

**B.C.R. PROJECT 151 Water Vapour Permeability
Test Results for Polystyrene and Particle Board.**

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**THE TECHNICAL UNIVERSITY OF DENMARK
DEPARTMENT OF CIVIL ENGINEERING
BUILDING MATERIALS LABORATORY**

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**B.C.R. PROJECT 151 Water Vapour Permeability
Test Results for Polystyrene and Particle Board**

This report gives the Danish cup test results for polystyrene and particle board.

The polystyrene specimens are cut and mailed by the University of Strathclyde, Scotland, while the particle board specimens are cut and mailed by the CSTB, France.

Polystyrene is tested during dry cup (0 - 50 %RH), and particle board is tested during wet cup (50 - 93 %RH). Inside the cup 0 %RH is obtained by using Calcium Chloride (CaCl_2), while 93 %RH is obtained by using Ammonium Dihydrogen Orthophosphate ($\text{NH}_4\text{H}_2\text{PO}_4$).

The test results are given in this report and in the data base on the diskette enclosed.

The test results will be used in an intercomparison organized by Graham H. Galbraith at the University of Strathclyde, Scotland.

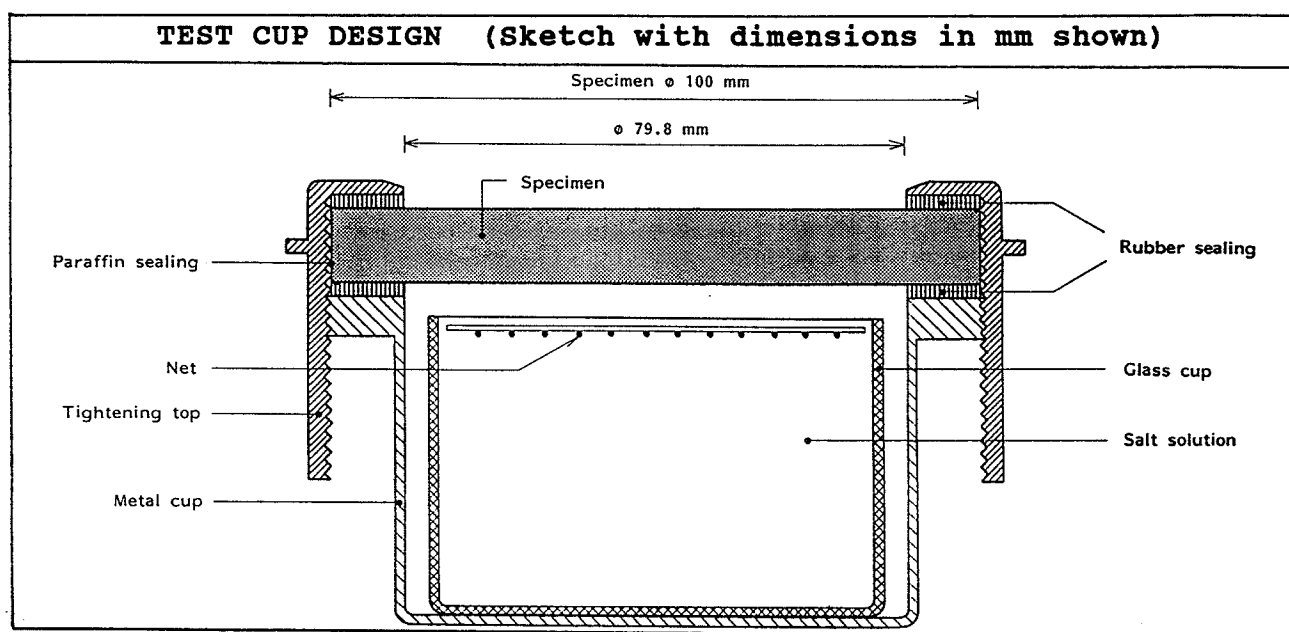
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GUIDANCE NOTES FOR PARTICIPANTS - B.C.R. PROJECT 151

ANNEX ONE

DETAILS OF TEST APPARATUS



SEALANT DETAILS

Material Used: Rubber rings. Paraffin sealing on vertical edge.

Method of Sealing (sketch where appropriate):

Paraffin sealing on vertical edge: The edge is put into heated paraffin (65°C).

Specimen sealing to cup: First, a rubber ring is laid on the metal cup, and the specimen on this rubber ring. Then another rubber ring. The tightening top is screw on, and at last the top is tightened using a special tool.

Note: No glass cup using desiccant

PLEASE INCLUDE COMMENTS ON ANY SEALING DIFFICULTIES EXPERIENCED AND PROVIDE PHOTOGRAPHS SHOWING THE SAMPLE MOUNTING PROCEDURE.

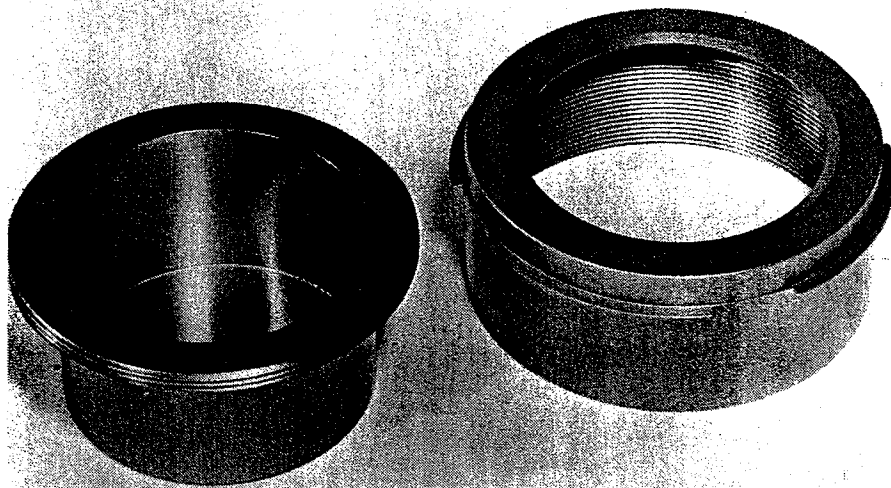


Figure 1. Metal cup and tightening top.

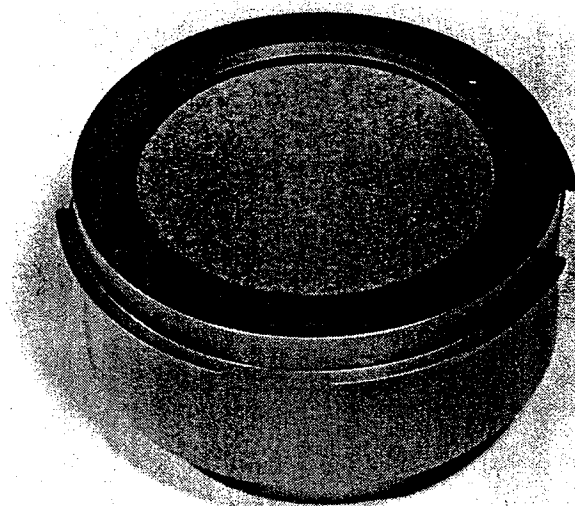


Figure 2. Mounted cup.

BALANCE DETAILS

Make & Model : Sartorius Excellence E 1200 S
Accuracy : 0.001 g
Date last calibrated : 22/3 1990 (by balance contractor)
(include calibration certificate where appropriate)
Method of Calibration: Before the weighing procedure for the cups the balance is checked using a reference weight. This is done every day. The reference weight has about the same weight as the cups.

ENVIRONMENTAL MEASUREMENTS

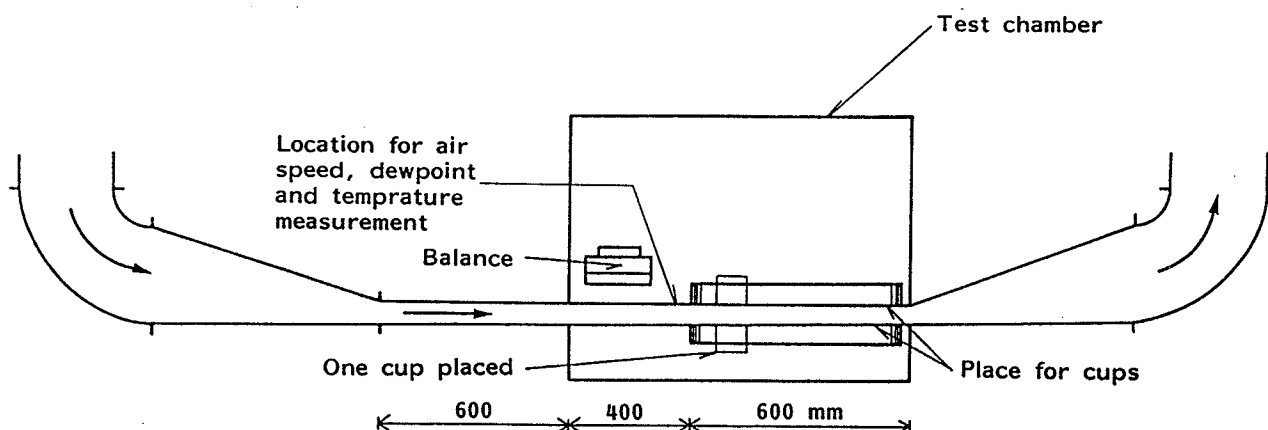
TEMPERATURE - Method of Measurement: Platinum resistance thermometer*
Measurement Accuracy : $\pm 0.27^{\circ}\text{C}$
Date last calibrated : 25/4 1990

Make & Model : Michell Monitor S3000 Temperature
HUMIDITY - Method of Measurement: Dewpoint hygrometer*
Measurement Accuracy : $\pm 0.27^{\circ}\text{C}$
Date last calibrated : 19/4 1990
Make & Model : Michell Monitor S3000 Dewpointmeter
(include Calibration certificate where appropriate)

* Michell Measuring Head DT3000 is a combined dewpoint/temperature probe.
Calibration certificate enclosed in Annex III.

ENVIRONMENTAL CHAMBER

Description of chamber (sketch chamber indicating its size, the location of the samples, and the relative location of measuring positions)



Note: In figure 3 is shown all equipment for water vapour transmission tests using cup methods.

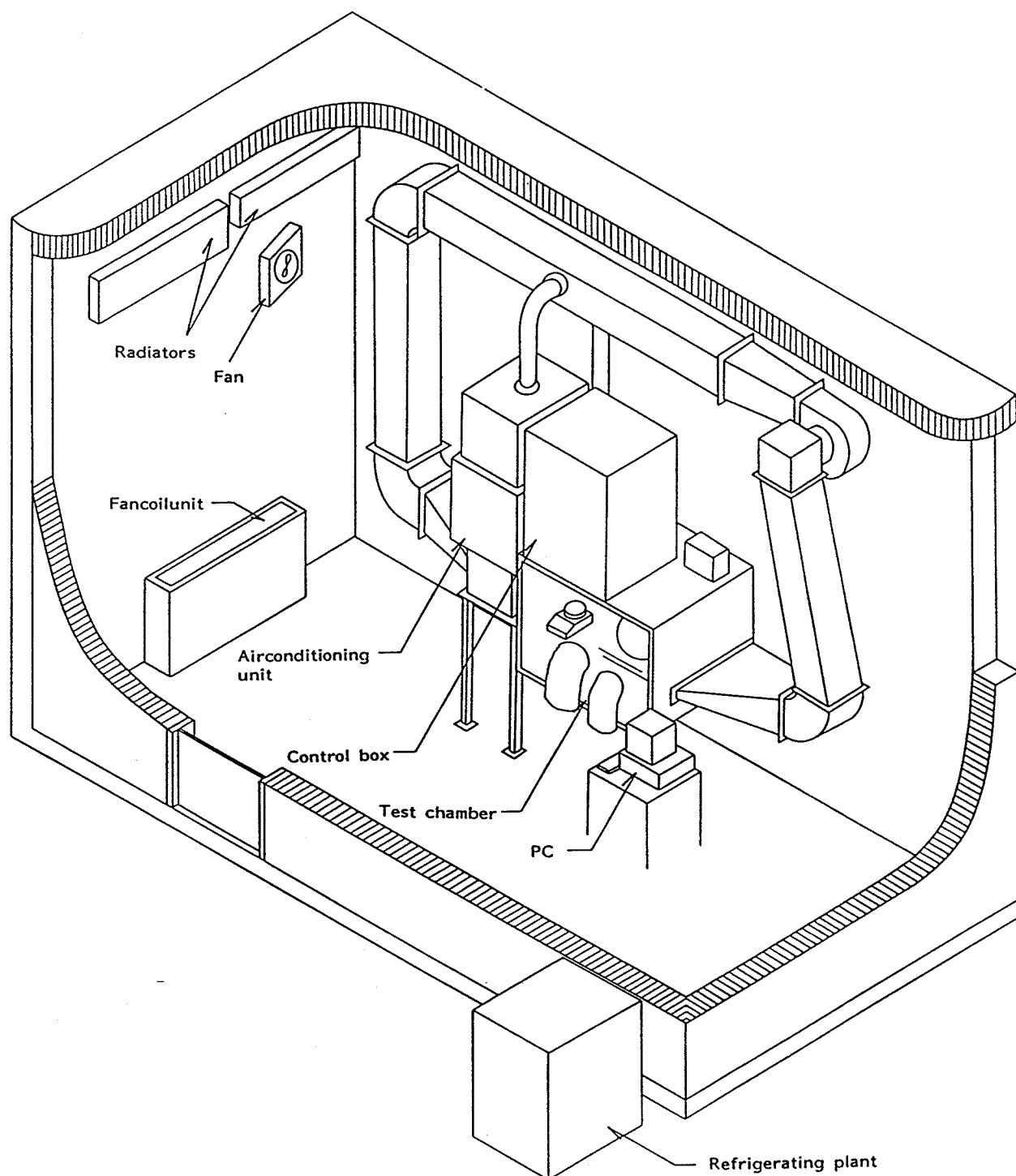


Figure 3. Equipment for water vapour transmission tests using cup methods.

SAMPLE THICKNESS MEASUREMENTS

Make of guage used : MITUTOYO 500/110 SR44
Accuracy : 0.01 mm

BAROMETRIC PRESSURE MEASUREMENTS

Method of Measurement : Piezoresistive pressure transducer.
Estimated Accuracy : $\pm 0.2 \text{ kN/m}^2$ ($\pm 2 \text{ mbar}$)
Date last calibrated : 13/2 1990
Make & Model : Haenni Digital Electronic Barometer ZED 150
Calibration certificate enclosed in Annex III.

GUIDANCE NOTES FOR PARTICIPANTS - B.C.R. PROJECT 151

ANNEX TWO A

DETAILS OF TEST RESULTS

Extruded polystyrene

PRECONDITIONING TEST RESULTS

TEST LABORATORY : Building Materials Laboratory, Denmark

SAMPLE MATERIAL : Extruded polystyrene

TEST DATES : 22/2-1/3

SAMPLE NUMBER	CONDITIONING PERIOD (DAYS)	WEIGHT AFTER CONDITIONING(kg)	SAMPLE AV. THICKNESS(m)	SAMPLE DIAMETER(m)	SAMPLE VOLUME(m3)	SAMPLE DENSITY(kg/m3)
D1	7.00	0.006805	0.02448	0.09965	0.0001909	35.65
D3	7.00	0.006842	0.02450	0.09976	0.0001915	35.73
D4	7.00	0.007195	0.02456	0.09971	0.0001918	37.51
D5	7.00	0.006801	0.02449	0.09976	0.0001914	35.53
D7	7.00	0.006923	0.02455	0.09989	0.0001924	35.98
D8	7.00	0.007105	0.02459	0.09980	0.0001924	36.93
OVERALL MEAN	7	0.006945	0.02453	0.09976	0.0001917	36.22
ST. DEV.	0	0.000167	0.00004	0.00008	0.0000006	0.81

Note: Graphs of weight change against time are not included
as the preconditioning should be for a period of 7 days.

PLEASE INCLUDE GRAPHS OF WEIGHT CHANGE AGAINST TIME

CUP TEST RESULTS

TEST LABORATORY : Building Materials Laboratory, Denmark

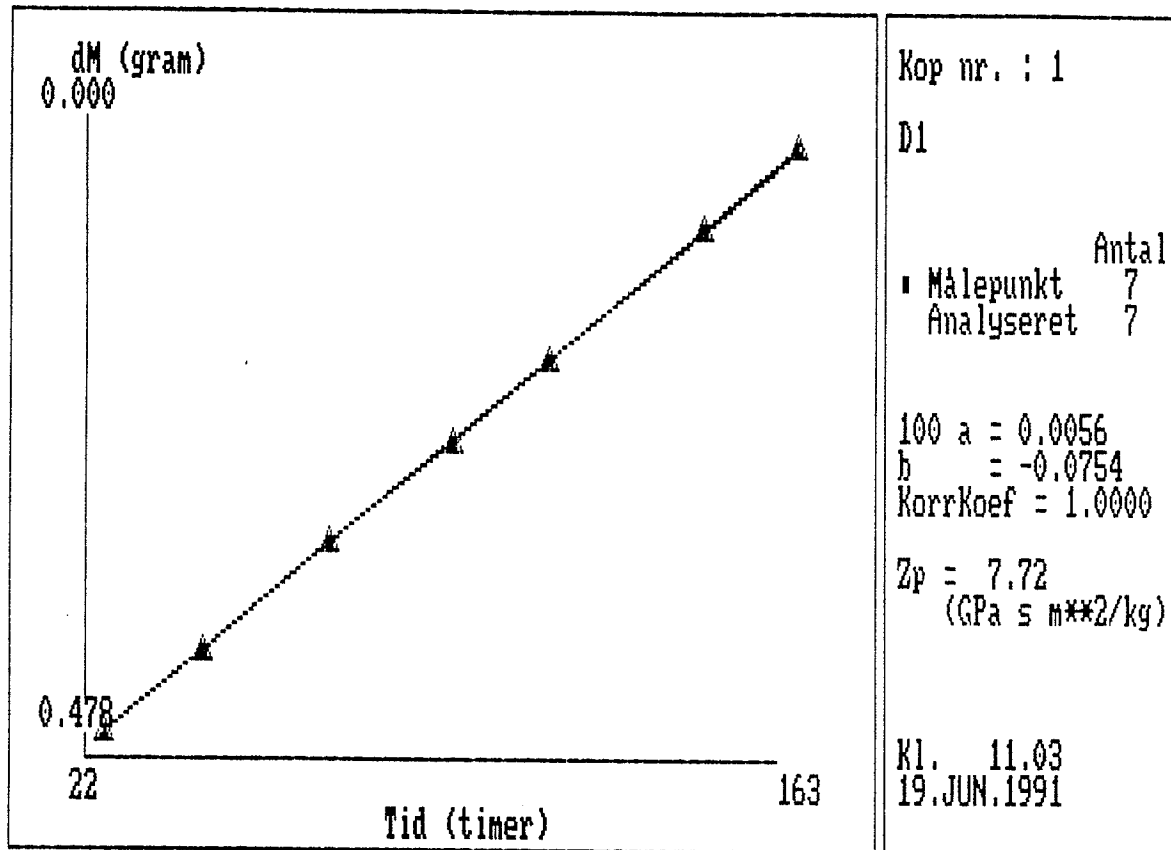
TEST DATES : 8/3-15/3 1991 MEAN BAROMETRIC PRESSURE (kN/m²):100.7 (1007 mbar)SAMPLE MATERIAL : Extruded polystyrene VAPOUR PRESSURE DIFFERENCE (N/m²) :1450 (0 - 51.3 %RH)SAMPLE AVERAGE^{*)} AREA (m²) : 0.007817 SAMPLE AVERAGE THICKNESS (m) :0.02453

DISTANCE FROM SAMPLE SURFACE TO SALT SOLUTION/DESICCANT : 0.008

SAMPLE NUMBER	PRECON. DENSITY	NO. DAYS TO STEADY STATE	DAILY WEIGHT OF CUPS AFTER STEADY STATE (m g)						MEAN CHANGE (mg/day)	CORR. COEF.	PERMEABILITY (seconds)
			DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6			
D1	35.65	8	66	155	239	305	410	478	80.6	1.0000	3.17E-12
D3	35.73	8	61	143	221	282	380	444	74.9	1.0000	2.95E-12
D4	37.51	8	37	89	140	179	241	282	47.5	0.9999	1.88E-12
D5	35.53	8	59	136	216	273	369	429	73.4	1.0000	2.85E-12
D7	35.98	8	53	124	197	252	340	397	67.7	0.9999	2.65E-12
D8	36.93	8	40	91	144	185	250	291	49.0	0.9999	1.95E-12
OVERALL MEAN	36.22								65.5		2.58E-12
ST. DEV	0.81								14.0		0.54E-12

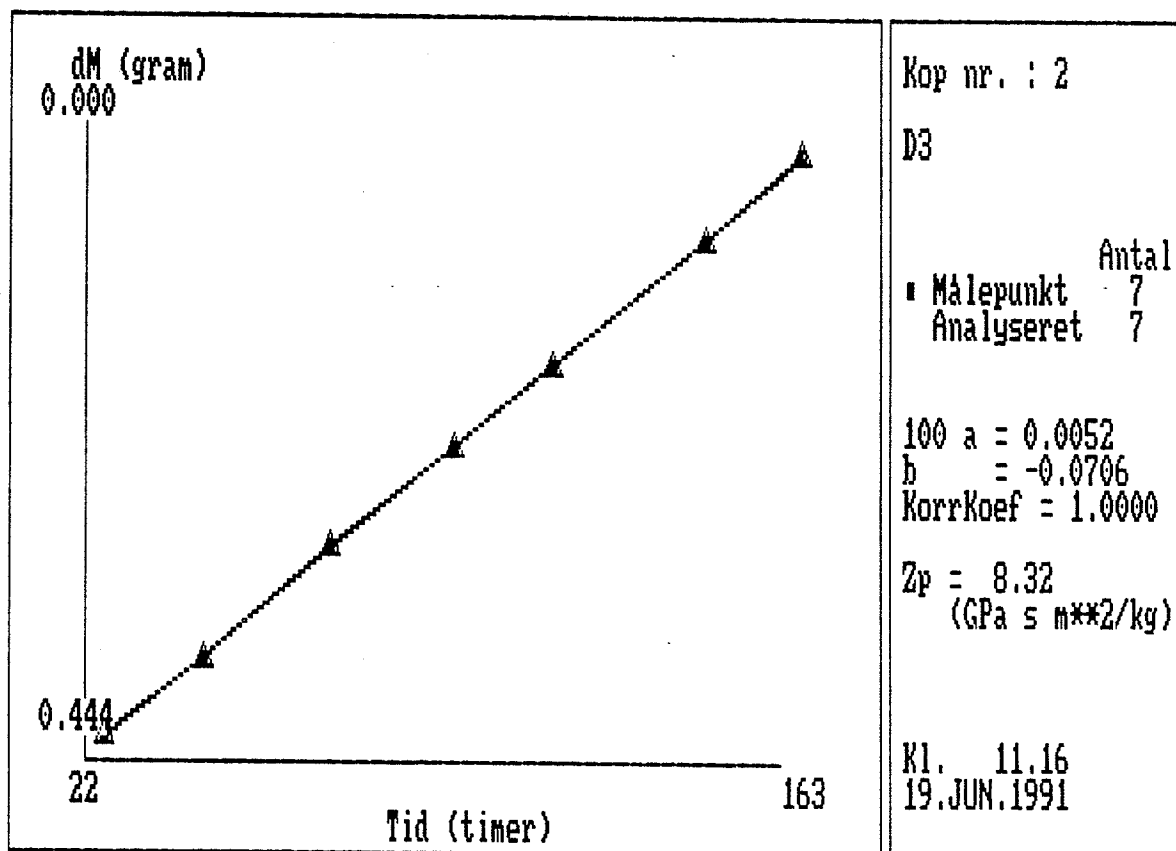
*) Exposed free area = 0.005000 m²

PLEASE INCLUDE GRAPHS OF WEIGHT AGAINST TIME AND
BAROMETRIC PRESSURE AGAINST TIME



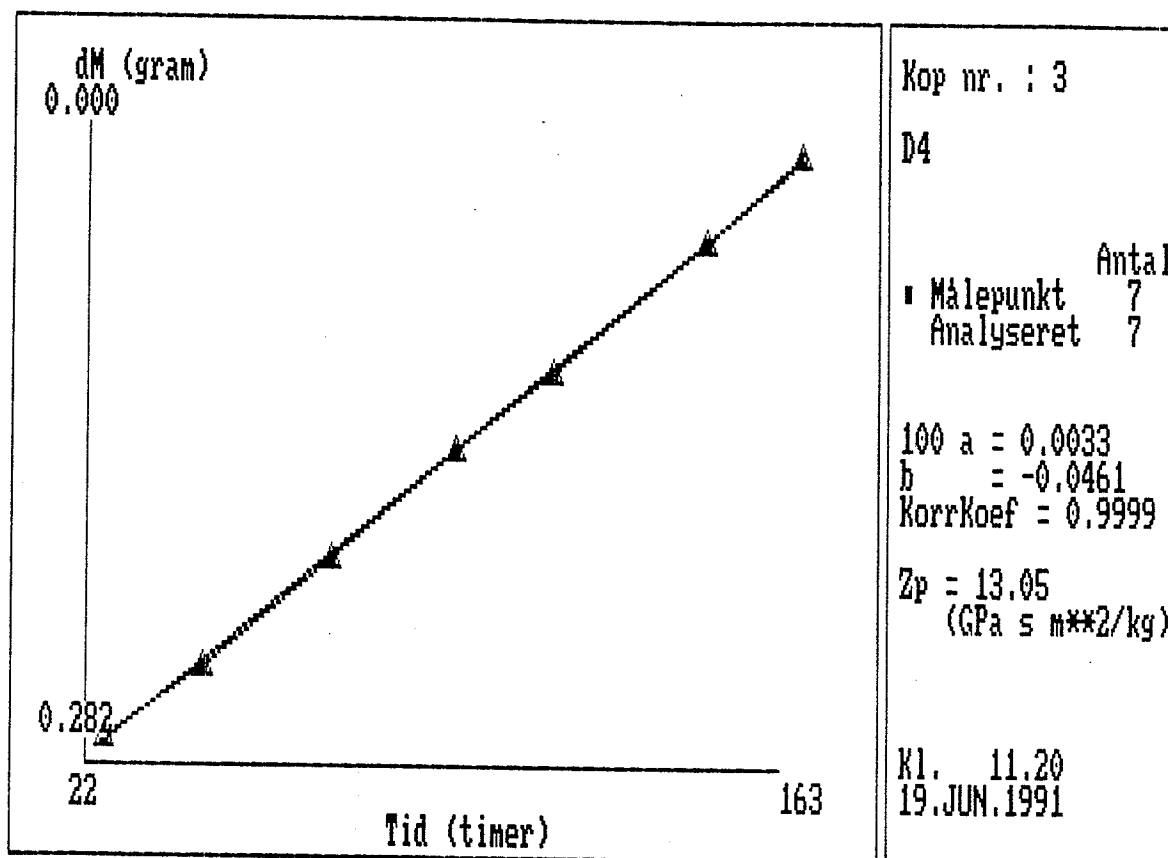
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F6: Returner



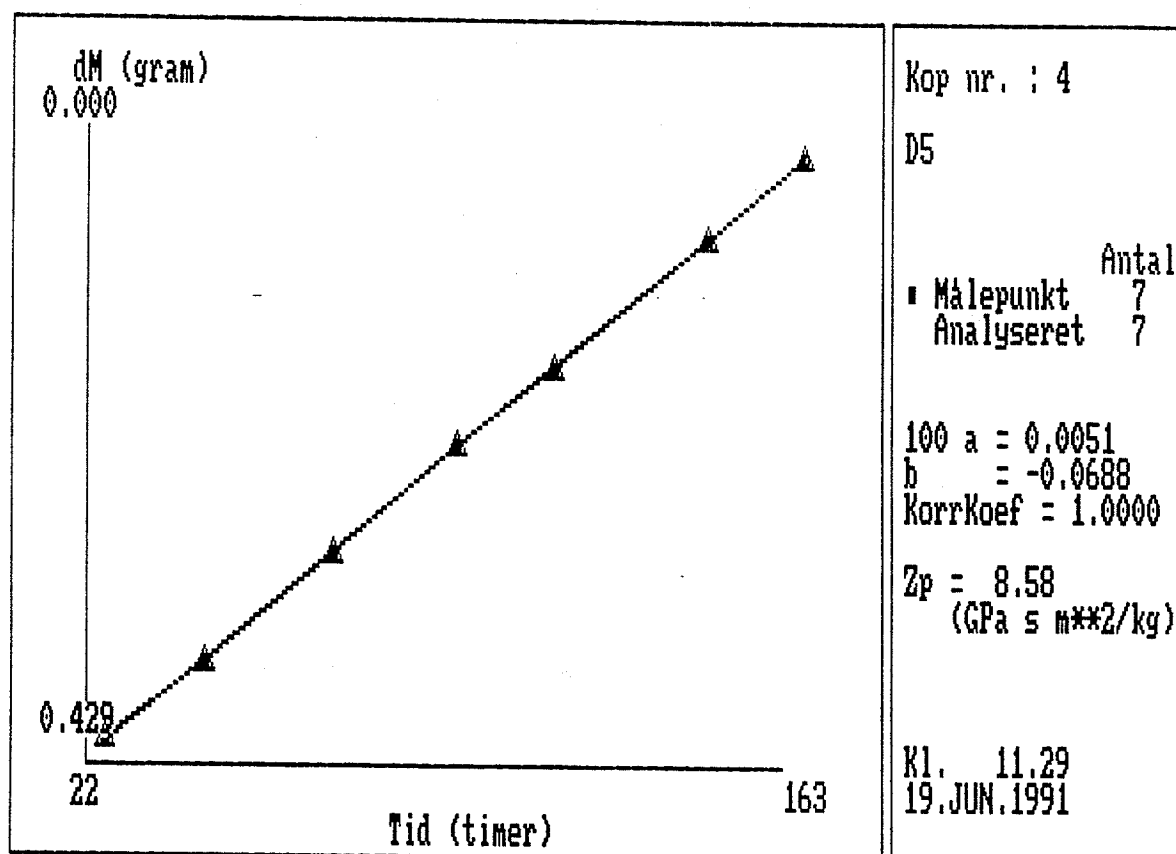
Prt Scr: Udskriv billedet på printer

F6: Returner



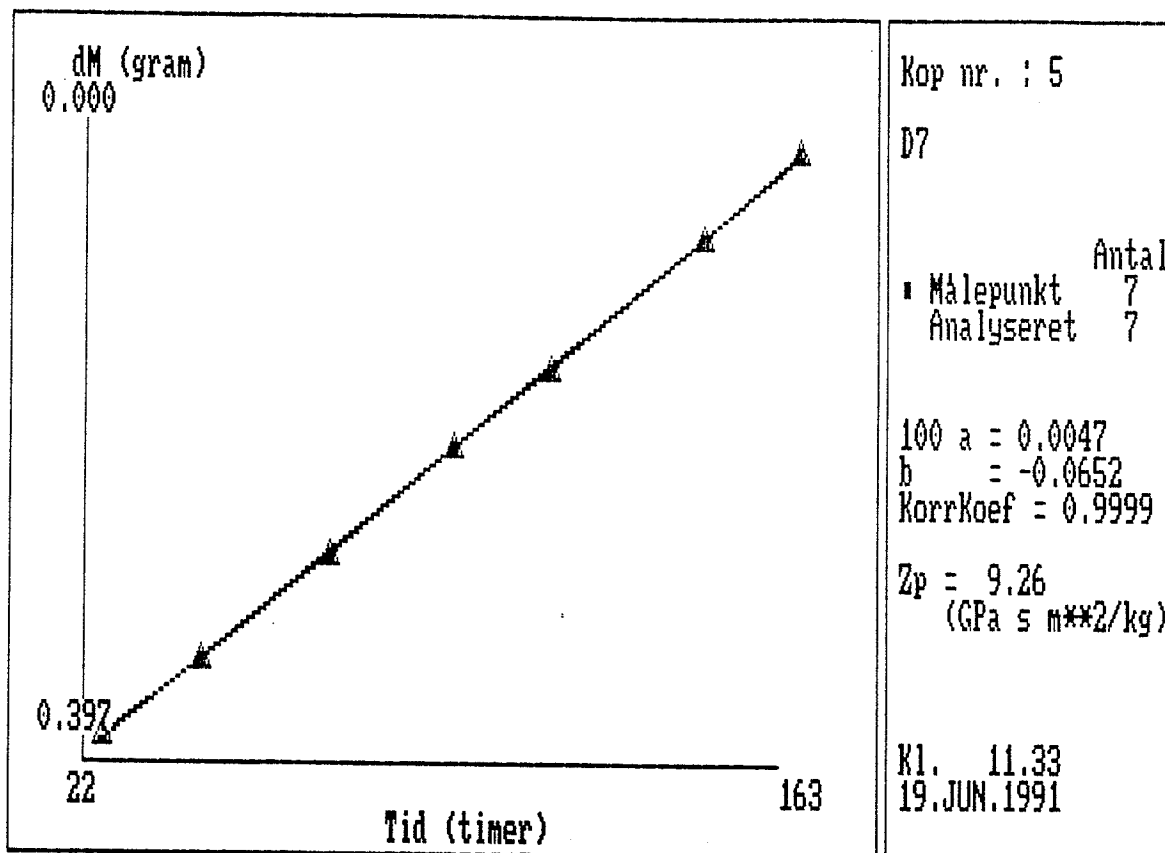
Prt Scr: Udskriv billedet på printer

F6: Returner



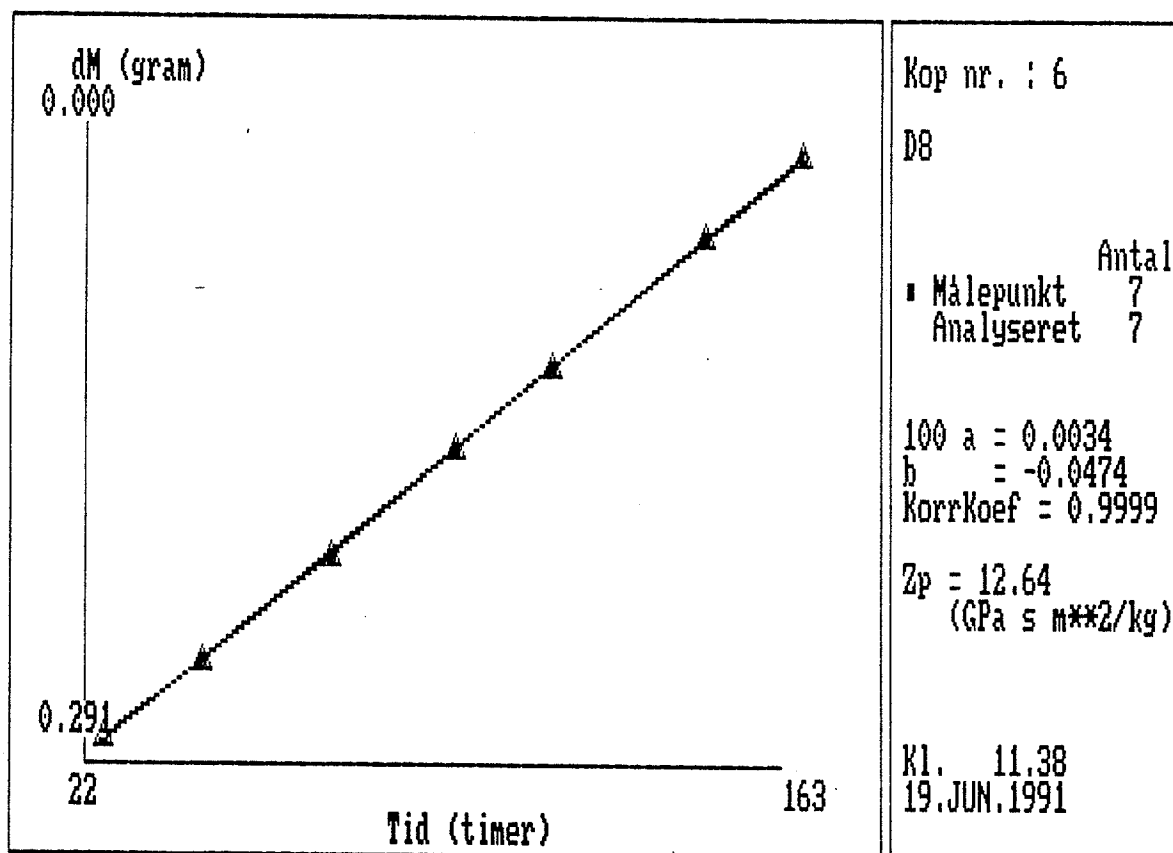
Prt Scr: Udskriv billedet på printer

F6: Returner



Prt Scr: Udskriv billedet på printer

F6: Returner

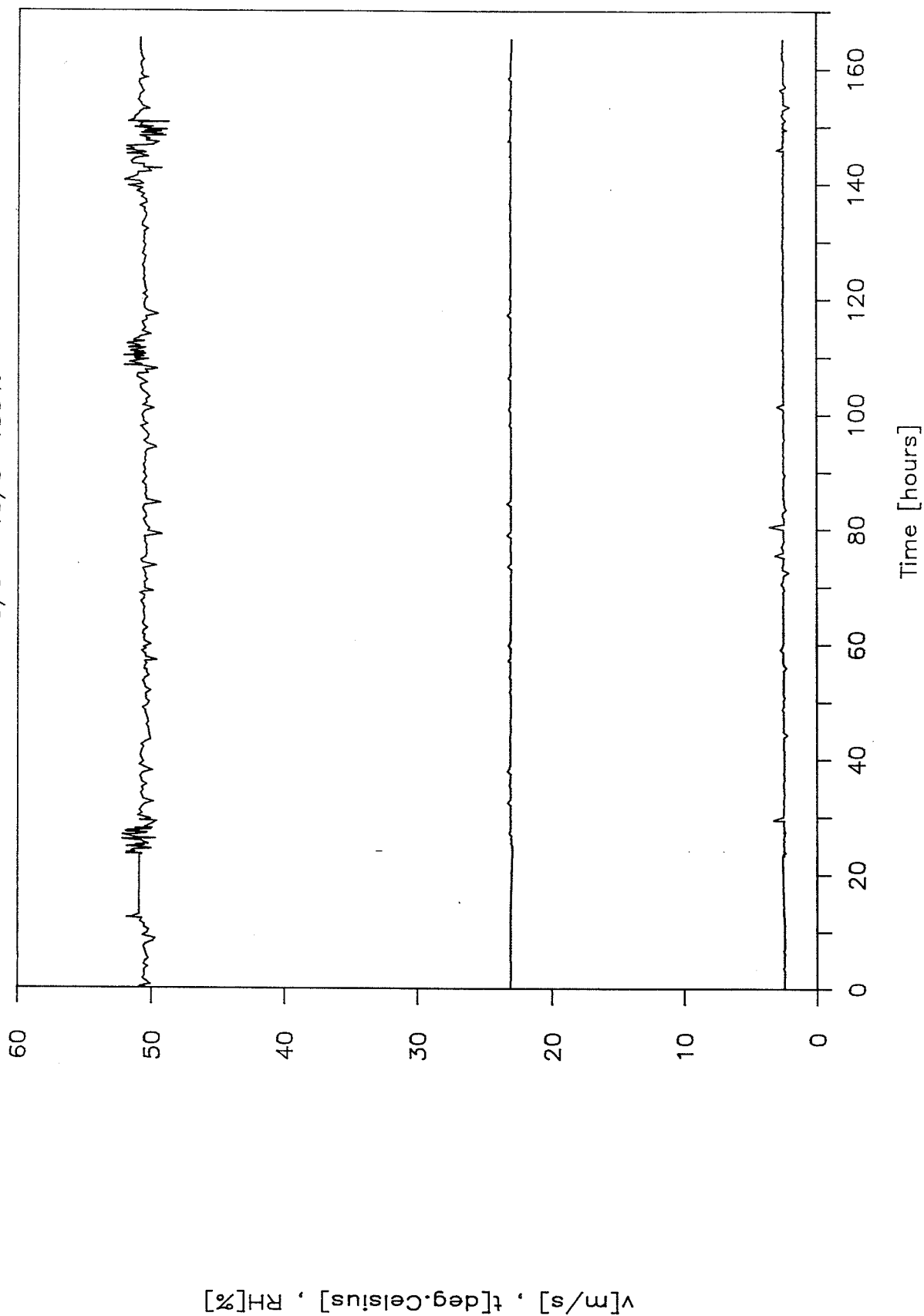


Prt Scr: Udskriv billedet på printer

F6: Returner

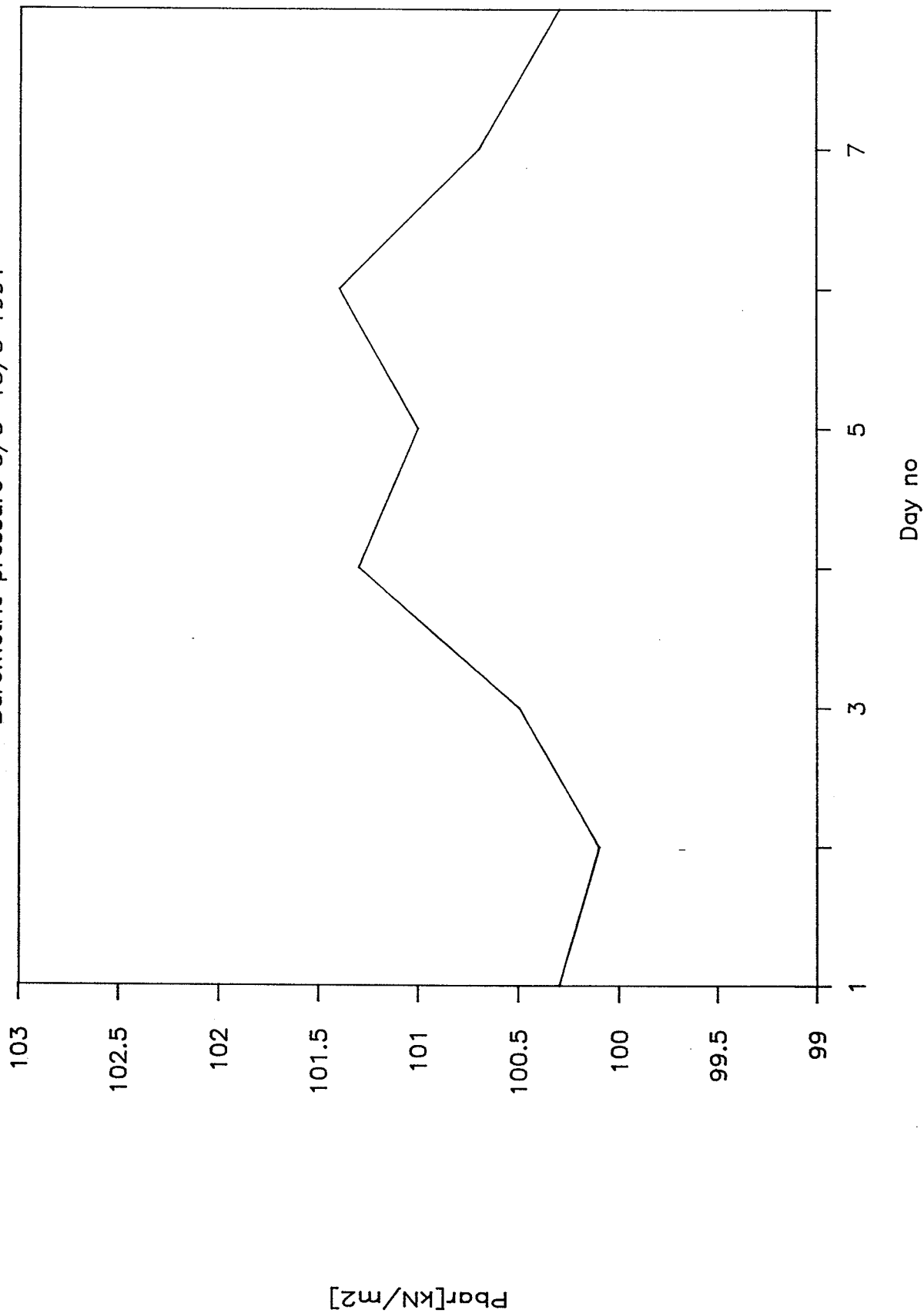
BCR, Polystyrene.

8/3 - 15/3 1991.



BCR, Polystyrene

Barometric pressure 8/3-15/3 1991



MOISTURE CONTENT TEST RESULTS

TEST LABORATORY : Building Materials Laboratory, Denmark

TEST MATERIAL : Extruded polystyrene

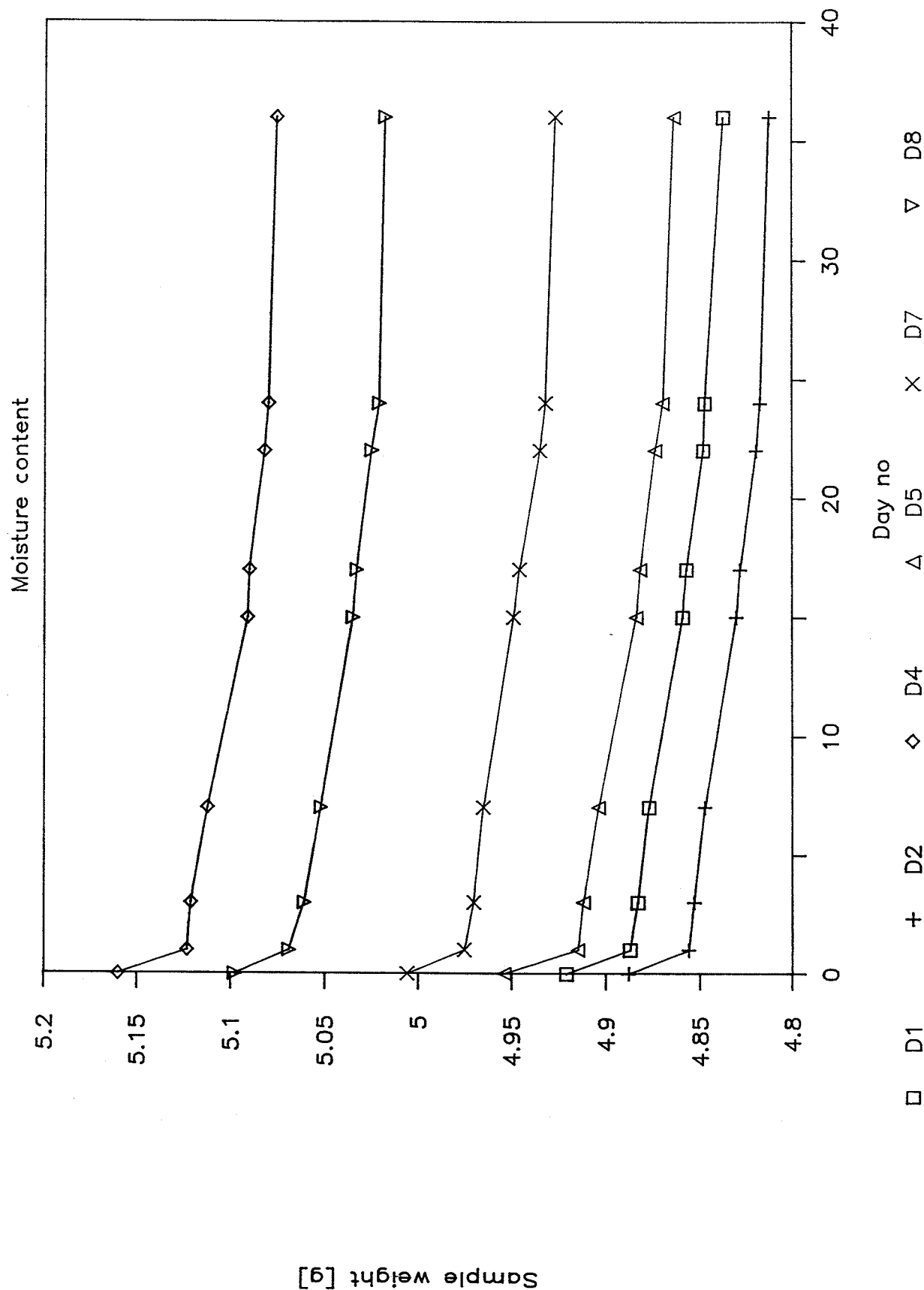
DRYING TEMPERATURE : 70

SAMPLE NUMBER	SIZE OF SECTION(mm)	INITIAL VOLUME(m3)	INITIAL MASS(kg)	INITIAL DENSITY	NO. DAYS DRYING	DRY VOLUME (m3)	DRY MASS (kg)	DRY DENSITY	MOISTURE CONTENT (g/kg)
D1	85	n.m.	0.004921	n.m.	36	n.m.	0.004837	n.m.	17.37
D3	85	n.m.	0.004888	n.m.	36	n.m.	0.004812	n.m.	15.79
D4	85	n.m.	0.00516	n.m.	36	n.m.	0.005076	n.m.	16.55
D5	85	n.m.	0.004954	n.m.	36	n.m.	0.004864	n.m.	18.50
D7	85	n.m.	0.005006	n.m.	36	n.m.	0.004927	n.m.	16.03
D8	85	n.m.	0.005098	n.m.	36	n.m.	0.005018	n.m.	15.94
OVERALL MEAN				n.m.				n.m.	16.70
STD. DEV.				n.m.				n.m.	0.96

Note: n.m. = not measured, because 1) measurement of volume was not mentioned in Guidance Notes for Participants 2.4(vi),
2) it was difficult to cut exactly circular sections.

PLEASE INCLUDE GRAPHS OF WEIGHT CHANGE AGAINST TIME

BCR, Polystyrene



SUMMARY OF TEST RESULTS

TEST LABORATORY : Building Materials Laboratory, Denmark

TEST MATERIAL : Extruded polystyrene

SAMPLE NUMBER	PRECONDITIONED DENSITY(kg/m3)	DRY DENSITY (kg/m3)	PRECON. MOISTURE CONTENT (g/kg)	TEST MOISTURE CONTENT (g/kg)	PERMEABILITY (seconds)	CORRECTED PERMEABILITY
D1	35.65	n.m.	n.m.	17.37	3.17E-12	
D3	35.73	n.m.	n.m.	15.79	2.95E-12	
D4	37.51	n.m.	n.m.	16.55	1.88E-12	
D5	35.53	n.m.	n.m.	18.50	2.85E-12	
D7	35.98	n.m.	n.m.	16.03	2.65E-12	
D8	36.93	n.m.	n.m.	15.94	1.95E-12	
OVERALL MEAN	36.22	n.m.	n.m.	16.70	2.58E-12	
ST. DEV.	0.81	n.m.	n.m.	0.96	0.54E-12	

Note: No corrections applied to produce corrected permeabilities
n.m. = not measured.

PLEASE PROVIDE A DESCRIPTION OF ALL CORECTIONS APPLIED
TO PRODUCE THE CORRECTED PERMEABILITIES - IF APPLIED -

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GUIDANCE NOTES FOR PARTICIPANTS - B.C.R. PROJECT 151

ANNEX TWO B

DETAILS OF TEST RESULTS

Particle board

PRECONDITIONING TEST RESULTS

TEST LABORATORY: Building Materials Laboratory, Denmark

SAMPLE MATERIAL: Particle board

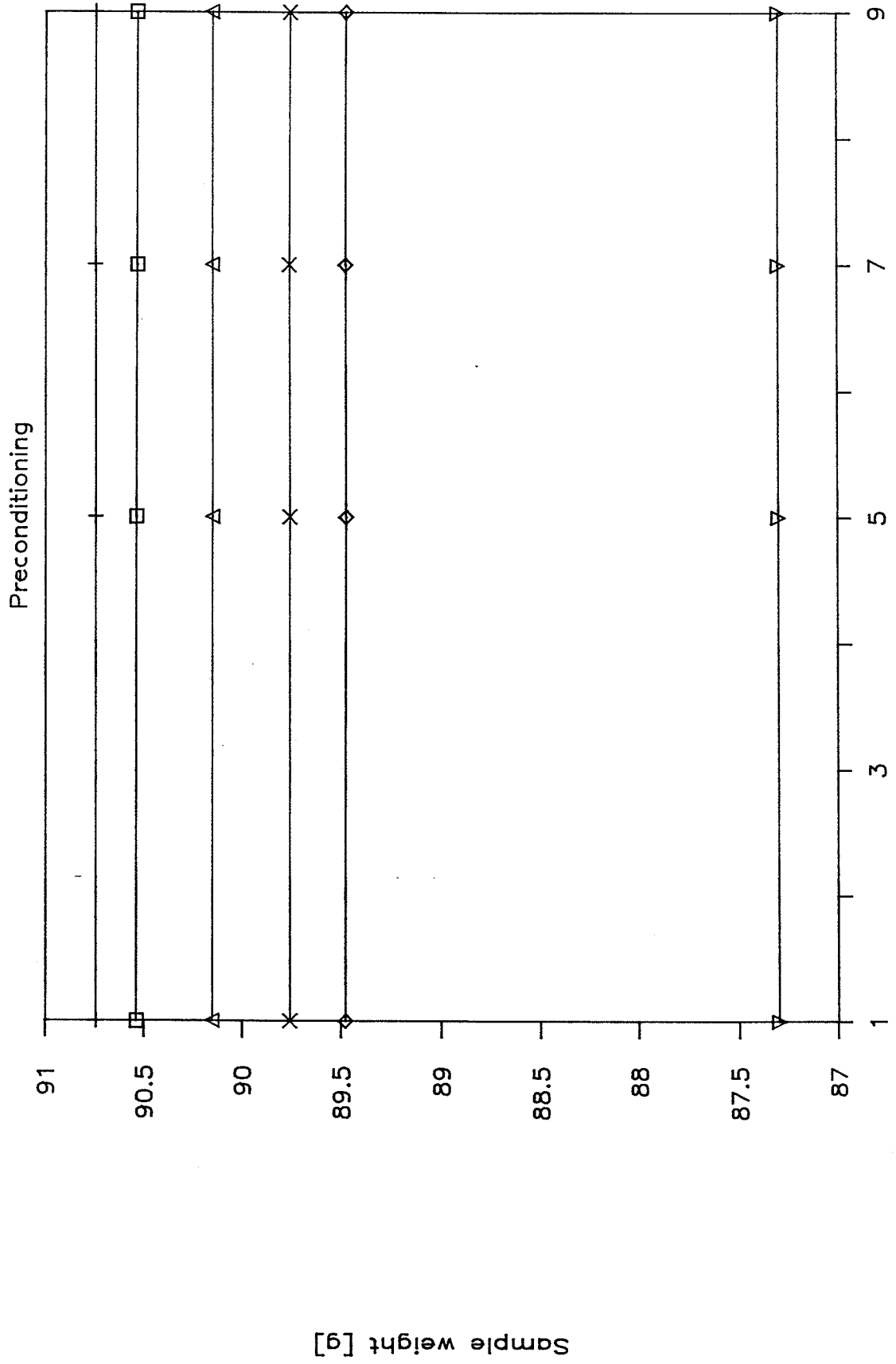
TEST DATES: 11/3-20/3

SAMPLE NUMBER	CONDITIONING PERIOD (DAYS)	WEIGHT AFTER CONDITIONING(kg)	SAMPLE AV. THICKNESS(mm)	SAMPLE DIAMETER(mm)	SAMPLE VOLUME(m3)	SAMPLE DENSITY(kg/m3)
8/2	9 +)	0.090535	0.03027	0.10010	0.0002382	380.08
8/7	9	0.090745	0.03066	0.10007	0.0002411	376.38
8/10	9	0.089476	0.03055	0.09984	0.0002392	374.06
8/11	9	0.090154	0.03024	0.10013	0.0002551	353.41
8/12	9	0.089756	0.03090	0.10009	0.0002431	369.21
8/14	9	0.087299	0.02999	0.10015	0.0002362	369.60
OVERALL MEAN	9	0.089661	0.03043	0.10006	0.0002421	370.46
ST. DEV.	0	0.001249	0.00033	0.00011	0.0000068	9.31

+) Conditioning period should be a maximum of 10 days according to letter 7 March 1991 from University of Strathclyde.

PLEASE INCLUDE GRAPHS OF WEIGHT CHANGE AGAINST TIME

BCR, Particle board



CUP TEST RESULTS

TEST LABORATORY : Building Materials Laboratory, Denmark

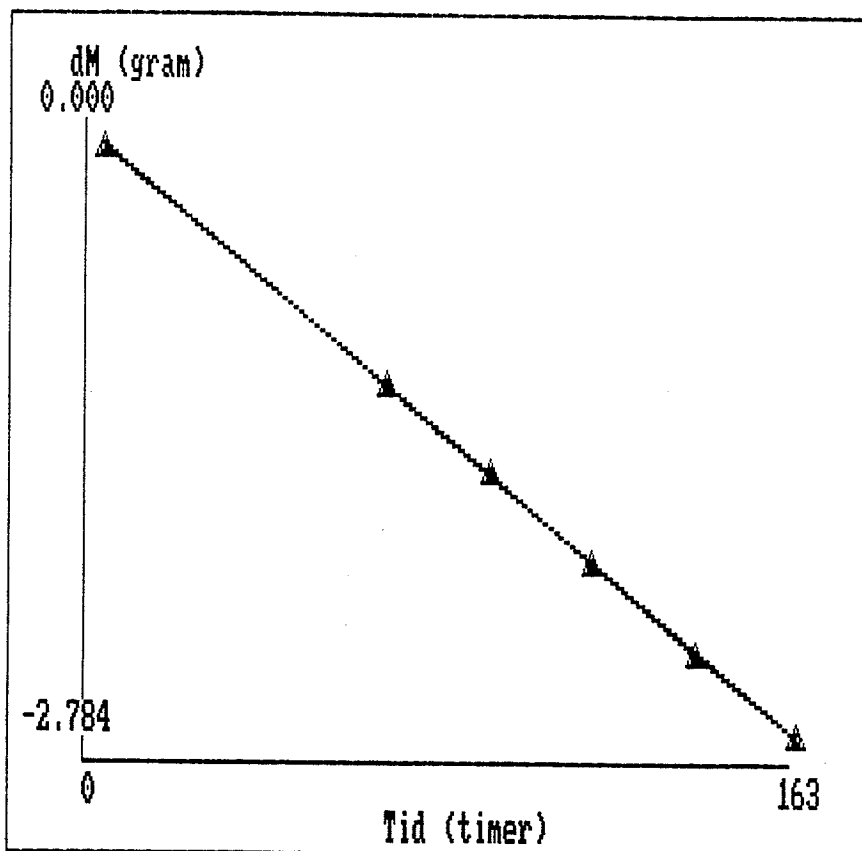
TEST DATES : 12/4-19/4 1991 MEAN BAROMETRIC PRESSURE (kN/m²):101.6 (1016 mbar)SAMPLE MATERIAL :Particle board VAPOUR PRESSURE DIFFERENCE(N/m²) :1206 (50.6 - 93 %RH)SAMPLE AVERAGE ^{*)} AREA (m²) : 0.007864 SAMPLE AVERAGE THICKNESS (m) :0.03044

DISTANCE FROM SAMPLE SURFACE TO SALT SOLUTION/DESICCANT : 0.007

SAMPLE NUMBER	PRECON. DENSITY	NO. DAYS TO STEADY STATE	DAILY WEIGHT OF CUPS AFTER STEADY STATE (m g)						MEAN CHANGE (mg/day)	CORR. COEF.	PERMEABILITY (seconds)
			DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6			
8/2	380.08	5	0	1131	1542	1950	2375	2784	409.0	1.0000	23.7E-12
8/7	376.38	5	0	1103	1506	1906	2325	2728	400.3	0.9999	23.5E-12
8/10	374.06	5	0	1134	1542	1944	2364	2770	406.1	1.0000	23.8E-12
8/11	353.41	5	0	1134	1545	1952	2376	2786	409.0	1.0000	23.7E-12
8/12	369.21	5	0	1183	1615	2037	2484	2910	427.7	1.0000	25.3E-12
8/14	369.60	5	0	1196	1629	2056	2499	2930	430.6	1.0000	24.7E-12
OVERALL MEAN	370.46								413.8		24.1E-12
ST. DEV	9.31								12.4		0.7E-12

*) Exposed free area = 0.005000 m²

PLEASE INCLUDE GRAPHS OF WEIGHT AGAINST TIME AND
BAROMETRIC PRESSURE AGAINST TIME



Kop nr. : 1

Particle board 8/2.

	Antal
■ Målepunkt	6
Analysert	6

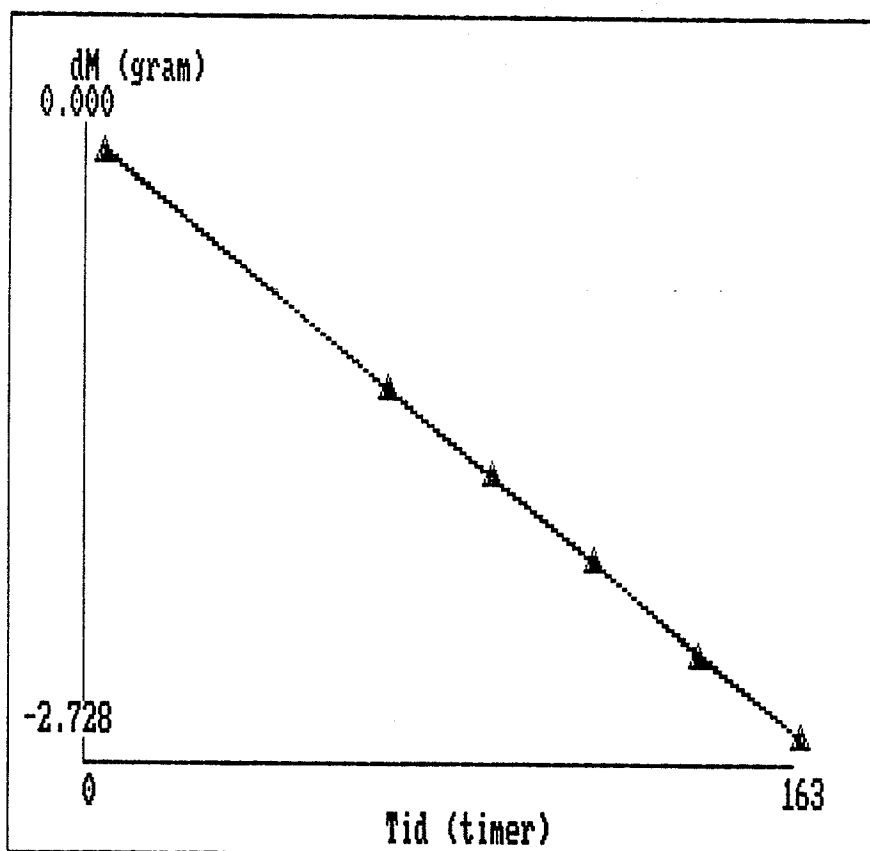
100 a = -0.0284
 b = 0.0097
 KorrKoef = -1.0000

Zp = 1.28
 (GPa s m**2/kg)

Kl. 17.38
 20.JUN.1991

Prt Scr: Udskriv billedet på printer

F6: Returner



Kop nr. : 2

Particle board 8/7.

	Antal
■ Målepunkt	6
Analysert	6

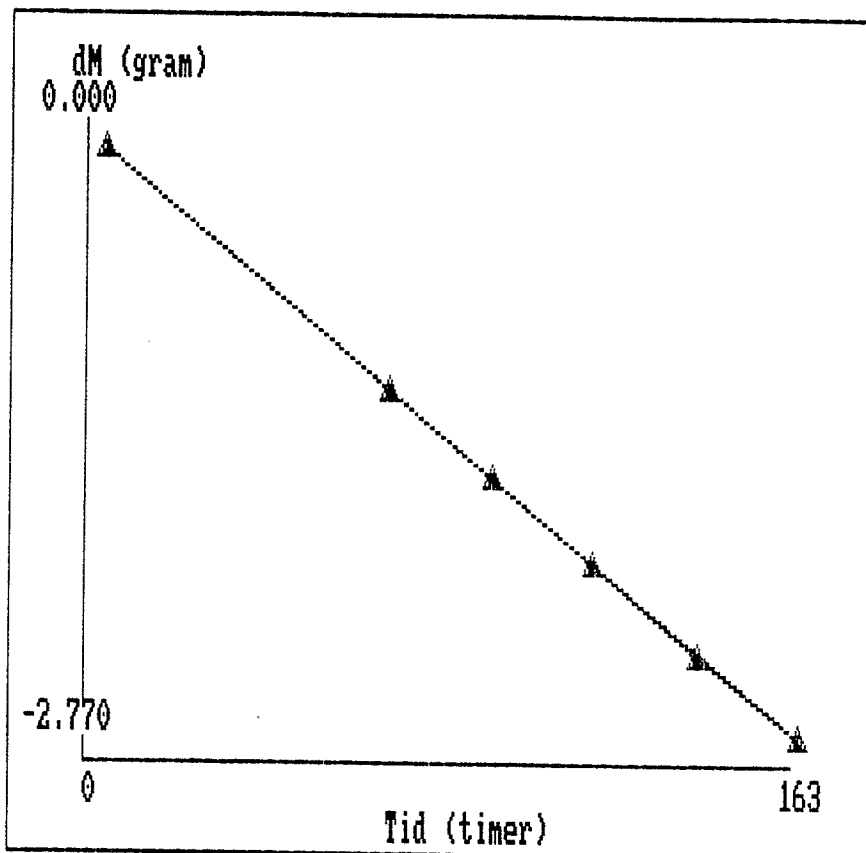
100 a = -0.0278
 b = 0.0128
 KorrKoef = -0.9999

Zp = 1.30
 (GPa s m**2/kg)

Kl. 17.42
 20.JUN.1991

Prt Scr: Udskriv billedet på printer

F6: Returner



Kop nr. : 3

Particle board 8/10.

	Antal
■ Målepunkt	6
Analysert	6

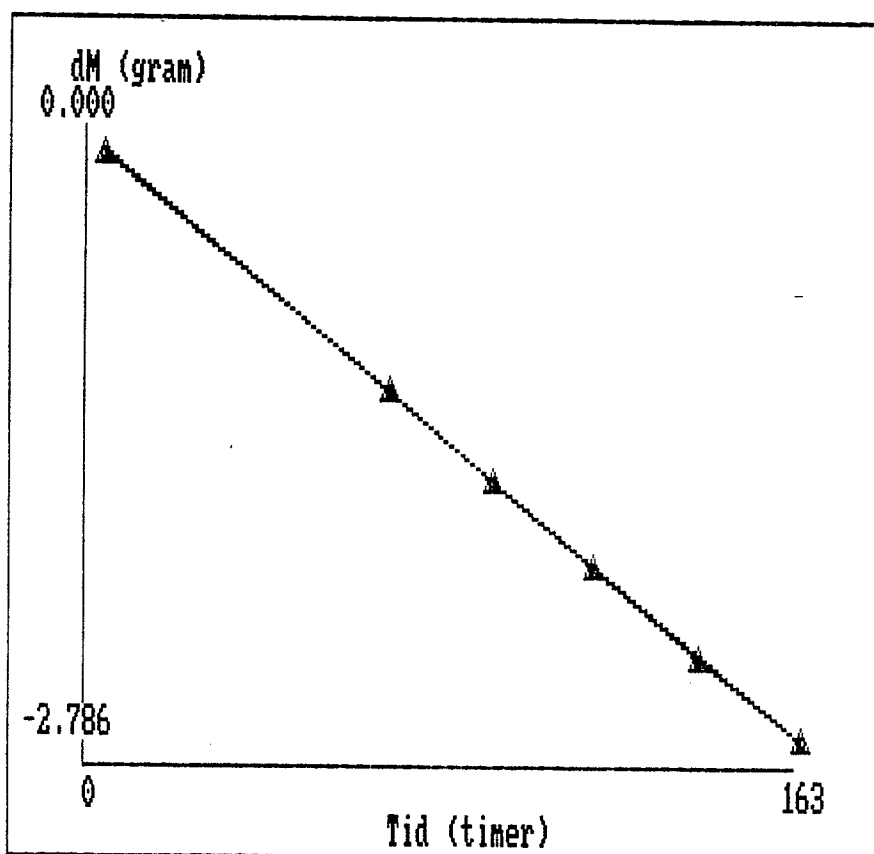
100 a = -0.0282
 b = 0.0060
 Korrkoeff = -1.0000

Zp = 1.28
 (GPa s m**2/kg)

K1. 17.46
 20.JUN.1991

Prt Scr: Udskriv billedet på printer

F6: Returner



Kop nr. : 4

Particle board 8/11.

	Antal
■ Målepunkt	6
Analysert	6

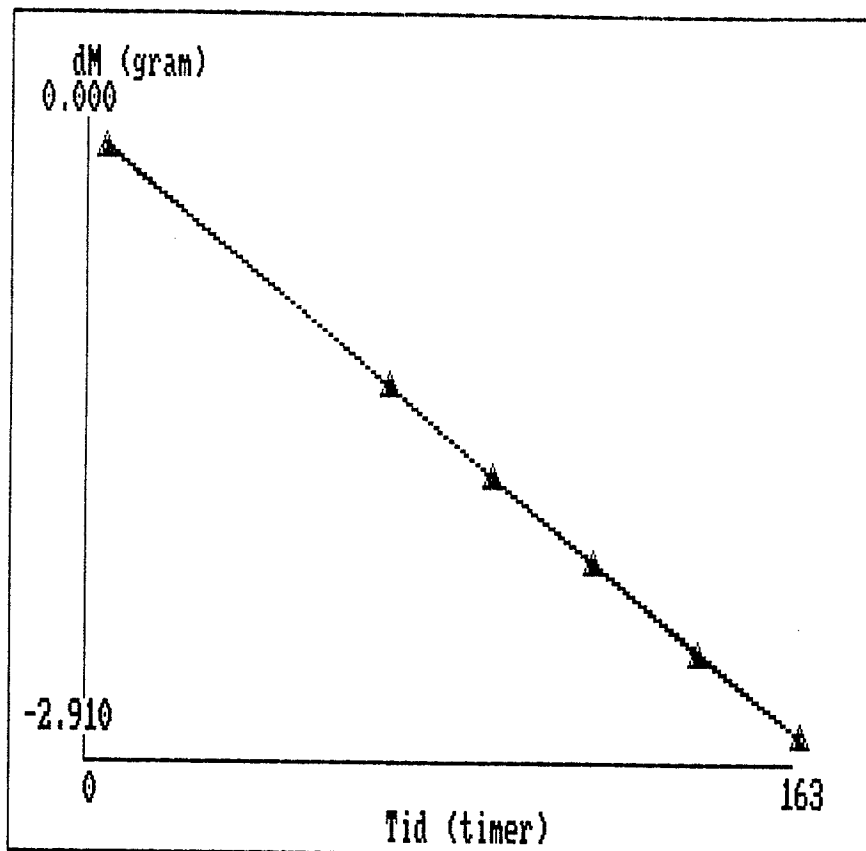
100 a = -0.0284
 b = 0.0094
 Korrkoeff = -1.0000

Zp = 1.28
 (GPa s m**2/kg)

K1. 17.50
 20.JUN.1991

Prt Scr: Udskriv billedet på printer

F6: Returner



Kop nr. : 5
Particle board 8/12.

Antal
Målepunkt 6
Analyseret 6

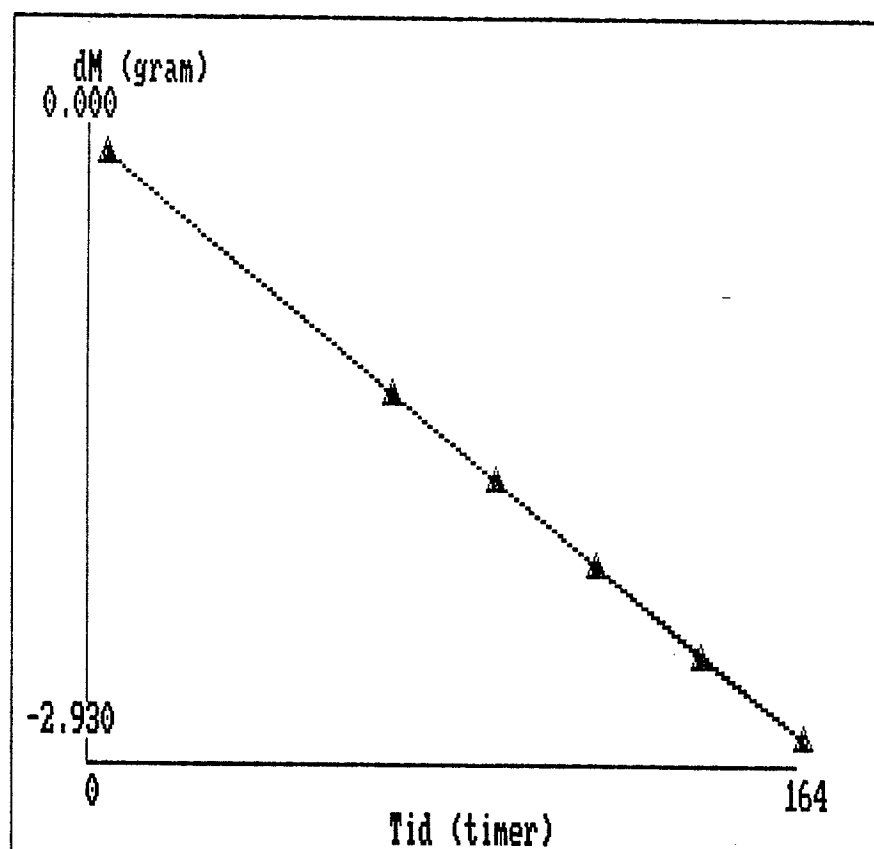
100 a = -0.0297
b = 0.0106
KorrKoeff = -1.0000

Zp = 1.22
(GPa s m**2/kg)

Kl. 17.55
20.JUN.1991

Prt Scr: Udskriv billedet på printer

F6: Returner



Kop nr. : 6
Particle board 8/14.

Antal
Målepunkt 6
Analyseret 6

100 a = -0.0299
b = 0.0084
KorrKoeff = -1.0000

Zp = 1.21
(GPa s m**2/kg)

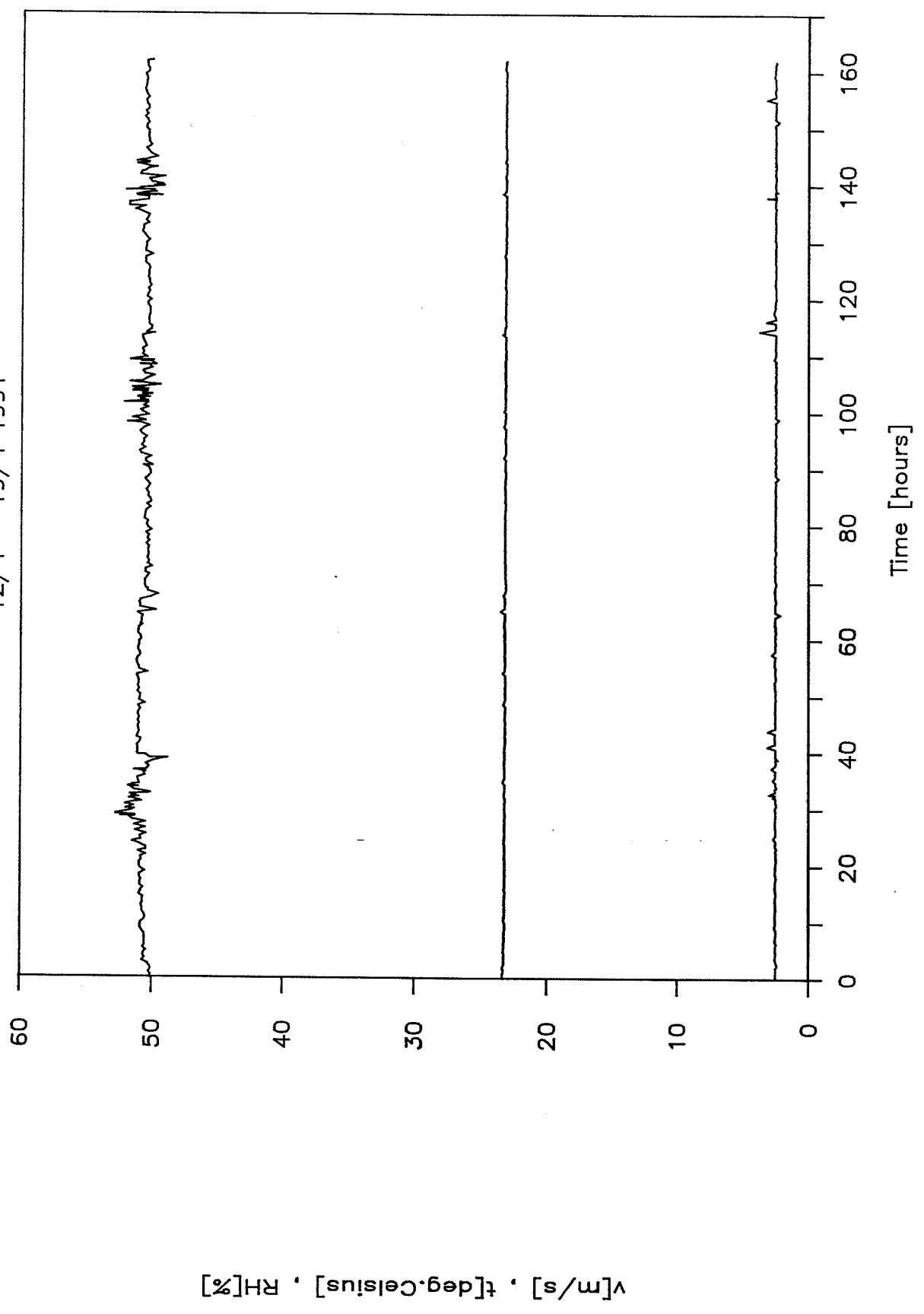
Kl. 17.59
20.JUN.1991

Prt Scr: Udskriv billedet på printer

F6: Returner

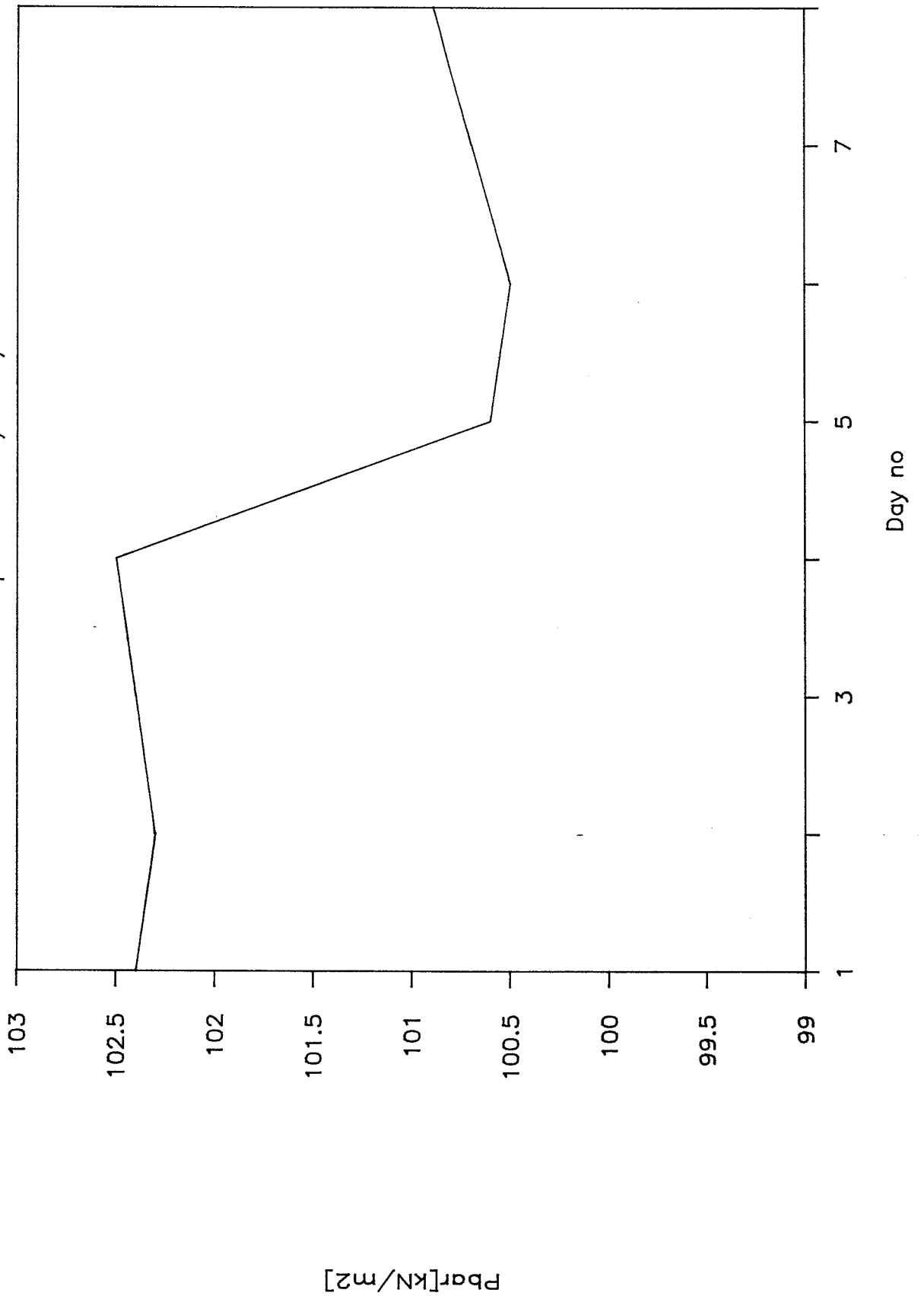
BCR, Particle board

12/4 - 19/4 1991



BCR, Particle board

Barometric pressure 12/4-19/4 1991



MOISTURE CONTENT TEST RESULTS

TEST LABORATORY : Building Materials Laboratory, Denmark

TEST MATERIAL : Particle board

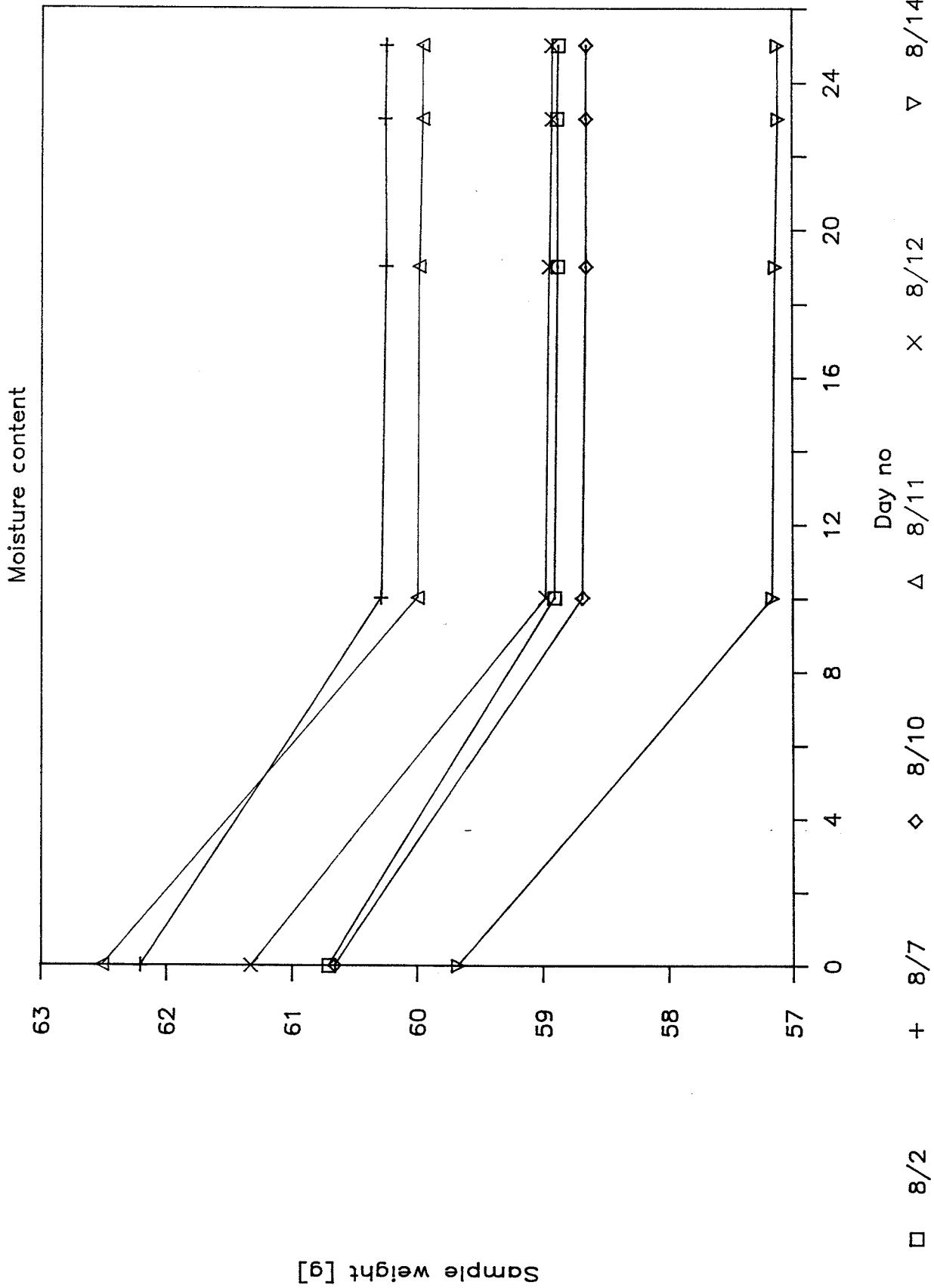
DRYING TEMPERATURE : 70

SAMPLE NUMBER	SIZE OF SECTION(mm)	INITIAL VOLUME(m3)	INITIAL MASS(kg)	INITIAL DENSITY	NO. DAYS DRYING	DRY VOLUME (m3)	DRY MASS (kg)	DRY DENSITY	MOISTURE CONTENT (g/kg)
8/2	82	n.m.	0.06071	n.m.	25	n.m.	0.058883	n.m.	31.03
8/7	82	n.m.	0.062208	n.m.	25	n.m.	0.060246	n.m.	32.57
8/10	82	n.m.	0.060661	n.m.	25	n.m.	0.058666	n.m.	34.01
8/11	82	n.m.	0.062512	n.m.	25	n.m.	0.059958	n.m.	42.60
8/12	82	n.m.	0.061333	n.m.	25	n.m.	0.058936	n.m.	40.67
8/14	82	n.m.	0.059677	n.m.	25	n.m.	0.057119	n.m.	44.78
OVERALL MEAN				n.m.				n.m.	37.61
STD. DEV.				n.m.				n.m.	5.28

Note: n.m. = not measured, because 1) measurement of volume was not mentioned in Guidance Notes for Participants 2.4(vi),
2) it was difficult to cut exactly circular sections.

PLEASE INCLUDE GRAPHS OF WEIGHT CHANGE AGAINST TIME

BCR, Particle board



SUMMARY OF TEST RESULTS

TEST LABORATORY : Building Materials Laboratory, Denmark

TEST MATERIAL : Particle board

SAMPLE NUMBER	PRECONDITIONED DENSITY(kg/m3)	DRY DENSITY (kg/m3)	PRECON. MOISTURE CONTENT (g/kg)	TEST MOISTURE CONTENT (g/kg)	PERMEABILITY (seconds)	CORRECTED PERMEABILITY
8/2	380.08	n.m.	n.m.	31.03	2.37E-11	
8/7	376.38	n.m.	n.m.	32.57	2.35E-11	
8/10	374.06	n.m.	n.m.	34.01	2.38E-11	
8/11	353.41	n.m.	n.m.	42.6	2.37E-11	
8/12	369.21	n.m.	n.m.	40.67	2.53E-11	
8/14	369.52	n.m.	n.m.	44.78	2.47E-11	
OVERALL MEAN	370.46	n.m.	n.m.	37.61	2.41E-11	
ST. DEV.	9.31	n.m.	n.m.	5.28	0.07E-11	

Note: No corrections applied to produce corrected permeabilities
n.m. = not measured.

PLEASE PROVIDE A DESCRIPTION OF ALL CORRECTIONS APPLIED
TO PRODUCE THE CORRECTED PERMEABILITIES - IF APPLIED -

ANNEX III:

Calibration verification of instruments for temperature, RH and barometric pressure.

CERTIFICATE OF CALIBRATION



CALIBRATION

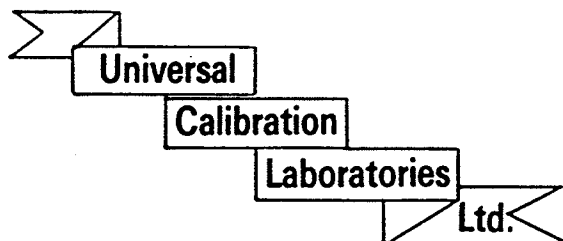
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DATE OF ISSUE
25.04.90

SERIAL NUMBER
03785T

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APPROVED SIGNATORY
C CLIFFORD-SMITH



UNIVERSAL HOUSE
Units F/G, Romsey Industrial Estate,
Greatbridge Road,
Romsey,
Hants, SO51 0HR

Telephone (0794) 523935

Customer: MICHELL INSTRUMENTS LIMITED
Address: UNIT 9 NUFFIELD CLOSE
NUFFIELD ROAD
CAMBRIDGE CB4 1SS

Order No: P017640/S6/GD

Apparatus Tested - DEW POINT METER AND MEASURING HEAD

Type No: INDICATORS S3000 AND S3005, HEAD PRT
Serial No: INDICATORS 95509, 95510, HEAD H1349
Range/Scale: -50 TO 50°C (0 TO 1 VOLT), 0.1° RESOLUTION
Manufacturer: MICHELL

Test Conditions -

Date: 25 APRIL 1990
Temperature: 20 ± 2°C
Humidity: 61 ± 10% RH
Reference No: 4561 H2/56

Certified by C. Clifford-Smith

The uncertainties are for a confidence probability of not less than 95%

This certificate is issued in accordance with the conditions of accreditation granted by the National Measurement Accreditation Service which has assessed the measurement capability of the laboratory and its traceability to United Kingdom national standards and to the units of measurement realised at the National Physical Laboratory. Copyright of this certificate is owned jointly by the Crown and the issuing laboratory and may not be reproduced other than in full except with the prior written approval of Head of NAMAS and the issuing laboratory.

CERTIFICATE OF CALIBRATION

ACCREDITATION NUMBER 0072

SERIAL NUMBER

03785T

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NB: INDICATOR 95509 IS FOR DISPLAYING DEW POINT
INDICATOR 95510 IS FOR DISPLAYING TEMPERATURE

SERIAL NO: INDICATOR 95510, HEAD H1349

THE INSTRUMENT WAS CALIBRATED BY IMMERSING THE PROBE IN CLOSELY CONTROLLED TEMPERATURE REFERENCE ENVIRONMENTS TOGETHER WITH TWO REFERENCE STANDARD INSTRUMENTS HAVING KNOWN AND TRACEABLE VALUES OF UNCERTAINTY.

THE FOLLOWING RESULTS ARE DERIVED FROM THE MEAN VALUES OF A NUMBER OF OBSERVATIONS.

TEST TEMPERATURE °C	INSTRUMENT READING °C	INSTRUMENT READING VOLTS
20.00	20.0	0.700 1
23.12	23.0	0.730 5
26.23	26.1	0.761 3

THE UNCERTAINTY ASSOCIATED WITH THE TEST TEMPERATURE DOES NOT
EXCEED $\pm 0.3^{\circ}\text{C}$ UP TO 100°C

THE ABOVE UNCERTAINTY REFERS TO THE MEASUREMENT AND IS NOT INTENDED TO
INDICATE THE SPECIFICATION OF THE INSTRUMENT.

THE TEMPERATURE SCALE IN USE IS THE INTERNATIONAL TEMPERATURE SCALE OF 1990,
ITS - 90.

Test Engineer C. Clifford-Smith

The uncertainties are for a confidence probability of not less than 95%

CERTIFICATE OF CALIBRATION

ISSUED BY MICHELL INSTRUMENTS LTD.
DATE OF ISSUE 28TH APRIL 1990 SERIAL NUMBER 00114



CALIBRATION
No. 0179



MICHELL

PAGE 1 OF 2 PAGES

APPROVED SIGNATORY

MICHELL INSTRUMENTS LIMITED, UNIT 9, NUFFIELD CLOSE, CAMBRIDGE CB4 1SS
Telephone: Cambridge (0223) 424427 Telex: 817741 Telefax: (0223) 426557

INSTRUMENT	MICHELL DEWPOINT HYGROMETER
TYPE	SERIES 3000
SERIAL NUMBER	INSTRUMENT 95509 SENSOR H1349
CUSTOMER	A/S MOBRO INSTRUMENTERING
ORDER NUMBER	V39024/BH
ACKNOWLEDGEMENT NUMBER	A5639
DATE	19TH APRIL 1990
AMBIENT TEMPERATURE	21 DEG C +/- 2 DEG C
GAS TEMPERATURE	21 DEG C +/- 2 DEG C
GAS FLOW RATE	0.5 LITRE PER MINUTE

THE UNCERTAINTIES QUOTED IN THIS CERTIFICATE OF CALIBRATION
ONLY APPLY TO THE MEASURED VALUE OBTAINED DURING THE PERIOD
OF CALIBRATION AND ARE NOT INDICATIVE OF THE LONG TERM STABILITY
OF THE INSTRUMENT UNDER TEST.

The uncertainties are for a confidence probability of not less than 95%

This certificate is issued in accordance with the conditions of accreditation granted by the National Measurement Accreditation Service, which has assessed the measurement capability of the laboratory and its traceability to recognised national standards and to the units of measurement realised at the corresponding national standards laboratory. Copyright of this certificate is owned jointly by the Crown and the issuing laboratory and may not be reproduced other than in full except with the prior written approval of the Head of NAMAS and the issuing laboratory.

CERTIFICATE OF CALIBRATION

NAMAS ACCREDITED CALIBRATION LABORATORY No 0179

SERIAL NUMBER

00114

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GENERATED DEWPOINT DEG C	INSTRUMENT OUTPUT VOLTS	INSTRUMENT DEWPOINT DISPLAY DEG C	HEAD COOLANT TEMPERATURE DEG C	CORRECTION REQUIRED TO DISPLAY DEG C
0.39	0.5028	0.3	21	+0.1
5.16	0.5508	5.1	21	+0.1
10.17	0.6003	10.0	21	+0.2
15.10	0.6495	15.0	21	+0.1
19.99	0.6989	19.9	22	+0.1

THE UNCERTAINTY OF MEASUREMENT INCREASES LINEARLY FROM
+/- 0.2 DEG C TO +/- 0.5 DEG C OVER THE DEWPOINT TEMPERATURE RANGE
+20 DEG C TO -75 DEG C.



STATENS
TEKNISKE
PRØVENÆVN

Autorisations reg. nr. 97

PRØVNINGSRAPPORT

over autoriseret teknisk prøvning i henhold til Statens Tekniske Prøvenævns autorisation af 22. august 1978.

Kalibrering af: Digital Electronic Barometer
Fabrikat/Type/Ser.nr.: Haenni / ZED 150 / 1012
Bestilt af: Danmarks Tekniske Højskole, Bygning 118, 2800 Lyngby
Deres ordre: Ifølge brev af 07 FEB 1990
Instrument modtaget: 08 FEB 1990 returneret: 14 FEB 1990

Målingerne er udført ved:

Rumtemperatur: 20 +- 1⁰C Relativ fugtighed: 45 +- 5%

Prøvningen er foretaget på omstående vilkår samt efter prøvningsbestemmelserne i MIL-C-45662A »Calibration System Requirements« med resultat som vist på følgende sider.

Dato: 26 FEB 1990
Kalibreret af: Finn Hansen
Godkendt af: T. Erland Madsen

Finn Hansen
T. Erland Madsen

Note: Prøvningsrapporter må kun gengives i uddrag, hvis rapporten er offentlig tilgængelig, eller laboratoriet har godkendt uddraget.



SAS NORMALLABORATORIUM I CPH
Metrology Engineering TA-S
Københavns Lufthavn
DK-2770 Kastrup
Tlf. 32 32 42 09.

Certifikat nr. A97-1559
TK-I 887/TEM/
Side 2 af 2 sider

Kalibrering af Electronic Barometer, Heanni Model ZED 150 s/n 1012.

Måleresultat:

Kalibreringsdato: 13 FEB 1990.

Tilført tryk i mbar $\pm 0,1$ mbar	Aflæst tryk på ZED 150 i mbar	Målt udg.spænding fra ZED 150 i V.	Usikkerhed på spænd. i uV
850,0	850	0,0756	0,6
875,0	875	0,3254	2,4
900,0	900	0,5761	4,0
925,0	925	0,8265	5,7
950,0	950	1,0767	7,3
975,0	976	1,3272	8,9
1000,0	1001	1,5778	10,8
1013,2	1014	1,7099	11,5
1050,0	1051	2,0785	13,5
1100,0	1102	2,5801	16,3

Instrumentet er ikke justeret.

Der var ingen målelig hysteresis på instrumentet.

Ved kalibreringen er anvendt Air Data Tester, Sperry Model 222B p/n 4047505-214 s/n 82070239, hvis reference er Micrometer Standard Barometer, Hass Model MS-3 s/n 2984.

Sporbarhed for tryk:

- Mikrometerskrue via certificerede Johansson måleklodser og barometerskala certificeret af Statens Provningsanstalt, Sverige den 11 MAJ 1984.
- Temperatur via Platinum Resistance Temperature Standard, Rosemount Model 162CE s/n 1435 certificeret af Jysk Teknologisk, Termometrilaboratoriet, STP aut. nr. 99 den 12 - 14 JUL 1989 i.h.t. certifikat nr.99-1256 af 31 JUL 1989.
- Urenheder i Kviksølv (vægtfylde) certificeret til mindre end 0,1 ppm.
- Tyngdeacceleration for Barometer, Hass Model MS-3 placering målt af Geodætisk Institut den 4 MAJ 1984 til $9,815425 \text{ m/s}^2$.

Desuden er der anvendt et Precision Voltmeter, Solartron Model 7081 s/n 000137 hvis reference er Standard Cell Enclosure, Guildline Model 9152T/6 s/n 33.646 som er certificeret af National Physical Laboratory, England den 20 AUG 1989 med en estimeret max. usikkerhed på 0,5 uV.

ANNEX IV:

Building Materials Laboratory reports:
RESULTAT AF KOPMÅLINGER serie 44 og serie 46

20. JUN. 1991

RESULTAT AF KOPMÅLINGER

Rekvirent : Strathclyde University Glasgow, Scotland.
Kontaktperson : Graham H. Galbraith.

Prøveleder : Kurt K. Hansen. Udført af: Peter V. Albertsen.

Prøveperiode : 8/3 - 15/3 1991 LBM-serienummer: 44

Prøvekammer : 23.1°C, 51.3 %RH v_luft: 2.5 m/s
Det angivne klima i prøveammeret er middelværdi for hele prøveperioden.

Effektivt prøveareal: $A = 5000 \text{ mm}^2$

Fugtmodstandstal

$$Z_p = A \cdot dp / \alpha \quad (\text{Pa} \cdot \text{s} \cdot \text{m}^2 / \text{kg})$$

dp: Damptryksforskel over prøveemne.
 α : Hældningen af vægtændringskurven.

$$Z_c = Z_p \cdot 7.3 \cdot 10^{-6} \quad (\text{s/m})$$

Diffusivitet

$$\delta_p = 1 / Z_p \quad (\text{kg} / \text{Pa} \cdot \text{s} \cdot \text{m})$$

$$D_c = 462 \cdot T \cdot \delta_p \quad (\text{m}^2 / \text{s})$$

l : Prøvelegemets tykkelse.
T : Temperatur i Kelvin.

Kommentarer:

Prøveleders underskrift: Kurt K. Hansen
Kurt K. Hansen.

20. JUN. 1991

=====

RESULTAT AF KOPMÅLINGER

=====

Prøveperiode: 8/3 - 15/3 1991

IBM-serienummer: 44

Prøvechamber : 23.1°C, 51.3 %RH

v_{luft}: 2.5 m/s

Kop	Prøveemne	Tykkelse	RH i kop	Modstand		Diffusivitet	
		l		Z _p	Z _c	δ _p	D _c
		mm	%	·10 ⁹ Pa·s·m ² /kg	·10 ³ s/m	·10 ⁻¹² kg/Pa·s·m	·10 ⁻⁶ m ² /s
1	D1	24.48	0	7.72	56.4	3.17	0.43
2	D3	24.50	0	8.32	60.7	2.95	0.40
3	D4	24.56	0	13.0	95.3	1.88	0.26
4	D5	24.49	0	8.58	62.6	2.85	0.39
5	D7	24.55	0	9.26	67.6	2.65	0.36
6	D8	24.59	0	12.6	92.3	1.95	0.27
7	D21	24.56	0	8.97	65.5	2.74	0.37
8	D22	24.63	0	8.93	65.2	2.76	0.38
9	D23	24.74	0	13.2	96.4	1.87	0.26
10	D24	24.71	0	12.9	94.4	1.91	0.26
11	D25	24.58	0	8.23	60.1	2.99	0.41
12	D33	24.62	0	8.76	64.0	2.81	0.38

Et nul for Z_p, Z_c, δ_p og D_c angiver, at disse ikke er beregnet.

Bemærkninger:

Luftlagstykkelse = 0,008 m

Kop nr. 1 - 6 : Calcium chloride (CaCl₂)

Kop nr. 7 - 12 : Magnesium perchloride (Mg(ClO₄)₂)
 (Extra test)

Datafiler: serie44c.dat, serie44h.rec

20. JUN. 1991

RESULTAT AF KOPMÅLINGER

Rekvirent : Strathclyde University Glasgow, Scotland.
Kontaktperson : Graham H. Galbraith.

Prøveleder : Kurt K. Hansen. Udført af: Peter V. Albertsen.

Prøveperiode : 12/4 - 19/4 1991. LBM-serienummer: 46

Prøvekammer : 23.2°C, 50.6 %RH v_luft: 2.5 m/s
Det angivne klima i prøveområdet er middelværdi for hele prøveperioden.

Effektivt prøveareal: $A = 5000 \text{ mm}^2$

Fugtmodstandstal

$$Z_p = A \cdot dp / \alpha \quad (\text{Pa} \cdot \text{s} \cdot \text{m}^2 / \text{kg})$$

dp: Damptryksforskelle over prøveemne.
 α : Hældningen af vægtændringskurven.

$$Z_c = Z_p \cdot 7.3 \cdot 10^{-6} \quad (\text{s/m})$$

Diffusivitet

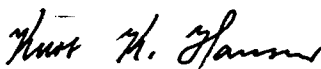
$$\delta_p = l / Z_p \quad (\text{kg} / \text{Pa} \cdot \text{s} \cdot \text{m})$$

$$D_c = 462 \cdot T \cdot \delta_p \quad (\text{m}^2 / \text{s})$$

l: Prøvelegemets tykkelse.
T: Temperatur i Kelvin.

Kommentarer:

Prøveleders underskrift:



Kurt K. Hansen.

L. Laboratoriet for Bygningsmaterialer, Danmarks Tekniske Højskole

B M Building Materials Laboratory, The Technical University of Denmark

20. JUN. 1991

=====

RESULTAT AF KOPMÅLINGER

=====

Prøveperiode: 12/4 - 19/4 1991.

LBM-serienummer: 46

Prøvekammer : 23.2°C, 50.6 %RH

v_luft: 2.5 m/s

Kop	Prøveemne	Tykkelse	RH i kop	Modstand		Diffusivitet	
		l		Zp	Zc	δp	Dc
		mm	%	$\cdot 10^9$ Pa·s·m ² /kg	$\cdot 10^3$ s/m	$\cdot 10^{-12}$ kg/Pa·s·m	$\cdot 10^{-6}$ m ² /s
1	Particle board 8/2.	30.27	93	1.28	9.32	23.7	3.25
2	Particle board 8/7.	30.66	93	1.30	9.51	23.5	3.22
3	Particle board 8/10.	30.55	93	1.28	9.37	23.8	3.26
4	Particle board 8/11.	30.24	93	1.28	9.31	23.7	3.25
5	Particle board 8/12.	30.90	93	1.22	8.91	25.3	3.47
6	Particle board 8/14.	29.99	93	1.21	8.86	24.7	3.39

Et nul for Zp, Zc, δp og Dc angiver, at disse ikke er beregnet.

Bemærkninger:

Luftlagstykkelse = 0,007 m

93 %RF : Ammonium Dihydrogen Orthophosphate (NH₄H₂PO₄)

Datafiler: serie46.dat, serie46.rec