

physiological limit of air flow for which protection should be provided. The curves should be of aid in the design of canisters, pumps and testing apparatus for use in simulating the actual conditions present in these experiments.

SUMMARY AND CONCLUSIONS

The measurements in this study were made to obtain data for designing apparatus to simulate human respiration. A study of the available classified and unclassified literature indicated that only a few scattered simultaneous measurements of inspiratory and expiratory flow at various work rates have been made.

Data were obtained on several healthy male subjects. Simultaneous measurements of instantaneous inspiratory and expiratory air flow and gas exchange were obtained on sedentary subjects and on subjects working at 0, 208, 415, 622, 830, 1,107, 1,384 and 1,660 Kg.-M. per minute (0, 1,500, 3,000, 4,500, 6,000, 8,000, 10,000 and 12,000 f.-p.). Measurements were obtained with the subjects breathing through minimal resistance and with subjects breathing through a combined resistance, 64 mm. of water inspiratory and 41 mm. of water expiratory, at 85 l. per minute. The number of subjects performing the various experiments depended on the rate of work. At high rates, above 1,107 Kg.-M. per minute, only a few subjects were able to perform the work for 10 minutes. At lower rates the only limitation was the number of subjects available for study.

From this investigation the following conclusions are drawn:

1. Air flow curves obtained on human subjects at various work rates vary in rate and amplitude with the work rate. The inspiratory and expiratory maximum air flows and minute volumes increase exponentially with increasing work rate.
2. Subjects in excellent physical condition can maintain oxygen consumption as high as 3,500 ml. per minute for periods as long as 10 minutes when working on a bicycle ergometer at a work rate of 1,660 Kg.-M. per minute and breathing through minimal resistance.
3. At work rates above 830 Kg.-M. per minute on the bicycle ergometer an inspiratory resistance of 64 mm. of water and an expiratory resistance of 41 mm. of water at 85 l. per minute lowers the oxygen consumption considerably as compared with the minimal resistance condition.
4. The data contained in this report may be used in the design of cams for pumps and other apparatus used to simulate human breathing for testing protective respiratory equipment.

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