Test Report

CEN/TS 15083-2

Report No.: 152690-2

DANISH TECHNOLOGICAL INSTITUTE

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Assignor: WTT Service APS
Heimdalsvej 14
7200 Grindsted

Material: WTT hybrid FA was treated at Danish Technological Institute for the assignor prior to this test. The wood was treated with 20% furfurylic alcohol (FA) at 130 ºC on the 19-05-2022. WTT hybrid FA was ready for testing on 01-09-2022.

Period: The testing was carried out from 01-09-2022 to 17-07-2023.

Methods: CEN/TS 15083-2, 2005: *Durability of wood and wood-based products – Determination of natural durability of solid wood against wood-destroying fungi, test methods – Part 2: Soft rotting micro-fungi.*

EN 84, 2020: *Durability of wood and wood-based products - Accelerated ageing of treated wood prior to biological testing - Leaching procedure*.

MOE according to EN 310, 1994: *Wood-based panels – Determination of modulus of elasticity in bending strength.*

Durability classes according to EN 350; 2016: *Durability of wood and wood-based products – Testing and classification of the durability to biological agents of wood and wood-based materials.*

Result: Durability classification according to EN 350; 2016.

X-value according to EN 350 (2016)

	WTT hybrid FA (130 °C, 20%)
Median loss in MOE	0.00
x-value (MOE)	0.00
Durability class	1
Description	Very durable

Storage: The test material will be destroyed after 3 months, unless otherwise agreed.

Terms: Accredited testing was carried out in compliance with international requirements (EN/ISO/IEC 17025:2017) and in compliance with Danish Technological Institute's General Terms and Conditions regarding Commissioned Work accepted by Danish Technological Institute. The test results apply to the tested products only. This report may be quoted in extract only if the laboratory has granted its written consent.

Note: The interpretation and practical conclusions that can be drawn from a test report demand a specialized knowledge of wood preservation and, for this reason, the test report cannot of itself constitute an approval certificate.

Date/place: 20-07-2023, Danish Technological Institute, Wood Technology, Taastrup

Signature:

Test responsible

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Detailed information

Wood Species:	Scots pine sapwood (*Pinus sylvestris* L.). Average density 645 kg/m^3
Wood under test:	WTT Hybrid FA
Visual description of wood under test:	Dark brown. The samples were free from cracks, stain, knots and are even grained.
Sampling regime:	30 samples were cut from 5 different EN 252:2014 samples.
Ageing test:	EN 84, 2020: *Durability of wood and wood-based products - Accelerated ageing of treated wood prior to biological testing - Leaching procedure*. The ageing was carried out at The Danish Technological Institute from 06-10-2022 to 19-10-2022
Test soil:	Pindstrup så-og priklemuld (sowing and pricking soil) WHC 58% pH 5.
Date of MOE before exposure	19-09-2022
Date of exposure:	09-11-2022
Exposure period:	32 weeks.
Date of removal from exposure	21-06-2023
Date of MOE after exposure:	17-07-2023
Date of final examination:	17-07-2023
Calculation:	Calculation of the initial dry mass (m_i) of each test timber specimen:

$$m_i = m_1 * \frac{100}{100 + MC}$$

Where:
m_i is the initial dry mass, in grams, of the timber test specimen;
m_1 is the initial conditioned mass, in grams of the timber test specimen;
MC is the mean moisture content, in percentage, of the timber test specimen.

Detailed information

Evaluation: WTT hybrid FA is evaluated as softwood species according to CEN/TS 15083-2, 2005.

Results and durability classes are evaluated according to EN 350; 2016:

Durability class	Description	X-value according to DS/EN 350 (2016)
1	Very durable	x ≤ 0.10
2	Durable	0.10 < x ≤ 0.20
3	Moderately durable	0.20 < x ≤ 0.45
4	Slightly durable	0.45 < x ≤ 0.80
5	Not durable	x > 0.80
For softwoods: $x - value = \frac{median\ value\ of\ loss\ in\ MOE\ for\ timber\ test\ specimens}{median\ value\ of\ loss\ in\ MOE\ for\ reference\ timber\ test\ specimens}$		

Validity of test: According to CEN/TS 15083-2, 2005:
For softwoods: the mean loss in MOE of the reference timber test specimens is equal to or higher than 40% and the presence of soft rot has been confirmed microscopically.

The mean loss in MOE for reference timber test specimens is 52%, which is accepted as a validation of the test.

The presence of soft rot is confirmed microscopically in 5 samples of the reference timber test specimens.

The test is valid.

Detailed results

Results of testing of natural durability against soft rotting micro-fungi according to CEN/TS 15083-2 – Test specimens

Treatment	Item no.	Moisture content after exposure (%)	Mass loss (%)	Losses in MOE (%)
WTT hybrid FA (130 ^{O}C. 20%)	1001	129	3.70	-6.68[a]
	1002	127	3.54	-4.93[a]
	1003	130	4.30	3.59
	1004	123	2.87	-7.01[a]
	1005	142	3.19	-1.20[a]
	1006	154	3.01	-0.96[a]
	1007	127	3.77	2.14
	1008	128	4.55	-3.64[a]
	1009	152	3.83	-1.36[a]
	1010	105	4.23	1.25
	1011	104	4.54	-7.78[a]
	1012	102	4.58	-10.37[a]
	1013	135	6.99	14.49
	1014	122	5.21	14.36
	1015	129	7.20	21.82
	1016	121	4.45	-6.24[a]
	1017	130	8.19	29.38
	1018	133	5.25	2.31
	1019	118	4.75	-8.68[a]
	1020	134	4.06	-4.71[a]
	1021	126	4.47	-12.74[a]
	1022	126	4.30	-8.95[a]
	1023	129	4.66	-7.92[a]
	1024	142	3.39	-2.37[a]
	1025	142	3.19	-6.82[a]
	1026	143	2.58	-8.00[a]
	1027	134	3.19	-3.87[a]
	1028	142	3.42	-6.54[a]
	1029	144	3.19	-8.91[a]
	1030	142	2.80	-11.47[a]
Mean		***130***	***4.25***	***2.98***
Median		***130***	***4.14***	***0.00***
Std. dev.		***13***	***1.31***	***7.22***
x-value (MOE) = 0.00 Provisional durability rating – 1 (Very durable)				

[a] Gains in MOE are taken as zero in subsequent calculations.

Detailed results

Results of testing of natural durability against soft rotting micro-fungi according to CEN/TS 15083-2 – Reference timber test specimens

Treatment	Item no.	Moisture content after exposure (%)	Mass loss (%)	Losses in MOE (%)
Untreated Reference timber test specimens	1	163	18.03	70.75
	2[b]	144	16.85	50.85
	3	148	13.70	52.39
	4	168	17.19	55.70
	5	166	14.44	51.86
	6	150	11.00	50.35
	7	174	15.06	64.82
	8	165	16.08	63.60
	9	139	12.33	53.31
	10	143	9.03	34.23
	11	174	13.13	64.73
	12[b]	161	14.68	51.70
	13	200	14.94	64.00
	14	193	14.93	61.24
	15	154	11.18	57.71
	16	162	12.34	56.55
	17	196	13.33	56.74
	18	165	12.58	49.92
	19	142	5.64	45.53
	20	177	15.00	59.92
	21	167	13.03	58.44
	22	155	18.18	50.47
	23[b]	163	14.63	50.39
	24	148	14.85	54.10
	25	173	16.80	67.06
	26	157	14.10	47.56
	27	147	11.28	52.28
	28	122	4.87	38.01
	29	159	18.42	63.65
	30[b]	138	11.51	42.67
	31	186	17.86	67.41
	32	174	14.56	46.13
	33	180	16.66	56.83
	37	175	15.30	61.14
	38[b]	142	11.71	49.44
	39	151	15.05	59.99
	40	175	21.48	76.65
Mean		***162***	***14.10***	***55.62***
Median		***163***	***14.63***	***55.70***
Std. dev.		***17***	***3.31***	***8.90***

[b] The presence of soft rot was confirmed microscopically.

Detailed results 2

Results of testing of natural durability against soft rotting micro-fungi according to CEN/TS 15083-2 –Test specimens

Treatment	Originates from 252 no.	Item no.	Initial conditioned mass (g)	Mass after EN 84 conditioned (g)	Initial dry mass (calculated) (g)	Mass after exposure (g)	Dry mass after exposure (g)	Moisture content after exposure (%)	Mass loss (%)
WTT hybrid FA (130 ^{O}C, 20%)	75	1001	3.17	3.04	2.76	6.09	2.66	129	3.70
		1002	3.18	3.07	2.79	6.10	2.69	127	3.54
		1003	3.17	3.05	2.77	6.11	2.65	130	4.30
		1004	3.23	3.10	2.82	6.09	2.74	123	2.87
		1005	2.92	2.80	2.55	5.97	2.47	142	3.19
		1006	2.78	2.66	2.42	5.97	2.35	154	3.01
		1007	3.20	3.07	2.79	6.10	2.69	127	3.77
		1008	3.22	3.10	2.82	6.15	2.70	128	4.55
		1009	2.85	2.73	2.48	6.01	2.39	152	3.83
	76	1010	3.80	3.65	3.32	6.52	3.18	105	4.23
		1011	3.86	3.71	3.37	6.57	3.22	104	4.54
		1012	3.89	3.73	3.40	6.54	3.24	102	4.58
	78	1013	3.31	3.18	2.89	6.33	2.69	135	6.99
		1014	3.45	3.30	3.00	6.31	2.85	122	5.21
		1015	3.44	3.29	3.00	6.38	2.78	129	7.20
		1016	3.48	3.32	3.03	6.38	2.89	121	4.45
		1017	3.46	3.32	3.02	6.39	2.78	130	8.19
	83	1018	3.23	3.11	2.83	6.23	2.68	133	5.25
		1019	3.51	3.39	3.09	6.42	2.94	118	4.75
		1020	3.16	3.03	2.76	6.20	2.65	134	4.06
		1021	3.33	3.21	2.93	6.32	2.80	126	4.47
		1022	3.26	3.14	2.86	6.18	2.73	126	4.30
		1023	3.33	3.20	2.92	6.35	2.78	129	4.66
	93	1024	2.95	2.84	2.59	6.05	2.50	142	3.39
		1025	2.95	2.83	2.58	6.04	2.50	142	3.19
		1026	2.93	2.81	2.56	6.05	2.49	143	2.58
		1027	3.00	2.88	2.62	5.94	2.54	134	3.19
		1028	2.91	2.81	2.56	5.98	2.47	142	3.42
		1029	2.85	2.75	2.50	5.92	2.42	144	3.19
		1030	2.93	2.83	2.58	6.05	2.50	142	2.80
Mean			***3.22***	***3.10***	***2.82***	***6.19***	***2.70***	***130***	***4.25***
Median			***3.21***	***3.08***	***2.81***	***6.13***	***2.69***	***129***	***4.14***
Std. dev.			***0.30***	***0.28***	***0.26***	***0.19***	***0.23***	***12***	***1.31***

Detailed results 2

Moisture content test specimens

Treatment	Originates from 252 no.	Item no.	Initial conditioned mass (g)	Initial dry mass (g)	Moisture content (%)
WTT hybrid FA (130 °C. 20%)	75	1031	3.14	2.87	9.63
		1032	3.15	2.87	9.83
		1033	3.25	2.96	9.55
		1034	3.13	2.85	9.83
	76	1035	3.57	3.24	10.42
	78	1036	3.43	3.11	10.24
	83	1037	3.25	2.96	9.76
		1038	3.23	2.93	10.12
	93	1039	2.81	2.57	9.44
		1040	2.87	2.62	9.53
Mean (MC)			***3.18***	***2.90***	***9.83 (MC)***
Std. dev.			***0.23***	***0.20***	***0.33***

Results of testing of natural durability against soft rotting micro-fungi according to CEN/TS 15083-2 – Reference timber test specimens

Treatment	Item no.	Initial dry mass (g)	Mass after exposure (g)	Dry mass after exposure (g)	Moisture content after exposure (%)	Mass loss (%)
Untreated Reference timber test specimens	1	2.63	5.68	2.16	163	18.03
	2	2.85	5.78	2.37	144	16.85
	3	2.83	6.06	2.45	148	13.70
	4	2.71	6.00	2.24	168	17.19
	5	2.64	6.01	2.26	166	14.44
	6	2.62	5.82	2.33	150	11.00
	7	2.65	6.17	2.25	174	15.06
	8	2.63	5.85	2.20	165	16.08
	9	2.83	5.93	2.48	139	12.33
	10	2.78	6.14	2.53	143	9.03
	11	2.53	6.02	2.20	174	13.13
	12	2.66	5.93	2.27	161	14.68
	13	2.40	6.12	2.04	200	14.94

Detailed results 2

	14	2.48	6.18	2.11	193	14.93
	15	2.67	6.01	2.37	154	11.18
	16	2.69	6.16	2.36	162	12.34
	17	2.45	6.29	2.12	196	13.33
	18	2.70	6.27	2.36	165	12.58
	19	2.64	6.03	2.49	142	5.64
	20	2.67	6.29	2.27	177	15.00
	21	2.66	6.18	2.31	167	13.03
	22	2.84	5.91	2.32	155	18.18
	23	2.67	6.00	2.28	163	14.63
	24	2.84	6.00	2.42	148	14.85
	25	2.64	6.00	2.20	173	16.80
	26	2.81	6.22	2.42	157	14.10
	27	2.83	6.19	2.51	147	11.28
	28	2.66	5.61	2.53	122	4.87
	29	2.83	5.96	2.30	159	18.42
	30	2.76	5.82	2.45	138	11.51
	31	2.64	6.20	2.17	186	17.86
	32	2.66	6.22	2.27	174	14.56
	33	2.65	6.18	2.21	180	16.66
	37	2.65	6.15	2.24	175	15.30
	38	2.73	5.82	2.41	142	11.71
	39	2.74	5.83	2.32	151	15.05
	40	2.77	5.98	2.18	175	21.48
Mean		***2.69***	***6.02***	***2.31***	***162***	***14.10***
Median		***2.67***	***6.01***	***2.31***	***163***	***14.63***
Std. dev.		***0.11***	***0.17***	***0.12***	***17***	***3.31***

Detailed results 2

EMC

Treatment	Originates from 252 no.	Mass at 65% RH (g)	Dry mass (g)	EMC (%)
WTT hybrid FA (130 ^{O}C. 20%)	93	18.19	16.68	9.0
	74	43.07	39.31	9.6
	75	17.74	16.24	9.2
	76	20.70	18.79	10.2
	77	40.74	37.16	9.6
	78	20.04	18.26	9.8
	79	35.30	32.28	9.4
	81	43.39	39.58	9.6
	82	42.29	38.52	9.8
	83	19.97	18.18	9.8
Mean				***9.6 (EMC)***
Std. dev.				***0.3***

pH-values for leaching in EN 84, 2020: Durability of wood and wood-based products - Accelerated ageing of treated wood prior to biological testing - Leaching procedure. – Test specimens

Treatment	Leaching	Water exchange after 2 hours	1st Exchange	2nd Exchange	3rd Exchange	4th Exchange	5th Exchange	6th Exchange	7th Exchange	8th exchange	9th Exchange
	Date	06-10-2022	06-10-2022	07-10-2022	10-10-2022	11-10-2022	12-10-2022	14-10.2022	17-10-2022	18-10-2022	19-10-2022
	Day	1	1	2	5	6	7	9	12	13	14
WTT hybrid FA (130 ^{O}C. 20%)	**pH**	4.65	4.92	4.3	3.89	4.32	4.66	4.4	4.55	5.2	5.82
Untreated reference		5.9	5.64	5.66	4.76	5.03	6.65	5.63	5.5	6.18	5.88

Detailed results 2

Mass loss after leaching according to EN 84, 2020: *Durability of wood and wood-based products - Accelerated ageing of treated wood prior to biological testing - Leaching procedure*.

Treatment	Item no.	Dry mass before EN 84 (g)	Dry mass after EN 84 (g)	Mass loss after EN 84 (%)
WTT hybrid FA (130 °C. 20%)	M1001	3.09	2.97	3.76
	M1002	2.88	2.78	3.50
	M1003	3.07	2.95	3.85
	M1004	2.75	2.65	3.73
	M1005	2.66	2.56	3.88
Mean		***2.89***	***2.78***	***3.74***
Std. dev.		***0.19***	***0.18***	***0.15***

Detailed results 3

Results of MOE according to EN 310;1994

Performed at DTI on 19-09-2022 and 17-07-2023.

Results of modulus of elasticity (MOE) in bending strength according to EN 310, 1994 – Test specimens

Treatment	Item no.	MOE before exposure (MPa)	MOE after exposure (MPa)	Losses in MOE (%)
Date		**19-09-2022**	**17-07-2023**	
WTT hybrid FA (130 °C, 20%)	1001	5417	5779	-6.68[a]
	1002	6242	6550	-4.93[a]
	1003	6121	5901	3.59
	1004	6109	6537	-7.01[a]
	1005	5163	5225	-1.20[a]
	1006	4169	4209	-0.96[a]
	1007	6248	6114	2.14
	1008	6038	6258	-3.64[a]
	1009	4424	4484	-1.36[a]
	1010	6966	6879	1.25
	1011	6540	7049	-7.78[a]
	1012	5822	6426	-10.37[a]
	1013	5513	4714	14.49
	1014	7369	6311	14.36
	1015	7254	5671	21.82
	1016	6991	7427	-6.24[a]
	1017	6485	4580	29.38
	1018	6225	6081	2.31
	1019	6116	6647	-8.68[a]
	1020	5734	6004	-4.71[a]
	1021	5597	6310	-12.74[a]
	1022	6115	6662	-8.95[a]
	1023	6187	6677	-7.92[a]
	1024	6907	7071	-2.37[a]
	1025	6467	6908	-6.82[a]
	1026	6674	7208	-8.00[a]
	1027	6881	7147	-3.87[a]
	1028	6772	7215	-6.54[a]
	1029	6075	6616	-8.91[a]
	1030	6321	7046	-11.47[a]
Mean		***6165***	***6257***	***2.98***
Median		***6206***	***6482***	***0.00***
Std. dev.		***736***	***870***	***7.22***

[a] Gains in MOE are taken as zero in subsequent calculations.

Detailed results 3

Results of modulus of elasticity (MOE) in bending strength according to EN 310, 1994 – Reference timber test specimens

Treatment	Item no.	MOE before exposure (MPa)	MOE after exposure (MPa)	Losses in MOE (%)
Date		**19-09-2022**	**17-07-2023**	
Untreated reference timber test specimens	1	8037	2351	70.75
	2	7933	3899	50.85
	3	8316	3959	52.39
	4	6977	3091	55.70
	5	5802	2793	51.86
	6	6977	3464	50.35
	7	7945	2795	64.82
	8	5800	2111	63.60
	9	9059	4230	53.31
	10	8429	5544	34.23
	11	5288	1865	64.73
	12	7124	3441	51.70
	13	6675	2403	64.00
	14	7312	2834	61.24
	15	7331	3100	57.71
	16	6803	2956	56.55
	17	7064	3056	56.74
	18	8289	4151	49.92
	19	6121	3334	45.53
	20	8069	3234	59.92
	21	7589	3154	58.44
	22	7137	3535	50.47
	23	5491	2724	50.39
	24	8447	3877	54.10
	25	7453	2455	67.06
	26	7851	4117	47.56
	27	5375	2565	52.28
	28	6640	4116	38.01
	29	8384	3048	63.65
	30	6450	3698	42.67
	31	6064	1976	67.41
	32	7020	3782	46.13
	33	7625	3292	56.83
	37	5245	2038	61.14
	38	6531	3302	49.44
	39	7198	2880	59.99
	40	7414	1731	76.65
Mean		***7115***	***3159***	***55.62***
Median		***7137***	***3100***	***55.70***
Std. dev.		***994***	***794***	***8.90***