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DURATION AND INTERMITTANCY OF NOISE EXPOSURE
FOR THE OPERATOR OF A SELF PROPELLED BALER

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February 26, 1976

INTRODUCTION:

Evaluation of the noise exposure of agricultural machine operators requires that machine operation time and intermittancy of work patterns be determined. One method of obtaining such data is by using event-activity recorders. These data are available for haying machines operated at the University of Nebraska Field Laboratory, Mead during the 1963 through 1966 seasons. Approximately 60 machine operator days per season were recorded on service recorder charts for the following machines:

1. self-propelled windrowers
2. self-propelled and pull-type balers
3. self-propelled and pull-type bale wagons

In addition some motion-time study data are available for the newer loose hay stackers and large roll balers.

One seasons data, 1965, has been analyzed for a self-propelled baler to illustrate the information already available. Machine operator time and intermittancy work patterns were determined for the 35 days of baling when activity charts were obtained. Briefly, the results are summarized as follows:

<u>Activity</u>	<u>Average time per day, hr.</u>	<u>Average No. of Durations</u>
Engine Time	5.01	6.97
Baling Time	3.99	13.62
Engine Idle	.49	8.17
Non-Field Travel	.58	6.71
Engine Off, Excluding Lunch	1.10	5.46

ANALYSIS OF SERVICE RECORDER DATA:

Procedure

A daily intermittancy work pattern has been determined for one self-propelled baler using the recorder charts from the 1965 haying season. Charts for 35 baling days were analyzed. An example of a chart and the log which was kept is shown in Figure 1. The outside line recorded the baler engine operation time. The inside line indicates the time when hay was entering the bale chamber. This was obtained by installing a limit switch which was actuated by movement of hay into the bale chamber.

Duration Intervals

The activities from each chart were broken down into four categories; engine idling, baling, engine off and miscellaneous which included a lunch break and out of field travel. The duration time for each activity was determined from the chart and recorded. An example of the tables kept is shown in Figure 2. Duration time was recorded in minutes and the correct sequence of activities in the table is illustrated by the arrows.

Daily Duration Averages

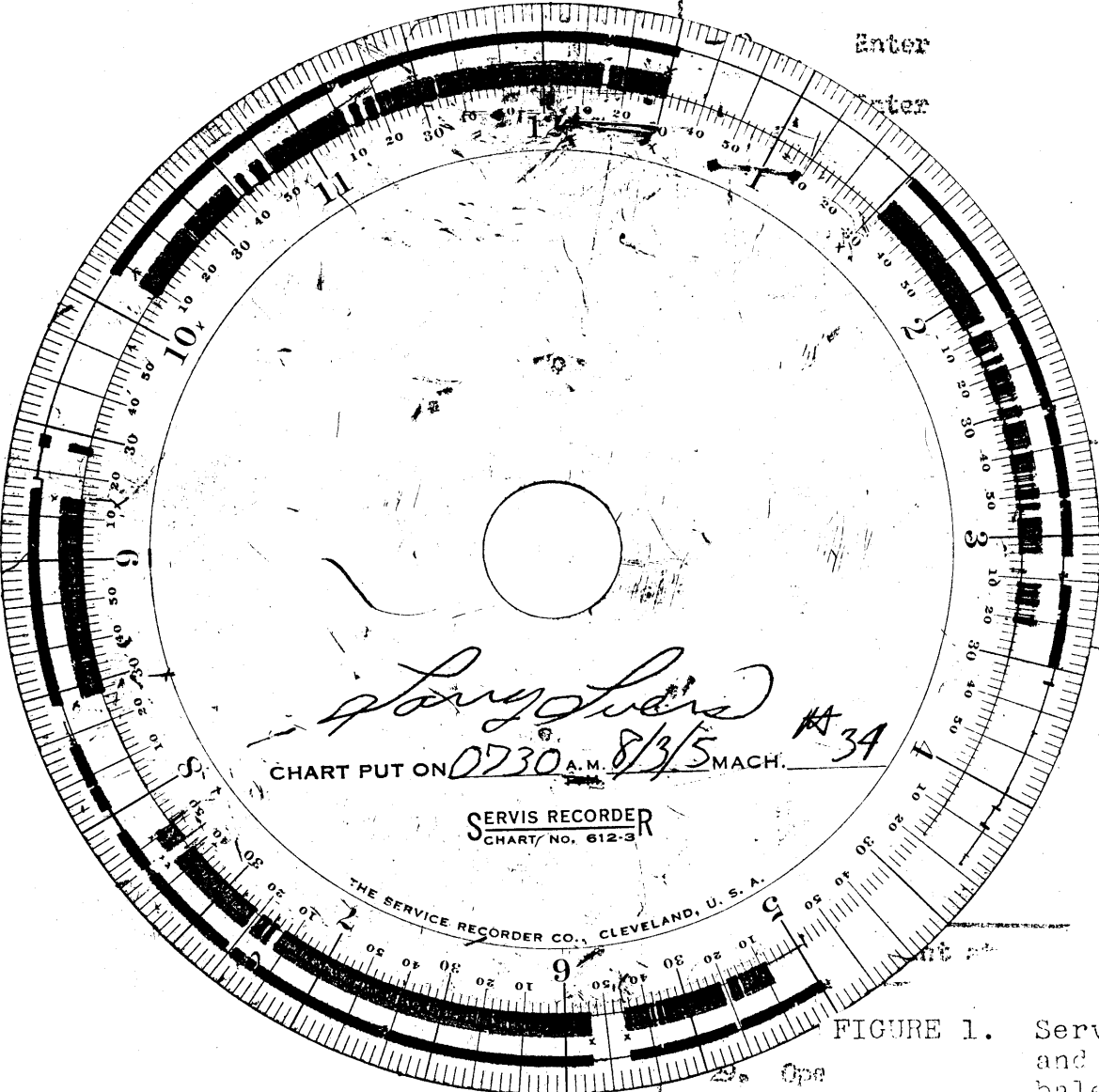
The duration for each activity category were summed for each day. A mean time and standard deviation were determined. An example for several days is given in Figure 3. Finally, the data for all 35 days were combined to obtain an overall total for each activity category as well as an average time per day and an average time per duration. These results are shown in Figure 4.

RECORD OF UNUSUAL EVENTS:

*Fuel pump
bad.*

DAILY LOG SHEET - Baler No.

1. Date		8/3/5
2. Arrival time		2:15
3. Service and Maintenance	hr.	1/2
4. Repair time	hr.	✓
5. Fuel added	gal.	✓
6. Oil added	qt.	✓
7. Oil changed	qt.	✓
8. Filter		✓
9. Wire added		5
10. Wheel count at start of day		0
11. Field	No.	236



Enter time	0740
Enter wheel count	381
bale count	0
time	8:15
wheel count	520
bale count	1620
No.	11
No.	
time	
wheel count	
bale count	
time	
wheel count	
bale count	
No.	

FIGURE 1. Service recorder chart and daily log for s.p. baler.

T = TRAVEL

ENGINE @ Id.	BALING	ENGINE OFF	MISC.
8/2/65		12:50 PM	
(5) → (6)	(6) → (6)	(5T)	
(6) → (7)	(17) → (6)		
(2) → (7)	(19) → (6)		
(1) → (4)	(7) → (6)		
	(18) → (4)		
	11	8T	
		41	8T
		52L	2T
	12		1T
	7		1T
	2		1T
	25		
4	4		3T
		6:55 PM	
8/3/65		8:27 AM	
	47		
12			2T
		40	
	31		
2	2		2T
	3		
1	21		

ENGINE @ Id.	BALING	ENGINE OFF	MISC.
1	2		
2	2		
1	54		
2	14		60L
	35		
2	5		
2	1		
1	9		
2	3		
1	7		
1	6		2T
	2		
1	2		
2	8	8	
	8		10T
		90	
			8T
	11	2	
	25	8	
	78		2T
	5		
5	21		

FIGURE 2. Duration intervals for separate activity categories.

DATE	8/2/65	# DURATIONS	AVERAGE DURATION TIME
TOTAL TIME	6 hr 04 min		
TOTAL ENGINE TIME	4 hr 10 min	5	52.20 (38.17)
TOTAL BALER TIME	3 hr 42 min	11	19.45 (19.24)
TOTAL TRAVEL TIME	29 min	8	3.63 (3.02)
ENGINE IDLE TIME	18 min	5	3.60 (2.07)
engine off	51 min	3	17 (20.81)
lunch	52 min		

DATE	8/3/65	# DURATIONS	AVERAGE DURATION TIME
TOTAL TIME	12 hr 34 min		
TOTAL ENGINE TIME	8 hr 14 min	8	63.88 (52.7)
TOTAL BALER TIME	6 hr 56 min	26	15.65 (19.24)
TOTAL TRAVEL TIME	46 min	8	5.75 (4.86)
ENGINE IDLE TIME	40 min	17	2.35 (2.67)
engine off	154 min	6	25.67 (34.40)
lunch	60 min		

DATE	8/4/65	# DURATIONS	Average Duration TIME
TOTAL TIME	7 hr 24 min		
TOTAL ENGINE TIME	6 hr 02 min	4	91.75 (42.57)
TOTAL BALER TIME	4 hr 59 min	19	15.11 (14.18)
TOTAL TRAVEL TIME	36 min	8	4.50 (4.11)
ENGINE IDLE TIME	44 min	11	4.00 (3.61)
engine off	75 min		

FIGURE 3. Average daily duration time and standard deviation for separate activity categories

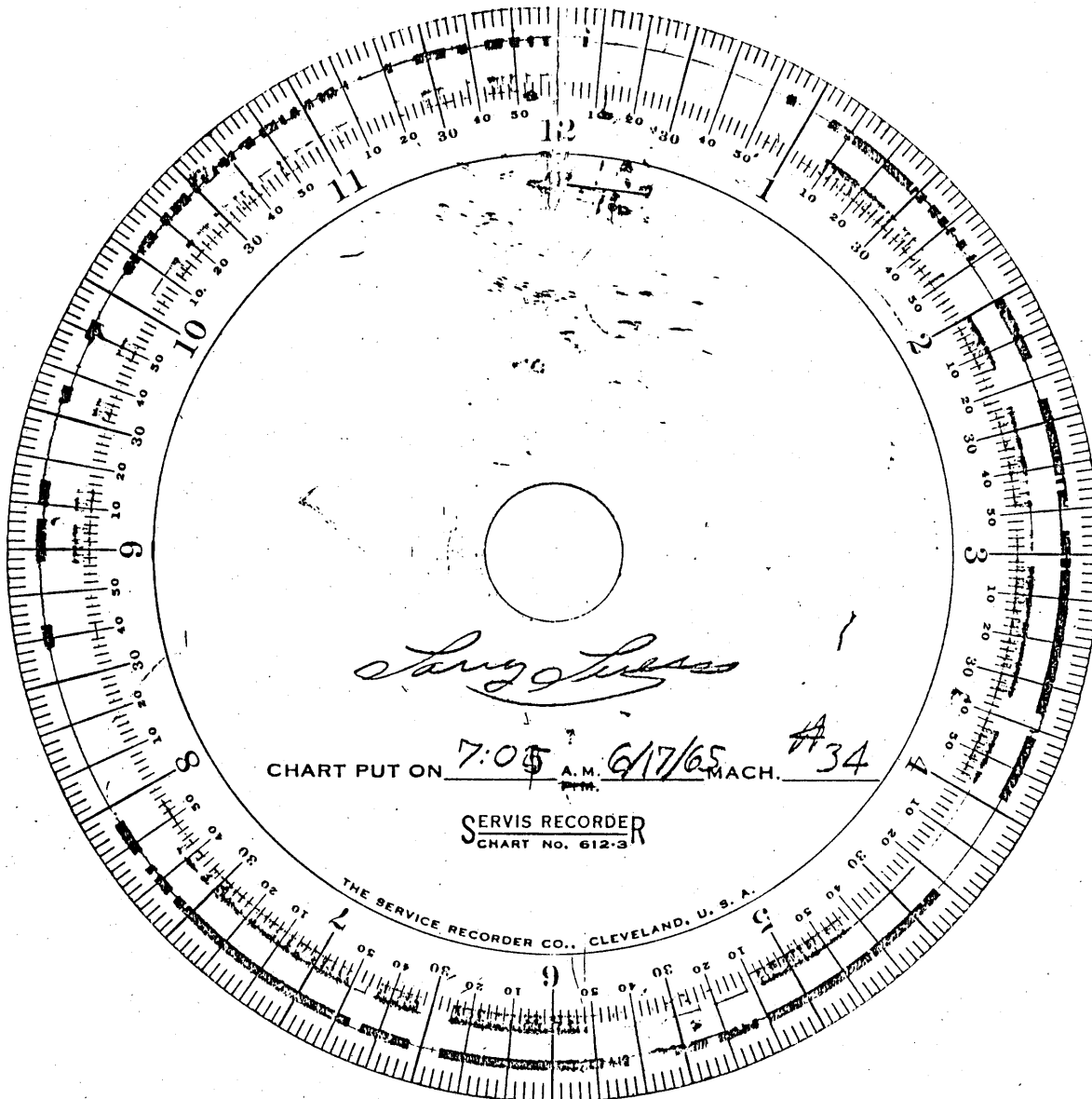
FIGURE 4. Intermittancy work pattern for s.p. baler. (1965 haying season)

	Σ	\bar{X}	S	Total # Durations	AV # Durations Per day	Average time Per duration
35 baling days						
Total Engine Time	10527 min 175.45 hr	300.77 $\frac{\text{min}}{\text{day}}$ 5.01 $\frac{\text{hr}}{\text{day}}$	(128.38) (2.14)	244	6.97	43.14 $\frac{\text{min engine time}}{\text{DURATION}}$
Total Baler TIME	8377 min 139.62 hr	239.34 $\frac{\text{min}}{\text{day}}$ 3.99 $\frac{\text{hr}}{\text{day}}$	(107.68) (1.79)	479	13.69	17.49 $\frac{\text{min Baling time}}{\text{Duration}}$
TOTAL Travel Time	1223 min 20.38 hr.	34.74 $\frac{\text{min}}{\text{day}}$.58 $\frac{\text{hr}}{\text{day}}$	(19.48) (.32)	235	6.71	5.20 $\frac{\text{min travel time}}{\text{duration}}$
Engine Idle Time	1024 min 17.07 hr.	29.26 $\frac{\text{min}}{\text{day}}$.49 $\frac{\text{hr}}{\text{day}}$	(25.84) (.43)	286	8.17	3.58 $\frac{\text{min engine idle}}{\text{duration}}$
ENGINE OFF	2309 min 38.48 hr.	65.97 $\frac{\text{min}}{\text{day}}$ 1.10 $\frac{\text{hr}}{\text{day}}$	(57.71) (.95)	191	5.46	12.09 $\frac{\text{min Engine off}}{\text{duration}}$
Lunch $\frac{16 \text{ days}}{35 \text{ days}}$	857 min 14.28 hr.	24.49 $\frac{\text{min}}{\text{day}}$.41 $\frac{\text{hr}}{\text{day}}$	(31.53) (.53)	—	—	—

Work Pattern Intermittancy

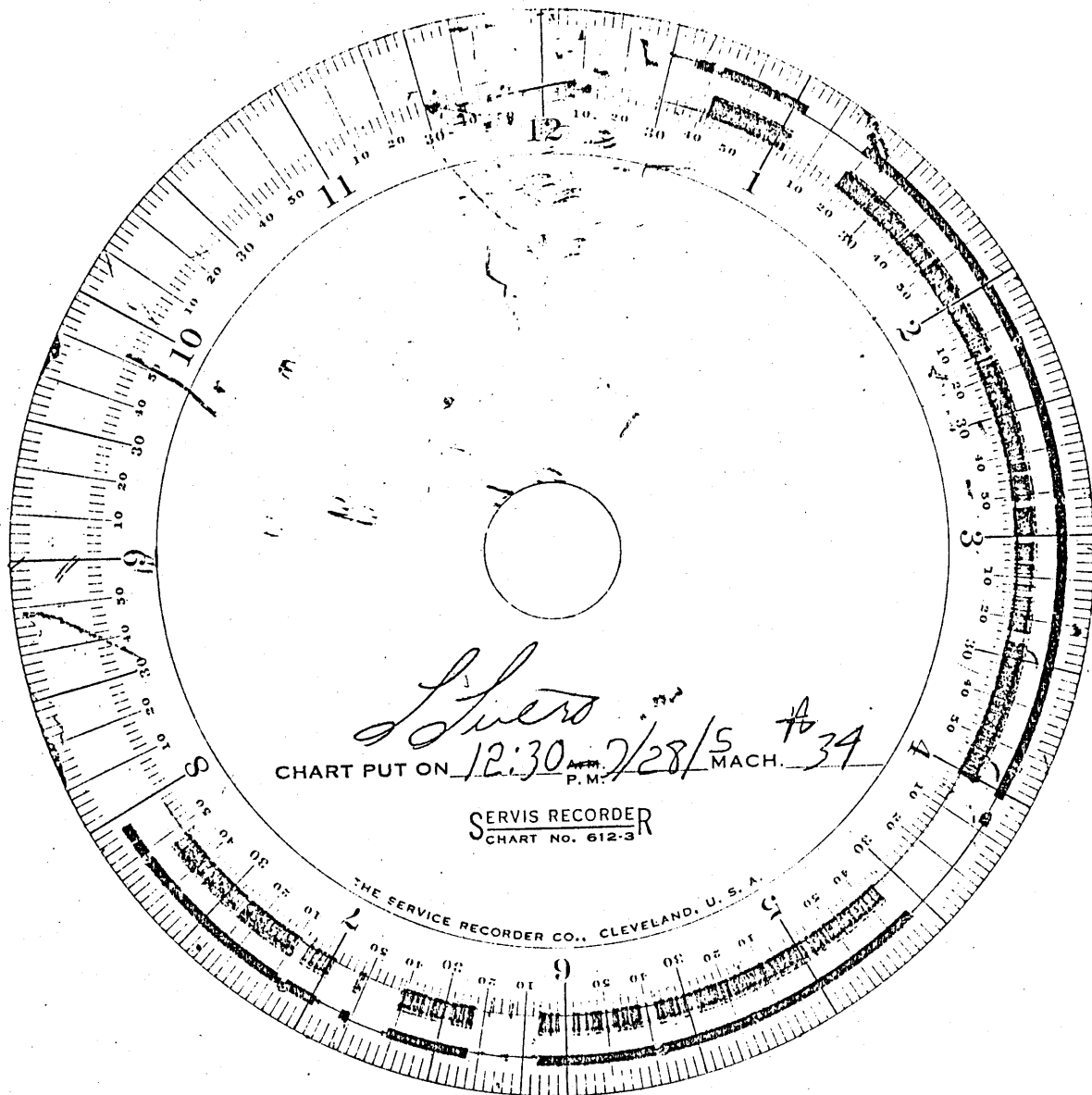
The number of activity durations that occurred each day were determined. An example for several days is given in Figure 3. Average daily durations were then determined and are summarized in Figure 4.

As an example of the variation of durations between days, two days (6/17/65 and 7/28/65) were chosen for comparison. Total engine time and total baler time during the two days are quite comparable, Figures 5 and 6. However, the two days differ greatly in the number of durations involved and the total time required to accomplish the same amount of engine time. The day, 6/17/65 required 4 times as many engine durations and 4 hours additional time to achieve the equivalent amount of engine time on 7/28/65. The two histograms illustrate the frequency of occurrence duration time by five minute intervals, Figures 7 and 8.



		# Durations	Average Duration Time
Total time	11 hr. 18 min.		(s)
Total engine time	6 hr. 42 min.	30	14.93 (17.56)
Total baler time	5 hr. 49 min.	30	9.93 (11.09)
total travel time	09 min.	1	9.00 (-----)
Engine idle time	2 hr. 10 min.	38	3.42 (3.66)
Engine off	3 hr. 08 min.	28	6.71 (5.80)
Lunch	47 min.	--	---- (-----)

FIGURE 5. Service recorder chart and average duration times for 6/17/65.



		# Durations	Average Duration Time
Total time	7 hr. 22 min.		(s)
Total engine time	6 hr. 05 min.	7	57.86 (62.38)
Total baler time	5 hr. 20 min.	24	12.96 (11.59)
Total travel time	38 min.	16	2.38 (1.89)
Engine idle time	17 min.	8	2.13 (.99)
Engine off	1 hr. 16 min.	6	12.67 (8.04)
Lunch	none	--	----- (-----)

FIGURE 6. Service recorder chart and average duration times for 7/28/65.

FIGURE 7. Engine operation intervals
(6/17/65)

Total engine time- 6 hrs. 42 min.

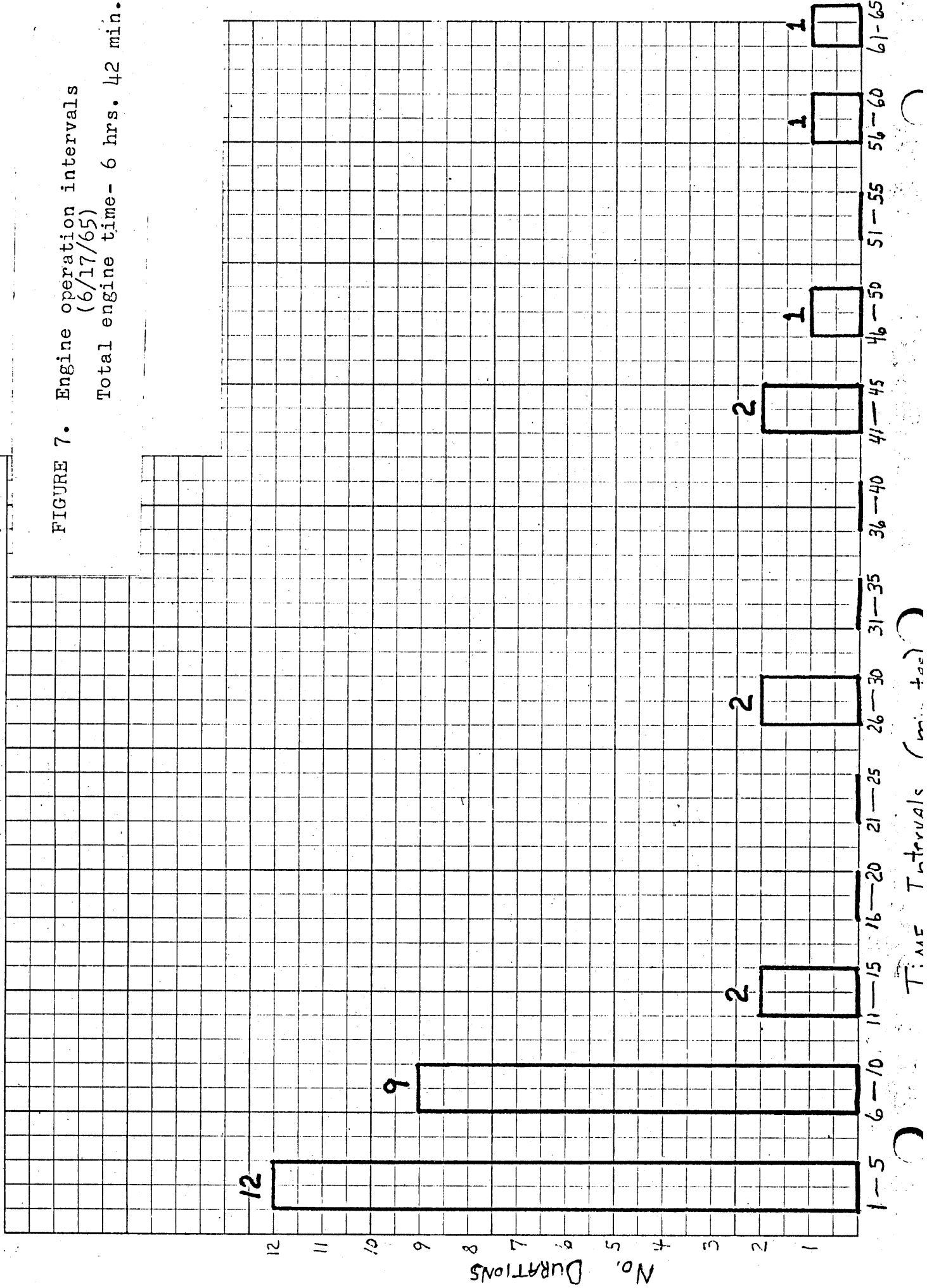
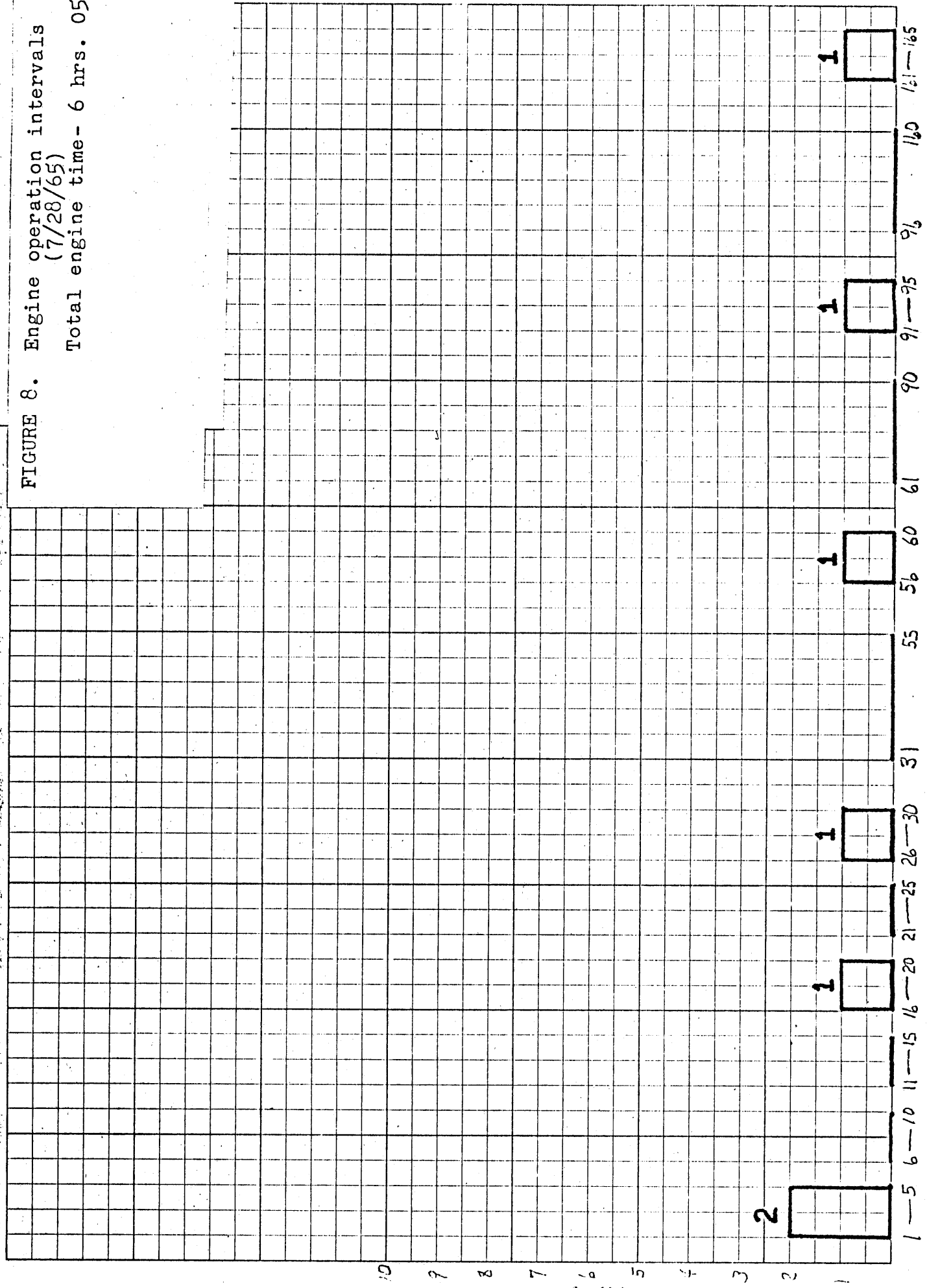


FIGURE 8. Engine operation intervals
(7/28/65)

Total engine time- 6 hrs. 05 min.



TIME INTERVALS (MINUTES)