

7. Interruption of Work Operations	Moderate	Low	Fairly high	Fairly high	None
8. Applicability: For physical, clerical, professional work	Very good	Average	Average	Very good	Good
9. Savings: How quickly, how much	Average to high	High	Average to high	Fair to good	Fair
10. Usability: In scheduling production, evaluating performance	Average to high	High	High	Fair to good	Fair
11. Reporting Requirements: Difficulty of furnishing data	Average	Average	Average	Fair	Simple

Fig. 9.20.

## 9.28. ERGONOMICS

### Definition

*Ergons* means 'Work' and *Nomos* means 'Natural Laws'. Ergonomics or its American equivalent 'Human Engineering' may be defined as the scientific study of the relationship between man and his working environments. Ergonomics implies 'Fitting the job to the worker'. Ergonomics combines the knowledge of a psychologist, physiologist, anatomist, engineer, anthropologist and a bio-metrician.

**Objectives.** The objectives of the study of ergonomics is to optimize the integration of man and machine in order to increase work rate and accuracy. It involves the design of,

- (i) a work place befitting the needs and requirements of the worker,
- (ii) equipment, machinery and controls in such a manner so as to minimize mental and physical strain on the worker thereby increasing the efficiency, and
- (iii) a conducive environment for executing the task most effectively.

Both Work study and Ergonomics are complementary and try to fit the job to the workers; however, Ergonomics adequately takes care of factors governing physical and mental strains.

**Applications.** In practice, ergonomics has been applied to a number of areas as discussed below :

- (i) Working environments,
  - (ii) The workplace, and
  - (iii) Other areas.
- (i) **Working Environments**

(a) The environment aspect includes considerations regarding light, climatic conditions (i.e., temperature, humidity and fresh air circulation), noise, bad odour, smoke, fumes, etc., which affect the health and efficiency of a worker.

(b) Day light should be reinforced with artificial lights, depending upon the nature of work.

(c) The environment should be well-ventilated and comfortable.

(d) Dust and fume collectors should preferably be attached with the equipments giving rise to them.

(e) Glares and reflections coming from glazed and polished surfaces should be avoided.

(f) For better perception, different parts or sub-systems of an equipment should be coloured suitably. Colours also add to the sense of pleasure.

(g) Excessive contrast, owing to colour or badly located windows, etc., should be eluded.

(h) Noise, no doubt distracts the attention (thoughts, mind) but if it is slow and continuous, workers become habituated to it. When the noise is high pitched, intermittent or sudden, it is more dangerous and needs to be dampened by isolating the place of noise and through the use of sound absorbing materials.

**(ii) Work place layout**

- The workplace is a space in a factory/machine which must accommodate an operator(s), who may be sitting or standing.
- Ideally, a workplace should be custom built for the use of one person whose dimensions are known. For general use, however, a compromise must be made to allow for the varying dimensions of humans. Therefore, a workplace should be so proportioned that it suits a chosen group of people.

Adjustment may be provided (on seat heights for example) to help the situation.

- Fig. 9.21 shows suggested critical dimensions for a group of males using a seated workplace. These dimensions can be obtained quickly and easily and will be quite satisfactory for constructing a mock-up of the proposed design.

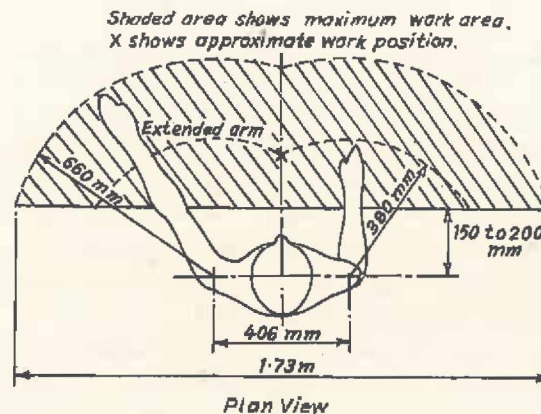


Fig. 9.21. Critical dimensions for seated male operator

The Fig. 9.21 shows the left hand covering the maximum working area and the right hand covering the normal working area.

**Normal working area** is the space within which a seated or standing worker can reach and use tools, materials and equipment when his elbows fall naturally by the side of the body.

**Maximum working area** is the space over which a seated or standing worker has to make full length arm movements (i.e., from the shoulder) in order to reach and use tools, materials and equipment.

Assuming the work as some operation requiring equipment, any tools, bins, etc., they should be placed within the area shaded so that they can be seen and reached quickly and easily.

- Fig. 9.22 shows the situation with respect to bench heights and seat heights. In this view, the seat should be adjustable for height and rake. It is not usually convenient to have adjustable benches or work tops and the value of 712mm to 762mm is probably the best compromise dimension.
- Workplace layout, design of seat, arrangement of different equipment, tools and components should not cause discomfort to the worker.
- The seat should be such that the worker is able to adopt different postures, if necessary, for carrying out different operations.
- The height and back of the chair should be adjustable.
- A proper foot rest, arm rest and leg room should be provided. While working, an operator should feel himself natural and comfortable.

- Design and layout of display panels and instrument dials should result in accurate observations. They should preferably form a part of the workplace and the display should be easily readable by all. Also the display panel should be at right angles to the line of sight of the operator.

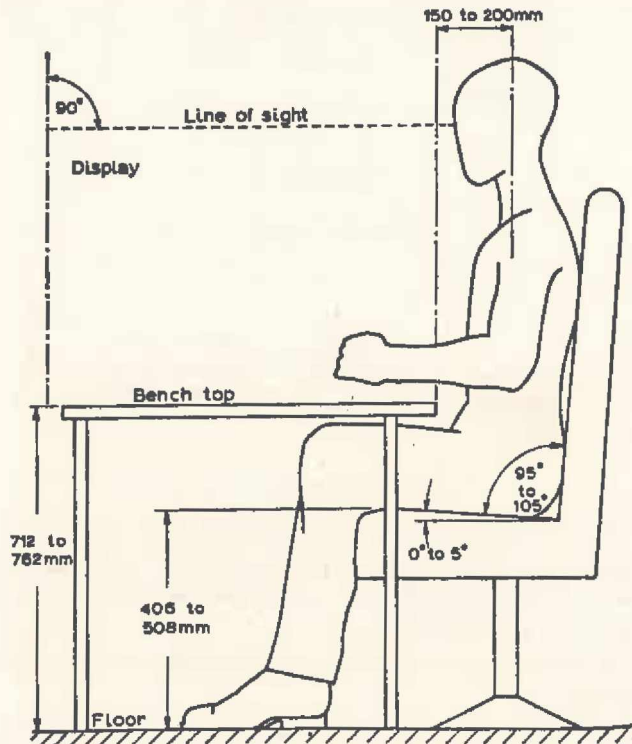


Fig. 9.22. Bench and seat heights

- An instrument with a pointer should be employed for check readings whereas for quantitative readings, digital type of instruments should be preferred.
- Design and location of various manual controls, knobs, wheels and levers should not cause excessive physical and mental strain to the worker. Levers and controls should be located close to the operator. Hand and foot controls, both, should be employed to advantage.
- All controls should preferably move in one direction for one kind of action. For example, upward movement of the levers should energise the subsystem and downward motion should deenergise and vice versa.
- In the case of tote boxes, bins, loose or portable tools, etc., there should be a definite place for their location within the working area. Hence the operator can develop habitual, confident movements when reaching for equipment often without any need for the eyes to direct the hands. The mental effort and strain are less. For the same reason, material and tools used at the workplace should always be located within the working area to permit the best sequence of operations (refer Fig. 9.23).

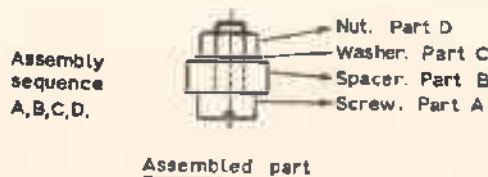
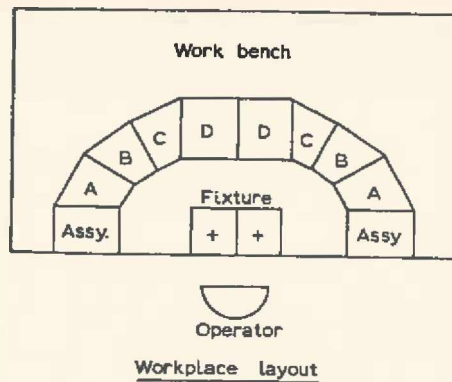


Fig. 9.23. Workplace layout for assembled part

The operation shown consists of assembling four parts A, B, C and D (two assemblies at a time) using both hands. As finished assemblies are placed in chutes, parts A are in the next bins as they are required first for the next assembly.

- Where possible, clear access should be given around industrial workplaces to allow for adequate supervision and inspection.
- It is clear that if ergonomic principles are observed in the design of workplaces, then the operator will be more efficient, less strained and tired and consequently less liable to have an accident.

(iii) **Other Areas.** Other areas include studies related to fatigue, losses caused due to fatigue, rest pauses, amount of energy consumed, shift work and age considerations.