Determination of the Standard of Care in the Tire Service Industry

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Abstract

Tire service professionals offer tire services to the motoring public. In the course of providing those services, they may expose themselves to liability. If a tire service professional is found to have fallen below the "Standard of Care" in the industry, negligence can be alleged. This paper discusses the concept of Standard of Care along with some common areas where tire service professionals may find themselves involved. A valid scientific approach to determination of the Standard of Care in a given locality is presented, along with the results of two investigations that were undertaken using this method.

Introduction

Tire service professionals obviously offer tire services to the motoring public. In the course of providing those services, they expose themselves to liability. Arguably, the most serious liability exposure is encompassed by an allegation of negligence. In order for any professional to be guilty of negligence, tort law requires that [1]:

1. The professional owes a duty to the person making the allegation of negligence.
2. The professional has breached this duty.
3. This breach of duty has caused harm to occur.
4. The person making the allegation of negligence was, in fact, harmed.

In the context of tire service, the professional is being paid for services, so any subsequent failure of the tires, wheels, or other serviced components/systems may create a danger for the vehicle owner and/or others on the road. It is therefore possible that harm may occur, and a legal duty is therefore presumed.

The question as to whether or not the tire service professional has breached the duty owed is the fundamental question. A term in litigation work is "Standard of Care", and a professional who has breached the duty owed to a customer is said to have fallen below the Standard of Care (SOC). This is a common term in medical malpractice and its use is found extensively in tire litigation as well. However, there is no specific legal definition for SOC in the tire service industry, and its definition is often determined on a case-by-case basis. This paper will present some background on SOC, along with some of the usual SOC issues that come up in tire litigation matters. A methodology for determining the actual SOC will be outlined, and the results of the use of that methodology in determining some SOC related practices will be shown. Although this paper does not provide legal

conclusions, some history and legal discussion of Standard of Care are provided for a better understanding of the present work.

Legal Elements of Standard of Care

There are numerous legal definitions for SOC. Indeed, the legal definition of the term has evolved over time. In the 19th century, medical SOC was based on custom, i.e., what was typically done by practitioners was considered standard [2]. In the 20th century, this definition expanded to that which was typically done plus anything that seemed reasonable even if it was not typically done [3]. The modern definition [4] has several elements:

> That which a minimally competent physician in the same field would do under similar circumstances.

The 1985 case of *Hill v. Hilburn* [5] stated that the law requires minimal competence in providing services. The services do not even have to be average, otherwise half of all services provided would fall below the standard of care and be malpractice. That case also stated that a competent physician is not necessarily liable for a mere error of judgment, mistaken diagnosis, or the occurrence of an undesirable outcome.

A definition, when applied to tire service professionals, holds that the standard of care would be the care provided by a minimally competent tire service professional under similar circumstances. The "best practice" for a given service is not, *a priori*, the SOC for that service. Again, the tire service professional, under this definition, would not normally be responsible for an error of judgment, a mistaken tire assessment, or the fact that a tire failed sometime later.

The standard of care for professionals has been [6] stated as:

> "the degree of learning and skill that the law requires all professionals to exhibit and which is ordinarily possessed by professionals in good standing in that profession in the same locality and under similar circumstances."

This definition, since it refers to learning and skill that the law requires, is focused on licensed professions like engineering and architecture, where the requirements for professional licensure clearly define minimal competence. The definition adds an additional element, that of locality. However, for tire service professionals, there is no legal licensure, so what constitutes a "minimally competent" tire service professional? And the question still remains as to what are "similar" circumstances?

SOC is a legal concept in the medical area. The concept is that a medical practitioner has provided treatment that meets the SOC test if he or she has performed the service using a "standard therapy". In turn, the standard therapy is that which meets the following three conditions [7]:

1. The therapy is proper for the condition being treated,
2. the therapy is accepted by the medical community, and
3. the therapy is widely used by the medical community.

This test applies to tire service as well. In general, in the tire industry, whether or not a particular tire service meets the SOC will be true if what has been done is appropriate in the given instance (i.e., actually resolves a problem or prevents some potential problem, based on the current science), is accepted as effective by the tire industry, and is widely practiced in similar shops in the area where the service was performed. In other words, the SOC must be supported by scientific testing and data that show it is beneficial for preventing or resolving some tire issue or issues. The science must have been generally accepted by the tire industry as addressing the stated problem. And, the SOC must be widely practiced by tire service personnel with similar backgrounds and in similar circumstances in tire service. Failing any one of these three tests will cast doubt on the practice rising to the level of the SOC.

The SOC in tire litigation matters is typically established through the testimony of individuals who hold themselves out, by virtue of training and/or experience, as experts in tire service. An "Expert" is defined [8] as a person who has education, training, skills or experience about evidence or facts before a court. Federal Rule 702, Testimony by Experts [9], says that expert testimony must meet three requirements:

1. The testimony must be based on sufficient facts and data,
2. The testimony is the product of reliable principles and methods, and
3. The expert has reliably applied the principles and methods to the facts of the case.

The SOC cannot be established by preferring one respectable body of professional opinion over another. Industry guidelines are often cited as a basis for expert opinions as to the SOC. The inherent difficulty in guidelines, especially those based on consensus rather than science, is that the biases of experts may shape the guidelines and either exclude reasonable choices or incorporate personal favorites as preferred options. Indeed, the National Institutes of Health Consensus Development Program stated [10] "this raises the possibility of potential conflicts of interest given the expert's financial and career ties to the topic." The term "standard of care", when based on such guidelines, should be used with caution. The "term can be self-awarded either by a group of like-minded individuals or by a specialist society or organization and is a term which can be abused with the intention of providing impact and authenticity to a point of view." [11] This warning certainly holds true for the tire service industry, where the many consensus guidelines are created by tire companies, vehicle makers, and other lobbying organizations servicing the industry.

Examples of Use of "Standard of Care" in The Tire Service Industry

Puncture Repairs

The Rubber Manufacturers Association (RMA) recommendation for puncture repairs to passenger and light truck tires states:

1. The repairable area of a tire is on the tread between the outer two circumferential tread grooves.
2. No puncture over 0.25 inch in diameter can be repaired.
3. The tire must be demounted from the rim and inspected for internal damage.
4. The puncture must be filled with a rubber plug, and the inner liner must be sealed with a rubber patch.

This recommended repair procedure is often cited as the SOC in repair of passenger and light truck tires. Therefore, a repair consisting of a plug only, or patch only, would fall below the SOC. The RMA recommendation is generally accepted by the tire industry. This repair method is arguably the best available repair method, as well as the most costly. While the recommendation is indeed a best practice, there is absolutely no scientific evidence supporting the notion that a repair not conforming to the RMA recommendation makes the tire more likely than not to fail. No scientific studies or peer reviewed papers exist that support the idea that not following the RMA's puncture repair recommendation will cause a repaired tire to fail prematurely. This means that the RMA repair recommendation does not have scientific support and does not satisfy that criterion. In the RMA's own 2006 survey [12] of worn out tires removed from service, it was found that fully 87% of puncture repairs in those tires did not conform to the RMA recommendation. That is, 87% of all repairs were done with a patch-only or plug-only repair technique, and the repaired tires did not fail with those repairs. Given these facts, the RMA repair procedure does not satisfy the criterion of being widely used. From this perspective, this repair recommendation cannot be considered the SOC.

To be sure, elements of the RMA's recommendation, namely demounting the tire to inspect for internal damage and restricting repairs to a certain size and region of the tire are certainly recommended for proper repairs. However, it is often opined that the simple fact that the tire was not repaired with both a patch and a plug made the repair service fall below the SOC. Clearly, the RMA recommendation is a consensus-based guideline developed and published by the tire industry.

Best Tires on Rear Axle

Most tire manufacturers recommend that when replacing tires on a vehicle, all four tires should be replaced at the same time. However, when a customer only wants to purchase two tires, a common tire industry recommendation is that the new tires should be placed on the rear axle of the vehicle. The justification for this recommendation is that cornering traction or hydroplaning on wet pavement can be a function of tread depth, and it is desirable from a vehicle stability standpoint to have greater corning force available on the rear axle. This may help to reduce the likelihood of a wet-pavement oversteer resulting in a single-vehicle loss of control. There is certainly scientific support in the literature for this determination, though the strength of the effect is also a function of several other important factors, such as vehicle speed, and pavement water depth [13]. Oversteer is one way in which single-vehicle wet traction loss of control can occur, and understeer, resulting from having tires with too little tread depth on the front axle, is another. Blythe and Seguin [14] have shown that single-vehicle wet traction loss of control crashes occur

in real situations when the tires on either the front axle or the rear axle have too little tread depth.

If a tire service, whether installation or rotation, results in the tread depth on the rear tires being less than that on the front tires, it may be alleged that the service falls below the SOC. This opinion is often offered regardless of the difference in tread depth between the front tires and the rear tires, and whether or not the accident occurred in wet weather. Since the science supporting new tire placement on the rear axle is based solely on the reduction of grip of lower tread depth tires on wet pavement, there must be wet pavement and there must be a measureable grip difference between the front and rear tires in order for any harm to have been attributed to the tire placement.

For example, if a person buys a new pickup truck, which will habitually wear the rear tires more rapidly than the front tires, then the tires would have to be rotated from front to rear at regular, and short, intervals to avoid progressively shallower treaded tires on the rear axle. In contrast, front wheel drive vehicles typically wear the front tires more rapidly than the rear tires. In that situation, the tires can never be rotated, since doing so will move the shallower tread front tires to the rear axle. Logically, there must be some threshold of difference in tread depth between the front and the rear tires for there to be some influence on wet traction. If the pavement was wet, then how much tread depth difference is significant needs to be determined scientifically. If the pavement was dry, this cannot apply at all.

This recommendation is sometimes extended to state that the older tires should have been placed on the front axle. This is an example of attempting to stretch the recommendation well beyond any scientific basis that may have existed. The rationale for this argument is that an older tire is more likely to sustain a tire failure, resulting in a loss of traction on that corner of the vehicle. These claims are typically seen where there has been a tread separation, since a tire missing the tread and outer steel belt has been shown to lose about 50% of its cornering power. However, in reviewing the National Highway Traffic Safety Administration's (NHTSA's) complaint database [15] associated with the Wilderness AT recall in the year 2000, an assessment of likelihood of crashes with tire failure can be made. In the 2,680 reported cases involving a tire failure where the tire location was reported as well as whether or not there was a crash, only 14.6% of the failures resulted in a crash (note that the existence of tire failure reports where there was not a crash is unique to this database). This was despite the fact that 76.9% of the tire failures occurred on the rear axle of the vehicle. Tire failure on the rear axle was shown to be slightly more difficult to control, as 88% of the crashes resulted from a tire failure on the rear axle, a higher value than the percentage of rear tire failures. In the non-crash cases, 75% of the tire failures occurred on the rear axle.

Mounting the two new tires (or the deeper tread depth tires) on the rear axle may be appropriate for treating wet traction loss of control. Early studies using shaved tires on the rear axle and new tires on the front axle showed dramatic instances of single-vehicle loss of control on wet pavement [16]. A more recent study [17] however, showed that single-vehicle loss of control is more likely if the tires on either axle have less than $^{4}/_{32}$" of tread

depth, rather than where they are placed. Indeed, these studies have called into question results from tests using shaved tires, as tires modified in this manner do not appear to perform like normally-worn ones. This implies that the recommendation to place two new tires on the rear axle is a best practice rather than a SOC, since the scientific support is mixed. However, the tire manufacturers' recommendations do not generally address tire rotation, which is a routine service recommended by both vehicle manufacturers and tire manufacturers based on mileage. Study work presented later in this paper will deal with the question of how widely this recommendation is practiced in the tire service industry.

Tire Age

Many vehicle manufacturers recommend that a passenger or light truck tire should be replaced if its chronological age exceeds six (6) years. Most tire manufacturers recommend that a passenger or light truck tire should be replaced if its chronological age exceeds ten (10) years. Tire makers also generally recommend that vehicle owners follow the recommendations of the manufacturer of their vehicle. Chronological age of a tire can easily be determined from the Department of Transportation (DOT) code molded into the tire sidewall, although physically accessing the DOT code may require raising the vehicle on a lift so the inner sidewalls of the tires can be seen. There is, however, no regulatory or statutory requirement to remove a tire from service simply due to its chronological age.

Any vehicle service not recommending replacement of tires over six years old is often criticized as falling below the SOC. Not surprisingly, the six-year threshold is almost always used in litigation. Note that very little research exists on aging in medium radial truck tires of the type that service the trucking industry, although the same six-year recommendation will likely be used for that tire type as well. The recommendations discussed above are consensus-based guidelines. The NHTSA has studied tire aging extensively, found no scientific basis for removing a tire at some age, and has therefore refused to require tire removal at any point due solely to chronological age [18]. The aging process is largely due to oxygen from the inflation gas inside the tire permeating into the rubber components of the tire. Research has shown that tires oxidatively age more rapidly in hotter climates than in colder ones, so a 10-year old tire in Detroit, for example, might have similar oxidation degradation as a 5-year old tire in Phoenix. Since the rate at which tire properties degrade with age is also highly variable, NHTSA concluded that it was not possible to determine the age at which any given tire would certainly fail in service.

Ford Motor Company was the first U.S. vehicle manufacturer to make the six-year recommendation. The rationale was based on the development of a protocol to artificially age tires in an oven in an oxygen-rich environment such that the rubber cross-link states were equivalent to tires that had aged in Phoenix, Arizona, for six years [20, 21, 22, 23, 24]. No scientific data was produced in the above-referenced papers that suggested that tires over six years old were more likely than not to fail. This confirms NHTSA's work noted earlier. Ford, however, recommended that all tires, including unworn spare tires, be replaced at six years of age. The vast majority of vehicle manufacturers followed Ford's

lead, even though little effort was expended to increase the use of the full-sized spare tire in a five-tire rotation.

Tire manufacturers have generally recommended a 10-year replacement. The vast majority, about 98%, of tires wear out in that time. The glaring exceptions are the full-size spare tires found on light trucks and sport utility vehicles. In addition, replacement tires may spend some extended time in a warehouse prior to their initial sale. In that situation, they are not mounted and inflated, and they are therefore not aging oxidatively due to the high-pressure internal inflation gas.

Identifying tire age based on the DOT code and recommending it be replaced if over a certain age is often cited as the SOC. This has been claimed in some cases even if the service performed on the vehicle was simply an oil change, state inspection, or multi-point inspection. Both the six-year and the ten-year removal recommendations appear to be consensus-based guidelines, since there is nothing scientific upon which to favor one of these recommendations over the other. However, since the environment that the tire works in plays a role in how it ages, any science-based recommendation must also take environment into account. The RMA's 2006 survey found tires had been removed from service all over the United States due to wear at ages ranging from 2 years to 16 years. While tires do age oxidatively, the chronological age at which any given tire must be replaced cannot be determined scientifically. Therefore, a removal recommendation based on chronological age cannot rise to the SOC. A scientific basis favoring either of these recommendations by the tire industry, as well as how widely these recommendations are used, remains in question.

Scientific Methodology for Determining Standard of Care

The above discussions have shed some light on issues surrounding SOC in the tire service industry. Typically, if a practice is claimed to be the SOC for the tire service industry, it has industry support. The scientific basis for the practice, if it exists, can be researched in the literature. If the science supports the recommendation, then the question becomes "How can one determine how widely the practice is used in a scientifically-valid manner?" If the practice can be shown to be widely used, in addition to being scientifically based and having industry support, then it can be readily claimed to be the SOC. The elements which must be addressed in establishing a SOC in a given litigation matter are related to the level of service that would be provided by

1. A service provider with similar background and training,
2. In the same geographical area, and
3. In similar circumstances

The use of field studies is an accepted method for developing data about practices, opinions, and the like. Field studies may take the form of polls, questionnaires, undercover testing, and so on. In order to yield information about the SOC useable in a litigation matter, field studies must be designed so that the data has validity in terms of the providers, geographical area, and circumstance. The following discussions cover the

statistical issues to be addressed along with field studies that were actually performed to determine how widely a practice is used in the tire service industry.

Field Study

The field studies presented here consisted of two methods for testing the standard of care of automotive tire service providers:

1. An interview process, whereby the shop owner, manager, service writer or mechanic was asked a series of questions pertaining to the subject issues.
2. Testing the SOC in a practical manner, i.e., equipping vehicles similarly so as to test the hypothesis with the same, or substantially similar set of circumstances.

While it is valuable to learn what a shop owner, manager, or technician has knowledge of, it is potentially more important from a SOC perspective to understand how that knowledge is actually applied in the shop on a day-to-day basis. From this perspective, the second study type, i.e. practical testing, may be more revealing than the first, but both study types can yield important information. Practical testing, however, can be significantly more expensive to actually accomplish.

The field studies discussed here were conducted by one of the authors in December 2010 and November 2011. The 2010 study was conducted in the Texas cities of Austin, Beaumont, Dallas, Fort Worth, Houston, and San Antonio (larger metropolitan areas). The 2011 study was conducted in the Texas cities of Abilene, Denton, San Angelo, and Wichita Falls (smaller metropolitan areas). The stores visited in the 2010 study included the national chains of eight (8) major tire sellers/servicers. The 2011 study included national chain and independent stores of eleven (11) tire sellers/servicers. Both study sets consisted of oral and practical methods, which included,

1. An oral survey of the store's protocols related to:
    a. Inspection criteria for selecting the two tires that will remain on the vehicle following a two tire replacement,
    b. Tire placement when installing two new tires on the vehicle, and
    c. Rotation as a preventative maintenance measure.
2. A practical test of the application of a store's practices when a vehicle needing a two tire replacement was presented and the customer specifically requested placement of the new tires on the front axle.

In all, 61 stores participated in the oral survey and 69 stores participated in the practical test. As can be deduced from the description of the oral survey elements above, this SOC area has many subtopics associated with how to select the tires that remain. In addition, once the new tires have been installed, the study addressed the issue of what criteria are used for ensuing rotations.

Researchers conducting field work engaged tire store participants simultaneously, i.e., conducting both a sit down interview and practical test at the same time. The researcher that engaged the participant for the oral interview would ask essay style questions and record the participant's answers. The researcher conducting the practical test would do so

as a surrogate customer with the test vehicle at hand. In this case, the participant would be unaware that their procedures were being documented.

Statistical Issues to be Addressed in Study Work

How large must a sample be or how many data points must be collected to ensure valid and reliable results? Here, a "point" is a shop that is the subject of a survey -- for each question or issue, there will be as many responses (i.e., points) as there are shops being surveyed. How do we define that number in order to ensure that the conclusions drawn are acceptable in a court of law?

Statistics is the study of the collection, analysis, interpretation, presentation, and organization of data that also includes the planning of data collection in terms of the design of surveys and experiments. In the Federal Court system, there are important requisites for the application of experimental design and statistical analyses that derive from the Federal Rules of Evidence. In particular, Rule 702 (amended in 2011) states:

“A witness who is qualified as an expert by knowledge, skill, experience, training, or education may testify in the form of an opinion or otherwise if:

1. The expert’s scientific, technical, or other specialized knowledge will help the trier of fact to understand the evidence or to determine a fact in issue;
2. The testimony is based on sufficient facts or data;
3. The testimony is the product of reliable principles and methods; and
4. The expert has reliably applied the principles and methods to the facts of the case.”

While being rather generic, the underlying implication is that data and facts introduced to the court must be based on sound scientific knowledge and valid statistical analysis. While Rule 702 does not specifically define these aspects, it supports both the Frye and Daubert decisions that empower judges to be the gate keeper and decision makers with respect to science, statistics, and expert testimony.

Within the context of determining the SOC in the tire industry, several questions must be addressed when creating surveys or developing experimental designs. The first such question is how many subjects or responders must there be to assure the results are valid and reliable. "Validity" implies that the research tools actually measure what they were intended to measure, while "reliable" suggests that if you use the test at one point in time and then at another point in time, the results should be similar, assuming a similar pool of subjects.

There is a complex statistical answer to the "how many" question, but it is also predicated on if and how a researcher intends to use that data. If, for example, the researcher is only intending to collect local information from a survey with one group, one might need only 10-12 subjects. The most important key here would be that the researcher has collected a representative sample of subjects that reflects the characteristics of the larger population. These descriptive methods typically calculate averages and variances, such as a mean and standard deviation. They can also involve using percentages, i.e., 80% of

our subjects agreed/disagreed, histograms, or frequency tables to further describe the data that was collected. While descriptive statistics are the most common form of statistical analysis summarizing data in a meaningful way, they do not allow the researcher to make generalizations to the population or generate conclusions beyond the data that have been analyzed. Descriptive statistics simply describe the data.

If on the other hand, the researcher needs to make generalizations about groups within the larger population, the researcher should use methods of inferential statistics. In this approach the researcher collects data by developing specific experimental designs and survey samples, with assurances that a representative sample or samples are collected from each group of concern. In an experimental study, the researcher also develops hypotheses that are to be tested, collects data from the subjects, then takes additional measurements using the same procedure to determine if the analysis has modified the values of the measurements.

For example, in one proposed study, the researchers were interested in determining the appropriate SOC for tire stores within a large US metropolitan area. The researchers generated several hypotheses, such as "large national tire chains differed in the standard of care compared to regional chains or individual mom and pop tire stores". For this study, great care was taken to eliminate experimental bias and error during the testing to assure accurate and reliable results. In this example, the null hypothesis was that there were no differences between the three types of stores. There was also a second hypothesis that “female tire buyers may be treated differently than male tire buyers.” So the researchers set up a complex protocol and experimental design with a sufficiently large number of data points (i.e. at least 15-18 in each group) to ensure that valid and reliable statistical inferences could be generated from the data, based on a representative sample for each of the three tire store groups and two genders. This example of representative sampling assures that inferences and conclusions from the statistical analyses could extend from the sample to the population as a whole, i.e. all of the tire stores within the large metropolitan area.

Descriptive statistics allow the researcher to qualitatively describe and compare results. However, when the researcher relies on the powerful inferential statistical methods, the comparisons of means or standard deviations from groups of subjects can generate probability values of how likely these results were to occur by chance as well as allowing the researcher to make statements related to whether observed differences between groups were statistically significant or not. When the researcher has a valid test of statistical significance, one can also begin to make inferential generalizations from the observed data with respect to characteristic of the population. These inferential statistics rely on mathematical theorems which in turn operate under the framework of probability theory. There are numerous statistical methods to use within descriptive and inferential statistics that accurately define the relationships within a data set or relationships between samples.

So we now return to the first question: how large must a sample be or how many data points must be collected to ensure valid and reliable results? As stated above, the answer can be complex, but it relies on the researcher’s requirement for accuracy and the underlying population. For simple descriptive statistical analyses, some statistical “rules

of thumb" suggest that an adequate sample size within each group should be 10-15 or more data points. Some suggest 30 or even 40 data points. Ideally more is better, because the larger the sample, the more likely it is to resemble the population from which the data was drawn. The "more is better" philosophy has to be bounded by the practical costs of collecting the data, but both views need to reflect that the collected data and statistical inferences are both valid and reliable and representative of the population. In the results discussed in the next section, one of the authors used descriptive statistics to analyze results, after collecting over 60 individual data points for each question in the survey. While no inferential statistical tests were done in this survey, this large sample helped ensure that the descriptive results were both valid and reliable.

Results of the Exemplar Study

Tire Inspection/Tire Chronological Age

Oral survey data indicated that when tire professionals were asked to list the criteria for inspecting the tires that would remain on the vehicle following a two-tire replacement, 100% of participants based their inspection decision on the outwardly visible appearance of the tires, with 83% listing tread wear or tread depth as a factor and 21% listing tire age as a factor, as shown in Figure 1.

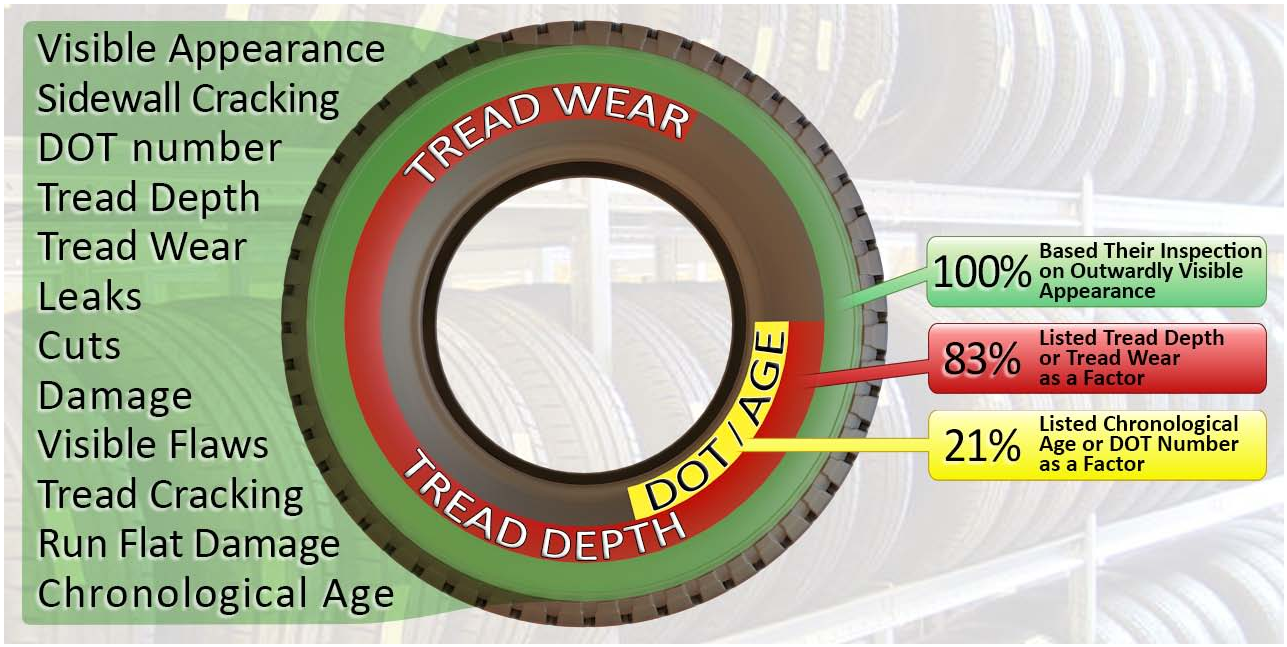


Figure 1. 2010/2011 Combined results: List the criteria for inspecting the tires that will remain on the vehicle following a two-tire replacement.

As discussed previously, there is no scientific support for removing a tire at any given age. Since the survey showed that only 21% of service providers considered tire age in selecting the tires to remain on the vehicle, age is not widely used in the selection process and cannot be considered the SOC.

When tire professionals were asked, “based on a tire’s DOT code, what is your store policy on selling new tires?” 62% said they would sell tires up to 3 years old. Figure 2 shows the percentage of survey answers for each chronological age question.

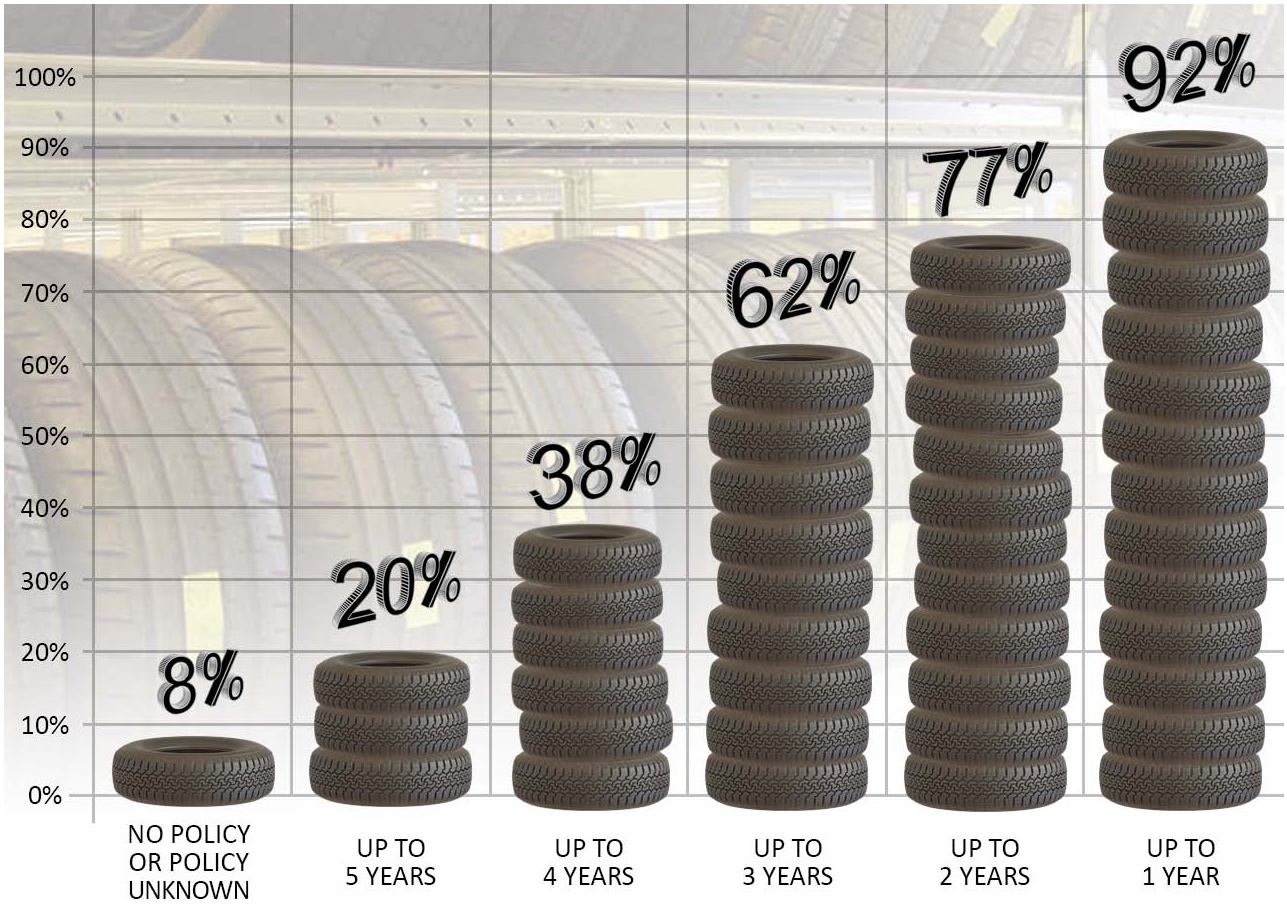


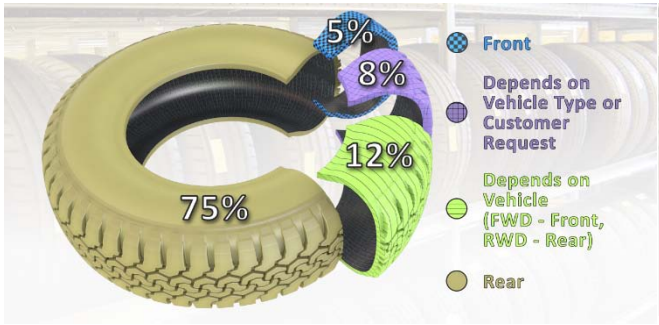
Figure 2. 2010/2011 Combined results: What is your store policy for selling new tires from store inventory?

With regards to chronological age, these data indicate the criteria for inspection of those tires that will remain on the vehicle during a two-tire installation is largely predicated on the outward appearance of the tire rather than the DOT manufacture date. The use of the manufacture date is further flawed when you consider the tire store’s sales policy; as mentioned above, 62% of tire stores said they would sell a tire up to three years old from store inventory. This presents another problem when you consider a tire that has perhaps an 80,000-mile tread warranty. Selling this tire at three years old most certainly means it will not come anywhere close to reaching its full tread wear potential by the end of six years. These data clearly indicate that considering the age of the tires on the vehicle is not widely done, so it is simply not possible to consider a recommendation to remove a tire at six years of age, based on its date of manufacture, as the SOC.

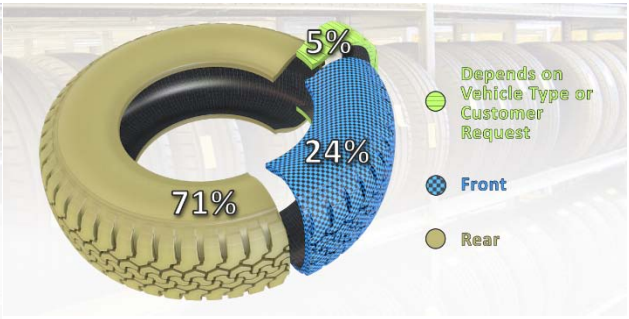
New Tire Placement

Oral survey data indicated that when tire professionals were asked, 75% of the 2010 survey participants and 71% of the 2011 survey participants said the recommended

placement for two new tires would be to the rear axle of the vehicle. These data are shown in Figure 3. Several expressed that the two new tires should be placed on the drive axle of the vehicle, i.e. placement on the front axle of front-wheel-drive vehicles and on the rear axle of rear-wheel-drive vehicles. The placement recommendation for new tires on the rear axle of the vehicle therefore appears to be widely known.



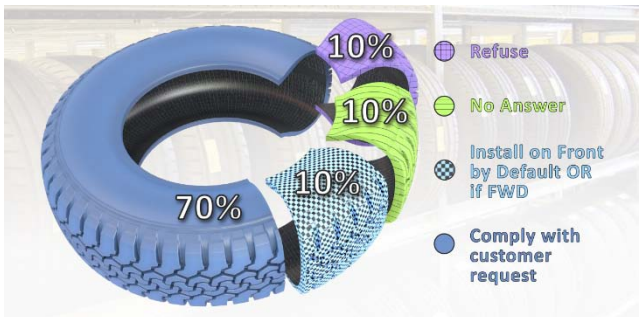
2010: On which axle will you install the new tires?



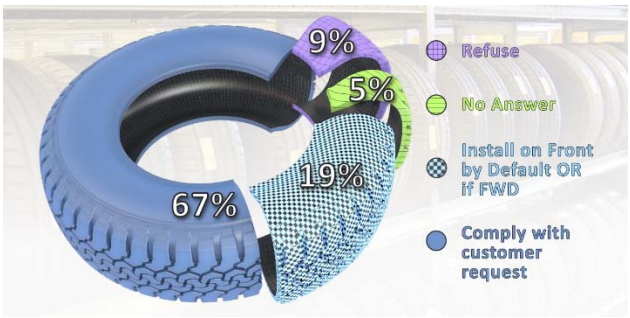
2011: On which axle will you install the new tires?

Figure 3. Oral Survey Data Considering Tire Placement.

When asked what they would do when a customer insists on placement of the new tires on the front axle, 70% of 2010 survey participants said, they would comply with the customer's request and 67% of 2011 participants said the same, as shown in Figure 4. This indicates that complying with customer requests is the norm in the tire service industry. Refusal of a customer request as to tire placement is not widely done, and therefore does not rise to the level of SOC.



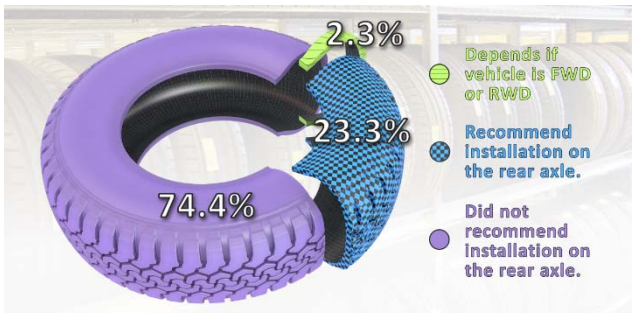
2010: When a customer insists on front placement!



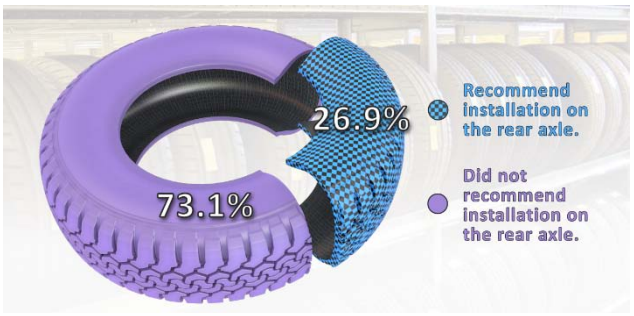
2011 When a customer insists on front placement!

Figure 4. Oral Survey Data showing response to Customer request.

Practical test data, shown in Figure 5, indicates that when a vehicle was presented for a two-tire installation, and the driver requested the new tire placement on the front axle, most tire stores did not make a recommendation for placement of the new tires on the rear axle. 74% of 2010 tire stores tested did not make a recommendation to install the new tires on the rear axle. Similarly, 73% of 2011 tire stores tested did not recommend new tire placement on the rear axle. This practical study confirms the results of the oral survey regarding customer request.



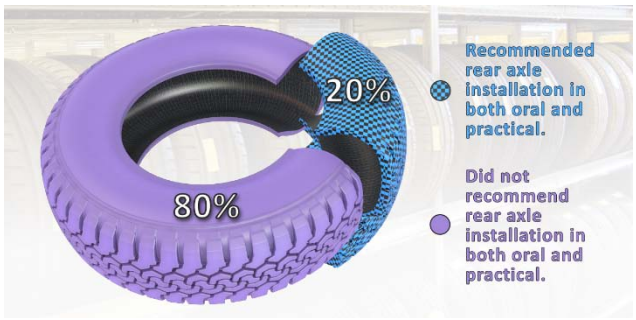
2010: Did not recommend rear axle installation when asked to install new on the front.



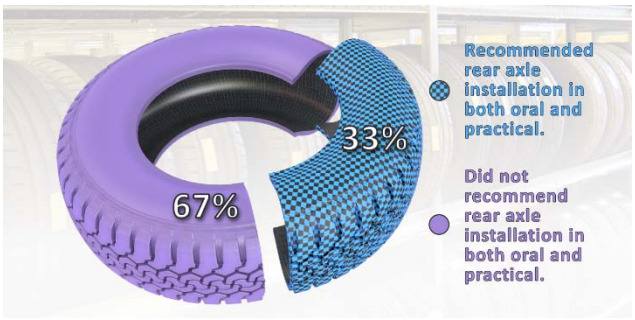
2011: Did not recommend rear axle installation when asked to install new on the front.

Figure 5. Practical Survey Data on Shop Recommendation.

A comparison analysis was performed of those tire stores that participated in both the oral survey questions and the practical test. Of those participants, 60 in total, 20% of 2010 participants said that the new tire installation should go on the rear during the oral survey and also made that recommendation during the practical test. 33% of 2011 participants responded with the recommendation on both the oral survey and the practical test. This comparison is shown in Figure 6, and confirmed that customer input was a significant factor in deciding tire placement when only installing two tires.



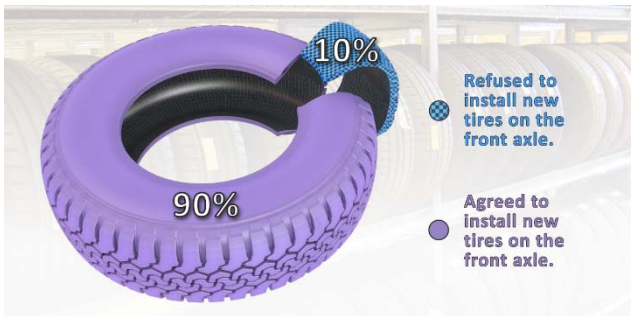
2010: Oral Recommendation versus Practical Recommendation



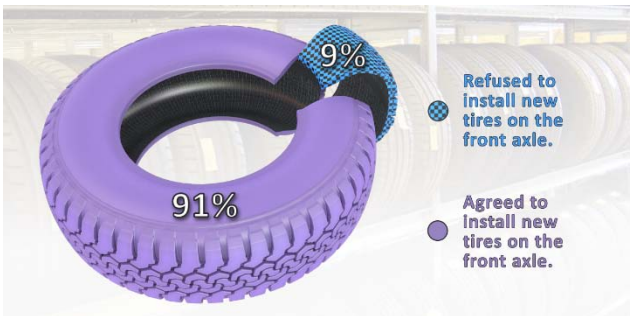
2011: Oral Recommendation versus Practical Recommendation

Figure 6. Comparison of the Oral survey data with the Practical evaluation data showed that a significant number of shops made the same recommendation in both cases.

After a test subject voiced the recommendation to install the new tires on the rear axle, the surrogate customer insisted that they be installed on the front axle of their vehicle. In this scenario, 10% of the 2010 test participants refused to install the tires as requested. Similarly, 9% of 2011 test participants also refused to install the tires on the front axle as requested. These data are shown in Figure 7. Figure 7 clearly shows that most tire stores will not refuse to sell the two new tires rather than place them on the front axle.



2010: Refused to install new tires on the front axle



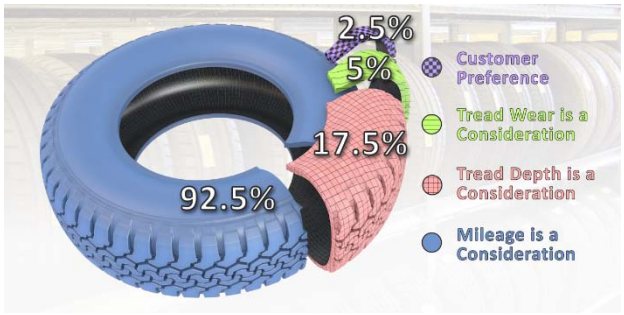
2011: Refused to install new tires on the front axle

Figure 7. Practical Survey Data on Shop Response to Customer Request after Recommendation.

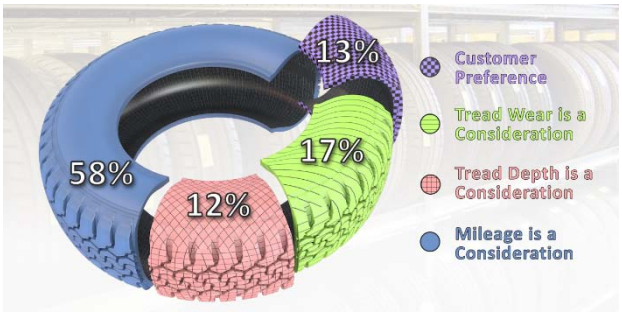
Both the oral and the practical data clearly show that complying with the customer's request to install new tires on the front axle takes precedence over the recommendation for installation of the new tires on the rear axle. Therefore, the installation of the new tires on the rear axle does not rise to the level of SOC, since it relies heavily on the wishes of the customer. Of note is that some tire companies, like Michelin, simply recommend that two new tires be installed on the rear axle "in the absence of a tire service professional's recommendation or consumer's preference to the contrary" [24], reflecting what actually occurs in practice.

Tire Rotation

Oral survey data regarding tire rotation practices indicates that most tire retail professionals said that they would rotate tires using various patterns that involved switching the mounted axle for each tire. The results of the oral surveys are shown in Figure 8. Generally, shops indicated they would rotate tires based on a mileage interval, typically 5,000 to 6,000 miles. Some tire professionals indicated that they would defer to the vehicle manufacturer's recommendations for the correct mileage interval for tire rotation. When asked, "What is your tire rotation recommendation based on?", 92% of 2010 participants identified mileage as a consideration. Similarly, 58% of 2011 participants identified mileage as a consideration.



2010: Rotation recommendation basis



2011: Rotation recommendation basis

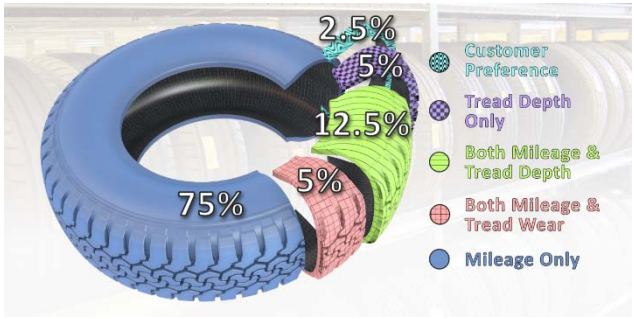
Figure 8. Oral Survey Data regarding Tire Rotation Criteria.

Practical Application of New on The Rear

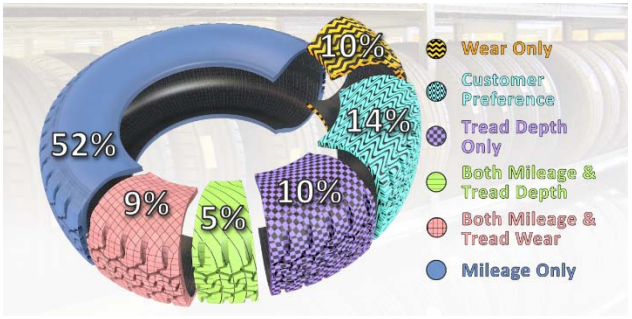
Vehicle design plays a role in whether or not "New on the Rear" can actually be accomplished. Many vehicles have different size tires on the front and on the rear. Others call out a particular tire for each wheel position, and as a result, no tire rotation can be accomplished under any circumstance. On such vehicles, when a tire needs

replacement, the new tire will always be placed in the position of the tire it replaces. These data do not include vehicles of this type.

The field study data shown further challenges the practical application of new on the rear when compared with preventative maintenance recommendations published by vehicle manufacturers. When asked, 75% of 2010 and 52% of 2011 survey participants indicated that they would rotate tires based on a mileage interval, regardless of the tread depths on the tires on the vehicle. These data are shown in Figure 9.



2010: Rotation on mileage only



2011: Rotation on mileage only

Figure 9. Field Survey Results on the Basis of Tire Rotation.

Figure 9 clearly shows that mileage is the predominant criterion service providers use in recommending tire rotation. Tread depth is minor consideration used by 5-10% of shops surveyed. Therefore, in a case where two new tires have been placed on the rear axle, refusing to rotate the tires after that point cannot be considered the SOC. Furthermore, any anti-hydroplaning benefit from placing new tires on the rear axle of a vehicle only lasts until the first tire rotation. Given equal wear rates for all the tires installed on the vehicle, following the manufacturer's recommended tire rotation interval would, therefore, place the less worn tires on the front axle for approximately 50% of the time. In the instances where two new tires are paired with two tires having 30% to 50% tread wear, the tread depth difference could be significant. Tire makers generally recommend replacement of all the tires on the vehicle at the same time. This approach completely eliminates the problems associated with follow-on tire rotations at the potential expense of scrapping a pair of tires that may have 50% or more useable tread remaining.

Conclusions

The SOC in the tire service industry has no specific legal definition. However, it is reasonable to expect that experts offering legal testimony on the SOC should be able to provide scientifically and/or statistically valid bases for their opinions. Any SOC must have scientific support, industry support, and be widely practiced. Clearly, many of the current SOC issues in the tire service industry are industry-supported and are consensus-based guidelines. What is clearly missing is the determination of how widely used the practice might be.

The data presented here challenge the notation that the recommendation to install two new tires on the rear axle is a SOC. It shows that, in day to day operation, tire professionals install new tires on the front for a variety of reasons, including customer preference, and that the placement of the tire with the deepest tread on the rear axle is a

temporary placement at best. Inconsistency in tire industry and vehicle manufacturer recommendations, i.e. placement and rotation recommendations, further undermine the notion that placement of new tires on the rear is the SOC.

With regards to chronological age, these data indicate that the criteria for inspection of those tires that will remain on the vehicle during a two-tire installation is largely predicated on the outward appearance of those particular tires. The chronological age of the tire as a criterion does not appear to be widely used in this regard. Furthermore, using the date of manufacture is inherently flawed when you consider tire stores' sales policies. Recall that 62% of tire stores said they would sell a tire up to 3 years old based on the date of manufacture. Because the new uninflated and properly stored tire does not substantially begin its oxidative aging process until mounted and inflated, this tire is still effectively new when sold. This presents a contradiction with regard to useful life, whether it be a mileage guarantee or calendar time guarantee when the date of manufacture is used to determine the chronological age.

These data support the conclusion that tire industry recommendations discussed above are likely consensus-based guidance for best practice, and that these recommendations do not rise to the level of a SOC. Ultimately, a court will decide if the facts of any legal matter at hand, along with the support of scientific study results like those presented here, prove or disprove negligence of the Standard of Care in any court case

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