



**Title:** Anti-slip test Envirodeck™

**Report code:** 8.233-AS

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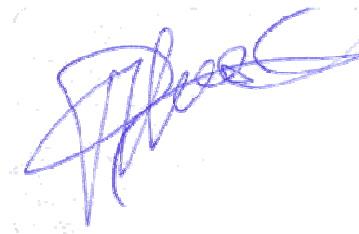
Appendices: 1

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Entries: Envirodeck™, Anti-slip test, DIN 51131,  
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## Summary

Fiberplast B.V. commissioned SHR to determine the slip resistance of Envirodeck™ and special Envirodeck™ with sanded surface, intended to be applied for decking with improved anti-slip resistance and compare this characteristic with Bankirai, a wood species commonly used for decking.

Based on the results achieved in this study it can be concluded that:

The friction coefficients found for leather on Envirodeck™ were found within the same range as found for Bankirai. The friction coefficients found for rubber on Envirodeck™ were somewhat lower compared to the Bankirai surface. For Rubber, according to the described guideline, for both wet and dry conditions all measured friction coefficients indicated a safe surface. For leather under all conditions the indication was “conditionally safe”, with the exception of Envirodeck™ on the dry surface, the indication was found unsafe ( $\mu < 0.30 = \text{unsafe}$ ).

The special treated Envirodeck™ boards with an anti slip layer (sanded surface) showed very high friction coefficients (all  $> 0.70$ ), under all conditions and for both rubber and leather the surface is classified as safe. For a surface to be classified as “safe” a dynamic friction coefficient of 0.45 or higher is required.

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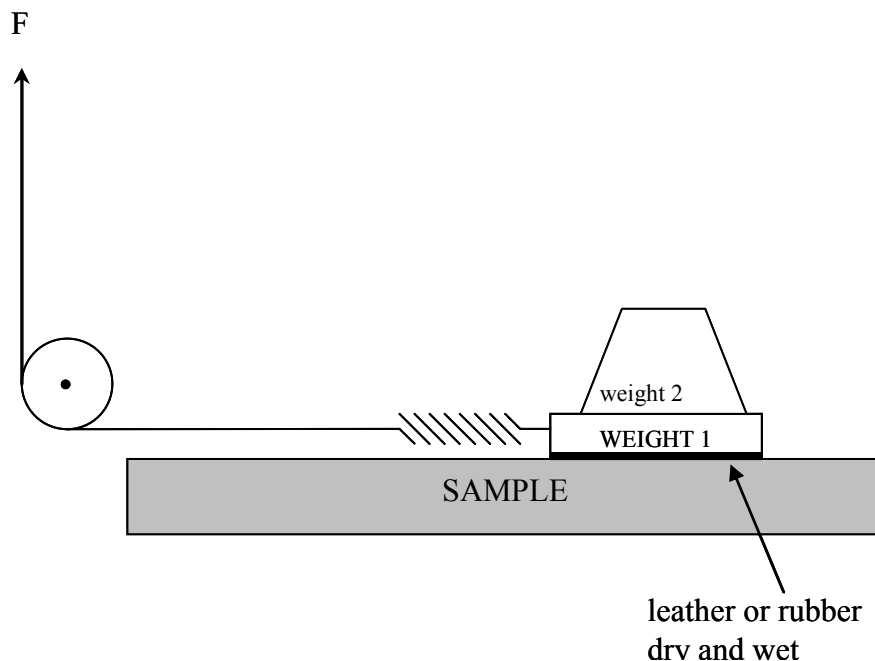
## 1 Assignment

May 27<sup>th</sup>, 2009 SHR was commissioned to perform anti-slip tests on Envirodeck™, sanded-Envirodeck™ and Bankirai. Fiberplast B.V. requested SHR to determine the slip resistance of Envirodeck™ and special Envirodeck™ with sanded surface, intended to be applied for decking with improved anti-slip resistance and compare this characteristic with Bankirai, a wood species commonly used for decking.

## 2 Method and Materials

The tests were performed according to the standard DIN 51131 with minor modifications in the performance with respect to sample sizes and test facilities set-up.

A testing mass with sliders (leather or rubber) was used. The slider, with a defined force on the sample surface, is pulled over that surface with a constant velocity (see figure 1). The force, necessary to move the mass, is recorded along a distance of 500 mm. The friction coefficient ( $\mu$ ) is calculated from the ratio of that force to the applied vertical force. The mean friction coefficient ( $\mu$ ) is based on the mean Force ( $F$ ) within the dynamic area of the measuring distance (see figure 2).



**Figure 1:** Set up of slipperiness test

The force was recorded and load-time curves of the slipperiness test of all measurements were made. From the results the static and dynamic coefficients of friction were calculated. The assessment of the friction coefficient  $\mu$  estimated according to DIN 51131 was done according to the “Dresdner parameters for the sliding safeness of surface coverings at operation state”; after the agreements of the expert committee Building Constructions, subject group “Coverings, stairs” of the association of commercial and industrial workers compensation insurance carriers (HVBG) from May 2000. For dry conditions, the following guideline is used:

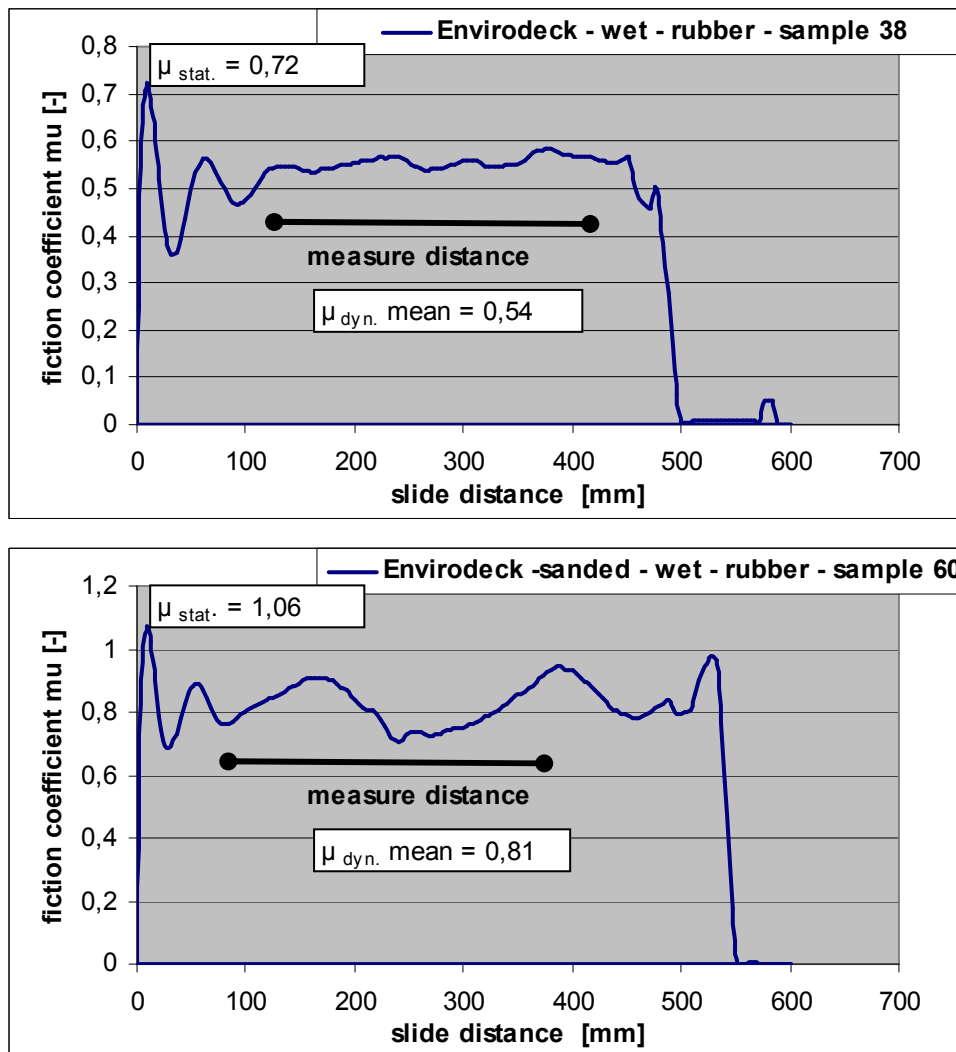
- $\mu < 0.30$  = unsafe (not rough enough)
- $0.30 \leq \mu \leq 0.45$  = conditionally safe
- $\mu > 0.45$  = safe

The tests were performed on:

- 10 boards of Envirodeck™ and 10 boards of sanded-Envirodeck™ and 10 boards of Bankirai.
- two sides of each 5 boards were measured: broad profile side and the slim profile side;
- the testing was performed for dry conditions and for wet conditions of the board samples using the rubber foot and the leather foot;
- per side and condition 3 measurements were performed, totally 300 measurements were performed.

### 3 Results and discussion

Two results out of the total 300 results of the slide test are shown in figure 2. These examples show the results of Envirodeck™ and Envirodeck™-sanded samples under wet condition tests with the “rubber foot”. Results of all individual samples can be found in appendix 1.



**Figure 2.** Friction coefficient – distance diagrams of two anti-slip tests (above Envirodeck™; below Envirodeck™ – sanded), both measured with rubber foot under wet conditions.

The average results of anti-slip testing of Kebony Maple and Teak under different conditions are shown in table 1.

**Table 1.** Average results of anti-slip testing of Envirodeck™ and Bankirai under different conditions.

μ-values		surface	test conditions			
			Dry		Wet	
Static			Leather	Rubber	Leather	Rubber
	Bankirai	Broad	0,68	0,81	0,71	0,83
		Slim	0,67	0,87	0,67	0,88
	Envirodeck™	Broad	0,58	0,70	0,72	0,71
		Slim	0,59	0,73	0,68	0,73
		Sanded	0,97	1,11	1,17	1,12
	Dynamic			Leather	Rubber	Leather
Bankirai		Broad	0,30	0,65	0,36	0,65
		Slim	0,36	0,72	0,36	0,72
Envirodeck™		Broad	0,24	0,47	0,41	0,49
		Slim	0,23	0,47	0,32	0,42
		Sanded	0,70	0,70	0,87	0,80
<i>all friction coefficients based on 15 independant measurements</i>						

## 4 Conclusion

Considering the dynamic friction coefficient shown in table 1 it can be concluded that:

The friction coefficients found for leather on Envirodeck™ were found within the same range as found for Bankirai. The friction coefficients found for rubber on Envirodeck™ were somewhat lower compared to the Bankirai surface. For Rubber, according to the described guideline, for both wet and dry conditions, all measured friction coefficients indicated a safe surface. For leather under all conditions the indication was “conditionally safe”, with the exception of Envirodeck™ on the dry surface, the indication was found unsafe ( $\mu < 0.30 = \text{unsafe}$ ).

The special treated Envirodeck™ boards with an anti slip layer (sanded surface) showed very high friction coefficients (all  $> 0.70$ ), under all conditions and for both rubber and leather the surface is classified as safe. For a surface to be classified as “safe” a dynamic friction coefficient of 0.45 or higher is required.

## Literature

DIN 51131, June 2006, Prüfung van Bodenbelägen – Bestimmung der rutschhemmenden Eigenschaften – Verfahren zur Messung des Gleitreibskoeffizienten.

**Appendix 1: Detailed results of the anti-slip test: DIN 51131**

Bankirai dry	Leather						Rubber					
	Broad			Slim			Broad			Slim		
	no.	$\mu$ stat.	$\mu$ dyn.	no.	$\mu$ stat.	$\mu$ dyn.	no.	$\mu$ stat.	$\mu$ dyn.	no.	$\mu$ stat.	$\mu$ dyn.
1	0,724	0,236	16	0,432	0,117	31	0,726	0,564	46	0,682	0,641	
2	0,688	0,250	17	0,590	0,270	32	0,884	0,707	47	0,863	0,690	
3	0,565	0,119	18	0,557	0,278	33	0,900	0,696	48	0,882	0,710	
4	0,764	0,381	19	0,532	0,222	34	0,911	0,700	49	0,808	0,660	
5	0,749	0,281	20	0,822	0,326	35	0,726	0,563	50	0,934	0,691	
6	0,633	0,249	21	0,595	0,200	36	0,713	0,573	51	0,856	0,620	
7	0,528	0,090	22	0,655	0,410	37	0,663	0,603	52	0,797	0,682	
8	0,694	0,318	23	0,837	0,593	38	0,756	0,562	53	0,976	0,782	
9	0,897	0,488	24	0,726	0,443	39	0,838	0,614	54	0,846	0,742	
10	0,648	0,434	25	0,792	0,508	40	0,694	0,645	55	0,920	0,769	
11	0,728	0,493	26	0,815	0,632	41	0,945	0,776	56	0,868	0,792	
12	0,815	0,515	27	0,801	0,538	42	1,031	0,844	57	0,871	0,726	
13	0,607	0,265	28	0,539	0,172	43	0,788	0,638	58	0,894	0,705	
14	0,567	0,221	29	0,695	0,375	44	0,770	0,618	59	0,922	0,749	
15	0,600	0,207	30	0,615	0,300	45	0,816	0,689	60	0,974	0,855	
<b>mean</b>	<b>0,680</b>	<b>0,303</b>	<b>mean</b>	<b>0,667</b>	<b>0,359</b>	<b>mean</b>	<b>0,811</b>	<b>0,653</b>	<b>mean</b>	<b>0,873</b>	<b>0,721</b>	

Bankirai wet	Leather						Rubber					
	Broad			Slim			Broad			Slim		
	no.	$\mu$ stat.	$\mu$ dyn.	no.	$\mu$ stat.	$\mu$ dyn.	no.	$\mu$ stat.	$\mu$ dyn.	no.	$\mu$ stat.	$\mu$ dyn.
1	0,909	0,588	16	0,432	0,117	31	0,726	0,564	46	0,834	0,644	
2	0,952	0,679	17	0,590	0,270	32	0,884	0,707	47	0,863	0,690	
3	0,565	0,119	18	0,557	0,278	33	0,900	0,696	48	0,882	0,710	
4	0,764	0,380	19	0,532	0,222	34	0,911	0,700	49	0,781	0,617	
5	0,749	0,281	20	0,822	0,326	35	0,726	0,563	50	0,934	0,691	
6	0,633	0,249	21	0,595	0,200	36	0,713	0,573	51	0,856	0,620	
7	0,528	0,090	22	0,655	0,410	37	0,799	0,589	52	0,797	0,682	
8	0,694	0,318	23	0,837	0,591	38	0,756	0,562	53	0,976	0,782	
9	0,897	0,488	24	0,726	0,443	39	0,838	0,614	54	0,846	0,742	
10	0,648	0,434	25	0,792	0,508	40	0,827	0,640	55	0,920	0,769	
11	0,728	0,493	26	0,815	0,632	41	0,945	0,776	56	0,868	0,792	
12	0,815	0,515	27	0,801	0,538	42	1,031	0,844	57	0,871	0,726	
13	0,607	0,265	28	0,539	0,172	43	0,788	0,638	58	0,894	0,705	
14	0,567	0,221	29	0,695	0,375	44	0,770	0,618	59	0,922	0,749	
15	0,600	0,207	30	0,615	0,300	45	0,816	0,689	60	0,974	0,855	
<b>mean</b>	<b>0,710</b>	<b>0,355</b>	<b>mean</b>	<b>0,667</b>	<b>0,359</b>	<b>mean</b>	<b>0,829</b>	<b>0,652</b>	<b>mean</b>	<b>0,881</b>	<b>0,718</b>	

Envirodeck™ dry	Leather						Rubber					
	Broad			Slim			Broad			Slim		
	no.	μ stat.	μ dyn.	no.	μ stat.	μ dyn.	no.	μ stat.	μ dyn.	no.	μ stat.	μ dyn.
1	0,549	0,219	16	0,582	0,222	31	0,643	0,405	46	0,758	0,472	
2	0,574	0,220	17	0,569	0,214	32	0,687	0,442	47	0,709	0,436	
3	0,548	0,220	18	0,593	0,255	33	0,675	0,461	48	0,820	0,534	
4	0,600	0,245	19	0,569	0,227	34	0,708	0,430	49	0,626	0,451	
5	0,548	0,203	20	0,582	0,244	35	0,724	0,449	50	0,730	0,464	
6	0,563	0,243	21	0,553	0,193	36	0,698	0,465	51	0,712	0,443	
7	0,594	0,237	22	0,606	0,224	37	0,787	0,504	52	0,738	0,432	
8	0,561	0,230	23	0,615	0,235	38	0,723	0,457	53	0,743	0,475	
9	0,577	0,251	24	0,607	0,222	39	0,704	0,462	54	0,823	0,513	
10	0,571	0,245	25	0,555	0,181	40	0,592	0,477	55	0,723	0,457	
11	0,621	0,240	26	0,559	0,234	41	0,742	0,512	56	0,708	0,476	
12	0,618	0,259	27	0,587	0,222	42	0,802	0,523	57	0,783	0,458	
13	0,620	0,251	28	0,614	0,231	43	0,694	0,499	58	0,663	0,440	
14	0,603	0,258	29	0,620	0,247	44	0,678	0,505	59	0,751	0,482	
15	0,607	0,251	30	0,576	0,228	45	0,698	0,478	60	0,711	0,468	
<b>mean</b>	<b>0,584</b>	<b>0,238</b>	<b>mean</b>	<b>0,586</b>	<b>0,225</b>	<b>mean</b>	<b>0,704</b>	<b>0,471</b>	<b>mean</b>	<b>0,733</b>	<b>0,467</b>	

Envirodeck™ wet	Leather						Rubber					
	Broad			Slim			Broad			Slim		
	no.	μ stat.	μ dyn.	no.	μ stat.	μ dyn.	no.	μ stat.	μ dyn.	no.	μ stat.	μ dyn.
1	0,661	0,348	16	0,681	0,292	31	0,664	0,343	46	0,872	0,440	
2	0,649	0,371	17	0,679	0,258	32	0,631	0,401	47	0,723	0,396	
3	0,672	0,409	18	0,688	0,328	33	0,727	0,479	48	0,787	0,437	
4	0,713	0,365	19	0,673	0,309	34	0,662	0,377	49	0,677	0,403	
5	0,646	0,382	20	0,646	0,310	35	0,741	0,471	50	0,689	0,412	
6	0,703	0,381	21	0,618	0,279	36	0,660	0,474	51	0,719	0,399	
7	0,849	0,508	22	0,705	0,321	37	0,609	0,510	52	0,743	0,392	
8	0,800	0,500	23	0,758	0,393	38	0,720	0,538	53	0,715	0,439	
9	0,826	0,455	24	0,706	0,366	39	0,800	0,535	54	0,789	0,435	
10	0,768	0,409	25	0,683	0,311	40	0,651	0,547	55	0,685	0,428	
11	0,730	0,399	26	0,654	0,314	41	0,702	0,553	56	0,693	0,445	
12	0,722	0,441	27	0,667	0,338	42	0,738	0,537	57	0,732	0,435	
13	0,716	0,427	28	0,662	0,316	43	0,823	0,546	58	0,714	0,447	
14	0,716	0,418	29	0,685	0,306	44	0,756	0,589	59	0,754	0,428	
15	0,701	0,352	30	0,705	0,331	45	0,782	0,497	60	0,700	0,436	
<b>mean</b>	<b>0,725</b>	<b>0,411</b>	<b>mean</b>	<b>0,681</b>	<b>0,318</b>	<b>mean</b>	<b>0,711</b>	<b>0,493</b>	<b>mean</b>	<b>0,733</b>	<b>0,425</b>	

Envirodeck™ sanded	Leather						Rubber					
	dry			wet			dry			wet		
	no.	$\mu$ stat.	$\mu$ dyn.	no.	$\mu$ stat.	$\mu$ dyn.	no.	$\mu$ stat.	$\mu$ dyn.	no.	$\mu$ stat.	$\mu$ dyn.
<b>sanded</b>	1	1,030	0,837	16	1,155	0,818	31	0,943	0,613	46	1,045	0,802
	2	1,067	0,671	17	1,108	0,666	32	1,065	0,627	47	1,172	0,794
	3	1,045	0,777	18	1,257	0,893	33	1,091	0,666	48	1,306	0,776
	4	1,073	0,717	19	1,211	0,865	34	1,048	0,791	49	1,057	0,777
	5	1,095	0,690	20	1,135	0,827	35	1,204	0,729	50	1,030	0,770
	6	0,959	0,709	21	1,252	0,950	36	1,055	0,696	51	0,992	0,781
	7	0,957	0,781	22	1,025	0,761	37	0,978	0,638	52	1,127	0,784
	8	0,776	0,516	23	1,093	0,902	38	0,908	0,700	53	1,051	0,805
	9	0,849	0,670	24	1,203	0,998	39	1,228	0,702	54	1,287	0,834
	10	0,953	0,657	25	1,244	0,892	40	1,301	0,760	55	1,112	0,826
	11	0,775	0,579	26	1,179	0,905	41	1,173	0,752	56	1,085	0,790
	12	0,923	0,684	27	1,302	0,879	42	1,081	0,521	57	1,214	0,809
	13	0,964	0,721	28	1,119	0,901	43	1,078	0,786	58	0,950	0,820
	14	0,988	0,765	29	1,151	0,871	44	1,183	0,721	59	1,316	0,886
	15	1,148	0,768	30	1,066	0,915	45	1,326	0,824	60	1,066	0,811
<b>mean</b>	<b>0,974</b>	<b>0,703</b>	<b>mean</b>	<b>1,167</b>	<b>0,870</b>	<b>mean</b>	<b>1,111</b>	<b>0,702</b>	<b>mean</b>	<b>1,121</b>	<b>0,804</b>	