

ABSTRACT

The tractor has progressed from its original primary use as a substitute for animal power on the farm to the present units designed for multiple uses. An important factor influencing the efficiency in the operation of tractors is the extent to which it has been designed to meet the human capabilities and limitations. Inclusion of these factors ensures higher working efficiency, increased work output, ease of operation, and maximum operator safety.

The increasing awareness of the potential benefits of good ergonomic design has resulted in a steady improvement of operator workplace. Therefore, greater emphasis is required to be given on adopting the operating controls to the physical needs of the operator belonging to different ethnic groups. Moreover, there should be uniformity in placement of these controls on all tractors to accommodate the Indian operators with a view to achieve an efficient and comfortable operation.

In order to achieve the above objectives, experiments were conducted under controlled laboratory conditions as well as in actual field conditions. For laboratory study a psychrometric chamber was used in which the temperature and relative humidity could be maintained. Instruments and other facilities used include anthropometer, integrating vibration meter, cardiomin & telemetry, and expirograph.

An anthropometric survey was conducted and the data were compared with mean values of those obtained from different parts of the country and also with three different ethnic groups. In order to study the physiological response of subjects in laboratory under submaximal loading in a tractor driving posture, a dual-mode bicycle ergometer was developed. From the field study it was observed that the speed of operation of the tractor as well as the mass of the operator has significant effect on the vibration acceleration level experienced by him. Among the field operations studied ploughing was found to be the most strenuous and the highest energy demanding ($25.27 \text{ kJ min}^{-1}$) while transportation was the least energy demanding ($19.98 \text{ kJ min}^{-1}$) operation. On the basis of energy spent by the operators, it was also observed that field operation with tractor drawn implements fall into the category of "moderately heavy" type of work.

A tractor operator workplace simulator has been designed and developed for studying the different tractor workplace configurations. Evaluation of the existing configurations indicated that TC_4 (steering column angle with respect to horizontal 70° , pedal locations from SRP: clutch 59.0 cm, brake 62.0 cm and draft control lever 29.5 cm) was superior to other configurations tested. Studies on evaluation of the most efficient location of controls resulted in steering column angle of 64.8° with horizontal, foot pedals (clutch & brake) distance of 62.7 cm from SRP and the draft control lever distance of 16.7 cm from SRP for Indian operators based on minimum energy expenditure rate (EER) and rated perceived exertion (RPE) scores. Theoretical values of different controls were calculated and these were found to be very close and comparable to the observed values.

KEY WORDS : *Tractor operator; Safety; Ergonomic; Workplace; Working efficiency; Posture; Simulator; Energy expenditure rate; Rated perceived exertion .*