

84.12 - Other engines and motors.

8412.10 - Reaction engines other than turbo-jets

- Hydraulic power engines and motors :

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This heading covers engines and motors not included in the preceding headings (headings 84.06 to 84.08, 84.10 or 84.11) or in heading 85.01 or 85.02. It therefore covers non-electric engines and motors **other than** steam turbines and other vapour turbines, spark-ignition and compression-ignition internal combustion piston engines, hydraulic turbines, water wheels, turbo-jets, turbo-propellers or other gas turbines.

The heading includes reaction engines (other than turbo-jets), pneumatic power engines and motors, wind engines (windmills), spring-operated or weight-operated motors, etc., certain hydraulic power engines and motors, and certain steam or other vapour power units.

(A) REACTION ENGINES OTHER THAN TURBO-JETS**(1) Ram-jets.**

This is a mechanically simple engine, which can function only on rapidly moving machines. It has no turbo-compressor, the feed air being forced in by the speed of motion alone and compressed in the combustion chamber under the effect of a duct. The motive force is provided by the reaction of the exhaust gases expanding through a nozzle.

(2) Pulse-jets.

This engine differs from the ram-jet in that its outlet nozzle emits a pulsating flow of gas instead of a continuous jet, due to the fact that combustion takes place intermittently. Unlike the ram-jet, it can be started from rest, the pulsing action providing for the intake of air.

Pulse-jets are used in aircraft mainly as an auxiliary take-off.

(3) Rocket engines.

These are reaction engines in which combustion is independent of external air supply, the charge comprising both fuel and the combustion agents.

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There are two main types :

- (i) Liquid propellant engines. These engines consist of a combustion chamber plus one or more tanks for the storage of propellants, interconnected by a system of tubes and pumps, and a jet-pipe. The pumps are powered by means of a turbine which is fed by a separate gas generator. An important part of this type of rocket engine is formed by the injection-system. The fuels used include ethyl alcohol, hydrazine hydrate, etc., and the combustion agents are hydrogen peroxide, potassium permanganate, liquid oxygen, nitric acid, etc.
- (ii) Solid propellant engines. These engines consist of a cylindrical pressure chamber and a jet-pipe. The combustion chamber and the supply of propellant form a whole. The propellant in this type of engine consists of a combustion agent (usually ammonium perchlorate) and a fuel (usually polyurethanes). Certain types employ solid fuels of the nature of the propellants of Chapter 36.

Rockets are classified in this heading **only** when forming propulsive units proper (e.g., for auxiliary or take-off engines for aircraft, or for fitting to guided missiles or for satellite or spacecraft launch vehicles).

This group **excludes** :

- (a) Anti-hail rockets, life-line rockets and similar rockets of a pyrotechnic type (**heading 36.04**).
- (b) Satellite or spacecraft launch vehicles (**heading 88.02**).
- (c) Guided missiles incorporating power-units (**heading 93.06**).

(B) HYDRAULIC POWER ENGINES AND MOTORS

This group includes :

- (1) **Certain engines, other than** turbines or wheels of **heading 84.10**, producing mechanical power by utilising the energy of the waves or sea swell (Savonius rotor with two semi-cylindrical bladings) or of the tides.
- (2) **Water column machines** operating by the pressure of water on pistons. The water acts on two or more pistons moving inside the cylinders which in turn drive a shaft.
- (3) **Hydraulic cylinders** consisting, for example, of a brass or steel barrel and a piston operated by oil (or other liquid) under pressure applied on one side (single-acting) or on both sides (double-acting) of the piston, the energy of the liquid under pressure being converted into a linear motion. These cylinders are used on machine-tools, construction machinery, steering mechanisms, etc.

- (4) **Hydraulic valve actuators**, presented separately, consisting of a metal casing containing a piston which, by means of a pin perpendicular to the piston rod, converts the linear motion caused by the action of a liquid under pressure into a rotary motion, in order to operate a plug valve or other appliance with a rotating mechanism.
- (5) **Hydraulic servomotors** which perform the role of final or intermediate actuators in feedback control systems or regulating systems. These servomotors are used, e.g., in aircraft.
- (6) **Hydraulic systems** consisting of a hydraulic power unit (comprising essentially a hydraulic pump, an **electric** motor, control valves and an oil tank), hydraulic cylinders and the pipes or hoses needed to connect the cylinders to the hydraulic power unit, the whole forming a functional unit within the meaning of Note 4 to Section XVI (see the General Explanatory Note to that Section). These systems are used, e.g., to operate civil engineering structures.
- (7) **"Hydraulic" jet engines** ("hydrojets") for motor boats. These consist of a powerful pump taking in the sea or river water and ejecting it as a high speed jet from an adjustable tube (or tubes) under or behind the boat.

(C) PNEUMATIC POWER ENGINES AND MOTORS

These engines use an external source of compressed air (or other gases) and, in principle, resemble a steam piston engine or, in some cases, a steam turbine. In suitable cases they may have burners or other heating devices to increase the air pressure (and hence the expansion energy) and also to prevent the cylinders from frosting due to a rapid drop in temperature.

These engines are mainly used in mines for haulage tractors and winches because of their safety as regards fire-damp explosion. They are also used in certain locomotives, on aircraft, in submarines, etc., as auxiliary starting motors for internal combustion engines, and for propelling torpedoes.

This group also includes :

- (1) Vane motors, gear motors, axial and radial piston motors for pneumatic transmission.
- (2) Pneumatic cylinders consisting, for example, of a brass or steel barrel and a piston operated by compressed air applied on one side (single-acting) or on both sides (double-acting) of the piston, the energy of the gas under pressure being converted into a linear motion. These cylinders are used on machine-tools, construction machinery, steering mechanisms, etc.
- (3) Pneumatic valve actuators, presented separately, consisting of a metal casing containing a piston which, by means of a pin perpendicular to the piston rod, converts the linear motion caused by the action of a compressed gas into a rotary motion, in order to operate a plug valve or other appliance with a rotating mechanism.

(D) WIND ENGINES (WINDMILLS)

This group includes all power units (wind engines or wind turbines), which directly convert into mechanical energy the action of the wind on the blades (often of variable pitch) of a propeller or rotor.

Usually mounted on a fairly tall metal pylon, the propellers or rotors have an arm perpendicular to their plane, forming a vane, or some similar device for orientating the apparatus according to the direction of the wind. The motive force is generally transmitted by reduction gearing through a vertical shaft to the power take-off shaft at ground level. Some wind motors ("depression motors") have hollow blades in which a pressure reduction is developed by rotation, and is transmitted to the ground by airtight conduits to drive a small reaction turbine.

Wind motors are usually of low power, and are mainly used in rural installations for driving irrigation pumps, drainage pumps or small electric generators.

Electric generator units composed of wind motors mounted integrally with an electric generator (including those for operation in aircraft slipstreams) are **excluded** (heading 85.02).

(E) SPRING-OPERATED OR WEIGHT-OPERATED MOTORS, ETC.

These include mechanisms which, like clockworks, use the energy produced by the release of wound-up springs, or which are operated by gravity (e.g., by a counterweight or any similar device). However, such mechanisms fitted, or adapted for fitting, with escapements are **excluded** (heading 91.08 or 91.09).

The motors of this group, particularly those of the spring-driven type, are used to operate a large variety of apparatus (e.g., musical boxes, automatic turnspits, revolving window displays, registering apparatus, engraving tools).

(F) PISTON ENGINES NOT INCORPORATING BOILERS

In these types the mechanical energy is produced by displacement of a piston inside a cylinder by the application of the pressure difference between the steam produced by the boiler and the atmospheric pressure (non-condensing engines) or the lower pressure of a condenser (condensing engines). The reciprocating or oscillating action of the piston is converted into rotary motion through a connecting-rod and crank shaft or flywheel.

The simplest types are the single-action engines in which the steam pressure acts on one end of the piston only; in other types (double-acting) the steam acts alternately on each end. In the more powerful engines the steam passes successively into two or more cylinders of increasing diameters, the connecting-rods of the respective pistons being coupled to a single crank shaft (compound, double or triple-expansion engines, etc.). Locomotive engines and ships' engines, for example, belong to this last category.

(G) STEAM OR OTHER VAPOUR POWER UNITS
INCORPORATING BOILERS

The engines of this group comprise a boiler (usually of the firetube type) together with a single expansion or compound piston-type steam engine equipped with one or two flywheels which frequently also act as the power take-offs.

Engines of this kind are essentially of low or medium power output designed for more or less permanent installation but capable, because of their compact structure, of easy dismantling and removal.

PARTS

Subject to the general provisions regarding the classification of parts (see the General Explanatory Note to Section XVI) parts of the engines and motors of this heading are also classified here (e.g., combustion chambers and vents for jet engines, fuel feed regulators, fuel nozzles, windmill airwheels, cylinders, pistons, slide-valves, centrifugal ball or flyweight-type governors, connecting-rods).

In general, parts of steam or other vapour power units incorporating boilers fall to be classified as parts of boilers (**heading 84.02**) or as parts of steam power units of this heading.

Transmission shafts and crank shafts are, however, **excluded (heading 84.83)**.