



**MMC INTERNATIONAL CORP**

**OPERATING AND MAINTENANCE  
INSTRUCTIONS**

**OXYGEN LEVEL SENSOR  
GAUGING TAPE**

**CLOSED AND RESTRICTED APPLICATIONS**

**MODEL D-2615-11**

APPROVED BY:  
BASEEFA AS  
INTRINSICALLY SAFE FOR USE IN  
CLASS I, DIVISION I, GROUPS C & D  
HAZARDOUS ENVIRONMENTS

**MMC INTERNATIONAL CORP.  
60 INIP DRIVE  
INWOOD, NEW YORK 11096**

# **TABLE OF CONTENTS**

	<b>PAGE NUMBER</b>
<b>I. GENERAL</b>	<b>1</b>
1.1 SPECIFICATIONS	2
1.2 SPECIAL FEATURES	3
<b>II. INTRODUCTION</b>	<b>4</b>
<b>III. THEORY OF OPERATION</b>	<b>5, 6</b>
<b>IV. REQUIRED CONDITIONS AND RECOMMENDED USAGE</b>	
4.1 REQUIRED CONDITIONS	7
4.2 RECOMMENDED SAFE USAGE CONDITIONS	7
4.3 FLUID LEVEL (ULLAGE) OF TANK OR OTHER VESSEL	8
<b>V. OPERATION</b>	
5.1 FAMILIARIZATION WITH OPERATING CONTROLS & FEATURES LOCATED ON THE TAPE REEL HUB BEZEL NAMEPLATE	8
5.2 OXYGEN LEVEL MEASUREMENT	8, 9
5.3 OXYGEN SENSOR CELL LIFE	10
<b>VI. CARE AND MAINTENANCE</b>	<b>11</b>
6.1 BATTERY REPLACEMENT	
6.2 OXYGEN CELL REPLACEMENT	
6.3 GAUGING TAPE REPLACEMENT	

CONTINUED ON NEXT PAGE

**VII. CALIBRATION PROCEDURE**

7.1	METHOD OF CALIBRATION	12
-----	-----------------------	----

**VIII. FAULT FINDING** 14, 15

**IX. APPENDIX** 16

**X. LIST OF APPLICABLE DRAWINGS** 24

## SECTION I

### 1. GENERAL:

#### 1.1 SPECIFICATIONS:

Oxygen Sensor Measurement Range	0% to 25%
Accuracy over the 1% to 25% Range	±0.2%
Batteries for Intrinsically Safe Operation Only (supplied)	Duracell #MN1604
Battery Life	Approximately 1000 Hours (Depends on night light use)
Battery Drain (Display Night Light off)	1.0 MA (IN AIR) 0.7 ma with <8% Oxygen
Night Light Battery Drain	9.0 ma/use
Storage Temperature	-20°C to 40°C
Tape Length (Standard)	50 FT. (15 Meters) 100 FT (30 Meters)
Hazardous Environments	Intrinsically Safe Class I, Division I, Groups C and D
Approval	BASEEFA
Hazardous Environments	Certified Intrinsically Safe BASEEFA/SIRA/CSA I, Gas Groups C & D

## 1.2 **SPECIAL FEATURES:**

Simple Automatic Push-Button Calibration in Air

Audible (Horn) and visual (Red LED) indication is provided to designate that the gaseous mixture within a particular tank or vessel contains an oxygen concentration greater than 8%.

Note: For the intended application area of this device, oxygen content percentages of 8% or less are considered non-explosive. Also see introductory text within this manual.

Tape Reel Position Lock

Watertight Electronics Housing with Sealed Switches

Stainless Steel Fasteners

Nylon Coated Aluminum Frame, for lightweight portability

Low Battery Indicator

Liquid Crystal Display with Extended Operating Temperature Range

Push Button Display Night Light

Automatic Turn Off (Turn off disabled during measurement)

Oxygen Cells easily replaceable with plug in assembly

Conductive Tape Surface to drain off any static charge

Grounding Lug and Cable supplied

Intrinsically Safe Equipment (BASEEFA) British Approval Service for Electrical Equipment in Flammable Atmosphere, recognized member of CENELEC

## SECTION II

### 2.0 INTRODUCTION:

- 2.1 The MMC portable oxygen sensor described herein incorporates extremely accurate instrumentation to provide measurements of oxygen percentage levels in inert gas protected vessels containing potentially explosive products. The primary field of application includes petroleum carrying barges and sea going tankers. Other application areas such as land-based petroleum storage tanks can also use the extra assurance of safety afforded by the use of this equipment.
- 2.2 The equipment incorporates the following novel and advantageous features:
  - 2.2.1 Extremely low battery drain (less than 1 milli-ampere) resulting in battery life of over 1,000 hours.
  - 2.2.2 Automatic power turn-off in air, with turn-off disabled during measurement use in gaseous environments containing less than 18% oxygen.
  - 2.2.3 Oxygen cell plugs in for simple replacement. 1-year minimum lifetime.
  - 2.2.4 Simple push button calibration with no other operator adjustment required even when replacing oxygen cells.

### **WARNING!**

**This equipment is solely intended for use in determining the percent by volume of the oxygen that may be present in a protective blanket of inert gas. It is not claimed, or intended for use in closed or confined spaces, or any other condition where human safety is of concern.**

- 2.3 The MMC system uses a sensor suspended at the end of a fluoropolymer covered gauging tape, wound on a reel assembly. The plastic covered steel gauging tape contains two isolated side conductors to carry the signal and ground from the electronic circuit within the sensor barrel to conditioning electronics in the reel hub. The surface of the tape has been treated to make it sufficiently conductive to prevent the build-up of static charges.

Percent oxygen indication is provided by a large digital liquid crystal display (LCD) located on reel hub assembly.
- 2.4 In addition to the LCD display described above, which provides accurate reading of percent of oxygen, the MMC tape also incorporates a pulsating horn and a light emitting diode (LED), to provide a visual and audible alarm indication of unsafe conditions, specifically, that oxygen content is above an 8% by volume level.

- 2.5 To minimize the danger of fire and explosive discharge within the tanks on petroleum carrying vessels, the U.S. Coast Guard has specified that the gaseous environment above the fluid levels in petroleum cargo tanks be maintained with sufficient inert gas to reduce oxygen levels below an 8% level.
- 2.6 A single 9-volt battery contained within the hub assembly powers the oxygen sensor tape and sensor assembly. Battery drain is extremely low, (approximately 0.75 milli-amperes), and if the unit is left unattended in the air for more than approximately 5 minutes, power is automatically shut off. Low battery warning is provided at the upper left corner of the LCD when the battery voltage has dropped to a level that would, with further operation, cause erroneous oxygen readings.

## SECTION III

### 3.0 THEORY OF OPERATION:

- 3.1 Drawing S-2615-OCX illustrates the main components of the oxygen sensor. A tape reel crank is used by the operator to raise and lower the oxygen sensing head assembly, which is attached to the reel via the tape. In the stored position, the reel lock prevents the sensor and tape from unreeling due to weight. Before lowering or raising the tape, the reel lock must be unlocked by turning locking screw counterclockwise.
- 3.2 The sensor head assembly contains the oxygen cell, resistors, a platinum temperature compensation sensor, and a cell holder terminated with a plug-in socket connector. A mating connector plug is part of the gauging tape. This connection is made within a barrel housing adapter, connecting the sensor, and gauging tape assemblies.
- 3.3 The sensor assembly is connected electrically to the hub electronics by two wires encased in a plastic jacket which covers and hermetically seals the wires and a center metallic gauging tape. The metallic gauging tape is used to connect the sensor barrel housing to hull ground and provide sensor payout positions. The marking of gauging tape is provided in a single marking system, English or Metric.
- 3.4 The electronic circuits in the hub assembly are comprised of LCD display that provide percent oxygen level readings, a night light switch, alarm horn and associated red LED lamp. The above parts and ancillary electronics parts are all assembled on a printed circuit board. A 9-volt battery power source and audio horn are located within the tape reel hub assembly directly below the printed circuit board of the modular hub cover assembly. The night switch in conjunction with the power on-off switch may be used to give instant push button calibration of the system in air (See section 7.0).
- 3.5 When the oxygen sensor is powered in a normal ambient environment, the reading of the digital will show an oxygen in air content of 20.9% ( $\pm 0.2\%$ ). This is the normally accepted value of atmospheric air at sea level. Ordinary air is therefore used in this system as a standard for calibration of the sensor. However, calibration is only necessary when replacing the oxygen cell contained within the sensor housing assembly, or when the battery is replaced. To perform a calibration, it is only necessary for the operator to first hold down the night light push button; and then, without releasing the night light push button, to press the power on-off button. The display will at first show a low value, but then change quickly to the correct percent air oxygen reading, namely 20.9% ( $\pm 0.2\%$ ). Both are then released.
- 3.6 It is important not to attempt calibration of the unit when the sensor is in a petroleum tank, or in other than a normal air environment. It is also desirable to perform the calibration at room temperature (70 to 80 degrees F). The latter condition is not a requirement, but will, in general, result in greater accuracy. Although the sensor is temperature compensated to provide minimum error for temperature change, sudden large temperature shifts may cause errors of approximately 0.3% unless the sensor is given time to recover and the temperature to stabilize.
- 3.7 In operation and as the oxygen sensor descends into a lower oxygen gaseous environment, such as that contained in a petroleum tank with inert gas, the output current from the sensor decreases causing the hub amplifier to linearly experience a lower input voltage. Digital output to the display is then also decreased. This voltage after conditioning will be proportionally displayed at the correct lower oxygen percent level encountered.



- 3.8 Normally, and if left unattended in air after power is applied, timing circuits within the hub assembly will permit the system to remain on for approximately 5 minutes and then will automatically turn the power off. However, when lowered into a gaseous environment containing less than 18% oxygen, an internal voltage comparator senses this condition and prevents the unit from turning off until it is once again exposed to a normal air environment, Thereafter, approximated one minute of additional on power is permitted before the unity automatically turns off during a measurement cycle.
- 3.9 The alarm circuit within the hub consists of 18% oxygen level comparator described above, an 8% comparator, a red lamp (LED) and horn as visual and audible alarm indicators, with other ancillary electronic circuits.
- 3.10 When the sensor is powered in a normal air environment, the oxygen level is well above the 8% level and the red LED lamp on the faceplate will flash slowly. The horn is silent. If the sensor is now lowered into a tank which contains an oxygen level below 18% but above 8%, the horn will now emit a pulsating audible tone and the red lamp will then begin to flash at a rapid rate. Below 8% the horn will be silent, and the red LED will extinguish.

To Summarize:

Above 18%	Lamp slowly Flashes, Horn Silent (Power on indicator)
From 8% to 18%	Lamp Rapidly Flashes, Horn Sounds
Below 8%	Lamp off, Horn Silent

- 3.11 As can be seen from the above table, during an above acceptable level of oxygen contents, both red LED and horn are off. In addition, the action of the red LED is explained as follows:
- 3.12 The red LED lamp served two purposes.
- 3.13 The first purpose is to act as a simple power on indicator in normal air during day and nighttime use. This feature is important at night since an operator may not be aware that automatic shut-off has occurred and attempt a gauging procedure.
- 3.14 The second purpose is to provide an additional indication that an unsafe in-tank oxygen level exists. In the event that an operator has difficulty in hearing the alarm horn, the rapidly flashing red LED can be clearly seen.

## SECTION IV

### 4.0 **REQUIRED CONDITIONS AND RECOMMENDATIONS FOR SAFE USAGE:**

The attention of the user of this apparatus is drawn to the possible hazards of oxygen sensing within flammable environments normally found above confined petroleum liquids, which are known to be generators of static electricity, and which are not covered with an inert gas blanket.

The following is a general guidance to safe usage, drawn from the advice and experience of various industry sources.

The specific safety standards or directives of your company are to be strictly adhered to, with the general guidance given here being regarded as only a supplement to existing and established operating safety procedures.

#### 4.1 **REQUIRED CONDITIONS:**

The oxygen sensor frame and reel assembly are to be earthed (grounded) to the liquid tank containment vessel or tank, before and during introduction of the gauging equipment into the vessel. The earthing conductor must not be disconnected until the equipment is completely withdrawn from the vessel being gauged. A coiled grounding cable with a heavy alligator spring clamp is provided with the equipment. Proper grounding of this cable is the responsibility of the user.

#### 4.2 **RECOMMENDED SAFE USAGE CONDITIONS:**

- 4.2.1 The apparatus' sensor should preferably be entered into a tank or vessel within an earthed sounding tube or pipe where such devices are provided and are normally used for temperature and/or other fluid measurements.
- 4.2.2 For sea going vessels where gauging is normally accomplished through standard cargo tank ullaging hatch ports or other approved means, the following precautions should be observed.
- 4.2.3 Sensor entry into tanks or vessels immediately following a tank filling or loading operation of known static accumulator type petroleum products or other flammable liquids, **should not** be attempted until, at least a period of **30 minutes** has elapsed since the cessation of filling.
- 4.2.4 Clean oil distillates are, in general, known to be accumulators of static electricity due to their low conductivity (i.e., less than 1000 picosiemens/meter) and therefore may require relaxation periods greater than 30 minutes before gauging is attempted. The foregoing does not consider use of anti-static additives to clean oils, as generally easing the need for proper precaution, unless actual and specific product testing has shown the product to have conductivity levels which eliminate the danger of static charging.
- 4.2.5 The presence of an inert gas blanket above products of this type may generally relax the above precautions. However, such determination is to be made by qualified authorities.

## **SECTION V**

### **4.3 FLUID LEVEL (ULLAGE) OF TANK OR OTHER VESSEL WHICH IS TO BE GAUGED FOR OXYGEN PERCENT LEVEL:**

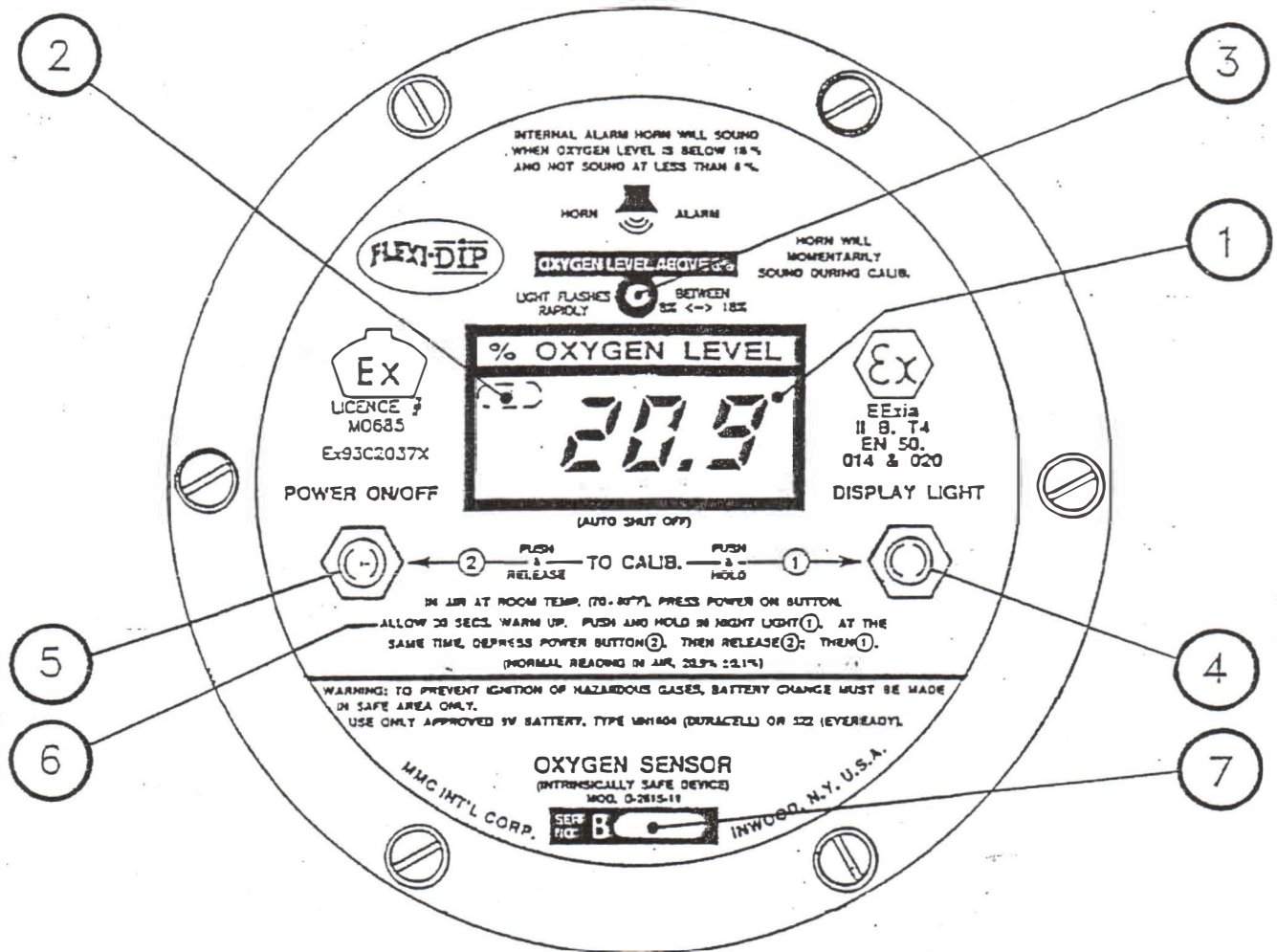
- 4.3.1 Before entering the free space above a liquid level, the level of the fluid contained within the tank or vessel should be known. If the location of fluid level is not known, it should be determined by suitable and reliable means.
- 4.3.2 With the fluid level known, the oxygen sensor can be entered into the tank and unreeled to the mid-point position of free space above and between the liquid level and tank top

#### **CAUTION!**

**Under no circumstances should the oxygen sensor be immersed into fluid. Immersion into fluid will disable use of the sensor unit until a thorough cleaning and drying of the sensor cell is performed. However, this procedure may not always return the sensor to an undamaged state, and sensor replacement should be performed.**

# FIGURE 1

## OXYGEN SENSOR HUB FACEPLATE



### FEATURE IDENTIFICATION & FUNCTION

ITEM#	IDENTIFICATION	FUNCTION
1	DIGITAL DISPLAY	PERCENT OXYGEN DISPLAYED
2	LO-BAT	LOW BATTERY INDICATOR
3	L.E.D. (RED)	RAPIDLY FLASHES WHEN OXYGEN LEVEL IS ABOVE 8%, SLOWLY FLASHES AT LEVEL ABOVE 18% EXTINGUISHED AT LEVELS BELOW 8%
4	NIGHT LIGHT/CALIB. PUSHBUTTON	DUAL FUNCTION BUTTON; NIGHT LIGHT/ AND CALIBRATION WHEN USED WITH ITEM 5.
5	POWER ON*/CALIB. PUSHBUTTON	DUAL FUNCTION BUTTON; POWER ON/OFF AND CALIBRATION WHEN USED WITH ITEM 4.
6	CALIBRATION INSTRUCTIONS	SEE SECTION VII OF THIS MANUAL FOR ADDITIONAL INFORMATION.
7	UNIT SERIAL NUMBER	REGISTERED TO ORIGINAL PURCHASER.

\*AUTOMATIC SHUT-OFF AFTER 5 MINUTES OF NON-USE.

## SECTION VI

### 6.0 **CARE AND MAINTENANCE:**

Proper care and maintenance should be practiced to maintain long, trouble free and accurate service and to maximize battery life, as follows:

- 6.0.1 When not in use, make sure power is off as evidenced by display being extinguished.
- 6.0.2 Store sensor head assembly in the fully wound position and store in a dry location. Do not allow the instrument to remain for long periods in direct sunlight, or store in temperature above 125° F, or in temperature below freezing. Such temperatures may damage the liquid crystal display.
- 6.0.3 Make sure before lowering the sensor into a tank, that the tank product level is known, so that the sensor is not immersed into the product. Before lowering the oxygen sensor, always obtain an accurate ullage reading by using an MMC ullaging tape or similar device. (See Section 5.0).
- 6.0.4 Each time the sensor is raised from the tank, place the spring-loaded tape wiper switch in the “ON” position, to clean gauging tape of product smears.
- 6.0.5 Lubricate drum shaft and bearing with light machine oil to keep it free turning.
- 6.0.6 Never permit tape and sensor head to unwind freely (control speed of descent by use of a restraining force on tape reel crank).

### 6.1 **BATTERY REPLACEMENT (In Safe Area Only!)**

The battery should be replaced whenever the “LO BAT” symbol appears at the upper left corner of the display. If the sensor is used to obtain oxygen level readings when the battery is low, large errors may result.

Before replacing battery, turn power off by depressing “ON/OFF” switch. Always replace battery in a gas free atmosphere. Remove the six machine screws from the outside retaining ring on the hub cover. Lift the bezel faceplate cover with its attached P.C. Board. The battery is retained within the reel by a spring clip battery holder under the modular faceplate assembly. Remove the battery from the battery cap connector. Replace the battery with a fresh battery of the type listed on the approval label only. Make sure the battery is inserted with correct polarity. Positive (+) side of battery to positive (red) side of battery cap. Take care to align the viton cover casket, and machine screw fasteners when re-assembling to tape reel hub.

### **IMPORTANT!**

After battery is replaced, it is necessary to re-calibrate the oxygen sensor using the simple push button procedure given in Section 7.0.

## **6.2 OXYGEN CELL REPLACEMENT**

- 6.2.1 The oxygen cell, located within the sensor barrel, has a life expectancy of at least one year. The cell is similar to a battery except unlike a battery, it produces a current which is directly proportional to the level of oxygen it senses in a gaseous environment. In normal air, the current generated by a live cell is approximately 0.8 milli-amperes, which produces a conditioned reading on the display of  $20.9\% \pm 0.2$ . This current output is very constant in normal air throughout the cell's life. At end of life the output drops quickly and reading in the air will suddenly drop below 20.9%. When the push button calibration procedure given in Section 7.0 can no longer be performed, the cell must be replaced.
- 6.2.2 To replace the cell, unscrew the retaining cap and screen at the lower extremity of the sensor barrel housing assembly. The cell housing can not be extracted by holding in a vertical position. Unplug cell from its mating connector. Replace with fresh cell, making sure to seat connector and mating plug securely before re-assembly into barrel housing. Re-insert cell into the barrel, while slightly rotating the cell assembly. Replace screen and retaining cap. Then follow procedure given for cell calibration in Section 7.0.

## **6.3 GAUGING TAPE REPLACEMENT**

In case of damage, the gauging tape may be replaced by following the procedure below:

- 6.3.1 Remove the oxygen sensor assembly by unplugging it from the tape end.
- 6.3.2 Remove storage barrel by loosening cap nuts on the side of the tape wiper housing.
- 6.3.3 Remove the round vapor seal assembly on the top of the tape wiper housing by backing off the Allen set screw which holds it in place.
- 6.3.4 Now place the tape wiper in the off position and remove the tape wiper housing by unfastening the (4) machine screws in the front of mounting plate. Pull the wiper assembly out.
- 6.3.5 Completely unreel the old tape assembly.
- 6.3.6 Remove the six machine screws from the hub cover and lay it to the side.
- 6.3.7 Remove the battery from the battery holder and unplug the battery cap.
- 6.3.8 Note that the end of the metallic tape inside the hub is grounded by a machine screw and washer. The tefzel tape cover at this point has been trimmed away to permit good ground contact. Also note that the tape's outer conductors are spliced to two of the wires that originated at circuit board. Notice the color of these wires so that when re-assembling, the correct wire will be connected to the top and bottom tape conductor.

- 6.3.9 Detach the tape at the hub removing the grounding machine screw and unsoldering the spliced connections between gauging tap and PCB connection wires.
- 6.3.10 Note on the tape reel which way the tape scale is facing.
- 6.3.11 Pull the tape away to the hub by reverting hub reel through the tape wiper housing, and out through the slot in the side of the reel hub.
- 6.3.12 Attach a new tape to hub by reversing the above procedure making sure that the tape numerals face in the same direction as the previous tape numerals faced.
- 6.3.13 Use a silicone rubber sealant to re-seal area around slotted tape entrance to reel hub. Re-wind tape onto reel, replace round vapor seal assembly, and re-install wiper assembly.
- 6.3.14 Replace battery, battery cap and hub cover, after allowing silicone sealant at least two hours curing time.
- 6.3.15 Re-connect oxygen sensor assembly to tape barrel housing end.
- 6.3.16 Since the battery is temporarily removed during the tape replacement procedure, re-calibration is required. Follow method of calibration procedure in Section 7.0.

## SECTION VII

### 7.0 CALIBRATION PROCEDURE:

- 7.0.1 The Oxygen Sensor and associated electronics have been accurately calibrated at factory. The oxygen cell used, and the electronic circuits are extremely stable and in general require calibration only when the 9-volt battery or the oxygen cell is replaced.
- 7.0.2 A simple way to perform push button calibration has been incorporated in the design which permits the operator to quickly bring the system into calibration using the oxygen content of normal air (20.9%)  $\pm 0.2\%$  as standard.

### 7.1 METHOD OF CALIBRATION:

Calibration should be performed in a normal air environment and if possible, at room temperature (68 to 78°F).

- 7.1.1 Turn power on by depressing the power “ON/OFF” push button. Wait approximately 10 seconds for display to stabilize. Display should read 20.9%  $\pm 0.2$ . If proper reading is obtained there is no need to calibrate. If an incorrect reading is obtained, look at the upper left corner of the display. If “LO BAT” appears, indicating a low battery condition, replace the 9-volt battery contained in the hub following the procedure given in Section 6.

**Note:** When a 9-volt battery is replaced or temporarily removed, the memory circuits within the hub may lose their charge and cause the display to produce an abnormally low reading. If all the charge has leaked off, the reading will be zero.

- 7.1.2 To perform the simple push button calibration depress the “Display Light” push button labeled “1” and while holding it in depress the power “ON/OFF” push button labeled “2”. Now release both. The display will jump to a low-value and quickly climb to a correct reading of 20.9%  $\pm 0.2$ . The order of button depression must be followed in the order described.
- 7.1.3 No further adjustment is required.

**Note:** If the oxygen cell has reached end of life, calibration will not be possible. A lower display reading of random value will be obtained each time calibration is attempted. Cell replacement must be performed to re-establish normal usage. See cell replacement in this manual.



## SECTION VIII

### 8.0 FAULT FINDING

The following section covers only simple faults that may occur. No attempt has been made in this section to cover highly technical faults.

PROBLEM NO. 1: Unit does not turn on when power “On/Off” switch is depressed.

PROCEDURE &

EXPLANATION: If unit does not turn on at all, check battery voltage using a voltmeter. If battery voltage is lower than 6.6 volts, the voltage is too low to illuminate display. Replace battery. (See Section VII Paragraph 7.5). If battery is okay, check power “On/Off” switch using an OHM meter with the battery disconnected. Switch is a double pole, single throw (DPST) unit. Both sections should normally show open circuits. When depressed, ohmmeter reading should be less than 2 ohms. If switch is not OK, return to factory or authorized service center for repair.

PROBLEM NO. 2: Unit stays on all the time, even though “On/Off” push-button is depressed.

PROCEDURE &

EXPLANATION: This symptom is usually indicative of a faulty power “On/Off” push-button switch. Check the switch with an Ohmmeter as explained in Problem No. 1 above.

PROBLEM NO. 3: When turned on in normal air, unit does not read  $20.9 \pm 0.2$ , and nothing happens when the simple push button calibration procedure is followed.

PROCEDURE &

EXPLANATION: If either the power “ON/OFF” switch or the display light switch has a faulty contact, it will not be possible to perform the calibration. These switches are both Double Pole Single Throw (DPST) switches, which can be easily checked with an ohmmeter. Remove the battery when making ohmmeter checks. Return to factory or authorized service center for repair.

PROBLEM NO. 4: When unit is turned on, in air, unit does not read  $20.9 \pm 0.2$ . When simple push button calibration is attempted several times, the readings are random, and always too low (less than 20.9). LCD does not indicate low battery voltage condition.

PROCEDURE &

EXPLANATION: The above symptom indicates that the oxygen sensor within its barrel has reached end of life and must be replaced. Follow replacement procedures given under Section 6.0.

PROBLEM NO. 5: Same as Problem #4 above, except the simple push button calibration always results in the same reading, which is incorrect (Too high or too low), by 0.3% or more.

PROCEDURE & EXPLANATION: Check upper left corner of display for “LO BAT” indication. If okay, unit needs factory calibration.

PROBLEM NO. 6: Display reads a value very close to zero (0.00) when unit is turned on in normal air.

PROCEDURE & EXPLANATION:

1. If battery has been replaced, the memory circuits have probably lost their charge and unit must be re-calibrated using the simple push button procedure given in Section 7.0.
2. If the simple push button calibration results in a reading close to zero or zero, remove oxygen cell from sensor assembly following procedure given under Section 6.0. Once removed, examine the female connector attached to cell housing. Hold the cell housing so that the “V” notch in the center ring of the connector is up. See drawing A-2615-17. Connect the positive lead of a digital voltmeter capable of reading millivolts to pin from the “V” notch. The reading should be at least 13.5 millivolts or more. If the reading is less than 12 millivolts, the cell has reached “end of life” and should be replaced. If reading is above this value and reading close to zero is obtained on the display, then a break in connection (open circuit) probably exists in the gauging tape wires or elsewhere. Use an ohmmeter to measure the continuity of the male mating plug pins (3, 4, 6) connecting the red, black and white wires to gauging tape 2 wire conductors and metal scale, back to the hub electronics connection point.

PROBLEM NO. 7: Alarm circuit (Red LED or horn) does not function properly.

PROCEDURE & EXPLANATION:

1. Unit requires factory calibration.
2. Horn may be badly corroded.
3. Comparator is not functioning properly.
4. Return to MMC or authorized service center for repair.

**CAUTION**

This equipment is an approved intrinsically safe device. The factory of approved service centers may only make circuitry repair. Unauthorized repairs will void any guarantee or warranty given elsewhere in this manual. In addition to the above statement, it is equally, if not more important to understand that repairs by unqualified persons may endanger the intrinsically safe construction of this device.

## **APPENDIX**

	PAGE NUMBER
A. MMC Warranty Statement	21
B. Oxygen Sensor Gauging Tape Warranty Addendum	22
C. Glossary of Approvals	23
D. BASEEFA Certificate of Conformity Ex93C2037X	25-28

## **WARRANTY**

### **MMC OXYGEN LEVEL SENSOR GAUGING TAPES:**

The seller, MMC or its licensed agents, fully warrants equipment of its manufacture against defects in materials or workmanship for a period of one year from the date of shipment. No other warranty period, in excess of one year, may be expressed or implied by sub-agents or others, unless authorized in writing by MMC. The liability of the seller under this warranty is limited, at seller's option, solely to repair or replace with equivalent equipment.

The seller, upon the expiration of the warranty period, has the option to apply a limited credit, not to exceed the original equipment sales price, toward the purchase of a new piece of equipment, if returned equipment is beyond reasonable repair. In any event, non-warranty repair charges will be quoted to the buyer, for authorization, before repair work commences.

This limited warranty does not include mechanical parts failure due to wear or corrosion from normal usage, nor does it cover limited life electrical or elastomer components.

This warranty is in lieu of all other warranties, expressed or implied, including that implied warranty of fitness for a particular purpose to the original purchaser or to any other person. Seller shall not be liable for consequential damages of any kind.

In the event of Returns for Warranty Repairs:

- A. The buyer is to notify the seller in writing upon discovery of the defects.
- B. Upon receipt of written authorization from the seller, the equipment is to be returned as directed, transportation prepaid by the buyer.
- C. Buyer is to disclose the use of this product within hazardous chemical substances. It is the responsibility of the buyer to clean or decontaminate this product before returning for repairs. Buyer's refusal will void repair warranty at seller's option.
- D. If seller's examination of such equipment disclosed to his satisfaction that defects were not caused by negligence, misuse, improper installation, accident or unauthorized repair or alteration by the buyer, repairs will be immediately affected.
- E. Buyer is to provide shipping instructions for the return, including mode of transportation. This warranty does not include mechanical parts failure due to wear or corrosion from normal usage, nor does it cover limited life electrical components or elastomer seals.

This warranty is in lieu of all other warranties, expressed or implied, including that implied of fitness for a particular purpose to the original purchaser or to any other person. Seller shall not be liable for consequential damages of any kind.

### **IMPORTANT:**

The equipment has been certified as intrinsically safe instrument for only those classes or categories of hazardous areas so stated on the equipment label, bearing the mark of the applicable approval agency. No other usage is implied or otherwise authorized.

Unauthorized repair or component replacement by the user will void this warranty and may affect the intrinsic safety of the equipment.

## **OXYGEN SENSOR GAUGING TAPE WARRANTY ADDENDUM:**

Warranty for MMC Oxygen Level Sensor Tapes is One (1) year from the ship date of shipment against defects in the material or workmanship, excluding oxygen cell assembly.

Warranty for Oxygen Cell Assembly is six (6) months from the date of shipment.

There is no warranty for oxygen cell assembly after improper use.

### **9.0 GUIDELINES FOR TAPE REPAIRS:**

- 9.0.1 The MMC oxygen sensor gauging tape is verified as intrinsically safe by BASEEFA (British Approval Service for Electrical Equipment in Flammable Atmosphere) in the United Kingdom.
- 9.0.2 In order to maintain the validity of the approval, tape units can be repaired only by MMC or our authorized guaranteed repair offices approved by BASEEFA. We cannot offer that approval; it must be given by the approving agency.
- 9.0.3 To maintain our agreements with the above-mentioned approval agencies, and yet accommodate our customers as much as possible, we have developed four modules, which can be purchased as units installed by the owners of the tapes.
- 9.0.4 The modules developed are:

**COMPLETE HUB ASSEMBLY**, (without battery), consisting of P.C. Board with ancillary components, faceplate, nameplate, gasket and battery connector cap. (Approval agency to be specified by customer when ordering).

**SENSOR ASSEMBLY**, consisting of non-separable oxygen cell, cells housing, associated electronics and connector.

**TAPE AND HEADER ASSEMBLY**, consisting of graduated measuring tape with molded header and connector.

**TAPE WIPER ASSEMBLY**, consisting of wiper blades, on/off knob, mounting plate and screws.

For a list of our guaranteed repair offices, please visit us at [www.mmcintl.com](http://www.mmcintl.com)

Please note, repairs carried out in any unauthorized repair facility will automatically void the guarantee. These repair procedures are in accordance with approval agencies' direction for intrinsically safe devices.

## **GLOSSARY OF APPROVALS**

MAJOR APPORVAL STANDARDS & GOVERNEMNT SPECIFICATIONS  
ADOPTED BY MMC INTERNATIONAL CORP. FOR  
CERTIFICATION, MANUFACTURE, INSPECTION CALIBRATION AND TESTING

### **INTRINSICALLY SAFE APPROVALS**

<b>CAS (CAN.)</b>	Sira Certification Service
<b>CSA</b>	Canadian Standards Association
<b>EECS</b>	Electrical Equipment Certification Service (U.K.)
<b>CSA (EUROPE)</b>	CSA Group Testing UK Limited
<b>BV</b>	Bureau of Veritas

### **GOVERNMENT REGULATORY BODIES APPROVALS**

<b>BV</b>	Bureau of Veritas
<b>EECS</b>	Electrical Equipment Certification Service (U.K.)

### **INDUSTRY RECOGNIZED INSPECTION BODIES APPORVALS**

<b>ABS</b>	American Bureau of Shipping
<b>CCS</b>	China Classification Society
<b>DNV</b>	Det Norske Veritas (Norway)
<b>LLOYD'S</b>	Lloyd's of London (U.K.)
<b>BV</b>	Bureau of Veritas

### **GAUGING TAPE AND OTHER MEASUREMENT SPECIFICATIONS**

<b>FEDERAL</b>	United States Government Specification
<b>NIST</b>	National Institute of Standards & Technology Test
<b>API</b>	American Petroleum Institute (Partial Adaptation)
<b>ASTM</b>	American Society for Testing Materials

### **PERIODIC FACTORY INSPECTIONS BY REGULATING BODIES**

<b>CSA (U.K.)</b>	Performs annual inspections for SIRA/CSA for equipment approval provisions of directive 2014/34/EU
<b>CSA (CANADA)</b>	CSA performs quarterly inspections
<b>BV</b>	Performs annual inspections
<b>DNV</b>	Performs annual inspections
<b>CCS</b>	Performs annual inspections

## LIST OF DRAWINGS

<b><u>DRAWING NUMBER</u></b>	<b><u>REV.</u></b>	<b><u>DESCRIPTION</u></b>
A-2615-17	-	Oxygen Sensor Cell Outline Drawing
B-2615-14	-	Tape Reel Hub Electronics Module Assembly
S-2615-OCX	-	“Flexi-Dip” Portable Tape Assembly, Oxygen Sensor, Closed Gauging
DB-2615-1FRX	-	“Flexi-Dip” Portable Tape Assembly, Oxygen Sensor, Restricted Gauging





British Approvals Service for Electrical  
Equipment in Flammable Atmospheres

## *Certificate of Conformity*

1.

2. BAS No Ex 93C2037X

3. This certificate is issued for the electrical apparatus:

AN OXYGEN SENSOR TYPE D2615

4. manufactured and submitted for certification by:

KDG MOBREY LTD  
of Slough, Berkshire, SL1 4DN

5. This electrical apparatus and any acceptable variation thereto is specified in the Schedule to this Certificate and the documents therein referred to.

6. BASEEFA being an Approved Certification Body in accordance with Article 14 of the Council Directive of the European Communities of 18 December 1975 (76/117/EEC) certifies that the apparatus has been found to comply with harmonised European Standards

EN50 014 (1977) + Amendments 1 to 5  
EN50 020 (1977) + Amendments 1 and 2

and has successfully met the examination and test requirements as recorded in confidential Report

No 93(C)033 dated 12 February 1993

7. The apparatus marking shall include the code

EEx ia IIB T4

File No: EECS 0131/02/031



Sheet 1/4

BP

I M CLEARE  
DIRECTOR EECS  
17 March 1993



Electrical Equipment Certification Service  
Health and Safety Executive  
Harpur Hill, Buxton, Derbyshire, SK17 9JN, United Kingdom  
Tel: 0298 262111 Fax: 0298 79514 Telex: 668113 RLSD G





British Approvals Service for Electrical  
Equipment in Flammable Atmospheres

Certificate BAS No Ex 93C2037X dated 17 March 1993

8. The manufacturer of the electrical apparatus referred to in this certificate, has the responsibility to ensure that the apparatus conforms to the specification laid down in the Schedule to this certificate and has satisfied routine verifications and tests specified therein.
9. This apparatus may be marked with the Distinctive Community Mark specified in Annex II to the Council Directive of 16 January 1984 (Doc 84/47/EEC). A facsimile of this mark is printed on sheet 1 of this certificate.

Sheet 2/4

This certificate is granted subject to conditions applicable to the Approval Service, it does not necessarily indicate that the apparatus may lawfully be used in particular industries or circumstances.



**Electrical Equipment Certification Service**  
Health and Safety Executive  
Harpur Hill, Buxton, Derbyshire, SK17 9JN, United Kingdom  
Tel: 0298 262111 Fax: 0298 79514 Telex: 668113 RLSD G







## Schedule

Certificate of Conformity BAS No Ex 93C2037X dated 17 March 1993

### APPARATUS

An **Oxygen Sensor Type D2615** is designed to measure the oxygen concentration in the atmosphere within a tank.

It comprises a drum containing the main electronics, display, and control switches, plus a sensor head which is connected to the main unit by a special tape wound on a reel. The tape incorporates conductors for connection of the sensor circuit, and a graduated scale to provide depth indication.

The apparatus is powered by an internal 9V battery, and the enclosure provides a degree of protection in excess of IP20.

The Oxygen Sensor is specifically designed to measure low levels of oxygen concentration (normally below 8%) in a mixture, and to provide audible and visual warning if concentrations exceed 8%, but are less than 18%. Oxygen readings between 18% and 21% are displayed visually.

### DRAWINGS

Number	Issue	Date	Description
71097/810	A	8.11.91	GA and Label
71097/815	A	19.11.91	Sensor GA
71097/819	B	8.12.92	Circuit Diagram
71097/816	B	15.12.92	Hub Details (PCB & Battery)

### SPECIAL CONDITIONS FOR SAFE USE

- 1 This certificate covers the use of the sensor to indicate oxygen concentrations in the range 0 to 21% only.
- 2 This certificate does not approve the apparatus for use in concentrations of oxygen in air greater than the normal ambient of 21%.
- 3 The apparatus is not intended or approved for the determination of conditions required for safe human occupancy.

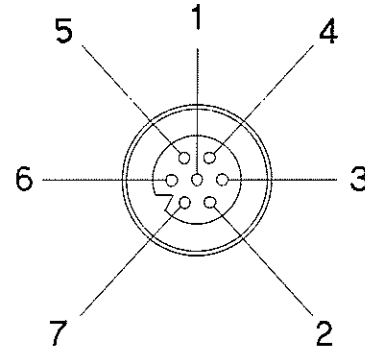
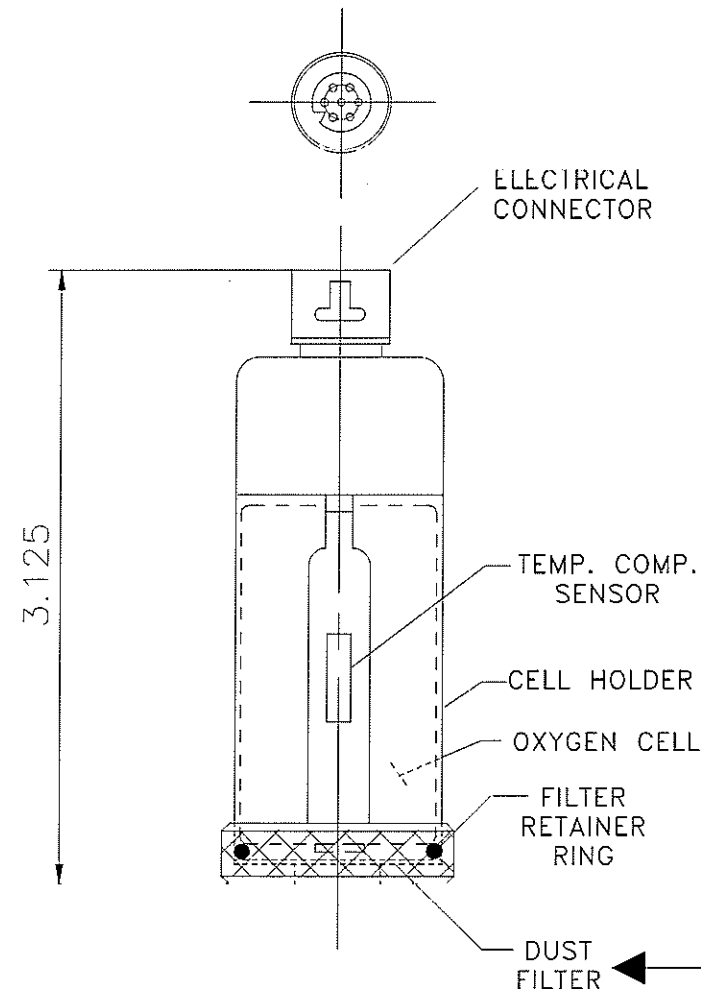


Certificate of Conformity BAS No Ex 93C2037X dated 17 March 1993

- 4 Attention is drawn to the possible hazard due to electrostatic charges which may be held by the liquid in the tank:
- 4.1 The apparatus must be connected to the tank earth before and during introduction into the tank. This connection must not be removed until after the apparatus has been completely withdrawn from the tank at the end of the measuring operation.
  - 4.2 It is anticipated that the user will have specific operating methods laid down to ensure safety when introducing apparatus such as this into a tank. In this case the users operating instructions should be observed.
  - 4.3 In the absence of such instructions, the following should be noted:
    - a) If an earthed sounding tube or pipe is provided, the probe should be entered into the tank within this tube.
    - b) The advice of the appropriate legislative authority for the installation should be obtained.

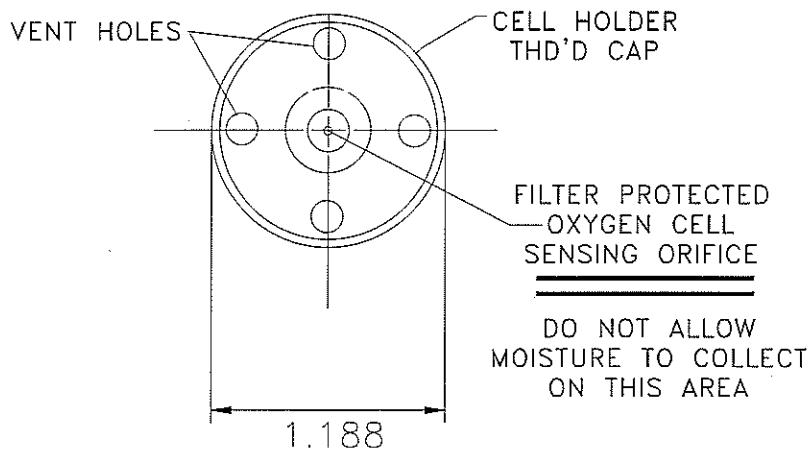
DIMENSIONS : INCHES

UNAUTHORIZED USE, MANUFACTURE OR  
REPRODUCTION IN WHOLE OR PART,  
IS STRICTLY PROHIBITED.



CELL CONNECTOR PIN NUMBER  
ASSIGNMENT

PIN NUM.	FUNCTION
1	NOT USED
2	NOT USED
3	CELL GROUND RETURN
4	SYSTEM GRD.
5	NOT USED
6	POSITIVE (+) CELL OUTPUT
7	TEST PIN (SEE INST. MANUAL)



( REPLACEABLE WAFER TYPE FILTER )  
UNSCREW CAP, REMOVE RETAINER "O"-RING,  
REMOVE FILTER DISC, REINSTALL NEW  
FILTER DISK IN REVERSE ORDER.

NOTE:

CELL IS A NON-FIELD REPAIRABLE  
PART, AND IS A PART OF AN  
INTRINSICALLY SAFE SYSTEM.

SEE INSTRUCTION MANUAL FOR  
PART REPLACEMENT PROCEDURE.

FULL SIZE

REV. C  
05/98

NEXT ASS'Y  
DB-2615-1FRX

JOB NUM.

OXYGEN SENSOR CELL  
OUTLINE DRAWING

PT# A-2615-17

MMC INTERNATIONAL CORP.  
INWOOD NEW YORK 11096

DRN BY : F.S.G

DATE : 10-21-92

APP'D

DWG. NO.

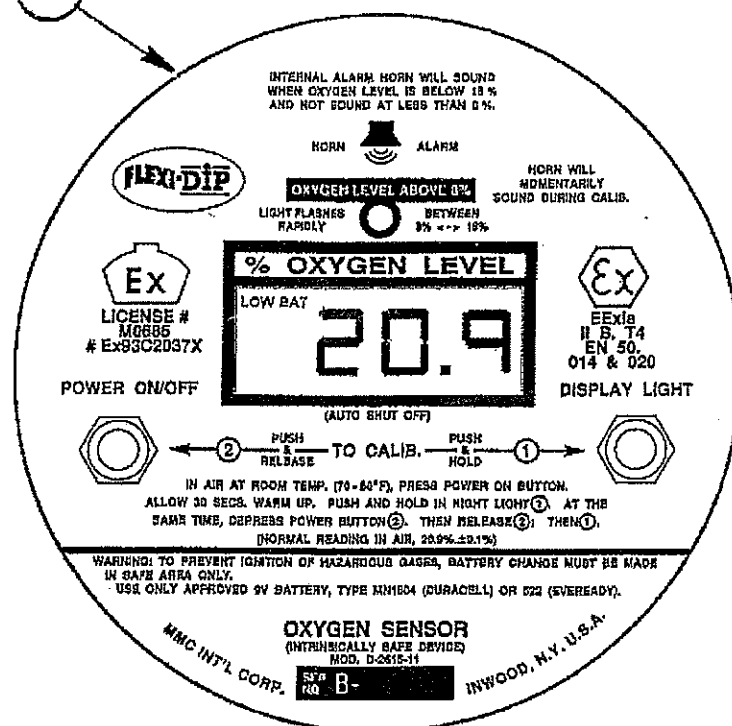
A-2615-17

REV.

C

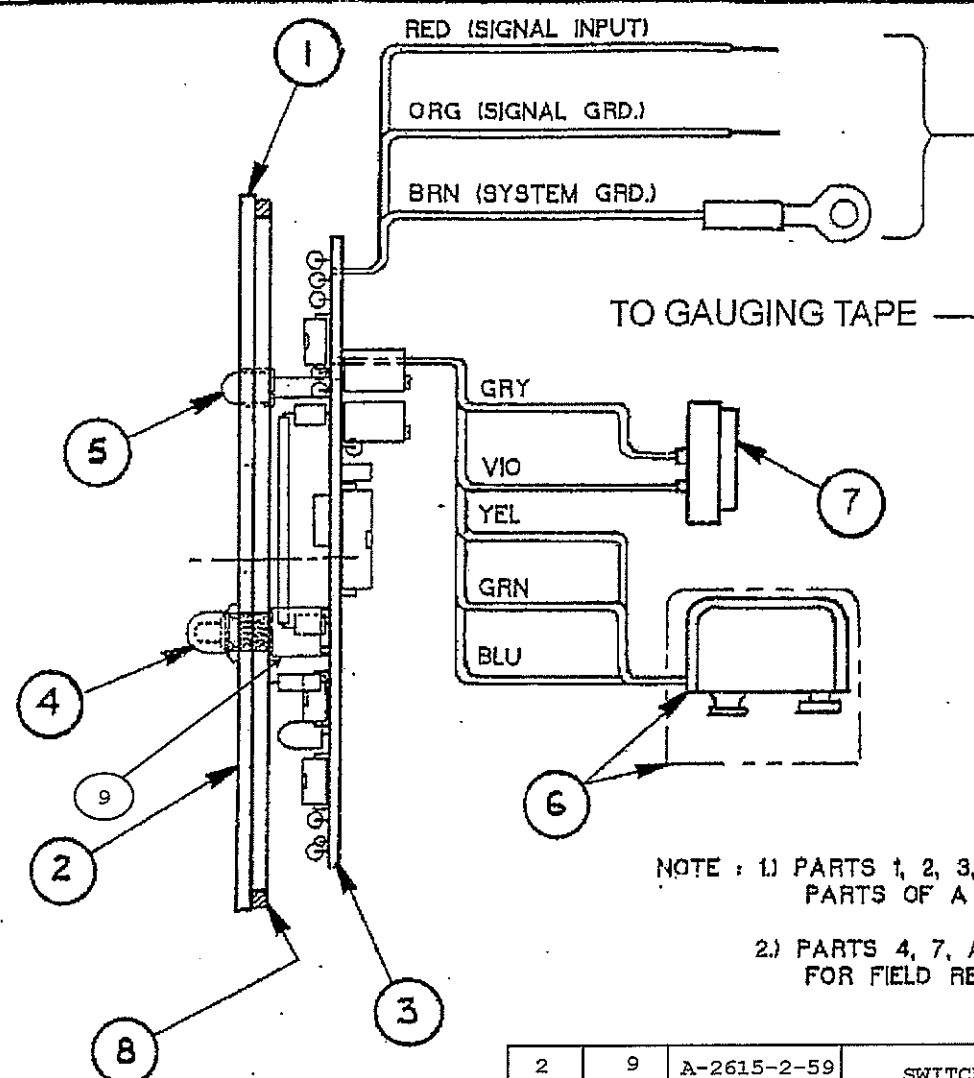
UNAUTHORIZED USE, MANUFACTURE OR  
REPRODUCTION IN WHOLE OR IN PART  
IS PROHIBITED.

B-2615-6  
(BASEEFA)



NOTES:

1. BASEEFA NAMEPLATE USED ON DWG.  
DB-2615-1PRX.



REVISIONS

SYM	DESCRIPTION	DATE	APP'D.
A	UPDATE & CAD CONVERT	02/26	FSG

SEE EQUIPMENT INSTRUCTION MANUAL  
FOR GAUGING TAPE REPLACEMENT PROCEDURE.

NOTE: 1.) PARTS 1, 2, 3, 5, AND 6, CAN ONLY BE SUPPLIED AS  
PARTS OF A COMPLETE ELECTRONIC MODULE REPLACEMENT.

2.) PARTS 4, 7, AND 8 CAN BE INDIVIDUALLY SUPPLIED FOR  
FOR FIELD REPLACEMENT PURPOSES ONLY.

QTY.	PT.#	DWG. NO.	DESCRIPTION	MAT'L
2	9	A-2615-2-59	SWITCH, PUSHBUTTON DPST	
1	8		"O" RING, PARKER #S-155	BUNA-N
1	7	A-2401-63	HORN, PIEZO ELECTRIC, #AT-20K	
1	6	B-2615-7	CAP, BATTERY CONNECTION	POTTED
1	5		L.E.D., 2ma, RED #HLM3301	PLASTIC
2	4		SEAL CAP, PUSHBUTTON #40083	BUNA-N
1	3	D-2615-4	PRINTED CIRCUIT BOARD, OXYGEN SENSOR	1/16, FR4
1	2	AS SHOWN	NAMEPLATE, OXYGEN SENSOR	MYLAR
1	1	A-2615-16	FACEPLATE, OXYGEN SENSOR	LEXAN

LIST OF MATERIALS

DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED			OXYGEN SENSOR TAPE REEL HUB ELECTRONIC MODULE ASSEMBLY		MMC INTERNATIONAL CORP.	
FRAC.	DEC.	ANG.			INWOOD	NEW YORK
± 1/64	± .005	± 10'			DWG. NO.	REV
SCALE	NONE	NO. 1 PER ASSY	DRAWN	J.A.	DATE	11-92
NEXT ASSY.	D-2615-1XXX		CHECKED		DATE	
			APPROVED		DATE	11-92
					B-2615-14	A

UNAUTHORIZED USE, MANUFACTURE OR REPRODUCTION IN WHOLE OR IN PART IS PROHIBITED  
DRAWING, DESIGN AND OTHER DISCLOSURES PROPERTY OF  
MMC INTERNATIONAL CORP  
INWOOD, L.I. NEW YORK

# GENERAL SPECIFICATIONS

ACCURACY . . . . 1% TO 25 %, +/- 0.2%  
0% TO 25% MEASUREMENT RANGE  
APPROVALS . . . . INTRINSICALLY SAFE; BASEEFA  
TEMP. LIMITS . . . . AMBIENT -20 TO 120°F (-29 TO 49°C)  
PRODUCT -40 TO 180°F (-40 TO 80°C)  
TAPE LENGTHS . . . 50, 75, 100FT. (15, 20, 25, 30, 37M)  
TYPICAL WEIGHT . . 6.8Kg 35 M  
PRESS. LIMITS . . . 3 PSI-WORKING, 7.5 PSI MAX.

27	WARNING LABEL, A-2615-21, PER APPROVAL
26	WIPER ASS'Y, PRIMARY SIGHT GLASS
25	FULL STOW LABEL, METRIC OR ENGLISH DIM., PER ORDER
24/28	APPROVAL LABEL WITH CALIB. DESCRIPTION, / OPER. INSTR
23	OXYGEN SENSOR ASSEMBLY D-2615-8
22	BATTERY, 9V, MN1604 PER APPROVAL LABEL, 1 AS SPARE
21	REPLACEABLE SENSOR CELL ASSEMBLY, A-2615-17
20	GAUGING TAPE ASSEMBLY, TEFEZEL COATED TAPE
19	TAPE REEL ROTATION LOCKING INSTRUCTIONS
18	OXYGEN CONTENT DISPLAY, LCD TYPE, 3 DIGIT
17	RED LED FLASHING ABOVE 8% OXYGEN
16	CALIBRATION & DISPLAY NIGHT LIGHT PUSH BUTTON
15	POWER ON-OFF PUSH BUTTON
14	GROUNDING INSTRUCTION LABEL, PER APPROVAL
13	GROUNDING LUG FOR SUPPLIED GROUNDING CABLE, (NOTE 8)
12	ELECTRONIC DISPLAY & BATTERY ENCLOSURE HUB CASE
11	CRANK, TAPE REEL & ELEC. HUB CASE, & REEL LOCK
10	CARRYING HANDLE, SWING AWAY TYPE, NYLATRON
9	PRES./VAC VENT BUTTON & VAPOR PURGING ADAPTOR
8	SECONDARY GAUGING TAPE SIGHT GLASS, REMOVABLE
7	PRIMARY GAUGING TAPE SIGHT GLASS, REMOVABLE
6	SENSOR STORAGE BARREL & VAPOR VALVE ENTRY TUBE
5	SECURING COLLAR, STORAGE BARREL TO VAPOR VALVE
4	REMOVABLE WIPER ASSEMBLY, W/VITON WIPERS
3	TAPE WIPER & STORAGE BARREL ATTACHMENT
2	TAPE REEL CASE. ALUM, NYLON COATED
1	REMOVABLE COVER WITH MOLDED VITON SEAL, NYLON COATED

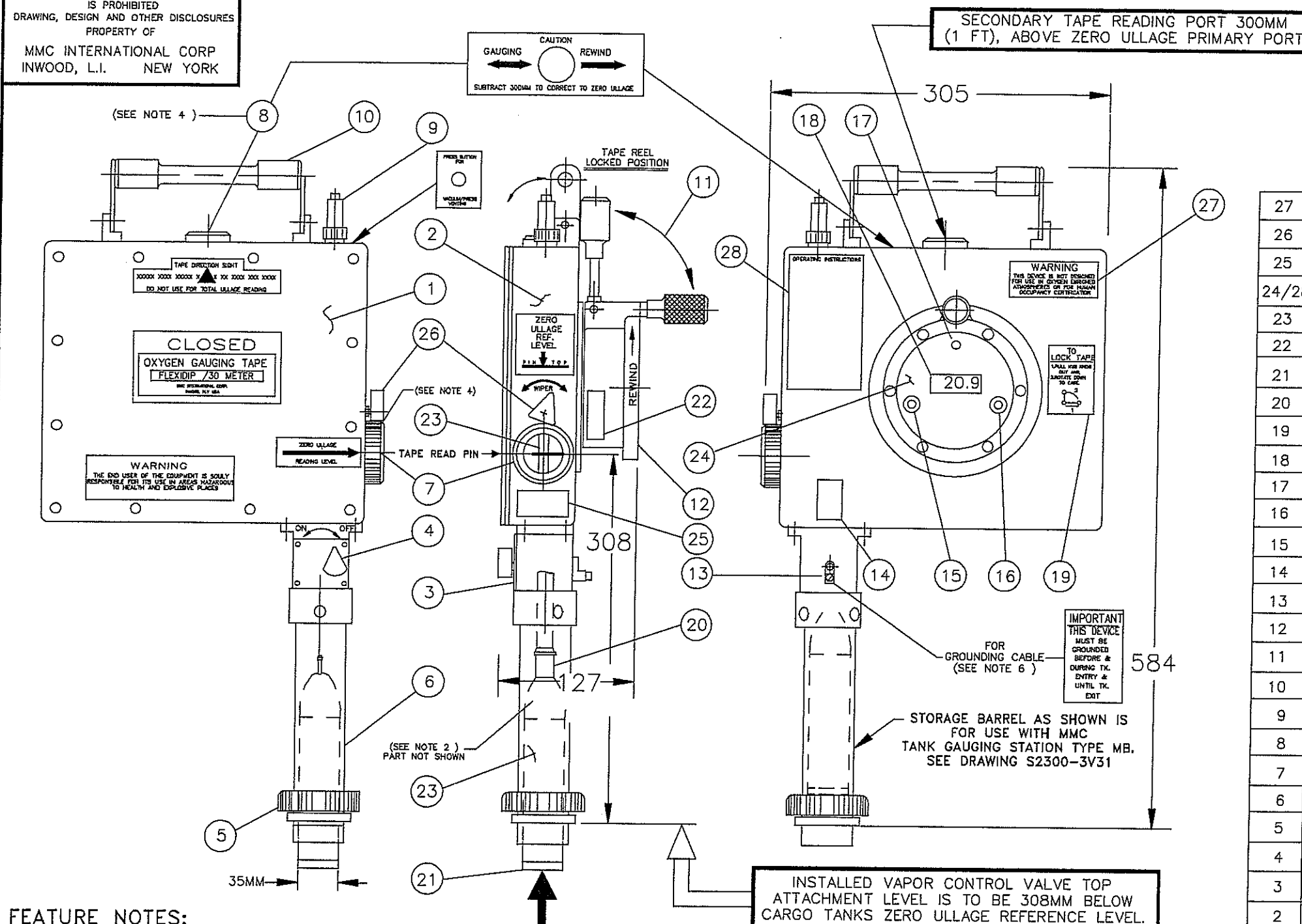
ITEM NO.	FEATURE DESCRIPTION		
<u>OUTLINE ASS'Y</u> MMC CLOSED OXYGEN SENSOR GAUGING TAPE SELF-CALIBRATING FOR USE WITH 2" TYPE "MB" TANK GAUGING STATION		MMC INTERNATIONAL CORP. 60 INIP DRIVE  INWOOD, NEW YORK, 11096	
DRAWN	F.S.G	DATE 10/05	DWG. NO.
CHECKED		DATE	REV.
APPROVED	F.S.GIANNONE	DATE 10/05	S-2615-OCX

## FEATURE NOTES:

- GAUGING TAPE IS ANTI-STATIC COATED.
- POSITIVE INTERNAL TAPE HEAD STOP STD.
- CASE IS LABELED PER FULL REWIND STOP POSITION.
- SIGHT GLASS EASILY REMOVEABLE FOR CLEANING OR REPLACEMENT WITH SUPPLIED TOOL. TEMPERED GLASS. TAPE DIRECTION & MOTION EASILY SEEN.
- INTERNAL REEL STOP TO PREVENT BACKWARD TAPE REWIND.
- COILED EXPANSION TYPE GROUNDING CABLE WITH LARGE ALLIGATOR CLIP, STANDARD SUPPLY

- MATING BARRELS FOR COMPETITIVE VALVES ARE ALSO AVAILABLE. CUSTOM VAVE ADAPTERS ARE MANUFACTURED TO CUSTOMER SPECIFICATIONS.
- MOLDED STORAGE CASE IS STANDARD SUPPLY.
- FIELD REPLACEABLE SENSOR CELL, ITEM 21

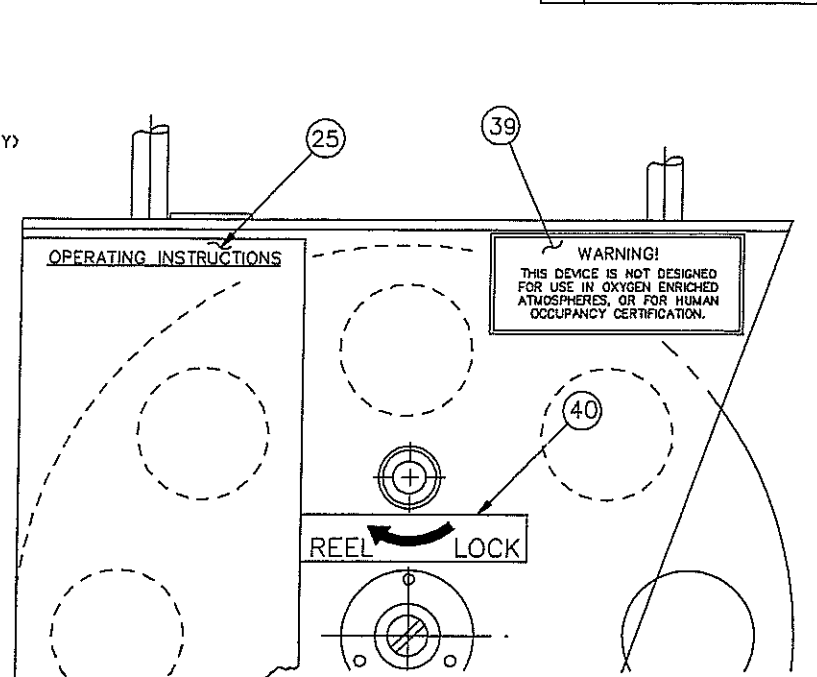
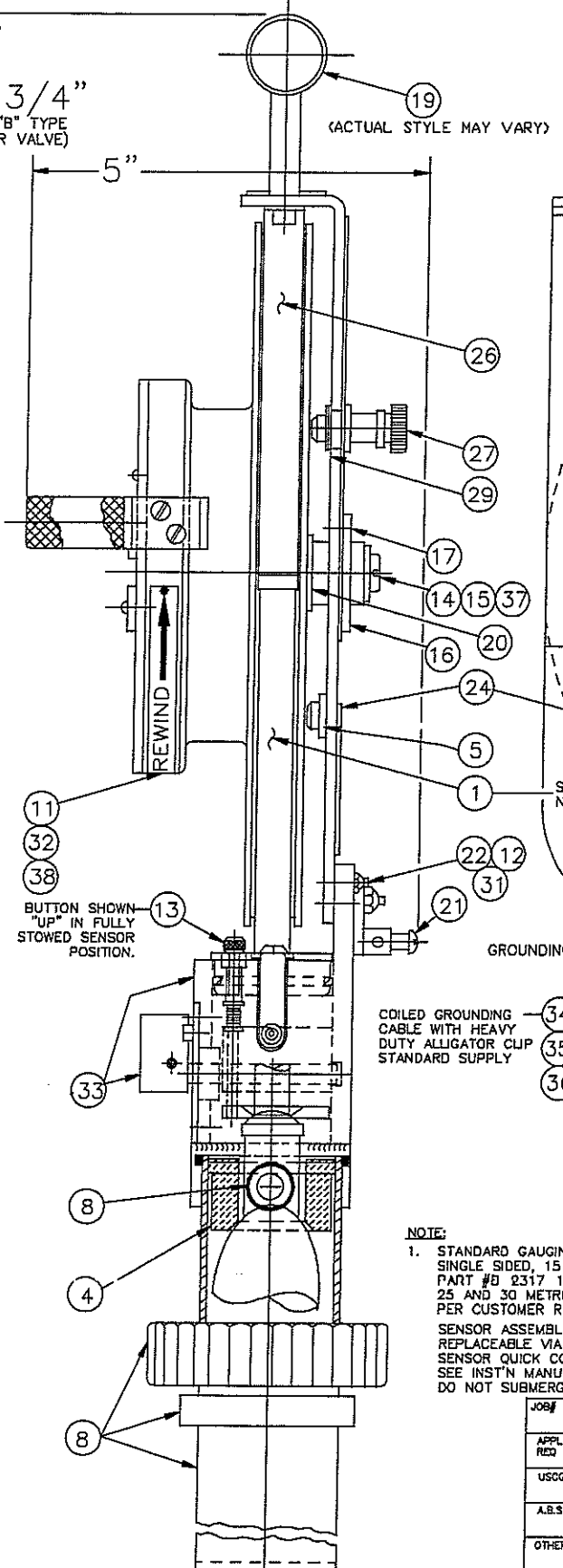
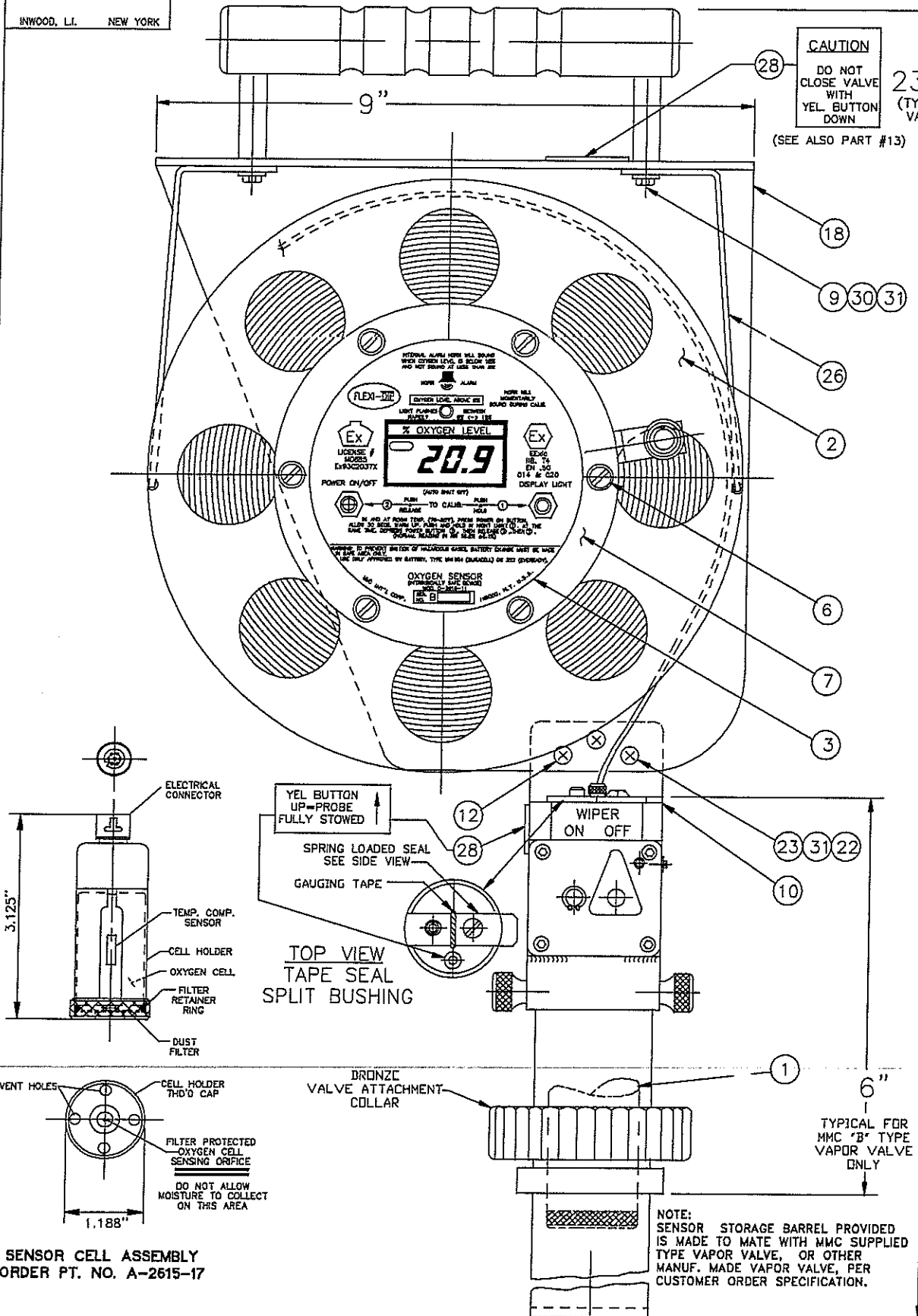
**WARNING: DO NOT SUBMERGE SENSOR IN PRODUCT.**





UNAUTHORIZED USE, MANUFACTURE, OR REPRODUCTION IN WHOLE OR IN PART IS PROHIBITED. DRAWINGS, DESIGN AND OTHER DISCLOSURES PROPERTY OF MMC INTERNATIONAL CORP. INWOOD, L.I. NEW YORK

REVISIONS				
SYN.	DESCRIPTION	DATE	BY	APP'D
A	ADDED SENSOR CELL VIEW, REVISED, UPDATED	03/08	FSG	



QTY	DESCRIPTION	MATERIAL	REF. QTY
1	NAMEPLATE, REEL LOCK	MYLAR	A-2562-57
1	NAMEPLATE, WARNING	MYLAR	A-2615-21
1	BATTERY, 9V, DURACELL MN1604 OR EVEREADY TYPE 522	ALKALINE	A-2562-67
1	RETAINING WASHER, DRUM SHAFT	BRASS	A-2562-72
1	SCREW, TRUSS HD., 6-32 X 1/4" LG.	STN. STL.	B-2562-50R
1	CABLE CLAMP, STRAIN RELIEF	NYLON	
1	GROUNDING CABLE, COILED, W/HVY ALLIGATOR TYPE GRD'G CLAMP	COPPER	B-2562-72
1	TAPE WIPER ASS'Y TO BARREL ASSEMBLY, VITON WIPERS		B-2562-50R
2	SCREW, DRIVE, NO. 4 X 1/4" LG.	STN. STL.	
5	WASHER, FLAT, NO. 8	STN. STL.	
2	WASHER, LOCK, NO. 8	STN. STL.	
1	RING, RETAINING, WALDES #5133-25 (REEL LOCK THUMBSCREW)	STN. STL.	
1	NAMEPLATE, A & B	MYLAR	A-2562-74
1	THUMBSCREW, REEL LOCK, ASSEMBLY	BRASS	A-2562-27
2	SPRING BAND, TAPE RETAINER	STN. STL.	A-2562-28
1	NAMEPLATE, OPERATING INSTRUCTIONS	MYLAR	A-2615-10
1	NAMEPLATE, GROUNDING INSTRUCTIONS	MYLAR	A-2272-9
1	SCREW, FLAT HD., 8-32NC X 7/8" LG.	STN. STL.	
3	NUT, ELASTIC LOCK, NO. 8-32NC	STN. STL.	
1	GROUNDING LUG & SCREW	COPPER	A-2401-65
2	WASHER, CURVED SPRING, BERG #SU-12	STN. STL.	A-2562-66
1	HANDLE ASS'Y, MOLDED BLACK NYLATRON		B-2562-19
1	FRAME, SUPPORT, BLACK NYLON COATED	ALUMINUM	B-2562-34
3	SCREW, FIL. HD., 8-32NC X 1/4" LG.	STN. STL.	
1	BEARING, DRUM SHAFT	BRASS	A-2562-70
1	WASHER, FLAT #10 .750 O.D. X .049 THK.	STN. STL.	
1	SCREW, PAN HD., 10-32NF X 3/4" LG. (SELF-LOCKING)	STN. STL.	A-2101-15
1	SENSOR STOWED INDICATOR ASSEMBLY		B-2562-50R
2	SCREW, FLAT HD., 8-32 X 3/4" LG.	STN. STL.	
1	NAMEPLATE, REWIND DIRECTION	ALUMINUM	A-2378-1A
REF.	10 LEAF SPRING, EXTERNAL SLIDING SEAL	STN. STL.	B-2562-50R
2	SCREW, HEX HD., 8-32 X 1/2" LG.	STN. STL.	
1	STORAGE BARREL ASSEMBLY, (PER USER SPECIFIED VALVE TYPE)	STN. STL.	
1	RING, HUB COVER (BLACK ANODIZED)	ALUMINUM	B-2401-4A
6	SCREW, PAN HD., 8-32NC X 1/4" LG.	STN. STL.	
1	BUTTON, REEL REST	NYLON	A-2562-39
1	GAUGING TAPE HEADER STOP	NYLATRON	B-2562-79
1	COVERPLATE, HUB AND P.C. BOARD ASS'Y		B-2615-14
1	TAPE REEL ASSEMBLY, BLACK NYLON COATED	ALUMINUM	D-2401-10
1	SENSOR ASSEMBLY (A-2615-17) WITH GAUGING TAPE (NOTE 1)		D-2615-B

NOTE:  
1. STANDARD GAUGING TAPE SUPPLY IS A SINGLE SIDED, 15 METER/50 FT. TYPE, PART #B 2317 10. TAPE LENGTHS OF 25 AND 30 METRES ARE ALSO AVAILABLE PER CUSTOMER REQUEST.  
SENSOR ASSEMBLY A-2615-17 IS FIELD REPLACEABLE VIA GAUGING TAPE TO SENSOR QUICK CONNECTOR. SEE INST'N MANUAL FOR PROPER USAGE. DO NOT SUBMERGE IN LIQUID.

JOB#			STOCK CODE NUM.			REF'D PART NO.			DESCRIPTION			MATERIAL			REF. QTY		
APPL'S ISSUED TO			PROD.			Q.C.			UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS DECIMALS ANGLES			DATE			SCALE: 1:1		
USG			OTHER:			A.B.S.			SURFACE FINISH DE-BURR ALL EDGES METRIC IN BRACKETS			DRAWN: J.A.			DATE 10/82		
OTHER			NEXT ASSY:			APP'D: F.S. GIANNONE			APP'D:			WT. MAX.			REV.		

BASEEFA LIST OF MATERIALS  
"FLEXDIP"  
PORTABLE TAPE ASSY.  
OXYGEN SENSOR  
RESTRICTED GAUGING  
(INTRINSICALLY SAFE DEVICE)

UNAUTHORIZED USE, MANUFACTURE OR REPRODUCTION IN WHOLE OR IN PART IS PROHIBITED. DRAWINGS, DESIGN AND OTHER DISCLOSURES PROPERTY OF MMC INTERNATIONAL CORP. INWOOD, L.I. NEW YORK DWG. NO. DB-2615-IFRX