SCIENCE PUMP CORPORATION

OPERATOR'S MANUAL

OZONIZER TEST UNIT MODEL TSC-1

February 22, 2002
SPC@2002

OZONIZER TEST UNIT MODEL TSC-1 ECC OPERATING INSTRUCTIONS

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OPERATING INSTRUCTIONS

MODEL TSC-1 ECC OZONIZER/TEST UNIT

1. SPECIFICATIONS

The model TSC-1 Ozonizer/Test Unit has been designed for conditioning ECC ozonesondes with ozone and for checking the performance of the sondes prior to balloon release.
The specifications for the Ozonizer/Test Unit:

Size	47 x 28 x 29 cm
Weight	10.5 kg
Power requirements	110 V, 1 A, 60 Hz or 220 V, 0.6 A, 50 Hz

Figure 1. Science Pump Corporation TSC-1 Ozonizer/Test Unit

2. GENERAL INSTRUCTIONS

The model TSC-1 Ozonizer/test unit is used for conditioning Type 6A ECC ozonesondes with ozone and checking the performance of the instruments prior to flight time. ECC ozonesondes are balloon-borne instruments used for measuring the vertical distribution of atmospheric ozone.
Safety instructions:

1) Ozone is a poisonous gas and user should not breath high concentrations. National health care regulations must be followed.
2) Used electrolytes are neutral salt solutions of water and not so poisonous. National health care regulations must be followed.

The five principal components of the Ozonizer/Test unit are: 1) a high ozone source used for conditioning the ECC ozonesonde pumps and sensors during preparation of the instruments for flight; 2) an adjustable, low ozone source used for conditioning ECC sensor cathodes charged with same source electrolyte, an ozone-free air source for determining ECC sensor background currents; 3) a microammeter for checking the response and response time characteristics of the ECC sensors to low ozone input; 4) a pump, ECC sensor and a microammeter, samples low ozone simultaneously with ozone sampled by the ECC sonde under test, thereby offering a means of comparing ozone concentrations measured by the two sensors; 5) meter for checking the current drain (mA) of the calibrator and sonde pump motors @ 12.3 volts. Pump voltage is also measured.

Before connecting the Ozonizer/Test Unit to a power source, check to see that all switches on the front panel of the instrument are in the OFF position and that the OZONE CONTROL tube is pushed as far as possible into the chassis front panel. Check also to insure that the input voltage selector switch, located in back of the unit, is turned to the correct voltage (110 or 220 VAC).

Now connect the sonde adapter cables to the Ozonizer/Test Unit as follows:

(a) Connect the adapter cable with the blue and white leads to the SONDE SENSOR terminals;

The blue lead connects to the red terminal and the white lead to the black terminal.

(b) Connect the adapter cable with the red and white leads to the SONDE OUTPUT terminals;
The red lead is connected to the red terminal and the white lead to the black terminal.

(c) Connect the adapter cable with the orange and black-leads to the SONDE MOTOR
Terminals; the orange lead connects to the red terminal and the black lead connects to the black terminal.

Preparation of the ECC OZONESONDE for flight should be performed one to several days prior to release time. Preferred temperature at which tests are conducted on the instrument is 25° to 30 °C.

3. CONDITIONING THE ECC SONDE WITH HI-OZONE

Connect the ECC sonde to sonde motor terminal on the Ozonizer/Test Unit. Remove the plastic cap from the HI OZONE output receptacle located on the front panel of the unit. Insert the sonde air intake tube into the receptacle to form an airtight connection.
IMPORTANT: The connection must be air-tight since it is important that the sonde pump draws highly ozonized air, the conditioning must be performed in a room that is free from noxious fumes and in which SMOKING IS NOT PERMITTED.

Begin conditioning the pump and dry sensor by turning on the POWER, SONDE MOTOR, and U.V. LAMP SWITCHES of the Ozonizer/Test Unit and pulling the OZONE CONTROL TUBE as far as possible out of the front panel of the instrument chassis. Condition the sensor for about 30 minutes. At the end of this time interval, turn off the U.V lamp switch and push the OZONE CONTROL tube into the TSC-1 unit as far as possible. Withdraw the sonde air intake tube from the HI OZONE output receptacle and insert it in the Low 0_3 receptacle. Continue operating the sonde for an additional 5-10 minutes to allow high-ozonized air to be expelled from the pump and sensor. . Now turn off the SONDE MOTOR switch.

4. CONDITIONING THE ECC SONDE WITH LOW-OZONE

Next, charge the ECC sonde sensor FIRST with 3.0 cm^3 cathode solution, THEN with 1.5cm^3 anode solution. Also, similarly charge the Ozonizer/Test Unit calibrator sensor. (If the calibrator sensor has been previously charged, replace the cathode electrolyte solution only with fresh solution.)

Important: check again to insure that the U.V. lamp switch is turned off, and that the OZONE CONTROL tube is pushed completely into the front panel of the Ozonizer/Test unit.

After 10 minutes of conditioning with Ozone-free air, the left-hand calibrator microammeter and the right-hand sonde microammeter should each indicate less the 0.3 microamperes of sensor background current, i_{bc} and i_{bs}.

Now begin conditioning the sensor electrolyte solutions with ozone, turn on the U.V. lamp switch and pull the OZONE CONTROL tube out of the instrument's panel approximately 1 cm. The current readings (due to ozone entering the calibrator and sonde sensors) of the two 0-10 A microammeter stabilize at about 5 microampere. Continue conditioning with low ozone for an additional 10 minutes. During the conditioning, measure the calibrator and ECC sonde airflow rates, t_c, and t_s, and record these results. Also record room temperature and relative humidity.

5. CHECKING RESPONSE OF THE ECC SENSOR TO OZONE AND OZONE DETECTION ACCURACY

At the end of the 10-minute LOW OZONE conditioning interval, record the calibrator sensor and sonde sensor output currents 1_c and 1_s. Compute the products.

$(i_c - i_{bc})\ \ t_c$ and $(i_s - i_{bs})\ \ t_s$

should agree to within +/- 5%. This is a one-point "calibration" check. In theory, sensor is an absolute sensor giving a current of two electrons when one 0_3 molecule has reacted. There are some interactions (explained in more detail in ECC-6A manual) making sensor not ideal.

The product current multiplied by flow rate is a measure of ozone amounts detected during the time period. The total amounts of detected ozone are compared.

> NOTE: The TSC-1 instrument may be calibrated against an ozone calibrator and thereby a calibration chain is formed. The electronic instrument's calibration interval is generally 6 months or whenever a change is detected.

Next, check the sensor response time as follows: Using a stopwatch, turn off the U.V. lamp switch and simultaneously push the OZONE CONTROL tube into the instrument. Record intervals for every 3 minutes, the calibrator and sonde output currents i ic' i 2c' i 3c' and i is' i 2s' i 3s'. The 1-minute data should yield

$i_{ic} \leq 0.20\ (i_c - i_{bc})$
$i_{is} \leq 0.20\ (i_s - i_{bs})$

indicating satisfactory sensor response times to change in ozone. This means that 80% sensor response time is equal or less than 1 minute (see figure 2)

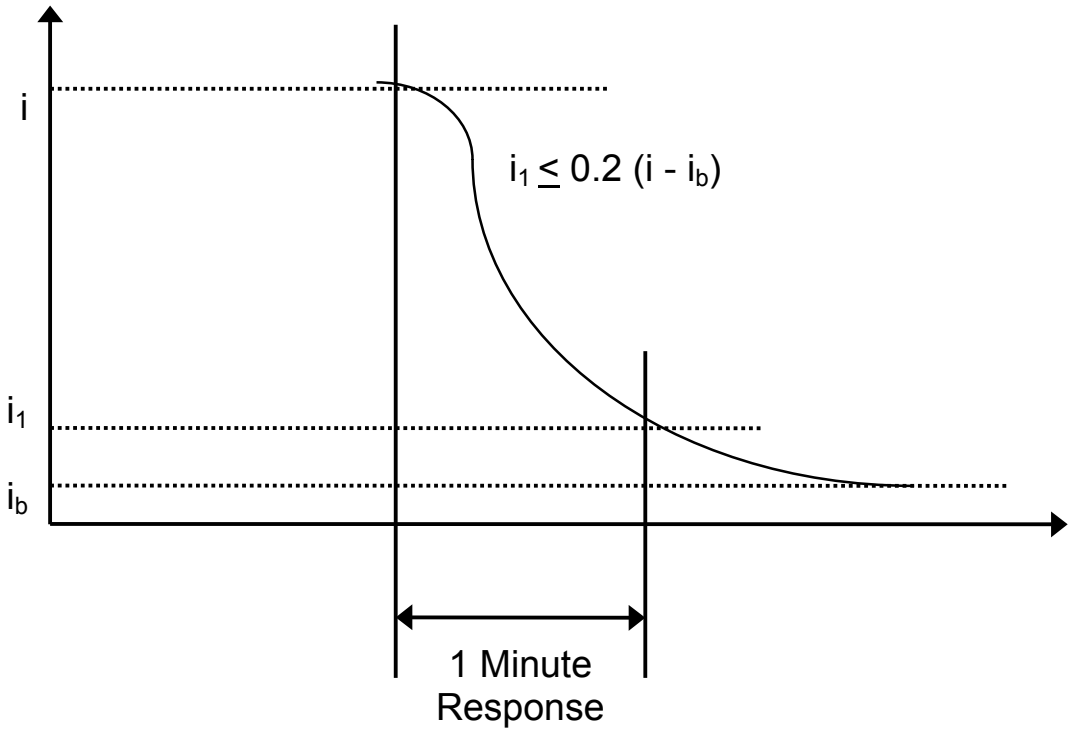


FIGURE 2. DETERMINATION OF TIME RESPONSE

Continue operations for 10 minutes and record the values i_{bc}' and i_{bs}'.

Turn off the CALIBRATOR MOTOR and the SONDE MOTOR switches. Turn off power to the Ozonizer/Test Unit and disconnect the sonde from the unit. Store the instrument prior to flight in a clean, dark environment at temperature of 25 ° to 30 ° C.

On the day of the flight, withdraw all cathode electrolyte solution from the sonde sensor and replenish the sensor cathode with fresh solution. Repeat operations described in section 4 and 5 above. The instrument should then be ready for flight.

6. TROUBLE SHOOTING INSTRUCTIONS

Possible checks if you experience any problems with the Ozonizer/test unit.

There are basically five (5) components, which make up the OZONIZER/test Unit.

1. High 0_3 source for conditioning the sonde pump and dry sensor with 0_3. Check to see if the U.V. lamp is working by looking through hole on ozone control tube. If not, replace U.V. lamp

2. A zero -to-low- (no/lo) ozone source for checking the sensor background current and for conditioning the 0_3 sensors charged with sensing solutions. If changing the cathode solution does not lower background, check the pump contamination with Hi- 0_3. If pump contamination is not a problem , try using freshly made sensor cathode solution.

3. An 0_3 calibrator, composed of an ECC sensor and teflon pump, against which performance of the sonde teflon pump and sensor can be compared. Check flow rate through OTU sensor. If slow, replace calibrator pump 200 ml/min $\pm$ 5%. If platinum screens are distorted, replace OTU sensor.

4. Meter for checking the current drain (mA) of the calibrator and sonde pump motors @ 12.3 volts. If no power, replace power supply.

5. Microammeters (0-10 mA) for measuring calibration sensor and sonde sensor output currents. If the sonde and calibrator sensor do not agree $\pm$ 5%, taking into account the air flow rates through the sensors, check to see that the flow rate of the air from the ozonizer test unit's No/Lo ozone port is 900 ml/min $\pm$ 100 ml/min. If flow rate is slow, check flow rate at the air pump and adjust dial accordingly. Once satisfactory, check flow rate after 0_3 destruction filter.

   If the above five (5) components of the OTU are working satisfactorily and the end user is following Vaisala's user guide for preparation, the Ozonizer Test Unit should be considered good and no additional calibration is needed.

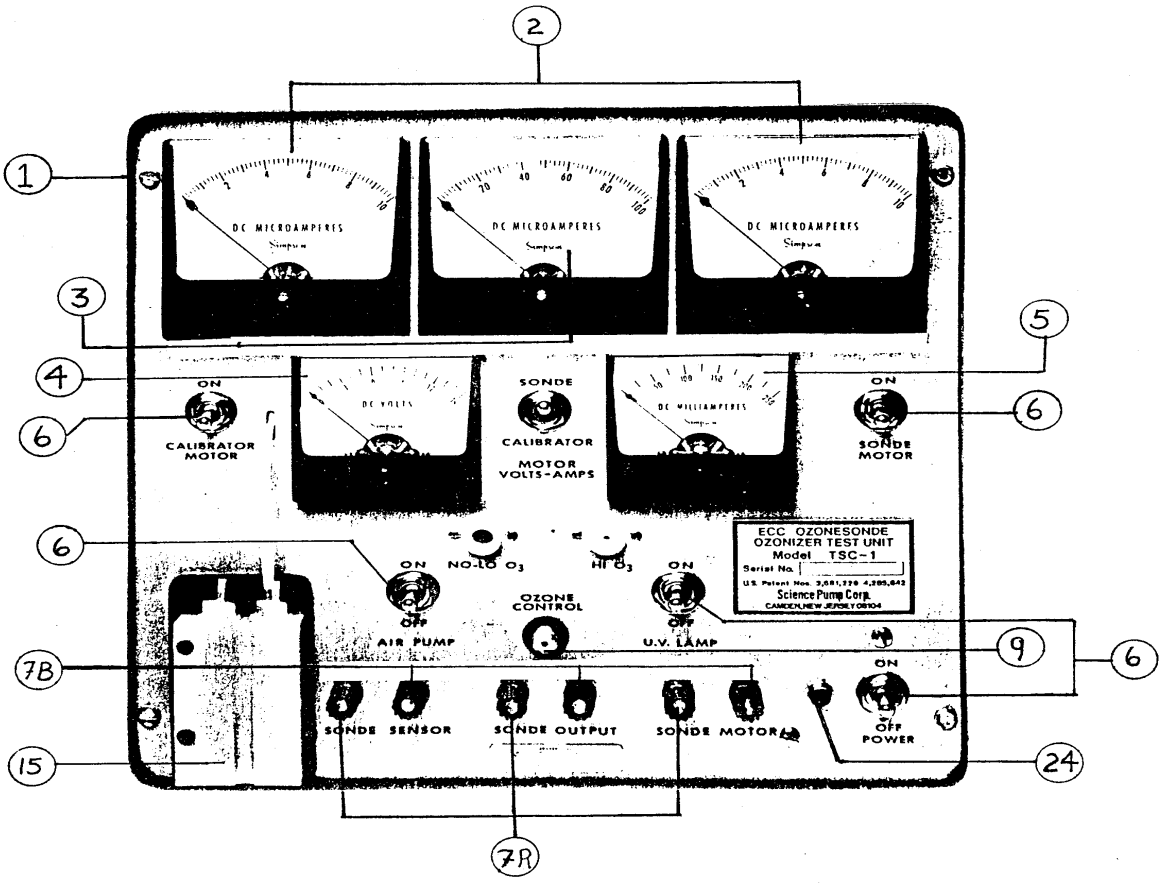
   A spare parts list and their locations in the OTU are described in the next chapter. SPC does offer a reconditioning service on the OTU. For further information, please contact SPC directly at the following address and phone numbers:

SCIENCE PUMP CORPORATION
1431 Ferry Avenue
Camden, New Jersey 08104 USA
Phone: 609 963-7700
FAX: 609 964-8977

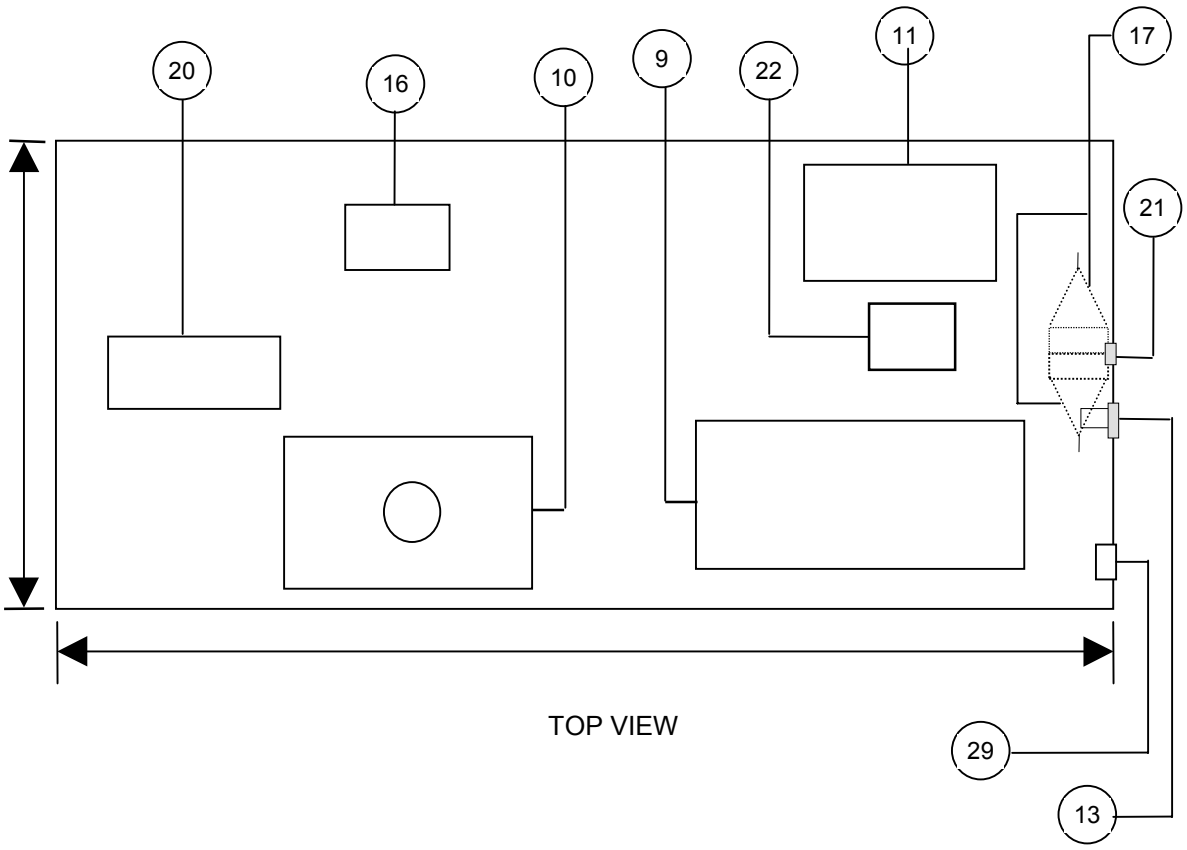
7. OZONIZER TEST UNIT SPARE PARTS

SPC PART NO.	DESCRIPTION
OTU-1	PORTA-CAB
OTU-2	A METER 0-10 µA
OTU-3	A METER 0-100 µA **used only for 4a ECC OZONESONDE
OTU-4	VOLT METER 0-15
OTU-5	MILLIAMMETER 0-250 mA
OTU-6	ON/OFF TOGGLE SWITCH MTG 106 D
OTU-7	BINDING POST (RED [R] OR BLACK [B])
OTU-8	UV LAMP
OTU-9	LAMP POWER SUPPLY
OTU-10	AIR PUMP
OTU-11	POWER SUPPLY 12 V DC
OTU-12	POWER CORD, BELDEN
OTU-13	FUSE HOLDER
OTU-14	FUSE
OTU-15	CALIBRATOR ECC OZONE SENSOR
OTU-16	CALIBRATOR SENSOR PUMP
OTU-17	OZONE DESTRUCTION FILTER (INSIDE TEST UNIT)
OTU-18	OZONE DESTRUCTION FILTER (OUTSIDE TESTING)
OTU-19	TUBING 12 AWG PTFE
OTU-20	OZONIZER BOX
OTU-21	VOLTAGE SELECTOR SWITCH
OTU-22	TRANSFORMER
OTU-23	RESISTORS 1.3 K ,3.6 K , 24.3 K
OTU-24	PILOT LIGHT
OTU-25	SONDE OUTPUT
OTU-26	SONDE MOTOR CABLES
OTU-27	SONDE MOTOR CABLE ADAPTER (PINK CONNECTOR TO MOLEX)
OTU-28	SONDE SENSOR SIGNAL OUTPUT CABLE
OTU-29	RECEPTACLE
OTU-30	TOGGLE SWITCH MTG 306D

Spare part locations are described in figures 3, 4, and 5 on the next pages.



FIQURE 3: FRONT PANEL OF TSC-1



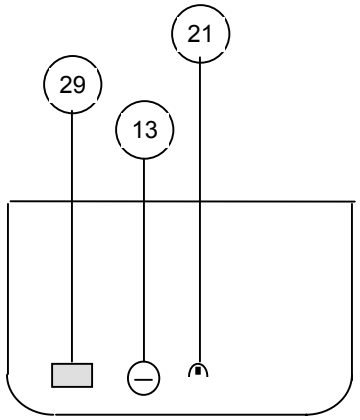
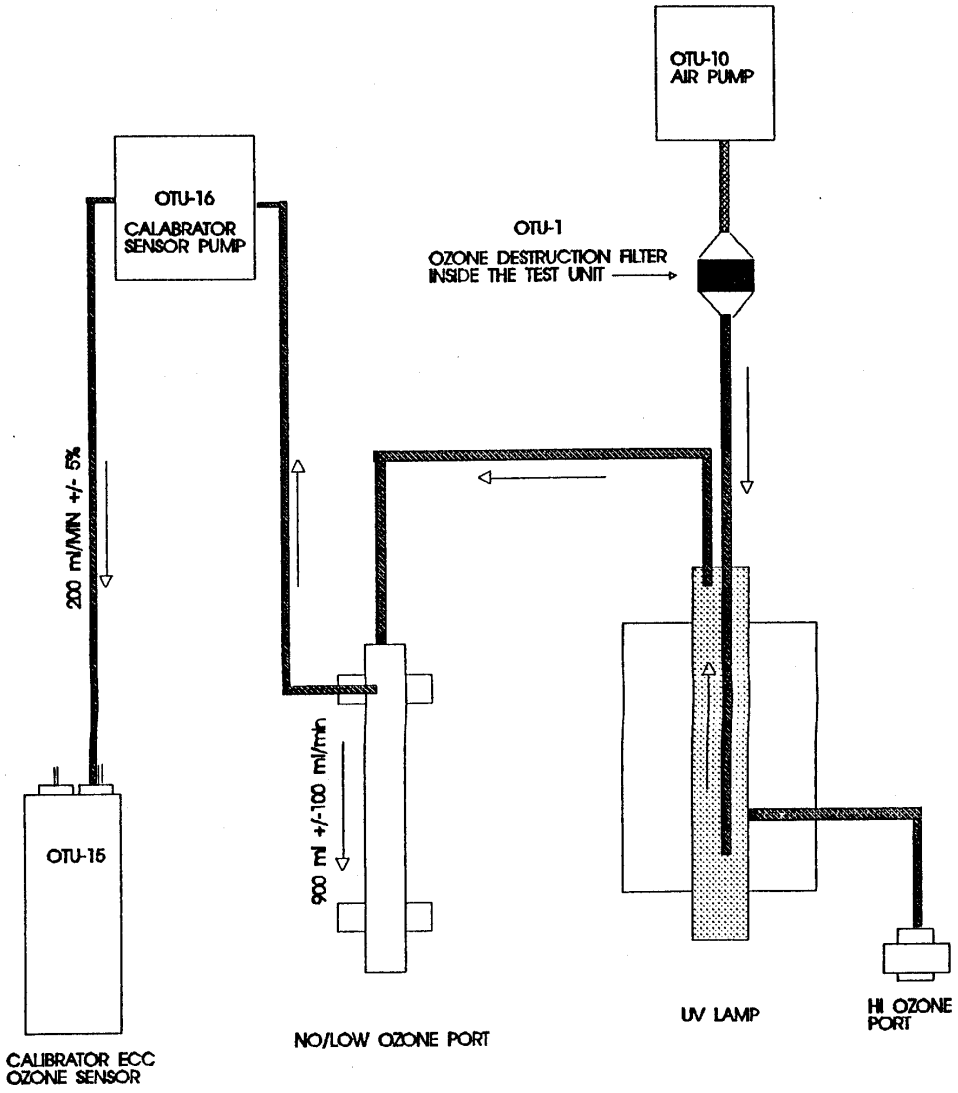


FIGURE 4. TOP AND REAR VIEW OF TSC-1



FIQURE 5: OZONIZER TEST UNIT PLUMBING SCHEMATIC