I've tried to show the endless opportunity and need for improvements and innovations in this field that are going to frustrate and excite the next generation of design engineers, human factors engineers and industrial designers.

WILLIAM F. H. PURCELL

The design of the modern tractor includes considerations of human factors. These factors, when properly incorporated in design, allow the operator to perform many complex tasks with efficiency, safety, and a minimum of fatigue. In general, human factors include such items as riding comfort, visibility, location and arrangement of controls, ease of operating controls, design for thermal comfort, and sound control. A typical work-space control center for a modern tractor is shown in figure 9-1.

This chapter briefly discusses and summarizes the main human factors that are considered in the design of the tractor operator's work space. This subject could occupy an entire book, and in fact, much has been written in recent years by researchers and designers whose interests were quite varied. For the benefit of the student or the designer interested in further exploration of this topic, numerous references and suggested readings are provided at the end of the chapter.

Operator Exposure to Environmental Factors

Tractors are used under varied geographical and climatological conditions. Direct exposure to temperature, humidity, wind, thermal radiation, dust, and
FIGURE 9-1 Major controls and instruments for a modern tractor. (Courtesy Deere & Company.)

Key:
1. Clutch pedal or inching pedal
2. Light switch
3. Fuel shutoff valve (diesel)
4. Air restriction indicator light
5. Transmission oil indicator light
6. Power takeoff clutch lever
7. Engine oil pressure gauge
8. Engine temperature gauge
9. Steering shaft adjusting knob
10. Steering wheel
11. High-beam indicator light
12. Speed hour meter
13. Shift levers
14. Hand throttle
15. Remote-hydraulic operating levers
16. Rockshaft control lever
17. Brake pedals
18. Differential lock pedal
19. Light dimmer switch
20. Steering wheel tilt lock
21. Ignition key and starter switch

chemicals is encountered. Design of a suitable enclosure for the tractor operator minimizes the effects of the extremes that these environmental parameters can generate.

Table 9-1 defines comfort and bearable zones for four of these parameters as they apply to humans. Temperature, humidity, ventilation, and thermal radiation zones are interrelated.

Research has been done in regard to dust effects. Permissible guideline limits for dust concentrations on combines in the Netherlands is 15 mg/m³. Zander (1972) reported greater levels on combines without cabs.

Noren (1985) reported peak dust concentrations of 577 mg/m³ occurring during soil tillage operations. Mean values were 146 mg/m³. Tractor cabs that were pressurized at 50 Pa and fitted with air filters of "fine" quality reduced the dust concentration to a mean value of 24.7 mg/m³ in the operator's breathing zone.