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TEST FOR SHIPPING CONTAINERS IN REVOLVING HEXAGONAL DRUM BOX-TESTING MACHINES

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UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

In Cooperation with the University of Wisconsin

TEST FOR SHIPPING CONTAINERS IN REVOLVING
HEXAGONAL DRUM BOX-TESTING MACHINES¹

By

Forest Products Laboratory,² Forest Service
U. S. Department of Agriculture

Purpose of the Drum Test

1. This test is used to give an indication of the ability of a shipping container to withstand various shocks and impact stresses simulating those which may be expected in handling or shipment, or to protect its contents when subjected to such shocks and stresses, or to obtain average results permitting a comparison of different designs of containers of the same size and carrying the same load. The test permits an observation of the progressive destruction or failure of the package, through which means of improving the design may be determined.

Scope

2. (a) This method of test covers two procedures for performing tests on loading containers, as follows:

Procedure A, to determine the ability of the container to withstand rough handling, and

Procedure B, to determine the ability of the container to provide protection to its contents.

¹For an account of the development of this test, see: American Society for Testing Materials Proceedings, Nineteenth annual meeting, Vol. XVI, Part II, Technical Papers, 1916, pages 320-342.

²Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

Apparatus

3. The testing machine consists of a revolving drum which is in the form of a geometrical prism whose bases are regular hexagons and whose lateral faces are rectangles. The axis of revolution is horizontal. Baffles or hazards shall be fixed on the inside faces of the drum. A conical projection shall usually be positioned on one face to simulate a puncture hazard; provided, however, that if the object of the test so justifies, it may be omitted.

The inner faces of the drum shall be clean, smooth, and polished bright.³

The drum shall be equipped with an automatic counting device which will record six drops for each revolution.

(a) Containers whose longest dimensions do not exceed 20 inches and whose gross weight does not exceed 250 pounds shall be tested in a drum of 7-foot diameter, whose faces measure 4 feet in the direction of the central axis, by 3.5 feet. The drum shall revolve at a speed of 1-5/6 r.p.m. about its central axis. The construction and arrangement of the hazards, and a typical drum, are shown in figures 1 and 2.

(b) Containers having a length of over 20 and up to about 72 inches and weighing up to 1,000 pounds gross (which cannot be accommodated in the 7-foot drum) shall be tested in a drum of 14-foot diameter, whose faces measure 8 feet in the direction of the central axis, by 7 feet. The drum shall revolve at a speed of one r.p.m. about its central axis. The construction and arrangement of the hazards, and a typical drum, are shown in figures 3 and 4.

Test Specimens

4. The container to be tested shall be packed with (a) the actual contents for which it was designed, or (b) a dummy load simulating such contents. The procedure for the identification of the faces, edges, and corners of the box shall be as follows: Facing one end of the box (in the case of a fiberboard container, with the manufacturer's joint on the right), the top of the container is designated as 1, the right side as 2, the bottom as 3, the left side as 4, the near end as 5, and the far end as 6. The edges are identified by the numbers of the two faces which form that

³—Wax is recommended to protect against rust when not in use.

edge; as for example, 1-2 identifies the edge where the top and right side meet, and 2-5 the edge formed by the right side and the near end. (In a fiberboard container, this edge will have the manufacturer's joint.) The corners are identified by the numbers of the three faces which meet to form that corner; as for example, 1-2-5 identifies the corner where the top, the right side, and the near end meet.

Conditioning

5. Depending on the purposes of the study, the containers may be conditioned prior to the drum test by either a different physical test, water immersion, or exposure to water-spray or fixed conditions of air temperature or humidity.

Procedure A

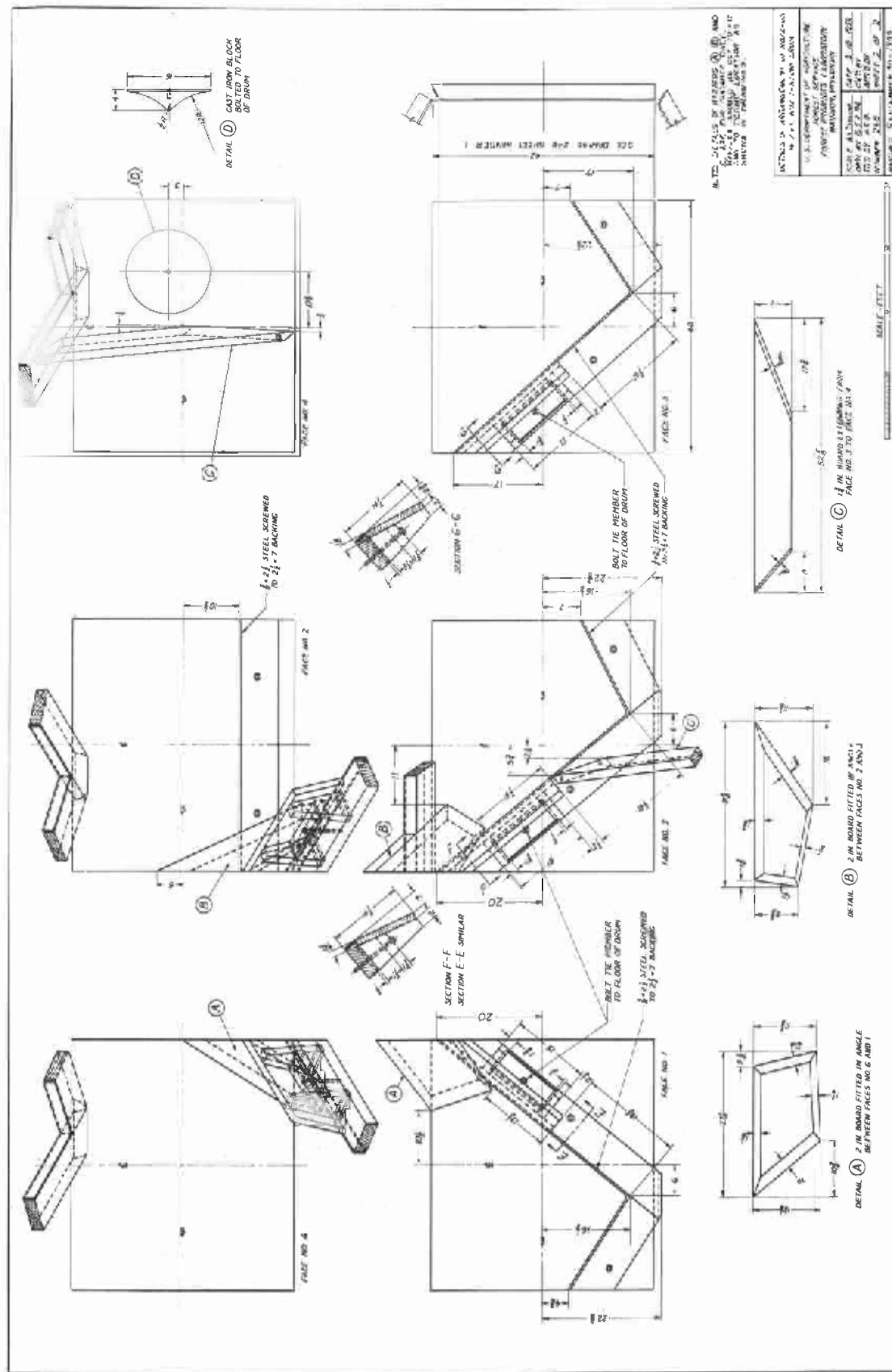
6. To measure ability of a container to withstand rough handling. --A record shall be made of the preconditioning, if any, of the container and of its state at the beginning of the test. The test shall be started with a container placed in the crotch of the hazard of face No. 1 of the drum with the top face 1 of the container upward and with end 5 and side 2 against the sides of the hazard. The drum is started in motion. As the drum revolves, the container slides, tumbles, and falls in varying positions from face to face of the drum, catching on and striking against the hazards and guides. As the test continues, a record shall be made of the development of damage, such as skewing, puncture, splits, or tears, and failure of the fastenings and reinforcements. This record is kept on a data sheet, samples of which, for different kinds of containers, are shown in figures 5 to 8. The drum may be stopped at intervals in the test to permit a close inspection of the container. Movement of the container from one face of the drum to the next is counted as one fall, and the number of falls sustained by the container up to the time of occurrence of any damage is recorded with the description of the damage. In this description, the faces, edges, and corners shall be designated as specified in Section 4. The test shall be continued until the container fails. Failure, depending on the purpose of the test, may be considered to have occurred when (a) the contents are exposed or (b) the contents have spilled from the container or (c) some other predetermined type or types of damage to the container have occurred.

Procedure B

7. To measure ability of a container to provide protection to its contents. --This test shall be conducted as described in Section 6 except that the drum may be stopped and the package opened for an inspection of the condition of the contents and interior blocking or packing material. Records shall be made of the condition of the container and the contents. After the examination, the container is closed and the test resumed. Examinations may be made every 6, 12, or 24 falls, as desired. This test may be continued until occurrence of failure of the container or damage to the interior supports or contents, or may be halted at a predetermined number of falls, based on the estimated probable amount of rough handling in actual service.

Number of Specimens

8. A minimum of five identical specimens shall be tested to obtain an average result. This number may frequently be greater, depending on the objectives of the test.



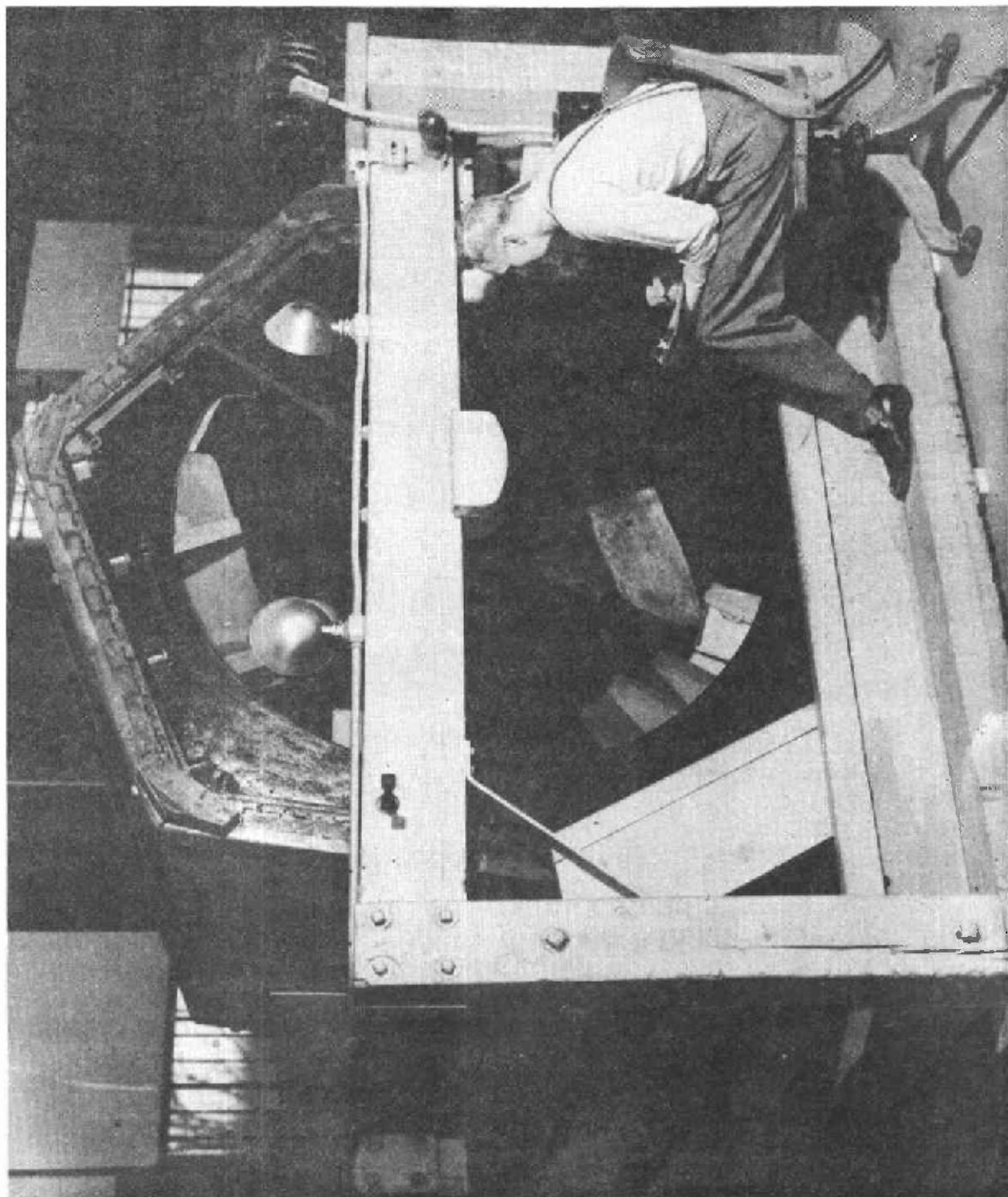
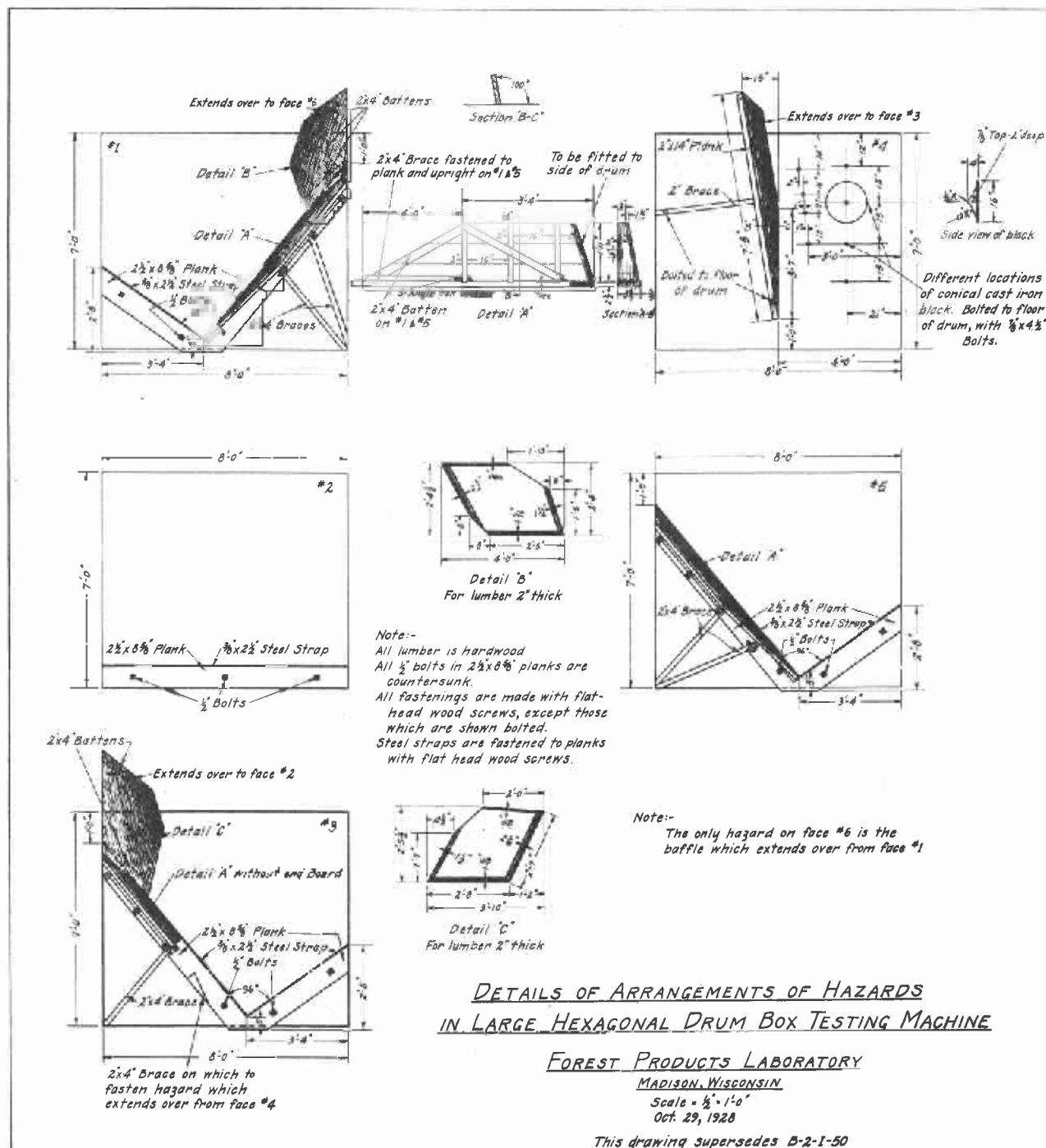


Figure 2.--Seven-foot box testing drum



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Figure 3

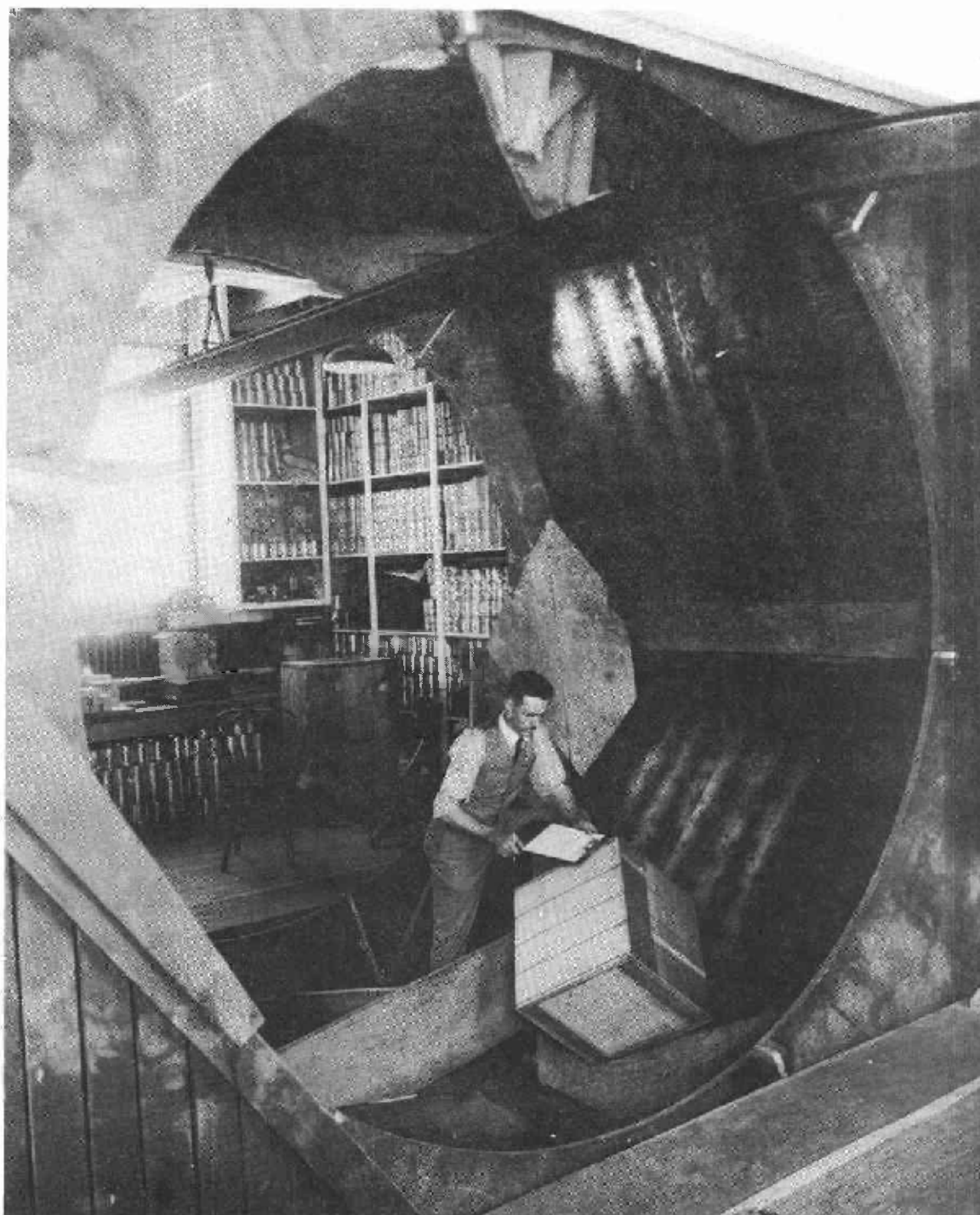


Figure 4.--Fourteen-foot box testing drum

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Figure 5.-- DATA SHEET - NAILED WOOD BOX

United States Department of Agriculture
Forest Service
Forest Products Laboratory
Madison, Wisconsin

PROJECT NO. L-207 SHIP. No. 1 LOT No. 3
LAB. NO. WT. OF BOX 150.3 WT. OF CONTENTS 135 Box No. 2
AVERAGE MOISTURE CONTENT: ENDS 8.7 SIDES 7.6 TOP 9.2 BOTTOM 8.7 CLEATS 6.5
AVERAGE SPECIFIC GRAVITY: ENDS SIDES TOP BOTTOM CLEATS

Counter Reading, number or height of drop	SIDES, TOP, BOTTOM ENDS						CLEATS						STRAPPING				Remarks	
	Breaking across grain	Split	Pulled nails	Pulled from nails	Sheared from nails	End of Side Nail Split	Nails broken off	Breaking across grain	Pulled nails	Pulled from nails	Sheared from nails	Pulled from end	Nail split	Nails broken off	Slipped off corner	Closure pulling		Closure broken
7			3-5															
12		1-2	3-5 4-5 2-5 2-6															
16		1-2 1-4						2-5										
24					2-5 4-5 2-6													
42			2-5 2-6							2-5								
69			side 2 pulled from end 6 revealing contents															

TOTAL NO. DROPS 69 TESTED BY L. U. K. DATE 7-5-44 CHECKED BY DATE

Figure 6--- DATA SHEET - CLEATED PANEL BOX

United States Department of Agriculture
Forest Service
Forest Products Laboratory
Madison, Wisconsin

Project No. L-207 _____ Ship No. 1 Lot No. 3
Lab. No. _____ Wt. of Box 76.2 Wt. of Contents 65 Box No. _____
Average moisture content: Panels 5.2 Cleats 10.1
Average specific gravity: Panels _____ Cleats _____

Counter Reading, number, or height of drop	PANELS								CLEATS							STRAPS				
	Breaking across grain	Split	Punctured	Pulled nails	Pulled from nails	Sheared from nails	Nail split	Nails broken off	Breaking across grain	Split	Pulled nails	Pulled from nails	Sheared from nails	Nail split	Nails broken off	Pulled from panel	Slipped off corner	Closure pulling	Closure broken	Broken
14														1-5						
19						1-5					4-5									
21			2																	
33									1-2	1-2	2-5			3-5						
47						2-5	6-2													
						6-3														
52	End 5 failed by cleat 1-5 splitting along line of nails used in assembling box, and by nails pulling from cleat 5-3																			

Total No. Drops 52 Tested by E.B. Date 7-5-44 Checked by _____ Date _____

Figure 7.-- DATA SHEET • WIREBOUND BOX

United States Department of Agriculture
Forest Service
Forest Products Laboratory
Madison, Wisconsin

Project No. L-207 Ship No. 1 Lot No. 3
Laboratory No. _____ Wt. of Box 52.5 Box No. 2

Sheet
Avg. moisture content: Material 5.6 Cleats 6.2 Battens 6.1
Sheet
Avg. specific gravity: Material _____ Cleats _____ Battens _____

	Ends, sides, top and bottom						Cleats		Battens			Wires						
Counter reading number or height of drop	Breaking across grain	Split	Pulled staples	Pulled nails	Pulled from nails	Sheared from nails	Sheared from staples	Breaking across grain	Pulled from nails or staples	Nail or staple split	Breaking across grain	Pulled from nails or staples	Nail or staple split	Slipped off corner of box	Closure pulling	Closure broken	Wire broke	Remarks
17			2-6 3-6															
24		1-2					1-5											
33	6	3 (Punctured)					3-6		5-2					1-2-5				
47														3-4-6		1-2		
	Broken closure revealed contents																	

Total No. Drops 47 Tested by R.S. Date 7-5-44 Checked by _____ Date _____

DRUM TEST FIBER BOX

Project No. _____ Shipment No. _____ Lot No. 3 Box No. 1
Lab. No. _____ Material Solid Fib. Caliper .100 Type of box R.S.C.
Inside dimensions 13 3/4 x 10 1/2 x 9 1/4 Kind of contents: 24 - #2 Cans Weight 42.0
Weight of box 3.10 Gross weight: Dry 45.2 Wet _____ Gain= _____
Sealing: Top flaps Glued Bottom flaps Stapled Date _____ Straps 2 - 3/8 x .015

Counter reading	Failures						Additional notes sketches of failures, etc.
	Crushed corners	Pierced	Cut 1" or more at score	Score cut entire length	flaps pulled loose	Tear not at score	
9		2					
21	3-4-6						
28	1-2-6						
39	2-3-5						
45		4					
78			3-6				
102	all		1-5				
148			1-6				
160			3-5				
218			1-4				
310				1-5			
318			1-2				
376			4-5				
402	Cuts at 1-5 & 1-4 meet						
468	Contents spilled at 1-4-5						

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MINOR TESTS

Lot No. _____
Box No. _____

Bursting or Tensile Strength Tests

[illegible]

Score Tests

	Direc-	Tension	Counter Reading	
Machine : Test :	tion of :	Ini- : Final :	Lbs.	: Ini- : : : : tial :Final:Dif.:
Setting : No.:	Score :	tial :	:	: tial :Final:Dif.:
Speed _____ V.P.M.	:	:	:	:
Angle _____ degrees:	:	:	:	:
Spring _____	:	:	:	:
No. of Pawls _____	:	:	:	:
Ledge _____	:	:	:	:
Notes: _____	:	:	:	:
_____	:	:	:	:
_____	:	:	:	:
_____	:	:	:	:
_____	:	:	:	:
_____	:	:	:	:
Temp. ____ °F.	R.H. ____ %	Tests made by _____	Date _____	

Pendulum Truss Test

	Pendulum A	:	:	Pendulum B	:	:
Drop No.	Angle	:	:	Angle	:	:
	Initial : Secondary	:	:		:	:
:	:	:	:	:	: Length to center of	:
:	:	:	:	:	: Hammer _____	:
:	:	:	:	:	: Temp. ____ R.H. ____ %	:
:	:	:	:	:	:	:
:	:	:	:	:	:	:
:	:	:	:	:	:	:
:	:	:	:	:	:	:
:	:	:	:	:	:	:
:	:	:	:	:	:	:
:	:	:	:	:	:	:
						Date _____
Tests made by _____						