# Basic Guide To COR & CT

Two key phrases you will encounter when reading about golf clubs is Coefficient of Restitution (COR) and more common now is CT (Characteristic Time)

## What is the Coefficient of Restitution?

The technical definition for COR is the ratio of velocity out to velocity in, so it is a measure of how much energy comes out of an impact versus how much energy was put it in. It gives you a measurement of the efficiency of an impact so in a perfect impact where no energy was lost the COR would be 1..

## Why is COR important?

COR has a direct influence on ball speed and therefore distance. In the 1990's golf club manufacturers used new technologies to improve average COR''s from 0.78 to the realm of 0.86 which resulted in a significant increase in distance. In 2003 the R&A and USGA brought in a unified standard to limit the maximum amount of COR a clubface could have.

## What are the limits?

The increases in ball speed, and therefore distance, is something that is closely monitored by the games governing bodies who are concerned that further advances may impact upon the game. The R&A and the USGA have set the COR limit at 0.83 meaning that a maximum of 83% of energy can be transferred to the ball at impact.

## How is COR measured?

COR is measured by launching a ball at the face of the golf club and measuring the speed velocity of the ball before and after it has made contact with the clubface. This is a relatively complex thing to do and as a result the R&A and USGA introduced a new measurement called Characteristic Time (CT) to measure the elasticity of the clubface.

## Are COR and CT the same thing?

COR and CT are not the same thing but the numbers yield the same result. CT was introduced by the governing bodies to allow measurement of the spring like effect of the face in a more portable environment. CT is a pendulum and it measures the amount of time in microseconds a metal ball is in contact with the face when it is swung against it.

A higher CT indicates the club has a higher spring like potential and can impart more energy to the ball and make ball speed higher. The CT limit is currently 239μs plus 18μs for manufacturing tolerance, so most manufacturers aim for 257μs. As manufacturing processes continue to improve they are able to get closer to this limit without going over it.

## Do All Clubs Reach the Max CT Limits?

Most leading drivers and fairway woods are at the limits and even hybrids are very close. Even if the center of the clubface may be at the limit, designers are focusing on approaching the maximum across the whole area of the clubface to maximize ball speed across the entire face on off center hits.

## C.o.G

The location of any given Driver's Centre of Gravity (CoG) will have a two-fold effect.

**1.** The ability of the golfer to manipulate the angle at which the clubface comes in contact with the ball is lessened as the CoG moves further back, away from the clubface. i.e. The closer the CoG is to the face, the greater the golfer's ability to work their ball flight in either direction (to create a fade or a draw).

**2.** The closer to the clubface the CoG the lower the initial launch angle of the ball will be. Why? Because a lower, deeper CoG pushes the back end of the Driver head down through the downswing (centrifugal force) causing a forward bend of the shaft – and thus an increased 'dynamic' loft.


### FOOD FOR THOUGHT

Don't be fooled into thinking that CoG is the 'be-all and end-all' when it comes to perfecting your ball flight; the greatest dictator of launch – and spin – conditions is the Driver's loft.

Matching your Driver's loft to your swing speed (the slower the speed the more loft is needed) is still the most effective way to optimise your ball flight and gain those invaluable extra few yards of carry.

## M.O.I

The "Moment of Inertia" reading – somewhat cryptically – describes a Driver's resistance to twisting when the clubface strikes the ball in a spot either side of the vertical axis through the clubs Centre of Gravity (CoG). In other words, how much the Driver head twists off-square when you miss the 'sweet spot'.

The higher the MOI, the greater the clubhead's resistance to twisting, and this equates to less distance and accuracy loss off the tee. MOI is increased by moving the Driver's CoG lower and/or deeper in the clubhead, away from the face, or by altering the shape of the Driver so more weight is placed towards the perimeters of the club (hence the introduction of square-headed Drivers).


### FOOD FOR THOUGHT

While a higher MOI clubhead resists twisting on off-centre hits (increasing forgiveness) this has a downside. When a golfer wants to 'work' their ball flight, the higher MOI nullifies the twisting actions of the wrists and hands through the impact zone, making it more difficult to purposefully open or close the clubface and produce a fade or a draw.

## C.o.R

CoR; the Coefficient of Restitution is a fractional value that measures the energy loss or retention when two objects collide. The CoR measurement is always expressed as a numbe between 0.000 (meaning all energy is lost in the collision) and 1.000 (which means a perfect, elastic collision in which all energy is transferred from one object to the other).

In golfing terms, this refers to the Driver's ability to create extra distance as a result of extra 'bounce' off the clubface (we've no doubt all heard of the "Trampoline Effect"). The CoR of a Driver face is now restricted by both the world's governing bodies, the R&A and the USGA, placing the upper limit at 0.83. This means that when the clubhead impacts the ball, there cannot be more than an 83% transfer of the energy of the head to the ball.


### FOOD FOR THOUGHT

All reputable Drivers are now manufactured 'as standard' with on-the-limit CoR, but what are you sacrificing if you're still using an older Driver or a cheap 'knock off'?

Here's a fact that may get your attention: "With a 100mph swing speed, the difference in carry yardage alone between a Driver with a CoR of 0.820 and another with a CoR of 0.830 equates to 4.2 yards".

## C T

CT or Characteristic Time has become the new standard, for measuring the Trampoline Effect. It corresponds with the C.O.R. but is easier to conduct a field test for compliance. 257ms is the equivalent energy loss to the .830 C.O.R. rating.