

# Colorimetric Gas Detector Tube Handbook

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**KITAGAWA**

**GAS DETECTOR TUBE SYSTEM**

**HANDBOOK**

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# 1. KITAGAWA GAS DETECTOR TUBE SYSTEM

## 1.1 HISTORY OF KITAGAWA GAS DETECTOR TUBES

The history of Kitagawa gas detector tubes goes back to 1946, when a study was undertaken to determine the efficiencies of desulfurisers in the production of ammonium sulphate, then used as a fertilizer. While ammonia, a raw material of ammonium sulphate, was produced by synthesizing hydrogen and nitrogen with the aid of a catalyst under high pressure, the catalyst was deteriorated by hydrogen sulphide mixed in the hydrogen as an impurity.

It was determined that a new method of gas detection was needed for a process control environment. This new method would need to meet the following requirements :

- (1) Hydrogen sulphide can be measured with high accuracy.
- (2) The detector must be small and light enough to carry.
- (3) The detector must be easy to operate, requiring no special skills.
- (4) Measurement results should be obtained fast, with no calculation required.
- (5) No liquid reagents were to be used.
- (6) The detector could not use electrical power to prevent possible gas/vapour explosion.

In solving these strict requirements, the basic concept of the Kitagawa gas detector tube, using a dry chemical reaction, was born. The detector tube made use of the discolouration reaction of a detecting reagent (lead acetate) adsorbed on the surface of solid granules (such as silica gel) . Gas measurement was made by the colour change of the detecting reagent. As the hydrogen sulphide was passed through the thin glass detector tube filled with the white detecting reagent, the tube turned black, and the degree of the discolouration increased in proportion to the hydrogen sulphide concentration. This new method was quickly adopted by a number of ammonia synthesis plants, where its performance was confirmed with an accuracy of plus or minus 5 per cent.

The highly successful development of the hydrogen sulphide detector tube suggested the possibility of detecting other gases. There quickly followed the development of a phosphide detector tube for quality control of acetylene production, and an ammonia detector tube for quality control of ammonium sulphide production. In this way the Kitagawa gas detector tube was established as a new gas detection method enabling anyone to quickly, and with a high degree of accuracy detect and measure concentrations of gases in different process environments.

Kitagawa detector tubes, first used for process and quality control, quickly penetrated into the field of industrial hygiene in the 1950's when detector tubes were developed for the measurement of chlorine leakage in electrolytic soda plants and for carbon monoxide build-up in coal mines.

Today, the Kitagawa Toxic Gas Detector System represents well over 200 different kinds of detector tubes, as part of a complete sampling and analysis system to detect and measure toxic gases and materials. Each production lot of tubes undergoes strict quality control and testing to ensure their performance.

## 1.2 GAS DETECTOR TUBE METHOD

### 1.2.1 PRINCIPLE

Kitagawa gas detector tubes are made from high-quality borosilicate glass tubes with a uniform inside diameter. Inside, each tube is packed with a gas detecting reagent. When both ends of a detector tube are broken, inserted into the Model AP-20 Kitagawa Gas Aspirating Pump, and an air sample is pulled through the tube by means of pulling back on the pump handle, the detecting reagent changes colour. The length of the discoloured layer is proportional to the concentration of the gas or vapour in the sample because of the fixed volume of sample, which is always 100 ml. The relationship between the length of the discoloured layer and the concentration of gas is shown in FIG. 1.1. Graduations printed on the tube showing the gas concentration make it fast and easy to take a reading with Kitagawa detector tubes.

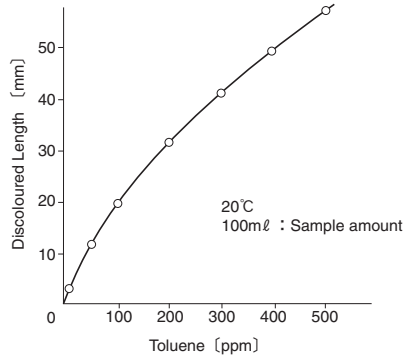
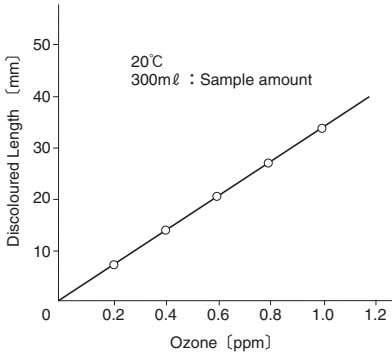


FIG. 1.1 DISCOLOURED LENGTH VS. GAS

### 1.2.2 DETECTING REAGENT

The detecting reagent is a reactive chemical adsorbed by granules (the carrier) of a highly purified silica gel, activated alumina, silica sand or silica glass. This packing changes colour by the chemical reaction with the target gas. Because of this, it is important to select the reactive reagent that meets the following criteria :

- (1) The colour-developing reagent must be stable when adsorbed on the carrier and have a long shelf life.
- (2) The reagent must show a sharp colour change reaction with the target gas and be acceptable in selectivity
- (3) The detecting reagent must give a strong colour contrast both before and after the colour change reaction.
- (4) The detecting reagent must react with the target gas in the sample quickly and develop a discoloured length with a clear end point.

### 1.3 ADVANTAGES OF THE GAS DETECTOR TUBE METHOD

The Kitagawa gas detector tube method has several advantages over other methods of gas detection :

- (1) As the gas detector tube method requires no chemical analyzers, reagents, etc., advance preparations are not needed ; detector tubes are always ready for use
- (2) The gas detector tube method is well-suited for use at the work site because it is small, light weight, and needs only a small sample volume to determine the concentration of gas or vapour in a sample.
- (3) The operating procedures are simple, allowing anyone to make measurements without the need for individual sampling technique.
- (4) The results of measurements are available in just minutes, so fast action can be taken when needed.
- (5) Since no electrical power source is required, detector tubes can be used even when flammable gases are present.
- (6) Different types of detector tubes are available for different gases and measuring ranges, from 0.1 ppm to more than 10 %, making the system flexible for different sampling situations.

## **1.4 CONDITIONS THAT AFFECT GAS DETECTOR TUBE RESULTS**

### **1.4.1 SAMPLE VOLUME**

Graduations on the detector tube showing the concentration of gas are generally calibrated to 100 mℓ / (100 cc), the quantity of gas passed through the detector tube in one pump stroke. Some detector tube graduations are calibrated to 200 mℓ or 300 mℓ (two or three pump strokes). The term pump "stroke" simply means the number of times the sample pump is operated (pump handle pulled back all the way and allowed to automatically lock).

The discoloured layer generally lengthens in proportion to the quantity of gas passed through the detector tube. When a gas or vapor is present in concentrations lower than the lowest graduation on the detector tube, the approximate concentration value can be found by increasing the sample volume to several hundred millilitres (several pump strokes) and dividing the concentration value read on the detector tube by the number of pump strokes. It should be noted, however, that the quantity of gas or vapour detected may not be exactly proportional to the length of the discoloured layer obtained due to the effects of moisture (RH) and a depleted oxidizer.

### **1.4.2 TEMPERATURE**

The temperature of the gas detector tube (normally the same temperature in the sampling environment) can also affect the measured concentration of gas or vapour for the following reasons :

- (1) An increase or decrease in the sample volume caused by a temperature change
- (2) A change in the quantity of gas adsorbed by the detecting reagent
- (3) A change in the rate in which the detecting reagent reacts with the gas or vapour

These effects can overlap one another, causing the length of the stain in the detector tube to increase or decrease. Or they can offset one another, having no effect on the measured value. Those Kitagawa gas detector tubes that can be affected by temperature changes are provided with a temperature correction table as part of the instruction sheet packed with each box of detector tubes.

### **1.4.3 HUMIDITY**

While nearly all Kitagawa gas detector tubes are not affected by unsaturated water vapour, some detector tubes are formulated with (a) both a dehumidifying reagent and detection reagent together in tube, or (b) a separate dehumidifying tube that is connected to the detector tube with a connector supplied in each box of tubes. However, water droplets can enter a detector tube ; water can even condense inside the detector tube due to temperature changes. Both these situations can have a serious effect on both the gas or vapour readings obtained and the actual colour change of the detector tube. For these reasons, taking readings with Kitagawa Water Vapour tubes prior to gas or vapour sampling is recommended.

### **1.4.4 COEXISTING GASES OR VAPOURS**

While the detecting reagents in Kitagawa gas detector tubes are formulated to react uniquely with the gas or vapour to be measured, it can also show a similar reaction (colour change) with another gas or gases having similar chemical properties. It is necessary to carefully consider this when taking gas or vapour readings with any gas detector tube.

A coexisting gas or vapour can have the following effects on gas detector tubes :

- (1) It may not discolour the detecting reagent, but can give a higher or lower reading.
- (2) It can discolour the detecting reagent in a similar way, giving a higher reading than the actual concentration.
- (3) It can give an entirely different colour change in the tube.
- (4) It can give the discoloured length with an indistinct end point.

### **1.4.5 SHELF LIFE**

Gas detector tubes use chemical reagents that inevitably deteriorate over time. Because of this, if detector tubes are used after the stated shelf life expiration date (stamped on each box of tubes) ,

they may not show an accurate gas or vapour concentration. While the highest purity reagents are used in formulating Kitagawa detector tubes to ensure the longest shelf life possible, complex chemistries used to detect some gases and vapours make it important to use tubes within the stamped expiration date.

#### **1.4.6 DETECTOR TUBE STORAGE**

All Kitagawa detector tubes should be stored in a cool, dark place to ensure adequate shelf life. Store tubes at a temperature of 25 °C (77 °F) or less out of direct sunshine in case a specific temperature is not shown on a box. Some detector tubes are required to store in a refrigerated place at a temperature between 0 °C and 10 °C (32-50 °F) as stated on the detector tube box. Detector tubes stored at high temperatures or in direct sunlight may show a performance deterioration even if they are within the stated shelf life.

## 2. COMPONENTS AND OPERATION

### 2.1 KITAGAWA GAS DETECTOR TUBES

#### 2.1.1 TYPES OF GAS DETECTOR TUBES

Kitagawa precision gas detector tubes vary in type according to the gas or vapour to be detected and the required detection range. They are used for measuring gases in different concentration ranges. As gas or vapour concentrations can vary from high to low, Kitagawa gas detector tubes vary in detectable concentration from high to low.

Detector tube Models vary from “H”, “A”, “B”, “C”, “D”, and “U” according to concentration ranges detectable, with “H” tubes detecting the highest ranges and the “U” tubes detecting ultra-low ranges of gases and vapours. Some detector tubes employ a multi-tube arrangement, two tubes connected in tandem (a pretreat or “scrubbing” tube, and a detector tube) in order to detect the gas or vapour of interest.

All Kitagawa gas detector tubes are of three basic types :

- (1) Direct Reading
- (2) Concentration Chart
- (3) Colour Intensity

#### 2.1.2 LENGTH OF STAIN DETECTOR TUBES

##### (1) DIRECT READING TUBES

Kitagawa direct reading detector tubes have gas concentration scales printed directly on the tubes themselves. This makes it convenient for taking gas or vapour measurements on-site because the tube is read just like a thermometer.

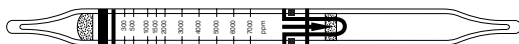


FIG. 2.1 DIRECT READING TUBE

##### (2) CONCENTRATION CHART TUBES

As the concentration chart shown in FIG. 2.2 can be drawn with calibration lines at close intervals, the resolution is improved over printed scale tubes. The chart, through the use of its slanted top and bottom lines, corrects for any difference in packing length.

#### 2.1.3 COLOUR INTENSITY TUBES

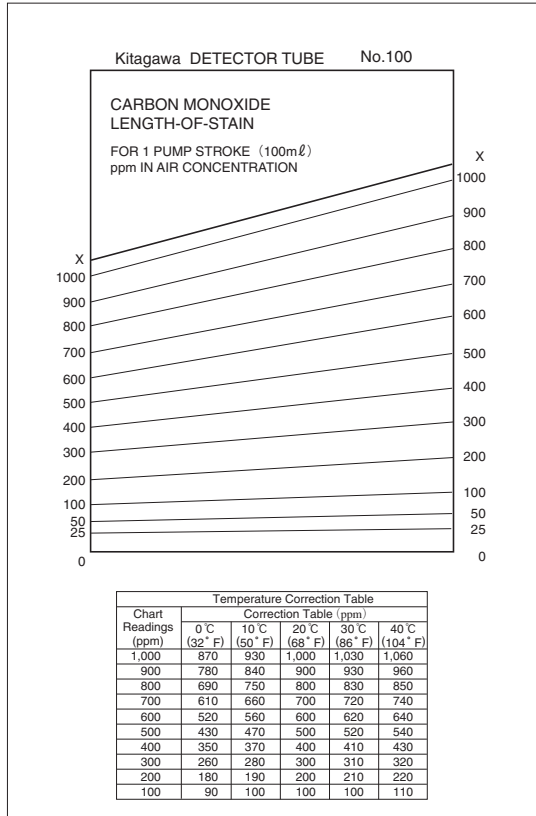
When a gas or vapour with little reactivity or a low reaction rate is detected, tube discoloration is nearly uniform throughout the tube’s length, with no clear end-stain border line. As this tube colour change shows a colour intensity proportional to concentration of the gas, that concentration can be measured by comparing the tube’s colour stain to a colour standard chart. (see FIG. 2. 3). This is the basis of the Colour intensity method for detector tubes. The Length of Stain detector tube method exceeds the Colour Intensity method in measurement accuracy. However, trace gas concentrations below the minimum detectable concentration of Length of Stain detector tubes can be measured by Colour Intensity tubes by passing a large quantity of sample through the detector tube.

#### 2.1.4 DETECTOR TUBES AND PRETREAT TUBES

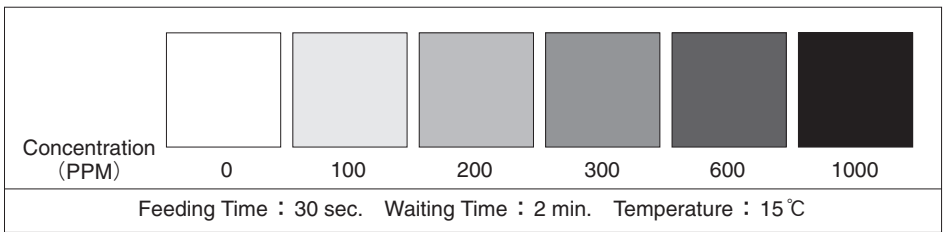
Two types of pretreat tubes are provided for sampling convenience :

- (1) pretreat tubes filled with an eliminating reagent or dehumidifying reagent for eliminating interfering gases or moisture in the sample, and
- (2) pretreat tubes filled with an oxidizing reagent for breaking down the sample gas before it enters the detector tube. For example : when a trichloroethylene detector tube is used, trichloroethylene is broken down in the pretreat tube to generate chlorine gas ; the chlorine gas is passed through and detected by the chlorine-detecting reagent in the detector tube. The tube’s scale graduations are calibrated by trichloroethylene in parts per million (ppm) . All pretreat tubes are connected to their detector tubes as shown in FIG.2.4.

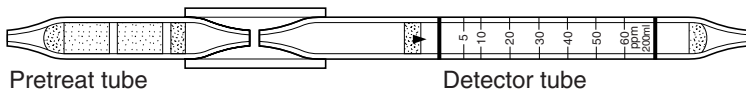




**FIG.2.2 CONCENTRATION CHART**



**FIG.2.3 COLOUR STANDARD CHART**



**FIG.2.4 CONNECTION WITH PRETREAT TUBE**

## 2.2 MODEL AP-20 SAMPLING PUMP KIT

The Kitagawa Model AP-20 consists of an aspirating pump, accessories, and a compact, lightweight carrying case (FIG.2.5, Tubes are optional.) .

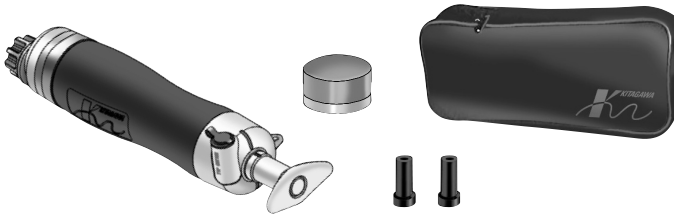


FIG.2.5 MODEL AP-20

The Model AP-20 is provided with a sample flow indicator, detector tube tip cutter and storage, and a two-stage locking mechanism on the pump handle that allows sampling of either 50 ml or 100 ml sample volumes. The carrying case can be used as a portable type.

### 2.2.1 MODEL AP-20 ASPIRATING PUMP CONSTRUCTION

#### (1) SAMPLE FLOW INDICATOR

The Model AP-20 pump includes an exclusive sample flow finish indicator as an aid in sampling. Before sampling, the red flow indicator is sticking out from the indicator base. As a sample is drawn through a detector tube, the red flow indicator will be sticking out from the indicator base. As sampling progresses, this red flow indicator sticks out fully. Sampling cycle is completed when the red flow indicator sticks out fully from the indicator base. With this handy sampling aid, it is not necessary to always time each sample, allowing multiple tasks to be performed. (See FIG. 2.7)

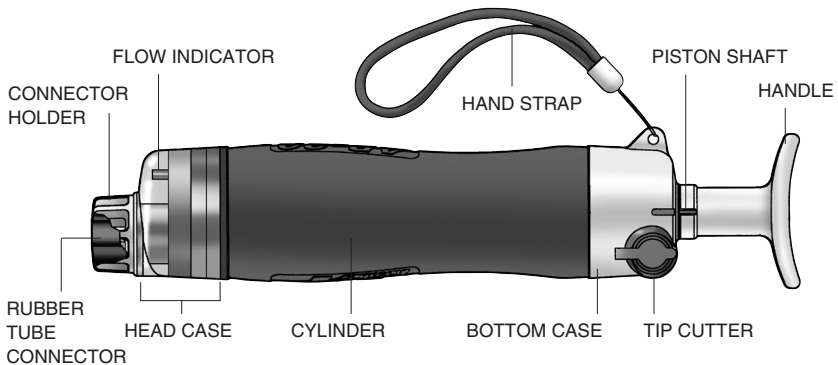


FIG.2.6 CONSTRUCTION AND PART NAMES

## (2) DETECTOR TUBE TIP STORAGE

Glass ends of detector tubes broken off in the tip cutter collect in the tip storage compartment. This reduces the possibility of glass cuts scatter. (See FIG. 2.8)

## (3) TWO-STAGE PUMP MECHANISM

Model AP-20 Aspirating Pump is provided with convenient grooves on the pump shaft at the 50 ml and 100 ml mark. When the red line on the pump shaft and bottom case are lined up and the handle is pulled straight out, the pump will automatically lock at either the 50 ml or 100 ml mark. To unlock the pump after sampling, simply turn the handle 90 degrees.

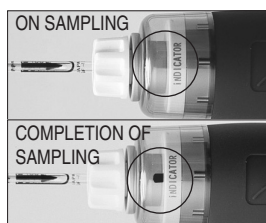


FIG.2.7 SAMPLE FLOW INDICATOR

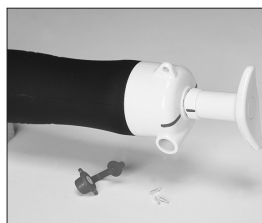


FIG.2.8 TIP STORAGE

## 2.2.2 CHECKING PRIOR TO USE (Leakage Test)

If there is leakage in the aspirating pump, (a) a lower reading can be obtained, or (b) the detecting reagent in the tube may not change colour. The Kitagawa Aspirating Pump should always be checked for sample leakage into the pump ("inboard" leakage) prior to use. If there is leakage into the pump, the full 100 ml sample volume required will not pass through the detector tube during sampling. This could result in possible low readings on the tube which could lead to injury by understating a hazardous condition. The procedure is as follows :

- ① Insert a sealed, unbroken detector tube into the rubber tube connector. Align the red line on the bottom case and that of shaft, and pull the handle to full stroke locked position.
- ② Wait one minute. Unlock the handle by turning it 1/4 turn (90 degrees), and check to see if the handle returns to the initial position. When the lock is released under full vacuum, the handle tends to snap back quickly. To prevent possible damage to the locking device allow the handle to return slowly by holding the cylinder and handle securely. If the handle returns completely to the original position, the performance is satisfactory.
- ③ If the pump fails the leak test, the following are possible causes.
  - A) A loose inlet connector holder.
  - B) Cracks and deterioration of the rubber tube connector.
  - C) Deterioration of the grease.

To correct a leaking pump, consult the "MAINTENANCE" section.

## 2.2.3 MAINTENANCE

### (1) RUBBER TUBE CONNECTOR

When the rubber tube connector is sufficiently worn to make tube insertion difficult, or does not hold detector tubes properly, replace the rubber tube connector.

## (2) APPLICATION OF NEW VACUUM GREASE

- ① Pull the handle part way and turn the bottom case counterclockwise to remove it.
- ② Pull the piston out from the cylinder.
- ③ Wipe off the old grease and dirt from the piston and inside the cylinder using a clean paper towel. Apply a thin coat of vacuum grease to the rubber gasket of the piston. When wiping off the old grease, be careful not to scratch the inside walls of the cylinder. Reassemble pump.

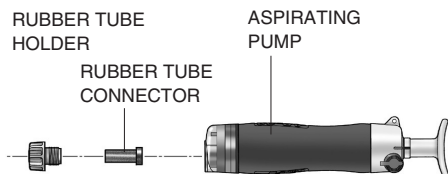


FIG. 2.10 RUBBER TUBE CONNECTOR

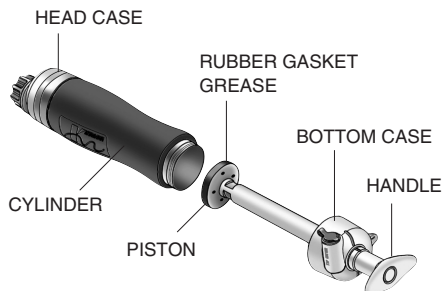


FIG. 2.11 TO REMOVE THE PISTON

## 2.3 GAS CONCENTRATION MEASUREMENT

### 2.3.1 KITAGAWA DETECTOR TUBE BOXES

Always confirm before sampling that the gas detector tube chosen is suitable for the type of sampling and environment. Be sure to read the necessary items for measurement printed on each tube box. An instruction sheet is enclosed in each tube box. Read the instruction sheet before sampling, as new improvement in chemical reactions and sampling methods will always be described there.

#### (1) On the tube box (See FIG. 2.12)

- ① Expiration date of shelf life
- ② Tube number (catalogue number)
- ③ Gas or vapour to be detected
- ④ Measuring range
- ⑤ Quantity of tubes in the box
- ⑥ Storage instructions (Refer to 1.4.6)
- ⑦ Manufacturing lot number

#### (2) In the instruction sheet (See FIG. 2.13)

- ① Performance of the tube
- ② Sampling and measurement procedures
- ③ Correction for ambient conditions
- ④ Interferences by single existence and coexistence
- ⑤ Chemical reaction in the detector tube
- ⑥ Disposal of used tubes
- ⑦ Properties of the measuring gas
- ⑧ Inspection of the aspirating pump
- ⑨ Users responsibility

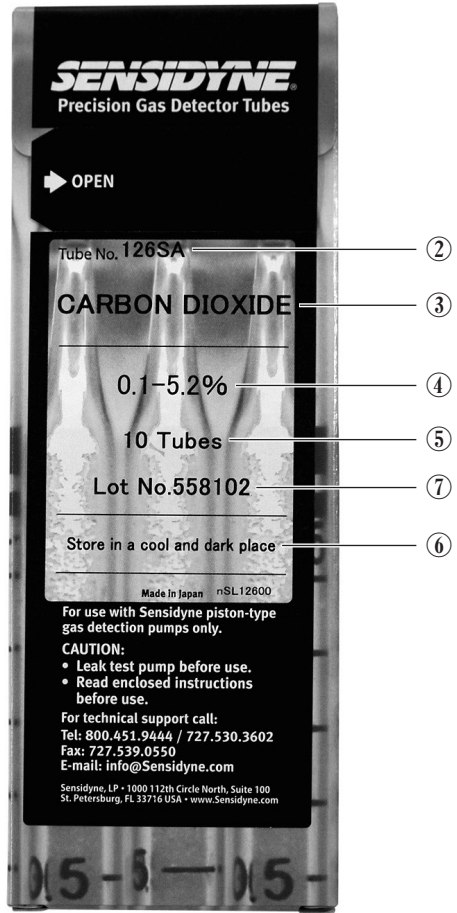


FIG. 2.12 DETECTOR TUBE BOX

## INSTRUCTION MANUAL No.126SA CARBON DIOXIDE DETECTOR TUBE

★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

### 1. PERFORMANCE :

Measuring Range:      0.2 - 5.2%                      0.1 - 2.6% (\*)

and Pump Stroke:      1/2 pump stroke              1 pump stroke

(\*) Graduations on the detector tube are based on 1 pump stroke.

Sampling Time:	2.5 minutes	5 minutes
Colour Change:	Purple blue → Pale pink	
Detectable Limit:	0.01% (100 ppm) (1 pump stroke)	
Operating Temperature:	0 - 40°C (32-104°F) (No temperature correction is necessary.)	
Aspirating Pump:	Model AP-20S, AP-1S, 400B OR 400A	

### ▲ CAUTION

1. THE DETECTOR TUBE CONTAINS CHEMICAL REAGENTS.
2. DO NOT TOUCH THESE REAGENTS DIRECTLY ONCE TUBES WERE BROKEN.
3. KEEP THE TUBES OUT OF THE REACH OF CHILDREN.

### NOTICE

1. USE ONLY WITH PUMP MODELS AP-20S, AP-1S, 400B OR 400A. OTHERWISE, CONSIDERABLE ERROR IN INDICATION MAY OCCUR.
2. BEFORE TESTING, CHECK THE ASPIRATING PUMP FOR LEAKS. (REFER TO ITEM 8. 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 9. USER RESPONSIBILITY.
6. READ THE CONCENTRATION IMMEDIATELY AFTER MEASUREMENT.

### 2. SAMPLING AND MEASUREMENT:

②

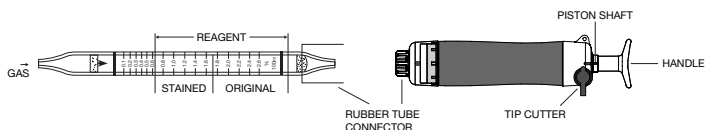


Fig. 1

- ① Break both ends of detector tube.

**▲CAUTION SAFETY GLASSES AND GLOVES SHOULD BE WORN TO PREVENT INJURY FROM SPLINTERING GLASS.**

- ② Insert the detector tube into the aspirating pump securely as shown in Fig.1. (Arrow mark shall point to the pump.)
- ③ Align the guide marks on the shaft and stopper of the aspirating pump.
- ④ Pull the pump handle at a full stroke until it locks and wait for 5 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.)
- ⑤ On completion of sampling, read the scale at the maximum point of the stained layer.
- ⑥ When the concentration is over the scale range, a 1/2 pump stroke can be used to determine concentrations of 0.2 to 5.2 ppm.
- 1) Remove the detector tube from the pump.
  - 2) Turn the pump handle right or left by 1/4 (90°), push back it toward to the pump.
  - 3) Insert the new tube into the aspirating pump.
  - 4) Pull the pump handle at a 1/2 stroke until it locks and wait for 2.5 minutes or until the completion of sampling is confirmed with the flow indicator of the pump.
  - 5) On completion of sampling, read the scale at the maximum point of the stained layer.
  - 6) Then multiply the reading value by 2.

**SPECIAL NOTE :**

- I. The scale is 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 **3. CORRECTION FOR AMBIENT CONDITIONS :**

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

Tube Readings (%)	Temperature Correction Table				
	Corrected Concentration (%)				
	0°C (32° F)	10°C (50° F)	20°C (68° F)	30°C (86° F)	40°C (104° F)
2.6	2.85	2.75	2.6	2.5	2.4
2.4	2.6	2.5	2.4	2.3	2.2
2.2	2.4	2.3	2.2	2.1	2.0
2.0	2.2	2.1	2.0	1.9	1.8
1.8	2.0	1.9	1.8	1.7	1.6
1.6	1.75	1.7	1.6	1.5	1.4
1.4	1.55	1.5	1.4	1.35	1.3
1.2	1.3	1.25	1.2	1.15	1.1
1.0	1.1	1.05	1.0	0.95	0.9
0.8	0.9	0.85	0.8	0.75	0.7
0.6	0.65	0.6	0.6	0.6	0.55
0.5	0.55	0.5	0.5	0.5	0.45
0.4	0.45	0.4	0.4	0.4	0.35

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

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

- ④ **4. INTERFERENCES :**  
 Coexistence of Nitrogen, Oxygen, Carbon Monoxide, and/or Ethylene does not affect the accuracy of readings.  
 Coexistence of less than 500ppm of Sulphur Dioxide, 100ppm of Hydrogen Sulphide, 200ppm of Hydrogen Cyanide, 100ppm of Chlorine or 500ppm of Ammonia does not affect the accuracy of readings. Coexistence of more than 10ppm of Nitrogen Dioxide will give lower readings.
- ⑤ **5. CHEMICAL REACTION IN THE DETECTOR TUBE :**  
 By reacting with alkali, pH indicator is discoloured.  
 $\text{CO}_2 + 2\text{NaOH} \rightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O}$
- ⑥ **6. DISPOSAL OF TUBE :**  
 USED TUBES SHOULD BE DISPOSED CAREFULLY ACCORDING TO RELEVANT REGULATIONS, IF ANY.
- ⑦ **7. HAZARDOUS AND DANGEROUS PROPERTIES OF CARBON DIOXIDE :**  
 T.L.V.◆ : 5000 ppm  
 Explosive range in air : —  
 ◆Threshold Limit Value established by the American Conference of Governmental Industrial Hygienists, 2010.
- ⑧ **8. 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 full stroke(100ml) and wait for 1 minute as it is.  
 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 in the instruction manual of the pump to correct the leakage.
- ⑨ **9. 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 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.  
 \* Product specifications are subject to change without any prior notice.

IME1260

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FIG. 2.13 INSTRUCTION SHEET



### 2.3.2 OPERATION FOR MEASUREMENT

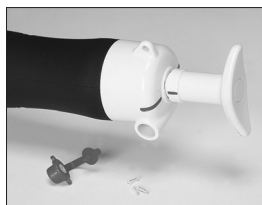
As the method of operating the Kitagawa gas detector tube varies somewhat according to the kind of tubes to be used, read the instruction sheet for the gas detector tube carefully and follow the instructions.

#### (1) Prepare Aspirating pump.

Check the pump for leaks in accordance with "CHECKING PRIOR TO USE". (Refer to page 8)

#### (2) Cut both ends of the gas detector tube.

Insert the tip of the gas detector tube into the tip cutter and scratch the tip of tube by rotating it for one revolution, then pull it toward you. (The glass tip can be thrown away by removing the tip cutter cap.)



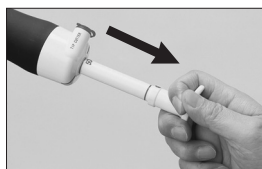
#### (3) Connect the gas detector tube to the aspirating pump.

The sample gas must be drawn through the gas detector tube in the correct direction. Insert the gas detector tube into the rubber tube connector with the tube's directional arrow pointing toward the pump.



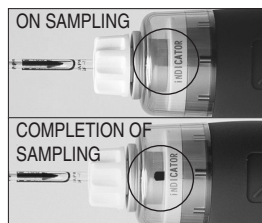
#### (4) Pull the handle.

Align the red line on the bottom case and that on the shaft and pull the pump handle to its full 100cc locking position. If the sample calls for a half stroke, pull out the pump handle until 50cc line appears, and shaft will be locked at 50cc.



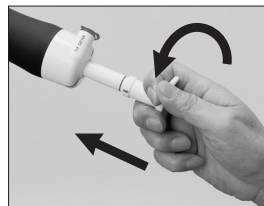
#### (5) Draw the sample gas.

Draw the sample gas for the specified time at the desired sampling point, and confirm with the flow indicator that the sample is completed. The sample time required for each detector tube is stated clearly in the instruction sheet.



### (6) Return the handle.

When the sample is completed, turn the handle 1/4 turn (90 degrees) clockwise or counterclockwise to unlock the handle. Confirm that the handle remains extended. (If the handle returns part way, the sample is incomplete, and this will cause a low reading). Some detector tubes require extra pump strokes (i.e., more than 100cc of air). In this case, push back the handle and repeat the operation.



### (7) Read the concentration.

Remove the gas detector tube from the aspirating pump after a prescribed quantity of gas is aspirated and read the concentration of gas at the maximum end of the discolored layer against graduations on the direct reading detector tube or by using the concentration chart for the concentration chart method tube,

Read the concentration chart in the following way. Bring the end of the detecting reagent on the gas inlet side in line with the 0-0 line on the concentration chart and the other end in line with the X-X line respectively to read out gas concentration at the end of the discoloured layer. When the end is oblique, read at the middle point of the oblique discoloured layer.

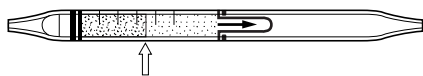


FIG. 2.19 READOUT OF DIRECT READING TUBE

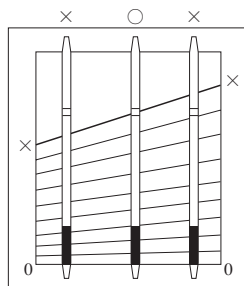


FIG. 2.20  
READOUT OF CONCENTRATION  
CHART TUBE

## 2.3.3 CORRECTION

### (1) Temperature correction

As graduations showing the concentration of gas on the gas detector tube are generally calibrated at 20°C, the reading value may have to be corrected according to the kind of the gas detector tube and the measuring range. (Refer to examples shown in FIG. 2.21 and 2.22.)

The temperature at which the gas detector tube is used generally ranges from 0 to 40°C and it is impossible to obtain an accurate measured value at temperatures outside of the range. The temperature means that of the gas detector tube (usually the temperature of the sampled gas.), and even if the temperature of sample gas varies somewhat, it will not affect the measured value because of a small thermal capacity of gas. Temperature correction need not be applied to the gas detector tube to which the temperature correction chart is not attached.

Example 1 : When the reading value is 500 ppm at 10 °C, the true concentration is 470 ppm.

Scale Readings (ppm)	True Concentration (ppm)				
	0 °C (32 ° F)	10 °C (50 ° F)	20 °C (68 ° F)	30 °C (86 ° F)	40 °C (104 ° F)
1,000	870	930	1,000	1,030	1,060
900	780	840	900	930	960
700	610	660	700	720	740
600	520	560	600	620	640
500	430	470	500	520	540
400	350	370	400	410	430
300	260	280	300	310	320
200	180	190	200	210	220
100	90	100	100	100	110

FIG. 2.21 TEMPERATURE CORRECTION

Example 2 : When the reading value is 550 ppm at 25 °C, the true concentration is 560 ppm which is found by proportional allotment of each concentration and temperature as shown in FIG. 2.22.

Scale Readings (ppm)	True Concentration (ppm)				
	0 °C (32 ° F)	10 °C (50 ° F)	20 °C (68 ° F)	30 °C (86 ° F)	40 °C (104 ° F)
1,000	870	930	1,000	1,030	1,060
900	780	840	900	930	960
700	610	660	700	720	740
600	520	560	600	620	640
500	430	470	500	520	540
400	350	370	400	410	430
300	260	280	300	310	320
200	180	190	200	210	220
100	90	100	100	100	110

Scale Readings	20 °C	25 °C	30 °C
600	600	(610)	620
(550)	(550)	(560)	(570)
500	500	(510)	520
(450)	(450)	(457.5)	(465)
400	400	(405)	410

Numerals in parentheses are determined by proportional allotment.

FIG. 2.22 CORRECTION UNDER EXPANSION

## (2) Pressure correction

When gas is measured in an atmosphere under pressure or reduced pressure, a true concentration can be obtained by following equation.

True concentration = Reading value X 101.3 / Atmospheric pressure (in kpa)

True concentration = Reading value X 760 / Atmospheric pressure (in mmHg)

P (mmHg) : Atmospheric pressure in the place where gas is measured.

### 2.3.4 SPECIAL PRECAUTIONS

- (1) When the concentration chart tube is used, be sure to use the concentration chart found in the box.
- (2) It is desirable to read the concentration immediately after measurement because the discoloured layer gets longer gradually or fades after measurement in some gas detector tubes. It is recommended to mark the end of the discoloured layer by a soft pen for keeping a record of the concentration.
- (3) If the end of the discoloured layer is slanted, read the numerical value at the middle of the oblique layer.

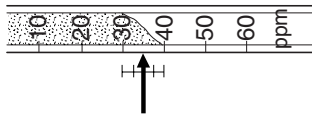


FIG. 2.23 OBLIQUE LAYER (Channeling)

## 2.4 SPECIAL DETECTOR TUBES FOR IONS AND TWA

### 2.4.1 ION DETECTOR TUBES

- (1) The ion detector tubes, used for measuring the concentration of ions in the water, include tubes for sulphide, chloride, iron, cyanide, residual chlorine and salinity detector tubes. The concentration of an ion is measured by three different method as follows : (1) Injection method (see FIG. 2.24) : Sample solution taken by a syringe is injected into the detector tube.
- (2) Immersion method (see FIG.2.25) : One end of the detector tube is immersed in the sample solution to draw it up by capillarity action.
- (3) Direct sampling method (see FIG. 2.26) : Sample solution is drawn into the tube end by a rubber bulb (an extra option). The concentration of the ion is read by the direct reading method or the concentration chart method as in case of the gas detector tubes.

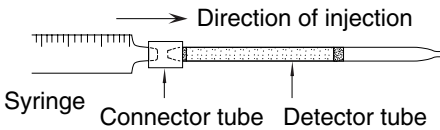


FIG. 2.24 INJECTION METHOD

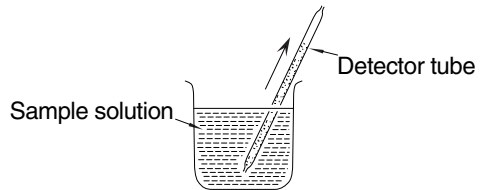


FIG. 2.25 IMMERSION METHOD

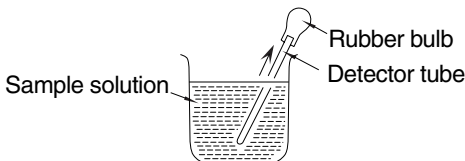


FIG. 2.26 DIRECT SAMPLING METHOD

## 2.4.2 TWA DETECTOR TUBES

The TWA detector tube is designed to produce a stain corresponding to a time-concentration relationship. For instance, when 200 ppm of gas is passed through the detector tube for one hour and when 100 ppm of gas is passed through the detector tube at the same flow rate for two hours the two conditions will produce equal stain lengths. Therefore, the length of the discoloured layer is given in terms of integrated value of gas measured, making it possible to derive the TWA concentration for the time during which gas is passed through the detector tube from the length of the discoloured layer. This detector tube is most suited for measuring the concentration of gas to which a person is exposed.

All the examples in which gas is passed through the detector tube as shown on the upper tier in FIG. 2.27-2.30 give a TWA concentration of 50 ppm after the lapse of 8 hours. When gas is passed through the TWA detector tube in these examples, the same reading value (X) is given by the detector tube after 8 hours in all the cases, though the reading value varies with the lapse of time as shown on lower tier.

### (1) How to use

- ① Connect the detector tube to the personal sampler or an equivalent, sampler and set the flow using a soap film flow meter to the specified flow rate (6 to 10 ml / min).
- ② Place the detector tube and sampler in the sample area and draw the sample gas for the required time.
- ③ Since graduations on the detector tube are calibrated in the value obtained for eight hours (480 minutes), convert the reading value obtained for a shorter time by the following equation.

$$\text{TWA value} = \text{Reading value on detector tube} \times \frac{480}{\text{Sampling time (minutes)}}$$

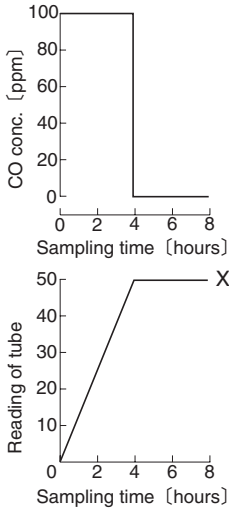


FIG. 2.27 SAMPLE DELIVERY MODE A

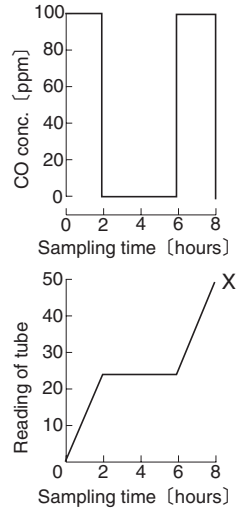


FIG. 2.28 SAMPLE DELIVERY MODE B

$$\text{TWA value} = \frac{100 \times 4 + 0 \times 4}{8} = 50 \text{ ppm}$$

$$\text{TWA value} = \frac{100 \times 2 + 0 \times 4 + 100 \times 2}{8} = 50 \text{ ppm}$$

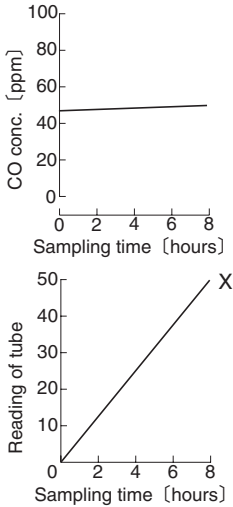


FIG. 2.29 SAMPLE DELIVERY MODE C

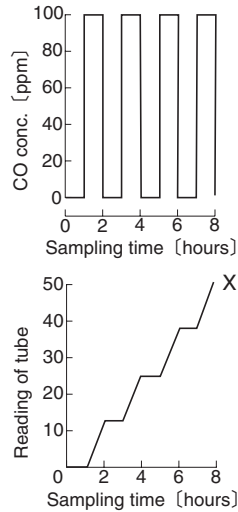


FIG. 2.30 SAMPLE DELIVERY MODE D

$$\text{TWA value} = \frac{50 \times 8}{8} = 50 \text{ ppm} \quad \text{TWA value} = \frac{0 \times 1 + 100 \times 1 + 0 \times 1 + 100 \times 1 + 0 \times 1 + 100 \times 1 + 0 \times 1 + 100 \times 1}{8} = 50 \text{ ppm}$$

### **3. DATA OF KITAGAWA GAS DETECTOR TUBES**

#### **3.1 EXPLANATION OF THE TUBE TABLE**

##### **3.1.1 PERFORMANCE**

An external view with printed graduations and specifications are described.

##### **3.1.2 RELATIVE STANDARD DEVIATION**

Errors which affect the measuring value are composed of a systematic error and an incidental error. The incidental error, however, originates in quality control throughout gas detector tube manufacturing process and it cannot be decreased by any caution in operation and handling by the user.

The incidental error of the Kitagawa gas detector tube is controlled as the relative standard deviation, shown in every tube table. The relative standard deviation is defined as a percentage in which a standard deviation is divided by a mean value of readings. Further, the Kitagawa gas detector tube is being controlled by dividing the full measuring range into three ranges, low, middle and high ranges, and giving quality control for the every range. (Some kinds of tubes are controlled with four divided ranges.) These controlled values are set forth as “RSD-low” for the low measuring range, “RSD-mid.” for the middle range and “RSD.-high” for the high range.

##### **3.1.3 CHEMICAL REACTION**

Chemical reaction for the measuring gas and reagents are shown.

##### **3.1.4 CALIBRATION OF THE TUBE**

The analytical method of gas, which is used for calibration and final accuracy testing of the tube, is set forth.

##### **3.1.5 INTERFERENCE & CROSS SENSITIVITY**

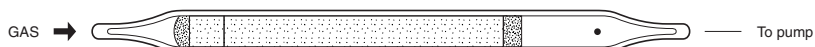
Coexistent gases, which give interferences to the measurement, are described. On the other hand, some of listed gases herein may be possible to detect in quantitativie or qualitative analysis.

#### **© MARK**

In cases where gas concentration is read using a conversion chart as shown in the tube instruction sheet, a mark © is affixed after the tube number in this brochure. For example : 190U ©. However, this mark © is shown only in the brochure and does not appear on the printed tube box or in the instrustion sheet. When ordering such tubes, it is unnecessary to include the © mark on your purchase orders.

## **3.2 KITAGAWA SHORT-TERM DETECTOR TUBES**





## 1. PERFORMANCE

- 1) Measuring range : 0.004-1.0 %
- Number of pump stroke : 1 (100ml)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 0.0005 % (5ppm)
- 4) Shelf life : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Concentration chart method
- 8) Colour change : Yellow → Pink

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with Hydroxylamine hydrochloride, Hydrogen chloride is liberated and PH indicator discoloured.

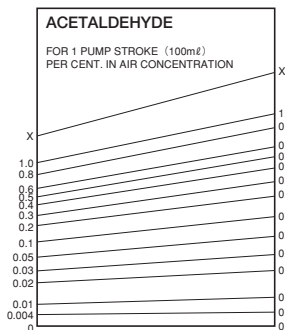
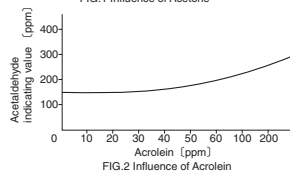
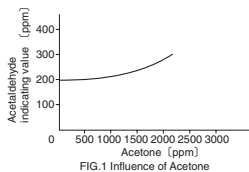


## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

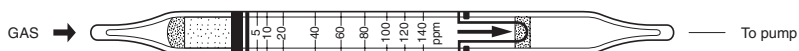
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Acetone            FIG.1	Similar stain is produced	1400	Higher readings are given.
Acrolein            FIG.2	∕	35	∕
Methyl ethyl ketone	∕	900	∕
Methyl isobutyl ketone	∕	2900	∕



### TEMPERATURE CORRECTION TABLE

Chart Readings (%)	Corrected Concentration (%)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
1.0	1.6	1.6	1.0	0.50	0.30
0.8	1.9	1.3	0.8	0.40	0.20
0.6	1.6	1.05	0.6	0.30	0.16
0.5	1.45	0.9	0.5	0.25	0.14
0.4	1.3	0.8	0.4	0.20	0.13
0.3	1.2	0.65	0.3	0.15	0.11
0.2	0.95	0.45	0.2	0.10	0.08
0.1	0.6	0.2	0.1	0.07	0.05
0.05	0.25	0.09	0.05	0.04	0.03
0.03	0.08	0.05	0.03	0.025	0.01
0.02	0.03	0.025	0.02	0.015	0.007
0.01	0.02	0.015	0.01	0.007	0.004



## 1. PERFORMANCE

- 1) Measuring range : 5-140 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 2 ppm
- 4) Shelf life : 2 years (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 10 ~ 40 °C
- 6) Operating humidity : 0 ~ 80% R.H. (See "HUMIDITY CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Yellow → Pink

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 5%    RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Hydroxylamine hydrochloride, Hydrogen chloride is liberated and PH indicator discoloured.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Other Aldehydes	Similar stain is produced.	Higher readings are given.
Ketones	∕	∕
Ethanol	The accuracy of readings is not affected.	∕

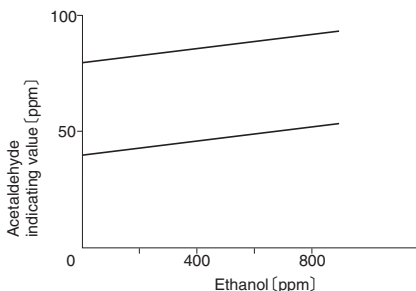
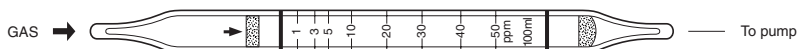


FIG.1 Influence of Ethanol

TABLE OF COEFFICIENT FOR HUMIDITY CORRECTION(50%R.H.)

Humidity(%R.H.)	0	10	20	30	40	50	60	70	80
Coefficient	1.70	1.40	1.20	1.10	1.05	1.00	0.97	0.95	0.93



## 1. PERFORMANCE

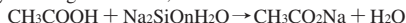
- 1) Measuring range : 1-50 ppm
- Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 0.2 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Pale pink → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

By reacting with alkali, PH indicator is discoloured.

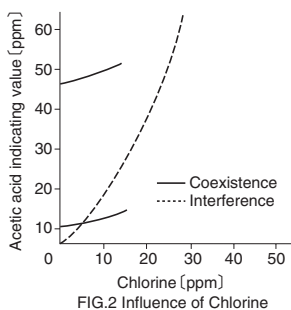
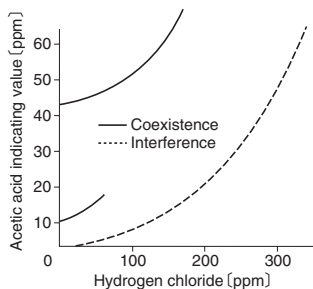


## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	ppm	Coexistence
Sulphur dioxide		Similar stain is produced.	$1/20 \times$ Acetic acid	Higher readings are given.
Nitrogen dioxide	300	∕	10	Unclear stain is produced.
Hydrogen chloride FIG.1		Pink stain is produced.	$2 \times$ Acetic acid	Higher readings are given.
Chlorine FIG.2		Yellow stain is produced.	5	∕



TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
50	63	57	50	45	40
40	50	45	40	36	31
30	37	33	30	27	23
20	24	22	20	18	16
10	12	11	10	9	8
5	6	6	5	5	4
3	4	4	3	3	2
1	1	1	1	1	1



## 1. PERFORMANCE

- 1) Measuring range : 1-15 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : Graduations printed on the tube are calibrated by Acetic acid at 1 pump stroke and Acetic anhydride concentration is determined by using a conversion chart at 1 pump stroke.
- 7) Colour change : Pale pink → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

By reacting with alkali, PH indicator is discoloured.

## 4. CALIBRATION OF THE TUBE

VAPOUR PRESSURE METHOD

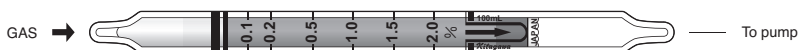
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	Coexistence
Sulphur dioxide		Similar stain is produced.	Higher readings are given.
Nitrogen dioxide	300	∕	The top of discoloured layer becomes unclear.
Hydrogen chloride		Pink stain is produced.	Higher readings are given.
Chlorine		Blueish yellow stain is produced.	∕
Acetic acid		Similar stain is produced.	∕

Acetic Anhydride (ppm)



No.216S tube reading (ppm)



## 1. PERFORMANCE

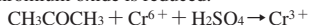
- 1) Measuring range : 1.0-5.0 %      0.1-2.0 %
- Number of pump strokes : 1/2 (50mℓ)      1 (100mℓ)
- 2) Sampling time : 1.5 minute/1 pump stroke
- 3) Detectable limit : 0.02 % (200 ppm) (100mℓ)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Orange → brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

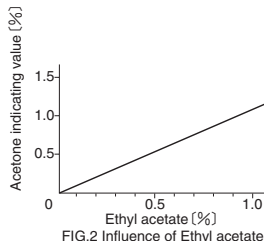
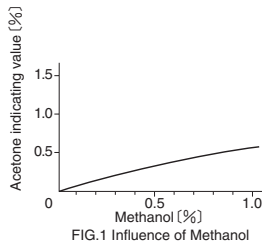
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols      FIG.1	Similar stain is produced.	Higher readings are given.
Other ketones	∕	∕
Aromatic hydrocarbons	∕	∕
Esters      FIG.2	∕	∕
Halogenated hydrocarbons	Whole reagent is slightly discoloured to pale brown.	0.5 %      ∕

\*Methanol is indicated with half the sensitivity and Ethyl acetate has the same sensitivity with Acetone.

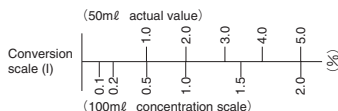
(NOTE)

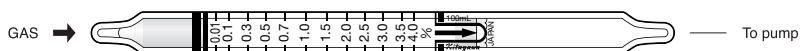
- 1) If the discolouration is over the scale, replace the tube with new one and pull the handle at half stroke (to 50mℓ line). And read a figure from the scale on the tube.
- 2) Correct the reading value with the TEMPERATURE CORRECTION TABLE first, and convert the value into an actual concentration by using the conversion scale shown in the instruction sheet.



### TEMPERATURE CORRECTION TABLE

Tube Readings (%)	Corrected Concentration (%)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
2.0	—	2.38	2.00	1.78	1.60
1.5	2.20	1.76	1.50	1.30	1.16
1.0	1.44	1.18	1.00	0.86	0.76
0.5	0.72	0.60	0.50	0.42	0.36
0.2	0.30	0.25	0.20	0.16	0.14
0.1	0.16	0.12	0.10	0.08	0.08





## 1. PERFORMANCE

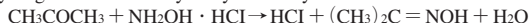
- 1) Measuring range : 0.01-4.0 %
- Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 0.001 % (10 ppm)
- 4) Shelf life : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Yellow → Pink

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Hydrogen chloride of Hydroxylamine hydrochloride is liberated and acidified, and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

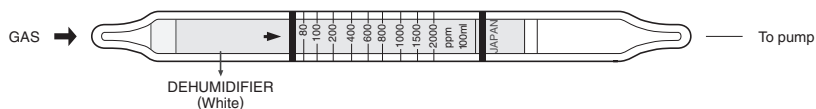
GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Acrolein	Similar stain is produced.	20	Higher readings are given.
Acetaldehyde	∕	30	∕
Methyl ethyl ketone	∕	150	∕
Methyl isobutyl ketone	∕	400	∕

### TEMPERATURE CORRECTION TABLE

Tube Readings (%)	Corrected Concentration (%)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
4.0	—	—	4.0	3.2	2.7
3.5	—	—	3.5	2.8	2.3
3.0	—	4.1	3.0	2.4	2.0
2.5	4.8	3.7	2.5	2.0	1.7
2.0	3.9	2.8	2.0	1.6	1.4
1.5	2.9	2.0	1.5	1.2	1.0
1.0	1.8	1.3	1.0	0.8	0.7
0.7	1.1	0.9	0.7	0.6	0.5
0.5	0.8	0.7	0.5	0.4	0.3
0.3	0.5	0.4	0.3	0.3	0.2
0.1	0.16	0.12	0.1	0.08	0.05



## 1. PERFORMANCE

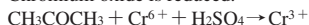
- |                             |   |              |            |
|-----------------------------|---|--------------|------------|
| 1) Measuring range          | : 125-5,000 ppm   | 50-2,000 ppm | 20-800 ppm |
| Number of pump strokes      | 1/2 (50mℓ)  | 1 (100mℓ)    | 2 (200mℓ)  |
| 2) Sampling time            | : 1.5 minutes/1 pump stroke                                 |              |            |
| 3) Detectable limit         | : 10 ppm (200mℓ)  |              |            |
| 4) Shelf life               | : 2 years   |              |            |
| 5) Operating temperature    | : 0 ~ 40 ℃  |              |            |
| 6) Temperature compensation | : Necessary (See "TEMPERATURE CORRECTION TABLE")            |              |            |
| 7) Reading                  | : Direct reading from the scale calibrated by 1 pump stroke |              |            |
| 8) Colour change            | : Yellow → Dark brown                                       |              |            |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 5%    RSD-high : 5%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Brown stain is produced.	Higher readings are given.
Other Ketones	∕	∕
Esters	∕	∕
Aromatic hydrocarbons	∕	∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	Whole layer is discoloured to Brown.	If the top of discoloured layer is possible to read, the accuracy of readings is not affected.
Halogenated hydrocarbons	∕	∕

(NOTE)

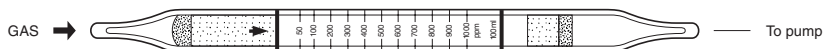
In case of 1/2 or 2 pump strokes, following formula is available for the actual concentration.

1/2 pump strokes : Actual concentration = 2.5 × Temperature corrected value

2 pump strokes : Actual concentration = 0.4 × Temperature corrected value

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 ℃ (32 ℉)	10 ℃ (50 ℉)	20 ℃ (68 ℉)	30 ℃ (86 ℉)	40 ℃ (104 ℉)
2,000	3,500	2,800	2,000	1,600	1,300
1,500	2,570	2,000	1,500	1,250	1,000
1,000	1,670	1,250	1,000	850	700
800	1,300	1,000	800	700	600
600	1,000	800	600	550	450
400	650	500	400	350	300
200	300	200	200	200	200
100	200	100	100	100	100
50	100	50	50	50	50



## 1. PERFORMANCE

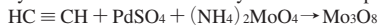
- 1) Measuring range : 50-1000 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 3 minutes/1 pump stroke
- 3) Detectable limit : 10 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Pale yellow → Brownish blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

Molybdate is reduced and molybdeum blue is produced.



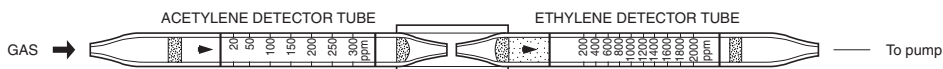
## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Carbon monoxide	Whole layer is discoloured to Green or Blue.	50	Whole layer is discoloured to Green or Blue and higher readings are given.
Hydrogen (over 40 °C)	∕	10%	Whole layer is discoloured to Green and higher readings are given.
Unsaturated hydrocarbons such as Ethylene, Propylene, Butylene, etc.	Similar stain is produced.	10	Higher readings are given.
Saturated hydrocarbons such as Propane, Butane, etc. (more than C <sub>3</sub> )	∕	10	∕
Butadiene	Original colour is faded to white.	25	Original colour is faded to White and lower readings are given.
Hydrogen sulphide	Whole layer is discoloured to Black.	10	Black stain is produced.
Ammonia	Original colour is faded to White.		Original colour is faded to White and lower readings are given.
Hydrogen cyanide	∕		Blue stain is produced and higher reading are given.
Chlorine	Yellowish orange or Yellowish brown stain is produced.		Higher readings are given.
Nitrogen dioxide	∕		∕
Carbon disulphide	∕		∕





## 1. PERFORMANCE

- 1) Measuring range :
  - Acetylene 20-300 ppm
  - Ethylene 200-2000 ppm
  - Number of pump strokes 1 (100mℓ)
- 2) Sampling time : 3 minutes/1 pump stroke with orifice
- 3) Detectable limit :
  - Acetylene 0.1 ppm
  - Ethylene 1 ppm
- 4) Shelf life : 1 year
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation :
  - Acetylene No temperature correction is necessary.
  - Ethylene Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change :
  - Acetylene Yellow → Dark brown
  - Ethylene Pale yellow → Blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

Acetylene detector tube :  $\text{HC}\equiv\text{CH} + \text{K}_2\text{Pd}(\text{SO}_3)_2 \rightarrow \text{Pd}$

Ethylene detector tube :  $\text{H}_2\text{C}=\text{CH}_2 + \text{PdSO}_4 + (\text{NH}_4)_2\text{MoO}_4 \rightarrow \text{Mo}_3\text{O}_8$

## 4. CALIBRATION OF THE TUBE

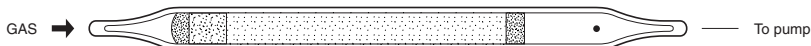
STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
<b>Acetylene detector tube</b>			
Carbon monoxide		10	Higher readings are given.
Hydrogen		5000	∕
Ethylene		2000	∕
<b>Ethylene detector tube</b>			
Carbon monoxide		1350	Higher readings are given.
Acetylene		370	∕
Propylene	Blue stain is produced.		∕

## TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (%)			
	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
2000	1550	2000		
1800	1400	1800	2050	
1600	1300	1600	1900	
1400	1150	1400	1600	
1200	1000	1200	1400	
1000	900	1000	1200	
800	750	800	950	
600	600	600	700	



## 1. PERFORMANCE

- 1) Measuring range : 0.005-1.8 %
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 0.0005 % (5 ppm)
- 4) Shelf life : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Concentration chart method
- 8) Colour change : Yellow → Pink

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with Hydroxylamine hydrochloride, Hydrogen chloride is liberated and PH indicator is discoloured.  
 $\text{CH}_2 = \text{CHCHO} + \text{NH}_2\text{OH} \cdot \text{HCl} \rightarrow \text{HCl} + \text{CH}_2 = \text{CHCH} = \text{NOH} + \text{H}_2\text{O}$

## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Acetone FIG.1	Similar stain is produced.	20	Higher readings are given.
Acetaldehyde FIG.2	∕	70	∕
Methyl ethyl ketone FIG.3	∕	60	∕
Methyl isobutyl ketone	∕	500	∕

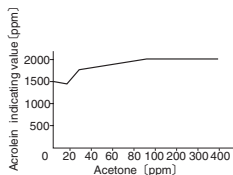


FIG.1 Influence of Acetone.

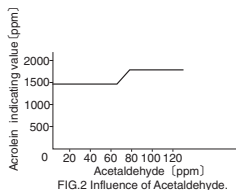


FIG.2 Influence of Acetaldehyde.

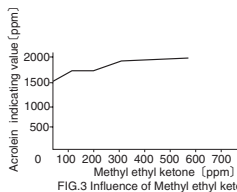
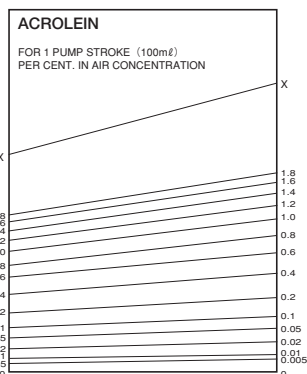
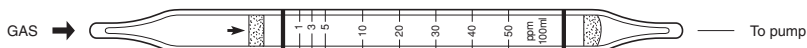


FIG.3 Influence of Methyl ethyl ketone.

### TEMPERATURE CORRECTION TABLE

Chart Readings (%)	Corrected Concentration (%)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
1.8	—	2.3	1.8	1.3	1.0
1.6	—	2.1	1.6	1.1	0.9
1.4	—	1.85	1.4	1.0	0.75
1.2	2.2	1.6	1.2	0.85	0.65
1.0	1.9	1.35	1.0	0.7	0.5
0.8	1.55	1.1	0.8	0.55	0.4
0.6	1.2	0.85	0.6	0.4	0.3
0.4	0.85	0.6	0.4	0.2	0.15
0.2	0.5	0.3	0.2	0.12	0.1
0.1	0.2	0.15	0.1	0.06	0.04
0.05	0.1	0.08	0.05	0.03	0.015
0.02	0.07	0.05	0.02	0.02	0.01
0.01	0.03	0.02	0.01	0.01	0.005





## 1. PERFORMANCE

- 1) Measuring range : 1-50 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : Graduations printed on the tube are calibrated by Acetic acid at 1 pump stroke and Acrylic acid concentration is determined by using a conversion chart at 1 pump stroke.
- 7) Colour change : Pale pink → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

By reacting with alkali, PH indicator is discoloured.

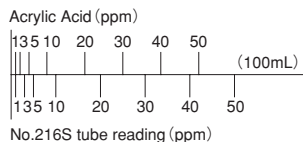


## 4. CALIBRATION OF THE TUBE

VAPOUR PRESSURE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	Coexistence
Sulphur dioxide		Similar stain is produced.	Higher readings are given.
Nitrogen dioxide	300	∕	The top of discoloured layer becomes unclear.
Hydrogen chloride		Pink stain is produced.	Higher readings are given.
Chlorine		Blueish yellow stain is produced.	∕
Acetic acid		Similar stain is produced.	∕





## 1. PERFORMANCE

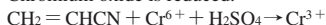
- 1) Measuring range : 0.1-3.5 %
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 0.001 % (10 ppm)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Orange → Dark green

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

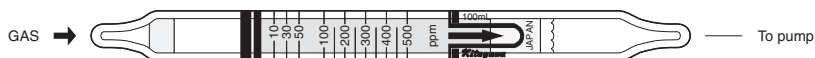
GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Acetylene	Whole layer is discoloured to Brown.	3%	Whole layer is discoloured to Brown and higher readings are given.
Propane	∕	0.2%	∕
Other organic gases or vapours except Halogenated hydrocarbons	Similar stain is produced.	50	Higher readings are given.

TEMPERATURE CORRECTION TABLE

Tube Readings (%)	Corrected Concentration (%)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
3.5	5.5	4.6	3.5	3.2	2.8
3.0	4.7	3.9	3.0	2.7	2.4
2.5	3.9	3.2	2.5	2.2	2.0
2.0	3.1	2.6	2.0	1.8	1.6
1.5	2.4	1.9	1.5	1.4	1.2
1.0	1.6	1.3	1.0	0.9	0.8
0.8	1.3	1.0	0.8	0.7	0.7
0.5	0.8	0.7	0.5	0.5	0.4
0.3	0.5	0.4	0.3	0.3	0.3
0.1	0.2	0.1	0.1	0.1	0.1



## 1. PERFORMANCE

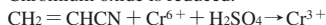
- 1) Measuring range : 10-500 ppm  
Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 1 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION COEFFICIENT TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 5 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

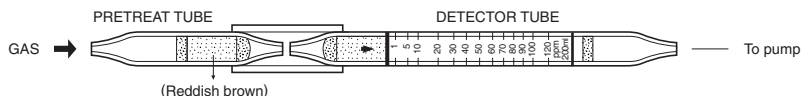
DIFFUSION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Alcohols	Similar stain is produced.		Higher readings are given.
Esters	∕		∕
Ketones	∕		∕
Aromatic hydrocarbons	∕		∕
Halogenated hydrocarbons			If the maximum end point of Pale blue stain is discernable, the accuracy of the readings is not affected.

TEMPERATURE CORRECTION COEFFICIENT TABLE

Tube Readings (ppm)	Correction Coefficient			
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)
500	—	—	1.00	0.90
400	—	1.25	1.00	0.90
300	1.60	1.25	1.00	0.90
200	1.60	1.25	1.00	0.90
100	1.55	1.25	1.00	0.90
50	1.34	1.20	1.00	0.94
30	1.30	1.17	1.00	0.97
10	1.30	1.10	1.00	1.00



## 1. PERFORMANCE

- 1) Measuring range : 1-120 ppm
- Number of pump strokes : 2 (200mℓ)
- 2) Sampling time : 3 minutes/2 pump strokes
- 3) Detectable limit : 0.5 ppm
- 4) Shelf life : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 2 pump strokes
- 8) Colour change : Yellow → Pink

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 10 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

By decomposing with an Oxidizer, Hydrogen cyanide is produced. This Hydrogen cyanide reacts with Mercuric chloride, then Hydrogen chloride is liberated and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

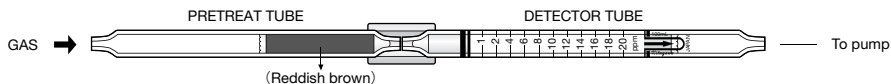
GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Hydrogen cyanide	Similar stain is produced.	2	Higher readings are given.
Methyl ethyl ketone		600	Lower readings are given.
Styrene		less than 350	The accuracy of readings is not affected.
Butadiene		200	Lower readings are given.

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
120	165	140	120	104	90
100	142	117	100	87	77
90	127	105	90	79	70
80	112	93	80	70	62
70	98	81	70	62	55
60	84	70	60	53	48
50	69	58	50	45	41
40	55	46	40	37	34
30	41	34	30	28	27
20	26	22	20	20	20
10	12	10	10	10	10



## 1. PERFORMANCE

- |                             |  |            |            |           |
|-----------------------------|--|------------|------------|-----------|
| 1) Measuring range          | : 1-20 ppm   | 0.5-10 ppm | 0.25-5 ppm | 0.2-4 ppm |
| Number of pump strokes      | 1 (100mℓ)  | 2 (200mℓ)  | 4 (400mℓ)  | 5 (500mℓ) |
| 2) Sampling time            | : 1.5 minutes/1 pump stroke  |            |            |           |
| 3) Detectable limit         | : 0.05ppm (500mℓ)  |            |            |           |
| 4) Shelf life               | : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C) |            |            |           |
| 5) Operating temperature    | : 0 ~ 40 °C  |            |            |           |
| 6) Temperature compensation | : Necessary (See "TEMPERATURE CORRECTION TABLE")                     |            |            |           |
| 7) Reading                  | : Direct reading from the scale calibrated by 1 pump stroke          |            |            |           |
| 8) Colour change            | : Yellow → Red   |            |            |           |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 5%    RSD-high : 5%

## 3. CHEMICAL REACTION

By decomposing with an Oxidizer, Hydrogen cyanide is produced, Hydrogen cyanide reacts with Mercuric chloride, then Hydrogen chloride is liberated and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	Coexistence
Butadiene	Less than 350 ppm		The accuracy of readings is not affected.
Toluene	Less than 600 ppm		∕
Hexane	Less than 800 ppm		∕
Styrene	Less than 720 ppm		∕
Hydrogen cyanide		Similar stain is produced.	Higher readings are given.

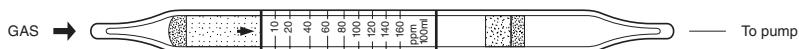
(NOTE)

In case of 2 to 5 pump strokes, following formula is available for actual concentration.

$$\text{Actual concentration} = \text{Temperature corrected value} \times \frac{1}{\text{Number of pump strokes}}$$

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
20	26	22.5	20	18	17
18	23	20	18	16.5	15.5
16	20.5	18	16	15	14
14	18	15.5	14	13	12
12	15.5	13.5	12	11	10.5
10	13	11	10	9.5	9
8	10.5	9	8	7.5	7
6	8	7	6	6	5.5
4	5.5	4.5	4	4	4
2	3	2	2	2	2
1	1.5	1	1	1	1



## 1. PERFORMANCE

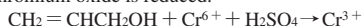
- 1) Measuring range : 20-500 ppm
- Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 5 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (10 ~ 40 °C) (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Graduations printed on the tube are calibrated by Methyl methacrylate at 1 pump stroke and Allyl alcohol concentration is determined by using a conversion chart.
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15% RSD-mid. : 10% RSD-high : 5%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Ethers	∕	∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	Whole reagent is changed to Pale brown.	∕
Aromatic hydrocarbons	∕	∕
Esters	∕	∕
Ketones	∕	∕
Halogenated hydrocarbons	FIG.1	∕

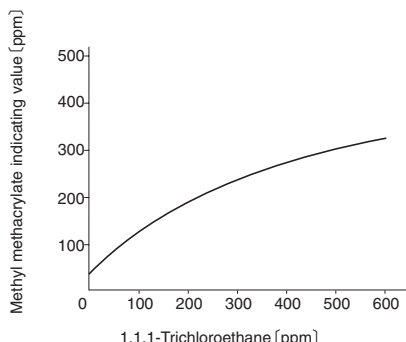
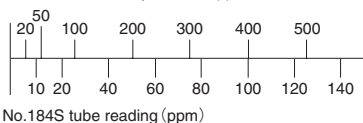


FIG.1 Influence of 1,1,1-Trichloroethane

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
500	—	600	500	430	380
400	—	480	400	350	300
300	480	360	300	260	230
200	320	240	200	170	150
100	240	120	100	90	80
50	80	60	50	43	38
20	32	24	20	17	15

### Concentration of Allyl alcohol (ppm)







## 1. PERFORMANCE

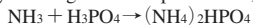
- 1) Measuring range : 0.5-10 %  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 0.04 %
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Pink → Gray · Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 5 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with Phosphoric acid, PH indicator is discoloured.

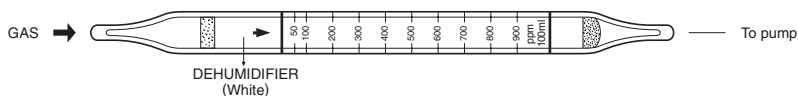


## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Amines	Similar stain is produced.	Higher readings are given.



## 1. PERFORMANCE

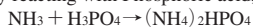
- 1) Measuring range : 50-900 ppm
- Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 5 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Pale purple → Pale yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 5 %   RSD-mid. : 5 %   RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with Phosphoric acid, PH indicator is discoloured.

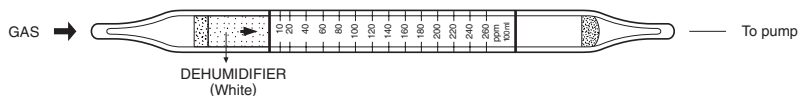


## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Amines	Similar stain is produced.		Higher readings are given.
Chlorine	The accuracy of readings is not affected.	2	Lower readings are given.
Sulphur dioxide	∕	$\text{NH}_3\text{conc.} \times 1/4$	∕



## 1. PERFORMANCE

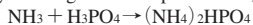
- 1) Measuring range : 10-260 ppm    5-130 ppm  
     Number of pump strokes    1 (100mℓ)    2 (200mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 0.5 ppm (200mℓ)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Pale purple → Pale yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 5%    RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Phosphoric acid, PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

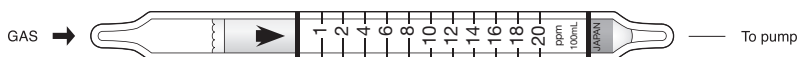
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Amines	Similar stain is produced.		Higher readings are given.
Sulphur dioxide	The accuracy of readings is not affected.	$\text{NH}_3 \text{ conc.} \times 1/5$	Lower readings are given.
Chlorine	∕	2	∕

(NOTE)

In case of 2 pump strokes, following formula is available for the actual concentration.

Actual concentration =  $1/2 \times$  Reading value



## 1. PERFORMANCE

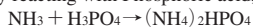
- |                          |   |            |           |
|--------------------------|---|------------|-----------|
| 1) Measuring range       | : 1-20 ppm  | 0.5-10 ppm | 0.2-4 ppm |
| Number of pump strokes   | 1 (100mℓ)   | 2 (200mℓ)  | 5 (500mℓ) |
| 2) Sampling time         | : 1 minute/1 pump stroke                                    |            |           |
| 3) Detectable limit      | : 0.1 ppm (100mℓ)   |            |           |
| 4) Shelf life            | : 3 years   |            |           |
| 5) Operating temperature | : 0 ~ 40 °C   |            |           |
| 6) Reading               | : Direct reading from the scale calibrated by 1 pump stroke |            |           |
| 7) Colour change         | : Pale purple → Pale yellow                                 |            |           |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Phosphoric acid, PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

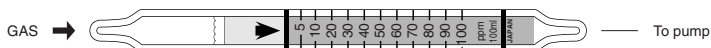
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Amines	Similar stain is produced.	Higher readings are given.

(NOTE)

When the concentration is below 1 ppm, 2 to 5 pump strokes can be used to determine the lower concentration. Following formula is available for actual concentration.

$$\text{Actual concentration} = \text{Reading value} \times \frac{1}{\text{Number of pump strokes}}$$



## 1. PERFORMANCE

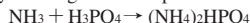
- |                             |   |           |           |
|-----------------------------|---|-----------|-----------|
| 1) Measuring range          | : 10-200 ppm  | 5-100 ppm | 1-20 ppm  |
| Number of pump strokes      | 1/2 (50mℓ)  | 1 (100mℓ) | 5 (500mℓ) |
| 2) Sampling time            | : 1 minute/1 pump stroke                                    |           |           |
| 3) Detectable limit         | : 0.2 ppm (500mℓ)   |           |           |
| 4) Shelf life               | : 3 years   |           |           |
| 5) Operating temperature    | : 0 ~ 40 °C   |           |           |
| 6) Temperature compensation | : Necessary (See "TEMPERATURE CORRECTION TABLE")            |           |           |
| 7) Reading                  | : Direct reading from the scale calibrated by 1 pump stroke |           |           |
| 8) Colour change            | : Pale purple → Pale yellow                                 |           |           |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 5%    RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Phosphoric acid, PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Amines	Similar stain is produced.	Higher readings are given.
Chlorine	The accuracy of readings is not affected.	Lower readings are given.
Sulphur dioxide	∕	∕

(NOTE)

When the concentration is below 5 ppm, 5 pump strokes can be used to determine the lower concentration and following formula is available to obtain the actual concentration.

Actual concentration = Temperature corrected concentration × 1/5

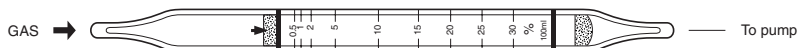
When the concentration is over 100 ppm, 1/2 pump strokes can be used to determine the higher concentration and following formula is available to obtain the actual concentration.

Actual concentration = Temperature corrected concentration × 2

COEFFICIENT TABLE FOR TEMPERATURE CORRECTION (AT 20 °C)

Temperature (°C)	0	1	2	3	4	5	6	7	8	9	10 ~ 40
Coefficient	0.90	0.91	0.92	0.93	0.94	0.95	0.96	0.97	0.98	0.99	1.00

Actual concentration = Reading value × Coefficient for temperature correction



## 1. PERFORMANCE

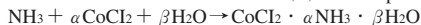
- 1) Measuring range : 0.5-30 %
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 0.01 %
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Pink → Blue · Brownish green

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Ammonia reacts with Cobalt chloride (II) and complex salt is produced.

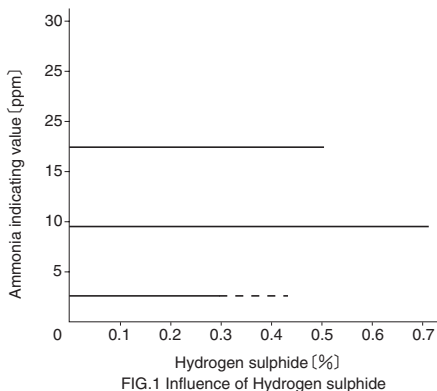


## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

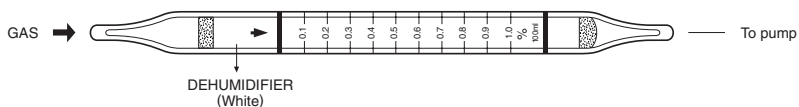
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	ppm	Coexistence
Hydrogen sulphide FIG.1	0.01%	Whole layer is discoloured to Black.	0.3%	If the maximum end point of the stain is discernable, the accuracy of readings is not affected.
Amines				The accuracy of readings is not affected.



TEMPERATURE CORRECTION TABLE

Tube Readings (%)	Corrected Concentration (%)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
30	—	35.0	30.0	27.0	25.0
25	35.0	30.0	25.0	23.0	21.0
20	28.0	24.0	20.0	18.0	17.0
15	22.0	18.0	15.0	13.0	12.0
10	15.0	12.0	10.0	9.0	8.0
5	8.0	6.0	5.0	4.5	4.0
2	3.0	2.5	2.0	1.9	1.8
1	1.2	1.2	1.0	1.0	0.9
0.5	0.5	0.5	0.5	0.5	0.5



## 1. PERFORMANCE

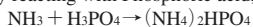
- 1) Measuring range : 0.1-1.0 %
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 0.5 minutes/1 pump stroke
- 3) Detectable limit : 0.01 %
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Pale purple → Pale yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 5 %    RSD-mid : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with Phosphoric acid, PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Amines      FIG.1	Similar stain is produced.		Higher readings are given.
Sulphur dioxide	The accuracy of readings is not affected.	200	Lower readings are given.

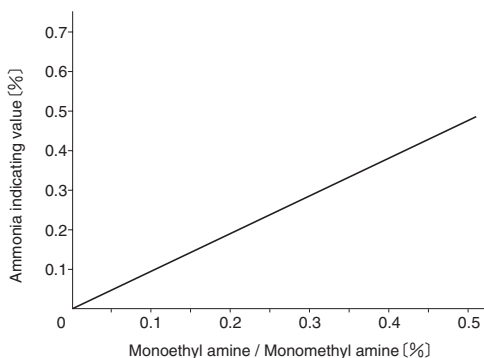
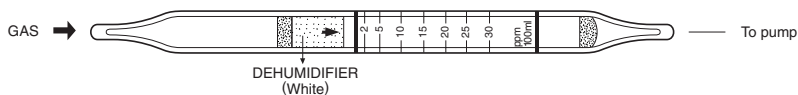


FIG.1 Influence of Monoethyl amine / Monomethyl amine



## 1. PERFORMANCE

- 1) Measuring range : 2-30 ppm      1-15 ppm
- Number of pump strokes : 1 (100mℓ)    2 (200mℓ)
- 2) Sampling time : 0.5 minutes/1 pump stroke
- 3) Detectable limit : 0.05 ppm (200mℓ)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : White → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

By reacting with *p*-Dimethylamino-benzaldehyde, Azomethine is produced.



## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Toluidine	Similar stain is produced.	Aniline conc.×1/3	Higher readings are given.
Ammonia	FIG.1 The accuracy of readings is not affected.	The same conc. of Aniline	∕
Paraffin amines	∕		∕
Aromatic amines	∕		∕

(NOTE)

In case of 2 pump strokes, following formula is available for the actual concentration.

Actual concentration = 1/2 × Reading value.

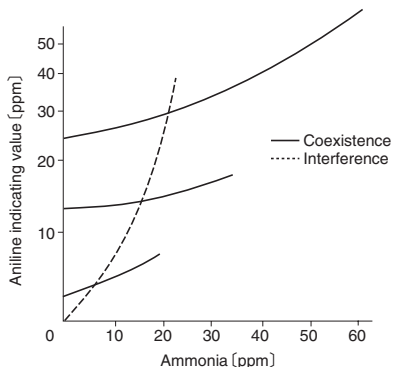
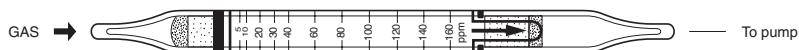


FIG.1 Influence of Ammonia





## 1. PERFORMANCE

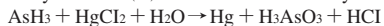
- 1) Measuring range : 5-160 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 1 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : White → Dark brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

Mercury chloride (II) is reduced and Mercury is liberated.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Hydrogen selenide	Similar stain is produced.	5	Higher readings are given.
Hydrogen sulphide	∕	5	∕
Phosphine	∕	5	∕



## 1. PERFORMANCE

- |                          |  |              |
|--------------------------|--|--------------|
| 1) Measuring range       | : 0.1-2.0 ppm  | 0.05-0.5 ppm |
| Number of pump strokes   | 1 (100mℓ)  | 2 (200mℓ)    |
| 2) Sampling time         | : 1 minute/1 pump stroke   |              |
| 3) Detectable limit      | : 0.02 ppm (200mℓ)   |              |
| 4) Shelf life            | : 2 years  |              |
| 5) Operating temperature | : 0 ~ 40 °C  |              |
| 6) Reading               | : The tube scale is calibrated based on Phosphine at 1 pump stroke and the tube has the same sensitivity for Arsine. |              |
| 7) Colour change         | : Pale yellow → Pink   |              |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 10 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with Mercury chloride (II), Hydrogen chloride is produced and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

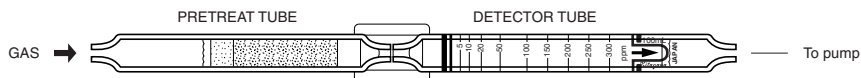
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Hydrogen selenide	Similar stain is produced.	Higher readings are given.
Mercaptans	∕	∕
Hydrogen sulphide	∕	∕
Hydrogen cyanide	Whole reagent is changed to Red.	∕
Sulphur dioxide	∕	Whole reagent is changed to Pale red, but Purplish red stain indicates Arsine concentration.

(NOTE)

When the concentration is below 0.5 ppm, 2 pump strokes can be used to determine the lower concentration with the following formula ;

Actual concentration =  $1/2 \times$  Reading value



## 1. PERFORMANCE

- 1) Measuring range : 5-300 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 3 minutes/1 pump stroke
- 3) Detectable limit : 3 ppm (100mℓ)
- 4) Shelf life : 2 years
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : White → Greenish brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

Iodine pentoxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

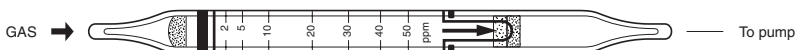
Substance	ppm	Interference	ppm	Coexistence
Toluene	20	Yellowish brown stain is	150	Higher readings are given.
Xylene	60	∕	300	∕
Hexane	200	Whole reagent is discoloured to Dark grey.	800	Whole reagent is discoloured to Dark grey and higher readings are given.

(NOTE)

Aromatic hydrocarbons except Benzene is eliminated.

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	10 °C (32 °F)	15 °C (50 °F)	20 °C (68 °F)	30 °C (80 °F)	40 °C (104 °F)
300	—	—	300	270	240
250	—	390	250	225	200
200	—	290	200	180	160
150	300	225	150	135	120
100	225	163	100	90	80
50	135	93	50	45	40
20	70	45	20	18	16
10	45	28	10	9	8
5	30	18	5	4.5	4



## 1. PERFORMANCE

- |                             |  |           |           |
|-----------------------------|--|-----------|-----------|
| 1) Measuring range          | : 4-100 ppm  | 2-50 ppm  | 1-25 ppm  |
| Number of pump strokes      | 1 (100mℓ)  | 2 (200mℓ) | 4 (400mℓ) |
| 2) Sampling time            | : 4 minutes/2 pump strokes                                   |           |           |
| 3) Detectable limit         | : 0.2 ppm (400mℓ)  |           |           |
| 4) Shelf life               | : 2 years  |           |           |
| 5) Operating temperature    | : 0 ~ 40 °C  |           |           |
| 6) Temperature compensation | : Necessary (See "TEMPERATURE CORRECTION TABLE")             |           |           |
| 7) Reading                  | : Direct reading from the scale calibrated by 2 pump strokes |           |           |
| 8) Colour change            | : White → Greenish brown                                     |           |           |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

Iodine pentoxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Toluene FIG.1	Yellowish brown stain is produced.		Higher readings are given.
Xylene FIG.2	∕		∕
Carbon monoxide		50	Whole reagent is discoloured to Pale brown, the top of discoloured layer becomes unclear and higher readings are given.
Hexane		100	∕

(NOTE)

In case of 1 or 4 pump strokes, following formula is available for the actual concentration.

$$\text{Actual concentration} = \text{Temperature corrected value} \times \frac{2}{\text{Number of pump strokes}}$$

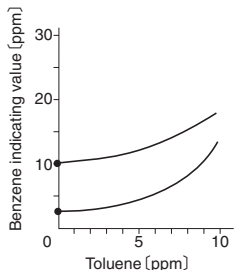


FIG.1 Influence of Toluene

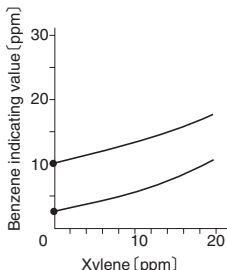
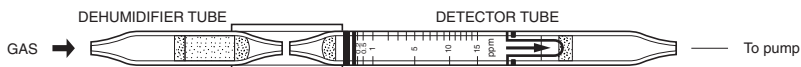


FIG.2 Influence of Xylene

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
50	38	44	50	—	—
40	30	35	40	45	50
30	23	26	30	34	38
20	15	18	20	23	25
10	8	9	10	11	13
5	4	5	5	6	6



## 1. PERFORMANCE

- |                             |  |            |             |
|-----------------------------|--|------------|-------------|
| 1) Measuring range          | : 1-75 ppm   | 0.2-15 ppm | 0.1-7.5 ppm |
| Number of pump strokes      | 1 (100mℓ)  | 5 (500mℓ)  | 10 (1000mℓ) |
| 2) Sampling time            | : 10 minutes/5 pump strokes                                  |            |             |
| 3) Detectable limit         | : 0.02 ppm (1000mℓ)  |            |             |
| 4) Shelf life               | : 2 years  |            |             |
| 5) Operating temperature    | : 0 ~ 40 °C  |            |             |
| 6) Temperature compensation | : Necessary (See "TEMPERATURE CORRECTION TABLE")             |            |             |
| 7) Reading                  | : Direct reading from the scale calibrated by 5 pump strokes |            |             |
| 8) Colour change            | : White → Greenish brown                                     |            |             |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 10 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

Iodine pentoxide is reduced.



## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Toluene			Higher readings are given.
Xylene			∕
Carbon monoxide		2.0	Whole reagent is changed to Pale brown, unclear stain is produced and higher readings are given.
Hexane		2.0	∕

(NOTE)

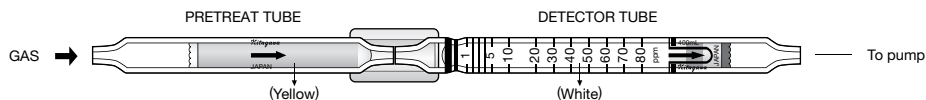
In case of 1 or 10 pump strokes, following formula is available for the actual concentration.

$$\text{Actual concentration} = \text{Temperature corrected value} \times \frac{5}{\text{Number of pump strokes}}$$

### CORRECTION FOR AMBIENT CONDITIONS:

Temperature; In order to correct for temperature, multiply the tube reading with the following factors.

Temperature (°C)	0	1	2	3	4	5	6	7	8	9
Correction Factor	0.69	0.71	0.72	0.73	0.75	0.76	0.78	0.79	0.81	0.82
Temperature (°C)	10	11	12	13	14	15	16	17	18	19
Correction Factor	0.84	0.85	0.87	0.88	0.90	0.92	0.93	0.95	0.97	0.98
Temperature (°C)	20	21	22	23	24	25	26	27	28	29
Correction Factor	1.00	1.02	1.04	1.05	1.07	1.09	1.11	1.13	1.14	1.16
Temperature (°C)	30	31	32	33	34	35	36	37	38	39
Correction Factor	1.18	1.20	1.22	1.24	1.26	1.28	1.30	1.32	1.34	1.36
Temperature (°C)	40									
Correction Factor	1.39									



## 1. PERFORMANCE

- |                             |   |           |
|-----------------------------|---|-----------|
| 1) Measuring range          | : 1-80 ppm  | 0.2-1 ppm |
| Number of pump strokes      | 1 (100mℓ)   | 5 (500mℓ) |
| 2) Sampling time            | : 2 minutes/1 pump stroke                                   |           |
| 3) Detectable limit         | : 0.1 ppm (500mℓ)   |           |
| 4) Shelf life               | : 2 years   |           |
| 5) Operating temperature    | : 0 ~ 40 °C   |           |
| 6) Temperature compensation | : Necessary (See "TEMPERATURE CORRECTION TABLE")            |           |
| 7) Reading                  | : Direct reading from the scale calibrated by 1 pump stroke |           |
| 8) Colour change            | : White → Brown   |           |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Iodine pentoxide is reduced.



## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

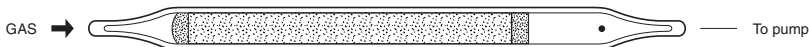
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Toluene	Similar stain is produced.	1000	Higher readings are given.
Xylene	∕	∕	∕
Ethyl benzene	∕	∕	∕
Carbon monoxide		2	Whole reagent is changed to Pale brown, indiscernible stain is produced and higher readings are given.
Hexane		∕	Very light brown is produced.

### TEMPERATURE CORRECTION TABLE

Temperature ; To correct for temperature, multiply the tube reading by the following factors.

Temperature (°C)	0	1	2	3	4	5	6	7	8	9
Correction Factor	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66
Temperature (°C)	10	11	12	13	14	15	16	17	18	19
Correction Factor	0.66	0.70	0.73	0.76	0.79	0.83	0.86	0.89	0.93	0.96
Temperature (°C)	20	21	22	23	24	25	26	27	28	29
Correction Factor	1.00	1.04	1.08	1.11	1.15	1.19	1.23	1.27	1.31	1.35
Temperature (°C)	30	31	32	33	34	35	36	37	38	39
Correction Factor	1.40	1.44	1.48	1.53	1.57	1.62	1.66	1.71	1.71	1.71
Temperature (°C)	40									
Correction Factor	1.71									



## 1. PERFORMANCE

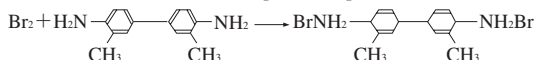
- 1) Measuring range : 1-20 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 2 minutes/1 pump stroke
- 3) Detectable limit : 0.1 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Concentration chart method
- 8) Colour change : White → Orange

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 5%    RSD-high : 5%

## 3. CHEMICAL REACTION

*o*-Toluidine is oxidized and Orthoquinone is produced.



## 4. CALIBRATION OF THE TUBE

ABSORPTIOMETRIC METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Nitrogen dioxide FIG.1	Similar stain is produced.		Higher readings are given.
Chlorine FIG.2	∕	1	∕
Chlorine dioxide FIG.3	∕	5	∕

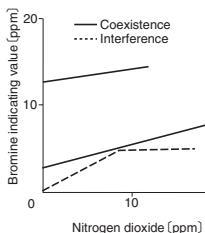


FIG.1 Influence of Nitrogen dioxide

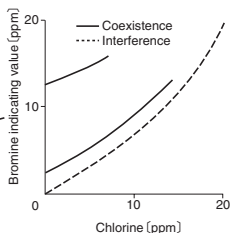


FIG.2 Influence of Chlorine

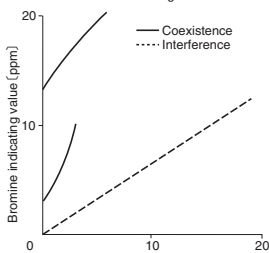
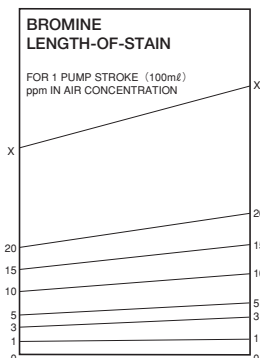
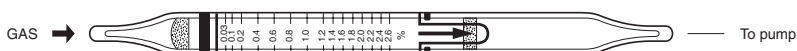


FIG.3 Influence of Chlorine dioxide

### TEMPERATURE CORRECTION TABLE

Chart Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
20	32	24	20	17	14
15	22	18	15	12	10
10	15	13	10	8	6
5	9	7	5	4	3
3	6	4	3	2	1.5
1	3	1.5	1	0.8	0.5





## 1. PERFORMANCE

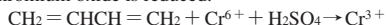
- 1) Measuring range : 0.03-2.6 %
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 0.001 % (10 ppm)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Brownish orange → Dark brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

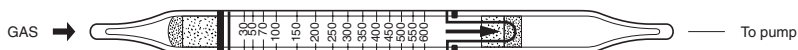
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Acetylene	Whole reagent is discoloured to Brown.	3 %	Higher readings are given.
Propane	∕	0.2 %	∕
Other organic gases or vapours except Halogenated hydrocarbons	Similar stain is produced.	50	∕

### TEMPERATURE CORRECTION TABLE

Tube Readings (%)	Corrected Concentration (%)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
2.6	3.3	3.0	2.6	2.5	2.4
2.4	3.0	2.7	2.4	2.3	2.2
2.2	2.7	2.5	2.2	2.1	2.0
2.0	2.4	2.2	2.0	1.9	1.8
1.8	2.1	2.0	1.8	1.8	1.7
1.6	1.9	1.8	1.6	1.6	1.5
1.4	1.6	1.5	1.4	1.4	1.3
1.2	1.4	1.3	1.2	1.2	1.1
1.0	1.1	1.1	1.0	1.0	0.9
0.8	0.9	0.8	0.8	0.8	0.7
0.6	0.7	0.6	0.6	0.6	0.6
0.4	0.4	0.4	0.4	0.4	0.4





## 1. PERFORMANCE

- 1) Measuring range : 30-600 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 5 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Pale yellow → White

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

Molybdate is reduced and molybdeum blue is produced.



## 4. CALIBRATION OF THE TUBE

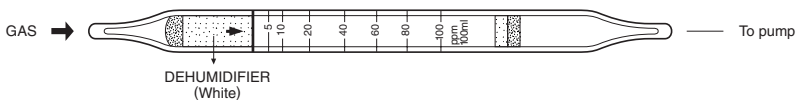
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## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Carbon monoxide	Whole layer is discoloured to Green or Blue.	
Hydrogen sulphide	Black stain is produced.	
Saturated Hydrocarbons (more than C <sub>3</sub> )	Whole layer is discoloured to Blue.	
Ethylene	Blue stain is produced.	
Propylene	∕	
Butylene	∕	
Benzene	Yellowish orange stain is produced.	
Ammonia	Similar stain is produced.	Higher readings are given.
Hydrogen cyanide	∕	∕

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
600	910	740	600	550	510
550	820	670	550	510	470
500	740	600	500	460	430
450	650	530	450	420	390
400	570	470	400	370	350
350	490	400	350	330	310
300	410	340	300	280	270
250	330	280	250	240	220
200	250	220	200	190	180
150	180	160	150	140	140
100	110	110	100	100	90



## 1. PERFORMANCE

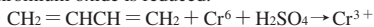
- |                          |   |            |
|--------------------------|---|------------|
| 1) Measuring range       | : 5-100 ppm   | 2.5-50 ppm |
| Number of pump strokes   | 1 (100mℓ)   | 2 (200mℓ)  |
| 2) Sampling time         | : 1.5 minutes/1 pump stroke                                 |            |
| 3) Detectable limit      | : 0.5 ppm (200mℓ)   |            |
| 4) Shelf life            | : 1 year  |            |
| 5) Operating temperature | : 0 ~ 40 °C   |            |
| 6) Reading               | : Direct reading from the scale calibrated by 1 pump stroke |            |
| 7) Colour change         | : Pale yellow → Pale blue                                   |            |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

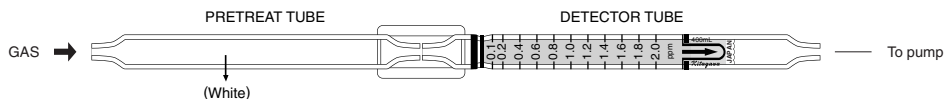
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Esters	Similar stain is produced.	Higher readings are given.
Alcohols	↕	↕
Ketones	↕	↕
Aromatic hydrocarbons (more than C <sub>3</sub> )	Whole reagent is changed to Pale brown.	↕

(NOTE)

In case of 2 pump strokes, following formula is available for the actual concentration.

Actual concentration = 1/2 × Reading value



## 1. PERFORMANCE

- |                          |  |              |
|--------------------------|--|--------------|
| 1) Measuring range       | : 0.1-2.0 ppm  | 0.5-10.0 ppm |
| Number of pump strokes   | 4 (400mℓ)  | 1 (100mℓ)    |
| 2) Sampling time         | : 12 minutes/4 pump strokes                                  |              |
| 3) Detectable limit      | : 0.02 ppm (400mℓ)   |              |
| 4) Shelf life            | : 3 years  |              |
| 5) Operating temperature | : 0 ~ 40 °C  |              |
| 6) Reading               | : Direct reading from the scale calibrated by 4 pump strokes |              |
| 7) Colour change         | : Pink → White   |              |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

Potassium permanganate is reduced.

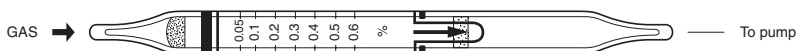
$\text{CH}_2 = \text{CHCH} = \text{CH}_2 + \text{KMnO}_4 \rightarrow \text{White reaction products}$

## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Hydrogen sulphide	Similar stain is produced.	Higher readings are given.
Isobutylene	∕	∕
Ammonia	The accuracy of readings is not affected.	Higher readings with unclear maximum point of stained layer will be given.



## 1. PERFORMANCE

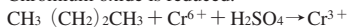
- 1) Measuring range : 0.05-0.6 %  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 4 minutes/1 pump stroke
- 3) Detectable limit : 0.002% (20 ppm)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Orange → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 % RSD-mid. : 15 % RSD-high : 15 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.

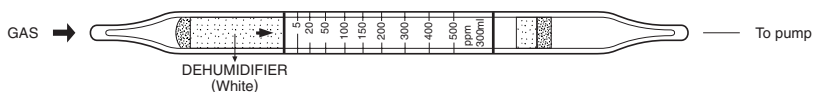


## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Toluene	Similar stain is produced.	Higher readings are given.
Hexane	∕	∕
Trichloroethylene	∕	∕
Ethyl alcohol	The accuracy of readings is not affected.	



## 1. PERFORMANCE

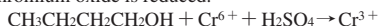
- 1) Measuring range : 5-100 ppm  
Number of pump strokes : 3 (300ml)
- 2) Sampling time : 4.5 minutes/3 pump strokes
- 3) Detectable limit : 2 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Graduations printed on the tube are calibrated by Ethyl cellosolve at 3 pump strokes and 1-Butanol concentration is determined by using a conversion chart.
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 5%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.

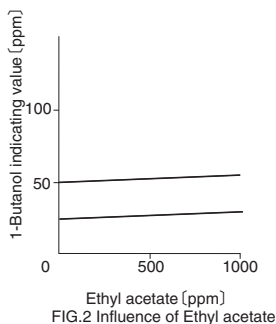
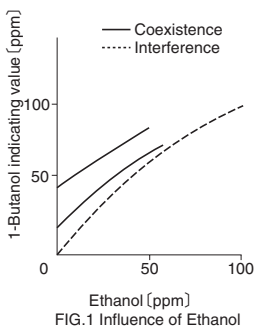


## 4. CALIBRATION OF THE TUBE

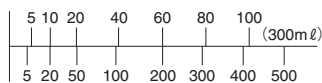
GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	Coexistence
Alcohols FIG.1		Similar stain is produced.	Higher readings are given.
Toluene	200	Whole reagent is changed to Pale blue.	∕
Hexane	1,000	The accuracy of readings is not affected.	The accuracy of readings is not affected.
Trichloroethylene	1,000	∕	∕
Ethyl acetate FIG.2	1,000	∕	∕



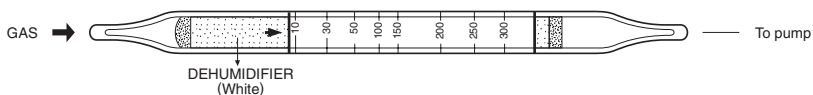
1-Butanol (ppm)



No.190U Tube reading (ppm)

TEMPERATURE CORRECTION TABLE

Conversion Value (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
100	—	—	100	85	77
80	—	—	80	70	63
60	—	80	60	53	50
40	75	50	40	35	33
20	30	23	20	18	16
10	13	11	10	9	8
5	5	5	5	5	5



## 1. PERFORMANCE

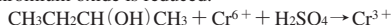
- 1) Measuring range : 10-300 ppm 4-120 ppm
- Number of pump strokes : 2 (200mℓ) 4 (400mℓ)
- 2) Sampling time : 3 minutes/2 pump strokes
- 3) Detectable limit : 3 ppm (200mℓ)
- 4) Shelf life : 2 years
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 2 pump strokes
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 % RSD-mid. : 10 % RSD-high : 10 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Brown stain is produced.	Higher readings are given.
Ethers	∕	∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	Whole reagent is change to Pale brown.	∕
Aromatic hydrocarbons	∕	∕
Esters	∕	∕
Ketones	∕	∕
Halogenated hydrocarbons FIG.1	∕	∕

(NOTE)

In case of 4 pump strokes, following formula is available for the actual concentration.

Actual concentration = 2/5 × Temperature corrected value

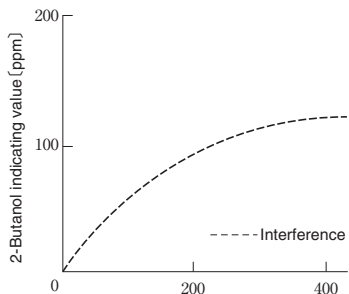


FIG.2 Influence of 1,1,1-Trichloroethane

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)					
	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	25 °C (77 °F)	30 °C (86 °F)	35 ~ 40 °C (95 ~ 104 °F)
300	480	360	300	270	250	240
250	390	290	250	230	220	210
200	300	230	200	190	190	180
150	200	160	150	150	140	140
100	110	100	100	100	100	100
50	50	50	50	50	50	50



## 1. PERFORMANCE

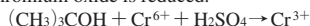
- 1) Measuring range : 20-500 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 2 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Ethyl acetate at 1 pump stroke and tert-Butanol concentration is determined by using a conversion chart at 1 pump stroke
- 7) Colour change : Yellow → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 5%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.

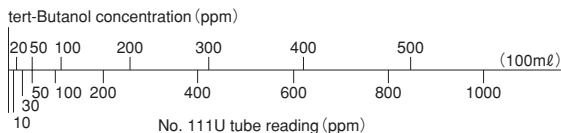


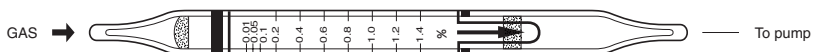
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar or brown stain is produced.	Higher readings are given.
Esters	∕	∕
Ketones	∕	∕
Aromatic hydrocarbons	∕	∕
Aliphatic hydrocarbons	Whole reagent is discoloured to Pale brown.	If the maximum end point of stained layer is discernable, the accuracy of readings is not affected.
Halogenated hydrocarbons	∕	∕





## 1. PERFORMANCE

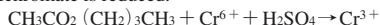
- 1) Measuring range : 0.01-1.0 %
- Number of pump strokes : 2 (200mℓ)
- 2) Sampling time : 3 minutes/2 pump strokes
- 3) Detectable limit : 10 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Graduations printed on the tube are calibrated by Methyl ethyl ketone at 2 pump strokes and Butyl acetate concentration is determined by using a conversion chart.
- 7) Colour change : Orange → Brownish green

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 %    RSD-mid. : 10 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

Dichromate is reduced.



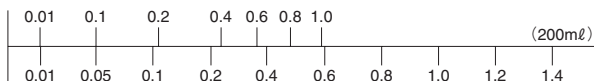
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

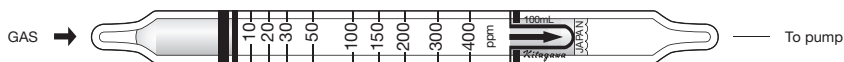
Substance	Interference	ppm	Coexistence
Acetylene		3 %	Whole reagent is changed to Brown.
Propane		0.2 %	∕
Other organic gases or vapours except Halogenated hydrocarbons	Similar stain is produced.	50	Higher readings are given.

Butyl acetate (%)



No.139SB Tube reading (%)





## 1. PERFORMANCE

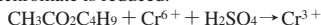
- 1) Measuring range : 10-400 ppm  
Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 10 ppm
- 4) Shelf life : 1 year
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Pale yellow → Pale blue (The top of discoloured layer is to Brown.)

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

Dichromate is reduced.

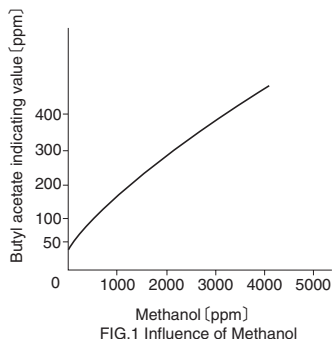


## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

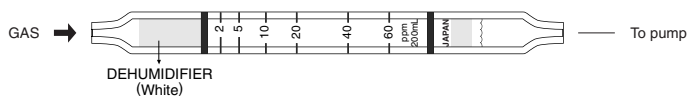
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Esters	Similar stain is produced.	Higher readings are given.
Alcohols	FIG.1	∕
Ketones	∕	∕
Aromatic hydrocarbons	Whole reagent is changed to Pale brown.	∕



TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)						
	10 C (50 F)	15 C (59 F)	20 C (68 F)	25 C (77 F)	30 C (80 F)	35 C (95 F)	40 C (95 F)
400	—	—	400	235	180	145	120
300	—	—	300	185	145	120	100
200	—	345	200	140	110	95	80
150	—	255	150	115	95	80	70
100	—	145	100	80	70	60	50
50	90	65	50	40	35	30	30
30	45	35	30	25	25	20	20
20	25	25	20	20	15	15	15
10	15	15	10	10	5	5	5



## 1. PERFORMANCE

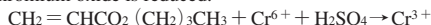
- 1) Measuring range : 2-60 ppm
- Number of pump strokes : 2 (200ml)
- 2) Sampling time : 3 minutes/2 pump strokes
- 3) Detectable limit : 0.5 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 2 pump strokes
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 %    RSD-mid. : 10 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

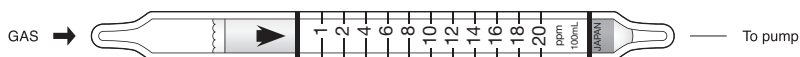
Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Aliphatic hydrocarbons (more than C <sub>3</sub> )	Whole reagent is changed to Dark brown.	∕
Halogenated hydrocarbons	∕	∕
Esters	∕	∕
Aromatic hydrocarbons	∕	∕

(NOTE)

Butyl acrylate has the same sensitivity at 20 °C to Methyl acrylate.

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
60	105	80	60	45	32
40	68	54	40	30	22
20	32	26	20	15	11
10	15	13	10	8	5
5	8	7	5	4	3



## 1. PERFORMANCE

- 1) Measuring range : 2-20 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : Graduations printed on the tube are calibrated by Ammonia at 1 pump stroke and Di-n-Butyl amine concentration is determined by using a conversion chart at 1 pump stroke.
- 7) Colour change : Pale purple → Pale Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Phosphoric acid, PH indicator is discoloured.

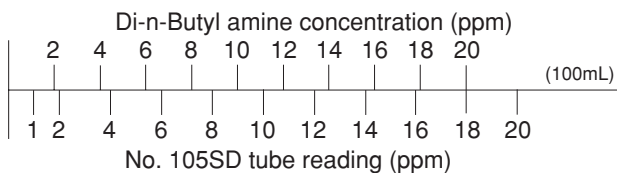


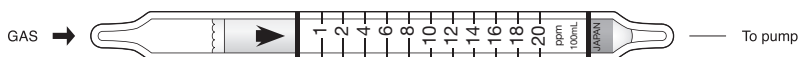
## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Amines	Similar stain is produced.	Higher readings are given.





## 1. PERFORMANCE

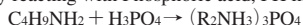
- 1) Measuring range : 1-20 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : Graduations printed on the tube are calibrated by Ammonia at 1 pump stroke and n-Butyl amine concentration is determined by using a conversion chart at 1 pump stroke.
- 7) Colour change : Pale purple → Pale Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with Phosphoric acid, PH indicator is discoloured.

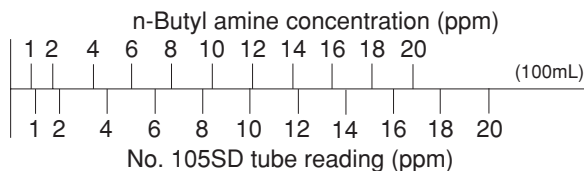


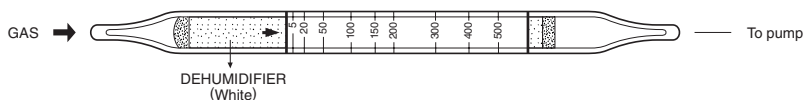
## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Amines	Similar stain is produced.	Higher readings are given.





## 1. PERFORMANCE

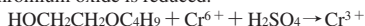
- 1) Measuring range : 10-1,000 ppm
- Number of pump strokes : 3 (300ml)
- 2) Sampling time : 4.5 minutes/3 pump strokes
- 3) Detectable limit : 2 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 10 ~ 35 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : The tube is calibrated based on Ethyl cellosolve. Butyl cellosolve concentration is determined by two times of the reading value after temperature correction.
- 8 Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Esters	∕	∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	Whole reagent is changed to Brown.	∕
Aromatic hydrocarbons	∕	∕
Ketones	∕	∕
Halogenated hydrocarbons FIG.1	∕	∕

(NOTE)

Multiply the corrected value with Ethyl cellosolve temperature correction table by 2.

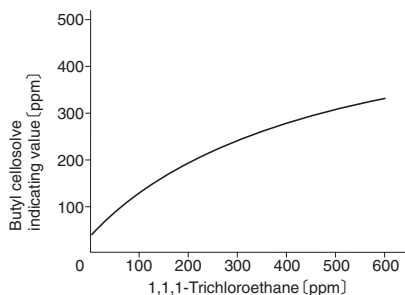


FIG.1 Influence of 1,1,1-Trichloroethane

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)					
	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	25 °C (77 °F)	30 °C (80 °F)	35 °C (95 °F)
500	800	620	500	410	335	265
400	620	490	400	325	260	200
300	450	365	300	245	195	145
200	290	245	200	160	125	95
150	215	185	150	120	90	70
100	145	125	100	80	60	45
50	75	65	50	40	30	25
20	30	25	20	15	12	10
5	10	7	5	4	3	2



## 1. PERFORMANCE

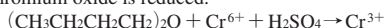
- 1) Measuring range : 10-1,200 ppm  
Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 2 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Ethyl acetate at 1 pump stroke and Butyl ether concentration is determined by using a conversion chart at 1 pump stroke
- 7) Colour change : Yellow → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 10 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.

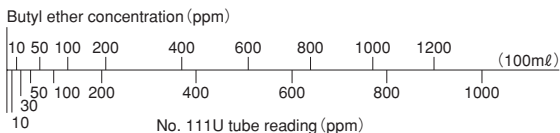


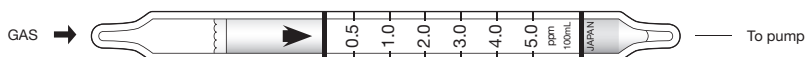
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar or brown stain is produced.	Higher readings are given.
Esters	∕	∕
Ketones	∕	∕
Aromatic hydrocarbons	∕	∕
Aliphatic hydrocarbons	Whole reagent is discoloured to Pale brown.	If the maximum end point of stained layer is discernable, the accuracy of readings is not affected.
Halogenated hydrocarbons	∕	∕





## 1. PERFORMANCE

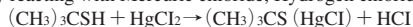
- |                          |  |           |
|--------------------------|--|-----------|
| 1) Measuring range       | : 1-10 ppm   | 0.5-5 ppm |
| Number of pump strokes   | 1/2 (50mℓ)   | 1 (100mℓ) |
| 2) Sampling time         | : 1 minute/1 pump stroke   |           |
| 3) Detectable limit      | : 0.2 ppm (100mℓ)  |           |
| 4) Shelf life            | : 2 years  |           |
| 5) Operating temperature | : 0 ~ 40 °C  |           |
| 6) Reading               | : The tube scale is calibrated based on Methyl mercaptan at 1 pump stroke and the tube has the same sensitivity for tert-Butyl mercaptan |           |
| 7) Colour change         | : Pale yellow → Pink   |           |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 5%    RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Mercuric chloride, Hydrogen chloride is produced and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

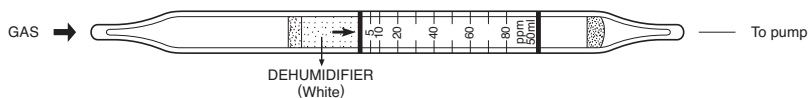
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Arsine	Similar stain is produced.	Higher readings are given.
Hydrogen selenide	∕	∕
Phosphine	∕	∕
Hydrogen sulphide	∕	∕
Hydrogen cyanide	Whole reagent is changed to Red.	∕
Sulphur dioxide		Whole reagent is changed to Pale red, but Pink stain indicates Mercaptans conc.

(NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.

Actual concentration = 2 × Reading value



## 1. PERFORMANCE

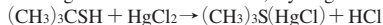
- |                          |  |            |
|--------------------------|--|------------|
| 1) Measuring range       | : 5-80 ppm   | 2.5-40 ppm |
| Number of pump strokes   | : 1/2 (50mℓ)   | 1 (100mℓ)  |
| 2) Sampling time         | : 30 seconds/1/2 pump strokes  |            |
| 3) Detectable limit      | : 1 ppm (100mℓ)  |            |
| 4) Shelf life            | : 2 years  |            |
| 5) Operating temperature | : 0 ~ 40 °C  |            |
| 6) Reading               | : The tube scale is calibrated based on Ethyl mercaptan at 1/2 pump strokes and the tube has the same sensitivity for tert-Butyl mercaptan |            |
| 7) Colour change         | : Yellow → Pink  |            |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 %    RSD-mid. : 10 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with Mercuric chloride, Hydrogen chloride is produced and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

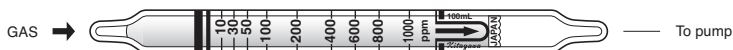
Substance	Interference	Coexistence
Hydrogen sulphide	Similar stain is produced.	Higher readings are given.
Phosphine	∕	∕
Other mercaptans	∕	∕
Arsine	∕	∕
Hydrogen selenide	∕	∕
Hydrogen cyanide	∕	∕
Nitrogen dioxide	The accuracy of readings is not affected.	Lower readings are given.
Ammonia	∕	∕
Sulphur dioxide	Whole layer is discoloured to Pale red.	The accuracy of reading is not affected if the maximum end point of stained layer is discernable.

(NOTE)

In case of a 1 pump stroke, following formula is available for the actual concentration.

Actual concentration = 0.5 × Reading value





## 1. PERFORMANCE

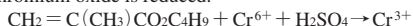
- 1) Measuring range : 20-1,000 ppm  
Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 2 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Ethyl acetate at 1 pump stroke and Butyl methacrylate concentration is determined by using a conversion chart at 1 pump stroke
- 7) Colour change : Yellow → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 5%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.

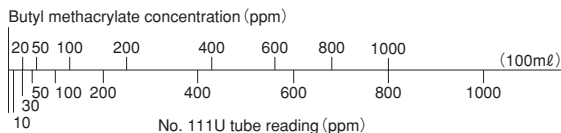


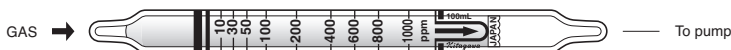
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar or brown stain is produced.	Higher readings are given.
Esters	∕	∕
Ketones	∕	∕
Aromatic hydrocarbons	∕	∕
Aliphatic hydrocarbons	Whole reagent is discoloured to Pale brown.	If the maximum end point of stained layer is discernable, the accuracy of readings is not affected.
Halogenated hydrocarbons	∕	∕





## 1. PERFORMANCE

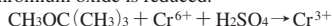
- 1) Measuring range : 25-500 ppm  
Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 2 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Ethyl acetate at 1 pump stroke and tert-Butyl methyl ether concentration is determined by using a conversion chart at 1 pump stroke
- 7) Colour change : Yellow → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 5%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



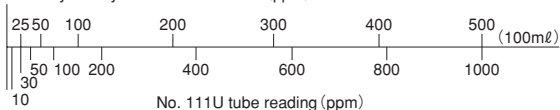
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar or brown stain is produced.	Higher readings are given.
Esters	∕	∕
Ketones	∕	∕
Aromatic hydrocarbons	∕	∕
Aliphatic hydrocarbons	Whole reagent is discoloured to Pale brown.	If the maximum end point of stained layer is discernable, the accuracy of readings is not affected.
Halogenated hydrocarbons	∕	∕

tert-Butyl methyl ether concentration (ppm)





## 1. PERFORMANCE

- 1) Measuring range : 3-60 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/ 1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : Graduations printed on the tube are calibrated by Acetic acid at 1 pump stroke and Butyric acid concentration is determined by using a conversion chart at 1 pump stroke.
- 7) Colour change : Pale pink → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

By reacting with alkali, PH indicator is discoloured.



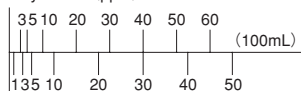
## 4. CALIBRATION OF THE TUBE

VAPOUR PRESSURE METHOD

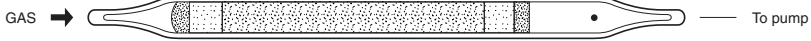
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	Coexistence
Sulphur dioxide		Similar stain is produced.	Higher readings are given.
Nitrogen dioxide	300	∕	The top of discoloured layer becomes unclear.
Hydrogen chloride		Pink stain is produced.	Higher readings are given.
Chlorine		Blueish yellow stain is produced.	∕
Acetic acid		Similar stain is produced.	∕

Butyric Acid (ppm)



No.216S tube reading (ppm)



## 1. PERFORMANCE

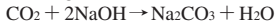
- 1) Measuring range : 0.03-0.7 % 100-1,500 ppm
- Number of pump strokes : 1 (100mℓ) 3 (300mℓ)
- 2) Sampling time : 5 minutes/1 pump stroke
- 3) Detectable limit : 20 ppm (300mℓ)
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Concentration chart method
- 8) Colour change : Purplish blue → Pale pink

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with alkali, PH indicator is discoloured.

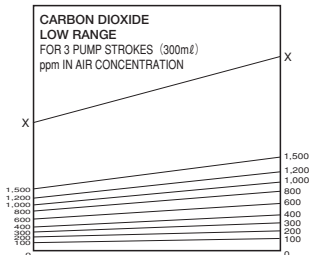


## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

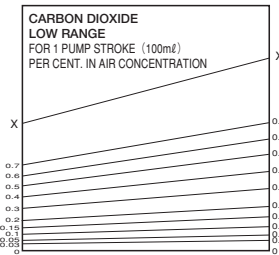
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Chlorine	The accuracy of readings not affected.		The accuracy of readings is not affected.
Hydrogen sulphide	∕		∕
Nitrogen dioxide	∕		∕
Sulphur dioxide	∕		∕
Hydrogen cyanide	Similar stain is produced.	120	Higher readings are given.



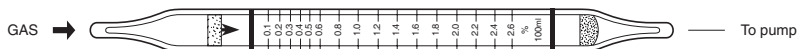
TEMPERATURE CORRECTION TABLE (3 pump strokes)

Chart Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
1,500	1,800	1,650	1,500	1,400	1,350
1,400	1,700	1,550	1,400	1,300	1,250
1,300	1,550	1,400	1,300	1,250	1,150
1,200	1,450	1,300	1,200	1,150	1,100
1,100	1,300	1,200	1,100	1,050	1,000
1,000	1,200	1,100	1,000	950	900
900	1,100	1,000	900	850	800
800	950	900	800	750	700
700	850	750	700	650	600
600	700	650	600	550	500
500	600	550	500	500	450
400	500	450	400	400	350
300	350	300	300	300	250
200	250	200	200	200	200



TEMPERATURE CORRECTION TABLE (1 pump stroke)

Chart Readings (%)	Corrected Concentration (%)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
0.7	0.8	0.75	0.7	0.65	0.6
0.6	0.7	0.65	0.6	0.55	0.5
0.5	0.6	0.55	0.5	0.45	0.4
0.4	0.45	0.4	0.4	0.4	0.35
0.3	0.35	0.3	0.3	0.3	0.25
0.2	0.25	0.2	0.2	0.2	0.2



## 1. PERFORMANCE

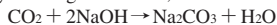
- 1) Measuring range : 0.2-5.2 %      0.1-2.6 %  
     Number of pump strokes    1/2 (50mℓ)    1 (100mℓ)
- 2) Sampling time : 5 minutes/1 pump stroke
- 3) Detectable limit : 0.01 % (100 ppm) (100mℓ)
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Pale blue → Pale pink

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 5%    RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with alkali, PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Chlorine	The accuracy of readings not affected.		The accuracy of readings is not affected.
Hydrogen sulphide	∕		∕
Nitrogen dioxide	∕		∕
Sulphur dioxide	∕		∕
Hydrogen cyanide	Similar stain is produced.	120	Higher readings are given.

(NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.

Actual concentration = 2 × Reading value



## 1. PERFORMANCE

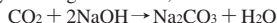
- 1) Measuring range : 0.05-1.0 %
- Number of pump strokes : 1 (100ml)
- 2) Sampling time : 5 minutes/1 pump stroke
- 3) Detectable limit : 0.005 % (50 ppm)
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Purple blue → Pale pink

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with alkali, PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

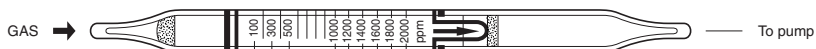
STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Chlorine	The accuracy of readings not affected.		The accuracy of readings is not affected.
Hydrogen sulphide	∕		∕
Nitrogen dioxide	∕		∕
Sulphur dioxide	∕		∕
Hydrogen cyanide	Similar stain is produced.	120	Higher readings are given.

TEMPERATURE CORRECTION TABLE

Tube Readings (%)	Corrected Concentration (%)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
1.0	1.16	1.09	1.00	0.94	0.89
0.9	1.05	0.98	0.90	0.85	0.80
0.8	0.93	0.87	0.80	0.75	0.70
0.7	0.81	0.76	0.70	0.66	0.62
0.6	0.70	0.65	0.60	0.57	0.53
0.5	0.58	0.54	0.50	0.47	0.44
0.4	0.46	0.43	0.40	0.38	0.35
0.3	0.36	0.33	0.30	0.28	0.26
0.2	0.24	0.22	0.20	0.19	0.17
0.1	0.12	0.11	0.10	0.09	0.08



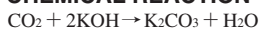
## 1. PERFORMANCE

- |                          |  |              |
|--------------------------|--|--------------|
| 1) Measuring range       | : 100-2000 ppm   | 200-4000 ppm |
| Number of pump strokes   | 1 (100mℓ)  | 1/2 (50mℓ)   |
| 2) Sampling time         | : 2 minutes/1 pump stroke                                    |              |
| 3) Detectable limit      | : 5 ppm (100mℓ)  |              |
| 4) Shelf life            | : 2 years  |              |
| 5) Operating temperature | : 0 ~ 40 °C  |              |
| 6) Reading               | : Direct reading from the scale calibrated by 1 pump strokes |              |
| 7) Colour change         | : Pink → Yellow  |              |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

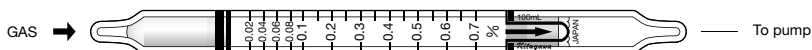
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Hydrogen cyanide	Similar stain is produced.	1000	Higher readings are given.
Hydrogen chloride	∕	30	The accuracy of readings is not affected.
Hydrogen sulphide	∕	10	∕
Nitrogen dioxide	∕	5	∕
Sulphur dioxide	∕	100	∕
Chlorine	Original colour is faded to White.	15	∕
Ammonia	The accuracy of readings is not affected.		∕

(NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.

Actual concentration = 2 × Reading value



## 1. PERFORMANCE

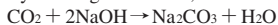
- 1) Measuring range : 0.02-0.7 %    0.04-1.4 %  
     Number of pump strokes    1 (100mℓ)    1/2 (50mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 0.001 % (10 ppm) (100mℓ)
- 4) Shelf life : 1 year
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Pink → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 10 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

By reacting with alkali, PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Hydrogen cyanide	Similar stain is produced.	1000	Higher readings are given.
Hydrogen chloride	∕	30	The accuracy of readings is not affected.
Hydrogen sulphide	∕	10	∕
Nitrogen dioxide	∕	5	∕
Sulphur dioxide	∕	100	∕
Chlorine	Original colour is faded to White.	15	∕
Ammonia	The accuracy of readings is not affected.		∕

### (NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.

Actual concentration = 2 × Reading value





## 1. PERFORMANCE

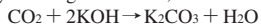
- 1) Measuring range : 1-20 %
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 0.2 %
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Pink → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 5 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with alkali, PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance		ppm	Interference	ppm	Coexistence
Nitrogen dioxide	FIG.1	50	White stain is produced.	50	Similar stain is produced, but if there is more than 3% of CO <sub>2</sub> , the accuracy of readings is not affected.
Sulphur dioxide	FIG.2	3,000	Similar stain is produced.	3,000	Higher readings are given.
Hydrogen sulphide	FIG.3	4,000	∕	3,000	∕

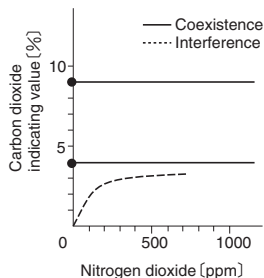


FIG.1 Influence of Nitrogen dioxide

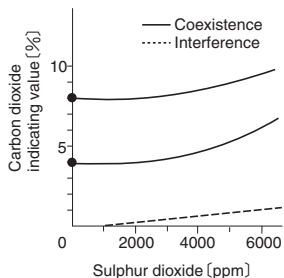


FIG.2 Influence of Sulphur dioxide

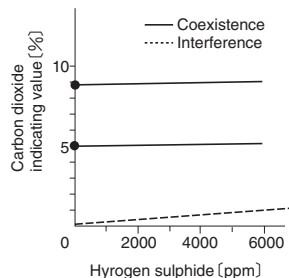
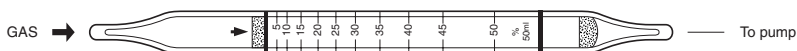


FIG.3 Influence of Hydrogen sulphide



## 1. PERFORMANCE

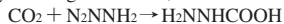
- 1) Measuring range : 5-50 %  
Number of pump strokes : 1/2 (50mℓ)
- 2) Sampling time : 1.5 minutes/1/2 pump stroke
- 3) Detectable limit : 1 %
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1/2 pump stroke
- 7) Colour change : White → Purple

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with alkali, PH indicator is discoloured.

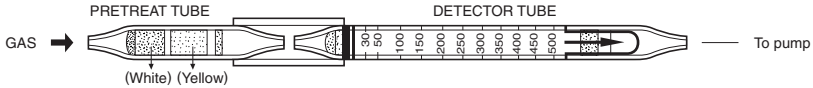


## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Sulphur dioxide	The accuracy of readings is not affected.	The accuracy of readings is not affected.
Ammonia	∕	∕
Hydrogen chloride	∕	∕
Chlorine	∕	∕
Hydrogen cyanide	∕	∕
Nitrogen dioxide	∕	∕
Hydrogen sulphide	∕	∕



## 1. PERFORMANCE

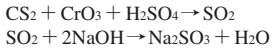
- 1) Measuring range : 30-500 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 2 minutes/1 pump stroke
- 3) Detectable limit : 10 ppm
- 4) Shelf life : 2 years (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Pink → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 5%    RSD-high : 5%

## 3. CHEMICAL REACTION

Sulphur dioxide is produced by an Oxidizer. By reacting between this Sulphur dioxide and alkali, PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	ppm	Coexistence
Sulphur dioxide FIG.1	50	Similar stain is produced.		Higher readings are given.
Hydrogen sulphide FIG.2	400	∕	400	∕
Chlorine		White stain is produced.		∕

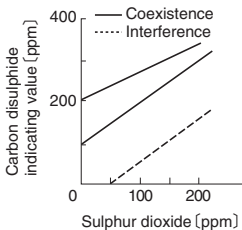


FIG.1 Influence of Sulphur dioxide

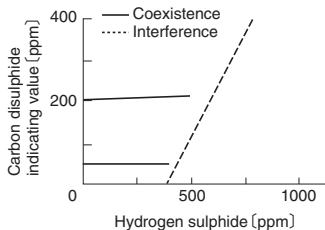
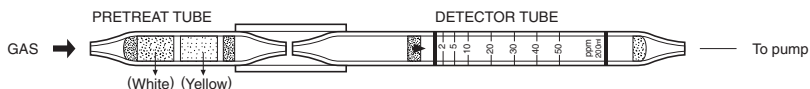


FIG.2 Influence of Hydrogen sulphide

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
500	600	550	500	490	470
450	540	500	450	440	430
400	480	440	400	390	370
350	420	380	350	340	330
300	360	330	300	290	280
250	300	270	250	240	230
200	240	220	200	190	180
150	180	170	150	140	130
100	120	110	100	95	90
50	60	55	50	50	50
30	35	30	30	30	30



## 1. PERFORMANCE

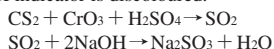
- 1) Measuring range : 2-50 ppm      0.8-20 ppm
- Number of pump strokes : 2 (200mℓ)    4 (400mℓ)
- 2) Sampling time : 4 minutes/2 pump strokes
- 3) Detectable limit : 0.3 ppm (400mℓ)
- 4) Shelf life : 3 years (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 2 pump strokes.
- 8) Colour change : Pink → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 10 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

Sulphur dioxide is produced by an Oxidizer. By reacting between this Sulphur dioxide and alkali, PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

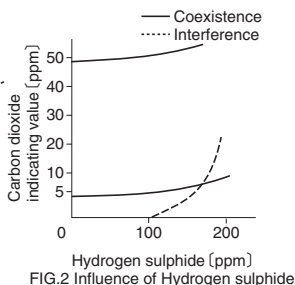
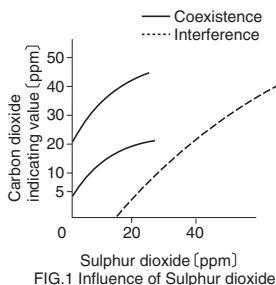
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	ppm	Coexistence
Sulphur dioxide FIG.1	15	Similar stain is produced.		Higher readings are given.
Hydrogen sulphide FIG.2	100	∕	120	∕
Chlorine		Pale pink stain is produced.		∕

(NOTE)

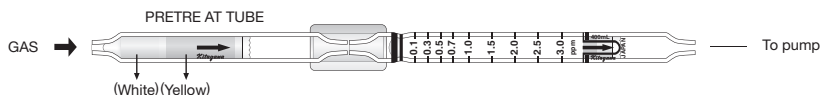
In case of 4 pump strokes, following formula is available for the actual concentration.

Actual concentration = 2/5 × Temperature corrected value



TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
50	72	59	50	43	38
45	65	54	45	39	34
40	58	48	40	34	30
35	51	42	35	30	26
30	44	36	30	26	22
25	37	30	25	21	18
20	31	25	20	17	14
15	24	19	15	13	10
10	16	12	10	8	7
5	9	7	5	4	3
2	3	3	2	2	1



## 1. PERFORMANCE

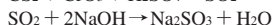
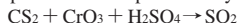
- 1) Measuring range : 0.2-6.4 ppm      0.1-3.0 ppm
- Number of pump strokes    2 (200mℓ)      4 (400mℓ)
- 2) Sampling time : 10 minutes / 4 pump strokes
- 3) Detectable limit : 0.02 ppm (400mℓ)
- 4) Shelf life : 1 year
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 4 pump strokes
- 8) Colour change : Pale purple → Pale yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 5%    RSD-high : 5%

## 3. CHEMICAL REACTION

Sulphur dioxide is produced by an Oxidizer. Sulphur dioxide reacts with alkali and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

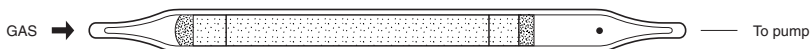
Substance	Interference	ppm	Coexistence
Sulphur dioxide		2	Higher readings are given.
Hydrogen sulphide		40	∕
Chlorine		0.2	White stain is produced from the inlet side of the tube, and higher readings are given.
Nitrogen dioxide	The accuracy of readings is not affected.		
Carbon tetrachloride	∕		

TEMPERATURE CORRECTION TABLE  
(2 pump strokes)

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
3.0	—	—	6.40	8.75	5.20
2.5	—	6.75	5.40	4.80	4.35
2.0	6.50	5.35	4.30	3.80	3.40
1.5	4.90	3.95	3.20	2.80	2.50
1.0	3.20	2.50	2.05	1.80	1.60
0.7	2.20	1.60	1.35	1.20	1.05
0.5	1.50	1.10	0.92	0.80	0.70
0.3	0.85	0.62	0.53	0.44	0.37
0.1	0.28	0.24	0.20	0.16	0.13

TEMPERATURE CORRECTION TABLE  
(4 pump strokes)

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
3.0	—	3.45	3.00	2.75	2.45
2.5	3.40	2.90	2.50	2.30	2.05
2.0	2.70	2.30	2.00	1.80	1.65
1.5	2.00	1.70	1.50	1.35	1.20
1.0	1.30	1.15	1.00	0.90	0.80
0.7	0.90	0.80	0.70	0.62	0.55
0.5	0.64	0.57	0.50	0.44	0.40
0.3	0.38	0.34	0.30	0.26	0.24
0.1	0.12	0.11	0.10	0.09	0.08



## 1. PERFORMANCE

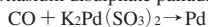
- 1) Measuring range : 25-1,000 ppm 5-300 ppm
- Number of pump strokes : 1 (100mℓ) 3 (300mℓ)
- 2) Sampling time : 3 minutes/1 pump stroke
- 3) Detectable limit : 1 ppm (300mℓ)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Concentration chart method
- 7) Colour change : Yellow → Dark brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 5 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Pottasium disulphate palladate (II) is reduced, and Palladium is liberated.

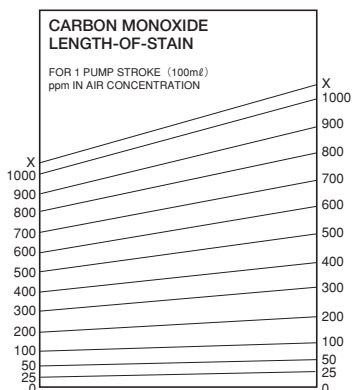


## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

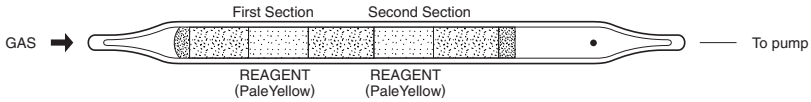
Substance	ppm	Interference	ppm	Coexistence
Ethylene	5,000	Pale grey stain is produced.	5,000	The top of discoloured layer becomes unclear and higher readings are given.
Hydrogen	5,000	Greyish yellow stain is produced.	5,000	Whole layer is discoloured to Greyish yellow and the top of discoloured layer becomes unclear.
Acetylene	1.5	Dark green stain is produced.	CO conc. $\times 1/5$	Higher readings are given.
Sulphur dioxide	100	Original colour is faded.	∕	∕
Nitrogen dioxide		The accuracy of readings is not affected.	∕	∕



TEMPERATURE CORRECTION TABLE

Chart Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
1,000	870	930	1,000	1,030	1,060
900	780	840	900	930	960
800	690	750	800	830	850
700	610	660	700	720	740
600	520	560	600	620	640
500	430	470	500	520	540
400	350	370	400	410	430
300	260	280	300	310	320
200	180	190	200	210	220
100	90	100	100	100	110

# CARBON MONOXIDE



## 1. PERFORMANCE

- 1) Measuring range : 10-1,000 ppm  
This tube is calibrated based on the sampling time not related with number of pump strokes.
- 2) Sampling time : 0.5-5.0 minutes
- 3) Detectable limit : 10 ppm (5.0 minutes)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Colour intensity method using colour standard chart shown in below
- 8) Colour change : Pale yellow → Green to Blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : RSD-mid. : RSD-high :

## 3. CHEMICAL REACTION

Molybdate is reduced and molybdeum blue is produced.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Nitrogen dioxide		1	Lower readings are given.
Hydrogen sulphide	Blue or Black stain is produced.	1,000	Black stain is produced and higher readings are given.
Ethylene	∕	5	∕
Hydrogen (over 40 °C)		10%	Whole reagent is discoloured to Blue and higher readings are given.

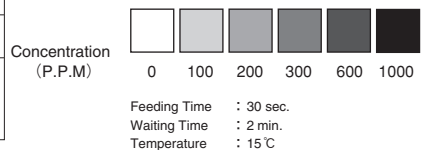
## 6. NOTE

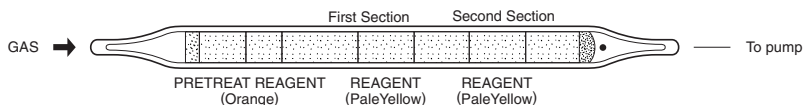
- 1) In case of determining CO concentration, it is necessary to take a waiting time related to the sampling time and ambient temperature. After the waiting time, compare the second section of reagent with the colour standard chart.
- 2) In case of spontaneous combustion of coal mines, Ethylene and CO are produced. The first section is partially stained to deep blue from the top of the section according to Ethylene concentration. Whole areas of first and second sections are equally stained to Greenish blue according to CO concentration. The first section is available to detect less than 5 ppm of Ethylene.

TEMPERATURE CORRECTION TABLE

Temperature	0 °C (32 °F)	5 °C (41 °F)	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	25 °C (77 °F)	30 °C (86 °F)	35 °C (96 °F)	40 °C (104 °F)
Waiting time (minute)									
Sampling time up to 1 minutes	5	5	3	2	2	1	1	1	1
Sampling time of 2 minutes	7	7	4	3	3	2	1	1	1
Chart Readings (ppm)									
100	400	250	150	100	70	50	40	30	20
200	800	500	300	200	140	100	70	50	40
300	1,200	800	450	300	200	150	100	80	60
600	2,300	1,500	900	600	400	300	200	150	120
1,000	3,900	2,500	1,500	1,000	700	500	300	250	200

Color Standards for CARBON MONOXIDE





## 1. PERFORMANCE

- 1) Measuring range : 10-1,000 ppm  
This tube is calibrated based on the sampling time not related with number of pump strokes.
- 2) Sampling time : 0.5-5 minutes
- 3) Detectable limit : 10 ppm (5.0 minutes)
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Colour intensity method using colour standard chart shown in below
- 8) Colour change : Pale yellow → Green to Blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : RSD-mid. : RSD-high :

## 3. CHEMICAL REACTION

Molybdate is reduced and molybdeum blue is produced.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Hydrogen sulphide	Black stain is produced.	1,000	Black stain is produced and higher readings are given.
Hydrogen (over 40 °C)	Similar stain is produced.	10 %	Whole reagent is discoloured to Blue and higher readings are given.

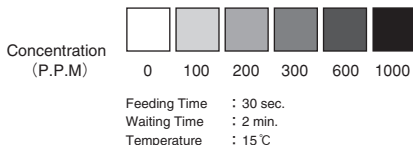
## 6. NOTE

- 1) No.106C is specially designed to eliminate an influence of Nitrogen dioxide from readings, which is produced after blasting, by providing a pretreat reagent. The pretreat reagent is available to eliminate Nitrogen dioxide up to 300 ppm.
- 2) The function of first and second section of detecting reagents is the same with the No.106B tube.

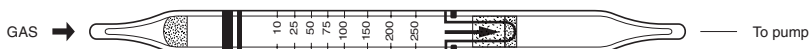
TEMPERATURE CORRECTION TABLE

Temperature	0 °C (32 °F)	5 °C (41 °F)	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	25 °C (77 °F)	30 °C (86 °F)	35 °C (96 °F)	40 °C (104 °F)
Waiting time (minute)									
Sampling time up to 1 minute	5	5	3	2	2	1	1	1	1
Sampling time of 2 minute	7	7	4	3	3	2	1	1	1
Chart Readings (ppm)									
100	400	250	150	100	70	50	40	30	20
200	800	500	300	200	140	100	70	50	40
300	1,200	800	450	300	200	150	100	80	60
600	2,300	1,500	900	600	400	300	200	150	120
1,000	3,900	2,500	1,500	1,000	700	500	300	250	200

Color Standards for CARBON MONOXIDE







## 1. PERFORMANCE

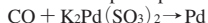
- 1) Measuring range : 10-250 ppm  
Number of pump strokes : 3 (300mℓ)
- 2) Sampling time : 9 minutes/3 pump strokes
- 3) Detectable limit : 1 ppm (300mℓ)
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 3 pump strokes
- 8) Colour change : Yellow → Dark brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

Potassium disulphate palladate (II) is reduced, and Palladium is liberated.



## 4. CALIBRATION OF THE TUBE

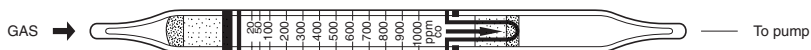
STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	%	Coexistence
Hydrogen sulphide	5	Dark red stain is produced.	CO conc. × 1/5	Higher readings are given.
Sulphur dioxide	120	Pale yellow stain is produced.	CO conc. × 1/5	∕
Nitrogen dioxide		The accuracy of readings is not affected.	CO conc. × 1/5	∕
Ethylene	0.5			∕
Alcohols	1			∕
Ketones	1			∕
Olefinic hydrocarbons	1			∕
Aromatic hydrocarbons	1			∕
Halogenated hydrocarbons	1			∕
Ammonia	1			∕
Aliphatic hydrocarbons	1			Lower readings are given.

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
250	210	230	250	275	300
200	170	185	200	220	240
150	130	140	150	165	180
100	80	90	100	110	120
75	65	70	75	80	85
50	40	45	50	55	60
25	20	25	25	25	30



## 1. PERFORMANCE

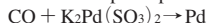
- 1) Measuring range : 20-1,000 ppm    5-50 ppm    40-2,000 ppm
- Number of pump strokes : 1 (100mℓ)    4 (400mℓ)    1/2 (50mℓ)
- 2) Sampling time : 3 minutes/1 pump stroke
- 3) Detectable limit : 2 ppm (400mℓ)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Yellow → Dark brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Potassium disulphate palladate (II) is reduced, and Palladium is liberated.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	ppm	Coexistence
Ethylene	5,000	Pale grey stain is produced.	5,000	The top of discoloured layer becomes unclear and higher readings are given.
Hydrogen	5,000	Greyish yellow stain is produced.	5,000	Whole layer is discoloured to Greyish yellow and the top of discoloured layer becomes unclear.
Acetylene	1.5	Dark green stain is produced.	CO conc. × 1/5	Higher readings are given.
Sulphur dioxide	100	Original colour is faded.	∕	∕
Nitrogen dioxide		The accuracy of readings is not affected.	∕	∕

(NOTE)

When the concentration is below 50 ppm, 4 pump strokes can be used to determine the lower concentration with the following formula ;

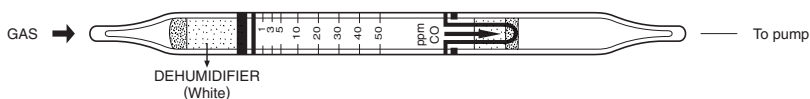
Actual concentration =  $1/4 \times$  Temperature corrected value

When the concentration is over 1,000 ppm, 1/2 pump strokes can be used to determine higher concentration with the following formula ;

Actual concentration =  $2 \times$  Temperature corrected value

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
1,000	870	930	1,000	1,030	1,060
900	780	840	900	930	960
800	690	750	800	830	850
700	610	680	700	720	720
600	520	560	600	620	640
500	430	470	500	520	540
400	350	370	400	410	430
300	260	280	300	310	320
200	180	190	200	210	220
100	90	100	100	100	110



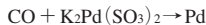
## 1. PERFORMANCE

- 1) Measuring range : 1-50 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 4 minutes
- 3) Detectable limit : 0.5 ppm
- 4) Shelf life : 1 year
- 5) Operating temperature : 5 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Orange → Reddish purple

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 10 % RSD-high : 10 %

## 3. CHEMICAL REACTION



## 4. CALIBRATION OF THE TUBE

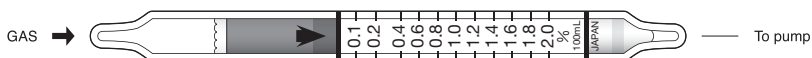
STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Sulphur dioxide	Similar stain is produced.	Higher readings are given.
Formic acid	∕	∕
Acetylene	Whole reagent is change to Pale red.	The maximum end point of the stain is indiscernible and higher readings are given.
Hydrogen sulphide	Dark reddish purple and red stain are produced.	Higher readings are given.
Hydrogen		∕

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)							
	5 °C (41 °F)	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	25 °C (77 °F)	30 °C (86 °F)	35 °C (95 °F)	40 °C (104 °F)
50	28	40	45	50	55	60	65	70
40	23	32	36	40	44	48	52	56
30	17	24	27	30	33	36	39	42
20	12	16	18	20	22	24	26	28
10	7	9	10	10	11	12	13	13
5	4	5	5	5	5	6	6	6



## 1. PERFORMANCE

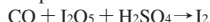
- 1) Measuring range : 0.1-2.0 %
- Number of pump strokes : 1 (100ml)
- 2) Sampling time : 3 minutes/1 pump stroke
- 3) Detectable limit : 0.02 %
- 4) Shelf life : 1 year
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : White → Dark brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 10 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Iodine pentoxide is reduced.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	%	Coexistence
Acetylene FIG.1	Similar stain is produced.	0.3	Higher reading are given.
Ethylene FIG.2	∕	0.15	∕
Hexane	Speckled stain is produced.	0.1	The maximum point of the stained layer becomes unclear and higher readings are given.
Isobutane	∕	0.2	
Propane	∕	15	

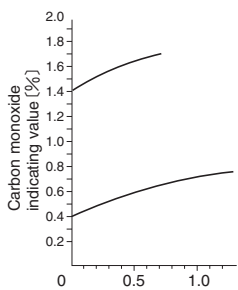


FIG.1 Influence of Acetylene

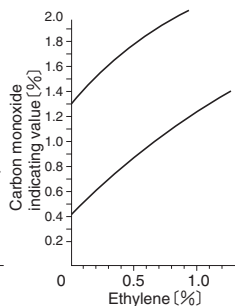
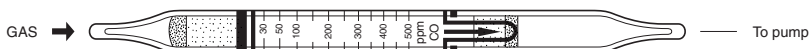


FIG.2 Influence of Ethylene

TEMPERATURE CORRECTION TABLE

Tube Readings (%)	Corrected Concentration (%)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
2.0	1.24	1.52	2.00	2.98	—
1.8	1.14	1.38	1.80	2.64	—
1.6	1.04	1.25	1.60	2.28	2.86
1.4	0.93	1.11	1.40	1.90	2.50
1.2	0.82	0.97	1.20	1.62	2.12
1.0	0.71	0.82	1.00	1.33	1.75
0.8	0.60	0.68	0.80	1.02	1.38
0.6	0.47	0.53	0.60	0.73	0.98
0.4	0.33	0.37	0.40	0.48	0.58
0.2	0.17	0.18	0.20	0.22	0.25
0.1	0.08	0.09	0.10	0.11	0.12



## 1. PERFORMANCE

- 1) Measuring range : 30-500 ppm  
Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1 minute
- 3) Detectable limit : 10 ppm
- 4) Shelf life : 1.5 years
- 5) Operating temperature : 0 ~ 60 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Yellow → Dark brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

Potassium disulphate palladate (II) is reduced, and Palladium is liberated.  
 $\text{CO} + \text{K}_2\text{Pd}(\text{SO}_3)_2 \rightarrow \text{Pd}$

## 4. CALIBRATION OF THE TUBE

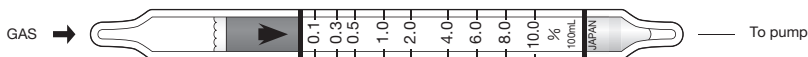
STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Sulphur dioxide	The accuracy of readings is not affected.	CO conc. × 1/2	Higher reading are given.
Ammonia	White stain is produced.	CO conc. × 100	∕
Acetylene	Similar stain is produced.	CO conc. × 1/20	∕
Hydrogen sulphide	Brown stain is produced.	CO conc. × 1/2	∕

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)							
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)	50 °C (122 °F)	60 °C (140 °F)	
500	400	450	500	550	600	650	700	
400	320	360	400	440	480	520	560	
300	240	270	300	330	360	380	400	
200	160	180	200	220	240	260	280	
100	80	90	100	110	120	130	140	
50	40	50	50	50	60	65	70	
30	30	30	30	30	30	35	40	



## 1. PERFORMANCE

- 1) Measuring range : 0.2-20 %      0.1-10 %
- Number of pump strokes : 1/2 (50mℓ)    1 (100mℓ)
- 2) Sampling time : 2 minutes/1 pump stroke
- 3) Detectable limit : 0.01 % (100mℓ)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (0 ~ 20 °C) (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : White → Dark brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 %    RSD-mid. : 15 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

Iodine pentoxide is reduced  
 $CO + I_2O_5 + H_2SO_4 \rightarrow I_2$

## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	%	Coexistence
Acetylene	Similar stain is produced.	2	Higher reading are given.
Ethylene	∕	2	∕
Isobutane	Speckled stain is produced.	0.5	∕
Propane	∕		The accuracy of reading is not affected.
Hexane	FIG.1 Similar stain is produced.	0.4	The top of discoloured layer becomes unclear and higher readings are given.

(NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.

Actual concentration = 2 × Temperature corrected value

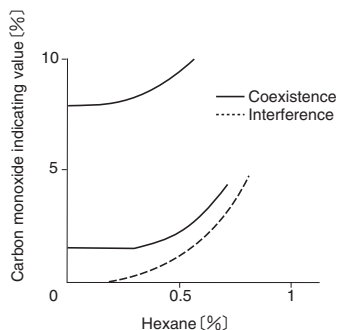


FIG.1 Influence of Hexane

TEMPERATURE CORRECTION TABLE

Tube Readings (%)	Corrected Concentration (%)			
	0 °C (32 °F)	5 °C (50 °F)	10 °C (68 °F)	20-40 °C (104 °F)
10.0	4.0	5.6	8.0	10.0
8.0	3.0	4.5	6.1	8.0
6.0	2.3	3.2	4.3	6.0
4.0	1.6	2.0	2.6	4.0
2.0	1.0	1.2	1.5	2.0
1.0	0.6	0.7	0.8	1.0
0.5	0.4	0.5	0.5	0.5



## 1. PERFORMANCE

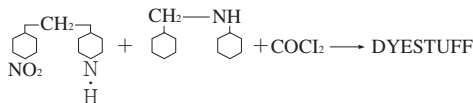
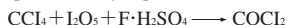
- 1) Measuring range : 5-60 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 0.5 ppm (100mℓ)
- 4) Shelf life : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : White → Red

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 %    RSD-mid. : 10 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

Carbon tetrachloride is decomposed and Phosgene is produced. By reacting with this Phosgene, 4-(p-Nitrobenzyl)-piperidine and Benzylaniline, dyestuff is produced.



## 4. CALIBRATION OF THE TUBE

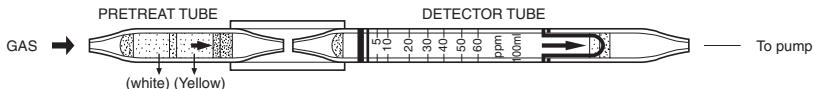
DIFFUSION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Phosgene	Similar stain is produced.	2	Higher reading are given.
Chlorine		12	∕
Trichloroethylene		2	∕

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
60	108	75	60	50	44
50	90	62.5	50	41	36.5
40	72	50	40	33	29
30	54	37.5	30	25	22
20	36	25	20	16.5	14.5
10	18	12.5	10	8	7
5	9	6	5	4	3.5



## 1. PERFORMANCE

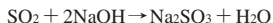
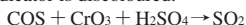
- 1) Measuring range : 5-60 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 2 minutes/1 pump stroke
- 3) Detectable limit : 2 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (0 ~ 20°C) (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Pink → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 5 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

By decomposing with an Oxidizer, Sulphur dioxide is produced. Sulphur dioxide reacts with Alkali and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

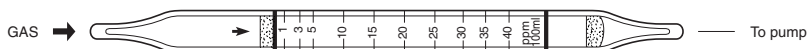
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	%	Coexistence
Sulphur dioxide			Higher readings are given.
Hydrogen sulphide			∕
Carbon disulphide			∕
n-Butane		0.1	Lower readings are given.

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)		
	0 °C (32 °F)	10 °C (50 °F)	20-40 °C (68-104 °F)
60	85	70	60
50	75	60	50
40	60	45	40
30	45	35	30
20	30	25	20
10	15	12	10
5	7	6	5





## 1. PERFORMANCE

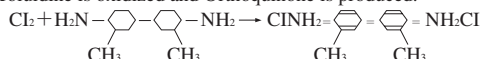
- 1) Measuring range : 1-40 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 2 minutes/1 pump stroke
- 3) Detectable limit : 0.3 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : White → Yellowish orange

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

*o*-Toluidine is oxidized and Orthoquinone is produced.

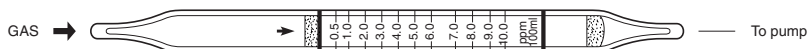


## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	ppm	Coexistence
Bromine	0.1	Similar stain is produced.	1	Higher readings are given.
Chlorine dioxide	0.3	∕	1	∕
Nitrogen dioxide		Pale yellow stain is produced.	Chlorine conc. × 1/2	The maximum end point of the stain is indiscernible and higher readings are given.



## 1. PERFORMANCE

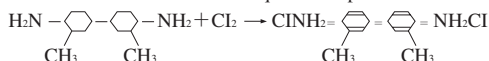
- |                          |   |               |             |
|--------------------------|---|---------------|-------------|
| 1) Measuring range       | : 0.5-10 ppm  | 0.125-2.5 ppm | 0.1-2.0 ppm |
| Number of pump strokes   | 1 (100ml)   | 4 (400ml)     | 5 (500ml)   |
| 2) Sampling time         | : 1 minute/1 pump stroke                                    |               |             |
| 3) Detectable limit      | : 0.06 ppm (500ml)  |               |             |
| 4) Shelf life            | : 2 years   |               |             |
| 5) Operating temperature | : 0 ~ 40 °C   |               |             |
| 6) Reading               | : Direct reading from the scale calibrated by 1 pump stroke |               |             |
| 7) Colour change         | : White → Pale orange                                       |               |             |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

*o*-Toluidine is oxidized and Orthoquinone is produced.



## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Bromine	Pale yellow stain is produced.	1	Higher readings are given.
Chlorine dioxide	∕	1	∕
Nitrogen dioxide	∕	Chlorine conc. × 1/5	∕
Nitrogen trichloride	∕	5	∕

(NOTE)

When the concentration is below 2 ppm, 4 or 5 pump strokes can be used to determine the lower concentration with the following formula ;

$$\text{Actual concentration} = \text{Reading value} \times \frac{1}{\text{Number of pump strokes}}$$



## 1. PERFORMANCE

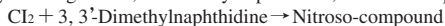
- 1) Measuring range : 0.1-2 ppm      0.05-1 ppm
- Number of pump strokes : 1 (100mℓ)    2 (200mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 0.01 ppm (200mℓ)
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : White → Pale purple

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 5%    RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with 3, 3<sup>2</sup>-Dimethylnaphthidine, Nitroso-compound is produced.



## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Hydrogen chloride    FIG.1	The accuracy of readings is not affected.	Chlorine conc. × 20	Higher readings are given.
Nitrogen dioxide    FIG.2	Similar stain is produced.		∕

(NOTE)

In case of 2 pump strokes, following formula is available for the actual concentration.

Actual concentration = 1/2 × Reading value

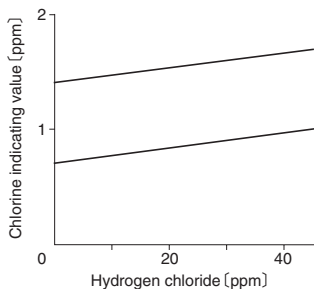


FIG.1 Influence of Hydrogen chloride

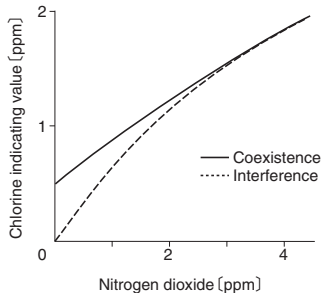
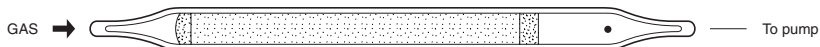


FIG.2 Influence of Nitrogen dioxide



## 1. PERFORMANCE

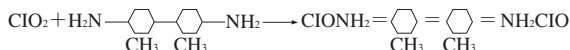
- 1) Measuring range : 1-20 ppm
- Number of pump strokes : 1 (100ml)
- 2) Sampling time : 2 minutes/1 pump stroke
- 3) Detectable limit : 0.3 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Concentration chart method
- 8) Colour change : White → Reddish orange

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

*o*-Toluidine is oxidized and Orthoquinone is produced.



## 4. CALIBRATION OF THE TUBE

ABSORPTIOMETRIC METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Nitrogen dioxide FIG.1	Similar stain is produced.	1	Higher readings are given.
Chlorine FIG.2	∕	1	∕
Bromine FIG.3	∕	1	∕

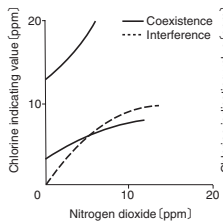


FIG.1 Influence of Nitrogen dioxide

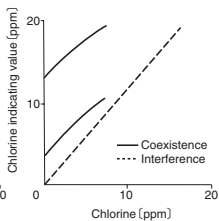


FIG.2 Influence of Chlorine

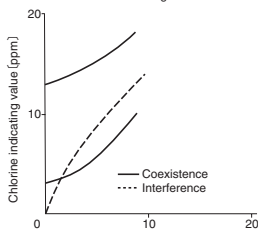
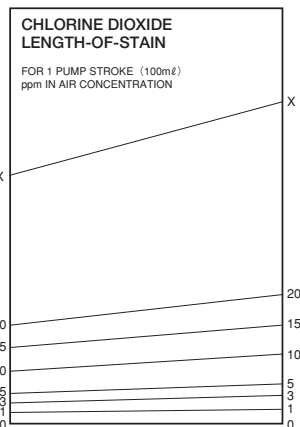
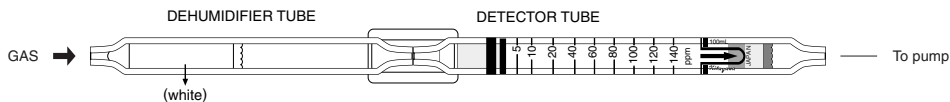


FIG.3 Influence of Bromine



TEMPERATURE CORRECTION TABLE

Chart Readings (ppm)	Corrected Concentration (ppm)			
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)
20	—	30	20	15
15	—	22	15	11
10	26	15	10	8
5	13	8	5	4
3	6	5	3	2.8
1	1	1	1	1



## 1. PERFORMANCE

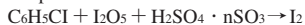
- |                          |   |           |
|--------------------------|---|-----------|
| 1) Measuring range       | : 5-140 ppm   | 1-5 ppm   |
| Number of pump strokes   | 1 (100mℓ)   | 5 (500mℓ) |
| 2) Sampling time         | : 2 minutes/1 pump stroke                                   |           |
| 3) Detectable limit      | : 0.5 ppm (500mℓ)   |           |
| 4) Shelf life            | : 2 years   |           |
| 5) Operating temperature | : 0 ~ 40 °C   |           |
| 6) Reading               | : Direct reading from the scale calibrated by 1 pump stroke |           |
| 7) Colour change         | : White → Pale brown  |           |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 20%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

Iodine pentoxide is reduced.



## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

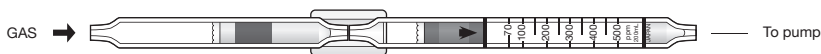
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Ethyl benzene	Similar stain is produced.		Higher readings are given.
Toluene	∕		∕
Xylene	∕		∕
Benzene	∕		∕
Carbon monoxide	Whole reagent is changed to the similar stain's colour.	50	∕
Hexane	∕	100	∕

(NOTE)

When the concentration is below 5 ppm, 5 pump strokes can be used to determine the lower concentration with the following formula ;

Actual concentration = 1/5 × Reading value



## 1. PERFORMANCE

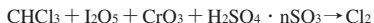
- 1) Measuring range : 70-500 ppm    35-250 ppm    23-167 ppm
- Number of pump strokes : 2 (200mℓ)    3 (300mℓ)    4 (400mℓ)
- 2) Sampling time : 3 minutes/2 pump strokes
- 3) Detectable limit : 20 ppm (400mℓ)
- 4) Shelf life : 2 years (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 2 pump strokes
- 8) Colour change : White → Yellowish orange

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 20 %    RSD-mid. : 15 %    RSD-high : 15 %

## 3. CHEMICAL REACTION

Chlorine is produced by an Oxidizer. By reacting between this Chlorine and *o*-Toluidine, yellow holoquinone is produced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Halogens	Similar stain is produced.		Higher readings are given.
Halogenated hydrocarbons	∕		∕
n-Hexane                      FIG.2	The accuracy of readings is not affected.	200	Lower readings are given.

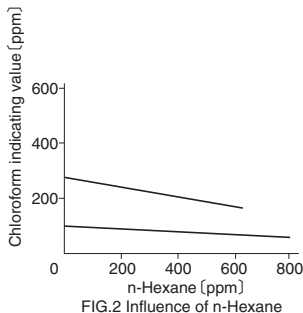
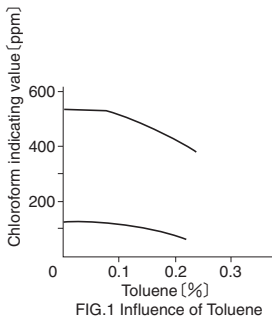
(NOTE)

In case of 3 pump strokes, following formula is available for the actual concentration.

Actual concentration = 1/2 × Temperature corrected value

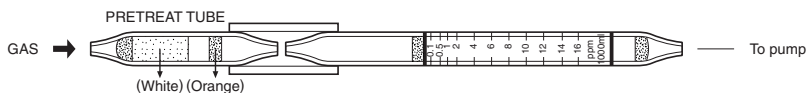
In case of 4 pump strokes, following formula is available for the actual concentration.

Actual concentration = 1/3 × Temperature corrected value



TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	30 °C (95 °F)	40 °C (95 °F)
500	—	—	500	335	260
400	—	520	400	280	215
300	590	390	300	215	165
200	380	260	200	145	115
100	180	130	100	80	65
70	120	85	70	60	50



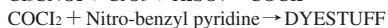
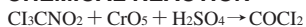
## 1. PERFORMANCE

- |                          |  |            |
|--------------------------|--|------------|
| 1) Measuring range       | : 0.1-16 ppm   | 0.05-8 ppm |
| Number of pump strokes   | 1 (100mℓ)  | 2 (200mℓ)  |
| 2) Sampling time         | : 1.5 minutes/1 pump stroke  |            |
| 3) Detectable limit      | : 0.02 ppm (200mℓ)   |            |
| 4) Shelf life            | : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C) |            |
| 5) Operating temperature | : 0 ~ 40 °C  |            |
| 6) Reading               | : Direct reading from the scale calibrated by 1 pump stroke          |            |
| 7) Colour change         | : White → Pink   |            |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

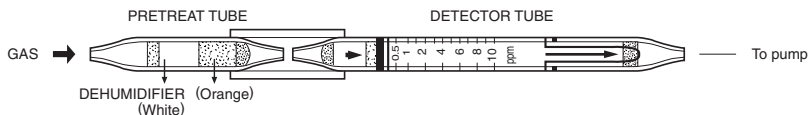
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Carbon tetrachloride	Similar stain is produced.	Higher readings are given.
Phosgene	∕	∕
Aliphatic hydrocarbons	The accuracy of readings is not affected.	The accuracy of readings is not affected.

(NOTE)

When the concentration is below the scale ranges, 2 pump strokes can be used to determine lower concentration with the following formula ;

$$\text{Actual concentration} = 1/2 \times \text{Reading value}$$



## 1. PERFORMANCE

- 1) Measuring range : 1-20 ppm    0.5-10 ppm
- Number of pump strokes : 1 (100mℓ)    2 (200mℓ)
- 2) Sampling time : 3 minutes/2 pump strokes
- 3) Detectable limit : 0.01 ppm (200mℓ)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (0-20 °C) (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 2 pump strokes
- 8) Colour change : Greenish yellow → Pink

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 10 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

By reacting with an Oxidizer, Hydrogen chloride is produced and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Acetylene	The accuracy of readings is not affected.	4 %	Lower readings are given.
Ethylene	∕	200	∕
Vinyl chloride	Similar stain is produced.		Higher readings are given.

(NOTE)

In case of 1 pump stroke, following formula is available for the actual concentration.

Actual concentration = 2 × Temperature corrected value

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	5 °C (41 °F)	10 °C (50 °F)	15 °C (59 °F)	20 °C ~ 40 °C (68 °F ~ 104 °F)
10.0	80.0	23.0	16.5	12.5	10.0
8.0	64.0	18.5	13.0	10.5	8.0
6.0	48.0	14.0	10.0	7.5	6.0
4.0	15.0	8.8	6.5	5.0	4.0
2.0	8.0	4.0	3.0	2.5	2.0
1.0	3.0	1.7	1.6	1.5	1.0
0.5	0.5	0.5	0.5	0.5	0.5





## 1. PERFORMANCE

- 1) Measuring range : 0.5-25.0 ppm  
Number of pump strokes : 2 (200ml)
- 2) Sampling time : 3 minutes/2 pump strokes
- 3) Detectable limit : 0.3 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : The tube scale is calibrated based on Phenol at 2 pump strokes and the tube has the same sensitivity for Cresol.
- 8) Colour change : Pale yellow → Pale brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

Cresol is oxidized and the polymer is produced.



## 4. CALIBRATION OF THE TUBE

ABSORPTIOMETRIC METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Phenols FIG.1	Similar stain is produced.	2.5	Higher readings are given.
Ammonia FIG.2	White stain is produced.	200	Discolouration of gas inlet side is faded and higher reading are given.
Aliphatic amines	∕	50	∕
Aromatic amines	Blue stain is produced.	50	Two layers discolouration of Pale brown and blue are produced and higher reading are given.

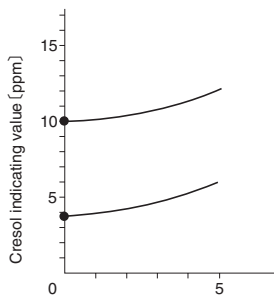


FIG.1 Influence of Phenol

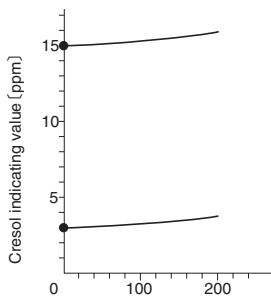
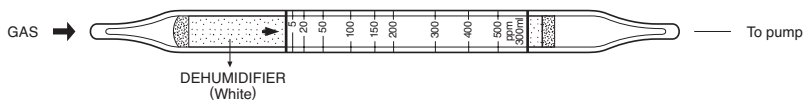


FIG.2 Influence of Ammonia

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	30 °C (95 °F)	40 °C (104 °F)
25.0	31.2	27.8	25.0	21.8	18.8
20.0	24.5	22.3	20.0	17.5	15.0
15.0	18.4	16.7	15.0	13.1	11.3
10.0	12.3	11.1	10.0	8.8	7.5
5.0	6.1	5.6	5.0	4.4	3.8
3.0	3.7	3.3	3.0	2.6	2.3
1.0	1.2	1.1	1.0	0.9	0.8
0.5	0.5	0.5	0.5	0.5	0.5



## 1. PERFORMANCE

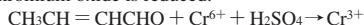
- 1) Measuring range : 2-40 ppm  
Number of pump strokes : 3 (300mℓ)
- 2) Sampling time : 4.5 minutes/3 pump strokes
- 3) Detectable limit : —
- 4) Shelf life : 2 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Ethyl cellosolve at 3 pump strokes and Crotonaldehyde concentration is determined by using a conversion chart at 3 pump strokes
- 7) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 10 % RSD-high : 10 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



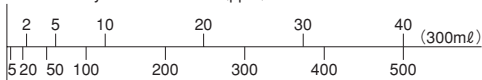
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

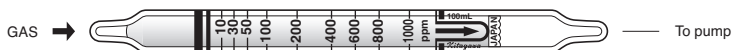
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Ethers	∕	∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	Whole reagent is changed to Brown.	∕
Aromatic hydrocarbons	∕	∕
Esters	∕	∕
Ketones	∕	∕
Halogenated hydrocarbons	∕	∕

Crotonaldehyde concentration (ppm)



No. 190U tube reading (ppm)



## 1. PERFORMANCE

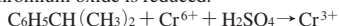
- 1) Measuring range : 20-140 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 2 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Ethyl acetate at 1 pump stroke and Cumene concentration is determined by using a conversion chart at 1 pump stroke
- 7) Colour change : Yellow → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 5%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.

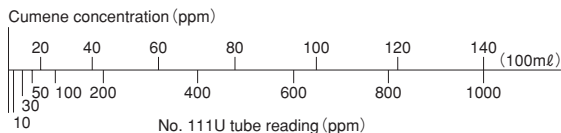


## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar or brown stain is produced.	Higher readings are given.
Esters	∕	∕
Ketones	∕	∕
Aromatic hydrocarbons	∕	∕
Aliphatic hydrocarbons	Whole reagent is discoloured to Pale brown.	If the maximum end point of stained layer is discernable, the accuracy of readings is not affected.
Halogenated hydrocarbons	∕	∕





## 1. PERFORMANCE

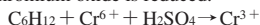
- 1) Measuring range : 0.01-0.6 %
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 0.005 % (50 ppm)
- 4) Shelf life : 3 years
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Orange → Dark green

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



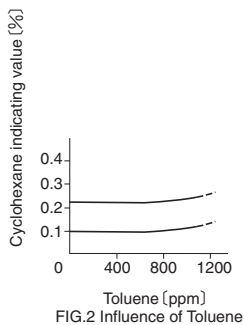
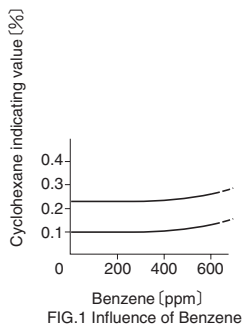
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

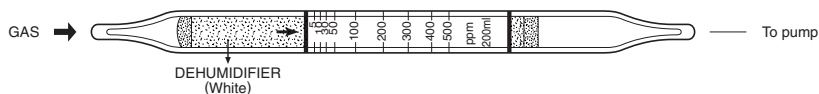
Substance	Interference	ppm	Coexistence
Benzene FIG.1	Black stain is produced.	400	Higher readings are given.
Toluene FIG.2	∕	800	∕
Xylene	∕	2,000	∕
Acetylene	Whole layer is discoloured to Dark green.		∕
Ethylene	Similar stain is produced.		∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	∕		∕

\* In presence of Alcohols, Ketones or Esters less than 6 %, the accuracy of readings is not affected.



TEMPERATURE CORRECTION TABLE

Tube Readings (%)	Corrected Concentration (%)				
	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
0.6	0.73	0.67	0.60	0.53	0.49
0.5	0.62	0.54	0.50	0.45	0.41
0.4	0.48	0.43	0.40	0.36	0.34
0.3	0.34	0.32	0.30	0.28	0.26
0.2	0.22	0.21	0.20	0.19	0.18
0.1	0.10	0.10	0.10	0.10	0.10



## 1. PERFORMANCE

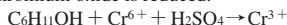
- 1) Measuring range : 5-500 ppm  
Number of pump strokes : 2 (200ml)
- 2) Sampling time : 3 minutes/2 pump strokes
- 3) Detectable limit : 2 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 2 pump strokes
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Aliphatic hydrocarbons (more than C <sub>3</sub> )	Whole reagent is changed to Pale brown.	The accuracy of reading is not affected.
Aromatic hydrocarbons	∕	∕
Halogenated hydrocarbons	∕	∕
Alcohols	FIG.1 Similar stain is produced.	Higher readings are given.
Esters	Pale ringed stain is produced near the bottom of the reagent.	The accuracy of reading is not affected.

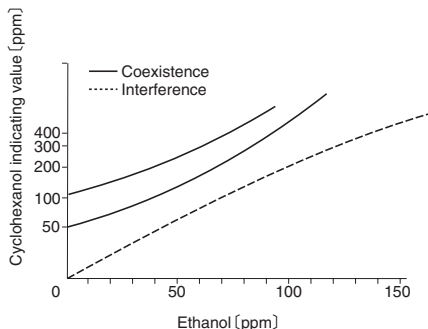
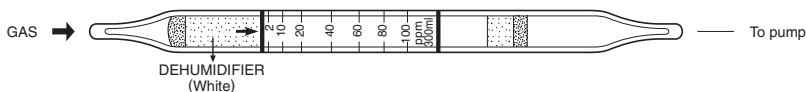


FIG.1 Influence of Ethanol

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)						
	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	25 °C (77 °F)	30 °C (80 °F)	35 °C (95 °F)	40 °C (95 °F)
500	—	—	500	380	280	210	160
400	—	520	400	300	230	170	130
300	—	400	300	220	170	130	100
200	—	270	200	140	110	90	70
100	230	140	100	90	70	50	40
50	90	70	50	40	35	20	15
30	50	40	30	25	18	14	10
10	18	13	10	8	6	4	2
5	9	7	5	4	3	2	1



## 1. PERFORMANCE

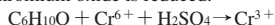
- 1) Measuring range : 2-100 ppm
- Number of pump strokes : 3 (300ml)
- 2) Sampling time : 4.5 minutes/3 pump strokes
- 3) Detectable limit : 1 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 3 pump strokes
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 10 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Aliphatic hydrocarbons (more than C <sub>3</sub> )	Whole reagent is changed to pale brown.	The accuracy of readings is not affected if the maximum end point of the pale blue stain is discernable.
Aromatic hydrocarbons	∕	∕
Halogenated hydrocarbons	∕	∕
Alcohols	FIG.1 Similar stain is produced.	Higher readings are given.
Esters	Pale brown stain is produced from the zero end of the detecting reagent (inlet side of the tube).	The accuracy of readings is not affected.

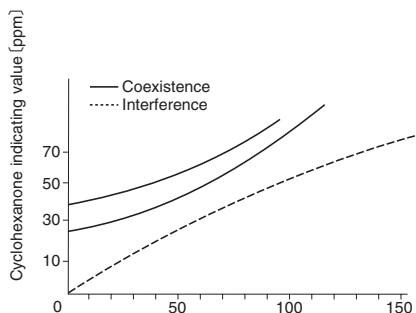


FIG.1 Influence of Ethanol

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
100	—	—	100	75	60
80	—	120	80	62	50
60	110	84	60	46	37
40	70	52	40	30	25
20	30	26	20	16	13
10	18	14	10	8	7
2	4	3	2	2	1



## 1. PERFORMANCE

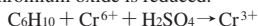
- 1) Measuring range : 20-300 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 2 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Ethyl acetate at 1 pump stroke and Cyclohexene concentration is determined by using a conversion chart at 1 pump stroke
- 7) Colour change : Yellow → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 5%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.

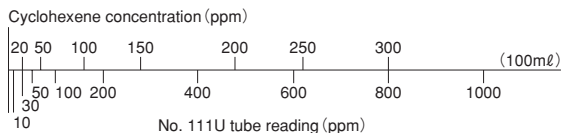


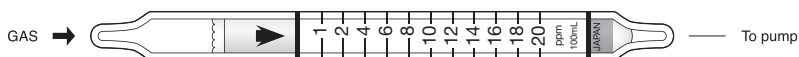
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar or brown stain is produced.	Higher readings are given.
Esters	∕	∕
Ketones	∕	∕
Aromatic hydrocarbons	∕	∕
Aliphatic hydrocarbons	Whole reagent is discoloured to Pale brown.	If the maximum end point of stained layer is discernable, the accuracy of readings is not affected.
Halogenated hydrocarbons	∕	∕





## 1. PERFORMANCE

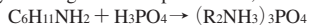
- 1) Measuring range : 1-20 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Pale purple → Pale Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Phosphoric acid, PH indicator is discoloured.



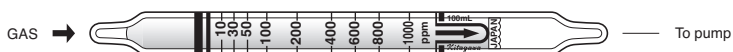
## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Amines	Similar stain is produced.	Higher readings are given.





## 1. PERFORMANCE

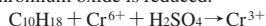
- 1) Measuring range : 20-200 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 2 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Ethyl acetate at 1 pump stroke and Decahydronaphthalene concentration is determined by using a conversion chart at 1 pump stroke
- 7) Colour change : Yellow → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 5%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.

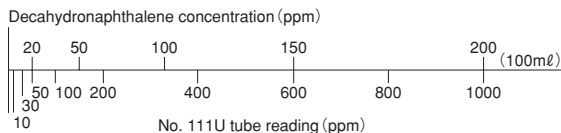


## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar or brown stain is produced.	Higher readings are given.
Esters	∕	∕
Ketones	∕	∕
Aromatic hydrocarbons	∕	∕
Aliphatic hydrocarbons	Whole reagent is discoloured to Pale brown.	If the maximum end point of stained layer is discernable, the accuracy of readings is not affected.
Halogenated hydrocarbons	∕	∕





## 1. PERFORMANCE

- 1) Measuring range : 5-90 ppm  
Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 2 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Ethyl acetate at 1 pump stroke and n-Decane concentration is determined by using a conversion chart at 1 pump stroke
- 7) Colour change : Yellow → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 10 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.

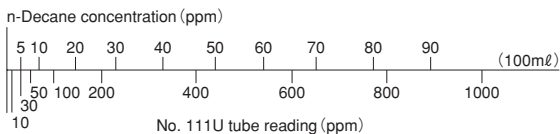


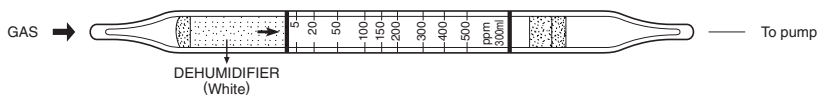
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar or brown stain is produced.	Higher readings are given.
Esters	∕	∕
Ketones	∕	∕
Aromatic hydrocarbons	∕	∕
Aliphatic hydrocarbons	Whole reagent is discoloured to Pale brown.	If the maximum end point of stained layer is discernable, the accuracy of readings is not affected.
Halogenated hydrocarbons	∕	∕





## 1. PERFORMANCE

- 1) Measuring range : 10-250 ppm  
Number of pump strokes : 3 (300ml)
- 2) Sampling time : 4.5 minutes/3 pump strokes
- 3) Detectable limit : 1 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Graduations printed on the tube are calibrated by Ethyl cellosolve at 3 pump strokes and Diacetone alcohol concentration is determined by using a conversion chart.
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols FIG.1	Similar stain is produced.	Higher readings are given.
Halogenated hydrocarbons	∕	
Aliphatic hydrocarbons	Whole reagent is discoloured to Pale brown.	If the top of Pale blue stain is clear, the accuracy of readings is not affected.
Aromatic hydrocarbons	∕	∕
Esters	∕	∕

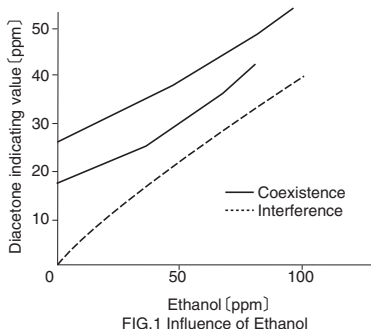
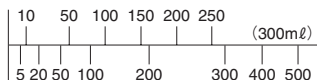


FIG.1 Influence of Ethanol

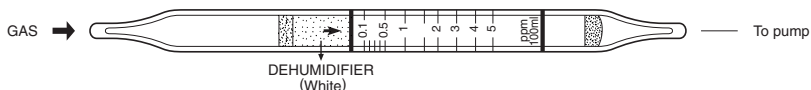
## TEMPERATURE CORRECTION TABLE

Conver. value (ppm)	Corrected Concentration (ppm)						
	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	25 °C (77 °F)	30 °C (86 °F)	35 °C (95 °F)	40 °C (104 °F)
250	—	380	250	170	130	90	70
200	440	300	200	140	100	80	60
150	330	210	150	110	80	60	50
100	200	130	100	80	60	40	30
50	80	60	50	40	30	20	16
30	50	40	30	23	18	12	8
10	16	14	10	8	6	4	3

Diacetone alcohol (ppm)



No.190U Tube reading (ppm)



## 1. PERFORMANCE

- |                             |   |              |              |
|-----------------------------|---|--------------|--------------|
| 1) Measuring range          | : 0.1-5 ppm   | 0.05-2.5 ppm | 0.02-1.0 ppm |
| Number of pump strokes      | 1 (100ml)   | 2 (200ml)    | 5 (500ml)    |
| 2) Sampling time            | : 1 minute/1 pump stroke                                    |              |              |
| 3) Detectable limit         | : 0.01 ppm (500ml)  |              |              |
| 4) Shelf life               | : 2 years   |              |              |
| 5) Operating temperature    | : 0 ~ 40 °C   |              |              |
| 6) Temperature compensation | : Necessary (See "TEMPERATURE CORRECTION TABLE")            |              |              |
| 7) Reading                  | : Direct reading from the scale calibrated by 1 pump stroke |              |              |
| 8) Colour change            | : Pale yellow → Reddish purple                              |              |              |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 10 % RSD-high : 10 %

## 3. CHEMICAL REACTION

By reacting with Mercuric chloride, Hydrogen chloride is liberated and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Arsine FIG.2		Higher readings are given.
Phosphine FIG.1		∕
Hydrogen selenide		∕
Monosilane		∕ (Boundary is unclear.)
Disilane		∕ ( ∕ )
Monogermene		Not affected.

(NOTE)

In case of 2 and 5 pump strokes, the following formula is available for the actual concentration.

2 pump strokes : Actual concentration = Temperature corrected value ÷ 2

5 pump strokes : Actual concentration = Temperature corrected value ÷ 5

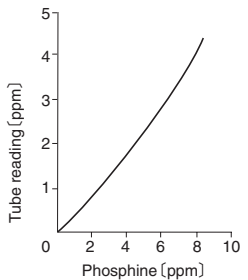


FIG.1 Influence of Phosphine

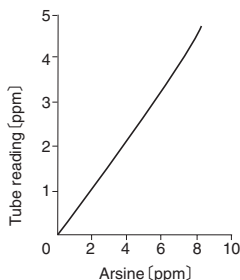
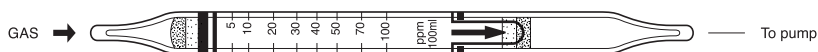


FIG.2 Influence of Arsine

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
5	—	9	5	3.5	2.5
4	—	7	4	3	2
3	—	5	3	2.5	1.5
2	8	3	2	1.5	1.3
1	1.5	1	1	1	0.8
0.5	0.5	0.5	0.5	0.5	0.5
0.1	0.1	0.1	0.1	0.1	0.1



## 1. PERFORMANCE

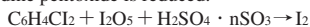
- 1) Measuring range : 5-100 ppm
- Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 2 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : White → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

Iodine pentoxide is reduced.

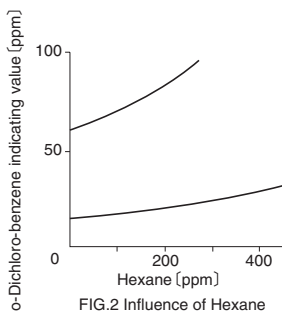
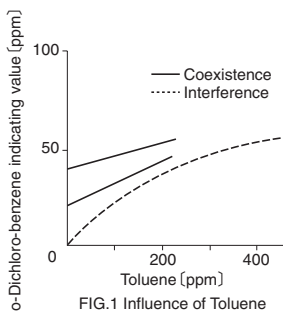


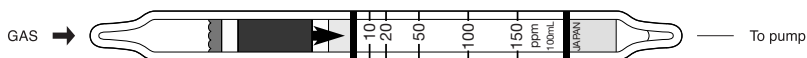
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stains are produced.	Higher readings are given.
Aliphatic hydrocarbons (more than C <sub>3</sub> )      FIG.3	Whole reagent is changed to Dark brown.	∕
Halogenated hydrocarbons	∕	∕
Ethyl alcohol	∕	∕
Aromatic hydrocarbons    FIG.1,2	∕	∕





## 1. PERFORMANCE

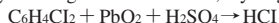
- 1) Measuring range : 10-150 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 6 ppm
- 4) Shelf life : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : White → Blueish purple

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 %    RSD-mid. : 10 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

By reacting with an Oxidizer, Hydrogen chloride is produced and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

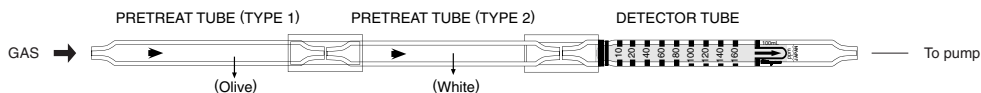
GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Benzene	The accuracy of reading is not affected.	The accuracy of reading is not affected.
Toluene	∕	∕
Xylene	∕	
Trichloroethylene	Similar stain is produced.	Higher readings are given.
Tetrachloroethylene	∕	∕
Chlorobenzene	∕	∕
o-Dichlorobenzene	∕	∕

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)						
	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	25 °C (77 °F)	30 °C (86 °F)	35 °C (95 °F)	40 °C (104 °F)
150	—	—	150	108	66	48	30
100	—	—	100	72	46	37	26
50	110	80	50	28	26	21	16
20	50	27	20	14	10	8	6
10	22	15	10	8	6	5	4



## 1. PERFORMANCE

- 1) Measuring range : 10-160 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 2 minutes/1 pump stroke
- 3) Detectable limit : 3 ppm
- 4) Shelf life : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 0 ~ 40 °C
- 6) Operating Humidity : 20-80 % R.H.
- 7) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 8) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 9) Colour change : White → Purple

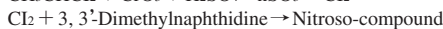
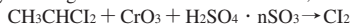
## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 %    RSD-mid. : 15 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

Chlorine is produced by decomposing with an Oxidizer.

By reacting between this Chlorine and 3, 3'-Dimethylnaphthidine, Nitroso-compound is produced.



## 4. CALIBRATION OF THE TUBE

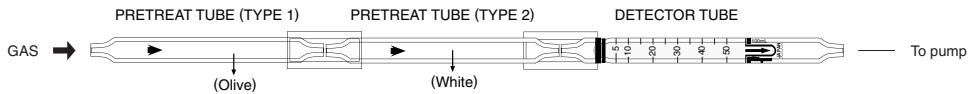
DIFFUSION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Nitrogen oxides	Similar stain is produced.		Higher readings are given.
Halogens	∕		∕
Halogenated hydrocarbons	∕		∕
Alcohols	The accuracy of readings is not affected.	400	Lower readings are given.
Hexane	∕	20	∕
Toluene	∕	20	∕

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
160	230	195	160	118	75
140	200	170	140	105	70
120	170	145	120	90	60
100	140	120	100	75	50
80	110	95	80	60	40
60	80	70	60	48	35
40	50	45	40	33	25
20	25	23	20	18	15
10	10	10	10	10	10



## 1. PERFORMANCE

- 1) Measuring range : 5-50 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 2 minutes/1 pump stroke
- 3) Detectable limit : 2 ppm
- 4) Shelf life : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : White → Purple

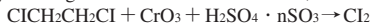
## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

Chlorine is produced by decomposing with an Oxidizer.

By reacting between this Chlorine and 3, 3<sup>2</sup>-Dimethylnaphthidine, Nitroso-compound is produced.



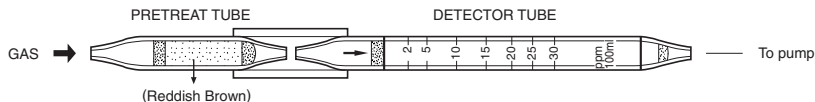
## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Nitrogen oxides	Similar stain is produced.		Higher readings are given.
Halogens	∕		∕
Halogenated hydrocarbons	∕		∕
Hexane	The accuracy of readings is not affected.	100	Lower readings are given.





## 1. PERFORMANCE

- 1) Measuring range : 2-30 ppm
- Number of pump strokes : 1 (100ml)
- 2) Sampling time : 40 seconds/1 pump stroke
- 3) Detectable limit : 0.5 ppm
- 4) Shelf life : 1 year
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Greenish yellow → Pink

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

By decomposing with an Oxidizer, Hydrogen chloride is produced and PH indicator is discoloured.  
 $(C_2H_5O)_2 + CrO_3 + H_2SO_4 \rightarrow 2HCl$

## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence	
Halogenated hydrocarbons	Similar stain is produced.		Higher readings are given.
Aliphatic hydrocarbons (more than C <sub>3</sub> )	The accuracy of readings is not affected.	less than 500	The accuracy of readings is not affected.
Aromatic hydrocarbons	∕	less than 300	∕
Alcohols	∕	less than 100	∕
Esters	∕	less than 300	∕

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)							
	0 °C (32 °F)	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	25 °C (77 °F)	30 °C (86 °F)	35 °C (95 °F)	40 °C (104 °F)
30	—	49	37	30	24	19	14	9
25	45	35	30	25	20	16	12	8
20	32	27	23	20	17	13	10	6
15	21	19	17	15	13	10	7	5
10	14	13	12	10	9	7	5	4
5	7	6	6	5	4	3	2	1
2	3	3	2	2	2	1	1	1



## 1. PERFORMANCE

- |                             |  |             |            |            |
|-----------------------------|--|-------------|------------|------------|
| 1) Measuring range          | : 4.2-84 ppm   | 9.2-184 ppm | 20-400 ppm | 42-840 ppm |
| Number of pump strokes      | 4 (400mℓ)  | 2 (200mℓ)   | 1 (100mℓ)  | 1/2 (50mℓ) |
| 2) Sampling time            | : 1.5 minutes/1 pump stroke  |             |            |            |
| 3) Detectable limit         | : 0.5 ppm (4 pump strokes)   |             |            |            |
| 4) Shelf life               | : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C) |             |            |            |
| 5) Operating temperature    | : 5 ~ 40 °C  |             |            |            |
| 6) Temperature compensation | : Necessary (See "TEMPERATURE CORRECTION TABLE")                     |             |            |            |
| 7) Reading                  | : Direct reading from the scale calibrated by 1 pump stroke          |             |            |            |
| 8) Colour change            | : Yellow → Red   |             |            |            |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Hydrogen chloride is produced by an Oxidizer and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Trichloroethylene	Similar stain is produced.	3	Higher readings are given.
Vinyl chloride	∕	300	∕
Hydrogen chloride	∕	10	∕
Chlorine	Pale red stain is produced.	15	∕

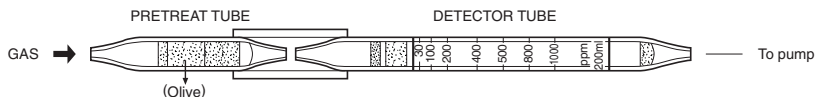
(NOTE)

This tube is calibrated based on Cis-1,2-Dichloroethylene.

In case of trans-1,2-Dichloroethylene measurement, correct the reading value by the temperature correction table if necessary, then multiply the value by 1.1.

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)	
	5 °C (41 °F)	10 °C ~ 40 °C (50 °F ~ 104 °F)
400	475	400
350	415	350
300	355	300
250	295	250
200	235	200
150	175	150
100	115	100
50	55	50
20	20	20



## 1. PERFORMANCE

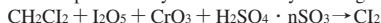
- 1) Measuring range : 30-1,000 ppm    10-200 ppm  
     Number of pump strokes : 2 (200ml)    4 (400ml)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 5 ppm (400ml)
- 4) Shelf life : 2 years (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 5 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 2 pump strokes
- 8) Colour change : White → Reddish orange

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15%    RSD-mid. : 15%    RSD-high : 15%

## 3. CHEMICAL REACTION

Chlorine is produced by an Oxidizer. By reacting between this Chlorine and *o*-Toluidine, Orthoquinone is produced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

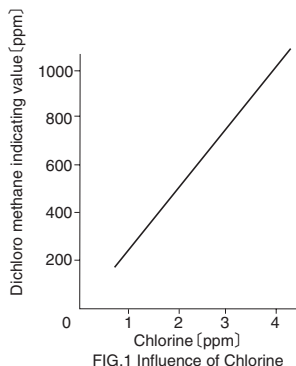
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Halogens or Halogenated hydrocarbons FIG.1	Similar stain is produced.	Higher readings are given.

(NOTE)

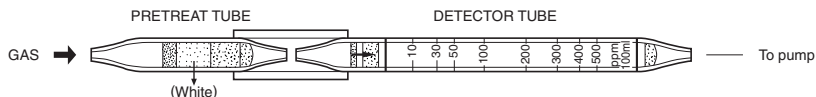
When the concentration is below 200 ppm, 4 pump strokes can be used to determine the lower concentration. Following formula is available for the actual concentration.

Actual concentration = 1/3 × Temperature corrected value.



TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)							
	5 °C (41 °F)	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	25 °C (77 °F)	30 °C (86 °F)	35 °C (95 °F)	40 °C (104 °F)
1000	—	—	1230	1000	820	670	550	450
800	—	1190	990	800	660	530	440	360
600	1120	900	740	600	500	400	330	270
400	720	600	500	400	330	260	220	180
200	360	300	250	200	165	135	110	90
100	170	145	120	100	80	65	50	45
30	50	45	35	30	25	20	15	10



## 1. PERFORMANCE

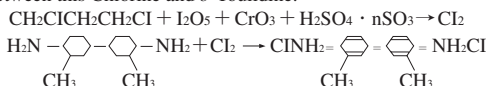
- 1) Measuring range : 10-500 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 1 ppm
- 4) Shelf life : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : White → Orange

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 %    RSD-mid. : 15 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

By decomposing with an Oxidizer, chlorine is produced. Yellowish Orthoquinone is produced by reacting between this Chlorine and *o*-Toulidine.

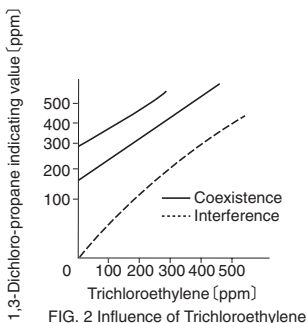
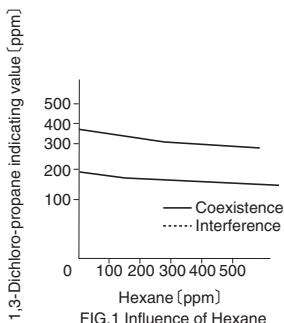


## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

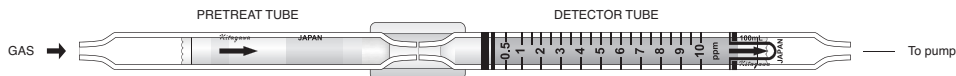
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	The accuracy of readings is not affected.	The accuracy of readings is not affected.
Esters	∕	∕
Aromatic hydrocarbons	∕	∕
Aliphatic hydrocarbons FIG.1	∕	∕
Halogenated hydrocarbons FIG.2	Similar stain is produced.	Higher readings are given.



TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
500	—	690	500	420	350
400	—	550	400	330	280
300	—	400	300	240	200
200	380	270	200	170	130
100	180	130	100	80	60
50	90	70	50	40	30
30	60	40	30	20	15
10	20	14	10	7	5



## 1. PERFORMANCE

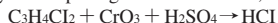
- 1) Measuring range : 0.5-10 ppm
- Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 0.1 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Yellowish green → Pink

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

By decomposing with an Oxidizer, Hydrogen chloride is produced and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

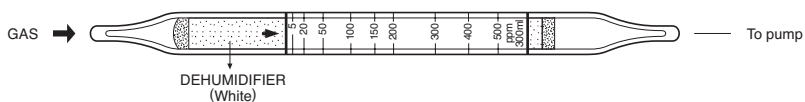
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Chloropicrin	The accuracy of readings is not affected.	1800	The accuracy of readings is not affected.
Methyl isothiocyanate	∕	600	∕

### TEMPERATURE CORRECTION TABLE

Temperature : To correct for temperature, multiply the tube reading by the following factors.

Temperature (°C)	0	1	2	3	4	5	6	7	8	9
Correction Factor	2.00	1.91	1.83	1.75	1.66	1.57	1.49	1.42	1.36	1.30
Temperature (°C)	10	11	12	13	14	15	16	17	18	19
Correction Factor	1.25	1.21	1.18	1.15	1.12	1.10	1.08	1.06	1.04	1.02
Temperature (°C)	20	21	22	23	24	25	26	27	28	29
Correction Factor	1.00	0.98	0.96	0.95	0.94	0.93	0.92	0.91	0.90	0.89
Temperature (°C)	30	31	32	33	34	35	36	37	38	39
Correction Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Temperature (°C)	40									
Correction Factor	0.88									



## 1. PERFORMANCE

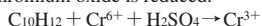
- 1) Measuring range : 2-60 ppm  
Number of pump strokes : 3 (300ml)
- 2) Sampling time : 4.5 minutes/3 pump strokes
- 3) Detectable limit : —
- 4) Shelf life : 2 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Ethyl cellosolve at 3 pump strokes and Dicyclopentadiene concentration is determined by using a conversion chart at 3 pump strokes
- 7) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 10 % RSD-high : 10 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



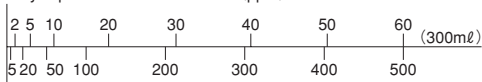
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

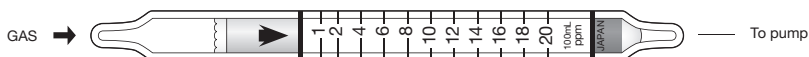
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Ethers	∕	∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	∕	∕
Ketones	∕	∕
Aromatic hydrocarbons	Whole reagent is changed to Brown.	∕
Esters	∕	∕
Halogenated hydrocarbons	∕	∕

Dicyclopentadiene concentration (ppm)



No. 190U tube reading (ppm)



## 1. PERFORMANCE

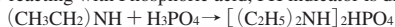
- 1) Measuring range : 1-20 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 0.3 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Pale purple → Pale yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

By reacting with Phosphoric acid, PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Ammonia	Similar stain is produced.	Higher readings are given.
Other Amines	∕	∕



## 1. PERFORMANCE

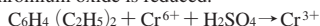
- 1) Measuring range : 10-180 ppm  
Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 2 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Ethyl acetate at 1 pump stroke and Diethyl benzene concentration is determined by using a conversion chart at 1 pump stroke
- 7) Colour change : Yellow → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 10 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



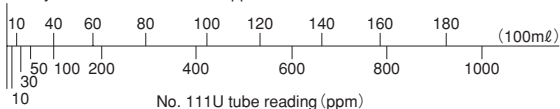
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

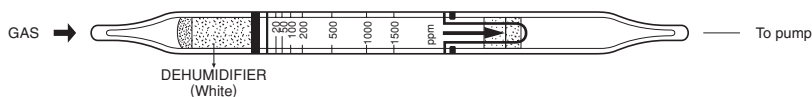
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar or brown stain is produced.	Higher readings are given.
Esters	∕	∕
Ketones	∕	∕
Aromatic hydrocarbons	∕	∕
Aliphatic hydrocarbons	Whole reagent is discoloured to Pale brown.	If the maximum end point of stained layer is discernable, the accuracy of readings is not affected.
Halogenated hydrocarbons	∕	∕

Diethyl benzene concentration (ppm)







## 1. PERFORMANCE

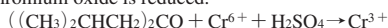
- |                          |   |
|--------------------------|---|
| 1) Measuring range       | : 20-1,000 ppm  |
| Number of pump strokes   | 1 (100mℓ)   |
| 2) Sampling time         | : 1.5 minutes/1 pump stroke   |
| 3) Detectable limit      | : —   |
| 4) Shelf life            | : 2 years   |
| 5) Operating temperature | : 15 ~ 25 °C  |
| 6) Reading               | : Graduations printed on the tube are calibrated by Metyl ethyl ketone at 1 pump stroke and Diisobutyl ketone concentration is determined by using a conversion chart at 1 pump stroke. |
| 7) Colour change         | : Yellow → Pale blue  |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.

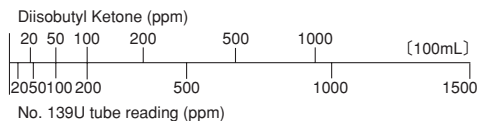


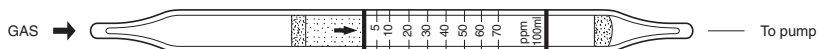
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohol	Similar or Brown stain is produced.	Higher readings are given.
Esters	∕	∕
Ketones	∕	∕
Aromatic hydrocarbons	∕	∕
Halogenated hydrocarbons		Whole reagent is changed to Brown, but if the maximum end point of the Pale blue stain is discernable, the accuracy of reading is not affected.
Aliphatic hydrocarbons		∕





## 1. PERFORMANCE

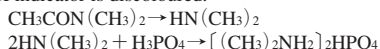
- 1) Measuring range : 5-70 ppm
- Number of pump strokes : 2 (200mℓ)
- 2) Sampling time : 2 minutes/1 pump stroke
- 3) Detectable limit : 1 ppm
- 4) Shelf life : 1 year
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation : Necessary under 20 °C (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 2 pump strokes
- 8) Colour change : Pale purple → Pale yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 %   RSD-mid. : 15 %   RSD-high : 15 %

## 3. CHEMICAL REACTION

By reacting with Alkali, Dimethyl amine is produced. Dimethyl amine reacts on Phosphoric acid and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence	
Carbon dioxide	The accuracy of readings is not affected.	0.17 %	Lower readings are given.
Sulphur dioxide	∕		
Ammonia	Similar stain is produced.		Higher readings are given.
Amines	∕		∕
Hydrazine	∕		∕

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)		
	10 °C (50 °F)	15 °C (59 °F)	20-40 °C (68-104 °F)
70	120	84	70
60	102	70	60
50	85	60	50
40	67	47	40
30	50	36	30
20	35	23	20
10	17	12	10
5	10	6	5



## 1. PERFORMANCE

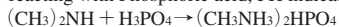
- 1) Measuring range : 1-20 ppm  
Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 0.2 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Pale purple → Pale yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

By reacting with Phosphoric acid, PH indicator is discoloured.

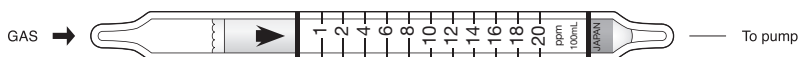


## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Ammonia	Similar stain is produced.	Higher readings are given.
Other Amines	∕	∕



## 1. PERFORMANCE

- 1) Measuring range : 0.5-9 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : Graduations printed on the tube are calibrated by Ammonia at 1 pump stroke and N, N-Dimethyl aniline concentration is determined by using a conversion chart at 1 pump stroke.
- 7) Colour change : Pale purple → Pale Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with Phosphoric acid, PH indicator is discoloured.

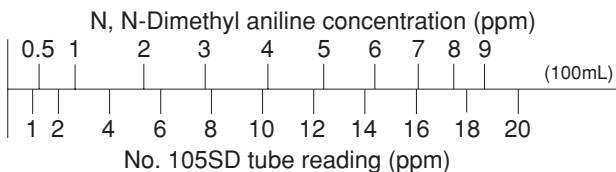


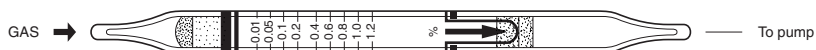
## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Amines	Similar stain is produced.	Higher readings are given.





## 1. PERFORMANCE

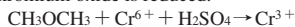
- 1) Measuring range : 0.01-1.2 %  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 0.001 % (10 ppm)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Orange → Dark brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.

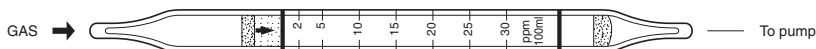


## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Acetylene		3%	Whole reagent is changed to Brown.
Propane		0.2%	“
Other organic gases or vapours except Halogenated hydrocarbons	Similar stain is produced.	50	Higher readings are given.



## 1. PERFORMANCE

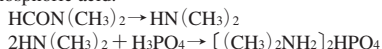
- 1) Measuring range : 2-30 ppm      1-5 ppm
- Number of pump strokes : 1 (100mℓ)    2 (200mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 0.2 ppm (200mℓ)
- 4) Shelf life : 2 years
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation : Necessary (0 ~ 20 °C) (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Pale purple → Pale yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with alkali, Amine is produced. Further, PH indicator is discoloured by reacting together with phosphoric acid.



## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Sulphur dioxide      FIG.1	The accuracy of readings is not affected.	200	Lower readings are given.
Carbon dioxide      FIG.2	∕	0.1 %	∕
Chlorine	∕		
Ammonia	Similar stain is produced.		Higher readings are given.
Amines	∕	∕	∕
Hydrazine	∕	∕	∕

(NOTE)

When the concentration is below 5 ppm, 2 pump strokes can be used to determine the lower concentration.

Following formula is available for the actual concentration.

Actual concentration = 1/2 × Temperature corrected value

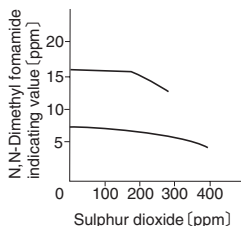


FIG.1 Influence of Sulphur dioxide

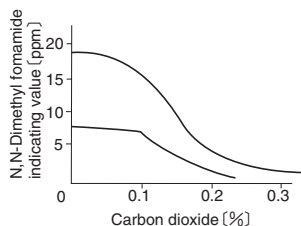


FIG.2 Influence of Carbon dioxide

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)		
	10 C (50 F)	15 C (59 F)	20-40 C (68-104 F)
30	81	40	30
25	67	33	25
20	54	27	20
15	40	20	15
10	27	13	10
5	13	7	5
2	5	3	2



## 1. PERFORMANCE

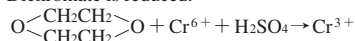
- 1) Measuring range : 0.05-2.5 %
- Number of pump strokes : 2 (200mℓ)
- 2) Sampling time : 3 minutes/2 pump strokes
- 3) Detectable limit : 10 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Graduations printed on the tube are calibrated by Methyl ethyl ketone at 2 pump strokes and 1,4-Dioxane concentration is determined by using a conversion chart.
- 7) Colour change : Orange → Brownish green

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

Dichromate is reduced.



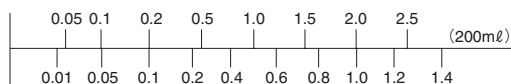
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

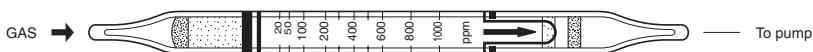
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Acetylene		3%	Whole reagent is discoloured to Brown.
Propane		0.2%	“
Other organic or vapours except Halogenated hydrocarbons	Similar stain is produced.	50	Higher reading are given.

Dioxane (%)



No. 139SB Tube reading (%)



## 1. PERFORMANCE

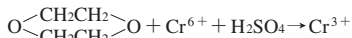
- 1) Measuring range : 20-500 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 5 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Graduations printed on the tube are calibrated by Methyl alcohol at 1 pump stroke and 1,4-Dioxane concentration is determined by using a conversion chart.
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



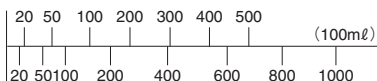
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols FIG.1	Similar stain is produced.	Higher readings are given.
Esters FIG.2		∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	Whole reagent is changed to Pale brown.	∕
Aromatic hydrocarbons	∕	∕
Ketones	∕	∕
Halogenated hydrocarbons	∕	∕

1,4-Dioxane concentration (ppm)

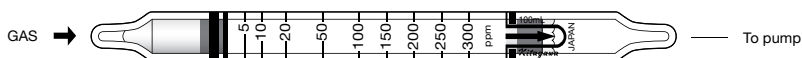


No. 119U Tube reading (ppm)

TEMPERATURE CORRECTION TABLE

Tube Readings (%)	Corrected Concentration (%)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
500	700	600	500	470	440
400	480	440	400	370	350
300	370	330	300	280	260
200	250	220	200	190	170
100	130	110	100	90	85
50	65	60	50	45	40
20	25	23	20	18	15





## 1. PERFORMANCE

- 1) Measuring range : 5-50 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Styrene at 1 pump stroke and Divinyl benzene concentration is determined by using a conversion chart at 1 pump stroke
- 7) Colour change : White → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 % RSD-mid. : 15 % RSD-high : 10 %

## 3. CHEMICAL REACTION

A polymer of Divinyl benzene is produced by Sulphuric acid.

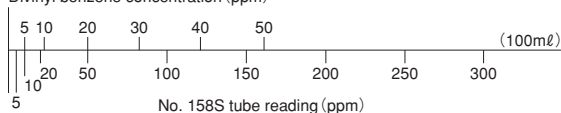
## 4. CALIBRATION OF THE TUBE

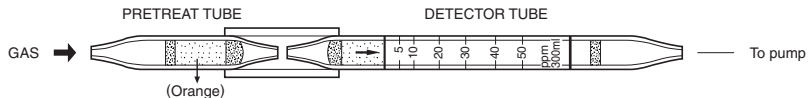
GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Acrylonitrile	The accuracy of readings is not affected.	400	Lower readings are given.
Butadiene	Similar stain is produced and higher readings are given.	5	Uneven discolouration is produced and higher readings are given.
Formaldehyde	∕	15	Yellowish orange stain is produced and higher readings are given.
Acetaldehyde	∕	350	Similar stain is produced and higher readings are given.
Methyl alcohol	The accuracy of readings is not affected.	0.35 %	Pale discolouration is produced and higher readings are given.
Ethyl alcohol	∕	0.18 %	∕
Ethyl acetate	∕	700	∕
Butyl acetate	∕	700	∕

Divinyl benzene concentration (ppm)





## 1. PERFORMANCE

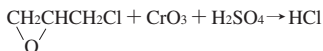
- 1) Measuring range : 5-50 ppm
- Number of pump strokes : 3 (300ml)
- 2) Sampling time : 2 minutes/3 pump strokes
- 3) Detectable limit : 1 ppm
- 4) Shelf life : 1 year
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 3 pump strokes
- 8) Colour change : Greenish yellow → Pink

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 10 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

By decomposing with an Oxidizer, Hydrogen chloride is produced and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Halogenated hydrocarbons FIG.1	Similar stain is produced.	Higher readings are given.

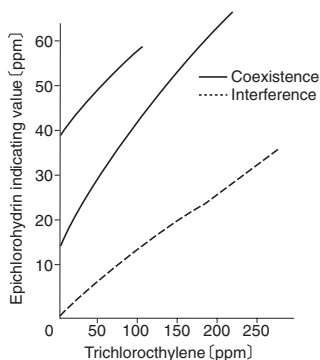
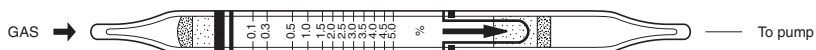


FIG.1 Influence of Trichloroethylene

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)							
	0 °C (32 °F)	5 °C (41 °F)	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)	
50	—	—	70	60	50	42	37	
40	—	—	57	47	40	34	30	
30	—	61	42	35	30	25	23	
20	80	39	29	24	20	17	15	
10	33	19	15	12	10	9	8	
5	15	10	8	6	5	5	4	



## 1. PERFORMANCE

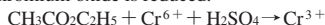
- 1) Measuring range : 0.1-5.0 %
- Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 0.001% (10 ppm)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Orange → Brownish green

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 5%    RSD-high : 5%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

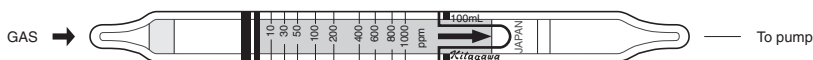
GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Acetylene		3%	Whole reagent is discoloured to Brown.
Propane		0.2%	∕
Other halogenic or vapours except Halogenated hydrocarbons	Similar stain is produced.	50	Higher reading are given.

TEMPERATURE CORRECTION TABLE

Tube Readings (%)	Corrected Concentration (%)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
5.0	—	—	5.0	4.0	3.0
4.5	—	—	4.5	3.6	2.7
4.0	—	5.8	4.0	3.2	2.4
3.5	—	5.0	3.5	2.8	2.1
3.0	—	4.2	3.0	2.3	1.7
2.5	—	3.5	2.5	1.9	1.4
2.0	—	2.6	2.0	1.5	1.1
1.5	2.6	1.9	1.5	1.1	0.7
1.0	1.5	1.2	1.0	0.7	0.4
0.5	0.6	0.6	0.5	0.3	0.2
0.3	0.4	0.3	0.3	0.2	0.1
0.1	0.1	0.1	0.1	0.1	0.1



## 1. PERFORMANCE

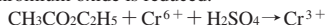
- 1) Measuring range : 10-1,000 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 5 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION COEFFICIENT TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Yellow → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 10 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher reading are given.
Esters	∕	∕
Ketones	∕	∕
Aromatic hydrocarbons	∕	∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	∕	∕
Halogenated hydrocarbons FIG.1	Whole reagent is discoloured to Pale brown.	If the maximum end point of the brown stain is discernable, the accuracy of readings is not affected.

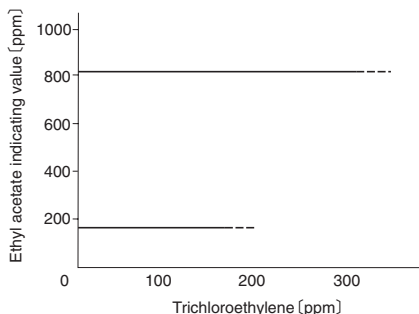
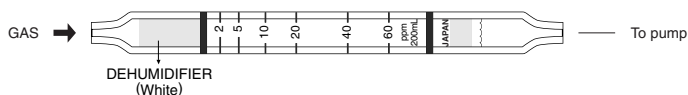


FIG.1 Influence of Trichloroethylene

TEMPERATURE CORRECTION COEFFICIENT TABLE

Tube Readings (ppm)	Correction Coefficient (at 20 °C)							
	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	25 °C (77 °F)	30 °C (86 °F)	35 °C (95 °F)	40 °C (104 °F)	
1,000	1.33	1.17	1.00	0.87	0.74	0.64	0.53	
800	1.38	1.19	1.00	0.86	0.73	0.63	0.53	
600	1.40	1.20	1.00	0.86	0.72	0.63	0.53	
400	1.40	1.20	1.00	0.85	0.70	0.58	0.46	
200	1.40	1.20	1.00	0.84	0.68	0.55	0.42	
100	1.50	1.25	1.00	0.81	0.62	0.48	0.33	
50	1.50	1.25	1.00	0.77	0.54	0.43	0.32	
30	1.50	1.25	1.00	0.77	0.53	0.42	0.30	
10	1.50	1.25	1.00	0.75	0.50	0.40	0.30	



## 1. PERFORMANCE

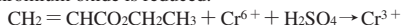
- 1) Measuring range : 5-60 ppm  
Number of pump strokes : 2 (200ml)
- 2) Sampling time : 3 minutes/2 pump strokes
- 3) Detectable limit : 0.5 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Graduations printed on the tube are calibrated by Methyl acrylate at 2 pump strokes and Ethyl acrylate concentration is determined by using a conversion chart.
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 % RSD-mid. : 10 % RSD-high : 10 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

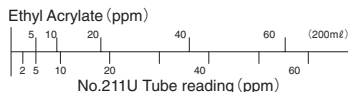
GAS CHROMATOGRAPHY

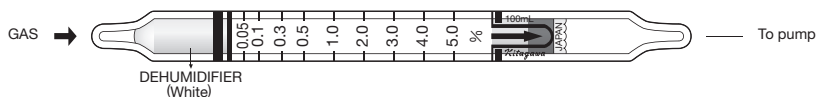
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher reading are given.
Aliphatic hydrocarbons (more than C <sub>3</sub> )	Whole reagent is discoloured to Dark brown.	∕
Halogenated hydrocarbons	∕	∕
Esters	∕	∕
Aromatic hydrocarbons	∕	∕

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
60	80	70	60	52	44
40	52	46	40	34	28
20	27	23	20	17	15
10	14	12	10	9	7
5	7	6	5	4	3





## 1. PERFORMANCE

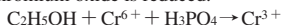
- 1) Measuring range : 0.05-5.0 %
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 0.01 %
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Yellowish orange → Light green (The top of discoloured layer is Brown, but read at the top of Pale green.)

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

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## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Aliphatic hydrocarbons (over C <sub>3</sub> )	Similar stain is produced.	Higher reading are given.
Alcohols	∕	∕
Esters	∕	∕
Ketones	∕	∕
Aromatic hydrocarbons	∕	∕
Halogenated hydrocarbons	Pale brown stain is produced.	If the maximum end point of the stain is discernable, the accuracy of readings is not affected.

### TEMPERATURE CORRECTION TABLE

Tube Readings (%)	Corrected Concentration (%)				
	0 °C (32 F)	10 °C (50 F)	20 °C (68 F)	30 °C (86 F)	40 °C (104 F)
5.0	—	—	5.0	3.9	3.2
4.0	—	—	4.0	3.2	2.6
3.0	—	—	3.0	2.4	2.0
2.0	—	—	2.0	1.6	1.3
1.0	—	1.9	1.0	0.8	0.7
0.5	—	0.8	0.5	0.4	0.3
0.3	0.9	0.4	0.3	0.3	0.2
0.1	0.1	0.1	0.1	0.1	0.1



## 1. PERFORMANCE

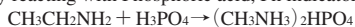
- 1) Measuring range : 1-20 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 0.2 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : The tube scale is calibrated based on Methyl amine at 1 pump stroke and the tube has the same sensitivity for Ethyl amine.
- 7) Colour change : Pale purple → Pale yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 10 % RSD-high : 10 %

## 3. CHEMICAL REACTION

By reacting with Phosphoric acid, Ph indicator is discoloured.

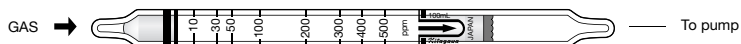


## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Ammonia	Similar stain is produced.	Higher reading are given.
Other amines	∕	∕



## 1. PERFORMANCE

- 1) Measuring range : 10-500 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 2 minutes/1 pump stroke
- 3) Detectable limit : 3 ppm
- 4) Shelf life : 1.5 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (0 ~ 20 °C) (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : White → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %   RSD-mid. : 10 %   RSD-high : 5 %

## 3. CHEMICAL REACTION

Iodine pentoxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

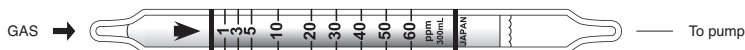
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Benzene	Similar stain is produced.		Higher readings are given.
Toluene	∕		∕
Xylene	∕		∕
Methanol	The accuracy of readings is not affected.	1 %	∕
Hexane	Pale brown stain is produced.	0.1 %	The maximum end point of the stain is indiscernable and higher readings are given.

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)			
	0 °C (32 °F)	5 °C (50 °F)	10 °C (68 °F)	20 °C (86 °F)
500	—	—	600	500
400	590	520	465	400
300	390	360	330	300
200	240	225	215	200
100	120	112	105	100





## 1. PERFORMANCE

- 1) Measuring range : 1-60 ppm  
Number of pump strokes : 3 (300mℓ)
- 2) Sampling time : 4.5 minutes/3 pump strokes
- 3) Detectable limit : 0.5 ppm
- 4) Shelf life : 1 year
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 3 pump strokes
- 8) Colour change : Pale yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

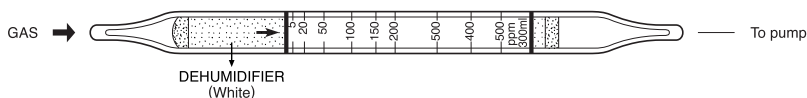
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Ethyl alcohol	Similar stain is produced.	Higher readings are given.

### TEMPERATURE CORRECTION TABLE

Temperature ; To correct for temperature, multiply the tube reading by the following factors.

Temperature (°C)	0	1	2	3	4	5	6	7	8	9
Correction Factor	1.86	1.81	1.75	1.70	1.65	1.60	1.55	1.50	1.46	1.41
Temperature (°C)	10	11	12	13	14	15	16	17	18	19
Correction Factor	1.37	1.33	1.29	1.25	1.21	1.17	1.13	1.10	1.06	1.03
Temperature (°C)	20	21	22	23	24	25	26	27	28	29
Correction Factor	1.00	0.97	0.95	0.92	0.90	0.88	0.86	0.84	0.82	0.81
Temperature (°C)	30	31	32	33	34	35	36	37	38	39
Correction Factor	0.79	0.78	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.73
Temperature (°C)	40									
Correction Factor	0.73									



## 1. PERFORMANCE

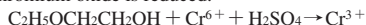
- 1) Measuring range : 5-500 ppm
- Number of pump strokes : 3 (300ml)
- 2) Sampling time : 4.5 minutes/3 pump strokes
- 3) Detectable limit : 2 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 10 ~ 35 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 3 pump strokes
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 10 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.

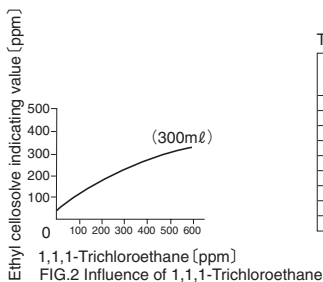
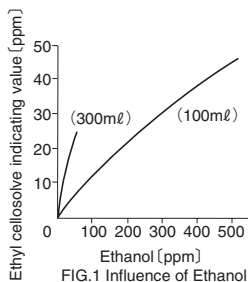


## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

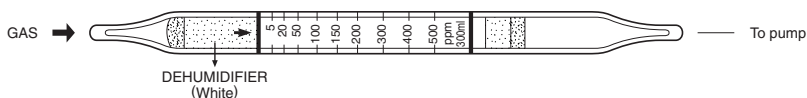
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols FIG.1	Similar stain is produced.	Higher readings are given.
Ethers	∕	∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	Whole reagent is changed to Brown.	∕
Aromatic hydrocarbons	∕	∕
Esters	∕	∕
Ketones	∕	∕
Halogenated hydrocarbons FIG.2	∕	∕



TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)					
	10 °C (50 F)	15 °C (59 F)	20 °C (68 F)	25 °C (77 F)	30 °C (80 F)	35 °C (95 F)
500	800	620	500	410	340	270
400	620	490	400	330	260	200
300	450	370	300	250	200	150
200	290	250	200	160	130	100
150	220	190	150	120	90	70
100	150	130	100	80	60	50
50	80	70	50	40	30	30
20	30	25	20	15	12	10
5	10	7	5	4	3	2



## 1. PERFORMANCE

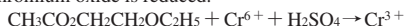
- 1) Measuring range : 5-150 ppm
- Number of pump strokes : 3 (300ml)
- 2) Sampling time : 4.5 minutes/3 pump strokes
- 3) Detectable limit : 2 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 10 ~ 35 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Graduations printed on the tube are calibrated by Ethyl cellosolve at 3 pump strokes and Ethyl cellosolve acetate concentration is determined by using a conversion chart.
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



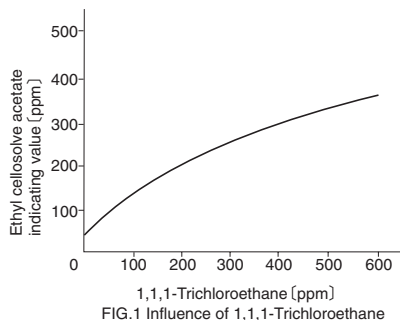
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

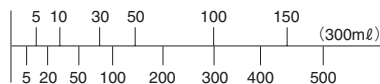
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Ethers	∕	∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	Whole reagent is changed to Pale Brown.	∕
Aromatic hydrocarbons	∕	∕
Esters	∕	∕
Ketones	∕	∕
Halogenated hydrocarbons	∕	∕

FIG.1



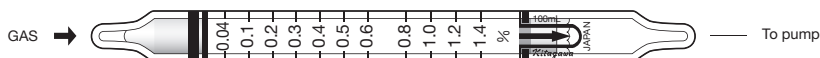
Ethyl cellosolve acetate (ppm)



No.190U Tube reading (ppm)

### TEMPERATURE CORRECTION TABLE

Conversion Value (ppm)	Corrected Concentration (ppm)					
	10 C (50 F)	15 C (59 F)	20 C (68 F)	25 C (77 F)	30 C (80 F)	35 C (95 F)
150	230	190	150	120	90	75
100	160	130	100	80	70	60
50	80	60	50	40	35	30
20	25	23	20	18	16	14
10	10	10	10	10	8	7
5	5	5	5	5	5	5



## 1. PERFORMANCE

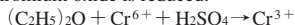
- 1) Measuring range : 0.04-1.4 %  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 0.001 % (10 ppm)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Orange → Dark green

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

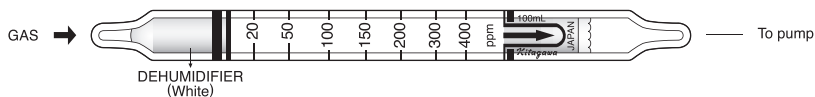
GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Acetylene		3 %	Whole reagent is changed to Brown.
Propane		0.2 %	∕
Other organic gases and vapours except Halogenated hydrocarbons	Similar stain is produced.	50	Higher readings are given.

TEMPERATURE CORRECTION TABLE

Tube Readings (%)	Corrected Concentration (%)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
1.4	1.8	1.6	1.4	1.3	1.1
1.2	1.5	1.4	1.2	1.1	0.9
1.0	1.2	1.1	1.0	0.9	0.8
0.8	0.9	0.9	0.8	0.7	0.6
0.6	0.6	0.6	0.6	0.6	0.5
0.5	0.5	0.5	0.5	0.5	0.4
0.4	0.4	0.4	0.4	0.4	0.3
0.3	0.3	0.3	0.3	0.3	0.3



## 1. PERFORMANCE

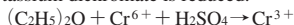
- 1) Measuring range : 20-400 ppm  
Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 1 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Pale yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 %    RSD-mid : 10 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Potassium dichromate is reduced.



## 4. CALIBRATION OF THE TUBE

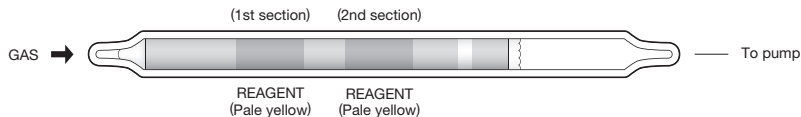
GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Esters	∕	∕
Ketones	∕	∕
Aromatic hydrocarbons	Whole reagent is changed to Pale brown.	∕

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)			
	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
400	640	400	290	230
300	480	300	220	180
200	320	200	150	120
150	240	150	110	90
100	160	100	80	60
50	90	50	40	30
20	40	20	20	10



## 1. PERFORMANCE

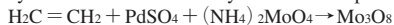
- |                          |                           |            |
|--------------------------|---------------------------|------------|
| 1) Measuring range       | : 0.5-100 ppm             | 0.1-20 ppm |
| Number of pump strokes   | 1 (100mℓ)                 | 5 (500mℓ)  |
| 2) Sampling time         | : 2 minutes/1 pump stroke |            |
| 3) Detectable limit      | : 0.01 ppm (500mℓ)        |            |
| 4) Shelf life            | : 3 years                 |            |
| 5) Operating temperature | : 0 ~ 40 °C               |            |
| 6) Reading               | : Colour intensity method |            |
| 7) Colour change         | : Pale yellow → Blue      |            |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : RSD-mid. : RSD-high :

## 3. CHEMICAL REACTION

Molybdate is reduced and molybdeum blue is produced.

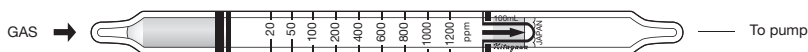


## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Hydrogen (over 40 °C)	Similar stain is produced.	10%	Whole reagent is discoloured to Blue and higher readings are given.
Saturated hydrocarbons	∕		Higher readings are given.
Acetylene	Dark blue stain is produced.		∕
Carbon monoxide	Green or Blue stain is produced.		Lower readings are given.
Hydrogen sulphide	Black stain is produced.	1,000	∕
Hydrogen cyanide	Original colour is faded to White.		∕
Benzene	Yellowish orange or Yellowish brown stain is produced.		
Carbon disulphide	∕		
Chlorine	∕		
Nitrogen dioxide	∕	1	
Ammonia	Original colour fades to White.		Lower readings are given.



## 1. PERFORMANCE

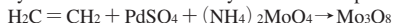
- 1) Measuring range : 20-1,200 ppm
- Number of pump strokes : 1 (100ml)
- 2) Sampling time : 3 minutes/1 pump stroke
- 3) Detectable limit : 10 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Yellow → Blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 5 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Molybdate is reduced and molybdeum blue is produced.

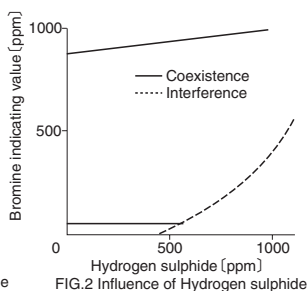
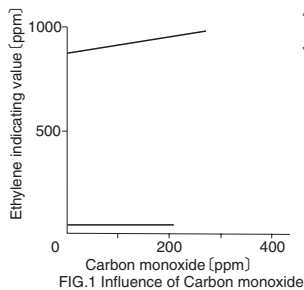


## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

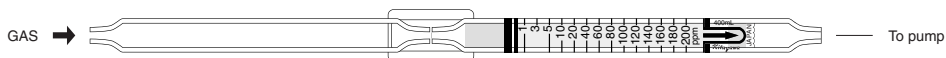
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	Coexistence
Carbon monoxide    FIG.1	10	Whole layer is discoloured to Green.	Higher readings are given.
Hydrogen sulphide    FIG.2	500	Black stain is produced.	∕
Acetylene	20	Similar stain is produced.	∕
Propylene		∕	∕



TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
1,200	950	1,100	1,200	1,300	1,350
1,000	800	900	1,000	1,050	1,100
800	650	720	800	820	840
600	500	550	600	600	600
400	400	400	400	400	400
200	200	200	200	180	150
100	100	100	100	50	—
50	70	60	50	—	—
20	40	30	20	—	—



## 1. PERFORMANCE

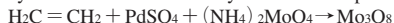
- 1) Measuring range : 1-200 ppm  
Number of pump strokes : 4 (400mℓ)
- 2) Sampling time : 12 minutes/4 pump strokes
- 3) Detectable limit : 0.1 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (0 ~ 20 °C) (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 4 pump strokes
- 8) Colour change : Yellow → Blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 5 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Molybdate is reduced and molybdeum blue is produced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

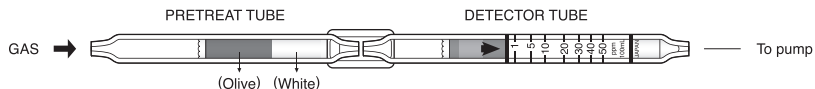
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Acetylene	Dark brown stain is produced.	Higher readings are given.
Carbon monoxide	Similar stain is produced.	∕
Hydrogen sulphide	Black stain is produced.	∕
Propylene	Similar stain is produced.	∕

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)		
	0 °C (32 °F)	10 °C (50 °F)	20 °C ~ 40 °C (68 °F ~ 104 °F)
200	220	210	200
180	200	190	180
160	180	170	160
140	160	150	140
120	130	140	120
100	120	110	100
80	105	92.5	80
60	85	72.5	60
40	70	65	40
20	55	40	20
10	40	25	10
5	25	15	5
3	18	12.5	3
1	7	4	1





## 1. PERFORMANCE

- 1) Measuring range : 1-50 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 0.2 ppm
- 4) Shelf life : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : White → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

Bromine is produced by an Oxidizer. By reacting between this Bromine and *o*-Toluidine, Orthoquinone is produced  
 $\text{BrCH}_2\text{CH}_2\text{Br} + \text{I}_2\text{O}_5 + \text{CrO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{Br}_2$

## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Halogens	Similar stain is produced.		Higher readings are given.
Halogenated hydrocarbons	∕		∕
Hexane FIG.1	The accuracy of readings is not affected.	200	Lower readings are given.

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)					
	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	25 °C (77 °F)	30 °C (80 °F)	35 °C (95 °F)
50	—	—	82	50	42	39
40	—	80	58	40	35	33
30	98	56	40	30	27	26
20	50	40	30	20	18	18
10	16	14	12	10	10	10
5	7	7	6	5	5	5
1	1	1	1	1	1	1

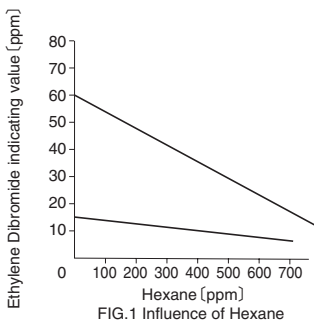
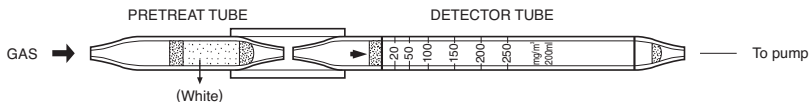


FIG.1 Influence of Hexane



## 1. PERFORMANCE

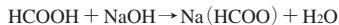
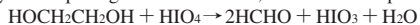
- 1) Measuring range : 20-250 mg/m<sup>3</sup>  
Number of pump strokes : 2 (200ml)
- 2) Sampling time : 3 minutes/2 pump strokes
- 3) Detectable limit : 5 mg/m<sup>3</sup>
- 4) Shelf life : 1.5 years
- 5) Operating temperature : 20 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 2 pump strokes
- 8) Colour change : Pink → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 10 % RSD-high : 10 %

## 3. CHEMICAL REACTION

By decomposing with an Oxidizer, Formic acid is produced and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

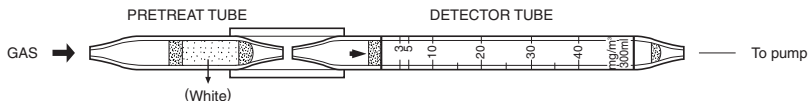
GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Aldehydes	Similar stain is produced.	Higher readings are given.
Sulphur dioxide	∕	∕
Ethylene oxide	∕	∕
Hydrogen sulphide	Orange/Yellow stain is produced.	∕

### TEMPERATURE CORRECTION TABLE

Tube Readings (mg/m <sup>3</sup> )	Corrected Concentration (mg/m <sup>3</sup> )				
	20 °C (68 °F)	22 °C (71.6 °F)	25 °C (77 °F)	30 °C (86 °F)	40 °C (104 °F)
250	—	370	250	200	155
200	—	260	200	165	130
150	270	170	150	125	105
100	120	110	100	85	75
50	60	55	50	45	40
20	23	20	20	18	15



## 1. PERFORMANCE

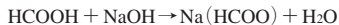
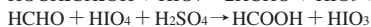
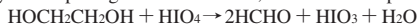
- 1) Measuring range : 3-40mg/m<sup>3</sup>  
Number of pump strokes : 3 (300mℓ)
- 2) Sampling time : 4.5 minutes/3 pump strokes
- 3) Detectable limit : 1mg/m<sup>3</sup>
- 4) Shelf life : 2 years
- 5) Operating temperature : 15 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 3 pump strokes
- 8) Colour change : Pale pink → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

By decomposing with an Oxidizer, Formic acid is produced and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

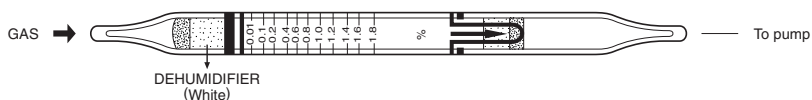
GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Aldehydes	Similar stain is produced.	Higher readings are given.
Sulphur dioxide	Brownish yellow stain is produced.	∕
Hydrogen sulphide	∕	∕

### TEMPERATURE CORRECTION TABLE

Tube Readings (mg/m <sup>3</sup> )	Corrected Concentration (mg/m <sup>3</sup> )			
	15 °C (59 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
40	67	40	32	25
30	50	30	24	19
20	34	20	16	12
10	17	10	8	6
5	8	5	4	3
3	5	3	2.5	2



## 1. PERFORMANCE

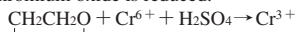
- 1) Measuring range : 1.0-4.0 %      0.01-1.8 %  
     Number of pump strokes : 1/2 (50ml)    1 (100ml)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 0.005 % (50 ppm)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Orange → Dark brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

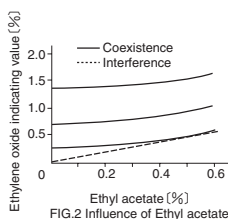
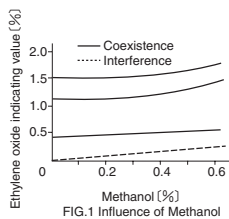
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Alcohols      FIG.1	Similar stain is produced.		Higher readings are given.
Esters      FIG.2	∕		∕
Ketones	∕		∕
Aromatic hydrocarbons	∕		∕
Halogenated hydrocarbons	Whole reagent is discoloured to Pale brown.	0.5 %	∕

Ethanol is indicated with half the sensitivity, Ethyl acetate has the same sensitivity with Ethylene oxide.

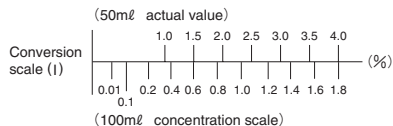
(NOTE)

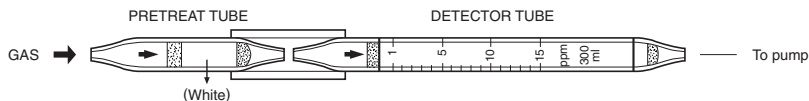
- 1) If the discolouration exceeds the scale, replace the tube with new one and pull the handle at half stroke (to 50ml line). And read the concentration.
- 2) Correct the reading value with the temperature correction table first, and convert the value into an actual concentration by using the conversion scale shown in the instruction sheet.



### TEMPERATURE CORRECTION TABLE

Tube Readings (%)	Corrected Concentration (%)			
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)
1.8	—	2.00	1.80	1.70
1.6	2.06	1.78	1.60	1.50
1.4	1.84	1.58	1.40	1.35
1.2	1.60	1.34	1.20	1.14
1.0	1.31	1.12	1.00	0.93
0.8	1.08	0.91	0.80	0.73
0.6	0.86	0.70	0.60	0.54
0.4	0.63	0.49	0.40	0.34
0.2	0.36	0.26	0.20	0.16
0.1	0.20	0.14	0.10	0.08
0.01	0.05	0.02	0.01	0.01





## 1. PERFORMANCE

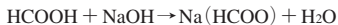
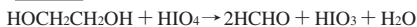
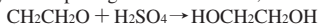
- 1) Measuring range : 1-15 ppm  
Number of pump strokes : 3 (300ml)
- 2) Sampling time : 4.5 minutes/3 pump strokes
- 3) Detectable limit : 0.5 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 3 pump strokes
- 8) Colour change : Pale pink → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

By decomposing with an Oxidizer, Formic acid is produced and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance		Interference	Coexistence
Aldehydes	FIG.2	Similar stain is produced.	Higher readings are given.
Sulphur dioxide		Pale yellow stain is produced.	∕
Hydrogen sulphide	FIG.1	∕	∕

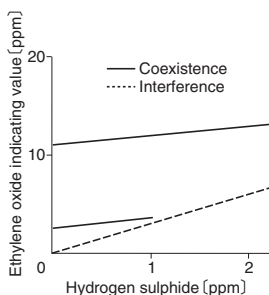


FIG.1 Influence of Hydrogen sulphide

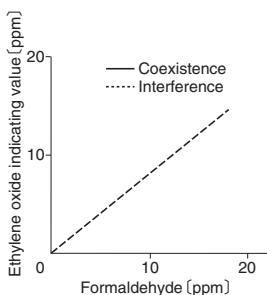
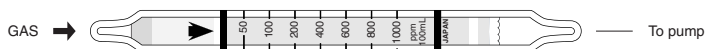


FIG.2 Influence of Formaldehyde

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)			
	10 °C (50 °F)	15-25 °C (59-77 °F)	30 °C (86 °F)	40 °C (77 °F)
15	19.0	15.0	13.0	10.0
10	12.5	10.0	8.5	7.0
5	6.0	5.0	4.0	3.5
1	1.0	1.0	1.0	0.5



## 1. PERFORMANCE

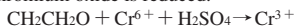
- |                             |   |              |
|-----------------------------|---|--------------|
| 1) Measuring range          | : 130-2,600 ppm   | 50-1,000 ppm |
| Number of pump strokes      | 1/2 (50mℓ)  | 1 (100mℓ)    |
| 2) Sampling time            | : 1.5 minutes/1 pump stroke                                 |              |
| 3) Detectable limit         | : 10 ppm (100mℓ)  |              |
| 4) Shelf life               | : 3 years   |              |
| 5) Operating temperature    | : 10 ~ 40 °C  |              |
| 6) Temperature compensation | : Necessary (See "TEMPERATURE CORRECTION TABLE")            |              |
| 7) Reading                  | : Direct reading from the scale calibrated by 1 pump stroke |              |
| 8) Colour change            | : Yellow → Pale blue  |              |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Esters	∕	∕
Ethers	∕	∕
Ketones	∕	∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	∕	∕
Aromatic hydrocarbons	∕	∕
Halogenated hydrocarbons	∕	∕

(NOTE)

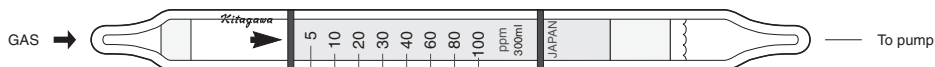
In case of 1/2 pump strokes, the following formula is available for the actual concentration.

Actual concentration = 2.6 × Reading value

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)						
	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	25 °C (77 °F)	30 °C (86 °F)	35 °C (95 °F)	40 °C (104 °F)
1000	990	990	1000	1080	1180	1350	1570
800	790	790	800	880	970	1130	1310
600	550	575	600	670	750	880	1050
400	330	360	400	460	520	650	790
200	150	175	200	240	280	330	430
100	85	85	100	115	120	140	170
50	45	45	50	50	55	60	70

\* In case of 1/2 pump strokes, no temperature correction is necessary at less than 20 °C.



## 1. PERFORMANCE

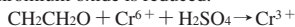
- 1) Measuring range : 5-100 ppm  
Number of pump strokes : 3 (300mℓ)
- 2) Sampling time : 4.5 minutes/3 pump strokes
- 3) Detectable limit : 3 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 3 pump strokes
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 5 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

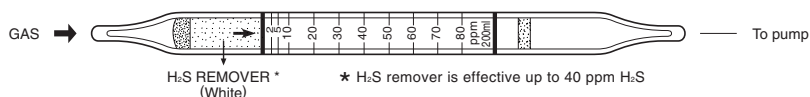
PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Ethers	∕	∕
Esters	∕	∕
Ketones	∕	∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	∕	∕
Aromatic hydrocarbons	∕	∕
Halogen hydrocarbons	∕	∕

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)							
	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	25 °C (77 °F)	30 °C (86 °F)	35 °C (95 °F)	40 °C (104 °F)	
100	70	79	100	122	—	—	—	
80	57	64	80	97	120	—	—	
60	44	48	60	73	92	115	140	
40	31	33	40	46	60	78	92	
30	25	26	30	33	40	50	60	
20	17	18	20	22	26	28	30	
10	9	10	10	10	10	11	11	
5	5	5	5	5	5	5	5	



## 1. PERFORMANCE

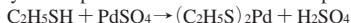
- |                             |  |           |           |
|-----------------------------|--|-----------|-----------|
| 1) Measuring range          | : 4-160 ppm  | 2-80 ppm  | 1-40 ppm  |
| Number of pump strokes      | 1 (100mℓ)  | 2 (200mℓ) | 4 (400mℓ) |
| 2) Sampling time            | : 3 minutes/2 pump strokes                                   |           |           |
| 3) Detectable limit         | : 0.2 ppm (200mℓ)  |           |           |
| 4) Shelf life               | : 2 years  |           |           |
| 5) Operating temperature    | : 0 ~ 40 °C  |           |           |
| 6) Temperature compensation | : Necessary (0 ~ 20 °C) (See "TEMPERATURE CORRECTION TABLE") |           |           |
| 7) Reading                  | : Direct reading from the scale calibrated by 2 pump strokes |           |           |
| 8) Colour change            | : White → Yellow   |           |           |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 10 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Ethyl mercaptan reacts with Palladium sulphate.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	ppm	Coexistence
Carbon monoxide	150	Dark grey stain is produced.		
Ethylene	200	∕		
Hydrogen sulphide	40	Dark brown stain is produced.		
Acetylene	20	Pale brown stain is produced.		
Methyl mercaptan	1	Reddish yellow stain is produced.		
Methyl sulphide			1	Lower readings are given.
Nitrogen dioxide			1	∕
Chlorine			0.2	∕

(NOTE)

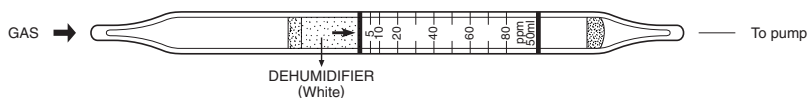
- 1) Max. 40 ppm of Hydrogen sulphide is eliminated by pretreat reagent.
- 2) In case of 1 or 4 pump strokes, following formula is available for the actual concentration.

$$\text{Actual concentration} = \text{Temperature corrected value} \times \frac{2}{\text{Number of pump strokes}}$$

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)		
	0 °C (32 °F)	10 °C (50 °F)	20-40 °C (68-104 °F)
80	91	85	80
70	80	75	70
60	69	64	60
50	57	53	50
40	45	42	40
30	33	31	30
20	21	20	20





## 1. PERFORMANCE

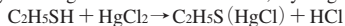
- |                          |  |            |
|--------------------------|--|------------|
| 1) Measuring range       | : 5-80 ppm   | 2.5-40 ppm |
| Number of pump strokes   | 1/2 (50mℓ)   | 1 (100mℓ)  |
| 2) Sampling time         | : 30 seconds/ 1/2 pump strokes                                 |            |
| 3) Detectable limit      | : 1 ppm (100mℓ)  |            |
| 4) Shelf life            | : 2 years  |            |
| 5) Operating temperature | : 0 ~ 40 °C  |            |
| 6) Reading               | : Direct reading from the scale calibrated by 1/2 pump strokes |            |
| 7) Colour change         | : Yellow → Pink  |            |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15%    RSD-mid. : 10%    RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Mercuric chloride, Hydrogen chloride is produced and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

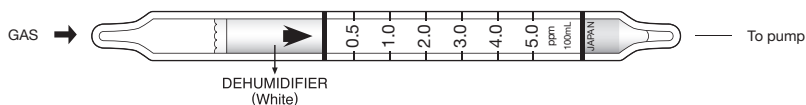
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Hydrogen sulphide	Similar stain is produced.	Higher readings are given.
Phosphine	∕	∕
Other mercaptans	∕	∕
Arsine	∕	∕
Hydrogen selenide	∕	∕
Hydrogen cyanide	∕	∕
Nitrogen dioxide	The accuracy of readings is not affected.	Lower readings are given.
Ammonia	∕	∕
Sulphur dioxide	Whole layer is discoloured to Pale red.	The accuracy of readings is not affected if the maximum end point of the pink stain is discernable.

### (NOTE)

In case of a 1 pump stroke, following formula is available for the actual concentration.

Actual concentration = 0.5 × Reading value



## 1. PERFORMANCE

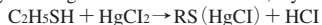
- |                          |  |           |
|--------------------------|--|-----------|
| 1) Measuring range       | : 1-10 ppm   | 0.5-5 ppm |
| Number of pump strokes   | : 1/2 (50mℓ)   | 1 (100mℓ) |
| 2) Sampling time         | : 1 minute/1 pump stroke   |           |
| 3) Detectable limit      | : 0.2 ppm (100mℓ)  |           |
| 4) Shelf life            | : 2 years  |           |
| 5) Operating temperature | : 0 ~ 40 °C  |           |
| 6) Reading               | : The tube scale is calibrated based on Methyl mercaptan at 1 pump stroke and the tube has the same sensitivity for Ethyl mercaptan. |           |
| 7) Colour change         | : Pale yellow → Pink   |           |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with Mercuric chloride, Hydrogen chloride is produced and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

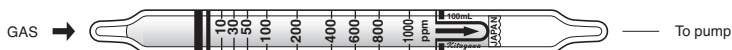
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Arsine	Similar stain is produced.	Higher readings are given.
Hydrogen selenide	∕	∕
Phosphine	∕	∕
Hydrogen sulphide	∕	∕
Hydrogen cyanide	Whole reagent is discoloured to Red.	∕
Sulphur dioxide		Whole reagent is changed to Pale red, but Pink stain indicates Mercaptans conc.

(NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.

Actual concentration = 2 × Reading value



## 1. PERFORMANCE

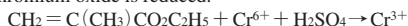
- 1) Measuring range : 20-500 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 2 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Ethyl acetate at 1 pump stroke and Ethyl methacrylate concentration is determined by using a conversion chart at 1 pump stroke
- 7) Colour change : Yellow → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 5%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.

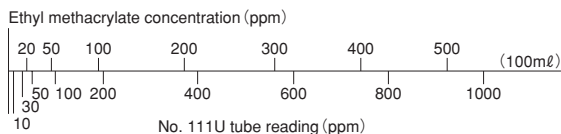


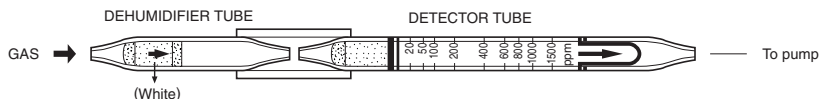
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar or brown stain is produced.	Higher readings are given.
Esters	∕	∕
Ketones	∕	∕
Aromatic hydrocarbons	∕	∕
Aliphatic hydrocarbons	Whole reagent is discoloured to Pale brown.	If the maximum end point of stained layer is discernable, the accuracy of readings is not affected.
Halogenated hydrocarbons	∕	∕





## 1. PERFORMANCE

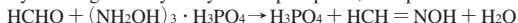
- 1) Measuring range : 20-1,500 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minute s/1 pump stroke
- 3) Detectable limit : 5 ppm
- 4) Shelf life : 2 years (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Yellow → Pink

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 10 % RSD-high : 10 %

## 3. CHEMICAL REACTION

By reacting with Hydroxylamine phosphate, Phosphoric acid is liberated and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

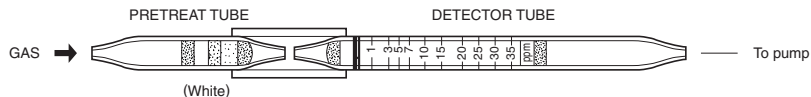
ABSORPTIOMETRIC METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Other Aldehydes	Similar stain is produced.		Higher readings are given.
Ketones	∕		∕
Methanol	The accuracy of readings is not affected.	Formaldehyde conc. × 1/2	Lower readings are given.

## TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)							
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	25 °C (77 °F)	30 °C (86 °F)	35 °C (95 °F)	40 °C (104 °F)	
1500	—	—	1500	900	690	530	410	
1000	—	—	1000	700	550	430	340	
800	—	1300	800	600	490	390	300	
600	1200	900	600	490	410	330	250	
400	600	520	400	350	290	230	180	
200	240	230	200	180	150	130	100	
130	100	100	100	90	80	70	60	
50	50	50	50	45	40	35	30	
20	20	20	20	20	20	20	20	



## 1. PERFORMANCE

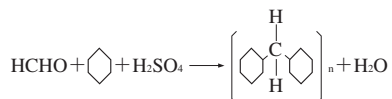
- 1) Measuring range : 1-35 ppm
- Number of pump strokes : 3 (300mℓ)
- 2) Sampling time : 3 minutes/3 pump strokes
- 3) Detectable limit : 0.5 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 3 pump strokes
- 7) Colour change : White → Brownish orange

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15% RSD-mid. : 15% RSD-high : 15%

## 3. CHEMICAL REACTION

By reacting with Aromatic compounds, a polymer is produced.

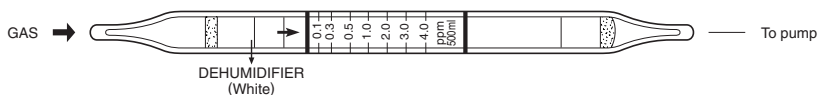


## 4. CALIBRATION OF THE TUBE

ABSORPTIOMETRIC METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Styrene	Similar stain is produced.		Higher readings are given.
Trichloroethylene		500	∕
Ethyl acetate		1,000	∕
Ether		1,000	∕
Acetaldehyde	Similar stain is produced.	1	∕



## 1. PERFORMANCE

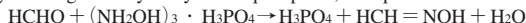
- 1) Measuring range : 0.1-4.0 ppm      0.05-2.0 ppm
- Number of pump strokes : 5 (500mℓ)      10 (1000mℓ)
- 2) Sampling time : 5 minutes/5 pump strokes
- 3) Detectable limit : 0.03 ppm (1000mℓ)
- 4) Shelf life : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 5 pump strokes
- 8) Colour change : Yellowish orange → Pink

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 10 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

By reacting with Hydroxylamine phosphate, Phosphoric acid is liberated and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

ABSORPTIOMETRIC METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	ppm	Coexistence
Ammonia		The accuracy of readings is not affected.	10	Lower readings are given. Inlet side is faded the discoloured layer.
Nitrogen dioxide	3	Similar stain is produced.	3	Higher readings are given. The top of discoloured layer becomes unclear.
Acetaldehyde		∕		Higher readings are given.
Toluene		The accuracy of readings is not affected.		The accuracy of readings is not affected.
Methanol		∕		

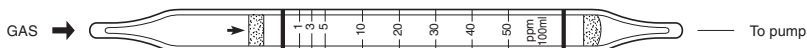
### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)			
	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
4.0	6.4	4.0	2.4	1.6
3.5	5.6	3.5	2.1	1.4
3.0	4.8	3.0	1.8	1.2
2.5	4.0	2.5	1.5	1.0
2.0	3.2	2.0	1.2	0.8
1.5	2.4	1.5	0.9	0.6
1.0	1.6	1.0	0.6	0.4
0.5	0.8	0.5	0.3	0.2
0.3	0.5	0.3	0.18	0.12
0.1	0.16	0.1	0.06	0.04

(NOTE)

In case of 10 pump strokes, following formula is available for the actual concentration.

Actual concentration = 1/2 × Temperature corrected value



## 1. PERFORMANCE

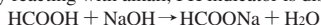
- 1) Measuring range : 1-50 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 0.1 ppm (100mℓ)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (0 ~ 20 °C) (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Pale pink → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

By reacting with alkali, PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

VAPOUR PRESSURE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	ppm	Coexistence
Sulphur dioxide		Similar stain is produced.	HCO <sub>2</sub> H conc. × 1/20	Higher readings are given.
Nitrogen dioxide	300	∕	10	The top of discoloured layer becomes unclear.
Hydrogen chloride FIG.1		Pink stain is produced.	HCO <sub>2</sub> H conc. × 2	Higher readings are given.
Chlorine FIG.2		Yellow stain is produced.	5	∕
Acetic acid		Similar stain is produced.		∕

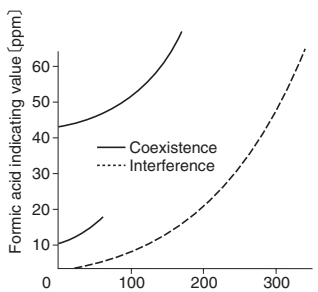


FIG.1 Influence of Hydrogen chloride

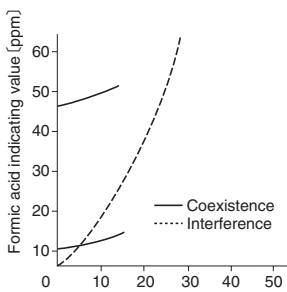


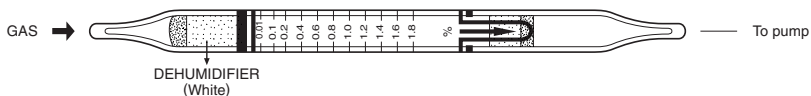
FIG.2 Influence of Chlorine

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)		
	0 °C (32 °F)	10 °C (50 °F)	20 ~ 40 °C (68 °F)
50	82	60	50
40	57	45	40
30	36	32	30
20	22	21	20
10	10	10	10

(NOTE)

This tube scale is calibrated based on Acetic acid and the same scale is available for Formic acid.



## 1. PERFORMANCE

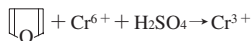
- 1) Measuring range : 0.2-2.0 %      0.01-0.9 %
- Number of pump strokes : 1/2 (50ml)      1 (100ml)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 10 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Graduations printed on the tube are calibrated by Ethylene oxide at 1 pump stroke and Furan concentration is determined by using a conversion chart.
- 7) Colour change : Orange → Black

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 %    RSD-mid. : 10 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

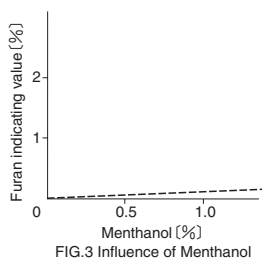
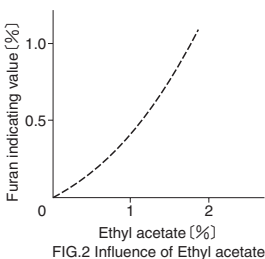
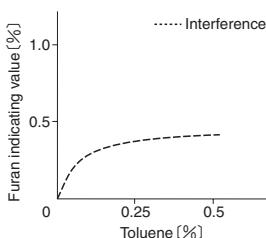
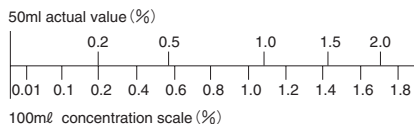
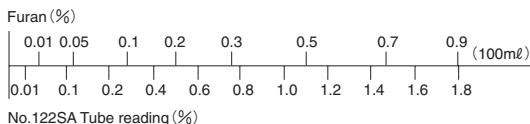
GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

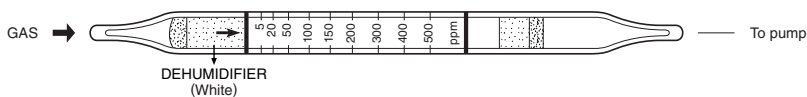
Substance	Interference	ppm	Coexistence
Aromatic hydrocarbons    FIG.1	Similar stain is produced.		Higher readings are given.
Esters                            FIG.2	//		//
Ketones	//		//
Alcohols                        FIG.3	//		//
Halogenated hydrocarbons	Whole reagent is changed to Pale brown.	0.5%	//

(NOTE)

In case of 1/2 pump strokes, following conversion scale is available for the actual concentration.







## 1. PERFORMANCE

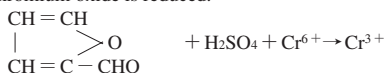
- 1) Measuring range : 2-60 ppm  
Number of pump strokes : 3 (300 ml)
- 2) Sampling time : 4.5 minutes / 3 pump strokes
- 3) Detectable limit : 0.5 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Graduations printed on the tube are calibrated by Ethyl cellosolve at 3 pump strokes and Furfural concentration is determined by using a conversion chart.
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



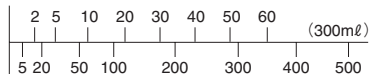
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	Coexistence
Alcohols		Similar stains are produced and higher readings are given.	
Toluene	200	Whole reagent is changed to Pale orange.	Unclear stains are produced.

Furfural (ppm)



No.190U Tube reading (ppm)

TEMPERATURE CORRECTION TABLE

Conver. value (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
60	—	—	60	50	45
50	—	71	50	45	40
40	—	53	40	35	35
30	63	35	30	30	30
20	25	22	20	20	20
15	17	15	15	15	15
10	10	10	10	10	10
5	5	5	5	5	5
2	2	2	2	2	2



## 1. PERFORMANCE

- 1) Measuring range : 5-25 ppm  
Number of pump strokes : 5 (500ml)
- 2) Sampling time : 5 minutes/5 pump strokes
- 3) Detectable limit : 3 ppm
- 4) Shelf life : 1 year
- 5) Operating temperature : 10 ~ 40 °C
- 6) Operating Humidity : Not affected at 20 ~ 90 % RH
- 7) Reading : Direct reading from the scale calibrated by 5 pump strokes
- 8) Colour change : White → Black

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 10 % RSD-high : 10 %

## 3. CHEMICAL REACTION

By reacting with Chromic acid, Polymer is produced.

## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Ethyl acetate		The accuracy of readings is not affected.
Hexane		//
Methanol		//
Toluene		//

### (NOTE)

An original colour of white in reagent sometimes could be pale orange, but it does not affect the tube readings.



## 1. PERFORMANCE

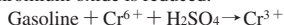
- 1) Measuring range : 0.05-0.6 %
- Number of pump strokes : 1 (100mℓ)
- (This detector tube is calibrated by Hexane.)
- 2) Sampling time : 1 minute / 1 pump stroke
- 3) Detectable limit : 0.005 % (50 ppm)
- 4) Shelf life : 3 years
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Orange → Dark green

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 10 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



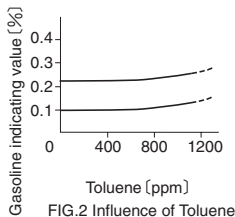
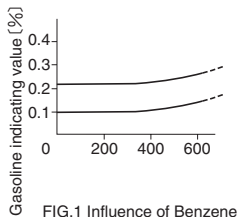
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Benzene FIG.1	Black stain is produced.	400	Higher readings are given.
Toluene FIG.2	∕	800	∕
Xylene	∕	2,000	∕
Acetylene	Similar stain is produced.		∕
Ethylene	∕		∕
Cyclohexane	∕		∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	∕		∕

In presence of Alcohols, Ketones or Esters less than 6 %, the accuracy of readings is not affected.



### TEMPERATURE CORRECTION TABLE

Tube Readings (%)	Corrected Concentration (%)				
	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
0.6	0.73	0.65	0.60	0.52	0.48
0.5	0.60	0.55	0.50	0.45	0.42
0.4	0.48	0.44	0.40	0.37	0.35
0.3	0.35	0.32	0.30	0.28	0.27
0.2	0.22	0.21	0.20	0.19	0.18
0.1	0.10	0.10	0.10	0.10	0.10



## 1. PERFORMANCE

- 1) Measuring range : 50-1,400 ppm (as n-Hexane)
- Number of pump strokes : 1 (100mℓ)  
2 pump strokes (200mℓ) are required for Kerosine and Mineral turpentine determination.
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 5 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (refer to "Table 2. Temperature CorrectionTable")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Orange → Yellowish green

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 5 %    RSD-high : 5 % (Controlled on n-Hexane)

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	%	Coexistence
Aromatic hydrocarbons			The bottom of the discoloured layer is changed to Black and higher readings are given.
Alcohols		6	Higher readings are given.
Esters		6	〃
Ketones		6	〃

It has no influence on readings even if Alcohols, Esters or Ketones each co-exists up to 6 %.

(NOTE)

- 1) Determine the concentration of objective gas by multiplication with the figure shown in Table 1 after temperature correction.

Table.1  
Coefficient Chart

Name of Gas	Figure	Name of Gas	Figure
Isobutane	0.8	Heptane	1.5
Pentane	0.8	Octane	2.0
n-Hexane	1.0	Cyclohexane	1.0

Table.2  
TEMPERATURE CORRECTION TABLE (20 °C standard)

Tube Readings	Corrected Concentration (ppm)				
	0 °C	10 °C	20 °C	30 °C	40 °C
1400	1630	1530	1400	1270	1180
1200	1400	1320	1200	1090	1010
1000	1170	1100	1000	910	840
800	930	870	800	720	670
600	700	660	600	550	500
400	460	430	400	360	330
200	220	210	200	180	170
100	100	100	100	100	100

Unit : ppm

Example) For measuring Heptane at 10 °C of temperature

- Reading concentration : 600 ppm
- Concentration on temperature correction : 660 ppm
- Concentration of Heptane : 990 ppm

2) Measurement of mixed solvents :

- (1) Take 2 pump strokes and use the following conversion graph to measure Kerosene or Mineral turpentine (Mineral spirits).
- (2) After temperature correction for the reading of the gas detector tube with the Table 2, determine the concentration from FIG.1 conversion graph.

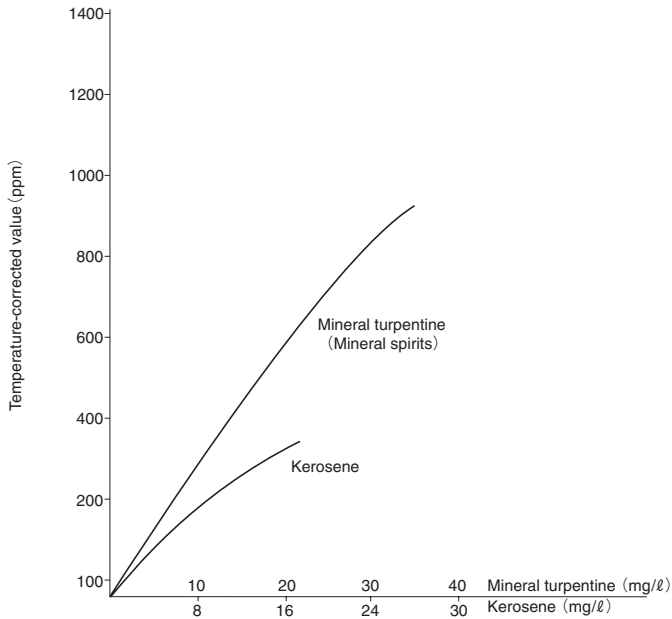
Instance)

For measuring mineral turpentine at 40 °C

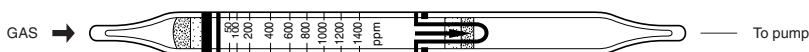
Reading Concentration 600 ppm

Concentration on temperature correction 500 ppm

Concentration of mineral turpentine 16mg/ℓ



Mineral turpentine (mg/ℓ)  
FIG.1 Conversion graph



**1. PERFORMANCE**

- 1) Measuring range : 100-2,000 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 15 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : The tube scale is calibrated based on n-Hexane at 1 pump stroke and Heptane concentration is determined by using a conversion chart at 1 pump stroke
- 8) Colour change : Orange → Yellowish green

**2. RELATIVE STANDARD DEVIATION**

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 5%

**3. CHEMICAL REACTION**

Chromium oxide is reduced.



**4. CALIBRATION OF THE TUBE**

GAS CHROMATOGRAPHY

**5. INTERFERENCE AND CROSS SENSITIVITY**

Substance	Interference	ppm	Coexistence
Alcohols	Similar stain is produced.	6 1/2%	
Ketones	∕	∕	∕
Esters	∕	∕	∕
Aromatic hydrocarbons FIG.1,2	∕		The bottom of the discoloured layer is stained to Black and higher readings are given.
Aliphatic hydrocarbons (more than C <sub>3</sub> )	∕		Higher readings are given.

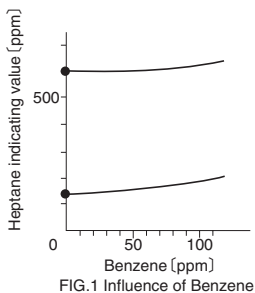


FIG.1 Influence of Benzene

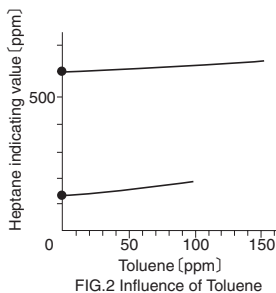
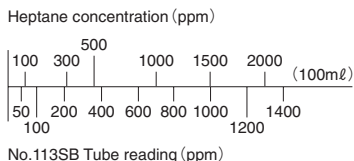


FIG.2 Influence of Toluene



**TEMPERATURE CORRECTION TABLE**

Tube Readings (ppm)	Corrected Concentration (ppm)			
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)
2000	—	—	2000	1680
1600	—	2000	1600	1380
1200	2000	1480	1200	1040
800	1200	940	800	720
400	520	460	400	360
200	260	230	200	180
100	100	100	100	100



## 1. PERFORMANCE

- 1) Measuring range : 0.11-1.32 % 0.05-0.6 %
- Number of pump strokes : 1/2 (50mℓ) 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 0.005 % (50 ppm) (100mℓ)
- 4) Shelf life : 3 years
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Orange → Dark green

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



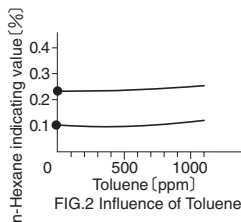
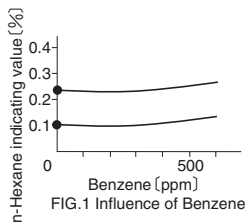
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Aliphatic hydrocarbons (more than C <sub>3</sub> )	Similar stain is produced.		Higher readings are given.
Acetylene	∕		∕
Ethylene	∕		∕
Cyclohexane	∕		∕
Benzene	FIG.1	400	∕
Toluene	FIG.2	800	∕
Xylene	∕	2,000	∕

In presence of Alcohols, Ketones or Esters less than 6 %, the accuracy of readings is not affected.



TEMPERATURE CORRECTION TABLE

Tube Readings (%)	Corrected Concentration (%)				
	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
0.6	0.73	0.65	0.60	0.52	0.48
0.5	0.60	0.55	0.50	0.45	0.42
0.4	0.48	0.44	0.40	0.37	0.35
0.3	0.35	0.32	0.30	0.28	0.27
0.2	0.22	0.21	0.20	0.19	0.18
0.1	0.10	0.10	0.10	0.10	0.10

(NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.

Actual concentration = 2.2 × Temperature corrected value



## 1. PERFORMANCE

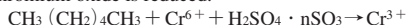
- 1) Measuring range : 50-1,400 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 5 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Orange → Yellowish green

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



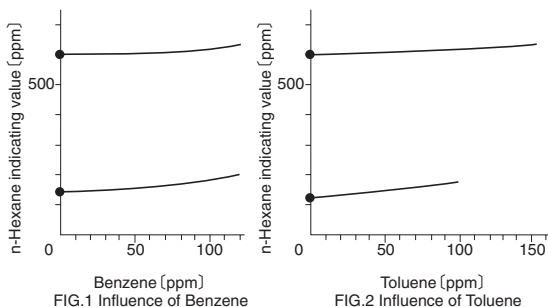
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Aromatic hydrocarbons FIG.1,2	Black stain is produced.	Higher readings are given.
Aliphatic hydrocarbons (more than C <sub>3</sub> )	Similar stain is produced.	∕

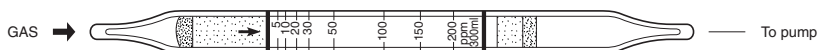
In presence of Alcohols, Ketones or Esters less than 6 %, the accuracy of readings is not affected.



TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
1400	1630	1530	1400	1270	1180
1200	1400	1320	1200	1090	1010
1000	1170	1100	1000	910	840
800	930	870	800	720	670
600	700	660	600	550	500
400	460	430	400	360	330
200	220	210	200	180	170
100	100	100	100	100	100





## 1. PERFORMANCE

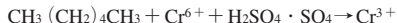
- 1) Measuring range : 20-800 ppm      5-200 ppm
- Number of pump strokes : 1 (100mℓ)      3 (300mℓ)
- 2) Sampling time : 6 minutes/3 pump strokes
- 3) Detectable limit : 2 ppm (300mℓ)
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (TEMPERATURE CORRECTION TABLE is provided.)
- 7) Reading : Direct reading from the scale calibrated by 3 pump strokes
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 5%    RSD-high : 5%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Methyl alcohol		500	Not affected.
Ethyl acetate		500	∕
Methyl ethyl ketone		500	∕
Toluene	Brown stain is produced.		Higher readings are given.

(NOTE)

In case of 1 pump stroke, following formula is available for the actual concentration.

Actual concentration = Temperature corrected value × 4

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
200	250	225	200	185	170
150	180	165	150	145	135
100	120	110	100	95	85
50	60	55	50	45	40
30	35	30	30	30	25
20	20	20	20	20	20
10	10	10	10	10	10
5	5	5	5	5	5



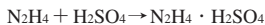
## 1. PERFORMANCE

- |                             |  |           |              |
|-----------------------------|--|-----------|--------------|
| 1) Measuring range          | : 0.2-10 ppm   | 0.1-5 ppm | 0.05-2.5 ppm |
| Number of pump strokes      | 2 (200mℓ)  | 4 (400mℓ) | 8 (800mℓ)    |
| 2) Sampling time            | : 4 minutes/4 pump strokes                                   |           |              |
| 3) Detectable limit         | : 0.02 ppm (800mℓ)   |           |              |
| 4) Shelf life               | : 2 years  |           |              |
| 5) Operating temperature    | : 0 ~ 40 °C  |           |              |
| 6) Temperature compensation | : Necessary (See "TEMPERATURE CORRECTION TABLE")             |           |              |
| 7) Reading                  | : Direct reading from the scale calibrated by 2 pump strokes |           |              |
| 8) Colour change            | : Yellow → Blue  |           |              |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION



## 4. CALIBRATION OF THE TUBE

ABSORPTIOMETRIC METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Amines	Similar stain is produced.	Higher readings are given.
Ammonia	∕	∕

(NOTE)

In case of 2 pump strokes, following formula is available for the actual concentration.

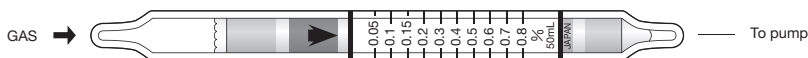
Actual concentration = Temperature corrected value × 2

In case of 8 pump strokes, following formula is available for the actual concentration.

Actual concentration = Temperature corrected value × 1/2

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
5.0	7.0	6.0	5.0	4.5	4.0
4.0	5.6	4.7	4.0	3.6	3.2
3.0	4.2	3.6	3.0	2.7	2.4
2.0	2.8	2.4	2.0	1.8	1.6
1.0	1.3	1.2	1.0	0.9	0.8
0.5	0.5	0.5	0.5	0.45	0.4
0.1	0.1	0.1	0.1	0.1	0.1



## 1. PERFORMANCE

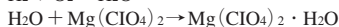
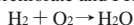
- 1) Measuring range : 0.05-0.8 %
- Number of pump strokes : 1/2 (50mℓ)
- 2) Sampling time : 0.5minutes/1/2 pump stroke
- 3) Detectable limit : 0.03 %
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1/2 pump strokes
- 8) Colour change : Yellow → Blue (over 0.1 %) or Yellowish green (below 0.1 %)

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

By reacting with Oxygen in Atmosphere, water vapour is produced. This Water vapour reacts with Magnesium perchlorate and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

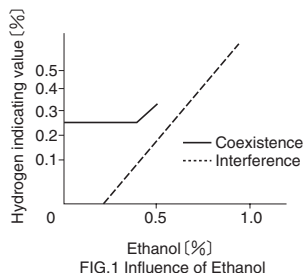
STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	%	Interference	ppm	Coexistence
Ethanol	FIG.1 0.25	Similar stain is produced.	0.4 %	Higher readings are given.
Carbon monoxide		The accuracy of readings is not affected.	500	Lower readings are given.

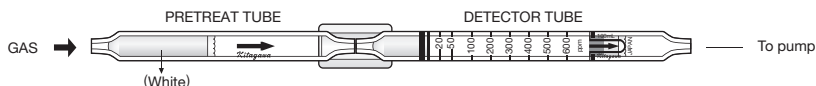
## 6. SPECIAL NOTE

- 1) The tube will not respond in the absence of oxygen.
- 2) When the concentration of Hydrogen is 12 to 16 %, pretreat reagent gives a heat but is not dangerous for use in hazardous area.
- 3) When the concentration of Hydrogen is over 40 %, the reading value may be indicated below 0.8 %. In this case, the bottom of the discoloured layer becomes dark purple. In order to make sure that the concentration is extremely high such as 40 %, measure the gas concentration with connecting 2 tubes. If both tubes are discoloured to green, extremely high concentration Hydrogen exists.



TEMPERATURE CORRECTION TABLE

Tube Readings (%)	Corrected Concentration (%)								
	0 °C (32 °F)	5 °C (41 °F)	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	25 °C (77 °F)	30 °C (86 °F)	35 °C (95 °F)	40 °C (104 °F)
0.8	—	—	—	—	0.80	0.88	0.58	0.51	0.45
0.7	—	—	—	1.00	0.70	0.80	0.52	0.45	0.40
0.6	—	—	1.00	0.80	0.80	0.52	0.44	0.39	0.35
0.5	—	—	0.80	0.65	0.50	0.44	0.37	0.33	0.30
0.4	—	—	0.62	0.51	0.40	0.35	0.30	0.27	0.25
0.3	—	0.70	0.46	0.37	0.30	0.26	0.23	0.21	0.19
0.2	0.65	0.47	0.30	0.25	0.20	0.18	0.16	0.14	0.13
0.15	0.46	0.34	0.22	0.19	0.15	0.13	0.12	0.11	0.10
0.1	0.28	0.21	0.15	0.12	0.10	0.09	0.08	0.08	0.07
0.06	0.13	0.10	0.07	0.06	0.05	0.05	0.05	0.05	0.05



## 1. PERFORMANCE

- 1) Measuring range : 40-1,200 ppm      20-600 ppm
- Number of pump strokes : 1/2 (50mℓ)      1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 5 ppm (100mℓ)
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Purple → Pink

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 5 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

PH indicator is discoloured by Hydrogen chloride.

## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Sulphur dioxide FIG.1	Yellow stain is produced.		Yellow - Pink double - layer stains are produced and this pink stain indicates Hydrogen chloride concentration.
Chlorine	∕		
Hydrogen sulphide		500	The accuracy of readings is not affected.

(NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.

Actual concentration = 2 × Reading value

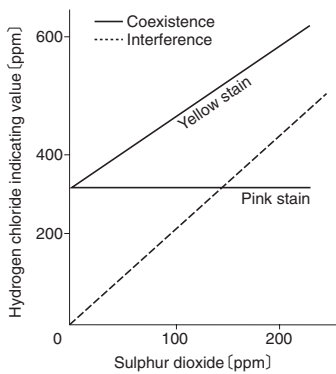
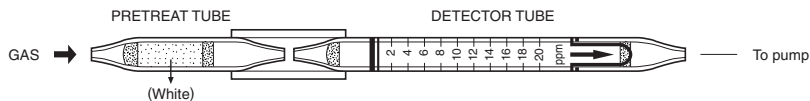


FIG.1 Influence of Sulphur dioxide



## 1. PERFORMANCE

- |                          |   |           |           |
|--------------------------|---|-----------|-----------|
| 1) Measuring range       | : 4-40 ppm  | 2-20 ppm  | 0.4-4 ppm |
| Number of pump strokes   | : 1/2 (50mℓ)  | 1 (100mℓ) | 5 (500mℓ) |
| 2) Sampling time         | : 1 minute/1 pump stroke                                    |           |           |
| 3) Detectable limit      | : 0.2 ppm (500mℓ)   |           |           |
| 4) Shelf life            | : 3 years   |           |           |
| 5) Operating temperature | : 0 ~ 40 °C   |           |           |
| 6) Reading               | : Direct reading from the scale calibrated by 1 pump stroke |           |           |
| 7) Colour change         | : Yellowish green → Pink                                    |           |           |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

PH indicator is discoloured by Hydrogen chloride.

## 4. CALIBRATION OF THE TUBE

COLOURIMETRY METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

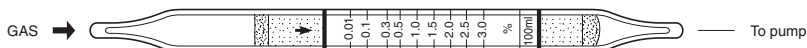
Substance	ppm	Interference	Coexistence
Sulphur dioxide	200	Similar pale stain is produced but can be distinguished from clear discoloration by Hydrogen chloride.	The accuracy of readings is not affected.
Nitric acid	High conc.	∕	∕
Nitrogen dioxide	100	∕	∕
Chlorine	1	Similar stain is produced.	Higher readings are given.

(NOTE)

In case of 1/2 and 5 pump strokes, the following formula is available for the actual concentration.

1/2 pump strokes ; Actual concentration = Reading value × 2

5 pump strokes ; Actual concentration = Reading value ×  $\frac{1}{5}$



## 1. PERFORMANCE

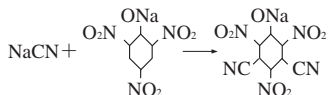
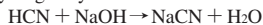
- 1) Measuring range : 0.01-3.0 %
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 2 minutes/1 pump stroke
- 3) Detectable limit : 0.001% (10 ppm)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Yellow → Brownish red

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Hydrogen cyanide reacts with Sodium picrate.

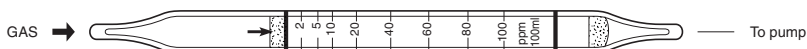


## 4. CALIBRATION OF THE TUBE

IODOMETRIC TITRATION METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Sulphur dioxide	Similar stain is produced.	200	Higher readings are given.
Hydrogen sulphide	∕	100	∕
Dicyan	∕		∕
Carbon disulphide	∕		∕
Acetone	∕		∕



## 1. PERFORMANCE

- 1) Measuring range : 2-100 ppm      0.5-25 ppm
- Number of pump strokes : 1 (100ml)      4 (400ml)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 0.2 ppm (400ml)
- 4) Shelf life : 2 years (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Yellow → Red

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 5%    RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Mercury chloride, Hydrogen chloride is liberated and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

ABSORPTIOMETRIC METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Sulphur dioxide	Similar stain is produced.	1	Higher readings are given.
Phosphine	∕	1	∕
Hydrogen sulphide      FIG.1	∕	3	∕
Ammonia	The accuracy of readings is not affected.	5	Lower readings are given.

(NOTE)

In case of 4 pump strokes, following formula is available for the actual concentration.

$$\text{Actual concentration} = \text{Reading value} \times \frac{1}{4}$$

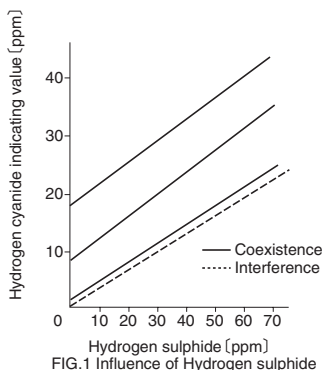
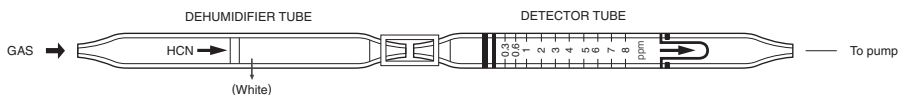


FIG.1 Influence of Hydrogen sulphide

### HUMIDITY CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	10%R.H.	30%R.H.	50%R.H.	70%R.H.	90%R.H.
100	91.0	95.0	100.0	105.0	111.0
80	73.0	76.0	80.0	84.0	88.5
60	54.5	57.0	60.0	63.0	66.0
40	36.0	38.0	40.0	42.0	44.5
20	18.0	19.0	20.0	21.0	22.5
10	8.4	9.2	10.0	10.8	11.6
5	4.2	4.6	5.0	5.4	5.8



## 1. PERFORMANCE

- 1) Measuring range : 0.3-8 ppm
- Number of pump strokes : 3 (300mℓ)
- 2) Sampling time : 4.5 minute s/3 pump strokes
- 3) Detectable limit : 0.15 ppm (300m ℓ)
- 4) Shelf life : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 3 pump strokes
- 8) Colour change : Yellow → Red

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 5 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Hydrogen cyanide reacts with Mercuric chloride and liberates hydrogen chloride, then PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

ABSORPTIOMETRIC METHOD

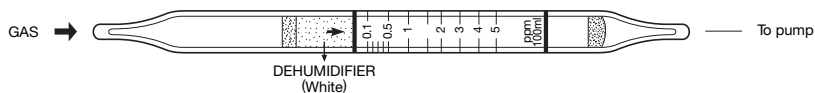
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Sulphur dioxide	Red stain is produced.	1.0	Higher readings are given.
Hydrogen sulphide	∕		∕
Acrylonitrile	∕		∕
Phosphine	∕		∕
Ammonia		2.0	Lower readings are given.

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
8	10.0	8.8	8.0	7.5	7.0
7	8.3	7.6	7.0	6.6	6.2
6	6.9	6.4	6.0	5.6	5.4
5	5.8	5.2	5.0	4.8	4.5
4	4.5	4.2	4.0	3.8	3.7
3	3.4	3.2	3.0	2.9	2.8
2	2.2	2.1	2.0	1.9	1.8
1	1.1	1.1	1.0	0.9	0.9
0.6	0.7	0.7	0.6	0.5	0.5
0.3	0.3	0.3	0.3	0.3	0.3





## 1. PERFORMANCE

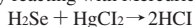
- 1) Measuring range : 1-20 ppm      0.5-10 ppm
- Number of pump strokes : 1 (100ml)    2 (200ml)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 2 years
- 5) Operating temperature : 15 ~ 20 °C
- 6) Reading : The tube scale is calibrated based on Diborane at 1 pump stroke and Hydrogen selenide concentration is determined by using a conversion chart at 1 and 2 pump strokes
- 7) Colour change : Pale yellow → Reddish purple

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

By reacting with Mercuric chloride, Hydrogen chloride is liberated and PH indicator is discoloured.

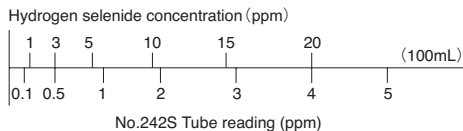


## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

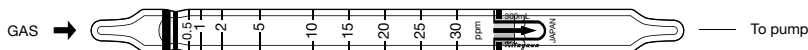
Substance	Interference	Coexistence
Arsine	Similar stain is produced.	Higher readings are given.
Phosphine	∕	∕
Monosilane	The maximum end point of stained layer is indiscernible.	∕
Disilane	∕	∕
Monogermane	The accuracy of readings is not affected.	The accuracy of readings is not affected.



### (NOTE)

In case of 2 pump strokes, following formula is available for the actual concentration.

$$\text{Actual concentration} = \text{Converted value} \times 1/2$$



## 1. PERFORMANCE

- |  |  |             |            |
|--|--|-------------|------------|
| 1) Measuring range                       | : 0.5-30 ppm   | 0.25-15 ppm | 0.17-2 ppm |
| Number of pump strokes                   | 3 (300mℓ)  | 6 (600mℓ)   | 9 (900mℓ)  |
| 2) Sampling time                         | : 1 minute/1 pump stroke                                     |             |            |
| 3) Detectable limit                      | : 0.05 ppm (900mℓ)   |             |            |
| 4) Shelf life                            | : 3 years  |             |            |
| 5) Operating temperature                 | : 0 ~ 40 °C  |             |            |
| 6) Temperature and humidity compensation | : Necessary (See "TEMP./R. H. CORRECTION COEFFICIENT TABLE") |             |            |
| 7) Reading                               | : Direct reading from the scale calibrated by 3 pump strokes |             |            |
| 8) Colour change                         | : Greenish yellow → Pink                                     |             |            |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

PH indicator is discoloured by Hydrogen fluoride.

## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance		Interference	Coexistence
Chlorine	FIG.1	Similar stain is produced.	Higher readings are given.
Hydrogen chloride	FIG.2	∕	∕

(NOTE)

- This detector tube is affected by ambient temperature and humidity, therefore, it is necessary to compensate the reading of gas detector tube with the following equation and correction coefficient table.  
Actual concentration = Reading Value × Correction Coefficient
- In case of 6 pump strokes, following formula is available for the actual concentration.  
Actual concentration = 1/2 × Temp./R.H. corrected value
- In case of 9 pump strokes, following formula is available for the actual concentration.  
Actual concentration = 1/3 × Temp./R.H. corrected value

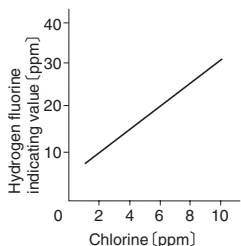


FIG.1 Influence of Chlorine

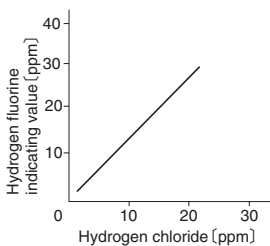


FIG.2 Influence of Hydrogen chloride

TEMP./R.H.CORRECTION COEFFICIENT TABLE

Relative Humidity (%)	Temperature				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
30	0.9	0.7	0.6	0.55	0.5
40	1.6	1.0	0.8	0.65	0.6
50	2.6	1.3	1.0	0.8	0.7
60	—	2.2	1.5	1.1	0.8
70	—	—	2.7	1.6	0.9
80	—	—	—	2.9	1.1



## 1. PERFORMANCE

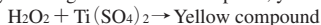
- 1) Measuring range : 0.5-10 ppm
- Number of pump strokes : 5 (500ml)
- 2) Sampling time : 7.5 minutes/5 pump strokes
- 3) Detectable limit : 0.2 ppm
- 4) Shelf life : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "NOTE")
- 7) Reading : Direct reading from the scale calibrated by 5 pump strokes
- 8) Colour change : White → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 10 % RSD-high : 10 %

## 3. CHEMICAL REACTION

By reacting with Titanium sulphate, yellow complex is generated.



## 4. CALIBRATION OF THE TUBE

ABSORPTIOMETRIC METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Chlorine	The accuracy of reading is not affected.		The accuracy of reading is not affected.
Ozone	∕		∕
Nitrogen dioxide	∕		∕
Acetaldehyde	∕		∕
Formaldehyde	∕	10	Lower readings are given.

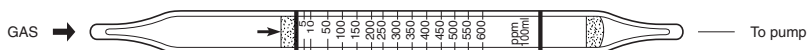
### (NOTE)

The scale is calibrated based on the temperature of 20 °C (68 °F). Readings obtained in other temperature circumstances should be corrected with the following temperature correction coefficient table.

TEMPERATURE CORRECTION COEFFICIENT TABLE (AT 20 °C)

Temperature (°C)	0	1	2	3	4	5	6	7	8	9
Correction Factor	1.35	1.32	1.28	1.25	1.23	1.20	1.17	1.15	1.13	1.11
Temperature (°C)	10	11	12	13	14	15				
Correction Factor	1.09	1.07	1.06	1.05	1.03	1.02				

Actual concentration = Reading value × Coefficient for temperature correction.



## 1. PERFORMANCE

- 1) Measuring range : 5-600 ppm      1-120 ppm  
     Number of pump strokes : 1 (100mℓ)      5 (500mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 0.5 ppm (500mℓ)
- 4) Shelf life : 1 year
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Pale yellow → Dark brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Gold chloride, Colloidal gold is liberated.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

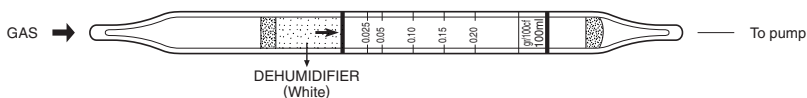
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	Coexistence
Acetylene	3%	Higher readings are given.	Higher readings are given.
Carbon monoxide	0.1%	∕	∕
Sulphur dioxide		Pale blue stain is produced.	∕
Hydrogen sulphide	10	Brown stain is produced.	∕
Mercury vapours		Similar stain is produced.	∕
Arsine	10	∕	∕
Iron carbonyl	10	∕	∕
Nickel carbonyl	10	∕	∕

(NOTE)

When the concentration is below 5 ppm, 5 pump strokes can be used to determine the lower concentration with the following formula.

Actual concentration =  $1/5 \times$  Reading value



## 1. PERFORMANCE

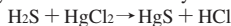
- |                          |   |                    |
|--------------------------|---|--------------------|
| 1) Measuring range       | : 0.025-0.2 gr/100 cf                                       | 0.05-0.4 gr/100 cf |
| Number of pump strokes   | 1 (100mℓ)   | 1/2 (50mℓ)         |
| 2) Sampling time         | : 1 minute/1 pump stroke                                    |                    |
| 3) Detectable limit      | : 0.005 gr/100 cf   |                    |
| 4) Shelf life            | : 2 years   |                    |
| 5) Operating temperature | : 0 ~ 40 °C   |                    |
| 6) Reading               | : Direct reading from the scale calibrated by 1 pump stroke |                    |
| 7) Colour change         | : Pale yellow → Pink  |                    |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

By reaction with Mercury chloride (II) , Hydrogen chloride is produced and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

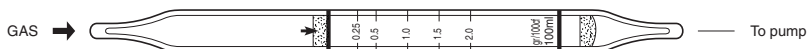
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Sulphur dioxide	Whole reagent is changed to Pale red, but Purplish red stain is indicated H <sub>2</sub> S concentration.	Higher readings are given.
Hydrogen selenide	Similar stain is produced.	∕
Arsine	∕	∕
Mercaptans	∕	∕
Phosphine	∕	∕
Hydrogen cyanide	Whole reagent is changed to red.	∕

(NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.

Actual concentration = 2 × Reading value



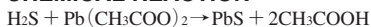
## 1. PERFORMANCE

- |                          |   |                 |
|--------------------------|---|-----------------|
| 1) Measuring range       | : 0.25-2 gr/100 cf  | 0.5-4 gr/100 cf |
| Number of pump strokes   | 1 (100ml)   | 1/2 (50ml)      |
| 2) Sampling time         | : 1 minute/1 pump stroke                                    |                 |
| 3) Detectable limit      | : 0.05 gr/100 cf  |                 |
| 4) Shelf life            | : 3 years   |                 |
| 5) Operating temperature | : 0 ~ 40 °C   |                 |
| 6) Reading               | : Direct reading from the scale calibrated by 1 pump stroke |                 |
| 7) Colour change         | : White → Pale brown  |                 |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION



## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

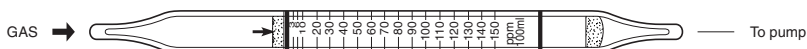
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Sulphur dioxide	The accuracy of readings is not affected.	Higher readings are given.
Mercaptans	∕	∕
Nitrogen dioxide	∕	∕

(NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.

Actual concentration = 2 × Reading value



## 1. PERFORMANCE

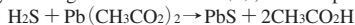
- |                          |   |           |               |            |
|--------------------------|---|-----------|---------------|------------|
| 1) Measuring range       | : 3-150 ppm   | 1-50 ppm  | 0.75-37.5 ppm | 6-300 ppm  |
| Number of pump strokes   | 1 (100mℓ)   | 3 (300mℓ) | 4 (400mℓ)     | 1/2 (50mℓ) |
| 2) Sampling time         | : 1 minute /1 pump stroke                                   |           |               |            |
| 3) Detectable limit      | : 0.3 ppm (300mℓ)   |           |               |            |
| 4) Shelf life            | : 3 years   |           |               |            |
| 5) Operating temperature | : 0 ~ 40 °C   |           |               |            |
| 6) Reading               | : Direct reading from the scale calibrated by 1 pump stroke |           |               |            |
| 7) Colour change         | : White → Dark brown  |           |               |            |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Lead acetate (II), Lead sulphide is produced.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Sulphur dioxide FIG.1	The accuracy of readings is not affected.	12	Higher readings are given.
Mercaptans FIG.2	∕	550	∕
Nitrogen dioxide FIG.3	∕	2	Lower readings are given.

(NOTE)

In case of 1/2, 3 or 4 pump strokes, following formula is available for the actual concentration.

$$\text{Actual concentration} = \text{Reading value} \times \frac{1}{\text{Number of pump strokes}}$$

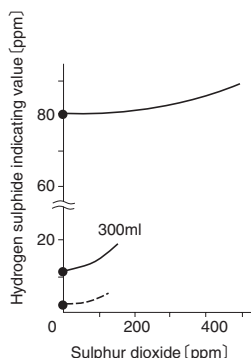


FIG.1 Influence of Sulphur dioxide

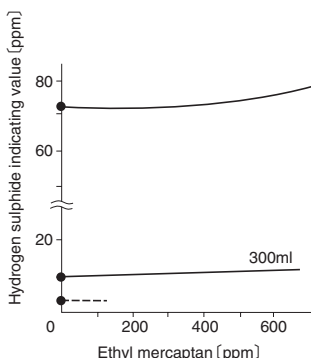


FIG.2 Influence of Ethyl mercaptan

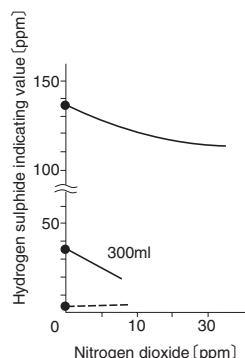
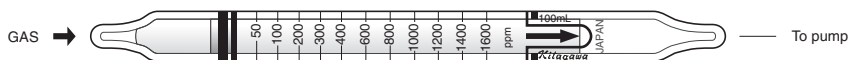


FIG.3 Influence of Nitrogen dioxide



## 1. PERFORMANCE

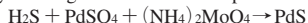
- 1) Measuring range : 50-1,600 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 20 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Pale yellow → Dark blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with Palladium sulphate and Ammonium molybdate, Palladium sulphide is produced.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

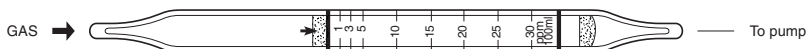
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Carbon monoxide		10	Whole reagent is changed to Blue and higher readings are given.
Ethylene		5	Similar stains are produced and higher readings are given.
Propylene		5	∕
Butylene		5	∕
Acetylene		5	∕
Methyl acetylene		5	∕
Hydrogen cyanide			White stain is produced and the discolouration by Hydrogen sulphide is interfered.
Ammonia			∕
Sulphur dioxide		less than 6%	The accuracy of readings is not affected.

TEMPERATURE CORRECTION TABLE

Tube Readings (%)	Corrected Concentration (%)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
1600	1400	1500	1600	1700	1700
1400	1300	1300	1400	1500	1500
1200	1100	1200	1200	1300	1300
1000	900	1000	1000	1000	1100
800	700	800	800	800	900
600	500	600	600	600	700
400	400	400	400	400	400
300	300	300	300	300	300
200	200	200	200	200	200





## 1. PERFORMANCE

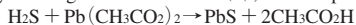
- 1) Measuring range : 2-60 ppm      1-30 ppm  
     Number of pump strokes : 1/2 (50mℓ)    1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 0.2 ppm (100mℓ)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : White → Pale brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 5%    RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Lead acetate (II), Lead sulphide is produced.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

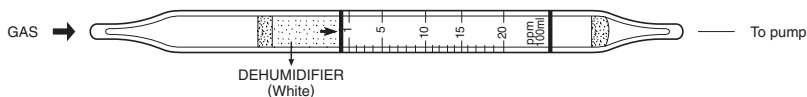
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Sulphur dioxide      FIG.1	The accuracy of readings is not affected.	10	Higher readings are given.
Mercaptans            FIG.2	∕	300	∕
Nitrogen dioxide      FIG.3	∕	2	Lower readings are given.

(NOTE)

When the concentration is over 30ppm, 1/2 pump strokes can be used to determine higher concentration with the following formula ;

Actual concentration = 2 × Reading value



## 1. PERFORMANCE

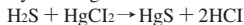
- |                          |   |           |            |
|--------------------------|---|-----------|------------|
| 1) Measuring range       | : 2-40 ppm  | 1-20 ppm  | 0.5-10 ppm |
| Number of pump strokes   | 1/2 (50mℓ)  | 1 (100mℓ) | 2 (200mℓ)  |
| 2) Sampling time         | : 1 minute/1 pump stroke                                    |           |            |
| 3) Detectable limit      | : 0.2 ppm (200mℓ)   |           |            |
| 4) Shelf life            | : 2 years   |           |            |
| 5) Operating temperature | : 0 ~ 40 °C   |           |            |
| 6) Reading               | : Direct reading from the scale calibrated by 1 pump stroke |           |            |
| 7) Colour change         | : Yellow → Pink   |           |            |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with mercuric chloride, Hydrogen chloride is produced and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Phosphine	Similar stain is produced.	Higher readings are given.
Mercaptans	∕	∕
Arsine	∕	Higher readings are given.
Hydrogen selenide	∕	∕
Hydrogen cyanide	∕	∕
Nitrogen dioxide	The accuracy of readings is not affected.	Lower readings are given.
Ammonia	Pale brown stain is produced.	∕
Sulphur dioxide	∕	If the maximum end point of the pink stain is discernable, the accuracy of readings is not affected.

(NOTE)

In case of 1/2 and 2 pump strokes, the following equation is available for the actual concentration.

1/2 pump strokes : Actual concentration = Reading value × 2

2 pump strokes : Actual concentration = Reading value ÷ 2

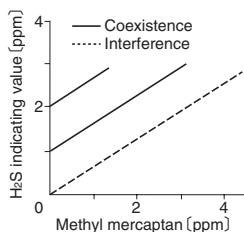


FIG.1 Influence of Methyl mercaptan

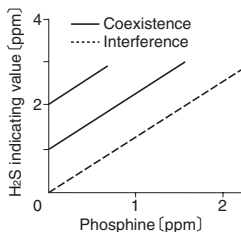
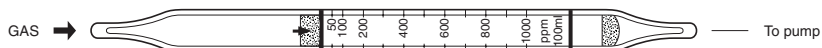


FIG.2 Influence of Phosphine



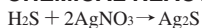
## 1. PERFORMANCE

- |                          |   |                           |            |
|--------------------------|---|---------------------------|------------|
| 1) Measuring range       | : 100-2,000 ppm   | 50-1,000 ppm              | 25-500 ppm |
| Number of pump strokes   | 1/2 (50mℓ)  | 1 (100mℓ)                 | 2 (100mℓ)  |
| 2) Sampling time         | : 1.5 minutes/1 pump stroke                                 | 1 minute/1/2 pump strokes |            |
| 3) Detectable limit      | : 0.5 ppm (100mℓ)   |                           |            |
| 4) Shelf life            | : 3 years   |                           |            |
| 5) Operating temperature | : 0 ~ 40 °C   |                           |            |
| 6) Reading               | : Direct reading from the scale calibrated by 1 pump stroke |                           |            |
| 7) Colour change         | : White → Black   |                           |            |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Sulphur dioxide	The accuracy of readings is not affected.	5000	Lower readings are given.
Mercaptans	Pale yellow stain is produced.	50	The mixmum end point of the stain is indiscernible, and higher readings are given.

(NOTE)

In case of 1/2 and 2 pump strokes, following formula is available for the actual concentration.

1/2 pump strokes : Actual concentration = 2 × Reading value

2 pump strokes : Actual concentration = 0.5 × Reading value



## 1. PERFORMANCE

- 1) Measuring range : 0.1-4.0 %
- Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 0.005 % (50ml)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Pale blue → Black

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with Cupric sulphate (II), Cupric sulphide is produced.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	%	Coexistence
Sulphur dioxide FIG.1	The accuracy of readings is not affected.	0.5	Lower readings are given.

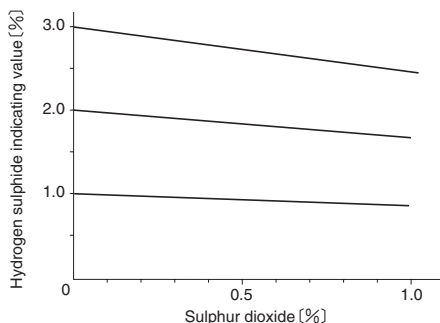
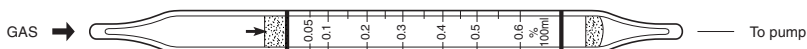


FIG.1 Influence of Sulphur dioxide



## 1. PERFORMANCE

- 1) Measuring range : 0.1-1.2 %      0.05-0.6 %  
     Number of pump strokes : 1/2 (50mℓ)    1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 0.001 % (10 ppm) (100mℓ)
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : White → Dark brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 5 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with Cupric sulphate (II), Cupric sulphide is produced.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	%	Coexistence
Sulphur dioxide FIG.1	The accuracy of readings is not affected.	0.3	Higher readings are given.
Ammonia	Blue stain is produced.		The accuracy of readings is not affected.
Methyl mercaptan	Pale yellow stain is produced.		∕

(NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.

Actual concentration = 2 × Reading value

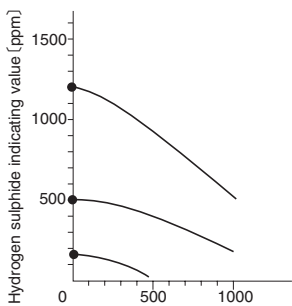


FIG.1 Influence of Nitrogen dioxide

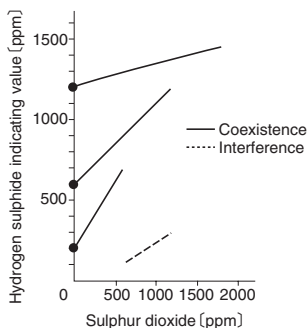
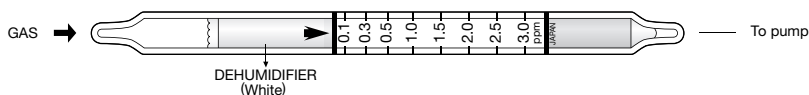


FIG.2 Influence of Sulphur dioxide



## 1. PERFORMANCE

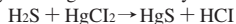
- 1) Measuring range : 0.2-6.0 ppm    0.1-3.0 ppm
- Number of pump strokes : 1/2 (50mℓ)    1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 0.05 ppm (100mℓ)
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Pale yellow → Pink

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 5%    RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Mercury chloride (II), Hydrogen chloride is produced and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Sulphur dioxide FIG.1	Whole reagent is changed to Pale red, but Purplish red stain is indicated H <sub>2</sub> S concentration.	
Hydrogen selenide	Similar stain is produced.	Higher readings are given.
Arsine	∕	∕
Mercaptans FIG.2	∕	∕
Phosphine	∕	∕
Hydrogen cyanide	Whole reagent is changed to Red.	∕

(NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.

Actual concentration = 2 × Reading value

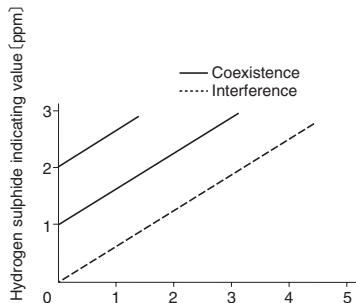


FIG.1 Influence of Sulphur dioxide

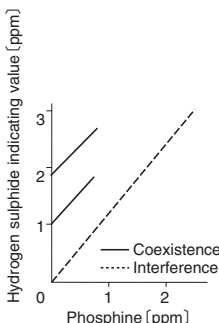
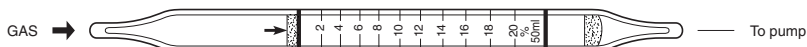


FIG.2 Influence of Ethyl mercaptan



## 1. PERFORMANCE

- 1) Measuring range : 2-20 %  
Number of pump strokes : 1/2 (50ml)
- 2) Sampling time : 1 minute/1/2 pump strokes
- 3) Detectable limit : 0.05 %
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1/2 pump stroke
- 7) Colour change : Pale blue → Black

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Cupric sulphate (II), Cupric sulphide is produced.



## 4. CALIBRATION OF THE TUBE

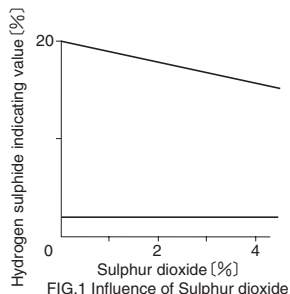
STANDARD GAS CYLINDER METHOD

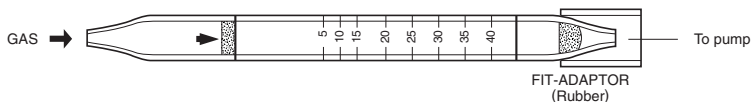
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	%	Coexistence
Sulphur dioxide FIG.1	The accuracy of readings is not affected.	2	Lower readings are given.
Carbon dioxide	∕		The accuracy of readings is not affected.

(NOTE)

- 1) Where the discolouration is over the scale, non-reacted Hydrogen sulphide remains in the pump. This residual Hydrogen sulphide is not exhausted even if the pump handle is pushed back, and it still remains in the pump. When the handle is pulled next, it is exhausted toward the operator from the stopper side of the pump. Accordingly, air purging of the pump inside by pulling/pushing the handle several times should be done in fresh air where there is not Hydrogen sulphide, because Hydrogen sulphide is very toxic. During the air purging, protection apparatus such as a gas mask should be worn.
- 2) Maximum sampling volume of the gas shall be approximately 70ml.





## 1. PERFORMANCE

- |                          |   |           |
|--------------------------|---|-----------|
| 1) Measuring range       | : 5-40 %  | 2.5-5 %   |
| Number of pump strokes   | : 1/2 (50mℓ)  | 1 (100mℓ) |
| 2) Sampling time         | : 1 minute/1/2 pump strokes                                   |           |
| 3) Shelf life            | : 3 years   |           |
| 4) Operating temperature | : 0 ~ 40 °C   |           |
| 5) Reading               | : Direct reading from the scale calibrated by 1/2 pump stroke |           |
| 6) Colour change         | : Pale blue → Black   |           |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with Copper sulphate (II), Cupric sulphide is produced.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

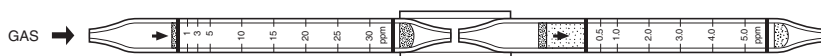
Substance	Interference	%	Coexistence
Sulphur dioxide	The accuracy of readings is not affected.	8	Lower readings are given.
Carbon dioxide	∕		The accuracy of readings is not affected.

(NOTE)

In case of 1 pump stroke, following formula is available for the actual concentration.

Actual concentration = 2 × Reading value





## 1. PERFORMANCE

- 1) Measuring range :
  - Hydrogen sulphide                      1-30 ppm
  - Mercaptans                                0.5-5 ppm
  - Number of pump strokes                1 (100mℓ)
- 2) Sampling time                            : 3 minutes/1 pump stroke
- 3) Detectable limit                         :
  - Hydrogen sulphide                      0.2 ppm
  - Mercaptans                                0.2 ppm
- 4) Shelf life                                 : 2 years
- 5) Operating temperature                : 0 ~ 40 °C
- 6) Reading                                  : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change :
  - Hydrogen sulphide                      White → Dark brown
  - Mercaptans                                Pale yellow → Pink

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

Hydrogen sulphide detector tube :  $\text{H}_2\text{S} + \text{Pb}(\text{CH}_3\text{CO}_2)_2 \rightarrow \text{PbS} + 2\text{CH}_3\text{CO}_2\text{H}$

Mercaptans detector tube :  $\text{R} \cdot \text{SH} + \text{HgCl}_2 \rightarrow \text{RS}(\text{HgCl}) + \text{HCl}$

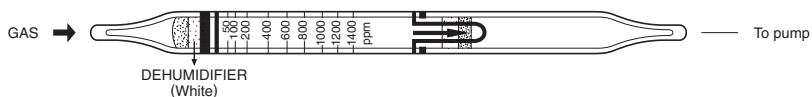
## 4. CALIBRATION OF THE TUBE

Hydrogen sulphide                      STANDARD GAS CYLINDER METHOD

Mercaptans                                STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
<b>H<sub>2</sub>S detector tube</b>			
Sulphur dioxide	The accuracy of readings is not affected.	H <sub>2</sub> S conc. × 1/3	The maximum end point of the stain becomes indiscernable and higher readings are given.
Nitrogen dioxide	∕	H <sub>2</sub> S conc. × 1/5	Lower readings are given.
<b>R·SH detector tube</b>			
Nitrogen dioxide	The accuracy of readings is not affected.	2	Lower readings are given.
Ammonia	∕	R·SH conc. × 10	The stain from the gas inlet side is faded and lower readings are given.
Hydrogen sulphide		30	The maximum end point of the stain becomes indiscernable.



## 1. PERFORMANCE

- 1) Measuring range : 50-1,200 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 10 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Graduations printed on the tube are calibrated by n-Hexane at 1 pump stroke and Isobutane concentration is determined by using a conversion chart.
- 7) Colour change : Orange → Yellowish green

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %   RSD-mid. : 10 %   RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced  
 $(CH_3)_3CH = Cr^{6+} \rightarrow Cr^{3+}$

## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Alcohols	Similar stain is produced.	6 %	Higher readings are given.
Ketones	//	//	//
Esters	//	//	//
Aromatic hydrocarbons FIG.1.2			The top of the discoloured layer is stained to Black and higher readings are given.
Aliphatic hydrocarbons (more than C <sub>3</sub> )	Similar stain is produced.		Higher readings are given.

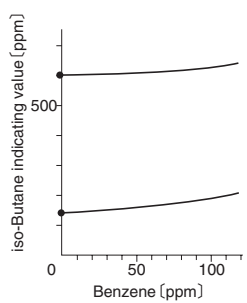


FIG.1 Influence of Benzene

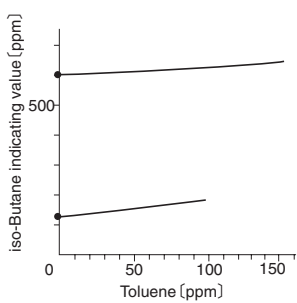
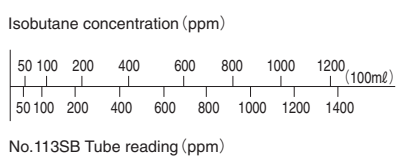
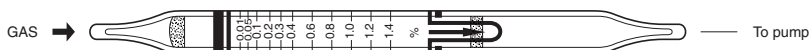


FIG.2 Influence of Toluene





## 1. PERFORMANCE

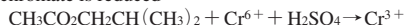
- 1) Measuring range : 0.01-1.4 %  
Number of pump strokes : 2 (200ml)
- 2) Sampling time : 3 minutes/2 pump strokes
- 3) Detectable limit : 0.001 % (10 ppm)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Graduations printed on the tube are calibrated by Methyl ethyl ketone at 2 pump strokes and Isobutyl acetate concentration is determined by using a conversion chart.
- 7) Colour change : Orange → Pale brownish green

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 %   RSD-mid. : 10 %   RSD-high : 5 %

## 3. CHEMICAL REACTION

Dichromate is reduced



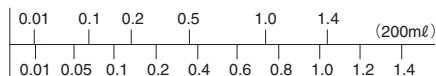
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

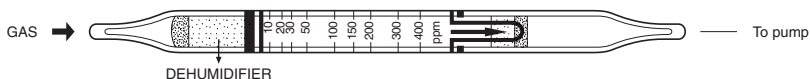
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Acetylene		3 %	Whole reagent is changed to Pale brown.
Propane		0.2 %	∕
Other organic gases or vapours except Halogenated hydrocarbons	Similar stain is produced.	50	Higher readings are given.

Isobutyl acetate (%)



No.139SB Tube reading (%)



## 1. PERFORMANCE

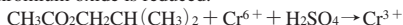
- 1) Measuring range : 10-400 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 3 ppm
- 4) Shelf life : 1 year
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Pale yellow → Pale blue (The top of discoloured layer is Brown, but read at the top of Pale blue.)

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 5%    RSD-high : 5%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Esters	Similar stain is produced.	Higher readings are given.
Alcohols	∕	∕
Ketones	∕	∕
Aromatic hydrocarbons FIG.1	∕	∕

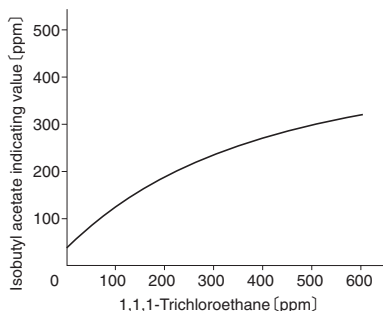
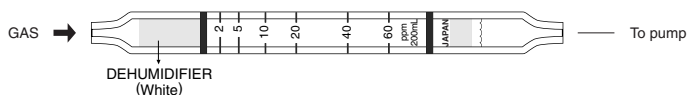


FIG.1 Influence of 1,1,1-Trichloroethane

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)					
	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	25 °C (77 °F)	30 °C (86 °F)	40 °C (104 °F)
400	—	—	400	285	240	210
300	—	—	300	225	190	170
200	—	275	200	165	140	130
150	—	195	150	125	110	103
100	—	120	100	90	80	75
50	70	55	50	45	40	40
30	40	35	30	25	20	20
20	25	20	20	20	15	15
10	15	10	10	10	5	5



## 1. PERFORMANCE

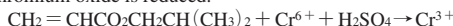
- 1) Measuring range : 5-60 ppm  
Number of pump strokes : 2 (200mℓ)
- 2) Sampling time : 3 minutes/2 pump strokes
- 3) Detectable limit : 0.5 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Graduations printed on the tube are calibrated by Methyl acrylate at 2 pump strokes and Isobutyl acrylate concentration is determined by using a conversion chart.
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 5% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



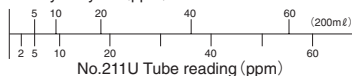
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

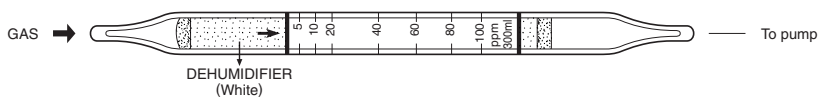
Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Esters	Whole reagent is discolored to Dark brown	∕
Aromatic hydrocarbons	∕	∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	∕	∕
Halogenated hydrocarbons	∕	∕

Isobutyl acrylate (ppm)



TEMPERATURE CORRECTION TABLE

Conversion Value (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
60	—	90	60	48	40
40	115	57	40	32	27
20	50	27	20	16	14
10	20	13	10	8	6
5	10	6	5	4	3



## 1. PERFORMANCE

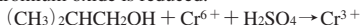
- 1) Measuring range : 5-100 ppm
- Number of pump strokes : 3 (300mℓ)
- 2) Sampling time : 4.5 minutes/3 pump strokes
- 3) Detectable limit : 2 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 3 pump strokes
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 10 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	Coexistence
Alcohols    FIG.1		Similar stain is produced.	Higher readings are given.
Toluene	200	Whole reagent is changed to Pale blue.	∕
Hexane	1,000	The accuracy of readings is not affected.	The accuracy of readings is not affected.
Trichloroethylene	1,000	∕	∕
Ethyl acetate    FIG.2	1,000	∕	∕

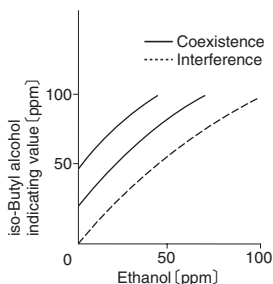


FIG.1 Influence of Ethanol

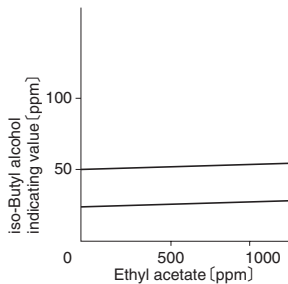


FIG.2 Influence of Ethyl acetate

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
100	—	—	100	85	80
80	—	100	80	75	80
60	95	70	60	53	50
40	58	47	40	36	34
20	27	22	20	18	17
10	13	11	10	9	8
5	5	5	5	5	5



## 1. PERFORMANCE

- 1) Measuring range : 0.03-2.0 %  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 2 years
- 5) Scale calibration temperature : 20 °C
- 6) Reading : Graduations printed on the tube are calibrated by n-Hexane at 1 pump stroke and Isobutylene concentration is determined by using a conversion chart at 1 pump stroke.
- 7) Colour change : Orange → Yellowish green

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 5%

## 3. CHEMICAL REACTION

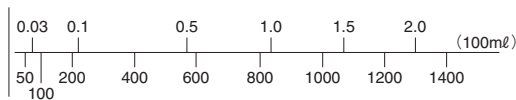
Chromium oxide is reduced



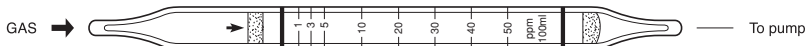
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

Isobutylene concentration (ppm)



No.113SB Tube reading (ppm)



## 1. PERFORMANCE

- 1) Measuring range : 3-50 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : Graduations printed on the tube are calibrated by Acetic acid at 1 pump stroke and Isobutyric acid concentration is determined by using a conversion chart at 1 pump stroke.
- 7) Colour change : Pale pink → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 10 % RSD-high : 10 %

## 3. CHEMICAL REACTION

By reacting with alkali, PH indicator is discoloured.

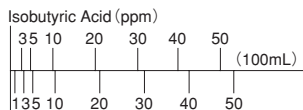


## 4. CALIBRATION OF THE TUBE

VAPOUR PRESSURE METHOD

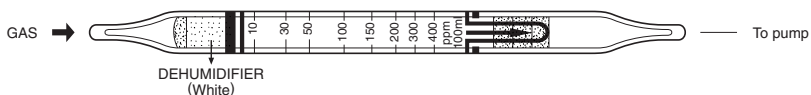
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	ppm	Coexistence
Sulphur dioxide		Similar stain is produced.	HCO <sub>2</sub> H conc. × 1/20	Higher readings are given.
Nitrogen dioxide	300	∕	10	The top of discoloured layer becomes unclear.
Hydrogen chloride		Pink stain is produced.	HCO <sub>2</sub> H conc. × 2	Higher readings are given.
Chlorine		Blueish yellow stain is produced.	5	∕
Acetic acid		Similar stain is produced.		∕



No.216S tube reading (ppm)





## 1. PERFORMANCE

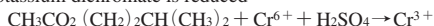
- 1) Measuring range : 10-400 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 4 ppm
- 4) Shelf life : 1 year
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Pale yellow → Pale blue (The top of discoloured layer is Brown, but read at the top of Pale blue.)

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

Potassium dichromate is reduced



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Esters	Similar stain is produced.	Higher readings are given.
Alcohols	FIG.1	∕
Ketones	∕	∕
Aromatic hydrocarbons	Whole reagent is changed to Pale brown.	∕

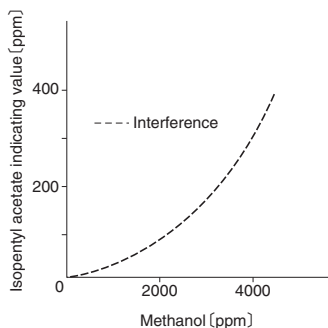
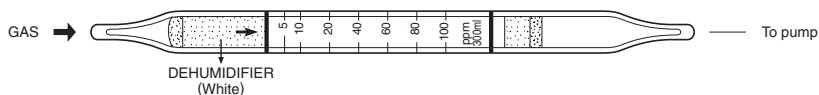


FIG.1 Influence of Methanol

## TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)							
	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	25 °C (77 °F)	30 °C (86 °F)	35 °C (95 °F)	40 °C (104 °F)	
400	—	—	400	240	190	160	140	
300	—	—	300	200	160	140	120	
200	—	360	200	150	125	110	95	
150	—	230	150	120	100	90	80	
100	—	135	100	85	75	67	60	
50	80	60	50	45	40	35	35	
30	40	35	30	30	25	25	25	
10	10	10	10	10	10	10	10	



## 1. PERFORMANCE

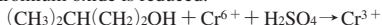
- 1) Measuring range : 5-100 ppm
- Number of pump strokes : 3 (300mℓ)
- 2) Sampling time : 4.5 minutes/3 pump strokes
- 3) Detectable limit : 2 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 3 pump strokes
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 10 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.

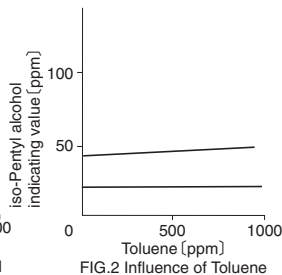
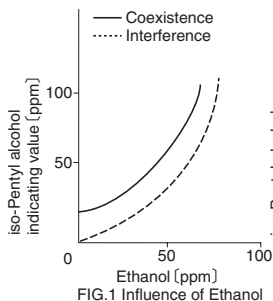


## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

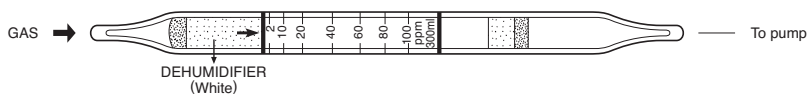
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	Coexistence
Alcohols    FIG.1		Similar stain is produced.	Higher readings are given.
Toluene    FIG.2	200	Whole reagent is changed to Pale blue.	∕
Hexane	1,000		∕
Trichloroethylene	∕		∕
Ethyl acetate	∕		∕



TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
100	—	—	100	80	70
80	—	—	80	65	55
60	—	83	60	50	45
40	90	50	40	33	30
20	32	23	20	16	15
10	14	11	10	9	8
5	5	5	5	5	5



## 1. PERFORMANCE

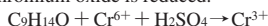
- 1) Measuring range : 5-80 ppm  
Number of pump strokes : 3 (300ml)
- 2) Sampling time : 4.5 minutes/3 pump strokes
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Cyclohexanone at 3 pump strokes and Isophorone concentration is determined by using a conversion chart at 3 pump strokes
- 7) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 5%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



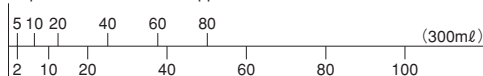
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

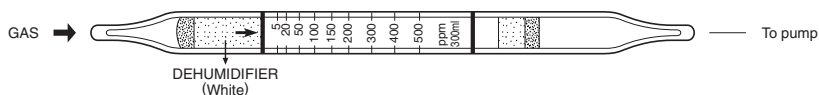
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Aliphatic hydrocarbons (more than C <sub>3</sub> )	Whole reagent is changed to pale brown.	The accuracy of readings is not affected if the maximum end point of the blue stain is discernable.
Aromatic hydrocarbons	//	//
Halogenated hydrocarbons	//	//
Alcohols	Similar stain is produced.	Higher readings are given.
Esters	Pale brown stain is produced from the zero end of the detecting reagent (inlet side of the tube).	The accuracy of readings is not affected.

Isophorone concentration (ppm)



No. 197U tube reading (ppm)



## 1. PERFORMANCE

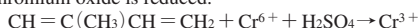
- 1) Measuring range : 1-16 ppm
- Number of pump strokes : 3 (300ml)
- 2) Sampling time : 4.5 minutes/3 pump strokes
- 3) Detectable limit : 0.5 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Graduations printed on the tube are calibrated by Ethyl cellosolve at 3 pump strokes and Isoprene concentration is determined by using a conversion chart.
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



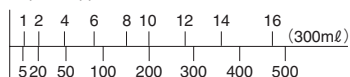
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Ethers	∕	∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	Whole reagent is changed to Pale brown.	∕
Aromatic hydrocarbons	∕	∕
Esters	∕	∕
Ketones	∕	∕
Halogenated hydrocarbons	∕	∕

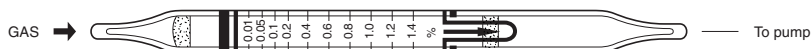
Isoprene (ppm)



No.190U Tube reading (ppm)

TEMPERATURE CORRECTION TABLE

Conversion Value (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
16	20.5	18.0	16.0	14.5	13.0
14	18.0	15.5	14.0	12.5	11.0
12	15.5	13.5	12.0	10.5	9.5
10	12.5	11.0	10.0	9.0	8.0
8	10.0	9.0	8.0	7.5	6.5
6	7.5	6.5	6.0	6.0	5.0
4	5.0	4.0	4.0	4.0	3.5
2	2.0	2.0	2.0	2.0	2.0
1	1.0	1.0	1.0	1.0	1.0



## 1. PERFORMANCE

- 1) Measuring range : 0.01-1.2 %
- Number of pump strokes : 2 (200mℓ)
- 2) Sampling time : 3 minutes/2 pump strokes
- 3) Detectable limit : 10 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Graduations printed on the tube are calibrated by Methyl ethyl ketone at 2 pump strokes and Isopropyl acetate concentration is determined by using a conversion chart.
- 7) Colour change : Orange → Brownish green

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %   RSD-mid. : 5 %   RSD-high : 5 %

## 3. CHEMICAL REACTION

Dichromate is reduced



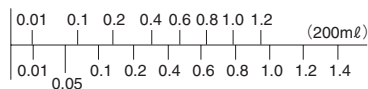
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

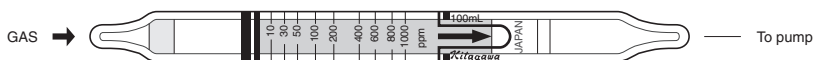
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Acetylene		3%	Whole reagent is changed to brown.
Propane		0.2%	"
Other organic gases or vapours except Halogenated hydrocarbons	Similar stain is produced.	50	Higher readings are given.

Isopropyl acetate (%)



No. 139SB Tube reading (%)



## 1. PERFORMANCE

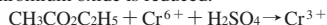
- 1) Measuring range : 10-1,000 ppm  
Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 5 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION COEFFICIENT TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Yellow → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 10 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Esters	∕	∕
Ketones	∕	∕
Aromatic hydrocarbons	∕	∕
Aliphatic hydrocarbons	Whole reagent is discoloured to Pale brown.	If the top of brown stain is clear, the accuracy of readings is not affected.
Halogenated hydrocarbons	∕	

FIG.1

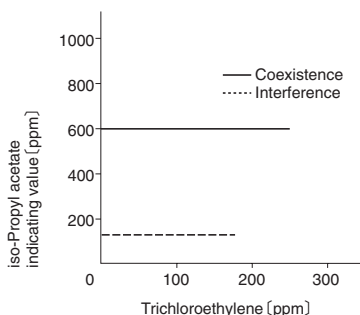
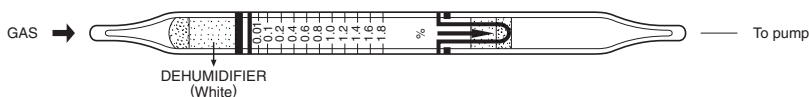


FIG.1 Influence of Trichloroethylene

TEMPERATURE CORRECTION COEFFICIENT TABLE

Tube Readings (ppm)	Correction Coefficient (at 20 °C)						
	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	25 °C (77 °F)	30 °C (86 °F)	35 °C (95 °F)	40 °C (104 °F)
1,000	1.33	1.17	1.00	0.87	0.74	0.64	0.53
800	1.38	1.19	1.00	0.86	0.73	0.63	0.53
600	1.40	1.20	1.00	0.86	0.72	0.63	0.53
400	1.40	1.20	1.00	0.85	0.70	0.58	0.46
200	1.40	1.20	1.00	0.84	0.68	0.55	0.42
100	1.50	1.25	1.00	0.81	0.62	0.48	0.33
50	1.50	1.25	1.00	0.77	0.54	0.43	0.32
30	1.50	1.25	1.00	0.77	0.53	0.42	0.30
10	1.50	1.25	1.00	0.75	0.50	0.40	0.30



## 1. PERFORMANCE

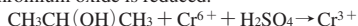
- 1) Measuring range : 0.05-2.5 %
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 100 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Graduations printed on the tube are calibrated by Ethylene oxide at 1 pump stroke and Isopropyl alcohol is determined by using a conversion chart.
- 8) Colour change : Orange → Dark brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 % RSD-mid. : 15 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

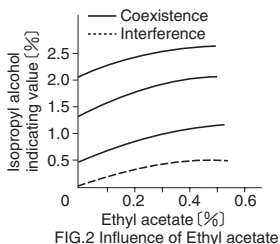
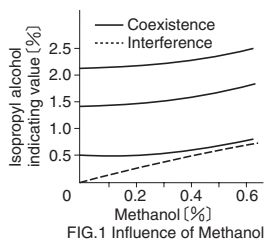
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	%	Coexistence
Alcohols FIG.1	Similar stain is produced.		Higher readings are given.
Esters FIG.2	∕		∕
Ketones	∕		∕
Aromatic hydrocarbons	∕		∕
Aliphatic hydrocarbons	Whole reagent is discoloured to Pale brown.	0.5	∕

(NOTE)

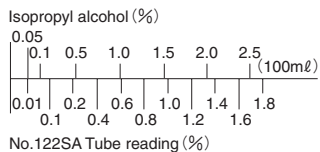
Methanol and Ethyl acetate have the same sensitivity as Isopropyl alcohol.

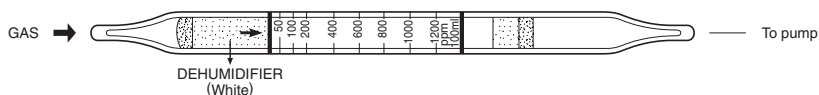
Methyl ethyl ketone has 3/4 sensitivity of Isopropyl alcohol.



TEMPERATURE CORRECTION TABLE

Conversion Value (%)	Corrected Concentration (ppm)			
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)
2.5	—	—	2.50	2.10
2.0	—	—	2.00	1.70
1.5	—	—	1.50	1.28
1.0	—	1.43	1.00	0.85
0.5	1.00	0.62	0.50	0.42
0.1	0.16	0.14	0.10	0.09
0.05	0.09	0.06	0.05	0.04





## 1. PERFORMANCE

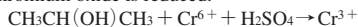
- |                          |  |            |
|--------------------------|--|------------|
| 1) Measuring range       | : 50-1,200 ppm   | 20-480 ppm |
| Number of pump strokes   | 1 (100mℓ)  | 2 (200mℓ)  |
| 2) Sampling time         | : 1.5 minutes/1 pump stroke                                  |            |
| 3) Detectable limit      | : 5 ppm (200mℓ)  |            |
| 4) Shelf life            | : 2 years  |            |
| 5) Operating temperature | : 10 ~ 40 °C   |            |
| 6) Reading               | : Direct reading from the scale calibrated by 1 pump stroke. |            |
| 7) Colour change         | : Yellow → Pale blue   |            |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols FIG.1	Similar stain is produced.	Higher readings are given.
Ethers	∕	∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	Whole reagent is discoloured to Pale brown.	∕
Aromatic hydrocarbons	∕	∕
Esters	∕	∕
Ketones	∕	∕
Halogenated hydrocarbons FIG.2	∕	∕

(NOTE)

In case of 2 pump strokes, following formula is available for the actual concentration.

Actual concentration = 2/5 × Reading value

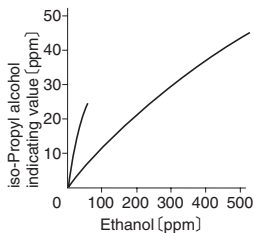


FIG.1 Influence of Ethanol

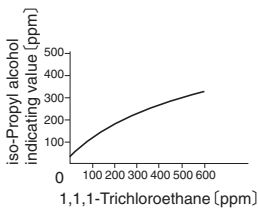
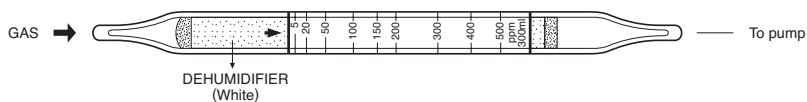


FIG.2 Influence of 1,1,1-Trichloroethane





## 1. PERFORMANCE

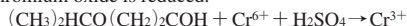
- 1) Measuring range : 5-350 ppm  
Number of pump strokes : 3 (300mℓ)
- 2) Sampling time : 4.5 minutes/3 pump strokes
- 3) Detectable limit : —
- 4) Shelf life : 2 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Ethyl cellosolve at 3 pump strokes and Isopropyl cellosolve concentration is determined by using a conversion chart at 3 pump strokes
- 7) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.

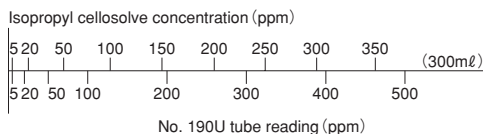


## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Ethers	∕	∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	∕	∕
Ketones	∕	∕
Aromatic hydrocarbons	Whole reagent is changed to Brown.	∕
Esters	∕	∕
Halogenated hydrocarbons	∕	∕





## 1. PERFORMANCE

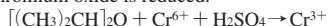
- 1) Measuring range : 30-800 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 2 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Ethyl acetate at 1 pump stroke and Isopropyl ether concentration is determined by using a conversion chart at 1 pump stroke
- 7) Colour change : Yellow → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 10 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.

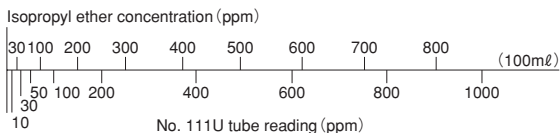


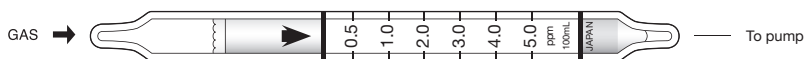
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar or brown stain is produced.	Higher readings are given.
Esters	∕	∕
Ketones	∕	∕
Aromatic hydrocarbons	∕	∕
Aliphatic hydrocarbons	Whole reagent is discoloured to Pale brown.	If the maximum end point of stained layer is discernable, the accuracy of readings is not affected.
Halogenated hydrocarbons	∕	∕





## 1. PERFORMANCE

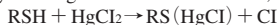
- |                          |  |           |
|--------------------------|--|-----------|
| 1) Measuring range       | : 1-10 ppm   | 0.5-5 ppm |
| Number of pump strokes   | : 1/2 (50mℓ)   | 1 (100mℓ) |
| 2) Sampling time         | : 1 minute/1 pump stroke   |           |
| 3) Detectable limit      | : 0.2 ppm (100mℓ)  |           |
| 4) Shelf life            | : 2 years  |           |
| 5) Operating temperature | : 0 ~ 40 °C  |           |
| 6) Reading               | : The tube scale is calibrated based on Methyl mercaptan at 1 pump stroke and the tube has the same sensitivity for Isopropyl mercaptan. |           |
| 7) Colour change         | : Pale yellow → Pink   |           |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 5%    RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Mercuric chloride, Hydrogen chloride is produced and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

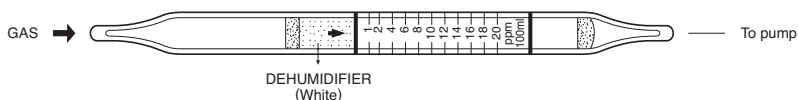
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Arsine	Similar stain is produced.	Higher readings are given.
Hydrogen selenide	∕	∕
Phosphine	∕	∕
Hydrogen sulphide	∕	∕
Hydrogen cyanide	Whole reagent is discoloured to Red.	∕
Sulphur dioxide		Whole reagent is changed to Pale red, but Pink stain indicates Mercaptans conc.

(NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.

Actual concentration = 2 × Reading value



## 1. PERFORMANCE

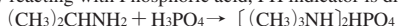
- 1) Measuring range : 1-12 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Diethyl amine at 1 pump stroke and Isopropylamine concentration is determined by using a conversion chart at 1 pump stroke
- 7) Colour change : Pale purple → Pale yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 10 % RSD-high : 10 %

## 3. CHEMICAL REACTION

By reacting with Phosphoric acid, PH indicator is discoloured.



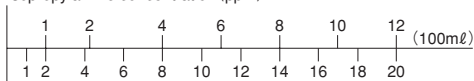
## 4. CALIBRATION OF THE TUBE

VAPOUR PRESSURE METHOD

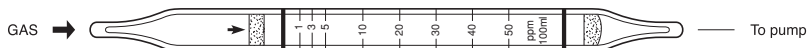
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Ammonia	Similar stains are produced.	Higher readings are given.
Other amines	∕	∕

Isopropylamine concentration (ppm)



No. 222S tube reading (ppm)



## 1. PERFORMANCE

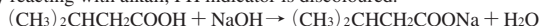
- 1) Measuring range : 3-50 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : Graduations printed on the tube are calibrated by Acetic acid at 1 pump stroke and Isovaleric acid concentration is determined by using a conversion chart at 1 pump stroke.
- 7) Colour change : Pale pink → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

By reacting with alkali, PH indicator is discoloured.

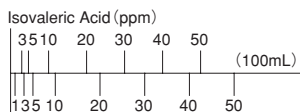


## 4. CALIBRATION OF THE TUBE

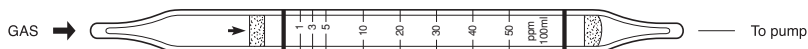
VAPOUR PRESSURE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	Coexistence
Sulphur dioxide		Similar stain is produced.	Higher readings are given.
Nitrogen dioxide	300	∕	The top of discoloured layer becomes unclear.
Hydrogen chloride		Pink stain is produced.	Higher readings are given.
Chlorine		Blueish yellow stain is produced.	∕
Acetic acid		Similar stain is produced.	∕



No.216S tube reading (ppm)



## 1. PERFORMANCE

- 1) Measuring range : 0.2-10 ppm  
Number of pump strokes : 4 (400mℓ)
- 2) Sampling time : 6 minutes/4 pump strokes
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : Direct reading from the scale calibrated by 4 pump strokes, then multiply the tube reading by 0.2 (tube reading × 0.2) .
- 7) Colour change : Pale pink → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %   RSD-mid. : 10 %   RSD-high : 10 %

## 3. CHEMICAL REACTION

By reacting with alkali, PH indicator is discoloured.

## 4. CALIBRATION OF THE TUBE

VAPOUR PRESSURE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	Coexistence
Sulphur dioxide		Similar stain is produced.	Higher readings are given.
Nitrogen dioxide	300	∕	The top of discoloured layer becomes unclear.
Hydrogen chloride		Pink stain is produced.	Higher readings are given.
Chlorine		Blueish yellow stain is produced.	∕
Acetic acid		Similar stain is produced.	∕



## 1. PERFORMANCE

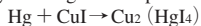
- |                          |  |                          |
|--------------------------|--|--------------------------|
| 1) Measuring range       | : 0.5-10mg/m <sup>3</sup>                                    | 0.1-2.0mg/m <sup>3</sup> |
| Number of pump strokes   | 1 (100mℓ)  | 5 (500mℓ)                |
| 2) Sampling time         | : 5 minute s/5 pump strokes                                  |                          |
| 3) Detectable limit      | : 0.02 mg/m <sup>3</sup> (500mℓ)                             |                          |
| 4) Shelf life            | : 3 years  |                          |
| 5) Operating temperature | : 0 ~ 40 °C  |                          |
| 6) Reading               | : Direct reading from the scale calibrated by 5 pump strokes |                          |
| 7) Colour change         | : Grey → Pale orange   |                          |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

By reacting with Cupric iodide (II), Cupric mercury iodide is produced.



## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

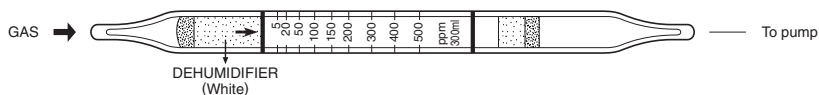
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Chlorine	The accuracy of readings is not affected.	0.1	Lower readings are given.
Hydrogen chloride	∕	0.5	∕
Nitrogen dioxide	Brown stain is produced.	0.1	∕
Hydrogen Sulphide	∕	0.5	∕

Coexistence of less than 2ppm of Chlorine does not affect the readings if Tube No.109SB Chlorine detector tube is connected as a pretreat tube.

(NOTE)

In case of 1 pump stroke, actual concentration is calculated with five times of reading value.



## 1. PERFORMANCE

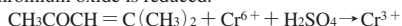
- 1) Measuring range : 5-100 ppm  
Number of pump strokes : 2 (200ml)
- 2) Sampling time : 3 minutes/2 pump strokes
- 3) Detectable limit : 1 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (0 ~ 20 °C) (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Graduations printed on the tube are calibrated by Ethyl cellosolve at 3 pump strokes and Mesityl oxide is determined by using a conversion chart.
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 10 % RSD-high : 10 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



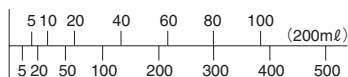
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	ppm	Coexistence
Alcohols		Similar stain is produced.		Higher readings are given.
Toluene	200	Whole reagent is discoloured to Brown.	500	The top of discoloured layer becomes unclear.
Hexane		The accuracy of reading is not affected. 1,000ppm	less than affected.	The accuracy of reading is not
Ethyl Acetate		∕		∕
Trichloroethylene		∕		∕

Mesityl oxide (ppm)

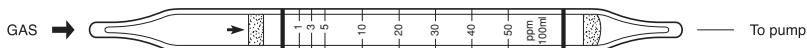


No.190U Tube reading (ppm)

TEMPERATURE CORRECTION TABLE

Conversion Value (ppm)	Corrected Concentration (ppm)		
	0 °C (32 °F)	10 °C (50 °F)	20 °C ~ 40 °C (68 °F) (104 °F)
100	—	—	100
80	—	95	80
60	100	70	60
40	60	45	40
20	30	25	20
10	15	12	10
5	7	6	5





## 1. PERFORMANCE

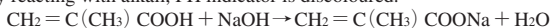
- 1) Measuring range : 1-50 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : Graduations printed on the tube are calibrated by Acetic acid at 1 pump stroke and Methacrylic acid concentration is determined by using a conversion chart at 1 pump stroke.
- 7) Colour change : Pale pink → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

By reacting with alkali, PH indicator is discoloured.

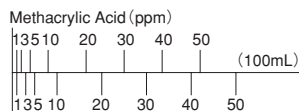


## 4. CALIBRATION OF THE TUBE

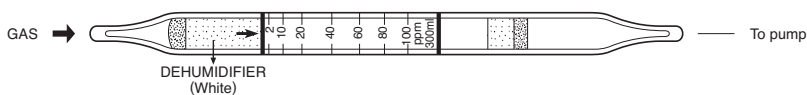
VAPOUR PRESSURE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	Coexistence
Sulphur dioxide		Similar stain is produced.	Higher readings are given.
Nitrogen dioxide	300	∕	The top of discoloured layer becomes unclear.
Hydrogen chloride		Pink stain is produced.	Higher readings are given.
Chlorine		Blueish yellow stain is produced.	∕
Acetic acid		Similar stain is produced.	∕



No.216S tube reading (ppm)



## 1. PERFORMANCE

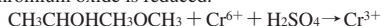
- 1) Measuring range : 10-500 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Cyclohexanone at 3 pump strokes and 1-Methoxy-2-propanol concentration is determined by using a conversion chart at 1 pump stroke
- 7) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 5%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



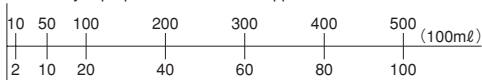
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

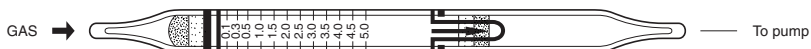
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Aliphatic hydrocarbons (more than C <sub>3</sub> )	Whole reagent is changed to pale brown.	The accuracy of readings is not affected if the maximum end point of the blue stain is discernable.
Aromatic hydrocarbons	∕	∕
Halogenated hydrocarbons	∕	∕
Alcohols	Similar stain is produced.	Higher readings are given.
Esters	Pale brown stain is produced from the zero end of the detecting reagent (inlet side of the tube).	The accuracy of readings is not affected.

1-Methoxy-2-propanol concentration (ppm)



No. 197U tube reading (ppm)



## 1. PERFORMANCE

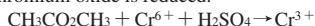
- 1) Measuring range : 0.1-3.0 %  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : The tube scale is calibrated based on Ethyl acetate at 1 pump stroke and Methyl acetate concentration is determined by using a conversion chart at 1 pump stroke
- 7) Colour change : Orange → Dark green

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 10 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



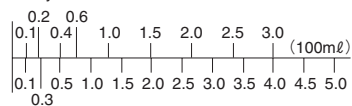
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

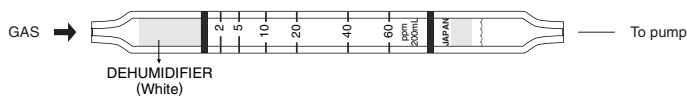
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Acetylene		3 %	Whole reagent is changed to Brown.
Propane		0.2 %	〃
Other organic gases or vapours except Halogenated hydrocarbons	Similar stain is produced.	50	Higher readings are given.

Methyl acetate concentration (%)



No. 111SA Tube reading (%)



## 1. PERFORMANCE

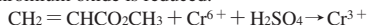
- 1) Measuring range : 2-60 ppm  
Number of pump strokes : 2 (200mℓ)
- 2) Sampling time : 3 minutes/2 pump strokes
- 3) Detectable limit : 0.5 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 2 pump strokes
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 %    RSD-mid. : 10 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

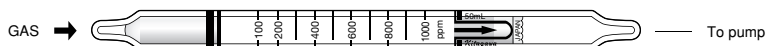
DIFFUSION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Aliphatic hydrocarbons (more than C <sub>3</sub> )	Whole reagent is changed to dark Brown.	∕
Halogenated hydrocarbons	∕	∕
Esters	∕	∕
Aromatic hydrocarbons	∕	∕

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
60	88	70	60	54	48
40	54	46	40	36	32
20	28	24	20	18	16
10	14	12	10	9	8
5	7	6	5	4	3
2	2	2	2	2	2



## 1. PERFORMANCE

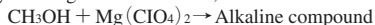
- 1) Measuring range : 100-1,000 ppmv  
Number of pump strokes : 1/2 (50mℓ)
- 2) Sampling time : 30 seconds/ 1/2 pump strokes
- 3) Detectable limit : 20 ppmv
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1/2 pump stroke
- 8) Colour change : Yellow → Blue or Yellowish green

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

By reacting with Perchlorate, PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

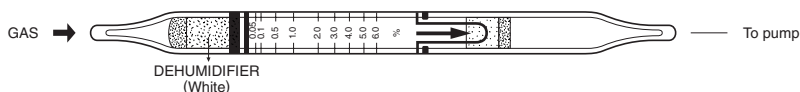
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppmv	Interference
Hydrogen sulphide	0.4	The accuracy of readings is not affected.
Sulphur dioxide	0.5	∕
Toluene	10	∕

### TEMPERATURE CORRECTION TABLE

Temperature ; Multiply the reading by the correction factors to correct for temperature.

Temperature (°C)	0	1	2	3	4	5	6	7	8	9
Correction Factor	1.40	1.38	1.36	1.34	1.32	1.30	1.28	1.26	1.24	1.22
Temperature (°C)	10	11	12	13	14	15	16	17	18	19
Correction Factor	1.20	1.18	1.16	1.14	1.12	1.10	1.08	1.06	1.04	1.02
Temperature (°C)	20	21	22	23	24	25	26	27	28	29
Correction Factor	1.00	0.98	0.96	0.94	0.92	0.90	0.88	0.86	0.84	0.82
Temperature (°C)	30	31	32	33	34	35	36	37	38	39
Correction Factor	0.80	0.80	0.79	0.79	0.78	0.78	0.77	0.77	0.76	0.76
Temperature (°C)	40									
Correction Factor	0.75									



## 1. PERFORMANCE

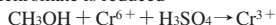
- 1) Measuring range : 0.05-6.0 %
- Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 0.01 % (100 ppm)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Yellow orange → Pale green

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Dichromate is reduced



## 4. CALIBRATION OF THE TUBE

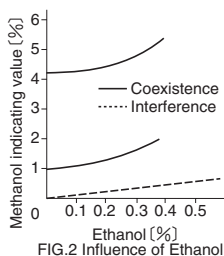
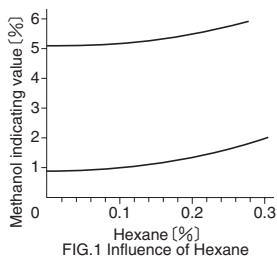
GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Aliphatic hydrocarbons (more than C <sub>3</sub> ) FIG.1	Similar stain is produced.		Higher readings are given.
Alcohols FIG.2	∕		∕
Esters	∕	50	∕
Ketones	∕		∕
Aromatic hydrocarbons	∕		∕
Halogenated hydrocarbons	Reagent is discoloured to Brown slightly.		If the top of the discolouration can be obtained, the accuracy of readings is not affected.

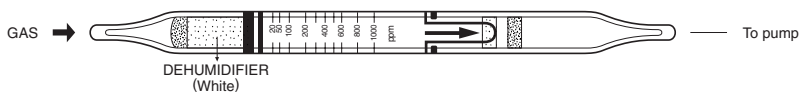
(NOTE)

Although the top of light green stain changes to Brown gradually, read the concentration on the top of the light green stain shortly.



TEMPERATURE CORRECTION TABLE

Tube Readings (%)	Corrected Concentration (%)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
6.0	—	—	6.0	4.3	3.3
5.0	—	—	5.0	3.7	2.8
4.0	—	—	4.0	3.0	2.3
3.0	—	5.1	3.0	2.3	1.8
2.0	—	3.0	2.0	1.6	1.2
1.0	2.7	1.4	1.0	0.8	0.6
0.5	1.0	0.7	0.5	0.4	0.3
0.1	0.1	0.1	0.1	0.1	0.1



## 1. PERFORMANCE

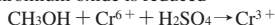
- 1) Measuring range : 20-1,000 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 5 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (0 ~ 20 °C) (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

Chromium oxide is reduced



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols                      FIG.1	Similar stain is produced.	Higher readings are given.
Esters                         FIG.2		∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	Whole reagent is changed to Pale brown.	∕
Aromatic hydrocarbons	∕	∕
Ketones	∕	∕
Halogenated hydrocarbons	∕	∕

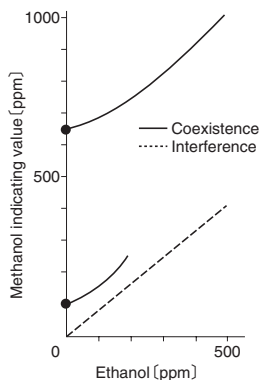


FIG.1 Influence of Ethanol

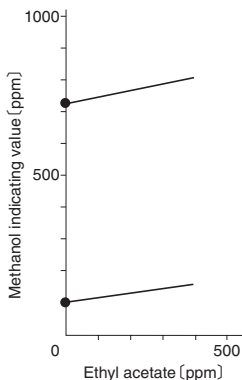
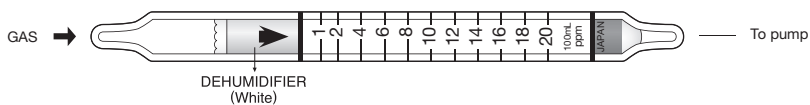


FIG.2 Influence of Ethyl acetate

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)		
	0 °C (32 °F)	10 °C (50 °F)	20-40 °C (68-104 °F)
1000	1200	1100	1000
800	960	880	800
600	720	660	600
400	480	440	400
200	240	220	200
100	120	110	100
50	60	55	50
20	24	22	20



## 1. PERFORMANCE

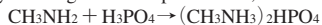
- 1) Measuring range : 1-20 ppm  
Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 0.2 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Pale purple → Pale yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

By reacting with Phosphoric acid, PH indicator is discoloured.



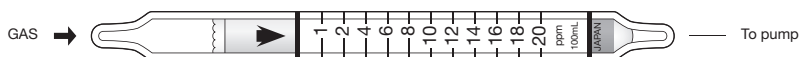
## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Ammonia	Similar stain is produced.	Higher readings are given
Other amines	∕	∕





## 1. PERFORMANCE

- 1) Measuring range : 0.5-6.0 ppm  
Number of pump strokes : 2 (200mℓ)
- 2) Sampling time : 2 minutes/2 pump strokes
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Ammonia at 1 pump stroke and N-Methyl aniline concentration is determined by using a conversion chart at 2 pump strokes
- 7) Colour change : Pale purple → Pale yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Phosphoric acid, PH indicator is discoloured.



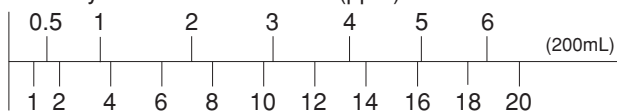
## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

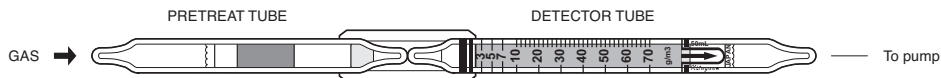
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Amines	Similar stain is produced.	Higher readings are given.

N-Methyl aniline concentration (ppm)



No. 105SD tube reading (ppm)



## 1. PERFORMANCE

- 1) Measuring range : 3-70 g/m<sup>3</sup>  
Number of pump strokes : 1/2 (50mℓ)
- 2) Sampling time : 2 minutes/1/2 pump strokes
- 3) Detectable limit : 0.6 g/m<sup>3</sup>
- 4) Shelf life : 2 years
- 5) Operating temperature : 24 ~ 45 °C
- 6) Reading : Direct reading from the scale calibrated by 1/2 pump strokes
- 7) Colour change : Yellow → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

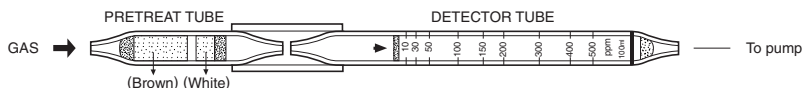


## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Chloropicrin		100	The bottom of the stained layer becomes light brown, but it does not affect the reading.



## 1. PERFORMANCE

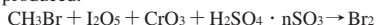
- 1) Measuring range : 10-500ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 2 minutes/1 pump stroke
- 3) Detectable limit : 1 ppm
- 4) Shelf life : 3 years (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : White → Reddish orange

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 % RSD-mid. : 10 % RSD-high : 10 %

## 3. CHEMICAL REACTION

By decomposing with an Oxidizer, Bromine is produced. Bromine reacts with *o*-Toluidine and red Orthoquinone is produced.



## 4. CALIBRATION OF THE TUBE

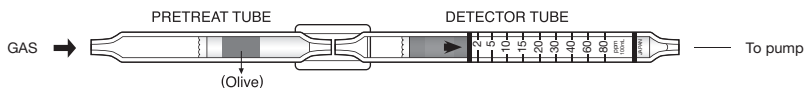
GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	ppm	Coexistence
Chlorine	1	Similar stain is produced.	1	Higher readings are given.
Bromine	1	∕	1	∕
Nitrogen dioxide	1	∕	1	∕
Dichloromethane	500	∕	500	∕
Chloroform	50	∕	50	∕
Ethylene dibromide	50	∕	50	∕
Trichloroethylene	50	∕	20	∕
Tetrachloroethylene	50	∕	40	∕

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)						
	0 °C (32 °F)	5 °C (41 °F)	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
500	—	—	—	620	500	430	390
400	—	—	630	475	400	360	325
300	—	675	430	345	300	280	260
200	580	320	235	210	200	190	175
150	260	185	160	150	150	140	130
100	120	110	100	100	100	95	90
50	50	50	50	50	50	50	50
10	10	10	10	10	10	10	10



## 1. PERFORMANCE

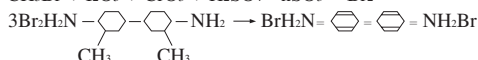
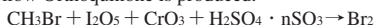
- |                             |   |           |            |
|-----------------------------|---|-----------|------------|
| 1) Measuring range          | : 2-80 ppm  | 1-25 ppm  | 0.4-10 ppm |
| Number of pump strokes      | 1 (100mℓ)   | 2 (200mℓ) | 4 (400mℓ)  |
| 2) Sampling time            | : 1.5 minutes/1 pump stroke   |           |            |
| 3) Detectable limit         | : 0.2 ppm (400mℓ)   |           |            |
| 4) Shelf life               | : 3 years (Necessary to store in refrigerated conditions ; 0 ~ 10 °C) |           |            |
| 5) Operating temperature    | : 0 ~ 40 °C   |           |            |
| 6) Temperature compensation | : Necessary (See "TEMPERATURE CORRECTION TABLE")                      |           |            |
| 7) Reading                  | : Direct reading from the scale calibrated by 1 pump stroke           |           |            |
| 8) Colour change            | : White → Yellow  |           |            |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 %    RSD-mid. : 10 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

By decomposing with an Oxidizer, Bromine is produced. Bromine reacts with *o*-Toluidine and yellow Orthoquinone is produced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Halogen	Similar stain is produced.		Higher readings are given.
Halogenated hydrocarbons	∕		∕
Hexane	FIG.1 The accuracy of readings is not affected.	200	Lower readings are given.

(NOTE)

2 pump strokes can be used with the following formula to measure the range of 1-25 ppm;

Actual concentration = 1/2 × Temperature corrected value

4 pump strokes can be used with the following formula to measure the range of 0.4-10 ppm;

Actual concentration = 1/5 × Temperature corrected value

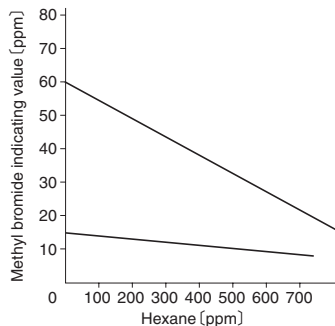
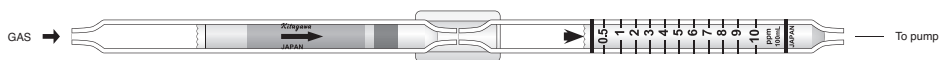


FIG.1 Influence of Hexane

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)					
	0 °C (32 °F)	5 °C (41 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
80	—	140	98	80	75	73
60	145	76	67	60	57	56
40	44	43	42	40	40	40
30	30	30	30	30	30	30



## 1. PERFORMANCE

- |                          |   |            |             |
|--------------------------|---|------------|-------------|
| 1) Measuring range       | : 8.8-22 ppm  | 0.5-10 ppm | 0.1-0.5 ppm |
| Number of pump strokes   | 1/2 (50mℓ)  | 1 (100mℓ)  | 3 (300mℓ)   |
| 2) Sampling time         | : 2.5 minutes/1 pump stroke, 1.5 minutes/ 1/2 pump strokes  |            |             |
| 3) Detectable limit      | : 0.03 ppm (300mℓ)  |            |             |
| 4) Shelf life            | : 1 year  |            |             |
| 5) Operating temperature | : 10 ~ 40 °C  |            |             |
| 6) Reading               | : Direct reading from the scale calibrated by 1 pump stroke |            |             |
| 7) Colour change         | : White → Purple  |            |             |

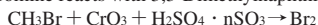
## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%   RSD-mid. : 10%   RSD-high : 10%

## 3. CHEMICAL REACTION

By decomposing with an Oxidizer, Bromine is produced.

Bromine reacts with 3,3-Dimethylnaphthidine and Bromine compound is produced.



## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference
Carbon dioxide	The accuracy of readings is not affected.

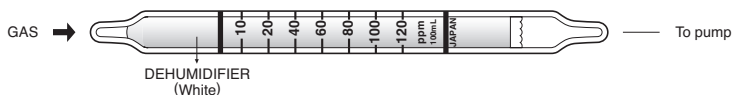
(NOTE)

1/2 pump strokes can be used with the following formula to measure the range of 8.8-22 ppm;

Actual concentration = 2.2 × Tube reading

3 pump strokes can be used with the following formula to measure the range of 0.1-0.5 ppm;

Actual concentration = 0.2 × Tube reading



## 1. PERFORMANCE

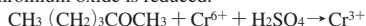
- 1) Measuring range : 5-80 ppm  
Number of pump strokes : 2 (200mℓ)
- 2) Sampling time : 3 minutes/2 pump strokes
- 3) Detectable limit : —
- 4) Shelf life : 2 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Vinyl acetate at 1 pump stroke and Methyl butyl ketone concentration is determined by using a conversion chart at 2 pump strokes
- 7) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



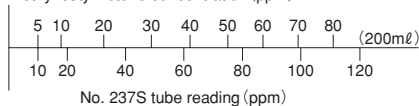
## 4. CALIBRATION OF THE TUBE

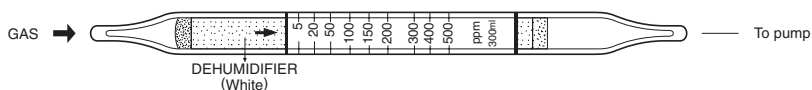
GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Acetic acid			The accuracy of readings is not affected.
Ethylene	Pale brown or pale blue stain is produced.	150	Lower readings are given.
Alcohols	Similar stain is produced.		Higher readings are given.
Ethers	∕		∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	Whole layer is discoloured to pale brown.		∕
Aromatic hydrocarbons	∕		∕
Halogenated hydrocarbons	∕		∕
Esters	∕		∕

Methyl butyl ketone concentration (ppm)





## 1. PERFORMANCE

- 1) Measuring range : 5-500 ppm  
Number of pump strokes : 3 (300mℓ)
- 2) Sampling time : 4.5 minutes/3 pump strokes
- 3) Detectable limit : 2 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : The tube scale is calibrated based on Ethyl cellosolve at 3 pump strokes and the tube has the same sensitivity for Methyl cellosolve.
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Ethers	//	//
Aliphatic hydrocarbons (more than C <sub>3</sub> )	Whole reagent is changed to Brown.	//
Aromatic hydrocarbons	//	//
Esters	//	//
Ketones	//	//
Halogenated hydrocarbons FIG.1	//	//

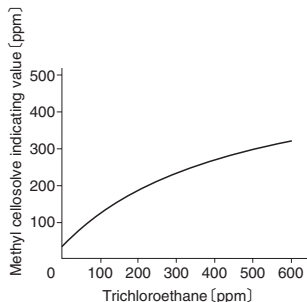
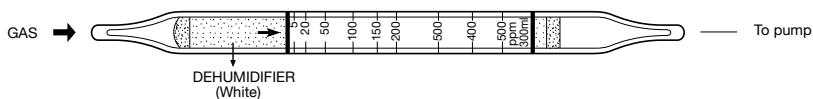


FIG.1 Influence of Trichloroethane

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)					
	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	25 °C (77 °F)	30 °C (86 °F)	35 °C (95 °F)
500	800	620	500	410	335	265
400	620	490	400	330	260	200
300	450	370	300	250	200	150
200	290	250	200	160	130	100
150	220	190	150	120	90	70
100	150	130	100	80	60	50
50	80	70	50	40	30	30
20	30	25	20	15	12	10
5	10	7	5	4	3	2



## 1. PERFORMANCE

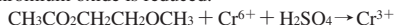
- 1) Measuring range : 3-120 ppm  
Number of pump strokes : 3 (300ml)
- 2) Sampling time : 4.5 minutes/3 pump strokes
- 3) Detectable limit : —
- 4) Shelf life : 2 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Ethyl cellosolve at 3 pump strokes and Methyl cellosolve acetate concentration is determined by using a conversion chart at 3 pump strokes
- 7) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



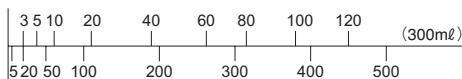
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Ethers	∕	∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	∕	∕
Ketones	∕	
Aromatic hydrocarbons	Whole reagent is changed to Brown.	∕
Esters	∕	∕
Halogenated hydrocarbons	∕	∕

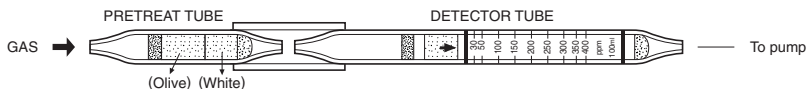
Methyl cellosolve acetate concentration (ppm)



No. 190U Tube reading (ppm)



# METHYL CHLOROFORM (1,1,1-TRICHLOROETHANE)



## 1. PERFORMANCE

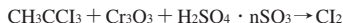
- 1) Measuring range : 30-400 ppm    15-30 ppm
- Number of pump strokes : 1 (100mℓ)    2 (200mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 10 ppm (200mℓ)
- 4) Shelf life : 3 years (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : White → Yellow orange

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

Chlorine is produced by an Oxidizer. By reacting between this Chlorine and *o*-Toluidine, Orthoquinone is produced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Halogens	Similar stain is produced.	Higher readings are given.
Halogenated hydrocarbons FIG.1,2	∕	∕

(NOTE)

When the concentration is below 30 ppm, 2 pump strokes can be used to determine the lower concentration.

Following formula is available for the actual concentration.

Actual concentration = 1/2 × Reading value

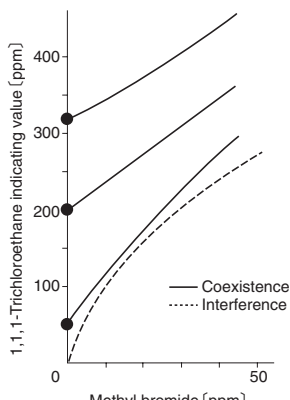


FIG.1 Influence of Methyl bromide

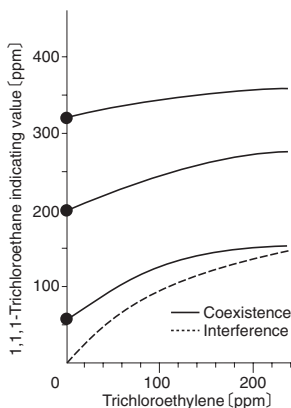


FIG.2 Influence of Trichloroethylene



## 1. PERFORMANCE

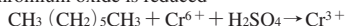
- |                          |  |
|--------------------------|--|
| 1) Measuring range       | : 100-1,600 ppm  |
| Number of pump strokes   | 1 (100mℓ)  |
| 2) Sampling time         | : 1.5 minutes/1 pump stroke  |
| 3) Detectable limit      | : —  |
| 4) Shelf life            | : 2 years  |
| 5) Operating temperature | : 15 ~ 25 °C   |
| 6) Reading               | : Graduations printed on the tube are calibrated by n-Hexane at 1 pump stroke and Methyl cyclohexane concentration is determined by using a conversion chart at 1 pump stroke. |
| 7) Colour change         | : Orange → Yellowish green   |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 5%

## 3. CHEMICAL REACTION

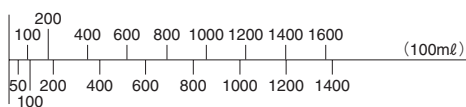
Chromium oxide is reduced



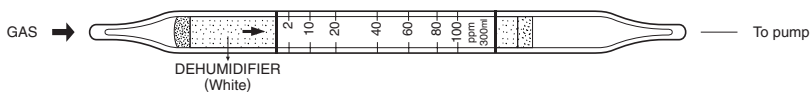
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

Methyl cyclohexane concentration (ppm)



No.113SB Tube reading (ppm)



## 1. PERFORMANCE

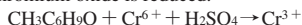
- 1) Measuring range : 2-100 ppm  
Number of pump strokes : 3 (300ml)
- 2) Sampling time : 4.5 minutes/3 pump strokes
- 3) Detectable limit : 1 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 3 pump strokes
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 5%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Aliphatic hydrocarbons (more than C <sub>3</sub> )	Whole reagent is changed to Pale brown.	The accuracy of readings is not affected.
Aromatic hydrocarbons	∕	∕
Halogenated hydrocarbons	∕	∕
Alcohols	FIG.1 Similar stain is produced.	Higher readings are given.
Esters	Pale ringed stain is produced near the bottom of the reagent.	The accuracy of readings is not affected.

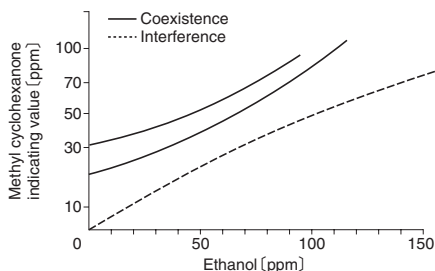
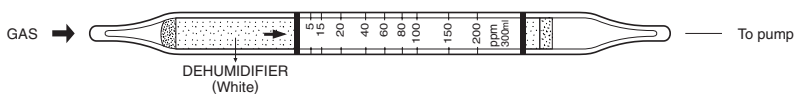


FIG.1 Influence of Ethanol

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (0°F)	10 °C (50°F)	20 °C (68°F)	30 °C (86°F)	40 °C (104°F)
100	—	130	100	80	66
80	130	105	80	65	52
60	100	80	60	48	36
40	68	54	40	30	22
20	35	26	20	14	10
10	18	14	10	7	5
2	3	3	2	1	1



## 1. PERFORMANCE

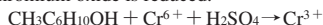
- 1) Measuring range : 5-200 ppm
- Number of pump strokes : 3 (300ml)
- 2) Sampling time : 4.5 minutes/3 pump strokes
- 3) Detectable limit : 1 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 3 pump strokes
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 10 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.

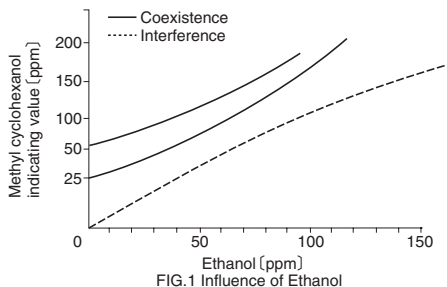


## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

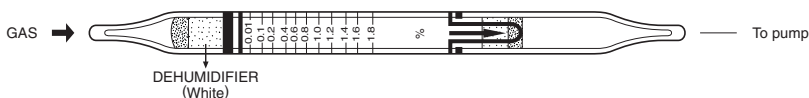
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Aliphatic hydrocarbons (more than C <sub>3</sub> )	Whole reagent is changed to Pale brown.	The accuracy of readings is not affected.
Aromatic hydrocarbons	∕	∕
Halogenated hydrocarbons	∕	∕
Alcohols	FIG.1 Similar stain is produced.	Higher readings are given.
Esters	Pale ringed stain is produced near the bottom of the reagent.	The accuracy of readings is not affected.



TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)			
	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
200	—	200	110	65
150	—	150	85	52
100	—	100	60	40
80	170	80	50	30
60	110	60	35	25
40	70	40	25	15
20	40	20	15	10
10	20	10	7	5
5	10	5	4	3



## 1. PERFORMANCE

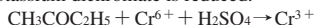
- 1) Measuring range : 1.0-5.0 %    0.05-2.2 %  
     Number of pump strokes : 1/2 (50mℓ)    1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 50 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Graduations printed on the tube are calibrated by Ethylene oxide at 1 pump stroke and Methyl ethyl ketone is determined by using a conversion chart.
- 7) Colour change : Orange → Dark brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Potassium dichromate is reduced.

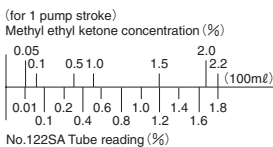
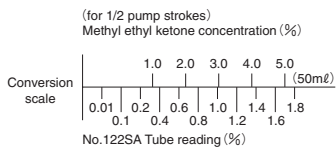


## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Alcohols            FIG.1	Similar stain is produced.		Higher readings are given.
Esters              FIG.2	∕		∕
Ketones	∕		∕
Aromatic hydrocarbons	∕		∕
Halogenated hydrocarbons	Whole stain is discoloured to Pale brown.	0.5 %	∕



### TEMPERATURE CORRECTION TABLE

Conversion Value (%)	Corrected Concentration (ppm)			
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)
2.5	—	2.88	2.50	2.34
2.0	2.70	2.30	2.00	1.84
1.5	2.36	1.74	1.50	1.35
1.0	1.52	1.16	1.00	0.88
0.5	0.70	0.58	0.50	0.42
0.1	0.14	0.12	0.10	0.08
0.05	0.07	0.05	0.05	0.03
0.01	0.01	0.01	0.01	0.01

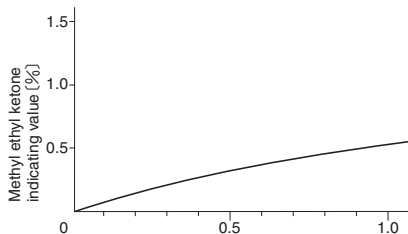


FIG.1 Influence of Methanol

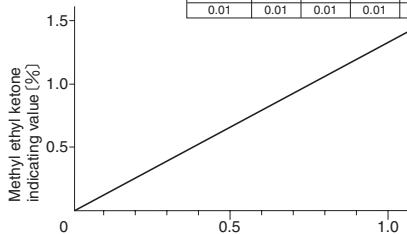
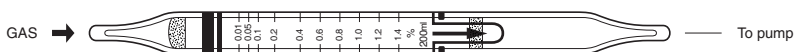


FIG.2 Influence of Ethyl acetate



## 1. PERFORMANCE

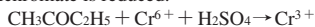
- 1) Measuring range : 0.01-1.4 %
- Number of pump strokes : 2 (200mℓ)
- 2) Sampling time : 3 minutes/2 pump strokes
- 3) Detectable limit : 0.001 % (10 ppm)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 2 pump strokes
- 7) Colour change : Orange → Brownish green

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Dichromate is reduced.

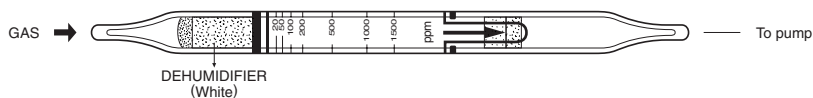


## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Acetylene		3%	Whole reagent is discoloured to Brown and higher readings are given.
Propane		0.2%	∕
Other organic gases or vapours except Halogenated hydrocarbons	Similar stain is produced.	50	Higher readings are given.



## 1. PERFORMANCE

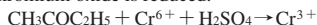
- 1) Measuring range : 20-1,500 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 10 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Yellow → Pale blue (The top of discoloured layer is Brown.)

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar or Brown stain is produced.	Higher readings are given.
Esters	∕	∕
Ketones	∕	∕
Aromatic hydrocarbons	∕	∕
Halogenated hydrocarbons FIG.2		Whole reagent is changed to Brown, but if the top of Pale blue stain is clear, the reading can be obtained.
Aliphatic hydrocarbons (more than C <sub>3</sub> ) FIG.1		∕

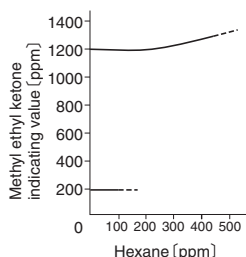


FIG.1 Influence of Hexane

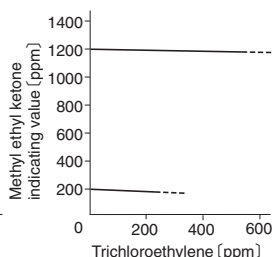


FIG.2 Influence of Trichloroethylene

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)							
	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	25 °C (77 °F)	30 °C (86 °F)	35 °C (95 °F)	40 °C (104 °F)	
1500	2050	1750	1500	1260	1100	940	820	
1000	1430	1200	1000	850	720	620	530	
500	750	620	500	430	360	320	280	
200	300	250	200	170	140	120	110	
100	160	120	100	90	70	60	50	
50	80	60	50	40	30	30	20	
20	30	30	20	20	10	10	10	



## 1. PERFORMANCE

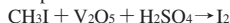
- 1) Measuring range : 0.4-8 ppm    1-20 ppm    2.5-50 ppm
- Number of pump strokes : 2 (200mℓ)    1 (100mℓ)    1/2 (50mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 0.2 ppm (200mℓ)
- 4) Shelf life : 1 year
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : White → Grey

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 %    RSD-mid. : 10 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Iodine pentoxide is reduced.



## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Carbon dioxide	The accuracy of readings is not affected.	50%	The accuracy of readings is not affected.
Methyl bromide	∕	1	∕
Acetone	∕	200	∕
Hexane	∕	200	∕
Hydrogen sulphide		0.5	Higher readings are given.
1,3-Dichloropropene		0.1	∕
Toluene			Lower readings are given.

(NOTE)

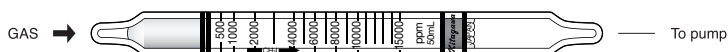
- 1) In case of 1/2 pump strokes, following formula is available for the actual concentration.  
Actual concentration = 2.5 × Temperature corrected value
- 2) In case of 2 pump strokes, following formula is available for the actual concentration.  
Actual concentration = 0.4 × Temperature corrected value

### TEMPERATURE CORRECTION TABLE

Temperature; To correct for temperature, multiply the tube reading by the following factors.

Pump stroke	Temperature (°C)	0	5	10	15	20	25	30	35	40
1	Coefficient	1.55	1.32	1.15	1.00					
		2.20	1.80	1.50	1.20	1.00				
2		1.30	1.22	1.15	1.00		1.15	1.22	1.30	





## 1. PERFORMANCE

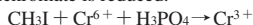
- 1) Measuring range : 500-15,000 ppm  
Number of pump strokes : 1/2 (50mℓ)
- 2) Sampling time : 45 seconds/1/2 pump strokes
- 3) Detectable limit : 75 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1/2 pump stroke
- 8) Colour change : Yellowish orange → Brownish green

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Bichromate is reduced.



## 4. CALIBRATION OF THE TUBE

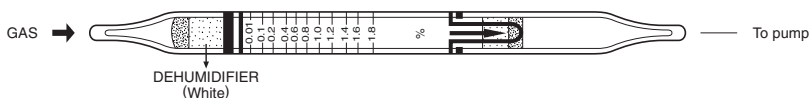
GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	%	Interference
Carbon dioxide	60	The accuracy of readings is not affected.

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (80 °F)	40 °C (104 °F)
15000	19500	17250	15000	12325	9650
14000	18200	16100	14000	11525	9050
13000	16900	14950	13000	10750	8500
12000	15600	13800	12000	9950	7900
11000	14300	12650	11000	9200	7400
10000	13000	11500	10000	8400	6800
9000	11700	10350	9000	7600	6200
8000	10400	9200	8000	6800	5600
7000	9100	8050	7000	6000	5000
6000	7800	6900	6000	5150	4300
5000	6500	5750	5000	4350	3700
4000	5200	4600	4000	3540	3080
3000	3900	3450	3000	2750	2500
2000	2500	2250	2000	1960	1920
1000	1060	1030	1000	1000	1000
500	500	500	500	500	500



## 1. PERFORMANCE

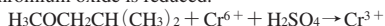
- 1) Measuring range : 0.01-0.6 %
- Number of pump strokes : 3 (300ml)
- 2) Sampling time : 4.5 minutes/3 pump strokes
- 3) Detectable limit : 10 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Graduations printed on the tube are calibrated by Ethylene oxide at 1 pump stroke and Methyl isobutyl ketone is determined by using a conversion chart at pump strokes.
- 8) Colour change : Orange → Dark brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Alcohols	Similar stain is produced.		Higher readings are given.
Esters FIG.1	∕		∕
Ketones	∕		∕
Aromatic hydrocarbons FIG.2	∕		∕
Halogenated hydrocarbons	Whole reagent is changed to Pale brown.	0.5 %	∕

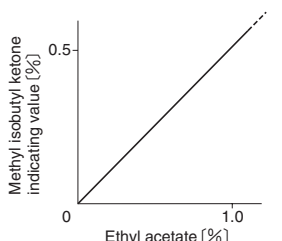


FIG.1 Influence of Ethyl acetate

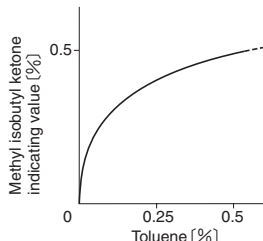
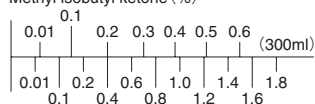


FIG.2 Influence of Toluene

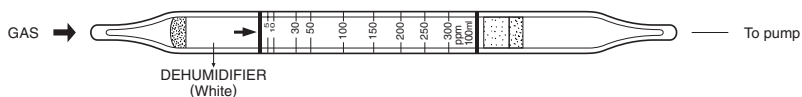
### TEMPERATURE CORRECTION TABLE

Conversion Value (%)	Corrected Concentration (%)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
0.6	—	—	0.60	0.55	0.52
0.5	—	—	0.50	0.46	0.43
0.4	—	—	0.40	0.37	0.35
0.3	—	—	0.30	0.28	0.27
0.2	—	0.23	0.20	0.19	0.18
0.1	0.16	0.11	0.10	0.10	0.10
0.05	0.05	0.05	0.05	0.05	0.05

Methyl isobutyl ketone (%)



No.122SA Tube reading (%)



## 1. PERFORMANCE

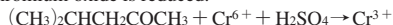
- 1) Measuring range : 5-300 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 2 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

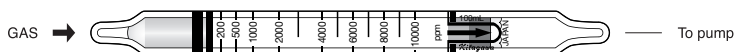
GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Ethers	∕	∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	Whole reagent is changed to Pale brown.	∕
Aromatic hydrocarbons	∕	∕
Esters	∕	∕
Ketones	∕	∕
Halogenated hydrocarbons	∕	∕

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
300	—	—	300	230	190
250	—	380	250	195	165
200	—	290	200	155	130
150	355	210	150	120	100
100	220	130	100	80	70
50	90	65	50	40	35
30	55	40	30	25	25
10	15	10	10	8	8
5	7	5	5	5	5



## 1. PERFORMANCE

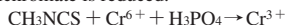
- 1) Measuring range : 200-10,000 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 50 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Yellowish orange → Pale green

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Bichromate is reduced.



## 4. CALIBRATION OF THE TUBE

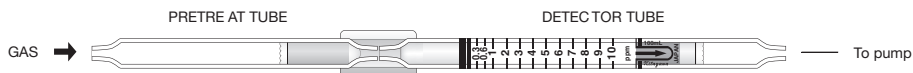
GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	%	Interference
Carbon dioxide	60	The accuracy of readings is not affected.
Sulphuryl fluoride	10	∕

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (80 °F)	40 °C (104 °F)
10000	—	—	10000	7500	6100
9000	—	—	9000	7000	5500
8000	—	—	8000	6200	4900
7000	—	—	7000	5400	4300
6000	—	14400	6000	4600	3700
5000	—	8600	5000	3900	3000
4000	11400	6100	4000	3100	2500
3000	7200	4200	3000	2400	1900
2000	3800	2600	2000	1700	1400
1000	1600	1200	1000	900	750
500	650	575	500	450	400
200	200	200	200	200	200



## 1. PERFORMANCE

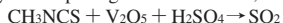
- |                             |  |             |
|-----------------------------|--|-------------|
| 1) Measuring range          | : 0.3-10 ppm   | 0.66-22 ppm |
| Number of pump strokes      | 1 (100mℓ)  | 1/2 (50mℓ)  |
| 2) Sampling time            | : 2 minutes / 1 pump stroke  |             |
| 3) Detectable limit         | : 0.1 ppm  |             |
| 4) Shelf life               | : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10℃) |             |
| 5) Operating temperature    | : 0 ~ 40℃  |             |
| 6) Temperature compensation | : Necessary (See "TEMPERATURE CORRECTION TABLE")                   |             |
| 7) Reading                  | : Direct reading from the scale calibrated by 1 pump stroke        |             |
| 8) Colour change            | : Pink → Yellowish orange  |             |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 5%    RSD-high : 5%

## 3. CHEMICAL REACTION

By decomposing with an oxidizer, Sulphur dioxide is produced and PH indicator is discoloured.



$\text{SO}_2 + \text{pH indicator (Pink)} \rightarrow \text{Yellowish orange}$

## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	%	Coexistence
Carbon dioxide		35	Higher readings are given.

(NOTE)

The scale is calibrated based on the temperature of 20℃. Reading obtained in other temperature circumstances should be corrected with the following temperature correction coefficient table.

TEMPERATURE CORRECTION COEFFICIENT TABLE (AT 20℃)

Pump stroke	Temperature (C)	0	5	10	15	20	25	30	35	40
1	Coefficient	1.30	1.23	1.15	1.08	1.00	0.95	0.90	0.85	0.80
		1.70	1.48	1.30	1.11	1.00	0.97	0.95	0.92	0.90

Actual concentration = Reading value × Coefficient for temperature correction



## 1. PERFORMANCE

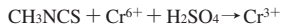
- 1) Measuring range : 10-600 ppm      25-1,500 ppm  
     Number of pump strokes : 1 (100mℓ)      1/2 (50mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke, 1 minute/1/2 pump strokes
- 3) Detectable limit : 3 ppm (100mℓ)
- 4) Shelf life : 1 year
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Pale yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 10 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Bichromate is reduced.

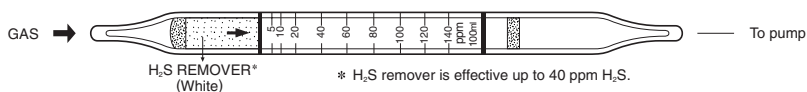


## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	%	Interference
Carbon dioxide	50	The accuracy of readings is not affected.



## 1. PERFORMANCE

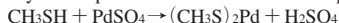
- 1) Measuring range : 5-140 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 1 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (0 ~ 20 °C) (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : White → Reddish yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 10 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Methyl mercaptan reacts with Palladium sulphate.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	ppm	Coexistence
Carbon monoxide	150	Dark grey stain is produced.		
Ethylene	200	∕		
Hydrogen sulphide	40	Dark brown stain is produced.		
Acetylene	20	Pale brown stain is produced.		
Ethyl mercaptan	1	Reddish yellow stain is produced.		
Methyl sulphide			1	Lower readings are given.
Chlorine			0.2	∕
Nitrogen dioxide			1	∕

(NOTE)

Max. 40 ppm Hydrogen sulphide is eliminated by pretreat reagent.

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)		
	0 °C (32 °F)	10 °C (50 °F)	20-40 °C (68-104 °F)
140	164	149	140
120	140	128	120
100	118	107	100
80	94	85	80
60	70	63	60
40	45	41	40
20	21	21	20
10	10	10	10



## 1. PERFORMANCE

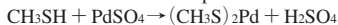
- 1) Measuring range : 50-1,000 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 10 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Pale yellow → Orange

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

It reacts with Palladium sulphate.



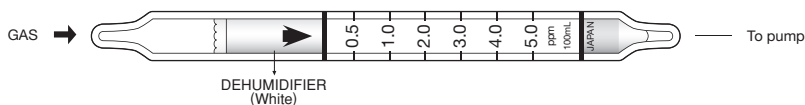
## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	ppm	Coexistence
Chlorine		The accuracy of readings is not affected.	Methyl mercaptan conc. X 1/3	Lower readings are given.
Carbon monoxide	500	Deep grey stain is produced.		The accuracy of readings is not affected If the top of the discolouration can be obtained.
Ethylene	500	∕		∕
Hydrogen sulphide	less than 500	The accuracy of readings is not affected.	650	Higher readings are given.
Nitrogen dioxide	5000	Yellow stain is produced.	1000	∕





## 1. PERFORMANCE

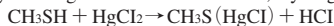
- |                          |   |           |
|--------------------------|---|-----------|
| 1) Measuring range       | : 1-10 ppm  | 0.5-5 ppm |
| Number of pump strokes   | : 1/2 (50mℓ)  | 1 (100mℓ) |
| 2) Sampling time         | : 1 minute/1 pump stroke  |           |
| 3) Detectable limit      | : 0.2 ppm (100mℓ)   |           |
| 4) Shelf life            | : 2 years   |           |
| 5) Operating temperature | : 0 ~ 40 °C   |           |
| 6) Reading               | : Direct reading from the scale calibrated by Methyl mercaptan at 1 pump stroke |           |
| 7) Colour change         | : Pale yellow → Pink  |           |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Mercuric chloride, Hydrogen chloride is produced and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

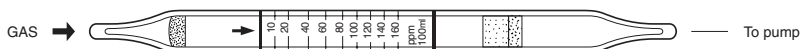
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Arsine	Similar stain is produced.	Higher readings are given.
Hydrogen selenide	∕	∕
Phosphine	∕	∕
Hydrogen sulphide	∕	∕
Hydrogen cyanide	Whole reagent is changed to Red.	∕
Sulphur dioxide		Whole reagent is changed to Pale red, but Pink stain indicates Mercaptans conc.

(NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.

Actual concentration = 2 × Reading value



## 1. PERFORMANCE

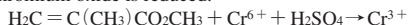
- 1) Measuring range : 10-160 ppm  
Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 2 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 % RSD-mid. : 10 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

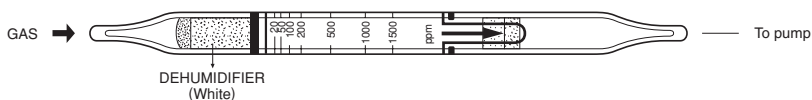
GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Ethers	∕	∕
Esters	Whole layer is discoloured to Pale brown.	∕
Ketones	∕	∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	∕	∕
Aromatic hydrocarbons	∕	∕
Halogenated hydrocarbons	∕	∕

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
160	190	175	160	150	140
140	165	155	140	130	125
120	140	130	120	110	105
100	120	110	100	95	90
80	95	90	80	75	70
60	70	65	60	55	50
40	47	44	40	37	35
20	24	22	20	19	17
10	12	11	10	9	9



## 1. PERFORMANCE

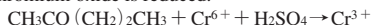
- 1) Measuring range : 20-1,500 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 2 years
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Yellow → Pale blue (The top of discoloured layer is Brown.)

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohol	Similar or Brown stain is produced.	Higher readings are given.
Esters	∕	∕
Ketones	∕	∕
Aromatic hydrocarbons	∕	∕
Halogenated hydrocarbons FIG. 2		Whole reagent is changed to Brown, but if the maximum end point of Pale blue stain is discernable, the accuracy of readings is not affected.
Aliphatic hydrocarbons FIG. 1		∕

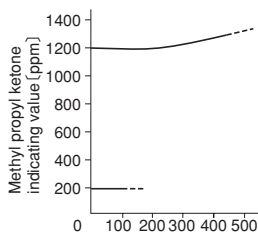


FIG.1 Influence of Hexane

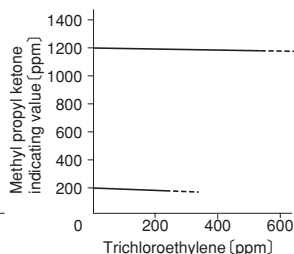


FIG.2 Influence of Trichloroethylene

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)							
	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	25 °C (77 °F)	30 °C (86 °F)	35 °C (95 °F)	40 °C (104 °F)	
1500	2050	1750	1500	1260	1100	940	820	
1000	1430	1200	1000	850	720	620	530	
500	750	620	500	430	360	320	280	
200	300	250	200	170	140	120	110	
100	160	120	100	90	70	60	50	
50	80	60	50	40	30	30	20	
20	30	30	20	20	10	10	10	



## 1. PERFORMANCE

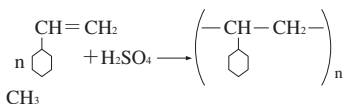
- 1) Measuring range : 10-500 ppm
- Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 1 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : White → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 %    RSD-mid. : 15 %    RSD-high : 15 %

## 3. CHEMICAL REACTION

A polymer of Styrene is produced by Sulphuric acid.



## 4. CALIBRATION OF THE TUBE

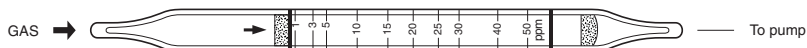
GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	The accuracy of readings is not affected.	The accuracy of readings is not affected.
Esters	∕	∕
Aromatic hydrocarbons (except Styrene)	∕	∕
Halogenated hydrocarbons	∕	∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	∕	∕
Styrene	Similar stain is produced.	Higher readings are given.

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
500	300	380	500	680	850
400	270	320	400	560	730
300	210	250	300	390	500
200	140	160	200	250	300
100	70	80	100	130	150
50	30	40	50	70	80
30	17	24	30	40	54
10	4	6	10	12	18



## 1. PERFORMANCE

- 1) Measuring range : 1-50 ppm    0.5-25 ppm
- Number of pump strokes    1 (100mℓ)    2 (200mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 0.2 ppm (200mℓ)
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Pink → Pale purple

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 5%    RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Sulphuric acid, PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

ABSORPTIOMETRIC METHOD

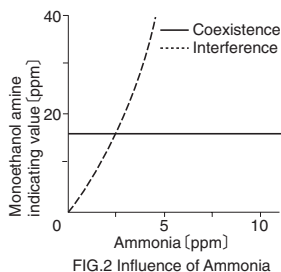
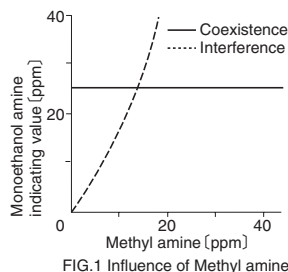
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Other amines    FIG.1	Brownish yellow stain is produced.	Double-stain layer (Brownish yellow and Pale purple) is produced, but the maximum end point of the Pale purple stain is discernable.
Ammonia    FIG.2	Similar stain is produced.	Double-stain layer (Yellow and Pale purple) is produced, but the maximum end point of the Pale purple stain is discernable.
Hydrazine	∕	∕
Atmospheric air (CO <sub>2</sub> + H <sub>2</sub> O)	∕	

(NOTE)

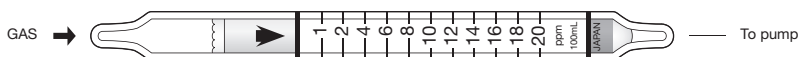
In case of 2 pump strokes, following formula is available for the actual concentration.

Actual concentration = 1/2 × Temperature corrected value



TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
50	—	—	50	35	29
40	—	65	40	30	25
30	—	49	30	23	20
25	—	39	25	20	17
20	65	30	20	16	14
15	45	22	15	12	10
10	29	14	10	8	7
5	12	7	5	4	3
3	6	4	3	3	2
1	1	1	1	1	1



## 1. PERFORMANCE

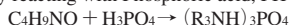
- 1) Measuring range : 2-22 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : Graduations printed on the tube are calibrated by Ammonia at 1 pump stroke and Morpholine concentration is determined by using a conversion chart at 1 pump stroke.
- 7) Colour change : Pale purple → Pale Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Phosphoric acid, PH indicator is discoloured.

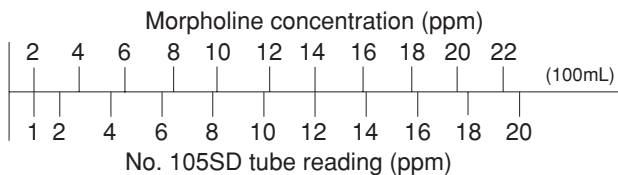


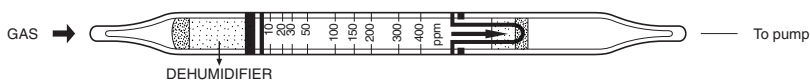
## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Amines	Similar stain is produced.	Higher readings are given.





## 1. PERFORMANCE

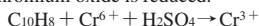
- 1) Measuring range : 10-100 ppm
- Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 2ppm
- 4) Shelf life : 1 year
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Graduations printed on the tube are calibrated by Isobutyl acetate at 1 pump stroke and Naphthalene is determined by using a conversion chart at pump strokes.
- 8) Colour change : Pale yellow → Blackish brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

VAPOUR PRESSURE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Methanol FIG.1	Pale blue stain is produced.	Higher readings are given.
Butyl acetate	∕	∕
Aromatic hydrocarbons FIG.2	Brown stain is produced.	∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	∕	∕
Esters	∕	∕

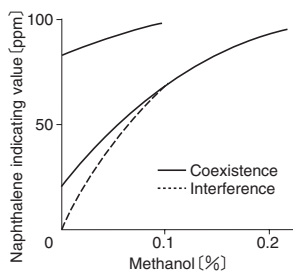


FIG.1 Influence of Methanol

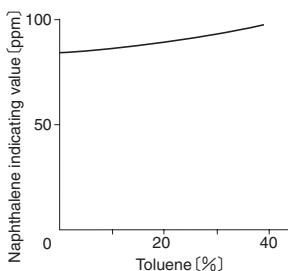
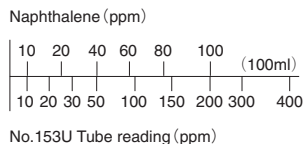
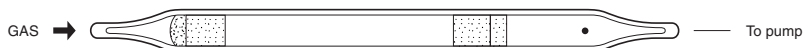


FIG.2 Influence of Toluene





## 1. PERFORMANCE

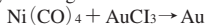
- 1) Measuring range : 20-700 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 3 minutes/1 pump stroke
- 3) Detectable limit : 10 ppm
- 4) Shelf life : 6 months
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Concentration chart method
- 7) Colour change : Pale yellow → Dark purple

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Gold chloride (III), colloidal gold is liberated.

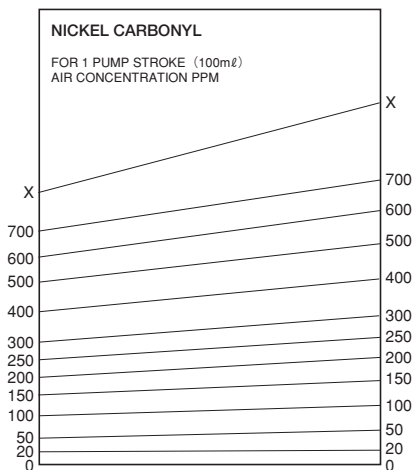


## 4. CALIBRATION OF THE TUBE

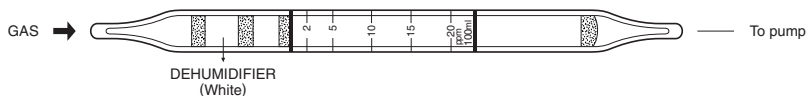
STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Arsine	Similar stain is produced.	10	Higher readings are given.
Iron carbonyl	∕	10	∕
Mercury vapour	∕	10	∕
Hydrogen sulphide	Brown stain is produced.	10	∕
Sulphur dioxide	Pale blue stain is produced.	10	∕
Carbon monoxide	The accuracy of readings is not affected.	1,000	∕
Acetylene	∕	3%	∕







## 1. PERFORMANCE

- 1) Measuring range : 2-20 ppm      1-10 ppm  
     Number of pump strokes : 1 (100mℓ)    2 (200mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 0.5ppm (200mℓ)
- 4) Shelf life : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 5 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Pale yellow → Purple

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 %    RSD-mid. : 15 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

PH indicator is discoloured.

## 4. CALIBRATION OF THE TUBE

ABSORPTIOMETRIC METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Hydrogen fluoride	Similar stain is produced.	8	The top of discoloured layer becomes unclear and higher readings are given.
Nitrogen dioxide    FIG.1	∕	50	∕
Hydrogen chloride    FIG.2	∕		Higher readings are given.

(NOTE)

In case of 2 pump strokes, following formula is available for the actual concentration.

Actual concentration =  $1/2 \times$  Temperature corrected value

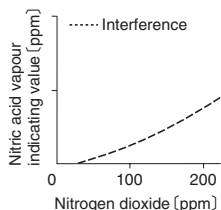


FIG.1 Influence of Nitrogen dioxide

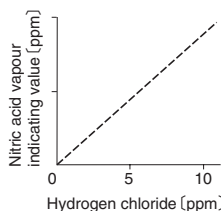
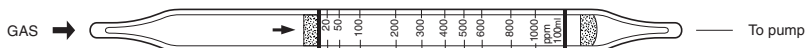


FIG.2 Influence of Hydrogen chloride

### CORRECTION FOR AMBIENT CONDITIONS:

Temperature; Correct the tube reading by following temperature correction table.

Temperature (°C)										
Coefficient										
Temperature (°C)	10	11	12	13	14	15	16	17	18	19
Coefficient	1.60	1.52	1.44	1.37	1.31	1.25	1.19	1.13	1.08	1.04
Temperature (°C)	20	21	22	23	24	25	26	27	28	29
Coefficient	1.00	0.96	0.92	0.89	0.86	0.83	0.80	0.77	0.74	0.71
Temperature (°C)	30	31	32	33	34	35	36	37	38	39
Coefficient	0.70	0.68	0.66	0.64	0.62	0.60	0.58	0.56	0.55	0.54
Temperature (°C)	40									
Coefficient	0.53									



## 1. PERFORMANCE

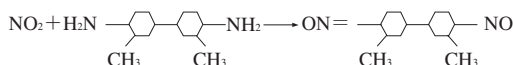
- 1) Measuring range : 20-1,000 ppm  
Number of pump strokes : 1 (100ml)
- 2) Sampling time : 2 minutes/1 pump stroke
- 3) Detectable limit : 5 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : White → Yellowish orange

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 10 % RSD-high : 10 %

## 3. CHEMICAL REACTION

By reacting with *o*-Toluidine, Nitroso-*o*-Toluidine (dyestuff) is produced.



## 4. CALIBRATION OF THE TUBE

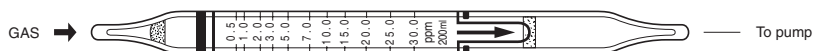
PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Chlorine	Similar stain is produced.	5	Higher readings are given.
Bromine	∕	5	∕
Iodine	∕	5	∕
Ozone	∕	5	∕
Nitrogen monoxide	The accuracy of readings is not affected.	10	The accuracy of readings is not affected.

## TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)						
	0 °C (32 °F)	5 °C (41 °F)	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
1,000	—	—	—	—	1,000	640	540
800	—	—	—	—	800	560	480
600	—	—	—	860	600	470	420
500	—	—	1,000	700	500	410	380
400	—	—	840	540	400	350	330
300	—	1,000	570	390	300	280	270
200	1,000	500	320	240	200	200	190
100	200	160	120	110	100	100	100
50	60	60	60	55	50	50	50
20	20	10	20	20	20	20	20



## 1. PERFORMANCE

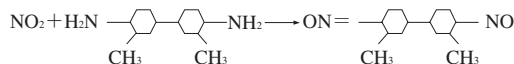
- 1) Measuring range : 0.5-30 ppm
- Number of pump strokes : 2 (200ml)
- 2) Sampling time : 1.5 minutes/2 pump strokes
- 3) Detectable limit : 0.1 ppm
- 4) Shelf life : 1 year
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 2 pump strokes
- 7) Colour change : White → Yellowish orange

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

By reacting with *o*-Toluidine, Nitroso-*o*-Toluidine (dyestuff) is produced.



## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Chlorine      FIG.1	Similar stain is produced.	2	Higher readings are given.
Bromine	“	2	“
Iodine	“	2	“
Nitrogen monoxide      FIG.2	The accuracy of readings is not affected.	15	“

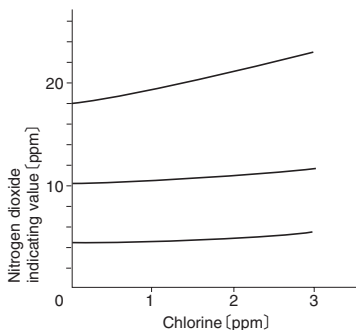


FIG.1 Influence of Chlorine

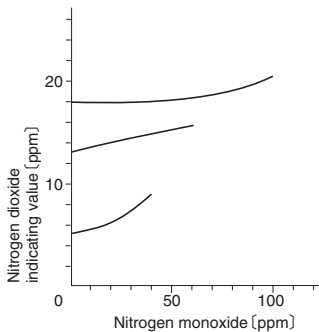


FIG.2 Influence of Nitrogen monoxide



## 1. PERFORMANCE

- 1) Measuring range : 0.1-1.0 ppm  
Number of pump strokes : 3 (300mℓ)
- 2) Sampling time : 135 seconds (45 seconds/1 pump stroke)
- 3) Detectable limit : 0.01 ppm (300mℓ)
- 4) Shelf life : 1.5 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 3 pump strokes
- 7) Colour change : White → Pale purple

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

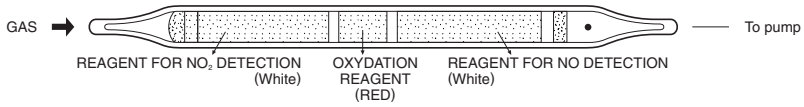
$\text{NO}_2 + 3, 3^2\text{-Dimethylnaphthidine} \rightarrow \text{Nitroso-compounds}$

## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	ppm	Coexistence
Chlorine	3	Similar stain is produced.	3	Higher readings are given.
Ozone		The accuracy of readings is not affected.	2	∕
Sulphur dioxide		∕	7	Lower readings are given.
Formaldehyde		∕		The accuracy of readings is not affected.
Formic acid		∕		∕
Carbon monoxide		∕		∕
Carbon dioxide		∕		∕
Ethyl alcohol		∕		∕



## 1. PERFORMANCE

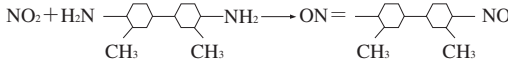
- 1) Measuring range : NO ; 10-300 ppm NO<sub>2</sub> ; 1-40 ppm  
Number of pump strokes 1 (100ml)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : NO ; 1 ppm NO<sub>2</sub> ; 0.5 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 10 ~ 30°C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Concentration chart method
- 8) Colour change : NO ; White → Yellowish orange  
NO<sub>2</sub>; White → Pale yellowish orange

## 2. RELATIVE STANDARD DEVIATION

NO ; RSD-low : 10% RSD-mid. : 10% RSD-high : 10%  
NO<sub>2</sub>; RSD-low : 10% RSD-mid. : 10% RSD-high : 5%

## 3. CHEMICAL REACTION

NO ; By reacting with an Oxidizer, NO<sub>2</sub> is produced.  
NO + CrO<sub>3</sub> + H<sub>2</sub>SO<sub>4</sub> → NO<sub>2</sub>  
NO<sub>2</sub>; By reacting with *o*-Toluidine, Nitroso-*o*-Toluidine is produced.



## 4. CALIBRATION OF THE TUBE

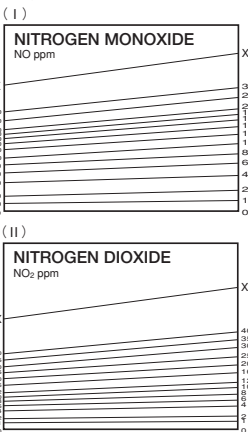
NO ; STANDARD GAS CYLINDER METHOD  
NO<sub>2</sub> ; PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Chlorine	Similar stain is produced.	1	Higher readings are given.

## NITROGEN OXIDES CONCENTRATION CHART

Sampling Gas Volum 100ml

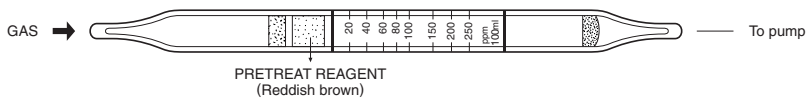


(I) NO TEMPERATURE CORRECTION TABLE

Chart Readings (ppm)	NO True Concentration (ppm)											
	10°C 50°F	12°C 53.6°F	14°C 57.2°F	16°C 60.8°F	18°C 64.4°F	20°C 68°F	22°C 71.6°F	24°C 75.2°F	26°C 78.8°F	28°C 82.4°F	30°C 86°F	
300	—	—	—	—	300	270	245	220	200	190	180	
280	—	—	—	—	280	250	230	210	190	180	170	
260	—	—	—	—	300	280	235	215	195	180	170	
240	—	—	—	—	280	240	215	195	180	170	160	
220	—	—	—	—	300	250	220	195	180	170	150	
200	—	—	—	—	290	230	200	185	165	155	145	
180	—	—	—	—	300	250	200	180	165	150	140	
160	—	—	—	—	310	260	215	180	160	150	140	
140	—	—	—	—	310	260	220	185	155	140	130	
120	—	—	—	—	260	215	180	155	135	120	110	
100	—	—	—	—	210	185	150	130	110	100	90	
80	—	—	—	—	160	140	120	100	87	80	77	
60	—	—	—	—	100	80	70	64	60	57	54	
40	—	—	—	—	60	56	52	48	43	40	38	
20	—	—	—	—	30	28	26	24	22	20	20	
10	—	—	—	—	10	10	10	10	10	10	10	

(II) NO<sub>2</sub> TEMPERATURE CORRECTION TABLE

Chart Readings (ppm)	NO <sub>2</sub> True Concentration (ppm)											
	10°C 50°F	12°C 53.6°F	14°C 57.2°F	16°C 60.8°F	18°C 64.4°F	20°C 68°F	22°C 71.6°F	24°C 75.2°F	26°C 78.8°F	28°C 82.4°F	30°C 86°F	
40	—	—	—	—	40	39	38	37	37	36	36	
38	—	—	—	—	39	38	37	36	35	35	34	
36	—	—	—	—	38	37	36	35	34	34	33	
34	—	—	—	—	39	37	36	35	34	33	32	
32	—	—	—	—	39	37	35	34	33	32	31	
30	—	—	—	—	36	34	33	32	31	30	29	
28	—	—	—	—	33	32	31	30	29	28	27	
26	—	—	—	—	31	30	29	28	27	26	25	
24	—	—	—	—	28	27	26	25	24	24	23	
22	—	—	—	—	26	25	24	23	22	22	21	
20	—	—	—	—	24	23	22	21	20	20	19	
18	—	—	—	—	21	20	19	19	18	18	17	
16	—	—	—	—	19	18	17	17	16	16	15	
14	—	—	—	—	17	16	15	15	14	14	14	
12	—	—	—	—	14	13	13	12	12	12	12	
10	—	—	—	—	12	12	11	11	10	10	10	
8	—	—	—	—	10	9	8	8	8	8	8	
6	—	—	—	—	7	7	6	6	6	6	6	
4	—	—	—	—	4	4	4	4	4	4	4	
2	—	—	—	—	2	2	2	2	2	2	2	



## 1. PERFORMANCE

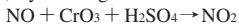
- 1) Measuring range : 20-250 ppm
- Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 2 ppm
- 4) Shelf life : 1 year
- 5) Operating temperature : 5 ~ 45 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : White → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

NO ; By reacting with an Oxidizer, NO<sub>2</sub> is produced.



NO<sub>2</sub> ; By reacting with Diphenylamine, N-Nitroso-diphenylamine is produced.

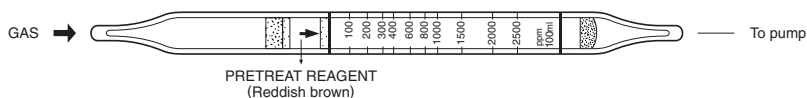


## 4. CALIBRATION OF THE TUBE

NO ; STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	ppm	Coexistence
Hydrogen chloride	Over 600	Dark blue stain is produced.		Lower readings are given.
	Over 1,000	Brownish red/Yellow/Dark blue stain is produced.		
Sulphur dioxide			100	∕



## 1. PERFORMANCE

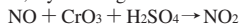
- 1) Measuring range : 100-2,500 ppm
- Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 10 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 5 ~ 45 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : White → Green

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

NO ; By reacting with an Oxidizer, NO<sub>2</sub> is produced.



NO<sub>2</sub> ; By reacting with Diphenylamine, N-Nitroso-diphenylamine is produced.



## 4. CALIBRATION OF THE TUBE

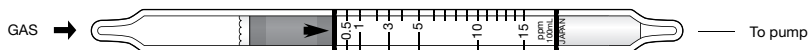
NO ; STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Hydrogen chloride	The bottom of discoloured layer is changed to Dark blue.	500	Higher readings are given.
Sulphur dioxide			The accuracy of readings is not affected.

(NOTE)

When the concentration of Nitrogen oxides is high (over 2,000 ppm) in the measuring range, a green ring may occur in the discoloured layer or double-stained layer may occur. The total stain length should be read, even if the stained layer gets multi-colour discolouration.



## 1. PERFORMANCE

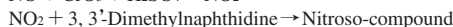
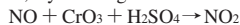
- |                          |   |            |
|--------------------------|---|------------|
| 1) Measuring range       | : 1.0-30 ppm  | 0.5-15 ppm |
| Number of pump strokes   | : 1/2 (50mℓ)  | 1 (100mℓ)  |
| 2) Sampling time         | : 1 minute/1 pump stroke                                    |            |
| 3) Detectable limit      | : 0.2 ppm (100mℓ)   |            |
| 4) Shelf life            | : 3 years   |            |
| 5) Operating temperature | : 0 ~ 40 °C   |            |
| 6) Reading               | : Direct reading from the scale calibrated by 1 pump stroke |            |
| 7) Colour change         | : White → Pale purple                                       |            |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

NO ; By reacting with an Oxidizer, NO<sub>2</sub> is produced.



NO<sub>2</sub> ; By reacting with 3, 3<sup>1</sup>-Dimethylnaphthidine, Nitroso-compound is produced.



## 4. CALIBRATION OF THE TUBE

NO ; STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Chlorine	Similar stain is produced.	1	Higher readings are given.
Hydrogen chloride	∕	300	The accuracy of readings is not affected.
Sulphur dioxide	The accuracy of reading is not affected.	500	Lower readings are given.
Hydrogen sulphide	∕	5	∕
Ozone	∕	Nox conc. × 1/10	Higher readings are given.
Hexane	∕	Nox conc. × 10	∕
Laughing gas	∕		

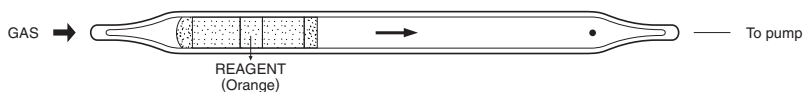
(NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.

Actual concentration = 2 × Reading value







## 1. PERFORMANCE

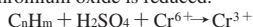
- 1) Measuring range : Refer to under-mentioned table
- Number of pump strokes : 1 (100ml)
- 2) Sampling time : 20 sec./1 pump stroke
- 3) Shelf life : 3 years
- 4) Operating temperature : 0 ~ 40 °C
- 5) Reading : Qualitatively
- 6) Colour change : Orange → Black or Dark green

## 2. RELATIVE STANDARD DEVIATION

RSD-low : % RSD-mid. : % RSD-high : %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

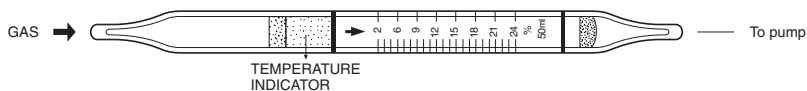
## 5. INTERFERENCE AND CROSS SENSITIVITY

Hydrocarbons except Methane and Ethane, Alcohols, Esters, Ketones, Aromatic hydrocarbons and Hydrogen sulphide can be detected qualitatively.

## 6. DETECTABLE GAS CONCENTRATION TABLE

A : U.S.A  
B : U.K.  
J : JAPAN

NO.	Classification	Detective Gas	Detectable Limit of Gas Concentration (ppm)	TLV (ppm)
1	Alcohol	Methanol	20	200(A, B, J)
		I.P.A.	50	400(A, B, J)
		Butanol	50	50(A, B, J)
2	Ester	Ethyl Acetate	400	400(A, B, J)
		Butyl Acetate	200	150(A, B), 200(J)
3	Ketone	Acetone	600	750(A), 1,000(B), 200(J)
		M.E.K.	200	200(A, B, J)
		M.I.B.K.	100	50(A, J), 100(B)
4	Aromatic	Benzene	40	10(A, B, J)
		Toluene	5	100(A, B, J)
		Xylene	5	100(A, B, J)
5	Aliphatic	Propane	1,500	—
		Butane	100	800(A), 600(B)
		Pentane	10	600(A, B)
		Hexane	10	50(A), 100(B), 40(J)
		Heptane	5	400(A, B)
		Octane	5	300(A, B)
		Acetylene	2,500	—
		Ethylene	100	—
		Propylene	10	—
		6	Chlorination Hydrocarbon	Trichloroethylene
Tetrachloroethylene	200			50(A, J), 100(B)
7	Mixed solvent	Gasoline (motor fuel)	10	300(A), 100(J)
		Kerosene	8 (mg/m <sup>3</sup> )	—
		Mineral Turpentine	8 (mg/m <sup>3</sup> )	—
8	Others	Ethyl acrylate	10	5(A), 25(B)
		Ether (ethyl)	10	400(A, B)
		Ethylene oxide	50	1(A), 5(B)



## 1. PERFORMANCE

- 1) Measuring range : 2-24 %
- Number of pump strokes : 1/2 (50mℓ)
- 2) Sampling time : 2 minutes/1/2 pump strokes
- 3) Shelf life : 2 years
- 4) Operating temperature : 0 ~ 40 °C
- 5) Reading : Direct reading from the scale calibrated by 1/2 pump strokes
- 6) Colour change : White → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 5 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Oxygen reacts with alkaline pyrogallol.

## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

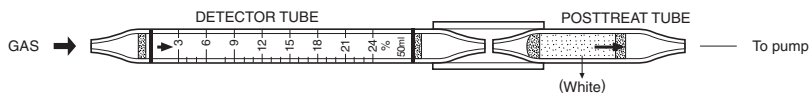
Substance	Interference	%	Coexistence
Hydrogen sulphide	The accuracy of reading is not affected.	2	Higher readings are given.
Nitrogen dioxide	∕	2	∕
Sulphur dioxide	Similar stain is produced.	2	∕
Carbon dioxide	∕	5	∕

## 6. NOTE

- 1) Coexistence of more than 5% of Carbon dioxide (CO<sub>2</sub>) gives higher reading and the reading from the scale should be corrected with the following correction table.
- 2) The No.159SA and SB tubes are necessary to heat the part of the temperature indicator until the indicator discolours from Red to Purple first. In case of No.159SA, it is necessary to use direct flame such as a match or lighter to heat it up a non-hazardous area. No.159SB consists of a thin aluminum belt rolled on the indicator and chemical liquid in a small bottle. When the liquid is dropped on the aluminum fully, a chemical reaction occurs with generating smoke and temperature comes high. Therefore, the No.159SB is possible to use in a hazardous area.

CO<sub>2</sub> CORRECTION TABLE

Tube Readings (%)	Corrected Concentration (%)			
	CO <sub>2</sub> 5%	CO <sub>2</sub> 10%	CO <sub>2</sub> 15%	CO <sub>2</sub> 20%
2	2.0	—	—	—
6	6.0	2.5	—	—
9	9.0	6.4	—	—
12	12.0	10.0	7.0	6.0
15	15.0	12.8	10.0	7.8
18	18.0	16.0	14.0	12.1
21	21.0	19.0	16.6	14.4
24	24.0	21.2	19.6	17.9



## 1. PERFORMANCE

- |                          |   |           |
|--------------------------|---|-----------|
| 1) Measuring range       | : 3-24 %  | 1.5-3 %   |
| Number of pump strokes   | : 1/2 (50mℓ)  | 1 (100mℓ) |
| 2) Sampling time         | : 1 minute/1/2 pump strokes                                   |           |
|                          | : 1.5 minutes/1 pump stroke                                   |           |
| 3) Shelf life            | : 2 years   |           |
| 4) Operating temperature | : 0 ~ 45 °C   |           |
| 5) Reading               | : Direct reading from the scale calibrated by 1/2 pump stroke |           |
| 6) Colour change         | : Black → White   |           |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 5 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Titanium trichloride is oxidized and Titanium oxide is produced.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Sulphur dioxide	The accuracy of readings is not affected.	The accuracy of readings is not affected.
Carbon dioxide	∕	∕
Nitrogen dioxide	∕	∕
Hydrogen sulphide	∕	∕

(NOTE)

When the concentration is below 3%, 1 pump stroke can be used to determine the lower concentration with following formula.

Actual concentration =  $1/2 \times$  Reading value



## 1. PERFORMANCE

- 1) Measuring range :
  - Oxygen : 2-10 %
  - Carbon dioxide : 1-20 %
  - Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 8 minutes/1 pump stroke
- 3) Detectable limit : Oxygen 0.1 % Carbon dioxide 0.2 %
- 4) Shelf life : 1.5 years
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation :
  - Oxygen : Necessary (See "TEMPERATURE CORRECTION TABLE")
  - Carbon dioxide : No temperature correction is necessary.
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change :
  - Oxygen : White → Brown
  - Carbon dioxide : Pink → Yellow

## 2. RELATIVE STANDARD DEVIATION

- Oxygen RSD-low : 10 % RSD-mid. : 10 % RSD-high : 10 %
- Carbon dioxide RSD-low : 10 % RSD-mid. : 10 % RSD-high : 10 %

## 3. CHEMICAL REACTION

- Oxygen : Oxygen reacts with alkaline pyrogallol.
- Carbon dioxide :  $\text{CO}_2 + 2\text{KOH} \rightarrow \text{K}_2\text{CO}_3 + \text{H}_2\text{O}$

## 4. CALIBRATION OF THE TUBE

- Oxygen · Carbon dioxide STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

- Ordinary combustion gases do not affect the reading value and discolouration.

## 6. CONCENTRATION CORRECTION

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

$$\text{CO}_2 \% = (\text{CO}_2) - \frac{(\text{O}_2) \times (\text{CO}_2)}{100} \text{ ----- equation (1)}$$

$$\text{O}_2 \% = (\text{O}_2) - \frac{(\text{O}_2) \times (\text{CO}_2)}{100} \text{ ----- equation (2)}$$

Where

(CO<sub>2</sub>) : indication of carbon (%)

(O<sub>2</sub>) : corrected oxygen concentration (%)

### [EXAMPLE]

At the measuring temperature of 30 °C, when Oxygen indication is 5 % (temperature corrected value 5.3 %) and Carbon dioxide indication is 10 %, each true concentration is calculated as below.

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

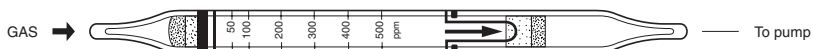
$$\text{O}_2 \% = 5.3 - \frac{5.3 \times 10}{100} = 5.3 - 0.53 = 4.77$$

Accordingly true concentration :

- Carbon dioxide 9.47 %
- Oxygen 4.77 %

TEMPERATURE CORRECTION TABLE

Tube Readings (%)	Corrected Oxygen 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



## 1. PERFORMANCE

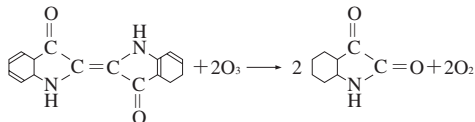
- |                          |   |            |
|--------------------------|---|------------|
| 1) Measuring range       | : 100-1,000 ppm   | 50-500 ppm |
| Number of pump strokes   | 1/2 (50mℓ)  | 1 (100mℓ)  |
| 2) Sampling time         | : 1 minute/1 pump stroke                                    |            |
| 3) Detectable limit      | : 5 ppm (100mℓ)   |            |
| 4) Shelf life            | : 2 years   |            |
| 5) Operating temperature | : 0 ~ 40 °C   |            |
| 6) Reading               | : Direct reading from the scale calibrated by 1 pump stroke |            |
| 7) Colour change         | : Dark blue → Yellow  |            |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

Indigo is oxidized and Isatin is produced.



## 4. CALIBRATION OF THE TUBE

COLOURIMETRY METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Nitrogen dioxide	Similar stain is produced.	The top of discoloured layer becomes unclear and higher readings are given.
Chlorine	∕	∕

(NOTE)

In case of 1/2 pump strokes, following formula is available for actual concentration.  
Actual concentration = 2 × Reading value



## 1. PERFORMANCE

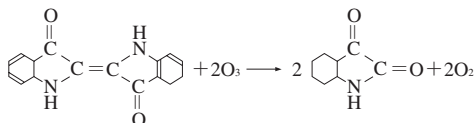
- |                          |   |           |            |
|--------------------------|---|-----------|------------|
| 1) Measuring range       | : 10-100 ppm  | 5-50 ppm  | 2.5-25 ppm |
| Number of pump strokes   | 1/2 (50mℓ)  | 1 (100mℓ) | 2 (200mℓ)  |
| 2) Sampling time         | : 1.5 minutes/1 pump stroke                                 |           |            |
| 3) Detectable limit      | : 1 ppm (100mℓ)   |           |            |
| 4) Shelf life            | : 2 years   |           |            |
| 5) Operating temperature | : 0 ~ 40 °C   |           |            |
| 6) Reading               | : Direct reading from the scale calibrated by 1 pump stroke |           |            |
| 7) Colour change         | : Blue → Pale yellow  |           |            |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

Indigo is oxidized and Isatin is produced.



## 4. CALIBRATION OF THE TUBE

COLOURIMETRY METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	Coexistence
Nitrogen dioxide	10	Similar stain is produced.	The top of discoloured layer becomes unclear and higher readings are given.

(NOTE)

- In case of 1/2 pump strokes, following formula is available for actual concentration.  
Actual concentration = 2 × Reading value
- In case of 2 pump strokes, following formula is available for actual concentration.  
Actual concentration = 1/2 × Reading value



## 1. PERFORMANCE

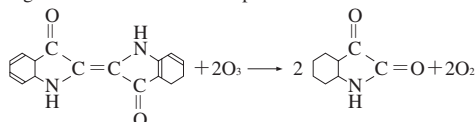
- |                          |  |              |               |
|--------------------------|--|--------------|---------------|
| 1) Measuring range       | : 0.15-3.0 ppm   | 0.05-1.0 ppm | 0.025-0.5 ppm |
| Number of pump strokes   | 1 (100ml)  | 3 (300ml)    | 6 (600ml)     |
| 2) Sampling time         | : 3 minutes/3 pump strokes                                   |              |               |
| 3) Detectable limit      | : 0.01 ppm (600ml)   |              |               |
| 4) Shelf life            | : 2 years  |              |               |
| 5) Operating temperature | : 0 ~ 40 °C  |              |               |
| 6) Reading               | : Direct reading from the scale calibrated by 3 pump strokes |              |               |
| 7) Colour change         | : Blue → White   |              |               |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

Indigo is oxidized and Isatin is produced.



## 4. CALIBRATION OF THE TUBE

COLOURIMETRY METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Nitrogen dioxide FIG.1	Similar stain is produced.	0.5	The top of discoloured layer becomes unclear and higher readings are given.
Chlorine	∕	10	
Oxidant	Similar stain is produced and this has same sensitivity with Ozone.		∕

(NOTE)

In case of 1 or 6 pump strokes, following formula is available for actual concentration.

$$\text{Actual concentration} = \text{Reading value} \times \frac{3}{\text{Number of strokes}}$$

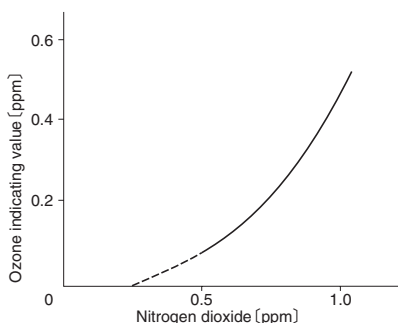


FIG.1 Influence of Nitrogen dioxide





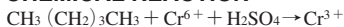
## 1. PERFORMANCE

- 1) Measuring range : 50-1,000 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 10 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Graduations printed on the tube are calibrated by n-Hexane at 1 pump stroke and Pentane concentration is determined by using a conversion chart.
- 7) Colour change : Orange → Yellowish green

## 2. RELATIVE STANDARD DEVIATION

RSD-low:10% RSD-mid. : 10% RSD-high : 5%

## 3. CHEMICAL REACTION



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Alcohols	Similar stain is produced.	6%	Higher readings are given.
Ketones	∥	∥	∥
Esters	∥	∥	∥
Aromatic hydrocarbons FIG.1,2	∥		The bottom of the discoloured layer is stained to Black and higher readings are given.
Aliphatic Hydrocarbons (more than C <sub>3</sub> )	∥		Higher readings are given.

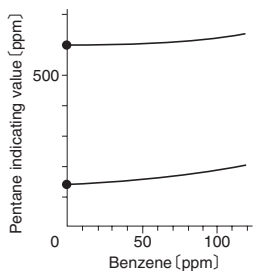


FIG.1 Influence of Benzene

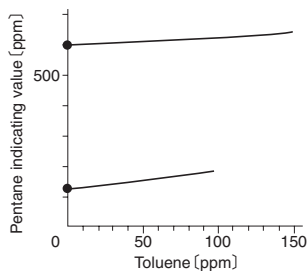
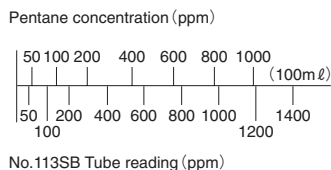
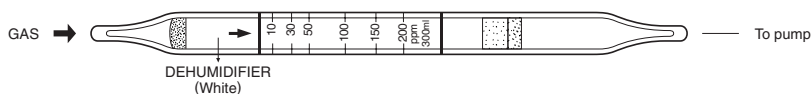


FIG.2 Influence of Toluene





## 1. PERFORMANCE

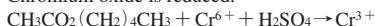
- 1) Measuring range : 10-200 ppm
- Number of pump strokes : 3 (300mℓ)
- 2) Sampling time : 4.5 minutes/3 pump strokes
- 3) Detectable limit : 4 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 3 pump strokes
- 8) Colour change : Pale yellow → Pale blue (more than 20 ppm)
- ∕ → Dark brown (20 ppm or less)

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

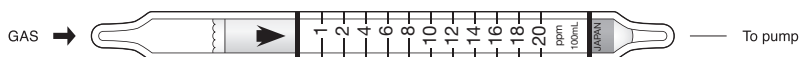
GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar or Brown stain is produced.	Higher readings are given.
Esters	∕	∕
Ketones	∕	∕
Aromatic hydrocarbons	The accuracy of readings is not affected.	Whole reagent is changed to Brown, but if the maximum end point of the stain is discernable, the accuracy of readings is not affected.
Aliphatic hydrocarbons (more than C <sub>3</sub> )	∕	∕
Halogenated hydrocarbons		∕

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)			
	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
200	240	200	160	120
150	180	150	130	100
100	120	100	80	70
50	60	50	40	30
30	36	30	24	18
10	10	10	8	6



## 1. PERFORMANCE

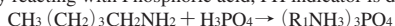
- 1) Measuring range : 2-22 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : Graduations printed on the tube are calibrated by Ammonia at 1 pump stroke and Pentyl amine concentration is determined by using a conversion chart at 1 pump stroke.
- 7) Colour change : Pale purple → Pale Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Phosphoric acid, PH indicator is discoloured.

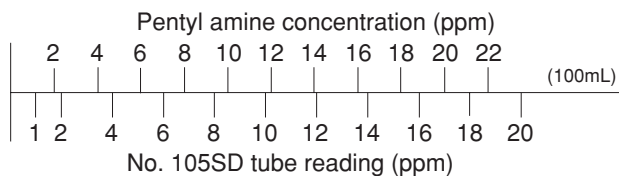


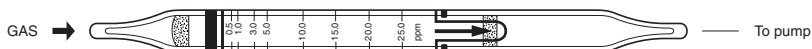
## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Amines	Similar stain is produced.	Higher readings are given.





## 1. PERFORMANCE

- 1) Measuring range : 0.5-25.0 ppm
- Number of pump strokes : 2 (200ml)
- 2) Sampling time : 3 minutes/2 pump strokes
- 3) Detectable limit : 0.3 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 2 pump strokes
- 8) Colour change : Pale yellow → Pale light brown (Pale brown)

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 5%    RSD-high : 5%

## 3. CHEMICAL REACTION

Phenol is oxidized and the Polymer is produced.



## 4. CALIBRATION OF THE TUBE

ABSORPTIOMETRIC METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Other phenols    FIG.1	Similar stain is produced.	2.5	Higher readings are given.
Ammonia            FIG.2	White stain is produced.	200	Discolouration of gas inlet side is faded and higher readings are given.
Aliphatic amines	∕	50	∕
Aromatic amines	Blue stain is produced.	50	Two layers discolouration of Pale brown and Blue are produced and higher readings are given.

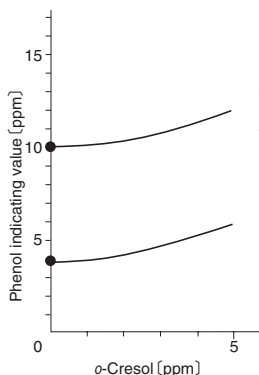


FIG.1 Influence of o-Cresol

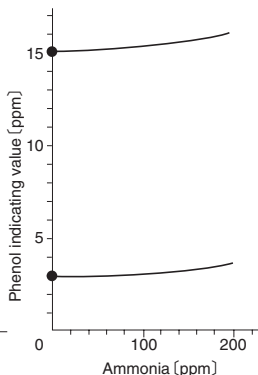
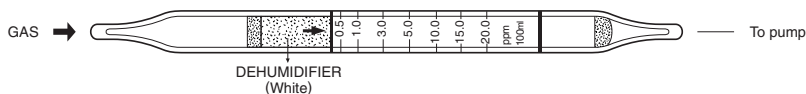


FIG.2 Influence of Ammonia

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
25.0	31.2	27.8	25.0	21.8	18.8
20.0	24.5	22.3	20.0	17.5	15.0
15.0	18.4	16.7	15.0	13.1	11.3
10.0	12.3	11.1	10.0	8.8	7.5
5.0	6.1	5.6	5.0	4.4	3.8
3.0	3.7	3.3	3.0	2.6	2.3
1.0	1.2	1.1	1.0	0.9	0.8
0.5	0.5	0.5	0.5	0.5	0.5



## 1. PERFORMANCE

- 1) Measuring range : 0.5-20 ppm      0.1-4.0 ppm
- Number of pump strokes    1 (100mℓ)      5 (500mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 0.05 ppm (500mℓ)
- 4) Shelf life : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : White → Red

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 %    RSD-mid. : 10 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with Nitro-benzyl pyridine, urea derivative is produced.  
This urea derivative reacts with Benzyl aniline and dyestuff is produced.



## 4. CALIBRATION OF THE TUBE

ABSORPTIOMETRIC METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Nitrogen dioxide    FIG.1	Yellow stain is produced.	100	Yellow stain is produced and higher readings are given.
Chlorine		5	A stained layer at the side of gas inlet is bleached out and higher readings are given.
Hydrogen chloride		10	∕
Sulphur dioxide		0.2%	∕

(NOTE)

When the concentration is below 0.5 ppm, 5 pump strokes can be used to determine the lower concentration with following formula.

Actual concentration = 1/5 × Temperature corrected value

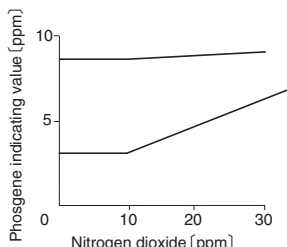


FIG.1 Influence of Nitrogen dioxide

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
20	13.5	17.0	20.0	21.8	23.0
15	10.5	12.8	15.0	16.5	17.5
10	7.0	8.6	10.0	11.0	11.8
5	3.5	4.3	5.0	5.5	5.8
3	3.0	3.0	3.0	3.0	3.0



## 1. PERFORMANCE

- 1) Measuring range : 20-800 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 3 minutes/1 pump stroke with orifice
- 3) Detectable limit : 5 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Pale blue → Reddish purple

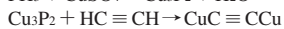
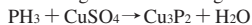
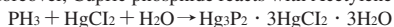
## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Mercuric chloride (II) and Cupric sulphate (II), Mercuric phosphorus chloride and Cupric phosphate are produced respectively.

Moreover, Cupric phosphide reacts with Acetylene and Copper acetylene is produced.



## 4. CALIBRATION OF THE TUBE

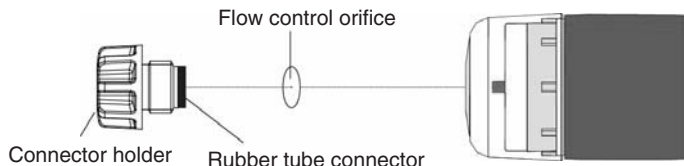
ABSORPTIOMETRIC METHOD

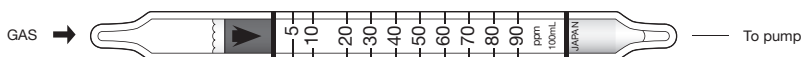
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Hydrogen sulphide	Black stain is produced.	10	Higher readings are given.
Arsine	Dim yellow stain is produced.	10	∕

## 6. NOTE

- 1) In case that Acetylene does not exist, lower readings are given.
- 2) A flow control orifice (an extra option) is required to attach as shown in the following drawing.





## 1. PERFORMANCE

- 1) Measuring range : 5-90 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 3 minutes/1 pump stroke with orifice
- 3) Detectable limit : 1 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Pale blue → Yellowish brown

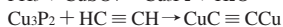
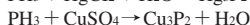
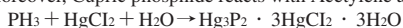
## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Mercuric chloride (II) and Cupric sulphate (II), Mercuric phosphorus chloride and Cupric phosphate are produced respectively.

Moreover, Cupric phosphide reacts with Acetylene and Copper acetylene is produced.



## 4. CALIBRATION OF THE TUBE

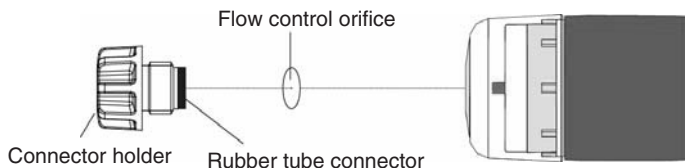
STANDARD GAS CYLINDER METHOD

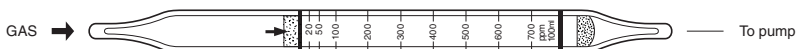
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Hydrogen sulphide	Black stain is produced.	10	Higher readings are given.
Arsine	Dim yellow stain is produced.	10	∕

## 6. NOTE

- 1) In case that Acetylene does not exist, lower readings are given.
- 2) A flow control orifice (an extra option) is required to attach as shown in the following drawing.





## 1. PERFORMANCE

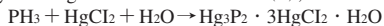
- 1) Measuring range : 40-1400 ppm    20-700 ppm  
     Number of pump strokes    1/2 (50mℓ)    (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 10 ppm (100mℓ)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : White → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 5%    RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Mercuric chloride (II), Mercuric phosphorus chloride is produced.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

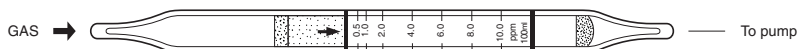
Substance	Interference	ppm	Coexistence
Arsine	Brown stain is produced.	30	Higher readings are given.
Hydrogen selenide	∕	50	∕
Hydrogen sulphide	∕	40	∕

(NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.

Actual concentration = 2 × Reading value





## 1. PERFORMANCE

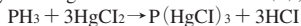
- |                          |   |              |            |
|--------------------------|---|--------------|------------|
| 1) Measuring range       | : 0.5-10.0 ppm  | 0.25-5.0 ppm | 1-20 ppm   |
| Number of pump strokes   | 1 (100mℓ)   | 2 (200mℓ)    | 1/2 (50mℓ) |
| 2) Sampling time         | : 1 minute/1 pump stroke                                    |              |            |
| 3) Detectable limit      | : 0.1 ppm (200mℓ)   |              |            |
| 4) Shelf life            | : 1 year  |              |            |
| 5) Operating temperature | : 0 ~ 40 °C   |              |            |
| 6) Reading               | : Direct reading from the scale calibrated by 1 pump stroke |              |            |
| 7) Colour change         | : Yellow → Pink   |              |            |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15%    RSD-mid. : 10%    RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Mercuric chloride (II), Hydrogen chloride is produced and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

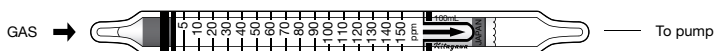
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Ammonia		20	A stained layer at the side of gas inlet is bleached out and lower readings are given.
Hydrogen sulphide	Similar stain is produced.	50	Higher readings are given.
Mercaptans	∕		∕

(NOTE)

When the concentration is below 0.5ppm, 2 pump strokes can be used to determine the lower concentration with the following formula ;  
Actual concentration = 1/2 × Reading value

When the concentration is over 10.0ppm, 1/2 pump strokes can be used to determine the higher concentration with the following formula ;  
Actual concentration = 2 × Reading value



## 1. PERFORMANCE

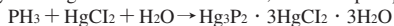
- 1) Measuring range : 5-150 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minute/1 pump stroke
- 3) Detectable limit : 3 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : White → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with Mercuric chloride, Mercuric phosphorus chloride is produced.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	%	Interference	Coexistence
Hydrogen selenide	5	Brown stain is produced.	Higher readings are given.
Hydrogen sulphide	5	∕	∕



## 1. PERFORMANCE

- 1) Measuring range : 100-1,600 ppm      200-3,200 ppm
- Number of pump strokes : 1 (100mℓ)      1/2 (50mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 5 ppm (100mℓ)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : White → Orange

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

Potassium iodate is reduced.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Nitrogen monoxide	The accuracy of reading is not affected.	Lower readings are given.
Nitrogen dioxide	∕	Higher readings are given.
Hydrogen sulphide	Orange stain is produced.	∕
Sulphur dioxide	∕	∕

(NOTE)

In case of 1/2 pump strokes, following formula is available for actual concentration.

Actual concentration = 2 × Reading value



## 1. PERFORMANCE

- 1) Measuring range : 200-3,000 ppm      400-6,000 ppm
- Number of pump strokes : 1 (100mℓ)      1/2 (50mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 5 ppm (100mℓ)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : White → Orange

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 5%    RSD-high : 5%

## 3. CHEMICAL REACTION

Potassium iodate is reduced.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	%	Coexistence
Carbon dioxide	The accuracy of readings is not affected.	100	The accuracy of readings is not affected.
Methyl bromide	∕	less than 3	∕
Hydrogen cyanide	∕	3	The stained layer at the side of the gas inlet is bleached out and higher readings are given.
Ammonia	∕	0.6	∕

(NOTE)

In case of 1/2 pump strokes, the following formula is available for the actual concentration.

Actual concentration = 2 × Reading value



## 1. PERFORMANCE

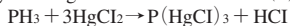
- |                          |   |              |
|--------------------------|---|--------------|
| 1) Measuring range       | : 0.1-2.0 ppm   | 0.05-1.0 ppm |
| Number of pump strokes   | 1 (100mℓ)   | 2 (200mℓ)    |
| 2) Sampling time         | : 1 minute/1 pump stroke                                    |              |
| 3) Detectable limit      | : 0.02 ppm (200mℓ)  |              |
| 4) Shelf life            | : 2 years   |              |
| 5) Operating temperature | : 0 ~ 40 °C   |              |
| 6) Reading               | : Direct reading from the scale calibrated by 1 pump stroke |              |
| 7) Colour change         | : Pale yellow → Pink  |              |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Mercuric chloride (II), Hydrogen chloride is produced and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

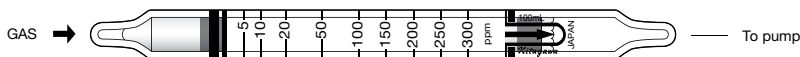
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Hydrogen sulphide	Similar stain is produced.	Higher readings are given.
Hydrogen selenide	∕	∕
Mercaptans	∕	∕
Arsine	∕	∕
Hydrogen cyanide	Whole reagent is changed to Red.	∕
Sulphur dioxide	∕	Whole reagent is changed to Pale red, but Purplish red stain indicates Phosphine concentration.

(NOTE)

When the concentration is below 0.5 ppm, 2 pump strokes can be used to determine the lower concentration with the following formula.

Actual concentration =  $1/2 \times$  Reading value



## 1. PERFORMANCE

- 1) Measuring range : 20-300 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Styrene at 1 pump stroke and  $\alpha$ -Pinene concentration is determined by using a conversion chart at 1 pump stroke
- 7) Colour change : White → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 %    RSD-mid. : 15 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

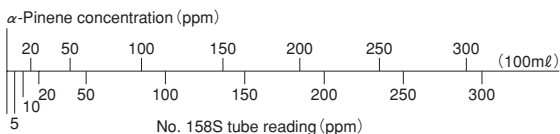
A polymer of  $\alpha$ -Pinene is produced by Sulphuric acid.

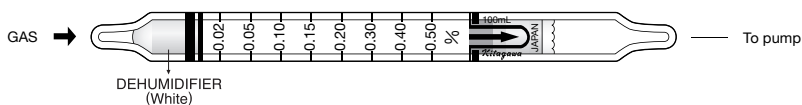
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Acrylonitrile	The accuracy of readings is not affected.	400	Lower readings are given.
Butadiene	Similar stain is produced and higher readings are given.	5	Uneven discolouration is produced and higher readings are given.
Formaldehyde	∕	15	Yellowish orange stain is produced and higher readings are given.
Acetaldehyde	∕	350	Similar stain is produced and higher readings are given.
Methyl alcohol	The accuracy of readings is not affected.	0.35 %	Pale discolouration is produced and higher readings are given.
Ethyl alcohol	∕	0.18 %	∕
Ethyl acetate	∕	700	∕
Butyl acetate	∕	700	∕





## 1. PERFORMANCE

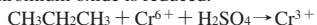
- 1) Measuring range : 0.02-0.5 %
- Number of pump strokes : 1 (100ml)
- 2) Sampling time : 4 minutes/1 pump stroke
- 3) Detectable limit : 0.002% (20 ppm)
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Orange → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 %    RSD-mid. : 15 %    RSD-high : 15 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

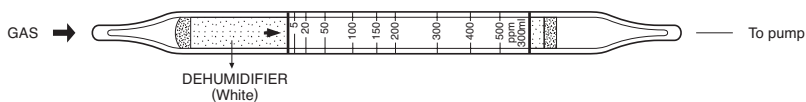
STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Toluene	Similar stain is produced.	Higher readings are given.
Hexane	∕	∕
Trichloroethylene	∕	∕
Ethyl alcohol	The accuracy of readings is not affected.	

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
0.50	0.40	0.45	0.50	0.60	—
0.40	0.33	0.37	0.40	0.50	0.65
0.30	0.26	0.28	0.30	0.35	0.42
0.25	0.21	0.23	0.25	0.28	0.32
0.20	0.17	0.19	0.20	0.22	0.26
0.15	0.13	0.14	0.15	0.16	0.19
0.10	0.09	0.10	0.10	0.11	0.13
0.05	0.05	0.05	0.05	0.05	0.05



## 1. PERFORMANCE

- 1) Measuring range : 20-300 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 2 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Ethyl cellosolve at 3 pump strokes and 1-Propanol concentration is determined by using a conversion chart at 1 pump stroke
- 7) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.

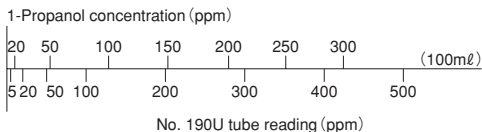


## 4. CALIBRATION OF THE TUBE

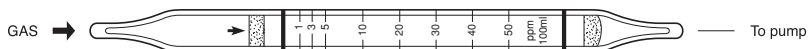
GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Ethers	∕	∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	∕	∕
Ketones	∕	∕
Aromatic hydrocarbons	Whole reagent is changed to Brown.	∕
Esters	∕	∕
Halogenated hydrocarbons	∕	∕







## 1. PERFORMANCE

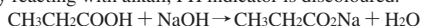
- 1) Measuring range : 3-50 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : Graduations printed on the tube are calibrated by Acetic acid at 1 pump stroke and Propionic acid concentration is determined by using a conversion chart at 1 pump stroke.
- 7) Colour change : Pale pink → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

By reacting with alkali, PH indicator is discoloured.



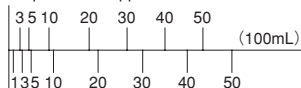
## 4. CALIBRATION OF THE TUBE

VAPOUR PRESSURE METHOD

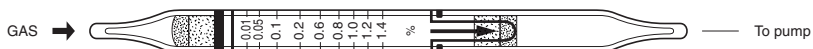
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	ppm	Coexistence
Sulphur dioxide		Similar stain is produced.	HCO <sub>2</sub> H conc. × 1/20	Higher readings are given.
Nitrogen dioxide	300	∕	10	The top of discoloured layer becomes unclear.
Hydrogen chloride		Pink stain is produced.	HCO <sub>2</sub> H conc. × 2	Higher readings are given.
Chlorine		Blueish yellow stain is produced.	5	∕
Acetic acid		Similar stain is produced.		∕

Propionic Acid (ppm)



No.216S tube reading (ppm)



## 1. PERFORMANCE

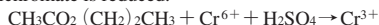
- 1) Measuring range : 0.01-1.4 %  
Number of pump strokes : 2 (200mℓ)
- 2) Sampling time : 3 minutes/2 pump strokes
- 3) Detectable limit : 10 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Graduations printed on the tube are calibrated by Methyl ethyl ketone at 2 pump strokes and Propyl acetate concentration is determined by using a conversion chart.
- 7) Colour change : Orange → Brownish green

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Dichromate is reduced.



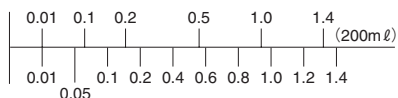
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

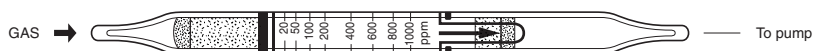
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Acetylene		3%	Whole reagent is changed to Brown.
Propane		0.2%	∕
Other organic gases or vapours except Halogenated hydrocarbons	Similar stain is produced.		Higher readings are given.

Propyl acetate (%)



No.139SB Tube reading (%)



## 1. PERFORMANCE

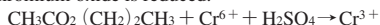
- 1) Measuring range : 20-1,000 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 10 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Yellow → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

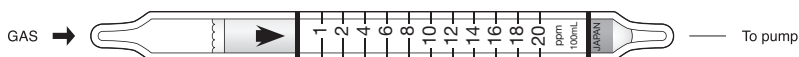
GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stains or Blue stains are produced.	Higher readings are given.
Esters	∕	∕
Ketones	∕	∕
Aromatic hydrocarbons	∕	∕
Aliphatic hydrocarbons (over C <sub>3</sub> )		Whole reagent is changed to Pale brown, but if the maximum end point of stained layer is discernable, the accuracy of readings is not affected.
Halogenated hydrocarbons		∕

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)			
	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
1000	—	1000	480	320
800	—	800	420	280
600	1450	600	340	240
400	850	400	240	160
200	380	200	120	80
100	200	100	60	40
50	100	50	30	20
20	45	20	10	6



## 1. PERFORMANCE

- 1) Measuring range : 1-20 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : Graduations printed on the tube are calibrated by Ammonia at 1 pump stroke and Propyl amine concentration is determined by using a conversion chart at 1 pump stroke.
- 7) Colour change : Pale purple → Pale Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Phosphoric acid, PH indicator is discoloured.

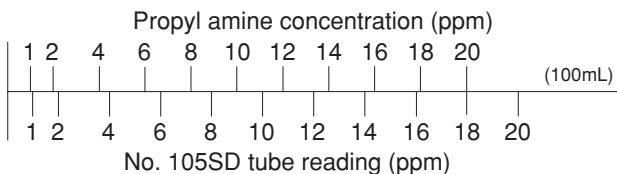


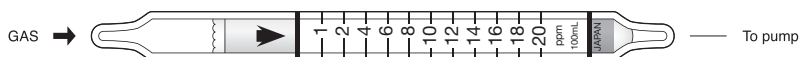
## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Amines	Similar stain is produced.	Higher readings are given.





## 1. PERFORMANCE

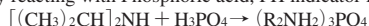
- 1) Measuring range : 1-16 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : Graduations printed on the tube are calibrated by Ammonia at 1 pump stroke and Di-iso-Propyl amine concentration is determined by using a conversion chart at 1 pump stroke.
- 7) Colour change : Pale purple → Pale Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Phosphoric acid, PH indicator is discoloured.

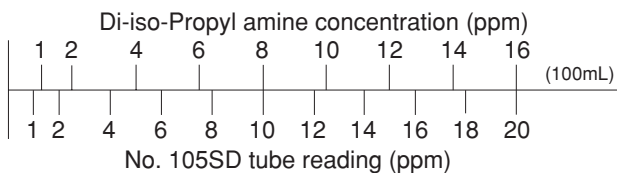


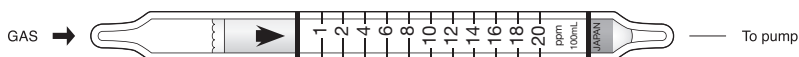
## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Amines	Similar stain is produced.	Higher readings are given.





## 1. PERFORMANCE

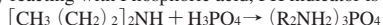
- 1) Measuring range : 1-14 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : Graduations printed on the tube are calibrated by Ammonia at 1 pump stroke and Di-n-Propyl amine concentration is determined by using a conversion chart at 1 pump stroke.
- 7) Colour change : Pale purple → Pale Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with Phosphoric acid, PH indicator is discoloured.

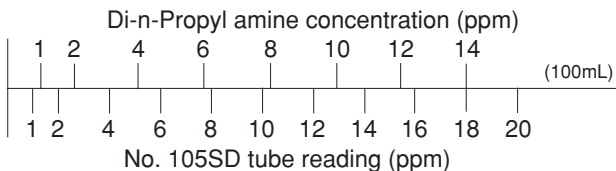


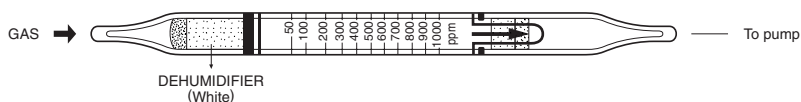
## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Amines	Similar stain is produced.	Higher readings are given.





## 1. PERFORMANCE

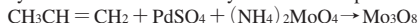
- 1) Measuring range : 50-1,000 ppm  
Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 10 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 10 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Yellow → Dark blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

Molybdate is reduced and molybdeum blue is produced.



## 4. CALIBRATION OF THE TUBE

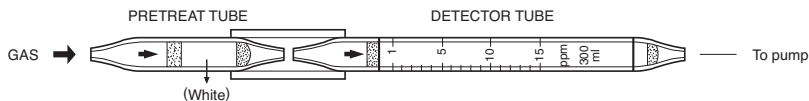
STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	ppm	Coexistence
Carbon monoxide	45	Similar stain is produced.	200	Higher readings are given.
Acetylene		Brown stain is produced.	50	∕
Ethylene		Similar stain is produced.		∕
Hydrogen sulphide	10	Black stain is produced.	50	Double-layer stain is produced and higher readings are given.

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)			
	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
1000	870	1000	—	—
800	760	800	900	1000
600	540	600	660	720
400	380	400	420	440
200	200	200	200	200



## 1. PERFORMANCE

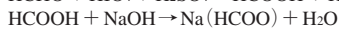
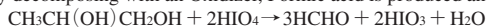
- 1) Measuring range : 5-50 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 2 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Ethylene oxide at 3 pump strokes and Propylene glycol concentration is determined by using a conversion chart at 1 pump stroke
- 7) Colour change : Pale pink → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

By decomposing with an Oxidizer, Formic acid is produced and PH indicator is discoloured.



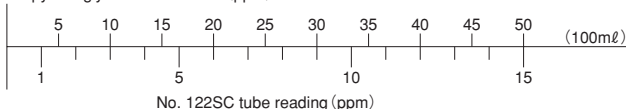
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

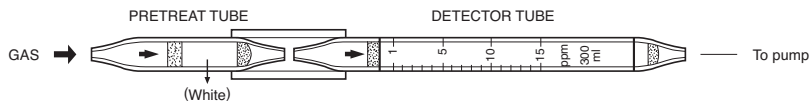
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Aldehydes	Similar stain is produced.	Higher readings are given.
Hydrogen sulphide	Pale yellow stain is produced.	∕
Sulphur dioxide	∕	∕

Propylene glycol concentration (ppm)







## 1. PERFORMANCE

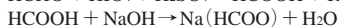
- 1) Measuring range : 3-70 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 2 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Ethylene oxide at 3 pump strokes and Propylene oxide concentration is determined by using a conversion chart at 1 pump stroke
- 7) Colour change : Pale pink → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

By decomposing with an Oxidizer, Formic acid is produced and PH indicator is discoloured.



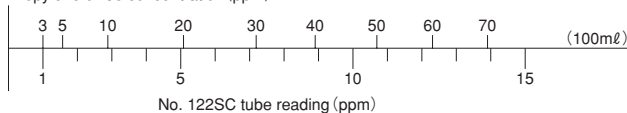
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Aldehydes	Similar stain is produced.	Higher readings are given.
Hydrogen sulphide	Pale yellow stain is produced.	∕
Sulphur dioxide	∕	∕

Propylene oxide concentration (ppm)





## 1. PERFORMANCE

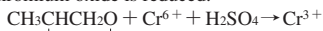
- |                          |   |            |
|--------------------------|---|------------|
| 1) Measuring range       | : 1.0-5.0 %   | 0.05-3.0 % |
| Number of pump strokes   | : 1/2 (50mℓ)  | 1 (100mℓ)  |
| 2) Sampling time         | : 1.5 minutes/1 pump stroke                                 |            |
| 3) Detectable limit      | : 0.002 % (20 ppm) (100mℓ)                                  |            |
| 4) Shelf life            | : 3 years   |            |
| 5) Operating temperature | : 0 ~ 40 °C   |            |
| 6) Reading               | : Direct reading from the scale calibrated by 1 pump stroke |            |
| 7) Colour change         | : Orange → Dark brown                                       |            |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

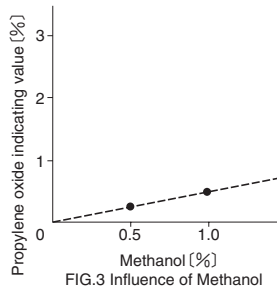
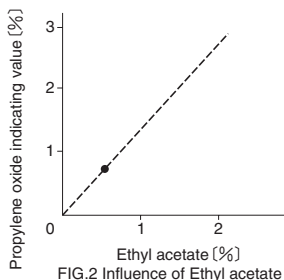
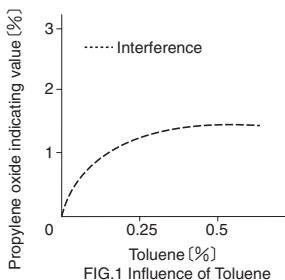
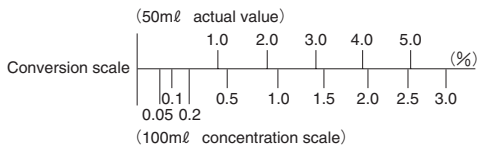
GAS CHROMATOGRAPHY

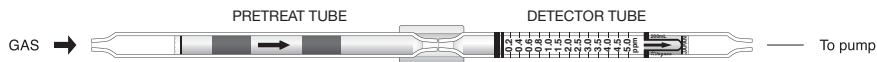
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance		Interference	%	Coexistence
Aromatic hydrocarbons	FIG.1	Similar stain is produced.		Higher readings are given.
Esters	FIG.2	∕		∕
Ketones		∕		∕
Alcohols	FIG.3	∕		∕
Halogenated hydrocarbons		Whole reagent is changed to Brown.	0.5	∕

(NOTE)

In case of 1/2 pump strokes, following conversion scale is available for actual concentration.





## 1. PERFORMANCE

- 1) Measuring range : 0.2-5.0 ppm  
Number of pump strokes : 2 (200mℓ)
- 2) Sampling time : 4 minute s/2 pump strokes
- 3) Detectable limit : 0.1 ppm
- 4) Shelf life : 1 year (Necessary to store in refrigerated conditions:0~10℃)
- 5) Operating temperature : 5~40℃
- 6) Reading : Direct reading from the scale calibrated by 2 pump strokes
- 7) Colour change : Yellow→Pale pink

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 5%

## 3. CHEMICAL REACTION

Aldehydes generated through the pretreat tube are detected.

## 4. CALIBRATION OF THE TUBE

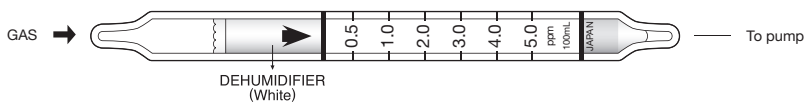
PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Ethylene oxide	Similar stain is produced.		Higher readings are given.
Formaldehyde		0.5	∕

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	5℃ (41°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (104°F)
5.0	7.9	6.3	5.0	4.5	4.0
4.5	7.1	5.6	4.5	4.1	3.6
4.0	6.3	5.0	4.0	3.6	3.2
3.5	5.5	4.4	3.5	3.1	2.8
3.0	4.7	3.8	3.0	2.7	2.4
2.5	3.8	3.1	2.5	2.2	1.9
2.0	3.0	2.5	2.0	1.8	1.5
1.5	2.2	1.9	1.5	1.3	1.1
1.0	1.4	1.3	1.0	0.86	0.71
0.8	1.1	1.0	0.80	0.68	0.56
0.6	0.83	0.75	0.60	0.50	0.40
0.4	0.55	0.50	0.40	0.32	0.25
0.2	0.27	0.25	0.20	0.16	0.12



## 1. PERFORMANCE

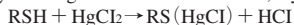
- |                          |   |           |
|--------------------------|---|-----------|
| 1) Measuring range       | : 1-10 ppm  | 0.5-5 ppm |
| Number of pump strokes   | : 1/2 (50mℓ)  | 1 (100mℓ) |
| 2) Sampling time         | : 1 minute/1 pump stroke  |           |
| 3) Detectable limit      | : 0.2 ppm (100mℓ)   |           |
| 4) Shelf life            | : 2 years   |           |
| 5) Operating temperature | : 0 ~ 40 °C   |           |
| 6) Reading               | : The tube scale is calibrated based on Methyl mercaptan at 1 pump stroke and the tube has the same sensitivity for n-Propyl mercaptan. |           |
| 7) Colour change         | : Pale yellow → Pink  |           |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with Mercuric chloride, Hydrogen chloride is produced and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Arsine	Similar stain is produced.	Higher readings are given.
Hydrogen selenide	∕	∕
Phosphine	∕	∕
Hydrogen sulphide	∕	∕
Hydrogen cyanide	Whole reagent is changed to Red.	∕
Sulphur dioxide		Whole reagent is changed to Pale red, but Pink stain indicates Mercaptans conc.

(NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.

Actual concentration = 2 × Reading value



## 1. PERFORMANCE

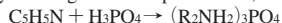
- 1) Measuring range : 0.5-10 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Ammonia at 1 pump stroke and Pyridine concentration is determined by deviding the tube reading by 2
- 7) Colour change : Pale purple → Pale yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with Phosphoric acid, PH indicator is discoloured.

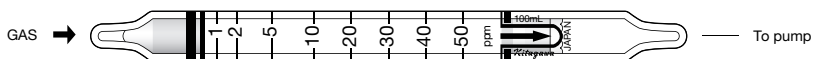


## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Amines	Similar stain is produced.	Higher readings are given.



## 1. PERFORMANCE

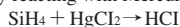
- 1) Measuring range : 1-50 ppm      0.5-25 ppm
- Number of pump strokes : 1 (100mℓ)    2 (200mℓ)
- 2) Sampling time : 5 minutes/1 pump stroke
- 3) Detectable limit : 0.3 ppm (200mℓ)
- 4) Shelf life : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (0 ~ 20 °C) (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Yellow → Red

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 10 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

By reacting with Mercuric chloride, Hydrogen chloride is liberated and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Phosphine	2 layers of greyish white and red stain are produced.	20	Higher readings are given.
Arsine	2 layers of dark brown and red stain are produced.	50	∕
Disilane	A Similar stain is produced.	2	∕
Diborane	∕	20	∕
Ammonia		100	Lower readings are given.
Sulphur dioxide			Whole reagent is changed to Orange. But the accuracy of readings is not affected by Sulphur dioxide if the maximum end point of stained layer is discernable.
IPA			Not affected.
Hydrogen			∕
Hydrogen chloride		less than 250	Not affected.
Dichlorosilane		less than 200	∕

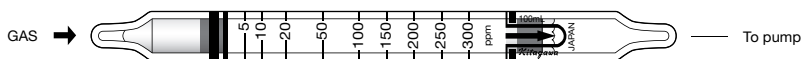
(NOTE)

In case of 2 pump strokes, following formula is available for the actual concentration.

Actual concentration = Temperature corrected value × 1/2

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)		
	0 °C (32 °F)	10 °C (50 °F)	20-40 °C (68-104 °F)
50	38	45	50
40	30	35	40
30	22	26	30
20	14	17	20
10	7	8	10
5	4	4	5
2	2	2	2
1	1	1	1



## 1. PERFORMANCE

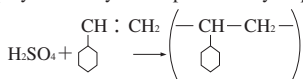
- 1) Measuring range : 5-300 ppm    2.5-150 ppm
- Number of pump strokes : 1 (100mℓ)    2 (200mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 0.5 ppm (200mℓ)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : White → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15%    RSD-mid. : 15%    RSD-high : 10%

## 3. CHEMICAL REACTION

A polymer of Styrene is produced by sulphuric acid.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

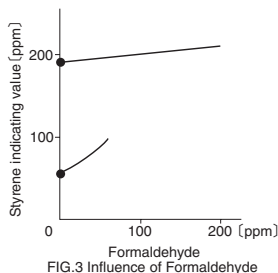
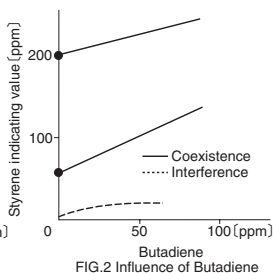
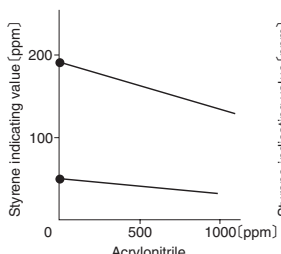
## 5. INTERFERENCE AND CROSS SENSITIVITY

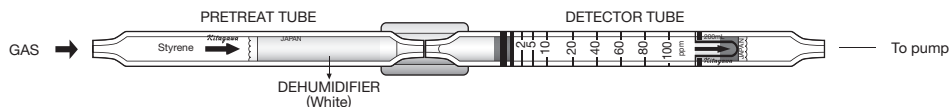
Substance	ppm	Interference	ppm	Coexistence
Acrylonitrile	FIG.1	The accuracy of readings is not affected.	400	Lower readings are given.
Butadiene	FIG.2	3 Similar stain is produced.	5	Uneven discolouration is produced and higher readings are given.
Formaldehyde	FIG.3	∕	15	Yellowish orange stain is produced and higher readings are given.
Acetaldehyde		∕	350	Similar stain is produced and higher readings are given.
Methyl alcohol		The accuracy of readings is not affected.	0.35%	Pale discolouration is produced and higher readings are given.
Ethyl alcohol		∕	0.18%	∕
Ethyl acetate		∕	700	∕
Butyl acetate		∕	700	∕

(NOTE)

In case of 2 pump strokes, following formula is available for actual concentration.

Actual concentration = 1/2 × Reading value.





## 1. PERFORMANCE

- 1) Measuring range : 2-100 ppm    1-50 ppm  
     Number of pump strokes    2 (200mℓ)    4 (400mℓ)
- 2) Sampling time : 2 minutes / 2 pump strokes
- 3) Detectable limit : 0.2 ppm (400mℓ)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 2 pump strokes
- 8) Colour change : White → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 5 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

A polymer of Styrene is produced by fume sulphuric acid.



## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Acrylonitrile	The accuracy of readings is not affected.	400	Lower readings are given.
Butadiene	Pale orange stain is produced.	5	Higher readings are given.
Formaldehyde	The accuracy of readings is not affected.	15	∕
Acetaldehyde	Orange stain is produced.	350	∕
Methyl alcohol	The accuracy of readings is not affected.	3500	∕
Ethyl alcohol	∕	1800	∕
Ethyl acetate	∕	700	∕
Butyl acetate	∕	700	∕

(NOTE)

In case of 4 pump strokes, following formula is available for actual concentration.

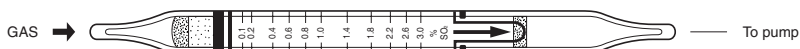
Actual concentration =  $1/2 \times$  Reading value.

### TEMPERATURE CORRECTION TABLE

Temperature : To correct for temperature, multiply the tube reading by the following factors.

Temperature (°C)	0	1	2	3	4	5	6	7	8	9
Correction Factor	0.80	0.81	0.82	0.83	0.84	0.85	0.86	0.87	0.88	0.89
Temperature (°C)	10	11	12	13	14	15	16	17	18	19
Correction Factor	0.90	0.91	0.92	0.93	0.94	0.95	0.96	0.97	0.98	0.99
Temperature (°C)	20	21	22	23	24	25	26	27	28	29
Correction Factor	1.00	1.01	1.02	1.03	1.04	1.05	1.06	1.07	1.08	1.09
Temperature (°C)	30	31	32	33	34	35	36	37	38	39
Correction Factor	1.10	1.11	1.12	1.13	1.14	1.15	1.16	1.17	1.18	1.19
Temperature (°C)	40									
Correction Factor	1.20									





## 1. PERFORMANCE

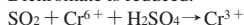
- 1) Measuring range : 0.1-3.0 %
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 0.01 % (100 ppm)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Yellow → Blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Dichromate is reduced.



## 4. CALIBRATION OF THE TUBE

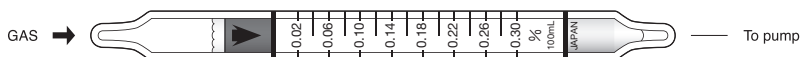
STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Hydrogen sulphide		400	Brown stain is produced and higher readings are given.

TEMPERATURE CORRECTION TABLE

Tube Readings (%)	Corrected Concentration (%)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
3.0	4.4	3.7	3.0	2.6	2.2
2.6	3.8	3.2	2.6	2.3	2.0
2.2	3.2	2.7	2.2	2.0	1.7
1.8	2.6	2.2	1.8	1.6	1.4
1.4	2.0	1.7	1.4	1.3	1.1
1.0	1.4	1.2	1.0	0.9	0.9
0.8	1.2	1.0	0.8	0.7	0.6
0.6	0.8	0.7	0.6	0.6	0.5
0.4	0.5	0.5	0.4	0.4	0.3
0.2	0.3	0.2	0.2	0.2	0.2
0.1	0.1	0.1	0.1	0.1	0.1



## 1. PERFORMANCE

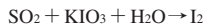
- 1) Measuring range : 0.02-0.3 %
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 0.001 % (10 ppm)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : White → Orange

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Potassium iodate is reduced.

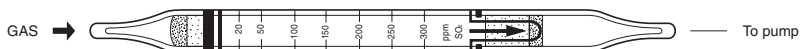


## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Hydrogen sulphide	The accuracy of readings is not affected.	100	Higher readings are given.



## 1. PERFORMANCE

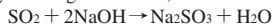
- 1) Measuring range : 20-300 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 3 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Purple → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with alkali, PH indicator is discoloured.

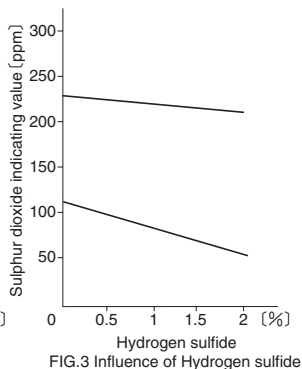
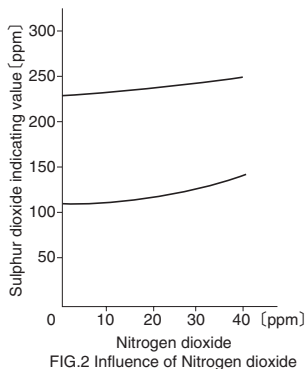
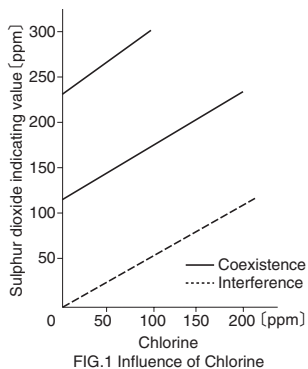


## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	ppm	Coexistence
Chlorine FIG.1		Similar stain is produced.	SO <sub>2</sub> conc. × 1/5	Higher readings are given.
Nitrogen dioxide FIG.2	100	Pink stain is produced.	∕	∕
Hydrogen sulphide FIG.3		The accuracy of readings is not affected.	SO <sub>2</sub> conc. × 100	Lower readings are given.





## 1. PERFORMANCE

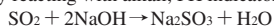
- 1) Measuring range : 1-60 ppm  
Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 0.5 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Pink → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with alkali, PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	ppm	Coexistence
Chlorine		Pale pink stain is produced.	SO <sub>2</sub> conc. × 2	Higher readings are given.
Nitrogen dioxide	20	∕	SO <sub>2</sub> conc. × 1	Higher readings with indiscernible maximum end point of stained layer are given.



## 1. PERFORMANCE

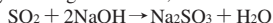
- |                          |  |            |
|--------------------------|--|------------|
| 1) Measuring range       | : 0.5-10 ppm   | 0.25-5 ppm |
| Number of pump strokes   | 1 (100mℓ)  | 2 (200mℓ)  |
| 2) Sampling time         | : 1.5 minutes/1 pump stroke  |            |
| 3) Detectable limit      | : 0.1 ppm (200mℓ)  |            |
| 4) Shelf life            | : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C) |            |
| 5) Operating temperature | : 0 ~ 40 °C  |            |
| 6) Humidity compensation | : Necessary (See "R.H. CORRECTION COEFFICIENT TABLE")                |            |
| 7) Reading               | : Direct reading from the scale calibrated by 1 pump stroke          |            |
| 8) Colour change         | : Pink → Yellow  |            |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 5%    RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with alkali, PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Nitrogen dioxide	Pale pink stain is produced.	3	Higher readings with indiscernible maximum end point of stained layer are given.
Hydrogen chloride	∕		Higher readings are given.

(NOTE)

1) This detector tube is affected by ambient relative humidity, therefore, it is necessary to compensate the reading of gas detector tube with the following formula and correction coefficient table.

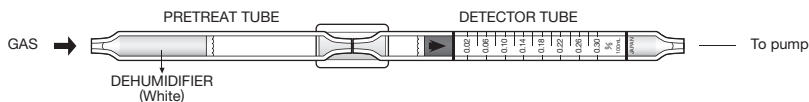
Actual concentration = Reading Value (ppm) × Correction Coefficient

2) In case of 2 pump strokes, following formula is available for actual concentration.

Actual concentration = 1/2 × Reading value corrected with above formula

R.H. CORRECTION COEFFICIENT TABLE

	10	30	50	60	70	80	90
coefficient of correction	0.9	0.95	1.0	1.1	1.2	1.3	1.4



## 1. PERFORMANCE

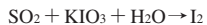
- 1) Measuring range : 0.02-0.3 %
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 0.001 % (10 ppm)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : White → Orange

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Potassium iodate is reduced.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Hydrogen sulphide	The accuracy of readings is not affected.	100	Higher readings are given.



## 1. PERFORMANCE

- 1) Measuring range : 0.5-25 ppm    0.1-3 ppm  
     Number of pump strokes : 1 (100mℓ)    4 (400mℓ)
- 2) Sampling time : 2 minutes/1 pump stroke
- 3) Detectable limit : 0.09 ppm (400mℓ)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Blue purple → White

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 5%    RSD-high : 5%

## 3. CHEMICAL REACTION

Iodine is reduced.



## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Hydrogen Sulphide	Whole reagent is changed to Pink.	0.5	Higher readings are given.
Nitrogen Dioxide	Whole reagent is changed to Black.	0.5	Lower readings are given.
Ammonia	The accuracy of readings is not affected.	1.0	∕

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
25	40.0	32.5	25.0	22.5	19.0
20	28.0	24.0	20.0	17.7	15.5
15	20.0	17.5	15.0	13.5	12.0
10	12.5	11.3	10.0	9.3	8.5
8	10.0	9.0	8.0	7.5	7.0
6	7.5	6.8	6.0	5.8	5.5
4	4.4	4.2	4.0	3.8	3.6
2	2.0	2.0	2.0	2.0	2.0
1	1.0	1.0	1.0	1.0	1.0
0.5	0.5	0.5	0.5	0.5	0.5



## 1. PERFORMANCE

- 1) Measuring range : 0.5-5 mg/m<sup>3</sup>  
Number of pump strokes : 5 (500ml)
- 2) Sampling time : 100 seconds/5 pump strokes
- 3) Detectable limit : 0.2 mg/m<sup>3</sup>
- 4) Shelf life : 2 years
- 5) Operating temperature : 5 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 5 pump strokes
- 8) Colour change : Yellow → Pink

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 10 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

The pH indicator is discoloured.

## 4. CALIBRATION OF THE TUBE

ION CHROMATOGRAPHY.

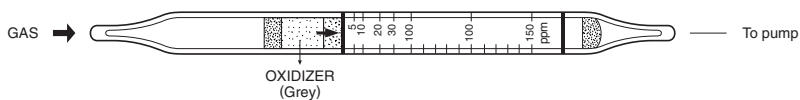
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Hydrogen chloride	Similar stain is produced.	Higher readings are given.
Hydrogen flouride	∕	∕
Nitrogen dioxide	∕	∕
Chlorine	∕	∕
Nitric acid	∕	∕
Hydrogen sulphide	The accuracy of readings is not affected.	The accuracy of readings is not affected.
Sulphur dioxide	∕	∕

### TEMPERATURE CORRECTION TABLE

Temperature	5 °C (41 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
Correction Factor	2.0	1.5	1.0	0.8	0.6





## 1. PERFORMANCE

- 1) Measuring range : 10-300 ppm    5-150 ppm
- Number of pump strokes : 1/2 (50mℓ)    1 (100mℓ)
- 2) Sampling time : 2 minutes/1 pump stroke
- 3) Detectable limit : 1 ppm (100mℓ)
- 4) Shelf life : 2 years (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Yellow → Red

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

By decomposing with an Oxidizer, Hydrogen chloride is produced and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Vinyl chloride	Similar stain is produced.	Higher readings are given.
Hydrogen chloride    FIG.1	∕	∕
1,2-Dichloroethylene    FIG.2	∕	∕
Trichloroethylene	∕	∕
Chlorine	Pale red stain is produced.	∕

(NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.

Actual concentration = 2 × Temperature corrected value

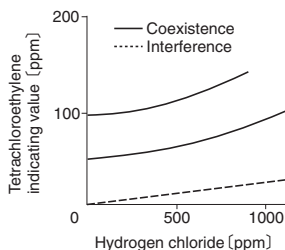


FIG.1 Influence of Hydrogen chloride

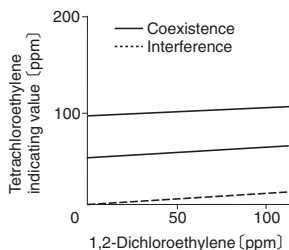
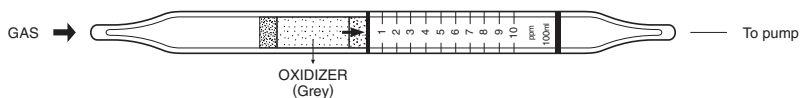


FIG.2 Influence of 1,2-Dichloroethylene

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
150	—	172	150	138	134
100	144	116	100	92	88
50	70	56	50	46	44
30	40	36	30	28	26
20	22	21	20	19	18
10	10	10	10	10	10



## 1. PERFORMANCE

- 1) Measuring range : 1-10 ppm      0.2-2.0 ppm
- Number of pump strokes : 1 (100mℓ)    4 (400mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 0.1 ppm (400mℓ)
- 4) Shelf life : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Pale orange → Blueish purple

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 10 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

By reacting with an Oxidizer, Hydrogen chloride is produced and PH indicator is discoloured.  
 $\text{Cl}_2\text{C} = \text{CCl}_2 + \text{PbO}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{HCl}$

## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Trichloroethylene FIG.1	Similar stain is produced.	2	Higher readings are given.
1,2-Dichloroethylene FIG.2	∕	2	∕
Hydrogen chloride	∕	2	∕
Vinyl chloride	∕	40	∕

(NOTE)

In case of 4 pump strokes, following formula is available for the actual concentration.

Actual concentration =  $1/5 \times$  Temperature corrected value

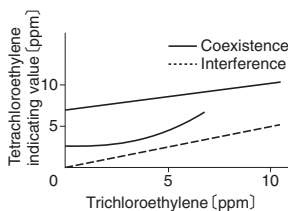


FIG.1 Influence of Trichloroethylene

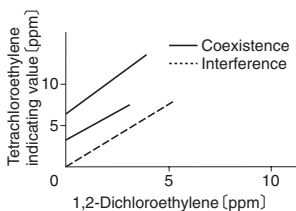


FIG.2 Influence of 1,2-Dichloroethylene

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
10	12.5	11.3	10.0	9.4	8.7
9	11.9	10.5	9.0	8.5	7.9
8	9.4	8.7	8.0	7.5	7.0
7	8.2	7.6	7.0	6.6	6.2
6	7.0	6.5	6.0	5.6	5.2
5	5.8	5.4	5.0	4.8	4.3
4	4.6	4.3	4.0	3.8	3.5
3	3.5	3.3	3.0	2.8	2.6
2	2.3	2.2	2.0	1.9	1.7
1	1.1	1.1	1.0	1.0	0.9



## 1. PERFORMANCE

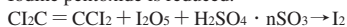
- 1) Measuring range : 0.2-2.0 %      0.1-0.2 %  
     Number of pump strokes    1 (100mℓ)    2 (200mℓ)
- 2) Sampling time : 3.5 minutes/1 pump stroke
- 3) Detectable limit : 0.08 % (200mℓ)
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : White → Dark brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

Iodine pentoxide is reduced.

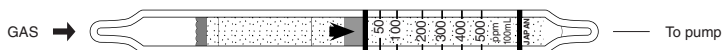


## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	%	Coexistence
Trichloroethylene	Yellow stain is produced.	0.2	Higher readings are given.
1,1,1-Trichloroethane	Orange stain is produced.	0.3	∕
1,2-Dichloroethylene	∕	0.1	∕
Vinyl chloride	∕	0.02	∕
Aromatic hydrocarbons	Blackish brown stain is produced.	—	The accuracy of readings is not affected.
Carbon monoxide	Brownish-red stain is produced.	0.05	Higher readings are given.
Carbon tetrachloride	The accuracy of readings is not affected.		The accuracy of readings is not affected.



## 1. PERFORMANCE

- 1) Measuring range : 50-500 ppm      125-1,250 ppm  
     Number of pump strokes : 1 (100mℓ)      1/2 (50mℓ)
- 2) Sampling time : 45 seconds/1 pump stroke
- 3) Detectable limit : 5 ppm (100mℓ)
- 4) Shelf life : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 5 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Yellow → Red

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 10 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

By decomposing with an Oxidizer, Hydrogen chloride is produced and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Trichloroethylene	Similar stain is produced.	10	Higher readings are given.
1,2-Dichloroethylene	∕	10	∕
1,1,1-Trichloroetane		less than 300	The accuracy of readings is not affected.

(NOTE)

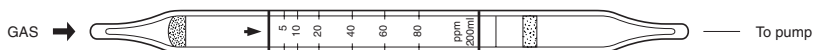
In case of 1/2 pump strokes, the following formula is available for the actual concentration.

Actual concentration = 2.5 × Reading value

### TEMPERATURE CORRECTION TABLE

Temperature : To correct for temperature, multiply the tube reading by the following factors.

Temperature (°C)	1	2	3	4	5	6	7	8	9	10
Correction Factor	—	—	—	—	1.40	1.36	1.32	1.28	1.24	1.20
Temperature (°C)	11	12	13	14	15	16	17	18	19	20
Correction Factor	1.18	1.16	1.14	1.12	1.10	1.08	1.06	1.04	1.02	1.00
Temperature (°C)	21	22	23	24	25	26	27	28	29	30
Correction Factor	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.92	0.91	0.90
Temperature (°C)	31	32	33	34	35	36	37	38	39	40
Correction Factor	0.89	0.88	0.87	0.86	0.85	0.84	0.83	0.82	0.81	0.80



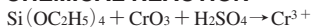
## 1. PERFORMANCE

- 1) Measuring range : 12.5-200 ppm    5-80 ppm  
     Number of pump strokes    1 (100mℓ)    2 (200mℓ)
- 2) Sampling time : 3 minutes/2 pump strokes
- 3) Detectable limit : 1 ppm (200mℓ)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 2 pump strokes
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 10 %    RSD-high : 10 %

## 3. CHEMICAL REACTION



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Phosphine	Similar stain is produced.	5	Higher readings are given.
Isopropyl alcohol	∕	7	∕
Ethyl alcohol	∕	10	∕
Silane			
Trichloroethylene	The accuracy of readings is not affected.		
Tetrachloroethylene			

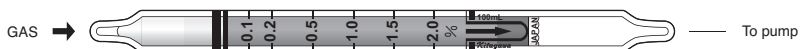
(NOTE)

In case of 1 pump stroke, following formula is available for the actual concentration.

Actual concentration = 2.5 × Temperature corrected value

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)					
	0 °C (32 °F)	5 °C (41 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
80	110	100	90	80	72	64
60	80	75	70	60	54	45
40	56	52	47	40	33	28
20	27	25	23	20	16	14
10	13	12	11	10	8	7
5	6	5	5	5	5	4



## 1. PERFORMANCE

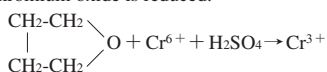
- 1) Measuring range : 2.0-5.0 %      0.2-3.0 %  
     Number of pump strokes : 1/2 (50ml)      1 (100ml)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 20 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Graduations printed on the tube are calibrated by Acetone at 1 pump stroke and Tetrahydrofuran is determined by using a conversion chart.
- 8) Colour change : Orange → Dark brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 %    RSD-mid. : 10 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.

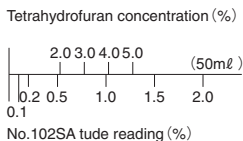
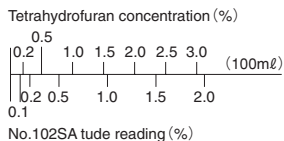


## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Alcohols	Similar stain is produced.		Higher readings are given.
Aromatic hydrocarbons    FIG.1	∕		∕
Ketones	∕		∕
Esters                            FIG.2	∕		∕
Halogenated hydrocarbons	Whole reagent is changed to Pale brown.	0.5 %	∕



### TEMPERATURE CORRECTION TABLE

Conversion Value (%)	Corrected Concentration (%)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
5.0	6.0	5.3	5.0	4.8	4.5
4.0	4.8	4.3	4.0	3.8	3.6
3.0	3.6	3.2	3.0	2.8	2.7
2.5	3.0	2.7	2.5	2.4	2.3
2.0	2.4	2.1	2.0	1.9	1.8
1.5	1.8	1.6	1.5	1.4	1.4
1.0	1.1	1.1	1.0	1.0	0.9
0.5	0.6	0.5	0.5	0.5	0.5

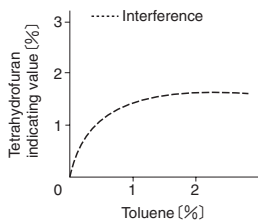


FIG.1 Influence of Toluene

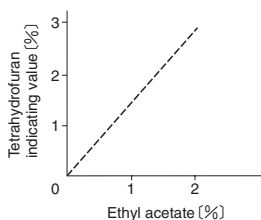
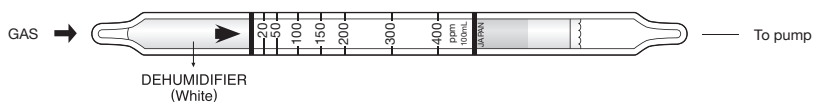


FIG.2 Influence of Ethyl acetate



## 1. PERFORMANCE

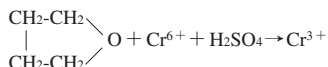
- 1) Measuring range : 20-400 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 10 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 10 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

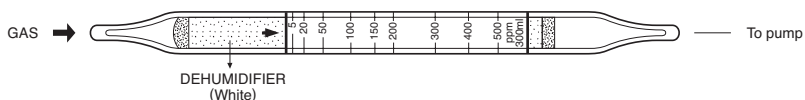
GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Ethers	∕	∕
Esters	Whole reagent is changed to Pale brown.	∕
Ketones	∕	∕
Aromatic hydrocarbons	∕	∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	∕	∕
Halogenated hydrocarbons	∕	∕

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)			
	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
500	680	500	390	320
400	540	400	320	250
300	400	300	240	190
200	260	200	160	130
150	190	150	120	90
100	130	100	80	60
50	60	50	40	30
20	30	20	20	10



## 1. PERFORMANCE

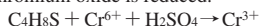
- 1) Measuring range : 4-100 ppm  
Number of pump strokes : 3 (300mℓ)
- 2) Sampling time : 4.5 minutes/3 pump strokes
- 3) Detectable limit : —
- 4) Shelf life : 2 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Ethyl cellosolve at 3 pump strokes and Tetrahydrothiophene concentration is determined by using a conversion chart at 3 pump strokes
- 7) Colour change : Yellow → Pale blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



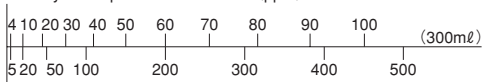
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

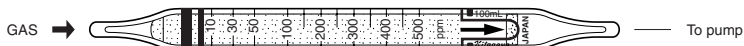
Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Ethers	∕	∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	∕	∕
Ketones	∕	∕
Aromatic hydrocarbons	Whole reagent is changed to Brown.	∕
Esters	∕	∕
Halogenated hydrocarbons	∕	∕

Tetrahydrothiophene concentration (ppm)



No. 190U tube reading (ppm)





## 1. PERFORMANCE

- 1) Measuring range : 10-500 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 2 minutes/1 pump stroke
- 3) Detectable limit : 3 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : White → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 5%

## 3. CHEMICAL REACTION

Iodine pentoxide is reduced.



## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Benzene	Similar stain is produced.		Higher readings are given.
Xylene	∕		∕
Ethyl benzene	∕		∕
Hexane	Whole layer is discoloured to Pale brown.	0.1 %	Higher readings with indiscernible maximum end point of stained layer are given.
Methyl alcohol	The accuracy of readings is not affected.	1 %	Higher readings are given.



## 1. PERFORMANCE

- 1) Measuring range : 2-100 ppm
- Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 1 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (0 ~ 10 °C) (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : White → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Iodine pentoxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Aromatic hydrocarbons FIG.1, FIG.2	Similar stain is produced.		Higher readings are given.
Hexane		1000	Double-layer stain (pale brown and brown) is produced, but if the maximum end point of the stained layer is discernable, the accuracy of readings is not affected.

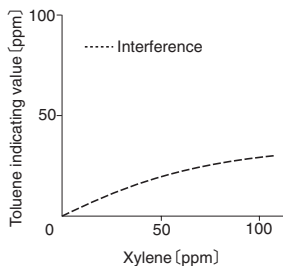


FIG.1 Influence of Xylene

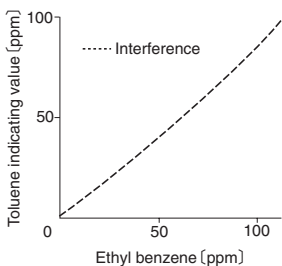
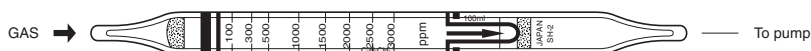


FIG.2 Influence of Ethyl benzene

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)		
	0 °C (32 °F)	5 °C (41 °F)	10-40 °C (50-104 °F)
100	150	125	100
80	120	100	80
60	85	75	60
40	55	45	40
30	40	35	30
20	28	23	20
10	13	10	10
5	6	5	5
2	2	2	2



## 1. PERFORMANCE

- 1) Measuring range : 100-3000 ppm  
Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 10 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : White → Dark brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

Iodine pentoxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Benzene	Dark green stain is produced.		Higher readings are given.
Ethyl benzene	Similar stain is produced.		∥
Xylene	∥		∥
Hexane	Whole reagents is changed to Pale brown.		∥
Methanol	The accuracy of readings is not affected.	1%	∥

## TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
3000	4000	3500	3000	2800	2600
2500	3300	2900	2500	2300	2200
2000	2700	2300	2000	1900	1800
1500	2000	1700	1500	1400	1300
1000	1300	1100	1000	970	940
500	500	500	500	500	500
300	300	300	300	300	300
100	100	100	100	100	100



## 1. PERFORMANCE

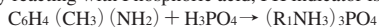
- 1) Measuring range : 2-22 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : Graduations printed on the tube are calibrated by Ammonia at 1 pump stroke and *o*-Toluidine concentration is determined by using a conversion chart at 1 pump stroke.
- 7) Colour change : Pale purple → Pale Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with Phosphoric acid, PH indicator is discoloured.

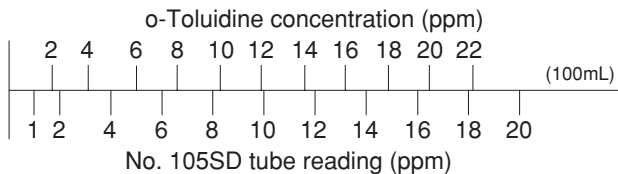


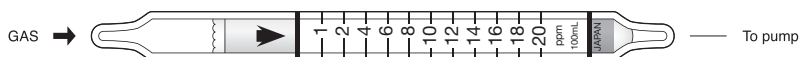
## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Amines	Similar stain is produced.	Higher readings are given.





## 1. PERFORMANCE

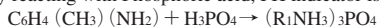
- 1) Measuring range : 2-20 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : Graduations printed on the tube are calibrated by Ammonia at 1 pump stroke and *p*-Toluidine concentration is determined by using a conversion chart at 1 pump stroke.
- 7) Colour change : Pale purple → Pale Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Phosphoric acid, PH indicator is discoloured.

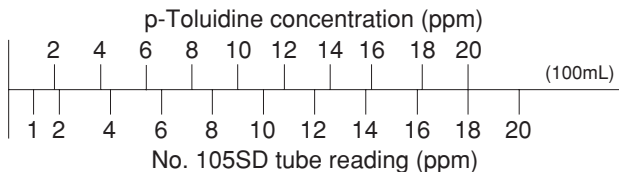


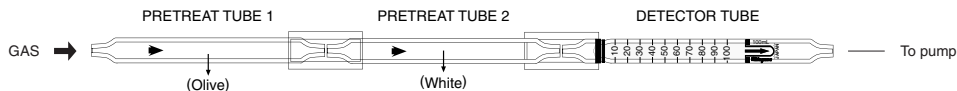
## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Amines	Similar stain is produced.	Higher readings are given.





## 1. PERFORMANCE

- 1) Measuring range : 10-100 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 2 minutes/1 pump stroke
- 3) Detectable limit : 5 ppm
- 4) Shelf life : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : White → Purple

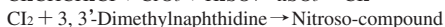
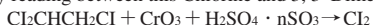
## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 10 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Chlorine is produced by decomposing with an Oxidizer.

By reading between this Chlorine and 3, 3'-Dimethylnaphthidine, Nitroso-compound is produced.



## 4. CALIBRATION OF THE TUBE

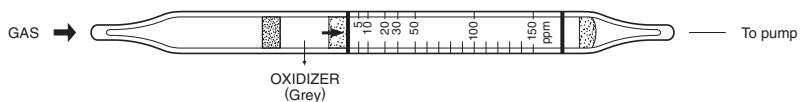
DIFFUSION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Nitrogen oxides	Similar stain is produced.		Higher readings are given.
Halogens	∕		∕
Halogenated hydrocarbons	∕		∕
Hexane	The accuracy of readings is not affected.	100	Lower readings are given.

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
100	81	89	100	114	129
90	71	80	90	105	119
80	60	71	80	96	109
70	51	61	70	87	97
60	43	52	60	76	85
50	34	43	50	65	72
40	26	34	40	54	59
30	19	25	30	42	45
20	13	15	20	29	31
10	6	8	10	13	15



## 1. PERFORMANCE

- 1) Measuring range : 10-300 ppm      5-150 ppm
- Number of pump strokes : 1/2 (50mℓ)      1 (100mℓ)
- 2) Sampling time : 2 minutes/1 pump stroke
- 3) Detectable limit : 1 ppm (100mℓ)
- 4) Shelf life : 2 years (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Yellow → Red

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

By decomposing with an Oxidizer, Hydrogen chloride is produced and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

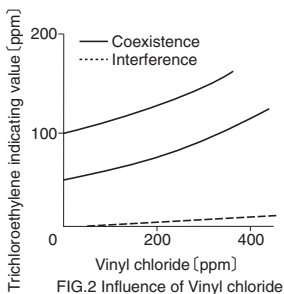
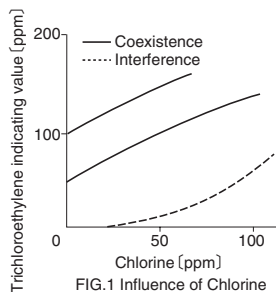
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Vinyl chloride      FIG.2	Similar stain is produced.	Higher readings are given.
Hydrogen chloride	∕	∕
1,2-Dichloroethylene	∕	∕
Tetrachloroethylene	∕	∕
Chlorine      FIG.1	Pale red stain is produced.	

(NOTE)

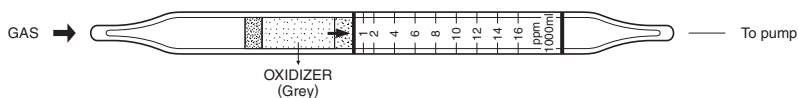
In case of 1/2 pump strokes, following formula is available for the actual concentration.

Actual concentration = 2 × Temperature corrected value



TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 °C (32 °F)	10 °C (50 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
150	—	162	150	144	142
100	120	108	100	96	94
50	58	53	50	48	46
30	34	32	30	29	28
20	20	20	20	20	20



## 1. PERFORMANCE

- |                          |  |           |             |
|--------------------------|--|-----------|-------------|
| 1) Measuring range       | : 2.3-36.8 ppm   | 1-16 ppm  | 0.2-3.2 ppm |
| Number of pump strokes   | : 1/2 (50mℓ)   | 1 (100mℓ) | 4 (400mℓ)   |
| 2) Sampling time         | : 1.5 minutes/1 pump stroke  |           |             |
| 3) Detectable limit      | : 0.1 ppm (400mℓ)  |           |             |
| 4) Shelf life            | : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C) |           |             |
| 5) Operating temperature | : 0 ~ 40 °C  |           |             |
| 6) Reading               | : Direct reading from the scale calibrated by 1 pump stroke          |           |             |
| 7) Colour change         | : Pale orange → Blueish purple                                       |           |             |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

By reacting with an Oxidizer, Hydrogen chloride is produced and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Tetrachloroethylene FIG.1	Similar stain is produced.	2	Higher readings are given.
1,2-Dichloroethylene FIG.2	∕	2	∕
Hydrogen chloride	∕	2	∕
Vinyl chloride	∕	20	∕

(NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.

Actual concentration = 2.3 × Reading value

In case of 4 pump strokes, following formula is available for the actual concentration.

Actual concentration = 1/5 × Reading value

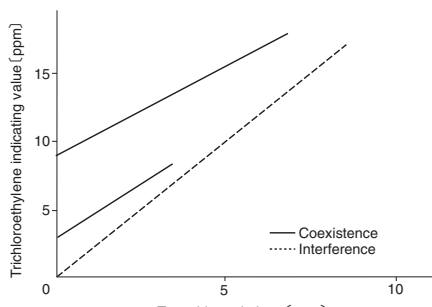


FIG.1 Influence of Tetrachloroethylene

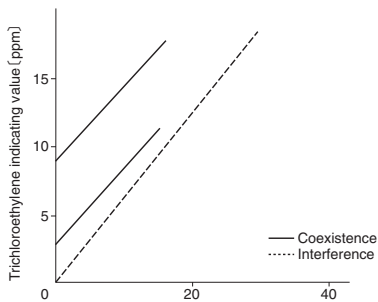
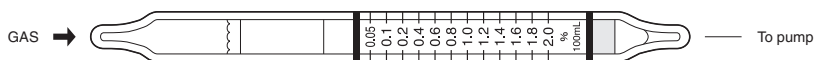


FIG.2 Influence of 1,2-Dichloroethylene





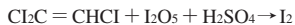
## 1. PERFORMANCE

- 1) Measuring range : 0.05-2.0 %  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 3 minutes/1 pump stroke
- 3) Detectable limit : 0.01 %
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (0 ~ 20 °C) (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : White → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 10 % RSD-high : 10 %

## 3. CHEMICAL REACTION



## 4. CALIBRATION OF THE TUBE

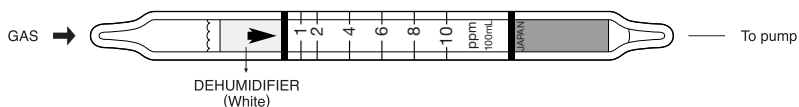
GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	%	Coexistence
Tetrachloroethylene	Brown stain is produced.	0.2	Higher readings are given.
1,1,1-Trichloroetane	Orange stain is produced.	0.2	∕
1,2-Dichloroethylene	∕	0.1	∕
Vinyl chloride	∕	0.02	∕
Aromatic hydrocarbons	Dark brown stain is produced.	—	The accuracy of readings is not affected.
Carbon monoxide	Brownish-red stain is produced.	0.05	Higher readings are given.
Carbon tetrachloride	The accuracy of readings is not affected.		The accuracy of readings is not affected.

TEMPERATURE CORRECTION TABLE

Tube Readings (%)	Corrected Concentration (%)			
	0 °C (32 °F)	5 °C (41 °F)	10 °C (50 °F)	20 °C-40 °C (68-104 °F)
2.0	—	2.7	2.3	2.0
1.8	—	2.4	2.1	1.8
1.6	—	2.1	1.9	1.6
1.4	2.4	1.8	1.6	1.4
1.2	1.9	1.55	1.4	1.2
1.0	1.5	1.3	1.15	1.0
0.8	1.2	1.0	0.9	0.8
0.6	0.9	0.75	0.7	0.6
0.4	0.6	0.5	0.45	0.4
0.2	0.3	0.25	0.22	0.2
0.1	0.15	0.13	0.11	0.1
0.05	0.06	0.05	0.05	0.05



## 1. PERFORMANCE

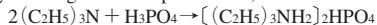
- |                          |   |           |
|--------------------------|---|-----------|
| 1) Measuring range       | : 2-20 ppm  | 1-10 ppm  |
| Number of pump strokes   | 1/2 (50mℓ)  | 1 (100mℓ) |
| 2) Sampling time         | : 1 minute/1 pump stroke                                    |           |
| 3) Detectable limit      | : 0.2 ppm (100mℓ)   |           |
| 4) Shelf life            | : 3 years   |           |
| 5) Operating temperature | : 0 ~ 40 °C   |           |
| 6) Reading               | : Direct reading from the scale calibrated by 1 pump stroke |           |
| 7) Colour change         | : Pale purple → Pale yellow                                 |           |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Phosphoric acid, PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

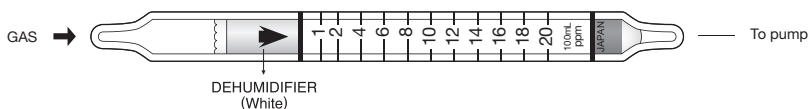
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Ammonia	Similar stains are produced and higher readings are given.	Higher readings are given.
Other amines	∕	∕

(NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.

Actual concentration = 2 × Reading value



## 1. PERFORMANCE

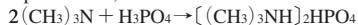
- |                          |   |
|--------------------------|---|
| 1) Measuring range       | : 1-20 ppm  |
| Number of pump strokes   | : 1 (100ml)   |
| 2) Sampling time         | : 1 minute/1 pump stroke  |
| 3) Detectable limit      | : 0.3 ppm   |
| 4) Shelf life            | : 3 years   |
| 5) Operating temperature | : 0 ~ 40 °C   |
| 6) Reading               | : The tube scale is calibrated based on Diethyl amine at 1 pump stroke and the tube has the same sensitivity for Trimethyl amine. |
| 7) Colour change         | : Pale purple → Pale yellow   |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

Phosphoric acid, PH indicator is discoloured.

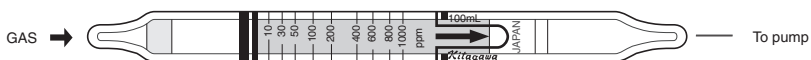


## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Ammonia	Similar stains are produced	Higher readings are given.
Other amines	∕	∕



## 1. PERFORMANCE

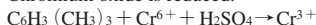
- 1) Measuring range : 20-250 ppm  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 1 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Graduations printed on the tube are calibrated by Ethyl acetate at 1 pump stroke and 1,2,4-trimethyl benzene is determined by using a conversion chart.
- 7) Colour change : Yellow → Dark brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.

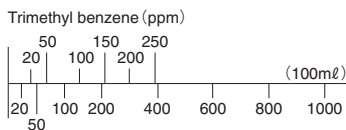


## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Brown stain is produced.	Higher readings are given.
Esters	∕	∕
Ketones	∕	∕
Aromatic hydrocarbons	∕	∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )		Double-layer stain is produced. If the dark brown stain is clear, the readings can be obtained by it.
Halogenated hydrocarbons		∕



No. 111U Tube reading (ppm)



## 1. PERFORMANCE

- |                          |  |               |
|--------------------------|--|---------------|
| 1) Measuring range       | : 200-4,000 ppm  | 100-1,400 ppm |
| Number of pump strokes   | 1/2 (50mℓ)   | 1 (100mℓ)     |
| 2) Sampling time         | : 1.5 minutes/1 pump stroke  |               |
| 3) Detectable limit      | : —  |               |
| 4) Shelf life            | : 2 years  |               |
| 5) Operating temperature | : 15 ~ 25 °C   |               |
| 6) Reading               | : Graduations printed on the tube are calibrated by n-Hexane at 1 pump stroke and 2, 2, 4-Trimethyl Pentane concentration is determined by using a conversion chart at 1/2 and 1 pump strokes. |               |
| 7) Colour change         | : Orange → Yellowish green   |               |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 5%

## 3. CHEMICAL REACTION

Chromium oxide is reduced

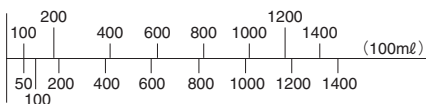


## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

(for 1 pump stroke)

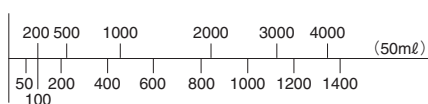
2, 2, 4-Trimethyl Pentane concentration (ppm)



No.113SB Tube reading (ppm)

(for 1/2 pump strokes)

2, 2, 4-Trimethyl Pentane concentration (ppm)



No.113SB Tube reading (ppm)



## 1. PERFORMANCE

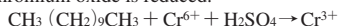
- 1) Measuring range : 10-140 ppm  
Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 2 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : The tube scale is calibrated based on Ethyl acetate at 1 pump stroke and n-Undecane concentration is determined by using a conversion chart at 1 pump stroke
- 7) Colour change : Yellow → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 10 % RSD-high : 5 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.

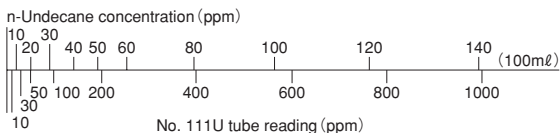


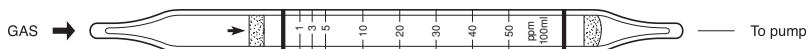
## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar or brown stain is produced.	Higher readings are given.
Esters	∕	∕
Ketones	∕	∕
Aromatic hydrocarbons	∕	∕
Aliphatic hydrocarbons	Whole reagent is discoloured to Pale brown.	If the maximum end point of stained layer is discernable, the accuracy of readings is not affected.
Halogenated hydrocarbons	∕	∕





## 1. PERFORMANCE

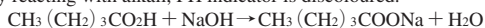
- 1) Measuring range : 3-70 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : —
- 4) Shelf life : 3 years
- 5) Operating temperature : 15 ~ 25 °C
- 6) Reading : Graduations printed on the tube are calibrated by Acetic acid at 1 pump stroke and n-Valeric acid concentration is determined by using a conversion chart at 1 pump stroke.
- 7) Colour change : Pale pink → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

By reacting with alkali, PH indicator is discoloured.



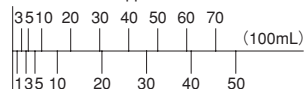
## 4. CALIBRATION OF THE TUBE

VAPOUR PRESSURE METHOD

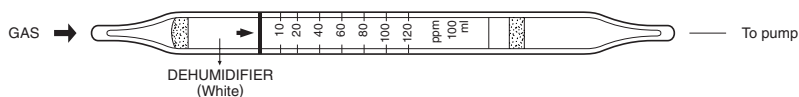
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	Coexistence
Sulphur dioxide		Similar stain is produced.	Higher readings are given.
Nitrogen dioxide	300	∕	The maximum end point of stained layer is indiscernible.
Hydrogen chloride		Pink stain is produced.	Higher readings are given.
Chlorine		Blueish yellow stain is produced.	∕
Acetic acid		Similar stain is produced.	∕

n-Valeric Acid (ppm)



No.216S tube reading (ppm)



## 1. PERFORMANCE

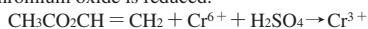
- |                          |   |           |
|--------------------------|---|-----------|
| 1) Measuring range       | : 10-120 ppm  | 5-60 ppm  |
| Number of pump strokes   | 1 (100mℓ)   | 2 (200mℓ) |
| 2) Sampling time         | : 1.5 minutes/1 pump stroke                                 |           |
| 3) Detectable limit      | : 1 ppm (200mℓ)   |           |
| 4) Shelf life            | : 2 years   |           |
| 5) Operating temperature | : 0 ~ 40 °C   |           |
| 6) Reading               | : Direct reading from the scale calibrated by 1 pump stroke |           |
| 7) Colour change         | : Yellow → Pale blue  |           |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

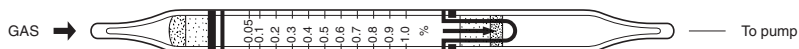
Substance	Interference	ppm	Coexistence
Acetic acid			The accuracy of readings is not affected.
Ethylene	Pale brown or pale blue stain is produced.	150	Lower readings are given.
Alcohols	Similar stain is produced.		Higher readings are given.
Ethers	∕		∕
Aliphatic hydrocarbons (more than C <sub>3</sub> )	Whole layer is discoloured to Pale brown.		∕
Aromatic hydrocarbons	∕		∕
Halogenated hydrocarbons	∕		∕
Esters	∕		∕
Ketones	∕		∕

(NOTE)

In case of 2 pump strokes, following formula is available for the actual concentration.

Actual concentration = 1/2 × Reading value





## 1. PERFORMANCE

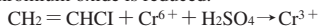
- 1) Measuring range : 0.05-1.0 %  
Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 2 minutes/1 pump stroke
- 3) Detectable limit : 10 ppm
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 7) Colour change : Brownish orange → Brownish green

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

Chromium oxide is reduced.

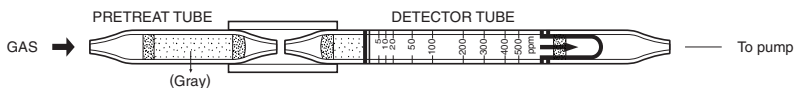


## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Acetylene	Whole layer is discoloured to Brown.	3%	Whole reagent is discoloured to Brown and higher readings are given.
Propane	∕	0.2%	∕
Other organic gases or vapours except Halogenated hydrocarbons	Similar stain is produced.	50	Higher readings are given.



## 1. PERFORMANCE

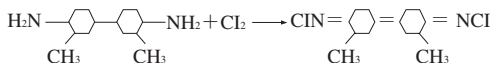
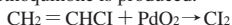
- 1) Measuring range : 5-500 ppm
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1.5 minutes/1 pump stroke
- 3) Detectable limit : 2 ppm
- 4) Shelf life : 1.5 years (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : White → Reddish orange

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15 % RSD-mid. : 10 % RSD-high : 10 %

## 3. CHEMICAL REACTION

By decomposing with an Oxidizer, Chlorine is produced. This Chlorine reacts with *o*-Toluidine and red Orthoquinone is produced.



## 4. CALIBRATION OF THE TUBE

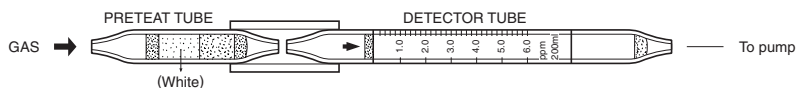
GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Hydrogen chloride	Similar stain is produced.		Higher readings are given.
Chlorine	∕		∕
Other halogens or Halogenated hydrocarbons	∕		∕

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)						
	0 °C (32 °F)	5 °C (41 °F)	10 °C (50 °F)	15 °C (59 °F)	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
500	—	—	820	600	500	430	400
400	—	850	610	470	400	340	310
300	—	640	440	350	300	250	230
200	750	400	300	230	200	160	140
100	340	200	150	120	100	80	70
50	150	100	70	60	50	40	30
20	50	40	30	25	20	15	10
10	25	20	15	10	10	8	6
5	15	10	10	5	5	5	5



## 1. PERFORMANCE

- |                             |  |             |             |
|-----------------------------|--|-------------|-------------|
| 1) Measuring range          | : 0.4-12.0 ppm   | 0.2-6.0 ppm | 0.1-3.0 ppm |
| Number of pump strokes      | 1 (100mℓ)  | 2 (200mℓ)   | 4 (400mℓ)   |
| 2) Sampling time            | : 3 minutes/2 pump strokes                                   |             |             |
| 3) Detectable limit         | : 0.05 ppm (400mℓ)   |             |             |
| 4) Shelf life               | : 3 years  |             |             |
| 5) Operating temperature    | : 0 ~ 40 °C  |             |             |
| 6) Temperature compensation | : Necessary (0 ~ 20 °C) (See "TEMPERATURE CORRECTION TABLE") |             |             |
| 7) Reading                  | : Direct reading from the scale calibrated by 2 pump strokes |             |             |
| 8) Colour change            | : Greenish yellow → Pink                                     |             |             |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

By decomposing with an Oxidizer, Hydrogen chlorine is produced and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Acetylene		4%	Lower readings are given.
Ethylene		400	∕
Hydrogen chloride		Less than 500	The accuracy of readings is not affected.
Chlorine		Less than 50	∕

(NOTE)

In case of 1 or 4 pump strokes, following formula is available for the actual concentration.

Actual concentration = Temperature corrected value × 2/Number of strokes

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0°C (32°F)	5°C (41°F)	10°C (50°F)	15°C (59°F)	20-40°C (68-104°F)
6.0	9.4	8.3	7.4	6.8	6.0
5.0	7.6	6.8	6.1	5.6	5.0
4.0	6.1	5.5	5.0	4.5	4.0
3.0	4.6	4.0	3.6	3.3	3.0
2.0	3.0	2.7	2.4	2.2	2.0
1.0	1.5	1.4	1.3	1.2	1.0



## 1. PERFORMANCE

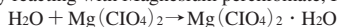
- 1) Measuring range : 1.7-33.8 mg/ℓ  
 Number of pump strokes : 1 (100ml)  
 From 10% RH (20°C = 68°F) to 100% RH (32°C = 90°F)  
 [40% RH (40°C = 104°F)]
- 2) Sampling time : 20 seconds/1 pump stroke
- 3) Detectable limit : 0.2 mg/ℓ
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40°C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Greenish yellow → Purple

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Magnesium perchlorate, PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

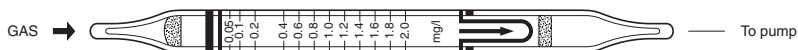
VAPOR PRESSURE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	%	Coexistence
Methanol		0.3	Unclear stain is produced.
Ethanol		0.3	∕
Ethyl acetate		0.3	∕
Acetone		0.5	∕
Nitrogen dioxide		0.2	∕
Ammonia		0.02	Purple and purplish red stains are produced and higher readings are given.

TEMPERATURE CORRECTION TABLE

Tube Readings	Corrected Concentration																	
	0°C 32°F	5°C 41°F	10°C 50°F	12°C 54°F	14°C 57°F	16°C 61°F	18°C 64°F	20°C 68°F	22°C 72°F	24°C 75°F	26°C 79°F	28°C 82°F	30°C 86°F	32°C 90°F	34°C 93°F	36°C 97°F	38°C 100°F	40°C 104°F
0	100.0 4.8	50.0 3.4	30.0 2.8	20.0 2.2	18.0 2.2	15.0 2.0	12.0 1.8	10.0 1.7	9.0 1.7	8.0 1.7	7.5 1.8	7.0 1.9	6.5 2.0	6.0 2.0	5.5 2.1	5.0 2.1	5.0 2.3	4.0 2.0
5		100.0 6.8	50.0 4.7	30.0 3.2	26.0 3.1	20.0 2.7	18.0 2.8	15.0 2.5	12.0 2.3	9.0 1.9	8.0 2.0	7.5 2.2	7.0 2.3	6.5 2.4	6.0 2.4	5.5 2.5	5.0 2.5	5.0 2.6
10			100.0 9.4	70.0 7.5	48.0 5.8	35.0 4.8	28.0 4.3	24.0 4.2	18.0 3.5	15.0 3.3	13.0 3.2	10.0 2.7	9.0 2.7	8.0 2.9	7.0 3.0	6.5 3.1	6.0 3.2	6.5 3.3
12				100.0 10.7	80.0 9.6	50.0 8.9	40.0 8.5	30.0 8.1	25.0 7.6	20.0 7.1	17.0 6.6	14.0 6.1	12.0 5.7	10.0 5.4	9.0 5.3	8.0 5.0	7.0 5.1	7.0 5.1
14					100.0 12.0	80.0 10.9	55.0 9.8	40.0 9.5	35.0 9.1	26.0 8.6	20.0 8.1	18.0 7.7	15.0 7.3	13.0 6.9	11.0 6.6	10.0 6.4	9.0 6.3	9.0 6.1
16						100.0 13.6	80.0 12.3	55.0 11.3	45.0 10.7	35.0 10.1	27.0 9.5	20.0 9.0	18.0 8.7	15.0 8.4	14.0 8.2	12.0 8.0	11.0 7.9	10.0 7.7
18							100.0 15.4	80.0 13.8	55.0 12.7	45.0 12.1	35.0 11.5	27.0 10.9	20.0 10.6	18.0 10.4	15.0 10.2	14.0 10.1	13.0 10.0	12.0 9.9
20								100.0 17.2	80.0 15.5	60.0 13.9	48.0 13.1	38.0 12.3	29.0 11.7	24.0 11.3	20.0 11.0	18.0 10.9	16.0 10.8	14.0 10.7
22									100.0 19.4	80.0 17.4	62.0 15.1	50.0 13.6	40.0 12.1	30.0 11.1	25.0 10.1	22.0 9.4	20.0 9.2	19.0 9.1
24										100.0 21.8	80.0 19.5	62.0 16.9	50.0 15.2	40.0 13.5	30.0 11.3	25.0 10.3	22.0 9.6	20.0 9.4
26											100.0 24.4	80.0 21.8	64.0 19.4	50.0 17.0	40.0 15.0	32.0 13.3	28.0 12.9	25.0 12.8
28												100.0 27.2	80.0 24.2	64.0 21.6	50.0 18.8	40.0 16.7	32.0 14.8	28.0 14.3
30													100.0 30.3	80.0 27.0	64.0 24.1	50.0 20.1	40.0 18.5	34.0 17.4
32														100.0 33.8	80.0 30.1	64.0 26.7	48.0 22.2	40.0 20.4



## 1. PERFORMANCE

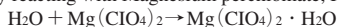
- 1) Measuring range : 0.05-2.0 mg/ℓ
- Number of pump strokes : 1 (100mℓ)
- 2) Sampling time : 1 minute/1 pump stroke
- 3) Detectable limit : 0.03 mg/ℓ
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Yellow → Blue (over 0.6 mg/ℓ) or Yellowish green (below 0.6 mg/ℓ)

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

By reacting with Magnesium perchlorate, PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols <span style="float: right;">FIG.1</span>	Similar stain is produced.	Higher readings are given.
Aliphatic hydrocarbons	The accuracy of readings is not affected.	The accuracy of readings is not affected.
Aromatic hydrocarbons	∕	∕
Sulphur dioxide	∕	∕
Hydrogen sulphide	∕	∕

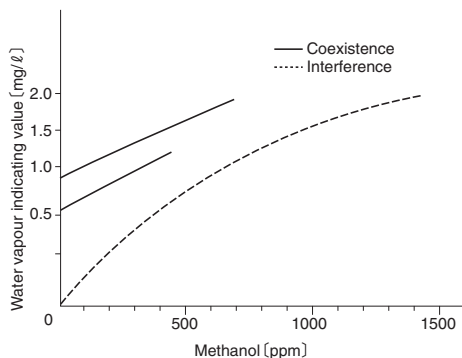
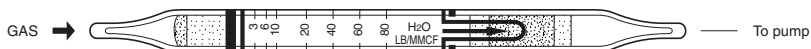


FIG.1 Influence of Methanol

TEMPERATURE CORRECTION TABLE

Tube Readings (mg/l)	Corrected Concentration (mg/l)									
	32°F	41°F	50°F	59°F	68°F	77°F	86°F	95°F	104°F	
2.0		3.70	3.06	2.46	2.00	1.60	1.28	0.92	0.66	
1.8	4.40	3.26	2.66	2.20	1.80	1.44	1.10	0.82	0.58	
1.6	4.00	2.94	2.40	1.95	1.60	1.30	0.98	0.74	0.52	
1.4	3.30	2.52	2.08	1.72	1.40	1.15	0.85	0.64	0.44	
1.2	2.70	2.06	1.80	1.48	1.20	0.98	0.72	0.54	0.38	
1.0	1.92	1.66	1.50	1.24	1.00	0.82	0.60	0.46	0.30	
0.8	1.58	1.38	1.24	1.00	0.80	0.66	0.50	0.36	0.25	
0.6	1.10	1.02	0.90	0.74	0.60	0.50	0.37	0.26	0.18	
0.4	0.72	0.68	0.60	0.50	0.40	0.34	0.25	0.18	0.12	
0.2	0.38	0.36	0.32	0.26	0.20	0.18	0.14	0.08	0.06	
0.1	0.18	0.17	0.15	0.13	0.10	0.08	0.06	0.05	0.04	
0.05	0.09	0.08	0.07	0.06	0.05	0.05	0.04	0.03	0.02	



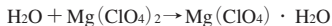
## 1. PERFORMANCE

- 1) Measuring range : 3-80 LB/MMCF  
Number of pump strokes : 1 (100ml)
- 2) Sampling time : 1 minute / 1 pump stroke
- 3) Detectable limit : 2 LB/MMCF
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 1 pump stroke
- 8) Colour change : Yellow → Blue, Yellowish green (below 40 LB/MMCF)

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION



## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

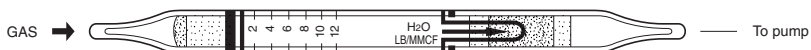
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Benzene	The accuracy of readings is not affected.	The accuracy of readings is not affected.
Toluene	∕	∕
Hexane	∕	∕
Sulphur dioxide	∕	∕
Hydrogen sulphide	∕	∕

### CORRECTION FOR AMBIENT CONDITIONS:

Temperature; To correct for temperature, multiply the tube reading by the following factors.

Temperature(°F)	32	33	34	35	36	37	38	39	40	41
Correction Factor	1.85	1.83	1.81	1.78	1.76	1.73	1.73	1.69	1.66	1.63
Temperature(°F)	42	43	44	45	46	47	48	49	50	51
Correction Factor	1.61	1.59	1.56	1.53	1.50	1.48	1.45	1.43	1.40	1.38
Temperature(°F)	52	53	54	55	56	57	58	59	60	61
Correction Factor	1.36	1.33	1.30	1.28	1.26	1.24	1.21	1.19	1.16	1.14
Temperature(°F)	62	63	64	65	66	67	68	69	70	71
Correction Factor	1.12	1.10	1.08	1.06	1.04	1.02	1.00	0.98	0.96	0.94
Temperature(°F)	72	73	74	75	76	77	78	79	80	81
Correction Factor	0.92	0.91	0.89	0.87	0.86	0.84	0.82	0.81	0.79	0.77
Temperature(°F)	82	83	84	85	86	87	88	89	90	91
Correction Factor	0.76	0.75	0.73	0.72	0.71	0.69	0.68	0.67	0.66	0.64
Temperature(°F)	92	93	94	95	96	97	98	99	100	101
Correction Factor	0.63	0.62	0.61	0.60	0.59	0.58	0.57	0.56	0.55	0.54
Temperature(°F)	102	103	104							
Correction Factor	0.53	0.52	0.51							



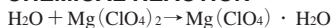
## 1. PERFORMANCE

- 1) Measuring range : 2-12 LB/MMCF
- Number of pump strokes : 2 (200mℓ)
- 2) Sampling time : 2 minutes/2 pump strokes
- 3) Detectable limit : 1 LB/MMCF
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 35 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 2 pump strokes
- 8) Colour change : Yellow → Yellowish green

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION



## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

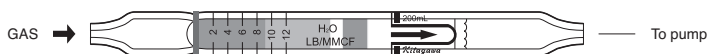
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Benzene	The accuracy of readings is not affected.	The accuracy of readings is not affected.
Toluene	∕	∕
Hexane	∕	∕
Sulphur dioxide	∕	∕
Hydrogen sulphide	∕	∕

### TEMPERATURE CORRECTION TABLE

Temperature : To correct for temperature, multiply the tube reading by the following factors.

Temperature (°C)	0	1	2	3	4	5	6	7	8	9
Correction Factor	1.69	1.65	1.61	1.57	1.53	1.50	1.46	1.42	1.39	1.35
Temperature (°C)	10	11	12	13	14	15	16	17	18	19
Correction Factor	1.32	1.28	1.25	1.22	1.19	1.15	1.12	1.09	1.06	1.03
Temperature (°C)	20	21	22	23	24	25	26	27	28	29
Correction Factor	1.00	0.98	0.95	0.92	0.90	0.87	0.85	0.82	0.80	0.78
Temperature (°C)	30	31	32	33	34	35				
Correction Factor	0.75	0.73	0.71	0.69	0.67	0.65				



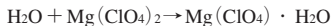
## 1. PERFORMANCE

- 1) Measuring range : 2-12 LB/MMCF    5-30 LB/MMCF
- Number of pump strokes    2 (200ml)    1 (100ml)
- 2) Sampling time : 4 minutes/2 pump strokes
- 3) Detectable limit : 2 LB/MMCF (200ml)
- 4) Shelf life : 3 years
- 5) Operating temperature : 0 ~ 35 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 2 pump strokes
- 8) Colour change : Yellow → Yellowish green or green

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION



## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	Coexistence
Methanol	50	Similar stain is produced.	Higher readings are given.
Alcohols(except Methanol)		∕	∕
Benzene		The accuracy of readings is not affected.	
Toluene		∕	
Hexane		∕	
Sulphur dioxide		∕	
Hydrogen sulphide		∕	

(NOTE)

In case of 1 pump stroke, following formula is available for the actual concentration.

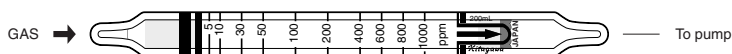
Actual concentration = 2.5 × Temperature corrected value

### TEMPERATURE CORRECTION TABLE

Temperature : To correct for temperature, multiply the tube reading by the following factors.

Tube Readings (LB/MMCF)	Corrected Concentration (LB/MMCF)				
	0 °C (32 F)	10 °C (50 F)	20 °C (68 F)	30 °C (86 F)	35 °C (95 F)
12	17.8	14.9	12.0	9.1	7.8
10	15.3	12.7	10.0	7.4	6.3
8	12.9	10.4	8.0	5.9	5.1
6	10.3	8.0	6.0	4.5	3.9
4	6.8	5.1	4.0	3.1	2.8
2	2.7	2.3	2.0	-	-





## 1. PERFORMANCE

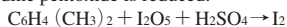
- 1) Measuring range : 5-1,000 ppm
- Number of pump strokes : 2 (200mℓ)
- 2) Sampling time : 4 minutes/2 pump strokes
- 3) Detectable limit : 2 ppm
- 4) Shelf life : 1.5 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Reading : Direct reading from the scale calibrated by 2 pump strokes
- 7) Colour change : White → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

Iodine pentoxide is reduced.

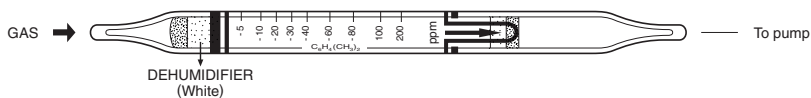


## 4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Benzene	Similar stain is produced.		Higher readings are given.
Toluene	∕		∕
Ethyl Benzene	∕		∕
Methyl alcohol	The accuracy of readings is not affected.	1 %	∕
Hexane	Whole layer is discoloured to Pale brown.	0.1 %	Higher readings with indiscernible maximum end point of stained layer are given.



## 1. PERFORMANCE

- 1) Measuring range : 5-200 ppm
- Number of pump strokes : 2 (200ml)
- 2) Sampling time : 3 minutes/2 pump strokes
- 3) Detectable limit : 1 ppm
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated by 2 pump strokes
- 8) Colour change : White → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 10 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

Iodine pentoxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	Coexistence
Toluene	Xylene conc. 1/5	Same stain is produced.	Higher reading are given.
Ethyl acetate		The accuracy of readings is not affected.	The accuracy of readings is not affected.
Methyl isobutyl ketone		∕	∕
Isobutyl alcohol		∕	∕

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)		
	20 °C (68 °F)	30 °C (86 °F)	40 °C (104 °F)
200	200	300	—
150	150	190	400
100	100	125	150
80	80	100	120
60	60	70	80
40	40	45	50
30	30	30	30

## **3.2 A SUBSTANCES TO BE MEASURED BY USING CONVERSION CHARTS**

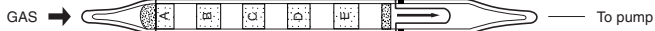
Chemical substances listed in this section can be measured by using respective conversion charts and existing gas detector tubes on demands.

However, note that this conversion chart method is available for 20 °C (68 °F) in temperature and detailed conditions such as other temperatures, humidity and coexisting gases are not confirmed.

SUBSTANCE	CHEMICAL FORMULA	MEASURING RANGE	USING TUBE (PAGE)
Allyl chloride	CH <sub>2</sub> CHCH <sub>2</sub> Cl	1-40 ppm	132SC (344)
Benzyl chloride	C <sub>6</sub> H <sub>5</sub> CH <sub>2</sub> Cl	1-16 ppm	132SC (344)
Bromochloromethane	CH <sub>2</sub> BrCl	2-400 ppm	157SB (233)
Bromoform	CHBr <sub>3</sub>	0.5-20 ppm	157SB (233)
1-Bromopropane	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> Br	10-500 ppm	157SA (232)
1-Bromopropane	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> Br	5-80 ppm	157SB (233)
2-Bromopropane	(CH <sub>3</sub> ) <sub>2</sub> CHBr	10-500 ppm	157SA (232)
2-Bromopropane	(CH <sub>3</sub> ) <sub>2</sub> CHBr	5-80 ppm	157SB (233)
m-Chlorotoluene	C <sub>6</sub> H <sub>4</sub> Cl (CH <sub>3</sub> )	0.5-10 ppm	132SC (344)
o-Chlorotoluene	C <sub>6</sub> H <sub>4</sub> CH <sub>3</sub>	1-50 ppm	132SC (344)
p-Chlorotoluene	C <sub>6</sub> H <sub>4</sub> CH <sub>3</sub>	1-50 ppm	132SC (344)
p-Cymene	CH <sub>3</sub> C <sub>6</sub> H <sub>4</sub> CH (CH <sub>3</sub> ) <sub>2</sub>	20-200 ppm	102SD (28)
Dibromomethane	CH <sub>2</sub> Br <sub>2</sub>	2.5-40 ppm	157SB (233)
1,1-Dichloroethylene	CH <sub>2</sub> = CCl <sub>2</sub>	1-22 ppm	132SC (344)
1,2-Dichloropropane	CH <sub>3</sub> CHClCH <sub>2</sub> Cl	20-250 ppm	157SB (233)
Disilane	Si <sub>2</sub> H <sub>6</sub>	1-50 ppm	240S (307)
Ethyl bromide	C <sub>2</sub> H <sub>5</sub> Br	2-400 ppm	157SB (233)
Ethylene chlorohydrine	CH <sub>2</sub> ClCH <sub>2</sub> OH	5-300 ppm	119U (228)
Iodine	I <sub>2</sub>	0.7-42 ppm	117SB (264)
Mineral turpentine	—	4-200 ppm	111U (137)
Trichlorotoluene	C <sub>6</sub> H <sub>5</sub> CCl <sub>3</sub>	0.2-4 ppm	132SC (344)
* Benzaldehyde	C <sub>6</sub> H <sub>5</sub> CHO	5-70 ppm	190U (143)
* 1,1,1,2-Tetrachloroethane	CHCl <sub>2</sub> CHCl <sub>2</sub>	20-80 ppm	236SA (331)
* N.B.)			

Upon these two kinds of measurement, the conversion chart and the measuring range may vary at each manufacturing lot.

### **3.3 KITAGAWA INORGANIC/ORGANIC GAS QUALITATIVE DETECTOR TUBES**



Section	Original Colour
A	Pale purple
B	Reddish purple
C	White
D	White
E	Yellow

## 1. SPECIFICATIONS

- 1) Substances to be detected : Acetic acid, Amines, Ammonia, Carbon monoxide, Chlorine, Hydrogen chloride, Hydrogen sulphide, Nitrogen dioxide, Phosphine, Sulphur dioxide, \* Acetylene and \* Methyl mercaptan (\*: Organic gas)
- 2) Tube per box : 10 tubes (10-time use)
- 3) Pump stroke : 1 (100mℓ)
- 4) Sampling time : 20 seconds
- 5) Shelf life : 1 year
- 6) Operating temperature : 0 ~ 40 °C
- 7) Colour change : Refer to following " 3. DISCOLOURATION / QUALITATIVE CHART"
- 8) Non-discolouration confirmed substances : Carbon dioxide, Hydrogen cyanide, Nitric oxide and \* Ethylene (\*: Organic gas)

## 2. CHEMICAL REACTION

### SECTION

### CHEMICAL REACTION PRINCIPLES

- A By reacting with Phosphoric acid, PH indicator is discoloured.  

$$2\text{NH}_3 + \text{H}_3\text{PO}_4 \rightarrow (\text{NH}_4)_2\text{HPO}_4$$
- B By reacting with an Alkaline, PH indicator is discoloured.  

$$\text{SO}_2 + 2\text{NaOH} \rightarrow \text{Na}_2\text{SO}_3 + \text{H}_2\text{O}$$
- C By reacting with o-Toluidine, Nitro-o-Toluidine (Dyestuff) is liberated.
- D By reacting with Lead Acetate (II), Lead sulphide is produced.  

$$\text{H}_2\text{S} + \text{Pd}(\text{CH}_3\text{COO})_2 \rightarrow \text{PdS} + 2\text{CH}_3\text{COOH}$$
- E Potassium disulphide palladate (II) is reduced and Palladium is liberated.  

$$\text{CO} + \text{K}_2\text{Pd}(\text{SO}_3)_2 \rightarrow \text{K}_2(\text{SO}_3)_2\text{PdCO}$$

$$\text{K}_2(\text{SO}_3)_2\text{PdCO} \rightarrow \text{CO}_2 + \text{SO}_2 + \text{K}_2\text{SO}_3$$

### 3. DISCOLOURATION / QUALITATIVE CHART

**CHART 1. INORGANIC GAS QUALITATIVE DETECTION CHART**

Selection (Original Colour)					* 1) Substances (* 2)
A (Pale purple)	B (Reddish purple)	C (White)	D (White)	E (Yellow)	
Yellow	—	—	—	—	1) Ammonia (5) 2) Amines (5)
—	Yellow	—	—	—	3) SO <sub>2</sub> (10) 4) Acetic Acid (15)
	Pink	—	—	—	5) Hydrogen chloride (20)
	White	Yellowish orange	—	—	6) Chlorine (5)
	—	Yellow	—	—	7) Nitrogen dioxide (5)
—	—	—	Brown	—	8) H <sub>2</sub> S (10)
		—	—	Pale blackish brown	9) CO (10)
		—	—	Dark black	10) Phosphine (2)
		—	—	Pale Yellowish green	11) Acetylene (10)
		—	—	Dark yellow	12) Methyl mercaptan (10)

**NOTES : —**

(1) — : Undiscoloured

(2) (\* 1) : Item No. for quick reference to details in CHART

(3) (\* 2) : Detectable gas concentration limit of the substance (Unit : ppm)

The discolouration length is approx. 0.5 to 1.0 mm.

(4) Substance No. 4, 11 and 12 are organic substances.

**CHART 2. CHART FOR GAS-CONCENTRATION LEVEL AND DISCOLOURATION**

INORGANIC SUBSTANCES	GAS CONCENTRATION (PPM)	SECTION				
		A (Pale purple)	B (Reddish purple)	C (White)	D (White)	E (Yellow)
1) Ammonia	50 5	Yellow (I) Yellow (III)	— —	— —	— —	— —
2) Amines	50 5	Yellow (I) Yellow (III)	— —	— —	— —	— —
3) Sulphur dioxide (SO <sub>2</sub> )	50 10	— —	Yellow (I) Yellow (III)	— —	— —	— —
4) Acetic Acid	30 15	— —	Yellow (II) Yellow (III)	— —	— —	— —
5) Hydrogen chloride	50 20	— —	Pink (II) Pink (III)	— —	— —	— —
6) Chlorine	20 5	— —	White (I) White & Pale purple (II)	Yellowish orange (I) —	— —	— —
7) Nitrogen dioxide	20 5	— —	— —	Yellow (I) Yellow (I)	— —	— —
8) Hydrogen sulphide (H <sub>2</sub> S)	100 10	— —	— —	— —	Brown (II) Brown (II)	Brown (II) —
9) Carbon monoxide (CO)	50 10	— —	— —	— —	— —	Blackish brown (I) Pale blackish brown (I)
10) Phosphine	30 2	— —	— —	— —	— —	Black (II) Pale black (III)
11) Acetylene	50 10	— —	— —	— —	— —	Yellowish green (I) Pale yellowish green (I)
12) Methyl mercaptan	100 10	— —	— —	— —	— —	Pale yellow (I) Dark yellow (II)

NOTES : —

1) ———: Undiscoloured

2) Discolouration level : I ; The whole layer is discoloured.

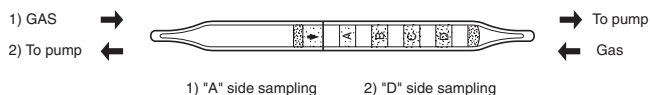
3) Substance No.4 , 11 and 12) are organic substances.

NON-DISCOLOURATION CONFIRMED SUBSTANCES

1) Hydrogen cyanide (HCN) 2) Carbon dioxide (CO<sub>2</sub>) 3) Ethylene (Organic substance) 4) Nitric oxide (NO)

II ; A half layer is discoloured. III ; Approx. 0.5-1.0mm of the layer is discoloured.





Section	Original Colour
A	Orange
B	White
C	Yellow
D	Yellow

## 1. SPECIFICATIONS

- 1) Substances to be detected : Acetaldehyde, Actone, Acetylene, Aniline, Benzene, 1,3-Butadiene, Butane, 1-Butanol, Butyl acetate, Carbon disulphide, Cresol, Ethyl acetate, Ethyl amine, Ethyl benzene, Ethyl cellosolve, Ethylene, Ethylene oxide, Formaldehyde, Gasoline, Heptane, Hexane, Isopropyl alcohol, Kerosine, Methyl alcohol, Methyl ethyl ketone, Methyl isobutyl ketone, Methyl mercaptan, Pentane, Phenol, Propane, Styrene, Tetrachloroethylene, Tetrahydrofuran, Toluene, 1,1,1-Trichloroethane, Trichloroethylene, Vinyl chloride, Xylene, \* Arsine, \* Carbon monoxide and \* Hydrogen sulphide (\* : Inorganic gas)
- 2) Tube per box : 10 tubes (5-time use)
- 3) Pump stroke : 1 (100mℓ) + 1 (100mℓ)
- 4) Sampling time : 30 + 30 seconds
- 5) Shelf life : 2 years
- 6) Operating temperature : 0 ~ 40 °C
- 7) Colour change : Refer to following "3. DISCOLOURATION / QUALITATIVE CHART"
- 8) Non-discolouration confirmed substances : Acetic acid, Carbon tetrachloride, Methane, Methyl bromide and Pyridine

## 2. CHEMICAL REACTION

### SECTION

### CHEMICAL REACTION PRINCIPLES

- A Chromium oxide is reduced.  

$$\text{CH}_3(\text{CH}_2)_4\text{CH}_3 + \text{Cr}^6 + \text{H}_2\text{SO}_4 \rightarrow \text{Cr}^{3+}$$
- B Molybdate is reduced and Molybdeum blue is produced.  

$$\text{H}_2\text{C} = \text{CH}_2 + \text{PdSO}_4 + (\text{NH}_4)_2\text{MoM}_4 \rightarrow \text{Mo}_3\text{O}_8$$
- C Iodine pent-oxide is reduced.  

$$\text{C}_2\text{H}_5\text{CH}_3 + \text{I}_2\text{O}_5 + \text{H}_2\text{SO}_4 \rightarrow \text{I}_2$$
- D Phenol is oxidized and the polymer is produced.  

$$\text{C}_6\text{H}_5\text{OH} + \text{Ce}^{4+} \rightarrow \text{C}_6\text{H}_5\text{O} \cdot \rightarrow (\text{C}_6\text{H}_5\text{O})_n$$

### 3. DISCOLOURATION / QUALITATIVE CHART

**CHART 1. ORGANIC GAS QUALITATIVE DETECTION CHART**

“A” side sampling	“D” side sampling				* 1) Substances — * 2 (X) — — * 3 (X/Y) —
Selection	Selection				
A (Orange)	A (Orange)	B (White)	C (Yellow)	D (Yellow)	
Dark brown	Dark brown	—	—	—	1) Propane (100) 2) Butane (10) 3) Pentane (10) 4) Hexane (10) 5) Trichloroethylene (10) 6) Tetrachloroethylene (100) 7) Vinyl chloride (10)
		White	—	8) Butadiene (100)	
	Greenish brown	—	Pale blue	—	9) Gasoline (0.1mg/ℓ)
	—	Pale brown	—	—	10) Benzene (10/100) 11) Toluene (30/200) 12) Xylene (60/1,000) 13) Ethyl benzene (60/400)
	—		Pale blue	—	14) Ethylene (10) 15) Acetylene (10,000/100)
	—	—	Yellowish orange	—	16) Styrene (100)
	—	—	—	—	17) Acetone (600) 18) Methyl ethyl ketone (100) 19) Ethyl acetate (600) 20) Butyl acetate (100) 21) Ethylene oxide (100) 22) Formaldehyde (600) 23) Kerosene (0.1mg/ℓ)

“A” side sampling Selection	“D” side sampling Selection				* 1) Substances — * 2 (X) — — * 3 (X/Y) —
	A (Orange)	B (White)	C (Yellow)	D (Yellow)	
Greenish brown	Greenish brown	—	—	—	24) Heptane (10) 25) Carbon disulphide (100)
	—	—	Yellowish orange —	—	26) Methyl mercaptan (100/20) 27) Methyl alcohol (100) 28) 1-Butanol (100) 29) Acetaldehyde (100) 30) Methyl isobutyl Ketone (100) 31) Ethyl cellosolve (100) 32) Tetrahydrofuran (100) 33) 1,1,1-Trichloroethane (1,000)
Green	—	—	Black —	—	34) Hydrogen sulphide (100,10) 35) Arsine (100,20) 36) Isopropyl alcohol (600)
	—	—	Pale blue —	—	37) Carbon monoxide (100)
—	—	—	—	Pale brown	38) Phenol (10) 39) Cresol (20)
				Bluish green	40) Aniline (40)
				Pale blue	41) Ethyl amine (100)

NOTES : —

- (1) —: Undiscoloured
- (2) \* 1 : Item No. for quick reference to details in CHART 2.
- (3) \* 2 (X) : Detectable gas concentration limit of the substance (Unit : ppm)  
\* 3 (X/Y) : “X” means detectable gas concentration limit (Unit : ppm) of “A” side sampling and “Y” means “D” side sampling's one.
- (4) The discolouration length is approx.0.5 to 1.0 mm.
- (5) Substance No.34) ,35) and 37) are inorganic gases.”

**CHART 2. CHART FOR GAS-CONCENTRATION LEVEL AND DISCOLOURATION**

ORGANIC SUBSTANCES	CONC. LEVEL	"A" side sampling			"D" side sampling		
		SECTION A (Orange)			SECTION C (Yellow)		
1) Propane	H	Dark brown (I)	Dark brown (I)	Dark brown (I)	___	___	___
	M	Dark brown (I)	Dark brown (I)	Dark brown (I)	___	___	___
	L	Dark brown (I)	Dark brown (I)	Dark brown (I)	___	___	___
2) Butane	H	Dark brown (I)	Dark brown (I)	Dark brown (I)	___	___	___
	M	Dark brown (I)	Dark brown (I)	Dark brown (I)	___	___	___
	L	Dark brown (III)	Dark brown (III)	Dark brown (III)	___	___	___
3) Pentane	H	Greenish brown (I)	Greenish brown (I)	Greenish brown (I)	___	___	___
	M	Dark brown (I)	Dark brown (I)	Dark brown (I)	___	___	___
	L	Dark brown (III)	Dark brown (III)	Dark brown (III)	___	___	___
4) Hexane	H	Greenish brown (I)	Greenish brown (I)	Greenish brown (I)	___	___	___
	M	Dark brown (II)	Dark brown (II)	Dark brown (II)	___	___	___
	L	Dark brown (III)	Dark brown (III)	Dark brown (III)	___	___	___
5) Trichloroethylene	H	Dark brown (I)	Dark brown (I)	Dark brown (I)	___	___	___
	M	Dark brown (II)	Dark brown (II)	Dark brown (II)	___	___	___
	L	Dark brown (III)	Dark brown (III)	Dark brown (III)	___	___	___
6) Tetrachloroethylene	H	Dark brown (I)	Dark brown (I)	Dark brown (I)	___	___	___
	M	Dark brown (I)	Dark brown (I)	Dark brown (I)	___	___	___
	L	Dark brown (III)	Dark brown (III)	Dark brown (III)	___	___	___
7) Vinyl chloride	H	Dark brown (I)	Dark brown (I)	Dark brown (I)	___	___	___
	M	Dark brown (II)	Dark brown (II)	Dark brown (II)	___	___	___
	L	Dark brown (III)	Dark brown (III)	Dark brown (III)	___	___	___
8) Butadiene	H	Dark brown (II)	Dark brown (II)	Dark brown (II)	___	___	___
	M	Dark brown (III)	Dark brown (III)	Dark brown (III)	___	___	___
	L	Dark brown (III)	Dark brown (III)	Dark brown (III)	___	___	___
9) Gasoline	H	Dark brown (I)	Greenish brown (II)	Greenish brown (II)	___	___	___
	M	Dark brown (III)	Greenish brown (III)	Greenish brown (III)	___	___	___
	L	Dark brown (III)	Greenish brown (III)	Greenish brown (III)	___	___	___
10) Benzene	H	Dark brown (I)	Dark brown (III)	Dark brown (III)	___	___	___
	M	Dark brown (II)	Dark brown (III)	Dark brown (III)	___	___	___
	L	Dark brown (III)	Dark brown (III)	Dark brown (III)	___	___	___
11) Toluene	H	Dark brown (I)	Dark brown (I)	Dark brown (I)	___	___	___
	M	Dark brown (III)	Dark brown (III)	Dark brown (III)	___	___	___
	L	Dark brown (III)	Dark brown (III)	Dark brown (III)	___	___	___

ORGANIC SUBSTANCES	CONC. LEVEL	"A" side sampling				"D" side sampling			
		SECTION A (Orange)				SECTION C (Yellow)			
		A (Orange)		B (White)		C (Yellow)		D (Yellow)	
12) Xylene	H	Dark brown (II)	Dark brown (II)	Pale brown (II)	—	—	—	—	
	M	Dark brown (III)	—	—	—	—	—	—	
	L	—	—	—	—	—	—	—	
13) Ethyl benzene	H	Dark brown (II)	Dark brown (II)	Brown (I)	—	—	—	—	
	M	Dark brown (III)	—	Pale brown (II)	—	—	—	—	
	L	—	—	—	—	—	—	—	
14) Ethylene	H	Dark brown (I)	Dark brown (I)	Dark brown (I)	—	—	—	—	
	M	Dark brown (I)	Dark brown (II)	Dark brown (II)	—	—	—	—	
	L	Dark brown (III)	—	—	—	—	—	—	
15) Acetylene	H	Dark brown (I)	Dark brown (I)	Dark brown (I)	—	—	—	—	
	M	Section "C" is also discoloured to Brown(III).	—	—	—	—	—	—	
	L	—	—	—	—	—	—	—	
16) Styrene	H	Dark brown (III)	Dark brown (III)	Dark brown (III)	—	—	—	—	
	M	Dark brown (III)	—	Dark brown (III)	—	—	—	—	
	L	—	—	—	—	—	—	—	
17) Acetone	H	Dark brown (III)	Dark brown (III)	Dark brown (III)	—	—	—	—	
	M	—	—	—	—	—	—	—	
	L	—	—	—	—	—	—	—	
18) Methyl ethyl ketone	H	Dark brown (III)	Dark brown (III)	Dark brown (III)	—	—	—	—	
	M	Dark brown (III)	—	—	—	—	—	—	
	L	—	—	—	—	—	—	—	
19) Ethyl acetate	H	Dark brown (III)	Dark brown (III)	Dark brown (III)	—	—	—	—	
	M	—	—	—	—	—	—	—	
	L	—	—	—	—	—	—	—	
20) Butyl acetate	H	Dark brown (III)	Dark brown (III)	Dark brown (III)	—	—	—	—	
	M	Dark brown (III)	—	—	—	—	—	—	
	L	—	—	—	—	—	—	—	
21) Ethylene oxide	H	Dark brown (III)	Dark brown (III)	Dark brown (III)	—	—	—	—	
	M	Dark brown (III)	—	—	—	—	—	—	
	L	—	—	—	—	—	—	—	

ORGANIC SUBSTANCES	CONC. LEVEL	"A" side sampling		"D" side sampling			
		SECTION		SECTION			
		A (Orange)	A (Orange)	B (White)	C (Yellow)	D (Yellow)	
22) Formaldehyde	H	Greenish brown (I)	___	___	___	___	
	M	Dark brown (III)	___	___	___	___	
	L	Dark brown (III)	___	___	___	___	
23) Kerosene	H	Dark brown (II)	___	___	___	___	
	M	Dark brown (III)	___	___	___	___	
	L	Dark brown (III)	___	___	___	___	
24) Heptane	H	Greenish brown (I)	Greenish brown (I)	___	___	___	
	M	Greenish brown (II)	Greenish brown (II)	___	___	___	
	L	Greenish brown (III)	Greenish brown (III)	___	___	___	
25) Carbon disulphide	H	Greenish brown (I)	Greenish brown (I)	___	___	___	
	M	Greenish brown (II)	Greenish brown (II)	___	___	___	
	L	Greenish brown (III)	___	___	___	___	
26) Methyl mercaptan	M	Greenish brown (III)	___	___	Deep blue (II) Yellowish orange (III)	___	
27) Methyl alcohol	H	Greenish brown (III)	___	___	___	___	
	M	Greenish brown (III)	___	___	___	___	
	L	___	___	___	___	___	
28) 1-Butanol	H	Greenish brown (III)	___	___	___	___	
	M	Greenish brown (III)	___	___	___	___	
	L	___	___	___	___	___	
29) Acetaldehyde	H	Green (II)	___	___	___	___	
	M	Greenish brown (III)	___	___	___	___	
	L	___	___	___	___	___	
30) Methyl isobutyl ketone	H	Greenish brown (III)	___	___	___	___	
	M	Greenish brown (III)	___	___	___	___	
	L	___	___	___	___	___	
31) Ethyl cellosolve	H	Green (III)	___	___	___	___	
	M	Greenish brown (III)	___	___	___	___	
	L	___	___	___	___	___	
32) Tetrahydrofuran	H	Green (III)	___	___	___	___	
	M	Greenish brown (III)	___	___	___	___	
	L	___	___	___	___	___	

ORGANIC SUBSTANCES	CONC. LEVEL	"A" side sampling		"D" side sampling			
		SECTION A (Orange)	SECTION A (Orange)	A (Orange)	B (White)	C (Yellow)	D (Yellow)
33) 1, 1, 1-Trichloroethane	H	Greenish brown (III)	---	---	---	---	---
	M	---	---	---	---	---	---
34) Hydrogen sulphide (H <sub>2</sub> S)	H	Green (II)	Green (II)	---	---	Black (II)	---
	M	Green (III)	---	---	---	Black (II)	---
	L	---	---	---	---	Black (III)	---
35) Arsine	M	Green (II)	---	---	---	Black (I)	---
	L	---	---	---	---	Black (II)	---
36) Isopropyl alcohol	H	Green (III)	---	---	---	---	---
	M	---	---	---	---	---	---
37) Carbon monoxide (CO)	H	---	---	---	---	Pale blue (II)	---
	M	---	---	---	---	Pale blue (III)	---
	L	---	---	---	---	---	---
38) Phenol	M	---	---	---	---	---	Pale brown (I)
	L	---	---	---	---	---	Pale brown (I)
39) Cresol	M	---	---	---	---	---	Pale brown (I)
	L	---	---	---	---	---	Pale brown (I)
40) Aniline	M	---	---	---	---	---	Bluish green (III)
	L	---	---	---	---	---	Bluish green (III)
41) Ethyl amine	H	---	---	---	---	---	White (I)
	M	---	---	---	---	---	---
	L	---	---	---	---	---	Pale blue (III)

NOTES : ---

1) ---: Undiscoloured

2) CONC. LEVEL (Gas concentration level) : H ; approx. 1,000-5,000 ppm  
M ; approx. 100-500 ppm  
L ; approx. 10-50 ppm

3) Discolouration level : 1 ; The whole layer is discoloured.

2 ; A half layer is discoloured.

3 ; Approx.0.5-2.0 mm of the layer is discoloured.

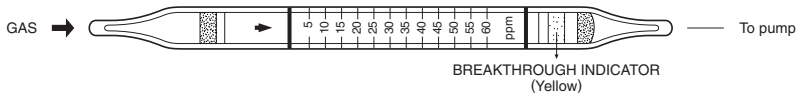
4) Substance No.34),35) and 37) are inorganic substances.

#### NON-DISCOLOURATION CONFIRMED SUBSTANCES

- |                         |             |                   |
|-------------------------|-------------|-------------------|
| 1) Carbon tetrachloride | 2) Pyridine | 3) Methyl bromide |
| 4) Acetic acid          | 5) Methane  | 6) Ethane         |

## **3.4 KITAGAWA TIME-WEIGHTED AVERAGE DETECTOR TUBES**





## 1. PERFORMANCE

- 1) Measuring range : 5-400 ppm  
(0.5 hr.) (4 hrs.) (8 hrs.)  
50-400 ppm 5-100 ppm 5-60 ppm
- 2) Sampling time : 8 hrs. (6 mℓ/min.)
- 3) Shelf life : 3 years
- 4) Operating temperature : 10 ~ 30 °C
- 5) Reading : Direct reading from the scale calibrated by 8 hrs. Sampling
- 6) Colour change : White → Brown ringed

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15% RSD-mid. : 15% RSD-high : 15%

## 3. CHEMICAL REACTION

Iodine pentoxide is reduced.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Butane		50	Higher readings are given.
Hexane		50	∕

### (NOTE)

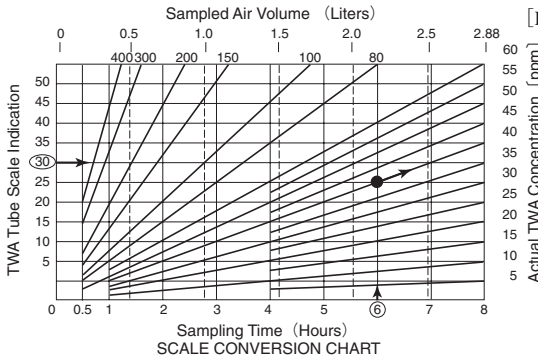
- 1) Air sampler is required for this tube.
- 2) Flow Rate and Sampling Time
  - (1) In case of 8 hours, sampling with 6 mℓ/min., the TWA concentration can read directly by the scale printed on the tube at the top of Brown ring.
  - (2) If the sampling duration is less than 8 hours, the actual TWA concentration can be obtained graphically from the chart provided below.
  - (3) If the flow rate is not 6 mℓ/min, divide the scale reading by the ratio of sampled air volume to 2880mℓ.

$$\text{Actual TWA concentration (ppm)} = I \times \frac{2880}{V}$$

I = Scale reading

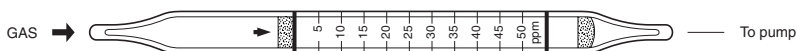
V = Sampled air volume in mℓ

[Flow rate (mℓ/min.) × Sampling duration (min.)]



Example :

- (a) If sampling time is 6 hours and scale reading is 30, the actual TWA concentration is 40 ppm.
- (b) If sampled air volume is 1.5ℓ and scale reading is 10, the actual TWA concentration is 19.2 ppm.



## 1. PERFORMANCE

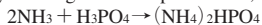
- 1) Measuring range : 5-200 ppm (1 hr.) (8 hrs.)  
10-200 ppm 5-50 ppm
- 2) Sampling time : 8 hrs. (8 mℓ/min.)
- 3) Shelf life : 3 years
- 4) Operating temperature : 10 ~ 30 °C
- 5) Reading : Direct reading from the scale calibrated by 8 hrs. Sampling
- 6) Colour change : Purple → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15% RSD-mid. : 15% RSD-high : 15%

## 3. CHEMICAL REACTION

By reacting with Phosphoric acid, PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Sulphur dioxide		20	Lower readings are given.

(NOTE)

- 1) Air sampler is required for this tube.
- 2) Flow Rate and Sampling Time
  - (1) In case of 8 hours, sampling with 8mℓ/min., the TWA concentration can be read directly by the scale printed on the tube at the top of Yellow stain.
  - (2) If the sampling duration is less than 8 hours, the actual TWA concentration can be obtained graphically from the chart provided below.
  - (3) If the flow rate is not 8mℓ/min, divide the scale reading by the ratio of sampled air volume to 3840mℓ.

$$\text{Actual TWA concentration (ppm)} = I \times \frac{3840}{V}$$

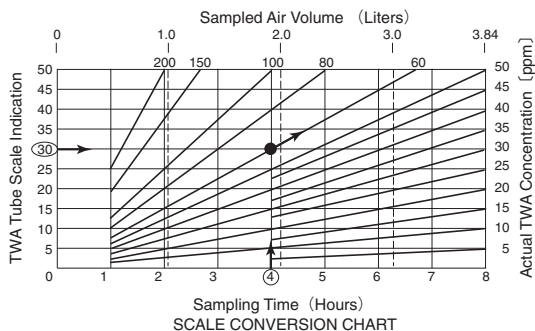
I = Scale reading

V = Sampled air volume in ml

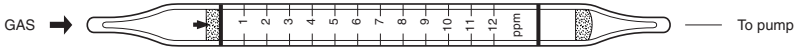
[Flow rate(mℓ/min.) × Sampling duration(min.)]

Example :

- (a) If sampling time is 4 hours at 8mℓ/min and scale reading is 30, the actual TWA concentration is 60 ppm.
- (b) If sampled air volume is 2.0ℓ and scale reading is 5, the actual TWA concentration is 9.6 ppm.



SCALE CONVERSION CHART



## 1. PERFORMANCE

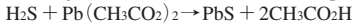
- 1) Measuring range : 1-20 ppm  
(1 hr.) (8 hrs.)  
2-20 ppm 1-12 ppm
- 2) Sampling time : 8 hrs. (6 mℓ/min.)
- 3) Shelf life : 1 year
- 4) Operating temperature : 10 ~ 30 °C
- 5) Reading : Direct reading from the scale calibrated by 8 hrs. Sampling
- 6) Colour change : White → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15% RSD-mid. : 15% RSD-high : 15%

## 3. CHEMICAL REACTION

By reacting with Lead acetate (II), Lead sulphide is produced.



## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Sulphur dioxide		10	Higher readings are given.

(NOTE)

- 1) Air sampler is required for this tube.
- 2) Flow Rate and Sampling Time
  - (1) In case of 8 hours, sampling with 6mℓ/min., the TWA concentration can be read directly by the scale printed on the tube at the top of Brown stain.
  - (2) If the sampling duration is less than 8 hours, the actual TWA concentration can be obtained graphically from the chart provided below.
  - (3) If the flow rate is not 6mℓ/min, divide the scale reading by the ratio of sampled air volume to 2880mℓ.

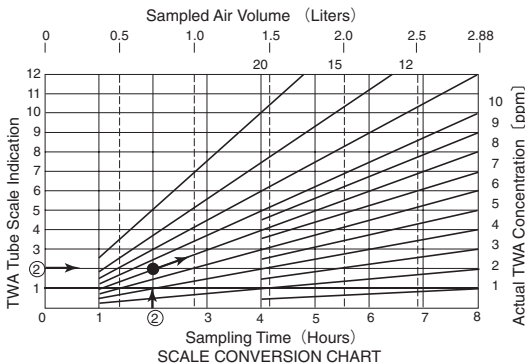
$$\text{Actual TWA concentration (ppm)} = I \times \frac{2880}{V}$$

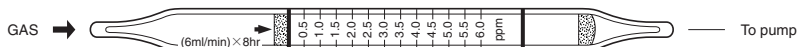
I = Scale reading  
V = Sampled air volume in ml

[Flow rate (mℓ/min.) × Sampling duration (min.)]

Example :

- (a) If sampling time is 2 hours at 6mℓ/min and scale reading is 2, the actual TWA concentration is 8 ppm.
- (b) If sampled air volume is 2.5ℓ and scale reading is 6, the actual TWA concentration is 7 ppm.





## 1. PERFORMANCE

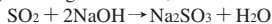
- 1) Measuring range : 0.5-20 ppm  
(1 hr.) (8 hrs.)  
1-20 ppm 0.5-6 ppm
- 2) Sampling time : 8 hrs. (6 ml/min.)
- 3) Shelf life : 3 years
- 4) Operating temperature : 10 ~ 30 °C
- 5) Reading : Direct reading from the scale calibrated by 8 hrs. Sampling
- 6) Colour change : Purple → Yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15% RSD-mid. : 15% RSD-high : 15%

## 3. CHEMICAL REACTION

By reacting with alkali, PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Carbon dioxide		1,000	Higher readings are given.
Nitrogen dioxide			The reagent colour fades, but the accuracy of the readings is not affected.

(NOTE)

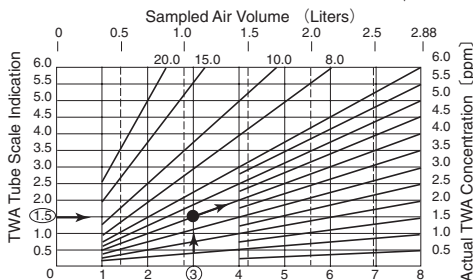
- 1) Air sampler is required for this tube.
- 2) Flow Rate and Sampling Time
  - (1) Read the scale printed on the tube at the top of Yellow stain.
  - (2) Correct the reading value by average relative humidity of sampling atmosphere with humidity correction table. (Table 1)
  - (3) In case of 8 hours, sampling with 6mℓ/min., the corrected value by Table 1 indicates actual TWA concentration.
  - (4) If the sampling duration is less than 8 hours, the actual TWA concentration can be obtained graphically from the chart provided below.
  - (5) If the flow rate is not 6mℓ/min, divide the corrected value by the ratio of sampled air volume to 2880mℓ.

$$\text{Actual TWA concentration (ppm)} = I \times \frac{2880}{V}$$

I = Corrected value by Table 1.

V = Sampled air volume in ml

[Flow rate (mℓ/min.) × Sampling duration (min.)]



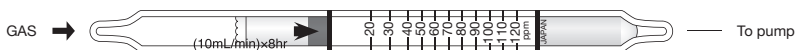
SCALE CONVERSION CHART

Example :

- (a) If sampling time is 3 hours and corrected value by Table 1 is 1.5, the actual TWA concentration is 4.0 ppm.
- (b) If sampled air volume is 2.0ℓ and corrected value by Table 1 is 3.5, the actual TWA concentration is 5.0 ppm

Table 1 Humidity Correction Table

Scale (ppm) Readings	True Concentration(ppm)						
	20%	30%	40%	50%	60%	70%	80%
6.0	4.5	5.0	5.5	6.0	—	—	—
5.5	4.1	4.6	5.1	5.5	5.9	—	—
5.0	3.8	4.2	4.6	5.0	5.4	5.8	—
4.5	3.4	3.8	4.1	4.5	4.8	5.2	5.5
4.0	3.0	3.4	3.7	4.0	4.3	4.6	4.9
3.5	2.6	2.9	3.2	3.5	3.8	4.0	4.3
3.0	2.3	2.5	2.8	3.0	3.2	3.5	3.7
2.5	1.9	2.1	2.3	2.5	2.7	2.9	3.1
2.0	1.5	1.7	1.9	2.0	2.2	2.3	2.4
1.5	1.2	1.3	1.4	1.5	1.6	1.7	1.8
1.0	0.8	0.8	0.9	1.0	1.1	1.2	1.2
0.5	0.4	0.4	0.5	0.5	0.5	0.6	0.6



## 1. PERFORMANCE

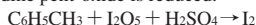
- 1) Measuring range : 20-200 ppm  
(1 hr.) (8 hrs.)  
40-200 ppm 20-120 ppm
- 2) Sampling time : 8 hrs. (10 mℓ/min.)
- 3) Shelf life : 3 years
- 4) Operation temperature : 10 ~ 40 °C
- 5) Reading : Direct reading from the scale calibrated by 8 hrs. Sampling
- 6) Colour change : White → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 15% RSD-mid. : 15% RSD-high : 15%

## 3. CHEMICAL REACTION

Iodine pent-oxide is reduced.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Acetone	Similar stain is produced	Toluene conc. × 0.2	Higher readings are given.
Xylene	∕	Toluene conc. × 0.7	∕
Benzene	∕	Toluene conc. × 1.8	∕
Methyl ethyl ketone	∕	Toluene conc. × 0.2	∕
Hexane	Whole reagent is discoloured to Brown.	50	Whole reagent is discoloured and readings cannot be obtained.

(NOTE)

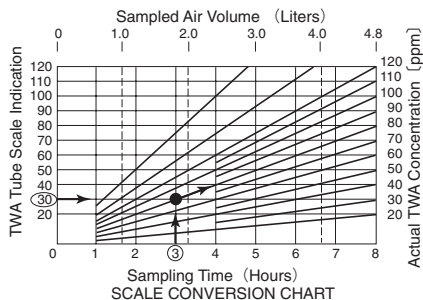
- 1) Air sampler is required for this tube.
- 2) Flow Rate and Sampling Time
  - (1) In case of 8 hours, sampling with 10mℓ/min., the TWA concentration can be read directly by the scale printed on the tube at the top of Brack stain.
  - (2) If the sampling duration is less than 8 hours, the actual TWA concentration can be obtained graphically from the chart provided below.
  - (3) If the flow rate is not 10mℓ/min, divide the scale reading by the ratio of sampled air volume to 4800mℓ.

$$\text{Actual TWA concentration (ppm)} = I \times \frac{4800}{V}$$

I = Scale reading in mℓ

V = Sampled air volume

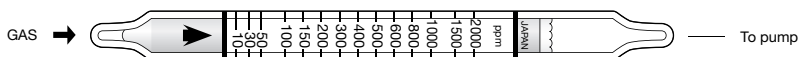
[Flow rate (mℓ/min.) × Sampling duration (min.)]



Example :

- (a) If sampling time is 5 hours and scale reading is 50, the actual TWA concentration is 80 ppm.
- (b) If sampled air volume is 4.0ℓ, and scale reading is 50, the actual TWA concentration is 60 ppm.

## **3.5 KITAGAWA DISSOLVED SUBSTANCE DETECTOR TUBES**



## 1. PERFORMANCE

- |                          |  |
|--------------------------|--|
| 1) Sampling method       | : Immersion method<br>(Refer to Page 17) |
| 2) Measuring range       | : 10-2,000 ppm                           |
| 3) Sampling time         | : 1.5 minutes                            |
| 4) Sample volume         | : over 5 ml                              |
| 5) Detectable limit      | : 3 ppm                                  |
| 6) Shelf life            | : 3 years                                |
| 7) Operating temperature | : 5 ~ 80 °C                              |
| 8) Operating PH          | : 3.5-13                                 |
| 9) Reading               | : Direct reading from the scale          |
| 10) Colour change        | : Brown → White                          |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 10 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

By reacting with Silver chromate, Silver chloride is produced.



## 4. CALIBRATION OF THE TUBE

SODIUM CHLORIDE STANDARD SOLUTION METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

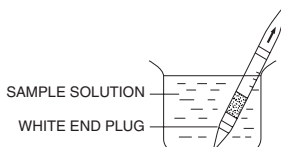
Substance	Interference	Coexistence
Bromide ion		Higher readings are given.
Iodide ion		∕
Cyanide ion		∕
Sulphide ion	Brown stain is produced.	The bottom of discoloured layer is changed to Brown and higher readings are given.

## 6. SAMPLING METHOD

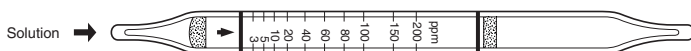
(Immersion method)

- 1) Cut both ends of a fresh detector tube with a file.
- 2) Immerse the filled end of the tube with white end plug into the prepared sample solution.

Capillary action will occur immediately and the sample solution rise through the reagent. If Chloride ion is existed in the sample solution, a discolouration will be occurred in the detecting reagent layer from its inlet and the discoloured layer shall be given according to the concentration of Chloride ion.







## 1. PERFORMANCE

- 1) Sampling method : Immersion method  
(Refer to Page 17)
- 2) Measuring range : 3-200 ppm
- 3) Sampling time : 1.5 minutes
- 4) Sample volume : over 5 ml
- 5) Detectable limit : 1 ppm
- 6) Shelf life : 2 years
- 7) Operating temperature : 5 ~ 80 °C
- 8) Operating PH : 3.5-13
- 9) Reading : Direct reading from the scale
- 10) Colour change : Brown → White

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with Silver chromate, Silver chloride is produced.  
 $Cl^- + Ag_2CrO_4 \rightarrow AgCl$

## 4. CALIBRATION OF THE TUBE

SODIUM CHLORIDE STANDARD SOLUTION METHOD

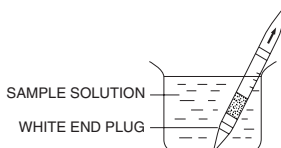
## 5. INTERFERENCE AND CROSS SENSITIVITY

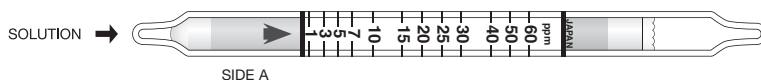
Substance	Interference	Coexistence
Bromide ion		Higher readings are given.
Iodide ion		∕
Cyanide ion		∕
Sulphide ion	Brown stain is produced.	The bottom of discoloured layer is changed to Brown and higher reading are given.

## 6. SAMPLING METHOD

(Immersion method)

- 1) Cut both ends of a fresh detector tube with a file.
- 2) Immerse the filled end of the tube with white end plug into the prepared sample solution.  
 Capillary action will occur immediately and the sample solution rise through the reagent. If Chloride ion is existed in the sample solution, a discolouration will be occurred in the detecting reagent layer from its inlet and the discoloured layer shall be given according to the concentration of Chloride ion.





## 1. PERFORMANCE

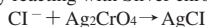
- |                          |                                 |
|--------------------------|---------------------------------|
| 1) Sampling method       | : Immersion method              |
| 2) Measuring range       | : 1-60 ppm                      |
| 3) Sampling time         | : Approx. 3 minutes             |
| 4) Sample volume         | : Over 5 mℓ                     |
| 5) Detectable limit      | : 0.5 ppm                       |
| 6) Shelf life            | : 2 years                       |
| 7) Operating temperature | : 5 ~ 40 °C                     |
| 8) Operating PH          | : 2-13                          |
| 9) Reading               | : Direct reading from the scale |
| 10) Colour change        | : Brown → Pale yellow           |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %   RSD-mid. : 5 %   RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with Silver chromate, Silver chloride is produced.



## 4. CALIBRATION OF THE TUBE

SODIUM CHLORIDE STANDARD SOLUTION METHOD

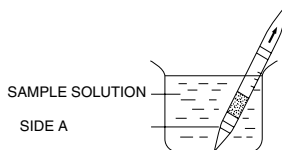
## 5. INTERFERENCE AND CROSS SENSITIVITY

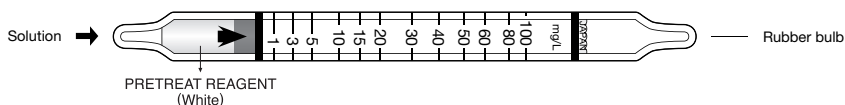
Substance	Interference	Coexistence
Bromide ion		Higher readings are given.
Iodide ion		“
Cyanide ion		“
Sulphide ion	The bottom of reagents is changed to Brown and higher readings are given.	

## 6. SAMPLING METHOD

(Immersion method)

- 1) Cut both ends of a fresh detector tube with an ampule cutter.
- 2) Immerse the end of the tube with side A into the sample solution by capillary action so that the sample solution is rose through the reagent. If Chloride ion exists in the solution, a discolouration will be occurred in the detecting reagent layer from its inlet and the discoloured layer will be given according to the concentration of Chloride ion.





## 1. PERFORMANCE

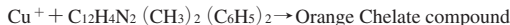
- 1) Sampling method : Direct sampling method  
(Refer to Page 17)
- 2) Measuring range : 1-100mg/ℓ
- 3) Sampling time : 1 to 2 minutes
- 4) Sample volume : over 5 mℓ
- 5) Detectable limit : 0.5mg/ℓ
- 6) Shelf life : 1 year
- 7) Operating temperature : 0 ~ 40 °C
- 8) Operating PH : 2-11
- 9) Reading : Direct reading from the scale
- 10) Colour change : White → Orange

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with Hydroxylamine sulphate, divalent Copper ion is reduced to monovalent Copper ion. This monovalent Copper ion is reacted with 2, 9-Diphenyl 1-4, 7-Diphenyl 1-1, 10-phenanthroline and Chelate is produced.



## 4. CALIBRATION OF THE TUBE

CUPRIC SULPHATE STANDARD SOLUTION METHOD

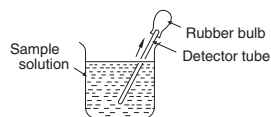
## 5. INTERFERENCE AND CROSS SENSITIVITY

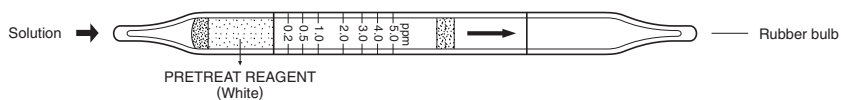
Substance	mg/ℓ	Interference	mg/ℓ	Coexistence
Ferric ion	20	Similar stain is produced.	Copper ion conc. × 2	Higher readings are given.
Zinc ion		The accuracy of readings in not affected.	100	∕
Chlorine ion		∕		∕
Manganous ion		∕		∕

(NOTE)

## 6. SAMPLING METHOD

- 1) Cut both ends of a fresh detector tube with a file.
- 2) Squeeze the rubber bulb (an extra option), insert the tube end (B) into it as it is and immerse filled end (A) of the tube.
- 3) Put the thumb off the rubber bulb, and the sample solution shall rise up.
- 4) When the sample solution rises up to (C) of the tube, remove the tube from the rubber bulb and from the sample solution.
- 5) The concentration can be obtained directly from the reading value of scale printed on the tube.
- 6) When the concentration is over 100mg/ℓ, dilute the sample solution and multiply the readings obtained by the dilution ratio.





## 1. PERFORMANCE

- 1) Sampling method : Direct sampling method  
(Refer to Page 17)
- 2) Measuring range : 0.2-5 ppm
- 3) Sampling time : 2 to 4 minutes
- 4) Sample volume : over 5 ml
- 5) Detectable limit : 0.05 ppm
- 6) Shelf life : 2 years
- 7) Operating temperature : 0 ~ 40 °C
- 8) Operating PH : 6-13
- 9) Reading : Direct reading from the scale
- 10) Colour change : White → Blue

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 5 % RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with *o*-Toluidine and Cupric sulphate (II), complex salt is produced.

## 4. CALIBRATION OF THE TUBE

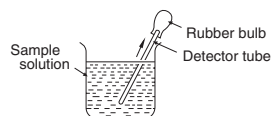
POTASSIUM CYANIDE STANDARD SOLUTION METHOD

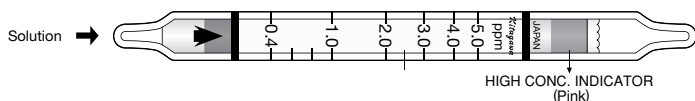
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Carbonate ion		1,700	Higher readings are given.
Chloride ion		100	∕
Sulphate ion		2,700	Lower readings are given.
Thiocyanate ion	Similar stain is produced.	200	Higher readings are given.
Sulphide ion			∕
Dichromate ion			Pretreat reagent is discoloured and the accuracy of readings is not affected.
Permanganate ion			∕
Ferricyanate ion			∕
Residual chloride ion			∕

## 6. SAMPLING METHOD

- 1) Make the sample solution at PH 6-13 before test.
- 2) Cut both ends of a fresh detector tube with a file.
- 3) Squeeze the rubber bulb (an extra option), insert the tube end (B) into it as it is and immerse filled end (A) of the tube.
- 4) Put the thumb off the rubber bulb, and the sample solution shall rise up.
- 5) When the sample solution rises up to (C) of the tube, remove the tube from the rubber bulb and from the sample solution.
- 6) The concentration can be obtained directly from the reading value of scale printed on the tube.
- 7) At concentration of over 5 ppm, dilute the sample solution and multiply the readings obtained by the dilution ratio.





## 1. PERFORMANCE

- 1) Sampling method : Immersion method  
(Refer to Page 17)
- 2) Measuring range : 0.4-5 ppm
- 3) Sampling time : 3 minutes
- 4) Sample volume : over 5 ml
- 5) Detectable limit : 0.1 ppm
- 6) Shelf life : 2 years
- 7) Operating temperature : 0 ~ 40 °C
- 8) Operating PH : 2-10
- 9) Reading : Direct reading from the scale
- 10) Colour change : White → Purple

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

By reacting with 3, 3'-Dimethylnaphthidine, Nitroso-compound is produced.

## 4. CALIBRATION OF THE TUBE

IODOMETRY METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Chloride ion		200	Lower readings are given.
Calcium ion			The accuracy of readings is not affected.
Copper ion			∕
Iron ion	Similar stain is produced.	20	Higher readings are given.

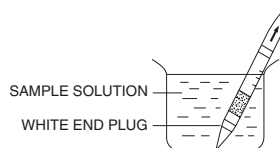
(NOTE)

1. This tube is for measuring FREE-RESIDUAL CHLORINE, not for COMBINED-RESIDUAL CHLORINE.
2. This tube is not suitable for measuring sea water or sample solution which includes sea water. Because it is affected by Chloride ion.
3. When the concentration is over full scale (5 ppm), the HIGH CONC. INDICATOR (Pink) is discoloured to White. In this case, dilute the sample solution and multiply the reading value obtained, by the dilution ratio.

## 6. SAMPLING METHOD

(Immersion method)

- 1) Cut both ends of a fresh detector tube with a file.
- 2) Immerse the filled end of the tube with white end plug into the prepared sample solution. Capillary action will occur immediately and the sample solution rise through the reagent. If Chloride ion is existed in the sample solution, a discolouration will be occurred in the detecting reagent layer from its inlet and the discoloured layer shall be given according to the concentration of Chloride ion.





## 1. PERFORMANCE

- 1) Sampling method : Direct sampling method  
(Refer to Page 17)
- 2) Measuring range : 0.01-0.8 %
- 3) Sampling time : 30 seconds
- 4) Sample volume : Over 5 ml
- 5) Detectable limit : 0.002 %
- 6) Shelf life : 2 years
- 7) Operating temperature : 5 ~ 80 °C
- 8) Reading : Direct reading from the scale
- 9) Colour change : Brown → White

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % RSD-mid. : 10 % RSD-high : 10 %

## 3. CHEMICAL REACTION

By reacting with Silver chromate, Silver chloride is produced.



## 4. CALIBRATION OF THE TUBE

SODIUM CHLORIDE STANDARD SOLUTION METHOD

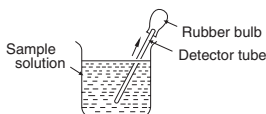
## 5. INTERFERENCE AND CROSS SENSITIVITY

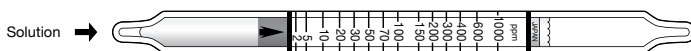
Substance	Interference	Coexistence
Bromide ion		Higher readings are given.
Iodide ion		∕
Cyanide ion		∕
Sulphide ion	Brown stain is produced.	The bottom of the discoloured layer is changed to Brown and higher readings are given.

## 6. SAMPLING METHOD

(Direct sampling method)

- 1) Cut both ends of a fresh detector tube with a file.
- 2) Squeeze the rubber bulb (an extra option), insert the tube end (B) into it as it is and immerse filled end (A) of the tube.
- 3) Put the thumb off the rubber bulb, and the sample solution shall rise up.
- 4) When the sample solution rises up to (C) of the tube, remove the tube from the rubber bulb and from the sample solution.
- 5) The concentration can be obtained directly from the reading value of scale printed on the tube.
- 6) At concentration over 0.8 %, dilute the sample solution and multiply the readings obtained by the dilution ratio.





## 1. PERFORMANCE

- 1) Sampling method : Immersion method  
(Refer to Page 17)
- 2) Measuring range : 2-1,000 ppm
- 3) Sampling time : 3 minutes
- 4) Sample volume : Over 5 mℓ
- 5) Detectable limit : 1 ppm
- 6) Shelf life : 1 year
- 7) Operating temperature : 5 ~ 60 ℃
- 8) Operating PH : 1-12
- 9) Reading : Direct reading from the scale
- 10) Colour change : White → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 10 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

By reacting with Lead nitrate, Lead sulphide is produced.



## 4. CALIBRATION OF THE TUBE

SODIUM SULPHIDE STANDARD SOLUTION METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Dichromate ion		500	Lower readings are given.
Mercaptans ion			Similar stain is produced.
Sulphate ion		less than 1.5 %	The accuracy of readings is not affected.
Iron ion		less than 0.2 %	∕
Chloride ion    FIG.1		less than 2.5 %	∕
Carbonic ion		less than 4.0 %	∕

## 6. SAMPLING METHOD

(Immersion method)

- 1) Cut both ends of a fresh detector tube with a file.
- 2) Immerse the filled end of the tube with white end plug into the prepared sample solution. Capillary action will occur immediately and the sample solution shall rise through the reagent. If Sulphide ion is existed in the sample solution, a discolouration will be occurred in the detecting reagent layer from its inlet and the discoloured layer shall be given according to the concentration of Sulphide ion.

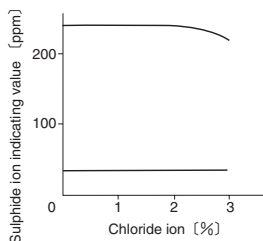
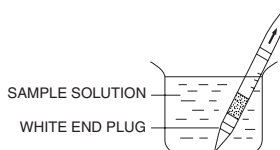
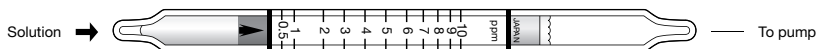


FIG.1 Influence of Chloride ion





## 1. PERFORMANCE

- |                          |  |
|--------------------------|--|
| 1) Sampling method       | : Immersion method<br>(Refer to Page 17) |
| 2) Measuring range       | : 0.5-10 ppm                             |
| 3) Sampling time         | : 2.5 minutes                            |
| 4) Sample volume         | : Over 5 mℓ                              |
| 5) Detectable limit      | : 0.1 ppm                                |
| 6) Shelf life            | : 2 years                                |
| 7) Operating temperature | : 5 ~ 40 °C                              |
| 8) Operating PH          | : 7-14                                   |
| 9) Reading               | : Direct reading from the scale          |
| 10) Colour change        | : White → Pale brown                     |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

By reacting with Lead acetate, Lead sulphide is produced.



## 4. CALIBRATION OF THE TUBE

SODIUM SULPHIDE STANDARD SOLUTION METHOD

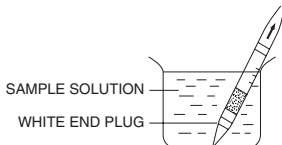
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Carbonate ion		1,000	Lower readings are given.
Chloride ion		2,000	Higher readings are given.
Copper ion			The accuracy of readings is not affected.

## 6. SAMPLING METHOD

(Immersion method)

- 1) Cut both ends of a fresh detector tube with a file.
- 2) Immerse the filled end of the tube with white end plug into the shall prepared sample solution. Capillary action will occur immediately and the sample solution shall rise through the reagent. If Chloride ion is existed in the sample solution, a discolouration will be occurred in the detecting reagent layer from its inlet and the discoloured layer shall be given according to the concentration of Chloride ion.





## **3.6 KITAGAWA COMPRESSED BREATHING AIR TEST TUBES**

# COMPRESSED BREATHING AIR TEST SYSTEM

This system is designed to measure impurities in compressed breathing air such as in scuba and rescue cylinders, as well as from an outlet of an air-change compressor.

● Model P-41R Compressed Breathing Air Sampling Kit

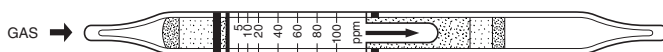


**Composition**

- ① Control assembly ..... 1set.  
(Including an adaptor with W22-14RH Female thread for rescue and on-land cylinders)
- ② International fitting yoke (For a scuba cylinder) ..... 1pc.
- ③ Gas detector tube (an extra option) ..... 1pc.
- ④ Tube protector ..... 1pc.
- ⑤ Tip cutter for Gas detector tube ..... 1pc.
- ⑥ Wrench ..... 1pc.
- ⑦ Digital stopwatch ..... 1pc.
- ⑧ Carrying case (Aluminum) ..... 1pc.
- ⑨ Instruction manual ..... 1set.

**Optional Accessory for 604SP only**

- ① 50ml plastic syringe
- ② 1m vinyl tube



## 1. PERFORMANCE

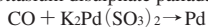
- |                          |   |           |
|--------------------------|---|-----------|
| 1) Measuring range       | : 2.5-5 ppm   | 5-100 ppm |
| 2) Sampling time         | : 4 minutes   | 2 minutes |
| 3) Detectable limit      | : 1 ppm (4 minutes)                                 |           |
| 4) Shelf life            | : 2 years   |           |
| 5) Operating temperature | : 0 ~ 40 °C   |           |
| 6) Reading               | : Direct reading from the scale printed on the tube |           |
| 7) Colour change         | : Yellow → Dark brown                               |           |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %   RSD-mid. : 10 %   RSD-high : 10 %

## 3. CHEMICAL REACTION

Pottasium disulphate palladate (II) is reduced and Palladium is liberated.



## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. PRESET

### PRESET CONDITION

- |                 |                                    |
|-----------------|------------------------------------|
| 1) 2nd pressure | : 0.6 kgf/cm <sup>2</sup> (60 Kpa) |
| 2) Flow rate    | : 2.0 ℓ/min.                       |



## 1. PERFORMANCE

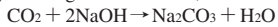
- |                          |   |
|--------------------------|---|
| 1) Measuring range       | : 100-3,000 ppm                                     |
| 2) Sampling time         | : 2 minutes   |
| 3) Detectable limit      | : 20 ppm  |
| 4) Shelf life            | : 2 years   |
| 5) Operating temperature | : 0 ~ 40 °C   |
| 6) Reading               | : Direct reading from the scale printed on the tube |
| 7) Colour change         | : Purplish blue → Pale pink                         |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 10 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

By reacting with an Alkali, PH indicator is discoloured.



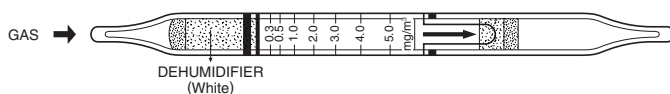
## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. PRESET

### PRESET CONDITION

- |                 |                                     |
|-----------------|-------------------------------------|
| 1) 2nd pressure | : 1.0 kgf/cm <sup>2</sup> (100 Kpa) |
| 2) Flow rate    | : 1.0 ℓ/min.                        |



## 1. PERFORMANCE

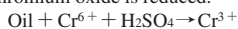
- |                          |   |
|--------------------------|---|
| 1) Measuring range       | : 0.3-5 mg/m <sup>3</sup>                           |
| 2) Sampling time         | : 25 minutes  |
| 3) Detectable limit      | : 0.1 mg/m <sup>3</sup>                             |
| 4) Shelf life            | : 2 years   |
| 5) Operating temperature | : 0 ~ 40 °C   |
| 6) Reading               | : Direct reading from the scale printed on the tube |
| 7) Colour change         | : Yellow → Pale blue                                |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10 %    RSD-mid. : 10 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

Chromium oxide is reduced.



## 4. CALIBRATION OF THE TUBE

INFRARED SPECTOPHOTOMETRY

## 5. PRESET

### PRESET CONDITION

- |                 |                                    |
|-----------------|------------------------------------|
| 1) 2nd pressure | : 1.0 kgf/cm <sup>2</sup> (100Kpa) |
| 2) Flow rate    | : 3.0 ℓ/min.                       |



### 1. PERFORMANCE

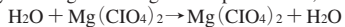
- |                          |   |
|--------------------------|---|
| 1) Measuring range       | : 20-160 mg/m <sup>3</sup>                          |
| 2) Sampling time         | : 1 minute  |
| 3) Detectable limit      | : 15 mg/m <sup>3</sup>                              |
| 4) Shelf life            | : 2 years   |
| 5) Operating temperature | : 0 ~ 40 °C   |
| 6) Reading               | : Direct reading from the scale printed on the tube |
| 7) Colour change         | : Yellow → Yellowish green or Blue                  |

### 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

### 3. CHEMICAL REACTION

By reacting with Magnesium perchlorate, complex salt is produced and PH indicator is discoloured.



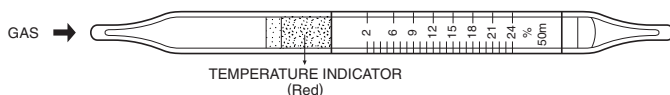
### 4. CALIBRATION OF THE TUBE

DEW-POINT METER

### 5. PRESET

#### PRESET CONDITION

- |                 |                                     |
|-----------------|-------------------------------------|
| 1) 2nd pressure | : 1.0 kgf/cm <sup>2</sup> (100 Kpa) |
| 2) Flow rate    | : 2.0 ℓ/min.                        |



## 1. PERFORMANCE

- |                             |   |
|-----------------------------|---|
| 1) Measuring range          | : 2-24 %  |
| 2) Sampling time            | : 1 minute  |
| 3) Shelf life               | : 2 years   |
| 4) Operating temperature    | : 0 ~ 40 °C   |
| 5) Temperature compensation | : (Necessary (0 ~ 10/30 ~ 40 °C) (Refer to "SPECIAL NOTE")) |
| 6) Reading                  | : Direct reading from the scale printed on the tube         |
| 7) Colour change            | : White → Brown   |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 5 %    RSD-mid. : 5 %    RSD-high : 5 %

## 3. CHEMICAL REACTION

Oxygen reacts with alkaline pyrogallol.

## 4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

## 5. PRESET/MEASUREMENT CONDITIONS

### PRESET CONDITION

- |                 |                                    |
|-----------------|------------------------------------|
| 1) 2nd pressure | : 0.6 kgf/cm <sup>2</sup> (60 Kpa) |
| 2) Flow rate    | : 2.0 ℓ/min.                       |

### MEASUREMENT CONDITION

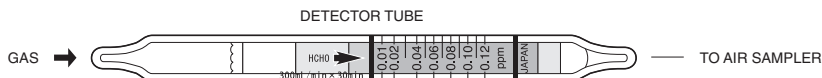
- |                    |         |
|--------------------|---------|
| 1) Sampling amount | : 50 mℓ |
|--------------------|---------|

### SPECIAL NOTE

- 1) TEMPERATURE COMPENSATION :
  - At 0 °C (32 °C) to 10 °C (86 °C), multiply the reading value by 1.05.
  - At 30 °C (86 °C) to 40 °C (104 °C), multiply the reading value by 0.95.
- 2) The sampling is made with an optional 50mℓ plastic syringe which collects accurate sampling volume in 50mℓ and 1mℓ vinyl tube which connects the syringe and the detector rubber, is recommendable in order to prevent influence by ambient oxygen.
- 3) Pressure regulator of which diaphragm is made of stainless steel or Teflon coated rubber, is recommendable in order to prevent influence by ambient oxygen.

## **3.7 KITAGAWA INDOOR AIR POLLUTANTS MEASUREMENT DETECTOR TUBES**





## 1. PERFORMANCE

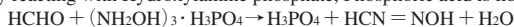
- 1) Measuring range : 0.01-0.12 ppm      0.04-0.48 ppm
- 2) Sampling time : 300mℓ/min × 30min    300mℓ/min × 10min
- 3) Detectable limit : 0.005 ppm (300mℓ × 30min)
- 4) Shelf life : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 10 ~ 35 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated at the sampling of 300mℓ × 30min
- 8) Colour change : Yellowish orange → Pink

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

By reacting with Hydroxylamine phosphate, Phosphoric acid is liberated.



## 4. CALIBRATION OF THE TUBE

ABSORPTIOMETRIC METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

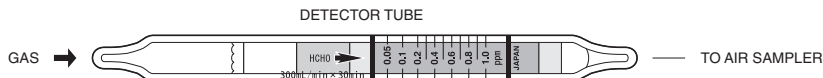
Substance	Interference	ppm	Coexistence
Ammonia	The accuracy of readings is not affected.	0.5	Discolouration layer fades from the bottom of stained layer.
Amines	∕	0.5	∕
Nitrogen dioxide	Similar stain is produced.	0.5	Higher readings with indiscernible maximum end point of stained layer are given.
Acetaldehyde	∕		Higher readings are given.
Acetone	∕		∕

(NOTE)

Air sampler is required for this tube.

TABLE OF THE COEFFICIENT FOR TEMPERATURE CORRECTION(20°C standard)

Temp(°C)	0	1	2	3	4	5	6	7	8	9
10	1.40	1.36	1.32	1.28	1.24	1.20	1.16	1.12	1.08	1.04
20	1.00	0.97	0.94	0.91	0.88	0.85	0.82	0.79	0.76	0.73
30	0.70	0.67	0.64	0.61	0.58	0.55	—	—	—	—



## 1. PERFORMANCE

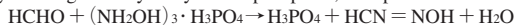
- 1) Measuring range : 0.05-1.0 ppm                      0.10-2.0 ppm
- 2) Sampling time : 300ml/min × 30min      300ml/min × 15min
- 3) Detectable limit : 0.005 ppm (300ml × 30min)
- 4) Shelf life : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 10 ~ 35 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated at the sampling of 300ml × 30min
- 8) Colour change : Yellowish orange → Pink

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 10%    RSD-high : 10%

## 3. CHEMICAL REACTION

By reacting with Hydroxylamine phosphate, Phosphoric acid is liberated.



## 4. CALIBRATION OF THE TUBE

ABSORPTIOMETRIC METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Ammonia		0.5	Discolouration layer fades from the bottom of stained layer.
Amines		0.5	∕
Nitrogen dioxide	Similar stain is produced.	0.5	Higher readings with indiscernible maximum end point of stained layer are given.
Acetaldehyde	∕		Higher readings are given.
Acetone	∕		∕

(NOTE)

Air sampler is required for this tube.

TABLE OF THE COEFFICIENT FOR TEMPERATURE CORRECTION (20 °C standard)

Temp(°C)	0	1	2	3	4	5	6	7	8	9
10	1.16	1.14	1.13	1.11	1.10	1.08	1.06	1.05	1.03	1.02
20	1.00	0.98	0.97	0.95	0.94	0.92	0.90	0.89	0.87	0.86
30	0.84	0.82	0.81	0.79	0.78	0.76	—	—	—	—



## 1. PERFORMANCE

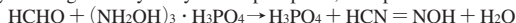
- 1) Measuring range : 0.01 ~ 0.50 ppm (12.5 ~ 625  $\mu\text{g}/\text{m}^3$ )
- 2) Sampling volume : 350mL/min  $\times$  10min
- 3) Sampling time : 10 minutes
- 4) Detectable limit : 0.005 ppm
- 5) Shelf life : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10°C)
- 6) Operating temperature : 10 ~ 35°C
- 7) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 8) Reading : Direct reading from the scale calibrated at sampling volume of 350mL $\times$ 10min
- 9) Colour change : Yellowish orange  $\rightarrow$  Pink

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

By reacting with Hydroxylamine phosphate, Phosphoric acid is liberated.



## 4. CALIBRATION OF THE TUBE

ABSORPTIOMETRIC METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

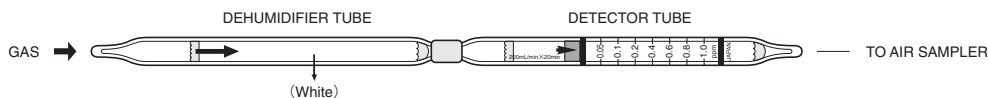
Substance	ppm	Interference	ppm	Coexistence
Ammonia		The accuracy of readings is not affected.	1.0	Discolouration layer fades from the bottom of stained layer.
Amines		∕	1.0	∕
Ethanol		∕	200	Higher readings are given.
Nitrogen dioxide	1	Similar stain is produced.	1.0	Higher readings with indiscernible maximum end point of stained layer are given.
Acetaldehyde		∕		Higher readings are given.
Acetone		∕		∕

(NOTE)

Air sampler is required for this tube.

### TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)					
	10°C (50°F)	15°C (59°F)	20°C (68°F)	25°C (77°F)	30°C (86°F)	35°C (95°F)
0.50		0.780	0.500	0.390	0.340	0.290
0.40	0.900	0.520	0.400	0.310	0.270	0.230
0.30	0.550	0.370	0.300	0.230	0.200	0.170
0.20	0.330	0.250	0.200	0.155	0.135	0.115
0.10	0.150	0.120	0.100	0.080	0.070	0.060
0.05	0.070	0.060	0.050	0.040	0.035	0.030
0.01	0.020	0.015	0.010	0.008	0.007	0.006



## 1. PERFORMANCE

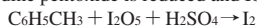
- 1) Measuring range : 0.05-1.0 ppm
- 2) Sampling time : 200m<sup>3</sup>/min × 20min
- 3) Detectable limit : 0.01 ppm
- 4) Shelf life : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 5 ~ 35 °C
- 6) Reading : Direct reading from the scale calibrated at the sampling of 300m<sup>3</sup> × 30min
- 7) Colour change : White → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 5 %    RSD-mid. : 10 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

Iodine pentoxide is reduced and Iodine pentoxide is liberated.



## 4. CALIBRATION OF THE TUBE

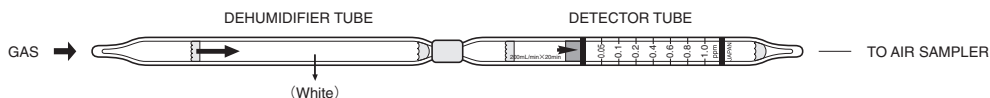
GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Xylene	Similar stain is produced.	Higher readings are given.
Ethyl Benzene	〃	〃

(NOTE)

Air sampler is required for this tube.



## 1. PERFORMANCE

- 1) Measuring range : 0.05-1.2 ppm
- 2) Sampling time : 200mℓ/min × 20min
- 3) Detectable limit : 0.01 ppm
- 4) Shelf life : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 5 ~ 35 °C
- 6) Reading : Scales printed on the tube are calibrated by Toluene at the sampling of 200mℓ × 20min and Ethyl benzene concentration is determined by using a conversion chart.
- 7) Colour change : White → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 5 %    RSD-mid. : 10 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

Iodine pentoxide is reduced and Iodine is liberated.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

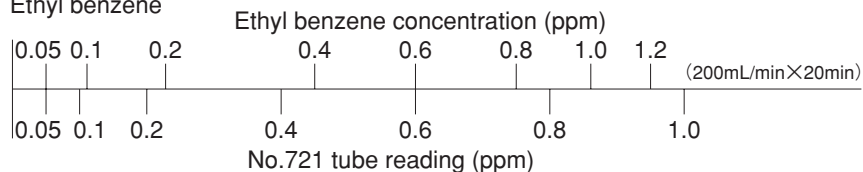
## 5. INTERFERENCE AND CROSS SENSITIVITY

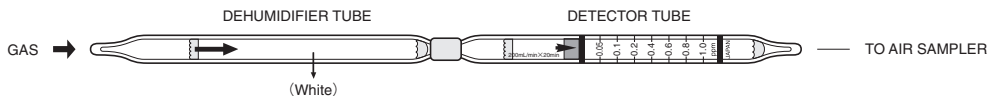
Substance	Interference	Coexistence
Toluene	Similar stain is produced.	Higher readings are given.
Xylene	∕	∕

(NOTE)

Air sampler is required for this tube.

Ethyl benzene





## 1. PERFORMANCE

- 1) Measuring range : 0.1-1.4 ppm
- 2) Sampling time : 200m<sup>l</sup>/min × 20min
- 3) Detectable limit : 0.01 ppm
- 4) Shelf life : 1 year (Necessary to store in refrigerated conditions ; 0 ~ 10 °C)
- 5) Operating temperature : 5 ~ 35 °C
- 6) Reading : Scales printed on the tube are calibrated by Toluene at the sampling of 200m<sup>l</sup> × 20min and Xylene concentration is determined by using a conversion chart.
- 7) Colour change : White → Brown

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 5 %    RSD-mid. : 10 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

Iodine pentoxide is reduced and Iodine pentoxide is liberated.



## 4. CALIBRATION OF THE TUBE

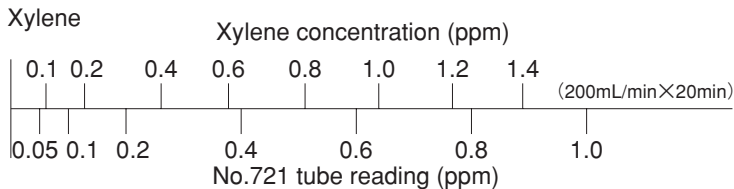
GAS CHROMATOGRAPHY

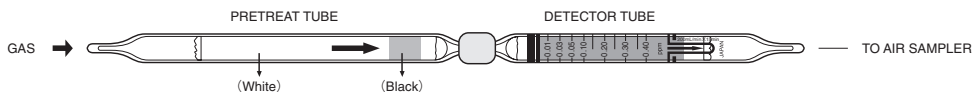
## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Toluene	Similar stain is produced.	Higher readings are given.
Ethyl Benzene	∕	∕

(NOTE)

Air sampler is required for this tube.





## 1. PERFORMANCE

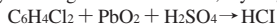
- 1) Measuring range : 0.01-0.40 ppm
- 2) Sampling time : 200mℓ/min × 15min
- 3) Detectable limit : 0.002 ppm
- 4) Shelf life : 1 year
- 5) Operating temperature : 10 ~ 35 °C
- 6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated at the sampling of 200mℓ × 15min
- 8) Colour change : Orange → Reddish purple

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 10% RSD-high : 10%

## 3. CHEMICAL REACTION

By reacting with an Oxidizer, Hydrogen chloride is produced and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Trichloroethylene	Similar stain is produced.	Higher readings are given.
Tetrachloroethylene	∕	∕
1,2-Dichloroethylene	∕	∕
Vinyl chloride	∕	∕

(NOTE)

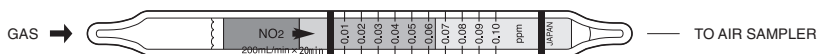
Air sampler is required for this tube.

TABLE OF THE COEFFICIENT FOR TEMPERATURE CORRECTION (20 °C standard)

Temp(°C)	0	1	2	3	4	5	6	7	8	9
10	2.13	1.95	1.78	1.63	1.50	1.38	1.28	1.19	1.11	1.05
20	1.00	0.95	0.92	0.88	0.84	0.81	0.78	0.75	0.73	0.72
30	0.70	0.69	0.68	0.68	0.67	0.66	—	—	—	—

## **3.8 ATMOSPHERIC ENVIRONMENT MEASUREMENT DETECTOR TUBES**





## 1. PERFORMANCE

- 1) Measuring range : 0.01-0.10 ppm      0.02-0.20 ppm
- 2) Sampling time : 200ml/min × 20min    200ml/min × 10min
- 3) Detectable limit : 0.002 ppm (at the sampling of 200ml/min × 20min)
- 4) Shelf life : 2 years
- 5) Operating temperature : 0 ~ 40 °C
- 6) Temperature compensation : Necessary (30 ~ 40°C) (See "TEMPERATURE CORRECTION TABLE")
- 7) Reading : Direct reading from the scale calibrated at the sampling of 200ml/min × 20min
- 8) Colour change : White → purple-red

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10%    RSD-mid. : 5%    RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with 3,3'-Dimethylnaphthidine, Nitroso compound is produced.



## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Sulphur dioxide		0.3	Lower readings are given.
Ozone		0.2	∕
Carbon monoxide			The accuracy of readings is not affected.
Carbon dioxide			∕
Nitrogen monoxide			∕
Formaldehyde			∕
Toluene			∕
Xylene			∕
Ethyl benzene			∕
Styrene			∕
p-Dichlorobenzene			∕
Acetone			∕

### (NOTE)

Air sampler is required for this tube.

TABLE OF THE COEFFICIENT FOR TEMPERATURE CORRECTION

Temperature (°C)	31	32	33	34	35	36	37	38	39	40
Correction factor	1.02	1.04	1.06	1.08	1.10	1.12	1.14	1.16	1.18	1.20





## 1. PERFORMANCE

- |                             |  |                                 |
|-----------------------------|--|---------------------------------|
| 1) Measuring range          | : 30-400 $\mu\text{g}/\text{m}^3$  | 69-920 $\mu\text{g}/\text{m}^3$ |
| 2) Sampling time            | : 100m $\ell$ /min $\times$ 30min  | 100m $\ell$ /min $\times$ 15min |
| 3) Detectable limit         | : 5 $\mu\text{g}/\text{m}^3$ (100m $\ell$ /min $\times$ 30min)                           |                                 |
| 4) Shelf life               | : 1 year   |                                 |
| 5) Operating temperature    | : 0 ~ 40 $^{\circ}\text{C}$  |                                 |
| 6) Temperature compensation | : Necessary (See "TEMPERATURE CORRECTION TABLE")   |                                 |
| 7) Reading                  | : Direct reading from the scale calibrated at the sampling of 100m $\ell$ $\times$ 30min |                                 |
| 8) Colour change            | : Yellow $\rightarrow$ Purple red  |                                 |

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 10% RSD-mid. : 5% RSD-high : 5%

## 3. CHEMICAL REACTION

By reacting with an Oxidizer, Hydrogen chloride is produced and PH indicator is discoloured.



## 4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Tetrachloroethylene	Similar stain is produced.	Higher readings are given.
1,2-Dichloroethylene	∕	∕
Vinyl chloride	∕	∕

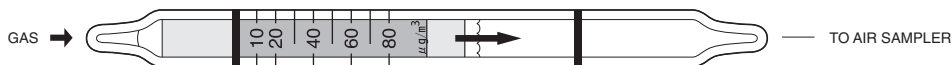
(NOTE)

Air sampler is required for this tube.

TABLE OF THE COEFFICIENT FOR TEMPERATURE CORRECTION(20 $^{\circ}\text{C}$  standard)

Temp( $^{\circ}\text{C}$ )	0	1	2	3	4	5	6	7	8	9
0	1.71	1.66	1.62	1.58	1.54	1.50	1.46	1.42	1.39	1.35
10	1.31	1.28	1.24	1.21	1.18	1.15	1.12	1.09	1.06	1.03
20	1.00	0.97	0.95	0.92	0.90	0.87	0.85	0.83	0.81	0.79
30	0.77	0.75	0.73	0.71	0.70	0.68	0.67	0.65	0.64	0.63
40	0.61	—	—	—	—	—	—	—	—	—

### **3.9 SUPER-HIGH SENSITIVITY DETECTOR TUBES FOR AMMONIA IN ART GALLERIES/ MUSEUM AND CLEAN ROOMS**



## 1. PERFORMANCE

- 1) Measuring range : 10-80  $\mu\text{g}/\text{m}^3$
- 2) Sampling time : 24000m $\ell$  (400m $\ell$ /min  $\times$  60min)
- 3) Detectable limit : —
- 4) Shelf life : 2 years
- 5) Operating temperature : 10 ~ 40  $^{\circ}\text{C}$
- 6) Reading : Direct reading from the scale calibrated at the sampling of 400m $\ell$   $\times$  60min
- 7) Colour change : Pale purple  $\rightarrow$  Pale yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 5 %    RSD-mid. : 5 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

Indicator is discoloured by neutralization of Ammonia with acid.

## 4. CALIBRATION OF THE TUBE

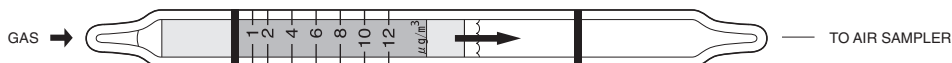
PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Amines	Similar stain is produced.	Higher readings are given.

(NOTE)

Air sampler is required for this tube.



## 1. PERFORMANCE

- 1) Measuring range : 1-12  $\mu\text{g}/\text{m}^3$
- 2) Sampling time : 24000m $\ell$  (400m $\ell$ /min  $\times$  60min)
- 3) Detectable limit : —
- 4) Shelf life : 2 years
- 5) Operating temperature : 10 ~ 40  $^{\circ}\text{C}$
- 6) Reading : Direct reading from the scale calibrated at the sampling of 400m $\ell$   $\times$  60min
- 7) Colour change : Pale purple  $\rightarrow$  Pale yellow

## 2. RELATIVE STANDARD DEVIATION

RSD-low : 5 %    RSD-mid. : 5 %    RSD-high : 10 %

## 3. CHEMICAL REACTION

Indicator is discoloured by neutralization of Ammonia with acid.

## 4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

## 5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Amines	Similar stain is produced.	Higher readings are given.

(NOTE)

Air sampler is required for this tube.

## 4. REFERENCE FOR MEASUREMENT

### 4.1 GENERAL KNOWLEDGE FOR GAS MEASUREMENT

#### 4.1.1 UNIT OF CONCENTRATION

% : percentage of volumetric ratio of gas, corresponding to millilitres of gas per 100 millilitres of air.

ppm : volumetric ratio of gas expressed by parts per million, corresponding to microlitres ( $\mu\ell$ ) per 1 litre of air, e.g. 0.1 % = 1,000 ppm

mg/m<sup>3</sup> : milligrams of substance per 1 cubic metre (1,000ℓ) of air, mainly used for concentration of particulate matter

##### (1) Conversion of gas volume

Volume of gas, V at t °C under a pressure of p hPa is derived from the volume, V<sub>0</sub> at 0 °C under 1 atmospheric pressure (1013 hPa) according to the following formula :

$$V = V_0 \times \frac{273 + t}{273} \times \frac{1013}{p}$$

For example, volume of gas, V at 20 °C under 1 atm. is 1.073V<sub>0</sub>.

##### (2) Relationship between volume and weight of gas

Volume of gas vapourized from M grams of a M molecular weight substance, i.e. 1 mol., is 22.4 litre at 0 °C under 1 atmospheric pressure. Preparing the standard gas vapourized from a liquid sample, the concentration of gas in a fixed volume vessel is obtained from the following formula :

$$C = \frac{x}{M} \times \frac{22.4}{V} \times \frac{273 + t}{273} \times \frac{1013}{p} \times 100$$

where C = concentration of gas [%] ; x = quantity of sample [g] ; M = molecular weight of sample [g] and V = internal volume of vessel [ℓ]. For example, the quantity of sample required for preparing the standard gas of 1,000 ppm (0.1 %) of toluene in a vessel of 1 litre at 20 °C under 1 atm. is as follows :

$$0.1 = \frac{x}{92.14} \times \frac{22.4}{1} \times \frac{273 + 20}{273} \times \frac{1013}{1013} \times 100 \quad \text{Then,} \quad x = 0.00383 \text{ [g]} \\ = 3.83 \text{ [mg]}$$

##### (3) Conversion of concentration

The relationship in gaseous state of a substance (molecular weight = M) between ppm and mg/m<sup>3</sup> at t °C under p hPa is as follows :

$$\text{ppm} = \text{mg/m}^3 \times \frac{22.4}{M} \times \frac{273 + t}{273} \times \frac{1013}{p} \quad \text{mg/m}^3 = \text{ppm} \times \frac{M}{22.4} \times \frac{273}{273 + t} \times \frac{p}{1013}$$

##### (4) Concentration derived from saturated vapour pressure

Vapour concentration on the surface of liquid, the upper limit at the temperature, is obtained according to the following formula :

$$C = \frac{P_t}{1013} \times 100$$

where P<sub>t</sub> = standard vapour pressure of substance at t °C [ hpa] and C = vapour concentration [%]

#### 4.1.2 NORMAL COMPOSITION OF AIR

Many studies on the chemical composition of atmosphere are made so far. The standard chemical composition of air is shown in Table 4.1. Various gaseous and particulate matters besides the normal Components are contained in the atmosphere on the surface of the earth. Air in urban districts contains the substances shown in Table 4.2.

#### 4.1.3 PROPERTIES OF SUBSTANCES

There are two groups of substances in air, uniformly dispersed gas or vapour and suspended particles. The names and properties of the particles are shown in Table 4.3. The substances measurable by gas detector tubes are gaseous and vapourized matter.

**TABLE 4.1 NORMAL COMPOSITION OF AIR**

GASES	CONCENTRATION	
	VOLUME [ppm]	WEIGHT [ppm]
Nitrogen	780,900	775,100
Oxygen	209,500	231,500
Argon	9,300	12,800
Carbon dioxide	300	400
Neon	18	12.5
Helium	5.2	0.72
Methane	2.2	1.2
Krypton	1	2.9
Nitrous oxide	1	1.5
Hydrogen	0.5	0.03
Xenon	0.08	0.36

**TABLE 4.2 POLLUTANTS IN URBAN DISTRICT AIR**

POLLUTANTS	CONCENTRATION [ppm]
Sulfur dioxide	0.001 ~ 0.7
Carbon monoxide	2.0 ~ 10.0
Aldehyde, as formaldehyde	0.02 ~ 0.2
Nitrogen oxides	0.02 ~ 0.9
Ozone	0.009 ~ 0.3
Ammonia	0.02 ~ 0.2
Hydrogen sulfide	0.002 ~ 0.1
Hydrogen fluoride	0.001 ~ 0.02

#### 4.1.4 HARMFULNESS

Some chemicals are harmful to the touch, depending on exposure time, quantity and human characteristics such as health condition, sex, age and others.

When a high concentration chemical substance is inhaled in a short time, symptoms of acute poisoning are developed. When a relatively low concentration chemical substance is inhaled for many hours, symptoms of chronic poisoning are developed. Acute poisoning is relatively well known, but chronic poisoning is not so well known, because it has various types of symptoms in subjective and objective symptoms. Since the symptoms by long exposure to low-concentration chemicals are not characteristic, the subjective symptoms must be carefully observed.

Classification of chemical substances by symptom is as follows :

- (1) Simple suffocative substances ...carbon dioxide, methane, propane
- (2) Chemical suffocative substances ...carbon monoxide, hydrogen cyanide
- (3) Upper air-passage irritating substances ...ammonia, sulphur dioxide, styrene, formaldehyde
- (4) Pulmonary issue irritating substances ...chlorine, phosgene, ozone
- (5) Toxic substances to central nervous system ...toluene, xylene, chloroform
- (6) Hematogenous organs and hematic system poisoning substances ...benzene, arsine, nitrobenzene



**TABLE 4.3 POLLUTANTS IN URBAN DISTRICT AIR**

SUBSTANCE	PROPERTIES	STATE	PARTICLE DIAMETER ( $\mu$ )	EXAMPLES
Gas	Gas at 25 °C under 1 atm. (critical temperature or higher)	Gas	Molecules	Ammonia, Chlorine, Ozone, Carbon dioxide, Sulphur dioxide
Vapour	Solid (critical temperature or lower) or liquid at 25 °C under 1 atm.			Acetone, Ethyl alcohol, Carbon disulphide, Ethyl acetate
Mist	Suspended fine particles of solid	Liquid	5-100	Sulphuric acid (0.8-5.5 $\mu$ ), Chromic acid, Sodium hydroxide, Cyanide, Hydrochloric acid, Fog (50 $\mu$ )
Fog	Finer particles than mist (5-50 $\mu$ particles condensed in air)			
Dust	Suspended fine particles of solid	Solid	1-150	Pigment (1-4 $\mu$ ). Talc (10 $\mu$ ), Coal dust (10 $\mu$ ), Grain flour (15-20 $\mu$ ), Cement mill dust (exhaust from kiln, 10 $\mu$ ), Dust in grain flour elevator (15 $\mu$ ), P.C.P., Mica, Asbestos
Fume	Suspended fine particulate compound derived from gas in air		0.1-1	
Smoke	Originally meaning of organic particles with a certain black colour	Mixed	0.01-1	Tobacco smoke (0.25 $\mu$ )

(7) Carcinogens ... vinyl chloride, benzidine

(8) General poisoning substances ... lead, mercury, arsenic, aniline

(9) Hepatic system poisoning substances ... carbon tetrachloride, trichloroethylene, tetrachloroethylene

Exposure to high concentration of these substances gives shortly symptoms, but generally the substances (1) through (4) develop acute poisoning, while those (5) through (9) develop chronic poisoning.

#### 4.1.5 THRESHOLD LIMIT VALUE

Threshold limit values of chemicals have been published from various organizations in the world as indicators of exposure for prevention of troubles so far.

The threshold limit values used most widely in the world are Threshold Limit value, TLV, published from American Conference of Governmental Industrial Hygienists (ACGIH). TLV is stated in the same manner as in the preceding documents as follows :

"Threshold limit values refer to airborne concentrations of substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect. Because of wide variation in individual susceptibility, however, a small percentage of workers may experience discomfort from some substances at concentrations at or below the threshold limit ; a smaller percentage may be affected more seriously by aggravation of a pre-existing condition or by development of an occupational illness."

The threshold limit value is expressed in the unit of ppm or mg/m<sup>3</sup> which is generally calculated from the concentrations by the actual working hours in a day, time weighted average concentration.

The threshold limit values are classified into the following three items by the ACGIH.

- (1) The Threshold Limit Value-Time Weighted Average (TLV-TWA) – the time-weighted average concentration for a normal 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect.
- (2) Threshold Limit Value-Short Term Exposure Limit (TLV-STEL) – the concentration to which workers can be exposed continuously for a short period of time without suffering from irritation, chronic or irreversible tissue damage, or narcosis of sufficient degree to increase the likelihood of accidental injury, impair self-rescue or materially reduce work efficiency, and provided that the daily TLV-TWA is not exceeded. It is not a separate independent exposure limit, rather it supplements the time-weighted average (TWA) limit where there are recognized acute effects from a substance whose toxic effects are primarily of a chronic nature. STELs are recommended only where toxic effects have been reported from high short-term exposures in either humans or animals.

A STEL is defined as a 15-minute time-weighted average exposure which should not be exceeded at any time during a work day even if the eight-hour time-weighted average is within the TLV. Exposures at the STEL should not be longer than 15 minutes and should not be repeated more than four times per day. There should be at least 60 minutes between successive exposures at the STEL. An averaging period other than 15 minutes may be recommended when this is warranted by observed biological effects.

- (3) Threshold Limit Value-Ceiling (TLV-C) – the concentration that should not be exceeded even instantaneously. It is necessary to investigate the synergistic ill effect rather than individual ill effects of two or more coexisting injurious materials. Unless any information concerning the synergistic effect is available, the weight of the individual injurious effect of each component may be considered as the total injurious effect for convenience as follows : if the sum total of Formula (1) exceeds 1, the overall concentration of injurious materials is considered to exceed the threshold limit value in the environment.

$$C_1/T_1 + C_2/T_2 + C_3/T_3 \dots + C_n/T_n$$

where  $C_1, C_2, C_3 \dots$  and  $C_n$  = concentration of each component and  $T_1, T_2, T_3 \dots$  and  $T_n$  = threshold limit value of each component. When only the concentration of one injurious material can be determined among various injurious ones escaping from the process, the harmfulness in the whole environment may be conservatively estimated from the threshold limit value of that material determined.

#### 4.1.6 DANGEROUSNESS

The material causing a fire or explosion is called dangerous material including combustible gas and liquid. If combustible liquid flows out, the danger range widely expands because of liquified properties. Besides, combustible vapour is always volatilised from the surface of the combustible liquid with high vapour pressure, so an ignition source causes ignition or explosion. Combustible liquid is particularly dangerous compared with other dangerous materials due to two characteristics mentioned above.

There is a range of mixture of certain characteristics of combustible gas or vapour and air in which an ignition source causes explosion. The range of the concentrations is called range of explosion. Combustion bolstering gas such as oxygen, chlorine and nitrogen dioxide causes explosion together with combustible gas. The higher the concentration of combustion bolstering gas is, the larger the range of explosion is. The range of explosion varies according to temperature, pressure and coexisting gas, but it is generally expressed by a triangular diagram based on the experimental values.

FIG. 4.1 illustrates the triangular diagram of three component system of combustible gas (benzene), bolstering gas (oxygen) and inert gas (nitrogen). The area enclosed with solid lines is the range of explosion and the intercept of the broken line between the points of intersection

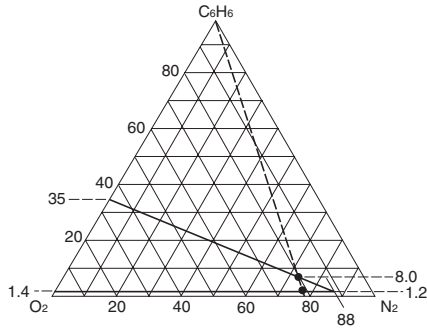


FIG. 4.1 EXPLOSION RANGE OF MIXED GASES (BENZENE, O<sub>2</sub>,N<sub>2</sub>)

shows the range of explosion of the mixture of combustible gas and air. The range of explosion of benzene in the air ranges 1.2 % to 8.0 % and that in oxygen ranges 1.4 % to 35 %. Existence of nitrogen over 88 % does not cause explosion. Since explosion is generally caused by an ignition source, the concentration measuring instrument must be explosion-proof. The measurement by a gas detector tube is based on chemical reaction, so it is used even in an explosive place.

## 4.2 SAMPLE COLLECTION

Careful sampling is especially important obtaining correct results even in highly accurate gas-analysis. The optimum sampling method varies depending upon sample gases and analytical methods. There are three sampling methods, liquid, solid and direct sampling methods. Sampling is eliminated in the gas detector tube method in which measurement is made at the same time as sampling. Errors caused by sampling and changing of the sample with time are, therefore, available. Since the direct sampling method accompanied by the gas detector tube method is widely applied, the sampling method and the precautions are stated hereinafter.

### 4.2.1 SAMPLING METHOD

The following attention must be paid to the sampling by a bag or a glass syringe :

- (1) Since the concentration of sample decreases with time depending upon the material and size of bag and the substance and concentration of sample, the sample shall be fed to the gas detector tube confirming the stabilization of the concentration based on the decreasing rate of it (see FIG. 4.2 and 4.3).
- (2) The sample is sometimes adsorbed to the diaphragm of the diaphragm pump for sampling into a bag. Instead of the diaphragm pump, therefore, the bag shall be placed in a vessel which will be evacuated as shown in FIG. 4.4.

### 4.2.2 SAMPLING SITE

Gas and vapour accumulate in different places depending upon the difference in specific gravity from that of air. Lighter gas such as hydrogen, methane and ammonia accumulates in the vicinity of ceiling, while heavier gas such as toluene, gasoline and hydrogen sulfide accumulates on the floor, especially in depressions such as ditch and pit. The specific gravities of typical gases are listed in Table 4.4.

- (1) Sampling shall be carried out at the possible gas leak position such as flange and slide section and the possible gas accumulating area to detect the gas leak.
- (2) Sampling of injurious gas shall be carried out in a close range of workers' breathing and of the source for the environmental management of working place. A rubber extension hose shall be used for sampling in a place where acute poisoning is possible to confirm whether or not the area is safe for entry.

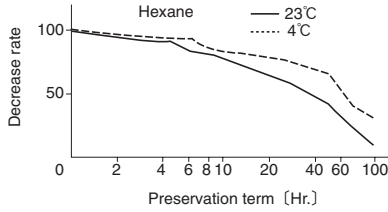


FIG.4.2 DECREASE IN A GLASS SYRINGE

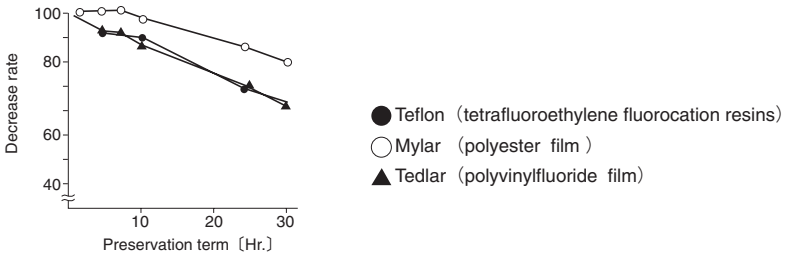


FIG.4.3 DECREASE IN A SAMPLING BAG

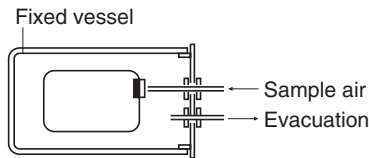


FIG 4.4 COLLECTION BY BAG

**TABLE 4.4 SPECIFIC GRAVITY**

SUBSTANCES	SPECIFIC GRAVITY (AIR = 1)
Hydrogen	0.07
Methane	0.55
Ammonia	0.59
Carbon monoxide	0.97
Hydrogen sulfide	1.19
Propane	1.52
Butane	2.0
Chlorine	2.45

### 4.3 DETERMINATION RESULTS AND MEASUREMENTS

Measurements shall be made to determine contaminant leads in the environment. The measurements to prevent gas poisoning and explosion will be mentioned hereinafter.

### 4.3.1 PREVENTIVE MEASURES FOR POISONING

People shall immediately leave the area where lack of oxygen and acute poisoning are imminent redistribution. A respirator or an air mask shall be put on to enter the dangerous area. Safety shall be confirmed by repeated measurements before entering the area even after ventilation. The general procedure for examining the acute poisoning sources and for reviewing the environmental management is described as follows ;

- (1) Exposure derived from changes in operation and the secondary pollution shall be prevented.
- (2) Redistribution of pollutants by local ventilation shall be prevented.
- (3) Redistribution of pollutants by push-pull ventilation shall be prevented.
- (4) Dilution of exhaust gas by total ventilation shall be promoted.
- (5) Facilities handling injurious materials shall be enclosed and automated.
- (6) Hazardous production plants shall be isolated and remote control shall be applied.
- (7) Process and operation shall be improved.
- (8) Production or use of hazardous chemical materials shall be discontinued or converted to less hazardous materials.

### 4.3.2 PREVENTIVE MEASURES FOR EXPLOSION

When combustible gas is detected, measurements shall be taken to determine the concentration. People shall immediately leave the area where the combustible gas concentration is within or close to the range of explosion. Since explosion is possible even if the concentration is low, the leak point shall be immediately examined with measuring equipment or gas detector tubes to connect it.

## 4.4 APPLICATIONS OF GAS DETECTOR TUBE METHOD

### 4.4.1 INSTANTANEOUS VALUE, HIGH TEMPERATURE GAS OR HIGH CONCENTRATION GAS MEASUREMENT

- (1) Instantaneous value or high temperature gas : Gas sampling shall be made with a glass syringe the inner wall of which will have been cleaned and dried shown in FIG. 4.5. Then the syringe shall be connected with a gas detector tube and an aspirating pump as shown in FIG.4.6 to determine the gas concentration. If the gas condenses on the inner surface of the syringe, care shall be taken that the piston of syringe will not stick to the cylinder.



FIG.4.5 GLASS SYRINGE

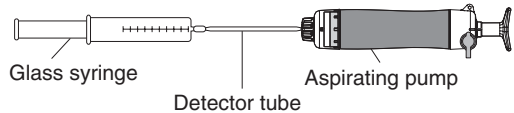


FIG.4.6 MEASUREMENT

- (2) Gas of high concentration exceeding the measuring range of gas detector tube : After sampling a constant volume of gas into a glass syringe, it shall be arbitrarily diluted with fresh air. Measurement shall be made in such a manner as described in FIG. 4.6. The value obtained shall be multiplied by the magnification of dilution to determine the real concentration.
- (3) Gas with a concentration as high as 5 % or more : Since the amount of gas absorbed in a gas detector tube is not negligible, the sample pump shall be purged with fresh air.

The inside of the glass syringe shall not be greased, because analytical error will be caused by

dissolving gas into the grease or the gas adsorption onto the grease.

#### 4.4.2 REMOTE MEASUREMENT

A rubber extension hose shown in FIG. 4.7 shall be used for detection of potentially harmful gases prior to entering a confined space such as a manhole or a tank. A gas detector tube is connected with the rubber extension hose and the aspirating pump to determine the gas concentration. The rubber extension hose is available in lengths of 5 or 10 metres.



FIG. 4.7 RUBBER EXTENSION HOSE

#### 4.4.3 FLUE GAS

The flue gas sampling instrument shown in FIG.4.8 and 4.9 is used in conjunction with the AP-1S pump and specific detector tubes for analyzing flue gas. The equipment consists of the stainless steel sampling probe equipped with a thermometer, heated by a ribbon heater for preventing condensation.



FIG. 4.8 FLUE GAS SAMPLING INSTRUMENT

#### 4.4.4 VAPOUR OF A MIXED SOLVENT

##### (1) Mixed solvent

Mixed solvent thinners, are used for dissolving paint and/or cleaning painting equipment.

Thinners are prepared by mixing organic solvents to meet the requirements of the paint. Thinner for paint, mainly comprised of petroleum hydrocarbons such as mineral turpentine and solvent naphtha is a typical one used for all the oil based paints and oil modified resin coatings. (Mineral spirit is a synonym of mineral turpentine.) Lacquer thinner comprised of aromatic hydrocarbons such as toluene and xylene, ester, ketones and alcohol is used for some synthetic resin paints as well as lacquer.

Table 4.5 lists the paints and main solvents to assist in choosing gas detector tubes for measurement.

##### (2) Examples of analysis for mixed solvents by gas chromatography

###### (a) Paint thinner

Paint thinner is mainly composed of petroleum hydrocarbons ( $C_9$  to  $C_{11}$ ) and may be

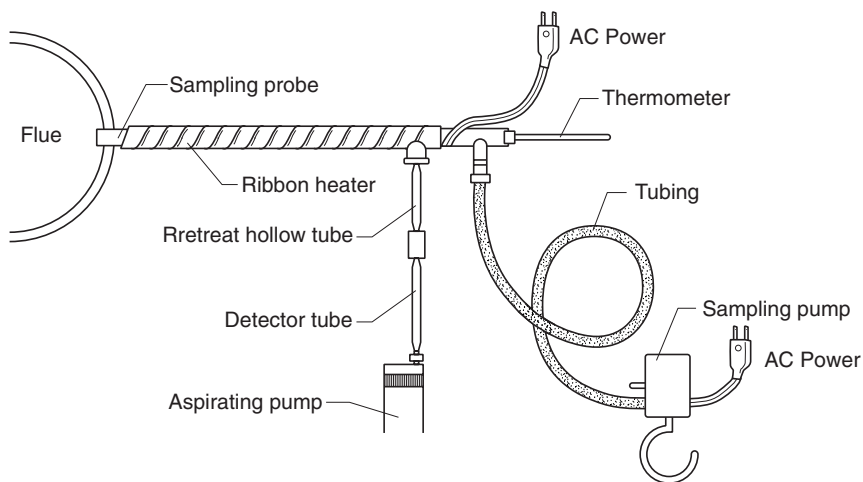


FIG.4.9 FLUE GAS MONITOR

TABLE 4.5 PAINTS AND MAIN SOLVENTS

PAINTS AND MATERIALS	MAIN SOLVENTS
① OIL PAINTS <ul style="list-style-type: none"> <li>● Compounding paint</li> <li>● Corrosion-resistant paint</li> <li>● Ship-hull paint</li> <li>● Others</li> </ul>	Mineral turpentine Xylene, Mineral Turpentine Mineral turpentine, Solvent naphtha Xylene, Mineral turpentine
② LACQUER	Toluene, Xylene, Methanol, Isopropanol, Butanol, Ethyl acetate, Butyl acetate, Methyl isobutyl ketone, Cellosolve
③ SYNTHETIC RESIN PAINTS <ul style="list-style-type: none"> <li>● Phenolic resins</li> <li>● Alkyd resins</li> <li>● Aminoalkyd resins</li> <li>● Vinyl resins</li> <li>● Epoxy resins</li> <li>● Urethane resins</li> <li>● Corrosion-Resist paint</li> <li>● Soluble resins</li> </ul>	Xylene, Mineral turpentine Xylene, Mineral turpentine Toluene, Xylene, Methanol, Butanol, Butylacetate Toluene, Xylene, Ethanol, Isopropanol, Butanol, Ethyl acetate, Butyl acetate, Methyl isobutyl ketone, Cellosolve Toluene, Xylene, Isopropanol, Methyl isobutyl ketone, Cellosolve Toluene, Ethyl acetate, Butyl acetate, Methyl ethyl ketone, Cellosolve Toluene, Xylene, Mineral turpentine Isopropanol, Butanol, Cellosolve

called mineral turpentine or mineral spirit. See FIG.4.10 for the example of analysis.

(b) Lacquer thinner

The FIG.4.11 is for a lacquer thinner which contains ethyl acetate and MIBK as well as the main component of toluene (for industrial use)

The FIG.4.12 is for a lacquer thinner which contains MIBK as well as the main component of xylene (for house use)

(3) Analysis of mixed solvent

The composition of solvent vapour (see FIG.4.14) is not consistent with that of liquified solvent (see FIG.4.13), because low boiling components are volatilised first and then higher

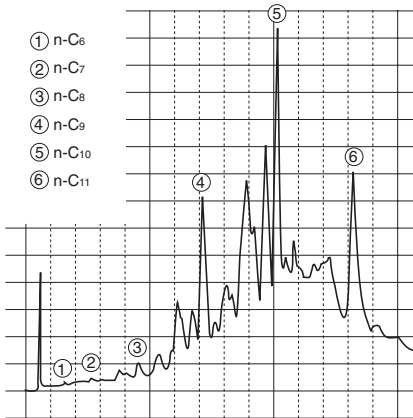


FIG.4.10 ANALYSIS 1

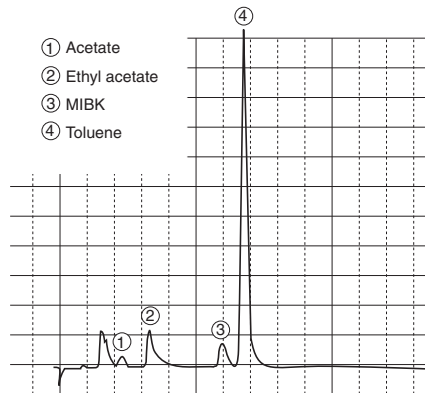


FIG.4.11 ANALYSIS 2

- ① MIBK
- ② p-Xylene
- ③ m-Xylene
- ④ o-Xylene

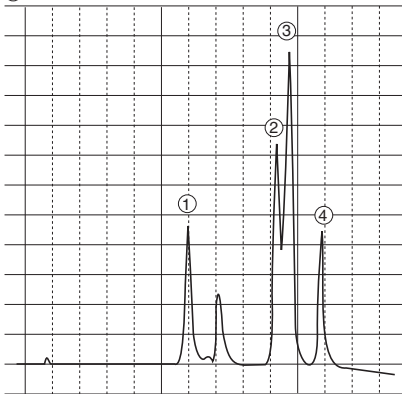


FIG.4.12 ANALYSIS 3

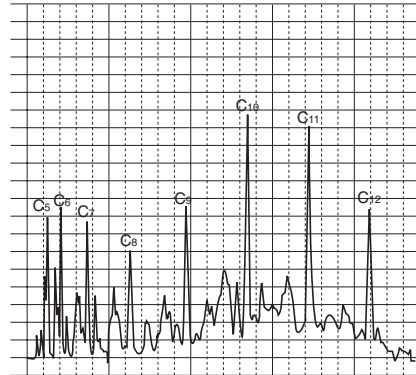


FIG.4.13 COMPOSITION OF LIQUID SOLVENT



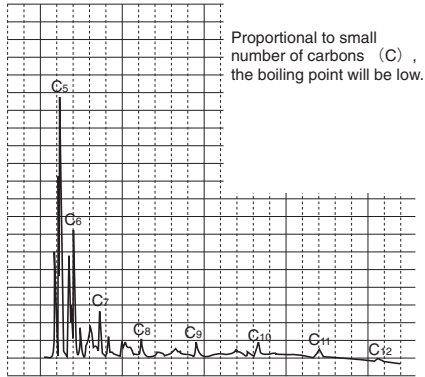


FIG.4.14 COMPOSITION OF SOLVENT VAPOUR

boiling ones are volatilized later with the passing of time.

(a) Gas detector tube method

The procedure for analyzing mixed solvent vapour like thinner in a work place using gas detector tube is as follows :

- ① Estimate the components of thinner from the type of paint (see TABLE 4.5). Consult the material safety data sheet, ask the manufacturer about it or analyse it by gas chromatography unless the composition is known.
- ② Select the components of solvent, of which boiling point is low and/or TLV is low.
- ③ Investigate the effect of interfering gas on the gas detector to be used. Choose detector tubes according to the instruction where there is no interfering gas or the effect of interfering gas is very low.
- ④ Make detector tube measurements of each component noting any that list negative interferences. Record the values. Record "zero" responses as being less than the listed detecting limit
- ⑤ When there are positive interfering gases overstating the reading and a certain value is indicated, convert or calibrate the measured value according to the analytical value by gas chromatography for future use.

(b) Solid sampling

A charcoal tube or a silica gel tube is used for solid media sampling which is an effective means for determining the components of mixed solvent (refer to 4.5.1 and 4.5.2).

#### 4.4.5 RESIDUAL SALINITY

Steel structures in coastal areas are damaged by defects such as swelling, peeling and rusting caused by salt deposits. The chloride ion detector tube is used for determining the salinity of the water washing the surface coating.

(1) Measuring apparatus

- Chloride ion detector tube (No. 201SA)
- Deionized water (or distilled water) 150 mℓ
- Gauze 30 × 30 cm
- Rubber glove
- Masking tape (approx. 20 mm width)
- Measuring scale
- Polyethylene beaker 250 mℓ

(2) Sampling procedure

- ① Mark off a division of 0.25m<sup>2</sup> (e.g. 50 × 50 cm) with masking tape after correctly measuring with a measuring scale.
  - ② Put on a rubber glove on a hand.
  - ③ Put 150 mℓ of deionized water into a polyethylene beaker.
  - ④ Wet gauze folded in a proper size with water in the beaker.
  - ⑤ Wipe the measuring surface in a parallel direction with wet gauze (see FIG. 4.15). Be sure not to drop water while wiping.
  - ⑥ Rinse the gauze in the water in the beaker. Repeat 5 and 6 three times.
- (3) Measuring procedure
- ① Cut off both ends of a chloride ion detector tube with a file. Put the detector tube into the sample water turning the arrow upward (see FIG. 4.16).
  - ② Take the detector tube out from the beaker when the water permeates up to the upper end of the reagent. Read the concentration at the end of discolored layer which has been developed by the salinity contained in the sample water.

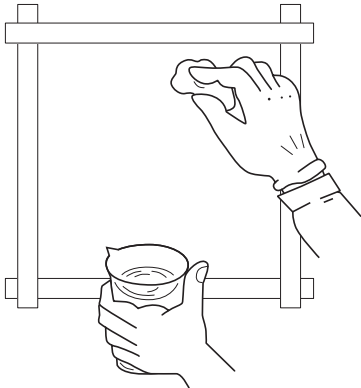


FIG.4.15 SALINITY SAMPLING

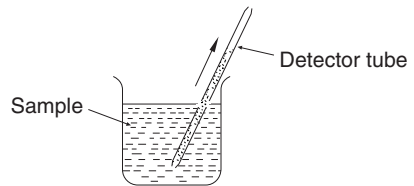


FIG.4.16 IMMERSION

- (4) Relationship between concentration of chloride ion and amount of salinity The relationship between concentration [ppm] of chloride ion and amount of salinity [mg/m<sup>3</sup>] is expressed by the following formula :

$$N = LC \times \frac{\text{NaCl}}{\text{Cl}} \times \frac{1}{M}$$

where N = amount of salinity mg/m<sup>2</sup> ; L = amount of deionized water [ℓ] ; C = concentration of chloride ion [ppm] [NaCl] = molecular weight of sodium chloride (58.5) ; Cl = molecular weight of chlorine (35.5) and M = area of salinity sampling [m<sup>2</sup>]. Using 0.15 for L, 0.25 for M and 58.5 and 35.5 for NaCl and Cl, respectively gives

$$N = 0.15 C \times \frac{58.5}{35.5} \times \frac{1}{0.25} \doteq C$$

The concentration of chloride ion [ppm] obtained by the detector tube is equal to the amount of salinity [mg/m<sup>2</sup>].

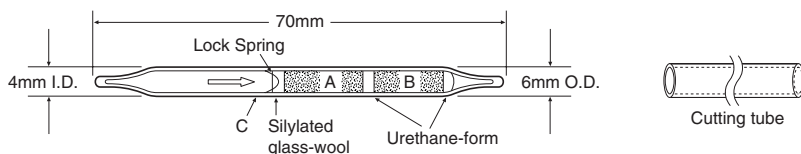
## 4.5 OTHER WORKING ENVIRONMENT MEASURING DEVICES

### 4.5.1 No. 800B CHARCOAL TUBE (CONFORMED TO NIOSH REQUIREMENTS)

A charcoal tube is used for sampling and measurement of organic solvents. Sample air containing vapour of organic solvents is passed through a glass tube packed with charcoal which adsorbs the solvent. Adsorbed solvent is recovered with desorption solvent leaching followed by gas-chromatographic analysis.

The charcoal tube consists of 10 to 30-mesh charcoal packed into a glass tube about 4 mm I.D., separated into front and back up sections of 100mg and 50mg, respectively. The ends of the tube are then fore-sealed by fusion as shown in FIG.4 17.

Every organic solvent has its own desorption efficiency as shown in Table 4.6.



- A : 100mg 20/40 mesh coconut shell charcoal (first section)
- B : 50mg 20/40 mesh coconut shell charcoal (back up section)

**Fig.4.17 No.800B Charcoal Tube**

**TABLE 4.6 DESORPTION EFFICIENCY**

Substance	Desorption Efficiency(%)	Desorption Solvent
Toluene	100	CS <sub>2</sub>
Trichloroethylene	100	∕
Acetone	69	∕
Iso-propanol	77	1 % of 2-Butanol in CS <sub>2</sub>
Butyl cellosolve	98	5 % of Methanol in Dichloromethane

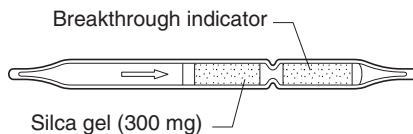
#### 4.5.2 No. 801 SILICA GEL TUBE

A silica gel tube is used for sampling organic solvents in environmental air, particularly for polar solvents such as methanol and acetone which cannot be sufficiently adsorbed onto charcoal. Organic solvent vapor is adsorbed onto the silica gel while passing through the tube. Adsorbed solvent is recovered with a desorption solvent followed by gas-chromatographic analysis.

The silica gel tube contains 20 to 40-mesh silica gel of 300 milligrams and a breakthrough indicator packed separately into the glass tube. The ends of the tube are fire sealed as shown in FIG. 4.18.

The breakthrough indicator was first introduced by Komyo. When sample air corresponding to 60 to 80 % of the amount causing breakthrough is passed, the colour begins to change from blue to pink by the moisture from the silica gel side predicting breakthrough.

Every organic solvent and every desorption solvent have their own recovery rates as shown in Table 4.7.



**FIG.4.18 SILICA GEL TUBE**

**TABLE 4.7 RECOVERY RATE OF SILICA GEL**

SUBSTANCE	DESORPTION SOLVENT	RECOVERY RATE(%)
Methanol	Distilled water 3 ml	90
IPA	Distilled water 3 ml	83
	DMF 2 ml	92
Acetone	Methanol 2 ml	98
MEK	DMF 2 ml	96
Ethyl acetate	DMF 2 ml	95
Toluene	Acetone 2 ml	99

### 4.5.3 AIR FLOW INDICATOR

There are many areas in work places where air flow must be examined for testing the performance of ventilating and exhaust systems. Although tobacco smoke and incense have been used for detecting air flow both have the problem of insufficient smoke or exclusion from use in fire-restricted areas. The air flow indicator develops smoke without combustion. The smoke is generated by the reaction of the reagent with the moisture contained in the air passing through the tube, (see FIG. 4.20).

(1) Special features

- ① Dry system with no need of a heat source
- ② Smoke is produced simply by squeezing the rubber bulb (Model AS-1)
- ③ Compact, lightweight and hand-held
- ④ Indicates the direction and velocity of air flow
- ⑤ Continuous Smoke production (Model AS-2)



FIG.4.20 MODEL AS-1 AIR FLOW INDICATOR

## 5. NUMERICAL INDEX WITH REFERENCES

TUBE NO.	NAME OF GAS TO BE DETECTED	SYNONYM	CHEMICAL FORMULA	T.L.V.-TWA (ppm)	T.L.V.-STEL (ppm)	LEL (%)	PAGE
100	CARBON MONOXIDE		CO	25(A), 30(B), 50(J)	300(B)	12.5	83
101S	ACETYLENE		HC CH			1.5	29
102SA	ACETONE		CH <sub>3</sub> COCH <sub>3</sub>	500(B), 200(A, J)	750(A), 1,500(B)	2.1	26
102SA©	TETRAHYDROFURAN			50(A, B), 200(J)	100(A)		323
102SC	ACETONE						27
102SD	/						28
103SA	SULPHUR DIOXIDE		SO <sub>2</sub>		0.25(A), 5(B)		310
103SB	/						311
103SC	/						312
103SD	/						313
103SE	/						314
103SF	SULPHUR DIOXIDE IN FLUE GAS						315
103SG	SULPHUR DIOXIDE IN CARBON DIOXIDE						316
104SA	ETHYL ALCOHOL	ETHANOL	C <sub>2</sub> H <sub>5</sub> OH	1,000(A, B)		3.5	139
105SA	AMMONIA		NH <sub>3</sub>	25(A, B, J)	35(A, B)	15.0	38
105SB	/						39
105SC	/						40
105SD	/						41
105SD	CYCLOHEXYL AMINE		C <sub>6</sub> H <sub>11</sub> NH <sub>2</sub>	10(A, B)			109
105SD©	Di-n-BUTYL AMINE						64
105SD©	n-BUTYL AMINE			5(J)	C 5(A)		65
105SD©	N, N-DIMETHYL ANILINE		C <sub>6</sub> H <sub>5</sub> N(CH <sub>3</sub> ) <sub>2</sub>	5(A, B, J)	10(A)		129
105SD©	n-METHYL ANILINE		C <sub>6</sub> H <sub>5</sub> NHCH <sub>3</sub>	0.5(A)			230
105SD©	MORPHOLINE		C <sub>4</sub> H <sub>9</sub> NO	20(A), 10(B)			259
105SD©	PENTYL AMINE		CH <sub>3</sub> (CH <sub>2</sub> ) <sub>4</sub> CH <sub>2</sub> NH <sub>2</sub>				280
105SD©	PROPYL AMINE		CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> NH <sub>2</sub>				297
105SD©	Di-iso-PROPYL AMINE		[(CH <sub>3</sub> ) <sub>2</sub> CH] <sub>2</sub> NH	5(A, B)			298
105SD©	Di-n-PROPYL AMINE						299
105SD	PYRIDINE		C <sub>5</sub> H <sub>5</sub> N	1(A), 5(J)		1.8	306
105SD©	o-TOLUIDINE		C <sub>6</sub> H <sub>4</sub> (CH <sub>3</sub> )(NH <sub>2</sub> )	2(A), 1(J)			329
105SD©	p-TOLUIDINE		C <sub>6</sub> H <sub>4</sub> (CH <sub>3</sub> )(NH <sub>2</sub> )	2(A)			330
105SE	AMMONIA						42
105SH	/						43
105SM	/						44
106B	CARBON MONOXIDE		CO	25(A), 30(B), 50(J)	300(B)	12.5	84
106C	/						85
106S	/						86
106SA	/						87
106SC	/						88
106SH	/						89
106SS	/						90
106UH	/						91
107SA	ETHYL ETHER	DIETHYL ETHER	(C <sub>2</sub> H <sub>5</sub> ) <sub>2</sub> O	400(A, J), 100(B)	500(A, B)	1.7	145
107U	/						146
108B	ETHYLENE		CH <sub>2</sub> =CH <sub>2</sub>	200(A)		2.7	147
108SA	/						148
108SC	/						149
109SA	CHLORINE		Cl <sub>2</sub>	0.5(A, B, J)	1(A, B)		94
109SB	/						95
109U	/						96
110S	GASOLINE	PETROL	C <sub>n</sub> H <sub>m</sub>	300(A), 100(J)	500(A)	1.0	168
111SA	ETHYL ACETATE		CH <sub>3</sub> CO <sub>2</sub> C <sub>2</sub> H <sub>5</sub>	400(A), 200(B, J)		2.1	136
111SA©	METHYL ACETATE		CH <sub>3</sub> CO <sub>2</sub> CH <sub>3</sub>	200(A, B, J)	250(A)		224
111U	ETHYL ACETATE						137
111U	ISOPROPYL ACETATE		CH <sub>3</sub> CO <sub>2</sub> CH(CH <sub>3</sub> ) <sub>2</sub>	100(A, J)	200(A, B)	1.8	211
111U©	tert-BUTANOL		(CH <sub>3</sub> ) <sub>3</sub> COH	100(A, B), 50(J)		2.4	60
111U©	BUTYL ETHER		(CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> ) <sub>2</sub> O				67
111U©	BUTYL METHACRYLATE		CH <sub>2</sub> =C(CH <sub>3</sub> )CO <sub>2</sub> C <sub>4</sub> H <sub>9</sub>			2	70
111U©	tert-BUTYL METHYL ETHER(MTBE)		CH <sub>3</sub> OC(CH <sub>3</sub> ) <sub>3</sub>	50(A), 25(B)		16.1	71

TUBE NO.	NAME OF GAS TO BE DETECTED	SYNONYM	CHEMICAL FORMULA	T.L.V.-TWA (ppm)	T.L.V.-STEL (ppm)	LEL (%)	PAGE
111U©	CUMENE		$C_9H_{10}CH(CH_3)_2$	50(A), 25(B)		0.8	104
111U©	CYCLOHEXENE		$C_6H_{10}$	300(A)		1.2	108
111U©	DECAHYDRONAPHTHALENE		$C_{10}H_{18}$				110
111U©	n-DECANE		$CH_3(CH_2)_8CH_3$				111
111U©	DIETHYL BENZENE		$C_6H_4(C_2H_5)_2$			0.8	125
111U©	ETHYL METHACRYLATE		$CH_2=C(CH_3)CO_2C_2H_5$			1.8	160
111U©	ISOPROPYL ETHER		$[(CH_3)_2CH]_2O$	250(A, B)	310(A)	1.4	215
111U©	n-NONANE		$CH_3(CH_2)_7CH_3$	200(A, J)			270
111U©	1,2,4-TRIMETHYL BENZENE			25(A, B, J)			337
111U©	n-UNDECANE		$CH_3(CH_2)_9CH_3$			0.7	339
112SA	HYDROGEN CYANIDE		HCN	5(J), 10(B)	C 4.7(A), 10(B)	5.6	179
112SB	◇						180
112SC	◇						181
113SA	n-HEXANE		$CH_3(CH_2)_4CH_3$	50(A), 20(B), 40(J)		1.1	172
113SB	◇						173
113SB©	HEPTANE		$CH_3(CH_2)_5CH_3$	400(A), 500(B), 200(J)	500(A)		171
113SB©	ISOBUTANE		$(CH_3)_3CH$				199
113SB©	ISOBUTYLENE						204
113SB©	METHYL CYCLOHEXANE		$C_6H_{11}(CH_3)$	400(A, J)			239
113SB©	2,2,4-TRIMETHYL PENTANE						338
113SB©	PENTANE		$CH_3(CH_2)_3CH_3$	600(A, B), 300(J)			278
113SC	n-HEXANE						174
114	BROMINE		$Br_2$	0.1(A, B, J)	0.2(A), 0.3(B)		52
115S	CYCLOHEXANE		$C_6H_{12}$	100(A, B), 150(J)	300(B)	1.2	105
116	CHLORINE DIOXIDE		$ClO_2$	0.1(A, B)	0.3(A, B)		97
117SA	NITROGEN DIOXIDE		$NO_2$	0.2(A)	5(A, B)		263
117SB	◇						264
117SD	◇						265
118SB	BENZENE		$C_6H_6$	0.5(A), 1(B), 10(J)	2.5(A)	1.2	48
118SC	◇						49
118SD	◇						50
118SE	◇						51
119LPG	METHYL ALCOHOL	METHANOL	$CH_3OH$	200(A, B, J)	250(A, B)	5.5	226
119SA	◇						227
119U	◇						228
119U©	1,4-DIOXANE			20(A), 25(B), 10(J)			133
120GR	HYDROGEN SULPHIDE		$H_2S$	1(A), 5(B, J)	5(A), 15(B)	4.0	186
120GT	◇						187
120SB	◇						188
120SC	◇						189
120SD	◇						190
120SE	◇						191
120SF	◇						192
120SH	◇						193
120SM	◇						194
120U	◇						195
120UH	◇						196
120UT	◇						197
121SA	PHOSPHINE IN ACETYLENE		$PH_3$	0.3(A, J), 0.1(B)	1(A), 0.3(B)		283
121SB	◇						284
121SC	PHOSPHINE						285
121SD	◇						286
121SG	◇						287
121SH	PHOSPHINE-high range						288
121SS	PHOSPHINE						289
121U	◇						290
121U	ARSINE		$AsH_3$	0.005(A), 0.05(B), 0.1(J)			47
122SA	ETHYLENE OXIDE		$CH_2CH_2O$	1(A, J), 5(B)		3.0	153
122SA©	FURAN	FURFURAN					165
122SA©	ISOPROPYL ALCOHOL	2-PROPANOL	$CH_3CH(OH)CH_3$	200(A), 400(J)	400(A)		212

TUBE NO.	NAME OF GAS TO BE DETECTED	SYNONYM	CHEMICAL FORMULA	T.L.V.-TWA (ppm)	T.L.V.-STEL (ppm)	LEL (%)	PAGE	
122SA©	METHYL ETHYL KETONE	2-BUTANONE	CH <sub>3</sub> COC <sub>2</sub> H <sub>5</sub>	200(A, B, J)	300(A)		242	
122SA©	METHYL ISOBUTYL KETONE	ISOPROPYL ACETONE	CH <sub>3</sub> COH <sub>2</sub> CH(CH <sub>3</sub> ) <sub>2</sub>	30(A), 50(B, J)	75(A)		247	
122SC	ETHYLENE OXIDE						154	
122SC©	PROPYLENE GLYCOL		CH <sub>3</sub> CH(OH)CH <sub>2</sub> OH	150(B)		2.6	301	
122SC©	PROPYLENE OXIDE		CH <sub>3</sub> CHCH <sub>2</sub> O	2(A), 5(B)		1.9	302	
122SL	∕						155	
122SM	∕						156	
123S	DIMETHYL ETHER	METHYL ETHER	CH <sub>3</sub> OCH <sub>3</sub>	400(B)		3.4	130	
124SA	TOLUENE	METHYL BENZENE	C <sub>6</sub> H <sub>5</sub> CH <sub>3</sub>	20(A, J), 50(B)	150(B)	1.2	326	
124SB	∕						327	
124SH	∕						328	
125SA	PROPANE		C <sub>3</sub> H <sub>8</sub>	1,000(A)		2.1	292	
126B	CARBON DIOXIDE		CO <sub>2</sub>	5,000(A, B, J)	30,000(A), 15,000(B)		73	
126SA	∕						74	
126SB	∕						75	
126SF	∕						76	
126SG	∕						77	
126SH	∕						78	
126UH	∕						79	
128SA	ACRYLONITRILE	VINYL CYANIDE	CH <sub>2</sub> =CHCN	2(A, B, J)		2.8	33	
128SB	∕						34	
128SC	∕						35	
128SD	∕						36	
129	NICKEL CARBONYL	NICKEL TETRACARBONYL	Ni(CO) <sub>4</sub>	0.05(A), 0.001(J)		2.0	261	
130U	tert-BUTYL MERCAPTAN		(CH <sub>3</sub> ) <sub>3</sub> C <sub>2</sub> SH	0.5(A)			68	
130U	ETHYL MERCAPTAN	ETHANETHIOL	C <sub>2</sub> H <sub>5</sub> SH	0.5(A, B)	2(B)	2.8	159	
130U	ISOPROPYL MERCAPTAN		(CH <sub>3</sub> ) <sub>2</sub> CHSH				216	
130U	METHYL MERCAPTAN	METHANETHIOL	CH <sub>3</sub> SH	0.5(A, B)		3.9	254	
130U	n-PROPYL MERCAPTAN		CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> SH				305	
131	INORGANIC GAS QUALITATIVE DETECTOR TUBE							355
132SA	VINYL CHLORIDE	CHLOROETHYLENE	CH <sub>2</sub> =CHCl	1(A), 3(B), 2.5(J)		3.6	342	
132SB	∕						343	
132SC	∕						344	
133A	ACETALDEHYDE		CH <sub>3</sub> CHO	20(B), 50(J)	C 25(A)	40.0	22	
133SB	∕						23	
134SA	TRICHLOROETHYLENE		Cl <sub>2</sub> C=CHCl	10(A), 100(B), 25(J)	25(A), 150(B)	8.0	332	
134SB	∕						333	
134SG	∕						334	
135SA	TETRACHLOROETHYLENE	PERCHLOROETHYLENE	Cl <sub>2</sub> C=CCl <sub>2</sub>	25(A), 50(B)	100(A), 150(B)		318	
135SB	∕						319	
135SG	∕						320	
135SM	∕						321	
136	ACROLEIN	ALLYL ALDEHYDE	CH <sub>2</sub> CHCHO	0.1(B, J)	C 0.1(A)	2.8	31	
137U	HYDROGEN		H <sub>2</sub>			4.0	176	
138U	BUTYL ACETATE		CH <sub>3</sub> CO <sub>2</sub> C <sub>4</sub> H <sub>9</sub>	150(A, B), 100(J)	200(A, B)		62	
139SB	METHYL ETHYL KETONE	2-BUTANONE	CH <sub>3</sub> COC <sub>2</sub> H <sub>5</sub>	200(A, B, J)	300(A, B)	1.7	243	
139SB©	BUTYL ACETATE		CH <sub>3</sub> CO <sub>2</sub> C <sub>4</sub> H <sub>9</sub>	150(A, B), 100(J)	200(A, B)		61	
139SB©	1,4-DIOXANE			20(A), 25(B), 10(J)			132	
139SB©	ISOBUTYL ACETATE		CH <sub>3</sub> CO <sub>2</sub> CH <sub>2</sub> CH(CH <sub>3</sub> ) <sub>2</sub>	150(A, B)			200	
139SB©	ISOPROPYL ACETATE		CH <sub>3</sub> CO <sub>2</sub> CH(CH <sub>3</sub> ) <sub>2</sub>	100(A, J)	200(A)		210	
139SB©	PROPYL ACETATE		CH <sub>3</sub> CO <sub>2</sub> (CH <sub>2</sub> ) <sub>2</sub> CH <sub>3</sub>	200(A, B, J)	250(A)		295	
139U	METHYL ETHYL KETONE						244	
139U	METHYL PROPYL KETONE		CH <sub>3</sub> CO(CH <sub>2</sub> ) <sub>2</sub> CH <sub>3</sub>		150(A)		256	
139U©	DIISOBUTYL KETONE		[(CH <sub>3</sub> ) <sub>2</sub> CHCH <sub>2</sub> ] <sub>2</sub> CO	25(A)			126	
140SA	ARSINE		AsH <sub>3</sub>	0.005(A, B), 0.1(J)			46	
141SA	CARBON DISULPHIDE		CS <sub>2</sub>	1(A), 10(B, J)		1.0	80	
141SB	∕						81	
141SC	∕						82	
142S	MERCURY VAPOUR		Hg	0.025mg/m <sup>3</sup> (A, J)	0.15mg/m <sup>3</sup> (B)		220	
143SA	XYLENE	DIMETHYL BENZENE	C <sub>6</sub> H <sub>4</sub> (CH <sub>3</sub> ) <sub>2</sub>	100(A), 50(B, J)	150(A, B)	1.1	350	

TUBE NO.	NAME OF GAS TO BE DETECTED	SYNONYM	CHEMICAL FORMULA	T.L.V.-TWA (ppm)	T.L.V.-STEL (ppm)	LEL (%)	PAGE
143SB	XYLENE						351
145SA	1, 2-DICHLOROETHYLENE	ACETYLENE DICHLORIDE	CHCl = CHCl	200(A, B), 150(J)	250(B)	9.7	119
146S	PHOSGENE	CARBONYL CHLORIDE	COCl <sub>2</sub>	0.1(A, J), 0.02(B)			282
147S	CARBON TETRACHLORIDE	TETRACHLOROMETHANE	CCl <sub>4</sub>	5(A, J), 2(B)	10(A)		92
150U	ISOPROPYL ALCOHOL	2-PROPANOL	CH <sub>3</sub> CH(OH)CH <sub>3</sub>	200(A), 400(J)	400(A), 500(B)	2.0	213
151U	PROPYL ACETATE		CH <sub>3</sub> CO <sub>2</sub> C <sub>3</sub> H <sub>7</sub>	200(A, B, J)	250(A, B)	1.7	296
152S	CHLOROFORM	TRICHLOROMETHANE	CHCl <sub>3</sub>	10(A), 2(B), 3(J)			99
153U	ISOBUTYL ACETATE		CH <sub>3</sub> CO <sub>2</sub> CH <sub>2</sub> CH(CH <sub>3</sub> ) <sub>2</sub>	150(A, B)	187(B)	2.4	201
153U©	NAPHTHALENE		C <sub>10</sub> H <sub>8</sub>	5(A)	15(A)		260
155U	METHYL ISOBUTYL KETONE	ISOPROPYL ACETONE, HEXONE	(CH <sub>3</sub> ) <sub>2</sub> CHCH <sub>2</sub> COCH <sub>3</sub>	50(A, B, J)	75(A)	1.2	248
156S	HYDROGEN FLUORIDE		HF	0.5(A), 1.8(B), 3(J)	C 2(A), 3(B)		183
157JS	METHYL BROMIDE	BROMOMETHANE	CH <sub>3</sub> Br	1(A, J), 5(B)	15(B)	10.0	231
157SA	∕						232
157SB	∕						233
157SD	∕						234
158S	STYRENE	VINYL BENZENE	C <sub>8</sub> H <sub>8</sub> CH = CH <sub>2</sub>	20(A, J), 100(B)	40(A), 250(B)	1.1	308
158S©	α-PINENE		C <sub>10</sub> H <sub>16</sub>				291
158S©	DIVINYL BENZENE		C <sub>8</sub> H <sub>8</sub> (CHCH <sub>2</sub> ) <sub>2</sub>	10(A)		1.1	134
158SB	STYRENE						309
159SA	OXYGEN		O <sub>2</sub>				272
159SB	∕						272
159SC	∕						273
160S	METHYL CHLOROFORM	1,1,1-TRICHLOROETHANE	CH <sub>3</sub> CCl <sub>3</sub>	350(A), 100(B), 200(J)	450(A, B)		238
162U	TETRAHYDROFURAN		C <sub>4</sub> H <sub>8</sub> O	50(A,B), 200(J)	100(A), 250(B)	1.5	324
163SA	PROPYLENE OXIDE	1,2-EPOXYPROPANE	C <sub>3</sub> H <sub>6</sub> O	2(A), 5(B)		1.9	303
163SD	∕						304
164SA	METHYL MERCAPTAN	METHANETHIOL	CH <sub>3</sub> SH	0.5(A,B)		3.9	252
164SH	∕						253
165SA	ETHYL MERCAPTAN	ETHANETHIOL	C <sub>2</sub> H <sub>5</sub> SH	0.5(A,B)	2(B)	2.8	157
165SB	∕						158
165SB	tert-BUTYL MERCAPTAN		(CH <sub>3</sub> ) <sub>3</sub> CSH				69
166S	ETHYLENE DIBROMIDE	1,2-DIBROMOETHANE	BrCH <sub>2</sub> CH <sub>2</sub> Br	0.5(B)			150
167S	HYDROGEN SELENIDE		H <sub>2</sub> Se	0.05(A,J), 0.02(B)			185
168SA	1,3-BUTADIENE		CH <sub>2</sub> = CHCH = CH <sub>2</sub>	2(A), 10(B)		1.1	53
168SB	∕						54
168SC	∕						55
168SE	∕						56
169S	CHLOROPRENE	2-CHLOROBUTADIENE	CH <sub>2</sub> = CClCH = CH <sub>2</sub>	10(A)		4.0	101
171SA	FORMALDEHYDE		HCHO	2(B), 0.5(J)	C 0.3(A), 2(B)	7.0	161
171SB	∕						162
171SC	∕						163
172S	CHLOROPICRIN	NITRO-TRICHLOROMETHANE	Cl <sub>3</sub> CNO <sub>2</sub>	0.1(A, J)			100
173SA	HYDROGEN CHLORIDE		HCl	1(B), 5(J)	C 2(A), 5(B)		177
173SB	∕						178
174A	NITROGEN OXIDE/DIOXIDE		NO & NO <sub>2</sub>	NO ; 25(A) NO <sub>2</sub> ; 3(A)	NO ; 35(B) NO <sub>2</sub> ; 5(A, B)		266
174B	-SEPARATELY						
175SA	NITROGEN OXIDES		NO <sub>x</sub>				267
175SH	∕						268
175U	∕						269
176SC	METHYL IODIDE	IODOMETHANE	CH <sub>3</sub> I	2(A, B)			245
176UH	∕						246
177SA	WATER VAPOUR		H <sub>2</sub> O				345
177U	∕						346
177UL	∕						347
177UR	∕						348
177UR2	∕						349
178SB	CHLOROBENZENE		C <sub>6</sub> H <sub>5</sub> Cl	10(A, J), 1(B)		1.3	98
179S	ETHYL BENZENE		C <sub>8</sub> H <sub>8</sub> C <sub>2</sub> H <sub>5</sub>	20(A), 100(B), 50(J)	125(A, B)		141
180S	DICHLOROMETHANE	METHYLENE CHLORIDE	CH <sub>2</sub> Cl <sub>2</sub>	50(A, J), 100(B)			120
181S	ANILINE	AMINO BENZENE	C <sub>6</sub> H <sub>5</sub> NH <sub>2</sub>	2(A), 1(B, J)		1.3	45



TUBE NO.	NAME OF GAS TO BE DETECTED	SYNONYM	CHEMICAL FORMULA	T.L.V.-TWA (ppm)	T.L.V.-STEL (ppm)	LEL (%)	PAGE	
182SA	OZONE		O <sub>3</sub>	0.05 (A), 0.1 (J)	0.3 (B)		275	
182SB	∅						276	
182U	∅						277	
183U	CRESOL		C <sub>6</sub> H <sub>4</sub> (CH <sub>3</sub> )OH	20mg/m <sup>3</sup> (A), 5 (J)		1.1	102	
183U	PHENOL		C <sub>6</sub> H <sub>5</sub> OH	5 (A, J), 2 (B)	10 (B)	1.8	281	
184S	METHYL METHACRYLATE		CH <sub>2</sub> = C (CH <sub>3</sub> ) CO <sub>2</sub> CH <sub>3</sub>	50 (A, B)	100 (A), 125 (B)	2.1	255	
184S©	ALLYL ALCOHOL		CH <sub>2</sub> = CHCH <sub>2</sub> OH	0.5 (A), 2 (B), 1 (J)	4 (B)	2.5	37	
185S	PROPYLENE		CH <sub>2</sub> = CHCH <sub>3</sub>	500 (A)			300	
186	ORGANIC GAS CHECKER						271	
186B	ORGANIC GAS QUALITATAIVE DETECTOR TUBE							358
187S	GENERAL HYDROCARBONS	i-C <sub>4</sub> H <sub>10</sub> , n-C <sub>5</sub> H <sub>12</sub> , n-C <sub>6</sub> H <sub>14</sub> , n-C <sub>7</sub> H <sub>16</sub> , C <sub>8</sub> H <sub>18</sub> , Mineral Turpentine					169	
188U	ISOPENTYL ACETATE	ISOAMYL ACETATE	CH <sub>3</sub> CO <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH(CH <sub>3</sub> ) <sub>2</sub>	50 (A), 100 (B, J)	100 (A), 125 (B)	1.1	206	
189U	2-BUTANOL	sec-BUTYL ALCOHOL	CH <sub>3</sub> CH <sub>2</sub> CH(OH)CH <sub>3</sub>	100 (A, B, J)		1.7	59	
190U	ETHYL CELLOSOLVE	ETHYLENE GLYCOL MONOETHYL ETHER/ 2-ETHOXYETHANOL	C <sub>2</sub> H <sub>5</sub> OCH <sub>2</sub> CH <sub>2</sub> OH	5 (A, J), 10 (B)		1.8	143	
190U	METHYL CELLOSOLVE	ETHYLENE GLYCOL MONOMETHYL ETHER/ 2-METHOXYETHANOL	CH <sub>3</sub> OCH <sub>2</sub> CH <sub>2</sub> OH	0.1 (A), 5 (B, J)		2.3	236	
190U©	BUTYL CELLOSOLVE	ETHYLENE GLYCOL MONOBUTYL ETHER/ 2-BUTOXYETHANOL	C <sub>4</sub> H <sub>9</sub> OCH <sub>2</sub> CH <sub>2</sub> OH	20 (A), 25 (B)		1.1	66	
190U©	1-BUTANOL	n-BUTYL ALCOHOL	CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub>	20 (A), 50 (J)	C50 (A)		58	
190U©	CROTONALDEHYDE		CH <sub>3</sub> CH = CHCHO		C0.3 (A)	2.1	103	
190U©	DIACETONE ALCOHOL			50 (A, B)			112	
190U©	DICYCLOPENTADIENE		C <sub>10</sub> H <sub>12</sub>	5 (A, B)			123	
190U©	ETHYL CELLOSOLVE ACETATE	ETHYLENE GLYCOL ETHYL ETHER ACETATE	CH <sub>3</sub> CO <sub>2</sub> CH <sub>2</sub> OC <sub>2</sub> H <sub>5</sub>	5 (A, J), 10 (B)		1.7	144	
190U©	FURFURAL	(2-FURALDEHYDE)		2 (A, B), 2.5 (J)			166	
190U©	ISOPRENE		CH <sub>2</sub> = C (CH <sub>3</sub> ) CH = CH <sub>2</sub>				209	
190U©	ISOPROPYL CELLOSOLVE		(CH <sub>3</sub> ) <sub>2</sub> HCO (CH <sub>2</sub> ) <sub>2</sub> OH				214	
190U©	MESITYL OXIDE	4-METHYL-3-PENTEN-2-ONE	CH <sub>3</sub> COCH = C (CH <sub>3</sub> ) <sub>2</sub>	15 (A), 50 (B)	25 (A)		221	
190U©	METHYL CELLOSOLVE ACETATE		CH <sub>3</sub> CO <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> OCH <sub>3</sub>	0.1 (A, J)			237	
190U©	1-PROPANOL		CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> OH	100 (A), 200 (B)		2.1	293	
190U©	TETRAHYDROTHIOPHENE		C <sub>4</sub> H <sub>8</sub> S			1.1	325	
192S	EPICHLOROHYDRIN	1-CHLORO-2,3-EPOXYPROPANE	CH <sub>2</sub> CHCH <sub>2</sub> ClO	0.5 (A, B)		2.3	135	
193S	METHYL STYRENE		CH <sub>3</sub> C <sub>6</sub> H <sub>4</sub> CH = CH <sub>2</sub>	5 (A)	150 (B)	1.9	257	
194S	1,3-DICHLOROPROPANE		ClCH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> Cl			93	121	
196S	N,N-DIMETHYL FORMAMIDE		HCON (CH <sub>3</sub> ) <sub>2</sub>	10 (A, B, J)	20 (B)		131	
197U	CYCLOHEXANONE		C <sub>6</sub> H <sub>10</sub> O	20 (A), 25 (J), 10 (B)	50 (A), 100 (B)	1.1	107	
197U©	ISOPHORONE		C <sub>9</sub> H <sub>16</sub> O		C5 (A)	0.8	208	
197U©	1-METHOXY-2-PROPANOL		CH <sub>3</sub> CHOCH <sub>2</sub> OCH <sub>3</sub>	50 (A, B)	150 (A)	1.9	223	
198U	METHYL CYCLOHEXANONE		CH <sub>3</sub> C <sub>6</sub> H <sub>9</sub> O	50 (A, B, J)	75 (A, B)	1.15	240	
199U	METHYL CYCLOHEXANOL		CH <sub>3</sub> C <sub>6</sub> H <sub>11</sub> OH	50 (A, B, J)	75 (B)	1.0	241	
200SA	SULPHIDE ION		S <sup>2-</sup>				380	
200SB	∅						381	
201SA	CHLORIDE ION		Cl <sup>-</sup>				373	
201SB	∅						374	
201SC	∅						375	
203S	COPPER ION		Cu <sup>2+</sup>				376	
204S	CYANIDE ION		CN <sup>-</sup>				377	
205SL	SALINITY		NaCl				379	
206U	CYCLOHEXANOL		C <sub>6</sub> H <sub>11</sub> OH	50 (A, B), 25 (J)		1.2	106	
208U	ISOBUTYL ALCOHOL	ISOBUTANOL	(CH <sub>3</sub> ) <sub>2</sub> CHCH <sub>2</sub> OH	50 (A, B, J)		1.7	203	
209U	ISOPENTYL ALCOHOL	ISOAMYL ALCOHOL	(CH <sub>3</sub> ) <sub>2</sub> CH (CH <sub>2</sub> ) <sub>2</sub> OH	100 (A, B, J)	125 (A)	1.2	207	
210U	PENTYL ACETATE	AMYL ACETATE	CH <sub>3</sub> CO <sub>2</sub> (CH <sub>2</sub> ) <sub>4</sub> CH <sub>3</sub>	50 (A, B), 100 (J)	100 (A), 150 (B)	1.0	279	
211U	BUTYL ACRYLATE		CH <sub>2</sub> = CHCO <sub>2</sub> (CH <sub>2</sub> ) <sub>3</sub> CH <sub>3</sub>	2 (A), 1 (B)		1.5	63	
211U	METHYL ACRYLATE		CH <sub>2</sub> = CHCO <sub>2</sub> CH <sub>3</sub>	2 (A)		2.4	225	
211U©	ETHYL ACRYLATE		CH <sub>2</sub> = CHCO <sub>2</sub> C <sub>2</sub> H <sub>5</sub>	5 (A, B)	15 (A)		138	
211U©	ISOBUTYL ACRYLATE		CH <sub>2</sub> = CHCO <sub>2</sub> CH <sub>2</sub> CH(CH <sub>3</sub> ) <sub>2</sub>				202	

TUBE NO.	NAME OF GAS TO BE DETECTED	SYNONYM	CHEMICAL FORMULA	T.L.V.-TWA (ppm)	T.L.V.-STEL (ppm)	LEL (%)	PAGE
213S	TRIETHYL AMINE		(C <sub>2</sub> H <sub>5</sub> ) <sub>3</sub> N	1(A), 2(B)	3(A), 15(B)	1.2	335
214S	o-DICHLOROBENZENE	1,2-DICHLOROBENZENE	C <sub>6</sub> H <sub>4</sub> Cl <sub>2</sub>	25(A, B, J)	50(A)	2.2	114
215S	p-DICHLOROBENZENE	1,4-DICHLOROBENZENE	C <sub>6</sub> H <sub>4</sub> Cl <sub>2</sub>	10(A, J), 25(B)	50(B)		115
216S	ACETIC ACID		CH <sub>3</sub> COOH	10(A, B, J)	15(A, B)	4.0	24
216S	FORMIC ACID		HCOOH	5(A, B, J)	10(A)		164
216S	MALEIC ANHYDRIDE		C <sub>4</sub> H <sub>2</sub> O <sub>3</sub>	0.01mg/m <sup>3</sup> (A)			219
216S©	ACETIC ANHYDRIDE		(CH <sub>3</sub> CO) <sub>2</sub> O	1(A), 5(J), 0.5(B)			25
216S©	ACRYLIC ACID		CH <sub>2</sub> =CHCOOH	2(A)			32
216S©	BUTYRIC ACID		CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> COOH				72
216S©	ISOBUTYRIC ACID		CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> COOH				205
216S©	ISOVALERIC ACID		(CH <sub>3</sub> ) <sub>2</sub> CHCH <sub>2</sub> COOH				218
216S©	METHACRYLIC ACID		CH <sub>2</sub> =C(CH <sub>3</sub> )COOH	20(A, B)			222
216S©	PROPIONIC ACID		CH <sub>3</sub> CH <sub>2</sub> COOH	10(A, B)			294
216S©	n-VALERIC ACID		CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub> CO <sub>2</sub> H				340
219S	HYDRAZINE	AMIDRAZONE	NH <sub>2</sub> NH <sub>2</sub>	0.01(A), 0.02(B), 0.1(J)		4.7	175
221SA	n-BUTANE		C <sub>4</sub> H <sub>10</sub>	1,000(A), 600(B), 500(J)	750(B)	1.5	57
222S	DIETHYL AMINE		(C <sub>2</sub> H <sub>5</sub> ) <sub>2</sub> NH	5(A, B), 10(J)	15(A), 25(B)	1.8	124
222S	TRIMETHYL AMINE		(CH <sub>3</sub> ) <sub>3</sub> N	5(A), 2(B)	15(A, B)	2.0	336
222S©	ISOPROPYLAMINE		(CH <sub>3</sub> ) <sub>2</sub> CHNH <sub>2</sub>	5(A)	10(A)	2.0	217
223S	2,2'-DICHLOROETHYL ETHER		(ClCH <sub>2</sub> CH <sub>2</sub> ) <sub>2</sub> O	5(A), 15(J)	10(A)		118
224SA	MONOETHANOL AMINE	2-AMINOETHANOL	H <sub>2</sub> NCH <sub>2</sub> CH <sub>2</sub> OH	3(A, J), 1(B)	6(A, B)	2.1	258
227S	DIMETHYL AMINE		(CH <sub>3</sub> ) <sub>2</sub> NH	5(A), 2(B), 10(J)	15(A)	2.8	128
227S	ETHYL AMINE		CH <sub>3</sub> CH <sub>2</sub> NH <sub>2</sub>	5(A), 2(B), 10(J)	15(A)	3.5	140
227S	METHYL AMINE		CH <sub>3</sub> NH <sub>2</sub>	5(A), 10(J)	15(A)	5	229
229S	N,N-DIMETHYL ACETAMIDE		CH <sub>3</sub> CON(CH <sub>3</sub> ) <sub>2</sub>	10(A, B, J)	20(B)		127
230SA	1,2-DICHLOROETHANE	ETHYLIDENE DICHLORIDE	ClCH <sub>2</sub> CH <sub>2</sub> Cl	10(A, J), 5(B)		6.2	117
232SA	ETHYLENE GLYCOL						151
232SB	ETHYLENE GLYCOL	MONOETHYLENE GLYCOL	HOCH <sub>2</sub> CH <sub>2</sub> OH		C100mg/m <sup>3</sup> (A)	3.2	152
233S	NITRIC ACID VAPOUR		HNO <sub>3</sub>	2(A, J)	4(A, B)		262
234SA	FREE RESIDUAL CHLORINE		Cl <sub>2</sub>				378
235SA	1,1-DICHLOROETHANE	ETHYLIDENE CHLORIDE	CH <sub>3</sub> CHCl <sub>2</sub>	100(A, B, J)	400(B)	5.6	116
236SA	1,1,2-TRICHLOROETHANE		Cl <sub>2</sub> CHCH <sub>2</sub> Cl	10(A, J)			331
237S	VINYL ACETATE		CH <sub>3</sub> CO <sub>2</sub> CH=CH <sub>2</sub>	10(A)	15(A), 20(B)	2.6	341
237S©	METHYL BUTYL KETONE		CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub> COCH <sub>3</sub>	5(A, B, J)	10(A)	1.2	235
238S	FURFURYL ALCOHOL	2-FURYL CARBINOL	C <sub>4</sub> H <sub>6</sub> OCH <sub>2</sub> OH	10(A), 5(B, J)	15(A, B)	1.8	167
239S	CARBONYL SULPHIDE	CARBON OXY SULPHIDE	COS	5(A)		12	93
240S	SILANE	MONOSILANE	SiH <sub>4</sub>	5(A), 0.5(B), 100(J)	1.5(B)		307
242S	DIBORANE	BOROETHANE	B <sub>2</sub> H <sub>6</sub>	0.1(A), 0.01(J)		0.9	113
242S©	HYDROGEN SELENIDE		H <sub>2</sub> Se	0.05(A, J), 0.02(B)			182
243U	TETRAETHOXYSILANE		Si(O <sub>2</sub> C <sub>2</sub> H <sub>5</sub> ) <sub>4</sub>	10(J)			322
244U	SULPHURIC ACID		H <sub>2</sub> SO <sub>4</sub>	0.2mg/m <sup>3</sup> (A), 1mg/m <sup>3</sup> (J)			317
245UH	METHYL ISOTHIOCYANATE		CH <sub>3</sub> NCS	0.02(A)			249
245UL	∕						250
245UM	∕						251
247S	HYDROGEN PEROXIDE		H <sub>2</sub> O <sub>2</sub>	1(A, B)			184
248U	ETHYL-tert-BUTYL ETHER		C <sub>2</sub> H <sub>5</sub> OOC(CH <sub>3</sub> ) <sub>3</sub>	25(A)		1.2	142
249S	1,3-DICHLOROPROPENE		ClCH <sub>2</sub> -CH=CHCl	1(A)		5.3	122
280S	ACETYLENE · ETHYLENE-SEPARATION MEASUREMENT						30
281S	OXYGEN · CARBON DIOXIDE-SEPARATION MEASUREMENT			CO <sub>2</sub> 5,000(A, B, J)			274
282S	HYDROGEN SULPHIDE · MERCAPTANS-SEPARATION MEASUREMENT						198
301	AIR FLOW INDICATOR TUBE						417
500	TWA-CARBON MONOXIDE		CO	25(A), 30(B), 50(J)	300(B)	12.5	366
501	TWA-AMMONIA		NH <sub>3</sub>	25(A, B, J)	35(A, B)	15.0	367
502	TWA-HYDROGEN SULPHIDE		H <sub>2</sub> S	1(A), 5(B, J)	5(A), 15(B)	4.3	368
503	TWA-SULPHUR DIOXIDE		SO <sub>2</sub>		0.25(A), 5(B)		369
504	TWA-TOLUENE	TWA-METHYL BENZENE	C <sub>6</sub> H <sub>5</sub> CH <sub>3</sub>	20(A), 50(B, J)	150(B)		371
600SP	COMPRESSED BRETHING AIR TEST TUBE(CO)						384
601SP	COMPRESSED BRETHING AIR TEST TUBE(CO <sub>2</sub> )						385
602SP	COMPRESSED BRETHING AIR TEST TUBE(OIL MIST)						386
603SPA	COMPRESSED BRETHING AIR TEST TUBE(H <sub>2</sub> O)						387

TUBE NO.	NAME OF GAS TO BE DETECTED	SYNONYM	CHEMICAL FORMULA	T.L.V.-TWA (ppm)	T.L.V.-STEL (ppm)	LEL (%)	PAGE
604SP	COMPRESSED BRETHING AIR TEST TUBE(O <sub>2</sub> )						388
710	FORMALDEHYDE						390
710A	◇						391
713	◇						392
721	TOLUENE						393
721◎	ETHYL BENZENE						394
721◎	XYLENE						395
730	p-DICHLOROBENZENE						396
740	NITROGEN DIOXIDE						398
750	TRICHLOROETHYLENE						399
760	TETRACHLOROETHYLENE						400
800B	CHARCOAL TUBE (CONFORMED TO NIOSH REQUIREMENTS)						415
801	SILICA-GEL TUBE						416
900NH	AMMONIA						402
901NHL	◇						403

\* Additionally, refer to page 315 for the conversion chart method.

### (NOTE)

- T.L.V. (A) : Threshold Limit Value for Chemical Substances in the Work Environment Adopted by ACGIH (American Governmental Industrial Hygienists, Inc.) with Intended Change for 2012
- T.L.V. (B) : Occupational Exposure Limits Listed Guidance Note EH 40/2007 from the Health and Safety Executive in U. K.
- T.L.V. (J) : Occupational Exposure Limits (OELs) recommended in Journal of Occupational Health issued by the Japan Society for Occupational Health in 2011
- T.L.V. -TWA (The Threshold Limit Value-Time Weighted Average) : the time-weighted average concentration for a 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect
- T.L.V. -STEL (The Threshold Limit Value-Short Term Exposure Limit) : the concentration to which workers can be exposed continuously for a short period of time without suffering from 1) irritation, 2) chronic or irreversible tissue damage, or 3) narcosis of sufficient degree to increase the likelihood of accidental injury, impair self-rescue or materially reduce work efficiency, and provided that the daily T. L. V.-TWA is not exceeded. It is not a separate independent exposure limit, rather it supplements the time-weighted average (TWA) limit where there are recognized acute effects from a substance whose toxic effects are primarily of a chronic nature. STELs are recommended only where toxic effects have been reported from high short-term exposures in either humans or animals. The period of the short term is defined as 15 minutes in U.S.A. and 10 minutes in U. K. The Japanese STELs are advised that a 15-minute average exposure concentration does not exceed 1.5 times of the 8-hour TWA.
- T.L.V. -STEL (C) (Threshold Limit Value-Ceiling) : the concentration that should not be exceeded during any part of the working exposure.
- LEL (vol.%) : Lower Explosive Limit-refer from “Recommended Practice for Explosion Protected Electrical Installations in General Industries” written by Ministry of Labour in Japan



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