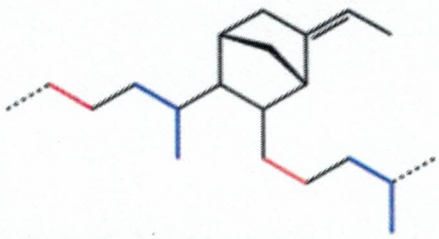
EPDM rubber

EPDM rubber (ethylene propylene diene monomer rubber),[1][2][3] is a type of synthetic rubber, which can be used in a wide range of applications. This is an M-Class rubber where the 'M' in M-Class refers to its classification in ASTM standard D-1418; the *M* class comprises elastomers having a saturated chain of the polyethylene type (the M deriving from the more correct term polymethylene). EPDM is made from ethylene, propylene and a diene comonomer that enables crosslinking via sulphur vulcanisation systems. The earlier relative of EPDM is EPR, ethylene-propylene rubber, that contains no diene units and can only be crosslinked using radical methods such as peroxides.[4] Dienes used in the manufacture of EPDM rubbers are ethylidene norbornene (ENB), dicyclopentadiene (DCPD), and vinyl norbornene (VNB).



Idealized EPDM polymer, red = ethylene-derived, blue = propylene-derived, black = ethylidene norbornene-derived.

EPDM is related to polyethylene, into which high amounts, from 45% to 85% by weight, of propylene have been copolymerised to reduce the formation of the typical polyethylene crystallinity. EPDM is a semi-crystalline material with ethylene-type crystal structures at higher ethylene contents, becoming essentially amorphous at ethylene contents that approach 50 wt%.

Rubbers with saturated polymer backbones, such as EPDM, have much better resistance to heat, light and ozone compared to unsaturated rubbers such as natural rubber, SBR or polychloroprene (Neoprene). As such, EPDM can be formulated to be resistant to temperatures as high as 150°C, and, properly formulated, can be used outside for many years or decades without degradation. EPDM has good low temperature properties, with elastic properties to temperatures as low as -40°C depending on the grade and the formulation.

As with most rubbers, EPDM is always used compounded with fillers such as carbon black and calcium carbonate, with plasticisers such as paraffinic oils, and has useful rubbery properties only when crosslinked. Crosslinking mostly takes place via vulcanisation with sulphur, but is also accomplished with peroxides (for better heat resistance) or with phenolic resins. High energy radiation such as from electron beams is sometimes used for producing foams and wire and cable.

A roll of EPDM flashing with fleece on the back, used for waterproofing roofs

Properties[5]

EPDM is compatible with polar substances, e.g. fireproof hydraulic fluids, ketones, hot and cold water, and alkalis. It is incompatible with most hydrocarbons, such as oils, kerosene, aromatic, gasoline, as well as halogenated solvents. EPDM exhibits outstanding resistance to heat, ozone, steam and weather. It is an electrical insulator.

Typical properties of EPDM vulcanizates are given below. EPDM can be compounded to meet specific properties to a limit, depending first on the EPDM polymers available, then the processing and curing method(s) employed. EPDMs are available in a range of molecular weights (indicated in terms of Mooney viscosity ML(1+4) at 125 °C), varying levels of ethylene, third monomer, and oil content.

Mechanical properties of EPDM

Property	Value
Appearance	
Hardness, Shore A	30–90
Tensile failure stress, ultimate	25 MPa (500-2500 PSI)
Elongation after fracture in %	≥ 300%
Density	Can be compounded from 0.90 to >2.00 g/cm^3

Thermal properties of EPDM

Property	Value
Coefficient of thermal expansion, linear[6]	160 µm/(m·K)
Maximum service temperature[7]	150 °C
Minimum service temperature[7]	−50 °C
Glass transition temperature	−54 °C

Uses

A common use is in vehicles: door seals, window seals, trunk seals, and sometimes hood seals.[8] Frequently, these seals are the source of noise due to movement of the door against the car body and the resulting friction between the EPDM rubber and the mating surface (painted sheet metal or glass). This synthetic rubber membrane has also been used for flat roofs because of its durability and low maintenance costs.[9]


An EPDM rubber roof

This noise can be alleviated using specialty coatings that are applied at the time of manufacture of the weather seal. Such coatings can also improve the chemical resistance of EPDM rubber. Some vehicle manufacturers also recommend a light application of silicone dielectric grease to weatherstripping to reduce noise. Other uses in vehicles include cooling system circuit hoses where water pumps, thermostats, EGR valves, EGR coolers, heaters, oil coolers, radiators, and degas bottles are connected with EPDM hoses, as well as charge air tubing on turbocharged engines to connect the cold side of the charge air cooler (intercooler) to the intake manifold. EPDM is also used for elastic hanger elements to attach exhaust systems to the underfloor of vehicles.

EPDM rubber is used in seals (for example, it is used in cold-room doors since it is an insulator, as well as in the face seals of industrial respirators in automotive paint spray environments. EPDM is also used in glass-run channels, radiators, garden, and appliance hose, tubing, pond liners, washers, belts, electrical insulation,

vibrators, O-rings, solar panel heat collectors, and speaker cone surrounds.

It is also used as a medium for water resistance in electrical cable-jointing, roofing membranes (since it does not pollute the run-off rainwater, which is of vital importance for rainwater harvesting), geomembranes, rubber mechanical goods, plastic impact modification, thermoplastic, vulcanizates, and many other applications.[10][11] Colored EPDM granules are mixed with polyurethane binders and troweled or sprayed onto concrete, asphalt, screenings, interlocking brick, wood, etc. to create a non-slip, soft, porous safety surface for wet-deck areas such as pool decks and as safety surfacing under playground play equipment (designed to help lessen fall injury).

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