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RATE OF HEAT RELEASE  
OF  
BUILDING MATERIALS  
FROM  
FM CONSTRUCTION MATERIALS CALORIMETER

June 15, 1964



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RATE OF HEAT RELEASE OF BUILDING MATERIALS  
FROM FM CONSTRUCTION MATERIALS CALORIMETER

Typical data on the combustibility of various building materials as measured by the heat release method are presented on the attached table and graphs. These values were obtained using the Factory Mutual Construction Materials Calorimeter.

The data is of immediate value in showing how various building materials or assemblies burn when subjected to a fire exposure and for comparing the combustibility of materials and assemblies. A specific method for the application of such data to actual use situations is under active consideration and is commented upon briefly in the last paragraph.

This material has been prepared for information and study purposes. Although in somewhat preliminary form at this time, it is hoped the data will eventually prove applicable to the solution of existing problems related to the combustibility of building materials. Since test results are reported in a manner unfamiliar to most, the following paragraphs briefly discuss how the data is obtained and plotted.

Each of the several step graphs show burning rates representing the manner in which a 16 sq. ft. test panel burned throughout the 10 minute test period. These burning rates are determined in the following manner.

The test panel is first placed on the Calorimeter and subjected to a standard heptane fire exposure under controlled conditions. The temperature resulting from the combined burning of the exposure and the test panel is recorded by thermocouples in the flue in the form of a time-temperature curve.

The test procedure is then duplicated using the standard exposure with a non-combustible cover on the Calorimeter and an auxiliary means of introducing metered fuel to take the place of the burning panel. This fuel, propane, is added through auxiliary burners as the test progresses so that the temperature resulting from the combined burning of the exposure and the propane follows the time-temperature curve created originally.

The various propane fuel rates and their time of occurrence are recorded and tabulated. With this data and knowing the heat value of the evaluating fuel, heat contribution rates are computed. These rates are identified on each chart by the horizontal portion of graph, which represents the rate of heat released by the specimen during the indicated time period. The total heat released from the 16 sq. ft. test panel at the end of any given time period has also been shown on the burning rate graphs.

The attached table has been prepared as a means of comparing results by several test methods which are either in use or proposed for use as a means of evaluating combustibility. Most of the data is self-explanatory. The one minute burning rate by the FM Heat Contribution Method was obtained by determining the maximum slope of the accumulated net heat release curve for a one minute period.

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Preliminary studies show promise for a Combustibility Index computed by multiplying the one minute burning rate by the duration of burning and then dividing by ten to make the value less cumbersome. Burning rate and duration are the important factors in considering the fire hazard of a material or assembly and they are the sole factors in the Index. A ranking of the products in this test program using the Combustibility Index (copy attached) shows a very logical order. This ranking also leads to a possible classification for the fire hazard of materials as follows:

<u>Fire Hazard</u>	<u>Limiting Combustibility Index</u>
Very low	25
Low	120
Medium	300
High	Over 300

Ranking of Products Using FM Combustibility Index

Index = One min. burning rate x Duration of Burning (min.) x 1/10

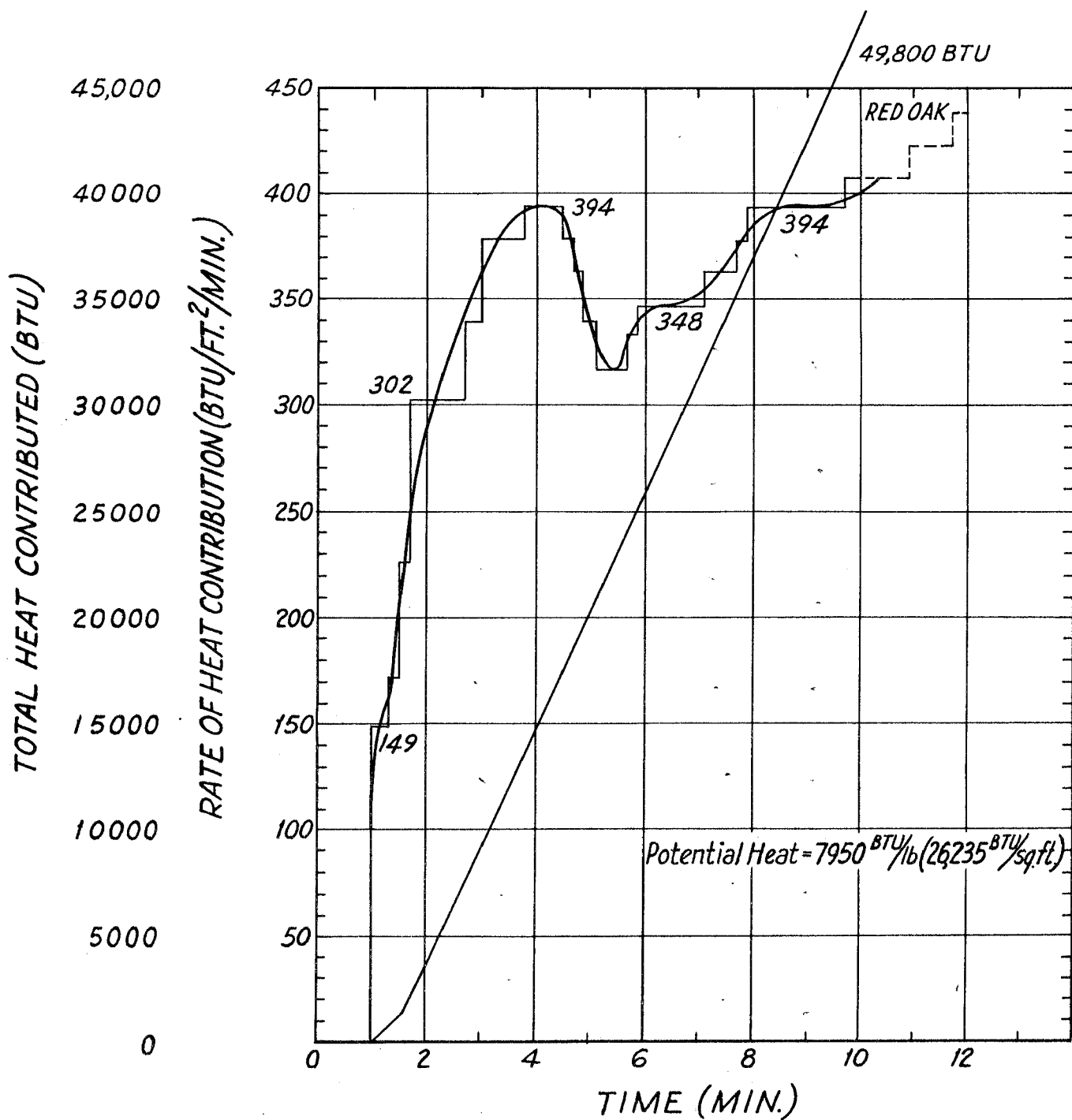
<u>Material</u>	<u>No. in Listing</u>	<u>Index</u>
Gypsum wall board	17	-
Plastic laminate (FR) on Cem-Asb	16	-
Corr. polyester plastic FR, GRP	18	-
Corrugated vinyl	5	20
Acoustical Tile, mineralized wood	13	22
Protected metal, colored	3	56
Paper honeycomb, treated (25F)	23	62
Vinyl clapboard	4	67
Paper honeycomb, treated (M)	22	72
Acoustical tile, glass fiber	12	76
Plywood, chem. impregnated	8	77
Paper honeycomb, plain, metal covered	21	103
Acoustical tile, mineral	11	107
Acoustical tile, chem. treated	10	117
Foam rubber, PVC	2	172
Acoustical tile, plain, FR paint	9	183
Plywood, treated, 1/28 in. oak face	7	221
Paper honeycomb, plain	20	222
Plastic laminate on wood chip core	14	245
Plastic laminate on cem. asb.	15	288
Red oak	1	350
Corrugated acrylic	19	360
Plywood, untreated, mahog. face	6	585

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BURNING CHARACTERISTICS

Material	Thickness Inches	Weight #cu.ft. /sq.ft.	Surface Front Back	A Emerson Bomb Btu/lb	Residue Btu/lb	A-B Potential Heat Btu/lb	PS E84 Flame Spread	SD	Peak Rate Btu/sq.ft./Min.	RM Heat Contribution 1 Min. Total Rate	Duration of Bureau Mins.
1. Red Oak, Select	3/4	44	Same	7950	0	26235	100	100	394	389	1 - 10
2. Foam Rubber, PVC	1	6.7	Same	8150	8	4580	105	44	241	229	1 - 8-1/2
3. Protected Metal, Colored	22 ga.	1.72	Same	1369	0	2355 Two Sides	45	5-15	188	159	1-1/2-5
4. Vinyl, Clapboard	.050	0.37	Same	8453	68	3100	25	NA	96	96	2 - 9
5. Vinyl, Corrugated	.060	0.44	Same	9000	0	3960	25	200	84	81	3-1/2-6
6. Plywood, Untreated, Mahog. Face	3/8	1.04	Mahog. - Ext. Fir	8795	0	9147	130	130	675	650	1 - 10
7. Plywood, 1/28 Red Oak Face, Treated Core	3/4	2.42	Red Oak - Treated	6110	0	14786	70	35	302	245	1 - 10
8. Plywood, Chem. Treated	3/4	2.44	Same	7530	0	18373	15-25	15	96	96	2 - 10
9. Acoustical Tile, Plain Wood	3/4	0.90	FR Paint - Plain	7180	0	6462	Class C	58A-1188	210	203	1 - 10
10. Acoustical Tile, Chem. Treated	3/4	1.06	Paint - Platin	6762	3	7165	20	25-35	142	138	1-1/2-10
11. Acoustical Tile, Mineral	5/8	1.21	Paint - Plain	966	5	1153	10-15	10-15	119	119	1 - 10
12. Acoustical Tile, Glass Fiber	1-1/2	0.22	Paint - Plain	2576	269	508	40	25	111	109	1 - 8
13. Acoustical Tile, Mineralized Wood	1	1.64	Same	2750	0	4510	15	15-20	40	36	4 - 10
14. Plastic Linn. on Wood 1/32 on 3/8 (VTP) 24/5	13/32	1.54	Plastic - Plain	8385	0	12913	100	105	310	307	2 - 10
15. Plastic Linn. on C-A Board 1/16 on 1/4 24/5	5/16	2.38	Plastic - Plain	1785	0	4248	35	25	531	480	1 - 7
16. Plastic Linn. (FR) on C-A Board	5/16	2.42	Plastic - Plain	2000	0	4840	20	5	No measurable contribution	No measurable contribution	
17. Gypsum Wallboard, Std.	1/2	2.08	Paper Both Sides	807	0	1679 Two Sides	10-15	5-15	No measurable contribution	No measurable contribution	
18. Plastic Corrug. Polyester FR, GRP	.050	0.46	Same	6580	0	3027	65	10	No measurable contribution	No measurable contribution	
19. Plastic Corrug. Acrylic, GRP	.060	0.69	Same	8890	0	6134	300-330	Understand.	900	900	
20. Paper Honeycomb, Plain (K) 22/2	3	0.34	Same	7990	0	2717	440		675	633	1/2 - 5
21. Paper Honeycomb, Plain (K) Metal Covered	3	--	Same				0		188	188	4-1/2-10
22. Paper Honeycomb, Treated (M) 72	3	0.30	Same	6660	0	1998	15		111	111	3-1/2-10
23. Paper Honeycomb, Treated (23F) 62	3	0.485	Same	7155	0	3470	25-30		73	73	1-1/2-10

*Com from the old Index*

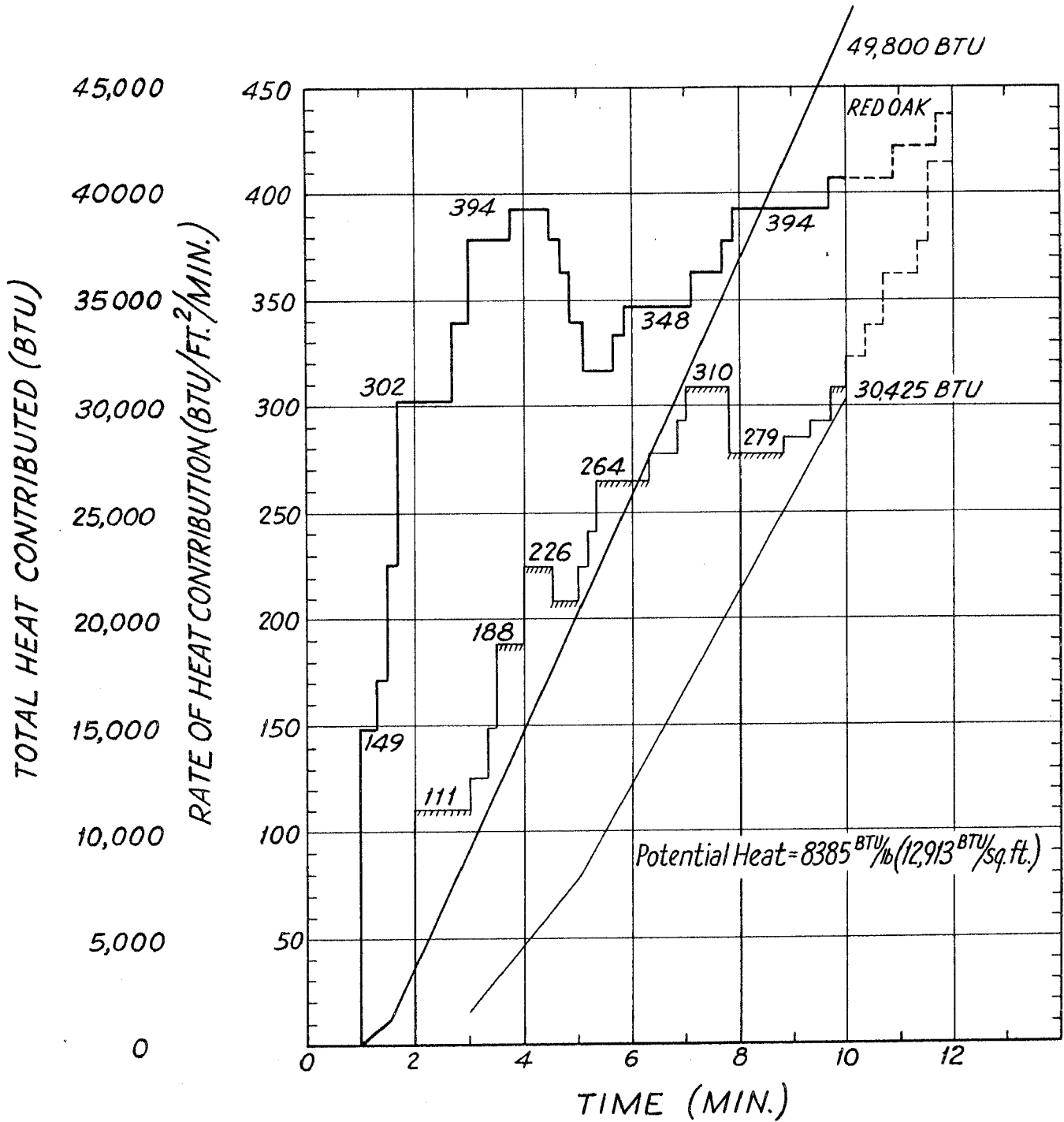
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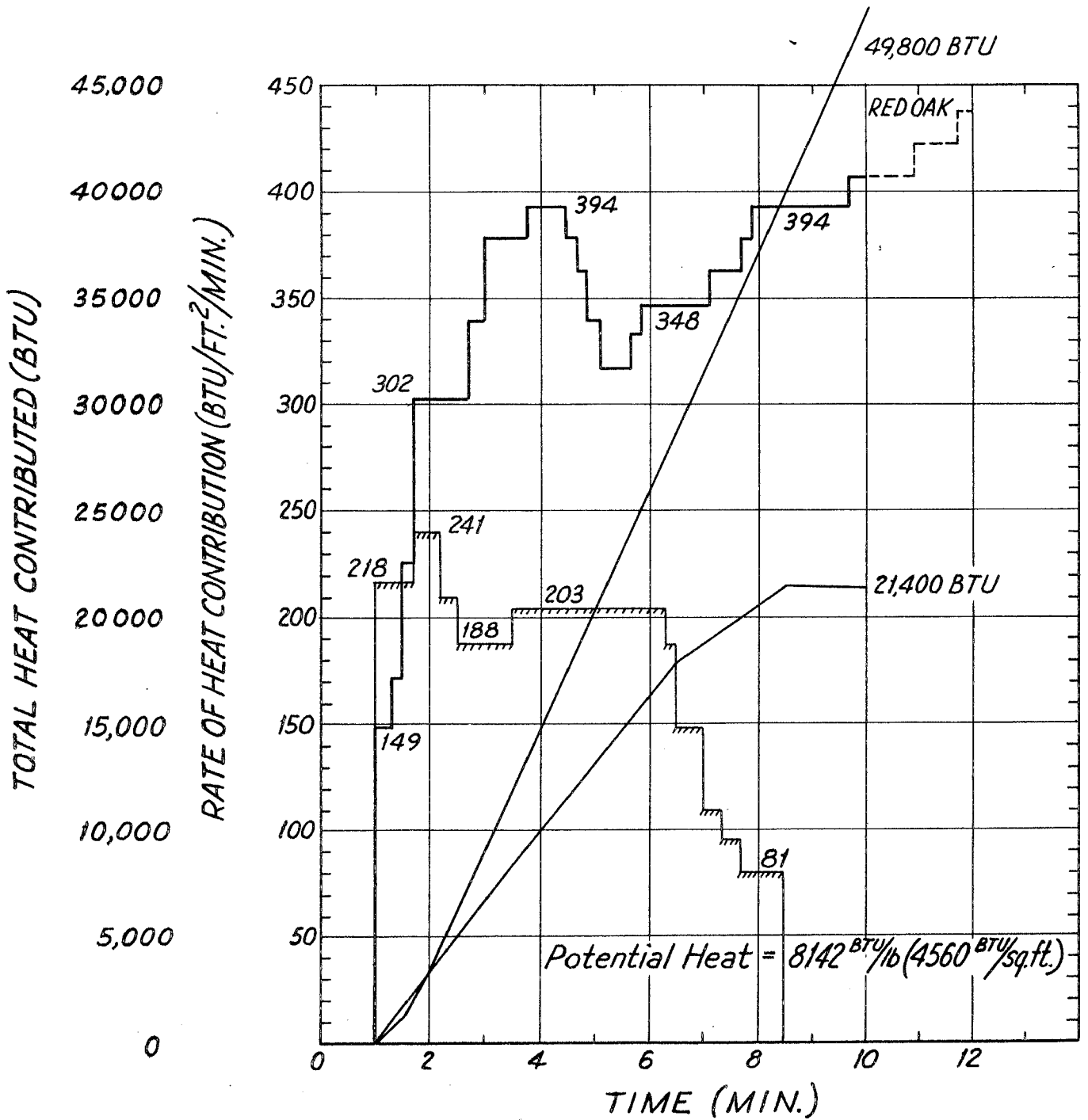
BURNING RATE & TOTAL HEAT vs. TIME

RED OAK 3/4"

E84 100 FS



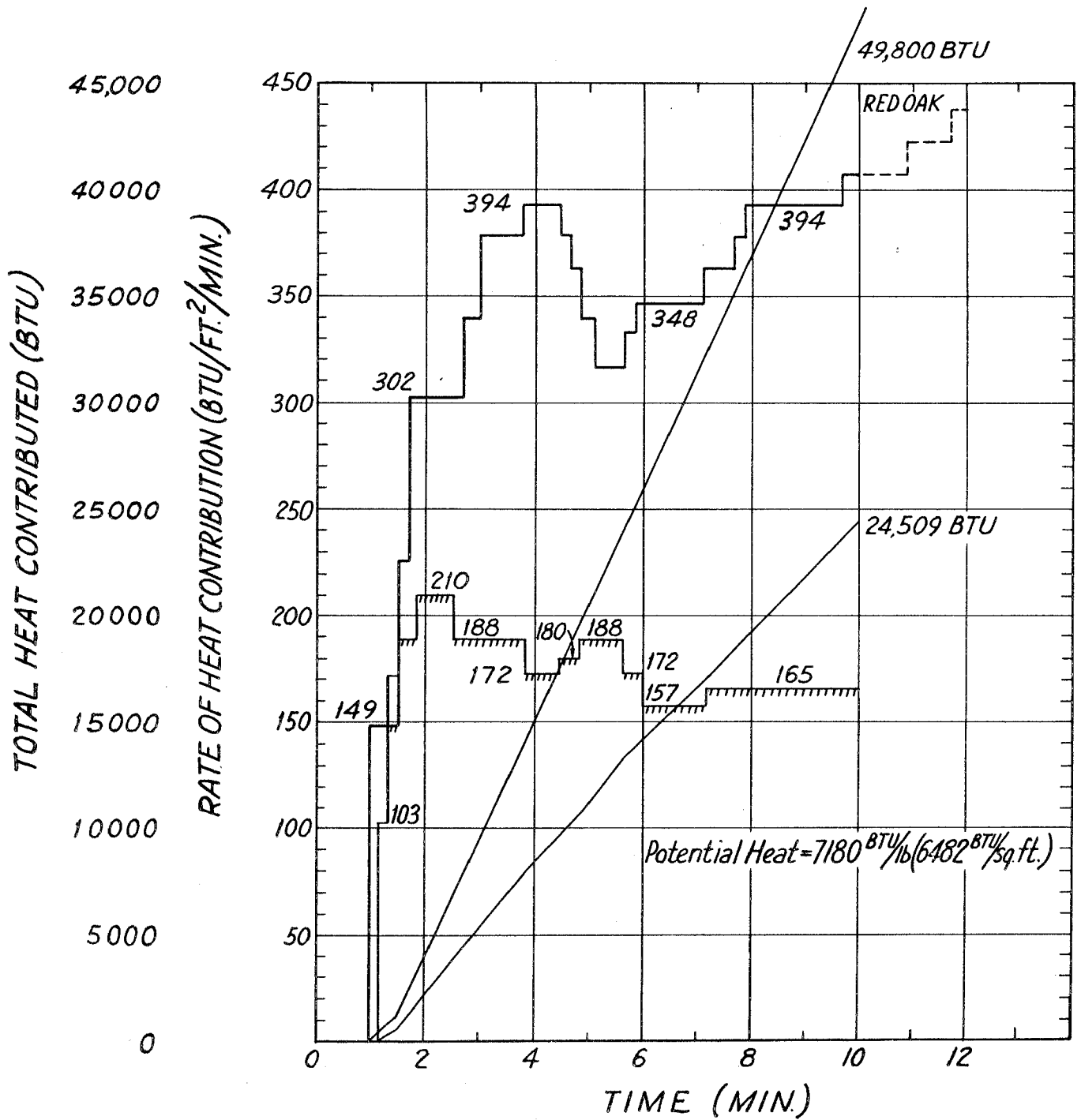
BURNING RATE & TOTAL HEAT vs. TIME  
 1/32" PLASTIC LAM. ON WOOD CHIP-UNTREATED  
 E 84 100 FS



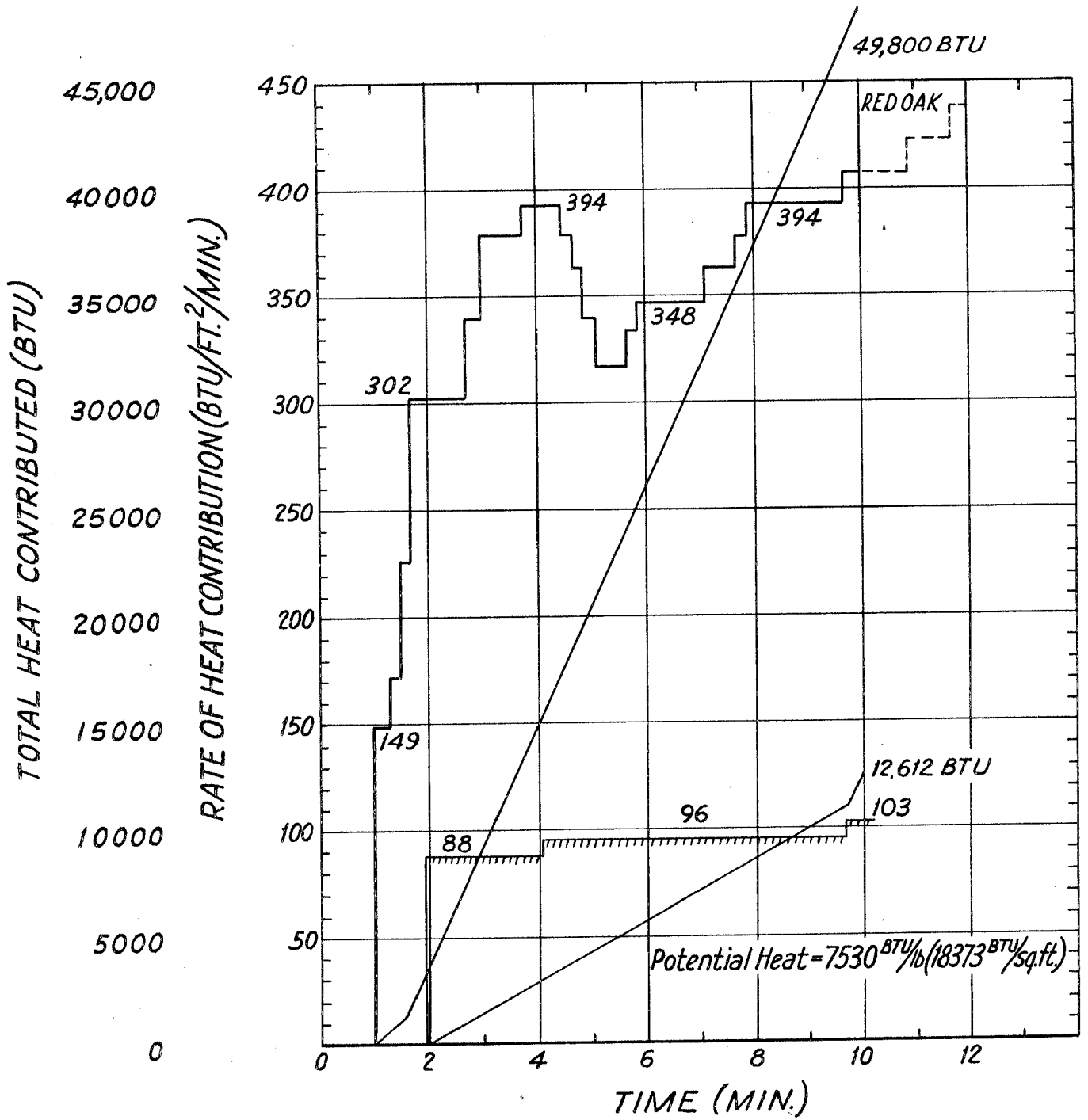
BURNING RATE & TOTAL HEAT vs. TIME

PVC - SYN. FOAM RUBBER  
E 84 105 FS



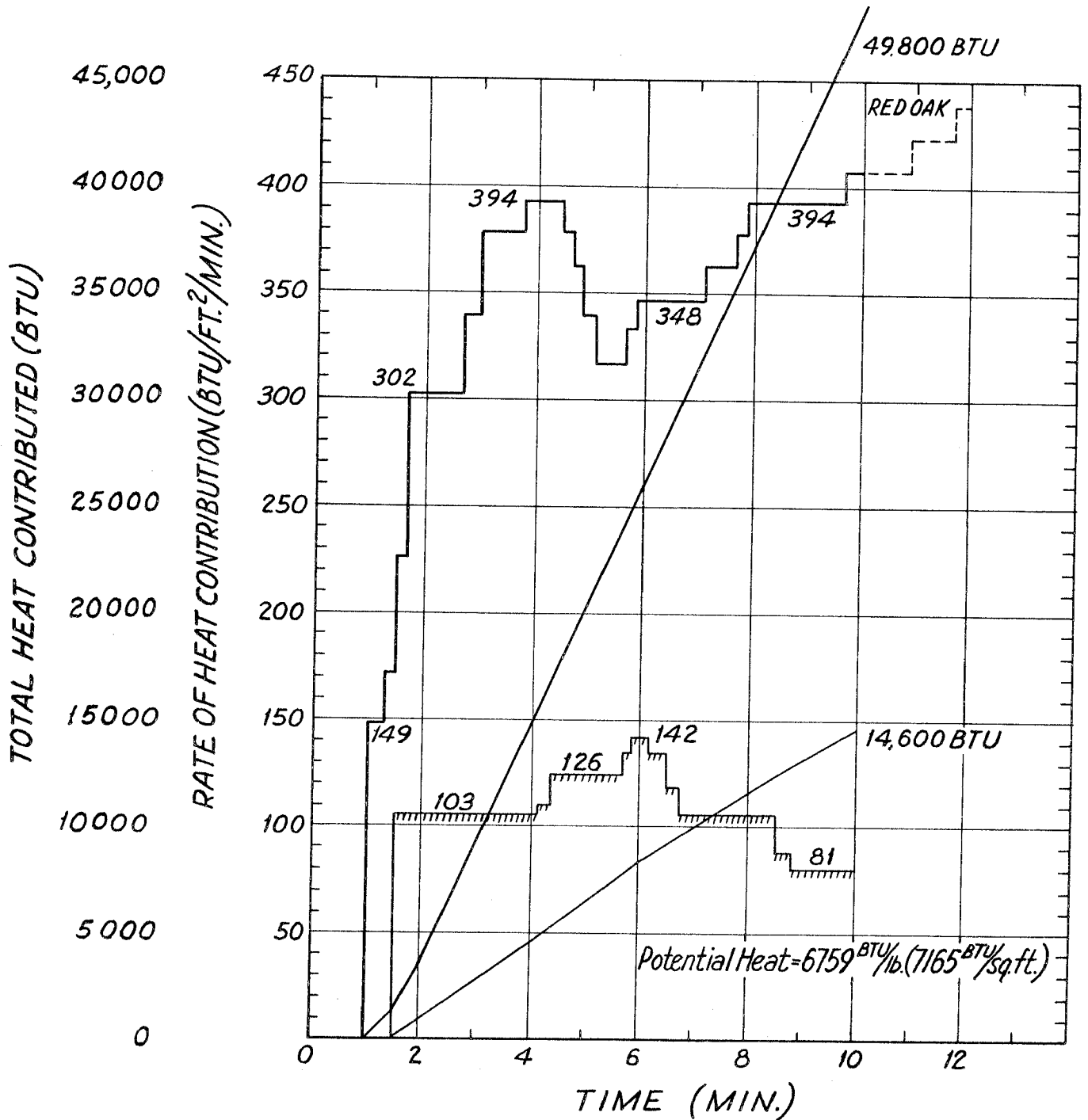


BURNING RATE & TOTAL HEAT vs. TIME  
 PLAIN WOOD ACOUSTICAL TILE  $\frac{3}{4}$ " ER. PAINT SURFACE  
 SSA-118b CLASS C

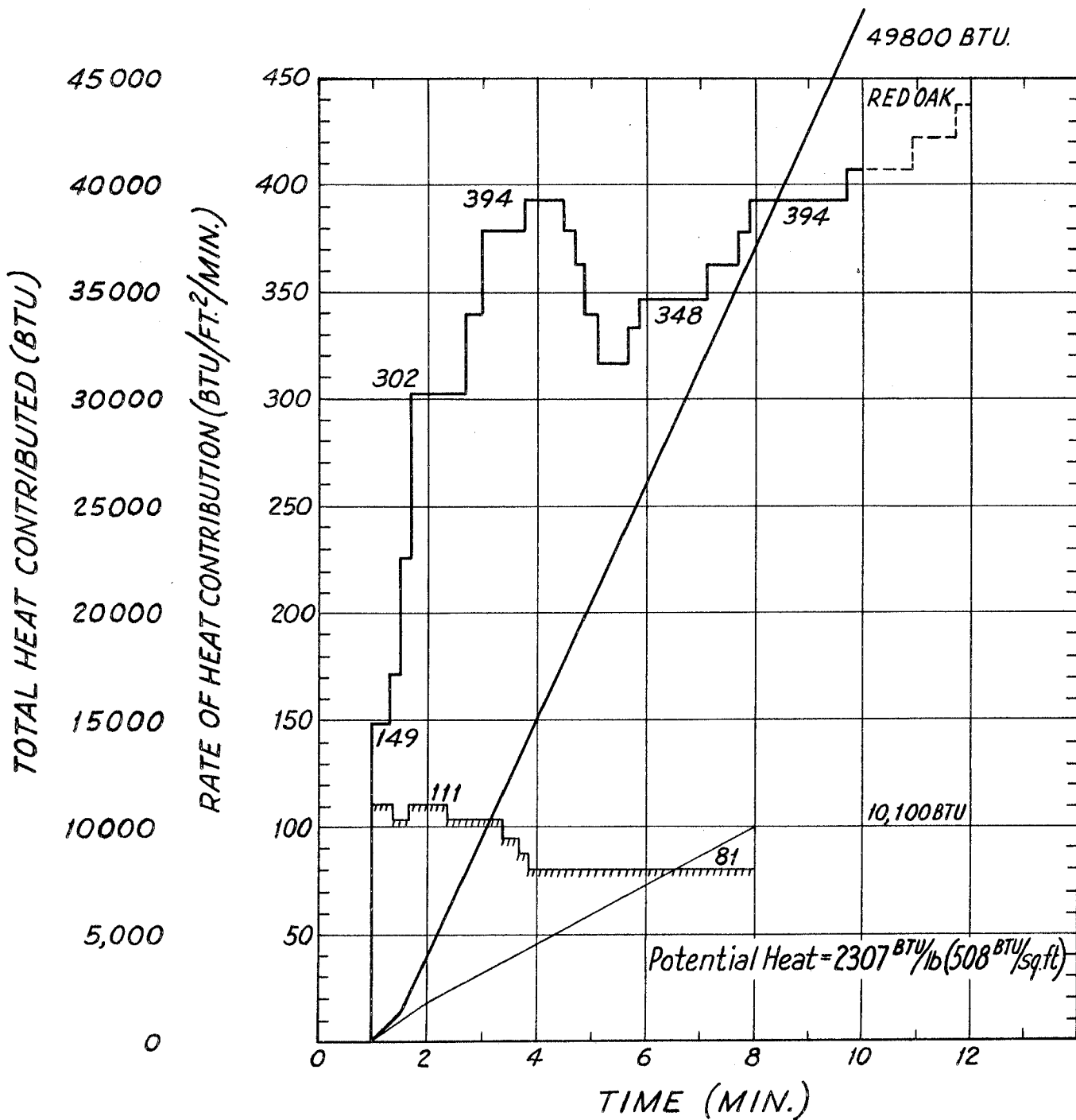


BURNING RATE & TOTAL HEAT vs. TIME  
 FR. TREATED PLYWOOD 3/4"  
 E 84 15-25 FS

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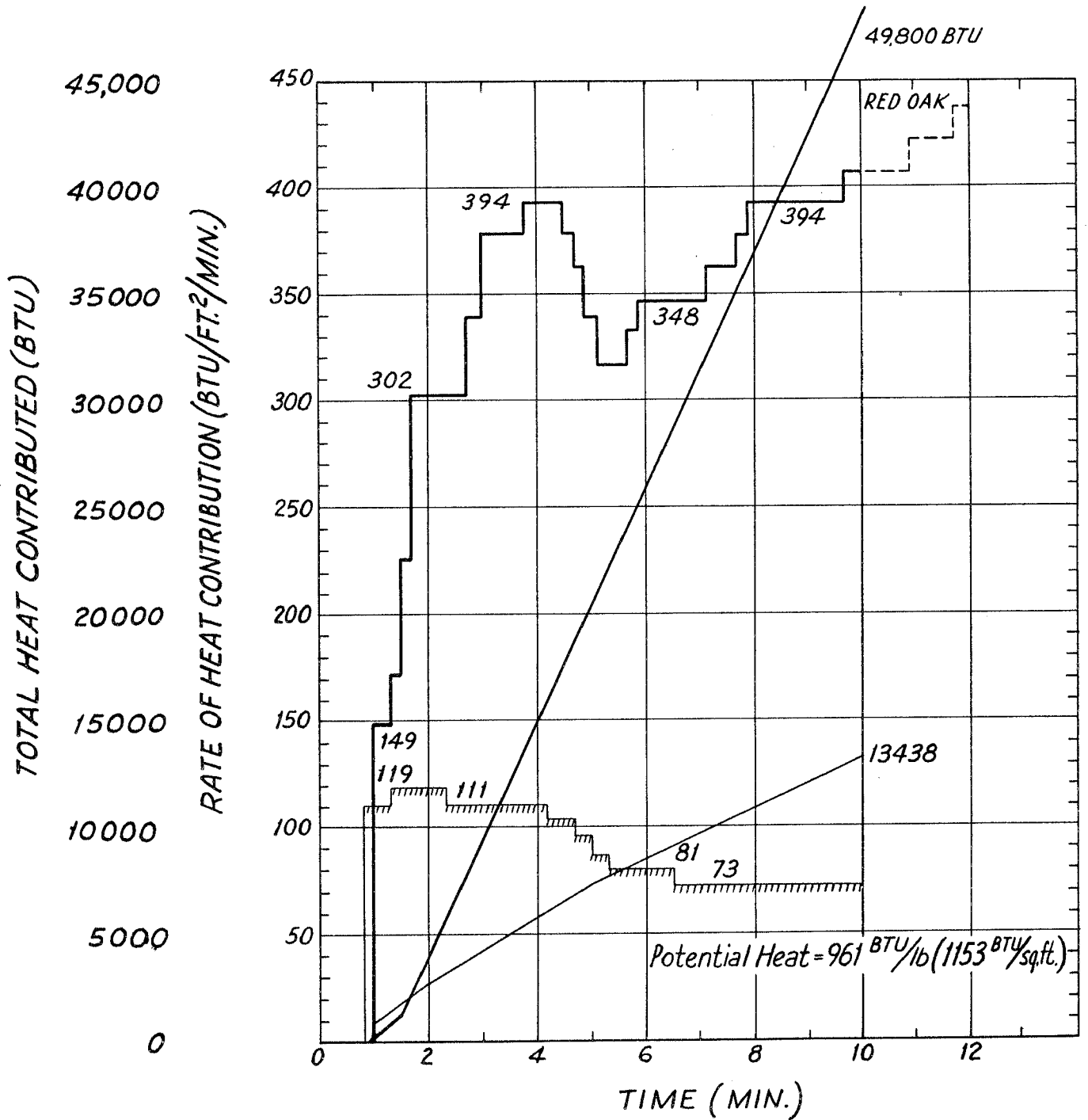


BURNING RATE & TOTAL HEAT vs. TIME  
 WOOD FIBER ACOUSTIC TILE  $\frac{3}{4}$ " CHEM. TREATED  
 E 84 20 FS ↑

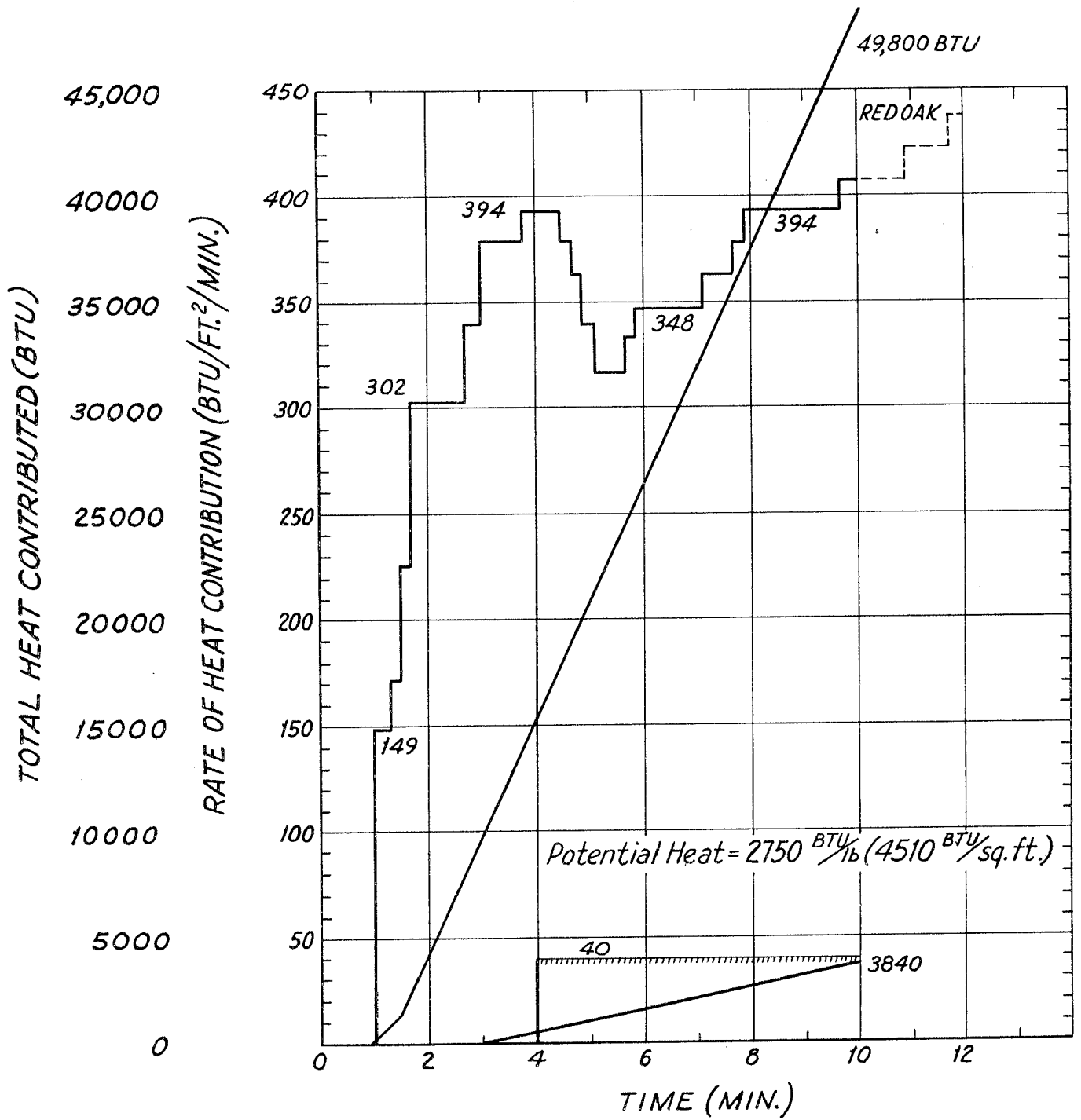


BURNING RATE & TOTAL HEAT vs. TIME  
 GLASS FIBER ACOUSTICAL TILE - 1 1/2" FR. PAINTED SURFACE  
 E 84 40 FS

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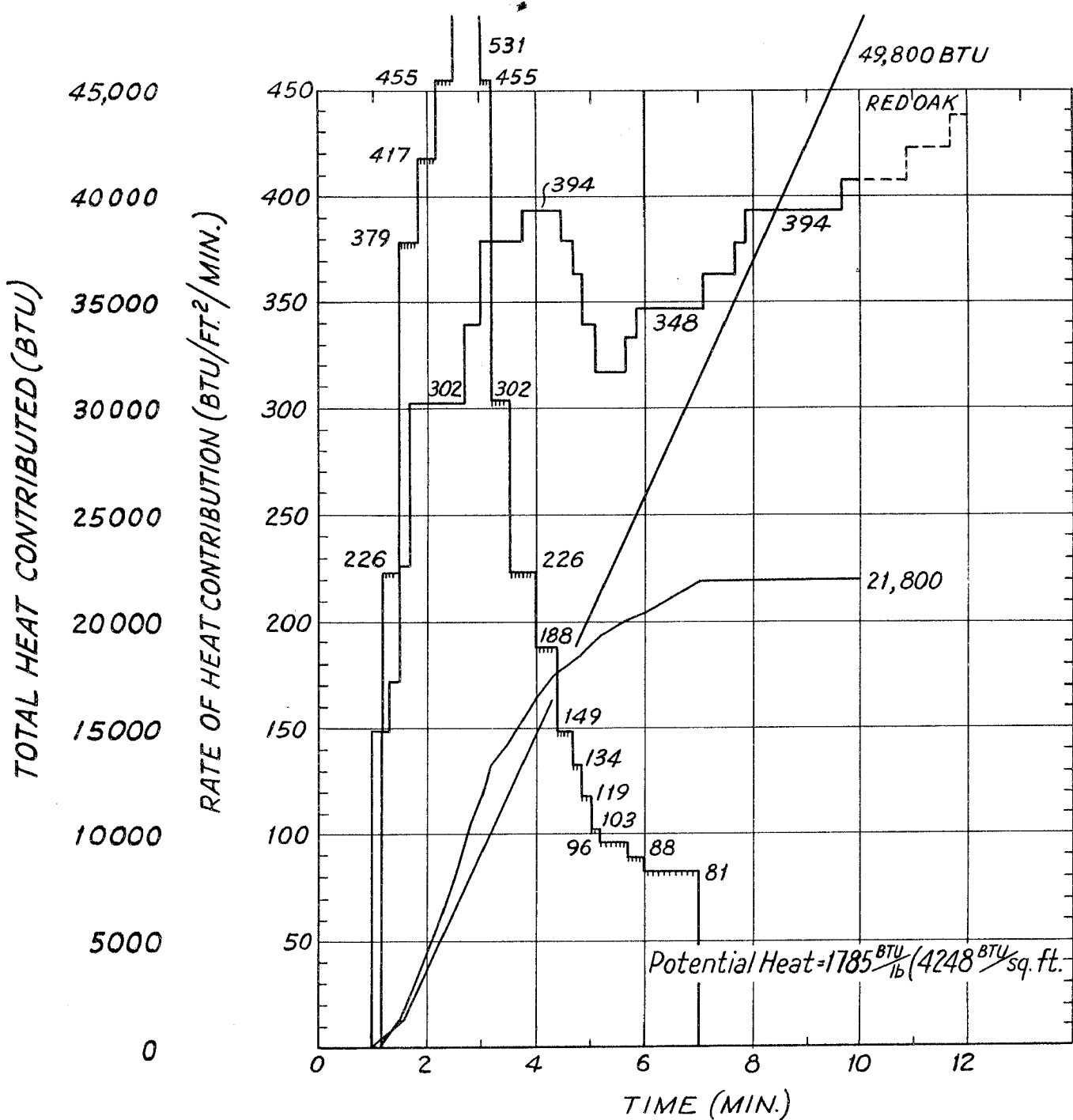
BURNING RATE & TOTAL HEAT vs. TIME  
 MINERAL ACOUSTICAL TILE 5/8"  
 E 84 10-15 FS



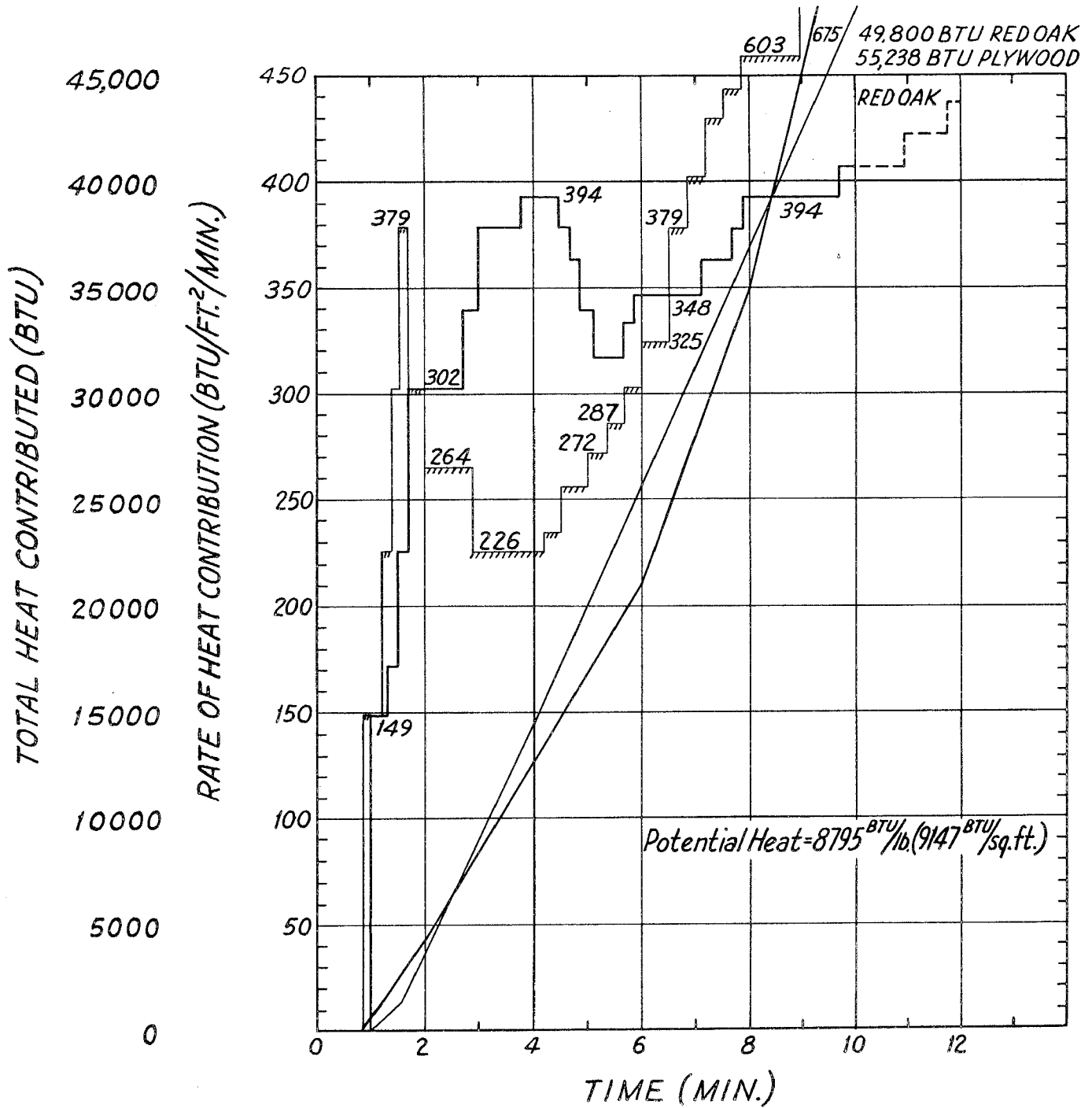
BURNING RATE & TOTAL HEAT vs. TIME

MINERALIZED WOOD ACOUSTICAL TILE 1"

E 84 15 FS.



BURNING RATE & TOTAL HEAT vs. TIME  
 1/16" PLASTIC LAMINATE ON CEM. ASB. BOARD 1/4"  
 E 84 35 FS

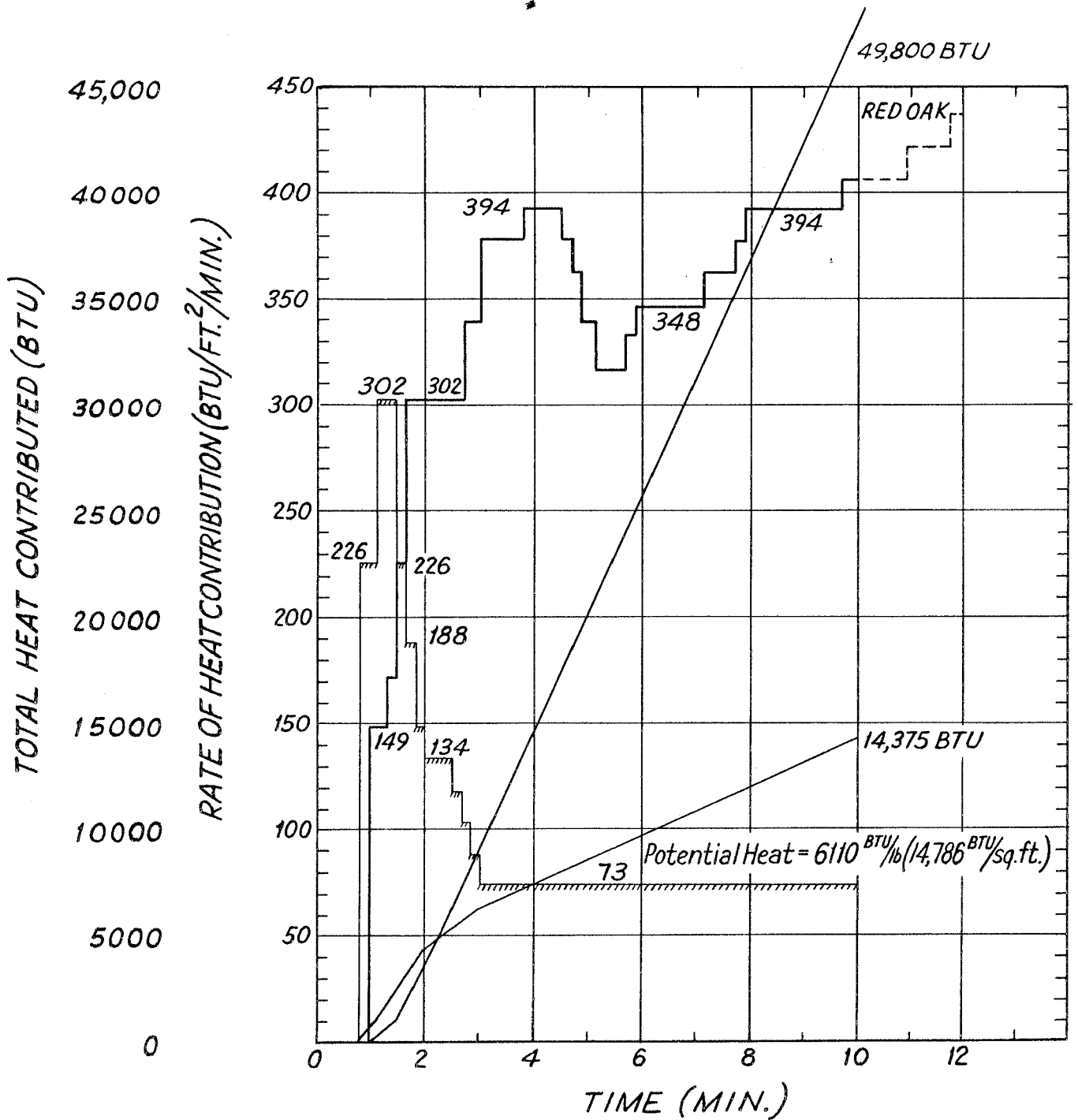


BURNING RATE & TOTAL HEAT vs. TIME

PLYWOOD UNTREATED - MAHOGANY FACE <sup>3</sup>/<sub>8</sub>"  
 E 84 FS 150



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BURNING RATE & TOTAL HEAT vs. TIME

3/4" PLYWOOD, TREATED CORE, RED OAK VENEER 1/28"  
E 84 FS 70