peak draw test was made in accordance with the procedure outlined in paragraph F-3f of the purchase specification. The highest outlet drinking water temperature observed during the test was 55.5°F after all tolerances in instrument and observation error had been resolved in favor of the test specimen. During another peak draw test, in which the amount of water withdrawn was limited to prevent the outlet water temperature from rising above 55.0°F, only 17.5 gallons instead of the required 18.5 gallons of water were withdrawn from the cooler, or approximately 5% less than required. This is the equivalent of 15 8-fl. oz. glasses of water. The required 18.5 gallons to be drawn during the peak draw test are equivalent to 296 8-fl. oz. glasses of water. The results of this second test corroborated the results of the first test. Inasmuch as the observed outlet water temperature during the prescribed peak draw test rose above 55.0°F, the specimen did not meet the requirements of the peak draw test.

(3) Maximum Operating Test (Paragraphs E-3, F-3d)

The specification required that the coolers should start and operate satisfactorily under conditions of 110°F ambient temperature, 100°F inlet water temperature, 50°F outlet water temperature, with 60% spill through the precooler in the case of specimen S-10 and with no spill through the precooler in the case of specimen S-30. The coolers should be operated continuously for at least 4 hours with the inlet water pressure at 20 psig, and for another 4 hours with the inlet water pressure at 75 psig.

Both cooler specimens were operated for the required length of time under the above conditions. At the conclusion of each of the 4-hour test periods, the coolers were turned off and left idle for a period of 5 minutes and then restarted to determine whether or not they would start satisfactorily without causing the motor overload mechanism to operate. Both cooler specimens started and operated satisfactorily during this test.

Table 2, which follows, shows the average conditions maintained during the maximum operating tests.

TABLE 2. MAXIMUM OPERATING TESTS

Performance Characteristics	Required Performance	Observed Performance	
		Inlet Water Pressure	
		20 psig	75 psig
SPECIMEN S-10			
Electric Power Input, watts	-	325	327
Terminal Voltage	115	115	112
Total Current, amps	-	3.9	4.0
Ambient Temp., °F	110	110.5	110.5
Drinking Water Inlet Temp., °F	100	99.2	100.4
Drinking Water Outlet Temp., °F	50	49.9	50.1
Drinking Water, Temp.Diff., °F	50	49.3	50.3
Spill through precooler, %	60	60.3	60.2
Drinking Water Flow Rate, observed, gal/hr	-	6.2	6.2
Drinking Water Flow Rate, Corrected for 50°F temp. diff., gph	-	6.1	6.2
SPECIMEN S-30			
Electric Power Input, watts	-	1437	1434
Terminal Voltage	115	115	115
Total Current, amps	-	15.9	15.9
Ambient Temp., °F	110	110.9	110.7
Drinking Water Inlet Temp., °F	100	99.8	99.8
Drinking Water Outlet Temp., °F	50	50.7	50.3
Drinking Water, Temp. Diff., °F	50	49.1	49.5
Drinking Water Flow Rate, observed, gal/hr	-	15.7	15.1
Drinking Water Flow Rate, corrected for 50°F temp. diff., gph	-	15.4	14.9

(4) Overload Test (Paragraphs E-4, F-3e)

Both cooler specimens were tested in accordance with the procedure outlined in paragraph F-3e of the purchase specification, which calls for 4 hours continuous operation in 104°F ambient with water withdrawn at a rate of 300% of the required hourly draw-off capacity, and with 60% spill through the precooler in the case of specimen S-10. The results of these tests are summarized in Table 3, which follows.

TABLE 3. OVERLOAD TEST

Performance Characteristics	Required Performance	Observed Performance	
		S-10	S-30
Ambient Temp., °F	104	103.6	104.7
Drinking Water, Inlet Temp., °F	90	89.8	89.9
Drinking Water, Outlet Temp., °F	-	75.0	74.0
Ratio of Water Flow to flow required for capacity test, %	300	301	302
Spill through precooler, % (Specimen S-10 only)	60	60.1	-
Electric Power Input, watts	-	387	1680
Terminal Voltage	115	115	115
Temp. rise of fan motor frame, °F	99 (maximum)	38.9	39.2
Temp. rise of compressor motor windings, °F	117 (maximum)	104.0	126.0

Both cooler specimens operated satisfactorily and without any indication of breakdown. The temperature of the compressor motor running windings was determined by the resistance method. Table 5 shows that the temperature rise of the compressor motor of specimen S-10 was below the permissible rise as listed in the specification.

In the preliminary letter report to the Marine Corps dated December 3, 1952, specimen S-30, as resubmitted, was reported as passing the requirements of the Overload Test. However, a final check of all data revealed that the temperature rise of the compressor motor winding was 9°F greater than the allowable maximum rise of 117°F. Hence specimen S-30 did not pass the requirements of the Overload Test.

(5) <u>Automatic Temperature Control Test</u> (Paragraph E-5, F-3g, as modified in Addendum #2)

Both cooler specimens were equipped with thermostats, actuated by refrigerant and/or water temperatures, which controlled the operation of the compressor motors. The thermostats were readily accessible for adjustment and servicing when the front covers of the coolers were removed, and could be replaced without breaking the main insulation of the cooling unit housing.

Adjustment of the thermostat on specimen S-10 could be effected by turning a knob on the thermostat. The thermostat caused the cooler to deliver colder water when this knob was turned in a clockwise direction, and caused delivery of warmer water if the knob was turned in a counterclockwise direction.

Adjustment of the thermostat on specimen S-30 could be effected by turning a screw located on the face of the thermostat. The thermostat caused the cooler to deliver colder water when this screw was turned in a clockwise direction, and caused delivery of warmer water when the screw was turned in a counterclockwise direction.

Specimen S-10, as delivered, did not meet the requirements of the automatic temperature control test. For the case of specimen S-10, the specification states in part:

> ". . . . the automatic temperature control shall provide drinking water at temperatures no lower than 40F. and no higher than 50 F. for some one position of the thermostat adjusting device, and shall provide drinking water at temperatures no lower than 50 F. and no higher than 60 F. for some other position of the thermostat adjusting device for any rate of water withdrawal from no-load to one-half the . . . hourly capacity . . . , when the coolers are operated in accordance with the conditions of Paragraph F-3g."

A knob setting was provided causing water delivery in the temperature range from 40°F to 50°F for both "no-load" and "half-load" withdrawal rates. However, water at temperatures between 50°F and 60°F could not be obtained for any setting of the adjustable knob.

Specimen S-10 was returned to the manufacturer and was resubmitted at the same time that specimen S-30 was resubmitted. The thermostat test was repeated, and after some internal adjustments of the thermostat by representatives of the manufacturer, the cooler met the requirements of the thermostat test. At the low setting of the thermostat adjusting knob, delivered water temperatures ranged from 43.0°F to 45.1°F at "half-load" rate, and from 44.7°F to 46.7°F at "no-load" rate. At the high setting of the thermostat adjusting knob, delivered water temperatures ranged from 52.2°F to 54.5°F at "half-load" rate and from 52.0°F to 53.5°F at "no-load" rate. Inasmuch as some internal adjustment of the thermostat was necessary after delivery of the cooler to this Bureau the thermostat was removed from the cooler and calibrated in a bath in order to provide information for inspection purposes. It was found that at the lowest setting of the thermostat adjusting knob, the cut-off was 45°F and the cut-on was 51°F, and at the highest setting of the knob, the cut-off was 53°F and the cut-on was 56°F.

For the case of specimen S-30, the thermostat requirement was similar to the requirement quoted above, except that the low setting temperature limits were 38°F to 44°F instead of 40°F to 50°F, and the high setting temperature limits were 44°F to 50°F instead of 50°F to 60°F. For the low setting of the thermostat adjusting screw, delivered water temperatures ranged from 40.0°F to 40.3°F for the "half-load" rate, and from 40.6 to 42.4 for the "no-load" rate. For the high setting of the thermostat adjusting screw, the delivered water temperatures ranged from 45.2°F to 49.4°F for the "half-load" rate and from 48.2°F to 50.0°F for the "no-load" rate. Hence specimen S-30 met the requirements of the automatic temperature control test.

Water at a temperature below 37°F could not be obtained from either of the cooler specimens at the lowest possible settings of the normal thermostat adjusting devices.

(6) <u>Motor Overload Protective Device Test</u> (Paragraph E-6, F-3h)

Paragraph D-13b of the purchase specification states in part: "Compressor motors shall be protected in case of failure of the starting mechanism, failure of the condensing medium, or excessive overload, by a thermal protective device of the automatic or hand-reset type."

Both specimen S-10 and specimen S-30 were equipped with such devices. Specimen S-10 had a single, automatic reset type overload protector, whereas specimen S-30 had two overload protectors, one an automatic reset type, the second a hand-reset type, which was connected in series with the first device.

Tests were made in accordance with the procedure outlined in paragraph F-3h. Winding temperatures were determined by the resistance method, using the formula in paragraph F-3h(4) to compute the temperature. The results obtained during the tests are listed in Table 4, below.

TABLE 4. MOTOR OVERLOAD PROTECTIVE TESTS

Test	Temperature of Windings, °F		
	Specification Requirement	Observed Performance	
	Maximum Permissible Temperature	S-10	S-30
Blocked Condenser	257	183	230
Starting Winding disconnected	257	204	250
Condenser fan motor, locked rotor test	257	297	222

The fan motor on specimen S-10, which reached a winding temperature of 297°F during the locked rotor test, did not have any overload protector, whereas the fan motor of specimen S-30 did have an internal overload protective device. The Technical Committee on Refrigeration and Air Conditioning Equipment of the General Services Administration, which is currently working on a revision of the Federal Specification for water coolers, at a recent meeting changed the temperature limits on electric motors from 257°F to 302°F after reviewing all available information from manufacturers of small motors and various regulatory groups. Hence, we believe that the temperature of 297°F, attained by the fan motor on this cooler, should be considered acceptable.

On specimen S-30, which was equipped with two overload protectors as outlined above, the automatic reset type protector disconnected the compressor motor during the test made with the condenser blocked. During the test made with the starting winding disconnected, the hand-reset type protector disconnected the compressor motor.

(7) <u>Water Regulator Test</u> (Paragraph E-7, F-3j)

The water regulator requirement states in effect that when the unit is adjusted so that the observed water flow is one-half gallon per minute for the case of specimen S-10, or 4-1/2 gallons per minute for the case of specimen S-30, at a supply line pressure of 35 psig, the total flow at either 20 psig and

75 psig, respectively, shall not vary by more than 15% from the total flow observed at 35 psig.

Specimen S-10 was equipped with an adjustable, automatic water-pressure regulator and a hand-operated, push-button type, self-closing stop valve. These two valves together with the bubbler and bubbler guard formed an integral assembly. The adjustment for the pressure regulator was accessible by removing the hexagonal nut holding the push-button on the bubbler assembly. Adjustments could then be made with a screw driver. The bubbler assembly could be removed from the cooler by hand without breaking the cooling unit insulation. Specimen S-10, as originally submitted, did not meet the requirements of the water regulator test. The test was repeated on the resubmitted cooler, which then met the requirements for this test. The test results are summarized in Table 5.

Specimen S-30 was equipped with three self-closing glass fillers, located at the front of the cooler. Each glass filler was equipped with a stream regulator, which could be adjusted with a screw driver. Specimen S-30 did not meet the water regulator test when originally submitted. When the cooler was resubmitted, an automatic water regulator had been incorporated into the water circuit of the cooler. This regulator was located in the top of the cooling unit housing; however, it was not accessible for adjustment, repair or replacement. The test was repeated when the cooler was resubmitted.

Table 5, which follows, shows the results of the water regulator test for specimen S-10 and specimen S-30.

TABLE 5. WATER REGULATOR TEST

	Water Supply Line Pressure, psig		
	35	20	75
SPECIMEN S-10			
Stream Height above guard, in.	2-1/2	1	3
Stream Throw-distance, in.	6	4-3/4	8-1/2
Water Flow, gal/min.	0.51	0.47	0.57
Percentage deviation from observed flow at 35 psig	-	8	12
SPECIMEN S-30			
Water flow from all glass fillers, gal/min.	4.47	3.57	4.95
Percentage deviation from observed flow at 35 psig	-	20	11

The deviation of 20% for the flow at 20 psig on specimen S-30 from observed flow at 35 psig does not comply with the requirements of the purchase specification. The maximum deviation permitted by the specification is 15%.

(8) Freezing Test (Paragraph E-8, F-3i)

Each of the two cooler specimens had a control to prevent freezing of the stored water in case of failure of the primary thermostat, or other cause of abnormal machine operation. On specimen S-10, this was a second thermostat, responsive to water temperature. Specimen S-30 was equipped with a pressure control, responsive to evaporator pressure.

Both coolers were operated in accordance with paragraph F-3i for 16 hours in an ambient temperature of 33°F ± 1°F. At the end of the 16-hour period, water could be drawn from both of the coolers, indicating that the freezing protection of both specimens was adequate.

(9) Hydrostatic Test (Paragraph F-3a, F-3k)

In accordance with the requirements of paragraph F-3k(1) and F-3k(2) of the purchase specification, a gas pressure test was applied to the water and refrigerant containing parts of the two cooler specimens. The water containing parts were subjected to a test at a pressure of 125 psig. The refrigerant containing parts were subjected to a test at a pressure of 350 psig. No evidence of leaks, rupture, or damage were observed on either specimen during the hydrostatic tests.

V. RESULTS OF INSPECTION

In order to determine compliance with other parts of the purchase specification, both water cooler specimens were disassembled and detailed analysis was made of certain components. Tests were made of the finish on the housings, of the thickness of the plating on chromium-plated parts, of the corrosion resistance of screws, fastenings, and other metal parts, etc. The following conclusions regarding compliance of specimen S-10 and specimen S-30 with the requirements of the purchase specification and its addenda are based on these tests and inspection of the disassembled coolers. The comparison between the inspection results and the specification requirements is made paragraph by paragraph using the numbering system employed in the purchase specification to identify the requirement under consideration.

A-1. No comment required.

A-2. No comment required.

A-3a, A-3b. Neither cooler specimen S-10 nor cooler specimen S-30 had an Underwriters' label. It is not known whether

any other evidence of compliance with Underwriters' Laboratories Standards was submitted to the purchasing agency.

A-3c, A-3d. No comment required.

B-1, B-2. Specimen S-10 was furnished as Type I, Size 10, specimen S-30 as Type III, Size 30.

C-1. All materials used in the two coolers appeared to be new.

C-1a(1). Sixteen miscellaneous pieces consisting of plated and coated parts such as screws, nuts, bolts, washers, portions of the exterior covering of the water coolers and portions of the galvanized tank, were removed from the two coolers and subjected to a 4-hour salt-spray test conducted in accordance with Federal Specification QQ-M-151. No significant corrosion was observed at the end of the test on any of the pieces. A spectrographic analysis of four samples of corrosion-resisting steel used for the basin top of specimen S-10 and the drain tray and strainer assembly of speciman S-30 disclosed that the samples met the requirements for Class I material of Federal Specification QQ-S-763 or QQ-S-766, as applicable, since concentrations of nickel and chromium were within the following ranges:

Ni	9-10%
Cr	18-19%

When the insulation and storage tank were removed from the cooler cabinet of specimen S-30, several large rust spots were discovered on the bottom of the cooling unit housing. These rust spots can be seen on Fig. 9. Although the inside of the cooling unit housing appeared to have been painted, we believe that discontinuities in the paint surfaces caused the appearance of rust spots. This portion of the cooling unit housing obviously did not meet the requirements of paragraph C-1a(1) with respect to corrosion resistance and points up the need for better quality control in the painting process.

C-1a(2). Both specimens complied with requirements.

C-1a(3). No tests were made by NBS.

C-1a(4). No tests were made by NBS.

C-1b. Both specimens complied with requirements.

C-1c. Six pieces of chromium-plated material was tested for thickness of coatings. The nickel coating with a minimum thickness of .00007 in. and an average thickness of .00009 in., on the glass filler of specimen S-30 did not meet the requirements of Federal Specification WW-P-541. All other pieces checked met the requirements of the specification, having minimum chromium thickness ranging from .000011 to .000038 in., and minimum nickel thickness ranging from .00010 to .00032 in.

C-2. See item 9 under performance test results.

D-1. No comment required.

D-1a. Specimen S-10 complied with the requirements for System T.

D-1b. No comment required.

D-1c. Specimen S-30 complied with the requirements for System TM.

D-1d. No comment required.

D-2, D-2a. Both cooler specimens complied with requirements.

D-2b. No comment required.

D-3a through D-3c. Both cooler specimens complied.

D-3d. The legs used on specimen S-30 did not comply with the requirement. The adjustable portions of the legs were painted metal and were not made of corrosion-resistant polished metal. The stationery portions were made of corrosion-resistant, formed sheet metal having what appeared to be a mill finish rather than either a "polished" or "satin" finish. Although the specification contained no strength requirement for the legs, those on the cooler appeared weak when sliding the cooler across a floor. A representative of the manufacturer stated that the legs on the production coolers would be different from the legs used on cooler specimen S-30.

D-3e. Both cooler specimens complied with requirements.

D-4 through D-5. Both cooler specimens complied with requirements.

D-6a. The organic finish on both cooler specimens was tested and complied with the requirements of the specification.

D-6b. Not applicable.

D-7 through D-7b. Specimen S-10 complied with the requirements. Paragraphs not applicable to specimen S-30.

D-7c through D-8a. Not applicable.

D-8b. Specimen S-30 complied. Not applicable to S-10.

D-8c. Not applicable.

D-9a. The adjustment for the water regulator on specimen S-30 was not located in a conveniently accessible spot. Both coolers complied with all other requirements of this paragraph.

D-10. The nickel plating on the glass filler of specimen S-30 did not comply with the plating requirement (see comment under C-1c). Both coolers complied with other requirements of this paragraph.

D-11b. Both coolers complied with requirements.

D-11c. Both coolers complied. The water storage chamber of specimen S-30 had a galvanized coating 1.34 oz/sq. ft. on each side of the metal.

D-11d. The water spreader used in the precooler drain passage of specimen S-10 reduced the internal dimension of the drain passage to below 5/8 inch. However, this type of construction is permissible under the interim specification for electric drinking water coolers dated July 24, 1952, and in our opinion, should be accepted.

D-11e. Both coolers complied with requirements.

D-12. No comment required.

D-12.a Specimen S-10 complied. Since charging valves were provided in the refrigeration system of specimen S-30, this system was considered "TM". A readily-removable suction strainer was not provided as required for this type system. Specimen S-30 complied with the other requirements of this paragraph.

D-12a(1). Not to be checked by NBS.

D-12b. Both coolers complied.

D-12c. Not applicable.

D-12d through D-13b. Both coolers complied.

D-13c. Not applicable.

D-13d. Both coolers complied with requirements.

D-14. Dichlorodiflouromethane (Freon-12) was used as refrigerant in both cooler specimens.

D-15a. Both cooler specimens complied with requirements.

D-15a(1). Specimen S-10 complied. The water piping on specimen S-30 was copper tubing, not plated. This paragraph required the use of galvanized steel pipe for water piping for all coolers having a galvanized steel storage tank. However, the interim specification for electric drinking water coolers dated July 24, 1952, permits the use of copper pipe or tubing for coolers having a galvanized steel storage chamber, provided such pipe or tubing is plated with tin, nicke, or chromium on the surface in contact with water. We believe that copper pipe or tubing plated in this manner is acceptable for this cooler.

D-15b, D-15b(1). Both coolers complied.

D-16. No instructions for care and operation were received with these coolers.

D-17a. Both cooler specimens complied with the requirements.

D-17b. The compressor and bubbler assembly on specimen S-10, and the compressor and glass filler assemblies on specimen S-30, did not have sufficient identification to comply with this requirement.

D-17c. Not applicable.

D-18. No comment required.

E-1. Water storage tank on specimen S-30 had a capacity of 22.4 gallons. Both specimens complied with requirements of this paragraph. For performance see item 1 under performance test results.

E-2 through E-8. Performance requirements. See applicable items under performance test results.

F-1 through F-2b. Not to be checked by NBS.

F-3a through F-3k(2). Performance tests. See applicable items under performance test results.

F-31. Not applicable.

F-4 through I. Not to be checked by NBS.

VI. CONCLUSION

The performance tests and inspection of the two cooler specimens indicated some deviations from the requirements of the purchase specification for both coolers.

Specimen S-10 essentially met all the performance tests after resubmission, and, with the exception of certain labeling requirements and the precooler water spreader, met all the other applicable requirements of the purchase specification.

Specimen S-30 did not meet all the requirements of the following performance tests:

(1) Peak Draw Test
(2) Water Regulator Test
(3) Overload Test

With respect to construction and material requirements, specimen S-30 did not meet all requirements for chrome plating, corrosion resistance of housing, legs, location of water regulator storage tank fittings, suction strainer in refrigerating system, water piping, and labeling. Inspection disclosed that certain of these failures to meet requirements could be remedied through better quality control in the manufacturing process.

FIG. 1

FIG. 2

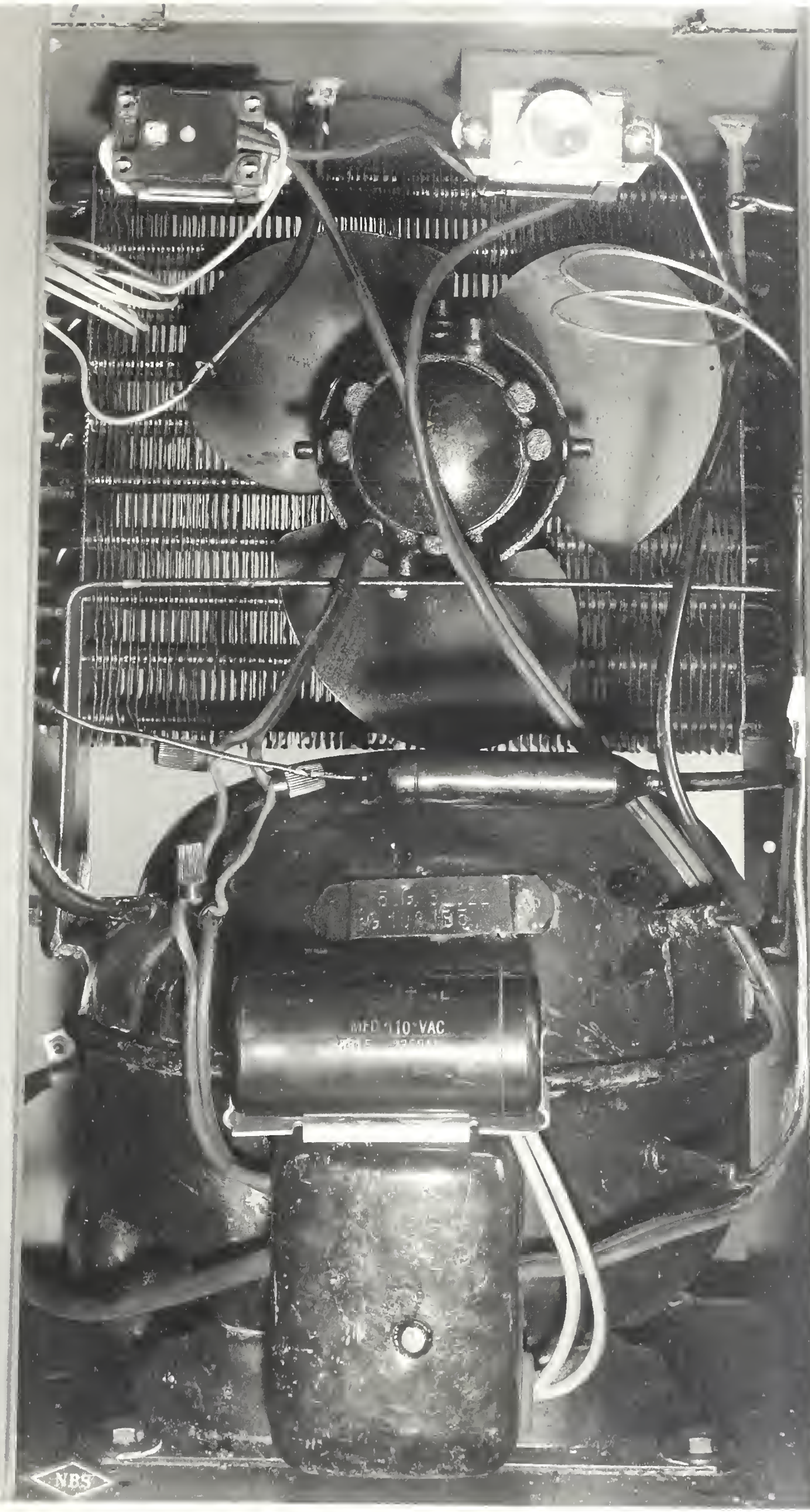

FIG. 3

FIG. 4

FIG. 5

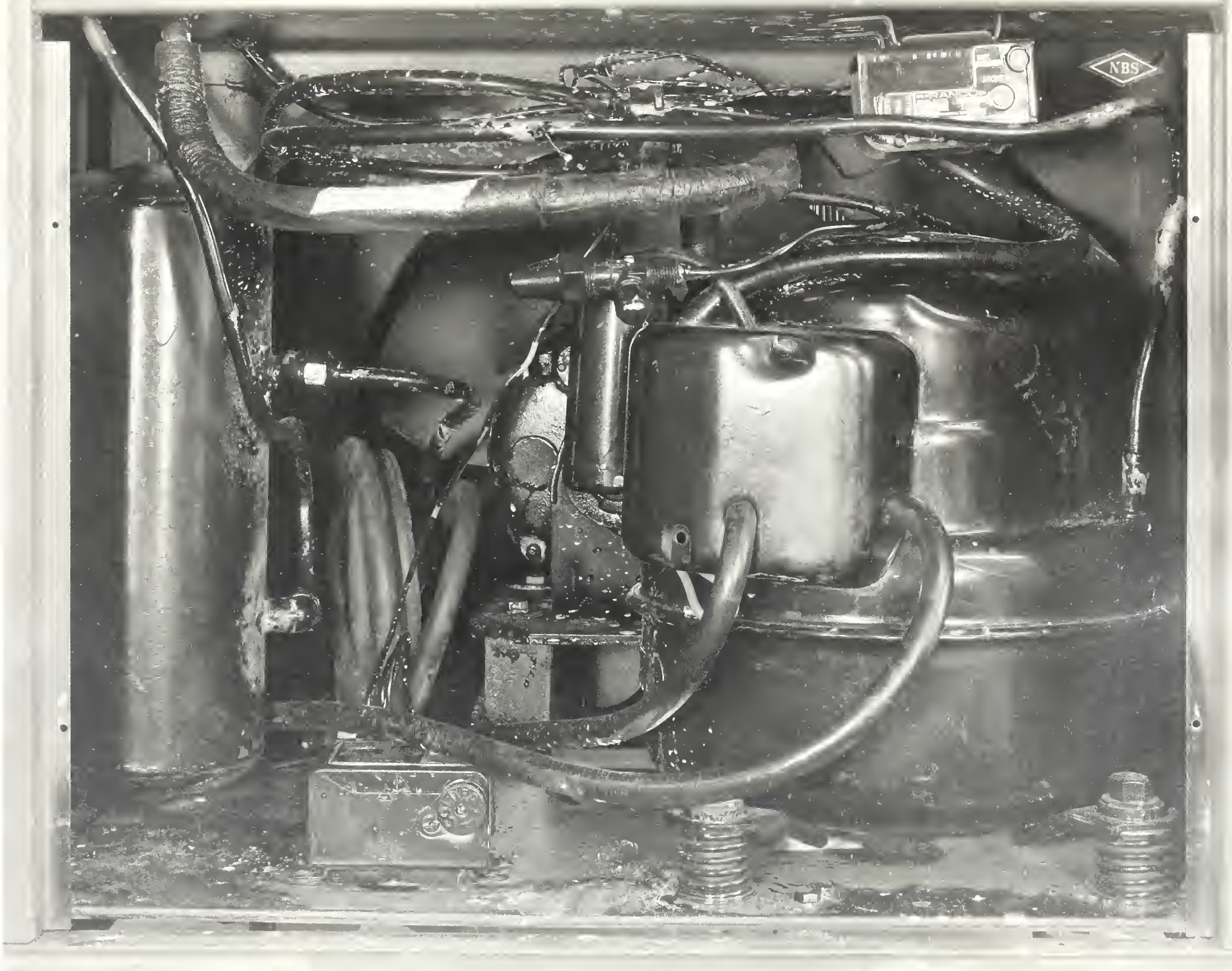

FIG. 6

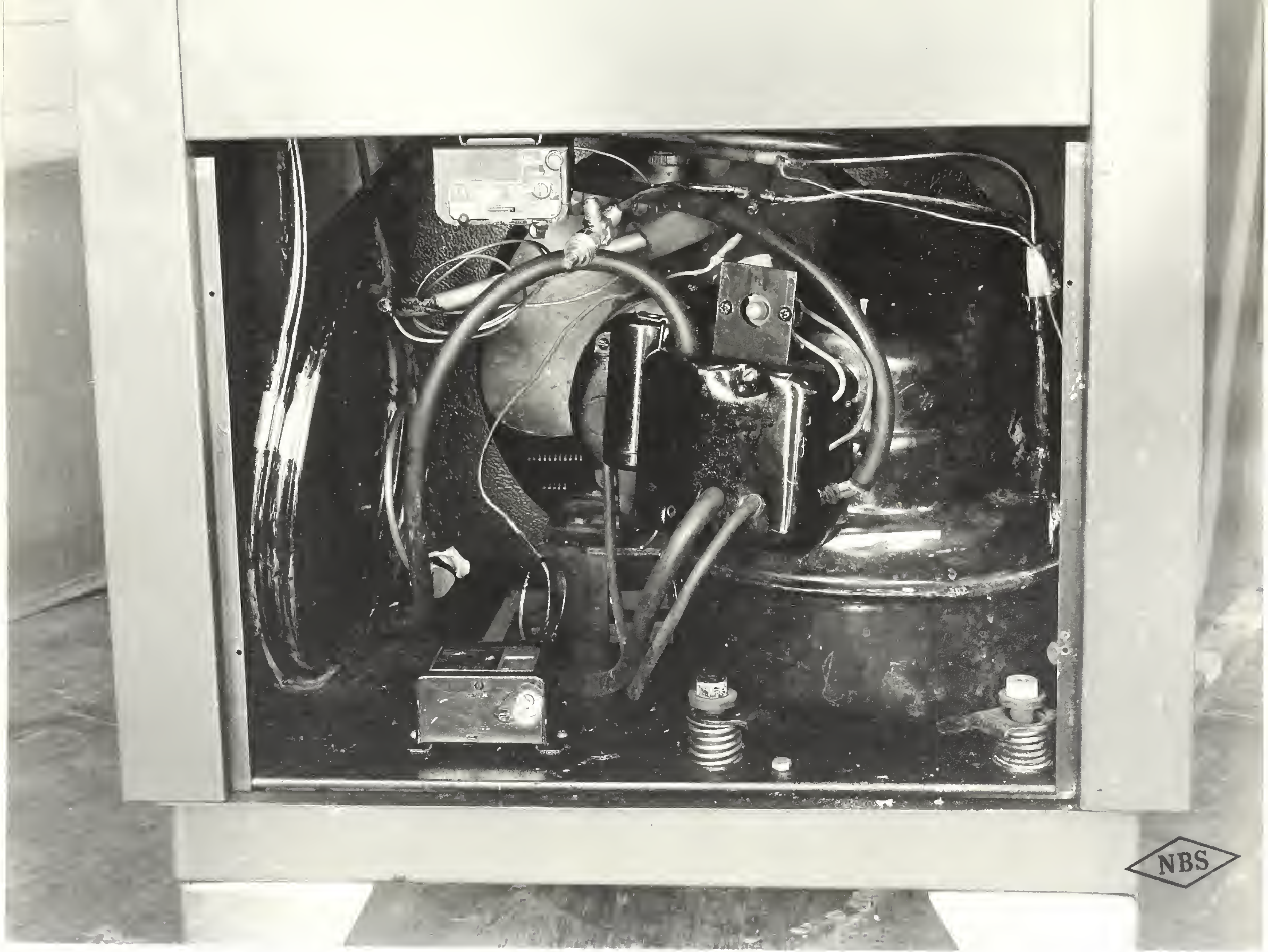

FIG. 7

FIG. 8

FIG.

THE NATIONAL BUREAU OF STANDARDS

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