

# ***LOI*** ***Limiting Oxygen Index*** ***Analyzer***

## **INSTRUCTION MANUAL**



Doc. P/N 18307300  
Rev. 1.0

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# GENERAL EQUIPMENT SPECIFICATIONS

This page is a record of your equipment specifications. This information is found on the stamped nameplate of your instrument. Please fill in the blanks below when you receive your Dynisco unit.

When contacting the sales or service department to order parts or obtain information, refer to this page. This will allow us to respond quickly and accurately to your request.

MODEL NO. \_\_\_\_\_

SERIAL NO. \_\_\_\_\_

WIRING DIAGRAM (See drawings at back of manual)

MAIN FUSE \_\_\_\_\_ Amperes

SINGLE PHASE \_\_\_\_\_ Volts AC

MODEL _____ LOI _____
TYPE _____ Limiting Oxygen Index Analyzer _____

# Dynisco Polymer Test - Product Warranty

Dynisco Polymer Test warrants to the original buyer only, that all products and services furnished hereunder shall be free from defects in material and workmanship. This warranty is subject to the following terms and conditions.

1. This warranty shall remain in effect for a period of one (1) year from date of start-up or fifteen (15) months from date of shipment whichever is earlier; provided however that notice of any such defect is reported to Dynisco Polymer Test within thirty (30) days following its discovery.
2. Parts that normally contact the material under test shall have a warranty period of three (3) months from start-up or five (5) months from date of shipment whichever comes first; provided however that notice of any such defect is reported to Dynisco Polymer Test within then (10) days following its discovery.
3. This warranty not applicable to the fiber optic image bundle. This item to be warranted for thirty days, and not to exceed the OEM warranty.
4. The start-up date for parts sold as "spare parts" will be considered the date of shipment for purposes of this warrantee only.
5. Consumables such as heat elements, light sources, infrared sources, printer ribbons and the like shall be considered expendable and will only be warranted to be functional at time of shipment.
6. In the event any material or workmanship shall be determined defective by Dynisco Polymer Test, Dynisco Polymer Test's liability hereunder is limited to the repair or replacement, at Dynisco Polymer Test's option, of the defective part. Dynisco Polymer Test shall have NO liability for the costs of removing, returning, or reinstalling any repaired or replaced part or component.
7. Dynisco Polymer Test shall have no liability whatsoever for any defects which directly or indirectly arise out of or result from accident, abuse, improper use, vandalism, unauthorized repairs, or similar deviations from normal use under Dynisco Polymer Test control.
8. This warranty shall be void and of no effect if the products covered hereby are:
  - A. Installed or moved and reinstalled without the presence of Dynisco Polymer Test's personnel at start-up.
  - B. Not maintained in strict accordance with Dynisco Polymer Test's published maintenance procedures.
  - C. Altered or modified in any way without Dynisco Polymer Test's authorization.

Except as provided above, Dynisco Polymer Test makes no other warranties, expressed or implied, including without limitation, warranties of merchantability, or of fitness for a particular purpose.

# LOI Limiting Oxygen Index Chamber & Smoke Density Attachment

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# **LOI Limiting Oxygen Index Chamber & Smoke Density Attachment**

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## **1.0 INTRODUCTION**

The **LIMITING OXYGEN INDEX CHAMBER** is a precision instrument for determining the relative flammability of various materials by measuring the minimum concentration of oxygen required to support combustion. As with all precision measurement devices, the accuracy of its performance is highly dependent on proper use and maintenance.

**Please read this manual thoroughly before proceeding with the installation and operation of the instrument.**

## **2.0 INSTALLATION**

### **2.1 Additional Equipment Required**

- Commercial grade or better oxygen supply cylinder.
- Commercial grade or better nitrogen supply cylinder.
- Two stage oxygen pressure regulator (Matheson #9-540 or equivalent).
- Two stage nitrogen pressure regulator (Matheson #9-580 or equivalent).
- Timer capable of indicating at least 10 minutes and accurate to 5 seconds.

### **2.3 LOI Set-up**

The **LOI** Tester should be located in a fume hood or near a room exhaust system, depending on the type of ventilation appropriate for the materials to be tested.

**Compliance with all applicable safety, health and environmental regulations is the responsibility of the user.**

**2.2.1.** Fit the oxygen and nitrogen supply cylinders with the two stage pressure regulators and connect them to the appropriate **LOI** supply hoses.

**2.2.2.** Fill the brass container inside the glass chimney with glass beads, cover with the wire screen and replace the container over the gas dispersion chamber.

# LOI Limiting Oxygen Index Chamber & Smoke Density Attachment

## 3.0 OPERATION

### 3.1 Summary of Method

The minimum concentration of oxygen in a mixture of oxygen and nitrogen that will just support combustion is measured under equilibrium conditions of candle-like burning. The equilibrium is established by the relation between the heat generated from the combustion of the specimen and the heat lost to the surroundings as measured by one or the other of two arbitrary criteria, a time of burning or a length of specimen burned. This point is approached from both sides of the critical oxygen concentration in order to establish the oxygen index.

### 3.2 Specimen Selection and Preparation

*Note: This is a general guideline. Refer to A.S.T.M. D 2863-77, ISO.DP.4589, and/or your company manual for complete instructions.*

3.2.1. Determine the appropriate specimen size from Table 1 (see next page for Table 1) and cut 5 to 10 samples from the material to be tested. The edges of the specimens should be relatively smooth and free from fuzz or burrs.

**Table I Specimen Dimensions, mm**

Type	Plastic's Form	Width	Thickness	Length
A	Physically self supporting	6.5 +/-0.5	3.0 +/- 0.5	70 to 150
B	Alternate for self-supporting flexible plastics	6.5 +/-0.5	2.0 +/-0.25	70 to 150
C	Cellular plastic	12.5 +/-0.5	12.5 +/-0.5	125 to 150
D	Film or Thin Sheet	52 +/- 0.5	As recieved	140 +/-5

### 3.3 Test Procedure

3.3.1. With the rotameter valves closed, turn on the gas cylinders. Open the rotameter valves and adjust the two gas cylinders so that they have **equal** incoming pressures of **less than 100 psi** while maintaining sufficient pressure to allow the rotameter to be adjusted to the highest level desired. Close the rotameter valves. **Caution: The rotameter valves are precision made and may be damaged if over-tightened.**

3.3.2. Remove the glass column and clamp a specimen in the specimen holder. Replace the column. The specimen should be in a vertical position with its top edge at least 100 mm below the top of the glass column.

## LOI Limiting Oxygen Index Chamber & Smoke Density Attachment

3.3.3. Select the desired initial concentration of oxygen, if known. If the desired initial concentration is unknown for the material being tested it may be determined as follows: Light the specimen in air and note the burning. If the specimen burns readily select an oxygen concentration below 22%. If it burns with difficulty, or burns briefly and then stops, select an oxygen concentration between 22% and 27%. If the specimen will not burn in air, the initial concentration should be 28% or higher.

3.3.4. Set the flow valves so that the initial concentration of oxygen is flowing through the column at a rate of 4 cm/s. Allow the gas to flow for 30 seconds to purge the system.

3.3.5. Turn off the ventilating hood and ignite the entire top of the specimen. When the specimen is well lighted, remove the ignition flame and start timing the burn.

3.3.6. Judge the burn according to the burn criteria in Table 2 (see next page for Table 2). Do not adjust the oxygen concentration after the specimen has been ignited.

**Table 2. Criteria For Burning.**

<b>Specimen Type</b>	<b>Criteria For Burning</b>
A and B	At Least 3 Minutes or 50 mm
C	At Least 3 Minutes or 75 mm
D	Past the 100 reference mark

3.3.7. If sufficient material is left on the current specimen invert it and/or trim off the burned portion and re-insert it, otherwise insert a new specimen. Repeat steps 3.3.4 through 3.3.6 using a **REDUCED** concentration of oxygen if the previous burn met or exceeded the criteria, or an **INCREASED** oxygen concentration if the specimen extinguished before meeting the criteria.

3.3.8. Continue repeating steps 3.3.4 through 3.3.7 until the **critical concentration** of oxygen is determined. This is the lowest oxygen concentration that will meet the criterion of Table 2. At the next lower concentration that will give a difference in oxygen index in oxygen index of 0.2% or less the criterion should not be met.

3.3.9. Repeat the test at least three times at different flow rates within the 3 to 5cm limits.



# LOI Limiting Oxygen Index Chamber & Smoke Density Attachment

## 4.0 CALCULATIONS

4.1 Calculate the oxygen index,  $n$ , of the material as follows:

$$n, \% = (100 \times O_2) / (O_2 + N_2)$$

Where:

$O_2$  = Volumetric flow of oxygen,  $\text{cm}^3/\text{s}$ , at the concentration determined in 3.3.8, and

$N_2$  = Corresponding volumetric flow rate of nitrogen,  $\text{cm}^3/\text{s}$ .

## 5.0 REPORT

5.1 The report shall include the following:

1. A description of the material tested including the Type, Density, General Direction of Anisotropy (for Type C Specimens), Source, Manufacturer's Code Number, Form, Previous History, and Conditioning (if any).

2. Test specimen dimensions.

3. Individual Oxygen Index values found for each of the tests and Average Oxygen Index value.

4. Description of any unusual behavior such as charring, dripping, bending, etc.

5. The following caveat in its entirety:

*This standard should be used to measure and describe the properties of materials, products or assemblies in response to heat and flame under controlled laboratory conditions and should not be used to describe or appraise the fire hazard or fire risk of materials, products or assemblies under actual fire conditions. However, results of this test may be used as elements of a fire risk assessment which takes into account all of the factors which are pertinent to an assessment of the fire hazard of a particular end use.*

## **APPENDIX A**

### **Optional Smoke Density Measurement System.**

The optional Smoke Density Measurement System consists of a Smoke Density Stack and a Control Console with Strip-chart recorder. The Stack contains a light source, photo-electric sensor and baffle system to eliminate stray light.

#### **A.1. Set-up.**

**A.1.1.** Position the Stack on top of the glass test column of the LOI and connect it to the Control Console by means of the keyed connector.

**A.1.2.** Plug the Control Console power cord into an appropriate power source.

#### **A.2. Operation.**

**A.2.1.** Remove, clean and replace the two glass plates protecting the light source and photo-electric cell respectively. **NOTE: These protective glass plates must be cleaned before each test. This device must never be operated without these glass plates.**

**A.2.2.** Turn on the control console and test the recorder.

**A.2.3.** Adjust the sensitivity control until the recorder stylus is at the top of the scale (100mm) on the strip chart. This represents 100% transmission of light.

**A.2.4.** Block the light source so that no light is being transmitted to the photo-electric cell and observe that the recorder stylus is at 0mm, representing 0% transmission.

21 DEGREES C

21 DEGREES C

FLOWMETER SETTING GUIDE

OXYGEN FLOWMETER S/N 0791-01

NITROGEN FLOWMETER S/N 0591-07

O P E R A T I O N	LOW VELOCITY (3.2 cm/sec)				NORM VELOCITY (4.0 cm/sec)				HIGH VELOCITY (4.8 cm/sec)				O P E R A T I O N
	OXYGEN FLOWMETER		NITROGEN FLOWMETER		OXYGEN FLOWMETER		NITROGEN FLOWMETER		OXYGEN FLOWMETER		NITROGEN FLOWMETER		
	cc/min	SET	cc/min	SET	cc/min	SET	cc/min	SET	cc/min	SET	cc/min	SET	
10	1368	30.0	12312	104.0	1710	35.5	15390	129.0	2052		18468		10
11	1505	32.5	12175	102.5	1891	38.5	15219	127.5	2257		18263		11
12	1642	34.5	12038	101.5	2052	41.0	15048	126.5	2462		18058		12
13	1778	36.5	11902	100.5	2223	43.5	14877	125.0	2668	51.0	17852	149.5	13
14	1915	39.0	11765	99.5	2394	46.5	14706	123.5	2873	54.0	17647	147.5	14
15	2052	41.0	11628	98.5	2565	49.5	14535	122.5	3078	57.5	17442	145.5	15
16	2189	43.0	11491	97.0	2736	52.0	14364	121.0	3283	61.0	17237	144.0	16
17	2326	45.5	11354	96.0	2907	55.0	14193	119.5	3488	64.5	17032	142.0	17
18	2462	47.5	11218	95.0	3078	57.5	14022	118.0	3694	67.5	16826	140.5	18
19	2599	50.0	11081	94.0	3249	60.5	13851	116.5	3899	71.0	16621	138.5	19
20	2736	52.0	10944	92.5	3420	63.0	13680	115.0	4104	74.5	16416	137.0	20
21	2873	54.0	10807	91.5	3591	66.0	13509	113.5	4309	77.5	16211	135.5	21
22	3010	56.5	10670	90.5	3762	69.0	13338	112.0	4514	81.0	16006	134.0	22
23	3146	58.5	10534	89.5	3933	71.5	13167	110.5	4720	84.0	15800	132.0	23
24	3283	61.0	10397	88.5	4104	74.5	12996	109.0	4925	87.5	15595	130.5	24
25	3420	63.0	10260	87.0	4275	77.0	12825	108.0	5130	91.0	15390	129.0	25
26	3557	65.5	10123	86.0	4446	80.0	12654	106.5	5335	94.0	15185	127.5	26
27	3694	67.5	9986	85.0	4617	82.5	12483	105.0	5540	97.0	14980	126.0	27
28	3830	70.0	9850	84.0	4788	85.5	12312	104.0	5746	100.0	14774	124.0	28
29	3967	72.0	9713	83.0	4959	88.0	12141	102.5	5951	103.5	14569	122.5	29
30	4104	74.5	9576	81.5	5130	91.0	11970	101.0	6156	106.5	14364	121.0	30
31	4241	76.5	9439	80.5	5301	93.5	11799	99.5	6361	110.0	14159	119.5	31
32	4378	78.5	9302	79.5	5472	96.0	11628	98.5	6566	113.5	13954	117.5	32
33	4514	81.0	9166	78.5	5643	98.5	11457	97.0	6772	117.0	13748	116.0	33
34	4651	83.0	9029	77.0	5814	101.0	11286	95.5	6977	120.5	13543	114.0	34
35	4788	85.5	8892	76.0	5985	104.0	11115	94.0	7182	124.0	13338	112.0	35
36	4925	87.5	8755	75.0	6156	106.5	10944	92.5	7387	127.0	13133	110.5	36
37	5062	89.5	8618	74.0	6327	109.5	10773	91.5	7592	130.5	12928	108.5	37
38	5198	92.0	8482	72.5	6498	112.5	10602	90.0	7798	134.0	12722	107.0	38
39	5335	94.0	8345	71.5	6669	115.5	10431	88.5	8003	138.0	12517	105.5	39
40	5472	96.0	8208	70.5	6840	118.5	10260	87.0	8208	141.5	12312	104.0	40
41	5609	98.0	8071	69.0	7011	121.0	10089	86.0	8413	145.0	12107	102.0	41
42	5746	100.0	7934	68.0	7182	124.0	9918	84.5	8618	148.5	11902	100.5	42
43	5882	102.5	7798	67.0	7353	126.5	9747	83.0	8824		11696		43
44	6019	104.5	7661	66.0	7524	129.5	9576	81.5	9029		11491		44
45	6156	106.5	7524	65.0	7695	132.5	9405	80.5	9234		11286		45
46	6293	109.0	7387	63.5	7866	135.5	9234	79.0	9439		11081		46
47	6430	111.0	7250	62.5	8037	138.5	9063	77.5	9644		10876		47
48	6566	113.5	7114	61.5	8208	141.5	8892	76.0	9850		10670		48
49	6703	116.0	6977	60.5	8379	144.5	8721	74.5	10055		10465		49
50	6840	118.5	6840	59.5	8550	147.0	8550	73.0	10260		10260		50
51	6977	120.5	6703	58.5	8721		8379		10465		10055		51
52	7114	123.0	6566	57.0	8892		8208		10670		9850		52
53	7250	125.0	6430	56.0	9063		8037		10876		9644		53
54	7387	127.0	6293	55.0	9234		7866		11081		9439		54
55	7524	129.5	6156	54.0	9405		7695		11286		9234		55

**For Reference Only!**  
 Refer to the certified flowmeter spec sheets that came with your unit & match its serial number

**FLOWMETER CALIBRATION DATA**

<b>CUSTOMER</b>		<b>CUST. P.O.NO.</b>		<b>REF. CURVE NUME</b>
		3487		0591-07
<b>MAX. FLOW</b>	<b>MIN. FLOW</b>	<b>UNITS</b>	<b>METERED FLUID</b>	<b>DATE</b>
17936.0	650.8	STD. ML/MIN	NITROGEN	05-20-91
<b>MODEL NUMBER</b>	SF231/1	<b>METERING TEMP.</b>	70 DEG.F	
<b>TUBE NUMBER</b>	034-39ST	<b>METERING PRESS.</b>	14.70 PSIA	
<b>SERIAL NUMBER</b>	032112	<b>METERING DENSITY</b>	0.001160 G/M	
<b>FLOAT MAT'L</b>	316 STAINLESS STEEL	<b>DENSITY AT STD.COND.</b>	0.001160 G/M	
<b>FLOAT DENSITY</b>	8.04 G/ML	<b>METERING VISCOSITY</b>	0.01756 CP	
<b>STD.CONDITIONS</b>	1 ATMOS @ 70 DEG.F	<b>ACCURACY</b>	0.5%	

**SCALE READINGS AT CENTER OF FLOAT**

SCALE READINGS	FLOW
150.0 ---	17936.0
140.0 ---	16792.3
130.0 ---	15527.5
120.0 ---	14229.2
110.0 ---	13090.5
100.0 ---	11842.8
90.0 ---	10604.8
80.0 ---	9363.0
70.0 ---	8170.7
60.0 ---	6917.3
50.0 ---	5686.0
40.0 ---	4481.5
30.0 ---	3241.0
20.0 ---	1922.2
10.0 ---	650.8

**For Reference Only!**  
 Refer to the certified flowmeter spec sheets that came with your unit & match its serial number.

**AALBORG INSTRUMENTS & CONTROLS INC**      CERTIFIED BY: *[Signature]*      DATE: 05-22-91

1011-352-3171

034-396

## FLOWMETER CALIBRATION DATA

CUSTOMER		CUST. P.O.NO.	REF. CURVE NUMBE	
		4102	0791-01	
MAX. FLOW	MIN. FLOW	UNITS	METERED FLUID	DATE
8719	237	STD. ML/MIN	OXYGEN	07-23-91
MODEL NUMBER	SF231/1	METERING TEMP.	70 DEG.F	
TUBE NUMBER	034-396	METERING PRESS.	14.70 PSIA	
SERIAL NUMBER	034629	METERING DENSITY	0.001326 G/ML	
FLOAT MAT'L	GLASS	DENSITY AT STD.COND.	0.001326 G/ML	
FLOAT DENSITY	2.53 G/ML	METERING VISCOSITY	0.02030 CP	
STD.CONDITIONS	1 ATMOS @ 70 DEG.F	ACCURACY	0.5 %	

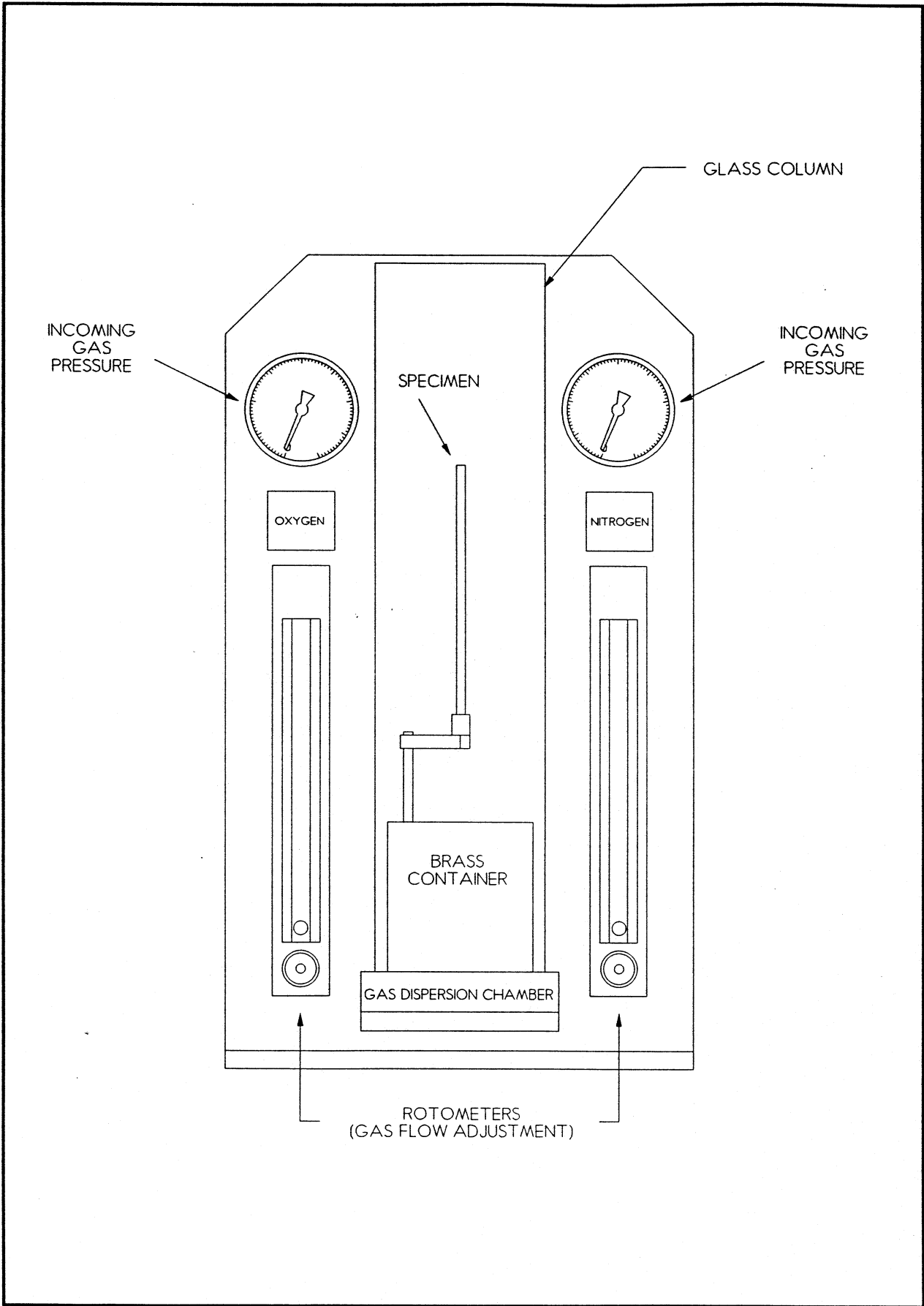
## SCALE READINGS AT CENTER OF FLOAT

SCALE READINGS	FLOW
150.0 ---	8719
140.0 ---	8121
130.0 ---	7565
120.0 ---	6933
110.0 ---	6359
100.0 ---	5740
90.0 ---	5079
80.0 ---	4459
70.0 ---	3831
60.0 ---	3229
50.0 ---	2610
40.0 ---	1993
30.0 ---	1352
20.0 ---	712
10.0 ---	237

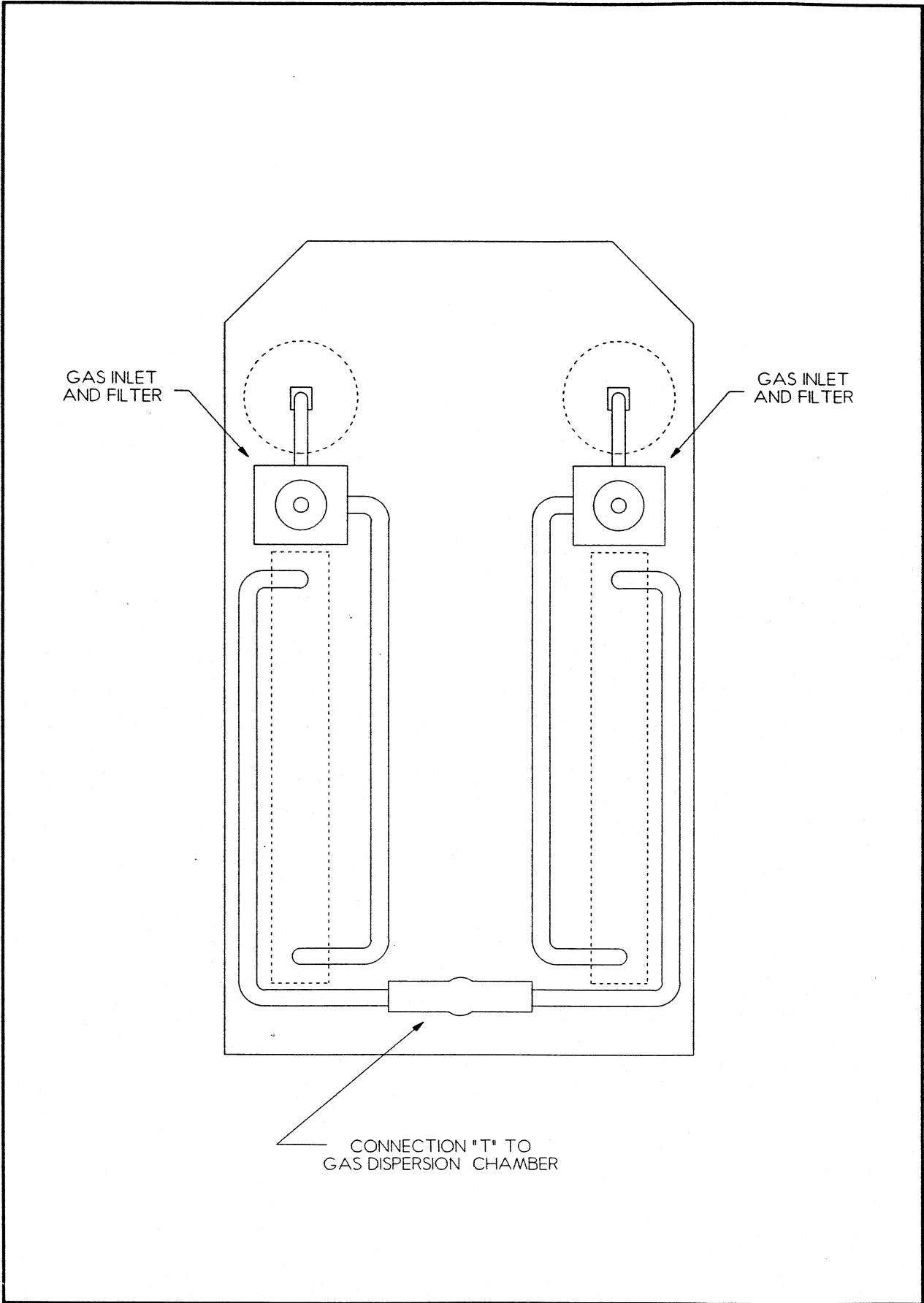
**For Reference Only!**  
Refer to the certified flowmeter spec  
sheets that came with your unit &  
match its serial number.

AALBORG

 CERTIFIED BY: *J. J. Malone*  
 INSTRUMENTS & CONTROLS INC
DATE: 07-23-91



LOI FRONT VIEW & CONTROLS



LOI REAR VIEW - GAS TUBING ROUTING

PART NO: 40-18-3708-00  
DWG. NO: A-11309  
FILE NO: 7R370800  
PAGES: 1 THROUGH 2  
REV: 0 DATED: 6/6/97

**ELECTRICAL COMPONENT DESIGNATIONS  
& ATLAS PART NUMBER FOR  
SMOKE DENSITY CABINET AND ATTACHMENT  
WIRING DIAGRAMS  
(1997)**

THIS BOOKLET CONTAINS A LISTING OF ALL COMPONENT  
DESIGNATIONS FOR SMOKE DENSITY CABINET AND ATTACHMENT.

The listing includes:

1. Designations as shown on the wiring diagrams & layouts.
2. Component Descriptions.
3. Atlas part numbers that correspond with the designations.
4. Listing of the model(s) on which each component is used.

N/A = Not Applicable

INFORMATION IS SUBJECT TO CHANGE WITHOUT NOTICE



**ELECTRICAL COMPONENT DESIGNATIONS & ATLAS PART NUMBER FOR  
SMOKE DENSITY CABINET AND ATTACHMENT (1997)**

<b>Electrical Diagram Designation</b>	<b>Component Description</b>	<b>Machine Model</b>	<b>Atlas Part Number</b>
CB1	SWITCH CIRCUIT BREAKER 1.5A, 2P, 250V	230V	13-2122-00
	SWITCH CIRCUIT BREAKER 2.5A, 1P, 115V	115V	13-1963-00
DS3/V1	LAMP/PHOTOCELL ASSEMBLY	ALL MODELS	18-3292-00
J2/P2	CONNECTOR INLET 10A, 250V	ALL MODELS	12-3675-00
J3/P3	CONNECTOR, 5 CONTACTS	ALL MODELS	13-1981-00
M1	RECORDER 1-PEN MR1000, YOKOGAWA	ALL MODELS	13-2085-00
P1	CABLE (PLUG STYLE) 2P, 3W - 10A	ALL MODELS	12-3842-00
R1	POTENTIOMETER, LDI/TFT 2000H	ALL MODELS	13-1654-00
S1	SWITCH, ROCKER SPST 16A 250V	ALL MODELS	12-5443-00
T1	TRANSFORMER, DUAL 115-230/12V	ALL MODELS	13-1655-00

PART NO: 40-18-3708-00  
DWG. NO: A-11309  
FILE NO: 7R370800  
PAGES: 1 THROUGH 2  
REV: 0 DATED: 6/6/97

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& ATLAS PART NUMBER FOR  
SMOKE DENSITY CABINET AND ATTACHMENT  
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<b>Electrical Diagram Designation</b>	<b>Component Description</b>	<b>Machine Model</b>	<b>Atlas Part Number</b>
CB1	SWITCH CIRCUIT BREAKER 1.5A, 2P, 250V	230V	13-2122-00
	SWITCH CIRCUIT BREAKER 2.5A, 1P, 115V	115V	13-1963-00
DS3/V1	LAMP/PHOTOCELL ASSEMBLY	ALL MODELS	18-3292-00
J2/P2	CONNECTOR INLET 10A, 250V	ALL MODELS	12-3675-00
J3/P3	CONNECTOR, 5 CONTACTS	ALL MODELS	13-1981-00
M1	RECORDER 1-PEN MR1000, YOKOGAWA	ALL MODELS	13-2085-00
P1	CABLE (PLUG STYLE) 2P, 3W - 10A	ALL MODELS	12-3842-00
R1	POTENTIOMETER, LDI/TFT 2000H	ALL MODELS	13-1654-00
S1	SWITCH, ROCKER SPST 16A 250V	ALL MODELS	12-5443-00
T1'	TRANSFORMER, DUAL 115-230/12V	ALL MODELS	13-1655-00