

gas exchange) at 1,107 Kg.-M. per minute than the rest of the subjects. The air flows and minute volumes plotted in chart 1 increase exponentially up to 1,384 Kg.-M. and then tend to decrease sharply in slope. The respiration rate, however, increases steadily up to the highest work rate. The pulse rate also increases steadily but appears to have a large shift between 622 and 830 Kg.-M. per minute. This shift may be caused by the larger number of subjects at 830 Kg.-M. per minute.

TABLE 4.—Mean Air Flow Measurements and Gas Analyses (Resistance: 64 Mm. Inspiratory, 41 Mm. Expiratory)

	Seden- tary	0 Kg.-M. per Min.	208 Kg.-M. per Min.	415 * Kg.-M. per Min.	415 Kg.-M. per Min.	622 Kg.-M. per Min.	830 Kg.-M. per Min.	1,107 Kg.-M. per Min.	1,384 Kg.-M. per Min.	1,660 Kg.-M. per Min.
Work rate										
Subjects in mean	13	12	12	14	12	12	48	22	6	3
Pulse rate per minute.....	75 †	91	103	118	115	131	155	169	176	184
Respiration rate per minute.....	14.8	17.5	18.7	22.0	20.7	22.5	27.4	32.5	34.2	42.0
Minute volume, l.....	9.1 †	13.2	19.8	28.2	27.0	36.2	48.9	64.4	81.3	90.3
Maximum inspiratory flow, l. per minute	37	44	60	79	78	101	128	160	192	240
Maximum expiratory flow, l. per minute	29	37	56	85 †	77	105	144	195	252	274
Maximum inspiratory flow Minute volume	3.9	3.4	3.1	2.8	2.9	2.8	2.6	2.5	2.4	2.7
Maximum expiratory flow Minute volume	3.1	2.8	2.8	3.0 †	2.9	2.9	2.9	3.0	3.1	3.0
Maximum inspiratory flow Maximum expiratory flow	1.3	1.2	1.1	0.9 †	1.0	1.0	0.9	0.9	0.8	0.9
Inspiratory cycle Total cycle, %.....	38.2	43.1	46.4	48.7	47.9	49.0	51.2	51.9	53.9	51.4
Expiratory cycle Total cycle, %.....	57.5	56.1	53.3	50.9	52.0	50.9	48.6	47.8	46.2	47.1
Rise Inspiratory cycle Sustained flow, %.....	19.1	17.7	15.1	13.3	14.5	12.6	11.6	11.5	10.2	11.8
Inspiratory cycle Sustained flow, %.....	62.6	60.1	62.2	66.5	65.2	66.0	71.7	73.0	74.3	71.9
Maximum flow occurrence, %.....	27.5	37.6	44.7	39.9	45.0	45.8	45.1	46.9	43.6	45.6
Expiratory cycle Rise Expiratory cycle Sustained flow, %.....	14.1	18.4	20.3	15.7	19.1	20.3	17.7	19.4	18.7	19.5
Expiratory cycle Sustained flow, %.....	42.3	49.2	54.9	57.2	57.8	60.1	61.4	62.1	65.8	62.8
Inspiratory work rate, Kg.....	0.4	0.6	1.3	2.5	2.3	4.1	7.2	12.7	19.3	27.8
Expiratory work rate, Kg.....	0.1	0.3	0.7	1.1	1.3	2.5	5.2	9.5	16.5	19.2
Total respiratory work rate, Kg.....	0.2	0.4	0.9	1.8	1.8	3.3	6.1	11.1	18.0	23.3
Oxygen deficit, %.....	3.79	4.15	4.60	4.75	4.85	4.98	4.70	4.54	4.14	3.98
Oxygen consumption, ml. per minute.	304	489	812	1,190	1,159	1,606	2,052	2,591	3,033	3,245
Carbon dioxide production, ml. per minute	259	416	709	1,052	1,039	1,482	1,976	2,621	3,231	3,450
Respiratory quotient	0.85	0.85	0.87	0.89	0.90	0.92	0.96	1.01	1.07	1.07

* Resistance was 64 mm. inspiratory and 27 mm. expiratory.

† One less subject is included in mean.

Effect of Resistance on Respiratory Air Flows.—The effect of resistance in this study is shown by the data in table 4. The standard deviations for these data are presented in table 5. The data of table 4 show the effect of a combined resistance of 64 mm. of water at 85 l. per minute during inspiration and 41 mm. of water during expiration. This resistance approximates that of gas masks and other breathing apparatus. The effects of inspiratory and expiratory resistance when they occur separately are described in a recent O.S.R.D. report.¹¹

The data of table 4 are plotted in chart 2. In shape all the curves are quite similar to those of chart 1. The values are reduced in several cases because of the