

★ READ CAREFULLY THIS INSTRUCTION MANUAL AND THE INSTRUCTIONS OF THE ASPIRATING PUMP PRIOR TO USING THIS PRODUCT.
 ★ DO NOT DISCARD THIS INSTRUCTION MANUAL UNTIL ALL THE TUBES IN THIS BOX ARE USED UP.

1. PERFORMANCE:	Oxygen	Carbon Dioxide
Measuring Range	: 2 - 10 %	1 - 20 %
and Pump Stroke	: 1 pump stroke	1 pump stroke
Sampling Time	: 8 minutes	8 minutes
Colour Change	: White → Brown	Pink → Yellow
Detectable Limit	: —	0.2%
Operating Temperature	: 10 - 40 °C (50 - 104°F)	10 - 40 °C (50 - 104°F)
	Temperature correction is necessary.	No correction is necessary.
Aspirating Pump	: Model AP-20, AP-20S, 400B, AP-1, AP-1S or 400A	

CAUTION

1. THE DETECTOR TUBES CONTAIN CHEMICAL REAGENTS.
2. DO NOT TOUCH THESE REAGENTS DIRECTLY ONCE TUBES WERE BROKEN.
3. KEEP THE TUBES OUT OF THE REACH OF CHILDREN.
4. DO NOT USE THE OXYGEN DETECTOR TUBE WHEN THERE ARE ANY DANGER OF GAS EXPLOSION IN MEASURING PLACE SUCH AS METHANE, ETHANE. IT IS CAUSE OF EXPLOSION.

NOTICE

1. USE ONLY WITH PUMP MODELS AP-20, AP-20S, 400B, AP-1, AP-1S OR 400A. OTHERWISE, CONSIDERABLE ERROR IN INDICATION MAY OCCUR.
2. BEFORE TESTING, CHECK THE ASPIRATING PUMP FOR LEAKS (REFER TO ITEM 9. INSPECTION OF ASPIRATING PUMP). ANY PUMPS SHOWING SIGNS OF LEAKAGE SHOULD BE CORRECTED BEFORE USE.
3. DO NOT USE THIS TUBE OUTSIDE THE STATED OPERATING TEMPERATURE RANGE.
4. STORE TUBES IN A COOL AND DARK PLACE (0-25 °C/32-77°F), AND USE BEFORE EXPIRATION DATE PRINTED ON THE TOP OF THE BOX.
5. PRIOR TO USE, READ CAREFULLY ITEM 10. USER RESPONSIBILITY.
6. READ THE CONCENTRATION IMMEDIATELY AFTER MEASUREMENT.
7. USE A OXYGEN DETECTOR TUBE AND A CARBON DIOXIDE TUBE IN A SAME TUBE BOX AS A PAIR. DO NOT USE THE OXYGEN DETECTOR TUBE ALONE.
8. IT CAN USE THE CARBON DIOXIDE DETECTOR TUBE ALONE.

2. SAMPLING AND MEASUREMENT:

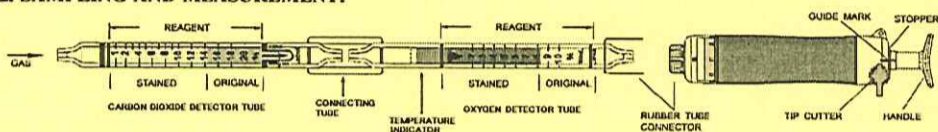


Fig. 1

- ① Heat the temperature indicator of the Oxygen detector tube with a match or cigarette lighter until the indicator is changed to purple from red.
WARNING THE TEMPERATURE INDICATOR IN THE OXYGEN DETECTOR TUBE BECOMES HOT AFTER HEATING. TO AVOID POSSIBLE INJURY, DO NOT TOUCH THE PART NEAR THE TEMPERATURE INDICATOR OR WEAR SAFETY GLOVES WHEN HANDLING THE OXYGEN DETECTOR TUBE.
- ② Break both ends of the detector tubes and connect each end of the detector tubes with connecting tube as shown in Fig. 1.
CAUTION SAFETY GLASSES AND GLOVES SHOULD BE WORN TO PREVENT INJURY FROM SPLINTERING GLASS.
- ③ Insert the end of the detector tubes into the aspirating pump securely as shown in Fig. 1. (Arrow marks shall point to the pump.)
- ④ Align the guide marks on the shaft and stopper of the aspirating pump.
- ⑤ Pull the pump handle at a full stroke until it locks and wait for 8 minutes or until the completion of sampling is confirmed with the flow indicator of the pump. (See descriptions about the flow indicator in the instruction manual of the pump.)
- ⑥ On completion of sampling, read the scales at the maximum point of the stained layer.

SPECIAL NOTE:

- I. The scales are calibrated at 20 °C (68°F), 50 %R.H. and 1013hPa. Readings obtained in other circumstances should be corrected (REFER TO ITEM 3. CORRECTION FOR AMBIENT CONDITIONS).
- II. When the maximum point of the stained layer is unclear or oblique, read the scale at the centre between the longest and shortest points.

3. CORRECTION FOR AMBIENT CONDITIONS:

- ① Temperature; Correct the tube reading for Oxygen detector tube by following temperature correction table.

Tube Readings (%)	Corrected Concentration (%)			
	10 °C (50°F)	20 °C (68°F)	30 °C (86°F)	40 °C (104°F)
10.0	9.7	10.0	10.3	10.5
9.0	8.7	9.0	9.3	9.5
8.0	7.7	8.0	8.3	8.5
7.0	6.7	7.0	7.3	7.5
6.0	5.7	6.0	6.3	6.5
5.0	4.7	5.0	5.3	5.5
4.0	3.9	4.0	4.2	4.5
3.0	2.9	3.0	3.1	3.3
2.0	2.0	2.0	2.0	2.1

- ② Humidity; No correction is necessary.
- ③ Atmospheric Pressure;

$$\text{True concentration} = \text{Corrected concentration} \times \frac{1013}{\text{Atmospheric pressure (in hPa)}}$$

4. INTERFERENCES:

The interference gas is not included in ordinary combustion gases.

5. CONCENTRATION CORRECTION:

On account of interaction of readings between Carbon dioxide and Oxygen, the true concentration is calculated by following equations.

$$\text{True CO}_2 \text{ concentration (\%)} = [\text{CO}_2 (\%)] - \frac{[\text{O}_2 (\%)] \times [\text{CO}_2 (\%)]}{100}$$

$$\text{True O}_2 \text{ concentration (\%)} = [\text{O}_2 (\%)] - \frac{[\text{O}_2 (\%)] \times [\text{CO}_2 (\%)]}{100}$$

[CO₂ (%)] Tube readings of CO₂ (%)
 [O₂ (%)] Temperature corrected concentration of O₂ (%)

[Example]

At the measurement temperature of 30 °C, when the readings of Oxygen tube is 5% (Temperature corrected concentration: 5.3%) and the readings of Carbon dioxide is 10%, each true concentration is calculated as follow.

$$\text{True CO}_2 \text{ concentration (\%)} = 10 - \frac{5.3 \times 10}{100} = 10 - 0.53 = 9.47$$

$$\text{True O}_2 \text{ concentration (\%)} = 5.3 - \frac{5.3 \times 10}{100} = 5.3 - 0.53 = 4.77$$

6. CHEMICAL REACTION IN THE DETECTOR TUBE:

Oxygen : Oxygen reacts with Alkaline Pyrogallol.
 Carbon Dioxide : CO₂ + 2KOH → K₂CO₃ + H₂O

7. DISPOSAL OF TUBES:

USED TUBES SHOULD BE DISPOSED CAREFULLY ACCORDING TO RELEVANT REGULATIONS, IF ANY.

8. HAZARDOUS AND DANGEROUS PROPERTIES OF CARBON DIOXIDE:

TLV-TWA ♦ : 5000 ppm
 Explosion range in air : —
 ♦ Threshold Limit Value established by the American Conference of Governmental Industrial Hygienists, 2009.

9. INSPECTION OF ASPIRATING PUMP:

- Checking for leaks:
- ① Insert a sealed, unbroken detector tube into the pump.
 - ② Align the guide marks on the shaft and stopper of the pump.
 - ③ Pull the handle to a full stroke and wait for 1 minute.
 - ④ Unlock the handle and allow it to return slowly into the pump by holding the cylinder and handle securely.
CAUTION HANDLE WILL TEND TO SNAP BACK INTO THE PUMP QUICKLY.
 - ⑤ If the handle returns completely to the original position, the performance is satisfactory. Otherwise, refer to maintenance procedures shown in the instruction manual of the pump to correct the leakage.

10. USER RESPONSIBILITY:

It is the sole responsibility of the user of this equipment to ensure that the equipment is operated, maintained, and repaired in strict accordance with these instructions and the instructions provided with each Model AP-20, AP-20S, 400B, AP-1, AP-1S or 400A aspirating pump, and that detector tubes are not used which are either beyond their expiration date or have a colour change different to that stated in the Performance specifications.
 The Manufacturer and Manufacturer's Distributors shall not be otherwise liable for any incorrect measurement or any damages, whether damages result from negligence or otherwise.