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How to read a stress strain curve

The stress-strain curve is one of the first graphs of resistance of the material we encounter during the journey to study materials. Although it's not really that difficult, it may seem a little discouraging at first. In this article, we will learn about the stress and tension curve to understand it better. But before we get there, we will try to explain some key concepts for a better understanding. Loading A metal in service or during manufacture is subjected to different forces. Depending on the size of these forces, metal can or cannot change its shape. The act of application of force is known as load. There are five different ways in which these forces can be applied on a metal part. The five loading forms are: Compression voltage Bending cutting Torsion The metals are elastic in nature up to a certain extent. When loaded, the metal undergoes deformation but can be too small to discern without special tools. When this applied force is removed, the metal recovers its original size (unless the force does not exceed a certain point). Just like a ball, for example, it resumes its original shape after a force is removed after the application. What's Stress? Stress is defined as the ratio of force applied to the transversal area of the material to which it is applied. The formula for calculating material stress: σ=F/A, where F is force (N) A is area (m2) σ is stress (N/m2 or Pa) For example, a force of 1 N applied on a transversal zone of 1 m2, will beas stress of 1 N/m2 or 1 pa. the unit can be viewed either as N/m2 or pa, both represent the pressure. stress can be understood as an internal force induced in metal in response to an externally applied force. will try to resist any change in size caused by external force. when the cross section area changes, the same force will cause greater or less stress in the metal. a smaller transversal zone will result in a greater stress value and vice versa. What is strain? strain is defined as the ratio of size change to the initial size of metal. He doesn't have a unit. There are three types of strain: normal, volumetric and shears. normal effort (or longitudinal effort) is concerned with change in one dimension, such as length. the formula for the calculation of the effort is: ε=(l-l0)/l0, where l0 is beginning or initial length (mm) l is lengthened (mm) for example, if a certain force changes the length of a metal from 100 mm to 101 mm, the normal voltage will be (101-100)/100 or 0.01. normal effort can be positive or negative depending on the direction of the external force and then effect on the original length. for simplicity, we will only talk about normal strain in our article. So, whenever we hear the word tension, it will refer to normal tension. Once we understand normal tension, it is easy to extend the same understanding to the other two. stress and strain every time a load acts on aproduces stress and tension in the material. We have a football as an example. when you try to squeeze it, it offers resistance. the resistance offered is induced stress while the change of size represents effort. The stomach causes stress. when applying the force that leads to deformation, a material tries to maintain its body structure by setting internal stresses. How is a Stress-Strain curve drilled? the most common method to trace a stress and stress curve is to submit a test piece bar to a traction test. This is done using a universal test machine. has two claws holding the two ends of the auction and pull it at a uniform rate. the applied force and the output voltage is recorded until a fracture occurs. the two parameters are then drawn on an X-Y chart to get the family chart. loading curve stress-strain curve is a chart showing stress change as tension increases. is a widely oated reference chart for metals in material science and production. there are various sections on the stress and tension curve that describe the different behavior of a ductile material depending on the amount of stress induced. stress and tension curves for fragile, hard (but not ductile) and plastic materials are different. the curve for these materials is easier and can be learned very easily. we will focus on the stress-strain curve of ductile materials. but before we deepen this, let's take a look at anotherconcept – Hooke Law. Law of Hooke This principle of physics speaks of elasticity and how the force necessary to extend or compress an elastic object from a certain distance is proportional to that distance. The more strength it produces the more distance. Hooke's law formula for calculating spring force: In the case of metals, Hooke's law states that for most metals, greater length changes will create greater internal forces. This means that stress is directly proportional to tension. This is because metals expose elasticity to a certain limit. In simple words, if the transile/compressive load is doubled, the increase/decrease of the length will be doubled even if the metal is within the proportional limit. Almost all metals behave as an elastic object on a specific range. This range varies for different metals and is influenced by factors such as mechanical properties, atmospheric exposure (corrosion), granulometry, heat treatment and working temperature. When the test machine begins to pull on the test piece, it undergoes the stress of traction. Initially, the material follows Hooke's law. The strain will be proportional to stress. It means that the relationship between stress and effort will be constant. In material science, this constant is known as the Young module of elasticity and is one of the most important mechanical properties to consider when choosing the right material for an application. There is no permanent deformation. The metal will belike a spring and return to its original size on the removal of the load. The point where this proportional behaviour is observed is known as a proportional limit. With increased stress, tension increases linearly. In the above diagram, this rule applies until the yield resistance indicator. Young's Elasticity Module is defined as the relationship between longitudinal stress and stress within the proportional limit of a material. Also known as a resilience module, it is similar to the rigidity of a spring. This is also why Hooke's law includes a spring constant. Let's say we have 2 materials with the same length and cross section. To change the size to an equal extent, the material with a higher module value of Young requires greater strength. Elastic point and point of performance As the test piece is subjected to increasing amounts of traction force, stress increases beyond the proportional limit. The stress-strain report deviates from Hooke's law. Tension increases at a faster pace than stress that manifests itself as a slight flattening of the curve in the stress and tension chart. This is the part of the chart in which the first curve begins, but has not yet taken a turn down. Although the proportionality of fatigue stress is lost, the property of elasticity is not, and on the removal of the load, the metal will still return to its original size. The change of size within the elastic limit is therefore temporary and reversible. The elasticof a material ensures its stability under stress. Here is the reason why engineering calculations use material yield resistance to determine its ability to resist a load. If the load is greater than the resistance to yield, the result will be unwanted plastic deformation. Plastic Behavior When the test piece is pulled further on the test machine, the elasticity property is lost. This aligns with the beginning of the strain hardening region in the drop down chart. The strength of the yield is where the plastic deformation of the material is observed. If the material is not expelled from the test machine beyond this point, it will not return to its original length. It is said that the hardening of the strain occurs when the number of dislocations in the material becomes too high and begin to hinder the movement of the other. The material is constantly reorganized and tends to harden. Necking Plastic deformation continues to occur with increasing stress. In due time, a narrowing of the cross section will be observed at a point on the bar. This phenomenon is known as the nape. Stress is so high that leads to the formation of a neck at the weakest point of the barrel. You can see this happening in the video above. The stress-strain curve also showed the region where the neck occurs. Its starting point also gives us the ultimate traction force of a material. The final tensile strength shows the maximum amount of stress a material can handle. Reaching this value pushes thetowards failure and breaking. Fracture Once in the neck region, we can see that the load should not increase for further plastic deformation. A fracture will occur at the neck usually with a cup shape and cone at both sides of the bar. This point is known as a fracture or breakpoint and is denoted by E on the stress and tension chart. Why is the Strain-Stress curve important? The stress-strain curve provides design engineers with a long list of important parameters necessary for designing applications. An stress-strain graph gives us many mechanical properties such as strength, strength, elasticity, yield point, energy of effort, resilience and stretching during loading. It also helps in manufacturing. If you are trying to perform extrusion, rolling, bending or some other operation, the values you are adjusting from this chart will help you determine the forces you need to induce plastic deformation. deformation. how to read a stress strain diagram. what does a stress strain curve tell you. how to make a stress strain curve