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BY FEDERAL EXPRESS

U.S. Customs and Border Protection
Office of International Trade
Regulations and Rulings
Attention: Trade and Commercial Regulations Branch
90 K Street NE (10th Floor)
Washington, DC 20002

Comments on Proposed Test Method For The Administration of Additional U.S. Note 5, Chapter 64, HTSUS, Concerning The Classification of Footwear With Textile Material on The Outer Sole

Dear Sirs/Madams:

On behalf of our client, Step It Up International, LLC ("SIU"), St. Charles, IL, we hereby submit comments regarding U.S. Customs and Border Protection's ("CBP") proposed adoption of a test methodology to administer Additional U.S. Note 5 to Chapter 64, Harmonized Tariff of the United States ("HTSUS"). Notice of the proposed test method and an invitation to the public to submit comments appeared in the Customs Bulletin of March 27, 2013 (47:14 Cust. Bull. 5).

SIU is an importer of footwear that incorporates textile material in the outer soles of its footwear. As such, it is an interested party which will be impacted if the proposed test method is adopted by CBP.

BACKGROUND

On October 31, 2011, the President issued Presidential Proclamation 8742, which "proclaimed the enactment of certain modifications to the HTSUS, including the insertion of Additional U.S. Note 5 to Chapter 64." 47:14 Cust. Bull at 7.[1]

Additional U.S. Note 5 to Chapter 64, HTSUS provides that:

> For the purposes of determining the constituent material of the outer sole pursuant to Note 4(b) to this Chapter, no account shall be taken of textile materials which do not possess the characteristics usually required for normal use of an outer sole, including durability and strength.

In the Customs Bulletin Notice CBP made the following response to one commenter:

> ... If the textile material is disregarded, then the constituent material of the outer sole under Note 4(b) to Chapter 64, HTSUS, will be the material to which the textile material is added. Accordingly, it stands to reason that in order to satisfy the note, textile material on outer soles must possess the characteristics, including strength and durability, normally associated with the merchandise to which it is attached.[2]

In response to the preliminary comments received, CBP proposed to recognize ISO 80271 "in assessing the characteristics of textile material attached to the outer sole." The essence of the test set forth in ISO 80271 is to determine the relative mass lost by abraiding the outer sole in an abrasion. While it is standard practice to utilize a

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[1] Presidential Proclamation 8742 was published in the Federal Register on November 3, 2011 (76 Fed. Reg. 68271). This proclamation followed the publication by the International Trade Commission ("ITC") of its report in Investigation No. 1205-8. This ITC investigation was conducted pursuant to Section 1205(a) of the Omnibus Competitiveness Act of 1988 (19 U.S.C. §3005(a).

[2] CBP's conclusion is misplaced. Textile material could be added to the outer sole because it has properties not found in the other materials of the outer sole.

percentage loss of material after abrasion of the sample being tested,[3] CBP does not adopt the percentage loss method, but instead:

> ... proposes to base the determination of whether the textile material possesses the characteristics normally required for use of an outer sole on whether the textile material subjected to ISO 80271 is still present on the samples after testing.

DISCUSSION

There can be no doubt that any outer sole that has fabric attached will serve to increase the "life" expectancy of the outer sole. Put another way, while the abrasion to which the outer sole is subjected may wear away all or substantially all of the textile material on the surface area of the outer sole, the textile will better protect the outer sole from abrasion than a sole that has no textile fabric embedded or attached. For example, if the abrasion test is performed for 30 seconds on an outer sole sample that has no fabric there will be less of the outer sole left than if the test is performed on a sample that has a fabric component. Conversely, if the test is performed on a sample that has a fabric component, the abrasion removes less of the rubber/plastic portion of the outer sole.

Logic dictates that when an outer sole with textile is subjected to abrasion it will take longer to abrade the sample than it would take if the sample lacked a textile layer. A timed abrasion may be more applicable than an untimed test. In a timed abrasion test, just as in a real word application, it will take more time to wear out an outer fabric surface layer than it would on an outer sole which lacks the fabric.

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[3] *See* ISO 20871 and *Rubber Abrasion Resistance* by Wanvimon Arayapranee, at www.intechopen.com, in which it is stated, at 157 that:

> ...where the amount of material lost is a concern regardless of whether the material fails, abrasion may be measured in terms of the percentage of material loss, wither by mass or by volume, between the start and end of the test.

This paper is attached as Exhibit A.

ISO 20871 is silent as to the length of time that the sample undergoing testing should be subjected to abrasion. Rather, the test is stopped automatically after an abrasion distance of 40 m (84 revolutions). There is no way that testing the outer sole for 84 revolutions in any way relates to the actual wearability of the outer sole of the footwear. Similarly, the proposed test does not take into account the age, weight and use of the wearer.

The test that CBP proposes to implement does not provide results that would demonstrate that the textile material "possess the characteristics, including strength and durability, normally associated with the merchandise to which it is attached." Since outer soles made of rubber or plastics have not been subjected to the same abrasion test, merely subjecting the sample that contains the textile material to determine if there is any textile left after being subject to the abrasion fails to establish that the textile material has the same characteristics as the outer sole to which it is attached. It is well known that different materials, resist abrasion at different rates.[4] Also, there may be no direct relationship between test results and the actual use of the product.[5]

An outer sole with textile material on the surface area in contact with the ground unequivocally provides the outer sole with greater durability and strength. What the proposed test procedure does not accomplish is a determination of the effect of having the textile material on the surface of the outer sole. If you are going to test the outer sole to determine whether the textile material has the strength and durability normally associated with the outer sole of the footwear to which it is attached, it would require that the test encompass both the outer sole material with the textile attached and a sample with no textile attached.

CBP's proposed test is to determine whether textile materials added to an outer sole provides strength and durability to that sole by examining whether textile material is present after the modified ISO 20871 test procedure. However, the purpose of CBP's test can easily be defeated by incorporating textile material throughout the outer sole rather than only near the outer layer of the sole. In this way, textile material will always be present after abrasion, regardless of the actual durability of the sole.

A better test would be to compare the amount of material lost during the abrasion test to a known standard.

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[4] *Rubber Abrasion Resistance, supra.*

[5] *See* Johnsonite, a Tarkett Co., brochure entitled *Specifications, Product Testing and Terminology*, paragraph on Abrasion Testing, copy attached hereto as Exhibit B.

The submission to CBP made on behalf of the Footwear Distributors and Retailers of America ("FDRA"), dated February 22, 2012, regarding Note 5, in response to CBP's solicitation of comments on the administration of Additional Note 5, Chapter 64, HTSUS, is particularly germane. FDRA there stated that:

> Note 5 presents significant challenges in interpretation and administration. The terms are ambiguous and depend in part on the use of the type of footwear (work, dress, athletic, beach sandal to name a few) to which the outer sole is attached. ... Inquiries of this sort are, if not impossible, highly impractical. Further, there are no tests available.

Additionally, FDRA urged CBP to adopt a position that reflected the market place. FDRA stated that:

> The only practical solution is to accept the decision of the market place. Outer soles of rubber/plastics to which textile materials have been attached are presumed "to possess the characteristics usually required for normal use of an outer sole."[6]

SIU asserts that FDRA's position regarding Note 5 is correct.

Respectfully submitted,

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By: _____
Jerry P. Wiskin
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JPW/PYS/el
Enclosures

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[6] McGuireWoods submission to CBP on behalf of FDRA dated February 22, 2012, at page 3

EXHIBIT A

8

Rubber Abrasion Resistance

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1. Introduction

Abrasion resistance is the ability of a material to resist mechanical action such as rubbing, scraping, or erosion that tends progressively to remove material from its surface. When a product has abrasion resistance, it will resist erosion caused by scraping, rubbing, and other types of mechanical wear. This allows the material to retain its integrity and hold its form. This can be important when the form of a material is critical to its function, as seen when moving parts are carefully machined for maximum efficiency. Abrasion resistant materials can be used for both moving and fixed parts in settings where wearing could become an issue.

The substances usually called "rubber" immediately brings to mind materials that are highly flexible and will snap back to their original shape after being stretched. In fact, there are three structural requirements for a given substance to be a rubber (i) rubber is made up of a polymer chain, liner or branched; (ii) the chain is flexible; and (iii) the chain is longer than a certain threshold length. Because the rubber is compliant and tough, it can easily absorb and survive a single strike of large deformation. However when used in contact with moving parts, a process of micro-tearing can occur on the rubber surface around the sharp asperities, gradually removing the material and finally terminating the functional life of the rubber. In many applications, abrasive wear is the major failure mode of rubbers. In normal materials, a rough surface is made smooth by repeated friction or abrasion with harder materials. Rubber hardly ever slides on other rubber like materials but on tracks grossly dissimilar from it in surface texture, chemical constitution and elastic behavior, however, when the smooth surface is abraded, periodic parallel ridged patterns, looking like a wind-wrought pattern on sand, are formed on the rubber surface. These typical patterns are held through all processes of rubber abrasion, on the surface of tires, conveyor belts, printing rolls and shoes for example, which are thus regarded as the essential basis of rubber abrasion.

Abrasion process involves removal of small particles (1-5 μm) leaving behind pits in the surface and then followed by removal of large particles (> 5 μm) (El-Tayeb & Nasir, 2007). Detachment of small particles plays an important role in initiating the abrasion (Muhr & Roberts, 1992) and this is related to either a structural unit or localized stresses in the rubber. Since abrasion is clearly a manifestation of mechanical failure, Shallamach (Schallamach, 1557/58, 1968) used tearing energy to describe the rubber wear mechanisms, and Ratner et al. (Ratner et al., 1967) has established an equation in which the wear loss is related to macroscopic mechanical properties such as tensile strength, elongation at break, hardness etc. Thomas (Thomas, 1958, 1974) proposed the problem of abrasion is presented using fracture mechanics which treats fatigue and tensile failure as crack growth processes from

small flaws. Crack growth can be influenced by the presence of oxygen or ozone. The nature of the vulcanizing system affects strength: crosslinks probably rupture and reform under stress. Other suggested factors responsible for particle detachment are internal subsurface failure due to flaws in the rubber such as dirt or voids (Gent, 1989) or interfacial adhesion at high speed rolling (Roberts, 1988). According to Pandey et al. (Pandey et al., 2003), there is no distinction between wear and abrasion, although other researcher (Schallamach, 1957/58) defined abrasion as that produced by laboratory machine on a rubber piece and wear as something that happens to tires or other rubber products. Thus, for rubber, "abrasion" covers all mechanisms, whereas the word "abrasion" for other materials refers in particular to scoring by hard, sharp particles. In the absence of transient effects such as clogging of the abrasive or evolution of an abrasion pattern it is found that the quantity of rubber abraded is proportional to the distance of sliding between rubber and counterface. However, wear of tires and abrasion on certain laboratory abrasion machines (e.g. the Akron abrader) brings into play gross properties of tire or test piece which affect the rate of wear just as much as does the abrasion resistance of the compound. However, Muhr and Roberts (Muhr & Roberts, 1992) proposed that abrasion reserves for processes where the amount of sliding is controlled, and that wear applies to the many practical situations for which the amount of sliding is as significant a variable as the attrition per unit sliding distance.

Schallamach (Schallamach, 1957/58, 1968) defines abrasion of rubber as a purely mechanical failure produced frictionally by the asperities of the track and this process creates periodic structures often called "abrasion pattern", a series of parallel ridges perpendicular to the sliding direction created on the surface of rubber during abrasive wear. He proposed the mechanism of rubber abrasion from a fracture mechanics point of view, relating the rate of wear to the crack growth resistance of the rubber. Although the concept of crack growth plays a very important role in abrasion, particularly in the growth of a single ridge, when we consider that the essential subject of rubber abrasion is in the formation of the periodic surface pattern consisting of very many cracks, moreover abrasive wear is a consequence of friction, in other words, it is impossible for any abrasive transfer of material to occur without friction phenomena. As is well known, an abrasion pattern is formed at the initial stage of abrasion and grows in ridge spacing and ridge height, whose geometric feature remains constant in appearance once it has grown up to the critical size. The abrasion pattern moves very slowly along in the sliding direction in a manner that the crack at the root of the pattern wedge is deepened somewhat and the protruding flap is tom off.

When rubber is slided over another abrasive surface, contact of abrasive grits (asperities) occurs. Upon application of a normal load, the extremely low tensile modulus of rubber ensures extensive deformation to establish a conformal contact with the counter part. This causes the real area of contact to become comparable to the apparent area of contact. Owing to the curved and entangled structure of chains of molecules in rubber, they can undergo considerable lateral deformation without fracture by stretching and twisting of chains. Gent (Gent, 1989) proposed a hypothetical mechanism for creating subsurface cracks during frictional sliding as part of the process of abrasive wear of rubber. It consists of the unbounded elastic expansion of microscopic precursor voids until they burst open as cracks, under the action of internal pressure or of a triaxial tension in the surrounding rubber. This conjecture accounts for enhanced resistance to abrasion for compounds reinforced with carbon black, in terms of increased stiffness without much loss of extensibility, and for the

lack of correlation of abrasion resistance with other measures of strength. It should be noted that it is specific to soft, extensible materials, and thus it also accounts for marked differences in the nature of the wear process in rubbery materials compared to plastics and metals. Only rubbery materials appear to abrade away by a linking up of microcracks at right angles to the sliding direction to produce characteristic wear ridges known as the Schallamach abrasion pattern. Three mechanisms of generating a sufficiently large inflation pressure or triaxial tension are discussed. The most probable one seems to be thermal decomposition of rubber, generating volatile decomposition products a microscale blowout process. This would be aggravated by a simultaneous softening of the rubber on heating. Although strictly conjectural, it would be helpful to know whether the character of wear changes when abrasion is carried out under a large superimposed hydrostatic pressure. Sliding contact generates a shear stress along the surface of rubber and extensive shear stress along the stress axis is found to occur owing to the nature of elastomer (Chandrasekaran & Batchelor, 1997). When the shear stress exceeds the cohesive strength of the chain, fracture occurs by propagation of crack along the root of the contact area. The sudden release of deformation energy in the form of fracture in the contact area surface results in recovery of rubber to original coiled and entangled state. The visco-elastic nature of rubber limits the rate of recovery which results in shear wave propagation along the surface of rubber during sliding. Fukahori and Yamazaki (Fukahori & Yamazaki, 1994) proposed a new concept to understand the mechanism of formation of the periodic patterns characteristic in rubber abrasion. They showed that the driving force to generate the periodic surface patterns, and thus rubber abrasion consist of two kinds of periodic motion, stick-slip oscillation and the microvibration generated during frictional sliding of rubber. The stick-slip oscillation is the driving force to propagate cracks, then abrasion patterns and the microvibration with the natural frequency of the rubber induced in the slip phase of the stick-slip oscillation is another driving force for the initiation of the cracks. Although initial cracks originate in the slip region of the rubber surface, the propagation of the cracks is strongly excited in the stick region. Accordingly, the initial size of the abrasion pattern, pattern spacing, equals the distance determined by the natural period of the rubber and the sliding velocity while the constant pattern spacing after the critical number of frictional slidings agrees with the distance given by the period of the stick-slip oscillation and the sliding velocity. Consequently, during rubber abrasion, two driving forces produce bimodal size distribution of abraded particles, small particles of the order of ten micrometres by microvibrations and large ones of the order of a few hundred micrometres by the stick-slip motions. Sliding of rubber with high frictional forces does not necessarily entail abrasion (as it does for metal-metal contacts). Rather, abrasion of rubber results from mechanical failure due to excessively high local frictional stresses which are most likely to occur on rough tracks.

In spite of its practical importance, abrasion is perhaps the least understood phenomena amongst the various types of failures of rubber, as it is difficult to predict the abrasion behaviour from other rubber properties (Pandey et al., 2003). It is influenced by the hysteresis properties of the vulcanizates, magnitude of the frictional force and the resistance of rubber to rupture. The abrasion is a combination of mechanical, mechanochemical and thermochemical processes. The formation of an abrasion pattern depends on several factors such as crack growth process (Uchiyama and Ishino, 1992), mechanical properties of the rubber, and on the chemical, ageing and thermal conductivity properties of the composite. It depends on the modulus of elastomer, the abrasion pattern may be characterized by either

ridges at the right angles to the rubbing direction if the modulus of elastomer is sufficiently low or score lines parallel to the rubbing direction if the modulus of elastomer is sufficiently high (Evstratov et al., 1967). There are a number of ways to make a material resistant to abrasion. One option is to utilize a special coating which creates a hardened layer over the material and resists friction. Some materials are also naturally extremely hard, and are ideal for settings in which abrasion resistance will be desirable. Other materials can be specifically formulated for increased hardness, as seen in plastics facilities which manufacture abrasion resistant plastics with the use of chemicals which harden and strengthen the plastic. The properties of a vulcanized rubber can be significantly influenced by details of the compounding. Practical materials will have, in addition to the base polymer, fillers, anti-degradants, crosslinking agents, accelerators etc. All of these can have an influence on the physical and chemical stability of the finished material.

2. Rubber use

2.1 Compounding

The rubber industry began when Charles Goodyear developed the first useful rubber compound: natural rubber plus sulfur. The concept of mixing materials into rubber to improve performance is still primary importance today. Without compounding, few rubbers would be of any commercial value. Any given rubber application will have a long list of necessary criteria in addition to cost, encompassing appearance, processing, mechanical, electrical, chemical, and thermal properties. Developing such compounds requires a broad knowledge of material science and chemistry combined with experience. The use of designed experiments can greatly facilitate selecting the optimum compound formulation.

The major components in a compound are rubber, vulcanizing agents, fillers, plasticizers, and antidegradants.

2.2 Rubber

Rubber is polymeric material endowed with the properties of flexibility and extensibility: with the application of force, the molecules straighten out in the direction in which they are being pulled; on release from being extended, they spontaneously recover their normal, random arrangements. Rubbers include natural rubber, a naturally occurring substance obtained from the exudations of certain tropical plants, and synthetic rubbers, artificially derived from petrochemical products. Among the most important synthetics are styrene-butadiene, polybutadiene, and polyisoprene (commonly classified as the "general purpose"), as well as ethylene-propylene rubber (often referred to as "specialty rubber"). The prices of these synthetics have been historically in the range of natural rubber prices and their markets have, although to varying degrees, overlapped those of natural rubber. Synthetic rubbers are materials with distinctive chemical structures, whereas the emphasis with natural rubber lies on different types and grades within one single broad category.

2.2.1 Natural rubber

Natural rubber (polymer designation cis-1-4 polyisoprene, empirical formula $(C_5H_8)_n$ obtained from the sap (latex) of several rubber-yielding plants (e.g. Hevea Brasiliensis and

Parthenia argentatum) by coagulation with chemicals, drying, electrical coagulation, and other processes is the prototype of all elastomers. Latex extracted in the form of latex from the bark of the Hevea tree is a polydispersed colloidal system of rubber particles in an aqueous phase. With Hevea latex, the dry rubber content varies between approximately 28-40%, although it may rise to 45-50% after a long period of non-tapping (notice that, for statistical purposes, figures for natural rubber may include the dry rubber content of latex). The rubber produced from latex contains, besides the hydrocarbon, relatively small quantities of protein, carbohydrates, resin-like substances, mineral salts, and fatty acids.

The natural rubber polymer is nearly 100% cis-1,4 polyisoprene with Mw ranging from 1 to 2.5 x 10^6. Due to its high structural regularity, natural rubber tends to crystallize spontaneously at low temperatures or when it is stretched. Low temperature crystallization causes stiffening, but is easily reversed by warming. The strain-induced crystallization gives natural rubber products outstanding resilience, flexibility, and tear and tensile strength, as well as low heat build-up and abrasion. However, a drawback is natural rubber moderate environmental resistance to factors such as oxidation and ozone; so too for its scarce resistance to chemicals, including gasoline, kerosene, hydraulic fluids, degreasers, synthetic lubricants, and solvents. In addition, latex contains proteins that can cause severe allergic response in a small percentage of the population and among medical professionals following extensive exposure. The largest use of natural rubber is in the tires. Over 70 percent of its manufacture consumption is in this area. The next largest use is as latex in dipped goods, adhesives, rubber thread, and foam. These uses account for approximately another 10 percent. The of applications remainder is used in a variety such as convey or belts, hoses, gaskets, footwear, and antivibration devices such as engine mounts.

2.2.2 Polyisoprene

Synthetic polyisoprene is designed to be similar to natural rubber in structure and properties. Although it still demonstrates lower green strength, slower cure rates, lower hot tear, and lower aged properties than its natural counterpart, synthetic polyisoprene exceeds the natural types in consistency of product, cure rate, processing, and purity. In addition, it is superior in mixing, extrusion, molding, and calendering processes. The lithium based polymers were found to produce up to 94 percent cis, which still was not high enough to provide the properties of natural rubber. Polymers made with the coordination catalysts have cis contents of up to 98 percent, providing products that can more closely serve as replacements for natural rubber than the lithium-based polymers. In comparison with natural rubber, they offer the advantage of a more highly pure rubber (no non-rubber material) and excellent uniformity. A high trans-1,4 structure was produced by Polysar, and is now being produced by Kuraray. A Li-IR with increased 3,4 structure can be prepared by adding polar modifiers to the alkyl lithium catalyst system. However, since the higher cis-1,4 configuration most closely mirrors the properties of natural rubber and is the most important commercially. Currently synthetic polyisoprene is being used in a wide variety of industries in applications requiring low water swell, high gum tensile strength, good resilience, high hot tensile, and good tack. Gum compounds based on synthetic polyisoprene are being used in rubber bands, cut thread, baby bottle nipples, and extruded hose. Carbon black loaded compounds find use in tires, motor mounts, pipe gaskets, shock absorber bushings and many other molded and mechanical goods. Mineral filled systems

find applications in footwear, sponge, and sporting goods. In addition, recent concerns about allergic reactions to proteins present in natural rubber have prompted increased usage of the more pure synthetic polyisoprene in some applications.

2.2.3 Styrene-butadiene rubber

The largest-volume synthetic rubber consumed is styrene-butadiene rubber (SBR) produced by both emulsion (E-SBR) and solution (S-SBR). In 2003, SBR solid rubber accounted for 4% percent of all synthetic rubber. If SBR latex and carboxylated SBR latex are included, its share increases to 55 percent. The major application of solid SBR is in the automotive and tire industry, accounting for approximately 70 percent of the use. Therefore, SBR has been tightly tied to the tire business.

Most of the E-SBR contains about 24% by weight of styrene and it is a random copolymer with butadiene. Some specific grades contain as much as 40-46% styrene, and are much stiffer. The polymerization is by free radical initiator and there is a finite probability of chain-transfer reaction, which generates long branches.

Emulsion polymerization is carried out either hot, at about 25-50°C, or cold, at about 5-25°C, depending upon the initiating system used. SBR made in emulsion usually contains about 24% styrene randomly dispersed with butadiene in the polymer chains. At high temperature polymerization, many long-braches and gels were formed. The rubber was stiff and difficult to mill, mix, or calender than natural rubber, deficient in building tack, and having relatively poor inherent physical properties. Processability and physical properties were found to be greatly improved by the addition of process oil and reinforcing pigments. Polymerization at a lower temperature became possible, giving less branches and gels. "Cold" SBR generally has a higher average molecular weight and narrower molecular weight distribution. It thereby offers better abrasion and wear resistance plus greater tensile and modulus than "hot" SBR. Since higher molecular weight can make cold SBR more difficult to process, it is commonly offered in oil-extended form. S-SBR comes in two distinctly different subgroups, one made by an anionic initiator and the other by free radical initiators. SBR made in solution contains about the same amount of styrene, but both random and block copolymers can be made. Solution SBR can be tailored in polymer structure and properties to a much greater degree than their emulsion counterparts. The random copolymers offer narrower molecular weight distribution, low chain branching, and lighter color than emulsion SBR. They are comparable in tensile, modulus, and elongation, but offer lower heat buildup, better flex, and higher resilience. Certain grades of solution SBR even address the polymer's characteristic lack of building tack, although it is still inferior to that of natural rubber. The processing of SBR compounds in general is similar to that of natural rubber in the procedures and additives used. SBR is typically compounded with better abrasion, crack initiation, and heat resistance than natural rubber. SBR extrusions are smoother and maintain their shape better than those of natural rubber. SBR was originally developed as a general purpose elastomer and it still retains this distinction. It is the largest volume and most widely used elastomer worldwide. Its single largest application is in passenger car tires particularly in tread compounds for superior traction and tread wear. Substantial quantities are also used in footwear, foamed products, wire and cable jacketing, belting, hoses, and mechanical goods.

2.2.4 Polybutadiene rubber

Polybutadiene rubber (BR) was originally made by emulsion polymerization, generally with poor results. It was difficult to process and did not extrude well. This rubber became commercially successful only after it was made by solution polymerization using stereospecific Ziegler-Natta catalysts. This provided a polymer with greater than 90% cis-1,4-polybutadiene configuration. This structure hardens at much lower temperatures (with T_g of -100°C) than natural rubber and most other commercial rubbers. This gives better low temperature flexibility and higher resilience at ambient temperatures than most rubbers. Greater resilience means less heat buildup under continuous dynamic deformation as well. This high-cis BR was also found to possess superior abrasion resistance and a great tolerance for high levels of extender oil and carbon black. High-cis BR was originally blended with natural rubber simply to improve the latter's processing properties, but it was found that the BR conferred many of its desirable properties to the blend. The same was found to be true in blends with SBR.

The 1,3-butadiene monomer can polymerize in three isomeric forms: by cis 1,4 addition, trans 1,4 addition, and 1,2 addition leaving a pendant vinyl group. By selection of catalyst and control of processing conditions, polybutadiene is now sold with various distributions of each isomer within the polymer chain, and with varying levels of chain linearity, molecular weight and molecular weight distribution. Each combination of chemical properties is designed to enhance one or more of BR's primary attributes.

The major use of polybutadiene (cis-1,4-BR) having a very low glass transition temperature in the region -75°C to -100°C is in tires, with over 70 percent of the polymer produced used by the tire industry, primarily in blends with SBR or natural rubber to improve hysteresis (resistance to heat buildup), abrasion resistance, and cut growth resistance of tire treads. The type of BR used depends on which properties are most important to the particular compound. High-cis and medium-cis BR have excellent abrasion resistance, low rolling resistance, but poor wet traction. High-vinyl BR offer good wet traction and low rolling resistance, but poor abrasion resistance. Medium-vinyl BRs balance reasonable wet traction with good abrasion resistance and low rolling resistance. Polybutadiene is also used for improved durability and abrasion and flex crack resistance in tire chaffer, sidewalls and carcasses, as well as in rubber blends for belting. High- and medium-cis BRs are also used in the manufacture of high impact polystyrene. Three to twelve percent BR is grafted onto the styrene chain as it polymerizes, conferring high impact strength to the resultant polymer.

Polybutadiene made by emulsion polymerization with a free radical initiator is used as the rubber component of an impact modifier in plastics, in particular high impact polystyrene (HIPS) and acrylonitrile-butadiene-styrene resin (ABS). In the HIPS application the rubber is dissolved in the styrene monomer, which is then polymerized via a free-radical mechanism. A complex series of phase changes occurs, resulting in small rubber particles containing even smaller polystyrene particles being incorporated into a polystyrene matrix. The rubber is added to increase impact strength. Because of the unique morphology that is formed, low levels of rubber (typically around 7%) provide rubbery particles having a volume fraction of 30-40 percent. This morphology leads to high impact at very low rubber levels, providing good stiffness and hardness.

There is also a fairly large market for high cis BR in solid core golf balls. In this application, the polymer is compounded with zinc acrylate and the mixture is cured with peroxide. This produces an ionically cross-linked compound that has outstanding resilience. The covers are also ionomers with superior cut resistance. In the last few years the golf ball market has been shifting away from the traditional wound ball to these new solid core balls that use polybutadiene.

2.2.5 Nitrile rubber

Acrylonitrile butadiene rubber (NBR) is made as an emulsion with a free radical initiator. Polymers are made with an acrylonitrile (AN) content of, for example, 28, 33 or 40 weight percent, depending upon the required oil resistance. It also has good elongation properties as well as adequate resilience, tensile and compression set. The major applications for this material are in areas requiring oil and solvent resistance. As the acrylonitrile content increases in the polymer chain, the properties change predictably. The glass transition temperature increases approximately 1.5°C for each percent increase in acrylonitrile. Properties such as hysteresis loss, resilience, and low-temperature flexibility will correspondingly change. The oil resistance increases with increased acrylonitrile content, as does the compatibility with polar plastics such as PVC. The major market for nitrile rubber is in the automotive area because of its solvent and oil resistance. Major end uses are for hoses, fuel lines, O-rings, gaskets, and seals. In blends with polyvinyl chloride (PVC) and acrylonitrile butadiene styrene (ABS), nitrile rubber acts as an impact modifier. Some nitrile rubber is sold in latex form for the production of grease-resistant tapes, gasketing material, and abrasive papers. Latex also is used to produce solvent resistant gloves.

Hydrogenated NBR (HNBR) is produced by first making an emulsion-polymerized NBR using standard technique. Almost all the butadiene units become saturated to produce an ethylene-butadiene-acrylonitrile terpolymer. These "post-polymerization" reactions are very expensive so HNBR usually command a premium price. HNBR is usually cured with peroxides, similar to ethylene-propylene rubber, because it has no unsaturation for a conventional sulfur cure system. HNBR has many uses in the oil-field, including down hole packers and blow-out preventers, because of its outstanding oil resistance and thermal stability. For the same reasons, it has also found uses in various automotive seals, O-rings, timing belts, and gaskets. Resistance to gasoline and aging make HNBR ideal for fuel-line hose, fuel-pump and fuel injection components, diaphragms, as well as emission-control systems. HNBR is the best selection to achieve to the highest abrasion and heat resistance. Service temperature of this rubber is up to 160°C and it's used in temperatures up to 200°C for short times and its abrasion resistance and wet traction is very good. But price of HNBR is high and it isn't an economy rubber for general applications.

2.2.6 Ethylene-propylene rubber

Ethylene-propylene rubber continues to be one of the most widely used and fastest growing synthetic rubber having both specialty and general purpose applications. Polymerization and catalyst technologies in use today provide the ability to design polymers to meet specific and demanding application and processing needs. Versatility in polymer design and performance has resulted in broad usage in automotive weather-stripping and seals, glass-

run channel, radiator, garden and appliance hose, tubing, belts, electrical insulation, roofing membrane, rubber mechanical goods, plastic impact modification, thermoplastic vulcanizates and motor oil additive applications. Ethylene-propylene rubber are valuable for their excellent resistance to heat, oxidation, ozone and weather aging due to their stable, saturated polymer backbone structure. Properly pigmented black and non-black compounds are color stable. As non-polar rubber, they have good electrical resistivity, as well as resistance to polar solvents, such as water, acids, alkalies, phosphate esters and many ketones and alcohols. Amorphous or low crystalline grades have excellent low temperature flexibility with glass transition points of about minus 60°C. Ethylene-propylene rubber uses the same chemical building blocks or monomers as polyethylene (PE) and polypropylene (PP) thermoplastic polymers. These ethylene (C2) and propylene (C3) monomers are combined in a random manner to produce rubbery and stable polymers. There are two general types of polymers based on ethylene and propylene: ethylene-propylene rubber (EPM) and ethylene-propylene terpolymer (EPDM). EPM accounts for approximately 20 percent of the polyolefin rubber produced. Comprising a totally saturated polymer, these materials require free-radical sources to cross-link. EPDM was developed to overcome this cure limitation. For EPDM a small amount (less than 15%) of a nonconjugated diene is terpolymerized into the polymer. One of the olefinic groups is incorporated into the chain, leaving its other unsaturated site free for vulcanization or polymer modification chemistry. This ensures that the polymer backbone remains saturated, with corresponding stability, while still providing the reactive side group necessary for conventional cure systems. The nonconjugated dienes used commercially are ethylidene norbornene, 1,4 hexadiene, and dicyclopentadiene. Each diene incorporates with a different tendency for introducing long chain branching (LCB) or polymer side chains that influence processing and rates of vulcanization by sulfur or peroxide cures.

2.3 Vulcanizing agents

Vulcanization is a chemical process for converting rubber or related polymers into more durable materials via the addition of sulfur or other equivalent vulcanizing agent. The function of vulcanizing agent is to modify the polymer by forming crosslinks (bridges) between individual polymer chains; the most common ones are the sulfur type for unsaturated rubber and peroxides for saturated polymers. Uncured natural rubber is sticky, deforms easily when warm, and is brittle when cold. In this state, it is a poor material when a high level of elasticity is required. Vulcanized material is less sticky and has superior mechanical properties. A vast array of products is made with vulcanized rubber including tires, shoe soles, hoses, and hockey pucks. The main polymers subjected to vulcanization are polyisoprene (natural rubber) and styrene-butadiene rubber, which are used for most passenger tires. Chemicals called accelerators may be added to control the cure rate in the sulfur system; these materials generally are complex organic chemicals containing sulfur and nitrogen atoms. Stearic acid and zinc oxide usually are added to activate these accelerators. Metal oxides are used to cure halogenated polymers such as polychloroprene or chlorosulfonated polyethylene.

2.4 Fillers

Natural and synthetic rubbers, also called elastomers are rarely applied in their pure form. They are too weak to fulfill practical requirements because of lack of hardness, strength

properties and wear resistance. A rubber compound contains, on average, less than 5 kg of chemical additives per 100 kg of rubber, while filler loading is typically 10-15 times higher. Of the ingredients used to modify the properties of rubber products, the filler often plays a significant role. Most of the rubber fillers used today offer some functional benefit that contributes to the processability or utility of the rubber product. Styrene butadiene rubber, for example, has virtually no commercial use as an unfilled compound. Fillers are used in order to improve the properties of rubber compounds. The characteristics which determine the properties a filler will impart to a rubber compound are particle size, particle surface area, particle surface activity and particle shape. Surface activity relates to the compatibility of the filler with a specific rubber and the ability of the rubber to adhere to the filler. Rubber articles derive many of their mechanical properties from the admixture of these reinforcing (active) fillers at quantities of 30% up to as much as 300% relative to the rubber part. The introduction of carbon black as a reinforcing agent in 1904, lead to strongly increased tread wears resistance. Carbon black is in use as the most versatile reinforcing filler for rubber, complemented by silicas. In tire manufacturing silicas are more and more used nowadays, mainly to decrease the rolling resistance. The increased attitude of protecting the environment gives rise to a demand for tires combining a long service life with driving safety and low fuel consumption, achieved by this lower rolling resistance. However, the change from carbon black to silica is not at all obvious because of technical problems involved. In particular, the mixing of rubber with pure silicas is difficult, because of the polarity-difference between silica and rubber. Therefore, coupling agents are applied in order to bridge this polarity difference. Sometimes fillers are added to reduce cost, increase hardness, and color the compound. Generally they do not provide the dramatic improvement in properties seen with reinforcing agents, but they may have some reinforcing capability. Carbon black and silica are the most common reinforcing agents. These materials improve properties such as tensile strength and tear strength; also, they increase hardness, stiffness, and density and reduce cost. Almost all rubbers require reinforcement to obtain acceptable use properties. The size of the particles, how they may be interconnected (structure), and the chemical activity of the surface are all critical properties for reinforcing agents. In tire applications, new polymers are currently being developed which contain functional groups that directly interact with carbon black and silica, improving many properties. Typical fillers are clays, calcium carbonate, and titanium dioxide.

2.5 Plasticizers

These materials are added to reduce the hardness of the compound and can reduce the viscosity of the uncured compound to facilitate processes such as mixing and extruding. The most common materials are petroleum-based oils, esters, and fatty acids. Critical properties of these materials are their compatibility with the rubber and their viscosity. Failure to obtain sufficient compatibility will cause the plasticizer to diffuse out of the compound. The oils are classified as aromatic, naphthenic, or paraffinic according to their components. Aromatic oils will be more compatible with styrene-butadiene rubber than paraffinic oils, whereas the inverse will be true for butyl rubber. The aromatic oils are dark colored and thus cannot be used where color is critical, as in the white sidewall of a tire. The naphthenic and paraffinic oils can be colorless and are referred to as nonstaining.

2.6 Antidegradents

An antidegradant, this group of chemicals is an ingredient in rubber compounds to deter the aging of rubber products. The most important are the antioxidants, which trap free radicals and prevent chain scission and crosslinking. Antiozonants are added to prevent ozone attack on the rubber, which can lead to the formation and growth of cracks. Antiozonants function by diffusion of the material to the surface of the rubber, thereby providing a protective film. Certain antioxidants have this characteristic, and waxes also are used for this purpose.

2.7 Processing

A wide range of processes are used to convert a bale of rubber into a rubber product such as a tire. The first process generally will be compounding. Typical compounding ingredients were discussed previously. In many compounds more than one rubber may be needed to obtain the performance required. Uncured rubber can be considered as a very high viscosity liquid; it really is a viscoelastic material possessing both liquid and elastic properties. Mixing materials into rubber requires high shear, and the simplest method is a double roll mill in which the rubber is shear-mixed along with the other compounding ingredients in the bite of the mill. Large scale mixing is most commonly done with a high-shear internal mixer called a Banbury. This mixing is a batch process, although continuous internal mixers also are used. The compounded rubber stock will be further processed for use. The process could be injection or transfer molding into a hot mold where it is cured. Tire curing bladders are made in this fashion. Extrusion of the rubber stock is used to make hose or tire treads and sidewalls. Another common process is calendaring, in which a fabric is passed through rolls where rubber is squeezed into the fabric to make fabric-reinforced rubber sheets for roofing membranes or body plies for tires. The actual construction of the final product can be quite complex. For example, a tire contains many different rubber components some of which are cord or fabric reinforced. All of the components must be assembled with high precision so that the final cured product can operate smoothly at high speeds and last over 50,000 miles.

3. Abrasion test

An abrasion test is a test used to measure the resistance of a material to wear stemming from sliding contact such as rubbing, grinding, or scraping against another material. Abrasion may be measured in a variety of ways, depending on the resistance test used and the information that is desired from the test (Dick, 2001). For example, where the amount of material lost is a concern regardless of whether the material fails, abrasion may be measured in terms of the percentage of material lost, either by mass or by volume, between the start and end of the test. Another measure sometimes used is the number of abrasion cycles a material withstands before failure. This would be more appropriate if information on how long the material or product will survive before outright failure is of primary interest. Abrasion tests try to accelerate the process by applying more cutting-like conditions; however, this approach may not simulate actual wear. It is also important to try to match the severity of the abrasion test to the severity of the product wear conditions. For example, the severity of test conditions imparted by most abraders is usually greater than what the

highway pavement may impart to a tire tread compound during normal driving. Wear resistance is an important rubber compound property related to the useful product life for tires, belts, shoe soles, rubber rolls, and sandblasting hose, among other products. A wide variety of different abrasion testers have been developed over the years in an attempt to correlate to these product wear properties. Several factors are typically considered in developing or selecting an appropriate abrasion test for the application at hand. The shape of the contact area is taken into consideration, as is the composition of the two surfaces making contact with one another. Speed of sliding contact between the two surfaces, the force with which they act on one another, and the duration of contact between them may also be considered. In addition to the materials themselves, the environment in which they are making contact also plays a role in selecting an appropriate abrasion test.

The abrasion resistance is expressed as volume loss in cubic millimetres or abrasion resistance index in percent. For volume loss, a smaller number indicates better abrasion resistance, while for the abrasion resistance index; a smaller number denotes poorer abrasion resistance. Tested compounds are usually compared on a "volume loss" basis which is calculated from the weight loss and density of the compound. Abrasion test results are known to be variable; therefore, it is important to control and standardize the abradant used in the test. Also, it is a good idea to relate test results to a standard reference vulcanizates.

ASTM D394, the Dupont Abrasion Test Method, consists of a pair of rubber test pieces pressed against a disk of a specified abrasive paper which rotates whilst a pair of moulded test pieces is continuously pressed against it either with a constant force or with a force adjusted to give a constant torque on the arm holding the test pieces. Care should be taken with soft rubber compounds because "smearing" can occur, affecting test results.

ASTM D1630 describes the rotary-platform, double-head abrader is commonly referred to as the NBS Abrader used on rubber compounds for shoe soles and heels. The NBS abrader uses rotating drums with a specified abrasive paper around them onto which the test pieces are pressed by means of levers and weights, a specified standard reference compound to be used for the calculation of an abrasive index.

ASTM D2228 describes the Pico Abrader. This unique test works on the principle of abrading the rubber surface by rotating a rubber specimen against a pair of tungsten carbide knives. A special dusting power is fed to the test piece surface, which doubtless helps to avoid stickiness. This method specifies five standard rubbers and the result also expressed as an abrasion index. Force on the test piece and speed of rotation can be varied and, presumably, different abradant geometries could be used, although the distinctive feature of the Pico is the use of blunt metal knives in the presence of a powder.

ASTM D3389 refers to the Taber Abrader using a pair of abrasive wheels, a method not originally from the rubber industry. This very general method uses two abrasive wheels against the rubber test piece (disk) attached to a rotating platform. Although the degree of slip cannot be varied; however, the force on the test piece and the nature of the abradant are very readily varied and tests can be carried out in the presence of liquid or powder lubricants. When using the usual type of abrasive wheel, a refacing procedure is carried out before each material tested.

ISO 4649 refers to the DIN Abrader, based on the German Standard. The rubber test piece with a holder is traversed a rotating cylinder covered with a sheet of the abradant paper. By allowing the sample holder to move the test piece across the drum as it rotates, there is less chance of rubber buildup on the abradant paper. This method, used extensively in Europe, is very convenient and rapid and well suited to quality control the uniformity of a specific material. The achieved test results provide important parameters in respect to the wear of rubbers in practical use. The details of procedure and expression of results are something of a compromise, being a compilation of the German approach and the British approach. Two procedures are specified, using a rotating or non-rotating test piece respectively. In principle, the abrasion should be more uniform if the test piece is rotated during test. The standard abradant is specified in terms of weight loss of a standard rubber using a non-rotating test piece and has to be run in against a steel test piece before use. Results can either be expressed as a relative volume loss with the abradant normalized relative to a standard rubber or as an abrasion index relative to a standard rubber.

British Standard BS903: Part A9 still describes the Akron Abrader. The rubber test piece is a moulded wheel which is positioned against an abrasive cylinder under constant speeds and held against the abrasive wheel by a constant force. The Akron Abrader has the advantage of allowing variation in the degree of slip in the test by varying the angle of the test piece.

4. Effect of compounding ingredients on abrasion resistance

4.1 Rubber

In rubbery materials, when the smooth surface is abraded, periodic parallel ridged patterns are formed on the rubber surface. These typical patterns are held through all processes of rubber abrasion, on the surface of tires, conveyor belts, printing rolls and shoes for example, which are thus regarded as the essential basis of rubber abrasion. In the absence of any serious chemical decomposition the abrasion process initially results in the removal of small rubber particles just a few microns in size, leaving pits behind in the surface. With continued rubbing, larger pieces of rubber are removed. Although most weight loss is attributable to the larger pieces, it is thought that the detachment of the smaller particles initiates the abrasion process. The small particles have a characteristic size of 1-5 μm, but whether this relates to a structural unit in the rubber compound (Muhr & Roberts, 1992). Other suggestions are that mechanical rupture to produce the particles relates to flaws in the rubber, including dirt, or voids that cavitate leading to internal subsurface failure (Gent, 1989). A rolling experiment suggested that particle detachment might be linked to interfacial adhesion (Roberts, 1988). Schallamach (Schallamach, 1557/58, 1968) reported that rubber often develops a pattern of ridges perpendicular to the direction of abrasion. In the simplest case abrasion is produced by a line contact pulling a tongue of rubber from the ridge producing crack growth at the base of the tongue. Provided the surface configuration is in a steady state, the quantity of rubber abraded can be related quantitatively to the frictional force and the crack growth characteristic of the rubber. The abrasion of rubber results from mechanical failure due to excessively high local frictional stresses which are most likely to occur on rough tracks. Theories of abrasion thus require details of the local stresses, which together with the strength properties of the rubber may enable the rate of abrasion to be predicted. Gent and Pulford (Gent & Pulford, 1983) reported the reversal in the relative rates of wear of unfilled polybutadiene rubber comparing to those of unfilled natural rubber and

styrene butadiene rubbers as frictional force increased. Fukahori and Yamazaki (Fukahori & Yamazaki, 1994) investigated the mechanism of the formation of the periodic ridges in rubber abrasion by designing the razor blade abrader. They reported that the driving force to generate the periodic surface patterns, and thus rubber abrasion consists of two kinds of periodic motions, stick-slip oscillation and the microvibration generated during frictional sliding of rubber. The stick-slip oscillation is the driving force to propagate cracks, then abrasion patterns and the microvibration with the natural frequency of the rubber induced in the slip phase of the stick-slip oscillation is another driving force for the initiation of the cracks. Although initial cracks originate in the slip region of the rubber surface, the propagation of the cracks is strongly excited in the stick region. Champ et al. (Champ et al., 1974) proposed the mechanism of rubber abrasion from a fracture mechanics point of view, relating the rate of wear to the crack growth resistance of the rubber. Although the concept of crack growth plays a very important role in abrasion, particularly in the growth of a single ridge, when consider that the essential subject of rubber abrasion. Liang et al. (Liang et al., 2010) investigated the blade abrasion of four different rubber materials, unfilled natural rubber, unfilled styrene butadiene rubber, unfilled polybutadiene rubber and carbon black filled styrene-butadiene rubber. Each is abraded until the steady state abrasion pattern is developed on the surface of moulded rubber wheels. The steady state conditions are measured using the weight loss per revolution of the wheel. The abraded surface is cut to examine the typical asperity profile. Each profile is modeled using finite element analysis to calculate the stored energy release rate for each combination of material and test condition. The stored energy release rate when combined with an independent measure of the rate of crack growth measured using a fatigue crack growth test gives a reasonable prediction of the abrasion rate. They has shown that the low strength of the BR material results in much smaller asperities being formed under steady state abrasion which results in a much slower abrasion rate. Conversely the strongest material NR has the longest tongue on the asperity and this in turn generates much larger values for the tearing energy at the tip of the asperity and this contributes to its poor abrasion resistance. Hong et al. (Hong et al., 2007) observed that BR compounds caused much slower wear than NR and SBR compounds. Arayapranee and Rempel (Arayapranee & Rempel, 2009) studied the cure characteristics, mechanical properties before and after heat ageing, and abrasion and ozone resistances of hydrogenated natural rubber (HNR), providing an ethylene–propylene alternating copolymer, vulcanizate and compared with those of natural rubber (NR), ethylene propylene diene terpolymer (EPDM) and 50:50 NR/EPDM vulcanizates. They reported that the highest abrasion resistance of the NR vulcanizate could be attributed to high unsaturated structure, as evident from its highest tensile strength compared to other vulcanizates. The abrasion loss of 48% HNR is higher than that of the NR vulcanizate, due to a reduction in the number of the double bonds. This suggests that abrasion resistance is heavily dependent on the unsaturation content in the backbone chain.

4.2 Fillers

Fillers increase the stiffness of rubber in various degrees depending on quantity and quality of the fillers. The properties of rubber compounds are affected not only by the filler content but also by its structure and particle size. Despite outstanding resilience and high tensile strength, natural rubber possesses poor abrasion resistance. Thus, blending with high abrasion resistance rubbers and/or reinforcing by inorganic fillers are generally used to

improve the abrasion resistance of NR and other rubbers. Carbon black and silica are two common fillers used to reinforce rubbers. However, high loadings of these fillers are required to obtain desirable properties. Incorporation of reinforcing fillers such as carbon black improves stiffness and strength of rubber (Tabsan et al., 2010). Hence, the abrasion resistance is improved by suppressing tearing of the rubber under the sliding contact (Gent & Pulford, 1983). Arayapranee at el. studied the effect of filler type and loading on the abrasion loss (Arayapranee at el., 2005). They found that the incorporation of silica and carbon black reduces the abrasion loss of the natural rubber materials notably, whereas rice husk ash shows no effect with filler loading. Reinforcing fillers, silica and carbon black, interact preferentially with the natural rubber phase, as shown by the higher reduction of abrasion loss in the compounds. This improvement is probably due to the greater surface area and better filler-rubber interfacial adhesion resulting in an improved abrasion resistance. Fine particles actually reflect their greater interface between the filler and the rubber matrix and, hence, provide a better abrasion resistance than the coarse ones. Similar results were also reported by (Sae-oui et al., 2002).

Filled compounds are found to be less sensitive to the frictional force, whether wear took place by tearing or by smearing (Gent & Pulford, 1983). Carbon black is an additive with a decisive effect on the abrasion resistance. Hong et al. (Hong et al., 2007) investigated the effects of the particle size and structure of various carbon blacks on friction and abrasion behavior of filled natural rubber, styrene-butadiene rubber and polybutadiene rubber using a modified blade abrader. The effect of particle size and structure on abrasion resistance should be considered for the optimum design of desired wear properties. The worn surfaces of the rubber compounds filled with carbon black having smaller particle size and a more developed structure showed narrower spaced ridges and better abrasion resistance. It means that smaller particle size and better structure development of carbon black resulted in improved abrasion resistance. Yang et al. (Yang et al., 1991) reported that the abrasive wear of rubbers is strongly affected by the filler particles dispersed in the rubber matrix. The fillers are incorporated usually for the purposes of mechanical reinforcement and improving the conductivity of the neat resins. It is found that rigid filler particles normally increase the abrasive wear loss of the filled silicone rubbers. The wear rates of the filled silicone rubbers increase slowly with filler concentration until a critical volume fraction is reached, at which point they increase very rapidly with increasing filler. The critical filler fraction should carry important information, as it apparently divides two wear regimes dominated by different mechanisms. The first regime, where the filler concentration is low, is dominated by the properties of the neat resin. The increase of wear rate due to the filler is gradual here. In the cases of effective filler reinforcement, a reduction of wear rate can occur. The second regime is dominated by the filler's detrimental effects where the wear rate increases very rapidly with filler concentration. The stress concentration introduced by the rigid particles effectively creates a 'damage zone' surrounding the particles, a location where micro-cavitation and debonding takes place. Cavitation appears to dominate in the composites of very small filler particles, while debonding dominates when larger particles are involved. In view of the importance of carbon blacks on tread wear, it is surprising that relatively little understanding of the phenomenon has been set out in print. Although for synthetic rubbers such as BR and SBR it may seem unnecessary to look further than the dramatic enhancement of strength properties imparted by the use of particular grades of black, for NR such enhancement is modest and additional mechanisms for the effect of blacks on tread

wear should be sought. In any case there is a consensus that high surface area, high surface activity and high structure promote tread wear resistance. Even so, the evidence that carbon black does not necessarily enhance the abrasion resistance of rubber under conditions of equal sliding suggests that the effect of carbon black on tread wear may in part be simply associated with stiffening, and hence reduced sliding, without weakening the compound as a high crosslink density would do. Arayapranee and Rempel (Arayapranee & Rempel, 2008) studied the effects of incorporation of three different fillers, i.e. rice husk ash (RHA), silica and calcium carbonate ($CaCO_3$), over a loading range of 0-60 phr on the abrasion loss of 75:25 natural rubber (NR)/ethylene propylene diene monomer (EPDM) blends. The incorporation of silica reduced the abrasion loss of the 75:25 NR/EPDM blends notably, whereas $CaCO_3$ showed a different trend in abrasion loss tending to increase it with an increase in $CaCO_3$ loading. However, RHA showed less of an effect with filler loading. At a similar filler loading, silica filled 75:25 NR/EPDM blends had the lowest abrasion loss followed by RHA and $CaCO_3$ filled 75:25 NR/EPDM blends.

4.3 Lubricants

Lubricants is widely used in the compounding of diene rubbers to improve the processability of the compounds and to impart the desired physicomechanical properties of rubber compounds and vulcanizates. The presence of a liquid can prevent moving surfaces from coming into inimate contact if viscous flow from the contact region is sufficiently sluggish. Lubricants, such as non-swelling fluids or dust, greatly reduce friction on smooth surface but the effect is smaller on rough surface. Changes in friction properties of rubber are possible by adding substantial amounts of standard lubricants, but this reduces strength, especially at high temperatures. Contrary, improvement in friction properties of rubbers based on blends NR and BR could be reached by introducing 0.5 wt% of K95 experimental lubricant (Jurkowska et al., 2006). Lubricant K95 added in a quantity of 0.5 wt% reduced the viscosity of rubber compound; it also improved compound flow in the mold. Mechanical properties of cured rubber not decrease while resistance to abrasion and fatigue increased. The influence of Lubricant K95 on reducing of the internal friction of rubbers is found.

Evstratov et al. (Evstratov et al., 1967) found that abrasion on a ribbed metal surface increases abruptly, by an order of magnitude or so, when the friction coefficient (μ) exceeds about 1.4. Abrasion patterns were observed for μ above the critical value, but not for lower values. It did not matter whether μ was an unlubricated value for the compound or was determined by the presence of a lubricant. The renowned abrasion resistance of cis-BR compounds may relate to this observation; such compounds have low dry friction and form only very fine abrasion patterns. In spite of their low strength, their abrasion resistance can be excellent. When a lubricant is applied, a much finer pattern develops and the rate of abrasion is much lower.

4.4 Antioxidants

Gent and Pulford (Gent & Pulford, 1983) determined rates of wear have been determined for several rubber materials, using a razor-blade abrading apparatus at different levels of frictional power input, corresponding to different severities of wear, at both ambient temperature and at 100°C, and both in air and in an inert atmosphere. It is concluded that

wear occurs as a result of two processes: local mechanical rupture (tearing) and general decomposition of the molecular network to a low-molecular-weight material (smearing). The decomposition process could, in principle, be ascribed to several mechanisms: thermal decomposition due to local heating during sliding; oxidative deterioration, possibly accelerated by local heating; and mechanical rupture of macromolecules to form reactive radical species. The most plausible mechanism of smearing appears to be oxidative consummation of scissions produced by mechanical stress, in much the same way as occurs during cold mastication of natural rubber. They provided rather convincing evidence of mechanochemical degradation of certain rubbers during abrasion by a razor blade. The degradation of carbon black-filled natural rubber (NR), styrene-butadiene rubber (SBR), and ethylene-propylene rubber (EPM) to a sticky material during blade abrasion occurred only in the presence of oxygen or thiophenol, but not in a nitrogen atmosphere (just as for cold mastication). Polybutadiene rubber (BR) produced only dry debris during abrasion, consist with the expectation that any free radicals of BR produced by main chain rupture would react with the polymer itself, leading to an increase in cross-linking rather than degradation. Carbon black-filled natural rubber, styrene-butadiene rubber, and ethylene-propylene rubber were particularly susceptible to decomposition and smearing, but for natural rubber and SBR the decomposition process was not observed in an inert atmosphere. It is attributed to molecular rupture under frictional forces followed by stabilization of the newly formed polymeric radicals by reaction with oxygen, if present, or with other polymer molecules, or with other macroradicals. Polybutadiene rubber produced only dry debris during abrasion. Radicals of BR produced by main chain rupture would react with the polymer itself, leading to an increase in cross-linking rather than degradation. Rates of wear have been found to increase with the applied frictional force raised to a power n. The value of n was between 2.5 and 3.5 for unfilled materials at ambient temperature. Filled materials were found to be less sensitive to the frictional force, whether wear took place by tearing or smearing, having values of the index n of 1.5-1.8. It is well known that for some conditions the surface of rubber becomes tacky during abrasion experiments, drum testing of tires and sometimes even for tires on the road. It has been suggested that either exudation of low molecular weight additives or degradation of the polymer to a material of low molecular weight could be responsible. Degradation might result from either thermal or mechanical stress, at high sliding speeds, such as skidding of a vehicle on locked wheels, frictional heating certainly causes degradation. However, the phenomenon of smearing is associated with conditions of mild abrasion, e.g. on smooth surfaces, and can occur even for low sliding speeds.

The most plausible mechanism of smearing appears to be oxidative consummation of scissions produced by mechanical stress, in much the same way as occurs during cold mastication of NR. Similar experimental observations to those of Gent and Pulford (Gent & Pulford, 1983) were previously obtained by Rudakov and Kuvshinski (Rudakov & Kuvshinski, 1967) for abrasion of NR and BR by a smooth indenter in air and in helium. They also gave a calculation suggesting that the rise in temperature of the rubber surface was quite inadequate to cause thermal degradation. However, this calculation ducks the possibility of local hotspots: the smaller the region of real contact, the higher is the calculated temperature rise, but we can only conjecture as to the size of the real contacts (Schallamach, 1967).

Schallamach (Schallamach, 1968) investigated the factors influencing smearing on the Akron laboratory abrader. He found that smearing could be prevented for NR tire tread

compounds by carrying out abrasion in nitrogen or obviated by feeding a dust (magnesia proved most effective) into the nip between test piece and abrasive wheel. He concluded that oxidative degradation (to which he attributed smearing) affects the rate of abrasion in two distinct ways. If smearing occurs, the rate of abrasion is reduced (presumably because the "smear" acts as a lubricant). When the abrasion of a rubber is low in air, owing to smearing, its abrasion in nitrogen can become greater than in air. However, in air the less grossly degraded rubber is mechanically weakened, so that if smearing is obviated by the use of a suitable dust, the rate of abrasion is greater in air than in nitrogen. He also showed that the susceptibility of the compound to oxidative degradation can be influenced by the choice of antioxidant and other formulation details. Pulford (Pulford, 1983) studied antioxidant effects during abrasion of NR tire tread compounds by a razor blade. He reported that all compounds exhibited smearing at sufficiently low friction loads, but antioxidants reduce the critical frictional force below which smearing occurs. He found that antioxidants reduce the rate of wear for conditions in which smearing occurs but have no effect at higher severities. He considered this to be evidence of two mechanisms of wear, namely degradation at low frictional force and fracture at high frictional force. However, antioxidants also protect against fatigue crack growth, but only at low tearing energies (Lake, 1983). Thus it may not be necessary to invoke an entirely different mechanism of abrasion when smearing occurs. Instead, smearing can be seen as a complication superimposed on the general fracture mechanism of abrasion. Antioxidants can be used to, at least, partially restore the abrasion and crack growth resistance.

5. Conclusions

Abrasion resistance is the ability of a material to withstand mechanical action such as rubbing, scraping, or erosion that tends progressively to remove material from its surface. Such an ability helps to maintain the material's original appearance and structure. Numerous companies manufacture abrasion resistant products for a variety of applications, including products which can be custom fabricated to meet the needs of specific users. Abrasion resistant materials can be used for both moving and fixed parts. In vulcanized material or synthetic rubber compounds, a measure of abrasion resistance relative to a standard rubber compound under defined conditions. The properties of a vulcanized rubber can be significantly influenced by details of the compounding. Practical materials will have, in addition to the base polymer, fillers, antioxidants, crosslinking agents, accelerators etc. All of these can have an influence on the physical and chemical stability of the finished material. For example, rubber abrasion resistance can be related quantitatively to the frictional force and the crack growth characteristic of the rubber. Rigid filler particles normally increase the abrasive wear loss of the filled rubbers. A lubricant may cause a small decrease in frictional force but a dramatic decrease in abrasion. Antioxidants can be used to, at least, partially restore the abrasion and crack growth resistance because they are added to prevent ozone attack on the rubber, which can lead to the formation and growth of cracks.

6. References

Arayapranee,W.; Na-Ranong, N. & Rempel, G. L. (2005). Application of Rice Husk Ash as Fillers in the Natural Rubber Industry. *Journal of Applied Polymer Science*, Vol. 98, pp. 34-41.

Arayapranee,W. & Rempel, G. L. (2008). A comparison of the properties of rice husk ash, silica, and calcium carbonate filled 75:25 NR/EPDM blends. *Journal of Applied Polymer Science*, Vol. 110, pp. 1165–1174.

Arayapranee,W. & Rempel, G. L. (2009). Synthesis and mechanical properties of diimide-hydrogenated natural rubber vulcanizates. *Journal of Applied Polymer Science*, Vol. 114, pp. 4066–4075.

Champ, D.H. ; Southern, E. & Thomas, A.G. (1974). Fracture mechanics applied to rubber abrasion. *American Chemical Society, Division of Organic Coatings and Plastics Chemistry*, Vol. 34, No. 1, pp. 237-243.

Chandrasekaran, M. & Batchelor, A.W. (1997). In situ observation of sliding wear tests of butyl rubber in the presence of lubricants in an X-ray micro focus instrument. *Wear*, Vol. 211(1), pp. 35–43.

Dick, J. S. (2001). Vulcanizate physical properties, performance characteristics and testing, In: *Rubber Technology Compounding and Testing for Performance*, 66-67, Hanser, ISBN 1-56990-278-X, Ohio, USA.

El-Tayeb, N. S. M. & Nasir, R. Md. (2007). Effect of soft carbon black on tribology of deproteinised and polyisoprene rubbers, *Wear*, Vol. 262, pp 350-361.

Evstratov, V. V.; Reznikovski, M. M.; Smirnova, L. A. & Sakhhinovabi, N. L. (1967). The mechanism of wear of tread rubbers, in: D.I. James (Ed.), Abrasion of Rubber, Maclaren, London, pp. 45–63.

Fukahori, Y. & Yamazaki, H. (1994). Mechanism of rubber abrasion—Part 1: abrasion pattern formation in natural rubber vulcanizate. *Wear*. Vol. 171, pp. 195–202.

Gent, A. N. (1989). A hypothetical mechanism for rubber abrasion. *Rubber Chemistry & Technology*, Vol. 62, pp. 750-756.

Gent, A. N. & Pulford, C. T. R. (1983). Mechanisms of rubber abrasion. *Journal of Applied Polymer Science*, Vol. 28, pp. 943-960.

Hong, C. K.; Kim, H. ; Ryu, C. ; Nah C. ; Huh, Y.-il & Kaang, S. (2007). Effect of paticle size and structure of carbon blacks on the abrasion of filled elastomer compounds, *Journal of Materials Science*, Vol 42, pp. 8391-8399.

Jurkowska, B.; Jurkowski, B.; Nadolny, K.; Krasnov, A. P.; Studniev, Y. N.; Pesetskii. S. S.; Koval, V. N.; Pinchuk, L. S. & Olkhov, Y. A. (2006). Influence of fluorine-containing lubricant on properties of NR/BR rubber. *European Polymer Journal*, Vol. 42, pp. 1676-1687.

Lake, G. J. (1983). Aspects of fatique and fracture of rubber. *Progress of Rubber Technology*, Vol. 45, pp. 89-143.

Liang, H.; Fukahori, Y.; Thomas, A. G. & Busfield, J. J. C. (2010). The steady state abrasion of rubber: Why are the weakest rubber compounds so good in abrasion? *Wear*, Vol. 268, pp. 756-762.

Muhr. A. H. & Roberts, A. D. (1992). Rubber abrasion and wear. *Wear*, Vol. 158, pp. 213-228.

Pandey, K. N.; Setua, D. K. & Mathur, G. N. (2003). Material behaviour fracture topography of rubber surfaces: an SEM study, *Polymer Testing*, Vol. 22, pp. 353–359.

Pulford, C. T. R. (1983). Antioxidant effects during blade abrasion of natural rubber. *Journal of Applied Polymer Science*, Vol. 28, pp. 709-713.

Ratner, S. B.; Farberova, I. I.; Radyukevich, O. V. & Lu're, E. G. (1967). Connection between wear resistance of plastics and other mechanical properties, In: *Abrasion of Rubber*, James, D. I. (Ed.), Macaren, London, pp. 145-154.

Roberts, A. D. (1988). Rubber adhesion at high rolling speeds. Journal of Natural Rubber Research. Vol 3, pp 239.

Rudakov, A. P. & Kuvshinski, E. V. (1967). Abrasion of rubber by a smooth indentor, In: *Abrasion of Rubber*, James, D. I (Ed.), Maclaren, London, pp. 36-44.

Sae-oui, P.; Rakdee, C. & Thanmathorn, P. (2002). Use of rice husk ash as filler in natural rubber vulcanizates: In comparison with other commercial fillers. *Journal of Applied Polymer Science*, Vol. 83, pp. 2485-2493.

Schallamach, A. (1957/58). Friction and abrasion, *Wear*, Vol. 1, pp. 384-417.

Schallamach, A. (1967). A note on the frictional temperature rise of tyres, *Journal of the Institution of the Rubber Industry*, Vol. 1, pp. 40-42.

Schallamach, A. (1968). Abrasion, fatigue, and smearing of rubber. *Journal of Applied Polymer Science*, Vol. 12, pp 281-293.

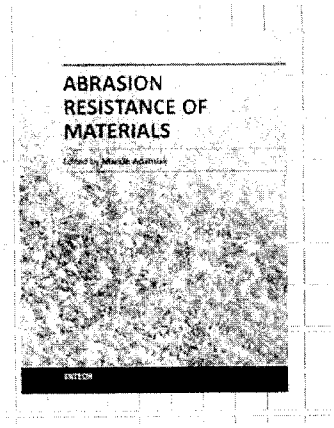
Tabsan, N.; Wirasate, S. & Suchiva, K. (2010). Abrasion behavior of layered silicate reinforced natural rubber. *Wear*, Vol. 269, pp. 394-404.

Thomas, A. G. (1958). Rupture of rubber. V. cut growth in natural rubber vulcanizates. *Journal of Polymer Science*. Vol. 31, pp. 467-480.

Thomas, A. G. (1974). Factors influencing the strength of rubbers. *Journal of Polymer Science*, Vol. 48. pp. 145-157.

Uchiyama, Y. & Ishino, Y. (1992). Pattern abrasion mechanism of rubber. *Wear*. Vol. 158, pp. 141-155.

Yang, A. C.-M.; Ayala, J. E. & Campbell Scott, J. (1991). Abrasive wear in filled elastomers. *Journal of Materials Science*, Vol. 26, pp. 5823-5837.



Abrasion Resistance of Materials

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EXHIBIT B

Johnsonite

Specifications, Product Testing and Terminology

The following synopsis provides a review of various material and final product testing, which is performed on our products, as well as, many of our competitors.

Frequently, we experience a situation where confusion results from the lack of familiarity or inaccurate interpretation of terminology, product testing, and product specifications. This document was developed with the intent to provide a "laymen's" knowledge of the technical and/or analytical aspects of product testing and terminology and its significance to our products.

Specifications:

Rubber Floor Tiles:

ASTM developed F-1344 Standard Specification for Rubber Floor Tiles in 1991, which replaced the old Federal Specification #SS-T-312b. These standards provide dimensional and performance criteria for product acceptability.

The ASTM F-1344 permits a thickness tolerance of + .015"/- .005" for pattern tile and +/- .005" for smooth.

The F-1344 permits a hardness not less than 85 when tested in accordance with ASTM D-2240 Durometer (Hardness).

In addition to dimensional tolerances, the standard provides performance requirements in the areas of static load limit, resistance to short-term chemical resistance, resistance to heat, and abrasion resistance.

All Johnsonite rubber tiles meet the dimensional and performance criteria of the specification.

Solid Vinyl Floor Tiles:

ASTM F-1700, Standard Specification for Solid Vinyl Floor Tiles provides dimensional and performance criteria for product acceptability. Due to the wide variety of solid vinyl floor tiles currently available on the market, the Specification's classification structure includes the following classes and types:

Class I - Monolithic:
Type A - Smooth Surface or Type B - Embossed Surface.

Class II - Surface Decorated: Type A - Smooth Surface or Type B - Embossed Surface.

Class III - Printed Film;Type A - Smooth Surface or Type B - Embossed Surface.

The specification provides dimensional tolerances for size of +/- 0.016" (0.4 mm) for 12" x 12" (30.5 mm x 30.5 mm) tiles and a thickness tolerance of +/- .005" (0.13 mm).

The specification also includes requirements for flexibility, residual indentation, chemical resistance, squareness, and dimensional stability.

Johnsonite Safety Stride Solid Vinyl Floor Tiles are Class I. Type B products and conform to the requirements of this specification.

Rubber and Vinyl Stair Treads:

ASTM developed F-2169 Standard Specification for Resilient Stair Treads in 2002, which replaces the old Federal Specification RR-T-650.

The new ASTM specification provides for three types of materials:

Type TS - Rubber, Thermoset
Type TP - Rubber, Thermoplastic
Type TV - Vinyl, Thermoplastic

The standard requires that the products have a durometer hardness of not less than 85 and meet Resistance to Short-term Chemical and Resistance to Heat requirements.

The dimensions and thickness of the treads are the manufacturer's standard or as specified in the order.

Depth tolerances shall be +/- 1/8" and a thickness tolerance of +/- 1/32" are permitted.

All Johnsonite rubber and vinyl treads meet the dimensional criteria of the specification.

Rubber and Vinyl Wall Base:

Federal Specification SS-W-40a, was cancelled by the General Services Administration in October of 1995. It has been replaced by ASTM F-1861, Standard Specification for Resilient Wall Base which is a dimensional and material performance specification.

The new ASTM specification provides for three types of materials:

Type TS - Rubber, Thermoset
Type TP - Rubber, Thermoplastic
Type TV - Vinyl, Thermoplastic

Wall base height tolerance is 1% the nominal height of the wall base. The thickness tolerance for .080 gauge wall base is + .015"/- .005" and for .125" (1/8") is +/- .015". (Note: Johnsonite manufactures .080 gauge wall base to +/- .005" and 1/8" to + .005"/-

.015".)

The length of the wall base cannot be less than as specified on the package. The angle of the cut can be 90 +/-5 degrees.

The material must pass tests for flexibility, resistance to staining and light aging, chemicals, and dimensional stability.

Johnsonite Rubber and Vinyl Wall Base meets the dimensional and material performance criteria of the specification.

Vinyl Mouldings:

The manufacture of these products is not governed by any known specification. They are specialty products.

Terminology and Product Testing:

Hardness (Durometer): This test is performed to the requirements outlined in ASTM D-2240 and utilizes a hand-held instrument called a "Shore" gauge. The gauge consists of a spring-loaded indentor and has a scale reading from 0 to 100. The indentor is applied to the surface of the test material and the hardness of the material is obtained from the reading on the scale.

The higher the reading, the harder the material.

Hardness testing is used primarily to classify materials and no simple relationship exists between hardness testing and indentation or any fundamental property of the material.

Hardness readings are also used as control measures to ensure that the proper amount of oils and/or plasticizers have been entered into the material formulation. Without these oils and plasticizers, the product can become much stiffer and difficult to manipulate, as in the case of forming wall base corners.

Tensile, Elongation, and Modulus: These tests are performed to the requirements outlined in ASTM D-412 and provide information regarding the elastic properties and uniformity of the material composition. The tests are performed on a pulling apparatus or Instron, utilizing stamped specimens developed from finished products. The test specimen is placed in the machine and the amount of force to pull it apart and eventually break the material is recorded on a chart recorder.

Tensile values are recorded in pounds per square inch of force required to pull the material until it breaks.

Elongation values are recorded in the percentage of stretch the material can withstand before breaking or in simpler terms, if the specimen is 1" long before testing and breaks

at 2", the elongation would be 100%. If 1" long and breaks at 3", the elongation would be 200% and etc.

Modulus values are obtained by determining the pounds force to pull the specimen 100% its pretested length or as required by the specification.

Example: A rubber band requires very little force to pull apart, therefore; its tensile value would be very low, but its elongation would be high, since you can stretch a rubber band several times its original length.

Abrasion Resistance: This test is performed to the requirements, as outlined, in ASTM D-3389 and uses a piece of equipment called a "taber abrader". A 4" x 4" product sample is weighed and then mounted into the machine. The machine is equipped with a motor drive, which abrading wheels are attached. Based on the specification requirements, the abrading wheels are weighted and the machine is cycled for a specific number of cycles.

After the test is completed, the sample is reweighed to determine the amount of material loss on the specimen.

This test is an attempt to determine the wearability of a finished product, but due to the wide range of variables in actual installation environments, there is no direct relationship between the test results and the longevity of a product. The test results can be used to classify and compare similar products only.

The test results are given in grams loss per cycle or revolution. The lower the value, the better the wearability. (Note: Typically the harder the material, the lower the abrasion value. The wearability of a product is contingent on many other test values. i.e.: resiliency, indentation, tensile strength, elongation, and etc.)

Indentation: This test is performed to the requirements, as outlined, in ASTM F-1914 Standard Test Method for Short Term and Residual Indentation of Resilient Floor Covering and provides a reference to the resiliency of a product and reported in the percentage of mass loss or compressive state of the product after testing.

The test is performed with actual production specimens. The specimens are mounted into the test apparatus and a weighted load is applied to the surface of the specimen. The load is mounted atop a 1/4" diameter foot, which contacts the specimen. The load is applied for 10 minutes and then removed and the depth of the depression is measured to determine the initial indentation of the material. The specimen is measured again 1 hour later to determine the residual indentation or the material's capability to recover from a load.

These values typically relate to dynamic loading such as a high heel shoe applied to the product's surface and its ability to recover from the load.

The lower the residual indentation percentage value, the better resiliency of the product.

Static Load Limit: This test is performed to the requirements, as outlined, in ASTM F-970 and was developed to determine the resiliency of a product when subjected to heavy loads and the product's capability to recover when the load is removed.

The thickness of an actual production sample is measured and then a weighted 1-1/8" diameter spherical foot is placed on the product's surface for a determined amount of time. The amount of weight and time is determined by the specific product specification.

The 1-1/8" diameter spherical foot is typical of most commercial furniture, appliances, and machinery found in many commercial and residential environments.

When the test time requirement is satisfied, the load is removed and the product is allowed to relax for a period of twenty-four (24) hours. After the relaxation period, the product thickness is once again measured where the foot made contact to the product surface. The difference between the initial thickness of the product and the thickness after the test provides the total amount of permanent indentation the product has incurred as a result of the testing.

Most of the specifications developed for rubber and vinyl flooring products have adopted an 125 pound load for a period of one (1) hour as the criteria for the test. This load would represent a piece of furniture or an appliance with a total weight of 500 pounds based on the assumption that the furniture or appliance is supported with four (4) feet.

Coefficient of Friction: The federal and industry standard for testing coefficient of friction or the slip resistance of a surface is tested to the requirements, as outlined, in ASTM D-2047, which utilizes a friction measurement machine, commonly referred to as the James Machine.

The test utilizes a shoe sole grade leather material attached to a weighted plate. The leather material is pulled across the surface of the specimen and the friction resistance is recorded on a graph.

The test procedure is designed for determining "dry" coefficient of friction measurements only, but many manufacturers perform the tests by applying a mist of water to the specimen surface and obtain "wet" friction values for their products. Due to the wide range of probable variation due to the lack of any specifics relating to water application to the specimen surface, the "wet" values should be considered only as reference values.

The Federal Standard for flooring materials and floor finishes is 0.5. This value of not less than 0.5 meets the requirements for compliance to Rule 5 on "The use of terms slip retardant, slip resistant, or terms of similar import." of the Proposed Trade Practice Rules for the Floor Wax and Floor Polish Industry as issued by the Federal Trade Commission on March 17, 1953.

The A.D.A recommendations are 0.6 for accessible routes and 0.8 for ramps, but were

developed utilizing an apparatus and test method not currently recognized in the industry.

Since the release of the A.D.A. document, several committees have meet with the A.D.A. and requested clarification. The outcome of the meetings resulted in the A.D.A. recognizing the ASTM D-2047 test method and federal standard of 0.5 for defining the term "slip-resistant surface", as listed in section 4.5 General and Floor Surfaces. The values of 0.6 for accessible routes and 0.8 for ramps are recommendations and will be eliminated from future revisions.

Most manufacturers involved with the ASTM Resilient Flooring subcommittees, responsible for developing flooring specifications and test procedures, have adopted this procedure (D-2047) when reporting coefficient of friction results for their respective products.

These specifications relate to Johnsonite's rubber tiles, vinyl tiles, rubber and vinyl stair treads. Johnsonite's rubber products exceed all requirements and recommendations.

Vinyl tiles, treads and nosings exceed the recommendations for ADA accessible routes, but not ramps.

Fire and Smoke Product Testing:

Critical Radiant Heat Flux: This test procedure was developed for testing the resistance of flooring materials to support a flame and is tested to the requirements, as outlined, in ASTM E-648. The test is performed with actual product samples. The test specimen, measuring 10" wide by 41-1/2" long, is glued to a reinforced concrete board and placed in the testing apparatus. The radiant heating panel is positioned at an angle of approximately 45 degrees to the specimen. The specimen is exposed to radiant heat for a specified time and the amount of wattage is calculated to determine how much radiant heat is required to produce a flame on the material. The test is performed three (3) times and the average of the tests are used for reporting critical radiant heat flux of a material in watts per square centimeter.

Class I applications require a minimum of 0.45 watts/sq. cm. and Class II require 0.22 watts/sq. cm.

The higher the wattage value, the more heat and time required for the sample to support a flame.

All of Johnsonite's rubber and vinyl tiles, rubber stair treads, vinyl stair treads and nosings exceed the requirements for Class I installations.

Flame Spread Index per ASTM E-84 (Steiner Tunnel Flame Test): This test is for determining the burning characteristics of wall and ceiling materials. Unfortunately, many specifiers confuse this requirement with the ASTM E-648 Critical Radiant Heat Flux test for Interior Floor Finishes. The Steiner Tunnel Flame Test (ASTM E-84) is only

required for Interior Wall and Ceiling Materials.

Due to the number of incorrect product specifications, the federal government developed a task group in 1997, in conjunction with the GSA, DOD, AIA and many other military and civilian specifying organizations, to eliminate any reference of this test requirement in Interior Floor Finish specifications.

The test procedure utilizes actual production samples, measuring 24" wide by 24' long, are glued to a reinforced concrete board and suspended from the ceiling of the tunnel chamber. The samples are exposed to a high-intensity flame, similar to a blow torch, for a specified time.

If the samples ignite, the flame duration and smoke generated is monitored and calculated into a flame spread index and smoke developed index.

The classification of products is as follows: Class "A" = Flame Index of 0 to 25 Class "B" = Flame Index of 26 to 75 Class "C" = Flame Index of 76 to 200 All classes must have a smoke developed index less than 450.

Johnsonite hopes this document has provided the information and clarification required to assist in proper product selection, but if additional information is required, please contact your local Johnsonite distributor or Johnsonite Customer Service at 1-800-899-8916 for additional assistance.

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May 24, 2013

Via Courier

U.S. Customs and Border Protection
Office of International Trade (R&R)
Attn: Trade and Commercial Regulations Branch
90 K Street, N.E. (10th Floor)
Washington, DC 20002

Proposed Test Method
47:14 Cust. Bull. & Decs. 14 (March 27, 2013)

Dear Ms. Bell:

These comments are submitted on behalf of the United States Association of Importers of Textiles and Apparel ("USA-ITA") in connection with the proposed test method for the administration of Additional U. S. Note 5, Chapter 64, Harmonized Tariff Schedule of the United States ("HTS").

USA-ITA is a voluntary association of some 200 importers and retailers of textile products and wearing apparel, as well as related service industries such as international transportation concerns. USA-ITA members import a variety of footwear products including footwear with textile outsoles and for that reason have a direct interest in the proposed test method.

USA-ITA's comments are limited to the treatment of footwear which has a textile outsole, not an outsole of rubber or plastics ("R/P") with a textile overlay of some sort.

The proposal provides that textile materials used in the outer soles of indoor footwear are presumed to be acceptable under the terms of Note 5. However, the proposal equates the term indoor footwear with the definition of house slippers found in Statistical Note 1(d) Chapter 64, HTS. This definition of house slippers is far too narrow to accommodate all of the types of footwear with what are unquestionably textile outsoles and which properly are classified in heading 6405. For example, footwear with an outsole consisting entirely of textile materials covering R/P foam of

some sort and R/P traction dots or strips. The materials are glued together. This footwear has always been classified in heading 6405. *E.g.*, NY N037035 (September 15, 2008); NY H84930 (August 28, 2001). Some of this type of footwear may satisfy the requirements of house slippers, indeed some may not be indoor footwear, and it is unlikely that any of it would meet the requirements of the proposed test. This would lead to an increase in duties for at least some of this footwear.

The solution is to state simply that textile outsoles, as opposed to R/P soles with an outer surface of textile materials, are not subject to the test. This footwear is not of the type Note 5 was intended to address and the proposal should be amended to make that clear. For this purpose the presumption would apply to outsoles consisting of textile alone or textile with no R/P, other than foam and traction dots or strips. This would resolve the problem and would not require an inquiry into the rather narrow definition of "house slippers" as found in Statistical Note 1(d).

This approach also accommodates a type of footwear of limited interest to USA-ITA members, wading boots with felt soles.

This approach would eliminate the problem faced by USA-ITA members without in any way jeopardizing the coverage or goals of the proposed method.

***

USA-ITA appreciates the opportunity to comment on this important matter and urges that its views be adopted.

Respectfully submitted,

McGUIREWOODS LLP

John B. Pellegrini

In Duplicate
cc: USA-ITA

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May 24, 2013

Via Courier

U.S. Customs and Border Protection
Office of International Trade (Regulations and Rulings)
Attn.: Trade and Commercial Regulations Branch
90 K Street NE (10th Floor)
Washington, DC 20229-1177

Proposed Test Method for the Administration of
Additional U.S. Note 5 to Chapter 64, HTSUS,
Concerning the Classification of Footwear with Textile
Material on the Outer Sole
47:14 Cust. Bull. & Decs. 5 (March 27, 2013)

Dear Ms. Bell:

These comments are submitted on behalf of the Footwear Distributors and Retailers of America ("FDRA") in response to the request for comments on the proposed test method cited above.

FDRA is a trade association of some 100 retailers, importers, distributors and producers of footwear. FDRA members account for some 75 percent of United States retail sales and imports of footwear. A large majority of FDRA members are affected by the proposed test method.

While FDRA continues to believe that a test is not necessary and that market conditions are adequate to determine which textile outer sole materials are acceptable, it does not object to the proposed general approach. However, the test method and the manner in which the test results will be used must be described in a great deal more detail in order to ensure uniformity and consistent results and to avoid unnecessary testing.

Test Method Details. FDRA requests that the test method include the following details.

1. The test specified in ISO 20871 calls for three samples to be taken from the outer sole. Obviously, the samples must be taken from areas where textile is present on the surface of the outer sole. The test method should make this clear.

2. The test method should be clear that as long as textile is present on one of the three samples after the abrasion test has been completed, the textile is deemed to satisfy the requirements of Additional U.S. Note 5. The method should make it clear that it is not necessary that textile remain on each of the three samples. Rather, the method should provide that the post-abrasion presence of textile on one of the three samples is sufficient. Any other approach would lead to anomalous and inconsistent results.

Assume textile is present on two of the three samples and the amount of textile remaining on the two samples is quite significant. In that circumstance it would be arbitrary to deem the textile materials not acceptable because there was no textile present on one of the three samples. On the other hand, assume that there is a minimal amount of textile on each of the three samples. Presumably the textile would be acceptable. The first tests would result in the textile being rejected but the minimum amount of textile in the second test would lead to it being accepted. These results would be inconsistent and

inherently unreasonable. The only approach that guarantees consistent results without adding an unacceptable degree of subjectivity and arbitrariness is to provide that as long as textile appears on one of the samples, the textile material is deemed to satisfy Additional U.S. Note 5.

3. The proposal is insufficiently clear on whether the test will be applicable to outer soles which are entirely textile, that is, they do not consist of textiles attached to a rubber/plastic substrate. FDRA suggests that the method details make it clear that this footwear is not subject to the abrasion test. Bowling shoes, which typically have one predominantly textile sole is an example of this footwear. See NY N152080 (March 11, 2011), NY 803138 (November 10, 1994). Another example is waders with felt outsoles.

In addition, the final rule should be clear that the presence of rubber/plastic traction dots or strips on an otherwise textile outer sole does not subject the shoe to testing.

Headings 6402 and 6404. FDRA requests that the final rule make it clear that the obligation of reasonable care does not require that the abrasion test be used with respect to footwear classified in the 6402 and 6404 headings that refer to textile materials not taken into account under the terms of Note 5. FDRA suggests this to eliminate the possibility of confusion and unnecessary testing.

CBPL Methods. FDRA assumes that Laboratories and Scientific Services will prepare an amendment to Chapter 64 of the CBPL Methods to reflect the final test method. FDRA requests that a draft be published prior to adoption.

Indoor Footwear. The proposal is clear that there is a presumption that textile materials used in the outer soles of indoor footwear are acceptable under the terms of Note 5. Unfortunately, the proposal equates the term "indoor footwear" with the term "house slippers" as defined in Statistical Note 1(d), Chapter 64, HTS. This definition of house slippers is very narrow; indeed, it excludes perhaps even a majority of the footwear sold as slippers. Also, limiting indoor footwear to "house slippers" represents a significant departure from CBP's prior practice. For example, there are numerous rulings which have treated footwear as indoor footwear that does not meet the narrow definition of house slippers, *e.g.*, footwear with outer sole/insole combinations in a thickness greater than one inch. Some examples are: NY N087723 (January 9, 2010); NY N049843 (January 30, 2009); NY N048844 (January 16, 2009); NY N027097 (May 14, 2008); NY N007526 (March 19, 2007); and NY H81244 (June 4, 2000). This footwear does not meet the requirement for classification as house slippers; nevertheless, they were considered indoor footwear. That approach should not be changed.

Protective Footwear. In addition, the term "indoor footwear" is used in connection with the definition of protective footwear. T.D. 93-88, "Footwear Definitions", 27 Cust. Bull. 312, 318-319 (1993), states that protective footwear does not include items that keep the foot warm but ordinarily are worn indoors and lists two examples, felt slippers and slipper socks. There is no mention of "house slippers". Further, the Informed Compliance Publication on Footwear (April 2010) limits protective footwear to that footwear which is designed for outdoor use. Again, there is no reference to "house slippers". The final rule must make it clear that the term "house slippers" does not define indoor footwear nor does

it have any relevance to whether footwear is designed for outdoor use in determining whether footwear is considered to provide protection against the cold.

* * *

FDRA appreciates the opportunity to comment on this important matter and urges that its views be incorporated in the description of the method ultimately adopted.

Respectfully submitted,

McGUIREWOODS LLP

John B. Pellegrini

In Duplicate
cc: FDRA
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rec'd 5/24/13
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May 23, 2013

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Regulations and Rulings
90 K Street NE 10th Floor
Washington, D.C. 20229-1177

Attn: Trade and Commercial Regulations Branch

Re: Response to General Notice Request for Comments
Test Method for Administration of U.S. Note 5, Chapter 64, HTSUS
Our ref. 2723-0050170

Dear Sir or Madam:

On behalf of our client, ES Originals, Inc. ("ESO"), we are responding to your request for comments published in General Notice "Proposed Test Method for the Administration of Additional U.S. Note 5 to Chapter 64, HTSUS, concerning the Classification of Footwear with Textile Material on the Outer Sole" (*Customs Bulletin and Decisions,* vol. 47, No. 14 of March 27, 2013). Customs proposes to base the determination of whether textile material possesses the characteristics normally required for use of an outer sole on test procedures under ISO 20871 ("Footwear – Test methods for outsoles – Abrasion resistance").

1. ISO 20871 IS NOT AN APPROPRIATE TEST UNDER NOTE 5

ISO 20871, published in 2001, specifies a method for determining the abrasion resistance of outer soles of footwear "irrespective of the material." Under this test protocol, the surface area of each of 3 samples from the subject outer sole is tested for resistance to wear by moving a test piece holder with an affixed sample laterally across a rotating cylinder covered with an abrasive cloth. ISO 20871 specifies the test apparatus, abrasive cloth, sample dimensions, and test procedure. The ISO 20871 test results are compared to the test results of "standard rubbers" that are specified in Appendix B of ISO 4649:1985 and are measured in terms of relative mass loss in milligrams and relative volume loss in cubic millimeters. See also ISO 20880 ("Footwear – Performance requirements for components for footwear – Outsoles"). Thus, this test was primarily designed to test rubber and/or was designed to measure the durability of the samples to be tested against the durability of rubber. As written, this is not a fair test for textile outer sole materials.

2. CUSTOMS SHOULD CONSIDER ASTM 4966-10 AS AN ALTERNATIVE

In its May 2012 written submission to Customs, ESO urged Customs to adopt the "Martindale Abrasion" test, ASTM D 4966-10 ("Abrasion Tester Method for Fabrics of All Types") for purposes of implementing Note 5 if Customs determined a laboratory test to be required. We stated that use of this test would sensibly build on the experience of European customs authorities that have already used a variation of it (SATRA TM31) to test the abrasion resistance of footwear textile outer soles shoes. The General Notice does not mention possible use of ASTM D 4966-10, commenting only that inherent lack of precision in test results

"significantly limits the utility of SATRA TM31." Customs should consider use of ASTM D-4966-10, which is specifically designed for testing textile fabrics of all types, especially those with a pile depth not greater than 0.08 in. (2 cm). If the Martindale Abrasion test was used, the U.S. would have the same test used by our trading partners which would further the objectives of using one Harmonized Tariff Schedule. We urge CBP to reconsider its test method selection and to adopt the Martindale testing method to interpret U.S. Note 5.

3. COMMERCIAL ACCEPTANCE IS THE BEST TEST OF "NORMAL USE"

In its May 2012 comments to Customs, ESO also urged Customs to acknowledge that certain textile material has proven to be a visible, plausible, and viable outer sole material for outdoor footwear when embedded into other material components of the outer sole and that any test standard adopted for implementation of Note 5 must take this commercial reality into account. It is undeniable that the "normal use" of footwear referenced in Note 5 changes constantly due to changing tastes and price sensitivities, consumer's personal needs and preferences, and technological developments. Thus, ESO believes that commercial acceptance is the best measure of "normal use." By proposing to adopt its modified ISO 20871 standard, Customs rejects "commercial acceptance" as the only criterion but acknowledges that the evolution of footwear outer sole technology and market considerations are to be taken into account, at least indirectly, in application of Note 5.[1]

[1] Customs also acknowledged as much when it stated during the ITC's Section 1205 investigation that ESO-type footwear it had examined "would continue to be classified" in subheading 6405, HTSUS, as footwear having outer soles of textile materials. See International Trade Commission ("ITC") Report on Investigation 1205-8 (Pub. 4178) at pp. 10-11.

4. CUSTOMS MUST AVOID ANY QUANTITATIVE ANALYSIS UNDER MODIFIED ISO 20871

In the General Notice, Customs comments that laboratory testing of footwear outer soles would provide "objectivity and consistency" to application of Note 5 for determination of "characteristics usually required for use of an outer sole, including strength and durability." Objectivity and consistency require that evaluation of test results under ISO 20871 not involve any quantitative analysis.

In order to overcome the proposed test method's bias toward rubber materials, Customs proposes to apply the test procedures specified in ISO 20871 but not the analysis of test results specified in that international standard for footwear outer sole testing. Instead, Customs proposes to analyze the test results solely in terms of "whether the textile material subjected to ISO 20871 is still present on the samples after testing." We understand that *Customs interprets this as a strictly non-quantitative standard, meaning that if any amount of textile material is visible on at least one of the three test* samples the test result is a "pass" for the tested outer sole material from the footwear.

We submit that it is critical for Customs to *confirm* that the evaluation of the test results will not involve quantitative analysis of any kind. Otherwise, there will be significant uncertainty regarding what passes and what does not. Non-quantitative analysis of test results is the only fair measure of durability for textile outer sole products and the only measure that would be consistent with the manner in which Customs represented the Note to the ITC.

E.S. Originals has begun testing textile outer sole products based on the non-quantitative "passing" standard described above. If the standard is different than the standard set out above,

then the general public must be advised and given an additional opportunity to comment, so that the test standard is fully understood and proper testing can be performed.

Should you have any questions, please do not hesitate to contact us.

Very truly yours,

GRUNFELD, DESIDERIO, LEBOWITZ,
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american apparel & footwear association

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May 28, 2013

Trade and Commercial Regulations Branch
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RE: Proposed Test Method for the Administration of Additional U.S. Note 5 to Chapter 64, HTSUS, Concerning the Classification of Footwear with Textile Material on the Outer Sole, Customs Bulletin, Vol. 47, No. 14, March 27, 2013

To Whom it May Concern:

On behalf of the American Apparel & Footwear Association (AAFA), I applaud U.S. Customs and Border Protection (CBP) for moving forward to eliminate the long-standing uncertainty hanging over the trade regarding the treatment of footwear with textile outsoles under Additional U.S. Note 5. While the proposal is a good step forward, the proposal leaves certain critical questions unanswered. Those questions are outlined below. Further, I am concerned that the notice in the Customs Bulletin does not provide any timeline for final resolution of this important issue. Without a definite timeline for establishing a final standard, the uncertainty hanging over the trade, and the tens, if not hundreds of millions of pairs of shoes entering the U.S. market every year that would be subject to Additional U.S. Note 5, will continue indefinitely.

AAFA is the national trade association representing apparel, footwear and other sewn products companies, and their suppliers, which compete in the global market. AAFA's members produce, market, and sell apparel and footwear in virtually every country around the world, including the United States. The U.S. apparel and footwear industry employs 4 million U.S. workers who support this global supply chain in research and development, design, manufacturing, compliance, sourcing, logistics, marketing, merchandising, and retail.

CBP Proposal is Great Start, But Important Questions Must Still be Answered

AAFA has received a lot of feedback from members regarding CBP's proposal. While most of that feedback has been very positive, members has raised significant questions.

Based on that member feedback, AAFA believes that CBP's proposal to use ISO 20871, while originally intended to test the performance of rubber, is a good choice as the method is already widely used in the footwear industry. The test method is also repeatable and replicable across labs and within labs.

AAFA also agrees with CBP's proposed requirement that the determination of whether a textile outsole meets the definition of Additional U.S. Note 5 "...on whether the textile material subjected to ISO 20871 is still present on the samples after testing.[1]"

[1] Page 11, CUSTOMS BULLETIN AND DECISIONS, VOL. 47, NO. 14, MARCH 27, 2013

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While AAFA believes CBP's proposed requirement is appropriate, many AAFA members noted that the requirement, as it stands, is not specific or detailed enough. Critical questions must still be answered.

First, does CBP mean if any textile material remains on the samples, even if a very small amount, the textile outsole qualifies? Or does CBP mean that the textile must still cover more than 50% of the external surface area of the sample, as is required to originally qualify for consideration as a textile outsole? Or some other percentage or formula as determined by CBP?

Second, as CBP notes in its proposal[2], ISO 20871 utilizes three samples in its test method. Does the textile material that must still be present, need to still be present on all three samples? On two of the three samples? Or on just one of the samples?

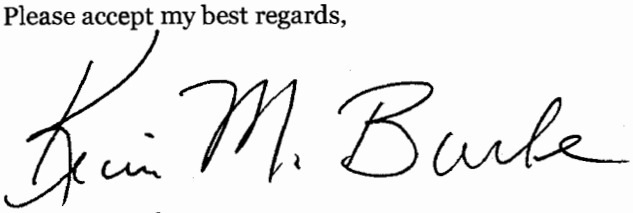
Third, CBP has previously drawn a strong distinction between indoor footwear (i.e. house slippers) and other footwear. Is CBP's proposal intended to apply to both types of footwear? If so, in light of the questions raised above, would the standard apply equally to both indoor footwear and other footwear?

In conclusion, AAFA strongly supports CBP's efforts to establish a standard for Additional U.S. Note 5. AAFA believes that the current proposal is a strong step in the right direction, but key questions must be answered before CBP establishes the final standard. Further, in determining the final standard, AAFA urges CBP to keep in mind the duty-neutrality requirement that guided the new textile outsole rules that were created as a result of the 1205-8 study.

Finally, regardless of how CBP answers these outstanding questions, AAFA urges CBP to establish a final standard as soon as possible. The uncertainty that has existed in the trade since Additional U.S. Note 5 was implemented almost 19 months ago must come to an end.

Thank you for your time and consideration in this matter. Please contact Nate Herman of my staff at 703-797-9062 or nherman@wewear.org if you have any questions or would like additional information.

Please accept my best regards,



Kevin M. Burke
President & CEO

[2] Ibid.

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May 22, 2013

FEDERAL EXPRESS
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RUBBER AND PLASTIC FOOTWEAR MANUFACTURERS ASSOCIATION COMMENTS ON PROPOSED TESTING METHODOLOGY FOR APPLYING ADDITIONAL U.S. NOTE 5 TO CHAPTER 64 OF THE HTSUS

The following comments are being submitted on behalf of the Rubber and Plastic Footwear Manufacturers Association ("RPFMA"), a trade association representing virtually all manufacturers and suppliers producing rubber and plastic footwear and components thereof in the United States. These written comments are submitted in response to the notice published in the *Customs Bulletin and Decisions* of March 27, 2013 (47 Cust. Bull. 14) in which a test and analytical framework are proposed for determining whether textile materials present on the outer soles of footwear are to be taken into account for purposes of determining the outer sole's constituent material in accordance with Note 4(b) of Chapter 64 of the Harmonized Tariff Schedules of the United States ("HTSUS").

A basic and fundamental maxim of the law, which has long been recognized in customs jurisprudence, is that the starting point in construing any statutory provision must be the language of the statute. *Madison Galleries Ltd. v. United States*, 870 F. 2d 627, 629 (Fed. Cir. 1989) (and U.S. Supreme Court decisions cited therein), and *The Hanover Insurance Co. v. United States*, 25 CIT 447, 453 (CIT 2001). It is therefore critical to bear in mind the two Chapter 64 notes, Note 4(b) and Additional U.S. Note 5, which underlie the testing model and analytic framework proposed in the *Customs Bulletin* notice. The two Chapter 64 notes, in pertinent part, provide as follows:

Notes

4. Subject to note 3 to this chapter:

* * *

(b) The constituent material of the outer sole shall be taken to be the material having the greatest surface area in contact with the ground, no account being taken of accessories or reinforcements such as spikes, bards, nails, protectors or similar attachments.

Additional U.S. Notes

5. For the purposes of determining the constituent material of the outer sole pursuant to note 4(b) of this chapter, no account shall be taken of textile materials which do not possess the characteristics usually required for normal use of an outer sole, including durability and strength.

As a matter of general principle, the RPFMA has no objection to utilizing the ISO 20871 test in determining whether textile materials in outer soles are to be taken into account for purposes of determining the constituent material of the outer soles. We do, however, have significant concerns with respect to how Customs and Border Protection ("CBP") has proposed construing the test results of ISO 20871, as well as practical concerns as to how the test will be administered.

With respect to the test results analysis, as provided in ISO 20871 and as explained in the *Customs Bulletin* notice, the results of ISO 20871 are generally expressed in terms of relative mass lost. Under CBP's proposed new test model, the determination as to whether or not to disregard the textile on the outer sole would not be based on relative mass lost, but whether textile material was "still present" on the samples following testing. This "still present" test standard, as we understand, in effect compels the complete elimination of textile on the outer sole for the textile material to be precluded for purposes of determining the outer sole's constituent material. CBP acknowledges, somewhat euphemistically, that the "still present" test is a "more permissive standard" than the test for footwear normally subject to ISO 20871 testing. With all due respect to CBP's characterization of its new test standard, the textile "still present" standard is wholly unrealistic and ignores the substance and clear direction of Additional U.S. Note 5.

Had Additional U.S. Note 5 provided that textile material on an outer sole could only be disregarded for purposes of determining the outer sole's constituent material when the textile provided **NO** durability and strength whatsoever to the outer sole, then perhaps establishing a test result for ISO 20871 wherein the textile completely disappears from the outer sole would be appropriate and logical. However, Additional U.S. Note 5 does not provide for such a stringent standard for disregarding the textile on an outer sole. The stated standard in Additional U.S. Note 5 is that the textile materials are to be given no account in determining the outer sole's constituent material if the textile materials "do not possess the characteristics usually required for normal use of an outer sole, including

durability and strength." Textile materials can, and we would submit do inherently possess durability and strength, but if the durability and strength are not of the kind required for normal use of an outer sole on footwear, the textile cannot constitute the outer sole's constituent material for tariff classification purposes. Textile materials exhibiting a modicum of durability and strength should not automatically be equated with the durability and strength required for normal use of an outer sole.

The textile "still present" standard proposed in CBP's notice, in effect, provides a metric whereby textile materials demonstrating **any** strength and durability can be considered as constituting the outer sole's constituent material. That is not what is provided for in Additional U.S. Note 5. The strength and durability possessed by the textile material on the outer sole must be commensurate with the strength and durability characteristics usually required for normal use of an outer sole. That is what Additional U.S. Note 5 explicitly provides. The "still present" test proposed in the notice gives no consideration for the strength and durability characteristics required for normal use on an outer sole. If any textile remains on the tested sample, regardless of the amount, under the analytic framework proposed in the CBP notice, the textile materials would be found to satisfy Additional U.S. Note 5's requirement of possessing characteristics usually required for normal use of an outer sole.

To better appreciate how the proposed textile "still present" metric would undermine Additional U.S. Note 5, imagine that a sample outer sole composed of rubber and textile undergoes the ISO 20871 test and 99% of the textile on the outer sole is eliminated during the test. All that remains on the tested sample is 1% of the original

textile material. As currently proposed, that textile material, which when abraded lost 99% of its substance, could still be considered the constituent material of the outer sole even though it would not even remotely possess the characteristics usually required for normal use of an outer sole. [1] We would respectfully submit that there is no footwear manufacturer in the world who could legitimately conclude that material diminished by 99% in an outer sole footwear abrading test possesses the characteristics usually required for the normal use of an outer sole. Regrettably, that is precisely what the textile "still present" standard would do.

Unless the "still present" test is modified to require some reasonable amount of textile material remaining on the outer sole after undergoing the ISO 20871 test, the plain language and intent of Additional U.S. Note 5 would be undermined and sabotaged. Should 1% textile coverage, let alone a single textile strand, establish that textile materials possess the characteristic usually required of materials used on an outer sole? We believe the answer to that question should be a resounding "No," yet that is what the proposed "still present" standard would permit.

Based on input from RPFMA members, we have been informed that using the ISO 20871 test on the softest material they would employ on outer soles, the expected mass

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[1] In fact, the way the proposed "still present" test currently reads, one could legitimately contend that even if a single textile thread remains on the sample after undergoing the ISO 20871 test, textile was still present on the sample and the textile material could be considered the outer sole's constituent material

Compounding the absurdity of the "still present" standard is that the proposed testing methodology provides for 3 samples being tested. Thus, if but 1 of the 3 samples had a single textile thread remain on the tested sample, the importer could properly assert that textile was "still present" on the tested samples.

loss would be no greater than 15%; for the hardest outer sole materials they use the mass loss would be far lower, approximately 2.5%. Mass loss of greater than 15% would make the tested outer sole material unsuitable for use as an outer sole. Based on the foregoing, but also bearing in mind that CBP in its proposed notice has indicated an inclination to be "permissive" in establishing the amount of loss a tested sample must sustain in the ISO 20871 test to conclude that the textile material does not possess the strength and durability characteristics usually required for normal use of an outer sole, we would submit that a textile loss percentage in the 25% to 50% [2] range would be a "permissive" standard that would also constitute an appropriate and rational test for applying Additional U.S. Note 5. A loss no greater than a percentage figure fixed between 25% to 50% of the textile on the outer sole sample plainly reflects a far more reasonable metric than the proposed textile "still present" test, which, as previously noted, requires a 100% textile loss before CBP would conclude that the textile material does not possess the characteristics usually required for normal use of an outer sole.

As to the application of the test itself, we would ask for two points of clarification. First, it should be made explicit that all the tested outer sole materials which undergo the

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[2] It is the considered view of our trade association that a loss greater than 25% in the ISO 20871 test would clearly demonstrate that the textile materials do not possess the characteristics usually required for normal use of an outer sole. The 25% figure would unquestionably represent a fair, accurate and appropriate standard.

We have purposefully broadened the percentage selection range we are positing to as great as 50% should CBP be looking for an even greater "permissive" standard. However, suggesting that materials which abrade above the 50% figure in the ISO 20871 test possess the strength and durability characteristics usually required for normal use of an outer sole would be nonsensical, irrational and not supported by any reputable footwear entity.

ISO 20871 test must be flat. Footwear outer soles can and are produced with recessed and protruding portions. If an outer sole with recessed and protruding portions undergoes the ISO 20871 test, the recessed portions would not come in contact with the abrading material used in the ISO 20871 test. Any textile in the recessed portions would not undergo the appropriate abrading and would therefore necessarily be present following the ISO 20871 test.

To avoid the situation where textile could be located in portions of the outer sole not coming in contact with the abrading material of ISO 20871, it should be made absolutely clear that the sample outer sole material being tested must be flat.

In addition, we have been advised by RPFMA members that due to the nature of the ISO 20871 test it is sometimes possible, because of how different materials in an outer sole may abrade, that the outer edges of the sample may not come in proper contact with the ISO 20871 abrading material. Therefore, it is necessary to make certain that the outer sole sample is fully in contact with the ISO 20871 abrading material throughout the test. This potential for uneven contact as the tested sample is diminished is another reason to modify the proposed textile "still present" test to one requiring diminution of the textile at a percentage figure no greater than between 25% to 50%.

In conclusion, we concur with CBP's proposed utilization of the ISO 20871 test for determining whether textile on the outer sole should be taken into account for ascertaining the outer sole's constituent material. However, it is the RPFMA's position that the textile "still present" test does not correlate to the Additional U.S. Note 5

requirement that the textile materials, at a minimum,[3] must possess the strength and durability characteristics of materials usually required for use of an outer sole. A test requiring total evisceration of the textile on the tested sample is too extreme. We would submit that if the metric for textile material remaining after the application of ISO 20871 was set at a figure between 75% to 50% of what was originally present, that would represent a fair and more reasonable approach for establishing satisfaction of the strength and durability test of Additional U.S. Note 5, while still providing a more permissive standard than footwear manufacturers would normally expect from footwear outer sole materials. Additionally, the final published notice for construing Additional U.S. Note 5 should make clear that the tested samples must be completely flat, with no recessed or hidden portions, and that all edges and portions of the sample remain in contact with the abrading material of ISO 20871 throughout the test.

Respectfully submitted,

Sidney H. Kuflik, Esq.
Lamb & Lerch
Customs Counsel to Rubber and Plastic
Footwear Manufacturers Association

Dated: May 22, 2013

[3] We employ the qualifying term "at a minimum" because Additional U.S. Note 5 does not identify all the characteristics usually required for normal use of an outer sole. Instead, it uses the phrase "including durability and strength." Clearly, durability and strength are two characteristics that the textile material must possess, but as written Additional U.S. Note 5 leaves open the possibility of additional characteristics the textile materials must possess.