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The Performance Requirements of DIN 18032 Part II

This article provides a summary of the requirements of both the DIN standard 18032 Part II (1991), and of the DIN pre-standard 18032 Part II (2001). This article also explains the difference between the standard and the pre-standard, and the reasons for the development of the pre-standard. For a description of the performance criteria presented in this article readers should refer to ***The Performance Criteria of DIN 18032 Part II*** *(Document Number DIN-001).*

This article is a follow-up to *The Performance Criteria of DIN 18032 Part II (Document Number DIN-001)*, in which the performance criteria from DIN 18032 Part II are outlined. If you have been involved in selecting a sport surface system since 1999 you may have heard about systems that 'meet DIN' and systems that meet 'the New DIN.' This article will explain the requirements specified in the 1991 DIN 18032-2 Standard, as well as the requirements specified in the 2001 DIN 18032-2 Pre-standard (commonly referred to the 'New DIN.') In addition this article will also explore the differences between the two versions, and explain how two versions have come to exist.

1. Why do two versions exist?

To put it simply one version of the standard exists and one version of the pre-standard exists. Within Germany, the pre-standard has replaced the 1991 version of the standard. Outside of Germany, the acceptance of the pre-standard is less uniform.

1.1. The Formation of the European Union

The European Union (hereafter referred to as the EU) was formed to promote commerce and travel between union member countries. The formation of the EU was supposed to be accompanied by the development of Central European Norms (or standards). These Central European Norms (hereafter referred to as CEN for short) were supposed to provide manufacturers with standards that would apply to all EU member nations.

The EU/CEN is actually the reason two versions of the standard exist. EU member nations agreed not to modify existing standards or to develop standards if CEN maintained a standing committee relating to the same product or area*[1]*.

Work on the development of a CEN sports surface standard actually was initiated in the early 1989*[2]*. The process of standardization moves slow within a single country, and the CEN committee was bogged down with delegations from several countries, the interests of various manufactures, and no doubt politics.

While Germany was and is bound by this agreement, they started to draft a new version of the standard as early as 1997 within their own standardization body, DIN. The hope was that the CEN would soon adopt a standard; DIN could then adopt their revisions. However, the CEN process has become a stalemate that has lasted more than a decade. During this time, numerous drafts of the revised DIN standard were circulated to test labs throughout Germany and Europe for comment.

As test labs received the drafts, they adopted the methods and requirements outlined in the draft. By 1999 it was apparent that DIN needed to do something to ensure uniform evaluation methods, but adopting the draft as the official standard was not allowed by the EU. DIN then decided to adopt the draft as a pre-standard. The adoption of the pre-standard in 2001 allowed the exact methods to be published and distributed to all test labs, thus providing a consistent testing basis for all materials tested for sale in Germany. The 2001 pre-standard replaces the 1991 standard within Germany.

1.1.1. The Source of Disagreement

A large number of the countries in the EU have national standards and requirements for indoor sports surfaces. While the methods and

the criteria that are considered important vary from country to country they all have some characteristics in common.

All of the tests are mechanical, and thus highly repeatable. Most of the countries have a long history (20-30 years) with their own national standard, and thus a thorough understanding of the information gathered in their tests. Because no study has ever found that sports surfaces that conform to a standard are safer than sports surfaces that do not confirm to a standard there is no standard within the international community that is clearly better than any other standard*[2]*.

Generally speaking, the CEN sports surface committee members has been asking each other, “Why should we give up our standard for your standard, when your’s is no better than ours?” This attitude has been the root cause of the delay in the adoption of a CEN standard on sports surfaces, and has caused the process to drag on for nearly 15 years now. Estimates are that the debate will continue for at least another 2 years and perhaps even another 15 years.*[2]*

2. What are the performance requirements of the two versions?

This section summarizes the requirements of the two versions of DIN 18032 currently being promoted in North America, and outlines the differences between the two versions. One version is the 1991 DIN 18032 part II *standard*, and the other version is the 2001 DIN 18032 part II *pre-standard*.

2.1. Requirements of DIN Standard 18032 Part II (1991)

It seems appropriate to first outline the requirements of the standard. After the standard has been outlined, the pre-standard will be compared to the standard.

In General there are three types of systems covered under the standard issued in 1991*[3]*:

- Area Elastic Systems - Systems with wood playing surfaces fall into this category. This category gets its name because an area significantly larger than the contact point is put into motion during impact.
- Point Elastic Systems - Synthetic playing surfaces installed on concrete fall into this category. This category gets it name because only a small contact area, or point, is displaced during an impact.
- Combination Systems - Synthetic playing surfaces installed over a resilient wood subfloor fall into this category. They represent a combination of area and point elastic systems with the point elastic portion forming the playing surface.

Each system type has different performance requirements under the DIN 18032 standard and pre-standard. Table 1 shows the requirements for each of the three system types using the DIN standard 18032 part II (1991). The values listed in Table 1 are applied only to the average performance of the entire system. This means that individual points can produce results that fall outside of these limits and the system will pass as long as the average of all points tested meets the requirements.

Table 1: Requirements for DIN Standard 18032 Part II (1991)*[3]*

	Area Elastic	Point Elastic	Combination
Force Reduction (min)	53%	51%	58%
Ball Rebound (min)	90%	90%	90%
Vertical Deformation (mm)	2.3min	3.0 max	3.0 min 5.0 max
Area Indentation (max)	15 %	-	5 %
Direction I	No Limit	No Limit	No Limit
Direction II	No Limit	No Limit	No Limit
Rolling Load	1500 N	1000 N	1500 N
Slip Resistance	0.5 min 0.7 max	0.5 min 0.7 max	0.5 min 0.7 max

2.2. Requirements of DIN pre-standard 18032 Part II (2001)

The pre-standard established a fourth major type of sport surface. It is defined as a mixed

system*[4]*. While it is defined as a new category, it maintains the same overall averages as those listed in Table 1 for area elastic surfaces, with the exception that the area indentation measured at 500 mm must be greater than 0%.

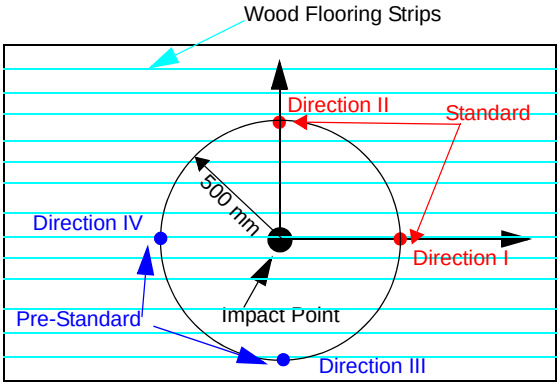
- Mixed Systems - This is a system that produces an area indentation between those of area and point elastic floors. Mixed systems are, at this time, almost exclusive to the German sports surfacing market.

Other than the introduction of a new classification of sports surface, the pre-standard does not make changes to the average requirements listed in Table 1. Significant changes were made in the evaluation of area indentation and in the importance of the performance at each test point.

2.2.1. Area Indentation

The 2001 pre-standard specifies that the area indentation is to be measured in a total of four directions (2 more than the 1991 standard requires)*[3,4]*. The figure below illustrates the directions that have been added to the pre-standard.

The 2001 pre-standard requires that the limits outlined in Table 1 are applied to the overall average area indentation of the system, and to each individual test point. The pre-standard places additional requirements on the maximum area indentation allowed in any single direction. This is also applied to the overall average and to individual test points.



2.2.2. Slip Resistance

The range of slip resistance has been reduced in the pre-standard from 0.5-0.7 to 0.4 to 0.6*[3,4]*. This is the only limit that has actually been changed from the standard to the pre-standard.

2.2.3. Point Based Evaluation

The pre-standard places a significant importance on the performance at each test point. Failure at any evaluation point results in failure according to the pre-standard.

Each system type has specific requirements under the pre-standard. Table 2 contains an outline of the differences between the standard and the pre-standard for area-elastic sports surfaces. Table 2 appears complex, but upon evaluation it becomes apparent that there are only four differences between the standard and the pre-standard, all of which have been discussed in prior sections:

- Performance limits applied to each test point
- Two additional directions for evaluation of area indentation
- Maximum limits set on area indentation in all directions.
- Minor change to allowable friction coefficient values

3. Which version is better for North America?

North America has no standard method or performance criteria for indoor sports surface systems, so evaluation under either version of DIN 18032 part II is voluntary. Purchasers will find systems promoted under compliance with the 2001 pre-standard, under compliance with the 1991 standard, and even under partial compliance of the 1991 standard.

Table 2: Differences Between DIN 18032 Part II (1991) and DIN 18032 Part II PreNorm (2001)[3,4]

Criteria	DIN 18032 Part II Standard (1991)	DIN 18032 Part II Pre-Standard (2001)
Vertical Deflection		
Average - Total Floor	Minimum 2.3 mm	
Average - Each Point	No Limit	Minimum 2.3 mm
Area Deflection		
Average - Total Floor	**Maximum Value 15 %**	
Average - Each Point	No Limit	Maximum 15 %
Direction I	No Limit	Maximum of 20%
Direction II	No Limit	Maximum of 20%
Direction III	Not Measured	Maximum of 20%
Direction IV	Not Measured	Maximum of 20%
Force Reduction		
Average - Total Floor	**Minimum Value 53%**	
Average - Each Point	No Limit	Minimum 53%
Ball Rebound		
Average - Total Floor	**Minimum 90%**	
Average - Each Point	No Limit	Minimum 90%
Slip Resistance	0.5 min 0.7 max	0.4 min 0.6 max

3.1. Area Indentation Significance

Area indentation has always been the most difficult performance limit to meet for sports surfaces using the traditional North American strip flooring. There are three schools of thought regarding area indentation's significance in North America.

The first group of people feel that it is completely inappropriate for North America given the differences in the typical loads applied on North American floors versus German or European Sports Surfaces. This group tends to support marketing surfaces based solely on the force reduction and ball rebound results.

A second group accepts that area indentation is a significant requirement but that it is no more significant than any of the other parameters. This group tends to support marketing of sports surfaces in North America using the 1991 Standard. In the 1991 standard, area indentation, vertical deflection, force reduction and ball rebound are equally weighted in the evaluation of the sports surface because only the average value of each is used to determine compliance with the standard.

The third and final group feel that Area Indentation is the critical component for the design of a sports surface. This group tends to support marketing of sports surfaces in North America using the 2001 Pre-Standard. Essential, the 2001 standard takes the position that area indentation is 5 times more significant than the individual vertical deflecting, force reduction, and ball rebound parameters. This is because the 2001 standard places limits on the average area indentation in each of the *four* directions, as well as on the *average* value. This results in 5 different places where a sports surface can fail area indentation requirements.

There is little to no agreement as to which group is correct. While the Maple Flooring Manufacturer's Association (or MFMA) now states that all of the parameters outlined in DIN 18032 Part II are to be desirable in a sports surface, they can find now situation where it is considered an important characteristic*[5]*. The fact that the parameter is considered 'desirable' in a sports surface, yet there was no sport were it was found a critical characteristic indicates some division within North America.

The North American market places design requirements on sports surfaces that are uniquely different than those imposed in

Europe. North American floors frequently support, portable back-stops, and man-lifts used for various maintenance activities. Levels that are appropriate for Europe may not be appropriate for North America. **Example:** Consider a floor that produces the minimum allowable vertical deflection of 2.3 mm. A deflection 500 mm from the impact point of 0.32 mm (0.013 in) will produce an passing area indentation of 14%. An increase in the deflection 500 mm from the impact point of just 0.07 mm (0.003 in) will result in a failing area indentation of 17%.

The previous example is actually quite conservative because, a difference of 1% or 0.02 mm (0.001 in) can be the difference between passing and failing the area indentation portion of DIN 18032 Part II. The pre-standard makes the difference between passing and failure even smaller by applying these differences to each point instead of to the average.

3.2. Uniformity

The Pre-standard is often presented by stating that it promotes uniformity, however with exception of area indentation, the 2001 pre-standard does not ensure that systems that meet its requirements are more uniform than those that met the 1991 standard. **Example:** Consider the force reductions from the two systems shown in Table 3. The results show that while only Floor B meets the limits specified in the 2001 pre-standard, the pre-standard does not ensure that the floor will be more uniform (note the larger range for Floor B), only that it will likely have to be designed to produce an increased level of force reduction in order to ensure that even the hardest point exceeds the standard.

Table 3: Uniformity Example, Using Force Reduction

	Floor A	Floor B
	FR	FR
Point 1	50 %	53 %
Point 2	52 %	60 %
Point 3	55 %	65 %
Point 4	60 %	55 %
Average	54 %	58 %
Range	10 %	12 %
1991 Result	Pass	Pass
2001 Result	Fail	Pass

The same general trend that has been used to examine force reduction uniformity can be presented for ball rebound, and vertical deflection.

The 2001 per-standard addresses the uniformity of area indentation by measuring in four primary directions, and by placing a maximum limit on all directions. However, it is unknown that this promotes systems that meet the demands of the North American marketplace.

3.3. DIN 18032 Part II and Safety

At this time no study or publication has been found that links a sports surface's compliance with the standard or pre-standard to a reduction in injuries. In fact, no study or publication has been found that links a sports surface's compliance to any standard or test method to a reduction in injuries. Likewise, no study linking floors in compliance with the 2001 pre-standard with improved safety compared to floors meeting the 1991 standard.

There are no guarantees that a system meeting all of the requirements of the DIN standard will reduce injuries. Specifiers should consider both the standard and pre-standard an indicator of athlete comfort not an indicator of athlete safety.

4. Conclusions

This paper has outlined the differences between the 1991 and the 2001 versions of DIN 18032 Part 2 in as concise a manner as possible. Owners, architects and selection committees have always had the final say in deciding the importance that DIN 18032 Part II will play in their individual job specification within North America. This paper was developed as a tool for these groups to use in their decision making process.

This publication is provided by ASET Services, Inc. ASET Services is committed to providing engineering and testing services to the sports surfacing industry. For further information contact ASET Services through one of the following methods:

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