Certification Test Report

Morsø Jernstøberi A/S

Freestanding Wood Stove
Model: Panther 2110 B

Report Number 192-S-01-3

OMNI-Test Laboratories, Inc.
Product Testing & Certification

Mailing: Post Office Box 743
Street: 5465 SW Western Avenue • Suite G
Beaverton, Oregon 97075 USA

Phone: (503) 643-3788
Fax: (503) 643-3799

Model: Panther 2110 B
Morsø Jernstøberi A/S
DK-7900
Nykøbing Mors
Denmark

Certification Test Report

Morsø Jernstøberi A/S

Freestanding Wood Stove
Model: Panther 2110 B

Prepared for:	Morsø Jernstøberi A/S DK-7900 Nykøbing Mors Denmark
Prepared by:	OMNI-Test Laboratories, Inc. 5465 SW Western Avenue, Suite G Beaverton, Oregon 97005 (503) 643-3788
Test Period:	June 24, 2002 – June 28, 2002
Report Date:	July 2002
Project Number:	192-S-01-3

Model: Panther 2110 B
Morsø Jernstøberi A/S
DK-7900
Nykøbing Mors
Denmark

AUTHORIZED SIGNATORIES

This report has been reviewed and approved by the following authorized signatories.

Paul E. Tiegs, President
OMNI-Test Laboratories, Inc.

Richard C. Sparwasser, Vice President
OMNI-Test Laboratories, Inc.

Model: Panther 2110 B
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Morsø Jernstøberi A/S
Model: Panther 2110 B
Test Dates: June 24, 2002 – June 28, 2002

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Section 1

Sampling Procedures and Test Results

Model: Panther 2110 B
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INTRODUCTION

Morsø Jernstøberi A/S retained OMNI-Test Laboratories, Inc. (O-TL) to perform U.S. Environmental Protection Agency (EPA) certification testing on the Model Panther 2110 B wood stove. The Model Panther 2110 B wood stove is a non-catalytic, freestanding, radiant-type room heater. The firebox is constructed primarily of cast iron. The usable firebox volume was measured to be 1.093 cubic feet. The stove is vented through a 6" diameter flue collar located at the top of the unit.

The testing was performed at the O-TL laboratory in Beaverton, Oregon. The altitude of the laboratory is 204 feet above sea level. The unit was received in good condition and logged in at the OMNI test facility on June 18, 2002; it was assigned and labeled with OMNI ID #387. OMNI representative, Ken Morgan, conducted the certification testing and completed all testing by June 28, 2002. The EPA was notified of the testing dates in a letter dated June 24, 2002. A testing contract, including provisions for Random Compliance Audit (RCA) testing, has been signed by Peter Jessen Hansen of Morsø Jernstøberi A/S and is on file at O-TL.

The Model Panther 2110 B wood stove was tested in accordance with the U.S. EPA 40 CFR Part 60, Subpart AAA – Standard of Performance for Residential Wood Heaters (Appendix A, Methods 28 and 5G). Particulate emissions were measured using a Method 5G sampling train consisting of two filters (front and back). The weighted average emissions of the four test runs indicate a particulate emission level of 4.28 grams per hour. Test runs were conducted in each of four burn rate categories (<0.80 kg/hr , 0.80-1.25 kg/hr, 1.25-1.90 kg/hr, and maximum). Emissions for each of their individual test runs did not exceed the cap. The Model Panther 2110 B results are within the emission limit of 7.5 grams per hour for non-catalytic affected facilities manufactured on or after July 1, 1990, or sold at retail on or after July 1, 1992.

The wood heater was sealed after completion of testing in compliance with the EPA regulation as follows:

- "DO NOT TAMPER" labels were placed on the door and all other openings;
- Plastic material sealed with "DO NOT TAMPER" labels and tape was wrapped around the unit;
- The unit was sealed in a wood box constructed for the unit and secured with steel banding; and
- "DO NOT TAMPER" labels were placed on all outer surfaces of the box.

This report is organized in accordance with the EPA-recommended outline and is summarized in the Table of Contents immediately preceding this report.

Model: Panther 2110 B
Morsø Jernstøberi A/S
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Table 1.1 – Particulate Emissions

Run	Burn Rate (kg/hr dry)	Method 5G Emissions (g/hr)
1	0.71	4.00
2	3.49	6.18
3	0.93	5.40
4	1.51	2.72
Weighted particulate emission average of four test runs: 4.28 grams per hour.		

Table 1.2 – Test Facility Conditions

Run	Room Temperature (°F)		Barometric Pressure (in Hg)		Air Velocity (ft/min)	
	Before	After	Before	After	Before	After
1	80	82	30.00	29.98	<50	<50
2	88	90	29.88	29.88	<50	<50
3	85	90	29.82	29.78	<50	<50
4	79	74	29.77	29.77	<50	<50

Table 1.3.1 – Fuel Measurement and Crib Description Summary – PRETEST

Run	Pretest Fuel Weight (Starting weight)	Pretest Moisture (Dry basis - %)	Coal Bed Weight (lb)
1	5.4	21.8	2.0
2	10.1	20.4	1.6
3	6.3	20.5	2.0
4	6.7	23.7	1.8

Table 1.3.2 – Fuel Measurement and Crib Description Summary – TEST

Run	Test Fuel Wet Basis (lb)	Firebox Volume (ft^3)	Fuel Loading Density Wet Basis (lb/ft^3)	Fuel Moisture Content Dry (%)	Piece Length (in)	2x4s Used	4x4s Used
1	8.2	1.093	7.50	20.3	16.0	4	0
2	7.8	1.093	7.14	21.5	16.0	4	0
3	8.2	1.093	7.50	19.9	15.5	4	0
4	7.4	1.093	6.77	21.6	16.0	4	0

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Table 1.4 – Dilution Tunnel Gas Measurements and Sampling Data Summary

Run	Length of Test (min)	Average Dilution Tunnel Gas Measurements		
		Velocity (ft/sec)	Flow Rate (dscf/min)	Temp (°F)
1	260	13.95	149.0	99.37
2	50	14.82	142.7	158.46
3	200	14.36	150.6	106.35
4	110	14.32	149.5	108.34

Table 1.5 - Heater Operation Data (Average Temperature Data)

Run	Beginning Surface Temp Average[a]	Ending Surface Temp Average[a]	Surface Delta T[b]
1	363.0	248.6	114
2	535.0	491.0	44
3	370.0	299.2	71
4	416.8	321.2	96
a. All temperatures are in degrees F.			
b. Surface Delta T represents the difference between beginning and ending average surface temperature.			

Table 1.6 – Pretest Configuration

Run	Combustion Air (in)	Fuel Added	Fuel Removed	Time (min)
1	Fully closed.	5.4 lbs. at start; no addition; coal bed 2.0 lbs.	N/A	60
2	Fully open (1.500 inches).	10.1 lbs. at start; 5.7 lbs. added at 38 minutes; coal bed 1.6 lbs.	N/A	70
3	Open 0.078 inches from fully closed.	6.3 lbs. at start; no addition; coal bed 2.0 lbs.	N/A	75
4	Primary air opened 0.188 inches.	6.7 lbs. at start; 2.1 lbs. added at 41 minutes; coal bed 1.8 lbs.	N/A	75

Table 1.7 – Run Data

Run	Average Dry Burn Rate (kg/hr)	Initial (Induced) Draft (in H_2O)	Primary Air Setting (in)	Run Time (min)	Average Draft (in H_2O)
1	0.71	0	Fully closed.	260	-0.036
2	3.49	0	Fully open (1.500 inches).	50	-0.087
3	0.93	0	Open 0.078 inches from fully closed.	200	-0.045
4	1.51	0	Primary air opened 0.188 inches.	110	-0.056

Table 1.8 – Test Configuration

Run	Five-Minute Startup	Combustion Air
1	Bypass: None. Fuel Loading: Loaded by 35 seconds. Door: Closed by 40 seconds. Primary Air: Fully open for $4^1/_2$ minutes, then slowly closed to test setting by 5 minutes. Other: N/A. Secondary: Fixed. Tertiary: None. Fan: None.	Fully closed.
2	Bypass: None. Fuel Loading: Loaded by 40 seconds. Door: Closed by 45 seconds. Primary Air: Fully opened – undisturbed. Other: N/A. Secondary: Fixed. Tertiary: None. Fan: None.	Fully open (1.500 inches).
3	Bypass: None. Fuel Loading: Loaded by 30 seconds. Door: Closed by 45 seconds. Primary Air: Fully open for $4^1/_2$ minutes, then slowly closed to test setting by 5 minutes. Other: N/A. Secondary: Fixed. Tertiary: None. Fan: None.	Open 0.078 inches from fully closed.
4	Bypass: None. Fuel Loading: Loaded by 30 seconds. Door: Closed by 45 seconds. Primary Air: Fully open for $4^1/_2$ minutes, then slowly adjusted to test setting by 5 minutes. Other: N/A. Secondary: Fixed. Tertiary: None. Fan: None.	Primary air opened 0.188 inches.

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TEST RESULTS AND DISCUSSION

A total of four test runs were conducted in the following categories: one in the <0.80 kg/hr dry category, one in the 0.80 to 1.25 kg/hr dry category; one in the 1.26 to 1.90 kg/hr dry category; and one at maximum.

The weighted particulate emission level was measured to be 4.28 grams per hour.

The proportionality results for all four test runs were acceptable. Quality check results for each test run are presented Section 2 of this report.

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APPLIANCE DESCRIPTION

Appliance Manufacturer: Morsø Jernstøberi A/S

Wood Stove Model: Panther 2110 B

Type: Freestanding, radiant-type room heater

WOOD HEATER DESCRIPTION:

Materials of Construction: The entire unit is constructed primarily of cast iron.

Air Introduction System: Air enters the firebox through an opening located at the back/bottom of the appliance. Secondary air enters the appliance through the bottom/back and is channeled internally to both sides of the firebox supplying four tiers of a stainless steel baffle.

Combustion Control Mechanisms: The combustion air inlet is actuated via a rod located in the front, under the firebox fuel-loading door.

Combustor: NA.

Internal Baffles: A stainless steel baffle is mounted in the upper portion of the firebox. The flame path is forced to the front of the firebox where it travels up through the opening between the baffle and primary air manifold.

Other Features: None.

Flue Outlet: The 6" diameter flue outlet is located in the top of the unit.

WOOD HEATER OPERATING INSTRUCTIONS

Specific written instructions: See Section 4 of this report. All markings and instruction materials were reviewed for content prior to printing.

Model: Panther 2110 B
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Section 2

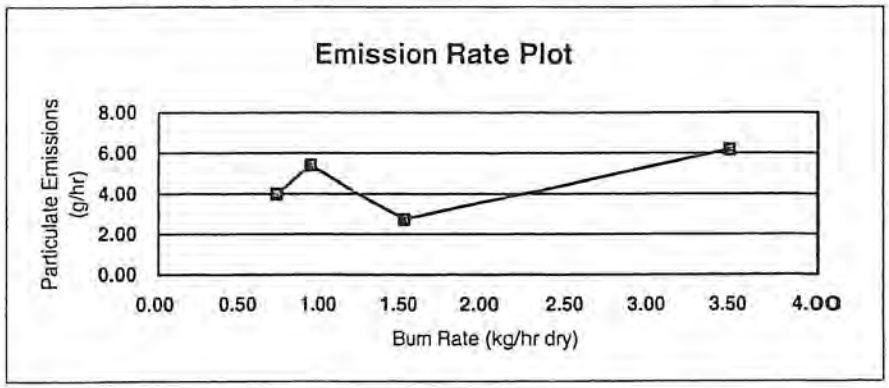
Test Data by Run

EPA Weighted Average Emissions
EPA Method 28

Client: Morso
Stove Model: 2110 Panther B
Test Dates: 6/24/2002 - 6/28/02
Project Number: 192-S-01-3
Tracking Number: 387
Signature/Date: see below

Status: FINAL
Stove Type: Non-Catalytic Stove

Weighted Average (g/hr)
4.28



Run #	1	
Burn Rate (dry kg/hr)	0.71	
Catagory	1	
Overall Efficiency (%)	63%	
Emissions (g/hr)	4	
Cap (g/hr)	15	
Weighting Factor	0.317	17.29%
Heat Output (BTU/hr)	8136	

Run #	3	
Burn Rate (dry kg/hr)	0.93	
Catagory	2	
Overall Efficiency (%)	63%	
Emissions (g/hr)	5.4	
Cap (g/hr)	15	
Weighting Factor	0.599	32.67%
Heat Output (BTU/hr)	10656	

Run #	4	
Burn Rate (dry kg/hr)	1.51	
Catagory	3	
Overall Efficiency (%)	63%	
Emissions (g/hr)	2.72	
Cap (g/hr)	18	
Weighting Factor	0.673	36.72%
Heat Output (BTU/hr)	17302	

Run #	2	
Burn Rate (dry kg/hr)	3.49	
Catagory	4	
Overall Efficiency (%)	63%	
Emissions (g/hr)	6.18	
Cap (g/hr)	18	
Weighting Factor	0.244	13.32%
Heat Output (BTU/hr)	39990	

NS for Ken Morgan 9/12/02

Model: Panther 2110 B
Morsø Jernstøberi A/S
DK-7900
Nykøbing Mors
Denmark

Run 1

OMNI-Test Laboratories, Inc.

Wood Heater Test Data - EPA Method 5G

Manufacturer: Morso
Model: 2110 Panther A
Project No.: 387
Tracking No.: 192-S-01-3
Run: 1
Test Date: 06/24/02

Burn Rate	0.71 kg/hr dry
Particulate Concentration (dry-standard) Particulate Emission Rate Adjusted Emissions	0.00029 grams/dscf 2.58 grams/hour 4.00 grams/hour
Average Tunnel Temperature	99 degrees Fahrenheit
Average Delta p	0.042 inches H2O
Total Sample Volume - Vm Average Gas Meter Temperature Average Gas Velocity in Dilution Tunnel - vs Average Gas Flow Rate in Dilution Tunnel - Qsd Total Sample Volume (Standard Conditions) - Vms	139.84 cubic feet 84 degrees Fahrenheit 13.95 feet/second 8938.71 dscf/hour 136.95 dscf
Total Particulates - mn Average Delta H Total Time of Test	39.6 mg 0.67 inches H2O 260 minutes

OMNI-Test Laboratories, Inc.

Wood Heater Test Data - EPA Method 5G

Run: 1
Manufacturer: [illegible]
Model: 2100 Panther A
Tracking No.: [illegible]
Project No.: [illegible]
Test Date: 2/13/2002
Beginning Clock Time: 12:20
Recording Interval: 10 min.
Total Sampling Time: 200 min.

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	
Initial dP	0.052	0.040	0.022	0.048	0.058	0.024	0.042	0.042	"H2O
Initial Temp.	99	99	99	99	99	99	99	99	oF

OMNI Equipment Numbers:

PM Control Module: 142
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.56 lb/lb-mole
Dilution Tunnel H2O: 4.00 percent
Dilution Tunnel Static: -0.360 "H2O
Pitot Tube Cp: 0.99
Meter Box Y Factor: 1.005
Barometric Pressure:

Begin	Middle	End	Average
29.99	29.95	29.98	29.99 "Hg

Signature/Date: AS for Ken Moreau 9/12/02
Tunnel Velocity: 13.95 ft/sec
Intial Tunnel Flow: 148.8 scfm
Average Tunnel Flow: 149.0 scfm
Tunnel Area: 0.196 ft2
Post-Test Leak Check: [illegible] cfm@"Hg
Fuel Moisture (dry basis 20.7 %
Total Particulate: 39.0 mg
Filter Holder No.:

Elapsed Time	Particulate Sampling Data								Fuel Weight, lb		Wood Heater Temperature Data, oF											Stack
	Gas Meter Cubic Feet	Sample Rate, cfm	Orifice dH	Meter oF	Meter Vac. In. Hg.	Dilution Tunnel Temp.	Dilution Tunnel dP	Pro. Rate (10%)	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Firebox Interior	Average Surface	Stack	Filter	Impinger exit	Ambient	Draft In. H2O
0	473.850	[illegible]	0.00	80	0	99	0.042	[illegible]	8.2	[illegible]	467	273	341	370	364		363.0	267	83	81	80	-0.038
10	479.215	0.54	0.70	80	5	100	0.042	102	6.9	-1.3	524	259	395	366	353		379.4	335	84	61	80	-0.055
20	484.600	0.54	0.70	81	5	101	0.042	102	6.1	-0.8	489	255	339	349	330		352.4	265	83	56	80	-0.050
30	490.000	0.54	0.70	82	5	102	0.042	102	5.1	-1	541	247	365	335	315		360.8	292	83	57	80	-0.053
40	495.385	0.54	0.70	82	5	101	0.042	101	4.2	-0.9	554	240	356	334	319		360.6	275	84	58	80	-0.050
50	500.800	0.54	0.70	82	5	102	0.042	102	3.3	-0.9	609	231	379	336	323		375.6	285	84	57	81	-0.053
60	506.190	0.54	0.70	83	5	100	0.042	101	2.6	-0.7	627	224	383	344	333		382.2	271	84	58	81	-0.050
70	511.580	0.54	0.70	83	5	100	0.042	101	2.2	-0.4	601	217	367	350	343		375.6	253	84	58	81	-0.048
80	516.950	0.54	0.70	83	5	99	0.042	101	2.0	-0.2	539	210	342	348	344		356.6	227	84	58	82	-0.040
90	522.380	0.54	0.70	84	5	98	0.042	102	1.9	-0.1	470	210	325	341	338		336.8	210	85	58	82	-0.038
100	527.760	0.54	0.70	84	5	98	0.042	101	1.7	-0.2	430	213	310	336	332		324.2	199	84	58	82	-0.035
110	533.150	0.54	0.70	84	5	99	0.042	101	1.6	-0.1	396	218	297	332	327		314.0	189	85	58	82	-0.033
120	538.540	0.54	0.70	84	5	102	0.042	101	1.5	-0.1	374	222	286	329	322		306.6	181	85	59	82	-0.033
130	543.920	0.54	0.70	85	5	101	0.042	101	1.4	-0.1	359	225	278	326	317		301.0	176	85	59	83	-0.031
140	549.300	0.54	0.70	85	5	100	0.042	101	1.2	-0.2	348	227	270	323	313		296.2	173	85	59	83	-0.030
150	554.705	0.54	0.70	86	5	100	0.042	101	1.1	-0.1	344	228	265	321	311		293.8	170	86	59	82	-0.030
160	560.065	0.54	0.70	86	5	100	0.042	100	1.0	-0.1	345	228	261	319	309		292.4	171	86	60	82	-0.030
170	565.445	0.54	0.70	86	5	98	0.042	100	0.9	-0.1	343	227	256	317	307		290.0	165	85	60	82	-0.030
180	570.820	0.54	0.70	85	5	97	0.042	100	0.8	-0.1	335	226	252	314	303		286.0	163	85	60	82	-0.028
190	576.200	0.54	0.70	85	5	97	0.042	100	0.7	-0.1	322	225	246	309	297		279.8	160	86	62	83	-0.028
200	581.570	0.54	0.70	85	5	96	0.042	100	0.6	-0.1	312	225	241	304	291		274.6	158	85	62	82	-0.028
210	586.930	0.54	0.70	86	5	97	0.042	100	0.5	-0.1	308	224	239	301	287		271.8	157	85	63	82	-0.028
220	592.300	0.54	0.70	85	5	96	0.042	100	0.4	-0.1	305	223	236	297	284		269.0	154	85	64	82	-0.025
230	597.660	0.54	0.70	85	5	99	0.042	100	0.3	-0.1	296	222	233	291	281		264.6	151	85	64	82	-0.025
240	603.000	0.53	0.70	85	5	98	0.042	100	0.2	-0.1	286	219	228	285	277		258.6	147	85	64	82	-0.025
250	608.250	0.54	0.70	85	5	97	0.042	100	0.1	-0.1	276	217	224	277	273		253.4	144	85	64	82	-0.025
260	613.685	0.53	0.70	85	5	97	0.042	100	0.0	-0.1	270	214	220	271	268		248.6	141	85	64	82	-0.023
Avg/Total	139.835	0.54	0.67	83.93	[illegible]	99.37	0.042	100.74	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	114	[illegible]	84.63	60.78	[illegible]	-0.036

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Final Laboratory Report - Method 5G
Dilution Tunnel Particulate Calculations

Client Name: Morso
Model: 2110 Panther B
Project No.: 192-S-01-3
Tracking No.: 387

Equipment Numbers:

Run #: 1
Date: 06/24/02

Sample Component	Reagent	Filter # or Volume, ml	Weights			
			Final, mg	Tare, mg	Blank, mg/ml	Particulate, mg
A. Front filter catch	Filter	M055	606.5	571.3		35.2
B. Rear filter catch	Filter	M054	574.3	571.8		2.5
C. Rinse of probe and filter assembly	Acetone	75	109909.3	109907.4	0.0	1.9

Total Particulate, mg :	39.6

Component	Equations:
A. Front filter catch	Final (mg) - Tare (mg) = Particulate, mg
B. Rear filter catch	Final (mg) - Tare (mg) = Particulate, mg
C. Rinse of probe and filter assembly	(Final, mg - Tare, mg) - (Blank, mg/ml x Volume, ml) = Particulate, mg

Analyst: K. T. Morgan Date: 7-02-02

OMNI-Test Laboratories, Inc.
Beaverton, Phone (503) 643-3788

STOVE TEMPERATURE TEST DATA - METHOD 5G

Client/Model: Morso 2110 Panther A Project #: 192-S-01-3 Tracking #: 387

Date: 6-24-02 Test Crew: K. Morgan Run #: 1

OMNI Equipment ID #: _____

Preburn [X] / Test [ ]				Coal Bed: Data: 0 =				Range: 1.7-2.0		Actual: Coal Bed: 2.0	
				12	3	TEMPERATURES (oF)	7		9		Not Used
Time	Fuel Weight	Delta Weight	Stack Draft	Ambient	Top	Bottom	Back	Left	Right	Flue	~~Catalyst~~
0	5.4		-.080	83	763	333	587	460	453	608	
10	4.5	-.9	-.0575	83	689	354	493	462	459	368	
20	3.8	-.7	-.0525	82	601	355	437	425	428	310	
30	3.0	0.8	-.053	83	596	332	413	398	404	288	
40	2.4	0.6	-.050	81	592	305	396	385	391	274	
50	2.1	0.3	-.043	80	549	288	373	382	385	245	
60	2.0	0.1	-.038	80	481	275	345	373	369	219	
70											
80											
90											
00											
10							Preliminary	0.72	@ 4.04	g/Hr	
20											
30											
40											
50											
60											
70											
80											
90											
AVG											

Technician signature: K. L. Morgan Date: 6-24-02

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OMNI-Test Laboratories, Inc.
Beaverton, OR Phone (503) 643-3788

FUEL DATA

Client / Model: Morso 2110 Panter H Tracking #: 387 Project #: 192-S-01-3

Date: 6-24-02 Test Crew: K. Morgan Run #: 1

OMNI Equipment ID #: _____

FUEL LOAD PREPARED BY: K. Morgan

FUEL: DOUGLAS-FIR SPECIES, UNTREATED, AIR-DRIED, STANDARD GRADE OR BETTER, DIMENSIONAL LUMBER.

PRE-BURN FUEL

MOISTURE CONTENT (METER - - DRY BASIS)

CALIBRATION: Cal Value (1) = 12% Actual Reading 12.0
Cal Value (2) = 22% Actual Reading 22.0

Piece	Length		Readings		Type
1	8 ft	23.2	19.8	22.4	2x4
2	____ ft	____	____	____	____
3	____ ft	____	____	____	____

Length of cut pieces: 4@8" 4@16 inches Pre-Burn Fuel Average Moisture: 21.8

Time (clock): 10:50 Room Temperature (F): 75 Initials: K

TEST FUEL

FUEL TYPE AND AMOUNT: 2 x 4 4 4 x 4 0

CALCULATED LOAD WEIGHT: 7.5 ACTUAL LOAD WEIGHT: 8.2 (2 x 4)
0 (4 x 4)
8.2 Total

FUEL PIECE LENGTH: 16.0"

MOISTURE CONTENT (METER - - DRY BASIS)

PIECE	READINGS			TYPE	
1	22.0	19.0	18.7	2x4	19.9
2	22.1	22.5	21.5	2x4	20.0
3	19.4	19.2	19.7	2x4	19.4
4	19.8	19.8	19.6	2x4	19.7
5	____	____	____	____	
6	____	____	____	____	
7	____	____	____	____	
8	____	____	____	____	
9	____	____	____	____	
10	____	____	____	____	

OVERALL TEST FUEL LOAD MOISTURE AVERAGE: ~~19.8~~ 20.3 AS

Time (clock): 10:45 Room Temperature (F): 75 Initials: K

Technician signature: K. Morgan Date: 6-24-02

2-8 of 2-34

OMNI-Test Laboratories
Beaverton, OR (503) 643-3788

Run Notes

Client/Model: Morso 2110 Panther A
Project #: 192-S-01-3
Tracking Number:
Run #: 1
Date: 6-24-02
Test Crew: K. Morgan
OMNI Equipment ID Numbers:

PREBURN

DESCRIBE OR SKETCH AIR OR THERMOMSTAT SETTINGS BELOW:
(SETTINGS MUST BE ACCURATE AND REPRODUCABLE)

PRIMARY:

Fully Closed

SECONDARY: Fixed

TERTIARY: None

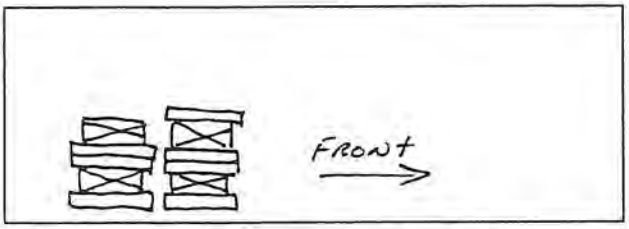
FAN: None

PREBURN SETTINGS AND ACTIVITIES

TIME	AIR (THERMO) CHANGES PRIMARY/SECONDARY/TERTIARY	FAN SETTING CHANGE	ADD FUEL + WT.	ADD FUEL - WT.	RAKE COAL	COMMENT
0	test setting					
60					X	

TEST

TEST FUEL CONFIGURATION SKETCH
(INDICATE VIEW ANGLE)



START UP PROCEDURES
BYPASS: N/A Loaded by 35 sec.
FUEL LOADING ~~Closed by 40 sec.~~ 16
DOOR: Closed by 40 sec.
PRIMARY AIR: Fully open for 4-1/2 min, then slowly closed to test setting by 5.0 min.
OTHER:

DESCRIBE OR SKETCH TEST SETTINGS BELOW:
(SETTINGS MUST BE ACCURATE AND REPRODUCIBLE)
PRIMARY:

Fully Closed

SECONDARY: Fixed

TERTIARY: None

FAN: None

Technician signature: K. J. Morgan Date: 6-24-02

OMNI-Test Laboratories, ...
Beaverton, OR (503) 643-3788

Supplemental Data EPA 5G/5H

Client / Model: Morso Panther 2110 A Project No.: 192-5-01-3

Tracking No.: 387 Date: 6-24-02 Run No.: 1 Booth: _____

Test Crew: K. Morgan Start Time: 12:36 Stop Time: 16:56

OMNI Equipment #'s: _____

Gas Analyzer Train Leak Check:

Stack: Dilution Tunnel (Method 5G Only):

Initial: N/A Initial: N/A

Final: N/A Final: N/A

Calibrations: Span Gas CO_2: N/A O_2: N/A CO: N/A CO_2(DT): N/A

	N_2 Span	N_2 Span	N_2 Span	N_2 Span	N_2 Span	N_2 Span	N_2 Span
Time			N/A				
O_2							
CO_2							
CO							
CO_2 (DT)							

Stack Diameter (inches): 6.0

Air Velocity (ft/min): Initial: < 50 Final: < 50

Scale Audit (lbs.): Pretest: 10.0 Post Test: 10.0

Induced Draft: Ø %Smoke Capture: 100

Pitot Tube Leak Test: Pre: @ 3.25 "w.c. Post: _____

Flue Pipe Cleaned Prior to First Test in Series: Date: 6-19-02 Initials: K

	Initial	Middle	Ending
Pb (in. Hg)	30.00	29.98	29.98
Room Temp (°F)	80	82	82

Technician signature: K. J. Morgan Date: 6-24-02

Model: Panther 2110 B
Morsø Jernstøberi A/S
DK-7900
Nykøbing Mors
Denmark

Run 2

2-1 of 2-31

OMNI-Test Laboratories, Inc.

Wood Heater Test Data - EPA Method 5G

Manufacturer: Morso
Model: 2110 Panther
Project No.: 387
Tracking No.: 192-S-03-1
Run: 2
Test Date: 06/25/02

Burn Rate	3.49	kg/hr dry
Particulate Concentration (dry-standard)	0.00051	grams/dscf
Particulate Emission Rate	4.36	grams/hour
Adjusted Emissions	6.18	grams/hour
Average Tunnel Temperature	158	degrees Fahrenheit
Average Delta p	0.042	inches H20
Total Sample Volume - Vm	27.10	cubic feet
Average Gas Meter Temperature	87	degrees Fahrenheit
Average Gas Velocity in Dilution Tunnel - vs	14.82	feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	8560.26	dscf/hour
Total Sample Volume (Standard Conditions) - Vms	26.30	dscf
Total Particulates - mn	13.4	mg
Average Delta H	0.58	inches H20
Total Time of Test	50	minutes

L. J. Morgan
7-11-02

2-12of2-3C

OMNI-Test Laboratories, Inc.

Wood Heater Test Data - EPA Method 5G

Run: 2

Manufacturer: Morso
Model: 2110 Panther
Tracking No.: 387
Project No.: 192-S-03-1
Test Date: 25-Jun-02
Beginning Clock Time: 13:03
Recording Interval: 10 min.
Total Sampling Time: 50 min.

OMNI Equipment Numbers:

Velocity Traverse Data									
	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	
Initial dP	0.036	0.038	0.044	0.048	0.042	0.044	0.044	0.042	"H2O
Initial Temp.	152	153	153	152	153	153	153	153	oF

PM Control Module: 141
Dilution Tunnel MW(dry): 29.00 lb/lb-mole
Dilution Tunnel MW(wet): 28.56 lb/lb-mole
Dilution Tunnel H2O: 4.00 percent
Dilution Tunnel Static: -0.560 "H2O
Pitot Tube Cp: 0.99
Meter Box Y Factor: 1.005
Barometric Pressure:

Begin	Middle	End	Average
29.88	29.88	29.88	29.88 "Hg

Signature/Date: 7-11-02

Tunnel Velocity: 14.82 ft/sec
Intial Tunnel Flow: 143.2 scfm
Average Tunnel Flow: 142.7 scfm
Tunnel Area: 0.196 ft2
Post-Test Leak Check: .008 @ 10 cfm@"Hg
Fuel Moisture (dry basis 21.5 %
Total Particulate: 13.4 mg
Filter Holder No.:

Elapsed Time	Particulate Sampling Data								Fuel Weight, lb		Wood Heater Temperature Data, oF											Stack
	Gas Meter Cubic Feet	Sample Rate, cfm	Orifice dH	Meter oF	Meter Vac. In. Hg.	Dilution Tunnel Temp.	Dilution Tunnel dP	Pro. Rate (10%)	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Firebox Interior	Average Surface	Stack	Filter	Impinger exit	Ambient	Draft In. H2O
0	613.800		0.00	85	0	153	0.042		7.8		762	329	570	504	510		535.0	590	88	88	88	-0.085
10	619.220	0.54	0.70	85	6	176	0.042	103	4.9	-2.9	846	343	659	504	504		571.2	747	89	67	91	-0.098
20	624.650	0.54	0.70	85	6.5	172	0.042	102	2.3	-2.6	904	329	677	501	488		579.8	719	89	65	92	-0.095
30	630.040	0.54	0.70	88	7	163	0.042	100	0.8	-1.5	891	315	654	506	491		571.4	666	89	62	92	-0.090
40	635.475	0.54	0.70	88	7	147	0.042	100	0.3	-0.5	738	314	556	525	510		528.6	554	88	61	91	-0.080
50	640.902	0.54	0.70	90	7	140	0.042	99	0.0	-0.3	621	322	495	513	504		491.0	494	88	62	90	-0.075
Avg/Total	27.102	0.54	0.58	86.83		158.46	0.042	100.79									44		88.50	67.50		-0.087

7-12-02

OMNI-Test Laboratories, Inc.

Final Laboratory Report - Method 5G
Dilution Tunnel Particulate Calculations

Client Name: Morso
Model: 2110 Panther B
Project No.: 192-S-01-3
Tracking No.: 387

Equipment Numbers:

Run #: 2
Date: 06/25/02

Sample Component	Reagent	Filter # or Volume, ml	Weights			
			Final, mg	Tare, mg	Blank, mg/ml	Particulate, mg
A. Front filter catch	Filter	M057	581.0	570.0		11.0
B. Rear filter catch	Filter	M056	570.1	569.5		0.6
C. Rinse of probe and filter assembly	Acetone	150	116313.6	116311.8	0.0	1.8

Total Particulate, mg :	13.4

Component	Equations:
A. Front filter catch	Final (mg) - Tare (mg) = Particulate, mg
B. Rear filter catch	Final (mg) - Tare (mg) = Particulate, mg
C. Rinse of probe and filter assembly	(Final, mg - Tare, mg) - (Blank, mg/ml x Volume, ml) = Particulate, mg

Analyst: K. J. Morgan Date: 7-02-02

OMNI-Test Laboratories, Inc.
Beaverton, OR Phone (503) 643-3788

STOVE TEMPERATURE TEST DATA - METHOD 5G

Client/Model: Morso 2110 Panther Project #: 192-S-03-1 Tracking #: 387

Date: 6-25-02 Test Crew: K. Morgan Run #: 2

OMNI Equipment ID #: _____

Preburn [X] Test [ ] Coal Bed: Data: 0 = Range: 1.6 - 1.9 Actual: Coal Bed: 1.6

Added 5.7 lb. Fuel + Raked Coals @ 38 min.

Time	Fuel Weight	Delta Weight	Stack Draft	TEMPERATURES (oF) Ambient	Top	Bottom	Back	Left	Right	Flue	~~Catalyst~~ Not Used
0	10.1		-0.06	83	478	287	393	436	419	399	
10	7.6	2.5	-.088	84	578	300	495	405	403	639	
20	4.7	2.9	-.088	86	744	294	567	410	433	667	
30	2.4	2.3	-.088	88	841	296	598	466	474	667	
40	7.1	* 1.0	-.090	88	709	312	531	501	501	635	
50	4.7	2.4	-.088	89	813	321	601	495	498	649	
60	2.9	1.8	-.085	89	789	320	574	495	504	612	
70	1.6	1.3	-.085	89	763	328	572	501	509	592	
80											
90											
00											
10											
20											
30						PRELIMINARY:	3.49 Kg/hr @ 6.79 g/hr				
40											
50											
60											
70											
80											
90											
AVG											

Technician signature: K. J. Morgan Date: 6-25-02

OMNI-Test Laboratories, Inc
Beaverton, OR Phone (503) 643-3788

FUEL DATA

Client / Model: Morso 2110 Panther Tracking #: 387 Project #: 192-S-03-1

Date: 6-25-02 Test Crew: K. Morgan Run #: 2

OMNI Equipment ID #: _____

FUEL LOAD PREPARED BY: K. Morgan

FUEL: DOUGLAS-FIR SPECIES, UNTREATED, AIR-DRIED, STANDARD GRADE OR BETTER, DIMENSIONAL LUMBER.

PRE-BURN FUEL

MOISTURE CONTENT (METER - - DRY BASIS)

CALIBRATION: Cal Value (1) = 12% Actual Reading 12.0
Cal Value (2) = 22% Actual Reading 22.0

Piece	Length		Readings		Type
1	8 ft	19.6	19.2	22.3	2x4
2	____ ft				
3	____ ft				

Length of cut pieces: 4@16" 5@8" inches Pre-Burn Fuel Average Moisture: 20.4%

Time (clock): 11:30 Room Temperature (F): 80 Initials: K

TEST FUEL

FUEL TYPE AND AMOUNT: 2 x 4 4 4 x 4 0

CALCULATED LOAD WEIGHT: 7.5 ACTUAL LOAD WEIGHT: 7.8 (2 x 4)
0 (4 x 4)
7.8 Total

FUEL PIECE LENGTH: 16.0"

MOISTURE CONTENT (METER - - DRY BASIS)

PIECE	READINGS			TYPE	
1	22.7	23.0	22.3	2x4	22.7
2	21.9	21.0	20.6	2x4	21.2
3	20.3	20.4	20.9	2x4	20.5
4	20.9	21.2	22.7	2x4	21.6
5					
6					
7					
8					
9					
10					

OVERALL TEST FUEL LOAD MOISTURE AVERAGE: 21.5

Time (clock): 11:40 Room Temperature (F): 80 Initials: K

Technician signature: K. Morgan Date: 6-25-02

2-1602-34

OMNI-Test Laboratories
Beaverton, OR (503) 643-3788

Run Notes

Client/Model: Monso 2WD Panther
Project #: 192-S-03-1
Tracking Number: 387
Run #: 2
Date: 6-25-02
Test Crew: K. Morgan
OMNI Equipment ID Numbers:

PREBURN

DESCRIBE OR SKETCH AIR OR THERMOMSTAT SETTINGS BELOW:
(SETTINGS MUST BE ACCURATE AND REPRODUCABLE)

PRIMARY:

Fully Open
(1.500 inch)

SECONDARY: Fixed

TERTIARY: None

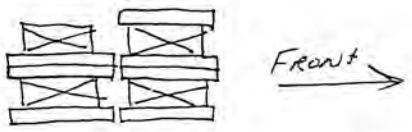
FAN: None

PREBURN SETTINGS AND ACTIVITIES

TIME	AIR (THERMO) CHANGES PRIMARY/SECONDARY/TERTIARY	FAN SETTING CHANGE	ADD FUEL + WT.	ADD FUEL - WT.	RAKE COAL	COMMENT
0	Test setting					
38			5.7		X	
70					X	

TEST

TEST FUEL CONFIGURATION SKETCH
(INDICATE VIEW ANGLE)



START UP PROCEDURES
BYPASS: None
FUEL LOADING: Loaded by 40 sec.
DOOR: Closed by 45 sec.
PRIMARY AIR: Fully open - undisturbed
OTHER: None

DESCRIBE OR SKETCH TEST SETTINGS BELOW:
(SETTINGS MUST BE ACCURATE AND REPRODUCIBLE)
PRIMARY:

Fully Open
(1.500")

SECONDARY: Fixed

TERTIARY: None

FAN: None

Technician signature: K. J. Morgan Date: 6-25-02

OMNI-Test Laboratories
Beaverton, OR (503) 643-3788

Supplemental Data EPA 5G/5H

Client / Model: Morso 2110 Panther Project No.: 192 - S - 03 - 1

Tracking No.: 387 Date: 6-25-02 Run No.: 2 Booth: _____

Test Crew: K. Morgan Start Time: 13:03 Stop Time: 13:53

OMNI Equipment #'s: _____

Gas Analyzer Train Leak Check:

Stack: Dilution Tunnel (Method 5G Only):

Initial: N/A Initial: N/A

Final: N/A Final: N/A

Calibrations: Span Gas CO_2: N/A O_2: N/A CO: N/A CO_2(DT): N/A

	N_2 Span	N_2 Span	N_2 Span	N_2 Span	N_2 Span	N_2 Span	N_2 Span
Time							
O_2			N/A				
CO_2							
CO							
CO_2 (DT)							

Stack Diameter (inches): 6.0

Air Velocity (ft/min): Initial: <50 Final: <50

Scale Audit (lbs.): Pretest: 10.0 Post Test: 10.0

Induced Draft: Ø %Smoke Capture: 100

Pitot Tube Leak Test: Pre: Ø @ 3.25" w.c. Post: Ø @ 3.5" w.c.

Flue Pipe Cleaned Prior to First Test in Series: Date: 6-19-02 Initials: JL

	Initial	Middle	Ending
Pb (in. Hg)	29.88	29.88	29.88
Room Temp (°F)	88	92	90

Technician signature: K. J. Morgan Date: 6-25-02

Model: Panther 2110 B
Morsø Jernstøberi A/S
DK-7900
Nykøbing Mors
Denmark

Run 3

OMNI-Test Laboratories, Inc.

Wood Heater Test Data - EPA Method 5G

Manufacturer: Morso
Model: 2110 Panther
Project No.: 387
Tracking No.: 192-S-01-3
Run: 3
Test Date: 06/26/02

Burn Rate	0.93	kg/hr dry
Particulate Concentration (dry-standard)	0.00041	grams/dscf
Particulate Emission Rate	3.71	grams/hour
Adjusted Emissions	5.40	grams/hour
Average Tunnel Temperature	106	degrees Fahrenheit
Average Delta p	0.043	inches H20
Total Sample Volume - Vm	108.88	cubic feet
Average Gas Meter Temperature	89	degrees Fahrenheit
Average Gas Velocity in Dilution Tunnel - vs	14.36	feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	9033.78	dscf/hour
Total Sample Volume (Standard Conditions) - Vms	105.07	dscf
Total Particulates - mn	43.1	mg
Average Delta H	0.67	inches H20
Total Time of Test	200	minutes

Ik J. Morgan
7-11-02

OMNI-Test Laboratories, Inc.

Wood Heater Test Data - EPA Method 5G

Run:	3
Manufacturer:	Morso
Model:	2110 Panther
Tracking No.:	387
Project No.:	192-S-01-3
Test Date:	26-Jun-02
Beginning Clock Time:	11:38
Recording Interval:	10 min.
Total Sampling Time:	200 min.

OMNI Equipment Numbers:

Velocity Traverse Data

	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	
Initial dP	0.036	0.042	0.046	0.048	0.042	0.046	0.044	0.042	"H2O
Initial Temp.	101	100	100	100	101	100	100	100	oF

PM Control Module:	141	
Dilution Tunnel MW(dry):	29.00	lb/lb-mole
Dilution Tunnel MW(wet):	28.56	lb/lb-mole
Dilution Tunnel H2O:	4.00	percent
Dilution Tunnel Static:	-0.540	"H2O
Pitot Tube Cp:	0.99	
Meter Box Y Factor:	1.003	

Barometric Pressure:	Begin	Middle	End	Average
	29.82	29.8	29.78	29.80 "Hg

Signature/Date: M. Morgan 7-11-02

Tunnel Velocity:	14.36	ft/sec
Intial Tunnel Flow:	151.3	scfm
Average Tunnel Flow:	150.6	scfm
Tunnel Area:	0.196	ft2
Post-Test Leak Check:	0.0019	cfm@"Hg
Fuel Moisture (dry basis	19.9	%
Total Particulate:	43.1	mg
Filter Holder No.:	A	

Elapsed Time	Particulate Sampling Data								Fuel Weight, lb		Wood Heater Temperature Data, oF											Stack
	Gas Meter Cubic Feet	Sample Rate, cfm	Orifice dH	Meter oF	Meter Vac. In. Hg.	Dilution Tunnel Temp.	Dilution Tunnel dP	Pro. Rate (10%)	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Firebox Interior	Average Surface	Stack	Filter	Impinger exit	Ambient	Draft In. H2O
0	641.144		0.00	84	0	100	0.043		8.2		455	278	361	372	384		370.0	309	87	86	85	-0.053
10	646.555	0.54	0.70	85	5	120	0.043	102	6.8	-1.4	538	276	420	371	383		397.6	393	86	67	87	-0.063
20	651.975	0.54	0.70	85	5	108	0.043	101	5.9	-0.9	541	277	377	357	369		384.2	307	86	62	87	-0.055
30	657.390	0.54	0.70	86	5	110	0.043	101	4.8	-1.1	557	273	386	338	347		380.2	331	87	61	87	-0.060
40	662.790	0.54	0.70	86	5	113	0.043	101	3.6	-1.2	645	263	433	345	356		408.4	359	88	61	88	-0.060
50	668.150	0.54	0.70	85	5	111	0.043	101	2.5	-1.1	701	249	450	369	379		429.6	423	88	61	88	-0.059
60	673.555	0.54	0.70	86	5	108	0.043	101	2.1	-0.4	644	246	422	378	385		415.0	304	87	61	87	-0.053
70	678.945	0.54	0.70	87	5	105	0.043	100	1.9	-0.2	537	247	383	372	379		383.6	263	87	61	87	-0.046
80	684.355	0.54	0.70	89	5	104	0.043	100	1.7	-0.2	482	250	362	367	371		366.4	248	86	61	87	-0.044
90	689.860	0.55	0.70	88	5	103	0.043	102	1.6	-0.1	444	256	345	361	367		354.6	234	86	60	88	-0.042
100	695.345	0.55	0.70	89	5	103	0.043	101	1.4	-0.2	421	261	334	357	360		346.6	227	88	61	89	-0.040
110	700.820	0.55	0.70	89	5	104	0.043	101	1.3	-0.1	404	263	326	351	356		340.0	216	89	61	89	-0.038
120	706.285	0.55	0.70	89	5	104	0.043	101	1.1	-0.2	391	267	319	347	349		334.6	212	88	62	89	-0.038
130	711.745	0.55	0.70	91	5	104	0.043	100	1.0	-0.1	385	269	315	344	344		331.4	210	88	62	89	-0.038
140	717.275	0.55	0.70	91	5	104	0.043	102	0.8	-0.2	374	268	306	340	341		325.8	205	89	63	89	-0.037
150	722.810	0.55	0.70	91	5	105	0.043	102	0.7	-0.1	364	266	297	336	338		320.2	202	88	63	89	-0.037
160	728.250	0.54	0.70	92	5	105	0.043	100	0.5	-0.2	356	264	290	333	335		315.6	199	88	64	89	-0.036
170	733.645	0.54	0.70	91	5	105	0.043	99	0.4	-0.1	349	262	286	329	331		311.4	197	89	64	90	-0.036
180	739.060	0.54	0.70	92	5	105	0.043	99	0.3	-0.1	345	259	281	326	328		307.8	197	89	65	90	-0.036
190	744.580	0.55	0.70	92	5	106	0.043	101	0.2	-0.1	342	256	275	322	323		303.6	193	90	66	90	-0.035
200	750.022	0.54	0.70	92	5	106	0.043	100	0.0	-0.2	336	253	269	318	320		299.2	190	90	66	90	-0.034
Avg/Total	108.878	0.54	0.67	88.57		106.35	0.043	100.75									71		87.81	63.71		-0.045

OMNI-Test Laboratories, Inc.

Final Laboratory Report - Method 5G
Dilution Tunnel Particulate Calculations

Client Name: Morso
Model: 2110 Panther B
Project No.: 192-S-01-3
Tracking No.: 387

Equipment Numbers:

Run #: 3
Date: 06/26/02

Sample Component	Reagent	Filter # or Volume, ml	Weights			
			Final, mg	Tare, mg	Blank, mg/ml	Particulate, mg
A. Front filter catch	Filter	M059	602.8	567.5		35.3
B. Rear filter catch	Filter	M058	573.5	570.5		3.0
C. Rinse of probe and filter assembly	Acetone	150	108735.4	108730.6	0.0	4.8

Total Particulate, mg :	43.1

Component	Equations:
A. Front filter catch	Final (mg) - Tare (mg) = Particulate, mg
B. Rear filter catch	Final (mg) - Tare (mg) = Particulate, mg
C. Rinse of probe and filter assembly	(Final, mg - Tare, mg) - (Blank, mg/ml x Volume, ml) = Particulate, mg

Analyst: K. J. Morgan Date: 7-02-02

2-22 of 2-34

OMNI-Test Laboratories, Inc.
Beaverton, [redacted] Phone (503) 643-3788

STOVE TEMPERATURE TEST DATA - METHOD 5G

Client/Model: Morso 2116 Panther Project #: 192-5-03-1 Tracking #: 387

Date: 6-26-02 Test Crew: K. Morgan Run #: 3

OMNI Equipment ID #: _____

Preburn Test [X] [ ] Coal Bed: Data: 0 = Range: 1.7 - 2.0 Actual: Coal Bed:

Time	Fuel Weight	Delta Weight	Stack Draft	TEMPERATURES (oF) Ambient	Top	Bottom	Back	Left	Right	Flue	~~Catalyst~~ Not Used
0	6.3		-.085	87	787	330	595	461	441	615	
10	5.3	1.0	-.065	86	721	339	513	463	443	418	
20	4.4	0.9	-.063	84	652	339	466	430	416	358	
30	3.5	0.9	-.063	85	659	324	462	412	401	349	
40	2.9	0.6	-.055	85	645	306	442	411	398	316	
50	2.6	0.3	-.050	85	568	295	408	403	396	283	
60	2.4	0.2	-.048	85	513	287	382	390	393	260	
70	2.2	0.2	-.048	85	462	280	361	376	385	282	
~~75~~ 80	2.0	0.2	-.053	85	454	279	361	373	384	319	
90											
00											
10											
20				Preliminary :		0.93 @	5,49				
30											
40											
50											
60											
70											
80											
90											
AVG											

2-2350-1.24
1280-1.03

Technician signature: K. L. Morgan Date: 6-26-02

OMNI-Test Laboratories, Inc
Beaverton, OR Phone (503) 643-3788

FUEL DATA

Client / Model: Morso 2110 Panther Tracking #: 387 Project #: 192-5-03-1

Date: 6-26-02 Test Crew: K. Morgan Run #: 3

OMNI Equipment ID #: _____

FUEL LOAD PREPARED BY: K. Morgan
FUEL: DOUGLAS-FIR SPECIES, UNTREATED, AIR-DRIED, STANDARD GRADE OR BETTER, DIMENSIONAL LUMBER.

PRE-BURN FUEL

MOISTURE CONTENT (METER - - DRY BASIS)

CALIBRATION: Cal Value (1) = 12% Actual Reading 12.0
Cal Value (2) = 22% Actual Reading 22.6

Piece	Length		Readings		Type
1	8 ft	20.1	19.1	22.3	2x4
2	____ ft	____	____	____	____
3	____ ft	____	____	____	____

Length of cut pieces: 4@8" 4@16" inches Pre-Burn Fuel Average Moisture: 20.5%

Time (clock): 09:30 Room Temperature (F): 85 Initials: K

TEST FUEL

FUEL TYPE AND AMOUNT: 2 x 4 4 4 x 4 0
CALCULATED LOAD WEIGHT: 7.5 ACTUAL LOAD WEIGHT: 8.2 (2 x 4)
0 (4 x 4)
FUEL PIECE LENGTH: 15.5" 8.2 Total

MOISTURE CONTENT (METER - - DRY BASIS)

PIECE	READINGS			TYPE	
1	20.0	19.8	21.4	2x4	20.4
2	20.0	19.1	19.0	2x4	19.4
3	21.1	19.2	20.0	2x4	20.1
4	19.5	19.6	19.6	2x4	19.6
5					
6					
7					
8					
9					
10					

OVERALL TEST FUEL LOAD MOISTURE AVERAGE: 19.9 %

Time (clock): 09:50 Room Temperature (F): 85 Initials: K

Technician signature: K. J. Morgan Date: 6-26-02

OMNI-Test Laboratories
Beaverton, OR (503) 643-3788

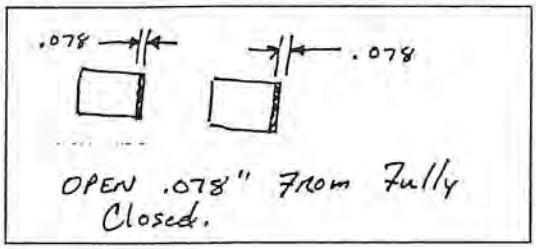
Run Notes

Client/Model: Morso 2110 Panther
Project #: 192-5-03-1
Tracking Number: 387
Run #: 3
Date: 6-26-02
Test Crew: K. Morgan
OMNI Equipment ID Numbers:

PREBURN

DESCRIBE OR SKETCH AIR OR THERMOMSTAT SETTINGS BELOW:
(SETTINGS MUST BE ACCURATE AND REPRODUCABLE)

PRIMARY:



SECONDARY: Fixed

TERTIARY: None

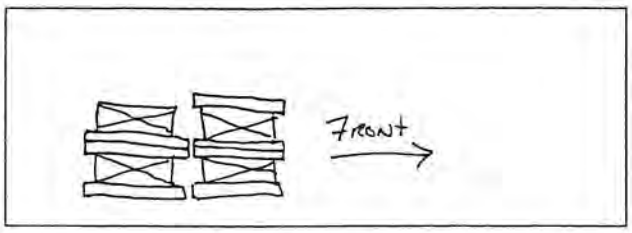
FAN: None

PREBURN SETTINGS AND ACTIVITIES

TIME	AIR (THERMO) CHANGES PRIMARY/SECONDARY/TERTIARY	FAN SETTING CHANGE	ADD FUEL + WT.	ADD FUEL - WT.	RAKE COAL	COMMENT
0	Test setting					
72					X	

TEST

TEST FUEL CONFIGURATION SKETCH
(INDICATE VIEW ANGLE)



START UP PROCEDURES
BYPASS: N/A
FUEL LOADING: Loaded by 30 sec.
DOOR: Closed by 45 sec.
PRIMARY AIR: Fully open for 4-1/2 min, Then slowly closed to test setting by 5 min.
OTHER: None

DESCRIBE OR SKETCH TEST SETTINGS BELOW:
(SETTINGS MUST BE ACCURATE AND REPRODUCIBLE)
PRIMARY:

Same As Above.

SECONDARY: Fixed

TERTIARY: None

FAN: None

Technician signature: K. J. Morgan Date: 6-26-02

OMNI-Test Laboratories
Beaverton, OR (503) 643-3788

Supplemental Data EPA 5G/5H

Client / Model: Morso 2110 Panther Project No.: 192 - S - 03 - 1

Tracking No.: 387 Date: 6-26-02 Run No.: 3 Booth: 1

Test Crew: K. Morgan Start Time: 11:38 Stop Time: 14:58

OMNI Equipment #'s: _____

Gas Analyzer Train Leak Check:

Stack: Initial: N/A Final: N/A

Dilution Tunnel (Method 5G Only): Initial: N/A Final: N/A

Calibrations: Span Gas CO_2: N/A O_2: N/A CO: N/A CO_2(DT): N/A

	N_2 Span	N_2 Span	N_2 Span	N_2 Span	N_2 Span	N_2 Span	N_2 Span
Time							
O_2			N/A				
CO_2							
CO							
CO_2 (DT)							

Stack Diameter (inches): 6.0

Air Velocity (ft/min): Initial: <50 Final: <50 Ft/min

Scale Audit (lbs.): Pretest: 10.0 Post Test: 10.0

Induced Draft: 0 %Smoke Capture: 100

Pitot Tube Leak Test: Pre: 0 @ 3.5" w.c. Post: 0.0 @ 3.2"

Flue Pipe Cleaned Prior to First Test in Series: Date: 6-19-02 Initials: JL

	Initial	Middle	Ending
Pb (in. Hg)	29.82	29.80	29.78
Room Temp (°F)	85	89	90

Technician signature: J. L. Morgan Date: 6-26-02

Model: Panther 2110 B
Morsø Jernstøberi A/S
DK-7900
Nykøbing Mors
Denmark

Run 4

OMNI-Test Laboratories, Inc.

Wood Heater Test Data - EPA Method 5G

Manufacturer: Morso
Model: 2110 Panther
Project No.: 387
Tracking No.: 192-S-01-3
Run: 4
Test Date: 06/28/02

Burn Rate	1.51	kg/hr dry
Particulate Concentration (dry-standard)	0.00018	grams/dscf
Particulate Emission Rate	1.62	grams/hour
Adjusted Emissions	2.72	grams/hour
Average Tunnel Temperature	108	degrees Fahrenheit
Average Delta p	0.043	inches H20
Total Sample Volume - Vm	59.17	cubic feet
Average Gas Meter Temperature	79	degrees Fahrenheit
Average Gas Velocity in Dilution Tunnel - vs	14.32	feet/second
Average Gas Flow Rate in Dilution Tunnel - Qsd	8966.31	dscf/hour
Total Sample Volume (Standard Conditions) - Vms	58.02	dscf
Total Particulates - mn	10.5	mg
Average Delta H	0.64	inches H20
Total Time of Test	110	minutes

OMNI-Test Laboratories, Inc.

Wood Heater Test Data - EPA Method 5G

Signature/Date: AS for Ken Morgan 9/12/02

Run:	4
Manufacturer:	Majestic
Model:	2100 Panther
Tracking No.:	557
Project No.:	102-5401-3
Test Date:	28-Jun-02
Beginning Clock Time:	1146
Recording Interval:	10 min.
Total Sampling Time:	110 min.

Velocity Traverse Data	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	
Initial dP	0.036	0.042	0.048	0.044	0.038	0.042	0.044	0.048	"H2O
Initial Temp.	114	116	117	115	113	113	113	113	oF

OMNI Equipment Numbers:

PM Control Module:	141
Dilution Tunnel MW(dry):	29.00 lb/lb-mole
Dilution Tunnel MW(wet):	28.56 lb/lb-mole
Dilution Tunnel H2O:	4.60 percent
Dilution Tunnel Static:	-0.530 "H2O
Pitot Tube Cp:	0.99
Meter Box Y Factor:	1.005

Barometric Pressure:	Begin	Middle	End	Average
	29.77	29.76	29.74	29.76 "Hg

Tunnel Velocity:	14.32 ft/sec
Intial Tunnel Flow:	148.6 scfm
Average Tunnel Flow:	149.4 scfm
Tunnel Area:	0.196 ft2
Post-Test Leak Check:	0.018 cfm@"Hg
Fuel Moisture (dry basis	21.6 %
Total Particulate:	10.5 mg
Filter Holder No.:	

Elapsed Time	Particulate Sampling Data								Fuel Weight, lb		Wood Heater Temperature Data, oF											Stack
	Gas Meter Cubic Feet	Sample Rate, cfm	Orifice dH	Meter oF	Meter Vac. In. Hg.	Dilution Tunnel Temp.	Dilution Tunnel dP	Pro. Rate (10%)	Scale Reading	Weight Change	Firebox Top	Firebox Bottom	Firebox Back	Firebox Left	Firebox Right	Firebox Interior	Average Surface	Stack	Filter	Impinger exit	Ambient	Draft In. H2O
0	750.202		0.00	77	6	113	0.043		7.4		542	286	399	432	425		416.8	326	77	82	79	-0.053
10	755.770	0.56	0.70	78	4	126	0.043	106	5.2	-2.2	647	269	464	405	399		436.8	479	79	64	80	-0.073
20	761.150	0.54	0.70	79	4	121	0.043	102	3.5	-1.7	707	260	481	399	392		447.8	467	78	64	79	-0.073
30	766.470	0.53	0.70	79	4	121	0.043	101	2.1	-1.4	734	255	501	406	397		458.6	462	79	62	80	-0.073
40	771.810	0.53	0.70	78	4	114	0.043	101	1.2	-0.9	728	256	499	421	414		463.6	413	78	60	79	-0.063
50	777.220	0.54	0.70	78	4	108	0.043	101	0.9	-0.3	628	258	442	420	424		435.6	355	76	59	78	-0.057
60	782.570	0.54	0.70	80	4	105	0.043	100	0.7	-0.2	549	261	401	410	419		409.8	322	75	57	76	-0.053
70	787.980	0.54	0.70	80	4	101	0.043	101	0.6	-0.1	484	258	364	402	404		382.4	296	74	58	76	-0.050
80	793.305	0.53	0.70	80	4	100	0.043	99	0.4	-0.2	444	254	337	380	388		361.8	278	74	57	75	-0.047
90	798.660	0.54	0.70	80	4	98	0.043	99	0.3	-0.1	414	252	316	375	374		346.2	262	74	57	75	-0.044
100	804.025	0.54	0.70	80	4	97	0.043	99	0.2	-0.1	388	249	298	364	361		332.0	249	73	57	74	-0.042
110	809.375	0.54	0.70	80	4	96	0.043	99	0.0	-0.2	369	245	286	356	350		321.2	240	73	57	74	-0.040
Avg/Total	59.173	0.54	0.64	79.08		108.34	0.043	100.69									96		75.92	61.17		-0.056

2-29+P2-34

OMNI-Test Laboratories, Inc.

Final Laboratory Report - Method 5G
Dilution Tunnel Particulate Calculations

Client Name: Morso
Model: 2110 Panther B
Project No.: 192-S-01-3
Tracking No.: 387

Equipment Numbers:

Run #: 4
Date: 06/28/02

Sample Component	Reagent	Filter # or Volume, ml	Weights			
			Final, mg	Tare, mg	Blank, mg/ml	Particulate, mg
A. Front filter catch	Filter	M061	570.4	566.8		3.6
B. Rear filter catch	Filter	M060	564.3	566.3		-2.0
C. Rinse of probe and filter assembly	Acetone	150	103367.8	103358.9	0.0	8.9

Total Particulate, mg :	10.5

Component	Equations:
A. Front filter catch	Final (mg) - Tare (mg) = Particulate, mg
B. Rear filter catch	Final (mg) - Tare (mg) = Particulate, mg
C. Rinse of probe and filter assembly	(Final, mg - Tare, mg) - (Blank, mg/ml x Volume, ml) = Particulate, mg

Analyst: K. J. Morgan Date: 7-11-02

2-30of2-34

OMNI-Test Laboratories, Inc.
Leaverto[illegible] Phone (503) 643-3788

STOVE TEMPERATURE TEST DATA - METHOD 5G

Client/Model: Morso 2110 Panther Project #: 192-S-01-3 Tracking #: 387

Date: 6-28-02 Test Crew: K. Morgan Run #: 4

OMNI Equipment ID #: _____

Preburn [X] Coal Bed: Actual:
Test [ ] Data: 0 = Range: 1.5 - 1.8 Coal Bed:

Time	Fuel Weight	Delta Weight	Stack Draft	TEMPERATURES (oF) Ambient	Top	Bottom	Back	Left	Right	Flue	Not used Catalyst
0	6.7		-.085	82	756	292	584	458	459	651	
10	5.3	1.4	-.070	81	665	306	482	444	447	455	
20	4.0	1.3	-.070	79	642	307	466	419	425	432	
30	2.7	1.3	-.070	80	653	301	472	417	425	428	
40	1.8	0.9	-.065	81	663	296	470	428	438	397	
50	2.9	* 1.0	-.065	79	665	293	475	440	441	414	
60	2.2	0.7	-.063	80	637	289	447	443	438	383	
70	1.9	0.3	-.058	79	582	289	422	441	430	349	
~~75~~ 80	1.8	0.1	-.053	79	546	287	401	432	426	328	
90											
00											
10											
20				Preliminary:		1.51 Kg/hr @		2.61			
30											
40											
50											
60											
70											
80											
90											
AVG											

* ADDED 2.1 lb. @ 41 min

Technician signature: K. Morgan Date: 6-28-02

2-3 of 2-34

OMNI-Test Laboratories, I.
Beaverton, OR Phone (503) 643-3788

FUEL DATA

Client / Model: Morso 2110 Panther Tracking #: 387 Project #: 192-5-01-3

Date: 6-28-02 Test Crew: K. Morgan Run #: 4

OMNI Equipment ID #:

FUEL LOAD PREPARED BY: K. Morgan

FUEL: DOUGLAS-FIR SPECIES, UNTREATED, AIR-DRIED, STANDARD GRADE OR BETTER, DIMENSIONAL LUMBER.

PRE-BURN FUEL

MOISTURE CONTENT (METER – – DRY BASIS)

CALIBRATION: Cal Value (1) = 12% Actual Reading 12.0
Cal Value (2) = 22% Actual Reading 22.0

Piece	Length	Readings			Type
1	8 ft	23.4	24.2	23.6	2x4
2	ft				
3	ft				

Length of cut pieces: 4@8" 4@16" inches Pre-Burn Fuel Average Moisture: 23.7%

Time (clock): 10:00 Room Temperature (F): 80 Initials: K

TEST FUEL

FUEL TYPE AND AMOUNT: 2 × 4 4 4 × 4 0

CALCULATED LOAD WEIGHT: 7.5 ACTUAL LOAD WEIGHT: 7.4 (2 × 4)
0 (4 × 4)
FUEL PIECE LENGTH: 16.0" 7.4 Total

MOISTURE CONTENT (METER – – DRY BASIS)

PIECE	READINGS			TYPE	
1	23.4	23.2	19.1	2x4	21.9
2	23.6	22.6	22.3	2x4	22.8
3	21.2	21.4	20.6	2x4	21.1
4	20.4	21.1	20.5	2x4	20.7
5					
6					
7					
8					
9					
10					

OVERALL TEST FUEL LOAD MOISTURE AVERAGE: 21.6%

Time (clock): 10:14 Room Temperature (F): 80 Initials: K

Technician signature: K. J. Morgan Date: 6-28-02

OMNI-Test Laboratories
Beaverton, OR (503) 643-3788

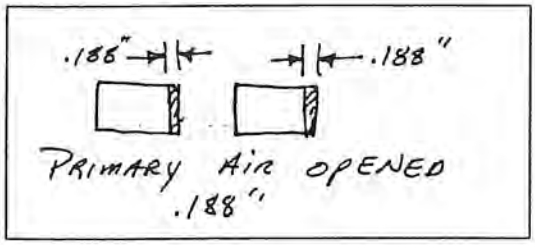
Run Notes

Client/Model: Morso 2110 Panther
Project #: 192-S-01-3
Tracking Number: 387
Run #: 4
Date: 6-28-02
Test Crew: K. Morgan
OMNI Equipment ID Numbers:

PREBURN

DESCRIBE OR SKETCH AIR OR THERMOMSTAT SETTINGS BELOW:
(SETTINGS MUST BE ACCURATE AND REPRODUCABLE)

PRIMARY:



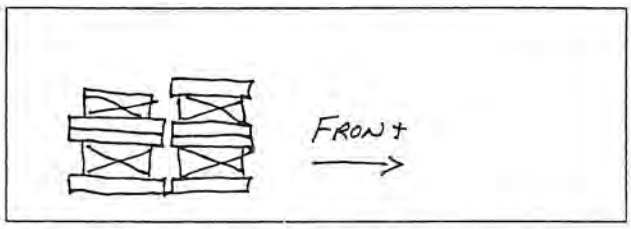
SECONDARY: ~~None~~ 1/4 Fixed
TERTIARY: None
FAN: None

PREBURN SETTINGS AND ACTIVITIES

TIME	AIR (THERMO) CHANGES PRIMARY/SECONDARY/TERTIARY	FAN SETTING CHANGE	ADD FUEL + WT.	ADD FUEL - WT.	RAKE COAL	COMMENT
0	test setting					
41			2.1			
60					X	

TEST

TEST FUEL CONFIGURATION SKETCH
(INDICATE VIEW ANGLE)



START UP PROCEDURES
BYPASS: N/A
FUEL LOADING Loaded by 30 sec.
DOOR: Closed by 45 sec.
PRIMARY AIR: Fully open for 4.5 min, then slowly adj. to test setting by 5 min.
OTHER: None

DESCRIBE OR SKETCH TEST SETTINGS BELOW:
(SETTINGS MUST BE ACCURATE AND REPRODUCIBLE)
PRIMARY:

Same as Above

SECONDARY: Fixed
TERTIARY: None
FAN: None

Technician signature: K. J. Morgan Date: 6-28-02

OMNI-Test Laboratories, I.
Beaverton, OR (503) 643-3788

Supplemental Data EPA 5G/5H

Client / Model: Morso 2110 Panther Project No.: 192 - 5 - 03 - 1

Tracking No.: 387 Date: 6-28-02 Run No.: 4 Booth: 1

Test Crew: K. Morgan Start Time: 11:46 Stop Time: 13:36

OMNI Equipment #'s: _____

Gas Analyzer Train Leak Check:

Stack: Initial: N/A Final: N/A

Dilution Tunnel (Method 5G Only): Initial: N/A Final: N/A

Calibrations: Span Gas CO_2: N/A O_2: N/A CO: N/A CO_2(DT): N/A

	N_2 Span	N_2 Span	N_2 Span	N_2 Span	N_2 Span	N_2 Span	N_2 Span
Time							
O_2			N/A				
CO_2							
CO							
CO_2 (DT)							

Stack Diameter (inches): 6.0

Air Velocity (ft/min): Initial: <50 Final: <50

Scale Audit (lbs.): Pretest: 10.0 Post Test: 10.0

Induced Draft: Ø %Smoke Capture: 100

Pitot Tube Leak Test: Pre: Ø @ 3.3" w.c. Post: Ø @ 3.5" w.c.

Flue Pipe Cleaned Prior to First Test in Series: Date: 6-19-02 Initials: JC

	Initial	Middle	Ending
Pb (in. Hg)	29.77	29.76	29.74
Room Temp (°F)	79	76	74

Technician signature: K. Morgan Date: 7-11-02

90 - 1,84
130 - 127

Model: Panther 2110 B
Morsø Jernstøberi A/S
DK-7900
Nykøbing Mors
Denmark

Section 3

Drawings and Fuel Photographs

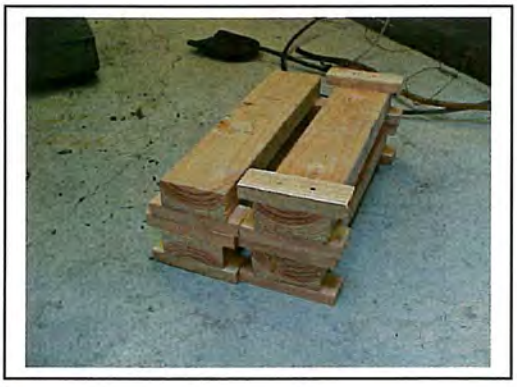
Model: Panther 2110 B
Morsø Jernstøberi A/S
DK-7900
Nykøbing Mors
Denmark

Morsø Jernstøberi A/S
Model: Panther 2110 B

Run 1 - Fuel

Run 1 - Newly Loaded Stove

Run 2 - Fuel



Run 2 – Newly Loaded Stove

Model: Panther 2110 B
Morsø Jernstøberi A/S
DK-7900
Nykøbing Mors
Denmark

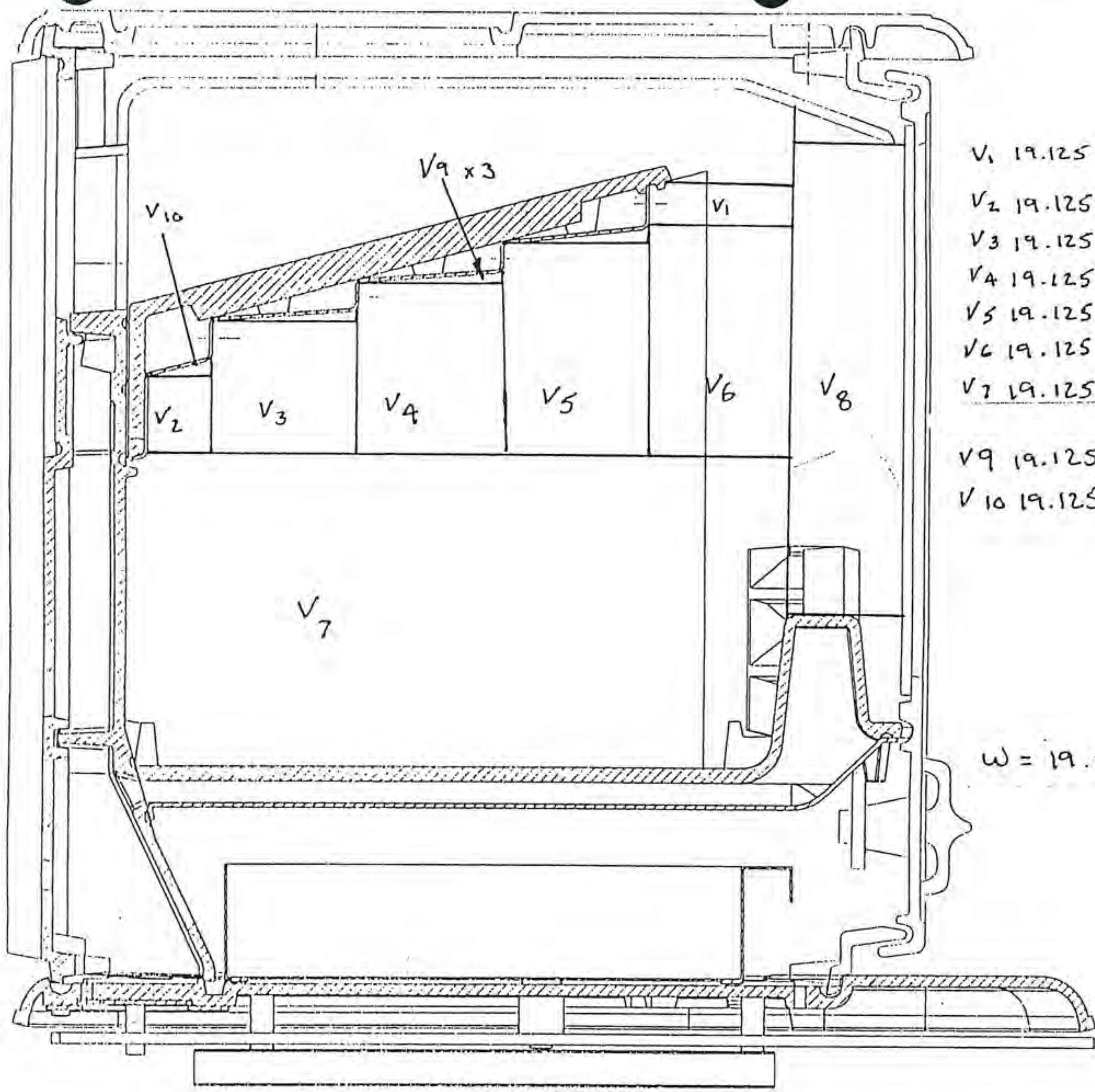
Morsø Jernstøberi A/S
Model: Panther 2110 B

Run 3 - Fuel

Run 3 – Newly Loaded Stove

Run 4 - Fuel

Run 4 – Newly Loaded Stove



V_1 19.125 x 2.125 x .875 = 35.561

V_2 19.125 x 1.125 x 1.5 = 32.27

V_3 19.125 x 2.5 x 2.437 = 116.52

V_4 19.125 x 2.5 x 3.25 = 155.39

V_5 19.125 x 2.5 x 4 = 191.25

V_6 19.125 x 2.125 x 4.437 = 180.32

V_7 19.125 x 11.25 x 5.375 1156.47

V_9 19.125 x 2.5 x .25 x .5 x 3 = 17.93

V_{10} 19.125 x 1.125 x .25 x .5 = 2.69

$= 1888.401\ in^3$

$= 1.093\ ft^3$

W = 19.125

morsø	Snit lodret 2110 USA Morsø 2100	15.08.2002 RSV 1:1 2100-170 a

SKAMOLEX
VIP-12 Vermiculite
Block Insulation

Chemical Analysis (typical)

SiO_2	48%	CaO	8%
$Al_2O_3 + TiO_2$	22%	Na_2O	0.3%
Fe_2O_3	3.4%	K_2O	6%
MgO	9%	Loss on ignition (1025°C)	3.0%

TECHNICAL PROPERTIES

Max. service temp.	°C °F	1150 2102	Specific heat	kJ/(kg·K) BTU/(lb·°F)	0.9 0.22
Bulk density, dry	kg/m³ lbs/cu.ft.	1200 75	Coefficient of reversible thermal expansion, 20°C-750°C (68°F-1382°F)	K^{-1} $°F^{-1}$	$14x10^{-6}$ $7.8x10^{-6}$
Compressive strength	MPa lbs/sq.in.	15.0 2175	Linear reheat shrinkage, 12 h at 1100°C (2012°F) (DIN 51067, Teil 2)	%	1.0
Modulus of rupture	MPa lbs/sq.in.	3.0 435	Pyrometric cone equivalent	°C °F	1180 2156
Total porosity	%	52	Thermal conductivity at mean temp. (ASTM C-201 supplemented by ASTM C-182)		W/(m·K)
Bath resistance ("Light Metals 1986", pp. 501-514)				200°C	0.23
				400°C	0.26
				600°C	0.29
				800°C	0.32
Cryolite Attack Ratio (k)		1.27			
Material Factor (m)		1.03			
					BTU/(sq.ft.·h·°F/in)
				392°F	1.59
				752°F	1.80
				1112°F	2.01
				1472°F	2.22

The physical and chemical properties represent typical average values obtained in accordance with accepted test methods and are subject to normal manufacturing variations. They are supplied as a technical service and are subject to change without notice.

OMNI-CHECKED
BY DATE

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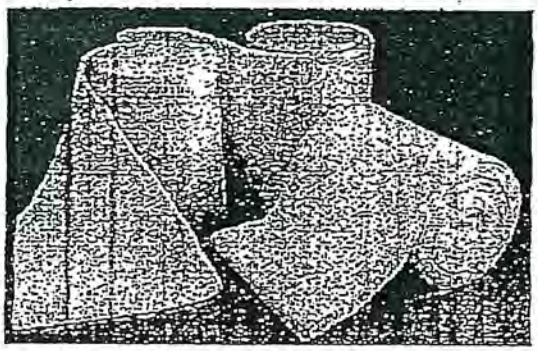
Keramab N.V.
Haverneidelaan 4
B - 9140 Temse
Belgium
Telephone +32(0)3 711.02.75
Telefax +32(0)3 711.02.56

REFRACTORY FIBER PRODUCTS

Technical Datasheet

INSULFRAX® BLANKET



KERAMAB's latest addition to its fibres product range, **INSULFRAX®**, is a revolutionary *breakthrough in insulating materials technology.*

This new product is based on a calcium-magnesium-silica chemistry, giving excellent thermal and physical stability up to its operational limit of 1100°C.

INSULFRAX® products can be used in a wide range of applications as thermal insulation, particularly in Fire Protection and in Domestic Appliances.

General Characteristics

INSULFRAX® Blanket offers users a number of important advantages over other man-made mineral fibres:

- Excellent thermal and physical stability up to 1100°C
- Light weight, flexibility and exceptional acoustic absorption properties
- Improved tensile strength of **INSULFRAX®** Blanket due to our specialist manufacturing technology
- ***INSULFRAX®** needle felted Blanket contains no organic binders*

Chemical Analysis (wt.%)		
SiO_2	-	61.0 - 67.0
CaO	-	27.0 - 33.0
MgO	-	2.5 - 6.5
Al_2O_3	-	< 1.0
Fe_2O_3	-	< 0.6

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BY DATE

Form:A1-050 Price List No.: BI 016
Effective: 2905|98/MJH.mvo
Supersedes: 0704|98/MJH/mvo

KERAMAB
REFRACTORY & CERAMIC INNOVATION

20/10 '00 14:22 AF/MT-NR. 6103 S02

3-6 of 3-53

Keramab N.V.
Haverhaidelaan 4
B - 9140 Temse
Belgium
Telephone +32(0)3 711.02.78
Telefax +32(0)3 711.08.56

REFRACTORY FIBER PRODUCTS

Technical Datasheet

Typical Applications

Domestic Appliances
- Boiler insulation
- Fire seals
- Storage heater insulation
- Wood-burning stove seals
- Domestic cooker insulation
- Chimney fill

Fire Protection
- Offshore rig accommodation modules
- Building expansion joints
- Column and beam wrap
- Fire door in fill

Typical Physical Properties					
Colour	-	Bluish-white			
Classification Temperature	-	1100°C			
Melting Point	-	>1330°C			
Fibre Diameter	-	3.2 microns (mean)			
Tensile Strength	-	> 35 kPa (128 kg/m³)			
Thermal Conductivity Data, W/m°K (based on CEN draft method ASTM C-201)		64 kg/m³	96 kg/m³	128 kg/m³	160 kg/m³	192 kg/m³
200°C Mean Temperature		0.07	0.06	0.05	–	–
400°C Mean Temperature		0.10	0.09	0.08	0.07	0.06
600°C Mean Temperature		0.18	0.14	0.12	0.11	0.10
800°C Mean Temperature		0.27	0.22	0.18	0.16	0.15
Permanent Linear Shrinkage		1000°C	1100°C			
24 hour soak		< 2.0 %	< 4.0%			

Where appropriate Physical Properties and Thermal Conductivity Data measured according to ENV 1094-7:1994

Fire Test Data

INSULFRAX® Blanket is non-combustible in accordance with BS476:Pt4 and is approved for use against cellulosic and hydrocarbon fires and for dry wrapping of structural steel. Certification details can be supplied on request.

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BY DATE

Form:A1-050
Effective: 2905 1998/MJH/mvo
Supersedes: 07041998/MJH/mvo

Price List No.: III 018

KERAMAB
REFRACTORY & CERAMIC INNOVATION

20/10 '00 14:22 AF/MT-NR. 6103 S03

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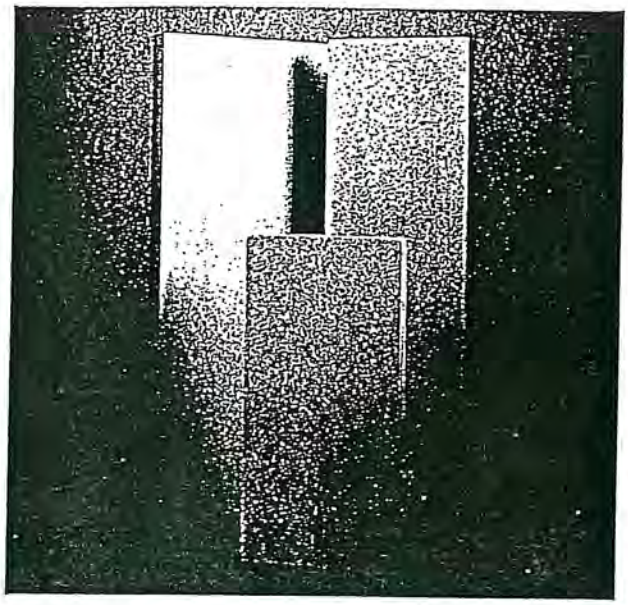
SKAMOLEX
VIP-12 Vermiculite
Block Insulation



Packing Colour Code:
GREEN/BLACK.

Grade: VIP-12
Temp. limit: 1150°C (2102°F)

The continuous efforts to improve energy efficiency of aluminium reduction cells have intensified demands for better heat insulation in pot cathodes.

Although a number of insulating products are available on the market, many smelters are still facing the problem of reducing the temperature of penetrating bath substances to solidifying point at a line between the carbon and the insulation layer, thus achieving a freezing of bath substances before they penetrate further into the more vulnerable bottom insulation.

With this end in view there is a need for a dense intermediate insulator, of a chemistry to resist bath attacks.

SKAMOLEX VIP-12 offers a perfect solution because it combines Vermiculite chemistry and good bath resistance with ample insulation and high strength.

Placed above the bottom insulation it will cause penetrating bath to stop and solidify, due to chemical reactions that transform the low-melting mixture of sodium fluoride and aluminium fluoride into a solid mixture of magnesium fluorides and silicates of sodium and aluminium (nephaline).

Product Data

SKAMOLEX VIP-12 is a Vermiculite based refractory block insulation of high bath resistance, characterized by good insulation value and very high mechanical strength.

Precision moulding ensures blocks of smooth, non-dusting surfaces and clean edges, and permits manufacture to close dimensional tolerances, i.e. ± 2.5 mm (0.10") on length and width, and ± 1.0 mm (0.04") on thickness.

Block Sizes

Metric:
1000 mm x 305 mm,
Thicknesses:
30 - 40 - 50 mm
610 mm x 305 mm,
Thicknesses:
25 - 30 - 40 - 50 - 60 - 75 mm

US/British:
36" x 12",
Thicknesses:
1¼" - 1½" - 2"
24" x 12",
Thicknesses:
1" - 1¼" - 1½" - 2" - 2½" - 3"

Derivatives cut from standards are made to order

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BY DATE

skamol
insulation

Skamol a/s · Ostergade 56-60 · DK-7900 Nykobing Mors · Tel.: +45 97 72 15 33 · Fax: +45 97 72 49 75
Technotherm GmbH & Co. KG · Postfach 10 14 37 · D-41414 Neuss · Tel.: +49 2131 10 64 0 · Fax: +49 2131 10 64 64
Skamol a/s, UK Sales Office · Aden Mount · Torrington · Essex CO7 8JJ · Tel.: +44 1 (206) 302 330 · Fax: +44 1 (206) 304 576
Skamol Inc · 2045 Niagara Falls Blvd Suite 16 Niagara Falls · NY 14304 · Tel.: +1 (716) 298 4115 · Fax: +1 (716) 298 4118

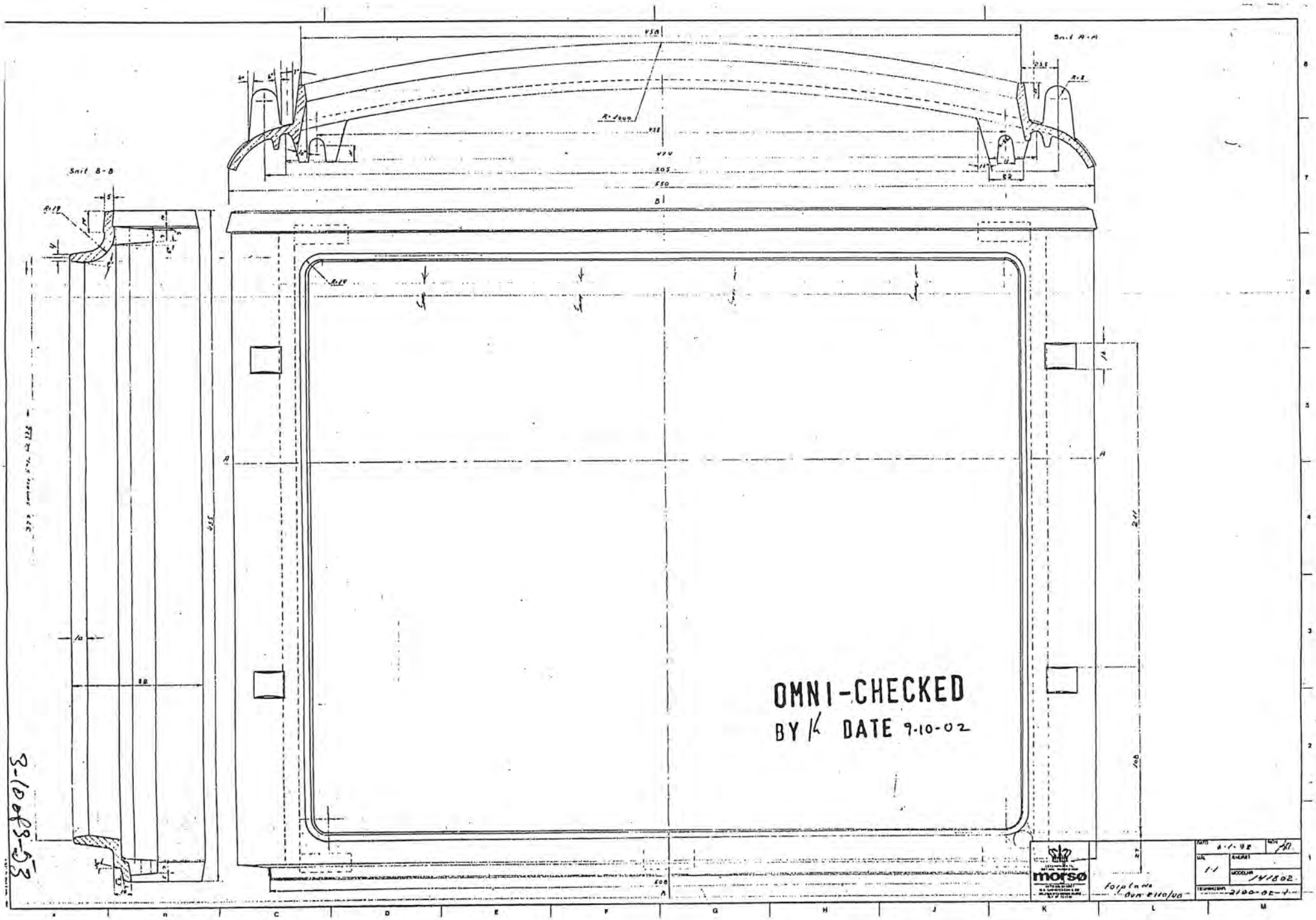
Certified under DS ISO 9001

Nykøbing Mors d. 16.08.2002

Morsø 2110 USA – Drawings

Parts	Drawing No.
Front frame	2100 - 02
Top plate	2100 - 05
Door left	2110 - 09
Door right	2100 - 10
Inside top plate	2100 - 11
Air valve	2100 - 13
Draft reducer	2100 - 54
Stone fitting	2100 - 56
Radiant shielding, bottom	2100 - 61
Ceramic glass	2100 - 64
Convection rear plate	2100 - 94
Base plate	2100 - 105
Distance bush	2100 - 112
Draught control	2100 - 113
Draught control frame	2100 - 114
Draught control arm	2100 - 115
Intermediate plate	2100 - 144
Baffle plate, cast iron	2100 - 145
Baffle plate, stainless	2100 - 146
Front grate	2100 - 147
Rear plate, inside	2100 - 148
Plate for intermediate frame	2100 - 149
Morsø 2110 USA	2100 - 150
Rear plate, outside	2100 - 152
Stone	2100 - 153
Horizontal section	2100 - 155
Insulation	2100 - 156
Handle	2100 - 158
Handle - complete	2100 - 159
Ash tray	2100 - 160
Hanging for handle	2100 - 163
Vertical section	2100 - 170
Leg	2B - 53
Cover	1126 - 16
Hinge pin	1126 - 38
Shaking handle	1126 - 42
Door axle, stainless steel	1126 - 44
Side plate w. squirrel	1400 - 04
Side plate w. ribs	1400 - 81
Fitting without thread f. cover	1400 - 199
Fitting w. thread for flue collar	1400 - 204
Glass fitting	1400 - 206
Flue collar	3400 - 97
Poker	9000 - 05

3-9-03-53


Snit A-A
Snit B-B
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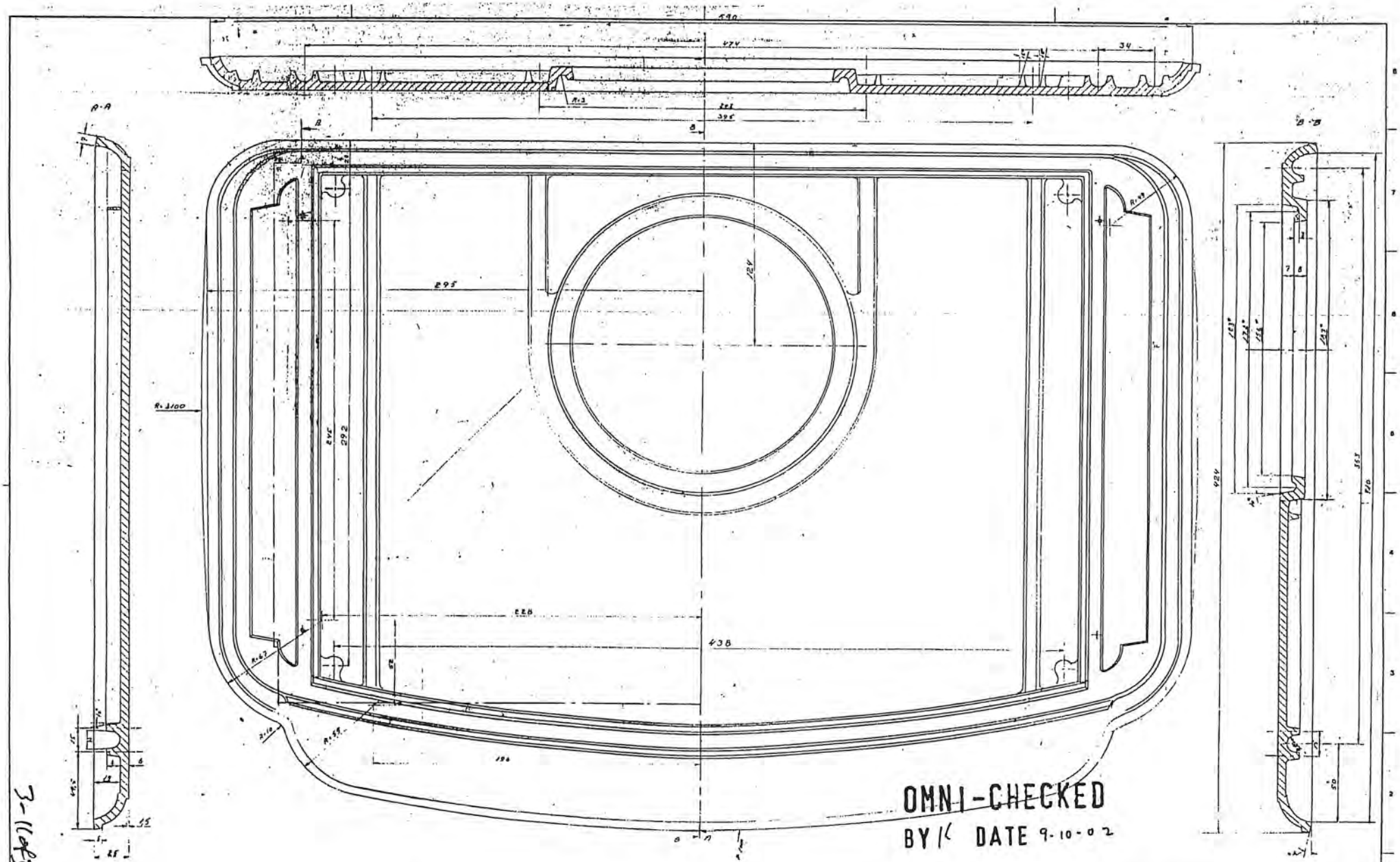
BY lk DATE 9-10-02
morsø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BY IC DATE 9-10-02

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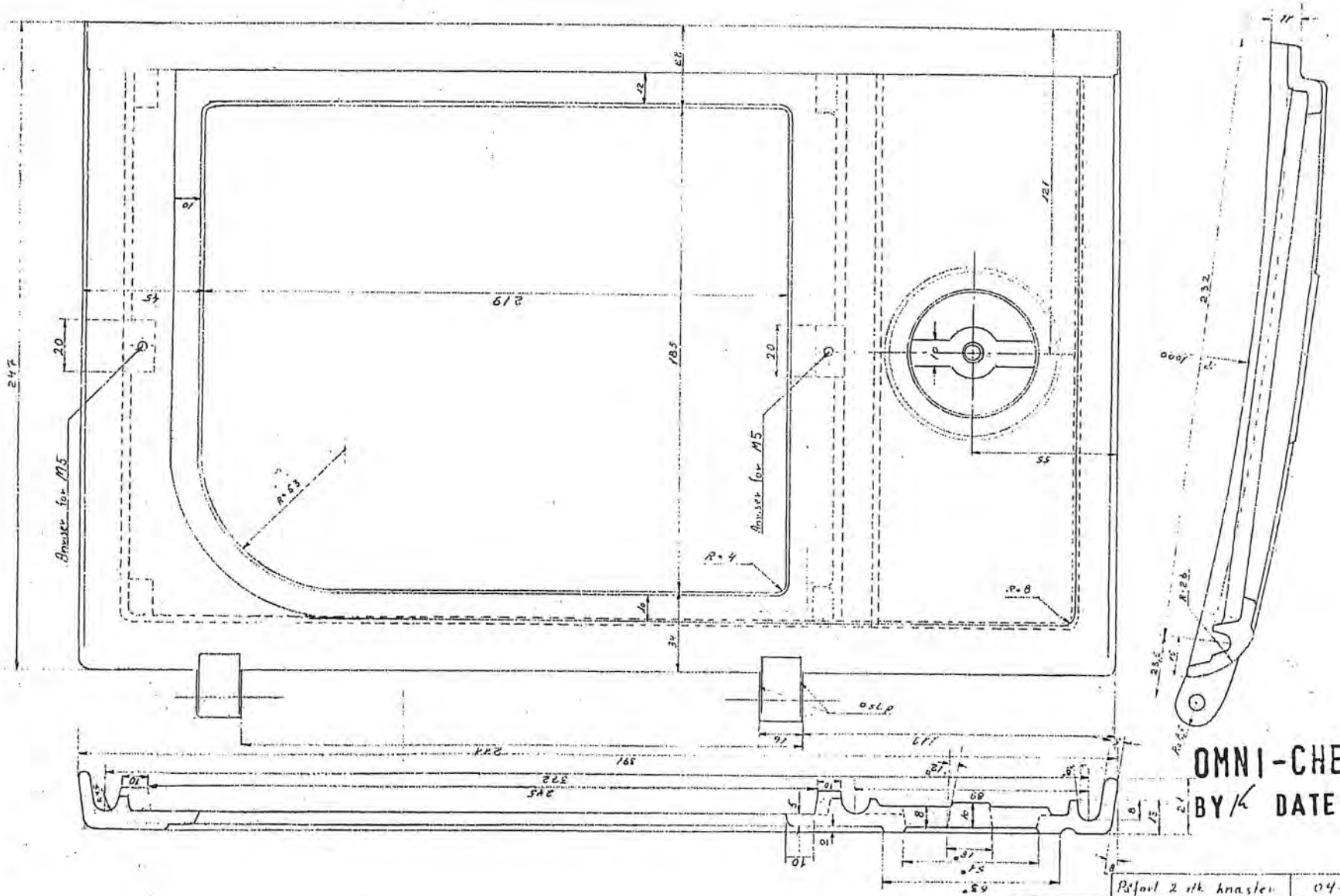


OMNI-CHECKED
BY /K DATE 9-10-02

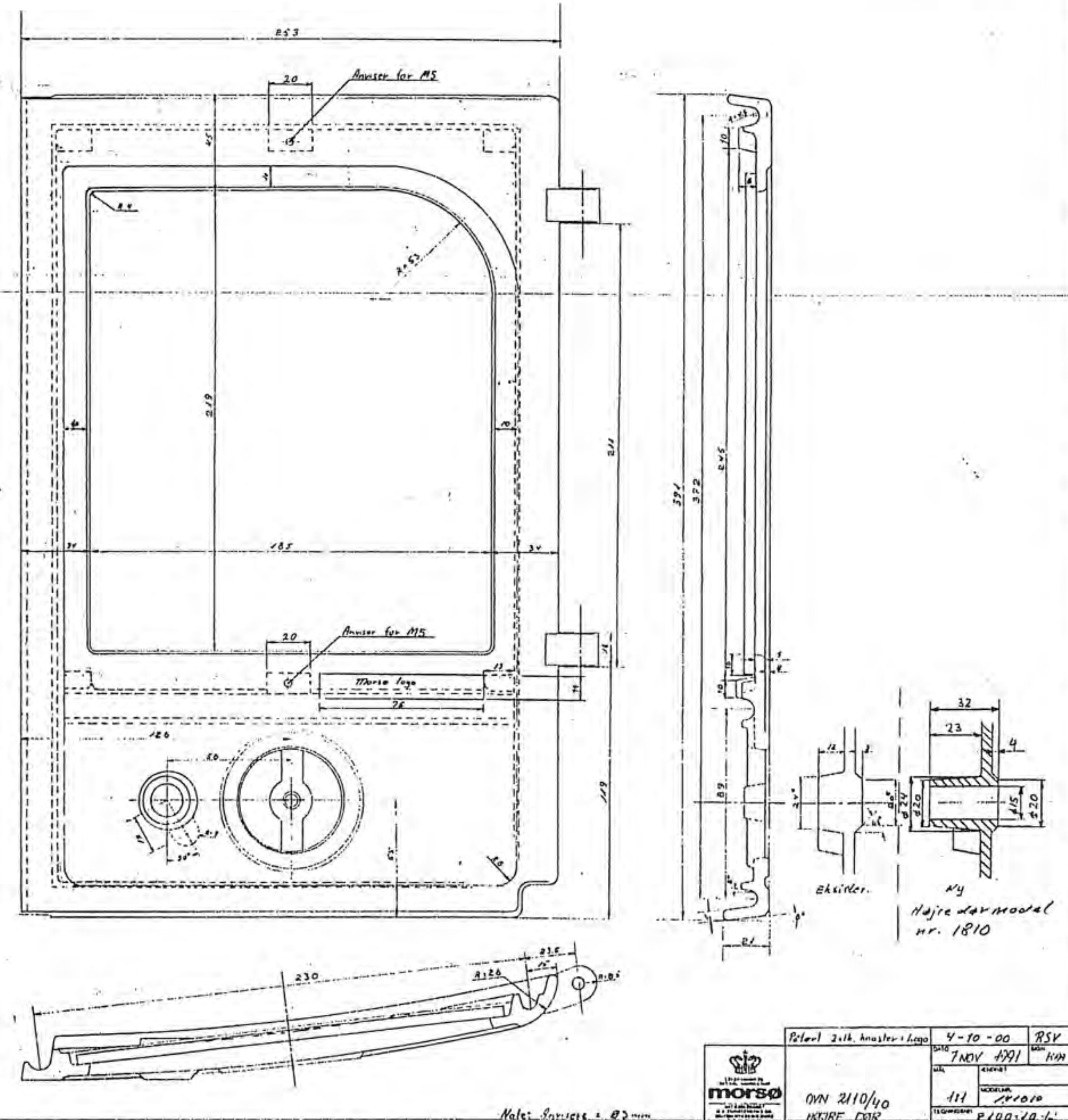
3-12 of 3-53

Note: Anvisere = Ø3mm

Påfør 2 stk knaster	04-10-00	RSV	
	DATO 19-11-91	SIGN.	
	MÅL 1:1	ÆNDRET	
		MODELNR 141809	
OVN B110/40 DØR VENSTRE	TEGNINGSNR B100-09 L		

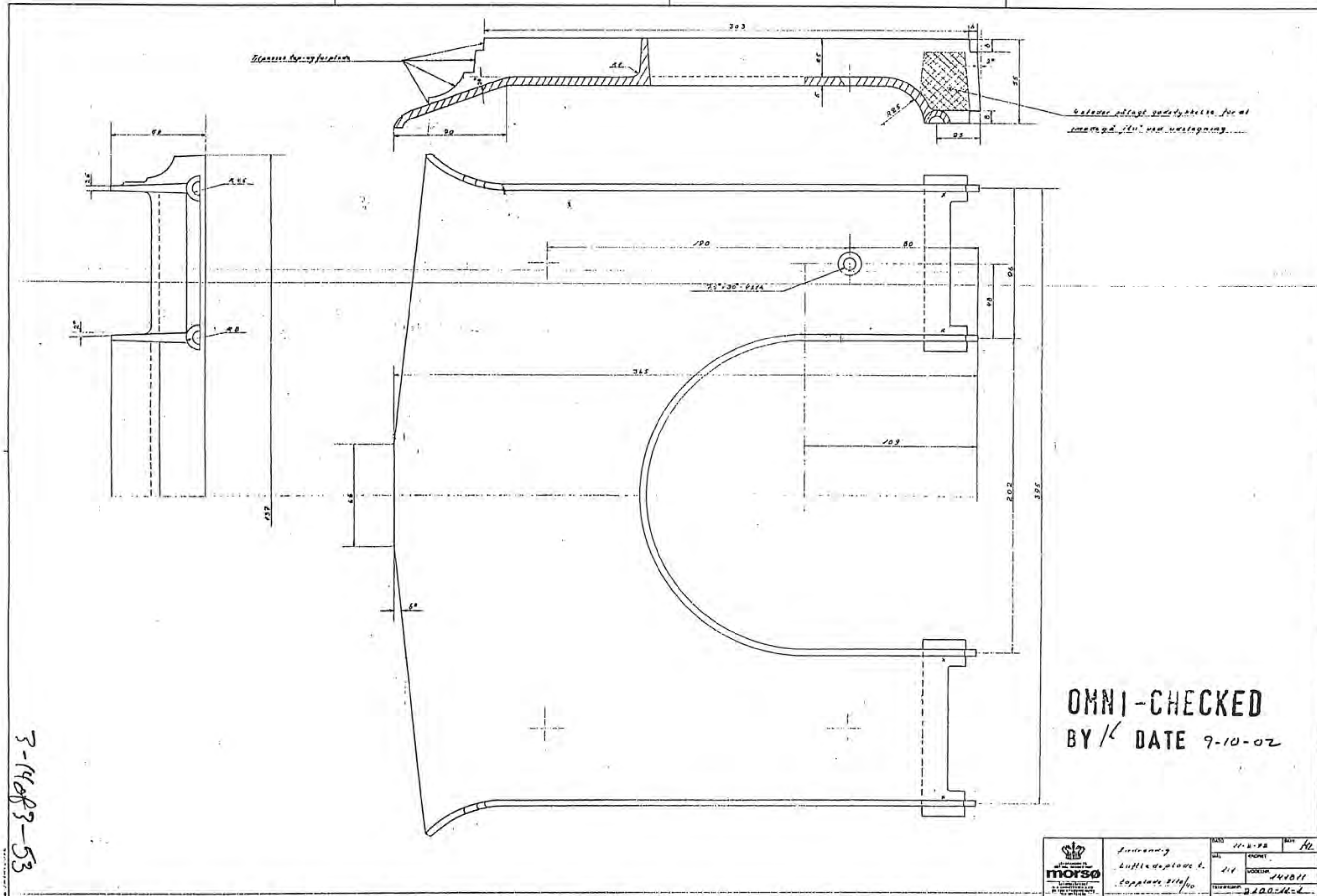
morsø
JERNSTØBERIET
A/S CHRISTENSEN & CO.
DK-3160 HELSINGHO MORSØ
TLF. 07-721500

A B C D E F G H J K L M



OMNI-CHECKED
BY /k DATE 9-10-02

3-13 of 3-53



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BY K DATE 9-10-02
morsø
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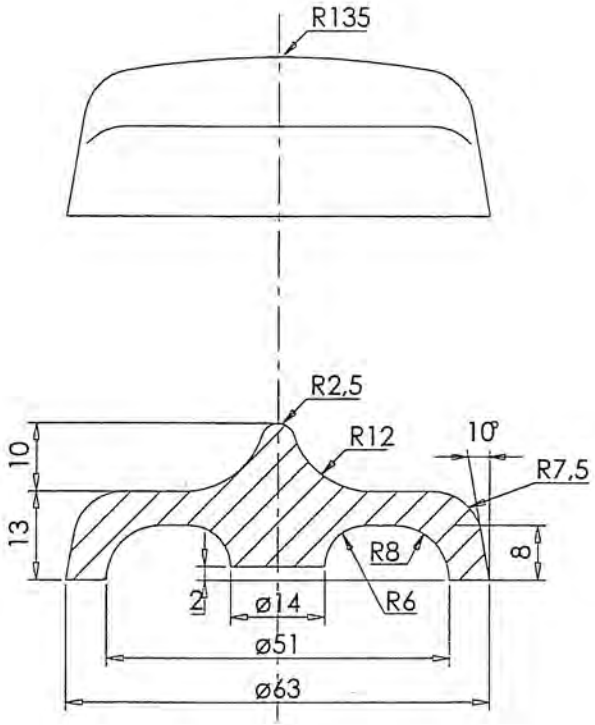
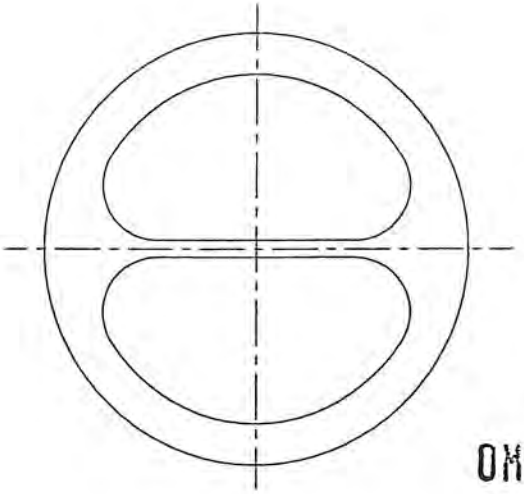
3-14of3-53

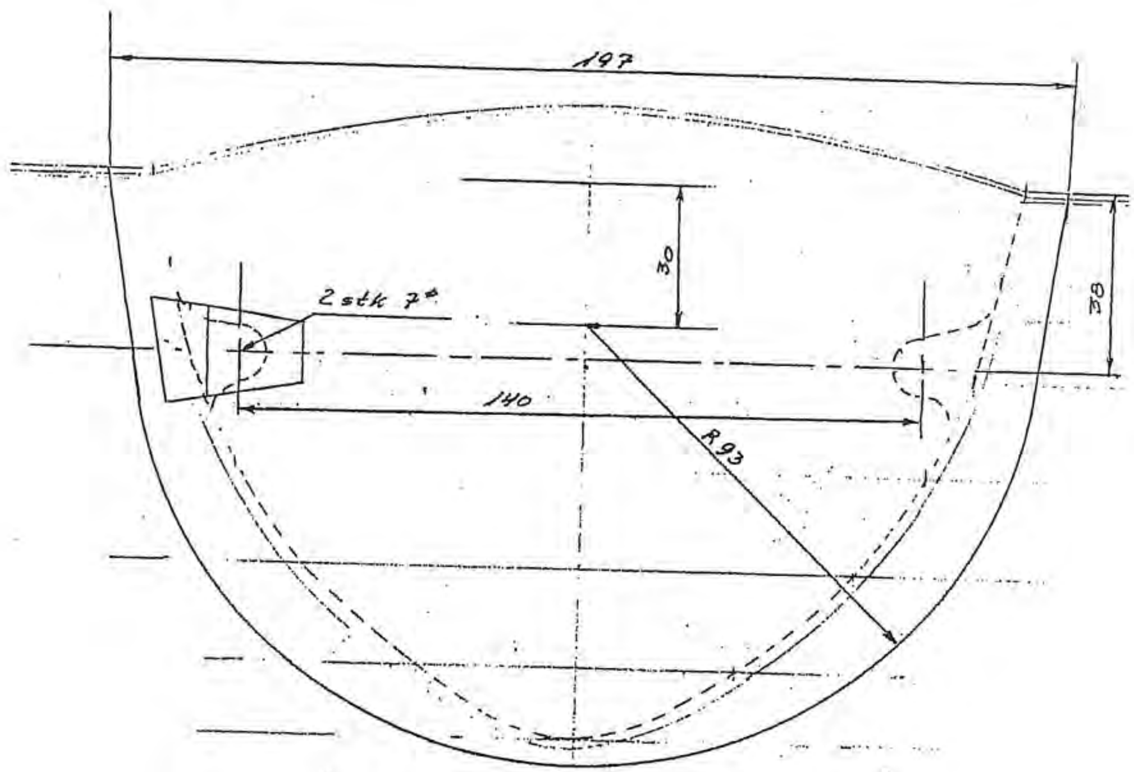




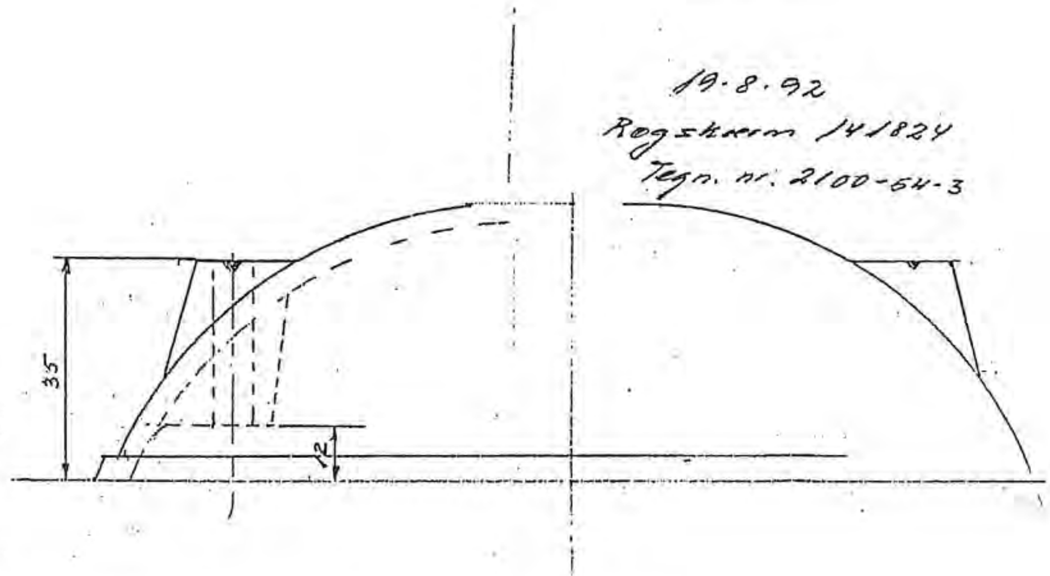
OMNI-CHECKED
BY K DATE 9-10-02

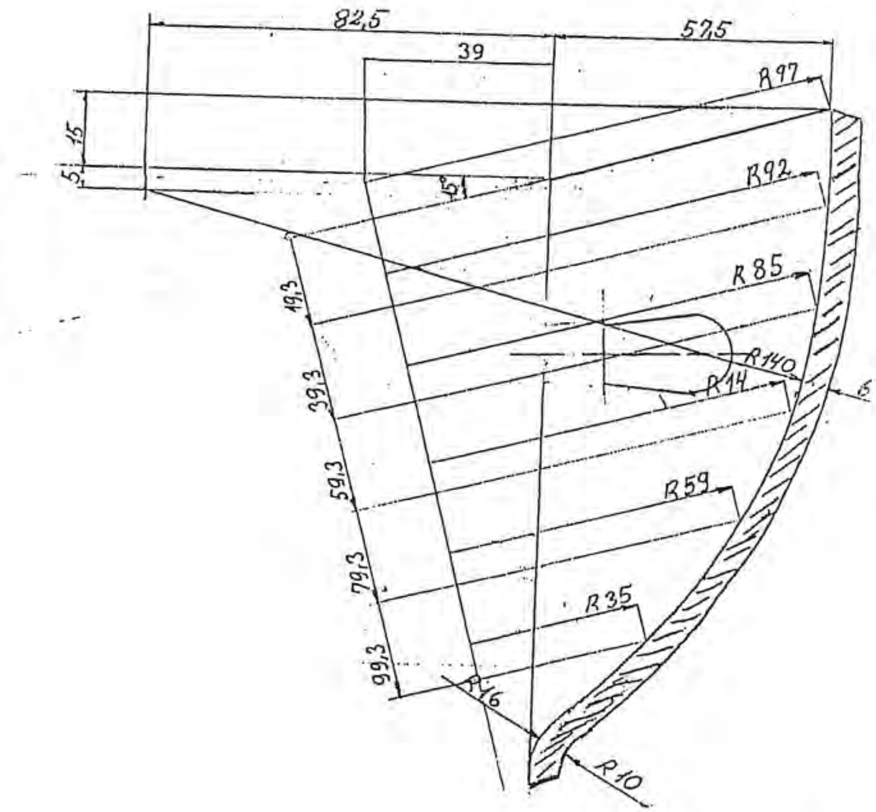
Titel: Trækventil til 2110/40	Sign.: Ha.	Dato: 06.03.92	Revision	Sign.	Dato
	Tegn.form.: A4	Målforhold 1:1	Gamdrup TegneTeknik	HCH	April 96
			Varenr.	RSV	10.02.97
Tegningsnummer: 2100-13-4	Varenummer: 44181300				
morsø By appointment to the Royal Danish Court	Filnavn: 2100-13				

3-15 of 3-53



19·8·92
Røgskærm 141824
Tegn. nr. 2100-54-3





OMNI-CHECKED
BY K DATE 9-10-02

13/10-93

Udgået til DS godkendt
S -"-
DIN -"-

Når restlager af "gamle" røgledeplader (ca 250) er brugt udgår den helt
2100 - 54 - 3

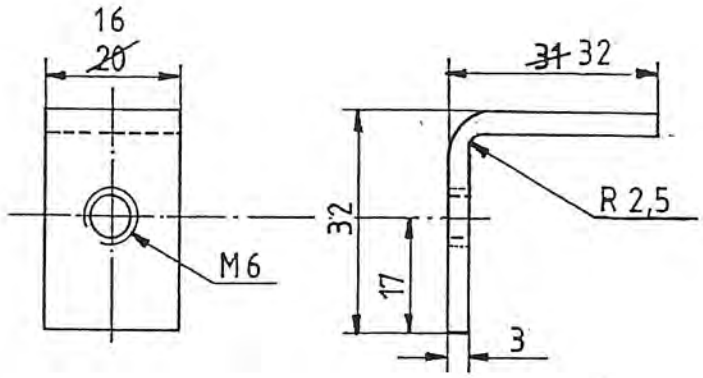
RC

3-16af3-53

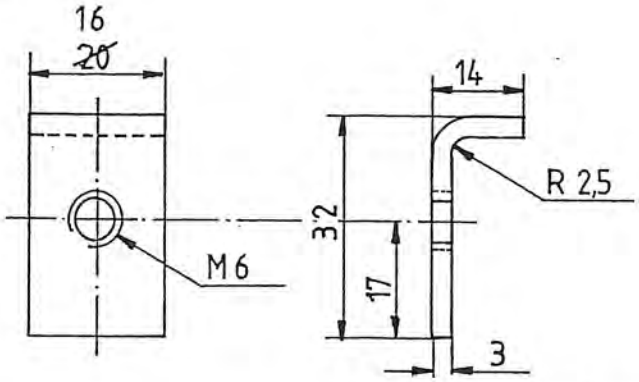
Dato	Kg. 10 stk.

2110

Varenummer: 541830



2140



Varenummer: 541831

OMNI-CHECKED
BY K DATE 9-10-02

Materiale: sort båndjern

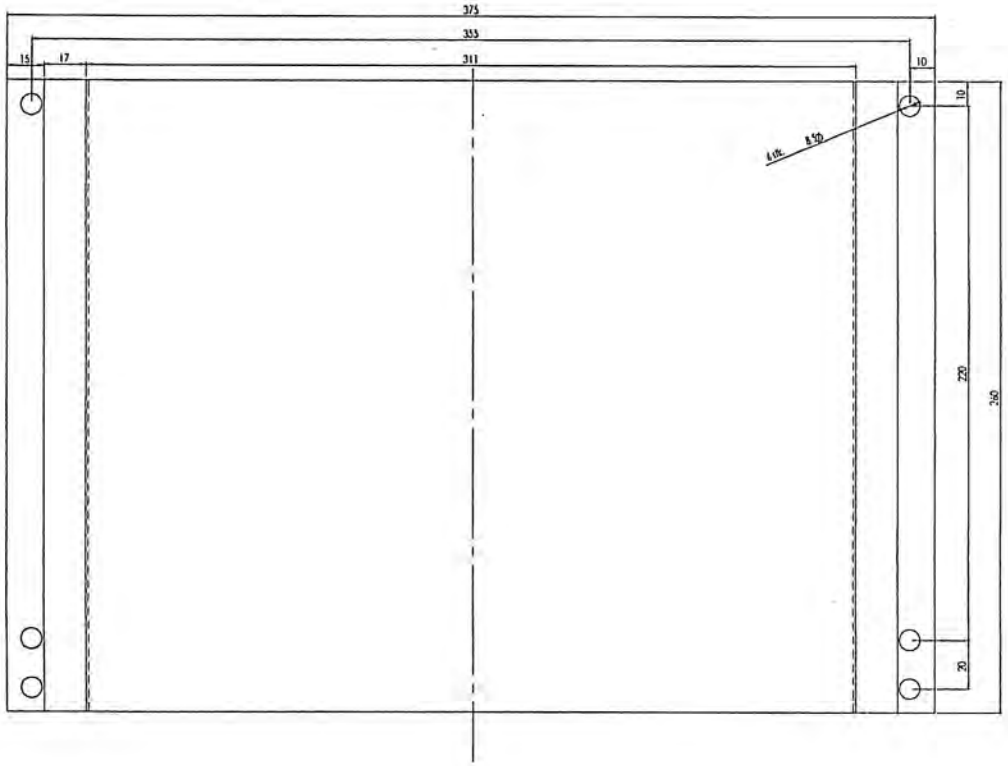
Antal	Model nr.	Gods	T & I	Specifikation	Indstøbt d. / 196
	2110/			Spændstykker til	Omstøbt d. / 196
	2140				27.8.1992 3C
				mellembund	Ændret: 6/11/1992 3C
		+	=		

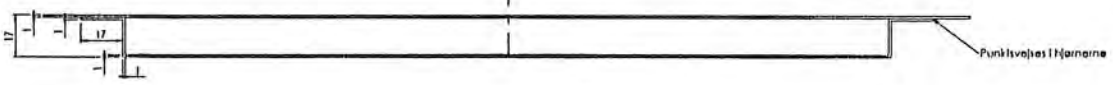
Type	Kasse	L	B	Ho	Hu	Vægt	Rumf.	Mod. matr.:

Benævnelse:	Firma:	Model nr.
		2100-56-4

RESTO 5526 - MI 8080

3-7 af 3-53

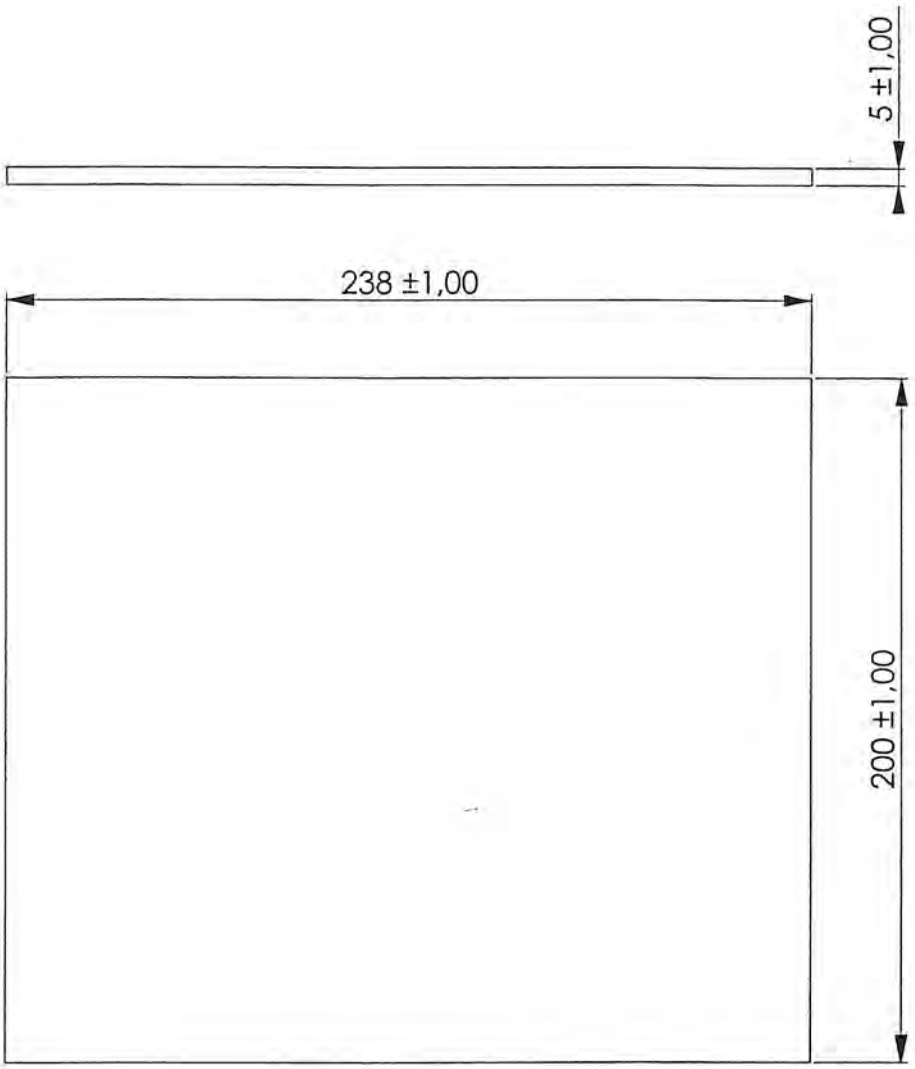




OMNI-CHECKED
BY K DATE 9-10-02

	Stråleskærm for bund		
	Morsø 2110/2140	Tegn.nr.	541820
			2100-61 d

3-1883-53



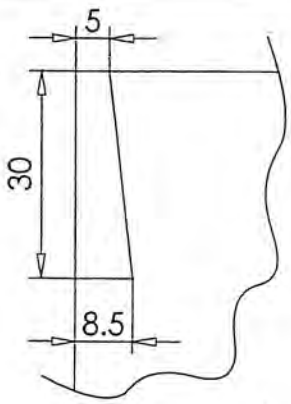
OMNI-CHECKED
BY K DATE 9.10-02

Rev.	Revisionstekst:	Sign.:	Dato:
d	Ændret tolerancer	RSV	13.03.1997
c	Filnavn ændret	RSV	28.01.1997
b	Gamdrup Tegne Teknik	HCH	April 1996

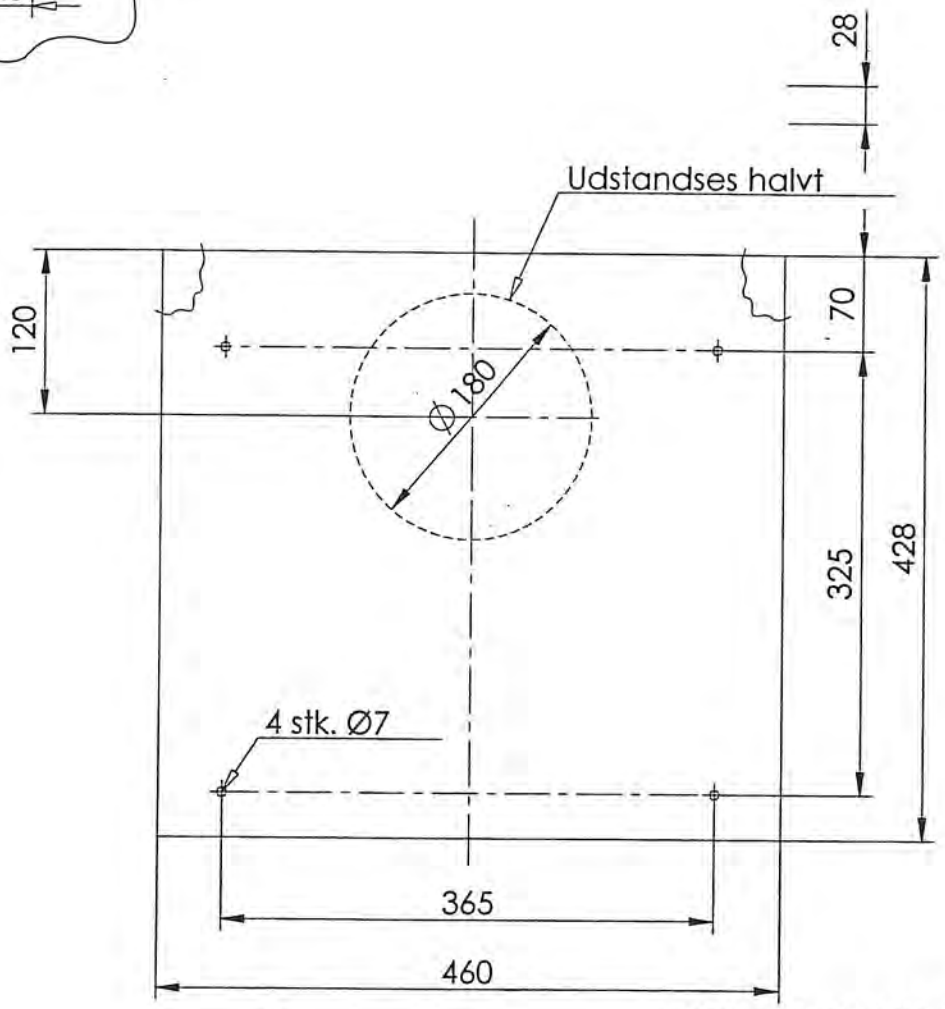
Materiale:	Keramisk glas		Titel:	Konstr.:	Aa.Gj 24.02.1993
Vægt:	- kg.	Bearbejdes: -	Glas	Frigivet:	- -
Overfladebeh.:	-	- m²	2110/2140/1495	Tegn.format:	A4
Måltolerance:	Mål uden toleranceangivelse DS/ISO 2768-1 m			Målforhold:	1:2
Ruhedstolerance:			Morsø 2100	Varenr.:	790721
Værktøjsnr.:	-		morsø	Tegningsnr.:	2100-64 d
Tegningstype:	Emnetegning				

2100-64 glas - Sheet1

3-1983-53



1:1



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BY // DATE 9-10-02

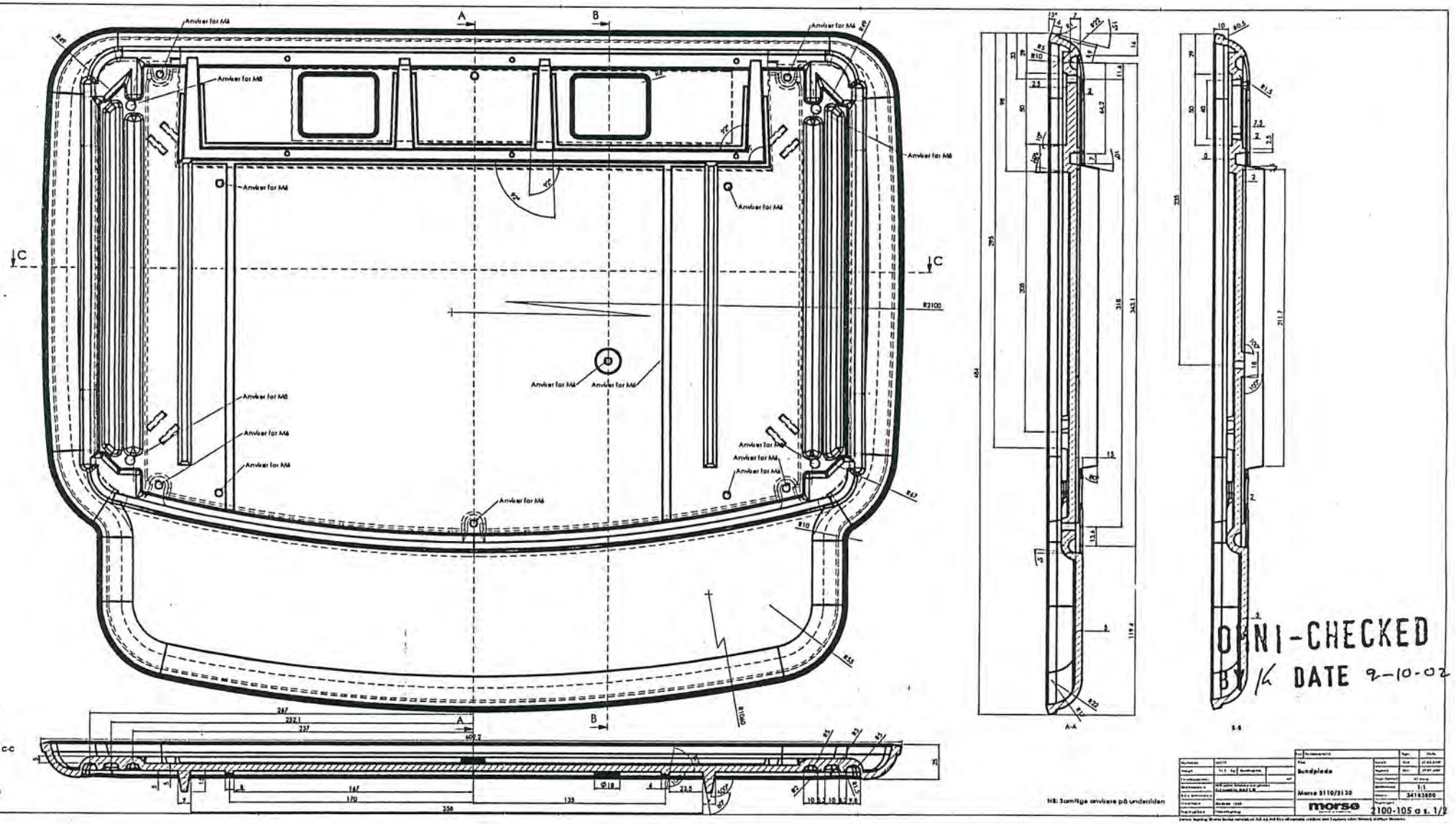
Klippemål: 512x428 mm

Pladetykkelse: 1mm

Rev.	Revision	Sign.	Dato

Titel: Konv. bagplade 2140 Norge		Sign.: KDU	Dato: 26.06.98
		Tegn.form.: A4	Målforhold 1:5
Filnavn: 2100-94		Varenummer: 54182400	
morsø Jernstøberi A/S		Tegningsnummer: 2100-94 a	

3-20 of 3-53



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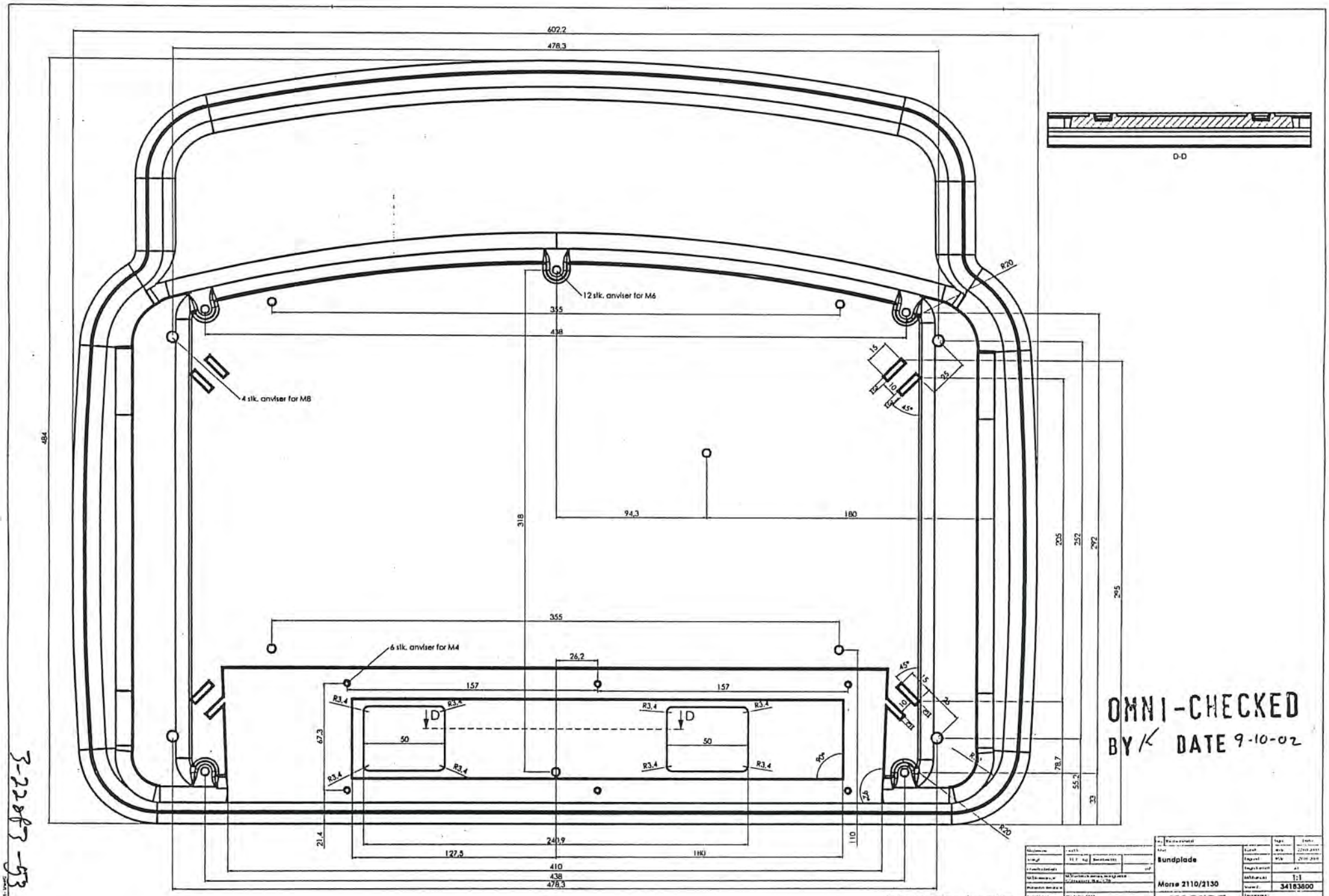
BY [illegible] DATE 9-10-02

Bundplade
Mærse 3110/3130
341153800
2100-105 a s. 1/2

3-21 B-B
53



NB: Samtlige anviser på undersiden

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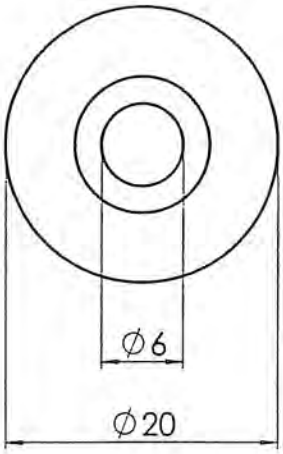
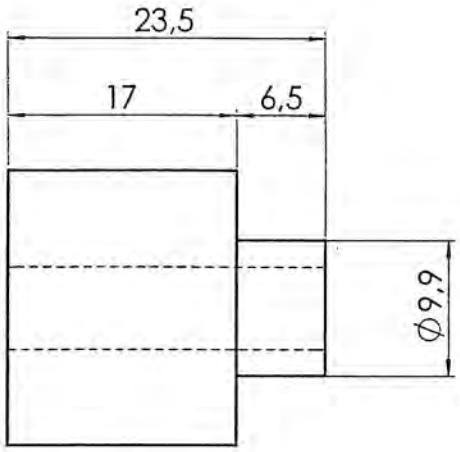
BY K DATE 9-10-02

3-22853-53



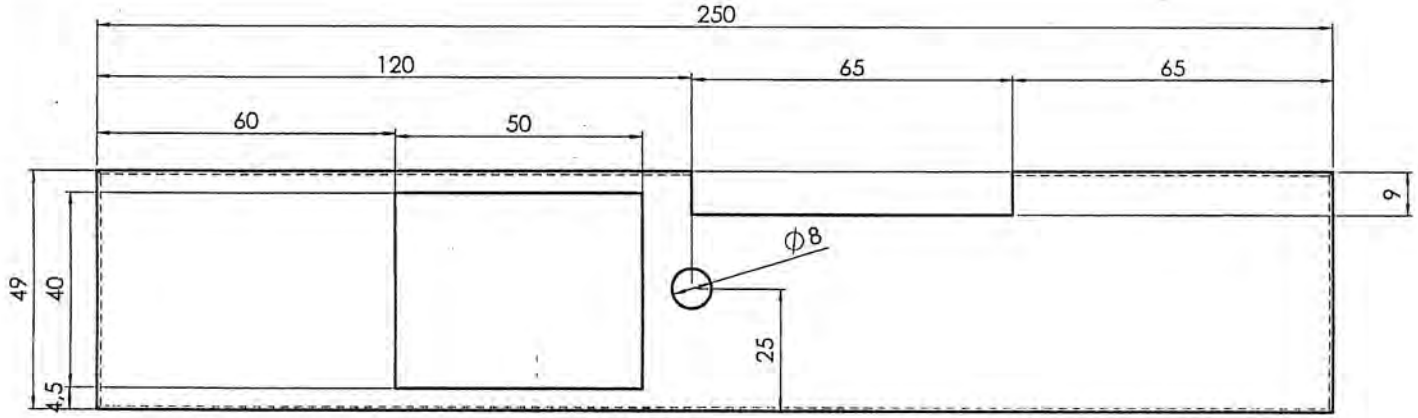


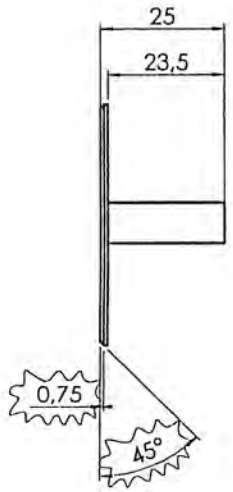
OMNI-CHECKED
BY K DATE 9-10-02

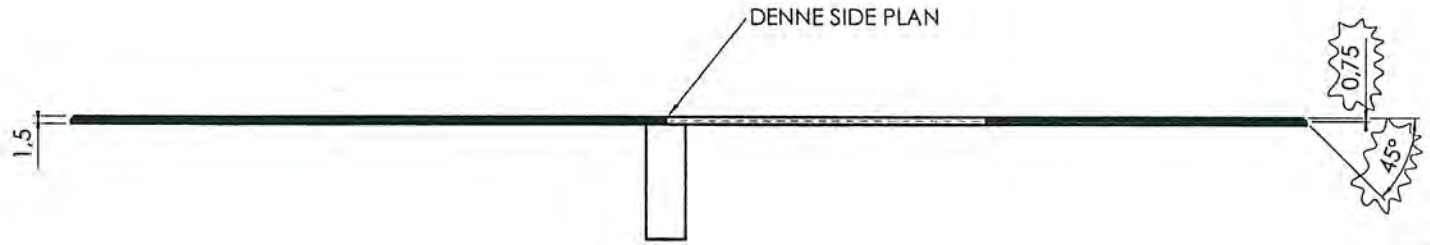
Rev.	Revisionstekst:	Sign.:	Dato:

Materiale:	Automatstål 37		Titel:	Konstr.:	RSV 22.03.2000
Vægt:	0,04 kg.	Bearbejdes:	**Afstandsbøsning**	Frigivet:	
Overfladebeh.:		m²		Tegn.format:	A4
Måltolerance:	Mål uden toleranceangivelse DS/ISO 2768-1 m			Målforhold:	2:1
Ruhedstolerance:			**Morsø 2100**	Varenr.:	54181700
Værktøjsnr.:			morsø	Tegningsnr.:	2100-112 a
Tegningstype:	Emnetegning				

2100-112 - Sheet1







OMNI-CHECKED
BY K DATE 9-10-02

Rev.	Revisionstekst:	Sign.:	Dato:
f	Påført rejfning	RSV	20.03.2002
e	Fjernet rekt. stykke + ændret pl.tykkelse og bredde	RSV	12.03.2002
d	Ændret pladetykkelse og bredde	RSV	29.05.2001
c	Ændret pladetykkelse	RSV	07.03.2001
b	Påført tekst	RSV	20.02.2001

Materiale:	2 mm SPD plade		
Vægt:	122 g	Bearbejdes:	Svejses/slibes
Overfladebeh.:			m²
Måltolerance:	Mål uden toleranceangivelse DS/ISO 2768-1 m		
Ruhedstolerance:			
Værktøjsnr.:			
Tegningstype:	Emnetegning		

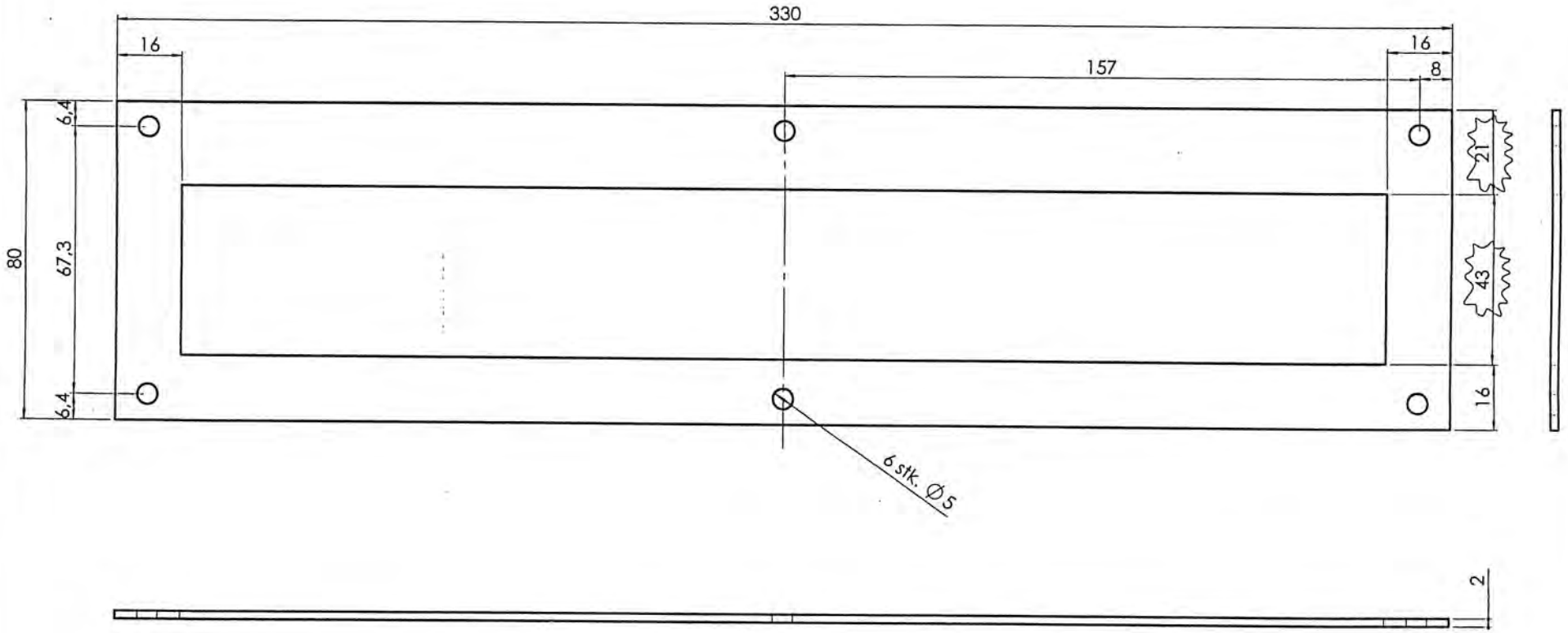
Titel: **Spjæld**

Morsø 2100

Konstr.:		22.03.2000
Frigivet:	RSV	07.03.2001
Tegn.format:	A3	
Målforhold:	1:1	
Varenr.:	71180200	
Tegningsnr.:	2100-113 f	

morsø

2100-113 - Sheet1

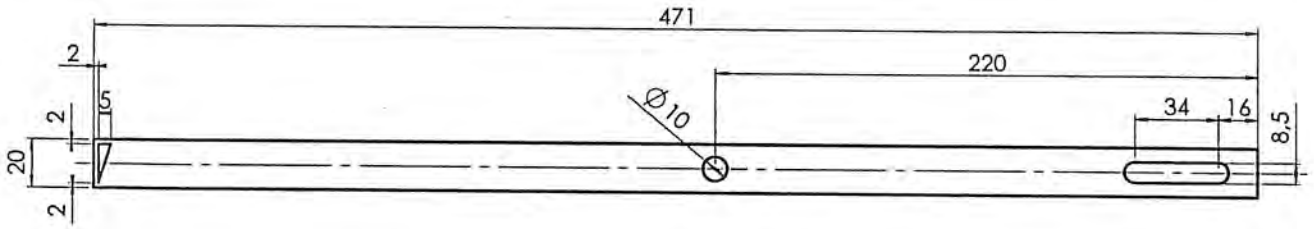


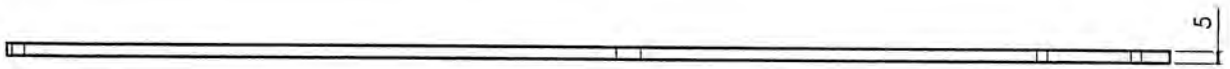
OMNI-CHECKED
BY K DATE 9-10-02

				Rev.	Revisionstekst:	Sign.:	Dato:
Materiale:	2 mm SPD plade			Titel:		Konstr.:	RSV 31.03.2000
Vægt:	0.19 kg.	Bearbejdes:		Luftlisteramme		Frigivet:	
Overfladebeh.:			m²			Tegn.format:	A3
Måltolerance:	Mål uden toleranceangivelse DS/ISO 2768-1 m					Måltorhold:	1:1
Ruhedstolerance:				Morsø 2100		Varenr.:	71180400
Værktøjsnr.:				morsø		Tegningsnr.:	2100-114 a
Tegningstype:	Emnetegning						

2100-114-

3-25 ø13 -





OMNI-CHECKED
BY K DATE 9-10-02

Rev.	Revisionstekst:	Sign.:	Dato:

Materiale:	5 mm SPD plade		
Vægt:	0.352 kg	Bearbejdes:	
Overfladebeh.:			m²
Måltolerance:	Mål uden toleranceangivelse DS/ISO 2768-1 m		
Ruhedstolerance:			
Værktøjsnr.:			
Tegningstype:	Emnetegning		

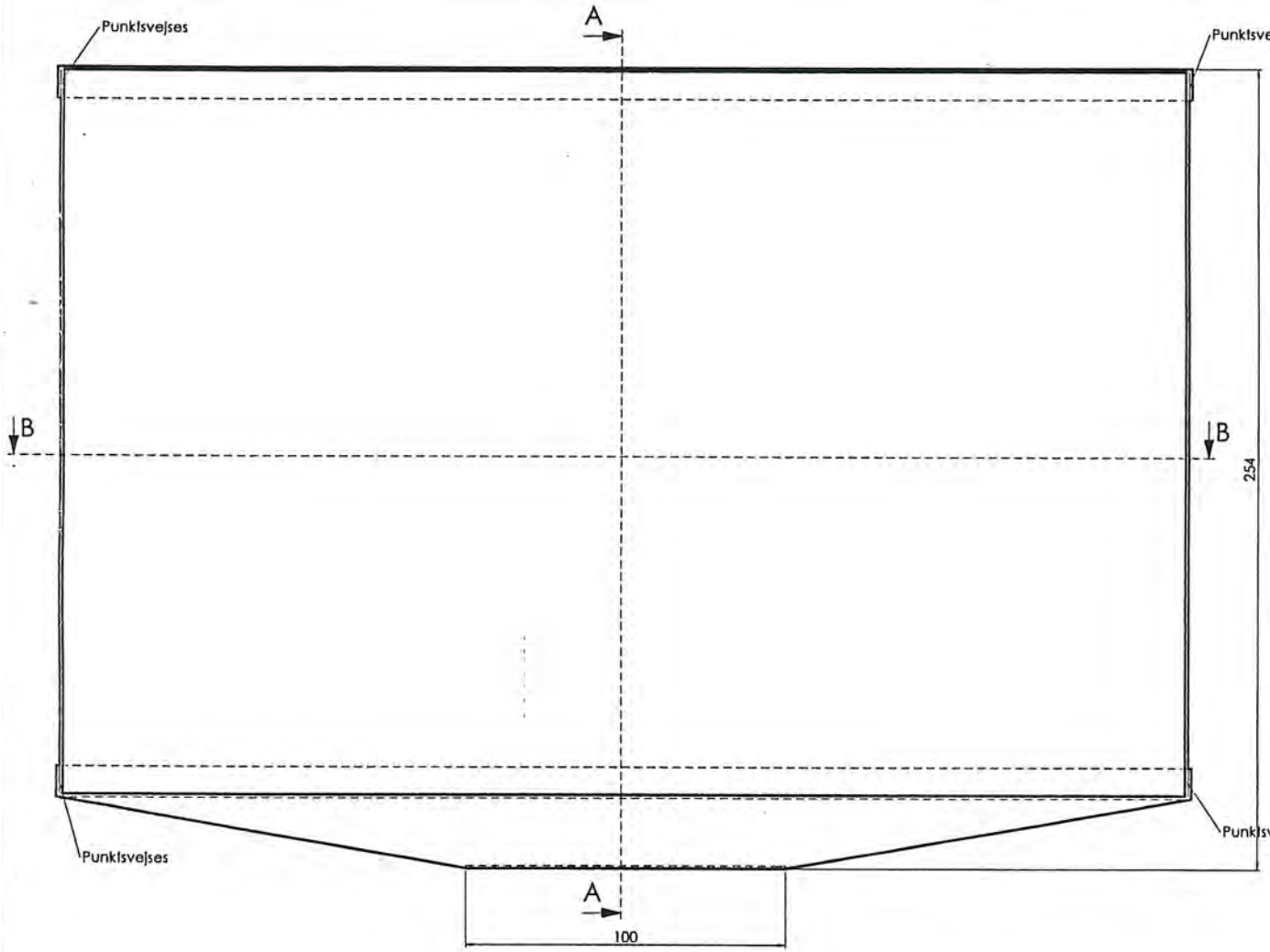
Titel: **Reguleringsstang**

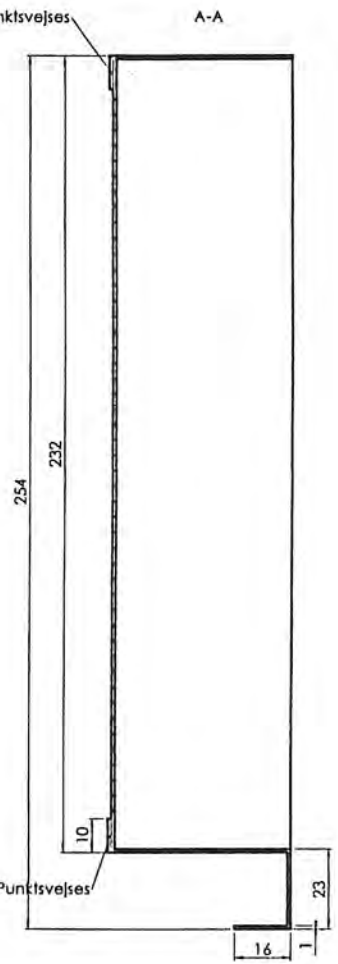
Morsø 2100

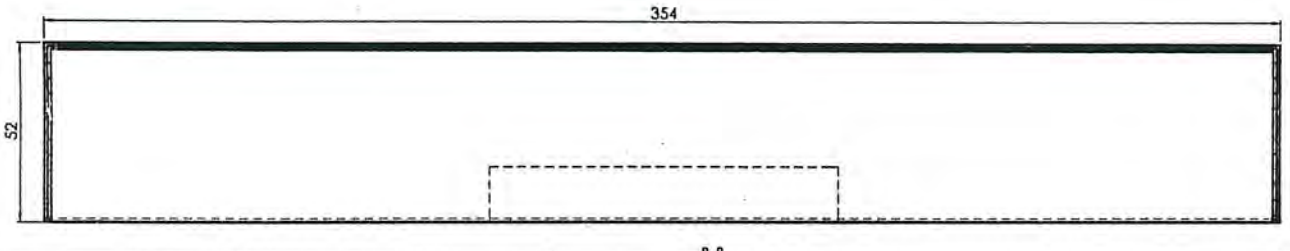
morsø

Konstr.:	RSV	22.03.2000
Frigivet:		
Tegn.format:	A3	
Målforhold:	1:2	
Varenr.:	71180300	
Tegningsnr.:	2100-115 a	

2100-115 Emne 3-2004-CS







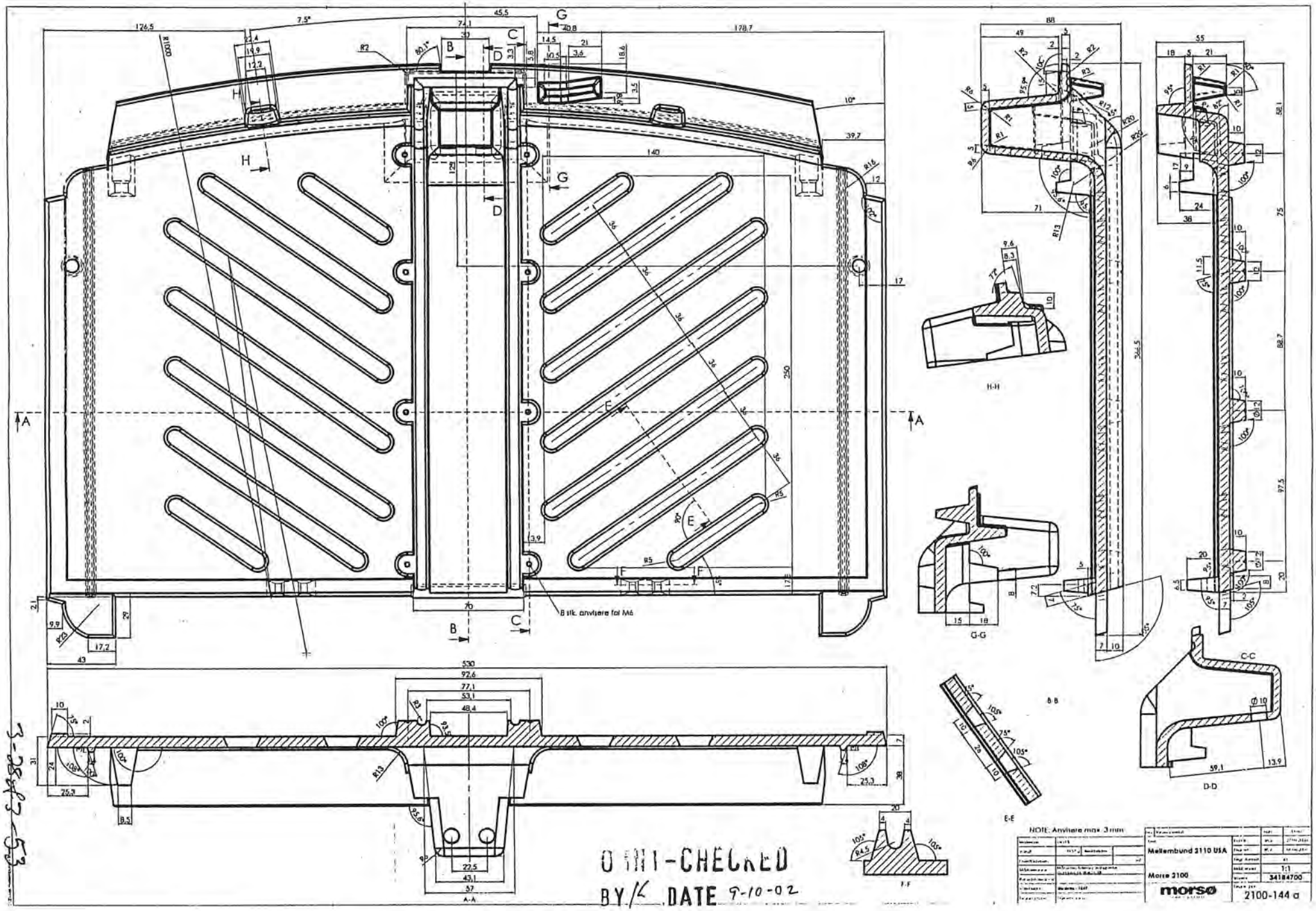
OMNI-CHECKED
BY K DATE 9-10-02

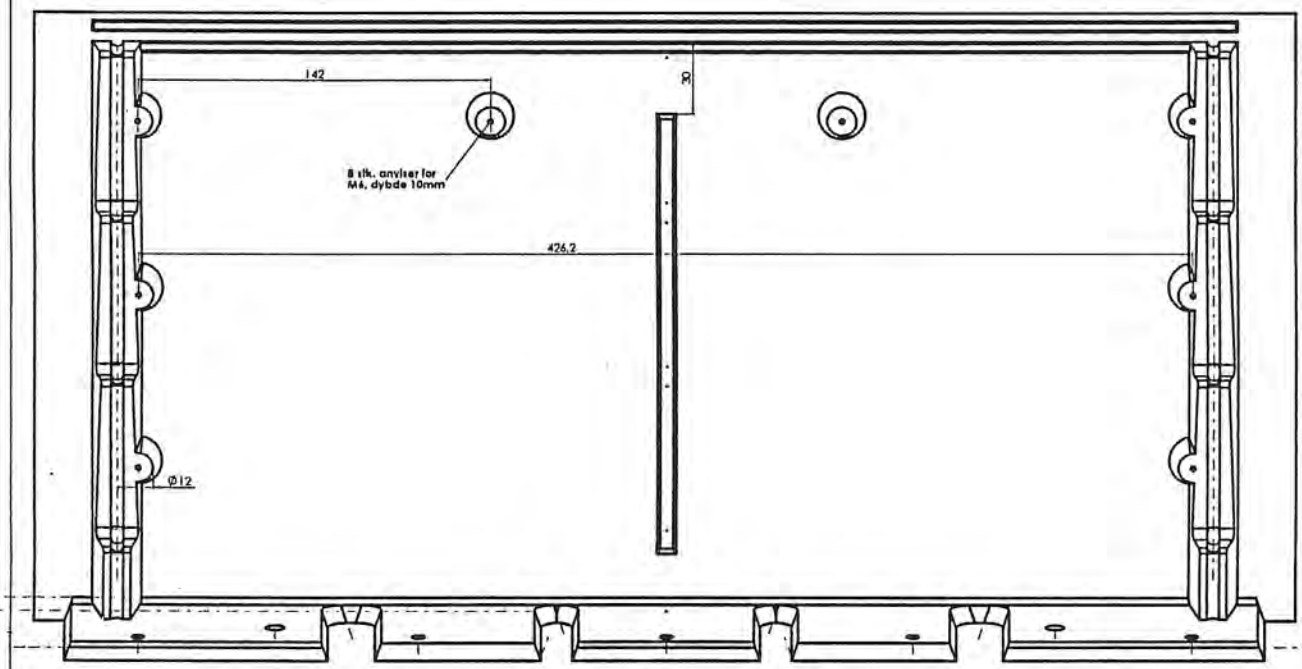
KLIPPEMÅL:
Svøb: 452x230
Front: 372x98
Bag: 372x61

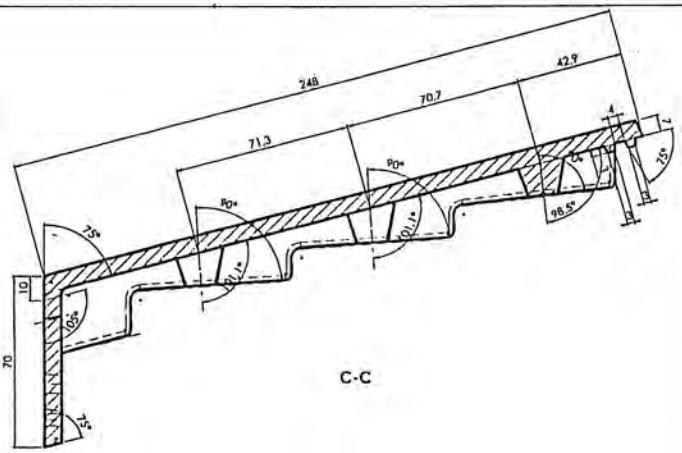
Materiale:	1 mm SPD plade			Rev.	Revisionstekst:	Sign.	Dato:
Vægt:	1,22 kg.	Bearbejdes:		Titel:		Konstr.:	RSV 24.03.2000
Overfladebeh.:			m²	Askeskuffe		Frigivet:	RSV 22.01.2001
Måltolerance:	Mål uden toleranceangivelse DS/ISO 2768-1 m			for luftindtag i bund		Tegn.format:	A2
Ruhedstolerance:				Morsø 2100		Målforhold:	1:1
Værktøjnr.:				morsø		Varenr.:	54181400
Tegningstype:	Emnetegning					Tegningsnr.:	2100-116 a

2100-116-Sheet1

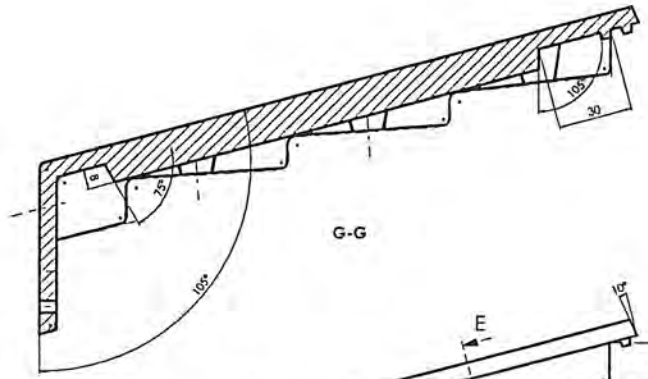
3-27 pcs - 53


8 stk. anvisere fol M6
A-A
B-B
C-C
D-D
E-E
F-F
G-G
H-H
NOTE: Anvisere max. 3mm
Mellembund 2110 USA
Morse 2100
morsø
2100-144 a
34184700
1:1
OMI-CHECKED
BY K DATE 9-10-02

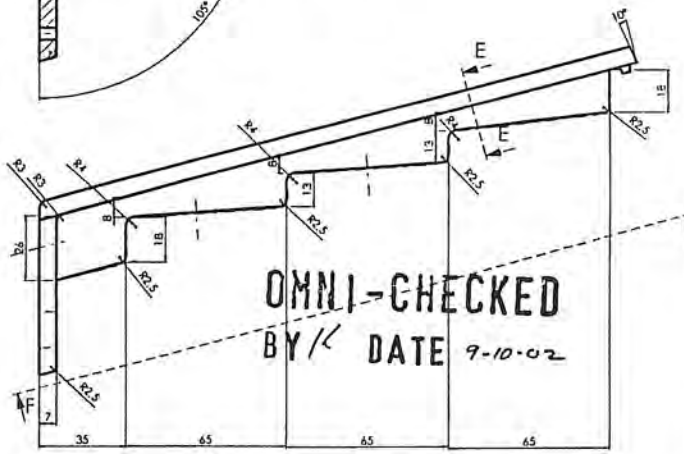


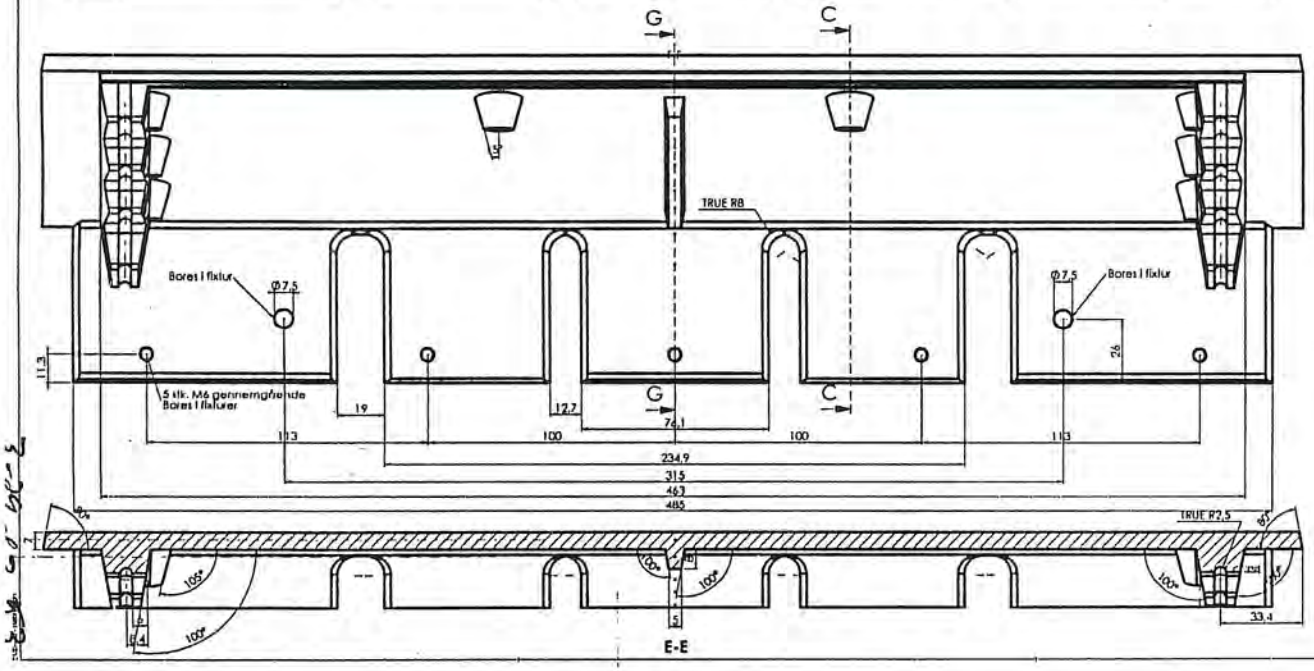


C-C



G-G



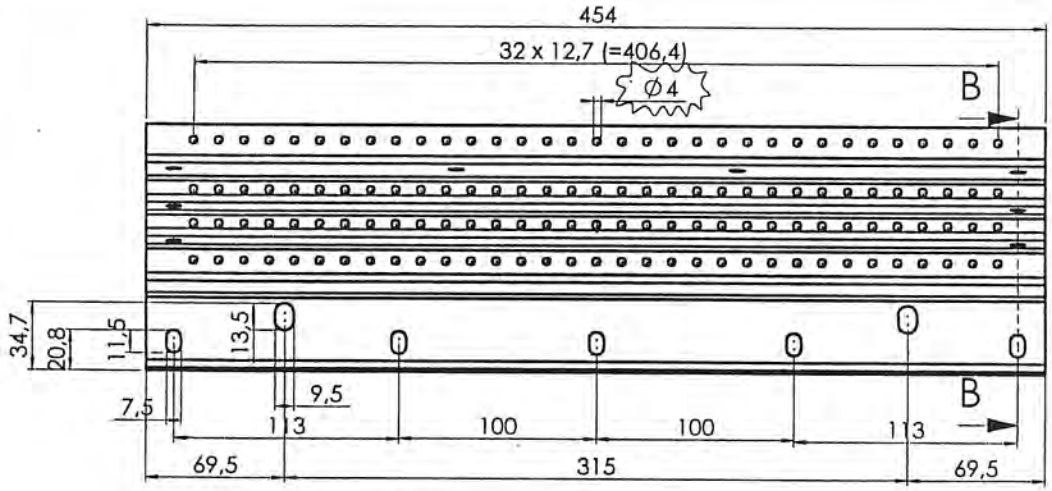


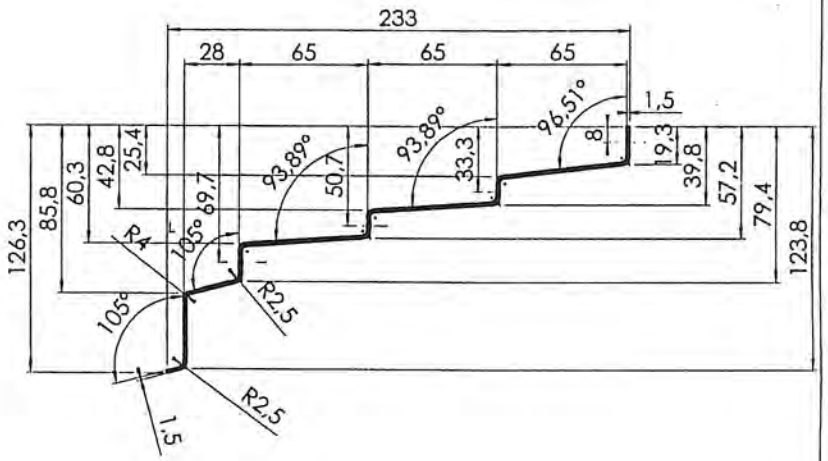
E-E

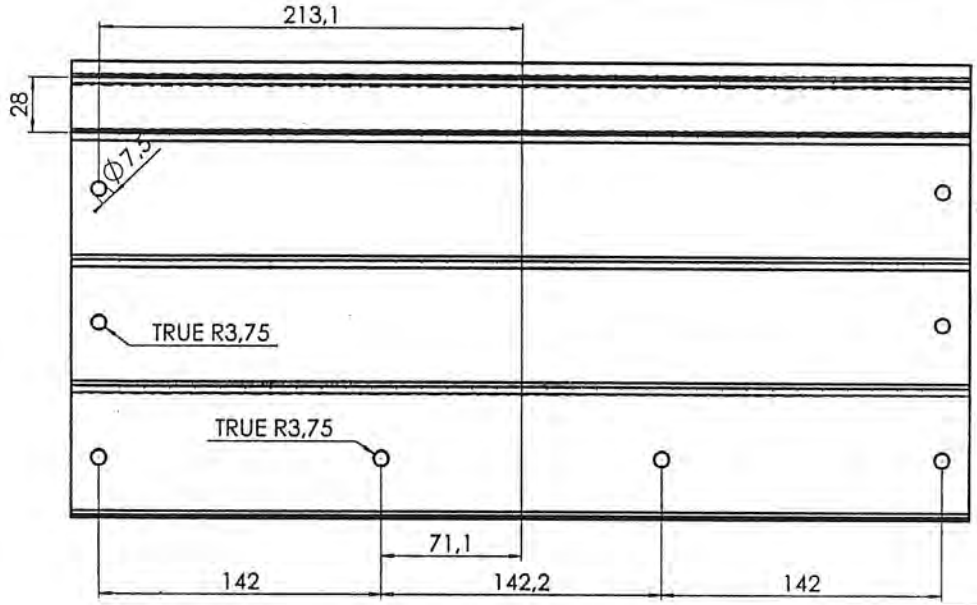
OMNI-CHECKED
BY K DATE 9-10-02

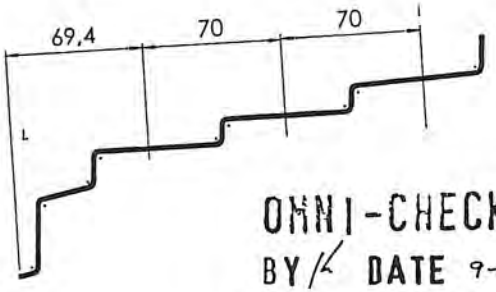
Note:
Ikke angivne radier: r=1

Regledeplade USA			
Morse 2110 USA		1:1	
morsø		34154600	
		2100-145 a	





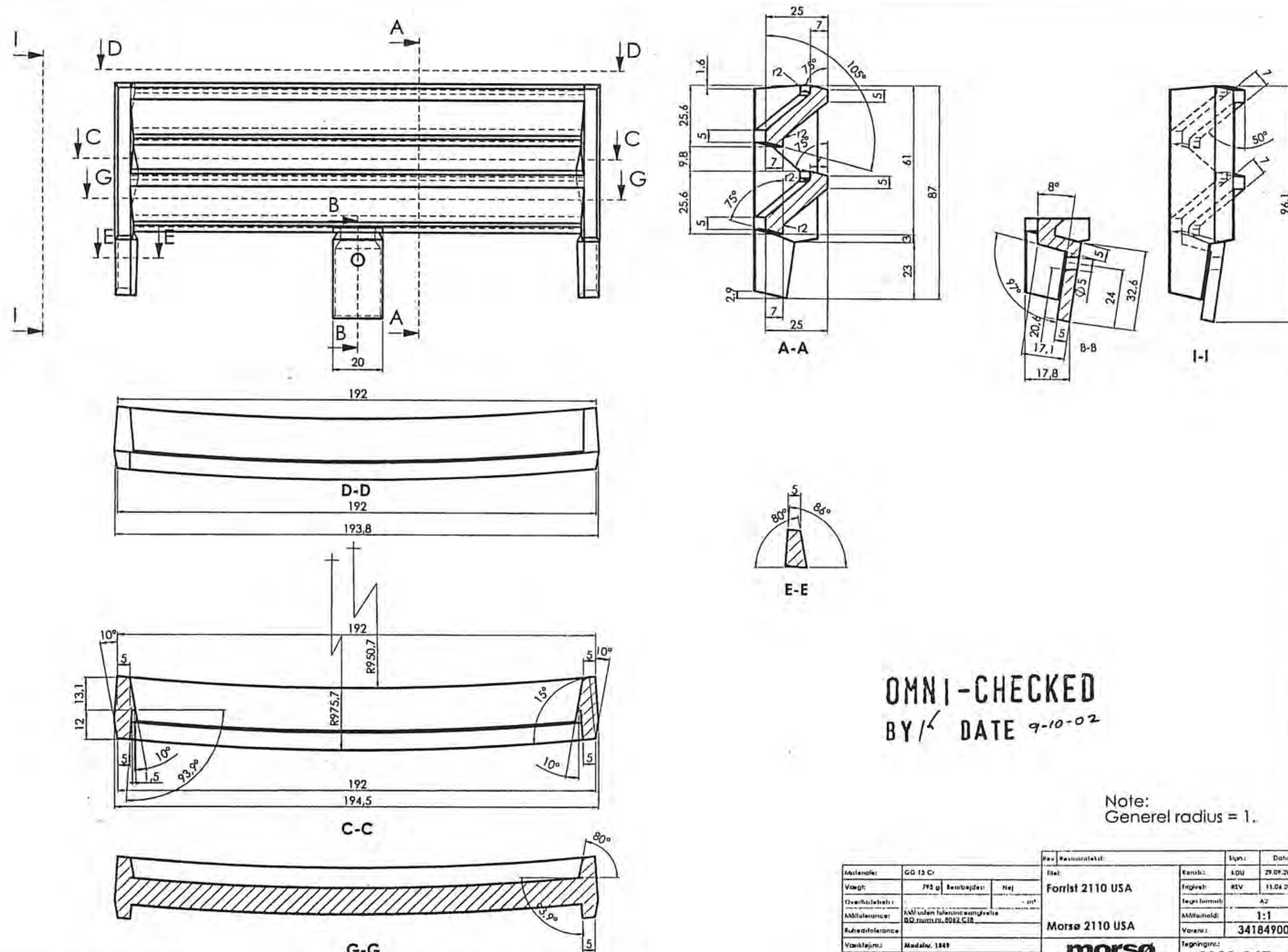




OMNI-CHECKED
BY /K DATE 9-10-01

B-B

c	Ændret huller fra ø3.2 til ø4				RSV	16.08.2002
b	Påført manglende målsætning				RSV	30.03.2001
Rev.	Revisionstekst:				Sign.:	Dato:
Materiale:	1,5 mm rustfri plade (ASIS 304)			Titel:	Konstr.:	KDU	26.09.2000
Vægt:	1,7 kg.	Bearbejdes:	Buk/bor	Rustfri røgledeplade USA	Frigivet:	RSV	07.03.2001
Overfladebeh.:	Ubehandlet		- m²		Tegn.format:	A3	
Måltolerance:	Mål uden toleranceangivelse DS/ISO 2768-1 m				Målforhold:	1:2.5	
Ruhedstolerance:				Morsø 2110 USA	Varenr.:	71181161	
Værktøjsnr.:	-			morsø	Tegningsnr.:	2100-146 c	
Tegningstype:	Emnetegning						

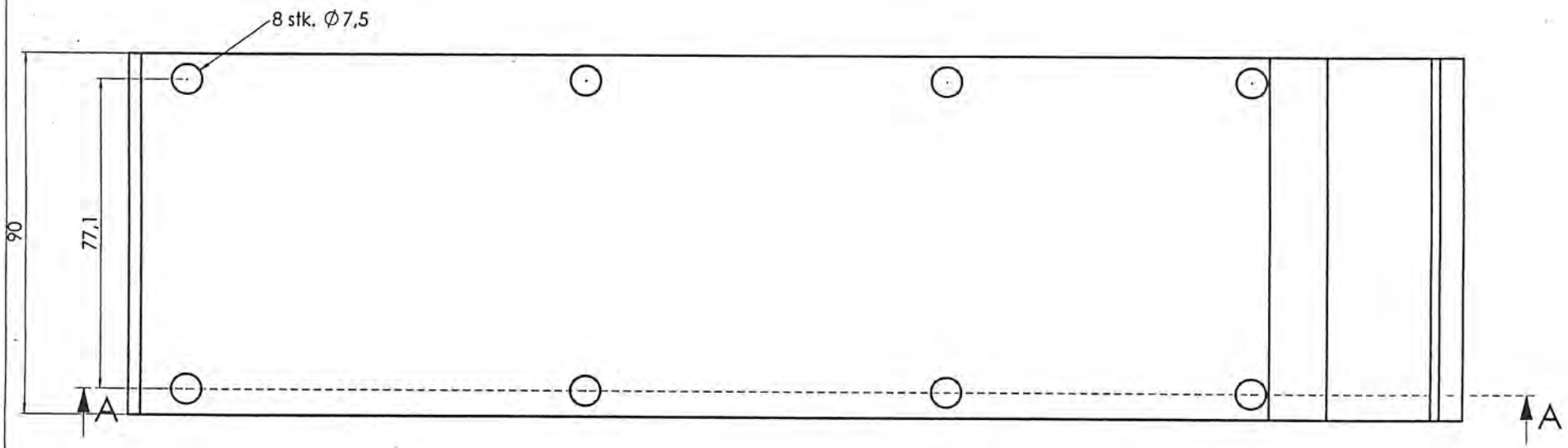


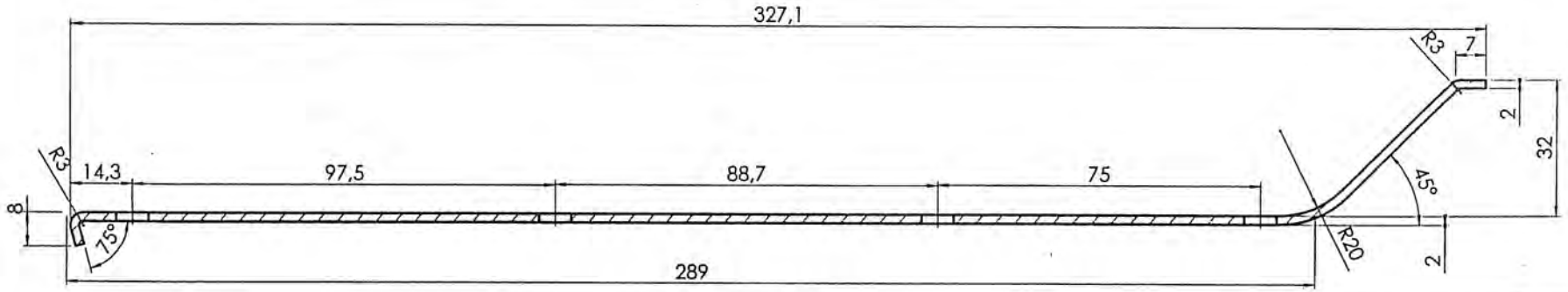
OMNI-CHECKED
BY/✓ DATE 9-10-02

Note:
Generel radius = 1.

				Rev. Revisionstekst:		Sign.:	Dato:
Materiale:	GG 15 Cr			Titel:	Konstr.:	LOU	29.09.2000
Vægt:	795 g	Bearbejdes:	Nej	Forrist 2110 USA	Frigivet:	RSV	11.06.2001
Overfladebeh.:			- m²		Tegn.format:	A2	
Måltolerancer:	Mål uden toleranceangivelse DO numr. nr. 8062 C18				Målforhold:	1:1	
Ruhedstolerance				Morsø 2110 USA	Varenr.:	34184900	
Værktøjsnr.:	Modelnr. 1849			morsø	Tegningnr.:	2100-147 a	
Tegningstype:	Støbetegning						

2-21 of 2-52





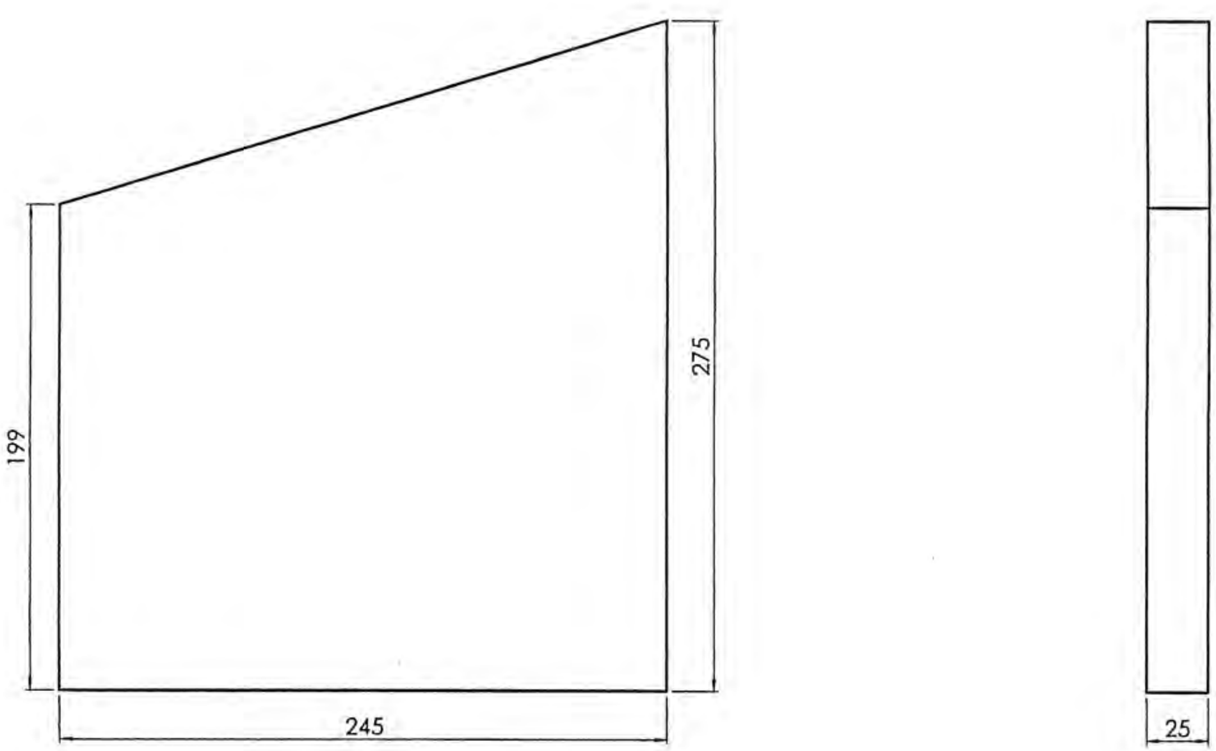
A-A

OMNI-CHECKED
BY IK DATE 9-10-02

Materiale:	2 mm rustfri plade (AISI 304)		
Vægt:	0.26 kg.	Bearbejdes:	Buk/bore
Overfladebeh.:			m²
Måltolerance:	Mål uden toleranceangivelse DS/ISO 2768-1 m		
Ruhedstolerance:			
Værktøjsnr.:			
Tegningstype:	Emnetegning		

Rev.	Revisionstekst:		Sign.:	Dato:
	Titel:	Konstr.:	RSV	13.11.2000
	Afdækningspl. f. luftkanal	Godkendt:	RSV	22.02.2001
	2110 USA	Tegn.format:	A3	
	Morsø 2100	Målforhold:	1:1	
		Varenr.:	71181261	
	morsø	Tegningsnr.:	2100-149 a	

2110 Afdækningspl. luftkanal 2mm rustfri

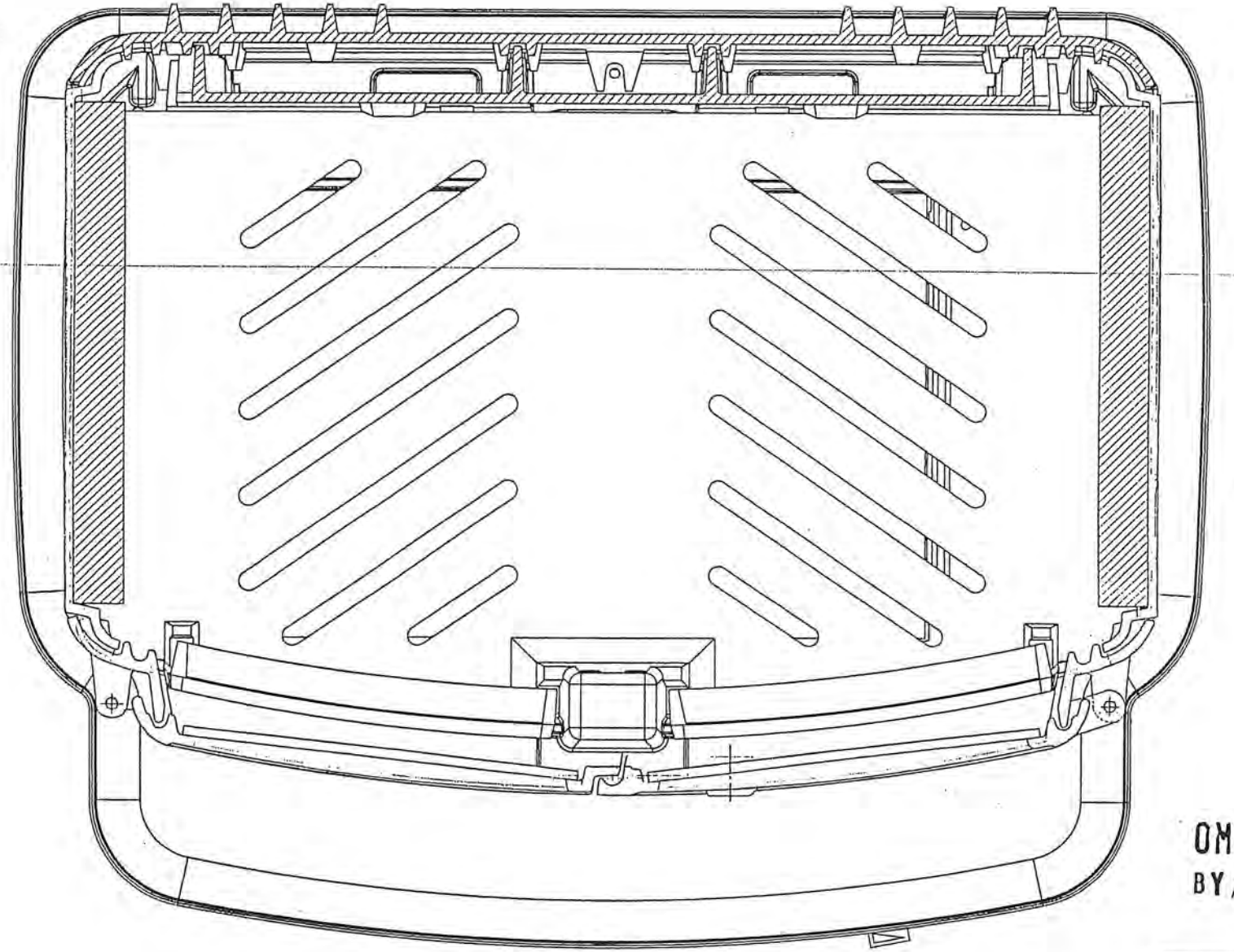


OMNI-CHECKED
BY K DATE 9-10-02

Materiale:	VIP 12			Rev.	Revisionstekst:	Sign.:	Dato:
Vægt:	- kg.	Bearbejdes:	-	Titel:	Konstr.:	RSV	09.11.2000
Overfladebeh.:	-		- m²	Sten	Frigivet:	RSV	08.03.2001
Måltolerance:	Mål uden toleranceangivelse DS/ISO 2768-1 m			2110 USA	Tegn.format:		A3
Ruhedstolerance:				Morsø 2100	Målforhold:		1:2
Værktøjsnr.:	-			morsø	Varenr.:		79094300
Tegningstype:	Emnetegning				Tegningsnr.:		2100-153 a

2100-153 sten-Sheet1

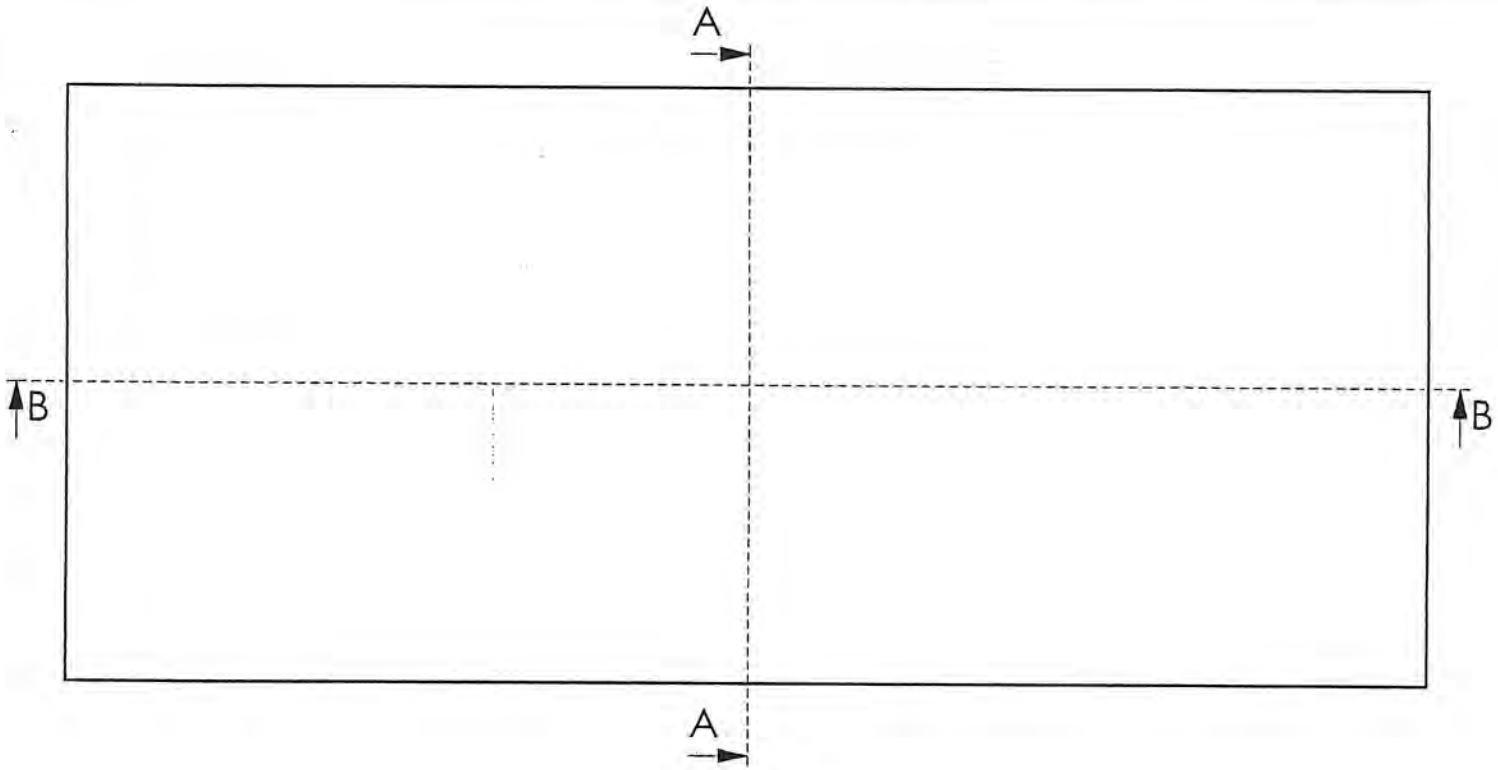
3-33 of 3-53



OMNI-CHECKED
BY K DATE 9-10-02

morsø	Snit vandret 2110 USA Morsø 2100	DATO 13 11 00	TEGN. RSV
		MÅL 1:1	RETTET UDGÅR
		TEGNINGSNR. 2100.2155.0.3/2	

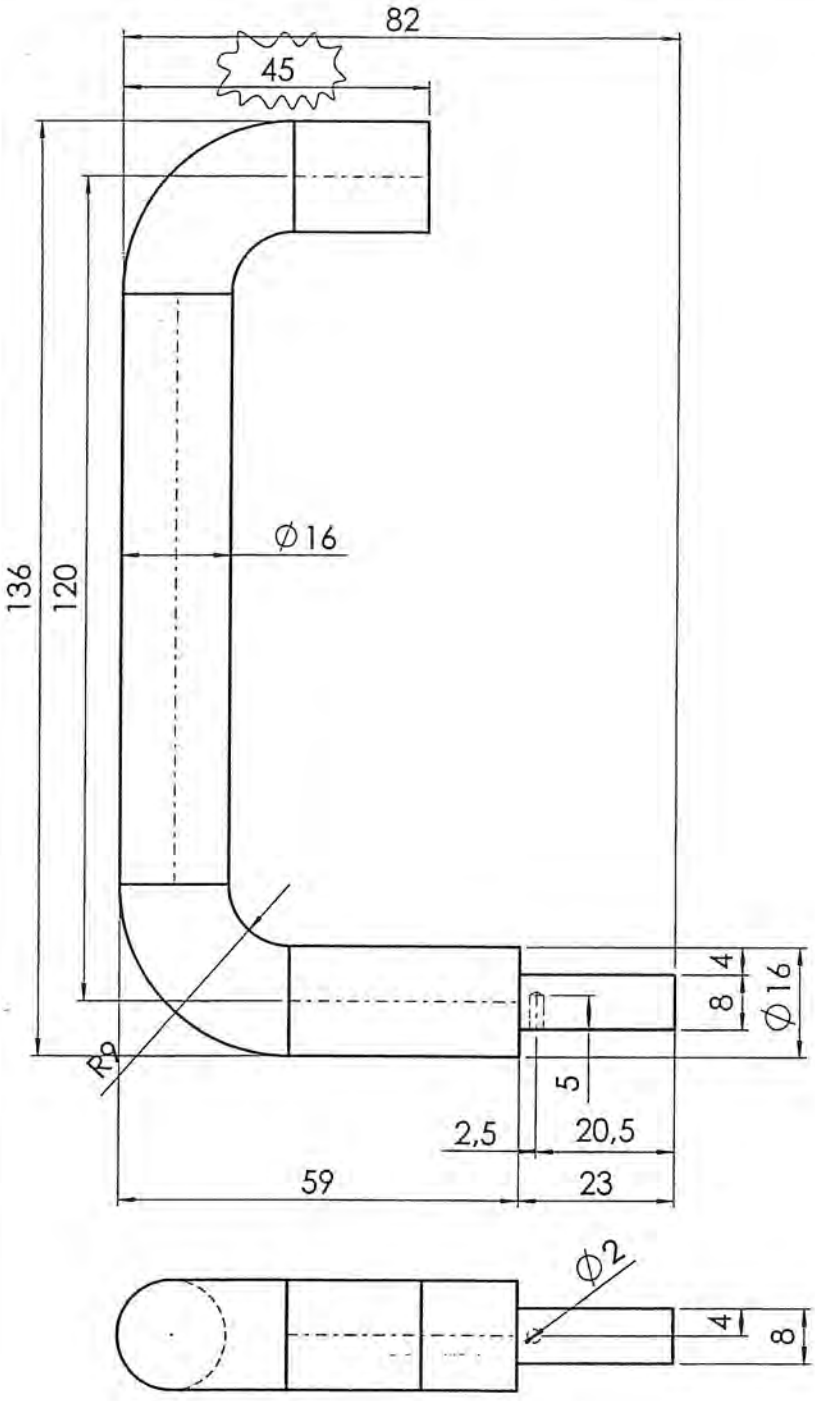
3-34 af 53



OMNI-CHECKED
BY /K DATE 9-10-02

Rev.	Revisionstekst:		Sign.:	Dato:
Materiale:	ISO glas (therm's)	Titel:	Konstr.:	RSV 13.11.2000
Vægt:	kg. Bearbejdes:	Isoleringsmåtte	Frigivet:	
Overfladebeh.:	m²	2110 USA	Tegn.format:	A3
Måltolerance:	Mål uden toleranceangivelse DS/ISO 2768-1 m	Morsø 2100	Målforhold:	1:2
Ruhedstolerance:			Varenr.:	79074700
Værktøjsnr.:		morsø	Tegningsnr.:	2100-156 a
Tegningstype:	Emnetegning			

2100-156 Isolering - Side 1 af 1



OMNI-CHECKED
BY K DATE 9-10-02

c	Ændret mål	RSV	29.05.2001
b	Ændret mål	RSV	27.02.2001
Rev.	Revisionstekst:	Sign.:	Dato:

Materiale:	Rustfast stål			Titel:	Konstr.:	RSV	22.01.2001
Vægt:	317	Bearbejdes:	Bores	Håndtag 2110 USA	Frigivet:	RSV	22.01.2001
Overfladebeh.:			m²		Tegn.format:	A4	
Måltolerance:	Mål uden toleranceangivelse DS/ISO 2768-1 m				Målforhold:	1:1	
Ruhedstolerance:				Morsø 2100	Varenr.:	75262400	
Værktøjsnr.:				morsø	Tegningsnr.:	2100-158 c	
Tegningstype:	Emnetegning						

2100-158 håndtag - Sheet1

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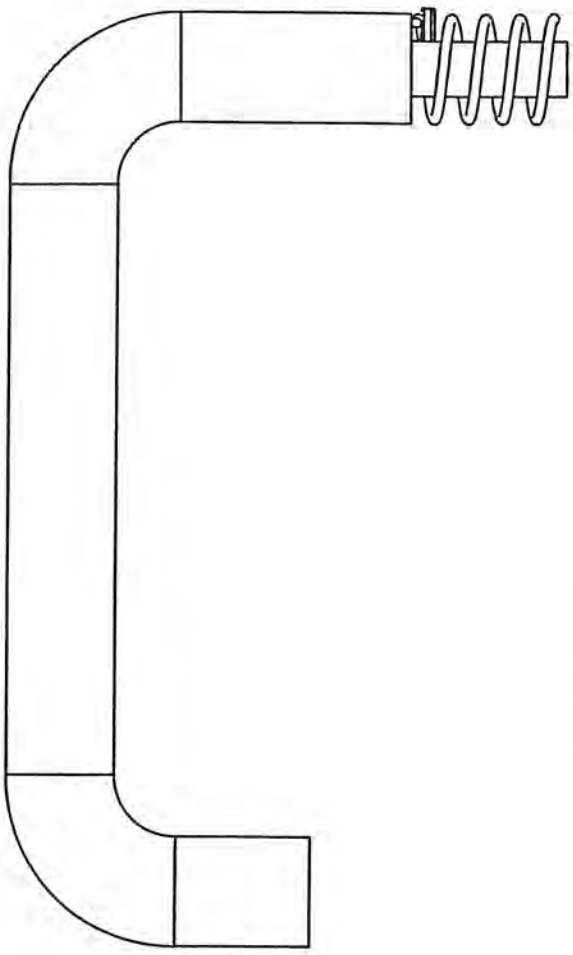
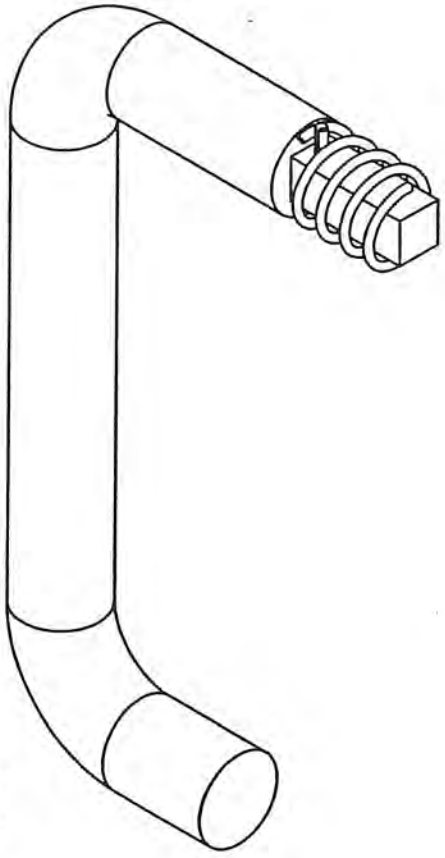


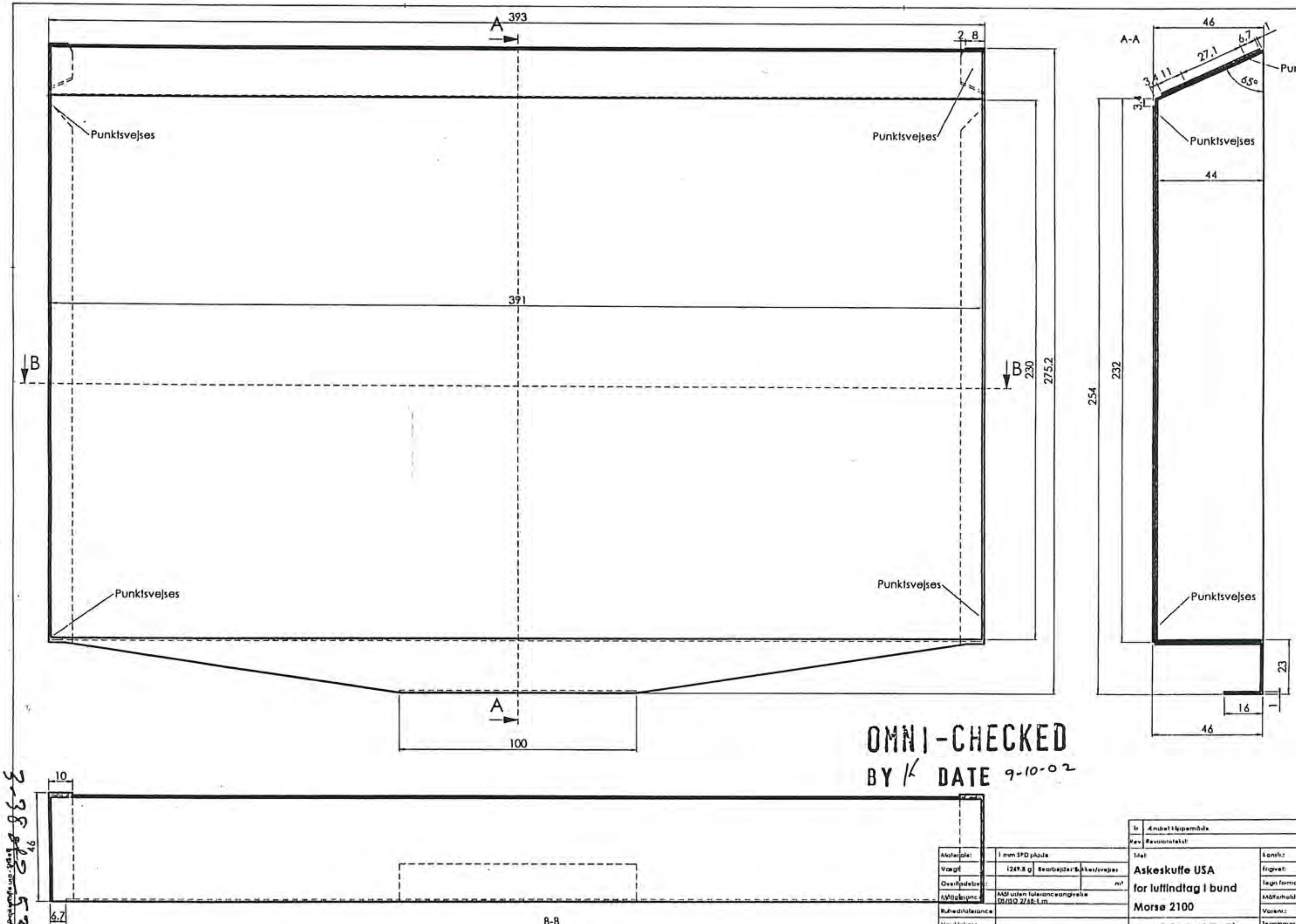


OMNI-CHECKED
BY K DATE 9-10-02

Rev.	Revisionstekst:	Sign.:	Dato:

Materiale:		Titel:	Konstr.:	RSV	26.01.2001
Vægt:	kg. Bearbejdes:	**Håndtag komplet USA**	Frigivet:		
Overfladebeh.:	m²		Tegn.format:	A4	
Måltolerance:	Mål uden toleranceangivelse		Målforhold:	1:1	
Ruhedstolerance:		**Morsø 2100**	Varenr.:		
Værktøjsnr.:		morsø	Tegningsnr.:	**2100-159 a**	
Tegningstype:	Samlingstegning				

2100-159 håndtag komplet - Sheet1



OMNI-CHECKED
BY K DATE 9-10-02

b	Ændret tippemåde	RSV	18.05.2001
Rev	Revisionstekst:	Sign.:	Dato:

Materiale:	1 mm SPD plade		Titel: Askeskuffe USA for luftindtag i bund Morsø 2100	Konstr.:	RSV 31.01.2001
Vægt:	1249.8 g	Bearbejder/bukkes/svejses		Frigivet:	RSV 08.02.2001
Overfladebeh.:		m²		Tegn format:	A2
Måltolerance:	Mål uden toleranceangivelse DS/ISO 2768-1 m			Målforhold:	1:1
Ruhedstolerance				Varenr.:	54181500
Værktøjnr.:			morsø	Tegningsnr.:	2100-160 b
Tegningstype:	Emnetegning				

Denne tegning tilhører Morsø Jernstøberi A/S og må ikke udleveres, udlånes eller kopieres uden firmaets skriftlige tilladelse

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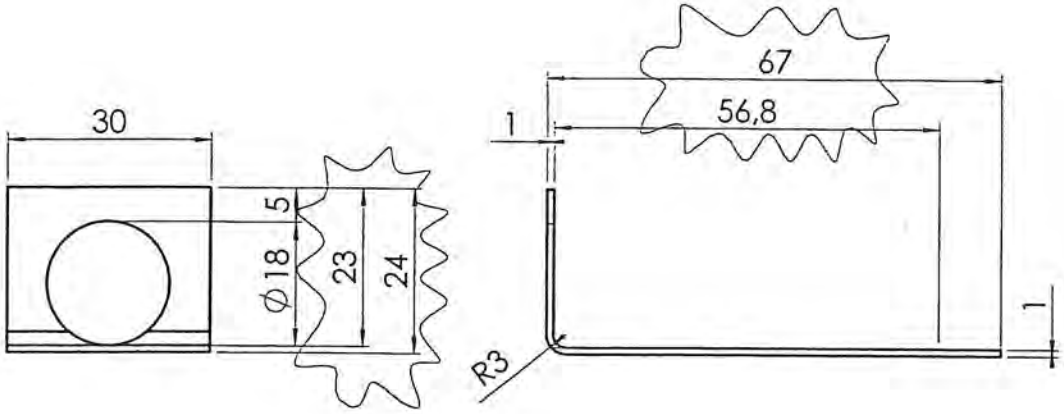
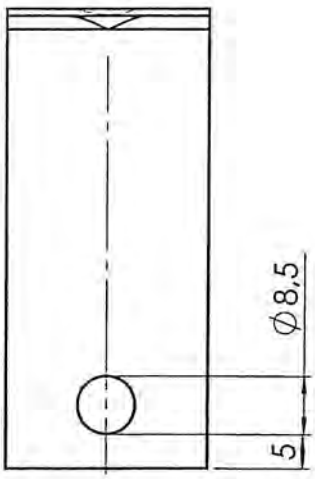
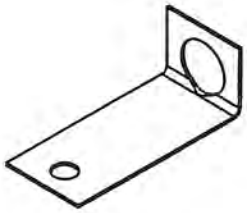






OMNI-CHECKED
BY K DATE 9-10-02

Note: Skarpe kanter brydes.

Rev.	Revisionstekst:		Sign.:	Dato:
b	Påført at skarpe kanter brydes		RSV	06.10.2000

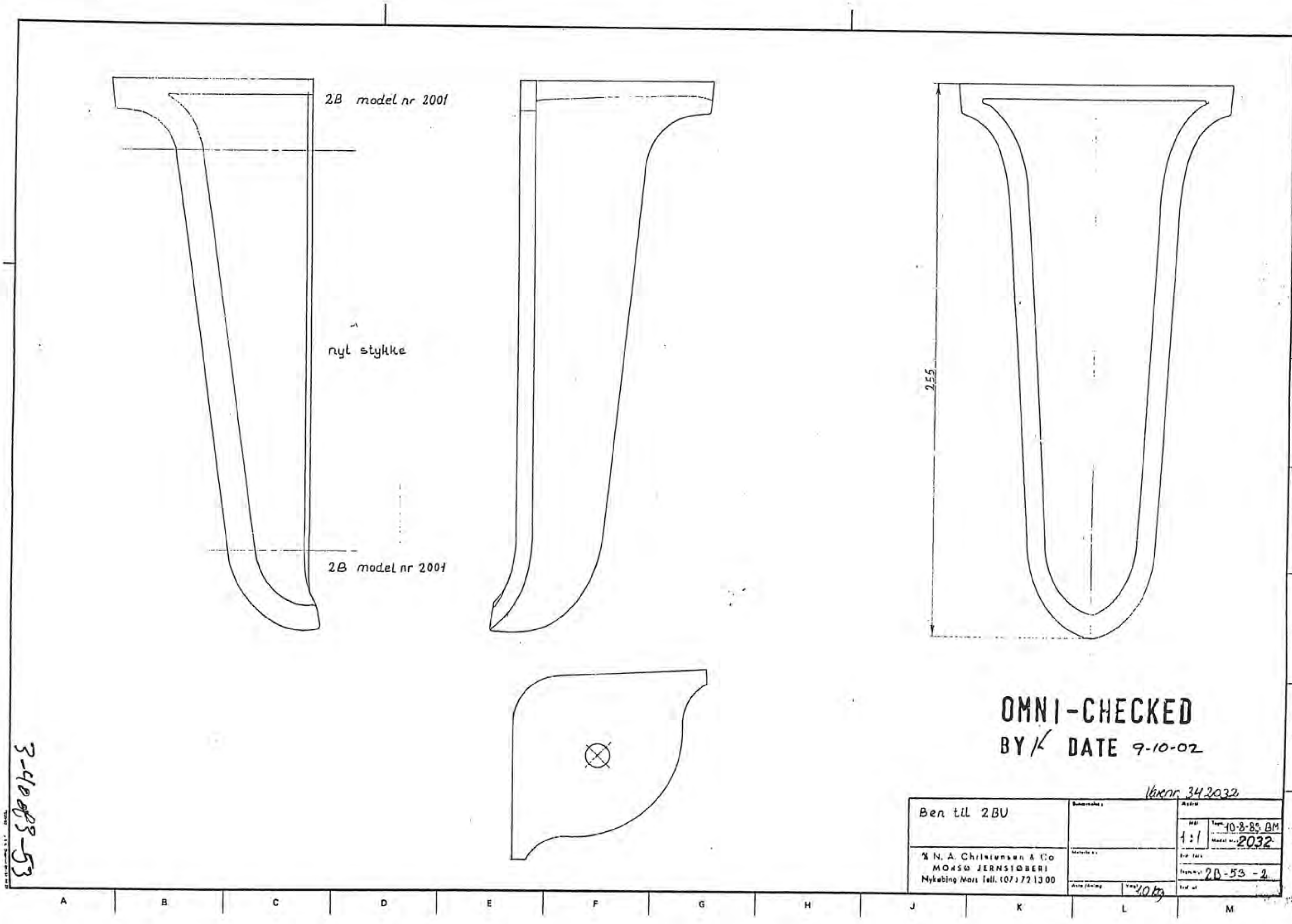
Materiale:	1 mm SPD plade			Titel:	
Vægt:	0,019 kg.	Bearbejdes:	Buk/bore	**Ophæng til greb**	
Overfladebeh.:	-		- m²		
Måltolerance:	Mål uden toleranceangivelse DS/ISO 2768-1 m				
Ruhedstolerance:				**Morsø 2100**	
Værktøjsnr.:	-				
Tegningstype:	Emnetegning				

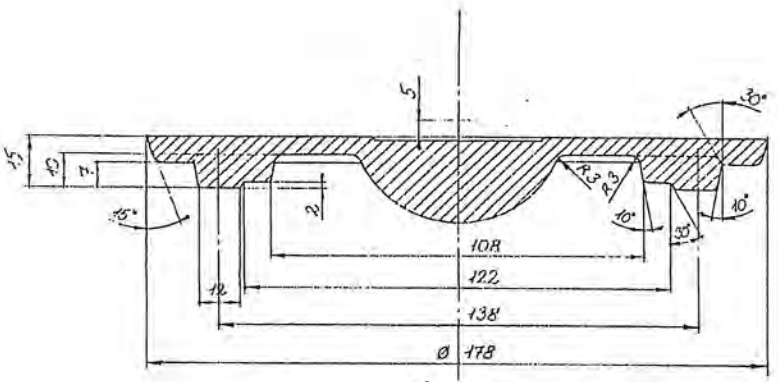
Konstr.:	RSV 07.07.2000
Frigivet:	RSV 15.03.2001
Tegn.format:	A4
Målforhold:	1:1
Varenr.:	54185800
Tegningsnr.:	2100-163 a

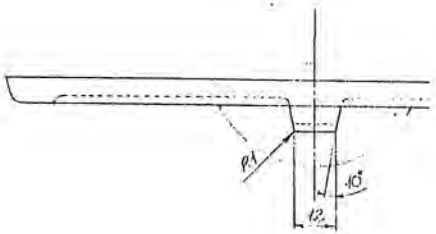
morsø

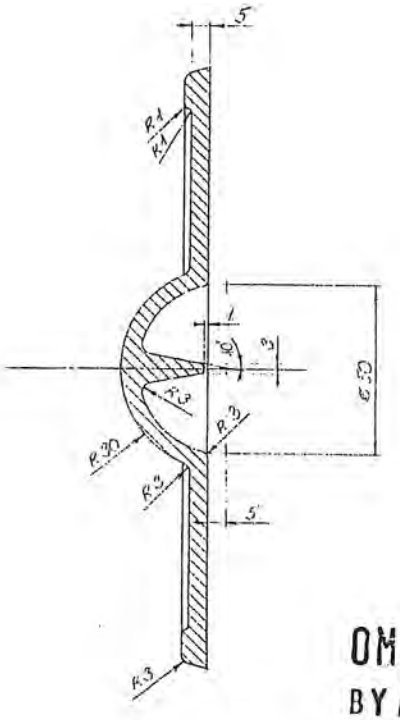
2100-163 ophæng til greb - Sheet1

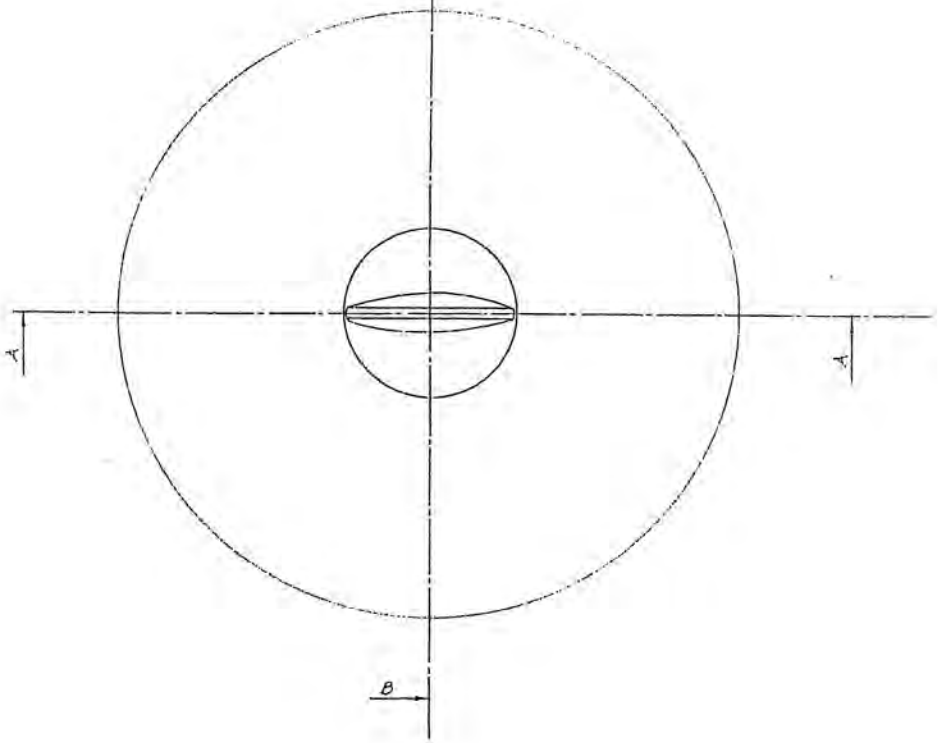
3-39 af 3-53


2B model nr 2001
nyt stykke
2B model nr 2001
255
OMNI-CHECKED
BY K DATE 9-10-02
Varenr. 342032
Ben til 2BU
N. A. Christensen & Co
MORSØ JERNSTØBERI
Nykøbing Mors Tell. (07) 72 13 00
1:1
10-8-85 BM
2032
2B-53 -2
10 kg
3-40 of 3-53







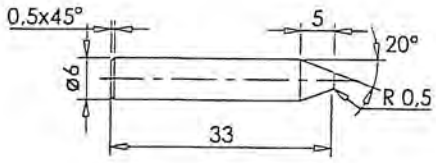
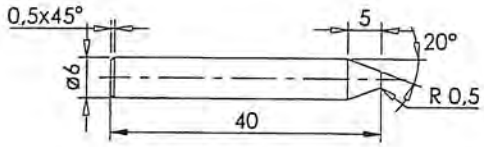
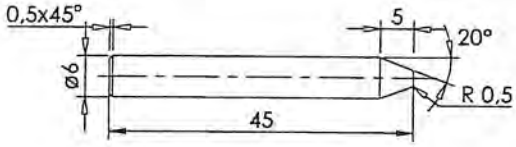


OMNI-CHECKED
BY IC DATE 9-10-02

Solidwork

LEVERANDØR TIL DET KGL. DANSKE HOF morsø AKTIESELSKABET H. A. CHRISTENSEN & CO. DK-7900 NYKØBING MORS TLF 97-722146	DATO 12. MAJ 1987	SIGN. IC	
	MÅL 1:1	ÆNDRET	
		MODELNR. 2610	
	TEGNINGSNR. 1126-16-2		

3-41 pg -53

	Anvendes til:
EDB nr. 541403  	1410
EDB nr. 542056  	1B 2B 1126
EDB nr. 541082  	1610 1710

Mart.: ø6 Rf. automatstål
EDB nr. 714005

OMNI-CHECKED
BY/ DATE 9-10-02

Titel:	Sign.:	Dato:	Revision	Sign.	Dato
Ø6 hængselstifter	N.Aa.	06.10.87			
	Tegn.form.:	Målforhold	Gamdrup TegneTeknik	HCH	April 96
	A4	1:1	Tilføjet grader	KD	20.12.96
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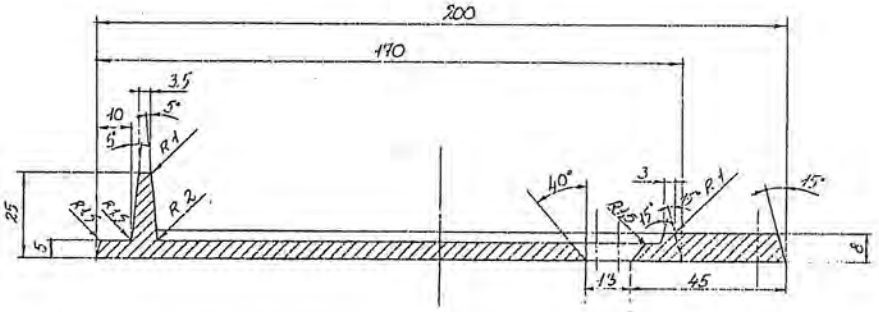
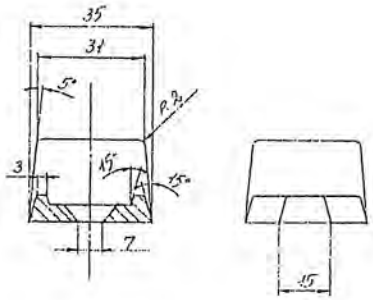
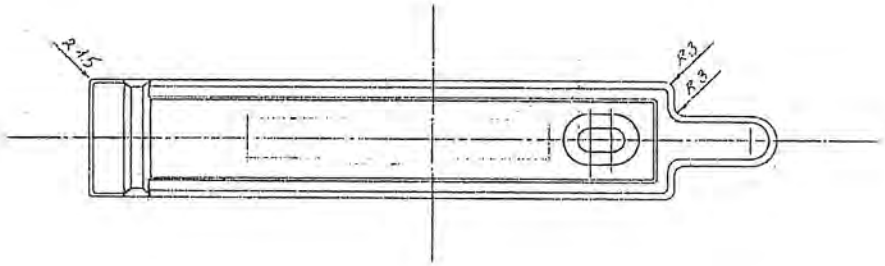
morsø	Filnavn: 1126-38				







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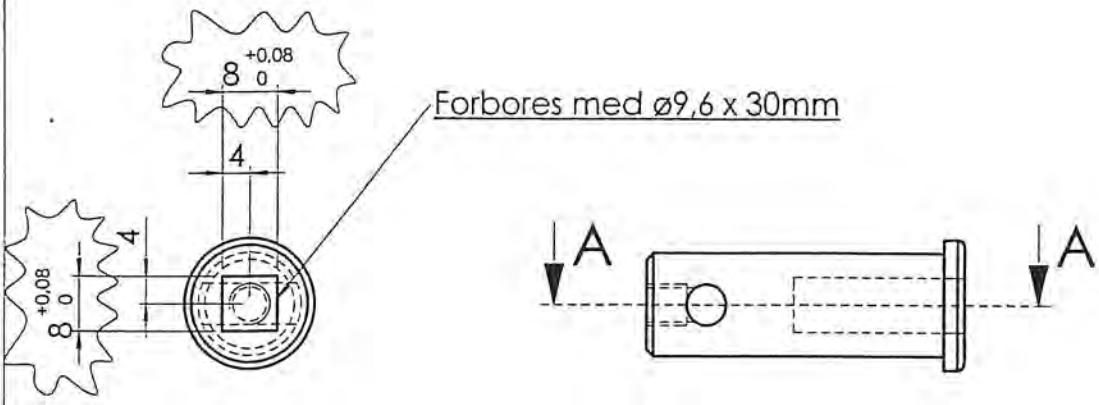
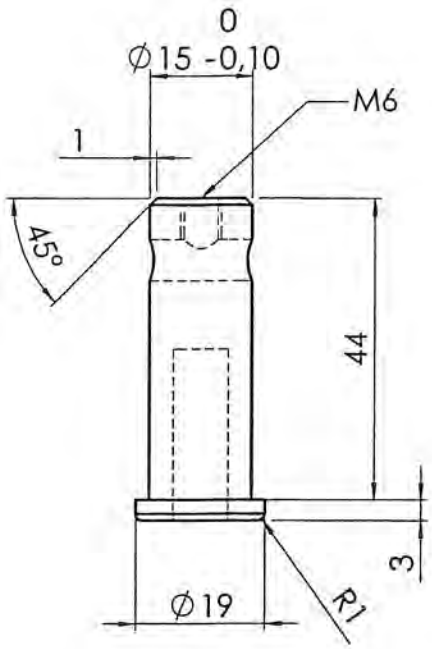
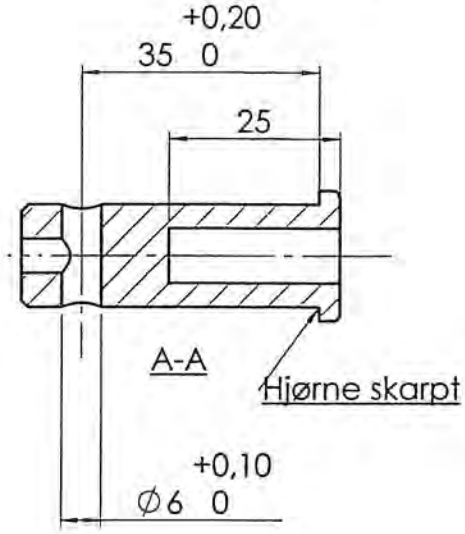
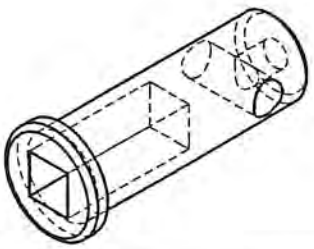
LEVERANDØR TIL DET KGL. DANSKE HOF morsø JERNSTØBERIET N.A. CHRISTENSEN & CO. DK-7900 NYKØBING MORS TLF. 97-72 12 66	MORSØ 1126 HYSTEHÅNDTAG	DATO 30 JAN 1987	SIGN K
		MÅL 1:1	ÆNDRET 7/10-02 11.421 + Rul
			MODELNR.
		TEGNINGSNR. 1126-42-2	

3-43 pt 3-53









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BY /< DATE 9-10-02

Materiale: Rustfast stål

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g	Tolerancer tilføjet	KDU	11.10.99
f	Notater tilføjet	KDU	07.09.99
e	Fjerne M4 - fiksering	KDU	07.09.99
d	Tilføje M4m - fiksering	KAA	16.09.97

Titel: Døraksel 1126

Filnavn: 1126/1126-44.drw

morsø
Jernstøberi A/S

Sign.:	Dato:
N.Aa	03.12.87
Tegn.format:	Målforhold:
A4	1:1

Varenummer: 752627

Tegningsnummer: **1126-44 h**

1400-04 Sideplade

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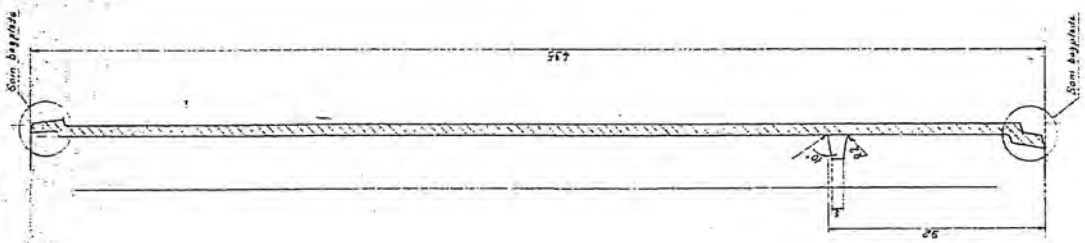
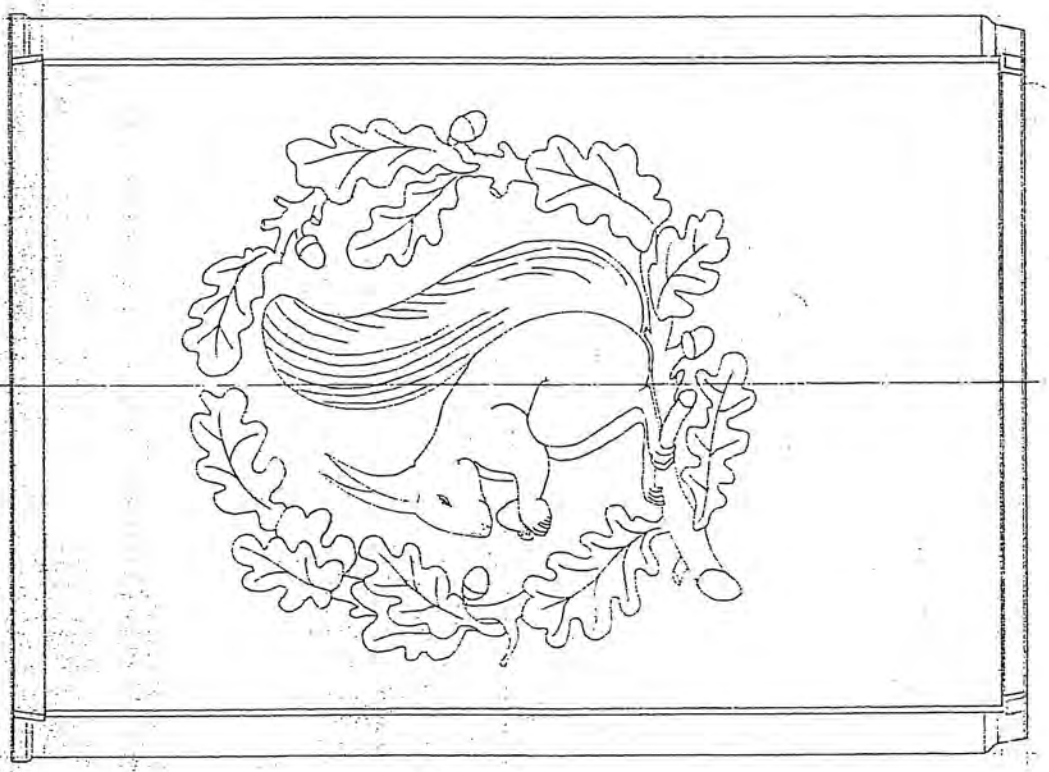
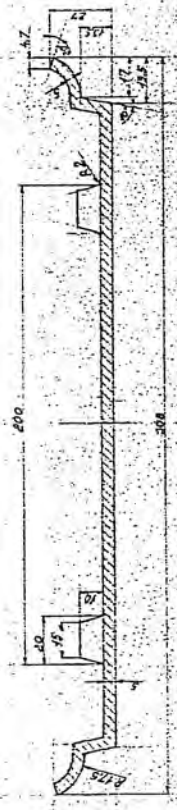
BY K DATE 9-10-02







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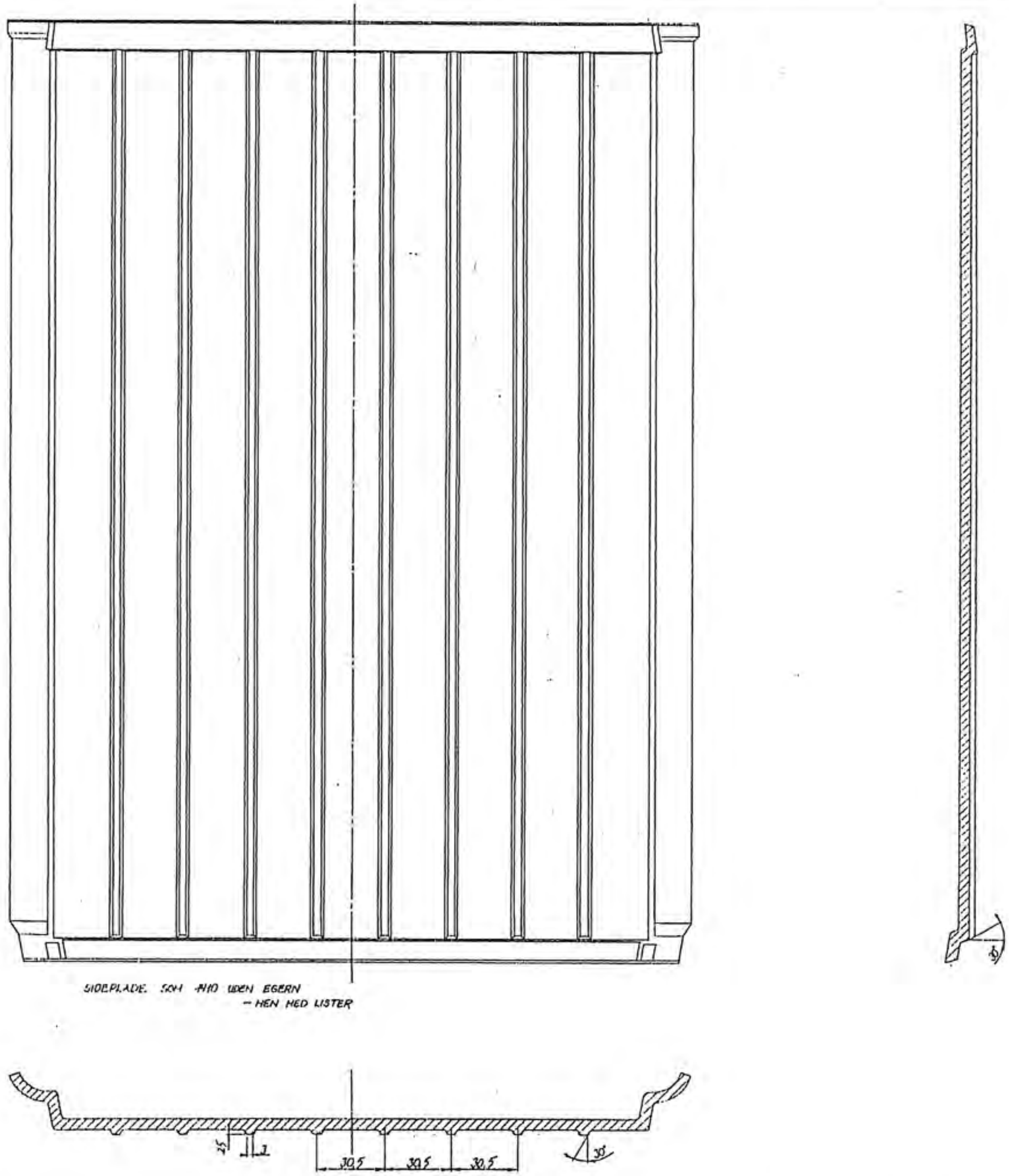

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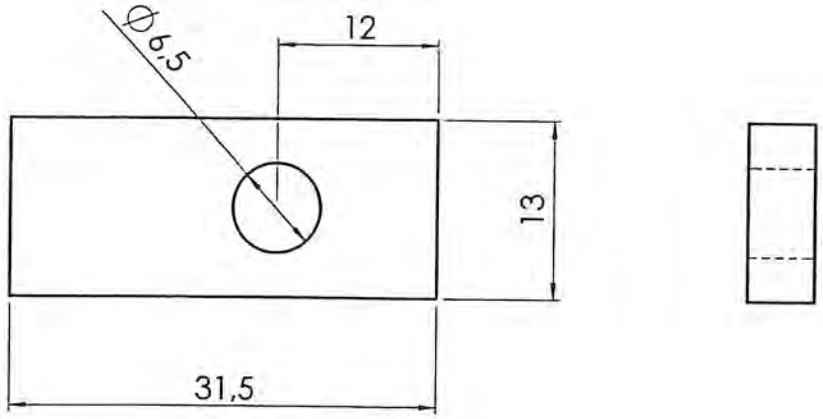
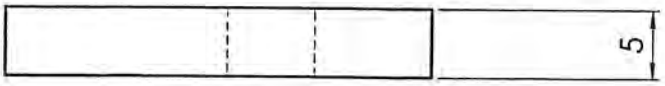
BY /k DATE 9-10-02

Vægt: 6,20 kg Varenr. 34/1129

morsø	SIDEPLADE MORSØ 1115	DATO 15 JAN. 1971	SIGN.
		1:1	MODEL NR. 1129
		TEGNINGSNR. MCO - 11 - 1	





OMNI-CHECKED
BY K DATE 9-10-02

Rev.	Revisionstekst:	Sign.:	Dato:

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Overfladebeh.:			m²	Tegn.format:	A4
Måltolerance:	Mål uden toleranceangivelse DS/ISO 2768-1 m			Målforhold:	2:1
Ruhedstolerance:				Varenr.:	44256800
Værktøjsnr.:				Tegningsnr.:	1400-199
Tegningstype:	Emnetegning				

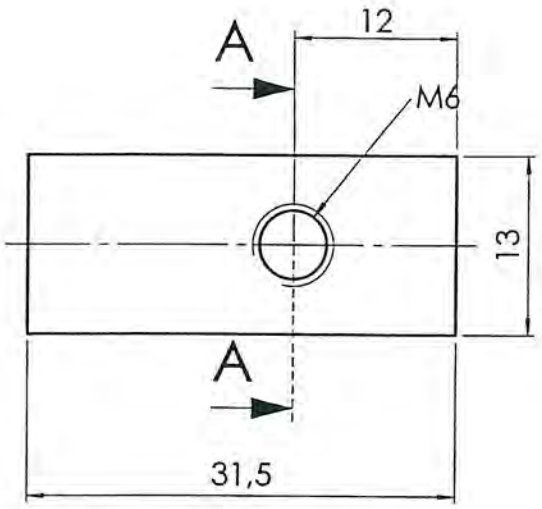
Titel: **Lus uden gevind**

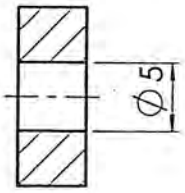
Morsø 1400

morsø

1400-199 - Sheet1

3-47 of 3-53





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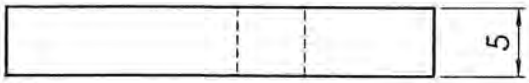

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BY IK DATE 9-10-02

Rev.	Revisionstekst:	Sign.:	Dato:

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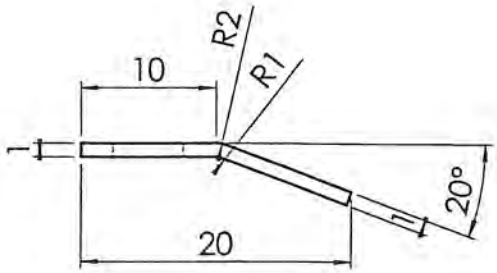
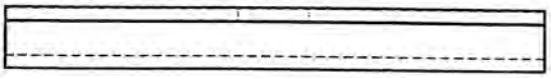
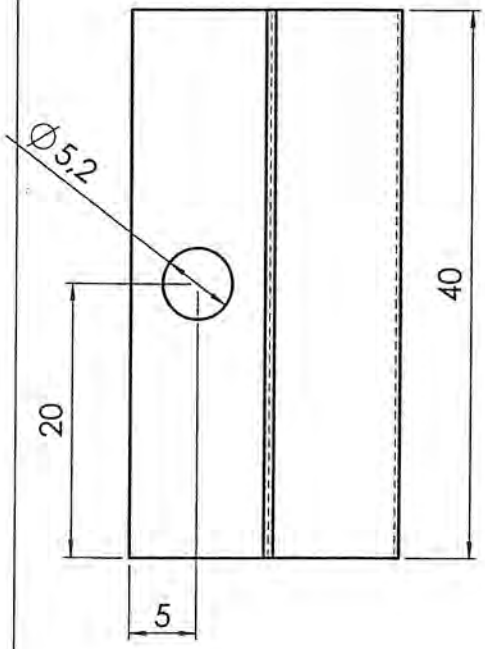
Overfladebeh.:		m²		Tegn.format:	A4
Måltolerance:	Mål uden toleranceangivelse DS/ISO 2768-1 m			Målforhold:	2:1
Ruhedstolerance:			Morsø 1400	Varenr.:	44256700
Værktøjsnr.:			morsø	Tegningsnr.:	1400-204
Tegningstype:	Emnetegning				

1400-204 - Sheet1

3-4883-53







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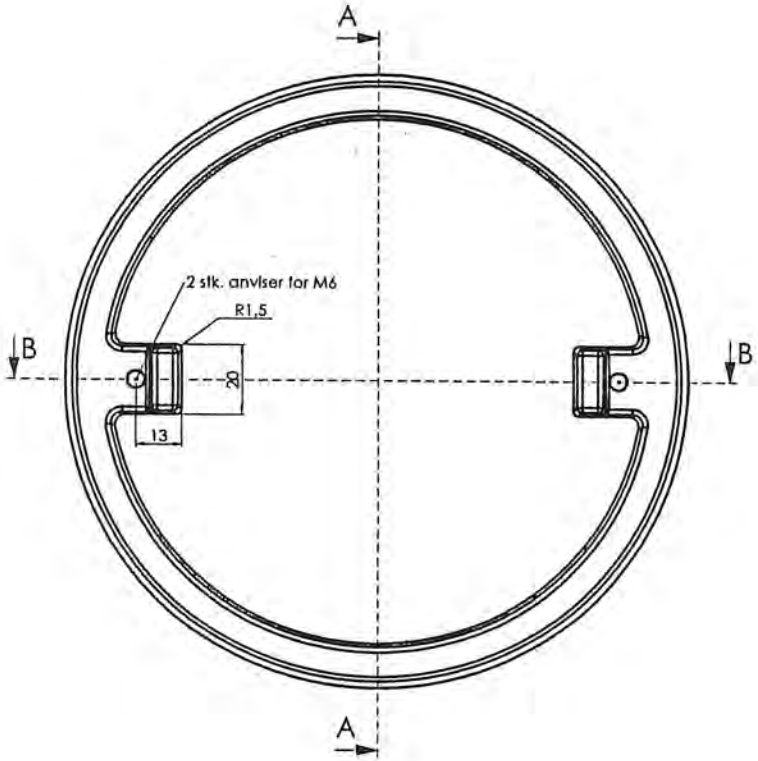
BY K DATE 9-10-02

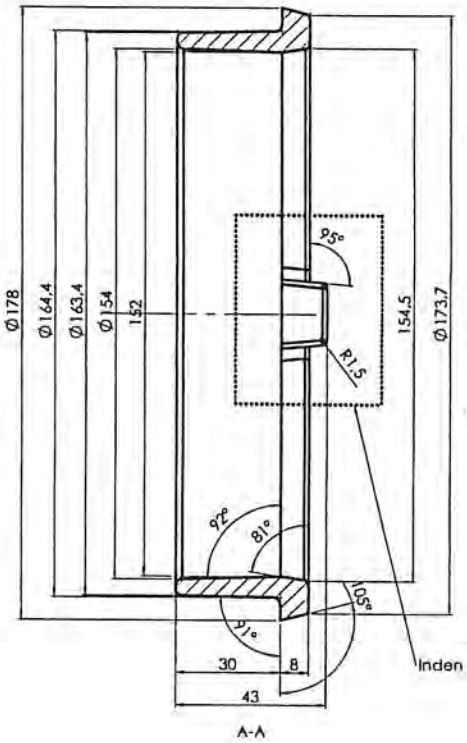
c	Ændret varenummer	RSV	14.03.2001
b	Ændret mål	RSV	06.09.2000
Rev.	Revisionstekst:	Sign.:	Dato:

Materiale:	1 mm rustfri plade		Titel:	Konstr.:	RSV 07.03.2000
Vægt:	0,006 kg.	Bearbejdes:	Glasbeslag 2	Frigivet:	RSV 30.06.2000
Overfladebeh.:		m²		Tegn.format:	A4
Måltolerance:	Mål uden toleranceangivelse DS/ISO 2768-1 m			Målforhold:	2:1
Ruhedstolerance:			Morsø 1400	Varenr.:	54146361
Værktøjsnr.:			morsø	Tegningsnr.:	1400-206 c
Tegningstype:	Emnetegning				

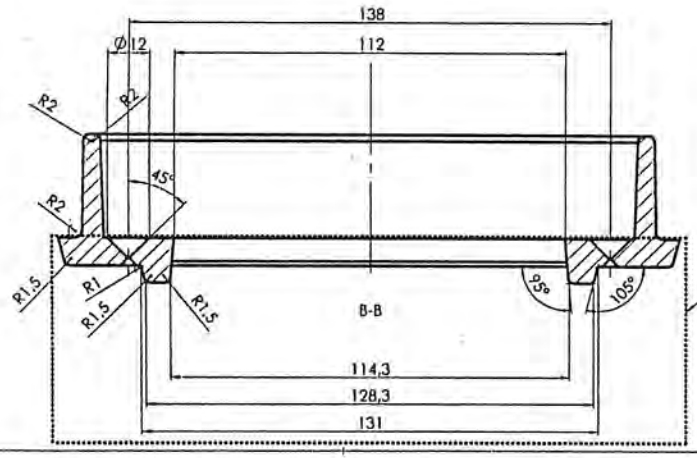
1400-206 - Sheet1

3-49 af 3-53





Inden for ramme identisk med model 2627



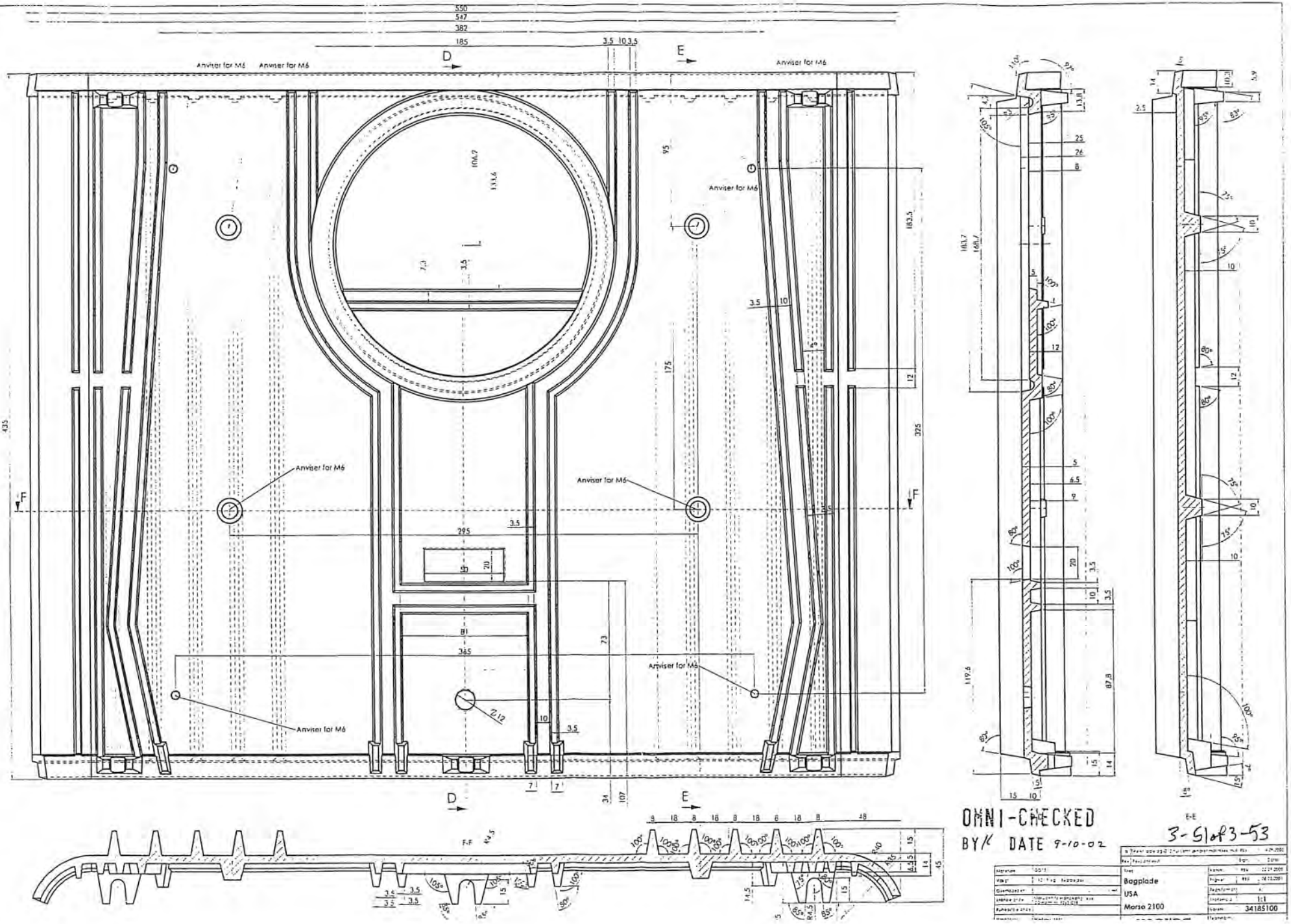
Inden for ramme identisk med model 2627

OMNI-CHECKED
BY K DATE 9-10-02

Rev	Revisionstekst:					Sign.:	Dato:
Materiale:	GG15			Tilet: Regfud USA		Konstr.:	RSV 13.12.2000
Vægt:	0,975 kg	Overfladebehandling:				Tilgivet:	RSV 21.08.2001
Overfladebehandling:			m²			Tegn.format:	A2
Måltolerancer:	ANSI uden tolerancesangivelse BD navn pr. B14.5 C18			Morsø 3400		Målforhold:	1:1
Ruhedstolerancer:						Varenr.:	34344100
Værktøjsnr.:	Modelnr.: 3441			morsø		Tegningsnr.:	3400-97 a
Tegningstype:	Stelletegning						

3400-97 regfud usa - Stel.tif

3-50 ø83-53


Anviser for M6
D
E
F
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E-E
F-F
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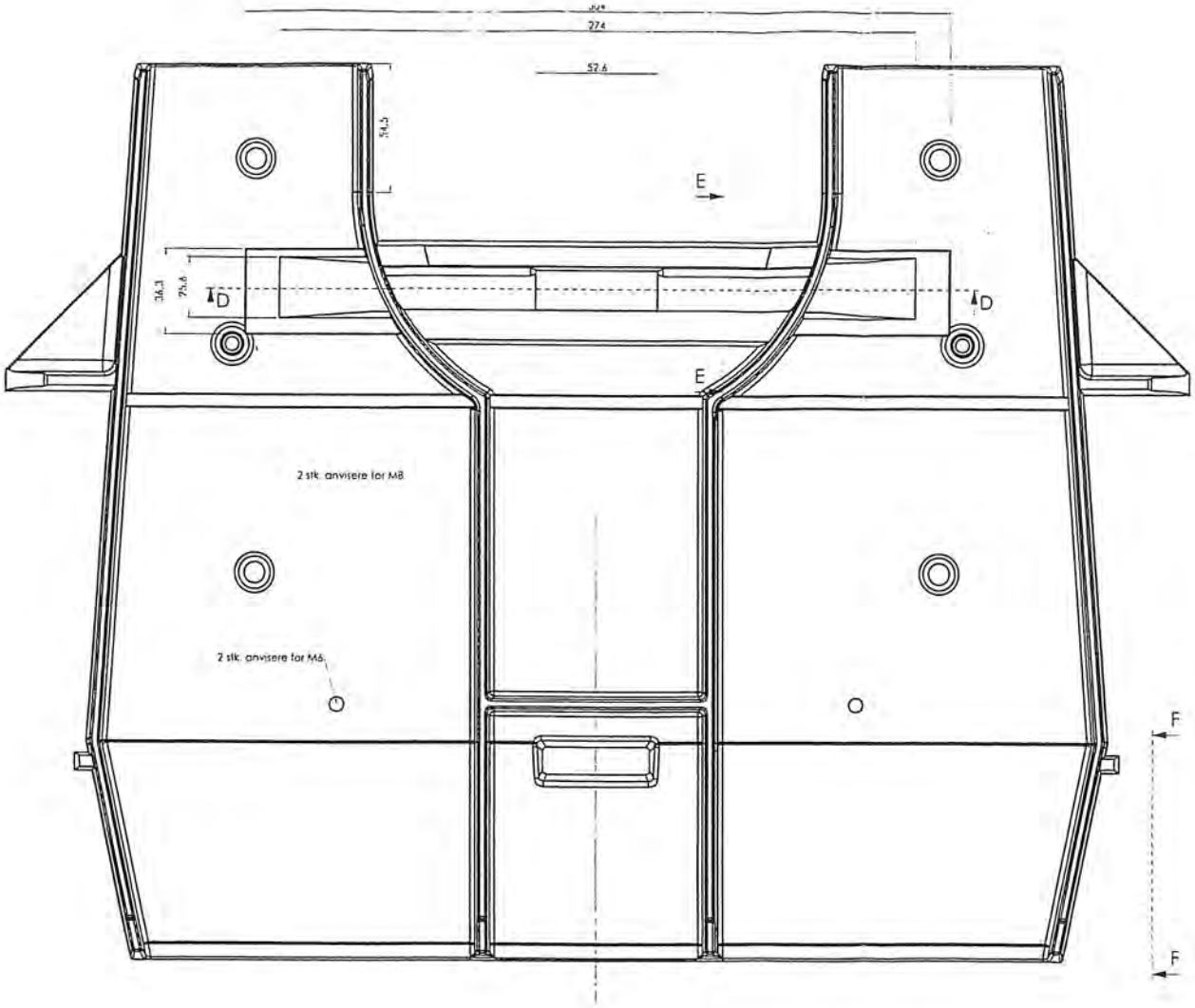
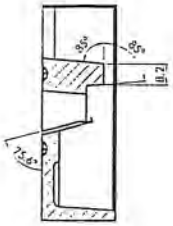
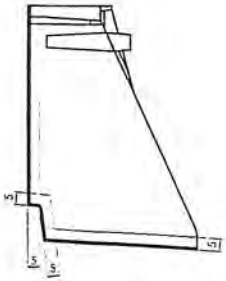
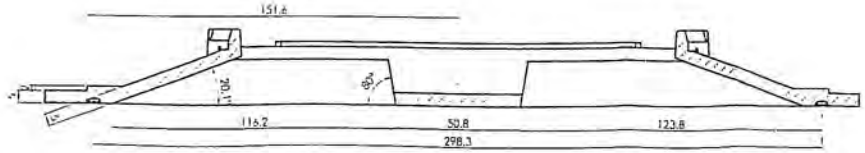
BY K DATE 9-10-02
3-51 af 3-53
Bagplade
USA
Morso 2100
34185100
1:1









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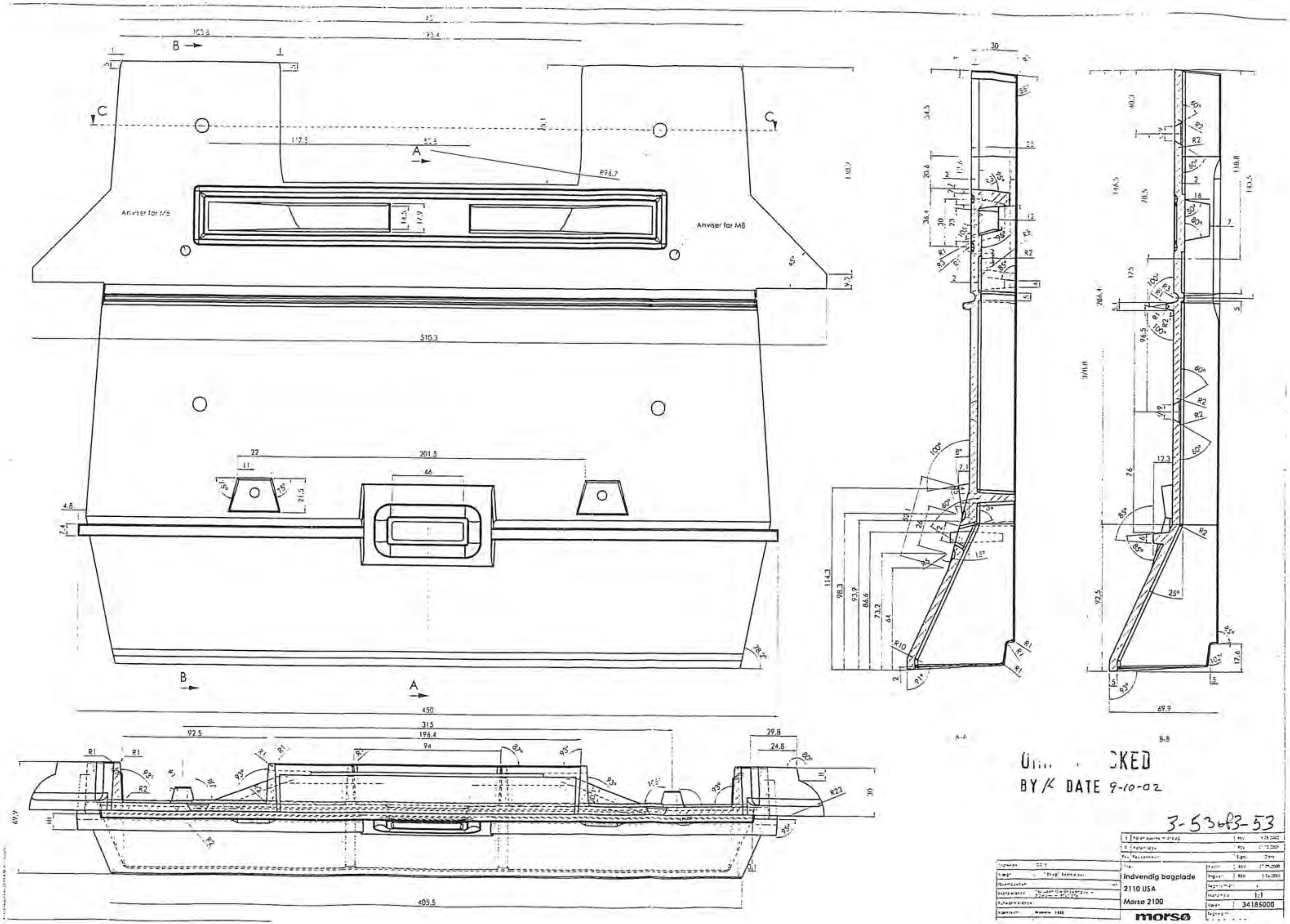
BYK DATE 9-10-02

3-5243-53

		Navn: Indvendig bagplade	Dato: 9.10.2002
		Type: 2110 USA	Tegner: BSV 9.10.2002
		Model: Morsø 2100	Målestok: 1:1
		morsø	Nummer: 34185000



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BY/K DATE 9-10-02

3-53-63-53

Indvendig bagplade
2110 USA
Morsø 2100
1:1
34185000
morsø

Model: Panther 2110 B
Morsø Jernstøberi A/S
DK-7900
Nykøbing Mors
Denmark

Section 4

Manufacturer Owner's Manual

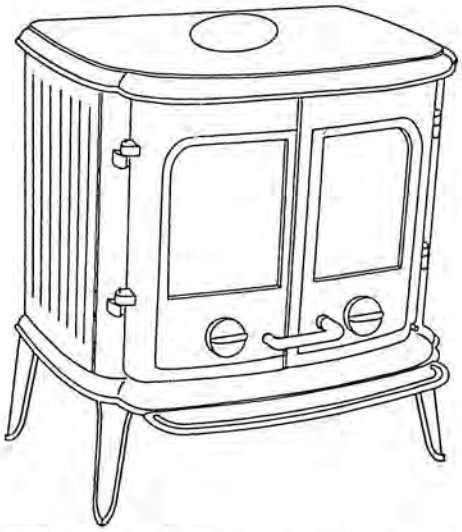
morsø

By appointment to the Royal Danish Court

Installation and Operating Instructions

2110

For use in North America



Read this entire manual before you install and use your new room heater. If this room heater is not properly installed, a house fire may result. To reduce the risk of fire, follow the installation instructions. Failure to follow instructions may result in property damage, bodily injury, or even death.

Contact local building officials about restrictions and installation inspection-equirements in your area.

Save these instructions

MORSØ JERNSTØBERI A/S . DK-7900 NYKØBING MORS
E-Mail: stoves@morsoe.com · Website: www.morsoe.com

Distributed by: HEARTHLINK INTERNATIONAL
9 Maple St. - Randolph, Vermont - 05060 - USA

4-2044-19

We congratulate you on your choice of a Morsø stove. Morsø has been producing some of the world's best stoves since 1853. If you follow this installation- and operating instruction carefully, we can assure you many years of warmth and pleasure.

Optional Accessories

A wide range of accessories (such as handling gloves, fireside tools, glass cleaner and heatproof paint) are available for use with your Morsø stove. They help with day-to-day running and maintenance. Contact your Morsø dealer for more information.

The Morsø 2110 meets the U.S. Environmental Protection Agency's emission limits for wood heaters sold on or after July 1, 1990

Warnock Hersey ®

The Morsø 2110 have been tested by Intertek Testing Services and is listed by Warnock Hersey, Inc. The test standards are ANSI/UL-1482 for the United States and ULC S627 for Canada.

The stove is listed for burning wood only. Do not burn other fuels.

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	1.2	The chimney / flue system	4
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9-484-19

1.0 Installation of your Morsø stove

Installation of woodburning stoves must be safe and legal.

If your Morsø stove is not installed correctly, it may cause a house fire. To reduce the risk of fire, the installation instructions must be followed carefully. Contact the local building officials about restrictions and installation inspection in your area.

Before you start installing your stove, make sure that:

- The stove and chimney connection are placed far enough from combustible materials to meet all clearance requirements.
- The floor protection must be adequate and must be made correctly according to the requirements.

All neccessary approvals are needed from the local building officials.

The data plate, which is located on the back of the stove, provides information regarding safety testing information, name of certified testing laboratory, and installation requirements.

Installation requirements vary in different districts, and the local building officials have the final authorization to approve your installation. You should discuss the installation with them before beginning. Please ask your dealer for further information.

Do not connect to any air distribution duct or system.

Important: If the installation instructions are not followed carefully, it may cause dangerous situations like chimney - and house fires. Follow the instructions carefully and do not deviate from them as it may cause injuries to people or property.

1.1 Checking loose parts in the stove

After unpacking, check that the fire bricks are firmly in position and have not shifted in transit. Check also that the air control works freely.

Standard Accessories

Poker, ceramic flue connection gasket and ash can tools are standard accessories, and can usually be found in the ashpan or firebox area.

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1.2 The chimney / flue system

Note that the flue system must be independently secured and must not rely on the stove for support.

The stove must not be connected to a chimney flue serving any other appliance. (Several flues may run up a single chimney stack; use one flueway per appliance).

Use a residential type masonry or listed type HT factory-built chimney.

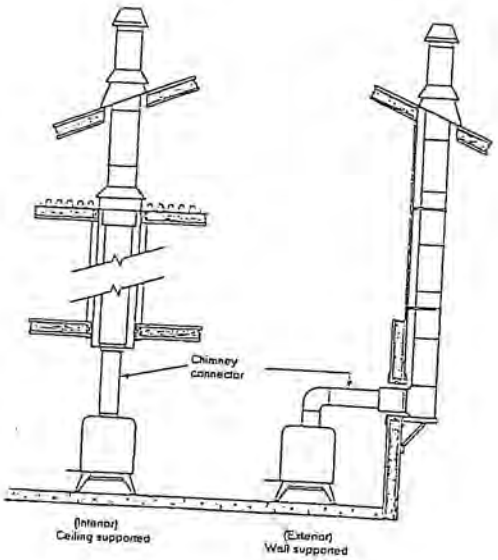
High Temperature (H.T.) Chimney Standard UL-103-1985 (2100° F.) for the USA, and High Temperature (650°C) Standard ULC S-629 for Canada.

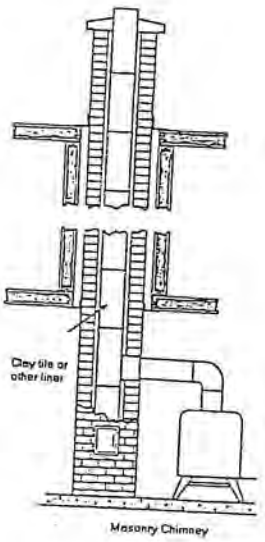
The internal dimensions of the chimney connector and chimney must not be less than 6 inches diameter (or equivalent cross section), and should not be significantly larger than this. Too large a section will tend to allow the flue gases to cool excessively, causing sluggishness or unpredictability in the stove's performance.

We recommend the length of the chimney system should be at least 16 feet (not required) above the stove in normal domestic situations, measured from the flue collar to the top of the chimney.

Local conditions like for example - roof constructions, large trees nearby and high altitude, may influence the chimney draft and height. Therefore, contact the local professional chimney sweep or your Morsø dealer.

Typical Factory-Built or Masonry Chimney Installations





4-6 of 4-19

1.3 Flue Connection

The stove is supplied from the factory with a flue collar fitted to the top plate and a round blanking plate blocking off the rear flue exit (behind the rear shield plate).

Use a 24 MSG black or blue chimney connector or listed double wall chimney connector. Refer to local codes and the chimney manufacturer's instructions for precautions required for passing a chimney through a combustible wall or ceiling. Remember to secure the chimney connector with a minimum of three screws to the product and to each adjoining section.
The collar can be fitted to the rear outlet. Simply knock out the round panel on the rear heat shield plate to reveal the cast iron plate. Untwist the blanking plate and the flue collar and swap their positions. Re-secure by pushing down and tighten the enclosed screws.
Position the stove and connect to the flue system.

Wear gloves and protective eyewear when drilling, cutting or joining sections of chimney connector

1.4 Connection to the existing chimney

A chimney connector is the double-wall or single-wall pipe that connects the stove to the chimney. The chimney itself is the masonry or prefabricated structure that encloses the flue. Chimney connectors are used only to connect the stove to the chimney.

Double-wall connectors must be tested and listed for use with solid-fuel burning appliances. Single-wall connectors should be made of 24 gauge or heavier gauge steel. Do not use galvanized connector; it cannot withstand the high-temperatures that smoke and exhaust gases can reach, and may release toxic furnes under high heat. The connector must be 6 inches (150mm) in diameter.

If possible, do not pass the chimney connector through a combustible wall or ceiling. If passage through a combustible wall is unavoidable, refer to the sections on Wall Pass- Throughs. Do not pass the connector through an attic, a closet or similar concealed space when installing the chimney connectors.

It is important to keep the flue gases moving smoothly in the right direction. Do not vent into a large void at this location; rather form one continuous section all the way up. Use mild bends (e.g. 45° vs. 90°) rather than sharp angles where a change of direction is required. All parts of the venting must be accessible for cleaning purposes.
In horizontal runs of chimney, maintain a distance of 18 inches from the ceiling. Keep it as short and direct as possible, with no more than two 90 degree turns. Slope horizontal runs of connector upward 1/4 per foot (20 mm per metre) going from the stove toward the chimney. The recommended maximum length of a horizontal run is 3 feet (1 metre), and the total length should be no longer than 8 feet (2.5 metres).
Information on assembling and installing connectors is provided by the manufacturer's instructions exactly as you assemble the connector and attach it to the stove and chimney.

Be sure the installed stove and chimney connector are correct distances from near by combustible materials. See the clearance paragraph page 8.

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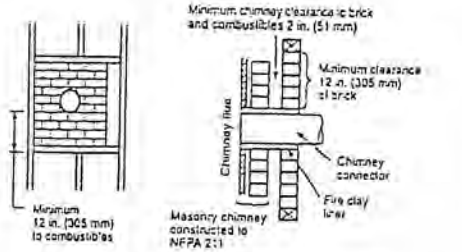
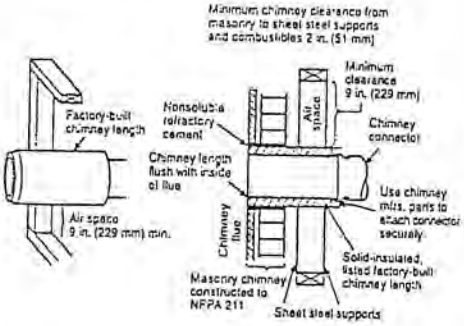
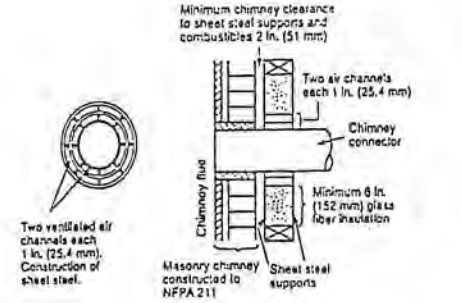


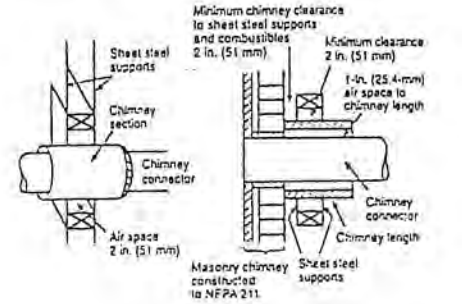
A Minimum 3.5-in thick brick masonry all framed into combustible wall with a minimum of 12-in brick separation from clay liner to combustibles. The fireclay liner shall run from outer surface of brick wall to, but not beyond, the inner surface of chimney flue liner and shall be firmly cemented in place.



B Solid-insulated, listed factory-built chimney length of the same inside diameter as the chimney connector and having 1-in. or more of insulation with a minimum 9-in. air space between the outer wall of the chimney length and combustibles.



C Sheet steel chimney connector, minimum 24 gauge in thickness, with a ventilated thimble, minimum 24 gauge in thickness, having two 1-in. air channels, separated from combustibles by a minimum of 6-in. of glass fiber insulation. Opening shall be covered, and thimble supported with a sheet steel support, minimum 24 gauge in thickness.



D Solid insulated, listed factory-built chimney length with an inside diameter 2-in. larger than the chimney connector and having 1-in. or more of insulation, serving as a pass-through for a single wall sheet steel chimney connector of minimum 24 gauge thickness, with a minimum 2-in. air space between the outer wall of chimney section and combustibles. Minimum length of chimney section shall be 12-in. chimney section spaced 1-in. away from connector using sheet steel support plates on both ends of chimney section. Opening shall be covered, and chimney section supported on both sides with sheet steel supports securely fastened to wall surfaces of minimum 24 gauge thickness. Fasteners used to secure chimney section shall not penetrate chimney flue liner.

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1.5 Positioning the stove

Distance to walls and lintel

When the stove is positioned near *combustible* materials, observe all current local and national building regulations with regards to clearances. Whatever regulations apply to your area, do not in any case install the stove within 8 inches of combustible materials around the sides or 16 inches above the top of the stove (fireplace installations require greater clearances above the stove - see below in the clearance chart). These distances may need to be increased if the materials are sensitive to heat. Note also that wall paper and other decorative materials may become detached with the effects of heat and care should be taken to ensure that they do not fall towards the stove in such an event.

When the stove is positioned near *non-combustible* materials, a gap of 4 inches or more is recommended for cleaning purposes and to ensure that heat circulates around the stove and out into the room.

Appliance Clearances

Chimney connector clearances	Unprotected Surfaces			Protected Surfaces (NFPA-211)		
	Parallel		Corner	Parallel		Corner
	Side	Rear		Side	Rear	
Single wall connector	22-in 560-mm	20-in 510-mm	16-in 405-mm	12-in 305-mm	12-in 305-mm	12-in 305-mm
Double wall connector	20-in 510-mm	16-in 405-mm	14-in 355-mm	12-in 305-mm	12-in 305-mm	12-in 305-mm

Fireplace Hearth Installation					
	In	Mm		In	Mm
Unit to top trim	27	685	Unit to side trim	18	460
Unit to mantle	31	790	Unit to sidewall	19	485

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Flooring requirements

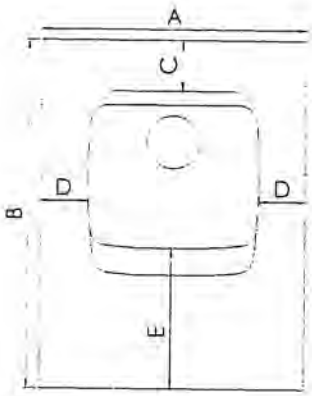
Non-combustible floor protection must be placed beneath the unit. The floor protection must extend as follows.

U.S. installations: 16-in beyond the front and 8-in beond each side of the fuel and ash doors.

Canadian installations: 450-mm beond the front and 200-mm beond each side and rear of the appliance.

The floor protection in front of the unit must have an insulative R-value of 1.0 (English units).

You must ensure that the floor in this area can hold the weight of the stove comfortably.



	U.S.	Canada
A.	40"	40" (1015 mm)
B.	41"	43" (1090 mm)
C.	8"	8" (200 mm)
D.	8"	8" (200 mm)
E.	16"	18" (450 mm)

If using rear exit the floor protection must extend beneath the chimney connector and 2-in beyond each side.

Distance to furniture

The recommended minimum distance from stove to furniture is 30 inches. Note that some furniture is more easily affected by heat and may need to be moved to a greater distance. This is your responsibility.

In addition other combustible materials, away from the stove. In general, a distance of 30 inches must be maintained between the stove and moveable combustible item such as drying clothes, newspapers, firewood etc.

Note:

Acid Protection

If acid-washing the masonry around the stove, protect the stove surface with an acid-proof cover

Fresh Air Inlet

Unless there is deemed to be sufficient ambient leakage of air into the room via doorways, windows and the like, a dedicated fresh air inlet will be needed. This inlet should have 2 square inches (1250 square mm) of free air space. This is particularly importent where the room is well sealed, or where an extractor hood or ventilation system disturbs the natural air pressure. Such an inlet should not be on a wall that is usually subject to negative pressure from normal wind pattern. Avoid placing the inlet directly across the room from the stove, thus causing a cold air draft.

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2.0 Operation

2.1 Before you start firing

For Use with Solid Wood Fuel Only. Do Not Overfire, If Heater or Chimney Connector Glows You Are Overfiring. Inspect and Clean Chimney Frequently. Under Certain Conditions of use creosote buildup may occur rapidly. Because of risk of smoke and flame spillage, operate only with door fully closed.
Caution:
Hot while in operation. Keep children, clothing and furniture away. Contact may cause skin burns.
Do not use chemicals or fluids to start the fire.
Do not burn garbage or flammable fluids.
Do not use gasoline, gasoline-type lantern fuel, kerosene, charcoal lighter or fluid or similar liquids to start or freshen up a fire in this heater. Keep all such liquids away from the heater while it is in use.

Choosing your fuel

All types of natural wood can be burned on your stove, but they must be well-seasoned and dry. Once the wood is cut to length, it should be split down middle - to suit the dimensions given below - to allow moisture to evaporate.
Cut the wood to a length of 18 inches (45 cm) and approx. 3 to 3.5 inches (7-8 cm) in section. If you can weigh your wood, aim for around 1.0 kg. The maximum moisture content of the wood should be around 20%.
Store the logs under cover in a location where fresh air can move through the stack. Some soft woods may take as little as one good summer to season whereas harder woods such as oak, maple, and elm may require seasoning up to 18 months. Avoid overly dry wood that is gray in color as it can cause performance problems, such as backpuffing and sluggishness, under certain conditions. Well seasoned wood will be remarkably light to hold and will probably have radial cracking at the ends. If your wood spits or sizzles when burnt, and your stove's door glass persistently mists up, your wood is not properly seasoned. Never use drift wood (from the sea), whose salt content may cause corrosion, nor construction wood that may have been impregnated with chemicals.

Starting the First Fire

The initial fire should be small, so that the stove paint can cure and the main plates of the stove can settle into position. Some fumes will be given off by the paint. Ventilate the room during this phase.
The setting of the air control, lighting techniques and loading intervals will depend on chimney draft, the fuel used, the heat required and so on. Some basic techniques are outlined below.

In principle

Your stove is fitted wih Primary and Secondary air inlets.
Primary Air is controlled using the lever situated under the ash lip of the stove. Moving the control lever into a downward position will open the air inlet and will allow a supply of preheated air to enter the firebox via the 'airwash' system situated inside the stove and the above glass.

Secondary Air is right to the firebox using the specially designed baffle at the back of the firebox. The secondary air is injected into the flue gases both above and in front of the fire resulting in a cleaner, more efficient combustion process. The supply of secondary air is fixed open and is not adjustable.
For extra safety, your stove has been fitted with a removable handle. When not in use the handle can be stored using the lug behind the right leg of the stove.

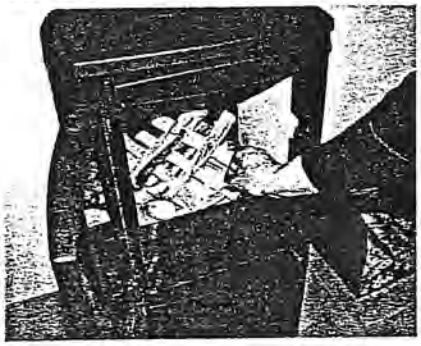
2.2 Lighting and loading intervals

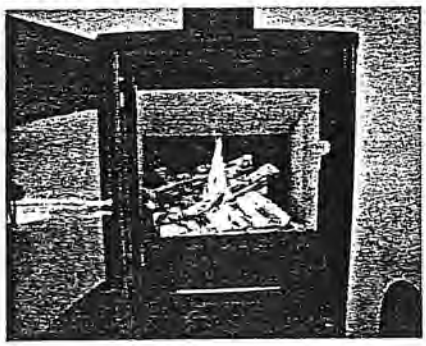
When first lighting the stove, a large volume of air is needed. When the stove is cold, you should leave the door open an inch or two for the first few minutes and open the primary air supply completely. While the door is open, do not leave the stove unattended.

To form a reasonable bed of ash on the floor of the stove, you should use 5-6 inches thickness (2-4 pound) of dry kindling at the initial lighting. Always maintain a 1-1.5 inch (2-3 cm) layer of ash on the floor of the combustion chamber at all other times.

Step-by-step procedure

1. The air supply must be fully open.
2. Light the fire. An ember bed will quickly be formed by lighting with firelighters, morso kindling bags or 7-10 pieces of twisted paper under the dry kindling wood (see above).
3. After lighting, partially close the doors, leaving them open an inch or two to allow in plenty of combustion air.
4. When the chimney is warmed through after 5-10 minutes, the doors should be closed. A suitable ember bed will be formed after a further 15-20 minutes.
5. When ready to reload, use a poker to spread the ember across the firebox floor, bringing plenty towards the front of the stove.
6. Lay three pieces of wood (see dimensions above) onto the embers. Leave half an inch (1 cm) or more between each piece. When using 10 inches (25 cm) logs, place the ends of your logs towards the opening, but not too close to the front.





7. Close the door. Leave the primary air supply fully open.
8. After a few minutes, and adjust the primary air supply to suit your heating requirements.
9. Anticipate each refueling, remembering to add a modest layer of wood while there are still plenty of live embers, Repeat steps 5-8.

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Do not for any reason attempt to increase the firing of your heater by altering the air control adjustment range outlined in these directions.

Warning: Fireplace stoves must never be left unattended with doors open.

If doors are left partly open, gas and flame may be drawn out of the fireplace stove opening, creating risks from both fire and smoke. We recommend you to fit a smoke detector in the room where the stove is installed.

DO NOT OVERFIRE THIS HEATER. Overfiring may cause a house fire, or can result in permanent damage to the stove. If any part of the stove glows, you are overfiring.

Draft conditions

If smoke or fumes come out of your stove when lightning up and reloading, or if the fire simply will not respond, a poor draft is almost certainly to blame. (In a very few cases, there may be insufficient fresh air getting into the room - see installation advice above). Take advice from your stove supplier on how best to upgrade your flue system to improve draft.

Rules of woodburning

If you want less heat, put fewer logs on the stove and reduce the amount of air. It is still important to maintain a good layer of embers.

Less heat - less wood - less air

Greater heat - more wood - more air

Soot deposits will settle on the glass if the stove is run too slowly or if your wood is not well seasoned.

3.0 MAINTENANCE

When perfoming maintenance on your stove, always protect yourself, using safety goggles or gloves

3.1 Exterior Maintenance

The stove surface is painted with heat-resistant Senotherm paint. It is best kept clean by vacuuming with a soft brush attachment or by wiping with a lint-free cloth.

Over a period of time, the painted surface may become slightly grey. A can of Morsø touch-up spray paint should be available from your stove supplier. This can be applied - in accordance with the instructions - in just a few minutes. When first firing after touching up, the stove will give off a slight smell as the paint cures. Make sure to ventilate the room well during this phase.

3.2 Internal maintenance

Glass

If the stove is generally run at the correct temperatures, there should be little or no dirt on the glass. If dirt does settle during lighting, most will burn off as temperatures increase.For heavier deposits that will not burn off, use morso glass cleaner, applied when the glass is cold, in accordance with the instructions. Never use abrasive cleaners on the glass surface.

Reasons for dirty glass

- Fuel too wet
- Logs too large or not split
- Combustion temperatures too low

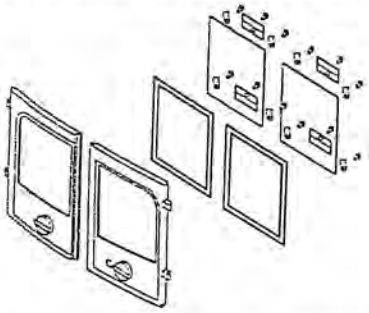
Replace broken glass immediately. Do not operate your stove if the glass in the door is damaged.

If you need to replace the glass, it should be replaced with the high temperature ceramic class supplied by Morsø, contact your Morsø dealer.

Installing the glass

Never install the glass when the stove is in function.

1. Lift the door off its hinges an place face-down on a sheet of cardboards or other non-abrasieve fabric.



2. Unscrew the six bolts that secure the glass. (In the event that a bolt sheers off when being unscrewed, remove the remaining body of the bolt by drilling down its cnetre with 1/8 inch high speed steel drill bit. Smaller drill bits may be successful, but do not use a lager bit. Make sure the bit stays away from the edges of the bolt - this may damage the thread in the cast iron).

3. Remove the old ceramic gaskets and clean up the surface underneath with wire wool or emery paper to remove loose particles.

4. Place the new gasket material in position around the perimeter of the window area, making sure to pinch them to the length in such a way that they make a continuous seal. Leave no gaps.

5. Place the new glass in position on the strips and screw home the fresh bolts and fitting by hand.

6. Finally, give each of the bolts an extra half turn or so. The glass should held tight enought that cleaning will not dislodge it. Do not over-tighten the bolts as this may put excessive pressure on the glass, resulting in cracking - important!

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To reduce the risk of breaking the glass, avoid striking the glass or slamming the door.

Internal service parts
The flame-path equipment - consisting of the ashpan, grate, firebricks, glass, baffle and flue collar - are subject to the extremes of heat produced by the fire. From time to time, one or other of these parts may need replacing as a matter of routine maintenance.

NOTE: The flame-path equipment, the ceramic rope and the paint finish are not covered by guarantee.

All of these service parts can be bought from your morsø dealer, and we recommend that damaged parts are replaced as soon as possible to avoid collateral damage.

Should the baffle be distorted by an overfire, the stove will still function, although its efficiency may be compromised. Replace it as soon as possible. The rear casing is removed (four bolts). Remove these and withdraw the baffle from the firebox (this may be easier if the firebricks are first removed).
Before replacing the baffle, scrape out the old fire furnace and replace with new to make an effective seal.

Reasons for fast internal wear and tear
Persistent heavy firing
Soot and ashes left to accumulate

Ceramic Gasket
The gasket around the perimeter of the doors may harden over a period of time. It should be replaced if it becomes difficult to close the door or if air starts to leak in around the perimeter of the doors, causing the fire to become a little less controllable. A morsø rope gasket kit is available from your stove supplier.

3.3 Cleaning the Stove and the Flue

Check for soot above the baffle plate and around the flue outlet every month or so to start with. If the stove suddenly becomes sluggish, check for a soot fall around the flue collar or in the flue/chimney. - at least once a year. Inspect every month.
Clean the flue/chimney - all the way from the stove to the flue terminal point above the house.

A good routine is to clean the flue after each heating season in any case, and inspect prior to the season to ensure that bird's nests or other blockages have not ocurred during the off season.

Ash disposal
Empty the ashpan on a daily basis or as needed. Ash allowed to build up towards the underside of the grate will trap heat and could cause premature failure of the grate.

Empty the ashpan according to this procedure:
Open the front door, and use a shovel or poker to stir excess ash through the ash slots in thegrate down into the ash pan. Remove the ash pan, making sure to keep it level.

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Dispose the ash in a metal container with a tight fitting lid.
The closed container of ashes should be placed on a noncombustible floor or on the ground, well away from all combustible materials, pending final disposal. If the ashes are disposed of by burial in soil or otherwise locally disperded, they should be retained in the closed container until all cinders have thoroughly cooled.
Return the ash pan to its original position in the stove, and close.

Caution:
Never empty a stove in operation.
Never use your household or shop vacuum cleaner to remove ash from the stove; always remove and dispose of the ash properly.
Creosote - formation and need for removal

When wood is burned slowly, it produces tar and other organic vapors, which combine with expelled moisture to form creosote. The creosote vapors condense in the relatively cool chimney flue of a slow-burning fire. As a result, creosote residue accumulates on the flue lining. When ignited this creosote makes an extremely hot fire. When burning wood, inspect the chimney connector periodically to determine if a creosote buildup has occurred.

Chimney sweeping

Inspect the system regularly during the heating season as part of a regular maintenance schedule.
To inspect the chimney, let the stove cool completely. Then, using a mirror, sight up through the flue collar into the chimney flue. If you cannot inspect the flue system in this fashion, the stove must be disconnected to provide better viewing access.
Clean the chimney using a brush the same size and shape as the flue liner. Run the brush up and down the liner, causing any deposits to fall to the bottom of the chimney where they can be removed through the clean-out door.
Clean the chimney connector disconnecting the sections, taking them outside, and removing any deposits with a stiff wire brush. Reinstall the connetor sections after cleaning, being sure to secure the joints between individual sections with sheet metal screws.
If you cannot inspect or clean the chimney yourself, contact your local Morsø Dealer or a professional chimney sweep.

If you do experience a chimney fire, act promptly and:

Close the air control.
Get everyone out of the house.
Call the Fire Department.

Annual maintenance

Before the heating season, perform a thorough cleaning, inspection and repair;
Thoroughly clean the chimney and chimney connector.
Inspect the chimney for damage and deterioration. Replace weak sections of prefabricated chimney. Have a mason make repairs to a masonry chimney.
Inspect the chimney connector and replace any damaged sections.
Check gasketing for wear or compression, and replace if necessary.
Check the glass for cracking; replace if needed.
Check door and handles for tightness. Adjust if needed.

3.4 Leaving the stove for extended periods

Important:

If the stove is to be left unused for any period of time, clean it out thoroughly and leave the air control slightly open to allow airflow. Make sure that the flue does not allow rainwater to come anywhere near the stove; install a chimney cap, but do not block off the flue completely.
These measures should ensure there is a slight movement of air through the stove, and that the body of the stove remains dry, right into the corners.
Any ash left within an unfired stove can attract moisture like blotting paper. If moisture is allowed to settle within the stove, rust will form. Rust expands as it takes a grip. This can lead to undue pressure on the stove joints, and this in turn may result in damage to the stove.

NOTE: It is best to thoroughly clean the stove after the heating season has concluded. Adding a dessicant, such as kitter litter, into the ash pan helps absorb moisture during the summer months. Be sure to remove this prior to the heating season.

Thank you for buying a morsø stove.

We hope you have many years of carefree warmth in its company. Some initial experimentation with loading and running techniques will decide your normal routine. If you have any problems after this short learning phase, please refer to your stove dealer. Should they be unable to help for any reason, please contact us in writing at the address on the front of this publication.

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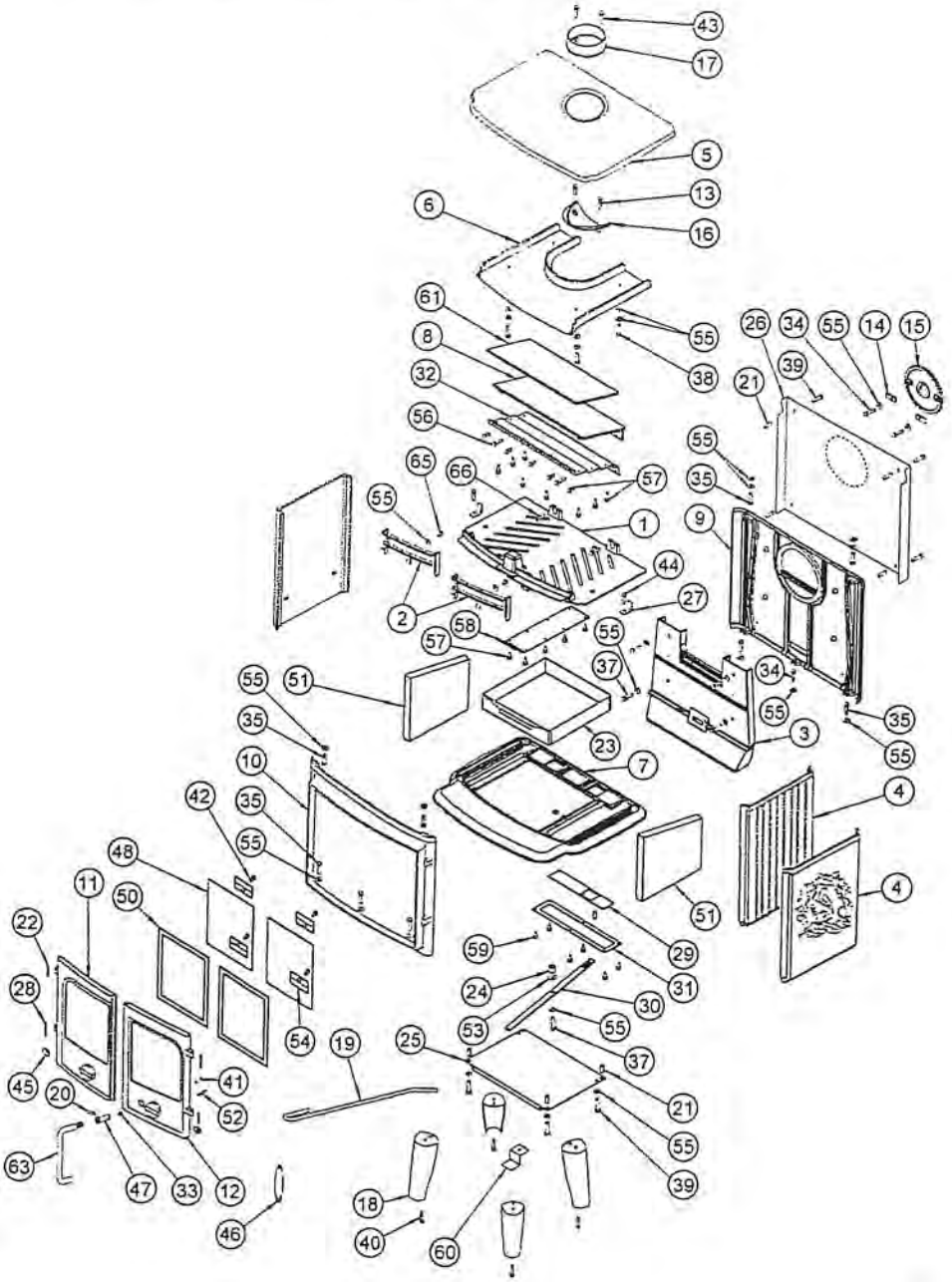
3.5 Parts diagram for model Morsø 2110



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3.6 Parts list for model Morsø 2110

Pos.No.	Parts	
1	Intermediate frame	44184700
2	Front grate	44184921
3	Inside rear plate	44185000
4	Side plate	44140621
5	Top plate	44180521
6	Inside top plate	44181100
7	Base plate	44184221
8	Baffle plate, cast iron	44184800
9	Rear plate, cast iron	44185121
10	Front frame	44185221
11	Door left	44185321
12	Door right	44185421
13	Screw	
14	Fitting w. thread for cover	44256800
15	Cover	44261021
16	Draft reducer	44342400
17	Flue collar	44262821
18	Leg	44340721
19	Poker	541075
20	Hinge pin	541082
21	Distance tube	541440
22	Hinge pin	541808
23	Ash tray	54181500
24	Distance bush	54181700
25	Radiant shielding, bottom	541820
26	Convection rear plate	54182421
27	Intermediate frame fitting	541831
28	Hinge pin	542056
29	Draught control	71180200
30	Draught control arm	71180300
31	Draught control frame	71180400
32	Baffle plate, stainless	71181161
33	Black steel set screw	
34	Black steel set screw	
35	Black steel set screw	
37	Black steel set screw	
38	Black steel set screw	
39	Black steel set screw	
40	Black steel set screw	
41	Black steel set screw	
42	Screw	
43	Screw	
44	Screw	
45	Brass washer	
46	Handle	44312921
47	Axis for handle	752627
48	Ceramic glass	790721
50	Tightening tape	79074400
51	Stone	79094300
52	Cotter pin	791870
53	Spring washer	79189600
54	Glass fitting	54181361
55	Air slider washer	
56	Screw	
57	Screw	
58	Plate for intermediate frame	71181261
59	Screw	
60	Hanging for handle	71347900
61	Insulation	79074700
63	Door handle	54186100
65	Black steel set screw	
66	Screw	

Section 5

Quality Assurance/Quality Control

Model: Panther 2110 B
Morsø Jernstøberi A/S
DK-7900
Nykøbing Mors
Denmark

QUALITY ASSURANCE/QUALITY CONTROL

OMNI follows the guidelines of ISO Guide 25 and the quality assurance/quality control (QA/QC) procedures found in OMNI's Quality Assurance Manual.

OMNI's scope of accreditation includes, but is not limited to, the following:

- to perform product safety testing by the American Association for Laboratory Accreditations (A2LA [107595]).
- to perform product safety testing by the International Conference of Building Officials (ICBO ES) under report TL-130.
- to perform product safety testing as a "Certification Organization" by the Standards Council of Canada (SCC).
- as a testing laboratory for the certification of wood heaters by the U.S. Environmental Protection Agency.

This report is issued within the scope of OMNI's accreditation. Accreditation certificates are available upon request.

Model: Panther 2110 B
Morsø Jernstøberi A/S
DK-7900
Nykøbing Mors
Denmark

Sample Analysis

Analysis Worksheets
Tared Filter and Beaker Data
Solvent Blank Data

OMNI-Test Laboratories,
Beaverton, OR Phone (503) 643-3788

Dilution Tunnel (Method 5G) Analysis Worksheet

Client/Model: Morso 2110 Panther A Project #: 192-5-01-3 Tracking #: 387
Date: 6-24-02 Test Crew: K. Morgan Run #: 1
Sample Train #: _____ Train assembled by: K. Morgan
Balance ID #: OMNI - 00023 Thermo/Hygro meter ID #: OMNI -
Audit weight ID #: OMNI – 00131 (Balance audit mfr. std: 500 ± 0.72 mg)

Train Part	Weighing Record						
	Date	Time	Weight (grams)	Audit (grams)	R/H %	Temp. (F)	Initials
Front Filter	6-25-02	17:15	.6064	.5002	12	76	IK
Lab ID # _____	6-26-02	16:20	.6065	.5002	13	78	IK
ID # moss							
Tare wt. .5713							
D/T in desiccator 6-24-02 17:00							
Preliminary wt.: IK ~~.6075~~ .6065							
Rear Filter	6-25-02	17:15	.5743	.5002	12	76	IK
Lab ID # _____	6-26-02	16:20	.5743	.5002	13	78	IK
ID # mo54							
Tare wt. .5718							
D/T in desiccator: 6-24-02 17:00							
Preliminary wt.: .5745							
Acetone Rinse	6-28-02	14:05	109.9112	.5002	24	77	IK
Lab ID # _____	~~6-31-02~~ 7-1-02 IK	09:25	109.9090	.5002	23	73	IK
Beaker # 2121							
Tare wt. 109.9074							
Volume 75 ml							
Cleaned by: IK	7-2-02	08:40	109.9093	.5002	21	73	IK
Solvent #: SA069							
D/T in desiccator: 6-26-02 16:20							
Preliminary wt.: 109.9117							

Technician signature: IK K. Morgan Date: 7-02-02

5-4 of 5 – 5U

OMNI-Test Laboratories,
Beaverton, OR Phone (503) 643-3788

Dilution Tunnel (Method 5G) Analysis Worksheet

Client/Model: Morso 2110 Panther Project #: 192-S-01-3 Tracking #: 378
Date: 6-25-02 Test Crew: K. Morgan Run #: 2
Sample Train #: _____ Train assembled by: K. Morgan
Balance ID #: OMNI - 00023 Thermo/Hygro meter ID #: OMNI -
Audit weight ID #: OMNI – 00131 (Balance audit mfr. std: 500 ± 0.72 mg)

Train Part	Weighing Record						
	Date	Time	Weight (grams)	Audit (grams)	R/H %	Temp. (F)	Initials
Front Filter	6-26-02	16:25	.5809	.5002	13	78	IK
Lab ID # _____	6-28-02	14:05	.5810	.5002	24	77	IK
ID # M057							
Tare wt. .5700							
D/T in desiccator 6-25-02 14:55							
Preliminary wt.: .5807							
Rear Filter	6-26-02	16:25	.5699	.5002	13	78	IK
Lab ID # _____	6-28-02	14:05	.5701	.5002	24	77	IK
ID # M056							
Tare wt. .5695							
D/T in desiccator: 6-25-02 14:55							
Preliminary wt.: .5700							
Acetone Rinse	6-28-02	14:05	116.3149	.5002	24	73	IK
Lab ID # _____	~~6-31-02~~ 7-01-02 IK	09:25	116.3133	.5002	23	73	IK
Beaker # 2264							
Tare wt. 116.3118							
Volume 150 ml							
Cleaned by: IK	7-02-02	08:40	116.3136	.5002	21	73	IK
Solvent #: SA 069							
D/T in desiccator: 6-26-02 16:25							
Preliminary wt.: 116.3160							

Technician signature: K. Morgan Date: 7-02-02

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OMNI-Test Laboratories, I
Beaverton, OR Phone (503) 643-3788

Dilution Tunnel (Method 5G) Analysis Worksheet

Client/Model: Morso 2110 Panther Project #: 192-5-03-1 Tracking #: 387
Date: 6-26-02 Test Crew: K. Morgan Run #: 3
Sample Train #: _____ Train assembled by: _____
Balance ID #: OMNI - 00023 Thermo/Hygro meter ID #: OMNI -
Audit weight ID #: OMNI – 00131 (Balance audit mfr. std: 500 ± 0.72 mg)

Train Part	Weighing Record						
	Date	Time	Weight (grams)	Audit (grams)	R/H %	Temp. (F)	Initials
Front Filter							
Lab ID # _____							
ID # M059	6-28-02	14:10	.6031	.5002	24	77	IC
Tare wt. .5675 (35.5 / 35.3)	6-31-02	09:25	.6028	.5002	23	73	IC
D/T in desiccator 6-26-02 1605							
Preliminary wt.: .6030							
Rear Filter							
Lab ID # _____							
ID # M058	6-28-02	14:10	.5739	.5002	24	77	IC
Tare wt. .5705 (3.5 / 3.0)	6-31-02	09:25	.5735	.5002	23	73	IC
D/T in desiccator: 6-26-02 1605							
Preliminary wt.: .5740 (3.4)							
Acetone Rinse	~~6-31-02~~ IC 7-1-02	09:25	108.7350	.5002	23	73	IC
Lab ID # _____							
Beaker # T11	7-2-02	08:40	108.7354	.5002	21	73	IC
Tare wt. 108.7306							
Volume 150 ml (4.4)							
Cleaned by: BR							
Solvent #: SA 069							
D/T in desiccator: 6-28-02 14:10							
Preliminary wt.: 108.7381							

Technician signature: IC J. Morgan Date: 7-02-02

OMNI-Test Laboratories,
Beaverton, OR Phone (503) 643-3788

Dilution Tunnel (Method 5G) Analysis Worksheet

Client/Model: Morso 2116 PANTHER Project #: 192-5-01-3 Tracking #: 387
Date: 6-28-02 Test Crew: K. Morgan Run #: 4
Sample Train #: _____ Train assembled by: K. Morgan
Balance ID #: OMNI - 00023 Thermo/Hygro meter ID #: OMNI -
Audit weight ID #: OMNI – 00131 (Balance audit mfr. std: 500 ± 0.72 mg)

Train Part	Weighing Record						
	Date	Time	Weight (grams)	Audit (grams)	R/H %	Temp. (F)	Initials
Front Filter	~~6-31-02~~ 7-1-02	09:30	.5703	.5002	23	73	IL
Lab ID # _____							
ID # M061	7-2-02	08:35	.5704	.5002	21	73	IL
Tare wt. .5668							
D/T in desiccator							
~~6~~-28-02 13:40							
Preliminary wt.: .5708							
Rear Filter	~~6-31-02~~ 7-1-02	09:30	.5643	.5002	23	73	IL
Lab ID # _____							
ID # M060	7-2-02	08:35	.5643	.5002	21	73	IL
Tare wt. .5663							
D/T in desiccator:							
6-28-02 13:40							
Preliminary wt.:							
~~6-28-02~~ .5656							
Acetone Rinse	7-02-02	08:35	103.3678	.5002	21	73	IL
Lab ID # _____							
Beaker # 2046	7-02-02	17:00	103.3678	.5002	13	75	IL
Tare wt. 103.3589							
Volume 150 ml							
Cleaned by: km							
Solvent #: SA 069							
D/T in desiccator:							
~~6-31-02~~ 09:30							
Preliminary wt.:							
103.3681							

Technician signature: K. Morgan Date: 7-11-02

OMNI Environmental Services, Inc
OMNI-Test Laboratories, Inc.
Beaverton, OR Phone (503) 643-3788

Filter Tares

Filter Type A/E GLASS Filter Size 102 mm

Date and Time Placed in Desiccator 4/12/02 11:45 Technician: R. SMITH

Balance ID #: OMNI - 00023 Thermo/Hygro meter ID #: OMNI -

Audit Weight ID #: OMNI -
(Balance audit mfr std.: OMNI-00131 500 ± 0.72 mg)

Filter ID #	Date: 4/4/02 4/17/02 Time: 1100 R/H %: 58 T (F): 62 Initial: DZB/~~RSS~~	Date: 4/17/02 Time: 11:00 R/H %: ~~72~~ 6 T (F): ~~6~~ 72 Initial: RSS	Date: 4/18/02 Time: 14:00 R/H %: 4 T (F): 73 Initial: RSS	Date: Time: R/H %: T (F): Initial:	Project/Run
Balance Audit *		0.5001g	0.5001g		
M046		0.5727	0.5727		STOUHR R+D 1 FRONT
M047		0.5696	0.5696		MORSO RUN 7
M048		0.5689	0.5690		Hontolator I-100 RUN 1
M049		0.5723	0.5723		King Iverson R&A 1
M050		0.5705	0.5705		
M051		0.5713	0.5713		
M052		0.5726	0.5725		
M053		0.5690	0.5689		
M054		0.5717	0.5718		MORSO RUN 1 Rear
M055		0.5713	0.5713		MORSO RUN 1 FRONT
M056		0.5696	0.5695		MORSO RUN 2 Rear
M057		0.5700	0.5700		MORO RUN 2 FRONT
M058		0.5704	0.5705		MORSO Run 3 Rear
M059		0.5675	0.5675		morso Run 3 Front
M060		0.5663	0.5663		morso Run 4
M061	0	0.5668	0.5668		morso Run 4
M062	0.5677				CSL test
M063	0.5671				CSL test

Final Technician signature: R. Smith Date: 4/18/02

OMNI Environmental Services, Inc.
OMNI-Test Laboratories, Inc.
Beaverton, OR Phone (503) 643-3788

Beaker Tares

Date/Time Placed in Desiccator: 1300 5/30/02 Technician: R. Smith

Balance ID #: OMNI - 00023 Thermo/Hygro meter ID #: OMNI -

Audit Weight ID #: OMNI – 00131 (Balance audit mfr. std.: 500 ± 0.72 mg)

Beaker Size/ID # 250 mL	Date: 6/6/02 Time: 08:00 R/H %: 6 T (F): 72 Initial: RSS	Date: 6/7/02 Time: 1445 R/H %: 7 T (F): 79 Initial: RSS	Date: 6/10/02 Time: 0815 R/H %: 8 T (F): 75 Initial: RSS	Date: 6/10/02 Time: 1530 R/H %: 9 T (F): 77 Initial: RSS	Project/Run
Balance Audit *	0.5001 g	0.5001 g	0.5001 g	0.5001 g	
214	93.8213	93.8212			
924	94.8020	94.8017			
1018	107.7353	107.7349			
2168	108.5699	108.5695			
2171	108.4807	108.4803			
223	90.3548	90.3541	90.3551	90.3547	
2169	107.4987	107.4980	107.4988	107.4985	
2180	101.6180	101.6175			
260	100.9235	100.9231			
2048	103.3589	103.3580	103.3593	103.3589	MORSO 2110 Run 4
2265	116.6972	116.6962	116.6975	116.6973	
2262	109.5278	109.5269	109.5280	109.5276	
805A	101.7499	101.7494			
2264	116.3118	116.3109	116.3122	116.3118	MORSO Run 2
2261	112.9733	112.9723	112.9735	112.9731	VOID K
T11	108.7307	108.7297	108.7309	108.7306	MORSO Run 3
T4	108.1242	108.1238			
2096	110.0792	110.0785	110.0793	110.0791	VOID K
2121	109.9075	109.9066	109.9075	109.9074	MORSO Run 1
T6	110.0735	110.0727	110.0738	110.0733	

Final Technician signature: R. Smith Date: 6/10/02

C II Environmental Services, Inc.
OM Test Laboratories, Inc.
Beaverton, OR Phone (503) 643-3788

Acetone Solvent Blank Analysis Worksheet

Date: 3-11-02 By: K. MORGAN Balance ID #: OMNI – 00023

Manuf. Lot #: 41344150 Solvent Bottle #: SM069 Audit Weight ID #: OMNI – 00131
(Balance audit mfr. std.: 500 ± 0.72 mg)

Mls. Sample	ID No.	Tare Weight	Date & Time in Dessicator	Weighing Record				Initials	Calculations & Remarks
				Date	Time	Weight	Audit Weight		
150	2219	94.2442	3-04-02 & 13:45	3-7-02	15:00	94.2428	.5002	IK	94.2435 – 94.2442
				3-8-02	13:50 +2 IK	94.2416	.5002	IK	= -0.0007g = -.70 mg / 150 ml
				3-11-02	0:700	94.2435	.5002	IK	= -.005 mg/ml
				3-11-02	13:00	94.2435	.5002	IK	= Ø
150	2222	105.0040	3-04-02 & 13:45	3-7-02	15:00	105.0028	.5002	IK	105.0033 – 105.0040
				3-08-02	13:50	105.0015	.5002	IK	= -0.7 mg / 150 ml = -.005 mg/ml
				3-11-02	09:00	105.0031	.5002	IK	
				3-11-02	15:00	105.0033	.5002	IK	
			___ & ___	___	___	___	___	___	Ø + Ø / 2 = Ø mg/ml
				___	___	___	___	___	
				___	___	___	___	___	
				___	___	___	___	___	

Technician Signature: IK L. Morgan Date: 3-11-02

Checked by: [illegible] Date: 3-11-02 Approved by: A. Smith Date: 3-11-02

S-1045-97

Model: Panther 2110 B
Morsø Jernstøberi A/S
DK-7900
Nykøbing Mors
Denmark

Calibrations

Method 28 and 5G

Test Series

Method 28:

ID #	Lab Name/Purpose	Log Name	Attachment Type
183	Moisture Meter	Moisture Meter – Delmhorst	Manual

Method 5G:

ID #	Lab Name/Purpose	Log Name	Attachment Type
27	Manometer	Microtector – Dwyer	Manual
141	Dry Gas Meter	Dry Gas Meter, Singer	Post-Test Calibration Log
C-SFO-0002		Temp Calibrations Stove Surface Thermocouples	FORM

OWNER'S MANUAL

MODELS J-2000, J-LITE, J-4

WOOD MOISTURE METERS

DELMHORST INSTRUMENT CO.

TOWACO, NJ USA

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CMM-NVI #183

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INTRODUCTION

Thank you for purchasing a DELMHORST Wood Moisture Meter. Delmhorst has been the leading manufacturer of high-quality, pin-type meters for 50 years. Our products are proven to help minimize defects and improve quality control.

The new "J" series offers our latest meter design with the performance you expect from a Delmhorst. The J-2000 and J-Lite models feature microcontroller circuits for greater reliability and accuracy; the J-4 incorporates a built-in calibration check and temperature-stable circuit.

The following operating instructions, together with our booklet "Measuring Wood Moisture Content: Straight Talk from Delmhorst," provide the information you need to make best use of your Delmhorst meter.

Thanks again for your business. If you have any additional questions, please call us toll-free at 1-800-PINS-DIC (746-7342).

MODEL J-2000

The J-2000 features a microcontroller circuit for increased reliability and accuracy. It also has built-in corrections for individual species and wood temperature, and averages up to 100 accumulated readings.

SPECIFICATIONS:

Moisture Range -- 6% - 40%

Species Corrections -- 47 Individual Species

Temperature Compensation -- 0 - 255°F, -17.9 - 123°C

Default Settings -- 70°F, Douglas Fir, Non-insulated pins

KEY SWITCH OPERATION:

Species:

Sets the species code between 1 and 47. (Refer to chart on page 2 for list of species.) This key also acts as an arrow (scroll) key, depending on the function.

[illegible]:

[illegible] the wood temperature and changes the [illegible] mode (Fahrenheit or Celsius) This key also acts as an arrow key, depending on the function.

Read:

Reads the Percent Moisture Content value (%MC), corrected for temperature and species.

Check:

Checks the meter calibration. Displays the average of up to 100 accumulated readings; displays the maximum stored reading; erases the readings.

>>>> When the battery is removed and then reconnected, the meter displays its software version for one second and then turns itself off. After replacing the battery, you must reset the meter as described on page 6.

TO SET THE SPECIES CODE:

Because the electrical characteristics of different wood species vary, all species read differently at the same moisture content. Delmhorst uses the USDA standard-Douglas Fir-as the basis for all calibrations.

The J-2000 defaults to Species Code #1 - Douglas Fir. If you are working with another species, set the Species Code and the meter will make the necessary correction.

Press the SPECIES key. The meter will display the current species code for one second. To scroll forward through the species list, hold the SPECIES key while the current species code is displayed. To scroll backward through the species list, press and hold the TEMPERATURE key within one second of pressing the SPECIES key.

When scrolling in either direction, release the key to stop at your desired species.

SPECIES CODES:

CODE	SPECIES	CODE	SPECIES
1	FIR, DOUGLAS	25	MAGNOLIA
2	PINE, SOUTHERN	26	MAHOGANY, AFRICAN (ALSO KHAYA)
3	SPF	27	MAHOGANY, HONDURAS
4	ALDER	28	MAHOGANY, PHILIPPINE
5	APITONG	29	MAPLE, HARD/SOFT
6	ASPEN	30	MERANTI, DARK RED
7	ASH, WHITE	31	OAK, RED
8	BASSWOOD	32	OAK, WHITE
9	BIRCH	33	PECAN
10	CEDAR, EASTERN RED	34	PINE, LONGLEAF
11	CEDAR, INCENSE	35	PINE, PONDEROSA
12	CHERRY	36	PINE, SHORTLEAF
13	COTTONWOOD	37	PINE, SUGAR
14	CYPRESS	38	PINE, WHITE
15	ELM, AMERICAN	39	POPLAR, YELLOW
16	FIR, RED	40	RAMIN
17	FIR, WHITE	41	RADIATA PINE
18	GUM, BLACK	42	REDWOOD
19	GUM, RED	43	SPRUCE, SITKA
20	HEMLOCK, WESTERN	44	SPF, COFI
21	HACKBERRY	45	TEAK
22	HICKORY	46	VIROLA
23	KERUING	47	WALNUT, BLACK
24	LARCH		

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TO SET THE TEMPERATURE:

As wood temperature increases, its electrical resistance decreases and indicated moisture content rises. Lower wood temperatures result in lower indicated moisture content.

Delmhorst meters are calibrated at 70° F. A correction is necessary if the wood temperature is outside of the range of 50°F - 90°F. Set the temperature accordingly and the meter will make the correction.

Press and release the TEMPERATURE key. The meter will display the current temperature for one second. To scroll forward through the temperature settings, press and hold the TEMPERATURE key while the current temperature is displayed. To scroll backward, press and hold the SPECIES key within one second of pressing the TEMPERATURE key.

When scrolling in either direction, release the key to stop at the desired temperature.

>>>> If the meter is in Fahrenheit mode, the letter "F" will display in the left hand corner. If it is in Celsius mode, no letter will appear in the display.

>>>> In the Fahrenheit mode, the temperature will change in increments of 5°. In Centigrade, the temperature will change in increments of either 2 or 3°C, depending on its conversion from Fahrenheit.

>>>> In the Fahrenheit mode, the temperature value will display in whole numbers. In the Celsius mode, positive values will display in whole numbers; negative values will display with a a decimal point and a "-" sign in the left hand corner. (ie:-17.0)

TO CHANGE TEMPERATURE MODE:

Press the TEMPERATURE key. Within one second, press the CHECK key and release it. The Temperature mode will change from F to C and vice versa. The meter will display the current temperature in the new mode and will wait one more second until shutting off so that you may change the temperature value as described above.

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TO CHANGE PIN CALIBRATION, INSULATED OR UNINSULATED:

The basic factory calibration of the J-2000 is for a 4-pin or 2-pin electrode with uninsulated pins. Uninsulated pins read higher than insulated ones. The difference is small below 10% moisture content, it increases as moisture content increases. When using an electrode with insulated pins, such as the 26-ES, you can change the calibration to compensate for this difference.

To change the pin setting, press and release the SPECIES key; then press the CHECK key within one second. The meter will display the current Pin Calibration as either 222 for insulated or 444 for uninsulated pins.

If you continue to hold the CHECK key, the meter will change the pin calibration. The new calibration will remain in "memory" until you change it again, or you remove the battery.

TO TAKE A READING:

Align the electrode pins parallel to the grain and force them into the wood. Press the READ key. The meter displays the %MC for two seconds.

Releasing the READ key within 2 seconds will add the last reading to the sum of all of the previously stored readings, provided the corrected value is less than 40.0%.

If you press and hold the READ key, the meter will repeat its read cycle, but will not add a new reading to the storage until the key is released.

The meter will accumulate up to 100 readings. After all 100 readings are "stored", it will not add new readings until the memory has been cleared. It will also continue to display the average of all 100 readings as a reminder that the memory is full.

If you are testing hardwoods over 4/4, we recommend using a remote probe such as the 26-ES ram-type electrode. Mount the 26-ES directly to the top of the instrument case.

When using uninsulated pins, push them into the wood to their full penetration, if possible. Insulated pins read only at the tip and can be driven to the desired depth.

For more information about the differences between insulated and non-insulated pins, refer to pages 12-13 of "...Straight Talk."

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SOME NOTES ABOUT YOUR READINGS:

>>>> The basic calibration for the meter is based on Douglas Fir at 70°F. Readings below 6% are displayed as -xx.x; those above 40% are displayed as 999. Neither are considered valid readings, and therefore, are not added to the accumulated readings.

However, because the meter corrects for species and and temperature, it is possible for the meter to read a corrected value below 6%. These readings will be added to the accumulated readings. The meter will only read 999 for any value above 40%, whether it is a corrected or non-corrected value. Any reading over 40% will not be added to the accumulated readings.

>>>> If you prefer to use the manual correction charts for species and temperature corrections, be sure the meter is set to species code #1, Douglas Fir, and Temperature to 70°F.

TO CHECK THE ACCUMULATED READINGS:

This feature allows you to view the total number of accumulated readings, the average of those readings, and the highest stored reading.

Press and release the CHECK key. First, the meter displays the number of accumulated readings for one second, then the average of those readings for two seconds. Then, it displays the highest stored reading for two seconds. The total "cycle" time is five seconds.

>>>> In order to keep the accumulated readings in memory, release the CHECK key before the meter finishes this cycle. IF YOU HOLD THE CHECK KEY DOWN FOR MORE THAN FIVE SECONDS, ALL THE ACCUMULATED READINGS WILL BE ERASED, and the meter will display "0".

TO CHECK THE METER CALIBRATION:

Press and hold the READ and CHECK keys simultaneously. The meter is in calibration, if it displays 12% (±.2).

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>>>> If you check the calibration and the meter does not display 12%, it is likely an indication of a low battery. If this occurs, change the battery immediately. Continued use with a low battery may cause the meter to go out of calibration. If you have a fresh battery and the instrument still does not indicate a proper calibration, return it to DELMHORST for service.

TO RESET THE METER:

Press and release the CHECK key. Within one second, press the SPECIES key. The meter will reset itself and display "170" to indicate Species #1 (Douglas Fir) at 70°F. All the readings stored in memory will also be cleared.

MODEL J-4

The J-4 uses the familiar analog readout in our great new case. It also features built-in calibration check and temperature-stable circuit. The J-4 measures moisture content over the range of 6-30%.

KEY SWITCH OPERATION:

Read: Reads the %MC value.

Check: Checks the meter calibration.

TO CHECK THE METER CALIBRATION:

Press the CHECK button. The meter is in calibration if the needle pointer moves to "20" on the scale. Any reading within the green band on the dial is acceptable.

>>>> Make sure the pins are not in contact with anything when checking the calibration.

>>>> If you check the calibration and the needle does not read "20", it is likely an indication of a low battery. If this occurs, change the battery immediately. Continued use with a low battery may cause the meter to go out of calibration. If you have a fresh battery and the instrument still does not indicate a proper calibration, return it to DELMHORST for service.

TO TAKE A READING:

Align the electrode pins parallel to the grain and force them into the wood. Press the READ key and read the %MC on the meter scale.

If you are testing hardwoods over 4/4, we recommend using a remote probe such as the 26-ES ram-type electrode. Mount the 26-ES directly to the top of the instrument case.

When using uninsulated pins, push them into the wood to their full penetration, if possible. Insulated pins read only at the tip and can be driven to the desired depth.

For more information about the differences between insulated and non-insulated pins, refer to pages 12-13 of "...Straight Talk."

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>>> If you have used an earlier model DELMHORST meter, you may have had to make a pin correction. The Model J-4 has values for both insulated and uninsulated pins. When using the pins mounted on top of the meter, be sure to refer to the scale marked "uninsulated." When using a 26-ES Electrode with insulated pins, refer to the scale marked "insulated."

Apply the temperature and species corrections according to the charts on pages 10 and 11. Correct for temperature first, then species.

>>>> You may also use the temperature slide rule provided instead of the temperature correction chart.

MODEL J-LITE

The J-Lite features a microcontroller circuit for increased reliability and accuracy. Its 12 bright LEDs give the most precise readings of any LED meter available today. The LEDs cover the range of 6-30%.

KEY SWITCH OPERATION:

Read: Reads the %MC value.

Check: Checks the meter calibration.

>>>> When the battery is removed and then reconnected, all the LEDs will flash for a few seconds, then the meter will turn itself off.

TO CHECK THE METER CALIBRATION:

Press the CHECK button. The meter is in calibration if the "12" lights up.

>>>> If you check the calibration and an LED other than the "12" lights up, it is likely an indication of a low battery. If this occurs, change the battery immediately. Continued use with a low battery may cause the meter to go out of calibration. If you have a fresh battery and the instrument still does not indicate a proper calibration, return it to DELMHORST for service.

TO TAKE A READING:

Align the electrode pins parallel to the grain and force them their full length into the wood, if possible. Press the READ button and read the moisture content on the LED display.

If you are testing hardwoods over 4/4, we recommend using a remote probe such as the 26-ES ram-type electrode. Mount the 26-ES directly to the top of the instrument case.

When using uninsulated pins, push them into the wood to their full penetration, if possible. Insulated pins read only at the tip and can be driven to the desired depth.

For more information about the differences between insulated and non-insulated pins, refer to pages 12-13 of "...Straight Talk."

>>>> Since the J-Lite displays %MC in a "range" between two values, corrections for pin, temperature, and species have less impact on the accuracy of the meter readings, especially below 12%. Therefore, these corrections are not necessary. If you choose to make them, correct for temperature first, using either the chart on page 10 or the slide rule, then correct for species.

UNDERSTANDING YOUR READINGS:

IF THE LED DISPLAYS:	THE %MC IS:
BLINKING 6%	BELOW 5.5%
6%	BETWEEN 5.5 AND 6.0
7%	BETWEEN 6.1 AND 7.0
8%	BETWEEN 7.1 AND 8.0
9%	BETWEEN 8.1 AND 9.0
10%	BETWEEN 9.1 AND 10.0
BLINKING 10% AND 12%	BETWEEN 10.1 AND 11.0
12%	BETWEEN 11.1 AND 12.0
BLINKING 12% AND 15%	BETWEEN 12.1 AND 13.5
15%	BETWEEN 13.6 AND 15.0
BLINKING 15% AND 17%	BETWEEN 15.1 AND 16.0
17%	BETWEEN 16.1 AND 17.0
BLINKING 17 AND 19%	BETWEEN 17.1 AND 18.0
19%	BETWEEN 18.1 AND 19.0
20%	BETWEEN 19.1 AND 20.0
BLINKING 20% AND 25%	BETWEEN 20.1 AND 22.5
25%	BETWEEN 22.6 AND 25.0
BLINKING 25% AND 30%	BETWEEN 25.1 AND 27.5
30%	BETWEEN 27.6 AND 30.0
BLINKING 30%	ABOVE 30%

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TEMPERATURE CORRECTION TABLE

WOOD TEMP		METER READINGS										
°C	°F	6	7	10	15	20	25	30	35	40	50	60
-20	0	9	11	15	22	*31*	*38*	*45*	*53*			
-10	20	8	10	14	20	28	*34*	*40*	*47*	*55*		
5	40	7	8	12	18	24	30	*36*	*42*	*48*		
15	60	6	7	11	16	21	27	*32*	*38*	*43*	*54*	
30	80	6	7	9	14	19	23	28	*33*	*38*	*47*	*55*
40	100	5	6	8	12	17	21	25	29	*34*	*42*	*50*
50	120	5	5	7	11	15	19	22	26	30	*38*	*44*
60	140	4	5	7	10	14	17	20	23	27	34	*40*
70	160	4	4	6	9	12	15	18	21	24	30	*36*
80	180	3	4	5	8	11	13	16	19	22	27	*33*
95	200	3	4	5	7	10	12	14	17	19	24	28
105	220	2	3	4	6	9	11	13	15	17	21	26

>>>> Moisture content values shown in *italics* are only qualitative, since they are above the fiber saturation point.

>>>> The temperature correction values shown in this chart have been rounded for easy reference. We recommend using a Temperature Correction Slide Rule to more easily interpolate meter readings and correction values in small gradual increments. A Slide Rule is included with each instrument.

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SPECIES CORRECTION TABLE:

SPECIES	METER READINGS WITH 4-E, 4-PIN ELECTRODE										
	7	8	9	10	12	14	16	18	20	22	24
ALDER	8	9	10	11	13	15	17.5	19.5	21.5	24	27
APITONG	8	9	10	11	13	15	17	20	22	24	27
ASPEN	7	8	9	10	11.5	13	15	16.5	18	20	21
ASH, WHITE	6.5	7.5	8	9	11	13	14.5	16	18	19.5	21
BASSWOOD	7	8	8	9	10.5	13	15	17	19	20.5	22
BIRCH	8	9	10	11	13	15	17	19	21.5	23.5	25.5
CEDAR, EAST. RED	8	9.5	10.5	12	14	17	19	21	23	25	26
CEDAR, INCENSE	7	8	9.5	10.5	12.5	15	17	19	21	23	25
CHERRY	8	9	10	11	13.5	15.5	18	20	22	24	26
COTTONWOOD	6	7.5	8.5	9.5	12	14	15	17	19.5	21	23
CYPRESS	7	8	9	10	12	14	16	18	19.5	21.5	23.5
ELM, AMERICAN	7	7.5	8	8.5	10	11.5	13	15	16	18	19
FIR, DOUGLAS	7	8	9	10	12	14	16	18	20	22	24
FIR, RED	7	8	9	10	12.5	15	17	19	21	23	25
FIR, WHITE	8	9	9.5	10.5	12.5	15	17	19	21	23	25
GUM, BLACK	7.5	9	10	11	13	15	16	18	19	20.5	22
GUM, RED	7	8	9	10	12.5	14.5	16.5	19	20.5	22.5	24
HE[illegible]OCK, WESTERN	7	8	9	10.5	13	15	17	19	20.5	22	23.5
HACKBERRY	7	8.5	9	9.5	12	13	15	17	18.5	20	22
HICKORY	8	8.5	9	10	11	12.5	14	15.5	17	19	20.5
KERUING	8	9	10	11	13	15	17	20	22	24	27
LARCH	7.5	9	10	11	13	15	17	19	21	23	25.5
MAGNOLIA	7.5	9	10	11.5	14	16	17.5	19	21	22.5	24.5
MAHOGANY, AFRICAN (ALSO KHAYA)	8	9.5	10.5	12	15	17	19.5	22	24	26	28
MAHOGANY, HOND.	7	8	9	10.5	12.5	14.5	16	18	19.5	21.5	22.5
MAHOGANY, PHIL	6	7	7.5	8	9.5	11	13	14	15.5	17	18
MAPLE, HARD/SOFT	8	9	9.5	10	12	14	16	18	20	22.5	25
MERANTI, DARK RED	8.5	9.5	10.5	11.5	12.5	16	18	20.5	22.5	24.5	26.5
OAK, RED	7	8	9	10	12	14	16	18	20	22	24
OAK, WHITE	7	8	8.5	9.5	11.5	13.5	15	17	18.5	20	22
PECAN	6.5	8	9.5	11	12.5	14	16	17.5	19	22	24
PINE, LONGLEAF	8	8.5	10	11	13	15.5	17.5	19.5	21	23	25
PINE, PONDEROSA	7.5	8.5	10	11	13.5	15.5	17.5	19.5	21	23	25.5
PINE, SHORTLEAF	7.5	9	10	11	13	15.5	17.5	19.5	21.5	23.5	25
PINE, SO. YELLOW*	8	9.5	10.5	12	14.5	16.5	19	21	23	25	28
PINE, SUGAR	7	8	9	10	12	15	17	19	21	23	25
PINE, WHITE	7	8	9	10	13	15	17	19	21	23	25.5
POPLAR, YELLOW	8	8.5	10	11	13	15.5	17.5	19.5	22	24	26

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SPECIES	METER READINGS WITH 4-E, 4-PIN ELECTRODE										
	7	8	9	10	12	14	16	18	20	22	24
RAMIN	7	8	9	10	11	13	15	16	18	20	21
RADIATA PINE	10	11	11	12	14	16	18	20	23	25	27
REDWOOD	7	8	9	10	12	13.5	15	17	19	22	24
SPRUCE, SITKA	7	8	9	10	12.5	14.5	17	19	21	23.5	26
SPF **	9	10	11.5	13	15.5	18	20.5	23	25	28	30
SPF/COFI	8	9	10	11	13	15	17	19	21	23	25
TEAK	7	8	8.5	9	11	12	14	15	17	18.5	20
VIROLA	6.5	7	8	9	11	12.5	14	16	18	18.5	20.5
WALNUT, BLACK	7.5	8.5	9.5	10.5	12.5	14.5	16	18	20	22	23.5

*Meter readings taken with 26-E 2-pin electrode. Do not apply 2-pin correction.

** SPF correction [illegible] in the 4-E reading with insulated pins. It is based on [illegible] Intek data and can also be used for the following species:

Lodgepole Pine
Alpine Fir
Eastern White Spruce
Black Spruce
Jack Pine

>>>> The species correction values shown in this chart have been rounded for easy reference.

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CARE INSTRUCTIONS:

To keep your new moisture meter in good working order:

- Store your meter in a clean, dry place. The protective carrying case provided is an ideal storage place when the meter is not in use.
- Change battery as needed. Continued use with a low battery may cause the meter to go out of calibration.
- Change pins as needed. Keep retainers tightened.
- Clean the meter and electrode with any biodegradable cleaner. Use the cleaner sparingly and on external parts only.

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IF YOUR INSTRUMENT NEEDS SERVICE:

- Pack the instrument and electrode securely. Enclose a purchase order or letter with brief description of malfunction.
- There is no need to call us for a Return Authorization Number if you are within the U.S. Customers from abroad must contact us for more specific instructions prior to returning an instrument.
- Include your name, address, and daytime phone and fax numbers. If you believe your meter is under warranty, please provide the original sales slip or invoice.
- Ship via UPS. Express Mail or any overnight courier also provide prompt service. Do not use parcel post.
- Insure your instrument for its full value and ship prepaid. We are not responsible for damage in transit.
- We do not accept COD shipments, or cover any incoming freight or duty charges on returned merchandise.

TERMS:

- Non-warranty repairs will be returned via UPS/COD unless you have already established other payment terms. There is no COD service outside the U.S. To pay by credit card, include the card number and expiration date with your repair. We accept VISA/MASTERCARD, AMERICAN EXPRESS AND DISCOVER.
- Warranty repairs will be returned at no charge if shipped within the U.S. via UPS Ground Service. Freight charges for expedited services (ie., Federal Express, UPS/2 Day, UPS/1 Day, etc) are the customer's responsibility, and will be charged as per the above terms.
- We will call you with an estimate if you specifically request one, or if we determine that the meter may be too costly to repair.
- Turnaround time on most repairs is approximately two weeks.

WARRANTY:

Delmhorst Instrument Co., referred to hereafter as Delmhorst, guarantees its moisture meters/electrodes ("instruments") against defects in parts and/or workmanship for the specified period from date of purchase. This is a limited warranty. The Warranty does not cover batteries, pins, or damage due to accidents, abuse, or unauthorized service. If the instrument has been tampered with, the warranty shall be void.

Delmhorst makes no representations or warranties, express or implied, of any kind whatsoever, including representations or warranties of merchantability or fitness for any particular purpose other than as set forth herein. Under no circumstances shall Delmhorst be liable for any incidental, indirect, special or consequential damages of any type whatsoever, including, but not limited to, lost profits or downtime arising out of or related in any respect to its instruments or any defect or failure therein. The express warranty set forth above constitutes the entire warranty with respect to Delmhorst "instruments" and no other warranty, written, oral or implied applies.

In the event any defect in material or workmanship exists, the purchaser's sole and exclusive remedy will be the repair or replacement, at Delmhorst's sole option, free of charge to the purchaser, said repair or replacement to be at Delmhorst's plant provided the "instrument" is returned by the purchaser during the warranty period prepaid and fully insured.

Specific warranty periods for each instrument:

J-4 - 1 Year
J-2000 - 1 Year
J-LITE - 3 Years
Electrodes - 90 Days

DELMHORST INSTRUMENT CO.
51 INDIAN LANE EAST
P.O. BOX 68
TOWACO, NJ 07082
(800) 222-0638

ADDENDUM TO OPERATING INSTRUCTIONS FOR J-2000

VERSION 1.4 - ALL INSTRUMENTS STARTING WITH SN 13898 (EXCLUDING 13901).

ADD:

Code no. 48 - WESTERN HEMLOCK - COFI

Species and temperature correction data for both WESTERN HEMLOCK and SPF - COFI (code no. ~~44~~) was developed by COFI.

NOTE: WHEN COMPARING READINGS BETWEEN THE RDM-2/COFI OR THE RDM-2S/COFI, USED WITH TYPE 26-E ELECTRODE WITH INSULATED PINS , AND THE J-2000, BE SURE BOTH METERS ARE SET TO 2-PIN ELECTRODE (INSULATED PINS).

DELMHORST INSTRUMENT CO.
TOWACO,N.J. 07082

9/96

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Negative Pressure or Vacuum Measurement

Zero the gage. Connect the source of vacuum or negative pressure to the right side gage connection (5) and proceed as described under Positive Pressure Measurement Section above. Remember that the pressure measured in this way is negative.

Differential Pressure Measurement

Differential pressures may be measured by connecting the higher (more positive) pressure to the left connection (2) and the lower pressure to the right connection (5).

Storage

Turn meter circuit switch to "off" position and withdraw "hook" point well clear of fluid (by turning Micrometer counter-clockwise) when gage is not in use. This will conserve the batteries and minimize build-up of oxides, etc., on the "hook." Keep the unit covered and in an area free of strong solvent fumes.

Maintenance

When the meter reading becomes reduced or the pointer movement gets sluggish (with circuit on and "hook" point in fluid), the following should be done:

1. Remove the hook point (by unscrewing) and clean the tip lightly using fine crocus cloth. Wipe off all grit and dirt with a clean rag, reassemble and recheck meter operation.
2. If the meter operation continues to be sluggish, replace the size AA, 1½ volt battery. (Replace the battery at least once a year to avoid deterioration of battery and damage to gage. Leakproof alkaline battery is recommended.)

To replace the battery, remove center screw (10) located in the back of the electronic enclosure. Cover (9) will come off exposing the battery. Pull the old battery out and push a new battery into the battery holder with the positive (center) terminal to the right (to the end marked with a + on the holder).

If the fluid becomes contaminated and requires replacement; empty old fluid from gage; flush out with clear water and replace with distilled water and Dwyer A126 Fluorescein Green Color Concentrate mixed 3/4 oz. concentrate to each quart of water. (CAUTION: Do not substitute other gage fluids as proper gage operation depends on use of the specified gage fluid to provide proper surface tension, wetting ability and electrolyte capability with unity specific gravity.)

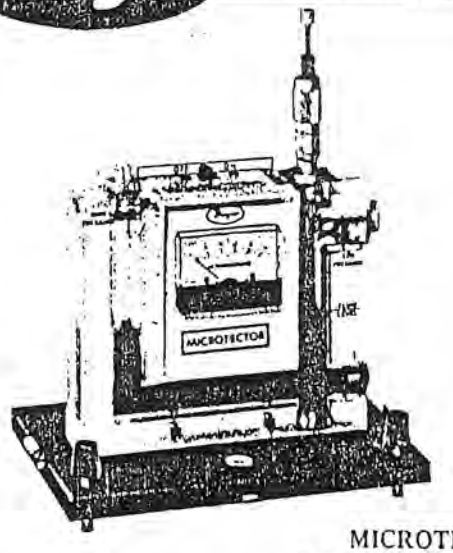
If the gage bore is very dirty, a mild soap solution may be used to aid in cleaning prior to flushing with clear water. (CAUTION; Do not clean with liquid soaps, special solvents, degreasers, aromatic hydro-carbons, etc. Such cleaners and solvents frequently contain chlorine, fluorine, acetone and related compounds which will permanently damage the gage, and prevent proper operation.)

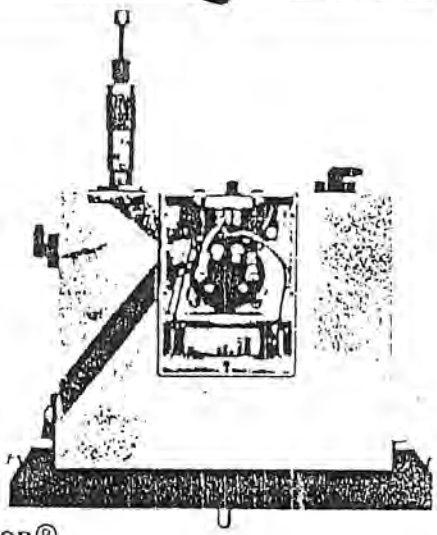
If meter becomes inoperative and cannot be made to operate properly by cleaning "hook" tip or replacing battery, return the entire gage to Dwyer Instruments, Inc., for service.

"Microtector" ®
A Product From
Dwyer Instruments, Inc.
"The Low Pressure People"

38-440190-00

DWYER INSTRUMENTS, INC.
P. O. Box 373, Michigan City, Indiana 46360, U.S.A.
Phone: Area 219 / 872-9141
Direct Chicago Line: Area 312 / 733-7883





MICROTECTOR®
Specifications and Features*

Time Proven Hook Gage Manometer Combined with Modern Electronics For Easier, Faster, more Accurate Precision Pressure Measurements.

Accurate and Repeatable to ±.00025 inches water column (.000009 P.S.I.).

Pressure Range 0-2" w.c. Positive, Negative or Differential Pressures.

Non Toxic and Inexpensive Gage Fluid Consists of Distilled Water Mixed with a Small Amount of Dwyer Color and Wetting Agent Concentrate.

Convenient, Portable, Light Weight, and Self-Contained, the Unit Requires No External Power Connections and is Operated by a 1½ Volt Penlight Cell.

A.C. Detector Current Eliminates Hook Plating, Fouling and Erosion.

Micrometer Complies with Federal Specification GGG-C-105A and is Traceable to a Master at the National Bureau of Standards.

Three Point Mounting with Dual Leveling Adjustment and Circular Level to Assure Rapid Set Up.

Durablock® Precision Machined Acrylic Plastic Gage Body.

Sensitive 0-50 Microamp D.C. Meter Acts as Detector and Also Indicates Battery and Hook Probe Condition.

Heavy One Half Inch Thick Steel Base Plate Provides Steady Mounting.

Top Quality Glass Epoxy Circuit Board and Solid State-Integrated Circuit Electronics.

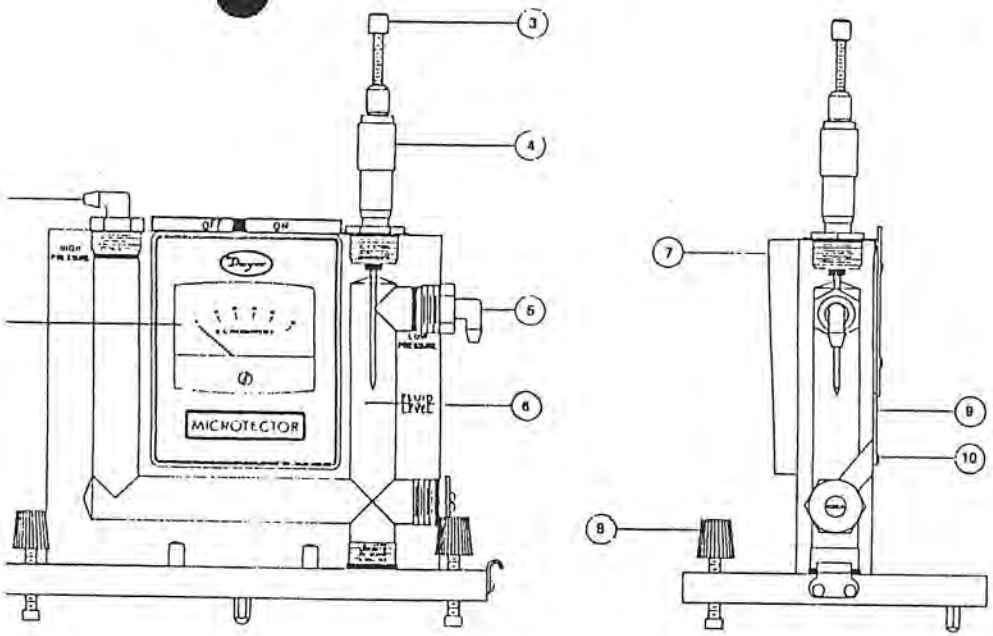
Electronic Enclosure of Tough Molded Styrene Acrylonitrile Provides Maximum Protection to Components Yet Allows Easy Access to Battery Compartment.

Rugged Sheet Steel Cover and Carrying Case Protects the Entire Unit When Not in Use.

Accessories Included are (2) 3 Foot Lengths Tygon Tubing, (2) 1/8" Pipe Thread Adapters and 3/4 oz. bottle of Fluorscein Green Color Concentrate with Wetting Agent.

**Patent Applied For*

DWYER INSTRUMENTS, INC.
P. O. BOX 373 • MICHIGAN CITY, INDIANA 46360 U.S.A.
Telephone 219/872-9141, or
Chicago 312/733-7883



MICROTECTOR® GAGE

Precision Pressure Measurement

The Dwyer Microtector® combines the time proven principles of the Hook Gage type manometer and modern solid state integrated circuit electronics. It provides an inexpensive means of achieving accuracy and repeatability within ± .00025 inches water column throughout its 0 to 2 inches w.c. range. It is truly a new standard in precision pressure measuring devices.

Principles of Operation

A pressure to be measured is applied to the manometer fluid which is displaced in each leg of the manometer by an amount equal to ½ the applied pressure. A micrometer mounted hook is then lowered until it contacts the manometer gage fluid. The instant of contact is detected by completion of a low power A.C. circuit. Current for this circuit is supplied by a 1½ volt penlight cell feeding two semiconductor amplifiers which act as a free-running multivibrator operating at a frequency of approximately two kilohertz. Completion of the A.C. circuit activates a bridge rectifier which provides the signal for indication on a sensitive (0 to 50 microamps) D.C. microammeter.

On indication of contact the operator stops lowering the hook and reads the micrometer which indicates one half the applied pressure. By reading the micrometer to the closest .000125 inches a total accuracy of .00025 inches w.c. is easily achieved. The micrometer complies with Federal Specification GGG-C-105A and is traceable to a master at the National Bureau of Standards.

Locating and Opening

Stand the Microtector and case on a firm flat level surface. Remove the cover by releasing the latches and lifting straight up. If it is necessary to move the gage without case, handle only the base plate or clear acrylic block. (CAUTION: Do not handle gage by grasping meter-electronic package housing Item 7 on drawing.)

Fluid Level

Level the gage by adjusting the two front leveling screws (Item 8 on drawing) until the bubble in the spirit level is centered in the small circle. After leveling the gage, open both rapid shut off valve tube connectors (2 and 5). Back off the Micrometer (4), if necessary, to make sure that the point or "Hook" is not immersed in the gage fluid. The fluid level in the gage should now coincide with the mark on the right hand bore plus or minus approximately 1/32 inch (6). If the level of fluid is too high, fluid can be removed with an eye dropper, pipette or carefully poured out of the right connection (5). If the level is too low, remove the top left rapid shut off valve tube connector (2), and add distilled water pre-mixed with the proper amount of Dwyer green concentrate. (See maintenance instruction for proportions.) After correcting the fluid level, reinstall the rapid shut off connectors and with them in the open position, relevel the Microtector. The gage is now ready to be zeroed.

Zeroing

Turn the Micrometer barrel (4) until its lower end just coincides with the zero mark on the internal vertical scale *and* the zero on the barrel scale coincides with the vertical line on the internal scale. Note that the internal scale is graduated every .025" from 0 to 1.00 inch and the barrel scale is graduated in one thousandths from 0 to .025." Turn the meter circuit switch at the top of gage to the "on" position. While holding the barrel at the zero position (and with the gage level), raise or lower the "hook" by turning the top knurled knob (3) until the "hook" or point is above, but near the fluid.

Check to be sure that the meter (1) registers zero. Watch the meter, hold the barrel (4) and lower the hook slowly by turning the top knurled knob (3). As the knob is turned, the point of the "hook" will contact the fluid and the meter pointer will move from zero to some upscale position. After making contact, turn the hook out of the fluid by turning the Micrometer barrel counter-clockwise to a reading of .010 or more. Again watch the meter and, this time, lower the hook by turning the Micrometer barrel. The "hook" position wh[illegible] meter pointer begins to move u[illegible]cale is the zero position. This position should correspond to the zero reading on the Micrometer. Adjust the hook in relation to the Micrometer barrel by turning the top knob while holding the barrel steady. Repeat lowering the hook, watching the meter for contact, and adjusting the hook until the zero position and zero reading exactly coincide. The gage is now zeroed and should not be moved.

An alternate method of zeroing and reading can be used wherein, instead of zeroing the gage completely, a zero correction reading is taken and recorded then subtracted from the final readin[illegible] Comparable results can be obtained w either method.

Positive Pressure Measurement

With the fluid at its proper level, a pressure of 2.0" water column maximum can be measured. Positive pressure should be applied to the top left connection (2) with the Micrometer zeroed as described above. This will permit simple direct readings to be taken.

After an unknown pressure has been applied at the top left connection, the fluid level will drop in the left bore and rise over the "hook" point in the right bore. Note the indicating meter pointer has moved upscale because the "hook" is immersed in the fluid. Turn the Micrometer counter-clockwise until the "hook" point leaves the fluid as indicated by the meter pointer dropping to zero on scale. Then slowly turn the Micrometer down until its point or "hook" just touches the fluid surface causing movement of the meter pointer. Withdraw the hook and repeat several times noting each time the Micrometer reading where the meter pointer movement begins. The average of these readings multiplied by two is the pressure applied to the gage. (Avg. reading x 2 = pressure applied in inches w.c.)

When the readings are complete the pressure should be removed and the zero-setting of the Microtector® rechecked. Any change in the zero position will indicate inaccurate readings. Should this happen the zero-set and pressure measurement procedure should be repeated.

BULLETIN NO. H-11

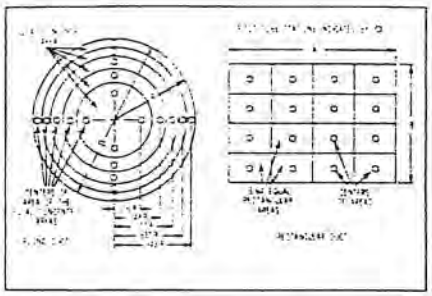
AIR VELOCITIES WITH THE DWYER PITOT TUBE

AIR VELOCITY

The total pressure of an air stream flowing in a duct is the sum of the static or bursting pressure exerted upon the sidewalls of the duct and the impact or velocity pressure of the moving air. Through the use of a pitot tube connected differentially to a manometer, the velocity pressure alone is indicated and the corresponding air velocity determined.

For accuracy of plus or minus 2%, as in laboratory applications, extreme care is required and the following precautions should be observed:

1. Duct diameter 4" or greater.
2. Make an accurate traverse per sketch at right, calculate the velocities and average the readings.
3. Provide smooth, straight duct sections a minimum of 8½ diameters in length upstream and 1½ diameters downstream from the pitot tube.
4. Provide an egg crate type straightener upstream from the pitot tube.



In making an air velocity check select a location as suggested above, connect tubing leads from both pitot tube connections to the manometer and insert in the duct with the tip directed into the air stream. If the manometer shows a minus indication reverse the tubes. With a direct reading manometer, air velocities will now be shown in feet per minute. In other types, the manometer will read velocity pressure in inches of water and the corresponding velocity will be found from the curves in this bulletin. If circumstances do not permit an accurate traverse, center the pitot tube in the duct, determine the center velocity and multiply by a factor of .9 for the approximate average velocity. Field tests run in this manner should be accurate within plus or minus 5%.

The velocity indicated is for dry air at 70°F., 29.9" Barometric Pressure and a resulting density of .075#/cu. ft. For air at a temperature other than 70°F. refer to the curves in this bulletin. For other variations from these conditions, corrections may be based upon the following data:

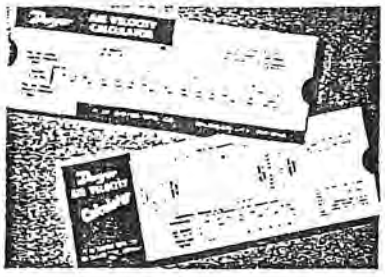
$$\text{Air Velocity} = 1096.2 \sqrt{\frac{P_V}{D}}$$

where P_V = velocity pressure in inches of water
D = Air density in #/cu. ft.

$$\text{Air Density} = 1.325 \times \frac{P_B}{T}$$

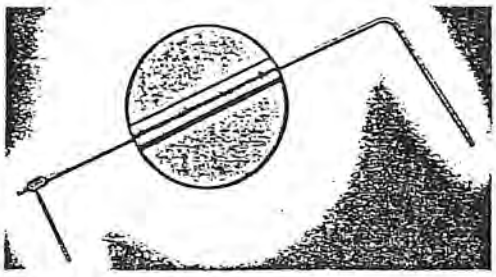
where P_B = Barometric Pressure in inches of mercury
T = Absolute Temperature (indicated temperature °F plus 460)

Flow in cu. ft. per min. = Duct area in square feet x air velocity in ft. per min.



AIR VELOCITY CALCULATOR

Computes velocity based on air density corrected for conditions of temperature and pressure. Eliminates tedious calculations. Ranges from .01 to 10" water corresponding to 400 to 20,000 FPM. Furnished with each pitot tube.



STAINLESS STEEL PITOT TUBES

Test confirmed unity coefficient and lifetime construction of No. 304 stainless steel. Inch graduations show depth of insertion for traversing. Complies with AMCA and ASHRAE specifications. Sizes 12" to 60" long. Hand or fixed mounting types.

LITHOGRAPHED IN U.S.A. 3/84

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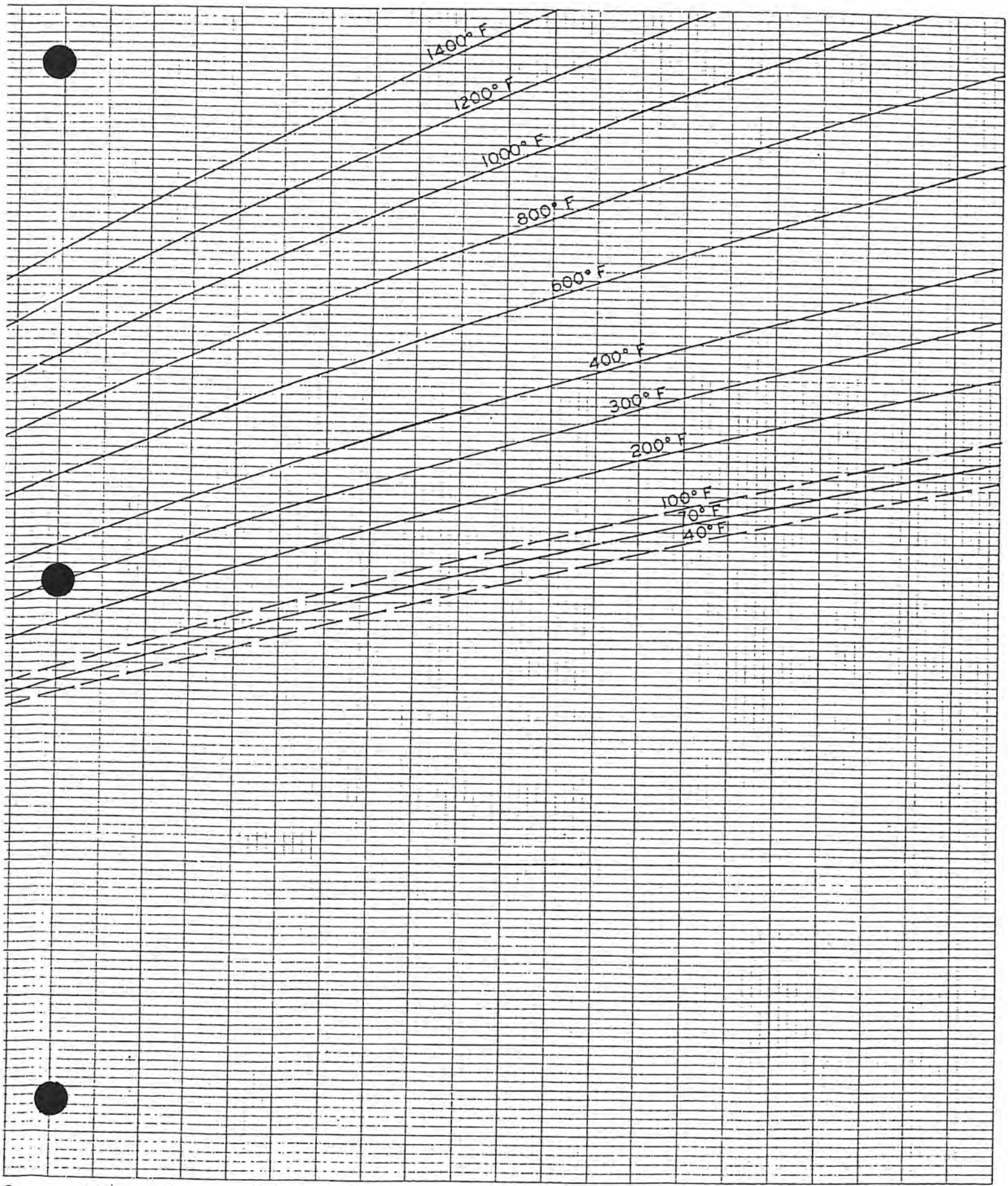
1400° F
1200° F
1000° F
800° F
600° F
400° F
300° F
200° F
100° F
70° F
40° F
.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
Tube (Velocity Pressure) in Inches of Water

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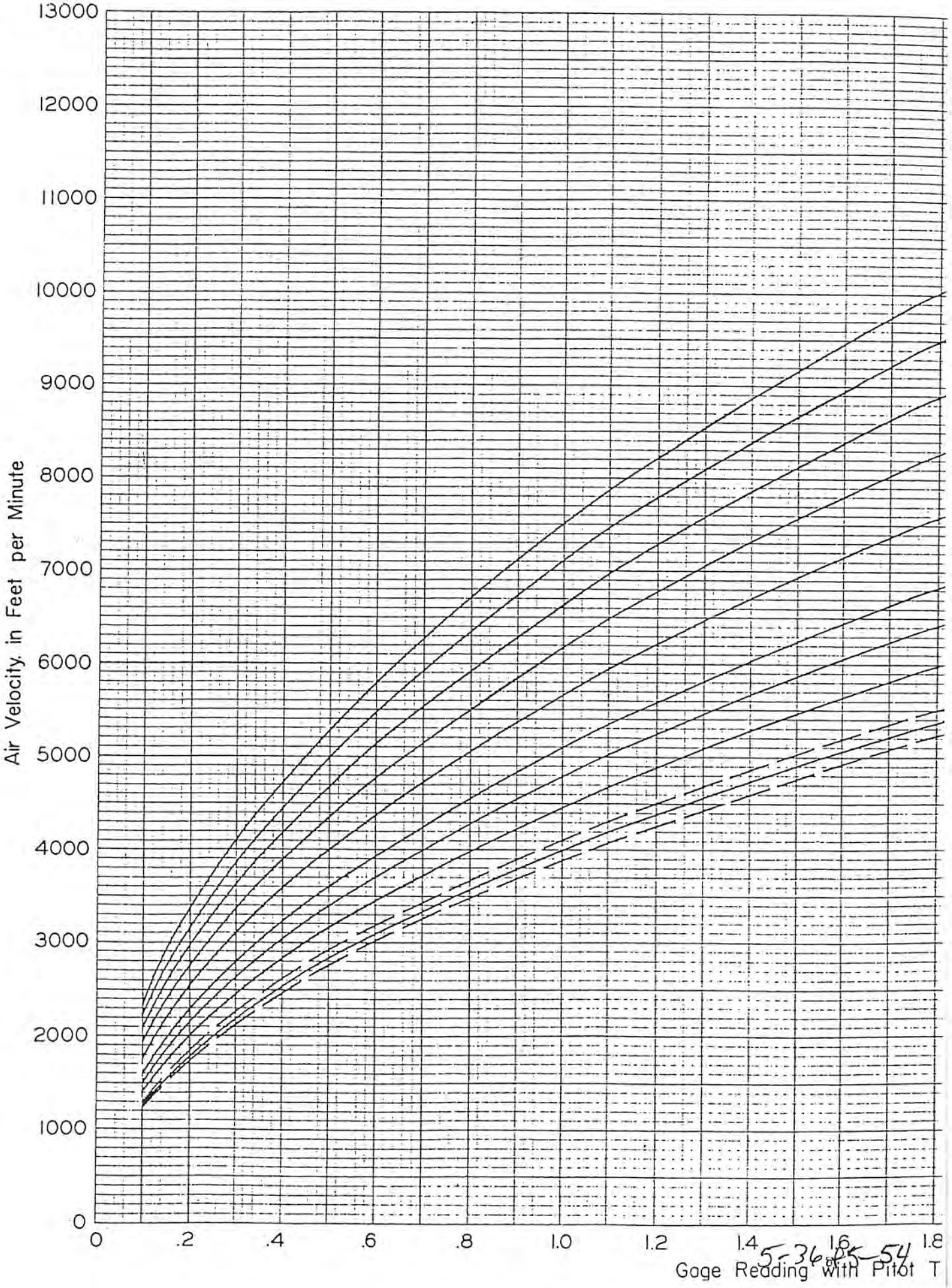
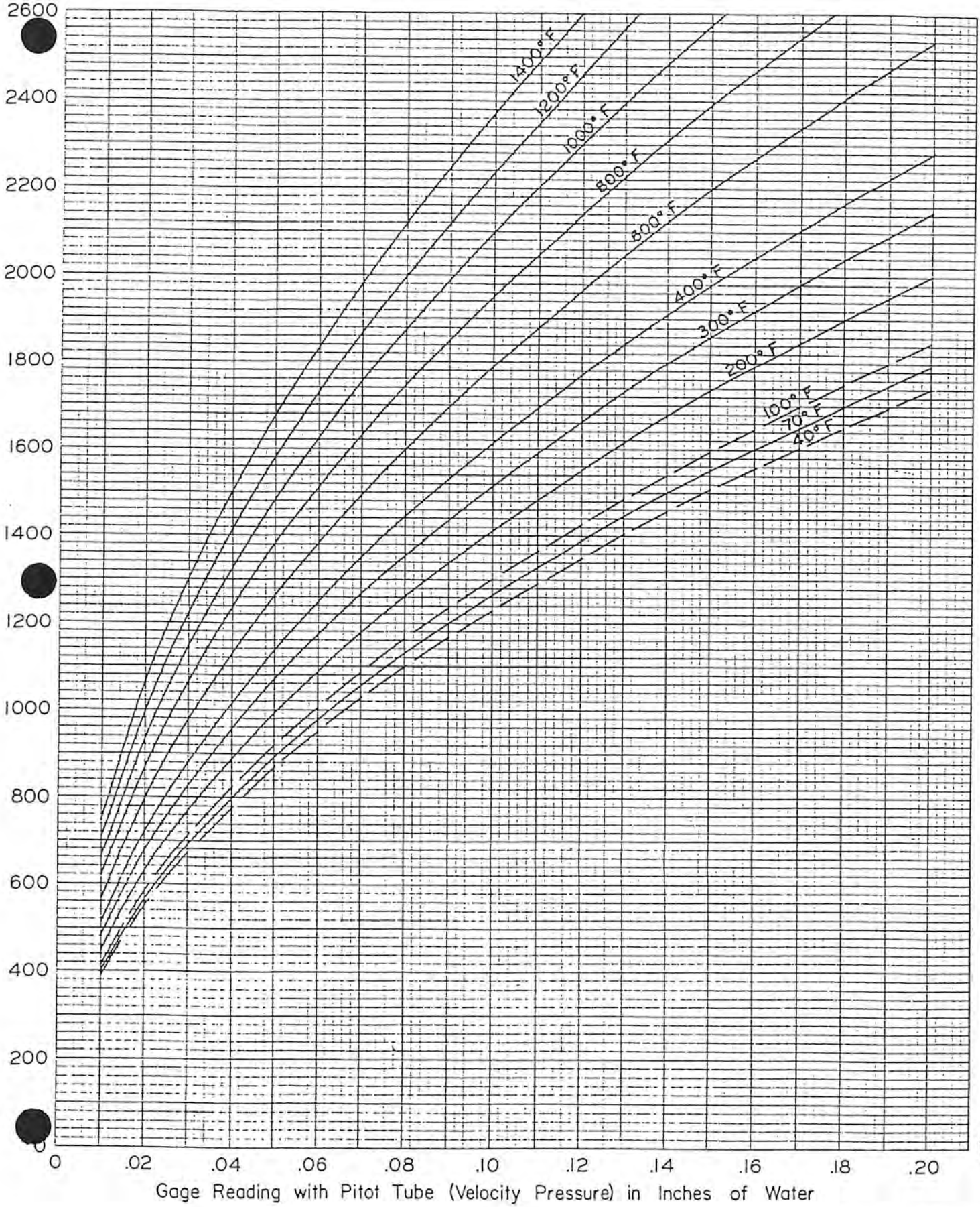

13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Air Velocity, in Feet per Minute
0
.2
.4
.6
.8
1.0
1.2
1.4
1.6
1.8
Gage Reading with Pitot T


2600
2400
2200
2000
1800
1600
1400
1200
1000
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600
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200
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1400° F
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1000° F
800° F
600° F
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200° F
100° F
70° F
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0
.02
.04
.06
.08
.10
.12
.14
.16
.18
.20
Gage Reading with Pitot Tube (Velocity Pressure) in Inches of Water

5-37 of 5-54

Thermal Metering System Calibration
Y and dH@

Manufacturer: American Meter Co.
Model: DTM-200A
Serial Number: W492393
OMNI Tracking No.: 141

Average Orifice Meter dH@	Average Gas Meter y Factor
1.377	1.005

Calibration Date: February 5, 2002
Calibrated by: B. Davis
Calibration Frequency: Annualy
Next Calibration Due: August 6, 2002
Instrument Range: 1.000 cfm
Standard Temp.: 68 oF
Standard Press.: 29.92 "Hg
Barometric Press.: 30.01 "Hg
Signature/Date: BD

Previous Calibration Comparision

Date	08/03/01	Acceptable	
dH@ Value	NA	Deviation (5%)	Deviation
y Factor	0.971	0.04855	0.034
Acceptance	Acceptable		

Current Calibration

Acceptable y Deviation	0.020
Maximum y Deviation	0.002
Acceptable dH@ Deviation	0.200
Maximum dH@ Deviation	0.023
Acceptance	Acceptable

Reference Standard *			
Standard Calibrator	Model	Standard Test Meter	
	S/N	OMNI-00001	
	Calib. Date	04-Feb-02	
	Calib. Value	1.0130	y factor (ref)

Calibration Parameters	Run 1	Run 2	Run 3
Vacuum ("Hg)	0.00	0.00	0.00
dH ("H2O)	3.00	1.00	0.50
Initial Reference Meter	732.923	738.634	743.785
Final Reference Meter	738.356	743.618	749.026
Initial DGM	204.459	210.201	215.396
Final DGM	209.918	215.239	220.696
Temp. Ref. Meter (°F), Tr	61.0	61.0	61.0
Temperature DGM (°F), Td	64.0	63.0	63.0
Time (Minutes)	5.0	8.0	12.0
Net Volume Ref. Meter, Vr	5.433	4.984	5.241
Net Volume DGM, Vd	5.459	5.038	5.3
Gas Meter y Factor =	**1.007**	**1.004**	**1.004**
Gas Meter y Factor Deviation (from avg.)	0.002	0.001	0.000
Orifice dH@	**1.35**	**1.38**	**1.40**
Orifice dH@ Deviation (from avg.)	0.022	0.001	0.023

Note: Adjusted Tangent ball to achieve 'Y' as found was = .960

where:

1. Deviation = |Average value for all runs - current run value|
2. y = [Vr x (y factor (ref)) x (Pb) x (Td + 460) / [Vd x (Pb + (dH / 13.6)) x (Tr + 460]
3. dH@ = 0.0317 x dH / (Pb (Td + 460)) x [(Tr + 460) x time) / Vr]^2

* Reference calibration is traceable to NIST through NIST Test # 40674, Kimble ASTM E1272

OMNI-Test Laboratories, Inc.
Beaverton, OR (503) 643-3788

Temperature Calibrations
Stove Surface Thermocouples

Temperature Monitor Type: T.C. LED Readout

OMNI Identification No.: 00112

Reference Temperature Calibration Device: CL 300 TC. Simulator

OMNI Identification No.: 00117

Calibration Performed by: Ken Ambient Temperature: 76 °F

Date: 06/19/02 Barometric Pressure: 29.96 In Hg

Barometer ID #: OMNI - 209

Reference Temperature Input (°F)	Temperature Monitor Response (°F)					
	Top	Bottom	Back	Left	Right	
200	201	201	201	200	201	
400	401	402	402	401	401	

Technician signature: K. J. Morgan Date: 6-19-02

Model: Panther 2110 B
Morsø Jernstøberi A/S
DK-7900
Nykøbing Mors
Denmark

Calibrations

Methods 28 and 5G

6-Month

Method 28:

ID #	Lab Name/Purpose	Log Name	Attachment Type
32	Vaneometer	Vaneometer, Air Velocity Meter-Dwyer	Calibration Log
112	Thermometer	Temperature Controller Meter - Omega Engineering	Calibration Log
126	Draft Gauge	Magnehelic, 0-0.25" H2O - Dwyer	Calibration Log
156	Incline Manometer	Incline Manometer 0-10" - Dwyer	Calibration Log
175	Relative Humidity Gauge	Digital Hygrometer/Thermometer-VWR	Calibration Log
185	Platform Scale	Weight Indicator, WI-127 - Weigh-Tronix	Calibration Log
209	Barometer	Barometer – Princo	Manual Cover

Method 5G:

ID #	Lab Name/Purpose	Log Name	Attachment Type
1	Calibrator Dry Gas Meter	Standard Test Meter - Rockwell Int'l	Calibration Log
23	Scale-Analytical Balance	Analytical Balance-Mettler Instrument	Calibration Log
117	Thermocouple Simulator	Standard Thermocouple Calibrator - Omega Engineering	Calibration Log
131	500 mg Weight	Weight Standard, 500 mg-Ohaus	Calibration Log
132	10 lb Weight	Weight Standard, 10 lb.	Calibration Log
141	Dry Gas Meter	Dry Gas Meter, Singer	Calibration Log

CALIBRATION RECORD

Vaneometer Air Velocity Meter – OMNI-00032

CALIBRATION/SERVICE RECORD			
DATE	**BY**	**RESULTS**	**DATE OF NEXT CALIBRATION**
3/10/98	BD	Installed new vane from factory	9/10/98
9/3/98	BD	Installed new vane from factory	3/3/99
3/8/99	JS	Installed new vane from factory	9/8/99
9/10/99	BD	Installed new vane from factory	3/10/00
3/10/00	BD	Installed new vane from factory	9/10/00
9/13/00	BD	Installed new vane from factory	3/13/01
5/4/01	BD	Installed new vane from factory	11/4/01
11/30/01	BD	Installed new vane from factory	5/30/02
3/20/02	BD	Installed new vane from factory	9/20/02
		Installed new vane from factory	
		Installed new vane from factory	
		Installed new vane from factory	
		Installed new vane from factory	
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		Installed new vane from factory	
		Installed new vane from factory	

OMNI-Test Laboratories, Inc. (
Beaverton, OR Phone (503) 643-3788

Temperature Calibration
EPA Method 28 and 5G

Booth: 1	Temperature Monitor Type:	Identification Number:
Emissions	IBM Data Acquisition System	~~OMSE025~~ 1K 112

Reference Temperature Monitor Type:	Identification Number:
OMEGA Calibrator Model CL300	Serial Number ~~506~~ K 117

Calibration Performed By:	Date:	Ambient Temperature:	Barometric Pressure:
Ken Morgan	4-22-02	67	30.10

Reference Point Source	Temperature Monitor (°F)					
		Method 5G Dilution Tunnel				
OMEGA Thermocouple Simulator Serial #506	Method 28 Room	Meter (Tm)	Filters (Tf)	Tunnel (Tt)	Dryer (Ts)	DB
0	Ø	-1	-1	-1	-1	
100	99	99	98	98	98	
300	303	302	302	302	301	
500	501	501	500	500	500	
700	701	701	700	700	699	

Technician signature: K. J. Morgan Date: 4-22-02

OMNI Environmental Services, Inc.
OMNI-Test Laboratories, Inc.
Beaverton, OR Phone (503) 643-3788

DIFFERENTIAL PRESSURE GAUGE CALIBRATION DATA SHEET
Magnehelic Gauge

Instrument to be calibrated: Magnahelic

Range: 0 - .25 "w.c. ID Number: 00126

Calibration Instrument: ~~Liquid~~ DIGITAL Manometer ID Number: 00186

Date: 4-22-02 By: K

Liquid Manometer (A) (inches of H_20)	Magnehelic Gauge (B) (inches of H_20)	Difference (A - B)	% Error of Full Span*
0.08	0.083 K	0.007	1~ 2.8 %
0.12	0.115	0.005	2.0 %
0.18	0.175	0.005	2.0 %
0.25	0.240	0.010	4.0 %

*Acceptable tolerance is 4%.

This calibration is traceable to NIST through the Dwyer Liquid Manometer, NIST Test #MAS 822/254143-94.

Technician signature: K. J. Morgan Date: 4-22-02

OMNI Environmental Servic Inc.
OMNI-Test Laboratories, Inc.
Beaverton, OR Phone (503) 643-3788

DIFFERENTIAL PRESSURE GAUGE CALIBRATION DATA SHEET
Liquid Manometer Gauge

Instrument to be calibrated: Incline Manometer

Range: 0 – 10 "w.c. ID Number: 00156

Calibration Instrument: Liquid Manometer ID Number: 00133

Date: 4-22-02 By: K. Morgan

Liquid Manometer (A) REF. (inches of H_20)	Liquid Manometer (B) (inches of H_20)	Difference (A - B)	% Error of Full Span*
10.0	10.0	0	0
5.0	5.0	0	0
1.5	1.5	0	0

*Acceptable tolerance is 4%.

This calibration is traceable to NIST through the Dwyer Liquid Manometer, NIST Test #MAS 822/254143-94.

Technician signature: K. J. Morgan Date: 4-22-02

Certificate of Calibration

Certificate # 242036 Page # 1 of 1 Order Date: 05Feb2002

[redacted] OMNI-TEST LABORATORIES 56

Department: NO PO#: WILL CAL IN P.O#

JJ Calibrations, Inc.

Instrument Identification

Property #: OMNI-00175 Serial #: 99130268

Make: VWR User:

Model: 35519-045

Noun: TEMP/HUM METER

Accuracy: ± 1°C ± 4%RH

Certification Information

As Found: Within Tolerance Cal Date: 06Feb2002

As Left: Within Tolerance *Due Date: 06Feb2003

Adjustments: None Repairs: None Seals: Intact

Procedure: CP 1

Environment: 22°C 30% RH

Technician: 79

Remarks

SEE DATA SHEET

*Any number of factors may cause this item to drift out of calibration before the recommended due date has expired.

Standards Used

ID#	Manufacturer	Model#	Nomenclature	Due Date	Trace ID
464	GENERAL EASTERN	M4-RH/D2	HUMIDITY STANDARD	22Jun2002	222673
497	HART SCIENTIFIC	1502A	TWEENER THERMOMETER	05Apr2002	215004
498	BURNS ENGR.	200G05B085	INDUSTRIAL PRT	05Apr2002	215005

JJ Calibrations, Inc., certifies that this instrument has been compared in accordance with the above referenced procedure using standards with accuracies traceable to the National Institute of Standards and Technology, derived from accepted values of physical constants, derived from ratio measurements, or compared to consensus standards. The results contained herein relate only to the item calibrated. This certificate is in compliance with the applicable requirements of; MIL-STD-45662A and ISO-9002.
A Test Accuracy Ratio (TAR) of at least 4:1, if achievable, is maintained unless otherwise stated.

[redacted] Moyer
Manager

Jodi L Martine
Quality Assurance

Issued 08Feb2002
Rev # 11

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H. HV. DRUCE DAVIS

Weigh-Tronix, Inc.
7933-SW Nimbus Ave. #28
Beaverton, OR 97005
503-626-3008
1-800-878-3008

WEIGH-TRONIX

SERVICE WORK ORDER

SHIP TO
NAME OMNI ENVIRONMENTAL SERVICES
ADDRESS 5465 SW WESTERN AVE
CITY BEAVERTON STATE OR ZIP 97075
PHONE 503 - 643-3788
FAX
CONTACT Bruce or Richard

JOB No. 111991
CUSTOMER No. / /
Order Date / /
Start Date / /
Complete Date 1 / 11 / 99

BILL TO
NAME
ADDRESS PO BOX 743
CITY STATE ZIP
ATTN:

P.O. No. 99-007

EQUIPMENT:

S/N	Location	Type	Cap.	Recommendations and Remarks
5547		WI-127	1K	10,000 DIV
21676		3030	1K	

COMMENTS:

Rental 1 Month

Set up calibrated 1000 x 0.1 LB per. order tested. good.

PARTS:

2.5

Qty.	Description	Price	Total

ZONE _____ VEHICLE _____
TECHNICIAN LD

SERVICE SUMMARY

Reg.	Agree.	Pref.	Inst.
	Hrs. @		
	Mileage		
	Parts		
	Shop Supplies		
	Other		
	TOTAL		

THIS IS NOT AN INVOICE

I acknowledge all service has been performed satisfactorily, as stated above. All parts installed are warranted for thirty days from this date.

Authorized Signature Bruce Davis

WEIGH-TRONIX
Rental / Sales / Service

Print Name Bruce Davis

DAMAGE TO RENTAL/DEMO EQUIPMENT IS SOLELY THE RESPONSIBILITY OF THE USER WHILE IN THEIR POSSESSION!

DISTRIBUTION: WHITE – OFFICE YELLOW – FILE PINK – CUSTOMER

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453
National
Weather
Service
Type

Instruction Booklet

for use with

PRINCO

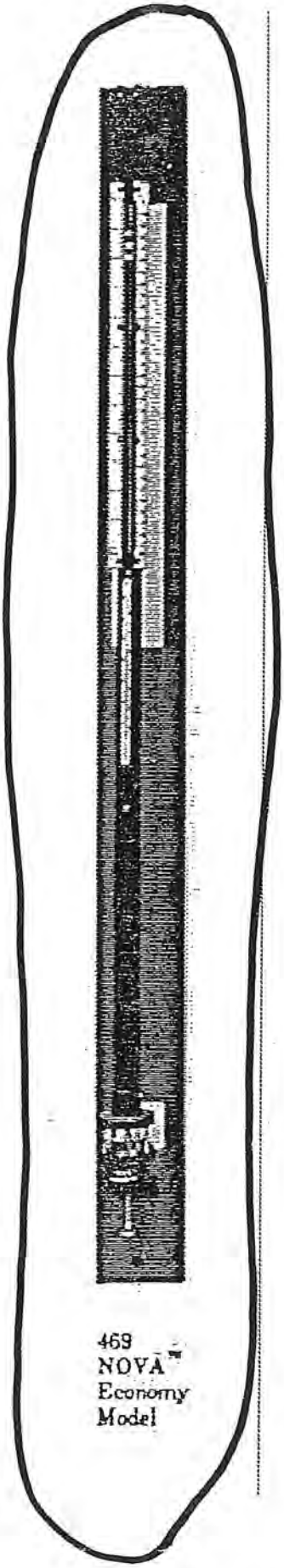
Fortin type mercurial

Barometers

Manufactured by

PRINCO INSTRUMENTS, INC.
1020 Industrial Blvd.
Southampton, Pa. 18966-4095
U.S.A.

Phone: 215 355-1500
Fax: 215 355-7766



469
NOVA™
Economy
Model

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Standard Gas Test Meter Calibration vs. Bubble Flowmeter

Date: 02/04/02
Calibrated by: B. Davis
Standard Test Meter S/N: OMNI 00001
Bubble Flow Meter S/N: OMNI 00134 (Volume: 1.000 liters = 0.035336 ft3, NIST traceable)
Barometric Pressure: 30.11 "Hg

Average Y Factor: 1.0132

Signature/Date:

Flow Rate #1
dH(pressure across meter, "H2O): 0.35

	Run #1	Run #2	Run #3
Standard Test Meter			
Initial Volume (ft3):	680	682.2	684.2
Final Volume (ft3):	682.097	684.098	686.65
Initial Temperature (oF):	62	61	61
Final Temperature (oF):	63	61	62
Elapsed Time (minutes):	5	5	6
(seconds):	30	0	30
Flow rate, Q (cfm):	0.3813	0.3796	0.3769
Bubble Flowmeter			
Time 1:	5.56	5.421	5.59
Time 2:	5.59	5.59	5.59
Time 3:	5.59	5.54	5.65
Time 4:	5.61	5.51	5.68
Time 5:	5.6	5.52	5.7
Initial Temperature (oF):	59	58	57
al Temperature (oF):	58	58	57
acuum ("H20):	0	0	0
Flow rate, Q (cfm):	0.3793	0.3844	0.3758
Y factor:	**1.0016**	**1.0175**	**1.0048**

Deviation of Y factor is acceptable

Flow Rate #2
dH(pressure across meter, "H2O): 0.45

	Run #1	Run #2	Run #3
Standard Test Meter			
Initial Volume (ft3):	687.3	689.3	691.3
Final Volume (ft3):	689.164	691.177	692.96
Initial Temperature (oF):	61	61	61
Final Temperature (oF):	61	61	62
Elapsed Time (minutes):	4	4	4
(seconds):	30	30	0
Flow rate, Q (cfm):	0.4142	0.4171	0.4150
Bubble Flowmeter			
Time 1:	5.01	5.08	5.04
Time 2:	5.03	5.01	5
Time 3:	5	5.03	5.06
Time 4:	5.06	5.02	5
Time 5:	5.02	5.05	5.03
Initial Temperature (oF):	57	57	57
Final Temperature (oF):	57	57	57
Vacuum ("H20):	0	0	0
Flow rate, Q (cfm):	0.4220	0.4208	0.4218
Y factor:	**1.0258**	**1.0159**	**1.0245**

Deviation of Y factor is acceptable

Flow Rate #3
dH(pressure across meter, "H2O): 0.3

	Run #1	Run #2	Run #3
Standard Test Meter			
Initial Volume (ft3):	693.2	695	704.1
Final Volume (ft3):	694.876	696.707	705.962
Initial Temperature (oF):	62	62	60
Final Temperature (oF):	62	62	60
Elapsed Time (minutes):	5	5	5
(seconds):	0	0	30
Flow rate, Q (cfm):	0.3352	0.3414	0.3385
Bubble Flowmeter			
Time 1:	6.23	6.2	6.21
Time 2:	6.31	6.17	6.23
Time 3:	6.24	6.15	6.21
Time 4:	6.25	6.15	6.24
Time 5:	6.28	6.15	6.24
Initial Temperature (oF):	58	57	57
Final Temperature (oF):	58	58	57
Vacuum ("H20):	0	0	0
w rate, Q (cfm):	0.3386	0.3440	0.3405
factor:	**1.0170**	**1.0154**	**1.0108**

Deviation of Y factor is acceptable

Flow Rate #4
dH(pressure across meter, "H2O): 0.5

	Run #1	Run #2	Run #3
Standard Test Meter			
Initial Volume (ft3):	706.8	708.7	710.6
Final Volume (ft3):	708.563	710.466	713.924
Initial Temperature (oF):	60	61	61
Final Temperature (oF):	61	61	61
Elapsed Time (minutes):	4	4	7
(seconds):	0	0	30
Flow rate, Q (cfm):	0.4408	0.4415	0.4432
Bubble Flowmeter			
Time 1:	4.73	4.74	4.75
Time 2:	4.74	4.77	4.73
Time 3:	4.74	4.74	4.72
Time 4:	4.72	4.77	4.74
Time 5:	4.76	4.75	4.74
Initial Temperature (oF):	57	57	57
Final Temperature (oF):	57	57	57
Vacuum ("H20):	0	0	0
Flow rate, Q (cfm):	0.4475	0.4460	0.4477
Y factor:	**1.0213**	**1.0171**	**1.0170**

Deviation of Y factor is acceptable

Standard Gas Test Meter Calibration vs. Bubble Flowmeter

Date: 02/04/02

Calibrated by: B. Davis

Standard Test Meter S/N: OMNI 00001

Bubble Flow Meter S/N: OMNI 00134 (Volume: 1.000 liters = 0.035336 ft3, NIST traceable)

Barometric Pressure: 30.11 "Hg

Average Y Factor: 1.0132

Signature/Date:

Flow Rate #5 dH(pressure across meter, "H2O): 0.55			
	Run #1	**Run #2**	**Run #3**
Standard Test Meter			
Initial Volume (ft3):	714.4	716.4	718.4
Final Volume (ft3):	716.262	718.262	720.52
Initial Temperature (oF):	64	65	62
Final Temperature (oF):	65	65	62
Elapsed Time (minutes):	4	4	4
(seconds):	0	0	30
Flow rate, Q (cfm):	0.4655	0.4655	0.4711
Bubble Flowmeter			
Time 1:	4.56	4.55	4.49
Time 2:	4.57	4.52	4.42
Time 3:	4.57	4.59	4.54
Time 4:	4.6	4.56	4.48
Time 5:	4.59	4.58	4.5
Initial Temperature (oF):	62	62	59
Final Temperature (oF):	62	62	61
Vacuum ("H20):	0	0	0
Flow rate, Q (cfm):	0.4631	0.4649	0.4726
Y factor:	**0.9988**	**1.0037**	**1.0062**
Deviation of Y factor is acceptable			

Acceptance criteria, Method 5 section 16.1.1.5
- The difference between the maximum and minimum values at each flow rate should be no greater than 0.030.
- The meter coefficients (Y) should be between 0.95 and 1.05.

Certificate of Calibration

Certificate # 249390 Page # 1 of 1 Order Date: 17May2002

OMNI-TEST LABORATORIES 56

Department: NO PO#: OnSite

JJ Calibrations, Inc.

Instrument Identification

Property #: OMNI-00023 Serial #: 010644

Make: METTLER User:

Model: AE200

Noun: SCALE

Accuracy: ±0.01% OF APPLIED WEIGHT

Certification Information

As Found: Within Tolerance Cal Date: 17May2002

As Left: Within Tolerance *Due Date: 17Nov2002

Adjustments: None Repairs: None Seals: N/A Environment: 21°C 38% RH

Procedure: CP 16 Technician: 53

Remarks

*Any number of factors may cause this item to drift out of calibration before the recommended due date has expired.

Standards Used

ID#	Manufacturer	Model#	Nomenclature	Due Date	Trace ID
400	RICE LAKE	WEIGHTS	WEIGHT SET	08Jun2002	222666

JJ Calibrations, Inc., certifies that this instrument has been compared in accordance with the above referenced procedure using standards with accuracies traceable to the National Institute of Standards and Technology, derived from accepted values of physical constants, derived from ratio measurements, or compared to consensus standards. The results contained herein relate only to the item calibrated. This certificate is in compliance with the applicable requirements of; MIL-STD-45662A and ISO-9002.
A Test Accuracy Ratio (TAR) of at least 4:1, if achievable, is maintained unless otherwise stated.

Thomas C Moody

[redacted]m Moody
Manager

Jodi L Martine
Quality Assurance

Issued 20May2002
Rev # 11

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Certificate of Calibration

Certificate # 242035 Page # 1 of 1 Order Date: 05Feb2002

For: OMNI-TEST LABORATORIES 56

Department: NO PO#: WILL CALL IN P.O

JJ Calibrations, Inc.

Instrument Identification

Property #: Serial #: 506

Make: OMEGA User:

Model: CL 300

Noun: CALIBRATOR

Accuracy: REFER TO MANUAL

Certification Information

As Found: Out of Tolerance Cal Date: 06Feb2002

As Left: Within Tolerance *Due Date: 06Feb2003

Adjustments: Minor Repairs: None Seals: Intact Environment: 22°C 28% RH

Procedure: MFR MANUAL Technician: 79

Remarks

0°C HIGH 2°C

*Any number of factors may cause this item to drift out of calibration before the recommended due date has expired.

Standards Used

ID#	Manufacturer	Model#	Nomenclature	Due Date	Trace ID
427	FLUKE	5500A-SC300	CALIBRATOR W/300MHz	25Jan2003	239090

JJ Calibrations, Inc., certifies that this instrument has been compared in accordance with the above referenced procedure using standards with accuracies traceable to the National Institute of Standards and Technology, derived from accepted values of physical constants, derived from ratio measurements, or compared to consensus standards. The results contained herein relate only to the item calibrated. This certificate is in compliance with the applicable requirements of; MIL-STD-45662A and ISO-9002.

A Test Accuracy Ratio (TAR) of at least 4:1, if achievable, is maintained unless otherwise stated.

Jason Moyer
Manager

Jodi L Martine
Quality Assurance

Issued 08Feb2002
Rev # 11

5-51 of 5-54

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Certificate of Calibration

Certificate # 232181 Page # 1 of 1 Order Date: 28Sep2001

For: OMNI-TEST LABORATORIES 56

Department: NO PO#: OTL-01-137

JJ Calibrations, Inc.

Instrument Identification

Property #: 27503 Serial #: 27503

Make: OHAUS User:

Model: 500mg

Noun: 500mg WEIGHT

Accuracy: CLASS F

Certification Information

As Found: Within Tolerance Cal Date: 03Oct2001

As Left: Within Tolerance *Due Date: 03Oct2002

Adjustments: None Repairs: None Seals: N/A Environment: 21°C 44% RH

Procedure: CP 16 Technician: 49

Remarks

*Any number of factors may cause this item to drift out of calibration before the recommended due date has expired.

Standards Used

ID#	Manufacturer	Model#	Nomenclature	Due Date	Trace ID
479	SARTORIUS	MC210S	210 GRAM SCALE	17Oct2001	203503

JJ Calibrations, Inc., certifies that this instrument has been compared in accordance with the above referenced procedure using standards with accuracies traceable to the National Institute of Standards and Technology, derived from accepted values of physical constants, derived from ratio measurements, or compared to consensus standards. The results contained herein relate only to the item calibrated. This certificate is in compliance with the applicable requirements of; MIL-STD-45662A and ISO-9002.
A Test Accuracy Ratio (TAR) of at least 4:1, if achievable, is maintained unless otherwise stated.

Tom Moody
Manager

Jodi L Martine
Quality Assurance

Issued 04Oct2001
Rev # 11

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Certificate of Calibration

Certificate # 232180 Page # 1 of 1 Order Date: 28Sep2001

For: OMNI-TEST LABORATORIES 56

Department: NO PO#: OTL-01-137

JJ Calibrations, Inc.

Instrument Identification

Property #: 27502 Serial #: 27502

Make: UNKNOWN User:

Model: 10lb

Noun: 10lb WEIGHT

Accuracy: ASTM E617

Certification Information

As Found: Within Tolerance Cal Date: 03Oct2001

As Left: Within Tolerance *Due Date: 03Oct2002

Adjustments: None Repairs: None Seals: N/A Environment: 21°C 44% RH

Procedure: CP 16 Technician: 49

Remarks

*Any number of factors may cause this item to drift out of calibration before the recommended due date has expired.

Standards Used

ID#	Manufacturer	Model#	Nomenclature	Due Date	Trace ID
550	AND	HP-30K	30k GRAM BALANCE	06Feb2002	210998

JJ Calibrations, Inc., certifies that this instrument has been compared in accordance with the above referenced procedure using standards with accuracies traceable to the National Institute of Standards and Technology, derived from accepted values of physical constants, derived from ratio measurements, or compared to consensus standards. The results contained herein relate only to the item calibrated. This certificate is in compliance with the applicable requirements of; MIL-STD-45662A and ISO-9002.
A Test Accuracy Ratio (TAR) of at least 4:1, if achievable, is maintained unless otherwise stated.

Thomas C Moody

Tom Moody
Manager

Jodi L Martine

Quality Assurance

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7007 SE Lake Rd. • Portland, OR 97267-2105 • Telephone (503) 786-3005 • Fax (503) 786-2994 • www.jjcalibrations.com

Thermal Metering System Calibration
Y and dH@

Manufacturer:	American Meter Co.
Model:	DTM-200A
Serial Number:	W492393
OMNI Tracking No.:	141

Average Orifice Meter dH@	Average Gas Meter y Factor
1.377	1.005

Calibration Date:	February 5, 2002
Calibrated by:	B. Davis
Calibration Frequency:	Annualy
Next Calibration Due:	August 6, 2002
Instrument Range:	1.000 cfm
Standard Temp.:	68 oF
Standard Press.:	29.92 "Hg
Barometric Press.:	30.01 "Hg
Signature/Date:	

Previous Calibration Comparision

Date	08/03/01	Acceptable	
dH@ Value	NA	Deviation (5%)	Deviation
y Factor	0.971	0.04855	0.034
Acceptance	Acceptable		

Current Calibration

Acceptable y Deviation	0.020
Maximum y Deviation	0.002
Acceptable dH@ Deviation	0.200
Maximum dH@ Deviation	0.023
Acceptance	Acceptable

Reference Standard *		
Standard Calibrator	Model	Standard Test Meter
	S/N	OMNI-00001
	Calib. Date	04-Feb-02
	Calib. Value	1.0130 y factor (ref)

Calibration Parameters	Run 1	Run 2	Run 3
Vacuum ("Hg)	0.00	0.00	0.00
dH ("H2O)	3.00	1.00	0.50
Initial Reference Meter	732.923	738.634	743.785
Final Reference Meter	738.356	743.618	749.026
Initial DGM	204.459	210.201	215.396
Final DGM	209.918	215.239	220.696
Temp. Ref. Meter (°F), Tr	61.0	61.0	61.0
Temperature DGM (°F), Td	64.0	63.0	63.0
Time (Minutes)	5.0	8.0	12.0
Net Volume Ref. Meter, Vr	5.433	4.984	5.241
Net Volume DGM, Vd	5.459	5.038	5.3
Gas Meter y Factor =	**1.007**	**1.004**	**1.004**
Gas Meter y Factor Deviation (from avg.)	0.002	0.001	0.000
Orifice dH@	**1.35**	**1.38**	**1.40**
Orifice dH@ Deviation (from avg.)	0.022	0.001	0.023

Note: Adjusted Tangent ball to achieve 'Y' as found WAS = .960

where:

1. Deviation = |Average value for all runs - current run value|
2. y = [Vr x (y factor (ref)) x (Pb) x (Td + 460) / [Vd x (Pb + (dH / 13.6)) x (Tr + 460]
3. dH@ = 0.0317 x dH / (Pb (Td + 460)) x [(Tr + 460) x time) / Vr]^2

* Reference calibration is traceable to NIST through NIST Test # 40674, Kimble ASTM E1272

Section 6

Example Calculations

Note: OMNI-Test Laboratories, Inc. uses the Excel computer program for all Method 5G and 5H calculations. The program automatically carries 14 decimal points in all calculations. The numbers on the printouts have been rounded for display only.

Equations and Sample Calculations - Method 5G

Equations used to calculate the parameters listed below are described in this appendix. Sample calculations are provided for each equation. The raw data and printout results from a sample run are also provided for comparison to the sample calculations.

BR	Dry burn rate, kg/hr
m_n	Total particulate matter collected, mg
$V_{m(std)}$	Volume of gas sampled corrected to standard conditions, dscf
v_s	Average dilution tunnel gas velocity, ft/sec
C_s	Particulate concentration, g/dscf
Q_{sd}	Average dilution tunnel gas flow rate, dscf/min
E	Particulate emission rate, lbs/hr
PR	Proportional rate variation, %

Dry Burn Rate

Using equation 28-3:

$$BR = \frac{60 \times W_{wd}}{\theta} \times \frac{100 - \%M_w}{100}$$

Where,

BR	=	Dry burn rate, lb/hr
W_{wd}	=	Mass of wood burned (wet basis) during test run, lb
θ	=	Total time of test run, minutes
$\%M_w$	=	Average moisture content of test fuel charge, wet basis percent

Sample Calculation:

Dry basis moisture of fuel = 20.03%

Using the equation 28-2 for converting dry basis moisture to wet basis moisture,

$$\%M_w = \frac{20.03 \times 100}{20.03 + 100}$$

$$\%M_w = 16.69\%$$

The wet weight of the fuel charge was 7.8 pounds. Converting pounds to kilograms yields a weight of 3.538 kg. The run time for this run was 180 minutes. Therefore, the burn rate equation appears thus:

$$BR = \frac{60 \times 3.538 \times (100 - 16.69)}{180 \times 100}$$

$$BR = 0.98\ kg/hr = 2.17\ lb/hr$$

Total Particulate Matter Collected

$$m_n = F_1 + F_2 + R - (V_a \times B_a)$$

Where:

m_n	=	Total particulate matter collected, mg
F_1	=	Particulate matter collected on front filter, mg
F_2	=	Particulate matter collected on rear filter, mg
R	=	Residue from evaporated probe and filter holder acetone rinse, mg
V_a	=	Volume of acetone evaporated probe and filter holder actone rinse, ml
B_a	=	Acetone blank value, mg/ml

Sample Calculation:

$m_n = 12.6 - 0.4 + 4.7 - (180 \times 0.0040)$

$m_n = 16.2$ mg

Volume of Gas Sampled Corrected to Dry Standard Conditions

Using equation 5-1:

$$V_{m(std)} = V_m \times Y \times \left(\frac{T_{std}}{P_{std}}\right) \times \frac{\left(P_b + \frac{\Delta H}{13.6}\right)}{T_m}$$

Where:

K	=	17.64 °R/in. Hg
T_{std}	=	528 °R
P_{std}	=	29.92 in. Hg
V_m	=	Volume of gas sample measured at the dry gas meter, dcf
Y	=	Dry gas meter calibration factor, dimensionless
P_b	=	Barometric pressure at the testing site, in. Hg
ΔH	=	Average pressure differential across the orifice meter, in. H_2O
T_m	=	Absolute average dry gas meter temperature, °R

Sample Calculation:

$$V_{m(std)} = 98.434 \times 1.01 \times \left(\frac{528}{29.92}\right) \times \frac{30.03 + \frac{0.7}{13.6}}{532.5}$$

$$V_{m(std)} = 99.116\ ft^3$$

Dilution Tunnel Gas Velocity

Using equations 2-7 and 2-6, calculated at each recorded interval:

$$v_s = k_p \times C_p \times \sqrt{\Delta P} \times \sqrt{\frac{T_{s(avg)}}{P_s \times M_s}}$$

$$M_s = M_d \times (1 - B_{ws}) + 18.0 \times B_{ws}$$

Where:

v_s = Average dilution tunnel gas velocity, ft/sec

k_p = Pitot tube constant: $85.49 \frac{ft}{\text{sec}} \left[\frac{(lb/lb-mole) \times (inches\ Hg)}{(^\circ R) \times (inches\ H_2O)}\right]^{\frac{1}{2}}$

C_p = Pitot tube coefficient (0.99 for standard pitot tube; 0.84 may be used for S-type pitot tubes constructed according to Method 2 procedures), unitless

ΔP = ΔP measured during the pre-test flow traverse of the dilution tunnel; the square root of the ΔP values are averaged for this calculation, in. H_2O

P_b = Barometric pressure at test site, in. Hg

P_g = Static Pressure of tunnel, in. Hg

P_s = Absolute tunnel pressure, = $P_b + P_g$

M_s = Molecular weight of tunnel gas; assume M_d =29 lb/lb-mole (per method 5G)

B_{ws} = Moisture content of dilution tunnel gas, ratio; assume 4% (per method 5G)

T_s = Dilution tunnel temperature, °R; (°R = °F + 460)

Sample calculation:

$$M_s = 29 \times (1 - 0.04) + 18.0 \times 0.04 = 28.56$$

$$v_s = 85.49 \times 0.99 \times \sqrt{0.0351} \times \sqrt{\frac{(548)}{(30.03 + \frac{-0.45}{13.6}) \times (28.56)}}$$

$$v_s = 12.69 \frac{ft}{sec}$$

Particulate Concentration

Using equation 5G-2:

$$C_s = 0.001 \frac{g}{mg} \times \frac{m_n}{V_{m(std)}}$$

Where:

C_s	=	Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, g/dscf
m_n	=	Total mass of particulate matter collected in the sampling train, mg
$V_{m(std)}$	=	Volume of gas sampled corrected to dry standard conditions, dscf

Sample calculation:

$$C_s = \frac{0.001 \times 16.2}{99.116}$$

$$C_s = 0.000163 \ g/dscf$$

6-7 of 6-10

Average Dilution Tunnel Gas Flow Rate

Using equation 2-8, calculated at each recorded interval:

$$Q_{sd} = 3600 \times (1 - B_{ws}) \times v_s \times A \times \frac{T_{std}}{T_{s(avg)}} \times \frac{P_s}{P_{std}}$$

Where:

Q_{sd}	=	Gas flow rate corrected to dry, standard conditions, dscf/hr
3600	=	Conversion from seconds to hours
B_{ws}	=	Moisture content of dilution tunnel gas, ratio; assume 4% (per method 5G)
v_s	=	Average dilution tunnel gas velocity, ft/sec
A	=	Cross sectional area of dilution tunnel, ft^2
T_{std}	=	Standard absolute temperature, 538°R
$T_{s(avg)}$	=	Average absolute dilution tunnel temperature, °R, (°R = °F + 460)
P_b	=	Barometric pressure at test site, in. Hg
P_g	=	Dilution tunnel static pressure, in. Hg
P_s	=	Absolute dilution tunnel gas pressure, in Hg, (Hg = $P_b + P_g$)
P_{std}	=	Standard absolute pressure, 29.92 in Hg

Sample calculation:

$$Q_{sd} = 3600 \times (1 - 0.04) \times 12.69 \times \frac{(\pi \times 3^2)}{144} \times \frac{528}{548} \times \frac{30.03 + \frac{-0.45}{13.6}}{29.92}$$

$$Q_{sd} = 8313.36\ dscf/hr = 138.56\ dscf/min$$

6-8-06-10

Particulate Emission Rate

Using equation 5G-3 and 5G-4:

$$E = C_s \times Q_{sd}$$

$$E_{adj} = K_3 \times E^{0.83}$$

Where:

E = Particulate emission rate, g/hr

E_{adj} = Particulate emission rate, adjusted, g/hr

C_s = Concentration of particulate matter in the stack, corrected to dry, standard conditions, g/dscf

Q_{sd} = Average dilution tunnel gas flow rate, dscf/hr

K_3 = Constant, 1.82 for metric units, 0.643 for English units

Sample calculation:

$$E = 0.000163 \times 8313.36 \times 60$$

$$E = 1.36\ g/hr$$

$$E_{adj} = 1.82 \times 1.36^{0.83}$$

$$E = 2.35\ g/hr$$

6-9 & 6-10

Proportional Rate Variation

Using equation 5H-9, calculated at each recorded interval:

$$PR = \frac{\theta \times (V_{mi} \times V_s \times T_m \times T_{si})}{10 \times (V_m \times V_{si} \times T_s \times T_{mi})} \times 100$$

Where:

PR	=	Percent proportional rate
θ	=	Time of test, min
S_i	=	Measured tracer gas concentration for the "i^{th}" interval, in this case, the inverse of the calculated flow in the stack based on CO_2 concentrations in the stack and in the dilution tunnel
$V_{mi(std)}$	=	Volume of gas sample measured by the dry gas meter during the "i^{th}" 10 minute interval, dscf
V_m	=	Volume of gas sample as measured by dry gas meter, dscf
V_{si}	=	Average gas velocity in the dilution tunnel during each 10 minute interval, i, of the test run, m/sec
V_s	=	Average gas velocity in the dilution tunnel, m/sec
T_{mi}	=	Absolute average dry gas meter temperature during each 10 minute interval, i, of the test run, °R
T_m	=	Absolute average dry gas meter temperature, °R
T_{si}	=	Absolute average gas temperature in the dilution tunnel during each 10 minute interval, i, of the test run, °R
T_s	=	Absolute average gas temperature in the dilution tunnel, °R

Sample calculation (for the reading at 50 minutes into test run 1):

$$PR = \frac{180 \times 5.6 \times 12.69 \times 533 \times 552}{10 \times 98.434 \times 12.63 \times 548 \times 532} \times 100$$

$$PR = 103.8\%$$