



SHORE HARDNESS

And Viscosity Charts

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Shore Hardness

Durometer, commonly known as hardness, refers to a material's ability to withstand localised deformation or indentation.

The Shore A hardness (durometer) scale is a crucial tool for measuring the hardness of various materials, particularly in the adhesives industry. This scale ranges from 0 to 100, with higher values indicating harder materials.

It plays a significant role in material selection, ensuring consistent quality in products, and facilitating easy comparisons between different materials.

However, it's essential to remember that hardness values cannot be compared across different durometer scales, such as Shore D and Shore A, as these values are relative only within their respective scales. The Shore A scale is particularly applicable for soft to medium-soft materials, including vulcanised and natural rubber, thermoplastic elastomers (TPEs), flexible polyacrylics, thermosets, leather, wax, and felt.

Understanding this scale can help manufacturers and engineers select the appropriate materials for their specific applications.

What Is the Shore A Hardness Scale?

The Shore A hardness scale is an essential tool for assessing the resistance of materials, particularly polymers, to localised deformation or indentation.

This scale, which ranges from 0 to 100, is specifically designed for measuring the hardness of a variety of materials, including soft rubbers, thermoplastic elastomers (TPEs), silicones, and semirigid plastics.

Hardness values on the Shore A scale are relative, established by comparing the depth of indentation made in a material against a standard reference. This empirical measurement helps to characterise the hardness of materials in a way that is consistent across different tests. In the polymer and plastics industry, the Shore A hardness scale is widely utilised for quality control during manufacturing processes, allowing manufacturers to check silicone or rubber hardness against established standards.

Designers also benefit from this scale, as it enables them to evaluate and select materials that are appropriate for specific applications based on their hardness characteristics.

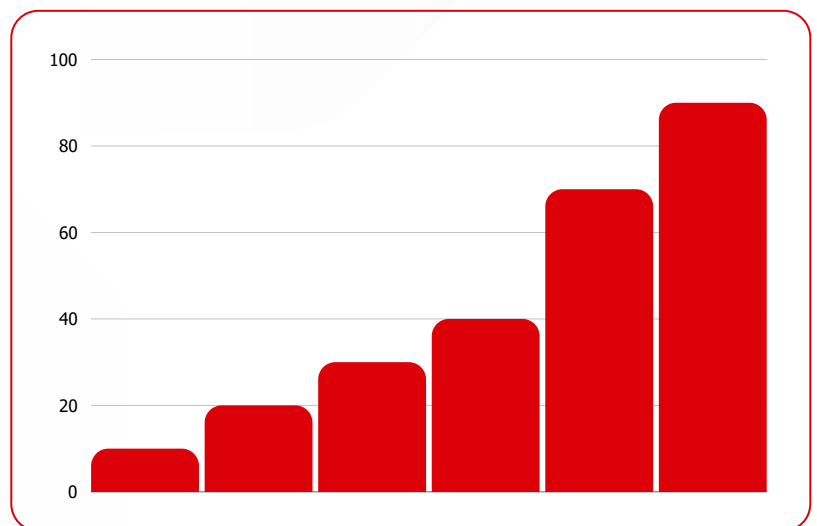
Benefits and Limitations of the Shore A Hardness Scale

The Shore A hardness scale offers several benefits, particularly for manufacturers in need of assessing material hardness for specific applications. It allows them to determine the appropriate hardness or softness of materials, facilitating the selection of suitable options for their products. Additionally, the scale enables easy comparison of hardness among materials when using the same measurement system, promoting consistency in quality. Furthermore, it serves as a valuable tool for statistical process control, helping manufacturers maintain high-quality standards in their production processes.

However, the Shore A hardness scale also has its limitations. One significant drawback is that its values cannot be accurately compared to those obtained from other hardness scales, which may lead to inconsistencies in assessments across different measurement systems. Additionally, the scale is primarily suitable for non-metallic materials, including thermoplastics, thermosets, thermoplastic elastomers (TPEs), silicones, cellular materials, and waxes, which restricts its applicability in evaluating a broader range of materials, particularly metals.

The types of applications that use the Shore A hardness:

- Gummy candy:** 10A
- Marshmallow:** 10A
- Rubber band:** 20A
- Gel shoe insole:** 30A
- Pacifier/Dummy:** 40A
- Shoe sole:** 70A
- Tyre tread:** 70A
- Golf ball:** 90A
- Shopping cart wheels:** 90A



What Is the Shore D Hardness Scale?

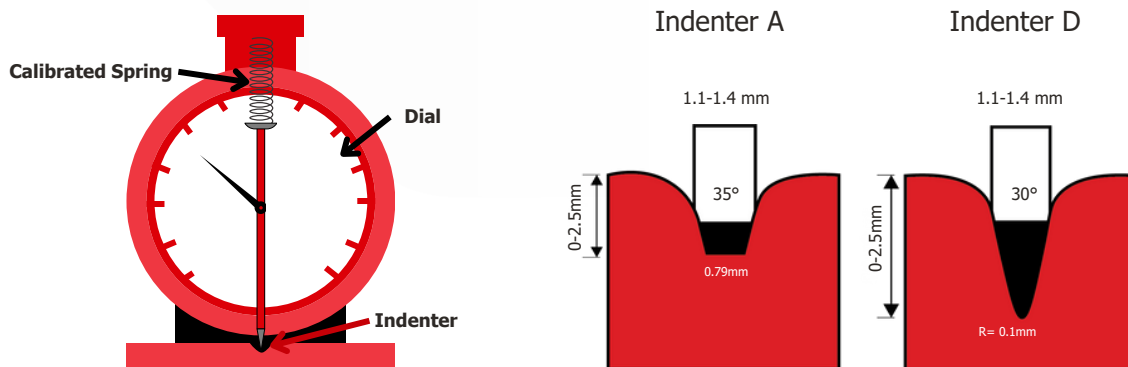
Shore D hardness is a method used to measure the hardness of materials, often referred to as the Durometer Hardness Test.

The Shore D hardness measurement tool, known as a durometer, is specifically designed to evaluate the hardness of materials, particularly polymers and elastomers. The "D" in Shore D signifies the type of durometer used for this purpose. Hardness levels are measured on a scale ranging from 0 to 100; a higher value indicates a harder material.

The durometer operates by determining the hardness based on the penetration of its indenter foot into the material sample under a defined spring force. This process provides a precise assessment of the material's durability and rigidity. The hardness value can be read directly from the durometer scale, making it an essential instrument in various industries for ensuring the quality and performance of materials.

What is the difference between Shore A and Shore D?

Type D describes a scenario where the foot penetrates the surface of the material, indicating a deeper interaction that goes beyond mere contact. In contrast, Type A involves the foot merely indenting the surface, creating a slight impression without fully breaking through. Both types illustrate different levels of engagement with the material, highlighting varying degrees of pressure and impact.



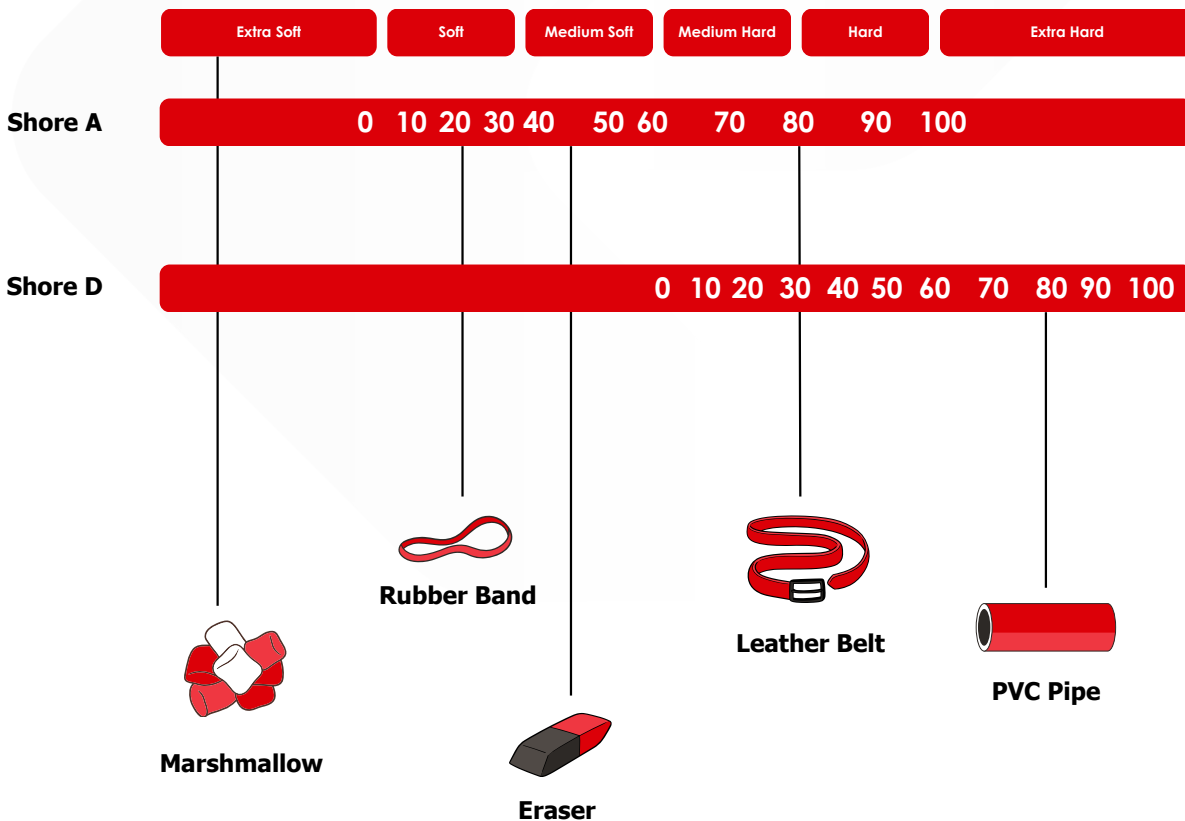
Common Shore A Values Meaning

When discussing the hardness of materials, the Shore A hardness scale is commonly used, with specific values indicating varying degrees of hardness. A material measuring 70 Shore A is considered to have a moderate hardness, exemplified by a tyre tread, which provides a balance between flexibility and durability.

In contrast, a hardness of 85 Shore A indicates a firmer material, such as a leather belt, which is noticeably harder than a 70 A material. At the upper end of the scale, a hardness measurement of 90 Shore A signifies a rigid material that is difficult to deform by hand.

Examples of this level of hardness include the casters on shopping carts and golf balls, which require greater resilience and strength. Understanding these measurements helps in selecting appropriate materials for various applications based on their hardness characteristics.

Shore Hardness Scales



Viscosity

Viscosity is a measure of a fluid's resistance to flow, intricately tied to the molecular interactions within liquids. It reflects how the molecules within a substance attract and interact with one another, influencing the fluid's behavior.

In fluids with high viscosity, the molecules exhibit strong cohesive forces, making them more resistant to movement and flow. Conversely, fluids with low viscosity have weaker molecular interactions, allowing them to flow more freely and easily. Understanding these molecular dynamics is essential for grasping the concept of viscosity and its implications in various applications.

How is Viscosity Measured?

Viscosity is measured using specialised instruments known as viscometers, which apply force to a fluid and assess its resistance to flow. There are several types of viscometers, each designed for specific fluids and measurement requirements.

One common type is the rotational viscometer, which operates similarly to a spinning stick immersed in the fluid. The resistance encountered by the spinning stick provides insights into the fluid's viscosity. This method is particularly effective for measuring liquids such as oils and paints.

Another type is the capillary viscometer, which consists of a narrow tube filled with the fluid. By measuring the time it takes for the fluid to flow through the tube, this viscometer can determine the viscosity of the fluid. Capillary viscometers are particularly useful for assessing thicker or stickier substances, like polymers.

Understanding the viscosity of a fluid is crucial for selecting appropriate bulk packaging. For instance, fluids with low viscosity can be easily transferred from rigid containers like steel drums or intermediate bulk containers (IBCs). In contrast, high-viscosity products and semi-solids are better suited for flexible intermediate containers, such as Fluid-Bag containers.

Dynamic viscosity, commonly referred to simply as viscosity, quantifies a fluid's resistance to shear or flow when subjected to an external force. It indicates how thick or sticky a fluid is, affecting how easily it can move or be manipulated. Dynamic viscosity is represented by the symbol η (eta) and is measured in units such as Pascal-seconds (Pa·s) or Poise (P).

On the other hand, **kinematic viscosity** takes into account the fluid's dynamic viscosity in relation to its density. This measure evaluates how a fluid flows under the influence of gravity, providing insights into its behavior in various conditions. Kinematic viscosity is denoted by the symbol ν (nu) and is typically expressed in units like square meters per second (m²/s) or centistokes (cSt). Together, these two properties are crucial for understanding fluid dynamics in both natural and industrial processes.

Viscosity Index (VI) is a measure of how much a fluid's viscosity changes with temperature. It provides important information about the temperature-viscosity relationship of the fluid. This index is crucial for choosing lubricants and hydraulic fluids that maintain consistent viscosity across a range of operating temperatures. A higher Viscosity Index indicates that the fluid's viscosity varies less with temperature, which ensures stability under different environmental conditions. Viscosity index tables are useful for comparing and selecting lubricants based on their VI values.

Comparing Viscosity of Different Liquids:

Alcohol	Typically flows more freely than water due to lower viscosity and weaker intermolecular forces.
Water	Exhibits low viscosity, enabling easy flow due to weak intermolecular forces and high molecular mobility.
Apple Juice	Lower viscosity than milk but higher than water, affected by sugar content and particle suspension.
Milk	Exhibits higher viscosity than water but lower than syrup due to protein and fat content.
Vinegar	Has higher viscosity than water but lower than syrup, resulting in a slightly thicker texture.
Olive Oil	Higher viscosity than water but less than honey, resulting in a smooth, slightly thick texture.
Honey	High viscosity causes honey to pour slowly because of its thick consistency and strong molecular cohesion.
Syrup	Typically exhibits high viscosity, resulting in a slow pouring rate.
Molasses	Exhibits very high viscosity, flowing slowly due to its thick, sticky nature.

Peanut Butter



150,000-250,000
mPa.s

Toothpaste



70,000
mPa.s

Tomato Ketchup



30,000
mPa.s

Preserve



8,500
mPa.s

Honey



2,000- 4,000
mPa.s

Olive Oil



85
mPa.s

Water



1
mPa.s

Elastomeric Materials with High Viscosity

Elastomeric materials, primarily rubber compounds, are characterised by their elastic properties. These materials are widely used in various applications due to their flexibility, resilience, and durability. Understanding the viscosity of elastomers is crucial for applications that require specific flow characteristics during processing and usage.

The viscosity of elastomeric materials can fluctuate based on several key factors:

✔ Molecular Weight

Higher molecular weight can lead to increased viscosity, as longer polymer chains create more resistance to flow.

✔ Cross-Linking Density

The degree of cross-linking affects the material's structure. A higher cross-linking density typically results in a more rigid structure, which can increase viscosity.

✔ Filler Content

The incorporation of fillers into elastomeric compounds can either raise or lower viscosity, depending on the type and amount of filler used. Fillers can enhance properties like strength and heat resistance but may also hinder flow.

Silicone Rubber Viscosity

Among various elastomers, silicone rubber stands out due to its unique properties. It often exhibits a higher viscosity, particularly in its uncured or liquid form. This is attributed to its distinct molecular structure and the interactions within the silicone polymer chains. The viscosity of silicone rubber can impact its processing and application in products requiring specific performance characteristics.

Understanding the factors that influence the viscosity of elastomeric materials, especially silicone rubber, is essential for selecting the right material for specific applications. By considering molecular weight, cross-linking density, and filler content, manufacturers can optimise the performance of elastomeric products.

By carefully regulating viscosity, manufacturers can achieve consistent coverage, optimal adhesion, and appropriate drying properties for their coatings and adhesives. Additionally, viscosity is a key factor in fluid flow during chemical processing, impacting the operation of reactors, the performance of mixers, and the functionality of pipelines. These effects ultimately influence reaction kinetics, heat transfer, and the overall quality of the final product.



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