

TECHNICAL OVERVIEW

- 2** GOLF BALL CONSTRUCTION AND THE EFFECT OF WATER ON A GOLF BALL
- 3** RESEARCH AND CONCLUSIONS (PAGE 4)
- 5** HOW WATER DAMAGE, UNAUTHORIZED REFINISHING, AND REFURBISHING AFFECT A GOLF BALL
- 6** HEAR IT FROM THE EXPERTS
- 8** ARTICLE LINKS
- 9** DID YOU KNOW THAT THE USGA REGULATES DISTANCE?

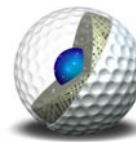
The Effect of Water on a Golf Ball

Despite the myriad of esoteric names created by golf ball manufacturers, the most common materials used to make a golf ball cover are either thermoplastic ionomers (Iotek, – Exxon product, Surlyn, – Dupont product) or thermoset polyurethane. These materials are susceptible to moisture uptake during the manufacturing process and must be kept in humidity-controlled areas. Polymeric materials, depending upon their molecular structure, take up water in varying degrees. Structure affects both the solubility and diffusion coefficients, which determine overall water permeability. Temperature also affects both diffusion and solubility coefficients.

The two final layers or coatings of golf ball construction include a primer and a “protective” gloss coating. The primer, in most cases, is water-borne polyurethane and the final layer of protective gloss coat is generally a two-part solvent-based polyurethane. The protective coating is designed to be water permeable. When a golf ball is struck, it creates micro-cracks, allowing for increased passage of humidity/water. To prevent macro cracking or bubbling of the protective gloss coat, the coating must be designed to allow water to flow freely. The core or “engine” of a golf ball is made out of polybutadiene rubber with proprietary fillers. The polybutadiene rubber is mixed with fillers, generally inorganic minerals, and is used to increase the overall weight and strength of the core. Although the polybutadiene rubber is hydrophobic, water will channel through the polymer and be attracted to the filler-polymer interface. The reduction in coupling between the filler and the rubber will decrease the core’s ability to rebound or its COR (Coefficient of Restitution) – which translates into a loss of distance.

Golf ball construction is generally broken down into four main types:

LIQUID CENTER



Construction: Small rubber or plastic core filled with liquid, surrounded by rubber windings tightly wrapped around the core. Primary cover materials include Balata, urethane or elastomer.

Models Include: Maxfli Elite, Slazenger Pro Preferred, Titleist Professional, Titleist Tour Distance.

Players: Tour Pros and low handicap amateurs looking for control and feel around the greens.

SOLID CORE WOUND



Construction: Large solid-rubber or plastic core, surrounded by thin layer of rubber windings tightly wrapped around the core. Primary cover materials include Surlyn and urethane.

Models Include: Maxfli Revolution, Maxfli Tour Patriot, Slazenger Players, Titleist DT Spin.

Players: Low- to mid-handicappers seeking added distance without sacrificing feel and control.

MULTILAYERED



Construction: Solid-rubber or plastic core surrounded by urethane-based layer between core and cover. Cover materials vary.

Models Include: Callaway Rule 35, Maxfli Revolution Solid,

Nike Tour Accuracy, Precept Tour Premium, Strata Tour Ultimate, TaylorMade InerGel Tour, Titleist HP, Titleist Pro V1, Wilson iWound.

Players: Low-handicappers and players seeking added distance and softer feel than a two-piece solid core.

SOLID CORE



Construction: Solid-rubber core surrounded by cover. Primary cover materials include Surlyn and ionomer.

Models Include: Pinnacle Titanium Extreme Distance, Precept MC

Lady, Slazenger Raw Distance, Top-Flite XL, Top-Flite XL 2000, Titleist DT Distance, Wilson Smart-Core Professional Distance.

Players: Mid- to high-handicappers looking for durability and distance at a lower price.

Affect of Water – Research

To better understand the fundamental changes occurring in golf balls upon water immersion, “virgin” cover stock materials and polybutadiene rubber (core) were analyzed. In addition, the cover was separated from the core of commercial golf balls, and the materials were used to conduct similar tests. Some samples were tested after natural and forced desorption to establish the permanence of property changes. The work performed involved the establishment of a property baseline for the pure polymers and analysis of specific properties after various increments of immersion in water. Several analytical techniques were used to ascertain property changes in the different samples after conditioning in water.

Specific elements of the scope of work are as follows:

- ▶ **Sorption/Desorption of Water Experiments** – for the Surlyn resin in order to furnish kinetic data and establish water diffusion rate.
- ▶ **Mass Spectroscopy** – to establish type of acrylate salts present in the Surlyn. The type of salt affects the affinity to water.
- ▶ **Infrared Analysis (FTIR)** – analyze IR Spectra of the cover and core materials to establish structural changes after conditioning in water.
- ▶ **Dynamic Mechanical Analysis (DMA)** – to determine elastic modulus E, and Tan D. Changes in the polymer morphology due to water adsorption/attack can be monitored by shifts in these properties.
- ▶ **Differential Scanning Calorimetry (DSC)** – to determine water adsorption and changes in thermal transitions.
- ▶ **Mechanical Characterization** – to determine the mechanical properties of the Surlyn and the polybutadiene rubber, before and after immersion in water for 70 hrs., 7 days and 14 days and 21 days at 71°C. Mechanical properties were measured following ASTM test methods and include:
 - ▶ Tensile strength, ASTM D-412
 - ▶ Modulus, ASTM D-412
 - ▶ Ultimate strain, ASTM D-412
 - ▶ Hardness, ASTM D-1415
 - ▶ Resilience, ASTM D-2632

- ▶ **Coefficient of Restitution (COR)** – a group of balls were weighed in the laboratory and sent to an independent test facility to establish COR. The balls were then placed in water and again measured for COR periodically to determine performance loss.

The data collected were analyzed to answer the two basic questions that motivated this work:

- ▶ Type and degree of polymer degradation that affects ball performance.
- ▶ Degree of permanence/reversibility of degradation, if any.

Degradation of performance of the finished product (golf balls) is assumed to occur if the laboratory measurements indicate appreciable changes from the original or baseline values obtained on the new materials. Change in property values after immersion in water should not be assumed to correlate directly to loss of performance of the golf ball. In other words, a 5% water adsorption does not necessarily mean that a golf ball loses 5% of its yardage. Field-testing can determine the correlation between water adsorption and change in performance characteristics.

Research Conclusions

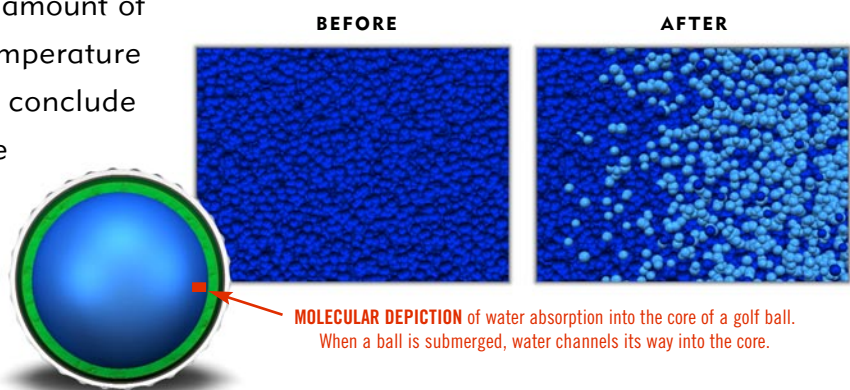
Golf balls do absorb water and the amount of water increases with increasing temperature of the water. Some of the findings conclude that the constituent material tensile strength decreases while the ultimate elongation significantly increases with water adsorption.

Furthermore, there is a marked decrease in resilience and a

general decrease occurs in the elastic modulus of the core material upon water adsorption.

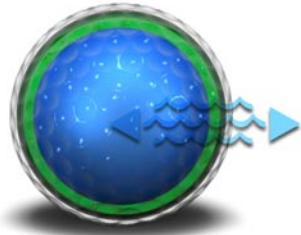
These results confirm the findings of the mechanical properties, which point to an impairment of a ball's distance when the core material gets softer and loses its resilience. Once the water is absorbed into the golf ball, drying of the ball is very slow at ambient temperature.

More importantly, even when extreme drying of the ball is attempted at 71°C under vacuum, the absorbed water is not completely removed.



EFFECTS ON A GOLF BALL

How Water Affects a Golf Ball

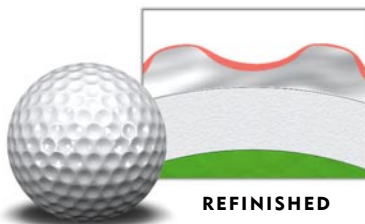


- It takes **12 hours** for water to penetrate the cover and finds its way to the core.
- Water channels its way into the core** utilizing the fillers as a “highway” and is attracted to the filler-polymer interface. The reduction in coupling between the filler and the rubber will decrease the core’s ability to rebound or its COR.

How Unauthorized “Refinishing” Affects a Golf Ball



- Manufacturers spend millions of dollars in research** pushing the distance and accuracy to their limits. Dimple shape, depth and pattern are essential to the desired aerodynamics of the golf ball.

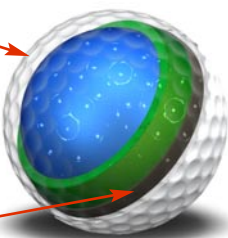


- By adding another layer of **polyurethane gloss coating** (laced with optical brighteners to make it “look” like new) the depth of the dimples is reduced which significantly alters the aerodynamics of the ball.

How Unauthorized “Refurbishing” Affects a Golf Ball

OUTER LAYERS are removed and the ball is re-coated, not according to manufacturers specifications.

THE COVER is the layer under the white paint and clear coatings.



- The outer layers of coating (primer, paint and polyurethane) are **sand-blasted off**, leaving only the urethane shell (cover).
- The ball is then **refurbished by re-coating each layer** and re-stamping the manufacturer’s brand name and markings. This re-coating is not applied according to manufacturers’ specifications, therefore significantly altering the aerodynamics of the golf ball.

HEAR IT FROM THE EXPERTS

“Just about all balls today are comprised of materials representing the same basic polymeric characteristics. Those materials generally adsorb water. Although the amount of water adsorbed varies amongst different types of balls, field-testing demonstrates that this adsorption of water translates into a noticeable loss of distance. The problem is that you cannot detect the performance impairment through visual inspection. It is evident only after hitting the ball.”

Robert Molitor

FORMER VICE PRESIDENT OF RESEARCH AND DEVELOPMENT, SPALDING

“The ionomers that are typically used in the composition of golf balls are hydrophillic and allow water to freely pass into the ball. The intended performance attributes of those materials are clearly affected by water...by even the smallest uptake in water.”

Paula T. Hammond

PROFESSOR, DEPARTMENT OF CHEMICAL ENGINEERING, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

“One thing is for certain, balls do absorb water, and drying them even at high temperatures does not completely rid the ball of the water. Submersion in water does result in the permanent adverse effect on the performance of the golf ball.”

Army Research Laboratory

DECEMBER 1998

“For a two-piece ball, being in the water typically makes the ball harder in terms of compression, and it also slows down the coefficient of restitution [the ability of the ball to regain its roundness after impact], and that makes it fly shorter. For the two-piece ball, the carry and roll after eight days in the water was 244.9 yards compared with 250.7 yards for the new two-piece balls [a loss of 5.8 yards in distance after only 8 days.]”

As reprinted from Golf Digest Magazine

SEPTEMBER 1996, “WATER, WATER, EVERYWHERE.”

“And last but not least, leave the beat-up, gray water ball at home, too. When you need to carry trouble, you want a ball that will really fly.”

Rick Smith

GOLF DIGEST TEACHING PROFESSIONAL

AS REPRINTED FROM GOLF DIGEST MAGAZINE, DECEMBER 2000, “NEVER EMBARRASS YOURSELF AGAIN.”

RICK SMITH IS RANKED NO. 5 AMONGST GOLF DIGEST'S 50 GREATEST TEACHERS.

→ more on next page

HEAR IT FROM THE EXPERTS

“It is well understood that water sorption into the kinds of polymeric materials that make up the cover and core of golf balls can alter the mechanical properties of the polymers. Consequently, it is natural to expect a change in performance of a golf ball after it has been exposed to water for long periods of time. It is doubtful that drying processes could be successful in completely returning the material to its original state. The change of mechanical properties of the golf ball should impact the “play” of the ball, in particular the response of the ball to impact with the golf club. How significant these changes are obviously depends on the total time of water immersion, which is generally unknown when a used ball is found.”

Howard A. Stone

GORDON MCKAY PROFESSOR OF CHEMICAL ENGINEERING AND APPLIED MECHANICS, HARVARD UNIVERSITY

“Golfers spend hundreds of dollars on equipment, club fitting, and golf lessons, and then they throw all that out the window by playing with a used/reclaimed golf ball that is not performing like a new ball. I see the Performance Indicator technology as a way to protect and enhance their game.”

Patrick J. Rielly

PAST PRESIDENT OF THE PGA OF AMERICA

“When a golfer hits a bad shot, the first thing they blame is themselves; the second thing they blame is their equipment; the last thing they blame is the ball. If you’re playing with a used ball, it could have been the ball’s fault and not your swing or equipment. Performance Indicator will protect and enhance my game.”

Focus Group Study

JANUARY 2001 – MULLEN

“The innovative Performance Indicator technology will ensure that golfers will not unknowingly be playing an inferior product. It is also consistent with the goal of all PGA Professionals, which is to help golfers improve their golf games and subsequently, enjoy the game more.”

Eddie Carbone

EXECUTIVE DIRECTOR, NEW ENGLAND PGA SECTION

“I can see how this (Performance Indicator technology) could help the senior golfer. As you get older, you have to deal with losing distance, and I would think a lot of senior players use reclaimed balls, which are working against them. I can see how they would benefit from the technology.”

Paul Barkhouse

PGA PROFESSIONAL, WOBURN C.C.

Never Embarrass Yourself Again

WRITTEN BY RICK SMITH GOLF DIGEST TEACHING PROFESSIONAL

GOLF DIGEST, DECEMBER 2000

RICK SMITH IS RANKED NO. 5 AMONG GOLF DIGEST'S 50 GREATEST TEACHERS.

Almost Everyone Skulls, Shanks, Whiffs, Chili-dipps, Chunked-chip, hits a bad sand shot, or mis-hits a ball at some point. The article identifies several techniques and swing thoughts which will help to eliminate these common miscues from happening. Please make special note of the last page of the article where Rick Smith states "And last but not least. Making a funky swing isn't the only way to embarrass yourself on the course. Here are some dos and don'ts:"

→ [see entire article](#)

Finders ... keepers? Getting to the bottom of the Acushnet-Nitro lawsuit

GOLF WORLD MAGAZINE, FEBRUARY 15, 2002

EDITED BY RON SIRAK AND GEOFF RUSSELL

There are more than 2.56 million dozen golf balls lost last year in the United States. As a result, hundreds of companies have emerged selling used golf balls on the internet and through a wide variety of conventional and unconventional retailers. One used ball company in particular has developed a process where they can refinish/refurbish golf balls and restamps the manufacturers name and sells them. Acushnet, makers of Titleist and Pinnacle brands have filed a lawsuit charging trademark infringement and false advertising, among other things.

→ [see entire article](#)

The Ball

▶ A. Weight

The weight of the ball shall not be greater than 1.620 ounces avoirdupois (45.93 gm).

▶ B. Size

The diameter of the ball shall be not less than 1.680 inches (42.67 mm).

This specification will be satisfied if, under its own weight, a ball falls through a 1.680-inch diameter ring gauge in fewer than 25 out of 100 randomly selected positions, the test being carried out at a temperature of 23 +/- 1° C.

▶ C. Spherical Symmetry

The ball must not be designed, manufactured or intentionally modified to have properties that differ from those of a spherically symmetrical ball.

▶ D. Initial Velocity

The velocity of the ball shall not be greater than 250 feet (76.2 m) per second when measured on apparatus approved by the United States Golf Association. A maximum tolerance of 2% will be allowed. The temperature of the ball when tested shall be 23 +/- 1° C.

▶ E. Overall Distance Standard

A brand of golf ball, when tested on apparatus approved by the USGA on the outdoor range at the USGA Headquarters under the conditions set forth in the Overall Distance Standard for golf balls on file with the USGA, shall not cover an average distance in carry and roll exceeding 280 yards (256 m) plus a tolerance of 6%.