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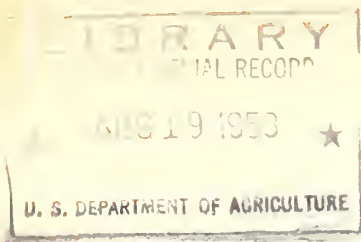
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Marketing Research Report No. 339

Rail Car
and
'Piggyback'
Transportation of

**FRESHLY
KILLED
BEEF**

Marketing Research Division

Agricultural Marketing Service

UNITED STATES DEPARTMENT OF AGRICULTURE

WASHINGTON, D. C.

PREFACE

This study is part of a broad program of research to improve the design and performance of equipment used to transport agricultural products, as a means of improving the efficiency of marketing and expanding outlets for farm products. The relative performances of mechanically refrigerated rail cars and trailer-on-flatcar equipment in the transportation of carcass beef were compared with a standard ice-bunker car commonly used in this service.

The following companies cooperated in the test: American Stores Company; Chicago, Burlington, and Quincy Railroad Company; Pennsylvania Railroad Company; Fruit Growers Express Company; and the General American Transportation Corporation.

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June 1959

RAIL CAR AND "PIGGYBACK" TRANSPORTATION
OF FRESHLY KILLED BEEF

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SUMMARY

This test was made to compare the performance of mechanically refrigerated cars and mechanically refrigerated trailers on a flatcar while transporting freshly killed beef from Lincoln, Nebr., to Philadelphia, Pa. Two mechanically refrigerated cars, two trailers, and a typical water-ice car, for control purposes, were used in the test.

Freshly killed beef will maintain its bloom and quality longest when it is cooled quickly and held at a temperature between 31° and 35° F. At temperatures above 35° the tendency of mold to develop on the surface of the meat increases. Therefore, transportation equipment should be capable of maintaining the commodity at a temperature in the optimum range of 31° to 35°.

One of the mechanically refrigerated cars performed well en route, maintaining proper air and commodity temperatures. The refrigerating unit of the second car did not perform properly en route and commodity temperatures rose above the desired 35° F. maximum. However, after repair of the refrigerating unit toward the end of the trip this car also maintained proper temperatures.

The water-ice car showed greater fluctuations in temperature than the cars with mechanical refrigeration or the trailers, especially when standing still. Maximum commodity temperatures in the water-ice car fluctuated between 37° and 49° F. The two trailers had somewhat higher temperatures than desired, especially at the rear of the load. This situation might be improved by blowing part of the cold air from the refrigerating unit to the rear of the trailer through ducts.

Humidity was between 70 and 80 percent in the ice car and between 83 and 100 percent in the mechanically refrigerated cars and trailers during most of the time in transit.

No exact measurement can be made of the harmful effect upon beef that reaches temperatures above 35° F. during transportation. Many shipments arrive in good condition even though the temperature may have been above 35° en route. Such treatment may, however, result in loss of quality at a subsequent point in the distribution process. Therefore, improvements in equipment should be made, where necessary, to insure transportation of fresh beef at temperatures in the 31° to 35° range.

INTRODUCTION

Approximately 15,500 of the refrigerated rail cars in service are equipped with meat-hanging rails designed to transport carcass beef. This number is composed of about 5,450 "RAM" type cars, 10,000 "RSM" type cars, and 50 "RPM" type cars. The RAM car has brine tank refrigeration which is designed primarily for the use of crushed ice and salt, usually without ventilating devices. The RSM car is equipped with ice bunkers for chunk ice, with or without ventilation. The RPM car is equipped with a mechanical refrigeration unit operated by its own power; that is, not through the car axle.

The RAM and RSM ice-type cars with beef-hanging rails have, for many years, been the only kinds used for hanging-beef shipments (that is, shipments of quarters of beef hanging from hooks on the rails). However, within the past few years several of the carriers have been experimenting with the mechanically refrigerated car for such shipments. Within the past 2 years "piggy-back," or trailer-on-flatcar, service has been initiated for hanging-beef shipments. Only a small number of such trailers are in this type of service.

Beef immediately after slaughter will have a temperature of 95° to 98° F. After slaughter the air temperature and air movement in the chilling room is regulated to lower the temperature of the beef as quickly as possible without freezing the outside surface of the meat. Beef will maintain its bloom and quality best when it is cooled and held at a temperature between 31° and 35°. If the temperature of the beef is allowed to rise above 35°, the tendency for mold to develop on the surface increases. Therefore, if beef is to maintain its quality and appearance the temperature should be kept between 31° and 35°.

The purpose of this test was to compare the performance of two mechanically refrigerated cars, two mechanically refrigerated trailers on a flat-car, and a water-ice car, as a control, when transporting freshly killed beef. The test was conducted between Lincoln, Nebr., and Philadelphia, Pa., in July 1958. Performances are measured in terms of temperatures and humidities maintained within the cars, fuel consumption, and refrigeration charges.

TEST CARS AND TRAILERS

The following cars and trailers were used in the test:

Car A

Body: Capacity, 75,000 pounds; load limit, 80,600 pounds; light weight, 55,400 pounds; 9 meat rails; floor racks; inside length, 34 feet 6 inches; inside width, 7 feet 7 inches; inside height, 6 feet 7 inches; inside volume, 1,727 cubic feet; insulation, rigid foam, 7 inches in floor and 6 inches in sides, ends, and roof; built November 1950.

Refrigeration Unit: Mechanical; 2-cylinder engine using propane fuel, 8.5 to 13 horsepower at 2,700 r.p.m., air-cooled, 12-volt starter and ignition system; 2-cylinder compressor; engine and compressor operation continuous at either high or low speed. Cold air is blown under the floor racks

and travels up through the floor racks and also around the load through side- and end-wall flues. The air travels thence over the top of the load to the return air grill.

Car B

Body: Capacity, 96,000 pounds; load limit, 96,200 pounds; light weight, 72,800 pounds; 9 meat rails; floor racks; inside length, 34 feet; inside width, 8 feet 3 inches; inside height, 6 feet 3 inches; inside volume, 1,815 cubic feet; insulation, 6 inches of hair insulation in floor, 8 inches of glass fiber in sides and ends, and 9 inches of glass fiber in roof; built December 1953.

Refrigeration Unit: Mechanical; 2-cylinder engine using diesel fuel, 18 horsepower at 1,800 r.p.m., water-cooled, 12-volt starting system; AC generator, 12 kilowatts, 220-volt, 39.4 amperes; 2-cylinder compressor. Cold air is circulated through a "semi-envelope" system. Cold air is blown into the false ceiling, down the side- and end-wall flues, and then under the floor racks to the return grill.

Car C

Body: Capacity, 103,000 pounds; load limit, 103,000 pounds; light weight, 66,000 pounds; 9 meat rails; floor racks; inside length, 33 feet 2 3/4 inches; inside width, 8 feet 3 inches; inside height, 6 feet 9 inches; 1,852 cubic feet, insulation, 4 1/2 inches of hair insulation in floor, 6 inches of glass fiber in sides and ends, and 6 inches of glass fiber in roof; side-wall air flues; built August 1955.

Refrigeration Unit: Three-stage ice bunker at each end of car. Cold air circulation depends upon natural convection from bottom of the bunkers to the underside of the floor racks, up through the load, and thence into the top of the bunkers.

Trailer D

Body: Seven meat rails mounted lengthwise in the trailer; inside length, 33 feet 10 5/8 inches; inside width, 7 feet 1/2 inch; inside height, 7 feet 2 1/2 inches; 1,720 cubic feet; insulation, 6 inches rigid foam and glass fiber in floor, sides, ends, and roof.

Refrigeration Unit: Mechanical unit mounted on nose of trailer, 4-cylinder gasoline engine, liquid-cooled, 24-volt starter and ignition system; 4-cylinder compressor directly connected to engine; engine starts and stops automatically, depending upon temperature need; unit refrigerates or heats. Cold air blast is at the top and air return is at the bottom of the unit without any ducts for air distribution inside the trailer.

Trailer E

Body: Seven meat rails mounted lengthwise in the trailer; inside length, 33 feet 11 inches; inside width, 7 feet 2 inches; inside height, 6 feet

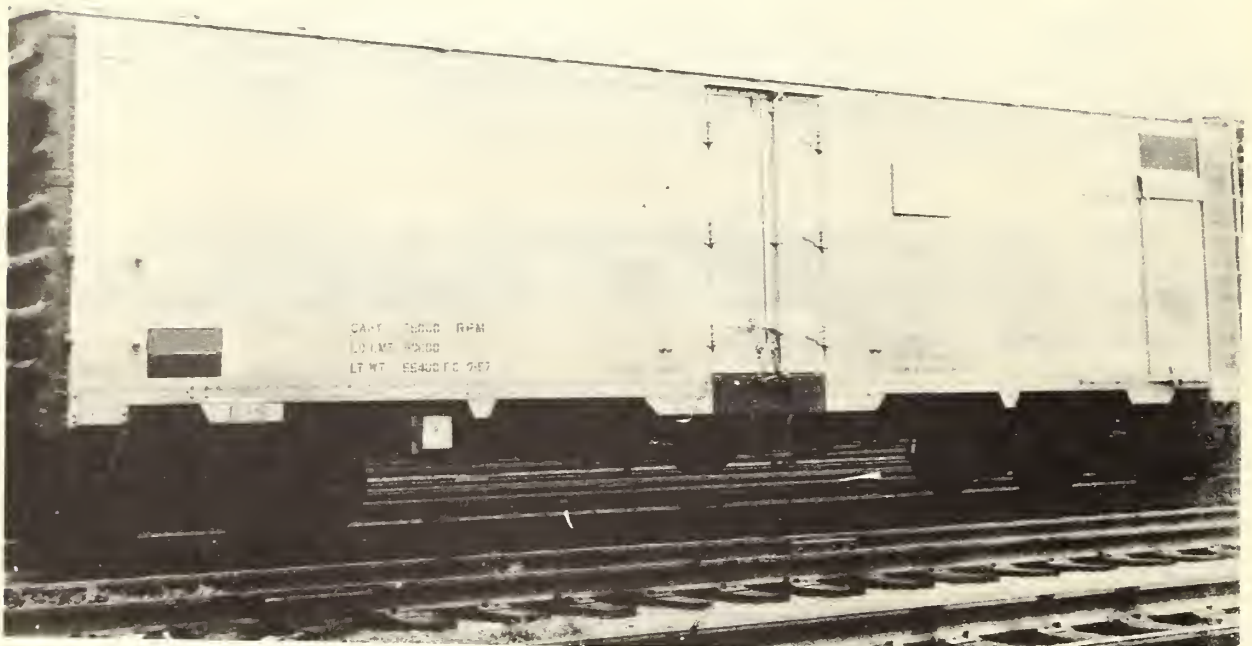
10½ inches; 1,714 cubic feet; insulation, 6 inches glass fiber in floor, sides, ends, and roof.

Refrigeration Unit: Mechanical; condensor mounted under trailer; evaporator mounted inside nose of trailer; 4-cylinder gasoline engine, liquid-cooled, 24-volt starter and ignition system; 4-cylinder compressor directly connected to engine; engine can be set for "start-stop" or continuous operation depending upon temperature need; unit refrigerates or heats. Cold air blast is at the top and air return is at the bottom of the unit without any ducts for air distribution inside the trailer.

Photographs of the above equipment are shown in figures 1 through 4.

TEST PROCEDURE

All of the beef for this test was slaughtered 2 days before loading and held in the chilling room so that the meat for each car and trailer would be approximately the same temperature at time of loading. Temperatures of a random sample of the carcasses were taken with a hand thermometer before loading. Each car and trailer was loaded with 96 forequarters and 96 hindquarters of beef. The thermostats of the mechanical refrigerating units were set at 34° F. Air and commodity temperatures inside each vehicle were obtained during transit by thermocouples; the temperature indicating instrument was mounted inside the caboose. Thirteen commodity temperatures, 5 air temperatures, and 1 wet bulb (for humidity) temperature were taken for each load at train



BN-7133

Figure 1.--Car A



BN-7138

Figure 2.--Car B



BN-7139

Figure 3.--Car C



BN-7137

Figure 4.--Trailers D (left) and E (right).

stops en route. The positions in cars and trailer at which temperatures were taken are shown in figures 5 through 8.

TEST RESULTS

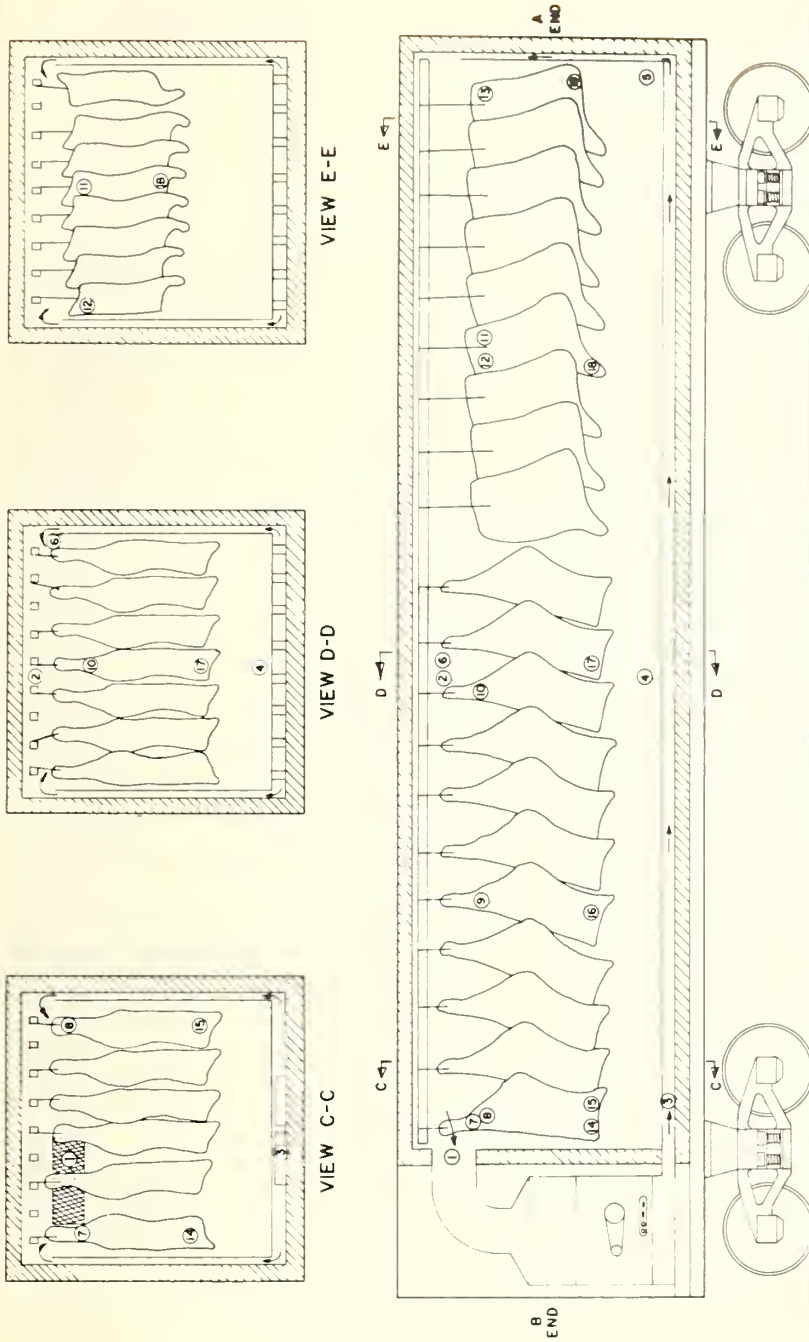
Temperatures of a random sample of the carcasses taken with a hand thermometer in the plant before loading ranged from 36° to 52° F.

The loading of the cars and trailers at the Lincoln plant proceeded smoothly. A canvas covering was used between the plant door and the car door to keep the inside of the car and the beef cool while loading. Loading was completed at 10:30 a.m. on July 23, and the test shipment arrived in Philadelphia at 4 p.m. on July 26, an in-transit time of 76½ hours.

Following is a resume of test results:

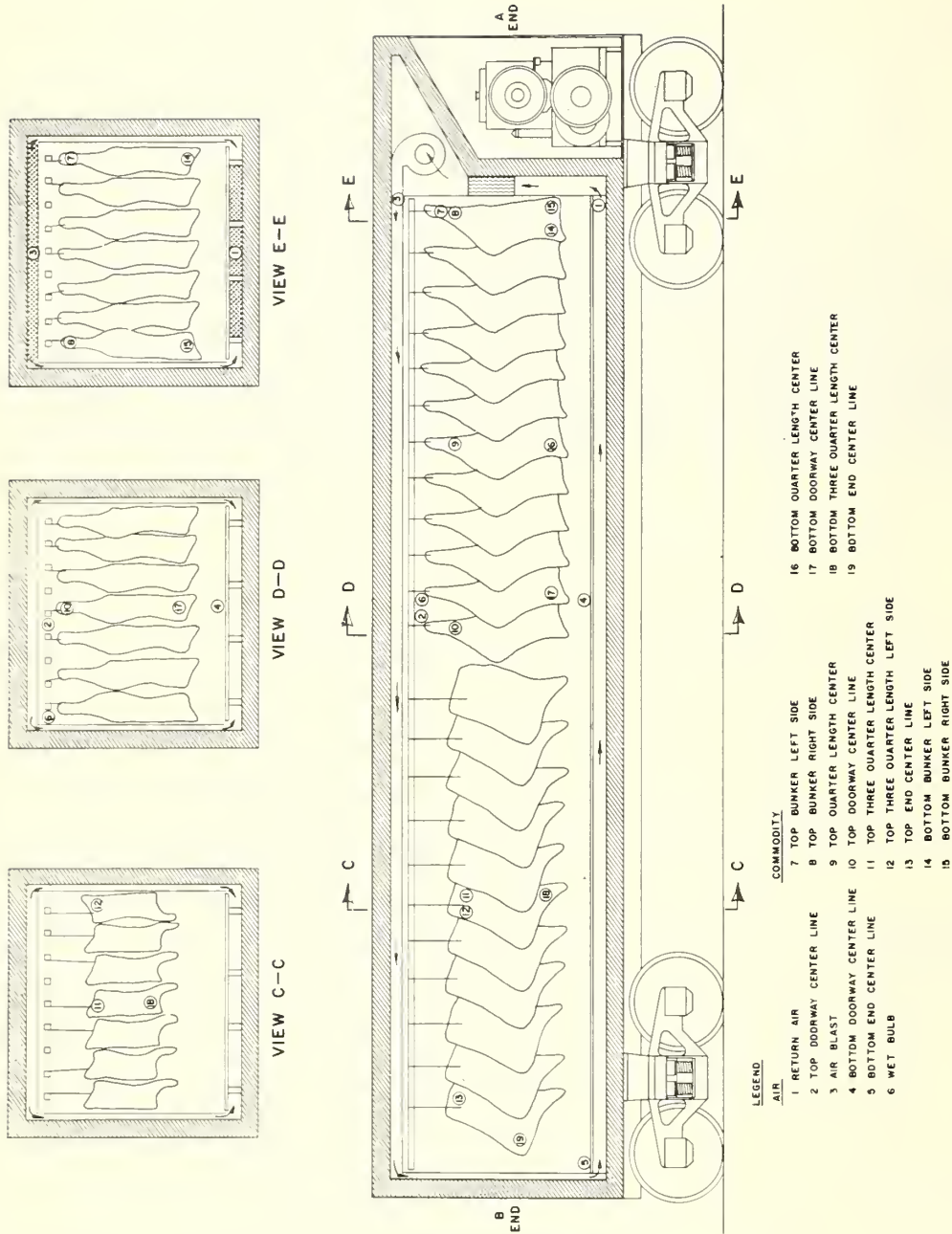
Car A

Load, 96 forequarters, 96 hindquarters	23,423 pounds
Temperature, taken at random with hand thermometer before loading, 4 carcasses	38° - 47° F.
Refrigeration thermostat setting	34° F.
Fuel used, propane, between 2 p.m., July 22 and 9 a.m., July 27 (114 hours)	65 gallons



- LEGEND**
- | | | | |
|------------|------------------------------|---------------------------------------|---------------------------------------|
| AIR | 1 RETURN AIR | 7 TOP BUNKER LEFT SIDE | 16 BOTTOM QUARTER LENGTH CENTER |
| | 2 TOP DOORWAY CENTER LINE | 8 TOP BUNKER RIGHT SIDE | 17 BOTTOM DOORWAY CENTER LINE |
| | 3 AIR BLAST | 9 TOP QUARTER LENGTH CENTER | 18 BOTTOM THREE QUARTER LENGTH CENTER |
| | 4 BOTTOM DOORWAY CENTER LINE | 10 TOP DOORWAY CENTER LINE | 19 BOTTOM END CENTER LINE |
| | 5 BOTTOM END CENTER LINE | 11 TOP THREE QUARTER LENGTH CENTER | |
| | 6 WET BULB | 12 TOP THREE QUARTER LENGTH LEFT SIDE | |
| | | 13 TOP END CENTER LINE | |
| | | 14 BOTTOM BUNKER LEFT SIDE | |
| | | 15 BOTTOM BUNKER RIGHT SIDE | |
- COMMODITY**

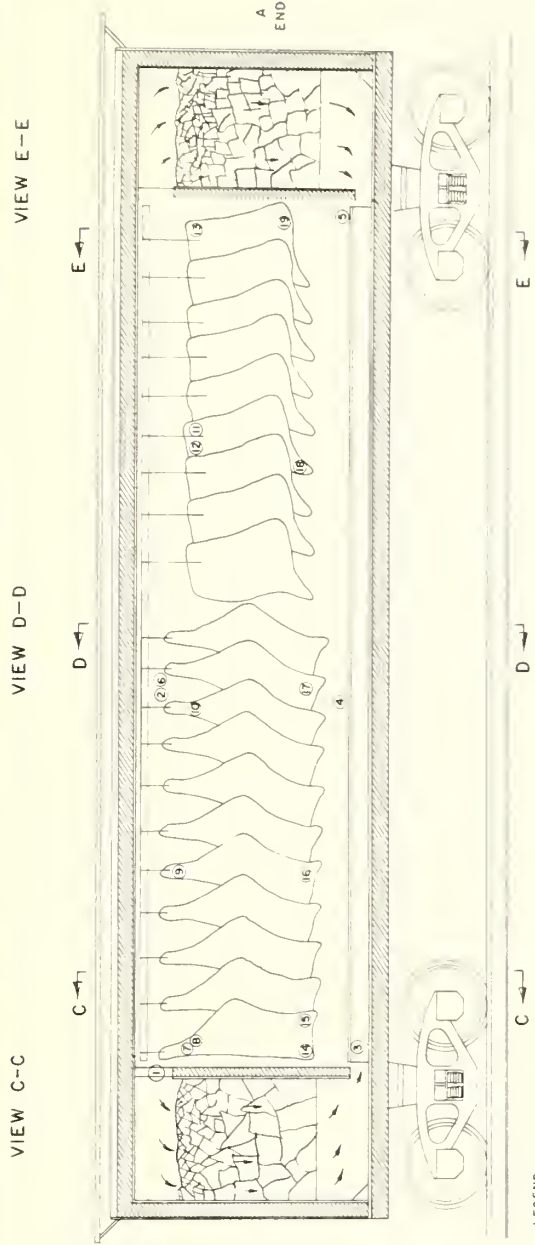
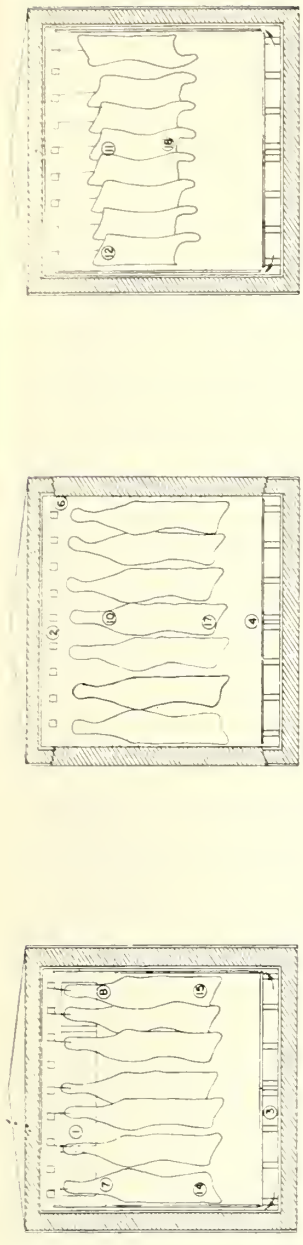
Figure 5.--Interior construction of Car A, including loading pattern and locations at which air and commodity temperatures were taken. Cross-sectional views of the load at points C, D, and E are shown in upper views C-C, D-D, and E-E, respectively.



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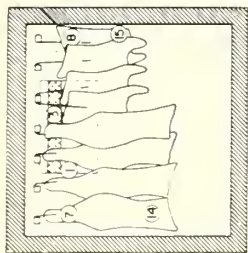
Figure 6.--Interior construction of Car B, including loading pattern and locations at which air and commodity temperatures were taken. Cross-sectional views of the load at points C, D, and E are shown in upper views C-C, D-D, and E-E, respectively.



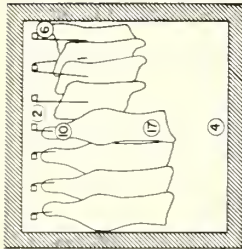
- LEGEND**
- | AIR | | COMMODITY | |
|-----|----------------------------|-----------|------------------------------------|
| 1 | RETURN AIR | 7 | TOP BUNKER LEFT SIDE |
| 2 | TOP DOORWAY CENTER LINE | 8 | TOP BUNKER RIGHT SIDE |
| 3 | AIR BLAST | 9 | TOP QUARTER LENGTH CENTER |
| 4 | BOTTOM DOORWAY CENTER LINE | 10 | TOP DOORWAY CENTER LINE |
| 5 | BOTTOM END CENTER LINE | 11 | TOP THREE QUARTER LENGTH CENTER |
| 6 | WET BULB | 12 | TOP THREE QUARTER LENGTH LEFT SIDE |
| | | 13 | TOP END CENTER LINE |
| | | 14 | BOTTOM BUNKER LEFT SIDE |
| | | 15 | BOTTOM BUNKER RIGHT SIDE |
| | | 16 | BOTTOM QUARTER LENGTH CENTER |
| | | 17 | BOTTOM DOORWAY CENTER LINE |
| | | 18 | BOTTOM THREE QUARTER LENGTH CENTER |
| | | 19 | BOTTOM END CENTER LINE |

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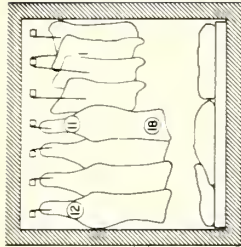
Figure 7.--Interior construction of car C, including loading pattern and locations at which air and commodity temperatures were taken. Cross-sectional view of the load at points C, D, and E are shown in views C-C, D-D, and E-E, respectively.



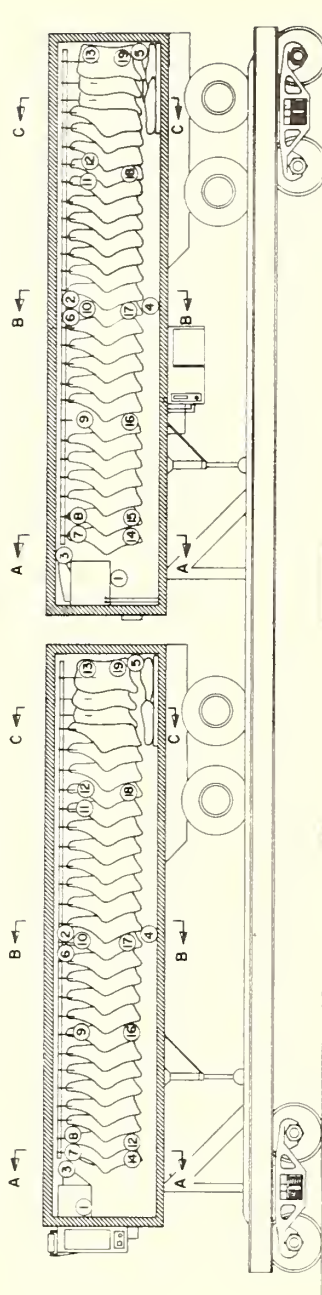
VIEW A-A



VIEW B-B



VIEW C-C



LEGEND

AIR

- 1 RETURN AIR
- 2 TOP DOORWAY CENTER LINE
- 3 AIR BLAST
- 4 BOTTOM DOORWAY CENTER LINE
- 5 BOTTOM END CENTER LINE
- 6 WET BULB

COMMODITY

- 7 TOP BUNKER LEFT SIDE
- 8 TOP BUNKER RIGHT SIDE
- 9 TOP QUARTER LENGTH CENTER
- 10 TOP DOORWAY CENTER LINE
- 11 TOP THREE QUARTER LENGTH CENTER
- 12 TOP THREE QUARTER LENGTH LEFT SIDE
- 13 TOP END CENTER LINE
- 14 BOTTOM BUNKER LEFT SIDE
- 15 BOTTOM BUNKER RIGHT SIDE

- 16 BOTTOM QUARTER LENGTH CENTER
- 17 BOTTOM DOORWAY CENTER LINE
- 18 BOTTOM THREE QUARTER LENGTH CENTER
- 19 BOTTOM END CENTER LINE

Figure 8.--Interior construction of trailer D (left) and E (right), including loading pattern and locations at which air and commodity temperatures were taken. Cross-sectional views of the load at points A, B, and C are shown in upper views A-A, B-B, and C-C, respectively.

Complete data obtained for this car are contained in tables 1 and 2 of the Appendix. A graph of average top and bottom air and commodity temperatures is shown in figure 9. The performance of this car was very good. The beef, after being loaded into the car had a maximum temperature of 46.0° F. at the top and 43.5° at the bottom. By the second day of the trip this car lowered the maximum beef temperature below 35° and held the maximum temperature below that point for the remainder of the trip. The average commodity temperatures ranged from 32° to 35°, with only a 2° spread between top and bottom of the beef.

Car B

Load, 96 forequarters, 96 hindquarters	24,437 pounds
Temperature, taken at random with hand thermometer	
before loading, 4 carcasses	38° - 50° F.
Refrigeration thermostat setting	34° F.
Fuel used, diesel No. 1, between 2 p.m., July 22	
and 9 a.m., July 27 (114 hours)	20 gallons

Complete data obtained for this car are contained in tables 3 and 4 of the Appendix. A graph of average top and bottom air and commodity temperatures is shown in figure 10. The diesel engine of the mechanical refrigerating unit stopped running several times during the trip. These shutdowns of the unit probably caused the low fuel consumption of 20 gallons as well as a greater fluctuation in air and commodity temperatures than would normally be expected. The unit was repaired, and toward the end of the trip maximum and average commodity temperatures were pulled down to a range of 33° to 35° F.

Car C

Load, 96 forequarters, 96 hindquarters	25,024 pounds
Temperature, taken at random with hand thermometer	
before loading, 4 carcasses	38° - 52° F.
Ice and salt used, between 3 p.m., July 22, and	
9:15 a.m., July 27 (113 hours) including quantity	
remaining in bunker at end of trip	Ice--13,000 pounds
	Salt- 1,300 pounds

Complete data obtained for this car are contained in tables 5 and 6 of the Appendix. A graph of average top and bottom air and commodity temperatures is shown in figure 11. This water-ice car had a greater spread between top and bottom air and commodity temperatures than did the other cars and trailers. This spread is typical of water-ice cars which have no air-circulating fans and depend entirely upon convection for air movement in the car. From Galesburg, Ill., to destination, a period of 3 days, the maximum commodity temperatures fluctuated between 37° and 49° F. Such temperatures are considerably higher than the 35° maximum recommended temperature.

Figure 11 shows that an extreme temperature rise occurred during the 6 hours immediately after loading while the car was stationary in the yards at Lincoln, Nebr. Other sharp rises in temperature coincide with times during which this car was stationary at yards.

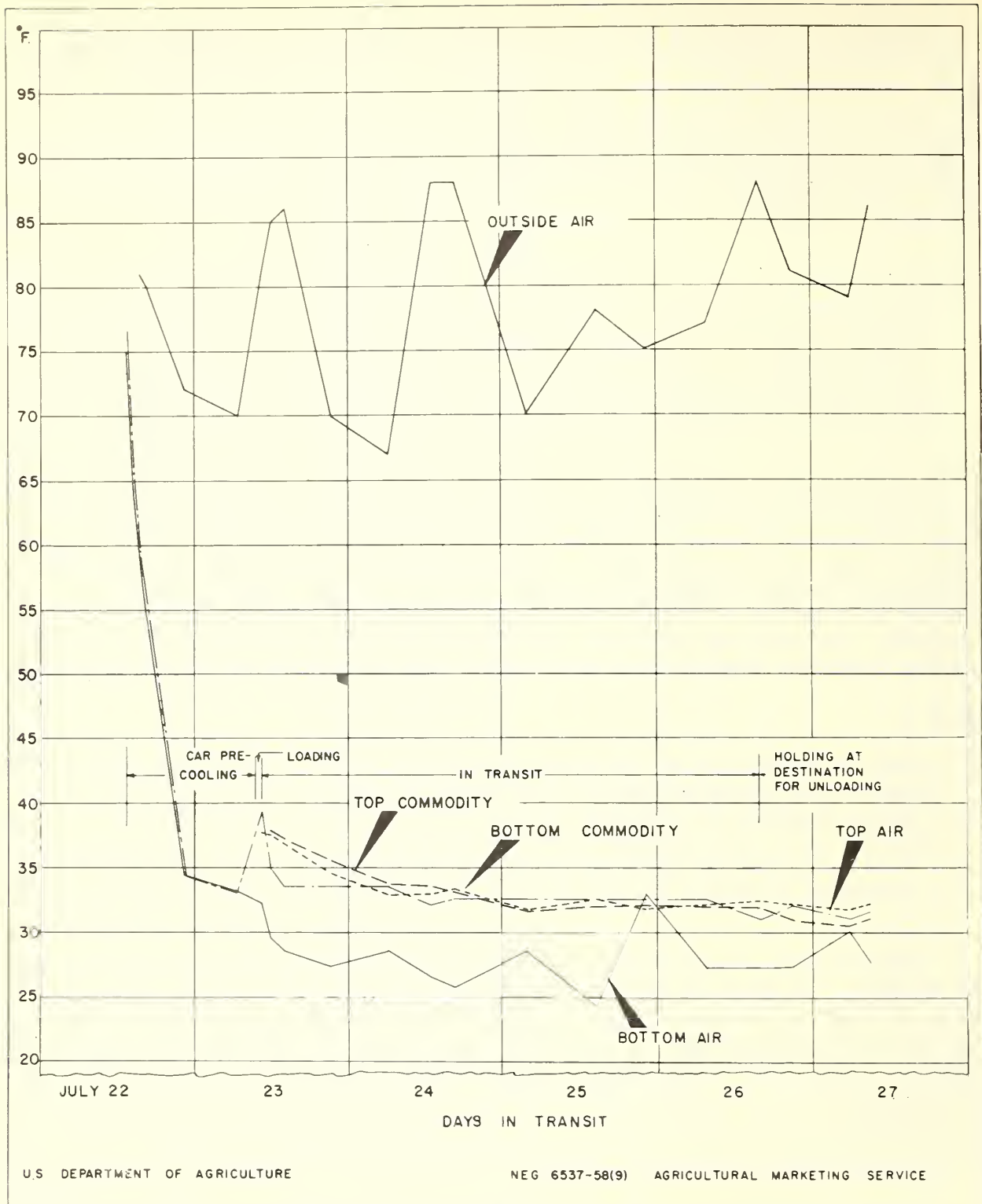


Figure 9.--Average air and commodity temperatures in Car A.

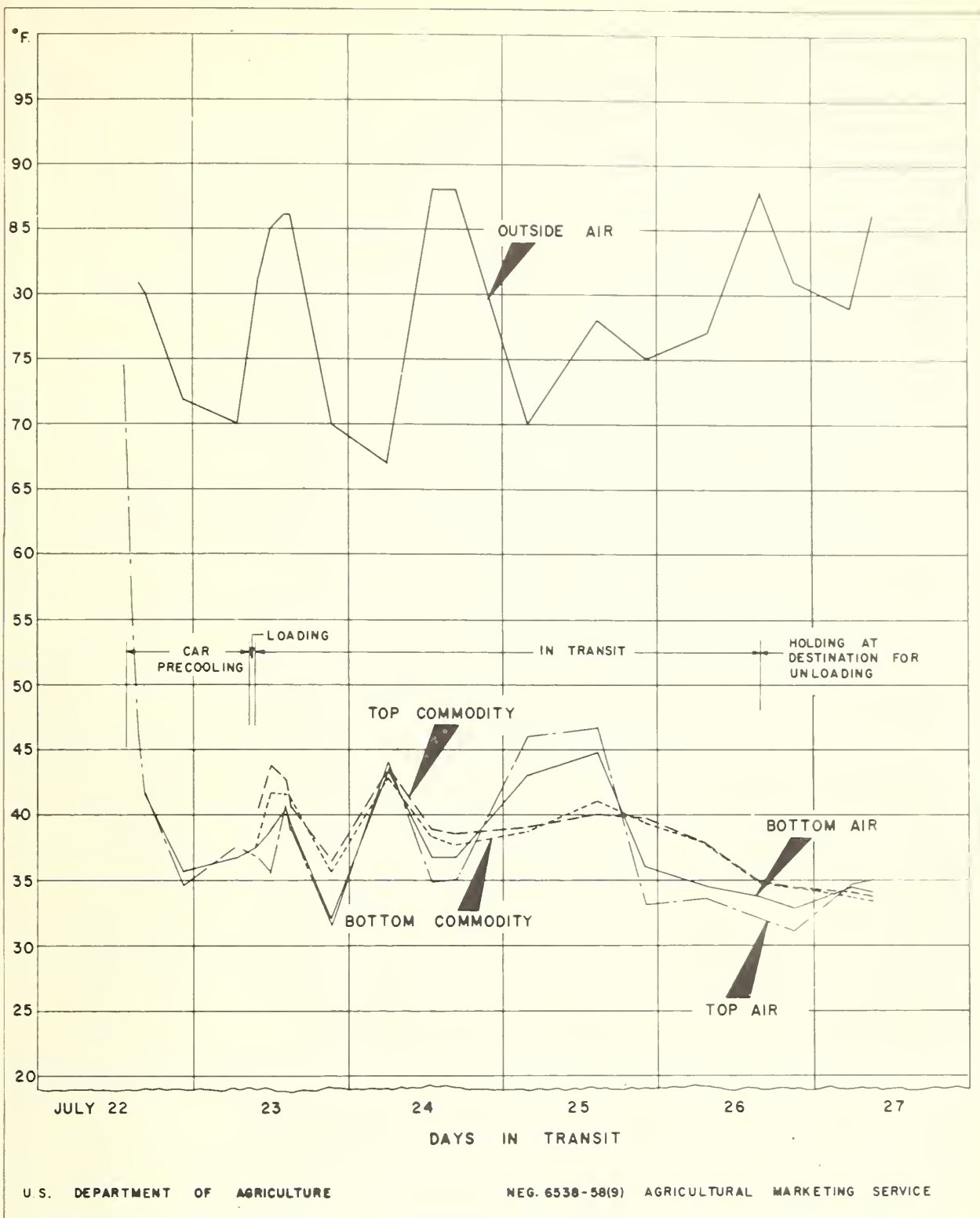


Figure 10.--Average air and commodity temperatures in Car B.

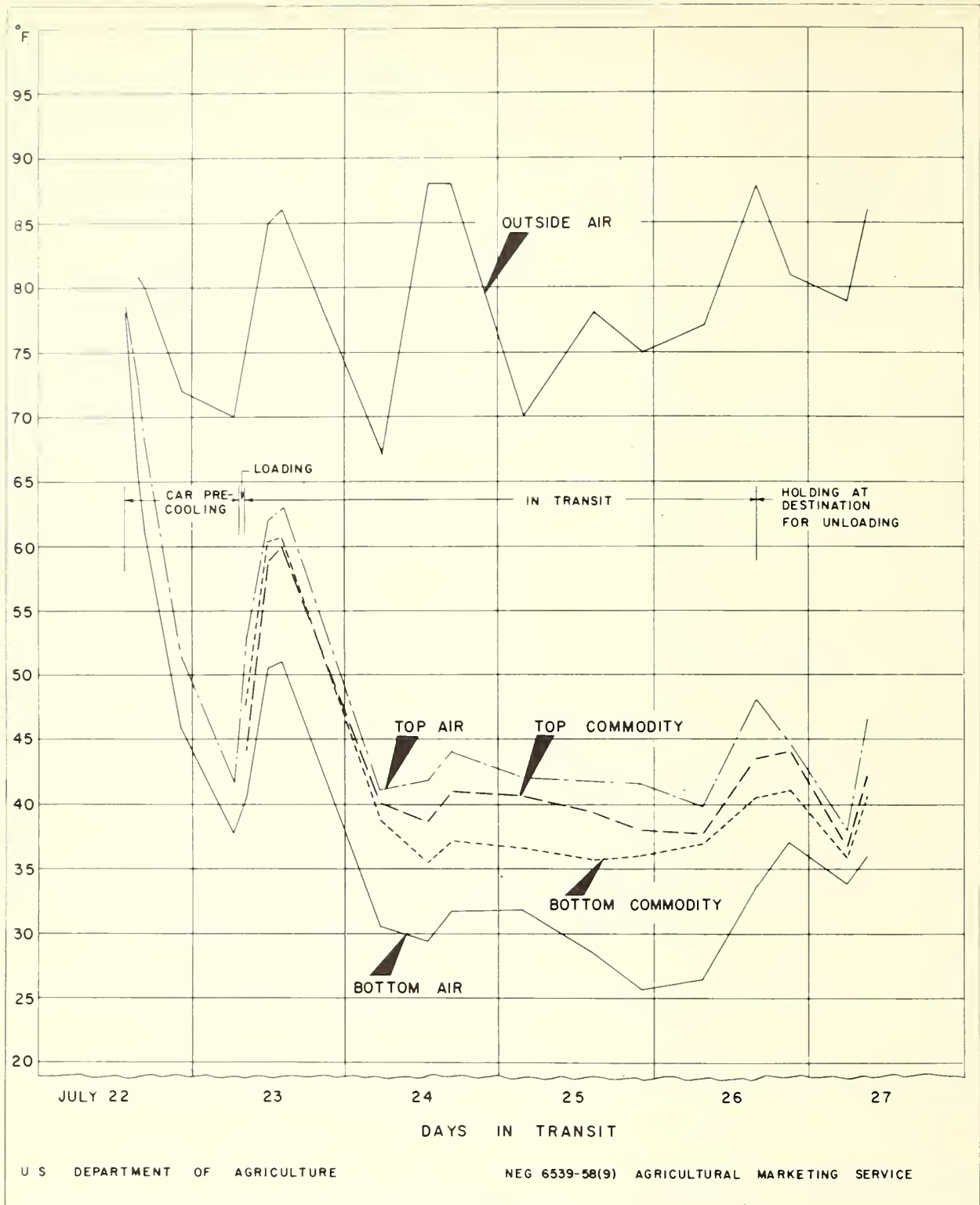


Figure 11.--Average air and commodity temperatures in Car C.

Two hindquarters of beef were on the floor at the end of the trip. All hanging beef in the other cars and trailers remained suspended to destination.

Trailer D

Load, 86 forequarters and 86 hindquarters, suspended weight, 22,362 pounds; 10 forequarters and 10 hindquarters on floor pallets, weight 1,332 pounds Total 23,694 pounds
Temperature, taken at random with hand thermometer before loading, 8 carcasses 36° - 50° F.
Refrigeration thermostat setting 34° F.
Fuel used, gasoline, between 4 a.m., July 23, and 10:30 a.m., July 27 (101½ hours) 59 gallons

Complete data obtained for this trailer are contained in tables 7 and 8 of the Appendix. A graph of average top and bottom air and commodity temperatures is shown in figure 12. Some interference with the electronic temperature indicator was experienced during the trip probably because of static from the electrical system of the trailer refrigerating unit. As a result, there are no temperature readings for some locations during the trip. However, the readings taken show that the commodity temperature in certain locations of the load was higher than desired. During the last 3 days of the trip, from Galesburg, Ill., to Philadelphia, Pa., the maximum commodity temperatures varied between 37.5 and 45° F., higher than the desired maximum of 35°

Table 8 shows that the maximum commodity temperatures occurred at positions 12, 13, 18, and 19 near the end of the trailer. The temperatures were probably higher at these positions because there are no ducts to distribute cold air to the rear of the trailer.

Trailer E

Load, 94 forequarters and 95 hindquarters, suspended weight, 24,747 pounds; 2 forequarters and 1 hindquarter on floor pallets, weight 479 pounds Total 25,226 pounds
Temperatures, taken at random with hand thermometer before loading, 8 carcasses 36° - 50° F.
Refrigeration thermostat setting 34° F.
Fuel used, gasoline, between 4 a.m., July 23 and 10:30 a.m., July 27 (101½ hours) 46 gallons

Complete data obtained for this trailer are contained in tables 9 and 10 of the Appendix. A graph of the average top and bottom air and commodity temperatures is shown in figure 13. The average commodity temperatures were below 35° only for the 11-hour period from Cicero, Ill., to Logansport, Ind. There were maximum temperatures as high as 41.8° during the trip and, as in trailer D, these higher temperatures occurred mainly at positions 12, 13, and 19 toward the rear of the trailer. This trailer had no ducts to insure distribution of cold air to the end of the trailer.

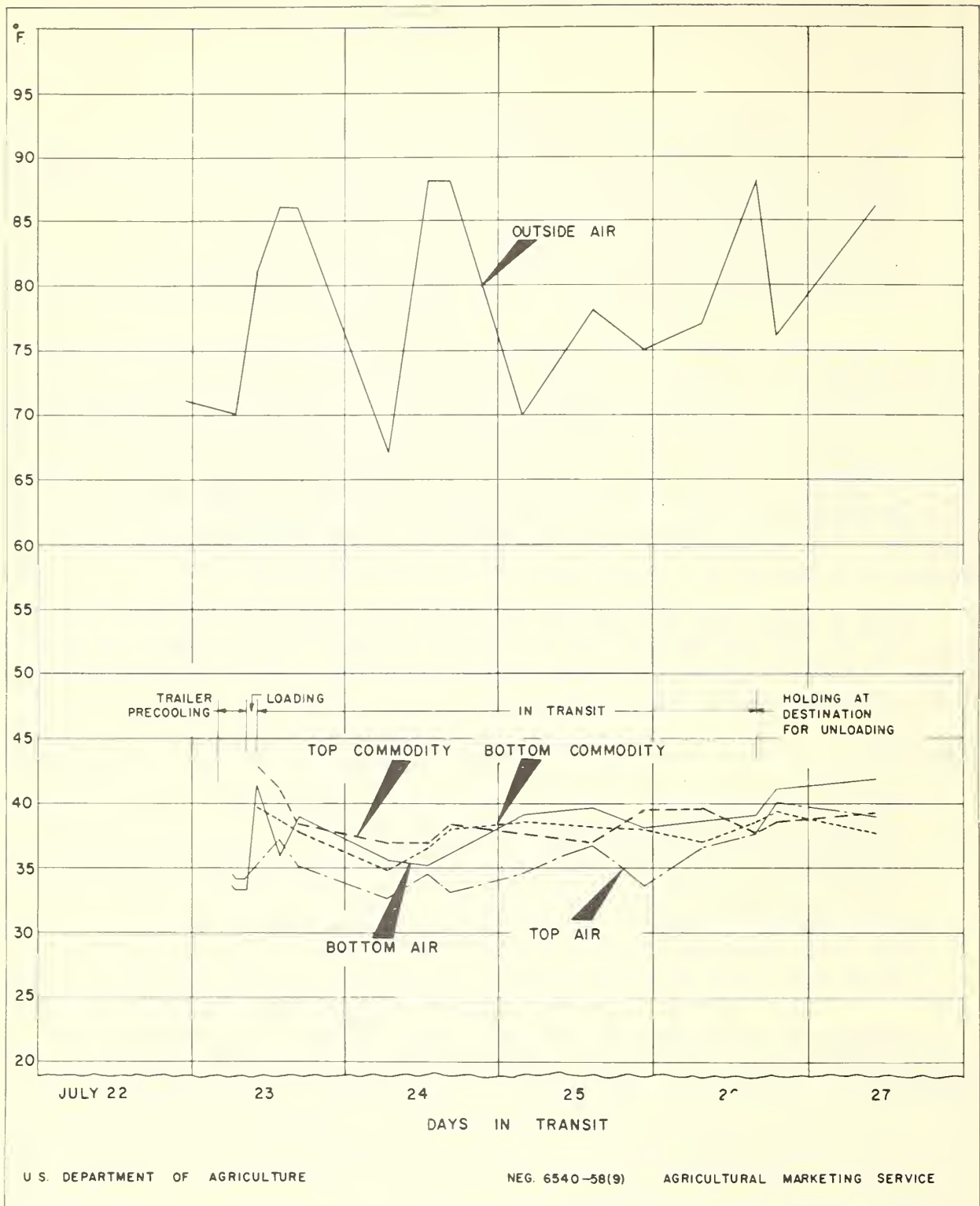


Figure 12.--Average air and commodity temperatures in Trailer D.

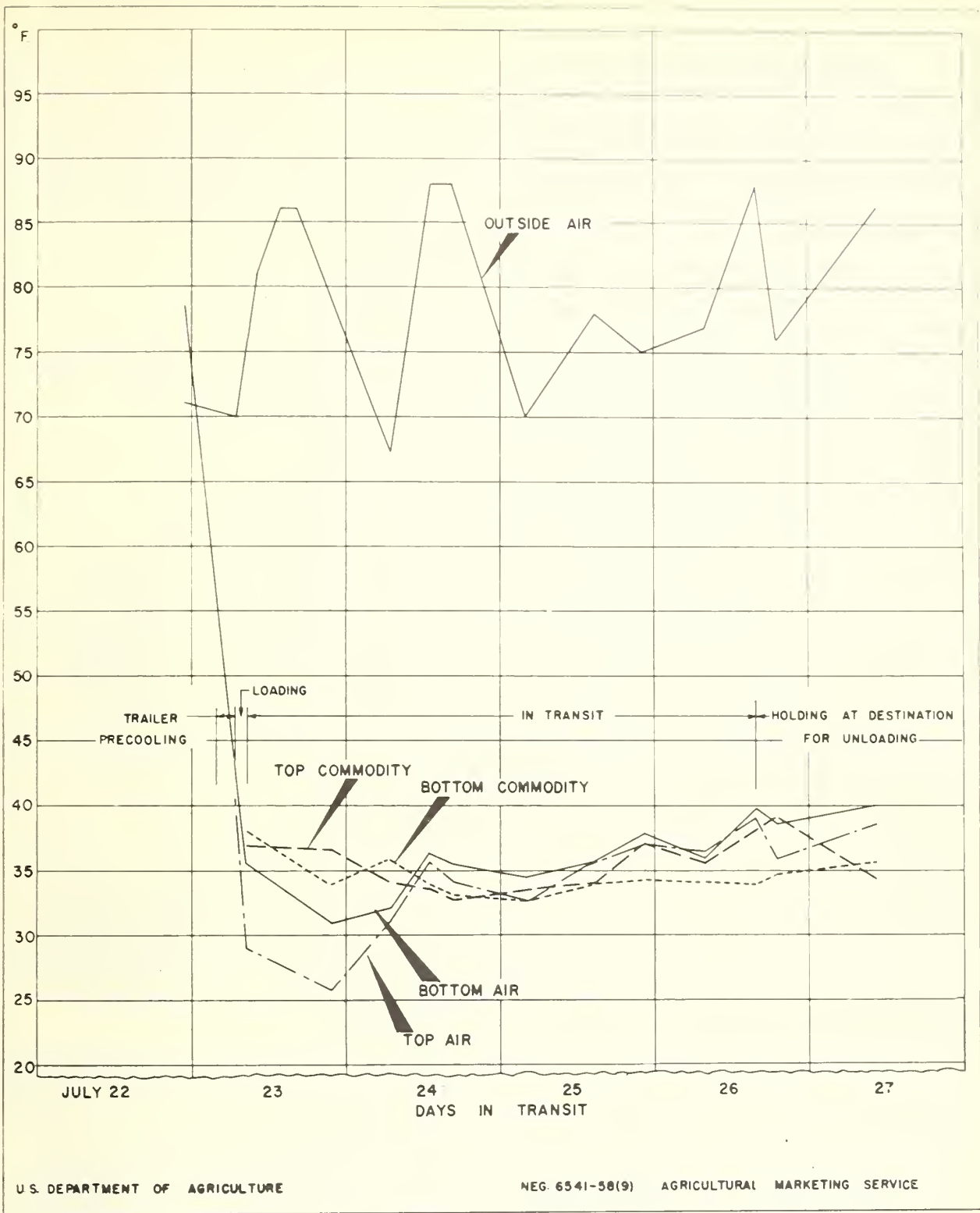


Figure 13.--Average air and commodity temperatures in Trailer E.

Humidity

Figure 14 is a record of the relative humidity of the air taken at the same location in each car and trailer. The humidity readings were taken in the same manner in each car and trailer, that is, by a thermocouple covered with a wet wick which gave a "wet-bulb" temperature. From these readings the relative humidity of the air was obtained from a standard psychrometric chart. During most of the time in transit the relative humidity in the ice car was between 70 and 80 percent while all of the mechanically refrigerated cars and trailers ranged between 83 and 100 percent.

Shrink En Route

The beef was unloaded at several different places at destination and accurate unloading weights were not available. Therefore, no accurate comparisons of loss of weight, or shrink, of the beef en route could be made.

TRANSPORTATION CHARGES

Following is a summary of transportation charges to the shipper:

	<u>Minimum weight</u>	<u>Freight rate per 100 lb.</u>	<u>Freight charge</u>	<u>Refrigeration charge</u>	<u>Total charge</u>
	<u>Pounds</u>	<u>Dollars</u>	<u>Dollars</u>	<u>Dollars</u>	<u>Dollars</u>
Car A	25,000	2.52	630.00	95.06	725.06
Car B	25,000	2.52	630.00	95.06	725.06
Car C	25,000	2.52	630.60	61.63	692.23
Trailer D	25,000	2.52	630.00	0	630.00
Trailer E	25,000	2.52	630.00	0	630.00

CONCLUSIONS

The packing plant at Lincoln was so designed that the cars and trailers could be loaded directly through the plant door into the car. This feature, together with use of a canvas cover between the plant door and the car door, keeps the car interior and the meat cool during loading. The arrangement is a considerable improvement over loading operations where an open loading dock allows warm outside air to enter the car or trailer.

Mechanically refrigerated car A gave the most consistent performance and maintained good air and commodity temperatures en route. Mechanically refrigerated car B showed fluctuations in air and commodity temperatures en route because the engine of the refrigerating unit did not operate properly. After the refrigerating unit had been repaired, this car also had good air and commodity temperatures. Commodity temperatures in water-ice car C were as high as 49° F. and fluctuated more than those in any of the mechanically refrigerated cars or trailers, particularly when the train was standing still in the yards. The mechanically refrigerated cars, which have blowers to circulate the air, are better able to cope with increases in solar heat load than ice

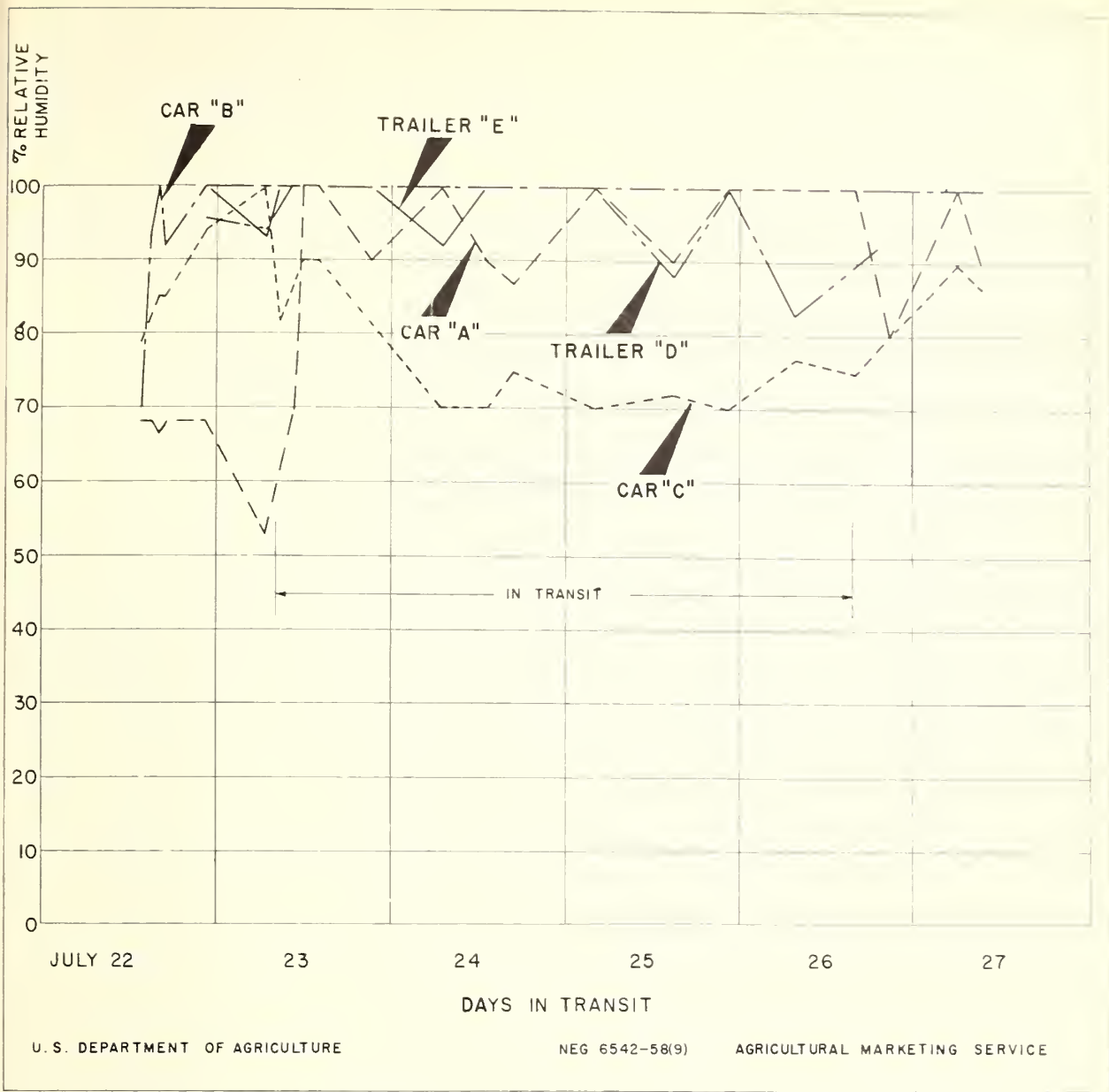


Figure 14.--Relative humidity in each car and trailer.

cars, which have inadequate air circulation. Also, there is no thermostatic control of air temperature in the ice car as in the mechanically refrigerated cars.

The mechanically refrigerated trailers had somewhat higher temperatures than desired, particularly at the rear of the load. This situation could probably be improved by blowing some of the cold air from the refrigerating unit through ducts to the rear of the trailer.

One trailer had a 50-gallon gasoline tank and the other an 18-gallon tank which required several fillings en route. Two 50-gallon tanks on a

trailer would save the time and labor cost of refilling en route. Also, at each stop the crewman had to climb up in the 1-foot space between trailers to read the temperature gage on the nose of trailer E. This task is inconvenient and hazardous. Temperature gages and controls should be mounted on the side of the trailer for ease in reading when the trailer is on a flatcar.

No conclusions can be reached regarding the difference in fuel consumption between cars A and B. The refrigerating unit in car B did not operate properly, and the fuel gage could have been indicating incorrectly. Likewise, the refrigerating units on trailers D and E were not similar, and differences in fuel consumption are not conclusive.

The rail cars were unloaded at a warehouse, while the trailers were unloaded at retail stores without intermediate unloading or warehousing. No data were obtained concerning length of route, number of stops, etc., for the trailers. However, the receiver indicated that the direct delivery of "piggy-back" trailer loads was a desirable feature.

No exact measurement can be made of the harmful effect upon beef if it is transported at a higher temperature than the desired range of 31° to 35° F. Many shipments probably arrive with good appearance and bloom even though the temperature was higher than 35° en route. Such treatment, however, will probably hasten the time at which the meat may lose its quality and appeal further in the distribution process. It is therefore to the interest of all concerned to make improvements in equipment where needed to insure transportation of fresh beef in the 31° to 35° temperature range.

APPENDIX

Table 1.--Air temperature data obtained from car A during a test from Lincoln, Nebr., to Philadelphia, Pa., July 23-26, 1958

Date	Place	Time	Air temperatures											
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
July 22	Lincoln, Nebr.	1:50 PM	-	-	77.0	78.0	77.5	70.0	78.0	75.0	74.3	70.0	68	
"	"	2:00 "	-	-	63.0	68.0	65.5	54.0	63.0	62.0	59.7	61.0	68	
"	"	3:00 "	-	-	57.0	63.0	60.0	48.0	57.0	57.0	54.0	56.0	66	
"	"	4:00 "	-	-	53.0	59.0	56.0	43.0	53.0	52.0	49.3	53.0	68	
"	"	5:00 "	-	-	37	38.0	35.0	31.0	30.0	32.0	31.0	35.0	68	
"	"	10:30 "	35	36	31.0	37.0	34.0	32.0	32.0	32.0	32.0	31.0	53	
July 23	"	6:45 AM	70	33	31.0	37.0	34.0	32.0	32.0	32.0	32.0	31.0	53	
<u>Precooling</u>														
Mechanical refrigerating unit started with thermostat set at 34° F.														
<u>Transit Test</u>														
July 23	Lincoln, Nebr.	9:50 AM	Loading started; completed at 10:30 a.m.											
"	"	10:35 "	82	45	55	36.0	43.0	39.5	30.5	33.0	32.2	39.0	70	
"	"	12:01 PM	85	36	38	33.0	37.0	35.0	26.0	31.0	29.6	35.0	100	
"	"	2:10 PM	86	36	38	33.0	34.0	33.5	26.0	29.0	28.6	35.0	100	
"	Creston, Iowa	9:20 "	70	35	35	32.0	35.0	33.5	21.0	26.0	24.8	34.0	90	
July 24	Galesburg, Ill.	6:25 AM	67	35	34	32.0	35.0	33.5	25.0	30.0	28.6	35.0	100	
"	Cicero, Ill.	1:00 PM	88	33	33	30.0	34.0	32.0	24.0	26.3	26.5	33.0	90	
"	Chicago, Ill.	4:50 "	88	33	35	30.0	35.0	32.5	22.5	26.0	25.8	33.5	87	
July 25	Logansport, Ind.	4:00 AM	70	-	31.0	34.0	32.5	24.0	30.0	32.0	28.6	34.0	100	
"	Columbus, Ohio	2:45 PM	78	34	35	31.0	34.0	32.5	20.0	26.0	24.3	33.0	90	
"	Pitcairn, Pa.	10:20 "	75	34	35	32.0	33.0	32.5	35.0	32.0	33.0	34.0	100	
July 26	Enola, Pa.	7:45 AM	77	35	35	31.0	34.0	32.5	23.0	29.0	27.3	34.0	100	
"	Phila., Pa.	4:00 PM	88	33	34	30.0	32.0	31.0	24.0	27.0	27.3	32.0	100	
"	"	9:00 "	81	33	35	30.0	34.0	32.0	28.0	26.0	27.3	32.0	80	
July 27	"	6:00 AM	79	33	33	31.0	31.0	31.0	28.0	31.0	30.0	31.0	100	
"	"	9:15 "	86	33	34	30.0	33.0	31.5	26.0	28.0	27.6	32.0	90	

1/ For locations at which temperatures were taken in car, see figure 5.

Table 2.--Commodity temperature data obtained from car A during a test from Lincoln, Nebr., to Philadelphia, Pa., July 23-26, 1958

Date	Place	Time	Commodity temperatures														
			Top 1/						Bottom 1/								
			TBLS : (7)	TQCL : (8)	T3/4CL : (9)	T3/4CL : (10)	T3/4CL : (11)	T3/4CL : (12)	T3/4CL : (13)	Average : (14)	BBS : (15)	BQCL : (16)	BDCL : (17)	B3/4CL : (18)	BECL : (19)	Average	
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	
July 22:	Lincoln, Nebr.	1:50 PM:	76.0	76.0	77.0	78.0	76.0	76.0	76.0	76.0	76.0	77.0	78.0	77.0	76.0	-	
"	"	2:00 "	Mechanical refrigerating unit started with thermostat set at 34° F.														
"	"	3:00 "	64.0	64.0	66.0	67.0	63.0	62.0	62.0	62.0	63.0	62.0	69.0	69.0	67.0	69.0	-
"	"	4:00 "	58.0	59.0	60.0	61.0	62.0	57.5	56.0	-	58.0	56.0	65.0	63.5	62.0	56.0	-
"	"	5:00 "	54.0	55.0	56.0	57.0	58.0	53.0	52.0	-	53.0	52.0	60.0	59.0	58.0	51.0	-
"	"	10:30 "	33.0	33.0	34.0	35.0	37.0	31.0	32.0	-	32.0	30.0	40.0	38.5	37.0	29.0	-
July 23:	"	6:45 AM:	32.0	32.0	32.0	33.5	33.5	32.0	32.0	-	32.0	31.5	35.5	34.0	33.0	31.0	-
Transit Test																	
July 23:	Lincoln, Nebr.	9:50 AM:	Loading started; completed at 10:30 a.m.														
"	"	10:35 "	38.0	46.0	39.0	38.0	33.5	34.0	35.0	37.6	33.0	39.0	43.5	33.0	35.0	43.0	37.8
"	"	12:01 PM:	38.0	45.0	40.0	39.0	33.0	35.0	35.0	37.9	33.5	39.0	42.5	32.0	36.0	42.0	37.5
"	"	2:10 "	37.0	43.0	39.0	38.0	33.5	35.0	35.0	37.2	33.0	37.0	42.0	31.0	35.5	42.0	36.8
"	Creston, Iowa	9:20 "	34.0	40.0	38.0	36.0	32.5	33.5	35.0	35.6	31.0	34.0	38.0	30.0	35.5	38.5	34.5
July 24:	Galesburg, Ill.	6:25 AM:	32.0	36.0	35.0	34.5	32.0	33.0	34.0	33.8	30.0	32.0	36.0	29.0	33.5	36.5	32.8
"	Cicero, Ill.	1:00 PM:	31.0	35.6	35.3	34.0	33.0	33.5	33.7	33.7	30.0	31.0	36.5	29.5	33.5	37.0	32.9
"	Chicago, Ill.	4:50 "	30.5	34.0	35.0	33.0	33.5	33.0	33.0	33.1	30.0	30.5	38.0	29.5	32.5	39.5	33.3
July 25:	Logansport, Ind.	4:00 AM:	29.0	32.0	32.5	31.5	33.0	32.0	32.0	31.7	29.5	29.5	36.0	29.0	31.0	36.0	31.8
"	Columbus, Ohio	2:45 PM:	30.0	32.0	32.0	32.0	32.0	33.0	33.0	32.0	30.0	30.0	37.0	29.0	32.0	37.0	32.5
"	Pitcairn, Pa.	10:20 "	30.0	32.0	32.0	32.0	33.0	33.0	33.0	32.1	30.0	30.0	35.0	30.0	31.0	35.0	31.8
July 26:	Enola, Pa.	7:45 AM:	31.0	31.0	32.0	32.0	33.0	33.0	33.0	31.9	30.0	31.0	35.0	29.5	32.0	35.0	32.1
"	Philadelphia, Pa.	4:00 PM:	30.0	32.0	32.0	32.0	32.0	32.0	33.0	31.9	30.0	30.0	36.0	29.5	32.0	37.0	32.4
"	"	9:00 "	30.0	31.0	31.0	31.5	31.0	31.0	31.0	30.7	28.5	30.0	36.5	30.0	31.0	36.5	32.1
July 27:	"	6:00 AM:	30.0	30.0	31.0	31.0	31.0	31.0	30.0	30.6	29.0	30.0	36.0	29.0	30.0	36.5	31.8
"	"	9:15 "	31.0	31.0	31.0	31.0	31.0	31.0	31.0	31.0	30.0	31.0	35.0	30.0	31.5	35.0	32.1

1/ For locations at which temperatures were taken in car, see figure 5.

2/ Data shown during precooling are actually air temperatures for positions at which commodity temperatures were taken after loading.

Table 3.--Air temperature data obtained from car B during a test from Lincoln, Nebr., to Philadelphia, Pa., July 23-26, 1958

Date	Place	Time	Air temperatures												
			Car thermometer:		Top 1/		Bottom 1/		Return:		Bulb:		Rel.		
			Top	Bottom	Top	IDCL	Average	BDCL	BECL	Average	(1)	(4)	(5)	(6)	Wet
°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	
Precooling															
July 22:	Lincoln, Nebr.	1:50 PM:	-	-	74.0	76.0	75.0	68.0	78.0	74.0	73.3	69.0	70		
"	"	2:05 "	-	-	49.0	57.0	53.0	52.0	56.0	56.0	54.7	56.0	94		
"	"	3:00 "	-	-	41.5	48.0	44.7	44.0	48.0	47.0	46.3	48.0	100		
"	"	4:00 "	81	-	37.0	43.0	40.0	43.0	43.0	42.0	42.7	42.0	92		
"	"	5:00 "	80	-	31.0	35.0	33.0	36.0	36.0	35.0	35.7	35.0	100		
"	"	10:30 "	72	-	38.0	37.0	37.5	37.0	37.0	37.0	37.0	37.0	100		
July 23:	"	6:45 AM:	70	-											
Transit Test															
July 23:	Lincoln, Nebr.	8:45 AM:	Loading started; completed at 9:45 a.m.												
"	"	9:55 "	81	-	34.0	39.2	36.6	38.0	38.0	36.5	37.5	37.2	83		
"	"	12:01 PM:	85	-	33.0	38.0	35.5	40.0	38.0	38.0	38.7	39.0	100		
"	"	2:10 "	86	37	38	40.0	41.0	40.5	42.0	40.0	40.3	41.0	100		
"	"	3:00 "	86	-	39.0	39.0	39.0	39.0	39.0	40.0	39.3	40.0	100		
"	Creston, Iowa	9:20 "	70	35	38	31.0	32.0	31.5	31.3	32.0	31.9	32.5	100		
July 24:	Galesburg, Ill.	6:20 AM:	67	34	37	44.0	44.0	44.0	44.0	44.0	43.3	44.0	100		
"	Cicero, Ill.	1:00 PM:	88	32	34	33.0	36.7	34.9	36.0	36.7	36.5	37.5	100		
"	Chicago, Ill.	4:50 "	88	33	35	33.0	37.0	35.0	36.0	37.0	36.7	38.0	100		
July 25:	Logansport, Ind.	4:00 AM:	70	-	45.5	44.0	44.8	45.0	41.0	43.0	43.0	44.0	100		
"	Columbus, Ohio	2:45 PM:	78	46	46	46.5	47.0	46.7	46.0	44.0	44.7	47.0	100		
"	"	3:00 "	-	-	Mechanical unit stopped. Alternator brushes replaced. Thermostat set to 34°. Restarted.										
"	Pitcairn, Pa.	10:20 "	75	31	35	30.0	36.0	33.0	37.0	36.0	36.0	40.0	100		
July 26:	Enola, Pa.	7:45 AM:	77	30	32	31.0	34.0	32.5	35.0	34.0	34.3	35.0	100		
"	Phila., Pa.	4:00 PM:	Mechanical unit stopped. Restarted.												
"	"	4:10 "	88	33	34	30.0	33.8	31.9	34.0	33.2	33.5	35.0	100		
"	"	9:00 "	81	33	32	29.0	33.0	31.0	33.0	33.0	32.7	34.0	100		
July 27:	"	6:00 AM:	79	31	34	34.0	35.0	34.5	34.0	35.0	34.3	35.0	100		
"	"	8:00 "	-	-	Mechanical unit stopped. Restarted.										
"	"	9:15 "	86	32	36	35.0	35.0	35.0	34.0	34.0	34.0	35.0	100		

1/ For locations at which temperatures were taken in car, see figure 6.

Table 4.--Commodity temperature data obtained from car B during a test from Lincoln, Nebr., to Philadelphia, Pa., July 23-26, 1958

Date	Place	Time	Commodity temperatures														
			Top 1/2						Bottom 1/2								
			TBLS : (7)	TQCL : (8)	TDCL : (9)	T3/4CL : (10)	T3/4CL : (11)	T3/4CL : (12)	TECL : (13)	Average : (14)	BBS : (15)	BQCL : (16)	BDCL : (17)	B3/4CL : (18)	BECL : (19)	Average	
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	
Precooling 2/																	
July 22:	Lincoln, Nebr.	1:50 PM:	75.0	72.0	75.0	77.0	74.0	75.0	72.0	-	75.0	74.0	77.0	74.0	72.0	-	
"	"	2:05 "	Mechanical refrigerating unit started with thermostat set at 34° F.														
"	"	3:00 "	58.0	61.0	56.0	54.0	55.0	55.0	57.0	-	57.0	58.0	57.0	54.0	57.0	-	
"	"	4:00 "	49.0	52.0	47.0	46.0	46.0	46.0	48.0	-	49.0	49.0	47.5	45.0	48.0	-	
"	"	5:00 "	43.0	46.0	41.0	43.0	41.0	41.0	42.0	-	43.0	43.0	41.0	42.0	42.0	-	
"	"	10:30 "	36.0	37.0	35.0	37.0	35.0	35.0	36.0	-	36.0	36.0	36.0	35.0	36.0	-	
July 23:	"	6:45 AM:	37.0	37.0	37.0	37.0	37.0	37.0	37.0	-	37.0	37.0	37.0	37.0	36.5	-	
Transit Test																	
July 23:	Lincoln, Nebr.	8:45 AM:	Loading started; completed at 9:45 a.m.														
"	"	9:55 "	45.0	42.5	40.5	46.0	35.0	38.7	35.0	40.4	33.0	39.6	30.0	37.6	46.0	41.0	37.9
"	"	12:01 PM:	48.0	45.0	51.0	44.0	38.0	41.0	39.0	43.7	39.0	43.0	41.0	41.0	43.0	43.0	41.7
"	"	2:10 "	48.0	44.0	49.0	43.0	37.0	40.0	38.0	42.7	40.0	42.0	41.0	40.0	44.0	42.0	41.5
"	"	3:00 "	47.0	44.0	40.0	40.0	37.0	38.0	38.5	40.6	40.0	42.0	42.0	39.0	42.0	42.5	41.3
"	Creston, Iowa	9:20 "	38.0	36.0	39.5	38.0	37.2	34.3	31.3	36.3	35.0	35.0	35.0	32.8	40.5	34.0	35.4
July 24:	Galesburg, Ill.	6:20 AM:	46.0	43.0	45.0	46.0	40.0	42.0	43.0	43.6	43.0	43.0	42.0	44.0	43.0	42.0	42.8
"	Chicago, Ill.	1:00 PM:	40.0	38.3	41.0	39.8	37.0	38.0	37.2	38.8	37.0	38.3	38.2	38.5	38.0	38.2	38.2
"	Chicago, Ill.	4:50 "	39.5	38.0	40.0	39.0	37.0	37.5	37.0	38.3	36.5	37.0	38.0	38.0	38.0	38.0	37.6
July 25:	Logansport, Ind.	4:00 AM:	39.0	39.0	39.0	39.0	38.0	40.0	39.0	39.0	39.0	39.0	38.0	40.0	38.0	38.0	38.7
"	Columbus, Ohio	2:45 PM:	42.0	47.0	40.0	41.0	41.0	43.0	43.0	41.7	42.0	42.0	40.0	42.0	40.0	40.0	41.0
"	"	3:00 "	Mechanical unit stopped. Alternator brushes replaced. Thermostat set to 34°. Restarted.														
"	Pitcairn, Pa.	10:20 "	40.0	39.0	40.0	41.0	40.0	39.0	39.0	39.7	39.0	39.0	39.0	39.0	40.0	40.0	39.3
July 26:	Enola, Pa.	7:45 AM:	38.0	37.0	39.0	39.0	37.0	38.0	36.0	37.7	37.0	37.0	38.0	37.0	38.0	39.0	37.7
"	Philadelphia, Pa.	4:00 PM:	Mechanical unit stopped. Restarted.														
"	"	4:10 "	36.0	35.0	35.2	35.2	34.0	34.0	34.0	34.8	34.7	35.0	34.7	35.0	34.8	35.0	34.9
"	"	9:00 "	35.0	34.0	36.0	35.0	34.0	34.0	33.0	34.4	34.0	34.0	35.0	34.0	35.0	35.0	34.5
July 27:	"	6:00 AM:	34.0	34.0	35.0	35.0	33.0	33.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
"	"	8:00 "	Mechanical unit stopped. Restarted.														
"	"	9:15 "	34.0	33.0	34.0	35.0	33.0	33.0	33.0	33.6	33.0	33.0	33.0	34.0	33.0	33.0	33.2

1/ For locations at which temperatures were taken in car, see figure 6.

2/ Data shown during precooling are actually air temperatures for positions at which commodity temperatures were taken after loading.

Table 5.--Air temperature data obtained from car C during a test from Lincoln, Nebr., to Philadelphia, Pa., July 23-26, 1958

Date	Place	Time	Out-side	Air temperatures											
				Top 1/		Average		Bottom 1/		Average		Wet Bulb	Rel. Hum.		
				(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
				°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%
Precooling															
July 22	Lincoln, Nebr.	2:00 PM		79.0	79.0	79.0	78.0	79.0	77.7			74.0	79		
"	"	2:45 "	Initial icing started; Completed 3 p.m.; 8,000 pounds crushed ice, plus 10 percent salt.												
"	"	4:00 "	81	72.0	74.5	73.7	43.0	70.0	46.5	53.2	71.0	85			
"	"	5:00 "	80	69.0	71.0	70.0	39.0	66.0	43.0	49.3	68.0	85			
"	"	10:30 "	72	52.0	53.0	52.5	30.0	50.0	33.0	37.7	52.0	94			
July 23	"	5:45 AM	70	42.0	43.0	42.5	27.0	41.0	28.0	32.0	43.0	100			
Transit Test															
July 23	Lincoln, Nebr.	7:30 AM	Loading started; completed at 8:15 a.m.												
"	"	8:25 "	75	52.0	54.0	53.0	32.0	54.0	34.0	40.4	51.0	82			
"	"	12:01 PM	85	61.0	63.0	62.0	43.0	64.0	46.0	50.4	61.0	90			
"	"	12:40 "	Re-iced, 1,200 pounds ice, 120 pounds salt.												
"	"	2:10 "	86	62.0	64.0	63.0	42.0	65.0	46.0	51.0	62.0	90			
July 24	Galesburg, Ill.	6:00 AM	Re-iced, 2,000 pounds ice, 200 pounds salt.												
"	"	7:00 AM	67	40.0	42.0	41.0	23.0	43.0	25.0	30.3	38.0	70			
"	"	1:00 PM	88	40.5	43.0	41.8	21.0	41.8	25.0	29.3	39.0	70			
"	"	4:50 "	88	42.5	45.5	44.0	25.5	42.0	27.3	31.6	42.0	75			
July 25	Logansport, Ind.	4:00 AM	70	41.0	43.0	42.0	24.5	41.8	28.5	31.6	39.0	70			
"	"	2:45 PM	78	41.0	42.3	41.7	26.4	29.5	29.0	28.3	38.5	72			
"	"	3:00 "	Re-iced, 1,800 pounds ice, 180 pounds salt.												
"	"	10:20 "	75	40.5	42.0	41.4	22.5	27.0	27.4	25.6	38.0	70			
July 26	Enola, Pa.	7:45 AM	77	39.2	40.3	39.8	23.3	27.5	28.0	26.3	37.6	77			
"	"	4:00 PM	88	47.0	49.2	48.1	31.8	34.0	35.0	33.6	45.4	75			
"	"	9:00 "	81	40.0	49.0	44.5	40.0	35.0	36.0	37.0	46.0	80			
July 27	"	6:00 AM	79	37.0	39.0	38.0	33.0	34.0	34.0	33.7	38.0	90			
"	"	9:15 "	86	46.0	47.0	46.5	35.0	36.0	37.0	36.0	45.0	87			

1/ For locations at which temperatures were taken in car, see figure 7.

Table 6.--Commodity temperature data obtained from car C during a test from Lincoln, Nebr., to Philadelphia, Pa., July 23-26, 1958

Date	Place	Time	Commodity temperatures													
			Top 1/4						Bottom 1/4							
			TBLS : (7)	TQCL : (8)	TDCL : (9)	T3/4CL : (10)	T3/4CL : (11)	T3/4CL : (12)	TECL : (13)	Average : (14)	BBSL : (15)	BQCL : (16)	BDCL : (17)	B3/4CL : (18)	Average : (19)	
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	
Precooling 2/																
July 22:	Lincoln, Nebr.	2:00 PM	78.0	78.0	80.0	78.0	78.0	79.0	-	78.0	78.0	78.0	80.0	78.0	77.0	-
"	"	2:45 "	Initial icing started; Completed 3 p.m.; 8,000 pounds crushed ice, plus 10 percent salt.													
"	"	4:00 "	72.0	71.0	75.0	76.0	72.0	63.0	-	67.0	69.0	75.0	75.0	76.0	65.0	-
"	"	5:00 "	68.0	67.0	72.0	70.0	68.0	58.0	-	62.0	65.0	72.0	70.0	73.0	61.0	-
"	"	10:30 "	51.0	50.0	54.0	53.0	54.0	44.0	-	46.0	48.0	54.0	53.0	54.0	45.0	-
July 23:	"	5:45 AM	41.0	41.0	43.0	44.0	41.0	36.0	-	38.0	39.0	43.0	43.0	43.0	37.0	-
Transit Test																
July 23:	Lincoln, Nebr.	7:30 AM	Loading started; completed at 8:15 a.m.													
"	"	8:25 "	47.0	43.0	43.5	40.0	48.0	52.0	36.0	44.2	56.0	45.0	47.0	44.5	43.5	47.8
"	"	12:01 PM	58.0	61.0	58.0	55.0	62.0	68.0	50.0	58.9	63.0	61.0	59.0	57.0	57.0	60.2
"	"	12:40 "	Re-iced, 1,200 pounds ice, 120 pounds salt.													
"	"	2:10 "	59.0	63.0	60.0	57.0	64.0	68.0	49.0	60.0	63.0	62.0	60.0	57.0	60.7	-
July 24:	Galesburg, Ill.	6:00 AM	Re-iced, 2,000 pounds ice, 200 pounds salt.													
"	"	7:00 "	40.0	45.0	40.0	40.0	43.0	30.0	40.1	39.0	41.0	39.0	46.0	34.0	38.7	-
"	"	1:00 PM	38.7	42.7	39.1	38.0	42.0	27.4	38.6	37.0	38.9	37.0	37.3	31.4	35.4	-
"	"	4:50 "	40.3	38.0	40.8	39.5	43.2	31.5	40.9	38.2	40.3	38.5	38.8	33.0	37.1	-
July 25:	Logansport, Ind.	4:00 AM	40.0	47.5	-	39.0	42.0	32.5	40.6	36.7	39.0	37.5	37.5	36.0	32.5	36.5
"	"	2:45 PM	39.5	45.5	37.0	38.6	41.5	41.0	33.0	39.4	35.8	37.5	37.0	36.6	35.7	-
"	"	3:00 "	Re-iced, 1,800 pounds ice, 180 pounds salt.													
"	"	10:20 "	38.8	43.5	35.3	38.2	37.2	40.7	32.0	38.0	36.0	38.2	36.0	37.0	31.7	36.0
July 26:	Enola, Pa.	7:45 AM	38.1	42.8	34.0	37.5	40.4	39.8	31.0	37.7	34.8	38.1	35.7	36.1	38.3	36.8
"	"	4:00 PM	43.8	48.0	41.2	43.5	44.7	44.5	38.0	43.4	40.0	43.0	41.0	41.5	38.0	40.3
"	"	9:00 "	44.0	49.0	41.0	44.0	45.0	40.0	44.0	40.0	44.0	42.0	42.0	39.0	41.0	-
July 27:	"	6:00 AM	37.0	39.0	32.0	37.0	38.0	36.0	36.6	35.0	37.0	36.0	36.0	35.0	35.7	-
"	"	9:15 "	44.0	41.0	41.0	42.0	44.0	43.0	40.0	42.1	40.0	43.0	41.0	39.0	39.0	40.5

1/ For locations at which temperatures were taken in car, see figure 7.

2/ Data shown during precooling are actually air temperatures for positions at which commodity temperatures were taken after loading.

Table 7.--Air temperature data obtained from trailer D during a test from Lincoln, Nebr., to Philadelphia, Pa., July 23-26, 1958

Date	Place	Time	Out- side	Trailer gage	Air temperatures											
					°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%
					Top 1/ TDCL	Blast	Return	Bottom 1/ BDCL	Average	BECL	Average	Wet	Rel.			
					(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)			
					°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%			
July 22	Precooling															
July 23	Lincoln, Nebr.	11:00 PM	71	72	76.0	76.0	76.0	76.0	76.0	76.0	76.0	75.0	96			
"	"	4:00 AM	Mechanical refrigerating unit started with thermostat set at 34°.													
"	"	7:00 "	70	34	33.0	35.5	34.2	33.5	32.0	36.0	33.2	33.0	94			
<u>Transit Test</u>																
July 23	Lincoln, Nebr.	8:45 AM	Loading started; completed at 10:10 a.m.													
"	"	10:15 "	81	-	33.5	38.0	35.5	40.0	40.0	44.0	41.3	46.0	100			
"	"	2:00 PM	86	36	35.5	39.0	37.2	38.0	38.0	34.0	35.9	40.0	100			
"	"	2:40 "	Added 4 gallons of gasoline.													
"	"	3:15 "	86	34	39.0	31.5	35.2	42.0	42.5	33.5	39.0	36.0	100			
July 24	Galesburg, Ill.	7:00 AM	67	33	30.5	34.0	32.5	32.5	37.0	36.5	35.5	36.5	100			
"	"	1:00 PM	88	35	31.0	38.0	34.5	33.0	34.0	38.5	35.1	42.0	100			
"	"	1:20 "	Added 13 gallons of gasoline.													
"	"	4:50 "	88	34	30.0	36.0	33.0	35.0	36.0	37.5	36.1	41.3	100			
July 25	Logansport, Ind.	4:00 AM	70	-	35.0	38.5	36.5	41.0	35.0	41.0	39.0	38.5	100			
"	"	2:45 PM	78	34	36.0	38.0	37.0	39.0	42.0	38.8	39.7	36.5	88			
"	"	2:55 "	Added 16 gallons of gasoline.													
"	"	10:40 PM	75	33	33.0	34.5	33.5	37.0	40.0	37.0	38.0	40.0	100			
July 26	Enola, Pa.	7:45 AM	77	32	33.2	40.0	36.6	38.0	-	39.0	38.5	38.0	83			
"	"	4:00 PM	88	-	37.5	-	37.5	42.0	35.0	40.0	39.0	-	-			
"	"	4:05 "	Added 14 gallons of gasoline.													
"	"	7:00 "	76	35	40.0	40.0	40.0	44.0	-	38.0	41.0	39.0	92			
July 27	"	10:30 AM	86	-	36.2	41.5	38.9	40.5	-	41.0	40.8	-	-			
"	"	10:35 "	Added 12 gallons of gasoline.													

1/ For locations at which temperatures were taken in trailer, see figure 8.

Table 8.--Commodity temperature data obtained from trailer D during a test from Lincoln, Nebr., to Philadelphia, Pa., July 23-26, 1958

Date	Place	Time	Commodity temperatures														
			Top 1/4CL						Bottom 1/4CL								
			TBLS	TQCL	TDCL	T3/4LS	IBCL	Average	BBLs	BRRS	BQCL	BDCL	B3/4CL	BECL			
			(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)		
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.		
<u>Precooling 2/</u>																	
July 22	Lincoln, Nebr.	11:00 PM	76.0	76.0	76.0	76.0	76.0	76.0	76.0	76.0	76.0	76.0	76.0	76.0	76.0		
July 23	"	4:00 AM	Mechanical refrigerating unit started with thermostat set at 34°.														
"	"	7:00 "	33.0	33.0	34.5	33.0	36.0	34.5	34.0	-	33.0	33.0	30.5	34.0	32.5	34.0	
<u>Transit Test</u>																	
July 23	Lincoln, Nebr.	8:45 AM	Loading started; completed at 10:10 a.m.														
"	"	10:15 "	44.5	42.0	43.0	39.0	41.0	48.0	42.0	42.8	38.0	45.5	42.0	39.0	40.2	33.5	39.7
"	"	2:00 PM	39.0	40.0	40.0	41.0	36.0	45.0	36.0	41.1	36.0	40.0	41.0	42.0	38.0	35.0	38.7
"	"	2:40 "	Added 4 gallons of gasoline.														
"	"	3:15 "	38.5	37.0	33.5	37.5	41.0	47.5	38.0	38.3	44.0	38.0	38.0	32.5	37.0	37.5	37.8
July 24	Galesburg, Ill.	7:00 AM	32.0	36.0	36.5	36.0	38.0	43.0	36.0	36.8	35.0	34.0	35.5	33.0	34.0	37.5	34.8
"	"	1:00 PM	34.5	39.0	36.0	35.0	36.5	38.5	38.5	36.9	40.0	34.5	35.5	33.0	38.5	37.5	36.4
"	"	1:20 "	Added 13 gallons of gasoline.														
"	"	4:50 "	36.0	41.6	36.0	36.0	39.0	41.6	38.4	38.4	45.0	36.5	36.8	34.5	37.2	38.0	38.0
July 25	Logansport, Ind.	4:00 AM	37.0	38.5	35.8	35.5	37.0	38.5	40.5	37.5	41.0	36.5	37.0	34.5	40.0	41.5	38.4
"	"	2:45 PM	-	36.0	38.5	36.5	35.0	-	38.0	36.8	41.0	34.5	36.0	35.0	42.5	40.4	38.1
"	"	2:55 "	Added 16 gallons of gasoline.														
"	"	10:40 PM	40.0	39.0	40.0	37.0	42.0	40.0	-	39.6	36.5	38.0	37.0	36.5	40.0	39.0	37.8
July 26	Enola, Pa.	7:45 AM	40.0	42.0	40.0	-	37.0	38.0	40.0	39.5	37.4	34.5	35.5	34.5	-	42.5	36.9
"	"	4:00 PM	-	-	-	39.0	36.0	38.0	-	37.7	38.7	36.5	38.0	-	39.0	40.0	38.4
"	"	4:05 "	Added 14 gallons of gasoline.														
"	"	7:00 "	39.0	-	36.0	38.0	-	40.0	39.0	38.4	41.5	33.8	39.0	-	40.0	41.0	39.1
July 27	"	10:30 AM	40.0	-	35.3	39.0	-	40.0	41.0	39.1	36.4	35.0	38.0	39.0	39.7	-	37.6
"	"	10:35 "	Added 12 gallons of gasoline.														

1/ For locations at which temperatures were taken in trailer, see figure 8.

2/ Data shown during precooling are actually air temperatures for positions at which commodity temperatures were taken after loading.

Table 9.--Air temperature data obtained from trailer E during a test from Lincoln, Nebr., to Philadelphia, Pa., July 23-26, 1958

Date	Place	Time	Out-side	Trailer gage	Air temperatures											
					°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	Wet bulb	Rel. Hum.
					(1)	(2)	Average	Return	BDCL	BECL	Average	(5)	(6)			
Precooling																
July 22	Lincoln, Nebr.	11:00 PM:	71	81	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	100
July 23	"	4:00 AM:	Mechanical refrigerating unit started. Thermostat set at 34° F.													
"	"	7:00 "	70		33.0	41.5	37.2	33.5	41.5	40.5	38.5	41.0	93			
Transit Test																
July 23	Lincoln, Nebr.	7:10 AM:	Loading started; completed at 8:45 a.m.													
"	"	8:50 "	73	38	26.0	32.0	29.0	34.2	36.0	35.4	32.0	100				
"	"	2:35 PM:	Added 6 gallons of gasoline.													
"	"	9:30 "	77		23.5	28.0	25.7	30.0	32.0	30.5	28.0	100				
July 24	Creston, Ia.	7:00 AM:	67	33	30.5	31.5	31.0	31.0	32.0	34.0	32.0	92				
"	Galesburg, Ill.	1:00 PM:	88	38	34.5	37.0	35.7	36.0	36.0	36.5	36.2	100				
"	"	1:15 "	Added 18 gallons of gasoline.													
"	"	4:50 "	88	33	31.5	36.8	34.0	34.0	37.3	34.8	35.4	100				
July 25	Chicago, Ill.	4:00 AM:	70	34	32.0	33.0	32.5	34.2	33.5	35.1	34.4	100				
"	Logansport, Ind.	2:45 PM:	78	34	31.8	39.7	35.8	37.0	34.5	35.2	39.7	100				
"	Columbus, Ohio	2:55 "	Added 7 gallons of gasoline.													
"	"	10:30 "	75	33	34.0	40.5	37.2	39.0	36.5	38.0	37.8	100				
July 26	Pitcairn, Ohio	7:45 AM:	77	35	34.2	38.4	36.3	36.7	34.7	36.1	35.8	100				
"	Enola, Pa.	4:00 PM:	88	34	34.2	44.0	39.1	42.0	37.2	40.0	39.7	100				
"	Philadelphia, Pa.	7:00 "	76	34	26.8	44.1	35.8	31.5	37.7	40.1	38.4	100				
July 27	"	10:30 AM:	86	39	36.4	40.4	38.4	39.5	38.7	40.3	40.0	100				
"	"	10:35 "	Added 15 gallons of gasoline.													

1/ For locations at which temperatures were taken in trailer, see figure 8.

Table 10.--Commodity temperature data obtained from trailer E during a test from Lincoln, Nebr., to Philadelphia, Pa., July 23-26, 1958

Date	Place	Time	Commodity temperatures															
			Top 1/2								Bottom 1/2							
			TBLS : (7)	TBRS : (8)	TQCL : (9)	TDCL : (10)	T3/4CL : (11)	T3/4LS : (12)	TECL : Average : (13)	BBLS : (14)	BRRS : (15)	BQCL : (16)	BDCL : (17)	B3/4CL : (18)	BECL : Average : (19)			
			°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.			
			Precooling 2/															
July 22:	Lincoln, Nebr.	11:00 PM	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	78.5	-		
July 23:	"	4:00 AM	Mechanical refrigerating unit started. Thermostat set at 34° F.															
"	"	7:00 "	42.0	42.0	43.0	41.5	41.5	41.5	40.0	-	42.0	42.0	43.0	41.5	41.5	40.0		
			Transit Test															
July 23:	Lincoln, Nebr.	7:10 AM	Loading started; completed at 8:45 a.m.															
"	"	8:50 "	36.8	37.0	35.5	33.0	36.0	42.5	36.5	36.8	34.0	37.0	40.0	39.0	42.0	36.5	38.0	
"	"	2:35 PM	Added 6 gallons of gasoline.															
"	"	9:30 "	33.5	32.0	32.0	30.0	30.5	36.0	31.0	32.1	32.5	33.0	33.5	35.0	36.5	32.0	33.8	
July 24:	Galesburg, Ill.	7:00 AM	36.5	33.3	33.5	30.4	33.5	36.6	34.0	34.0	35.0	36.5	39.0	34.0	36.2	34.0	35.8	
"	"	1:00 PM	34.0	33.8	35.0	32.0	32.0	34.5	33.8	33.6	34.5	32.5	33.8	33.5	34.5	34.7	33.8	
"	"	1:15 "	Added 18 gallons of gasoline.															
"	"	4:50 "	33.0	32.3	32.8	30.0	31.5	34.5	34.0	32.6	32.6	31.5	34.0	33.2	33.0	33.4	33.0	
July 25:	Logansport, Ind.	4:00 AM	34.8	34.0	31.5	30.5	33.0	36.0	33.5	33.3	33.5	33.0	32.7	31.5	32.0	34.0	32.5	
"	"	2:45 PM	33.2	35.0	31.6	34.7	36.5	32.0	35.2	34.0	32.0	37.2	31.6	32.3	34.5	36.0	33.9	
"	"	2:55 "	Added 7 gallons of gasoline.															
"	"	10:10 "	35.4	37.0	37.0	38.0	37.0	37.0	39.0	37.0	35.0	31.4	33.0	33.5	34.5	37.2	34.1	
July 26:	Enola, Pa.	7:45 AM	34.3	34.3	36.0	34.0	34.2	35.8	39.0	35.4	35.0	33.6	32.0	33.2	34.0	35.8	33.9	
"	"	4:00 PM	35.6	38.0	39.0	39.0	37.7	36.7	41.0	38.1	35.2	32.0	30.3	33.5	34.0	38.0	33.8	
"	"	7:00 "	36.5	39.4	40.0	40.0	38.6	37.7	41.8	39.1	35.7	33.0	31.4	33.8	35.0	38.6	34.6	
July 27:	"	10:30 AM	37.2	39.0	38.0	38.0	38.3	37.3	40.8	38.4	36.0	34.7	33.4	34.5	35.2	38.3	35.4	
"	"	10:35 "	Added 15 gallons of gasoline.															

1/ For locations at which temperatures were taken in trailer, see figure 8.

2/ Data shown during precooling are actually air temperatures for positions at which commodity temperatures were taken after loading.

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