Fachhochschule Weihenstephan
Forschungsanstalt für Gartenbau
Institut für Gartenbau

Test Report

Determination of resistance to root damage to flexible sheets and coatings for roof planting according FLL-method (1992)

Product name:

WOLFIN S

Principal/Manufacturer:

Henkel Bautechnik GmbH
WOLFIN + Teroson
D-63607 Wächtersbach
Germany

The report compiles 31 pages and is only allowed to be used unabridged.

The report has a 10 years period of validity.

Date: 1999-06-28

Information given by Henkel Bautechnik GmbH concerning data and characteristica of the flexible sheet WOLFIN S

(1995-11-29)

- **Name of the product:** WOLFIN S
- **Scope:** Resistance to root perforation for roof planting and for other applications of water proofing
- **Material designation:** Polyvinylchloride with softening agent (PVC-P)
- **Thickness (excluding bond):** 1.5 mm (self-adhesive bond: 0.8 mm)
- **Equipment/structure:** PVC-P-layer with self-adhesive bond
- **Delivery form:** rolls
- **Manufacturing technique:** extrusion
- **Product standards:** DIN 16734
- **Test certificates:** in accordance with DIN 16734, DIN 16937
- **Year of manufacture:** 1995
- **Layer resisting to perforation:** whole sheet
- **Installation method at the test site:**
  - **overlap:** 50 mm
  - **jointing technique:** welding with hot air
  - **jointing agent:** none
  - **type of joint seal:** with WOLFIN fluid
  - **wall corner joint reinforcing:** prefabricated PVC-P-parts
  - **cover strip over joints:** none
- **Addition of biocides incl. concentration:** none

1 Problem task

In order to prevent damage protection sheets against root perforation are required to perform permanent resistance against root invasion or perforation by plant roots and plant rhizomes (subterranean offshoots).

In this test the PVC-sheet WOLFIN S manufactured by Henkel Bautechnik GmbH, D-63607 Wächtersbach, Germany was tested for resistance to root perforation.

2 Test facility and procedure

The 4 years lasting test was carried out in accordance with the „Method of testing resistance to root damage to flexible sheets of roof planting“ (FLL, 1992).

The test was carried out between April 1995 and April 1999 comprising 8 containers equipped with the sheet to be tested. Another 4 containers with a prefabricated 85/25 bitumen sheet were serving as control that allows to compare the plant development in the different containers.

The sheet WOLFIN S was cut, jointed and installed in the containers at the test site of the Institut für Gartenbau, Fachhochschule Weihenstephan by Henkel Bautechnik GmbH.

The test plants *Alnus incana*, Grey Alder and *Populus tremula*, Aspen, perform sufficient root growth during the growing season under the given conditions. Additional Agropyron repens, Coach Grass, was used as test plant. This kind of grass is forming rhizomes which can damage protection sheets as well as roots.

The containers were installed in greenhouse without heating.

A check sample of the sheet was taken and stored at the testing institute.

The complete description of the test procedure can be found in annex 3 of this report.

3 Data given by the manufacturer of the sheet

The test of resistance against root perforation refers to the data and material characteristics of the tested sheet and to the applied jointing and manufacturing technique. The data given by Henkel Bautechnik GmbH, concerning the sheet WOLFIN S are listed on page 2 of this report.

4 Results

4.1 Plant development

The plants, Grey Alder, Aspen and Coach Grass, performed well during the whole test period. Growth of the test plants in the control containers (with 85/25 bitumen sheet) was only slightly differing from plant growth in the test containers covered by the sheet WOLFIN S.

Detailed information concerning vigorousness of growth are given in annex 2.

4.2 Root perforation and root perforation (see photos in annex 1)

4.2.1 During testing period

The tested sheet did not show any sign of root perforation during the testing period when checked through the transparent bottom. Also no rhizomes invading or perforating the sheet were detectable.

4.2.2 At the end of test period (April 1999, 4 years after beginning)

At the end of the test period the containers were emptied for a detailed check of the sheet WOLFIN S for root or rhizome invasion and perforation.

The sheet (surface and joints) did not show any invasions or perforations caused by roots and rhizomes respectively after the 4 year period.

5 Summary

In accordance with the „Method of testing resistance to root damage to flexible sheets of roof planting“ (FLL, 1992) a four years lasting test was carried out with the FPO-sheet WOLFIN S manufactured by Henkel Bautechnik GmbH.

The sheet WOLFIN S (surface and joints) did not show any invasions or perforations caused by roots and rhizomes respectively after the 4 year period.

The sheet WOLFIN S is therefore considered to be root resistant and rhizome resistant to Coach Grass according to FLL-standard.

The test on root resistance relates to the data and material characteristics as well as the applied jointing technique and manufacturing technique described on page 2 of this report.

Check samples of the tested sheet were taken and are stored at the Institut für Gartenbau, Fachhochschule Weihenstephan.

The test report was compiled in June 1999. The report has a 10 years period of validity

This report comprises 31 pages and is only allowed to be used unabridged.

Person responsible for the test and the report:
Dipl.-Ing. (FH) M. Jauch

Fachhochschule Weihenstephan, Forschungsanstalt für Gartenbau,
Institut für Gartenbau, Am Staudengarten 14, D-85354 Freising
Tel.: +49 (0) 8161 / 71-4413, Fax: +49 (0) 8161 / 71-3348
E-Mail: martin.jauch@fh-weihenstephan.de

Annex 1

Photos concerning the tested sheet WOLFIN S (1999-06)

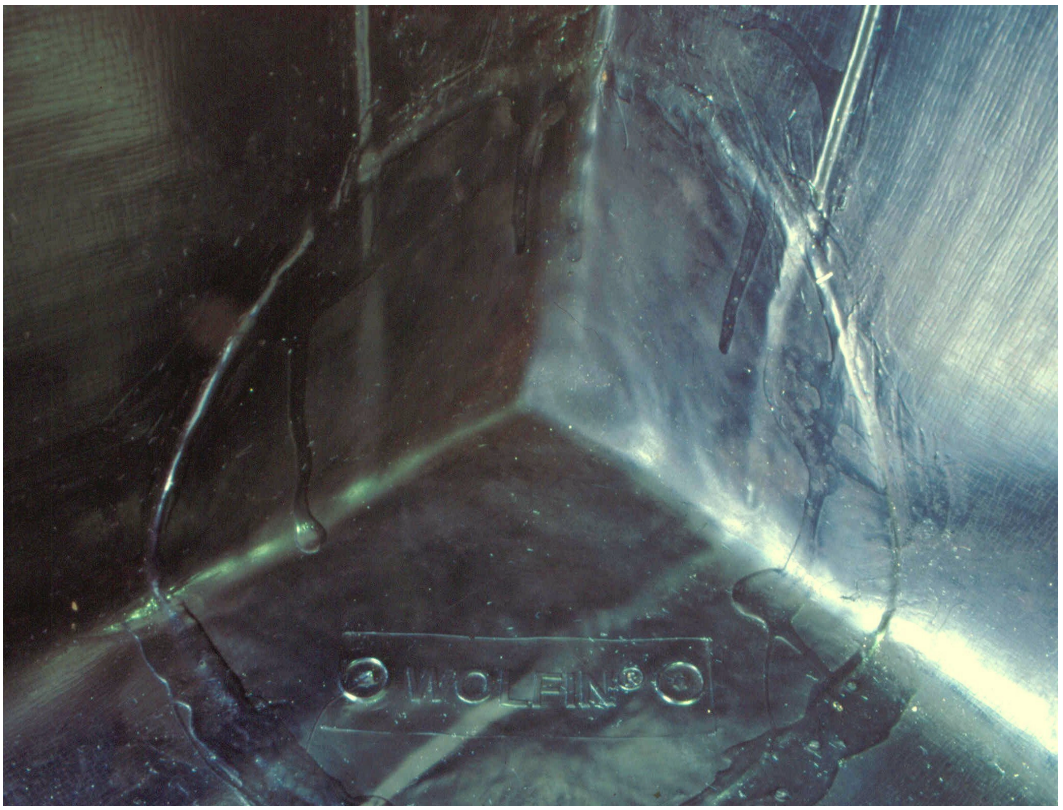

Figure 1: Wall corner joint reinforcing (prefabricated PVC-P-parts)

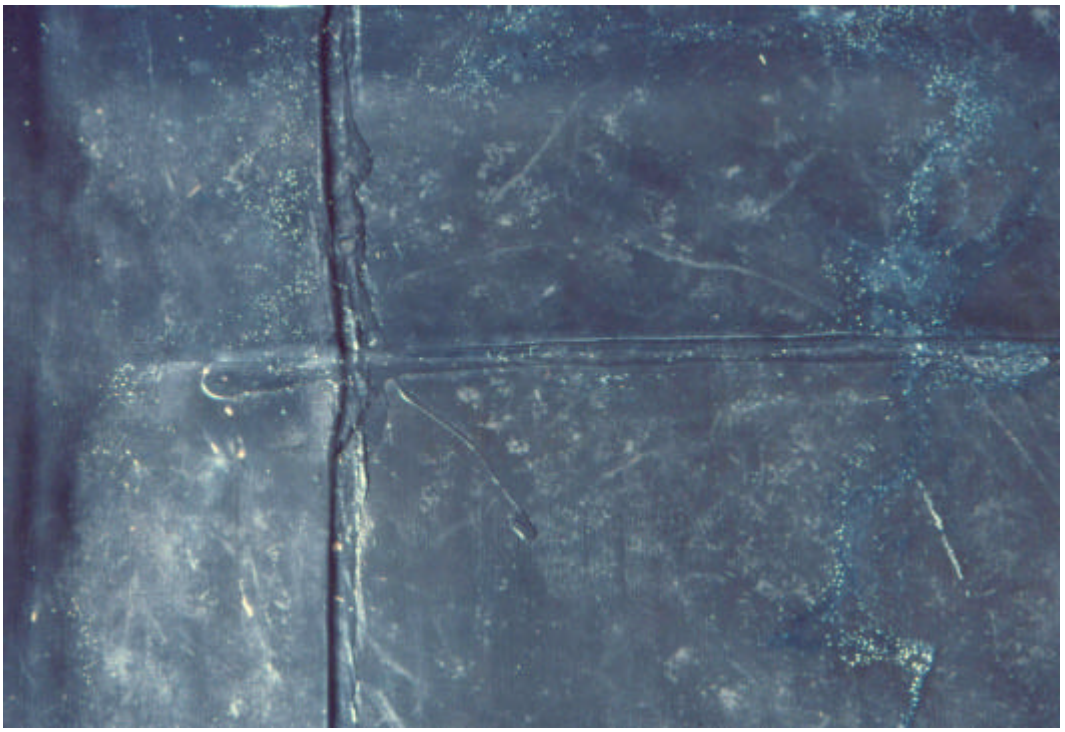

Figure 2: Sheet surface (T joint)

Annex 2

Data on plant development

Table 1: Vitality of the test plants in the growing season

	Aspen	**Grey Alder**	**Coach Grass**
June 1995	vigorous	very vigorous	rich growth, cut back at a height of approximately 10 cm in July 1995
June 1996	vigorous, cut back at a height of approximately 150 cm in November 1996	very vigorous, cut back at a height of approximately 150 cm in November 1996	rich growth, cut back at a height of approximately 10 cm in July 1996
June 1997	vigorous, cut back at a height of approximately 150 cm in November 1997	very vigorous, cut back at a height of approximately 150 cm in November 1997	rich growth, cut back at a height of approximately 10 cm in July 1997
June 1998	vigorous, cut back at a height of approximately 150 cm in November 1998	vigorous, cut back at a height of approximately 150 cm in November 1998	rich growth, cut back at a height of approximately 10 cm in July 1998

Growth of the test plants in the control containers (with 85/25 bitumen sheet) was only slightly differing from plant growth in the test containers covered by the sheet WOLFIN S.

Table 2: Height and trunk diameter of Aspen and Grey Alder in October 1995

Container No.	Plant No.	Aspen		Grey Alder	
		Diameter cm[1)]	Height cm	Diameter cm[1)]	Height cm
C 1[2)]	1	1.1	175	1.4	184
	2	0.9	166	1.4	178
C 2	1	1.1	162	1.6	200
	2	1.1	162	1.5	194
C 3	1	1.1	181	1.6	199
	2	1.2	157	1.5	175
C 4	1	1.1	164	1.6	202
	2	1.0	160	1.6	178
T 1[3)]	1	1.1	168	1.9	181
	2	1.0	172	1.9	193
T 2	1	1.2	177	2.1	204
	2	0.8	151	1.9	184
T 3	1	1.2	182	1.8	198
	2	1.3	172	1.9	186
T 4	1	0.9	156	1.8	216
	2	1.1	175	1.8	198
T 5	1	1.0	170	1.8	168
	2	1.3	163	1.7	184
T 6	1	1.1	154	1.9	175
	2	1.2	158	1.8	162
T 7	1	1.3	161	2.0	194
	2	1.2	168	1.9	181
T 8	1	1.1	174	2.0	173
	2	1.2	152	1.9	165

[1)] Trunk diameter measured at 20 cm above substrate surface

[2)] C1 - C4: control containers (with 85/25 bitumen sheet)

[3)] T1 - T8: test containers (with the sheet WOLFIN S)

Table 3: Height and trunk diameter of Aspen and Grey Alder in November 1996

Container No.	Plant No.	Aspen		Grey Alder	
		Diameter cm[1)]	Height cm	Diameter cm[1)]	Height cm
C 1[2)]	1	1.3	176	2.2	212
	2	1.2	165	2.1	223
C 2	1	1.3	171	1.8	240
	2	1.3	188	1.8	241
C 3	1	1.4	180	2.0	252
	2	1.3	185	1.9	228
C 4	1	1.4	170	1.9	233
	2	1.3	184	2.0	250
T 1[3)]	1	1.2	174	2.2	215
	2	1.2	160	2.2	243
T 2	1	1.4	165	2.4	218
	2	1.2	180	2.1	265
T 3	1	1.3	174	2.1	243
	2	1.5	163	2.0	230
T 4	1	1.2	175	2.0	251
	2	1.3	170	2.1	227
T 5	1	1.3	190	2.0	238
	2	1.5	164	2.1	267
T 6	1	1.2	174	2.3	240
	2	1.3	154	2.2	242
T 7	1	1.5	186	2.3	241
	2	1.4	182	2.2	285
T 8	1	1.3	180	2.2	251
	2	1.3	167	2.1	27

[1)] Trunk diameter measured at 20 cm above substrate surface

[2)] C1 - C4: control containers (with 85/25 bitumen sheet)

[3)] T1 - T8: test containers (with the sheet WOLFIN S)

Table 4: Height and trunk diameter of Aspen and Grey Alder in October 1997

Container No.	Plant No.	Aspen		Grey Alder	
		Diameter cm[1)]	Height cm	Diameter cm[1)]	Height cm
C 1[2)]	1	1.5	174	2.4	266
	2	1.5	162	2.5	260
C 2	1	1.6	171	2.5	251
	2	1.7	159	2.4	222
C 3	1	1.6	185	2.5	250
	2	1.5	181	2.2	251
C 4	1	1.6	165	2.3	265
	2	1.7	170	2.4	248
T 1[3)]	1	1.6	174	2.6	215
	2	1.7	168	2.6	238
T 2	1	1.9	188	2.9	237
	2	1.8	160	2.6	230
T 3	1	1.7	171	2.6	264
	2	1.9	150	2.5	233
T 4	1	1.5	174	2.5	240
	2	1.7	175	2.6	255
T 5	1	1.7	170	2.4	235
	2	1.9	163	2.6	247
T 6	1	1.5	180	2.8	240
	2	1.8	156	2.5	271
T 7	1	2.0	178	2.8	240
	2	1.9	170	2.5	267
T 8	1	1.7	185	2.3	240
	2	1.7	171	2.4	281

[1)] Trunk diameter measured at 20 cm above substrate surface

[2)] C1 - C4: control containers (with 85/25 bitumen sheet)

[3)] T1 - T8: test containers (with the sheet WOLFIN S)

Table 5: Height and trunk diameter of Aspen and Grey Alder in October 1998

Container No.	Plant No.	Aspen		Grey Alder	
		Diameter cm[1)]	Height cm	Diameter cm[1)]	Height cm
C 1[2)]	1	1.9	155	2.7	210
	2	1.9	175	2.8	241
C 2	1	2.0	160	2.9	219
	2	1.9	171	2.8	215
C 3	1	1.9	177	2.8	218
	2	1.9	175	2.8	194
C 4	1	2.0	184	2.7	179
	2	1.9	158	3.0	242
T 1[3)]	1	2.1	175	2.8	212
	2	2.0	168	3.1	201
T 2	1	2.2	190	3.2	210
	2	2.1	198	2.9	222
T 3	1	1.9	212	2.8	210
	2	2.2	178	2.8	235
T 4	1	1.8	175	2.7	235
	2	2.1	180	2.9	200
T 5	1	1.9	188	2.5	205
	2	2.2	175	3.1	184
T 6	1	1.8	160	3.3	258
	2	2.1	177	2.7	275
T 7	1	2.3	174	3.0	210
	2	2.0	183	2.8	223
T 8	1	1.9	195	2.8	190
	2	2.0	178	2.7	211

[1)] Trunk diameter measured at 20 cm above substrate surface

[2)] C1 - C4: control containers (with 85/25 bitumen sheet)

[3)] T1 - T8: test containers (with the sheet WOLFIN S)