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

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SECTION I

I. GENERAL

1.0 SPECIFICATION:

Oxygen Sensor Measurement Range……	0% to 25 %
Accuracy over the 1% to 25% range ……	± 0.2%
Batteries for intrinsically Safe Operation…….. Only (supplied)	9 Volt Eveready # 522 or Mallory #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)……	50FT. (15M),100FT(30M)
Hazardous Environments……	Intrinsically Safe Class I Division 1, Groups C and D
Approval ……..	BASEEFA

1.2 SPECIAL FEATURES

1.2.1 Simple automatic push button calibration in air.

1.2.2 Audible (Horn) and visual (Red LED) indication is provided to designate that the gaseous mixture within a particular tank or vessel contains 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.

1.2.3 Tape reel position lock.

1.2.4 Watertight electronics housing with sealed switches.

1.2.5 Stainless Steel Fasteners.

1.2.6 Nylon coat aluminum frame, for lightweight portability.

1.2.7 Low battery indicator.

1.2.8 Liquid Crystal Display with extended operating temperature range.

1.2.9 Push button display night light.

1.2.10 Automatic turn-off. (Turn off disable during measurement).

1.2.11 Oxygen cells easily replaceable with plug in assembly.

1.2.12 Conductive tape surface to drain off any static charge.

1.2.13 Grounding lug and cable supplied.

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

SECTION II

2.0 INTRODUCTION

2.0.1 The MMC portable oxygen sensor describe 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 area such as land based petroleum storage tanks can also use the extra assurance of safety afforded by the use of this equipment.

2.0.2 The equipment incorporates the following novel and advantageous features:

2.0.2.1 Extremely low battery current drain (less than 1 milli-ampere) resulting in battery life of over 1000 hours.

2.0.2.2 Automatic power turn-off in air, with turn-off disable during measurement use in gaseous environments containing less than 18 percent oxygen.

2.0.2.3 Oxygen cell plugs in for simple replacement.

2.0.2.4 Simple push button calibration procedure 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 amount of oxygen that may be present in a protective blanket of inert gas. It is not claimed, or intended for use in closed or confined space, or any other condition where human safety is of concern.

2.0.3 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.

2.0.4 In addition to the LCD display described above, which provides accurate reading of percent oxygen, the MMC tape also incorporates a pulsating horn and a light emitting diode (LED), to provide a visual and audible alarm indications of unsafe conditions, specifically, that oxygen content is above an 8% by volume level.

2.0.5 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 percent level.

2.0.6 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 level that would, with further operation cause erroneous oxygen readings.

SECTION III

3.0 THEORY OF OPERATION

3.0.1 Drawing S-2615-OCX illustrates the main components of the oxygen sensor. A tape reel accommodates the gauging tape when fully wound. 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 counter-clockwise.

3.0.2 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 together the sensor and gauging tape assemblies.

3.0.3 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.

3.0.4 The electronic circuits in the hub assembly are comprised of LCD display that provides 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).

3.0.5 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% (±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 press and 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% (±0.2%). Both are then released.

3.0.6 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 later condition is not a requirement, but will in general, results in greater accuracy. Although the sensor is temperature compensated to provided minimum error for temperature change, sudden large temperature shifts may cause errors of approx. 0.3% unless the sensor is given time to recover and temperature stabilize.

3.0.7 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.

3.0.8 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 approx. 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 units from turning off until it is once again exposed to a normal air environment. There after, approximately one minute of additional on power is permitted before the unit automatically turn-off during a measurement cycle

3.0.9 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

3.0.10 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 slowly flash. 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 to flash, at a rapid rate. Below 8% the horn will be silent and the red LED will extinguish.

<u>To Summarize</u>:
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

3.0.11 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:

3.0.12.0 The red LED lamp serves two purposes.

3.0.12.1 The first purpose is to act as a simple power on indicator in normal air during day and night time 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.

3.0.12.2 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 CONDITION AND RECOMMENDATIONS FOR SAFE USAGE

4.0.1 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 also known to be generators of the static electricity, and which are not covered with an Inert gas blanket.

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

4.0.3. 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 CONDITION

4.1.2 The oxygen sensor frame and reel assembly is 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 (Non-Inert gas condition)

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:

4.2.2.1 Sensor entry into tanks or vessel 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.

4.2.2.2 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 required 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.

4.2.2.3 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.

4.3.0 **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.

4.3.3 **CAUTION**

Under no circumstance 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.

SECTION V

5.0 **OPERATION** (REFER TO FIG. 1, page 11)

5.1 **FAMILIARIZATION WITH OPERATING CONTROLS AND FEATURES LOCATED ON THE TAPE REEL HUB BEZEL NAMEPLATE**

5.1.1 With the sensor in air, turn on power by momentarily depressing the "ON/OFF" push button switch. The display should illuminate and should read the percent of oxygen level of normal air, 20.9 (±0.2). With this figure displayed, the system is in correct calibration. If the display is not equal to 20.9 ±0.2 after a 30 seconds warm up, see push button calibration procedure described on the bezel nameplate. Also see Section 7.0 for additional details. In addition to the above display of 20.9%, the red LED located above the center of the display will slowly flash indicating power-on, and that oxygen level in the air is above 18%. The alarm will not sound during this operation.

5.1.2 Looking at the top left hand corner of the LCD display, notice if the symbol "LO BAT appears. If the symbol is displayed, the battery voltage is low and the battery should be replaced (see section 6.0). Always replace the battery if " LO BAT" appears even though the digital display turns on and reads correctly, since any may lower the battery voltage to a value, which result in erroneous readings. Again, momentarily depress the power "ON/OFF" switch. Note that the display turns off. It is good practice to turn power off when the system is not in use to prolong battery life, although automatic shut-off is a feature of the system.

5.1.3 **Note:** With power on in normal air for approximately 5 minutes, the auto shut-off circuits will turn power off. However, when in use to measure lower oxygen levels (below 18%), the turn off circuits are disable until the sensor is removed to normal air conditions. To re-activate after an automatic shut-off, depress the "ON/OFF" switch.

5.1.4 Depress and hold on the night light switch when light display reading becomes difficult to see due to low ambient light level. The display background will illuminate and the reading will be discernible.

5.2 **OXYGEN LEVEL MEASUREMENTS**

Before entering the tank and with sensor in normal air, depress power "ON/OFF" push button switch. The system comes on after a slight delay and the display should read should read 20.9 ±0.2%, the normal oxygen level in air at sea level. Note that the red LED is slowly flashing and the horn is silent indicating that the oxygen, level is above 18% and power is on.

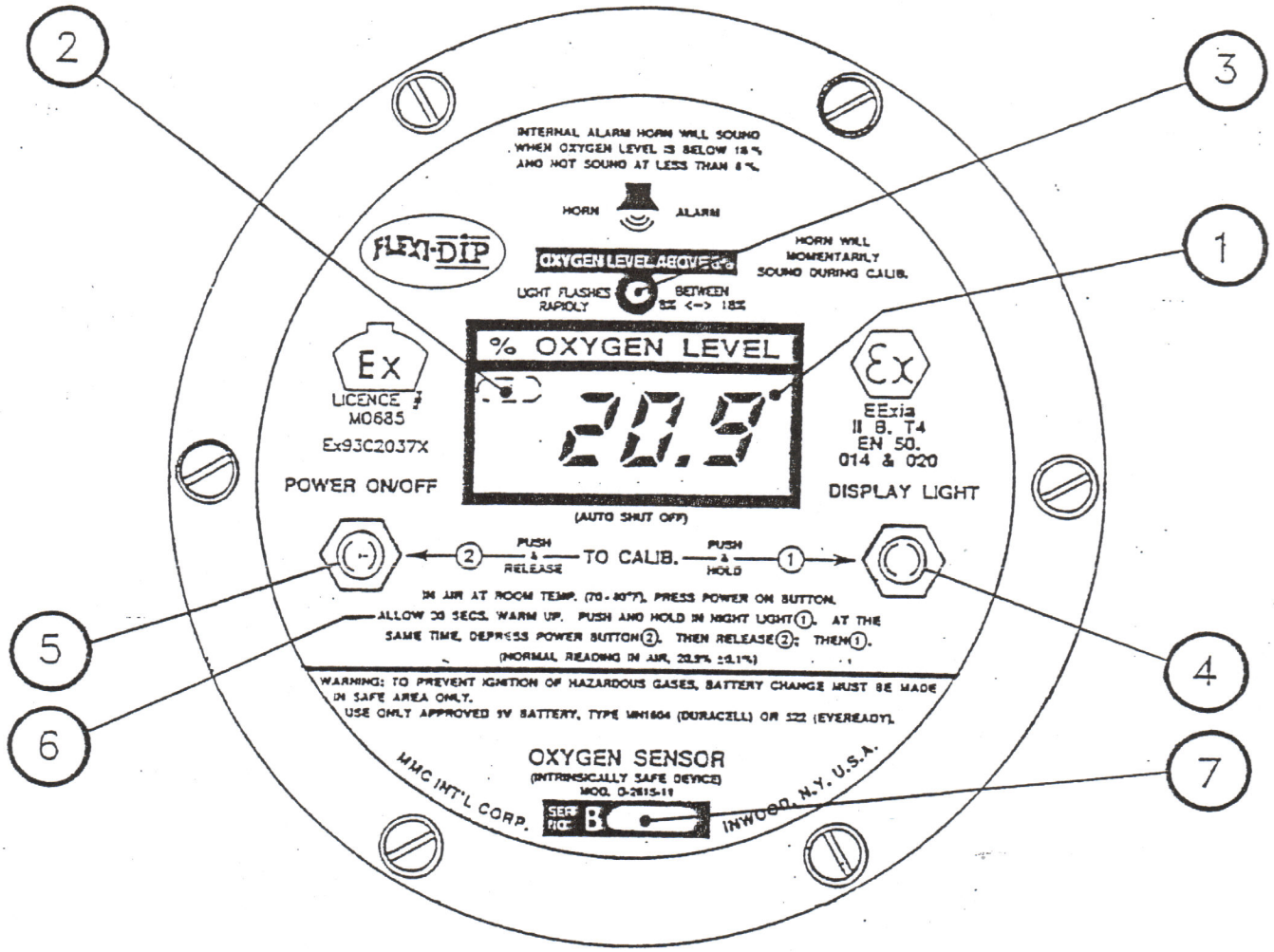
5.2.1 Make sure " LO BAT" has not appeared at upper left corner of display.

5.2.3 **CAUTION**

Before entering a tank with the oxygen sensor it is important the ullage level of the fluid within the tank be known by using a MMC ullage gauging tape or other gauging device. The oxygen sensor should not be arbitrarily lowered into a tank

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.

or immersed wholly or partially in fluid. Permanent damaged to the oxygen cell may be result.

5.2.4 After grounding the assembly, (see section 3.0), position tape and sensor over the vapor control valve or other tank entry port and insert the barrel of the hand gauging tape into the port. In the case of use with an MMC vapor valve, secure the threaded barrel cap to the vapor valve, then open the valve. Loosen the reel lock located below the handle on backside of the tape reel frame. Place the tape wiper in the "OFF" position by rotating the wiper knob, (located just above the barrel) clockwise, Grasp the knurled tape reel crank handle and lower the sensor head assembly, which contains the oxygen sensor, into the tank. If necessary, exert a restraining force to prevent the sensor from descending too rapidly or free falling. Make sure the sensor is not lowered any further than a distance equal to one half of the known tank ullage or "free space". For example, a tank with a maximum tank depth of fifty feet has a fluid ullage level of 20 feet. The oxygen sensor should be lowered and locked in place at a 10 feet ullage position. If the fluid level in terms of ullage distance (from tank top to the fluid level), is not the standard used, but instead tank innage is used, the proper position to lower the sensor can be as easily determined as follows.

5.2.5 In the foregoing example, maximum tank was given as 50 feet with a fluid level ullage of 20 feet, in terms of innage then, the innage would be 30 feet. By subtracting this innage reading from the maximum tank depth, a free space of 20 feet to tank top is determined. The mid-point of this free space is ten feet from tank top. Since the oxygen tape reads in terms of ullage, simply lower the sensor and tape to a 10 feet tape ullage level reading.

5.2.6 **CAUTION**
Under no circumstances should the reel and tape be permitted to unwind without restraint. Permanently damage may be incurred to the oxygen sensor head if the head is permitted to free fall to tank fluid level.

5.2.7 As the sensor is lowered into the tank to the ullage level desired, note that the percent oxygen level on the display lowered in value. At night or in low light conditions depress the Display Light push button to provide better display visibility.

5.2.8 Allow the sensor to remain at the desired ullage level until the reading on the display stabilizes. (Approx. 15 to 30 seconds). If the oxygen content at the sensor's position is below 8 %, the red LED, at the top center of the hub faceplate, will be extinguish and the horn will be silent, indicating that, the oxygen content is 8% or less. Confirm this condition by observing the digital display of the oxygen level is above 8%, the red LED will be rapidly flashing and the alarm horn will emit a beeping tone.

5.2.9 Raise the sensor to next ullage to be measured, if desired. Repeat step 5.2.8. Continue raising sensor to all levels at which readings are desired. Lower levels may also be gauged, however great care should be taken to avoid immersing the sensor in product.

5.2.10 When the measurements are complete, push the "ON/OFF" button to turn off power and conserve battery power. Rewind the tape into the carriage reel assembly. Wipe the tape as it is being rewound by placing the wiper switch in the "ON" position, to remove any dirt or fluid smears.

5.2.11 **CAUTION:**

When the Oxygen sensor is withdrawn from a tank with a low oxygen gaseous environment and subsequently rewound into its storage barrel, it usually takes at least 10 minutes for the oxygen in normal air to replace the inert gas captured in the sensor storage barrel. No attempt at recalibration should be made during this time period, until the percent oxygen reading at the sensor within its storage barrel, has recovered to a reading of at least 20%. The above caution is given to avoid a false calibration, at other than normal air conditions. Also be re-minded, that if during normal usage, the unit remains idle for more than 5 minutes, the unit will automatically power off.

If such becomes the case, the units power button must be depressed for continued operations. If a unit calibration has already been confirmed prior to the beginning of the current session of tank gauging, there is no need to re-calibrate the unit in-between a succession of gauging different tanks If however, a prior unit calibration is in doubt, perform the re-calibration process in accordance with Section 7.0, Page 19, bearing in mind the above caution.

5.2.12 **CAUTION**

Do not allow the instrument to remain in direct sunlight for long periods of time, or store in temperatures above 125°F, or in temperatures below freezing. Such temperature may damage the liquid crystal display and/or the oxygen cell. High temperature storage will shorten battery and oxygen cell life, while freezing temperatures may disable both battery and cell. Short-term exposure of the liquid crystal displays to either high or very low temperature is permissible. Longer exposure to these temperature extremes will cause temporary blackening of the display at the high temperature end, and loss of activity at low temperatures. In most cases however, these effects are reversible when the display regains normal operating temperature.

5.3 OXYGEN SENSOR CELL LIFE

The oxygen sensor cell used is an active type, chosen to provide maximum sensitivity in a small package size. The cell has a life expectancy of at least six months and during its life the output in normal air is very constant. Near end of life the cells output drops rapidly until infield calibration is no longer possible. See section 7.0 for calibration procedure.

Actual Sensor cell life is directly related to frequency of usage.
however,usable life should be a mininum of time period a stated above.

SECTION VI

6.0 CARE AND MAINTENANCE

6.0.1 Proper care and maintenance should be practiced to maintain long trouble-free and accurate service and to maximize battery life. As follows:

6.0.2 When not in use, make sure power is off as evidenced by display being extinguished.

6.0.3 Stored sensor head assembly in 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 temperature may damage the liquid crystal.

6.0.4 Make sure before lowering the sensor into a tank, that the tank product level is known, so that the sensor is not immersed in 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).

6.0.5 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.

6.0.6 Lubricate drum shaft and bearing with light machine oil to keep it free turning.

6.0.7 Never permit tape and sensor head to unwind freely (control speed of descent by use of a retraining force on tape reel crank).

6.1 Battery Replacement (In Safe Area Only!)

6.1.1 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, errors may result.

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

6.1.3 **IMPORTANT**

After battery replace 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 battery except unlike a battery, it produces a current which is directly proportional to level of oxygen it senses in a gaseous environment. In normal air, the current generated by a live cell is approximately 0.8 mili-amperes, which produces a conditioned reading on the display of 20.9% ±0.2. This current output is very constant in normal air throughout the cell's life. At end 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 now be extracted by holding it 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 Section 7.0.

6.3 Gauging Tape Replacement

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

6.3.2 Remove the oxygen sensor assembly by unplugging it from the tape end.

6.3.3 Remove storage barrel by loosening cap nuts on the side of the tape wiper housing.

6.3.4 Remove the round vapor seal assembly on the top of the tape wipe housing by backing off the Allen set screw which holds it in place.

6.3.5 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.

6.3.6 Completely unreel the old tape assembly.

6.3.7 Remove the six machines screws from the hub cover and lay it to the side.

6.3.8 Remove the battery from the battery holder and unplug the battery cap.

6.3.9 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 theses wires so that when re-assembling, the correct wire will be connected to the top and bottom tape conductor.

6.3.10 Detach the tape at the hub removing the grounding machine screw and unsoldering the spliced connections between gauging tape and PCB connection wires

6.3.11 Note on the tape reel that the tape scale is facing.

6.3.12 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.

6.3.13 Attach a new tape to hub by reversing the above the procedure making sure that the tape numerals face in the same direction as the previous tape numerals faced.

6.3.14 Make sure that the gauging tape to P.C. board wire splices are well insulated (used shrink tubing) and the grounding machine screw and washer are fastened tightly to provide a good metallic ground between center ground tape conductor and the reel hub.

6.3.15 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.

6.3.16 Replace battery, battery cap and hub cover, after allowing silicone sealant at least two hours curing time.

6.3.17 Re-connect oxygen sensor assembly to tape barrel housing end.

6.3.18 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 electronic 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%),±0.2% as standard.

7.1 METHOD OF CALIBRATION

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

7.1.2 Turn power on by depressing the power "ON/OFF" push button. Wait approximately 10 seconds for display to stabilize. Display should read 20.9 ±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 6.0.

7.1.1.2 **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.

7.1.1.3 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 correct reading of 20.9 ±0.2. The order of button depression must followed in the order described.

7.1.1.4 No further adjustment is required.

7.1.1.5 **Note**: If the oxygen cell has reached end 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 details in this manual.

SECTION VIII

8.0 FAULT FINDING:

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

PROBLEM #1: Unit does not turn on when power "ON/OFF" switch is depressed.

PROCEDURE & EXPLANATION: If unit does not turn at all, check battery voltage using a voltmeter. If battery voltage is lower than 6.6 volts, the voltage is too low to illuminate the display. Replace battery following the procedure given in Section 6.0. If battery is OK, check power "ON/OFF" switch using an ohmmeter with the battery disconnected. Switch is a double pole, single throw (DPST) unit. Both sections should normally show an open circuits. When depressed, ohmmeter reading should be less than 2 ohms If switch is OK, return to factory or authorized service center for repair.

PROBLEM # 2: Unit stays on all the time, even though "ON/OFF: push button switch is depress.

PROCEDURE & EXPLANATION: The symptom is usually indicative of a faulty power "ON/"OFF" Push button switch. Check the switch with ohmmeter as explained in Problem # 1, above. Return to factory or nearest service center for repair.

PROBLEM #3: When turn on in normal air, unit does not read 20.9 ±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 easily be checked with an ohmmeter. Remove the battery when making ohmmeter checks. Return to factory or authorized service center for repair.

PROBLEM #4: When unit is turned on in air, unit does not read 20.9±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 housing has reached end of life and must be replaced. Follow replacement procedure given under Section 6.0.

PROBLEM #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 "LoBat" indication. If okay, unit needs factory calibration.

PROBLEM #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 recalibrated using the simple push button procedure give 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 drawings 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 #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 equality, if not more important to understand that repairs by unqualified persons may endanger the intrinsically safe construction of this device.

SECTION IX

APPENDIX

9.0 WARRANTY; MMC SONIC ULLAGE, INTERFACE ,TEMPERATURE , TRIPLE FUNCTION AND OXYGEN

9.0.1 The seller, MMC or its licensed agents, fully warrants equipment of its manufacture against defects in materials or workmanship for period of one year 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.

9.0.2 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, towards the purchase of a new piece of equipment, if the returned unit is beyond reasonable repair. In any event, non-warranty repair charges will be quoted to buyer for authorization, before work commences.

9.0.3 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.

9.0.4 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.

9.1 IN THE EVENT OF WARRANTY REPAIRS:

9.1.1 The buyer is to notify the seller in writing upon discovery of the defects.

9.1.2 Upon receipt of written authorization from the seller, the equipment is to be returned as directed, transportation charges prepaid by the buyer.

9.1.3 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 warrant at seller 's option, and repairs will not be carried out.

9.1.4 If seller's examination of such equipment disclosed to his satisfaction that the defects were not caused by negligence. misuse , improper installation, accident or unauthorized repair or alteration by the buyer, repairs will be immediately effected.

9.1.5 Buyer is to provide shipping instructions for return, including mode of transportation.

IMPORTANT

9.1.6 The equipment has been certified as Intrinsically Safe Instrumentation for only those classes or categories of hazardous area so stated on the equipment label, bearing that mark of thee application approval agency. No other usage is implied or otherwise authorized.

9.1.7 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 material or workmanship, excluding the 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.

10.0 GUIDELINES FOR TAPE REPAIRS

10.1 The MMC oxygen sensor gauging tape is verified as intrinsically safe by BESEEFA* (British Approval Service for Electrical Equipment in Flammable Atmosphere) in the Untied Kingdom,

10.2 In order to maintain the Validity of the approval, tape units can be repaired only by MMC or our authorized guarantee repair offices approved by BASEEFA. We cannot offer that approval; it must be giving by the approving agency.

10.3 To maintain our agreements with the above mentioned approval agencies, and yet accommodate our customers as much as possible, we have developed three modules, which can be purchased as units installed by the owners of the tapes.

10.4 The modules developed are:

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

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

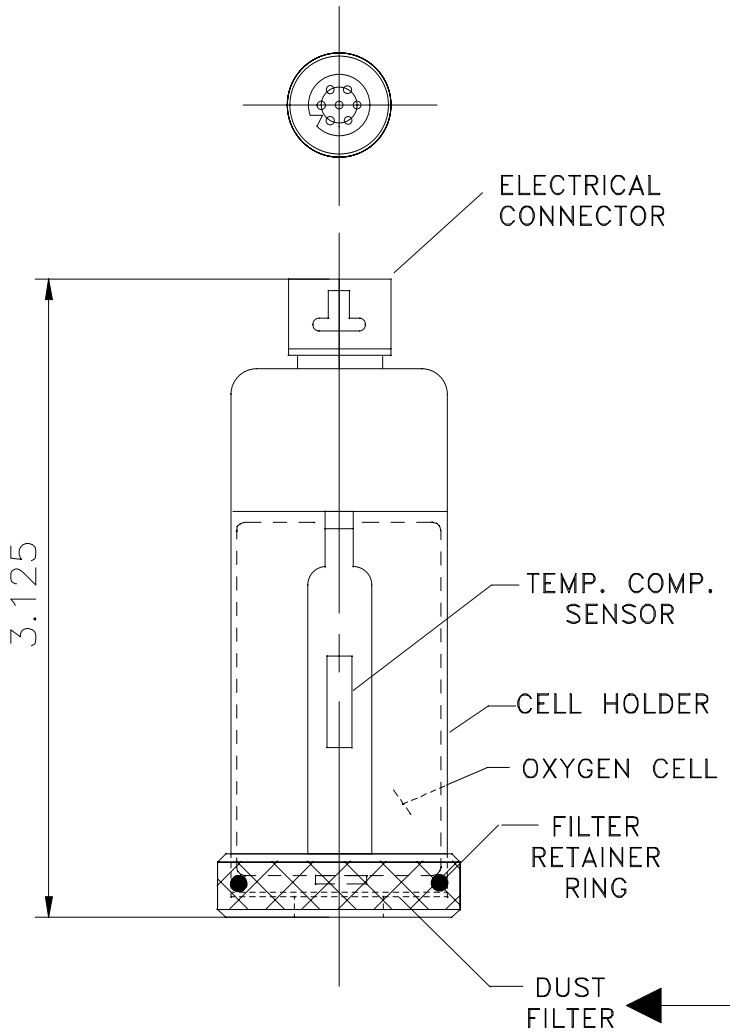
10.4.3 **TAPE AND HEADER ASSEMBLY**, consisting of graduated measuring tape with molded header and connector.

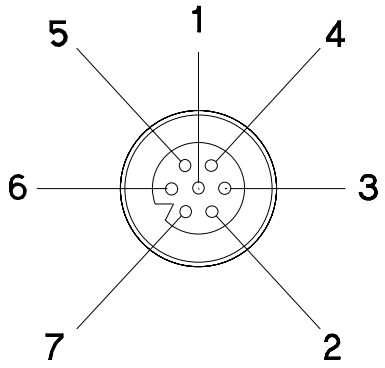
10.4.4 **TAPE WIPER ASSEMBLY,** consisting of wiper blades, on/off knob, mounting plate and screws.

LIST OF DRAWINGS

DRAWING NO.		DESCRIPTION
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

DIMENSIONS : INCHES



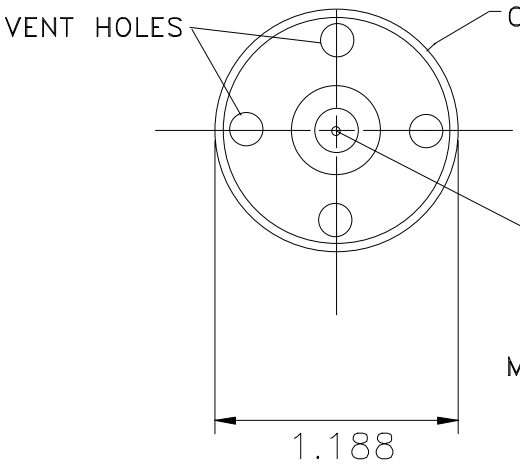


CELL CONNECTOR PIN NUMBER ASSIGNMENT

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

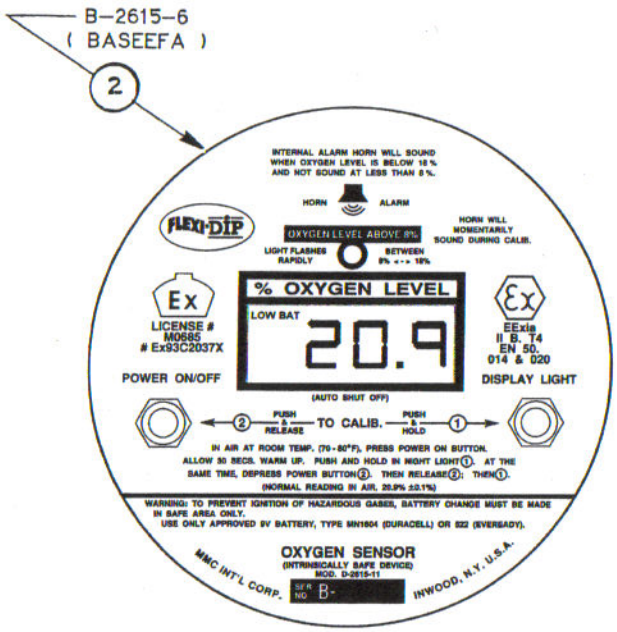
REV. C
05/98

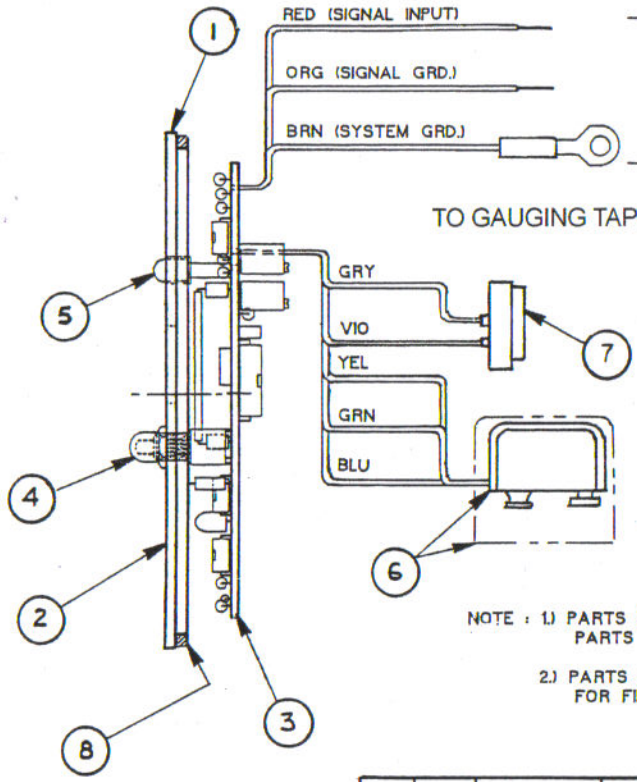
OXYGEN SENSOR CELL OUTLINE DRAWING

PT# A-2615-17

NEXT ASS'Y: DB-2615-1FRX	JOB NUM.			
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

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





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.

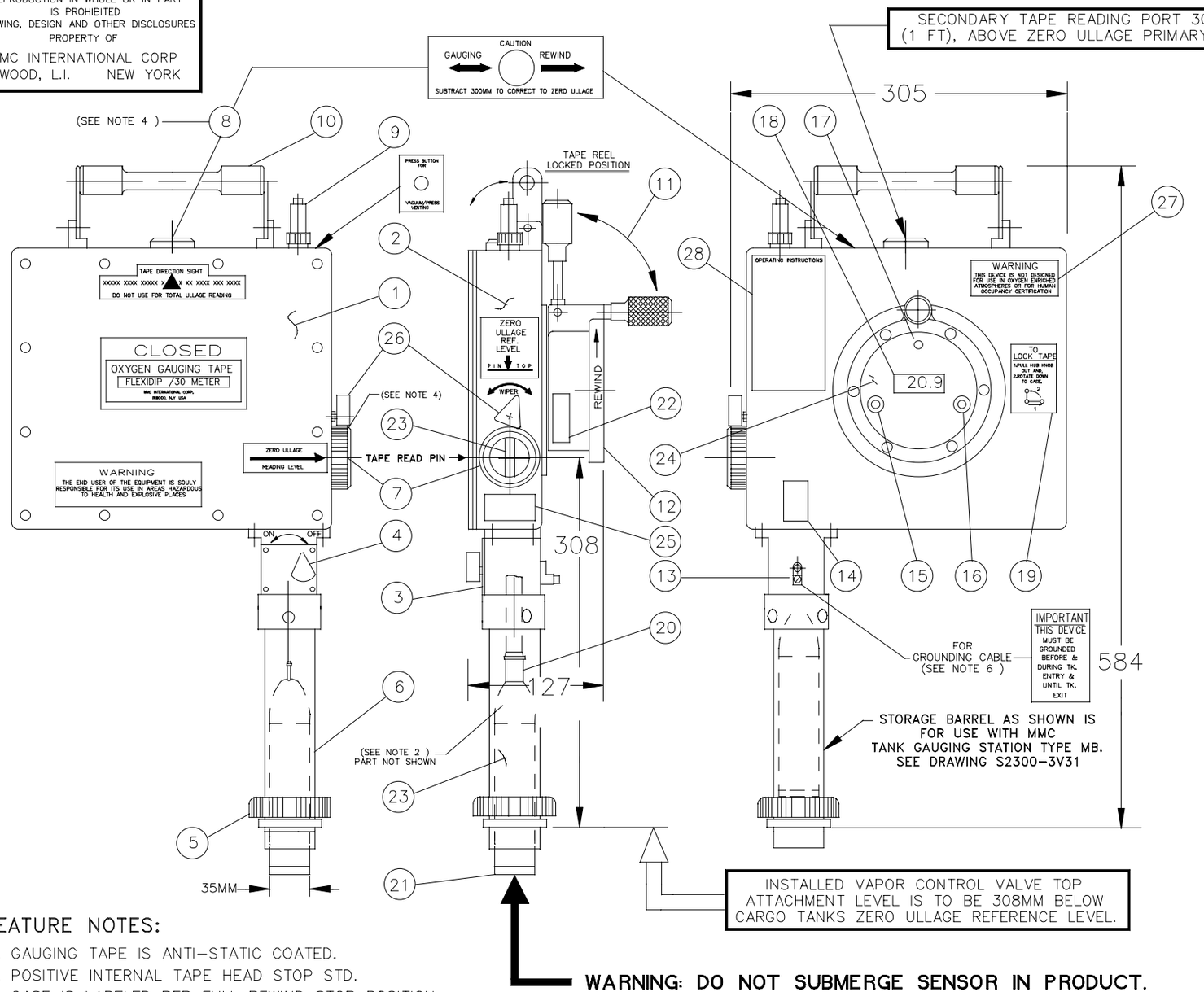
	QTY.	PT.#	DWG. NO.	DESCRIPTION	MAT'L
	1	8		"O" RING, PARKER #S-155	BUNA-N
	1	7	A-2401-63	HORN, PIEZO ELECTRIC, #AT-20K	
*	1	6	B-2615-7	CAP, BATTERY CONNECTION	POTTED
*	1	5		L.E.D., 2ma, RED #HLMP3301	PLASTIC
	2	4		SEAL CAP, PUSHBUTTON #40083	BUNA-N
*	1	3	D-2615- 4	PRINTED CIRCUIT BOARD, OXYGEN SENSOR	1/16, FR4
*	1	2	AS SHOWN	NAMEPLATE, OXYGEN SENSOR	MYLAR
*	1	1	A-2615-16	FACEPLATE, OXYGEN SENSOR	LEXAN

LIST OF MATERIALS

* (SEE NOTE 1)

NOTES:
1. BASEEFA NAMEPLATE USED ON DWG. DB-2615-1FRX.

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	± 30'		
SCALE NONE	NO. REQ'D	1 PER ASS'Y	DRAWN J. A. DATE 11-92	DWG. NO. B-2615-14 REV A
NEXT ASSY. D-2615-1XXX			CHECKED DATE	
			APPROVED DATE 11-92	



FEATURE NOTES:

1. GAUGING TAPE IS ANTI-STATIC COATED.
2. POSITIVE INTERNAL TAPE HEAD STOP STD.
3. CASE IS LABELED PER FULL REWIND STOP POSITION.
4. SIGHT GLASS EASILY REMOVEABLE FOR CLEANING OR REPLACEMENT WITH SUPPLIED TOOL. TEMPERED GLASS. TAPE DIRECTION & MOTION EASILY SEEN.
5. INTERNAL REEL STOP TO PREVENT BACKWARD TAPE REWIND.
6. COILED EXPANSION TYPE GROUNDING CABLE WITH LARGE ALLIGATOR CLIP, STANDARD SUPPLY
7. MATING BARRELS FOR COMPETITIVE VALVES ARE ALSO AVAILABLE. CUSTOM VAVE ADAPTERS ARE MANUFACTURED TO CUSTOMER SPECIFICATIONS.
8. MOLDED STORAGE CASE IS STANDARD SUPPLY.
8. FIELD REPLACEABLE SENSOR CELL, ITEM 21

PT. NO. 2615XC30M-BS-MM

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 LENGHTS	50, 75, 100FT. (15, 20, 25, 30, 37M)
TYPICAL WEIGHT	6.8Kg 35 M
PRESS. LIMITS	3 PSI-WORKING, 7.5 PSI MAX.

ITEM NO.	FEATURE DESCRIPTION
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

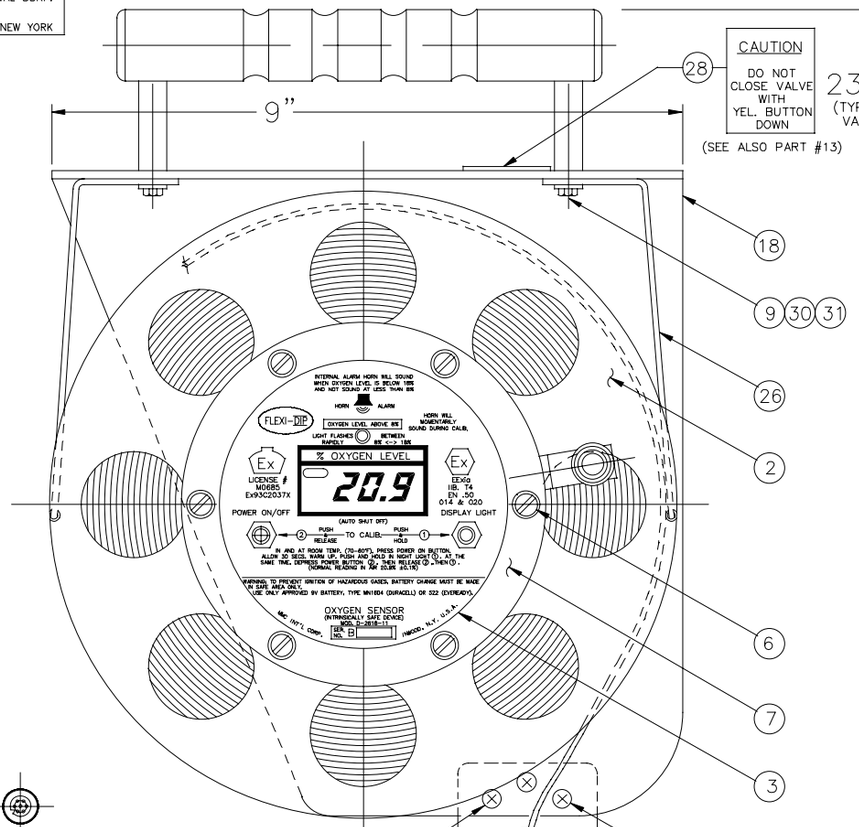
OUTLINE ASS'Y
MMC CLOSED OXYGEN SENSOR GAUGING TAPE SELF-CALIBRATING FOR USE WITH 2" TYPE "MB" TANK GAUGING STATION

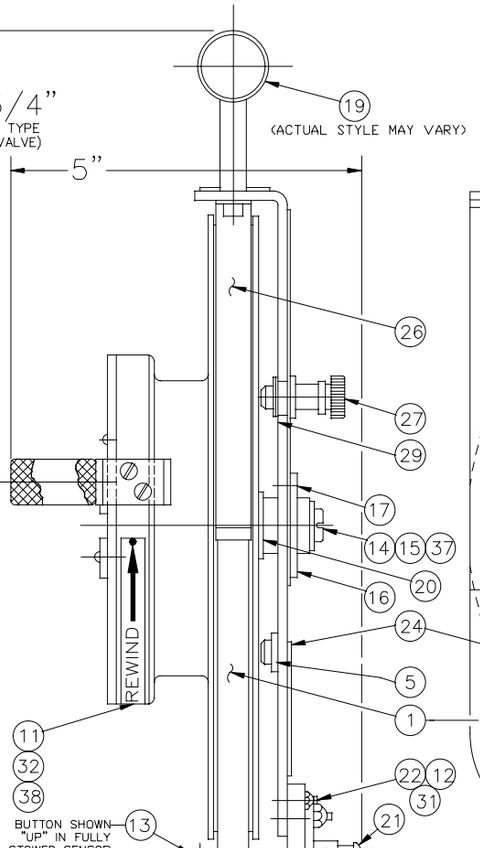
MMC INTERNATIONAL CORP.
60 INIP DRIVE
INWOOD, NEW YORK, 11096

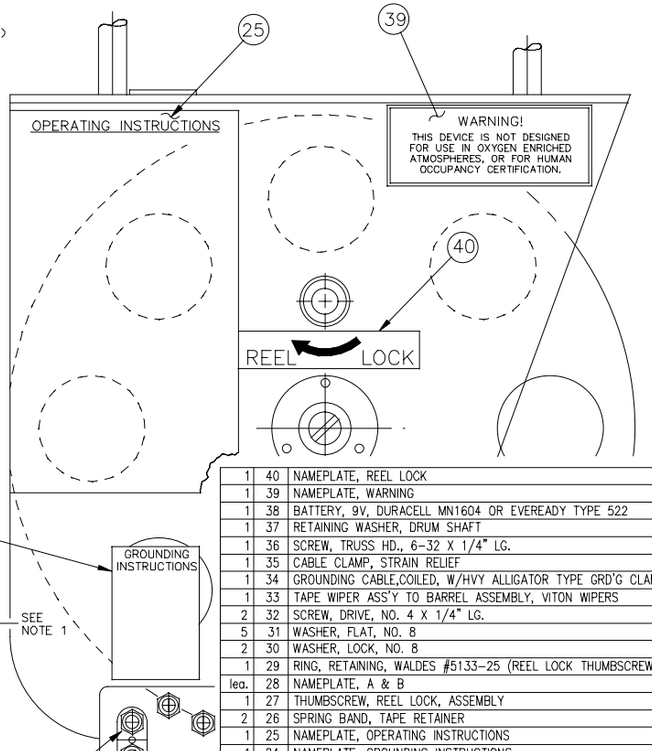
DRAWN	F.S.G	DATE	10/05
CHECKED		DATE	
APPROVED	F.S.GIANNONE	DATE	10/05

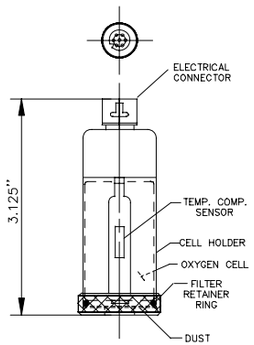
DWG. NO. S-2615-OCX
REV.

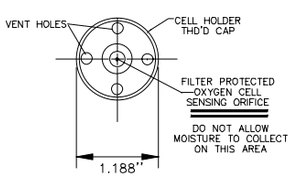
REVISIONS				
SYM.	DESCRIPTION	DATE	BY	APP'D
A	ADDED SENSOR CELL VIEW, REVISED, UPDATED	03/06	FSG	



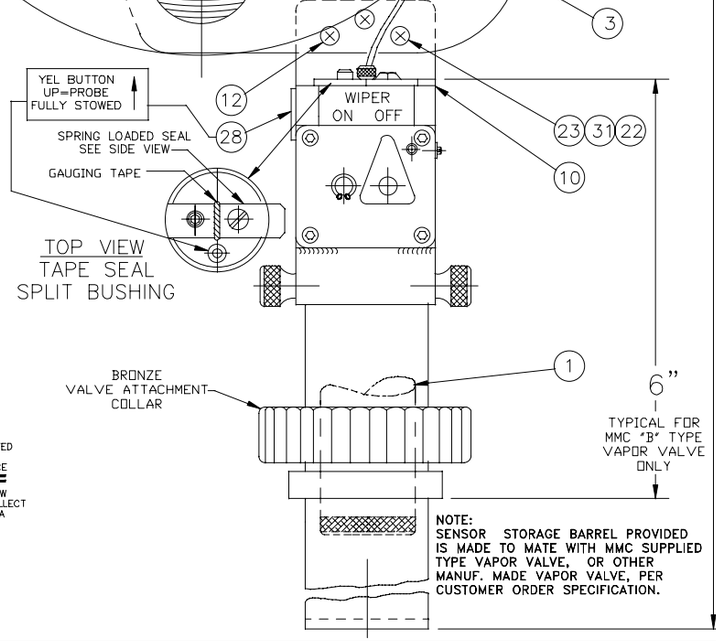








SENSOR CELL ASSEMBLY
ORDER PT. NO. A-2615-17



NOTE:
SENSOR STORAGE BARREL PROVIDED IS MADE TO MATE WITH MMC SUPPLIED TYPE VAPOR VALVE, OR OTHER MANUF. MADE VAPOR VALVE, PER CUSTOMER ORDER SPECIFICATION.

NOTE:
1. STANDARD GAUGING TAPE SUPPLY IS A SINGLE SIDED, 15 METER/50 FT. TYPE. PART #B-2317-1C. 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.

REQ'D	PART NO.	DESCRIPTION	MATERIAL	REF. DWG
1	40	NAMEPLATE, REEL LOCK	MYLAR	A-2562-57
1	39	NAMEPLATE, WARNING	MYLAR	A-2615-21
1	38	BATTERY, 9V, DURACELL MN1604 OR EVEREADY TYPE 522	ALKALINE	
1	37	RETAINING WASHER, DRUM SHAFT	BRASS	A-2562-67
1	36	SCREW, TRUSS HD., 6-32 X 1/4" LG.	STN. STL.	
1	35	CABLE CLAMP, STRAIN RELIEF	NYLON	
1	34	GROUNDING CABLE,COILED, W/HVY ALLIGATOR TYPE GRD'G CLAMP	COPPER	B-2562-72
1	33	TAPE WIPER ASS'Y TO BARREL ASSEMBLY, VITON WIPERS		B-2562-50R
2	32	SCREW, DRIVE, NO. 4 X 1/4" LG.	STN. STL.	
5	31	WASHER, FLAT, NO. 8	STN. STL.	
2	30	WASHER, LOCK, NO. 8	STN. STL.	
1	29	RING, RETAINING, WALDES #5133-25 (REEL LOCK THUMBSCREW)	STN. STL.	
lea.	28	NAMEPLATE, A & B	MYLAR	A-2562-74
1	27	THUMBSCREW, REEL LOCK, ASSEMBLY	BRASS	A-2562-27
2	26	SPRING BAND, TAPE RETAINER	STN. STL.	A-2562-28
1	25	NAMEPLATE, OPERATING INSTRUCTIONS	MYLAR	A-2615-10
1	24	NAMEPLATE, GROUNDING INSTRUCTIONS	MYLAR	A-2272-9
1	23	SCREW, FLAT HD., 8-32NC X 7/8" LG.	STN. STL.	
3	22	NUT, ELASTIC LOCK, NO. 8-32NC	STN. STL.	
1	21	GROUNDING LUG & SCREW	COPPER	A-2401-65
2	20	WASHER, CURVED SPRING, BERG #SU-12	STN. STL.	A-2562-66
1	19	HANDLE ASS'Y, MOLDED BLACK NYLATRON		B-2562-19
1	18	FRAME, SUPPORT, BLACK NYLON COATED	ALUMINUM	B-2562-34
3	17	SCREW, FIL. HD., 8-32NC X 1/4" LG.	STN. STL.	
1	16	BEARING, DRUM SHAFT	BRASS	A-2562-70
1	15	WASHER, FLAT #10 .750 O.D. X .049 THK.	STN. STL.	
1	14	SCREW, PAN HD., 10-32NF X 3/4" LG. (SELF-LOCKING)	STN. STL.	A-2101-15
1	13	SENSOR STOWED INDICATOR ASSEMBLY		B-2562-50R
2	12	SCREW, FLAT HD., 8-32 X 3/4" LG.	STN. STL.	
1	11	NAMEPLATE, REWIND DIRECTION	ALUMINUM	A-2378-1A
REF.	10	LEAF SPRING, EXTERNAL SLIDING SEAL	STN. STL.	B-2562-50R
2	9	SCREW, HEX HD., 8-32 X 1/2" LG.	STN. STL.	
1	8	STORAGE BARREL ASSEMBLY, (PER USER SPECIFIED VALVE TYPE)	STN. STL.	
1	7	RING, HUB COVER (BLACK ANODIZED)	ALUMINUM	B-2401-4A
6	6	SCREW, PAN HD., 8-32NC X 1/4" LG.	STN. STL.	
1	5	BUTTON, REEL REST	NYLON	A-2562-39
1	4	GAUGING TAPE HEADER STOP	NYLATRON	B-2562-79
1	3	COVERPLATE, HUB AND P.C. BOARD ASS'Y		B-2615-14
1	2	TAPE REEL ASSEMBLY, BLACK NYLON COATED	ALUMINUM	D-2401-10
1	1	SENSOR ASSEMBLY (A-2615-17) WITH GAUGING TAPE (NOTE 1)		D-2615-8

BASEEFA — LIST OF MATERIALS — APP'D

JOB#	STOCK CODE NUM.
APPL'S REQ	ISSUED TO: PROD. Q.C.
USCG	DATE:
A.B.S.	OTHER:
OTHER	NEXT ASSY:

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON FRACTIONS DECIMALS ANGLES
SURFACE FINISH 250
DE-BURR ALL EDGES
METRIC IN BRACKETS

	DATE
DRAWN: J.A.	10/92
C'K'D.:	
APP'D.: F.S. GIANNONE	
APP'D.:	

"FLEXDIP" PORTABLE TAPE ASSY. OXYGEN SENSOR RESTRICTED GAUGING (INTRINSICALLY SAFE DEVICE)

SCALE: 1:1 WT. MAX.

DWG. NO. DB-2615-IFRX REV. A