

MEASURING TIRE HARDNESS

A tire durometer is a tire hardness gauge. The purpose of the gauge is relatively simple; it measures the hardness of the rubber compound of a tire. Tire compounds have always been in racing. Too hard of a compound means that the racer is sacrificing grip and grip controls both forward as well as side slip of the kart.

Tire compounds are not as much of a black art as most racers think. The rubber compounds are all developed in a mix room at a rubber plant the mix is an assortment of chemicals which are blended with a large block of natural rubber in what is called a mix mill. This is a device that has two large rotating drums. The temperature of each drum is controlled by the steam or water that is applied to the internal surface of the drums the rubber is compressed between the drums and the temperature differential will cause the rubber to adhere to only one drum.

Because this mixing process deals with large volumes and the measures are done typically in pounds or even hundreds of pounds there is the possibility of gaining a slightly different compound from one batch of tires to the next. Rubber is not black in its natural form it is very similar to the color of honey. Most of the chemicals that are added aid the vulcanization process and alter the soft characteristics of natural rubber. The chemicals are either white or yellow so to get the black color a compound known as lampblack is added to the chemical mix.

After the rubber is mixed in the mill it is run through another process which prepares the rubber for tire production. The rubber is manufactured into what appear to be large wide rolls of black rubber tape. This rubber is usually cut to the width of the tire to be produced. You may have run some spec tires and noticed that the slick appeared to five or seven narrow strips of rubber across the width of the tire. That is exactly how the tire was constructed. The narrow strips are a rubber left over from another process and used to make low cost karting tires.

Then the tire casing is mounted on a rotating device and the rubber is applied to the rotating casing. The machines are automated and are programmed to a specific number of rotations to apply the depth of rubber specified for the tire.

The tire is then inserted into a mold where the casing and the applied rubber are heated and pressure is applied. In the tire business this is called curing the tire. To you and I this is the vulcanization process. The rubber is bonded to the casing and the rubber is vulcanized. In most plants this process is automated but variations do occur here in the process. At the start of a shift the mold may not be as hot as it was later in a production shift. Someone may be rushing and may alter the time by a few minutes. The pressure may be slightly higher or lower in one segment of the production area versus another. As you can see variations in the production process can alter the output of the process and produce a better or potentially a worse tire.

Tires are all rated with a compound designation and the tire manufacturers tell us how the compound code relates to a numeric value that ranges from 1 to 100. The numeric value of hardness is specified by the American Society for Testing and Materials D2240. This is the standard to which tires are produced and the standard used to define the calibration of a tire durometer.

Almost all durometers are an analog gauge with a test probe that is of a specified size and a footpad to get the gauge level on the surface of the tire.

The durometer is placed firmly and smoothly against the tire and read immediately. We always try to be very consistent in our test process so that our readings can be compared to other readings that we have taken or will take in the future.

If you apply the durometer and hold it in the same position for an extended period of time the reading will likely change, as the rubber of the tire will distort around the test probe.

Before you apply your durometer the first step in selecting tires is to determine the temperature of the tires that you will be testing. The temperature will have an impact on the durometer reading. A tire that has been exposed to the sun or a tire that has just come off of a racetrack will likely have a lower durometer reading than the same tire when the tire is allowed to get back to ambient temperature.

Another factor that will impact your durometer readings is how you treat your tires with chemicals. I know that lots of racers use chemicals to get extra weeks out of their tires as tires cost more than chemicals. The issue with chemicals is that the chemical penetration is very inconsistent around and across the tire and this makes the tire unpredictable from a performance perspective. I do not know any race organization that condones the chemical process so if you have to apply chemicals just limit those tires to practice sessions. Use legitimate tires for qualifying and races.

Be sure to evaluate the available tread depth when you are using your durometer to evaluate tires. If a tire has very little depth available when you are evaluating the tire and the tire has a relatively low durometer number it is possible that selecting that tire could put the driver or another competitor at risk as a soft tire wears very rapidly and may fail during practice, qualifying or a feature race.

The process of using a tire durometer is very straightforward. Select the tires that you wish to evaluate, start by determining if the temperatures of the tires that you have chosen are all the same. If the tires are not all the same temperature then your comparison may be flawed so get all of the tires into a common location like a shady spot inside or under the trailer. When the tires are all at the same temperature then begin the process.

Apply a firm but even pressure as you apply the durometer to the tire. If the tire is a used tire it is a good idea to be sure that you have used a scraper to remove any dirt or stones which may have adhered to the tire as the driver drove into the pits. Determine your reading immediately.

With most durometers being an analog gauge you will find that the reading stops and stabilizes at one number relatively fast. This is the hardness of the tire that you have just evaluated. If you apply the durometer at another point in the same tire it is expected that you will get the same result.

Record the reading including the temperature into your logbook or into your laptop computer if you are like us and use a database system. Remember soft tires have low numbers on the durometer. That indicates that these tires are likely to have a great deal of grip but they are likely to have very poor durability. Tires with low numbers will wear rapidly.

There are days when you still need more than all of the information that you can get from the tires in the pit area. On very hot days the crew chief has to select a tire that will grip well but will not be subject to blistering during the race. Durometer numbers do not always provide enough information when you need to make these decisions. You still need to walk up and down pit road during practice and determine which tire brand is providing the best durability. We have found that at some tracks we go with very soft tires on very hot days and we eliminate the blistering and chunking as the tire is giving up so much material that we are not overheating the casing.

If you are evaluating new tires you must always remember to remove any wrapper that the tire was delivered within. You can not apply the durometer and push the probe through the wrapper and get an accurate reading.

Once you have your readings then you are ready to match up sets of tires. The crew chief or the driver will want a second bit of information when you are done with the durometer. You should have a tape measure and tell the crew chief or the driver the circumference of the tire. The circumference is only valid if the tire is mounted on the wheel and if the tire is at the inflation pressure that the tire would use of race purposes.

Durometers are relatively low cost and should be in every racers toolbox or if the racer is part of a team then the crew chief of the team should have a durometer in the tool box so that the racers understand what compound is on the kart. It is acceptable to run different compounds at different position of the kart providing that you understand the durometer readings of the tires that you are applying.

Ovals may need a different compound on a right front or right rear, on road courses we sometimes run different compounds on the front that we run on the rear. The durometer, pyrometer, air pressure gauge and the tape measure and stopwatch are the tools you need to make the decisions.

If you have purchased tires from a vendors rack and the wrap is all discolored from exposure to the sun it is possible that you will find a tire which quite inconsistent from a hardness perspective. One side has been repeatedly exposed to the sun and has been heated and cooled repeatedly the other side of the tire has always remained shielded from the sun.

The exposed portion is likely to be harder than the portion which remained in the shade. My recommendation is if you buy these tires make sure that you get a real good price, as they will be a challenge to get to perform for you on the racetrack. If you are a contender for the win I would shop further for the set of tires that I would run in the race.

All crew chiefs have favorite brands of tools, for durometers I select the Intercomp 360092 which sells for \$69.00. While at Daytona this year I did a survey of the crew chiefs and found that there were four brands in the tool boxes of the crew chiefs, The predominant was the Intercomp 360092 unit, followed by the Rebco 300-8950 which has a price of \$64.96, then the Longacre 50540 which sells for \$69.95 and the REX model 2100 which listed for \$355.00. I also found one crew chief with a digital durometer which sold for \$895.00. I compared my Intercomp gauge to his unit and we were getting the same readings, I'll stick with my unit and spend the rest of the money buying more tires.

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