Topic Page: machine

Definition: **machine** from *Dictionary of Energy*

Consumption & Efficiency. **1.** an assembly of interrelated parts, each with a definite motion and separate function, used to perform a specific task. **2.** any device that transmits or modifies energy. **3.** relating to or produced by such a device; mechanical. See also simple machine.

Image from: **Pulleys (1) multiply the effect of a force...** in *Philip's Encyclopedia*

Summary Article: **machine**
From *The Columbia Encyclopedia*

arrangement of moving and stationary mechanical parts used to perform some useful work or to provide transportation. From a historical perspective, many of the first machines were the result of human efforts to improve war-making capabilities; the term *engineer* at one time had an exclusively military connotation. In the United States the original colonies were not permitted to make or import machine tools; it was only after the Revolution that the first manufacturing machines were built (c.1790) by Samuel Slater for a textile mill in Pawtucket, R.I.

Types of Machines

By means of a machine an applied force is increased, its direction is changed, or one form of motion or energy is changed into another form. Thus defined, such simple devices as the lever, the pulley, the inclined plane, the screw, and the wheel and axle are machines. They are called simple machines; more complicated machines are merely combinations of them. Of the five, the lever, the pulley, and the inclined plane are primary; the wheel and axle and the screw are secondary. The wheel and axle combination is a rotary lever, while the screw may be considered an inclined plane wound around a core. The wedge is a double inclined plane.

Complex machines are designated, as a rule, by the operations they perform; the complicated devices used for sawing, planing, and turning, for example, are known as sawing machines, planing machines, and turning machines respectively and as machine tools collectively. Machines used to transform other forms of energy (as heat) into mechanical energy are known as engines, i.e. the steam engine or the internal-combustion engine. The electric motor transforms electrical energy into mechanical energy. Its operation is the reverse of that of the electric generator, which transforms the energy of falling water or steam into electrical energy.

Mechanical Advantage and Efficiency of Machines

By means of a machine, a small force, or effort, can be applied to move a much greater resistance, or load. In doing so, however, the applied force must move through a much greater distance than it would if it could move the load directly. The mechanical advantage (MA) of a machine is the factor by which it multiplies any applied force. The MA may be calculated from the ratio of the forces involved or from the ratio of the distances through which they move. Ideally, the two ratios are equal, and it is simpler to calculate the ratio of the distance the effort moves to the distance the resistance moves; this is called the ideal mechanical advantage (IMA). In any real machine some of the effort is used to overcome friction. Thus, the ratio of the resistance force to the effort, called the actual mechanical advantage

(AMA), is less than the IMA.

The efficiency of any machine measures the degree to which friction and other factors reduce the actual work output of the machine from its theoretical maximum. A frictionless machine would have an efficiency of 100%. A machine with an efficiency of 20% has an output only one fifth of its theoretical output. The efficiency of a machine is equal to the ratio of its output (resistance multiplied by the distance it is moved) to its input (effort multiplied by the distance through which it is exerted); it is also equal to the ratio of the AMA to the IMA. This does not mean that low-efficiency machines are of limited use. An automobile jack, for example, must overcome a great deal of friction and therefore has low efficiency, but it is extremely valuable because small effort can be applied to lift a great weight.

Although most machines are used to multiply an effort so that it may move a greater resistance, they may have other purposes. For example, a single, fixed pulley merely changes the direction of the applied force; the pulley may make it easier to lift the load, since a person can pull down on a rope, thus adding his or her own weight to the effort, rather than simply lifting the load. In a catapult an effort greater than the load moves through a short distance, causing the load to be moved through a large distance before being released. As the load is being moved, it picks up speed so that it is traveling at a considerable velocity when it leaves the catapult.

The Columbia Encyclopedia, © Columbia University Press 2018

APA

machine. (2018). In P. Lagasse, & Columbia University, *The Columbia encyclopedia* (8th ed.). New York, NY: Columbia University Press. Retrieved from https://search.credoreference.com/content/topic/machine

Chicago

"machine." In *The Columbia Encyclopedia*, by Paul Lagasse, and Columbia University. 8th ed. Columbia University Press, 2018. https://search.credoreference.com/content/topic/machine

Harvard

machine. (2018). In P. Lagasse & Columbia University, *The Columbia encyclopedia*. (8th ed.). [Online]. New York: Columbia University Press. Available from: https://search.credoreference.com/content/topic/machine [Accessed 16 October 2019].

MLA

"machine." *The Columbia Encyclopedia*, Paul Lagasse, and Columbia University, Columbia University Press, 8th edition, 2018. *Credo Reference*, https://search.credoreference.com/content/topic/machine. Accessed 16 Oct. 2019.