The properties of a carbon fiber part are close to that of steel and the weight is close to that of plastic. Thus the strength to weight ratio (as well as stiffness to weight ratio) of a carbon fiber part is much higher than either steel or plastic. Carbon fiber is extremely strong. It is typical in engineering to measure the benefit of a material in terms of strength to weight ratio and stiffness to weight ratio, particularly in structural design, where added weight may translate into increased lifecycle costs or unsatisfactory performance.

* Ultra-high-modulus, type UHM (modulus >450Gpa)
* High-modulus, type HM (modulus between 350-450Gpa)
* Intermediate-modulus, type IM (modulus between 200-350Gpa)
* Low modulus and high-tensile, type HT (modulus < 100Gpa, tensile strength > 3.0Gpa)
* Super high-tensile, type SHT (tensile strength > 4.5Gpa)
* PAN-based carbon fibers
* Pitch-based carbon fibers
* Mesophase pitch-based carbon fibers
* Isotropic pitch-based carbon fibers
* Rayon-based carbon fibers
* Gas-phase-grown carbon fibers
* Type-I, high-heat-treatment carbon fibers (HTT), where final heat treatment temperature should be above 2000°C and can be associated with high-modulus type fiber.
* Type-II, intermediate-heat-treatment carbon fibers (IHT), where final heat treatment temperature should be around or above 1500°C and can be associated with high-strength type fiber.
* Type-III, low-heat-treatment carbon fibers, where final heat treatment temperatures not greater than 1000°C. These are low modulus and low strength materials.
* **Properties**
* **Carbon Fiber has High Strength to Weight Ratio (also known as specific strength)**
* Strength of a material is the force per unit area at failure, divided by its density. Any material that is strong AND light has a favourable Strength/weight ratio. Materials such as Aluminium, titanium, magnesium, Carbon and glass fiber, high strength steel alloys all have good strength to weight ratios.
* **Carbon Fiber is very Rigid**
* Rigidity or stiffness of a material is measured by its Young Modulus and measures how much a material deflects under stress. Carbon fiber reinforced plastic is over 4 times stiffer than Glass reinforced plastic, almost 20 times more than pine, 2.5 times greater than aluminium.
* **Carbon fiber is Corrosion Resistant and Chemically Stable**
* Although carbon fiber themselves do not deteriorate, Epoxy is sensitive to sunlight and needs to be protected. Other matrices (whatever the carbon fiber is imbedded in) might also be reactive.
* **Carbon fiber is Electrically Conductive**
* This feature can be useful and be a nuisance. In Boat building It has to be taken into account just as Aluminium conductivity comes into play. Carbon fiber conductivity can facilitate Galvanic Corrosion in fittings. Careful installation can reduce this problem.
* **Fatigue Resistance is good**
* Resistance to Fatigue in Carbon Fiber Composites is good. However when carbon fiber fails it usually fails catastrophically without much to announce its imminent break. Damage in tensile fatigue is seen as reduction in stiffness with larger numbers of stress cycles, (unless the temperature is hight) Test have shown that failure is unlikely to be a problem when cyclic stresses coincide with the fiber orientation. Carbon fiber is superior to E glass in fatigue and static strength as well as stiffness.
* **Carbon Fiber has good Tensile Strength**
* Tensile strength or ultimate strength, is the maximum stress that a material can withstand while being stretched or pulled before necking, or failing. Necking is when the sample cross-section starts to significantly contract. If you take a strip of plastic bag, it will stretch and at one point will start getting narrow. This is necking. It is measured in Force per Unit area. Brittle materials such as carbon fiber does not always fail at the same stress level because of internal flaws. They fail at small strains.
* Testing involves taking a sample with a fixed cross-section area, and then pulling it gradually increasing the force until the sample changes shape or breaks. Fibers, such as carbon fibers, being only 2/10,000th of an inch in diameter, are made into composites of appropriate shapes in order to test.
* **Fire Resistance/Non Flamable**
* Depending upon the manufacturing process and the precursor material, carbon fiber can be quite soft and can be made into or more often integreted into protective clothing for firefighting. Nickel coated fiber is an example. Because carbon fiber is also chemically very inert, it can be used where there is fire combined with corrosive agents. Carbon Fiber Fire Blanket excuse the typos.
* **Thermal Conductivity of Carbon Fiber**
* Thermal conductivity is the quantity of heat transmitted through a unit thickness, in a direction normal to a surface of unit area, because of a unit temperature gradient, under steady conditions. In other words its a measure of how easily heat flows through a material.
* Because there are many variations on the theme of carbon fiber it is not possible to pinpoint exactly the thermal conductivity. Special types of Carbon Fiber have been specifically designed for high or low thermal conductivity. There are also efforts to Enhance this feature.
* **Low Coefficient of Thermal Expansion**
* This is a measure of how much a material expands and contracts when the temperature goes up or down. Units are in Inch / inch degree F, as in other tables, the units are not so important as the comparison. In a high enough mast differences in Coefficients of thermal expansion of various materials can slightly modify the rig tensions. Low Coefficient of Thermal expansion makes carbon fiber suitable for applications where small movements can be critical. Telescope and other optical machinery is one such application.
* **Non Poisonous, Biologically Inert, X-Ray Permeable**
* These qualities make Carbon fiber useful in Medical applications. Prosthesis use, implants and tendon repair, x-ray accessories surgical instruments, are all in development. Although not poisonous, the carbon fibers can be quite irritating and long term unprotected exposure needs to be limited. The matrix either epoxy or polyester, can however be toxic and proper care needs to be exercised.
* **Carbon Fiber is Relatively Expensive**
* Although it offers exceptional advantages of Strength, Rigidity and Weight reduction, cost is a deterrent. Unless the weight advantage is exceptionally important, such as in aeronautics applications or racing, it often is not worth the extra cost. The low maintenance requirement of carbon fiber is a further advantage.
* It is difficult to quantify cool and fashionable. Carbon fiber has an aura and reputation which makes consumers willing to pay more for the cachet of having it. You might need less of it compared to fiberglass and this might be a saving.
* **Carbon Fibers are brittle**
* The layers in the fibers are formed by strong covalent bonds. The sheet-like aggregations readily allow the propagation of cracks. When the fibers bend they fails at very low strain.