

adjustability of the dimension between the foot controls and the seated position of the worker.

Although there is the possibility of making the controls themselves adjustable, it has generally been found easier and more satisfactory to have a range of front-to-back adjustability in the seat. The amount of adjustability will depend upon the range of leg length of the population operating the machine. To give a

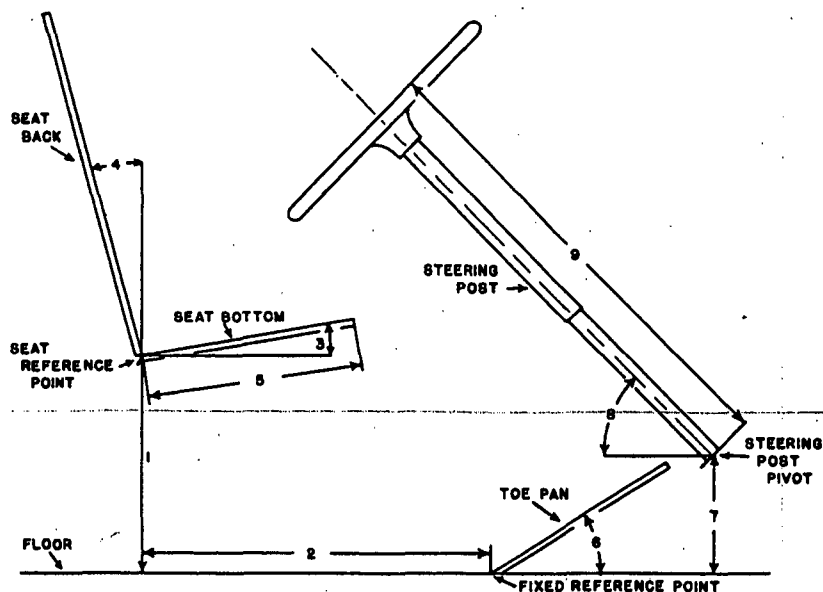


Figure 6. Schematic diagram of a mock-up truck cab designed to determine the various adjustments and arrangements required by a population of a given range in body size. A similar mock-up could be designed for almost any kind of equipment or working area. (From Kephart and Dunlap.²⁰)

concrete example, it was found that $6\frac{1}{4}$ inches of adjustability was completely adequate for 90 per cent of all commercial bus and truck drivers.²⁰ With other populations, as where small women are using the same equipment as large men, the range would be greater. This engineering problem occurs only when the seat is a fixed part of the working area, as in vehicular equipment; where the seat is a movable stool or chair, a wide range of positions is usually feasible, and the problem can be solved much more simply.

d. Seating Dimensions. In those industrial tasks that require or permit a seated position, the most efficient and comfortable design of seats and chairs is essential. This necessitates the use of a special group of body measurements, many of

which are basically static in nature, such as seat breadth. However, additional factors, including clothing increments, room for changing of positions, and body clearances during the operation of controls, require a partially dynamic treatment of the problem. The location, dimensions, and adjustability of the seat should be considered with reference to the arrangements and location of the tools, materials, controls, and displays used by the person. In addition, the seat must afford the operator maximum comfort, consistent with efficiency, in order to reduce fatigue. Functional, comfortable seat design can do much to add to the efficiency and safety of job performance.

In seat designs, equally as much as in other aspects of equipment design, the population that is to use the equipment must be measured directly. For this reason it is difficult to make specific recommendations applicable to industry in general. To give an extreme example, some of the seat dimensions and locations adequate for female factory workers would be most unsatisfactory for a substantial percentage of the size range of commercial truck drivers. What will be emphasized here are the pertinent body dimensions and design principles relevant to seat construction. Some specific figures will be given, based on data drawn from different segments of the population. The dimensions and characteristics of the seat that must be considered include the breadth, depth, height, slope, and shape of the seat and back rest.

Seat breadth. This dimension is one of the easiest to establish and can be based on the seat breadth of the individual as measured across the buttocks when in the seated position. In a study of the seating problem in industry, Garner has stated that the breadth need be only 16 to 17 inches.^{27,28} These may be acceptable as minimum figures, but if changes of seated position are occasionally possible or desirable, and if all but the very broadest of male workers are to be included, a breadth of 19 inches will be more satisfactory.

Seat depth. The most important single consideration in seat depth (length) is that the parts of the hip bones that bear the weight of the seated body (the ischial tuberosities) should be properly supported. A depth of as little as 8 to 10 inches will be sufficient for this purpose, a requirement fulfilled by almost all industrial seats. If the seat depth is excessive, workers with shorter legs will find the front edge of the seat cutting into the back of the calf, and will be unable to bend the knee satisfactorily unless they shift their buttocks forward on the seat. On the other hand, long-legged workers will have inadequate thigh support if the seat is too short. The upper limit for this dimension can be determined from the thigh length of the smallest segment of the population to be accommodated, as measured from the back of the calf to the plane of the back while in the seated position. The 5th percentile of a large series of the general population was 17.0 inches in this dimension (males 17.4, females 16.8).¹² A seat depth greater than

J. R. Garner, Posture in its relation to industrial fatigue, *Med. J. and Record*, 138, 15-17 (1933).

J. R. Garner, Fatigue in its relation to accident prevention, *Ind. Med.*, 6, 665-668 (1937).