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EVALUATION OF ELECTRIC, CONVEYOR-TYPE TOASTERS

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Three electric conveyor-type toasters were evaluated to compare the capabilities of different commercial models currently being procured under Federal Specification S-T-540, Toaster, Gas or Electric, Conveyor, (Heavy Duty), and to determine efficiency of design. Evaluation consisted of the hourly toast production rate, outer surface temperatures, uniformity of toast color at each setting, and operability at a 15-degree angle to simulate roll of a ship for Navy use.

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19. KEY WORDS:	Link A		Link B	
	Role	Weight	Role	Weight
Evaluation	8		8	
Safety	8		4	
Operability	8		4	
Comparison			8	
Acceptability			8	
Electrical Cooking Devices	9		9	
Kitchen Equipment & Supplies	9		9	
Toasters	9		9	
Conveyor-Type Toasters	9			
Military Requirements	4			
Design			4	
Production			4	
Variability			4	
Sanitation			4	

20. ABSTRACT (continued)

Two of the three models evaluated did not meet the 720 slices of toast-per-hour requirement for Size 3 toasters covered by Federal Specification S-T-540. Surface temperature of one model is too high. Toast color varied from a high of 80% to a low of 35% within any one setting. Toasters functioned satisfactorily at a 15-degree angle. except that some toast fell from the conveyor on one model, and the receiving tray would not remain in place on another model. The equipment is safe to use except for the high outer surface temperature.

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FOREWORD

Numerous complaints have been received from military users of electric, conveyor-type toasters procured under Federal Specification S-T-540, Toasters, Gas or Electric, Conveyor (Heavy Duty). In addition to the complaints, manufacturers have recently introduced new models to increase toast production and with the capability to toast buns as well as bread. Of the three known manufacturers of conveyor toasters, one model from each was evaluated to determine the efficiency of design, production capability, sanitation and safety.

Acknowledgment is given to personnel of the Engineering Evaluation Office, General Equipment & Packaging Laboratory for testing of the toasters.

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EVALUATION OF ELECTRIC, CONVEYOR-TYPE TOASTERS

1. Introduction

Three commercial electric, conveyor-type toasters were evaluated to provide a comparison of the Hatco Model TK-72, Savory Model C-20, and Wells Model WT-720, and to ascertain validity of users' complaints of thermostat failures, toast uniformity, and outer surface temperatures. The comparison encompassed efficiency of design, toast production and uniformity, sanitation and safety.

2. Description of Toasters

All three toasters conform generally to Figure 1 and are designed to toast bread slices and bun halves. Manufacturers' literature indicates an hourly rate of 800 slices of toast or buns for Model C-20 and 720 slices for Models TK-72 and WT-720. Toasters are electrically heated and have a motor-driven rotary conveyor. Controls are provided to produce light, medium, or dark toast. Toasters have an OFF-ON switch and a selector switch to provide heat for one electric element to toast buns on one side only or for two elements to toast bread slices on both sides. Model TK-72 has a variable speed conveyor with one constant heat and will deliver toasted slices or buns on the same side of the toaster that the slices are loaded. Models C-20 and WT-720 have a constant speed conveyor with variable heat and will deliver toasted slices or buns to either the front or rear. Toasters are countertop models with maximum dimensions of 83.82 cm (33 in.) high by 44.45 cm (17-1/2 in.) wide by 38.1 cm (15 in.) deep and weigh approximately 40.82 Kg (90 lb). The units are wired for operation on a 208-volt, 60-Hz, 1-phase, alternating current power supply and are rated at approximately 4.0 Kw. All three toasters bear the National Sanitation Foundation (NSF) Seal of Approval and are Underwriter Laboratories (UL) approved.

3. Tests

Each toaster was operated on a nominal 208-volt, 60-Hz, 1-phase a.c. circuit in an ambient temperature of approximately 22.22°C (72°F) and a relative humidity of 45%. Bread slices were white, sandwich type, approximately 1.27 cm (1/2 in.) thick by 10.16 cm (4 in.) square, purchased locally from the Continental Baking Company. Production tests were conducted with the toaster positioned for normal use and while tilted backward and forward at 15-degree angles to simulate pitch and roll of vessels for Navy use.

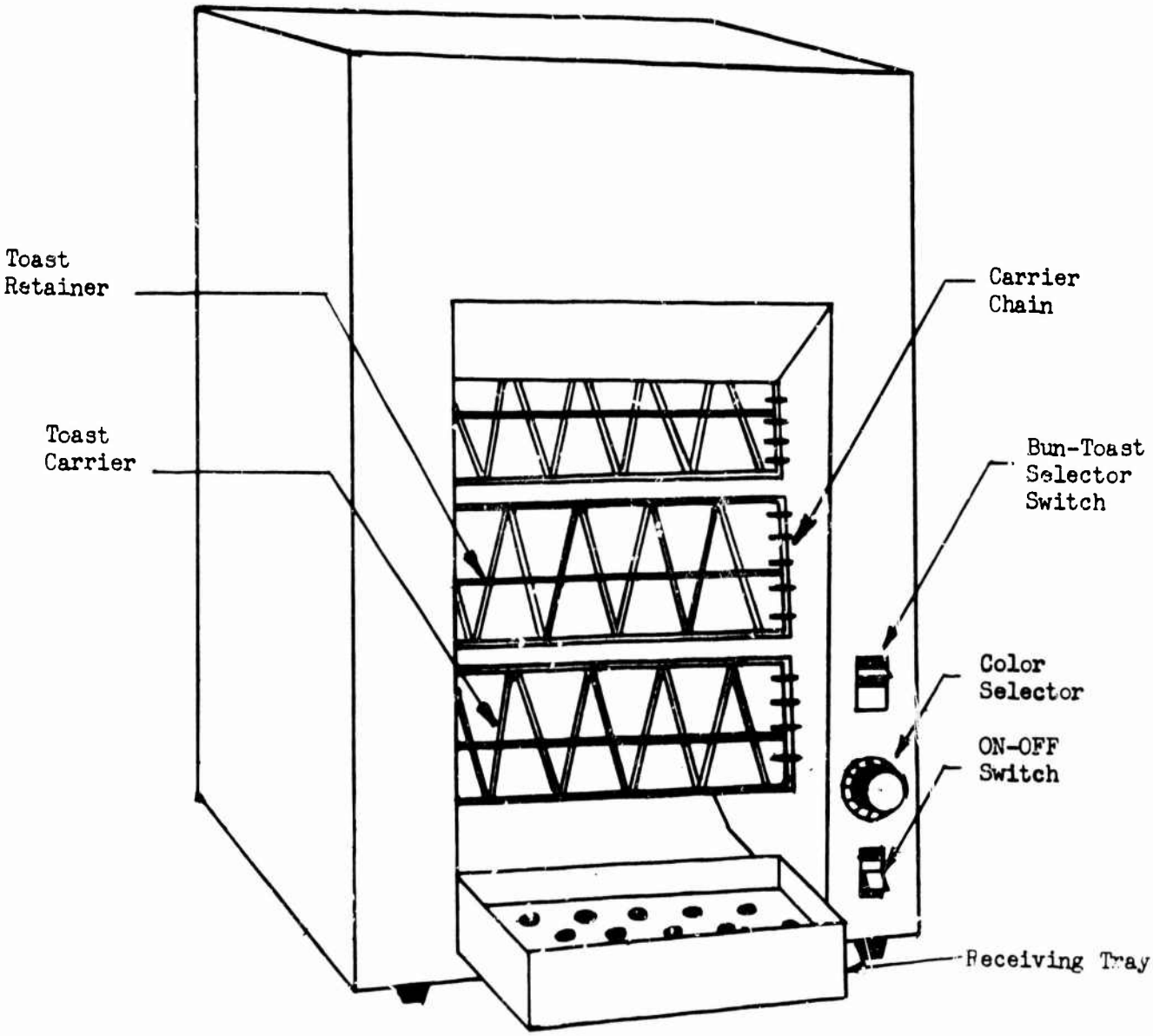

Figure 1. General View of All Three Toasters

a. Production

(1) Normal use position. The selector switch was placed in the TOAST position and the ON-OFF switch was placed in the ON position. Each toaster was operated for twenty minutes to allow thorough preheating. Time measurements were made with a stopwatch. The conveyor speed was timed, and the hourly production rate was computed. The rates are as shown in Table I.

(2) Fifteen-degree angle position. The toasters were positioned with the base at an angle of 15 degrees from the normal use position so that the toaster was tilted forward and operated for 10 minutes with the conveyor being continuously loaded. After the 10 minutes had elapsed, the toaster was tilted backward and the test repeated for 10 minutes longer. Production rates approximated those shown in Table I.

(3) Toast uniformity. Bread slices were continuously fed into the toaster while it remained in an upright position to determine visual uniformity of toasted slices. Three batches of one hundred and twenty slices each were evaluated at light, medium and dark settings. An evaluation was then made with the toaster tilted 15 degrees forward and another at a 15-degree tilt backward. Test findings are shown in Table II.

b. Outer Surface Temperatures

Each toaster was run empty for an hour with the controls set for dark toast. With the toaster still running, temperature readings were taken at 65 minutes, 70 minutes, and 75 minutes at each of six locations by use of iron-constantin thermocouples and a Leeds and Northrop potentiometer. Readings were taken at (1) the top center of the front opening; (2) center of the front panel; (3) center of rear panel; (4) center of top panel; (5) center of left panel; and (6) center of right panel. Ambient temperature was approximately 23.89° C (75° F). Only the maximum surface temperatures recorded are shown in Table III.

4. Findings

a. Production

(1) Normal use position. The hourly production rates are as shown in Table I. The rates for the Models C-20 and WT-720 do not vary at different temperature settings because the conveyor speed is constant; however, the rate for the Model TK-72 does vary because it has a variable conveyor speed. However, none of the toasters attained the production rate stated in the manufacturers' literature.

TABLE I. Toast Production Rate

Model No.	Dial Setting	Rate Slices/Hour	Manufacturers' Stated Rate
TK-72	No. 2 (light)	690	up to 720
	No. 5 (medium)	480	
	No. 9 (dark)	240	
C-20	No. 2 (light)	780	800
	No. 5 (medium)	780	
	No. 9 (dark)	780	
WT-720	L (light)	690	720
	M (medium)	690	
	D (dark)	690	

(2) Fifteen-degree angle. The hourly production rates with the toaster tilted forward and then backward at a 15-degree angle did not vary appreciably from the production rates in the upright position.

(3) Toast uniformity. Toasted slices varied in color and uniformity. None of the toasters produced consistently uniform color. The uniformity at any setting for any of the toasters varied from a high of 80 per cent to a low of 35 per cent. When tilted forward at a 15-degree angle some toast fell off the conveyor, and when tilted backward at a 15-degree angle, some toast burned. Uniformity comparison is shown in Table II. It appears that the heat control switch was defective on the Model WT-720, since the control could not be correctly set for light and medium toast when the toaster was inclined at a 15-degree angle.

b. Outer Surface Temperatures. The maximum surface temperatures are shown in Table III. Generally speaking, the temperatures were lowest on the Model TK-72 and highest on the Model C-20.

c. Design

(1) Model TK-72. The receiving tray will not stay in position when the toaster is inclined at a 15-degree angle.

(2) Model C-20. Some bread slices will not stay on the conveyor when the toaster is inclined at a 15-degree angle. High temperatures on the front caused excessive discoloration to the stainless steel exterior and receiving tray.

TABLE II. Toast Uniformity

A. Upright Position

Model No.	Dial Setting	Very Light	Light	Medium	Dark	Burned
TK-72	No. 2 (light)		80%	12%	8%	
	No. 5 (medium)		47%	53%		
	No. 9 (dark)		17%	38%	45%	
C-20	No. 2 (light)	19%	60%	21%		
	No. 5 (medium)		30%	62%	8%	
	No. 9 (dark)		20%	30%	45%	5%
WT-720	L (light)		(See NOTE 1)			
	M (medium)		47%	53%		
	D (dark)		17%	38%	45%	

B. Tilted 15 Degrees Forward and Backward

TK-72	No. 2 (light)		40%	45%	15%	
	No. 5 (medium)		20%	75%	5%	
	No. 9 (dark)		7%	35%	58%	10%
C-20	No. 2 (light)		40%	45%	15%	
	No. 5 (medium)		20%	76%	4%	
	No. 9 (dark)		20%	35%	45%	
WT-720	L (light)		(See NOTE 1)			
	M (medium)		(See NOTE 2)			
	D (dark)		29%	63%	8%	

NOTE 1. Control dial could not be set low enough to produce light toast.

NOTE 2. Control dial could not be set low enough to produce medium toasted bread.

TABLE III. Outer Surface Maximum Temperature Readings

Thermocouple Location			
Center of top of front opening	120.5°C(249°F)	244.5°C(472°F)	142.3°C(288°F)
Center of front panel	92.3°C(198°F)	152.2°C(306°F)	127.8°C(262°F)
Center of rear panel	43.3°C(110°F)	98.3°C(209°F)	75.5°C(168°F)
Center of top panel	49.5°C(121°F)	78.8°C(174°F)	73.3°C(164°F)
Center of left panel	49.5°C(121°F)	72.7°C(163°F)	73.3°C(164°F)
Center of right panel	49.5°C(121°F)	72.7°C(163°F)	73.3°C(164°F)

(3) Model WT-720. The toast color selector switch is not located at the front of the machine and has to be set by screwdriver or other similar tool. The switch did not operate correctly at the LIGHT and MEDIUM settings and appeared to be defective (see Table II).

5. Conclusions.

Models TK-72 and WT-720 do not meet the 720 slices per hour requirement specified for Size 3 of Federal Specification S-T-540. There were no electrical component problems except for the failure of the toast color selector switch on the Model WT-720. Toast color varied at each setting on all three toasters, and outer surface temperatures are considered excessive. Additional insulation on all toasters and particularly on the front of the Model C-20 would decrease possibility of operators getting burned and would increase ease of operation. A hand-operated control selector dial located at the front of the Model WT-720 instead of the screwdriver-operated selector switch would increase ease of operation. Restrictions to prevent the receiving tray from sliding out of place on the Model TK-72 and to prevent the toast retainers from allowing the toast to fall from the conveyor on the Model C-20 when the toaster is tilted forward and backward at a 15-degree angle would make the units more acceptable for shipboard use. The toaster design is considered sanitary and can be easily cleaned. Electrical components are wired in a safe manner and are in accordance with Underwriters Laboratories' requirements.