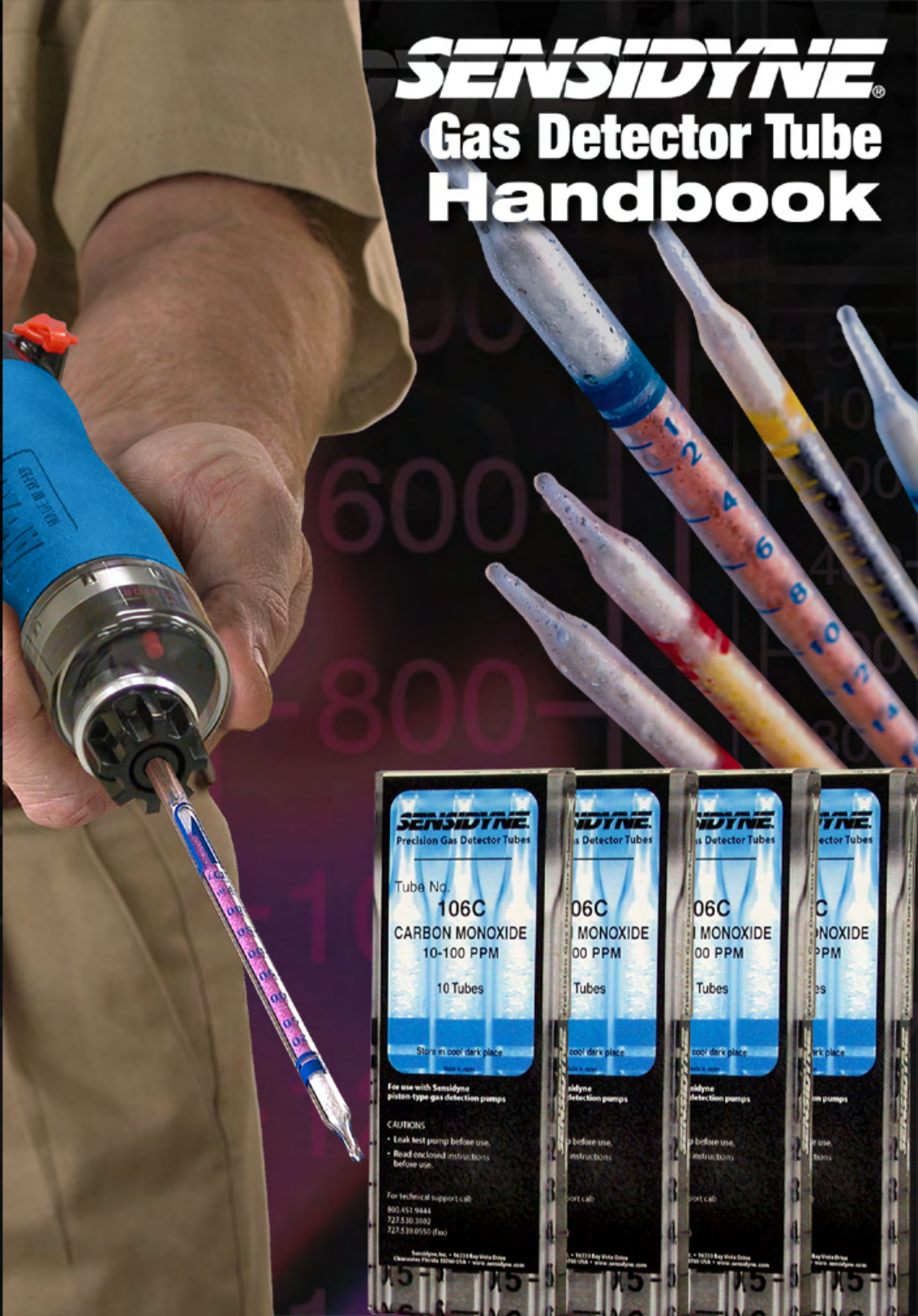
SENSIDYNE®

Gas Detector Tube Handbook



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 as 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.

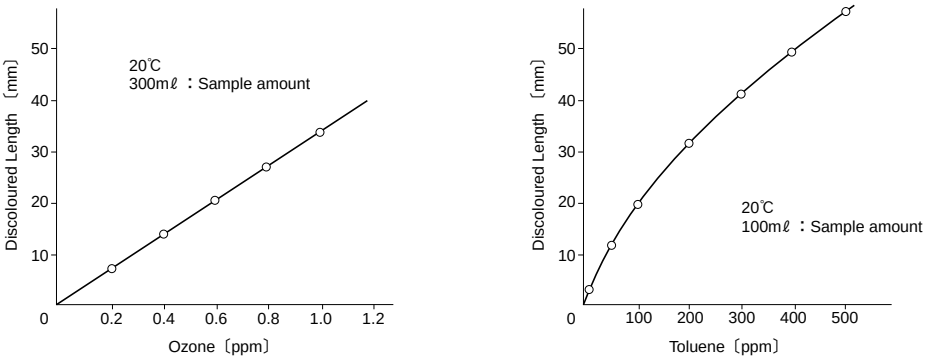


FIG. 1.1 DISCOLOURED LENGTH VS. GAS

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 absorbed 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 tor 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 concentraton. 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℃（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℃ and 10℃（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.

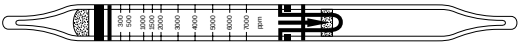


FIG. 2.1 DIRECT READING TUBE

（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.

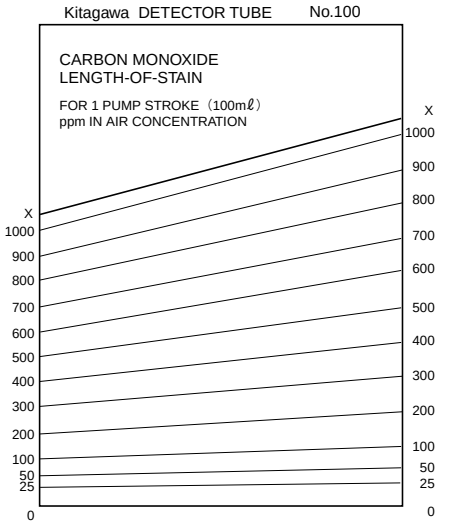
2.1.3 COLOUR INTENSITY TUBES

When a gas or vapour with little reactivity or a low reaction rate is detected, tube discolouration 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.



Temperature Correction Table					
Chart Readings (ppm)	Correction Table（ppm）				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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

FIG.2.2 CONCENTRATION CHART

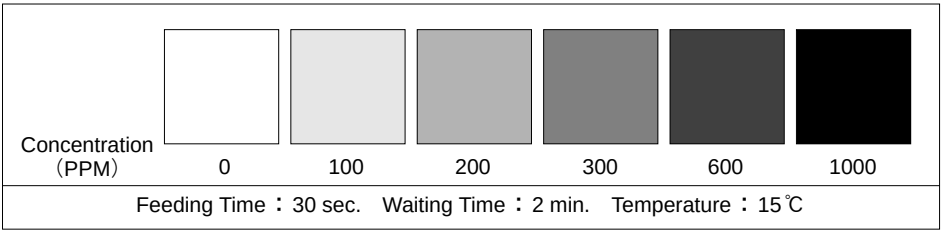


FIG.2.3 COLOUR STANDARD CHART

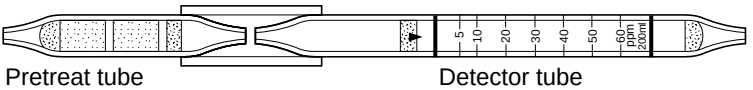


FIG.2.4 CONNECTION WITH PRETREAT TUBE

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）

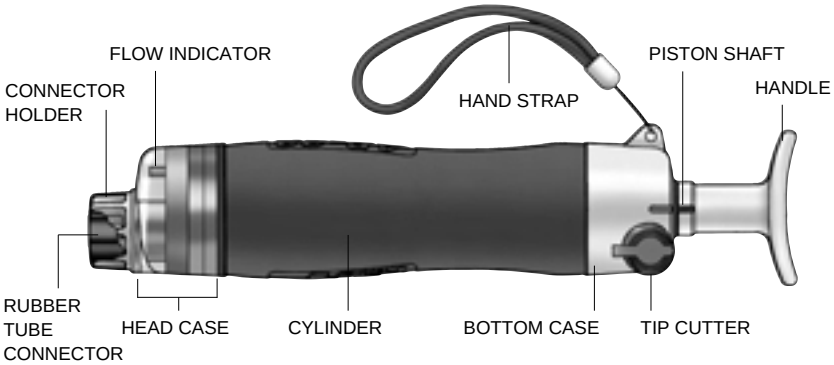


FIG.2.6 CONSTRUCTION AND PART NAMES

(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.

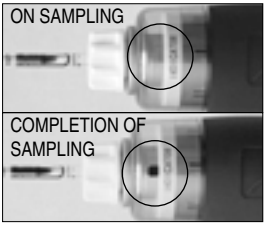


FIG.2.7 SAMPLE FLOW INDICATOR

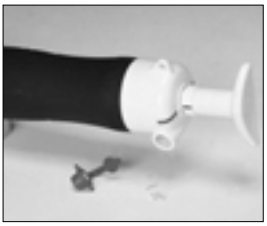


FIG.2.8 TIP STORAGE

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.

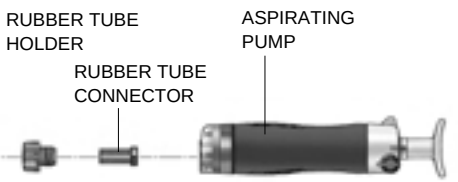


FIG. 2.10 RUBBER TUBE CONNECTOR

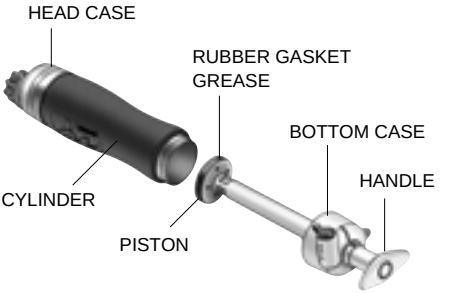


FIG. 2.11 TO REMOVE THE PISTON

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

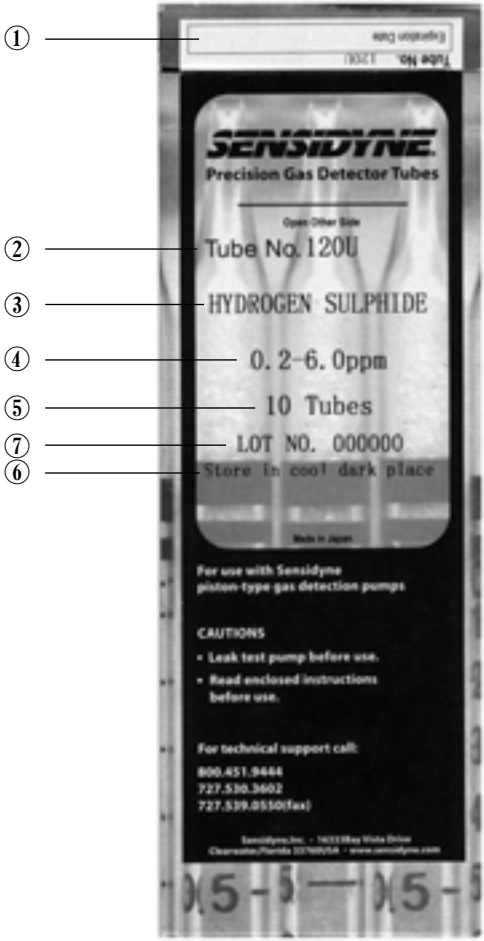


FIG. 2.12 DETECTOR TUBE BOX

INSTRUCTION MANUAL No.126SA
Kitagawa CARBON DIOXIDE DETECTOR TUBES

★READ CAREFULLY THIS INSTRUCTION MANUAL AND THE INSTRUCTIONS OF THE ASPIRATING PUMP PRIOR TO USING THIS PRODUCT.

★DON'T DISCARD THIS INSTRUCTION MANUAL UNTIL ALL THE TUBES IN THIS BOX ARE USED UP.

① **1. PERFORMANCE：**

Measuring Range and Sampling Time:	0.1 - 2.6％ (1 pump stroke) (5 minutrs)	0.2 - 5.2％ (1/2 pump strokes) (2.5 minutrs)

Graduations on the detector tube are based on 1 pump stroke.

Colour Change:	Purple blue→ Pale pink
Detectable Limit:	0.01％(100 ppm)
Operating temperature:	0-40℃ (32-104°F) (Temperature correction is necessary.)
Aspirating Pump	Model AP-20, AP-1, AP-1S or 400A

CAUTION !

1. DETECTOR TUBE CONTAINS REAGENTS.
2. DON'T TOUCH THESE REAGENTS DIRECTLY ONCE TUBES ARE BROKEN.
3. KEEP THE TUBES OUT OF THE REACH OF CHILDREN.

NOTICE

1. USE ONLY WITH PUMP MODELS AP-20, AP-1, AP-1S OR 400A. OTHERWISE,CONSIDERABLE ERROR IN INDICATION MAY OCCUR.
2. DON'T USE FLOW CONTROL ORIFICE WITH THIS TUBE. (FOR MORE DETAIL, REFER TO THE INSTRUCTIONS OF THE ASPIRATING PUMP.)
3. BEFORE TESTING, CHECK THE ASPIRATING PUMP FOR LEAKS (REF. ITEM 8).ANY PUMPS SHOWING SIGNS OF LEAKAGE SHOULD BE CORRECTED BEFORE USE.
4. DON'T USE THIS TUBE OUTSIDE THE STATED OPERATING TEMPERATURE RANGE.
5. STORE TUBES IN A COOL AND DARK PLACE (0-25℃/32-77°F), AND USE BEFORE EXPIRATION DATE PRINTED ON TOP OF THE BOX.
6. PRIOR TO USE, READ CAREFULLY ITEM 9 "USER RESPONSIBILITY".

② **2. SAMPLING AND MEASUREMENT：**

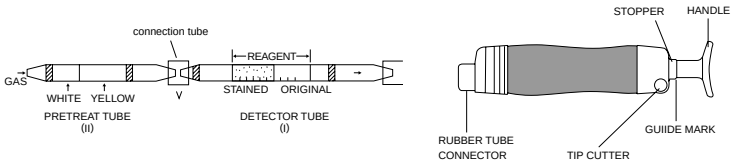


Fig. 1

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 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 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 instructions of the pump).
⑤ On completion of sampling, read the scale at the maximum point of the stained layer.
⑥ If the discolouration is over the full scale (2.6%), 1/2 (50ml) pump strokes sampling is available. Insert the new detector tube into the pump inlet and pull the pump handle at 1/2 pump strokes (to 50ml line), it will be automatically locked. Leave it for 1.5 minutes as it is.
⑦ Remove the detector tube from the pump and read the concentration.
⑧ Then multiply the reading value by 2.

SPECIAL NOTE：

I. The scale is calibrated at 20℃ (68°F) and 1013hPa. Readings obtained in other circumstances should be corrected (REF. ITEM 3).
II. When the maximum point of the stained layer is unclear, 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.

	Temperature Correction Table				
Tube Readings (%)	Corrected Concentration (%)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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 are necessary.
③ Atmospheric Pressure;

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

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 discolouerd.
$CO_2 + 2NaOH \rightarrow Na_2CO_3 + H_2O$

⑥ **6. DISPOSAL OF TUBE：**

USED TUBES SHOULD BE DISCARDED 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, 2000.

⑧ **8. INSPECTION OF ASPIRATING PUMP：**

Checking for leaks:
① Insert 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 and wait for 3 minutes.
④ Unlock the handle and allow it to return slowly into the pump by holding the cylinder and handle securely.
⑤ If the handle returns completely to the original position, the performance is satisfactory.

CAUTION! HANDLE WILL TEND TO SNAP BACK INTO THE PUMP QUICKLY

Otherwise, refer to maintenance procedure in the pump instructions to correct the fault.

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-1, AP-1S or 400A aspirating pump, and that detector tubes are not used which are either beyond their expiration date or have a colour change different to that stated in the Per- formance specifications.
The Manufacturer and Manufacturer's Distributor shall not be otherwise liable for any incorrect measurement or any damages, whether damages result from negligence or otherwise.

Printed in Japan

IME1260

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.

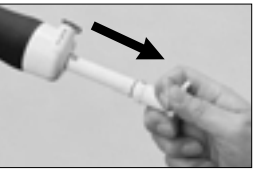
Insert the tip of the gas detector tube into the tip cutter and scratch the tip of tube by rotating it for one revolution, then pull it toward you. (The glass tip can be thrown away by removing the tip cutter cap.)

(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.

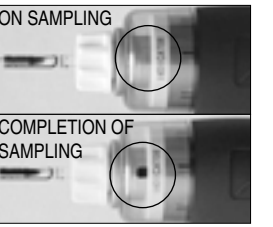
(4) Pull the handle.

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.



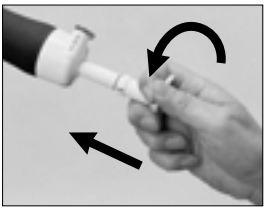
(5) Draw the sample gas.

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.

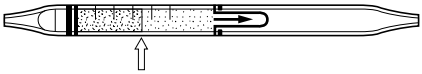


FIG. 2.19 READOUT OF DIRECT READING TUBE

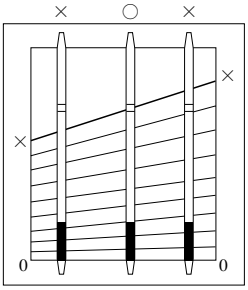


FIG. 2.20
READOUT OF CONCENTRATION CHART TUBE

2.3.3 CORRECTION

(1) Temperature correction

As graduations showing the concentration of gas on the gas detector tube are generally calibrated at 20℃, 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℃ 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 ℃, the true concentration is 470 ppm.

Scale Readings (ppm)	True Concentration (ppm)				
	0 ℃ (32° F)	10 ℃ (50° F)	20 ℃ (68° F)	30 ℃ (86° F)	40 ℃ (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 ℃, 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 ℃ (32° F)	10 ℃ (50° F)	20 ℃ (68° F)	30 ℃ (86° F)	40 ℃ (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 ℃	(25 ℃)	30 ℃
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.

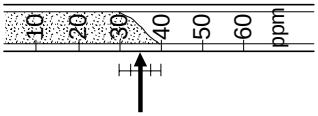


FIG. 2.23 OBLIQUE LAYER (Channeling)

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.

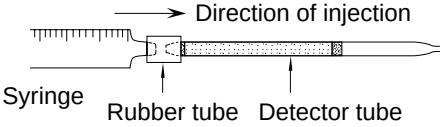


FIG. 2.24 INJECTION METHOD

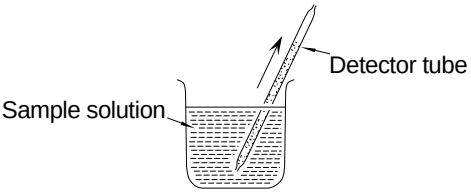


FIG. 2.25 IMMERSION METHOD

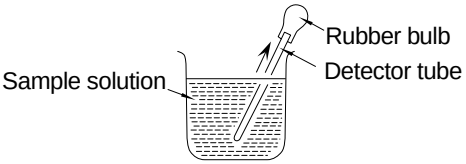


FIG. 2.26 DIRECT SAMPLING METHOD

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.

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

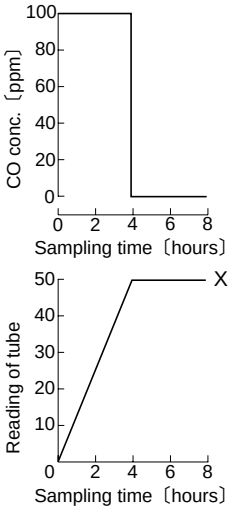


FIG. 2.27 SAMPLE DELIVERY MODE A

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

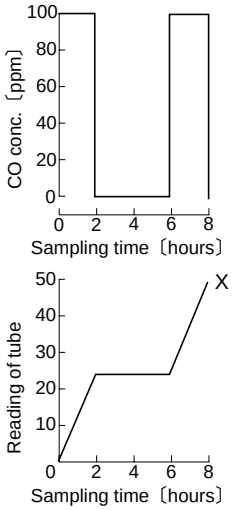


FIG. 2.28 SAMPLE DELIVERY MODE B

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

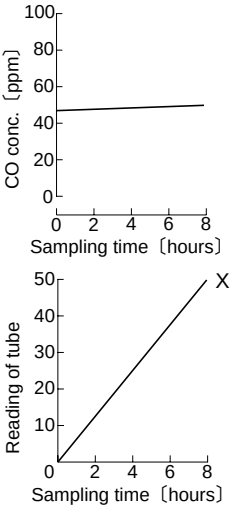


FIG. 2.29 SAMPLE DELIVERY MODE C

$$\text{TWA value} = \frac{50 \times 8}{8} = 50 \text{ ppm}$$

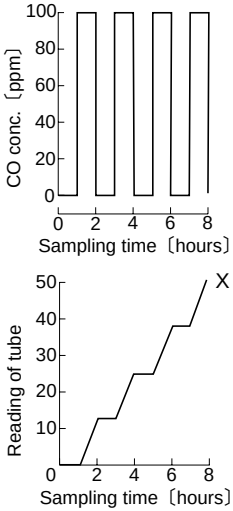


FIG. 2.30 SAMPLE DELIVERY MODE D

$$\text{TWA value} = \frac{0\times1+100\times1+0\times1+100\times1+0\times1+100\times1+0\times1+100\times1}{8} = 50 \text{ ppm}$$

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 quantitatvie or qualitative analysis.

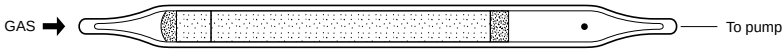
© MARK

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.

SHORT-TERM DETECTOR TUBES

Tube No.
133A

ACETALDEHYDE



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 : 5 ppm
4) Shelf life : 1 year (Necessary to store in a refrigerated place ; 0 ~ 10 ℃)
5) Operating temperature : 0 ~ 40 ℃
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.

$CH_3CHO + NH_2OH \cdot HCI \rightarrow HCI + CH_3CH : NOH + H_2O$

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	〃
Sulphur dioxide		〃	10	〃

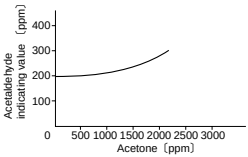


FIG.1 Influence of Acetone

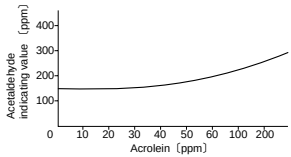
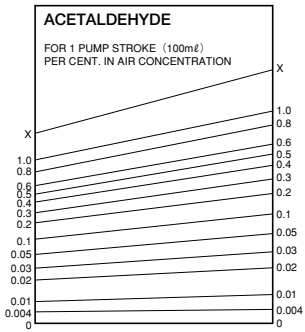


FIG.2 Influence of Acrolein

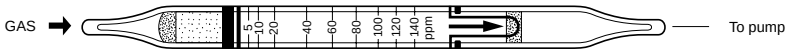


TEMPERATURE CORRECTION TABLE

Chart Readings (%)	True Concentration (%)				
	0℃ (32° F)	10℃ (50° F)	20℃ (68° F)	30℃ (86° F)	40℃ (104° F)
1.0		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

Tube No.
133SB

ACETALDEHYDE



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 a refrigerated place ; 0 ~ 10℃)
5) Operating temperature : 10 ~ 40℃
6) Operating humidity : 20 ~ 80 % R.H.
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.

$$CH_3CHO + (NH_2OH)_3 \cdot H_3PO_4 \rightarrow H_3PO_4 + CH_3CH = NOH + H_2O$$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Other Aldehydes	Similar atain is produced.	Higher readings are given.
Ketones	〃	〃
Ethanol FIG. 1	The accuracy of readings is not affected.	〃

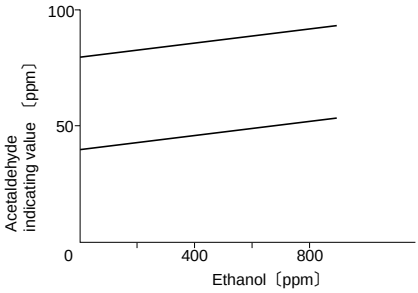
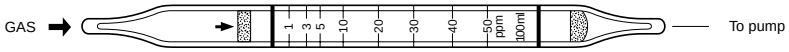


FIG.1 Influence of Ethanol

Tube No.
216S

ACETIC ACID



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℃
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.

$CH_3COOH + NaOH \rightarrow CH_3CO_2Na + H_2O$

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 × Acetic acid	Higher readings are given.
Nitrogen dioxide	300	〃	10	Unclear stain is produced.
Hydrogen chloride FIG.1		Pink stain is produced.	2 × Acetic acid	Higher readings are given.
Chlorine FIG.2		Yellow stain is produced.	5	〃

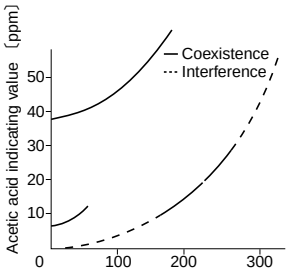


FIG.1 Influence of Hydrogen chloride

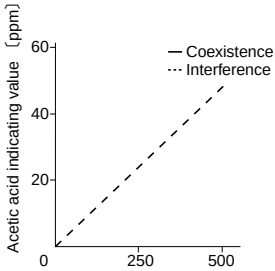


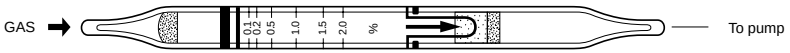
FIG.2 Influence of Chlorine

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32˚F)	10℃ (50˚F)	20℃ (68˚F)	30℃ (86˚F)	40℃ (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

Tube No.
102SA

ACETONE



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 : 200 ppm
4) Shelf life : 3 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 : Orange → brown

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

Chromium oxide is reduced.

$CH_3COCH_3 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

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.	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 theTEMPERATURE CORRECTION TABLE first . and convert the value into an actual concentration by uing the conversion scale shown in the instruction sheet.

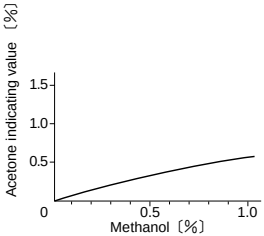


FIG.1 Influence of Methanol

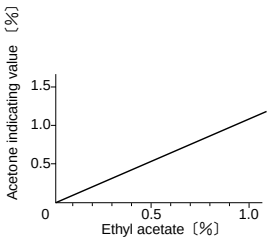
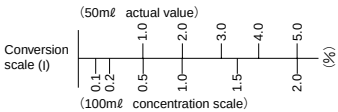


FIG.2 Influence of Ethyl acetate

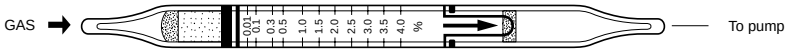
TEMPERATURE CORRECTION TABLE

Scale Readings (%)	True Concentration (%)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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
0.1	0.16	0.12	0.10	0.08	0.08



Tube No.
102SC

ACETONE



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 : 10 ppm
4) Shelf life : 1 year (Necessary to store in a refrigerated place ; 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 : 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 acidfied, and PH indicator is discoloured.

$$CH_3COCH_3 + NH_2OH \cdot HCI \rightarrow HCI + (CH_3)_2C = NOH + H_2O$$

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

Scale Readings (%)	True Concentration (%)				
	0 ℃ (32 ° F)	10 ℃ (50 ° F)	20 ℃ (68 ° F)	30 ℃ (86 ° F)	40 ℃ (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

Tube No.
102SD

ACETONE

1. PERFORMANCE

1) Measuring range	: 250-5,000 ppm	100-2,000 ppm	40-800 ppm
Number of pump strokes	1/2 (50mℓ)	1 (100mℓ)	2 (200mℓ)

2) Sampling time : 1.5 minutes/1 pump stroke
3) Detectable limit : 20 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.

$CH_3COCH_3 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

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	〃	〃
Paraffin hydrocarbons (more than C_3)	〃	If the top of discoloured layer is possible to read, the accuracy of readings is not affected.
Halogenated hydrocarbons	〃	〃

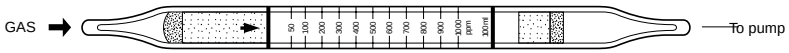
(NOTE)
In case of 1/2 or 2 pump strokes, following formula is available for the actual concentration.
1/2 stroke : Actual concentration = 2.5 × Temperature corrected value
2 strokes : Actual concentration = 0.4 × Temperature corrected value

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0 ℃ (32 ° F)	10 ℃ (50 ° F)	20 ℃ (68 ° F)	30 ℃ (86 ° F)	40 ℃ (104 ° F)
2,000	—	2,800	2,000	1,600	1,300
1,500	4,000	2,000	1,500	1,250	1,000
1,000	1,750	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

Tube No.
101S

ACETYLENE



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 ℃
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

Molybadate is reduced and molybdeum blue is produced.

$$HC \equiv CH + PdSO_4 + (NH_4)_2MoO_4 \rightarrow Mo_3O_8$$

4. CALIBRATION OF THE TUBE

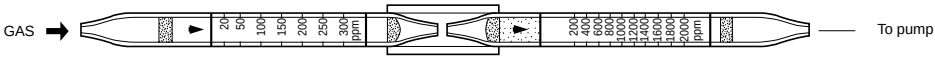
STANDARD GAS CYLINDER METHOD

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 ℃)	〃	10 %	Whole layer is discoloured to Blue 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_3)	〃		〃
Butadiene	Original colour is faded to white.	25	Original colour is faded toWhite 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	〃		〃
Benzene	〃		〃

Tube No.
280S

ACETYLENE · ETHYLENE



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 ℃

6) Temperature compensation ：

Acetylene	No temperature correction is necessary.
Ethylene	Necessary（refer to "Table 2. Temperature CorrectionTable"）

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 ：$C_2H_2 + K_2Pd(SO_3)_2 \rightarrow Pd$

Ethylene detector tube ：$C_2H_2 + PdSO_4 + (NH_4)_2Mo_3O_5$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

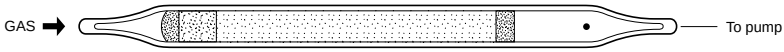
5. INTERFERENCE AND CROSS SENSITIVITY

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (%)		
	10 ℃ (50° F)	20 ℃ (68° F)	30 ℃ (86° F) 40 ℃ (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

Tube No.
136

ACROLEIN



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 : 5 ppm
4) Shelf life : 1 year (Necessary to store in refrigerated place ; 0～10℃)
5) Operating temperature : 0～40℃
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.

$CH_2 = CHCHO + NH_2OH \cdot HCI \rightarrow HCI + CH_2 = CHCH = NOH + H_2O$

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	〃

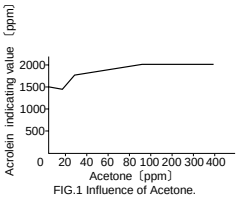


FIG.1 Influence of Acetone.

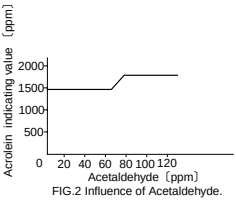


FIG.2 Influence of Acetaldehyde.

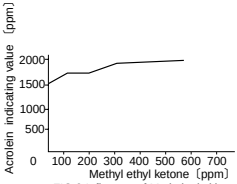
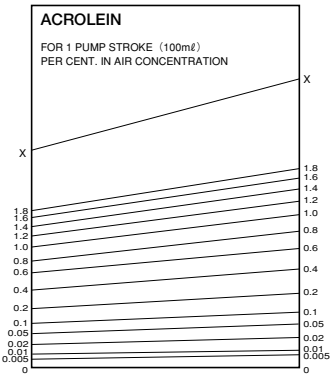


FIG.3 Influence of Methyl ethyl ketone.

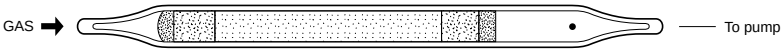
TEMPERATURE CORRECTION TABLE

Scale Readings (%)	True Concentration (%)				
	0℃ (32˚F)	10℃ (50˚F)	20℃ (68˚F)	30℃ (86˚F)	40℃ (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



Tube No.
128B

ACRYLONITRILE



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 : 1 ppm
4) Shelf life : 3 years
5) Operating temperature : 0～40℃
6) Reading : Concentration chart method
7) Colour change : Orange→Brown

2. RELATIVE STANDARD DEVIATION

RSD-low：15％ RSD-mid：15％ RSD-high：10％

3. CHEMICAL REACTION

Chromium oxide is reduced.

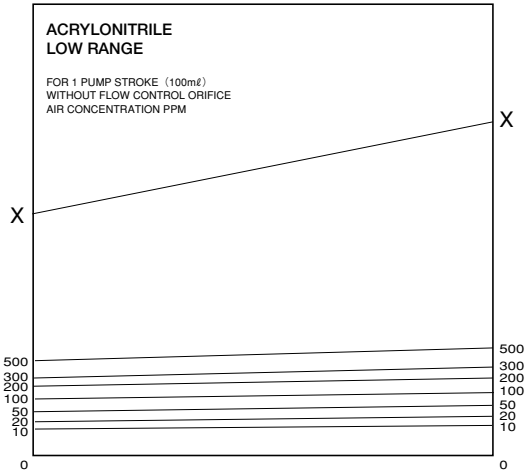
$CH_2=CHCN + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

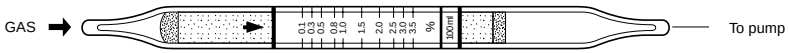
5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Acetylene	Similar stain is produced.	3％	Higher readings are given.
Propane	〃	0.2％	〃
Other organic gases or vapours except Halogenated hydrocarbons	〃	50	〃



Tube No.
128SA

ACRYLONITRILE



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 : 10 ppm
4) Shelf life : 3 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 : Orange → Dark green

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

Chromium oxide is reduced.

$CH_2 = CHCN + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

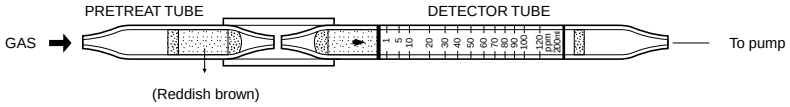
Substance	Interference	ppm	Coexistence
Acetylene	Whole layer is discoloured to Brown.	3%	Whole layer is discoloured to Brown and higher readings are given.
Propane	〃	0.2%	〃
Other organic gases or vapours except Halogenated hydrocarbons	Similar stain is produced.	50	Higher readings are given.

TEMPERATURE CORRECTION TABLE

Scale Readings (%)	True Concentration (%)				
	0℃ (32˚F)	10℃ (50˚F)	20℃ (68˚F)	30℃ (86˚F)	40℃ (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

Tube No.
128SC

ACRYLONITRILE



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 (200mℓ)
4) Shelf life : 1 year (Necessary to store in refrigerated place ; 0 ~ 10℃)
5) Operating temperature : 0 ~ 40℃
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.

$CH_2 = CHCN + CrO_3 + H_2SO_4 \rightarrow HCN$

$HCN + HgCI_2 \rightarrow HCI + Hg(CN)_2$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

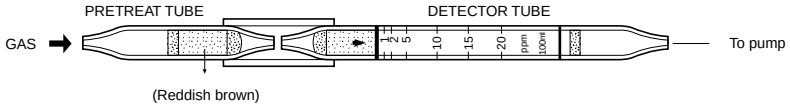
Substance	Interference	ppm	Coexistence
Hydrogen cyanide	Similar stain is produced.	2	Higher readings are given.
Methyl ethyl ketone		600	Lower readings are given.
Styrene		less than 250	The accuracy of readings is not affected.
Butadiene		200	Lower readings are given.

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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

Tube No.
128SD

ACRYLONITRILE



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 place ; 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 : 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.

$CH_2 = CHCN + CrO_3 + H_2SO_4 \rightarrow HCN$

$HCN + HgCI_2 \rightarrow HCI$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Butadiene		Less than 350 ppm	Not affected.
Toluene		Less than 600 ppm	〃
Hexane		Less than 800 ppm	〃
Styrene		Less than 720 ppm	〃

(NOTE)

In case of 2 to 5 pump strokes can be used to detemine the lower concentration.
Following formula is available for actual concentration.

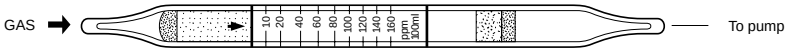
$$\text{Actual concentration} = \text{Tmperature corrected value} \times \frac{1}{\text{Number of strokes}}$$

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32˚F)	10℃ (50˚F)	20℃ (68˚F)	30℃ (86˚F)	40℃ (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

Tube No.
184Sⓒ

ALLYL ALCOHOL



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 ℃
6) Temperature compensation : Necessary (10 ~ 40 ℃) (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 converstion chart.
8) Colour change : Pale yellow → Pale blue

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

Chromium oxide is reduced.

$$H_2C=CHCH_2OH + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

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	〃	〃
Paraffin hydrocarbons (more than C_3)	Whole reagent is changed to Brown.	〃
Aromatic hydrocarbons	〃	〃
Esters	〃	〃
Ketones	〃	〃
Halogenated hydrocarbons FIG.1	〃	〃

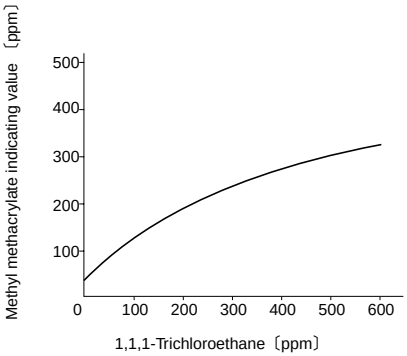
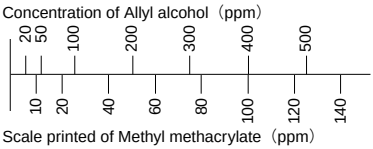


FIG.1 Influence of 1,1,1-Trichloroentane

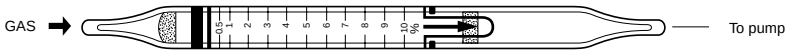
TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0 ℃ (32 ° F)	10 ℃ (50 ° F)	20 ℃ (68 ° F)	30 ℃ (86 ° F)	40 ℃ (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



Tube No.
105SA

AMMONIA



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 : 400 ppm
4) Shelf life : 3 years
5) Operating temperature : 0 ~ 40 ℃
6) Reading : Direct reading from the scale calibrated by 1 pump stroke
7) Colour change : Pink → Gray or 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.

$3NH_3 + H_3PO_4 \rightarrow (NH_4)_3PO_4$

4. CALIBRATION OF THE TUBE

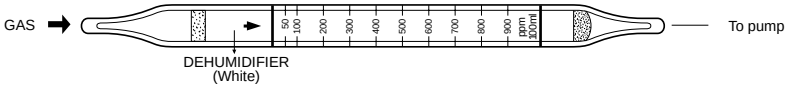
STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

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

Tube No.
105SB

AMMONIA



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℃
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.

$2NH_3 + H_3PO_4 \rightarrow (NH_4)_2PO_4$

4. CALIBRATION OF THE TUBE

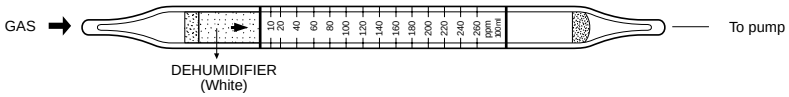
STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Amines	Similar stain is produced.		Higher readings are given.
Chlorine		2	Lower readings are given.
Sulphur dioxide		NH_3conc.×1/4	〃

Tube No.
105SC

AMMONIA



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℃
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.

$2NH_3 + H_3PO_4 \rightarrow (NH_4)_2PO_4$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

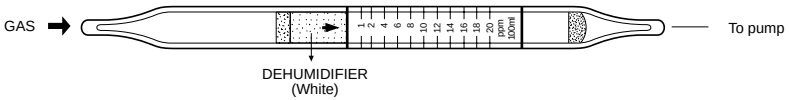
Substance	Interference	ppm	Coexistence
Amines	Similar stain is produced.		Higher readings are given.
Sulphur dioxide		NH_3conc.×1/3	Lower readings are given.
Chlorine		2	〃

(NOTE)

In case of 2 strokes, the following equation is available for the actual concentration.
Actual concentration = 1/2 × Reading value.

Tube No.
105SD

AMMONIA



1. PERFORMANCE

1) Measuring range	: 1-20 ppm	0.2-1 ppm
Number of pump strokes	1 (100mℓ)	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 ℃	
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.

$2NH_3 + H_3PO_4 \rightarrow (NH_4)_2PO_4$

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.

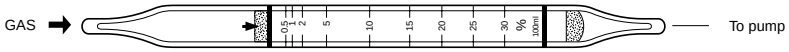
(NOTE)

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

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

Tube No.
105SH

AMMONIA



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 : 100 ppm
4) Shelf life : 3 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 : 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.

$NH_3 + \alpha CoCl_2 + \beta H_2O \rightarrow CoCl_2 \cdot \alpha NH_3 \cdot \beta H_2O$

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 top of discoloured layer is possible to read, the accuracy of readings is not affected.
Amines				The accuracy of readings is not affected.

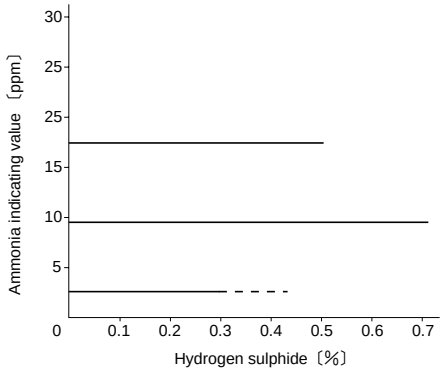
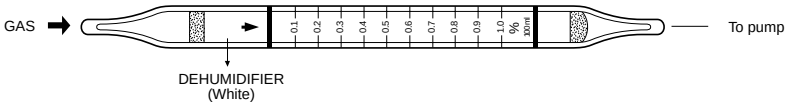


FIG.1 Influence of Hydrogen sulphide

TEMPERATURE CORRECTION TABLE

Scale Readings (%)	True Concentration (%)				
	0 ℃ (32 °F)	10 ℃ (50 °F)	20 ℃ (68 °F)	30 ℃ (86 °F)	40 ℃ (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

Tube No.
105SM AMMONIA



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 : 100 ppm
4) Shelf life : 2 years
5) Operating temperature : 0 ~ 40 ℃
6) Reading : Direct reading from the scale calibrated by 1 pump stroke
7) Colour change : Pale purple → 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.

$2NH_3 + H_3PO_4 \rightarrow (NH_4)_2PO_4$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

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

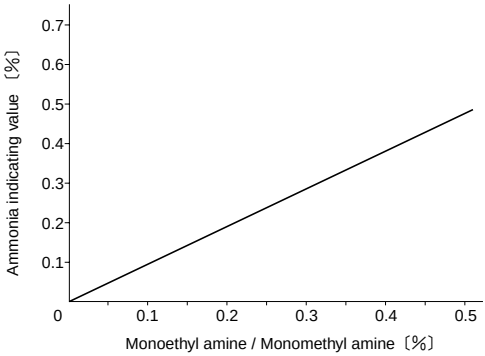
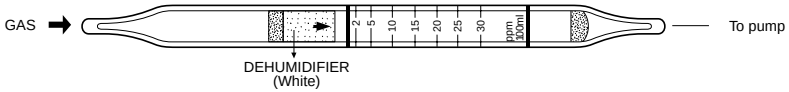


FIG.1 Influence of Monoethyl amine / Monomethyl amine

Tube No.
181S

ANILINE



1. PERFORMANCE

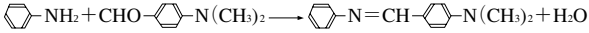
1) Measuring range : 2-30 ppm 1-15 ppm
   Number of pump strokes 1(100mℓ) 2(200mℓ)
2) Sampling time : 0.5 minutes/1 pump stroke
3) Detectable limit : 0.05 ppm(200mℓ)
4) Shelf life : 2 years
5) Operating temperature : 0～40℃
6) Reading : Direct reading from the scale calibrated by 1 pump stroke
7) Colour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

COLOURIMETRY 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 strokes, following formula is available for the actual concentration.
Actual concentration = 1/2 × Reading value.

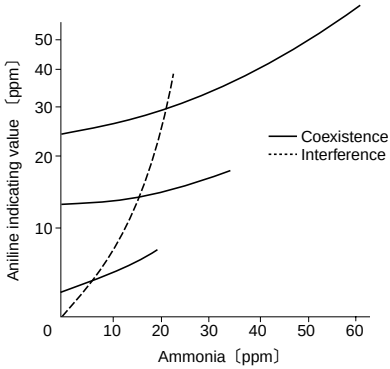
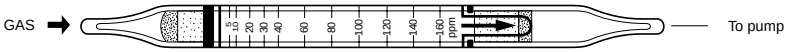


FIG.1 Influence of Ammonia

Tube No.
140SA ARSINE



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℃
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.

$AsH_3 + HgCl_2 + H_2O \rightarrow Hg + H_3AsO_3 + HCl$

4. CALIBRATION OF THE TUBE

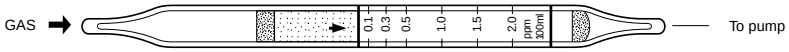
STANDARD GAS CYLINDER METHOD

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	〃

Tube No.
121U

ARSINE



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℃
6) Reading : Although the scale of this tube is calibrated based on Phosphine at 1 pump stroke, the sensitivity of Arsine is completely same.
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.

$AsH_3 + HgCl_2 \rightarrow As(HgCl)_3 + HCl$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

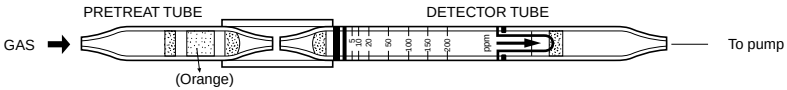
Substance	Interference	Coexistence
Hydrogen selenide	Similar stain is produced.	Higher readings are given.
Mercaptans	〃	〃
Hydrogen sulphide	〃	〃
Hydrogen cyanide	Whole reagent is changed to Red.	〃
Sulphur dioxide	Whole reagent is changed toPale red, but Purplish red stainindicates Arsine concentration.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

(NOTE)

This tube scale is calibrated based on Phosphine and the same scale is available for Arsine.
When the concentration is below 0.5 ppm , 2 pump strokes can be used to detemine the lower concentration.
Following formula is available for the actual concentration.
Actual concentration = 1/2 × Reading value

Tube No.
118SB

BENZENE



1. PERFORMANCE

1) Measuring range : 5-200 ppm
   Number of pump strokes 1 (100mℓ)
2) Sampling time : 3 minutes/1 pump stroke
3) Detectable limit : 3 ppm
4) Shelf life : 2 years
5) Operating temperature : 10 ~ 40 ℃
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.

$$C_6H_6 + I_2O_5 + H_2SO_4 \rightarrow I_2$$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	ppm	Coexistence
Toluene FIG.1	20	Yellowish brown stain is produced.	less than 150	The accuracy of readings is not affected.
Xylene FIG.2	60	〃	less than 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.

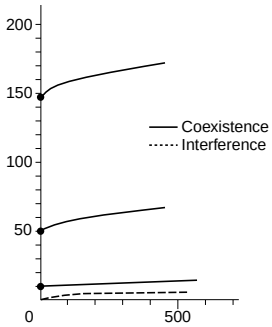


FIG.1 Influence of Toluene

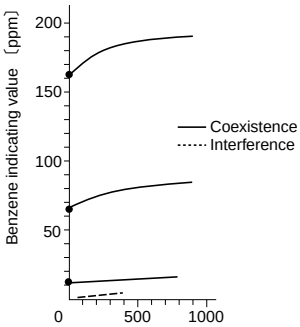


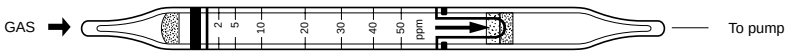
FIG.2 Influence of Xylene

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)			
	10 ℃ (50 ˚F)	20 ℃ (68 ˚F)	30 ℃ (86 ˚F)	40 ℃ (104 ˚F)
200	—	200	170	160
150	200	150	130	120
100	126	100	90	83
50	60	50	45	40
20	25	20	18	15
10	13	10	9	8
5	6	5	4.5	4

Tube No.
118SC

BENZENE



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℃
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.

$$C_6H_6 + I_2O_5 + H_2SO_4 \rightarrow I_2$$

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 strokes, following formula is available for the actual concentration.

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

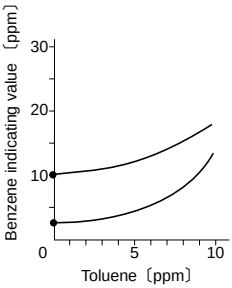


FIG.1 Influence of Toluene

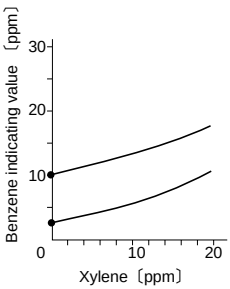
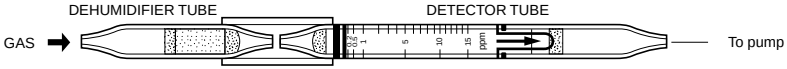


FIG.2 Influence of Xylene

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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

Tube No.
118SD BENZENE



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 ℃
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.

$$C_6H_6 + I_2O_5 + H_2SO_4 \rightarrow I_2$$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

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 areproduced and higherreadings are given.
Hexane		2.0	〃

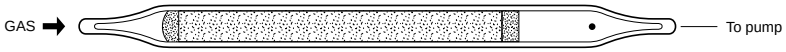
(NOTE)

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

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

Tube No.
114

BROMINE



1. PERFORMANCE

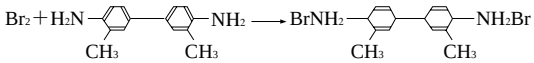
1) Measuring range : 1-20 ppm
   Number of pump strokes 1(100mℓ)
2) Sampling time : 2 minutes/1 pump stroke
3) Detectable limit : 0.1 ppm
4) Shelf life : 2 years
5) Operating temperature : 0～40℃
6) Reading : Concentration chart method
7) Colour change : White→Orange

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

o-Toluidine is oxidized and Orthoquinone is produced.

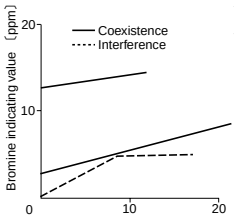


4. CALIBRATION OF THE TUBE

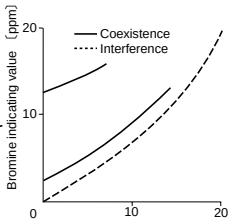
COLOURIMETRY METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

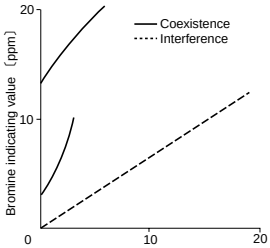
Substance		Interference	ppm	Coexistence
Nitrogen dioxide	FIG.1	Similar stain is produced.		Higher readings are given.
Chlorine	FIG.2	〃	1	〃
Chlorine dioxide	FIG.3	〃		〃



Nitrogen dioxide〔ppm〕
FIG.1 Influence of Nitrogen dioxide



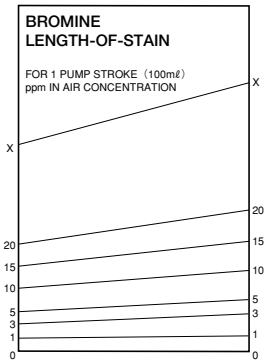
Chlorine〔ppm〕
FIG.2 Influence of Chlorine



Chlorine dioxide〔ppm〕
FIG.3 Influence of Chlorine dioxide

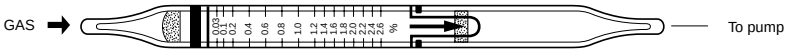
TEMPERATURE CORRECTION TABLE

Chart Readings (ppm)	Correct Concentration (ppm)				
	0℃ (32˚F)	10℃ (50˚F)	20℃ (68˚F)	30℃ (86˚F)	40℃ (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



Tube No.
168SA

1, 3-BUTADIENE



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 : 10 ppm
4) Shelf life : 3 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 : Brownish orange → Dark brown

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

Chromium oxide is reduced.

$$CH_2 = CHCH = CH_2 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

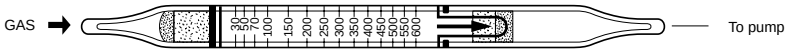
Substance	Interference	ppm	Coexistence
Acetylene	Whole regent is discoloured to Brown.	3 %	Higher readings are given.
Propane	〃	0.2 %	〃
Other organic gases or vapours except Halogenated hydrocarbons	Similar stain is produced.	50	〃

TEMPERATURE CORRECTION TABLE

Scale Readings (%)	True Concentration (%)				
	0 ℃ (32 ° F)	10 ℃ (50 ° F)	20 ℃ (68 ° F)	30 ℃ (86 ° F)	40 ℃ (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

Tube No.
168SB

1,3-BUTADIENE



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℃
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 REACTI0N

Molybdate is reduced and molybdeum blue is produced.

$$CH_2 = CHCH = CH_2 + PdSO_4 + (NH_4)_2MoO_4 \rightarrow Mo_3O_8$$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

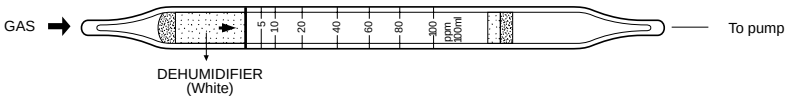
Substance	Interference	Coexistence
Carbon monoxide	Whole layer is discoloured to Green or Blue.	
Hydrogen sulphide	Black stain is produced.	
Saturated Hydrocarbons (more than C_3)	Whole layer is discoloured to Blue.	
Ethylene	Blue stain is produced.	
Propylene	〃	
Butylene	〃	
Benzene	Yellowish orange stain is produced.	
Ammonia	Similar stain is produced.	Higher readings are given.
Hydrogen cyanide	〃	〃

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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

Tube No.
168SC

1,3-BUTADIENE



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℃
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.

$CH_2=CHCH=CH_2+Cr^6+H_2SO_4 \rightarrow Cr^{3+}$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

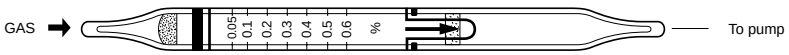
Substance	Interference	Coexistence
Esters	Similar stain is produced.	Higher readings are given.
Alcohols	〃	〃
Ketones	〃	〃
Aromatic hydrocarbons (more than C_3)	Whole reagent is changed to Pale brown.	〃

(NOTE)

In case of 2 strokes, following formula is available for the actual concentration.
Actual concentration = 1/2 × Reading value.

Tube No.
221SA

n-BUTANE



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 : 20 ppm
4) Shelf life : 3 years
5) Operating temperature : 0 ~ 40 ℃
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.

$CH_3(CH_2)_2CH_3 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

4. CALIBRATION OF THE TUBE

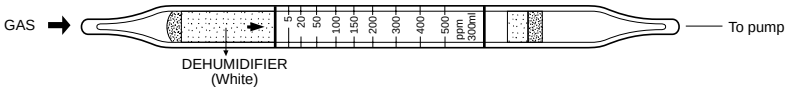
GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Toluene	Similar stain is produced.	Higher readings are given.
Hexane	〃	〃
Trichloroethylene	〃	〃

Tube No.
190UⒸ

1-BUTANOL



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 ℃
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.

$$CH_3CH_2CH_2CH_2OH + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

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	〃	〃

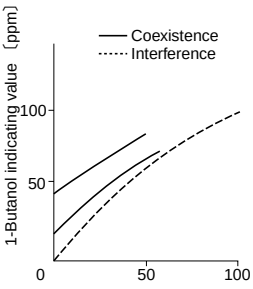


FIG.1 Influence of Ethanol

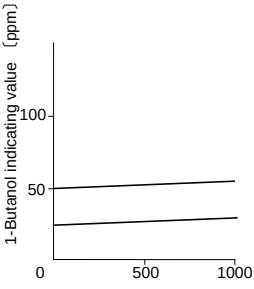
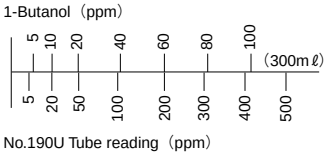


FIG.2 Influence of Ethyl acetate

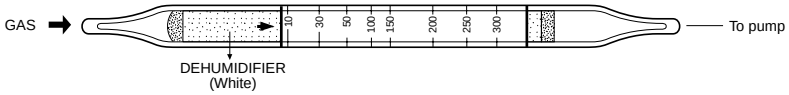
TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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



Tube No.
189U

2-BUTANOL



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 ℃
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.

$CH_3CH_2CH(OH)CH_3 + Cr^{6+} H_2SO_4 \rightarrow Cr^{3+}$

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	〃	〃
Paraffin hydrocarbons (more than C_3)	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

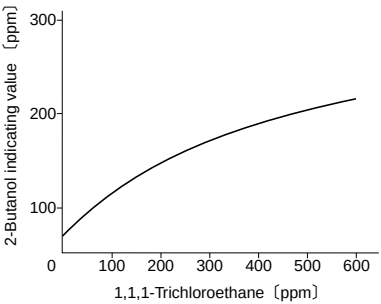


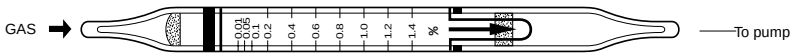
FIG.1 Influence of 1,1,1-Trichloroethane

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)					
	10 ℃ (50 ° F)	15 ℃ (59 ° F)	20 ℃ (68 ° F)	25 ℃ (77 ° F)	30 ℃ (80 ° F)	35 ~ 40 ℃ (95 ~ 104 ° F)
300	480	360	300	270	250	235
200	300	230	200	190	185	185
150	200	160	150	145	145	140
100	110	100	100	100	100	100
50	50	50	50	50	50	50
30	30	30	30	30	30	30
10	10	10	10	10	10	10

Tube No.
139SB Ⓒ

BUTYL ACETATE



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 ℃
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

Potassium dichromate is reduced.

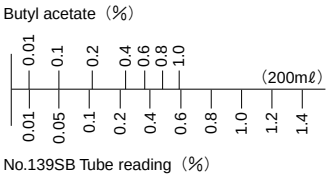
$$CH_3CO_2(CH_2)_3CH_3 + Cr^{6+} H_2SO_4 \rightarrow Cr^{3+}$$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

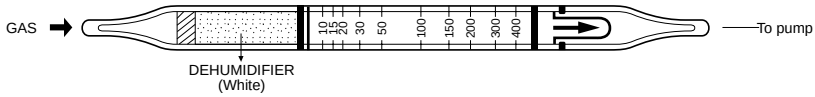
5. INTERFERENCE AND CROSS SENSITIVITY

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



Tube No.
138U

BUTYL ACETATE



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 ℃
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

Potassium dichromate is reduced.

$CH_3CO_2(CH_2)_3CH_3 + Cr^{6+} H_2SO_4 \rightarrow Cr^{3+}$

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.	〃

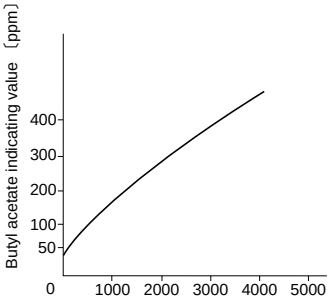


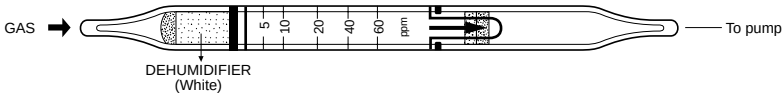
FIG.1 Influence of Methanol

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)						
	10℃ (50˚F)	15℃ (59˚F)	20℃ (68˚F)	25℃ (77˚F)	30℃ (80˚F)	35℃ (95˚F)	40℃ (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
15	20	20	15	15	10	10	10

Tube No.
211U

BUTYL ACRYLATE



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 ℃
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.

$CH_2 = CHCO_2(CH_2)_3CH_3 + Cr^{6+} H_2SO_4 \rightarrow Cr^{3+}$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Paraffin hydrocarbons (more than C_3) FIG.2	Whole reagent is changed to Dark brown.	〃
Halogenated hydrocarbons	〃	〃
Esters	〃	〃
Aromatic hydrocarbons FIG.1	〃	〃

(NOTE)

Butyl acrylate have the same sensitivity at 20 ℃ to Methyl acrylate.

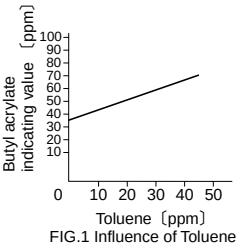


FIG.1 Influence of Toluene

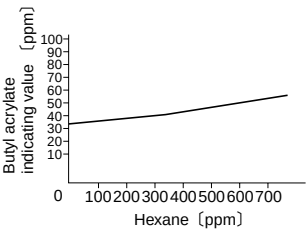


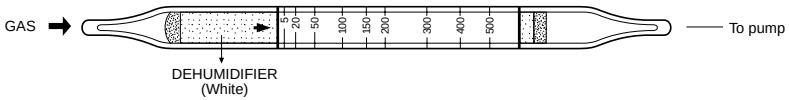
FIG.2 Influence of Hexane

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0 ℃ (32 ˚ F)	10 ℃ (50 ˚ F)	20 ℃ (68 ˚ F)	30 ℃ (86 ˚ F)	40 ℃ (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

Tube No.
190U©

BUTYL CELLOSOLVE



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 ℃
6) Temperature compensation : Necessary(See "TEMPERATURE CORRECTION TABLE")
7) Reading : This tube is calibrated based on Ethyl cellosove. 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.

$$HOCH_2CH_2OC_4H_9 + Cr^{6+} H_2SO_4 \rightarrow Cr^{3+}$$

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	〃	〃
Paraffin hydrocarbons (more than C_3)	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.

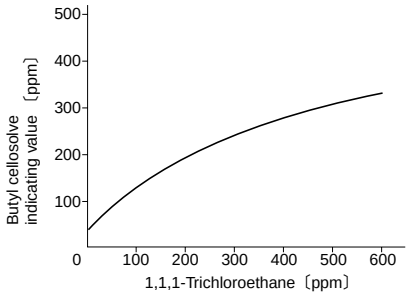


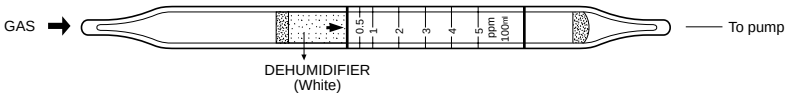
FIG.1 Influence of 1,1,1-Trichloroethane

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)					
	10 ℃ (50 ˚F)	15 ℃ (59 ˚F)	20 ℃ (68 ˚F)	25 ℃ (77 ˚F)	30 ℃ (80 ˚F)	35 ℃ (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

Tube No.
130U

TERT-BUTYL MERCAPTAN



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℃
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.

$(CH_3)_3CSH + HgCI_2 \rightarrow (CH_3)_3CS(HgCI) + HCI$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

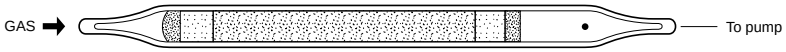
Substance	Interference	Coexistence
Arsine	Similar stain is produced.	Higher readings are given.
Hydrogen selenide	〃	〃
Phosphine	〃	〃
Hydrogen sulphide	〃	〃
Hydrogen cyanide	Whole reagent is changed to Red.	〃
Sulphur dioxide		Whole reagent is changed to Pale red, Pink stain indicates Mercaptans conc.

(NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.
Actual concentration = 2 × Reading value
This tube scale is calibrated based on Methyl mercaptan and the same scale is available for tert-Butyl mercaptan.

Tube No.
126B

CARBON DIOXIDE



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 ℃
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.

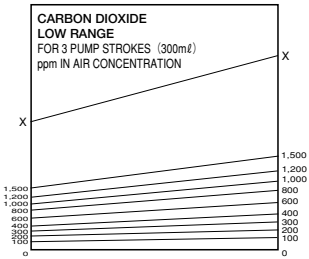
$CO_2 + 2NaOH \rightarrow Na_2CO_3 + H_2O$

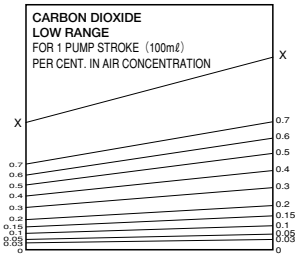
4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	ppm	Coexistence
Chlorine	20	Pale yellowish blue stain is produced.		When CO_2 comcentration is more than 300 ppm, the accuracy of readings is not affected.
Sulphur dioxide	100	〃		〃
Hydrogen cyanide		The accuracy of readings not affected.		〃
Hydrogen sulphide		〃		〃
Nitrogen dioxide	30	Pale yellowish blue stain is produced.		〃





TEMPERATURE CORRECTION TABLE (3 pump strokes)

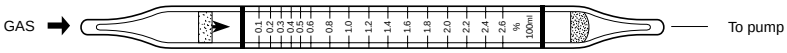
Chart Readings (ppm)	True Concentration (ppm)				
	0 ℃ (32 ˚F)	10 ℃ (50 ˚F)	20 ℃ (68 ˚F)	30 ℃ (86 ˚F)	40 ℃ (104 ˚F)
1,500	1,800	1,650	1,500	1,400	1,350
1,400	1,700	1,550	1,400	1,300	1,250
1,300	1,550	1,400	1,300	1,250	1,150
1,200	1,450	1,300	1,200	1,150	1,100
1,100	1,300	1,200	1,100	1,050	1,000
1,000	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 (%)	True Concentration (%)				
	0 ℃ (32 ˚F)	10 ℃ (50 ˚F)	20 ℃ (68 ˚F)	30 ℃ (86 ˚F)	40 ℃ (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

Tube No.
126SA

CARBON DIOXIDE



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 : 100 ppm (100mℓ)
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 : 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.

$CO_2 + 2NaOH \rightarrow NaCO_3 + H_2O$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Hydrogen sulphide	Similar stain is produced.	100	Higher readings are given.
Chloride	〃	100	〃
Hydrogen cyanide	〃	200	〃
Sulphur dioxide	〃	500	〃

(NOTE)

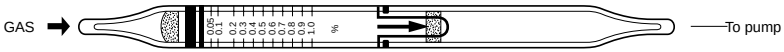
In case of 1/2 pump strokes, following formula is available for the actual concentration.
Actual concentration = 2 × Temperature corrected value.

TEMPERATURE CORRECTION TABLE

Scale Readings (%)	True Concentration (%)				
	0 ℃ (32 ° F)	10 ℃ (50 ° F)	20 ℃ (68 ° F)	30 ℃ (86 ° F)	40 ℃ (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

Tube No.
126SB

CARBON DIOXIDE



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 : 50 ppm
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 : 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.

$CO_2 + 2NaOH \rightarrow Na_2CO_3 + H_2O$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

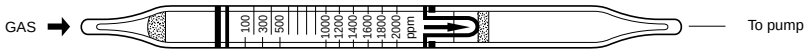
Substance	ppm	Interference	ppm	Coexistence
Chlorine	20	Pale yellowish blue stain is produced.		When CO_2 comcentration is more than 300 ppm, the accuracy of readings is not affected.
Sulphur dioxide	100	〃		〃
Hydrogen cyanide		The accuracy of readings not affected.		〃
Hydrogen sulphide		〃		〃
Nitrogen dioxide	30	Pale yellowish blue stain is produced.		〃

TEMPERATURE CORRECTION TABLE

Scale Readings (%)	True Concentration (%)				
	0℃ (32˚F)	10℃ (50˚F)	20℃ (68˚F)	30℃ (86˚F)	40℃ (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

Tube No.
126SF

CARBON DIOXIDE



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℃	
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

$CO_2 + 2NaOH \rightarrow Na_2CO_3 + H_2O$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

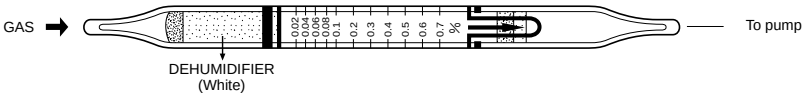
5. INTERFERENCE AND CROSS SENSITIVITY

(NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.
Actual concentration = 2 × Reading value

Tube No.
126SG

CARBON DIOXIDE



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 %
4) Shelf life : 1 year
5) Operating temperature : 0 ~ 40 ℃
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

$CO_2 + 2NaOH \rightarrow Na_2CO_3 + H_2O$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Hydrogen cyanide	Similar stain is produced.	Higher readings are given.
Hydrogen chloride	Under the TLV conc.	The accuracy of readings is not affected.
Chlorine	〃	〃
Hydrogen sulphide	〃	〃
Nitrogen dioxide	〃	〃
Sulphur dioxide	〃	〃
Ammonia	〃	〃

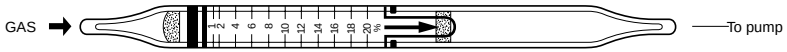
(NOTE)

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

Actual concentration = 2 × Reading value

Tube No.
126SH

CARBON DIOXIDE



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 ℃
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.

$CO_2 + 2KOH \rightarrow K_2CO_3 + H_2O$

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_2,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	〃

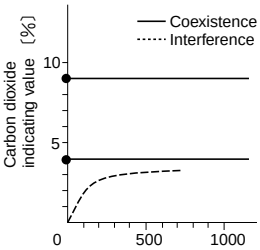


FIG.1 Influence of Nitrogen dioxide

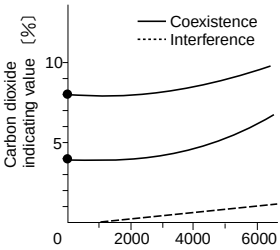


FIG.2 Influence of Sulphur dioxide

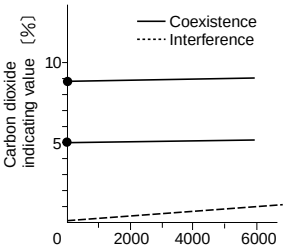
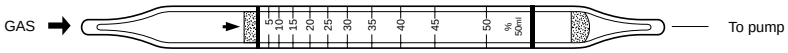


FIG.3 Influence of Hydrogen sulphide

Tube No.
126UH

CARBON DIOXIDE



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 ℃
6) Reading : Direct reading from the scale calibrated by1/2 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.

$CO_2 + N_2NNH_2 \rightarrow H_2NNHCOOH$

4. CALIBRATION OF THE TUBE

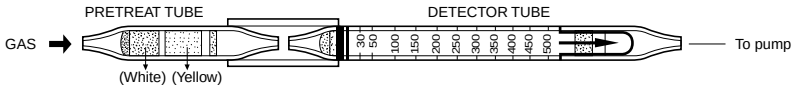
STANDARD GAS CYLINDER METHOD

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	〃	〃

Tube No.
141SA

CARBON DISULPHIDE



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 a refrigerated place ; 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 → 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.

$CS_2 + CrO_3 + H_2SO_4 \rightarrow SO_2$

$SO_2 + 2NaOH \rightarrow Na_2SO_3 + H_2O$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	ppm	Coexistence
Sulphur dioxide FIG.1	500	Similar stain is produced.		Higher readings are given.
Hydrogen sulphide FIG.2	400	〃	400	〃
Chlorine		White stain is produced.		〃

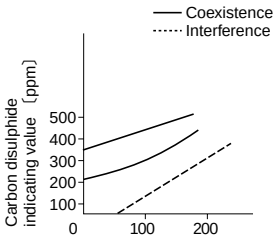


FIG.1 Influence of Sulphur dioxide

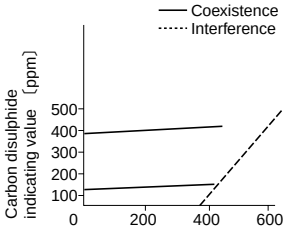


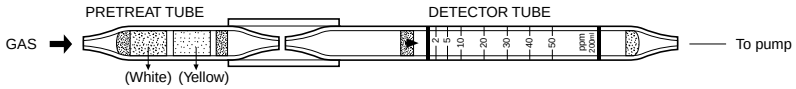
FIG.2 Influence of Hydrogen sulphide

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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

Tube No.
141SB

CARBON DISULPHIDE



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 a refrigerated place ; 0 ~ 10℃)
5) Operating temperature : 0 ~ 40℃
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

C.V-low : 10% C.V.-mid. : 10% C.V.-high : 10%

3. CHEMICAL REACTION

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

$CS_2 + CrO_3 + H_2SO_4 \rightarrow SO_2$

$SO_2 + 2NaOH \rightarrow Na_2SO_3 + H_2O$

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

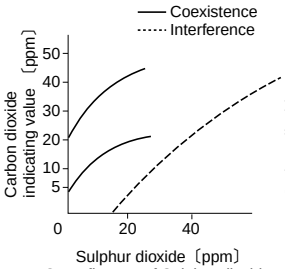


FIG.1 Influence of Sulphur dioxide

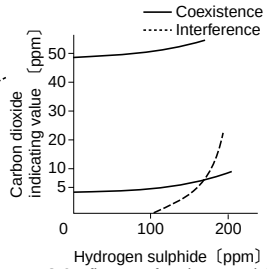


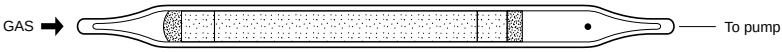
FIG.2 Influence of Hydrogen sulphide

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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

Tube No.
100

CARBON MONOXIDE



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 ℃
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.

$CO + K_2Pd(SO_3)_2 \rightarrow K_2(SO_3)_2PdCO$

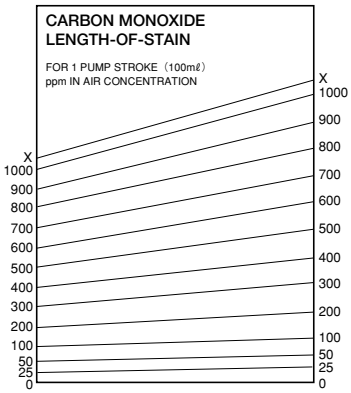
$K_2(SO_3)_2PdCO \rightarrow CO_2 + SO_2 + Pd + K_2SO_3$

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 isproduced.	CO conc. ×1/5	Higher readings are given.
Sulphur dioxide	100	Original colour is faded.	〃	〃
Nitrogen dioxide		The accuracy of readings is not affected.	〃	〃

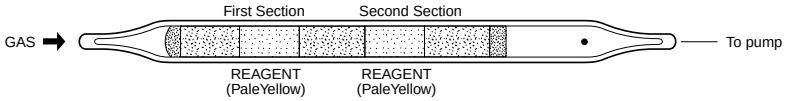


TEMPERATURE CORRECTION TABLE

Chart Readings (ppm)	Correct Concentration (ppm)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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

Tube No.
106B

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 ℃
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.

$CO + PdSO_4 + (NH_4)MoO_4 \rightarrow Mo_3O_8$

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	Black stain is produced.	1,000	Black stain is produced and higher readings are given.
Hydrogen (over 40 ℃)	Similar stain is produced	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 andambient tenperature.After thewaiting time,compare the second section of reagent with the colour standard chart.

2) In case of spontaneous conbustion of coal mines,Ethylene and CO are produced.The first section is partially stained to deep blue from the top of the section according tc Ethylene concentration .Whole areas of first and second sectionsare equallystained to greenishblue according to CO concentration.The first sectionis available to detect less 5 ppm of Ethylene.

TEMPERATURE CORRECTION TABLE

Temperature	0 ℃ (32 ˚ F)	5 ℃ (41 ˚ F)	10 ℃ (50 ˚ F)	15 ℃ (59 ˚ F)	20 ℃ (68 ˚ F)	25 ℃ (77 ˚ F)	30 ℃ (86 ˚ F)	35 ℃ (96 ˚ F)	40 ℃ (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

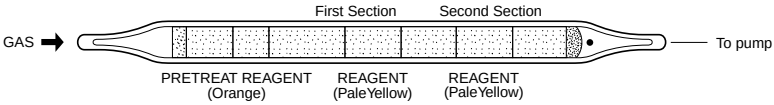
Color Standards for CARBON MONOXIDE

Concentration (P.P.M) 0 100 200 300 600 1000

Feeding Time : 30 sec.
Waiting Time : 2 min.
Temperature : 15 ℃

Tube No.
106C

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 ℃
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.

$CO + PdSO_4 + (NH_4)_2MoO_4 \rightarrow Mo_3O_8$

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 ℃)	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 ℃ (32 ˚ F)	5 ℃ (41 ˚ F)	10 ℃ (50 ˚ F)	15 ℃ (59 ˚ F)	20 ℃ (68 ˚ F)	25 ℃ (77 ˚ F)	30 ℃ (86 ˚ F)	35 ℃ (96 ˚ F)	40 ℃ (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

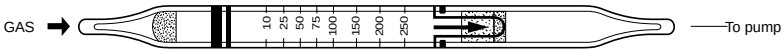
Color Standards for CARBON MONOXIDE

Concentration (P.P.M) 0 100 200 300 600 1000

Feeding Time : 30 sec.
Waiting Time : 2 min.
Temperature : 15 ℃

Tube No.
106S

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 : 3 years
5) Operating temperature : 0 ~ 40 ℃
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.

$CO + K_2Pd(SO_3)_2 \rightarrow K_2(SO_3)_2PdCO$

$K_2(SO_3)_2PdCO \rightarrow CO_2 + SO_2 + Pd + K_2SO_3$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

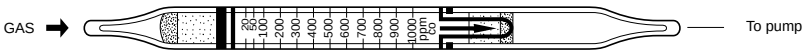
Substance	Interference	ppm	Coexistence
Acetylene	Dark brown stain is produced.	5	Higher readings are given.
Hydrogen sulphide	Dark red stain is produced.	20	〃
Sulphur dioxide		COconc.× 1/5	〃
Nitrogen dioxide		COconc.×1/10	〃

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0 ℃ (32 ° F)	10 ℃ (50 ° F)	20 ℃ (68 ° F)	30 ℃ (86 ° F)	40 ℃ (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

Tube No.
106SA

CARBON MONOXIDE



1. PERFORMANCE

1) Measuring range : 20-1,000 ppm 5-50 ppm
Number of pump strokes 1(100mℓ) 4(400mℓ)
2) Sampling time : 3 minutes/1 pump stroke
3) Detectable limit : 2 ppm(400mℓ)
4) Shelf life : 3 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

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

$CO + K_2Pd(SO_3)_2 \rightarrow K_2(SO_3)_2PdCO$

$K_2(SO_3)_2PdCO \rightarrow CO_2 + SO_2 + Pd + K_2SO_3$

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.	COconc. ×1/5	Higher readings are given.
Sulphur dioxide	100	Original colour is faded.	〃	〃
Nitrogen dioxide		The accuracy of readings is not affected.	〃	〃

(NOTE)

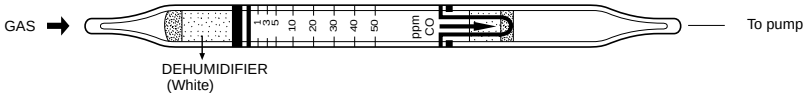
When the concentration is below 50 ppm, 4 pump strokes can be used to detemine the lower concentration.
Following formula is available for the actual concentration.
Actual concentration = 1/4 × Temperature corrected value

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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

Tube No.
106SC

CARBON MONOXIDE



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 ℃
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

$CO + K_2Pd(SO_3)_2 \rightarrow Pd$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

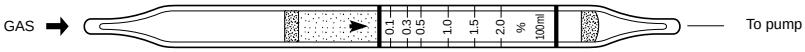
Substance	Interference	Coexistence
Sulphur dioxide	Similar stain is produced.	Higher readings are given.
Formic acid	〃	〃
Acetylene	Whole reagent is change to Pale red.	〃
Hydrogen sulphide	Dark reddish purple and red stain are produced.	〃

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)							
	5 ℃ (41 ° F)	10 ℃ (50 ° F)	15 ℃ (59 ° F)	20 ℃ (68 ° F)	25 ℃ (77 ° F)	30 ℃ (86 ° F)	35 ℃ (95 ° F)	40 ℃ (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

Tube No.
106SH

CARBON MONOXIDE



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 ℃
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. : 10 % RSD-high : 5 %

3. CHEMICAL REACTION

Iodine pent-oxide 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	ppm	Interference	ppm	Coexistence
Acetylene FIG.1	0.02	Brown stain is produced.	0.3	Pretreat reagent is discoloured to Black and higher readings are given.
Ethylene FIG.2	0.04	〃	0.3	Pretreat reagent is faded and higher readings are given.
Propane	5	Speckled stain is produced.	0.15	Speckled stain is produced and the top of discoloured layer becomes unclear.Higher readings are given.
Isobutane		〃	0.2	〃
Hexane		〃	0.1	〃

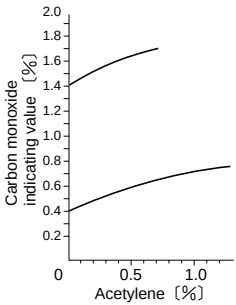


FIG.1 Influence of Acetylene

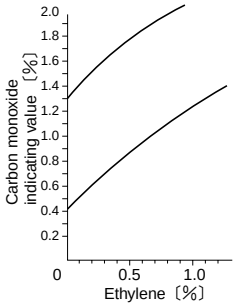


FIG.2 Influence of Ethylene

TEMPERATURE CORRECTION TABLE

Scale Readings (%)	True Concentration (%)				
	0℃ (32˚F)	10℃ (50˚F)	20℃ (68˚F)	30℃ (86˚F)	40℃ (104˚F)
2.0	1.24	1.52	2.00	—	—
1.8	1.14	1.38	1.80	—	—
1.6	1.04	1.25	1.60	—	—
1.4	0.93	1.11	1.40	1.90	—
1.2	0.82	0.97	1.20	1.62	—
1.0	0.71	0.82	1.00	1.12	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

Tube No.
106SS

CARBON MONOXIDE

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 year
5) Operating temperature : 0 ~ 60 ℃
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

$CO + K_2Pd(SO_3)_2 \rightarrow Pd$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

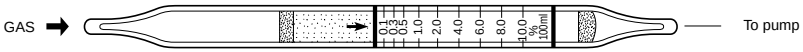
Substance	Interference	ppm	Coexistence
Sulphur dioxide	The accuracy of readings is not affected.	CO conc. 1/2	Higher reading are given.
Ammonia	White stain is produced.	CO conc.×100	〃
Acetylene	Similar stain is produced.		〃
Hydrogen sulphide	Brown stain is produced.	CO conc. 1/2	〃

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)						
	0℃ (32˚F)	10℃ (50˚F)	20℃ (68˚F)	30℃ (86˚F)	40℃ (104˚F)	50℃ (122˚F)	60℃ (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

Tube No.
106UH

CARBON MONOXIDE



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 ℃
6) Temperature compensation : Necessary (0 ~ 20 ℃) (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 DEVIATON

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

3. CHEMICAL REACTION

Iodine pent-oxide 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	〃		
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

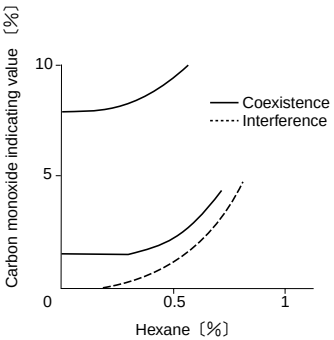


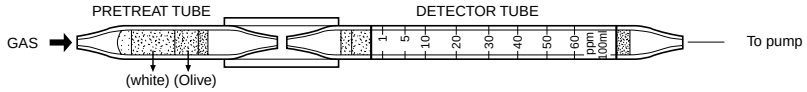
FIG.1 Influence of Hexane

TEMPERATURE CORRECTION TABLE

Scale Readings (%)	True Concentration (%)			
	0 ℃ (32 ° F)	5 ℃ (50 ° F)	10 ℃ (68 ° F)	20-40 ℃ (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

Tube No.
147S

CARBON TETRACHLORIDE



1. PERFORMANCE

1) Measuring range : 1-60 ppm 0.5-1 ppm
   Number of pump strokes 1(100m ℓ) 2(200m ℓ)
2) Sampling time : 1.5 minutes/1 pump stroke
3) Detectable limit : 0.2 ppm(200m ℓ)
4) Shelf life : 1 year
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 : White → Red

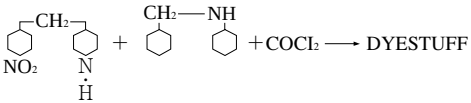
2. RELATIVE STANDARD DEVIATION

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)-phridine and Benzylaniline, dyestuff is produced.

$$CCl_4 + I_2O_5 + H_2SO_4 \longrightarrow COCl_2$$



4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Phosgene	Similar stain is produced.	2	Higher reading are given.
Halogenes FIG.1			〃
Halogenated hydrocarbons FIG.2			〃

(NOTE)

When the concentration is below 1 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

6.CAUTION

When high concentration gas(over the full scale)is sampled, the indicator will be discoloured from pale yellow to dark blue. If extremely high concentration gas is sampled, the detecting reagent may be faded and it is not possible to distinguish with original colour.

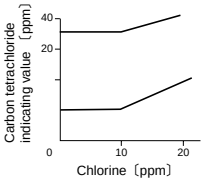


FIG.1 Influence of Chlorine

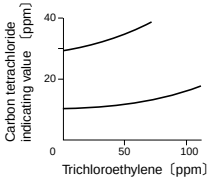


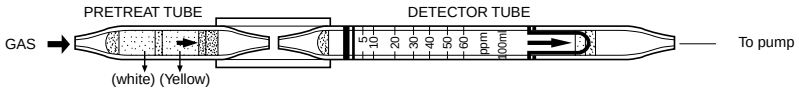
FIG.2 Influence of Trichloroethylene

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (104°F)
60	40	50	60	78	—
50	34	42	50	62	76
40	27	34	40	46	57
30	21	25	30	33	38
20	15	17	20	21	22
10	9	10	10	10	10
5	5	5	5	5	5
1	1	1	1	1	1

Tube No.
239S

CARBONYL SULPHIDE



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 ℃
6) Temperature compensation : Necessary under 20 ℃ (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 REACTI0N

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

$COS + CrO_3 + H_2SO_4 \rightarrow SO_2$

$SO_2 + 2NaOH \rightarrow Na_2SO_3 + H_2O$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

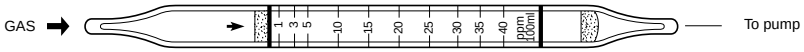
Substance	Interference	Coexistence
Sulphur dioxide		Higher readings are given.
Hydrogen sulphide		〃
Carbon disulphide		〃

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	Corrected Concentration (ppm)		
	0 ℃ (32 ˚F)	10 ℃ (50 ˚F)	20-40 ℃ (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

Tube No.
109SA

CHLORINE



1. PERFORMANCE

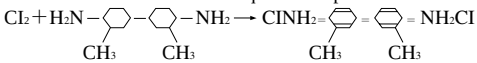
1) Measuring range : 1-40 ppm
   Number of pump strokes 1(100mℓ)
2) Sampling time : 2 minutes/1 pump stroke
3) Detectable limit : 0.3 ppm
4) Shelf life : 2 years
5) Operating temperature : 0～40℃
6) Reading : Direct reading from the scale calibrated by 1 pump stroke
7) Colour change : White→Yellowish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

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

0-Toluidine is oxidized and Orthoquinone is produced.



4. CALIBRATION OF THE TUBE

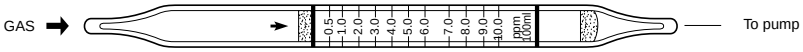
PERMEATION TUBE METHOD

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 top of discoloured layer becomes unclear higher readings are given.

Tube No.
109SB

CHLORINE



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)

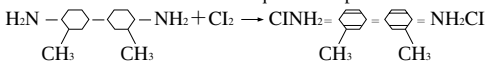
2) Sampling time : 1 minute / 1 pump stroke
3) Detectable limit : 0.06 ppm (500mℓ)
4) Shelf life : 2 years
5) Operating temperature : 0 ~ 40 ℃
6) Reading : Direct reading from the scale calibrated by 1 pump stroke
7) Colour change : White → Pale orange

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

0-Toluidine is oxidized and Orthoquinone is produced.



4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

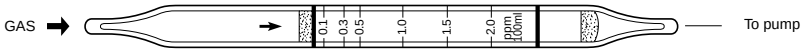
Substance	Interference	ppm	Coexistence
Bromine	Pale yellow stain is produced.	1	Higher readings are given.
Chlorine dioxide	〃	1	〃
Nitrogen dioxide	〃	Chlorine conc. × 1/5	〃
Nitrogen trichloride	〃	5	〃

(NOTE)

When the concentration is below 2 ppm, 4 or 5 pump strokes can be used to determine the lower concentration.
Following formula is available for the actual concentration.
Actual concentration = Reading value × 1 / Number of strokes

Tube No.
109U

CHLORINE



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℃
6) Reading : Direct readingfrom 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'-Dimethylnaphthidine, Nitroso-compound is produced.

CI_2 + 3, 3'-Dimethylnaphthidine→Nitroso-compound

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

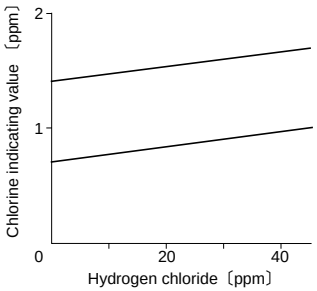


FIG.1 Influence of Hydrogen chloride

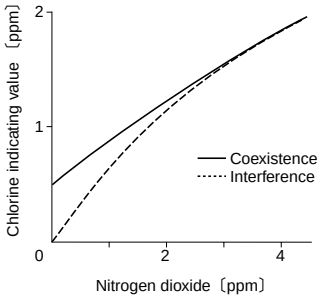
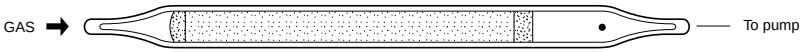


FIG.2 Influence of Nitrogen dioxide

Tube No.
116

CHLORINE DIOXIDE



1. PERFORMANCE

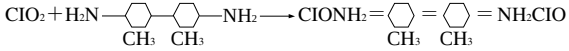
1) Measuring range : 1-20 ppm
   Number of pump strokes 1 (100mℓ)
2) Sampling time : 2 minutes/1 pump stroke
3) Detectable limit : 0.3 ppm
4) Shelf life : 2 years
5) Operating temperature : 0 ~ 40℃
6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
7) Reading : Concentration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

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

0-Toluidine is oxidized and Orthoquinone 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.	1	Higher readings are given.
Chlorine	FIG.2	〃	1	〃
Bromine	FIG.3	〃	1	〃

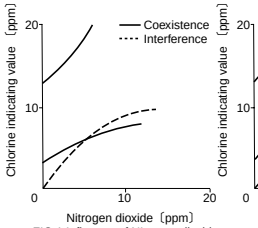


FIG.1 Influence of NItrogen dioxide

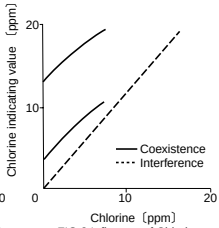


FIG.2 Influence of Chlorine

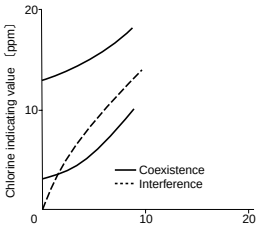
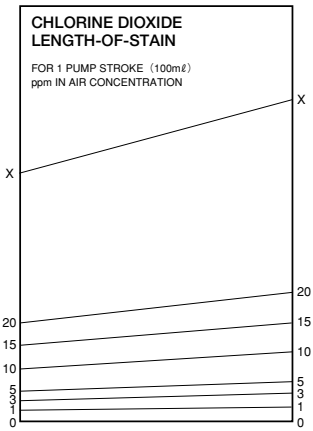


FIG.3 Influence of Bromine

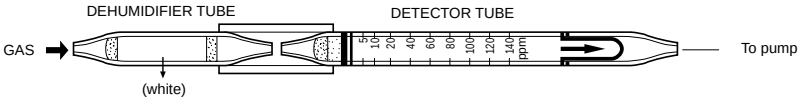
TEMPERATURE CORRECTION TABLE

Chart Readings (ppm)	Correct Concentration (ppm)				
	0℃ (32˚F)	10℃ (50˚F)	20℃ (68˚F)	30℃ (86˚F)	40℃ (104˚F)
20	—	30	20	15	12
15	—	22	15	11	10
10	26	15	10	8	7
5	13	8	5	4	3.5
3	6	5	3	2.8	2.5
1	1	1	1	1	1



Tube No.
178SB

CHLOROBENZENE



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 : 1 year
5) Operating temperature : 0～40℃
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 pent-oxide is reduced.

$$C_6H_5CI + I_2O_5 + H_2SO_4 \rightarrow I_2$$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance		Interference	ppm	Coexistence
Ethyl benzene		Similar stain is produced.		Higher readings are given.
Toluene	FIG.1	〃		〃
Xylene	FIG.2	〃		〃
Benzene		〃		〃
Carbon monoxide	FIG.3	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.
Following formula is available for the actual concentration.
Actual concentration = 1/5 × Reading value

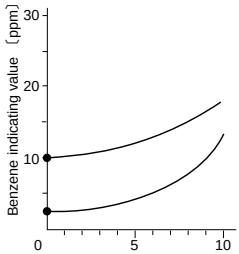


FIG.1 Influence of Toluene

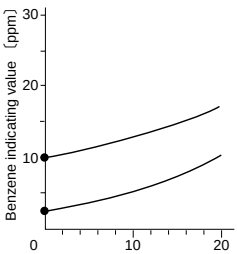


FIG.2 Influence of Xylene

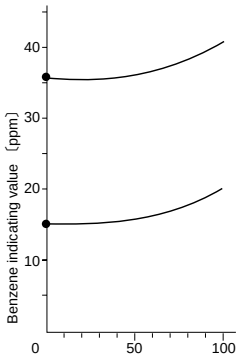
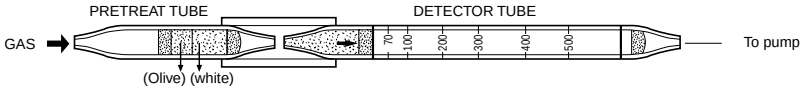


FIG.3 Influence of Carbon monoxide

Tube No.
152S

CHLOROFORM



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 a refrigerated place ; 0 ~ 10 ℃)
5) Operating temperature : 10 ~ 40 ℃
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.

$CrO_3 + H_2SO_4 \rightarrow (O)$

$CHCl_3 + (O) \rightarrow Cl_2 + H_2O + CO$

$Cl_2 + C_{14}H_{16}N_2 \rightarrow C_{14}H_{14}N_2 + 2HCl$

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		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.

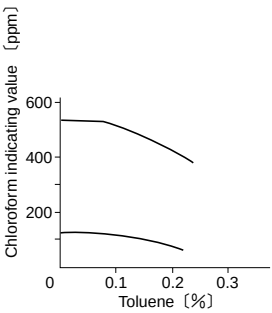


FIG.1 Influence of Toluene

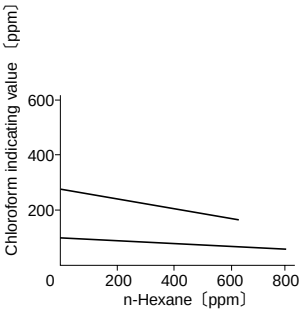


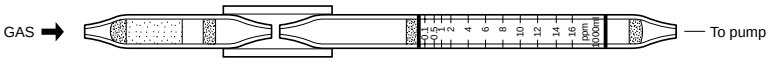
FIG.2 Influence of n-Hexane

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	10 ℃ (50 ˚F)	15 ℃ (59 ˚F)	20 ℃ (68 ˚F)	30 ℃ (95 ˚F)	40 ℃ (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

Tube No.
172S

CHLOROPICRIN



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 a refrigerated place ; 0 ～ 10℃）	
5) Operating temperature	: 0 ～ 40℃	
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

$CI_3CNO_2 + CrO_5 + H_2SO_4 \rightarrow COCI_2$

$COCI_2$ + Nitro-benzyl pyridine → DYESTUFF

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

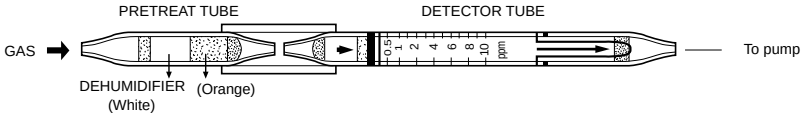
5. INTERFERENCE AND CROSS SENSITIVITY

（NOTE）

In case of 2 pump strokes, following formula is available for the actual concentration.
Actual concentration = 1/2 × Reading value.

Tube No.
169S

CHLOROPRENE



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℃
6) Temperature compensation : Necessary(20-40℃)(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.

$CH_2 = CCICH = CH_2 + CrO_3 + H_2SO_4 \rightarrow HCI$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Acetylene	The accuracy of readings is not affected.	1%	Lower readings are given.
Ethylene	〃		〃
Hydrogen chloride		1,000	Higher readings are given.
Chlorine	Similar stain is produced.		〃
Vinyl chlorine	〃		〃

(NOTE)

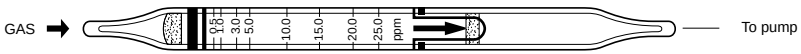
In case of 1 pump stroke, following formula is available for the actual concentration.
Actual concentration = 2 × Temperature corrected value.

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)			
	0℃-10℃ (32-50°F)	30℃ (86°F)	35℃ (95°F)	40℃ (104°F)
16.0	16.0	14.3	13.6	12.1
14.0	14.0	12.6	11.9	10.6
12.0	12.0	11.1	10.5	9.3
10.0	10.0	9.5	9.0	8.0
8.0	8.0	7.6	7.2	6.4
6.0	6.0	5.8	5.4	4.8
4.0	4.0	3.8	3.5	3.1
2.0	2.0	1.9	1.8	1.5
1.0	1.0	1.0	0.9	0.8
0.5	0.5	0.5	0.45	0.4

Tube No.
183U

CRESOL



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 ℃
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 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.

$$CH_3C_6H_4OH + Ce^{4+} \rightarrow CH_3C_6H_4O \rightarrow (CH_3C_6H_4O)_n$$

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.

(NOTE)

This tube scale is calibrated based on Phenol and the same scale is available for Cresol.

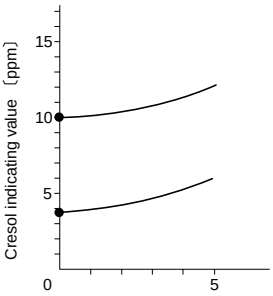


FIG.1 Influence of Phenol

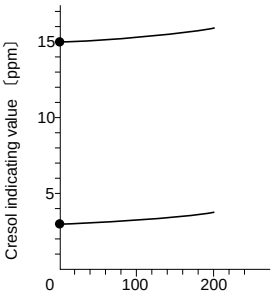


FIG.2 Influence of Ammonia

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	10℃ (50°F)	15℃ (59°F)	20℃ (68°F)	30℃ (95°F)	40℃ (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

Tube No.
115S

CYCLOHEXANE

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 : 50 ppm
4) Shelf life : 3 years
5) Operating temperature : 10 ~ 40 ℃
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.

$$C_6H_{12} + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

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.		〃
Paraffin hydrocarbons		〃		〃

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

TEMPERATURE CORRECTION TABLE

Scale Readings (%)	True Concentration (%)				
	10 ℃ (50 ˚ F)	15 ℃ (59 ˚ F)	20 ℃ (68 ˚ F)	30 ℃ (86 ˚ F)	40 ℃ (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

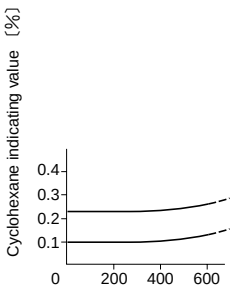


FIG.1 Influence of Benzene

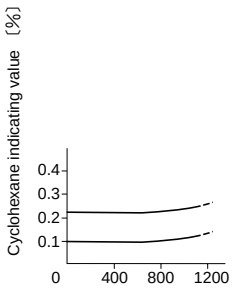
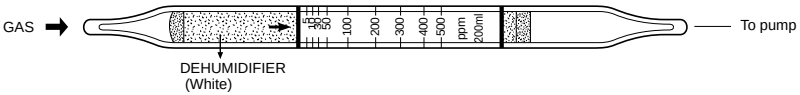


FIG.2 Influence of Toluene

Tube No.
206U

CYCLOHEXANOL



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 ℃
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.

$$C_6H_{11}OH + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Aliphatic hydrocarbons	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.

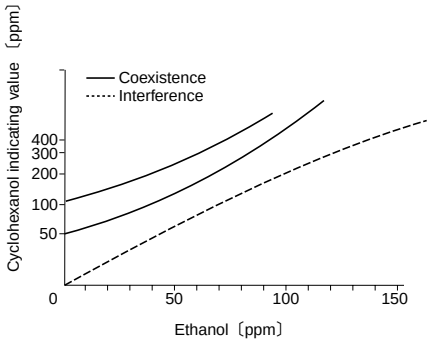


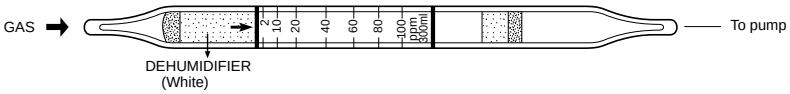
FIG.1 Influence of Ethanol

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)						
	10℃ (50°F)	15℃ (59°F)	20℃ (68°F)	25℃ (77°F)	30℃ (80°F)	35℃ (95°F)	40℃ (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

Tube No.
197U

CYCLOHEXANONE



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℃
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.

$$C_6H_{10}O + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Aliphatic hydrocarbons	Whole stain is changed to 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.

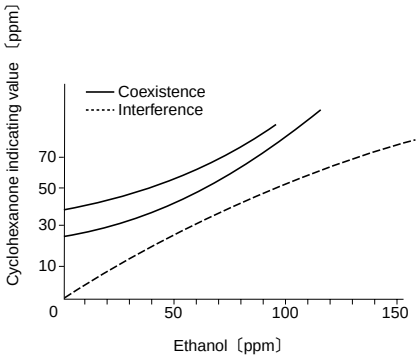


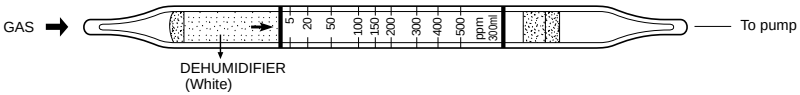
FIG.1 Influence of Ethanol

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)			
	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (104°F)
100	—	100	75	60
80	120	80	62	50
60	84	60	46	37
40	52	40	30	25
20	26	20	16	13
10	14	10	8	7
2	3	2	2	1

Tube No.
190U Ⓒ

DIACETONE ALCOHOL



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 ℃
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.

$(CH_3)_2C(OH)CH_2COCH_3 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

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.	It the top of Pale blue stain is clear,the accuracy of readings is not affected.
Aromatic hydrocarbons	〃	〃
Esters	〃	〃

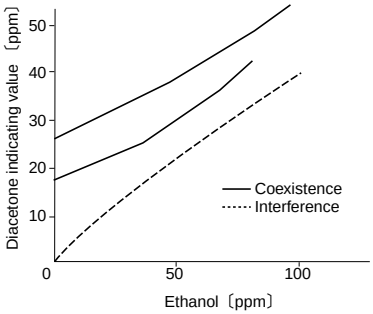
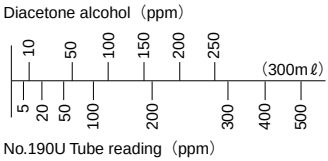


FIG.1 Influence of Ethanol

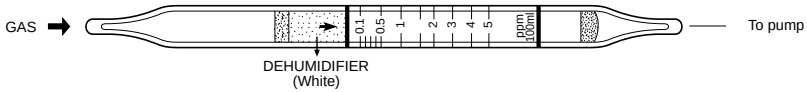
TEMPERATURE CORRECTION TABLE

Conver. value (ppm)	Corrected Concentration (ppm)						
	10 ℃ (50 ° F)	15 ℃ (59 ° F)	20 ℃ (68 ° F)	25 ℃ (77 ° F)	30 ℃ (86 ° F)	35 ℃ (95 ° F)	40 ℃ (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



Tube No.
242S

DIBORANE



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℃
6) Operating Humidity : No corrections are necessary in case of 1 or 2 pump strokes. In case of 5 pump strokes, the available humidity range is up to 25mg H_2O/ℓ [~ 30℃ (86° F), 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 : Pale yellow → Reddish purple

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

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

$B_2H_6 + HgCI_2 \rightarrow HCI$

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		〃 (Boundery is unclear.)
Disilane		〃 (〃)
Monogermane		Not affected.

(NOTE)

In case of 2 and 5 strokes, the following equation is available for the actual concentration.
2 pump strokes : Actual concentration = Temperature corrected value ÷ 2
5 pump strokes : Actual concentration = Temperature corrected value ÷ 5

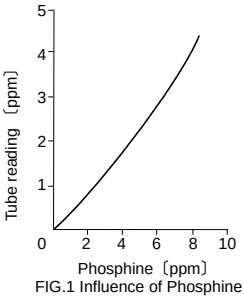


FIG.1 Influence of Phosphine

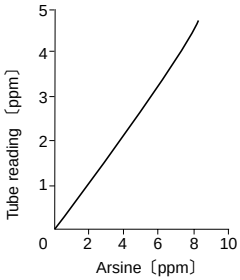


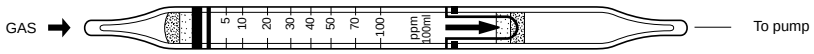
FIG.2 Influence of Arsine

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	Corrected Concentration (ppm)				
	0℃ (32° F)	10℃ (50° F)	20℃ (68° F)	30℃ (86° F)	40℃ (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

Tube No.
214S

o-DICHLOROBENZENE



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℃
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.

$C_6H_4CI_2 + I_2O_5 + H_2SO_4 \rightarrow I_2$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stains are produced.	Higher readings are given.
Paraffin hydrocarbons (more than C_3) FIG.3	Whole reagent is changed to Dark brown.	〃
Halogenated hydracarbons	〃	〃
Esters	〃	〃
Aromatic hydrocarbons FIG.1,2	〃	〃

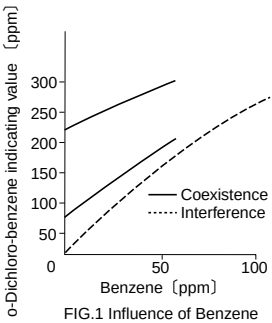


FIG.1 Influence of Benzene

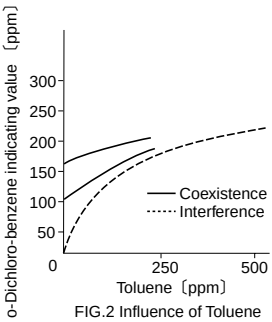


FIG.2 Influence of Toluene

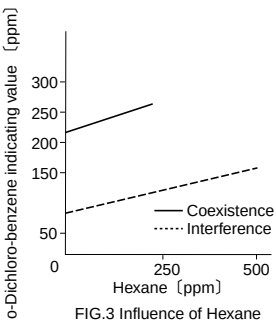
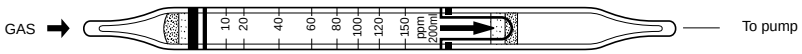


FIG.3 Influence of Hexane

Tube No.
215S

p-DICHLOROBENZENE



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 a refrigerated place ; 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 : 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 prodaced and PH indicator is discoloured.

$C_6H_4CI_2 + PbO_2 + H_2SO_4 \rightarrow HCI$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

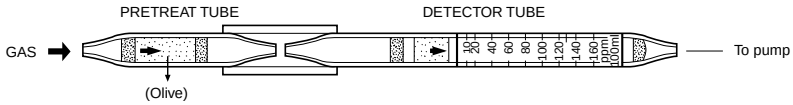
Substance	Interference	Coexistence
Benzene		Similar stains are produced and higher readings are given.
Toluene		〃
Hexane	Blueish green stains are produced and the top of discoloured layer becomes unclear.	〃
Ethanol	The accuracy of reading is not affected.	The accuracy of reading is not affected.

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)						
	10℃ (50˚F)	15℃ (59˚F)	20℃ (68˚F)	25℃ (77˚F)	30℃ (86˚F)	35℃ (95˚F)	40℃ (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

Tube No.
235S

1,1-DICHLOROETHANE



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 a refrigerated place ; 0 ~ 10℃)
5) Operating temperature : 0 ~ 40℃
6) Operating Humidity : 20-90 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.

$CH_3CHCl_2 + CrO_3 + H_2SO_4 \rightarrow Cl_2$

Cl_2 + 3, 3'-Dimethylnaphthidine→Nitroso-compound

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

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 FIG.1	〃	20	〃
Toluene FIG.2	〃	20	〃

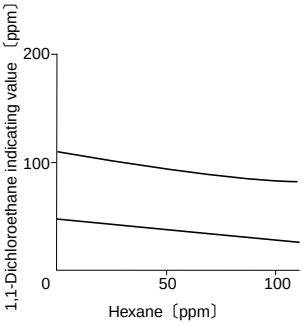


FIG.1 Influence of Hexane

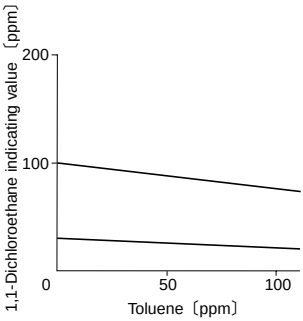


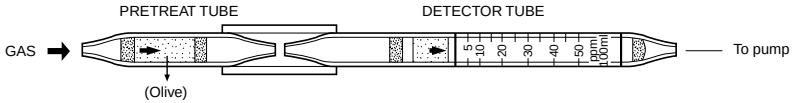
FIG.2 Influence of Toluene

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (104°F)
160	205	180	160	130	105
140	180	160	140	115	90
120	150	135	120	100	80
100	125	115	100	85	65
80	100	90	80	65	55
60	75	70	60	50	40
40	50	45	40	35	30
20	25	23	20	17	15
10	10	10	10	10	10

Tube No.
230S

1,2-DICHLOROETHANE



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 a refrigerated place ; 0 ~ 10℃)
5) Operating temperature : 0 ~ 40℃
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'-Dimethylnaphthidine, Nitroso-compound is produced.

$ClCH_2CH_2Cl + CrO_3 + H_2SO_4 \rightarrow Cl_2$

Cl_2 + 3, 3'-Dimethylnaphthidine→Nitroso-compound

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Nitrogen oxides	Similar stain is produced.		Higher readings are given.
Halogens	〃		〃
Halogenated hydrocarbons	〃		〃
Hexane FIG.1	The accuracy of readings is not affected.	100	Lower readings are given.

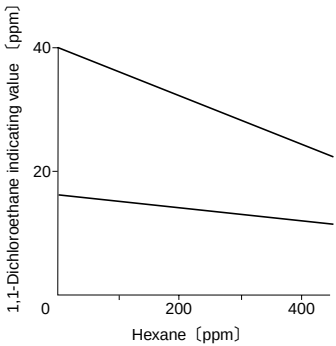
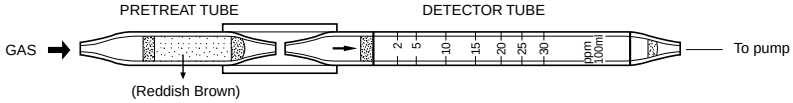


FIG.1 Influence of Hexane

Tube No.
223S

2,2-DICHLOROETHYL ETHER



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 ℃
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. : 10 % RSD-high : 10 %

3. CHEMICAL REACTION

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

$(ClCH_2CH_2)_2O + CrO_3 + H_2SO_4 \rightarrow 2HCl$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

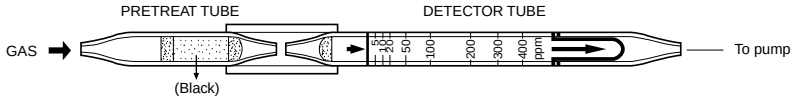
Substance	Interference	Coexistence
Halogenated hydrocarbons	Similar stain is produced.	Higher readings are given.
Aliphatic hydrocarbons (more than C_3)	The accuracy of readings is not affected.	
Aromatic hydrocarbons	〃	
Alcohols	〃	
Esters		Higher readings are given.

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)								
	0 ℃ (32 ° F)	5 ℃ (41 ° F)	10 ℃ (50 ° F)	15 ℃ (59 ° F)	20 ℃ (68 ° F)	25 ℃ (77 ° F)	30 ℃ (86 ° F)	35 ℃ (95 ° F)	40 ℃ (104 ° F)
30	65	53	49	37	30	24	19	14	9
25	45	40	35	30	25	20	16	12	8
20	32	30	27	23	20	17	13	10	6
15	21	20	19	17	15	13	10	7	5
10	14	14	13	12	10	9	7	5	4
5	7	7	6	6	5	4	3	2	1
2	3	3	3	2	2	2	1	1	1

Tube No.
145S

1,2-DICHLOROETHYLENE



1. PERFORMANCE

1) Measuring range : 5-400 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 (Necessary to store in a refrigerated place ; 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 : White → Reddish orange

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

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

$$ClCH = CHCl + PbO_2 + H_2SO_4 \rightarrow Cl_2$$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Trichloroethylene FIG.1	Similar stain is produced.	3	Higher readings are given.
Tetrachloroethylene FIG.2	〃	3	〃
Vinyl chloride	〃	5	〃
Chloride	〃	15	〃

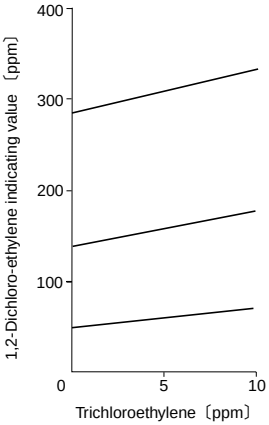


FIG.1 Influence of Trichloroethylene

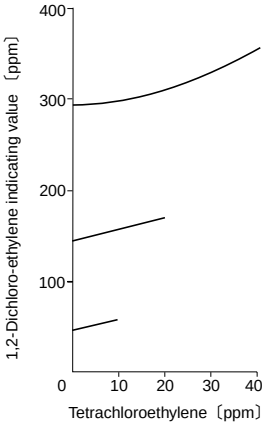


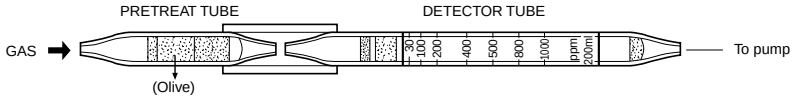
FIG.2 Influence of Tetrachloroethylene

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32˚F)	10℃ (50˚F)	20℃ (68˚F)	30℃ (86˚F)	40℃ (104˚F)
400	570	465	400	330	280
300	420	350	300	235	205
200	290	235	200	160	145
150	220	180	150	130	115
100	145	120	100	90	70
50	65	58	50	45	40
30	40	35	30	26	22
10	10	10	10	10	10

Tube No.
180S

DICHLOROMETHANE



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 a refrigerated place ; 0 ~ 10℃)
5) Operating temperature : 5 ~ 40℃
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 an Oxidizer. By reacting between this Chlorine and *o*-Toluidine, Orthoquinone is produced.

$CH_3OCl_3 + CrO_3 + H_2SO_4 \rightarrow Cl_2$

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.

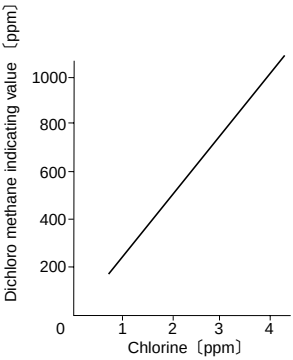


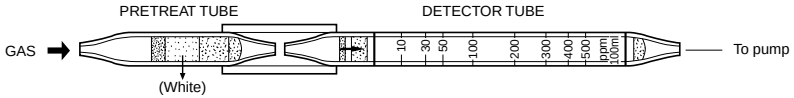
FIG.1 Influence of Chlorine

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)							
	5℃ (41°F)	10℃ (50°F)	15℃ (59°F)	20℃ (68°F)	25℃ (77°F)	30℃ (86°F)	35℃ (95°F)	40℃ (104°F)
1,000	—	—	1,230	1,000	820	670	550	450
800	—	1,190	990	800	660	530	440	360
600	1,120	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

Tube No.
194S

1,3-DICHLOROPROPANE



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 a refrigerated place ; 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 : White → Orange

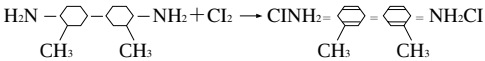
2. RELATIVE STANDARD DEVIATION

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.

$$CH_2ClCH_2CH_2Cl + I_2O_4 + CrO_3 + H_2SO_4 \rightarrow Cl_2$$



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.

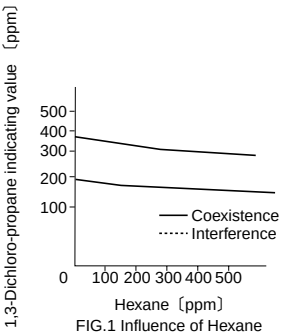


FIG.1 Influence of Hexane

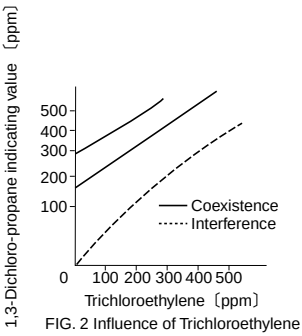


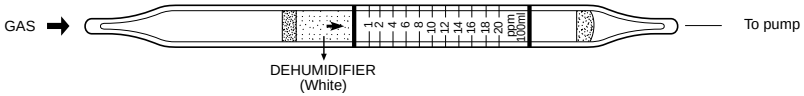
FIG. 2 Influence of Trichloroethylene

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0 ℃ (32 ° F)	10 ℃ (50 ° F)	20 ℃ (68 ° F)	30 ℃ (86 ° F)	40 ℃ (104 ° F)
500	—	685	500	415	350
400	—	550	400	330	275
300	—	400	300	240	200
200	380	265	200	165	130
100	175	130	100	75	60
50	90	70	50	40	37
30	55	40	30	20	15
10	20	14	10	7	5

Tube No.
222S

DIETHYL AMINE



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℃
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, PH indicator is discoloured.

$(C_2H_5)_2NH + H_3PO_4 \rightarrow [(C_2H_5)_2NH]\ HPO_4$

4. CALIBRATION OF THE TUBE

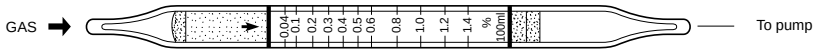
VAPOUR PRESSURE METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

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

Tube No.
107SA

DIETHYL ETHER



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 : 10 ppm
4) Shelf life : 3 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 : Orange → Dark green

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

Chromium oxide is reduced.

$C_2H_5OC_2H_5 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

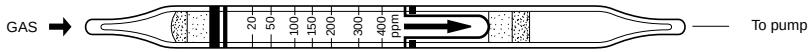
Substance	Interference	ppm	Coexistence
Acetylene		3%	Whole reagent is changed to Brown.
Propane		0.2%	〃
Other organic gases and vapours except Halogenated hydrocarbons	Similar stain is produced.	50	Higher readings are given.

TEMPERATURE CORRECTION TABLE

Chart Readings (%)	True Concentration (%)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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

Tube No.
107U

DIETHYL ETHER



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 ℃
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.

$$C_2H_5OC_2H_5 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

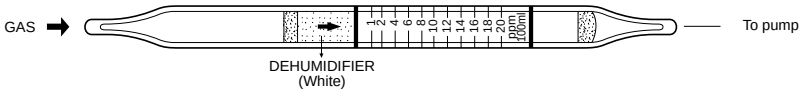
Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Esters	〃	〃
Ketones	〃	〃
Aromatic hydrocarbons	Whole reagent is changed to Pale brown.	〃

TEMPERATURE CORRECTION TABLE

Chart Readings (ppm)	True Concentration (ppm)			
	10 ℃ (50 ° F)	20 ℃ (68 ° F)	30 ℃ (86 ° F)	40 ℃ (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

Tube No.
227S

DIMETHYL AMINE



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℃
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.

$$(CH_3)_2NH + H_3PO_4 \rightarrow (CH_3NH_3)_2HPO_4$$

4. CALIBRATION OF THE TUBE

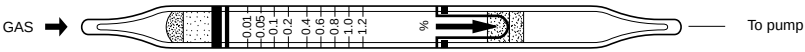
COLOURIMETRY METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

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

Tube No.
123S

DIMETHYL ETHER



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 : 10 ppm
4) Shelf life : 3 years
5) Operating temperature : 0 ～ 40 ℃
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

Potassium dichromate is reduced.

$$CH_3OCH_3 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

4. CALIBRATION OF THE TUBE

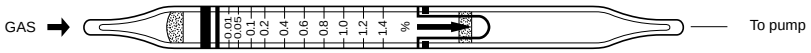
GAS CHROMATOGRAPHY

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.

Tube No.
139SBⓒ

1, 4-DIOXANE



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 ℃
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

Potassium dichromate is reduced.

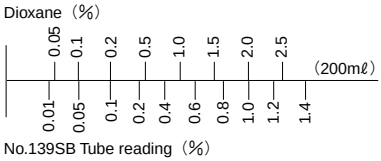
$$O\begin{matrix}\diagup CH_2CH_2 \diagdown \\ \diagdown CH_2CH_2 \diagup\end{matrix}O + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

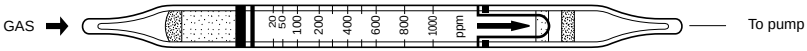
5. INTERFERENCE AND CROSS SENSITIVITY

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



Tube No.
119U©

1, 4-DIOXANE



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℃
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 : Orange → Pale blue

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

Pottassium dichromate is reduced.

$$O\begin{matrix}\diagup CH_2CH_2 \diagdown \\ \diagdown CH_2CH_2 \diagup\end{matrix}O + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

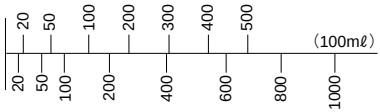
4. CALIBRATION OF THE TUBE

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 changed to Brown.	500	The top of discoloured layer becomes unclear.
Hexane		The accuracy of readings is not affected.	below 1,000ppm	The accuracy of readings is not affected.
Ethyl acetate		〃	〃	〃
Trichloroethylene		〃	〃	〃

1,4-Dioxane concentration (ppm)



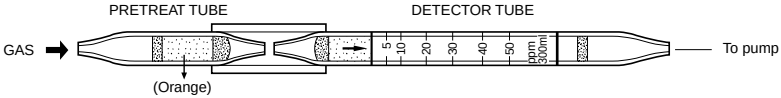
No.119U Tube reading (ppm)

TEMPERATURE CORRECTION TABLE

Scale Readings (%)	True Concentration (%)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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

Tube No.
192S

EPICHLOROHYDRIN



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℃
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, Hyrogen chloride is produced and PH indicator is discoloured.

$$CH_2CHCH_2Cl + CrO_3 + H_2SO_4 \rightarrow HCl$$
$$\diagdown O \diagup$$

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.

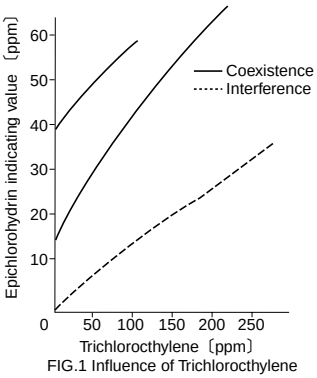


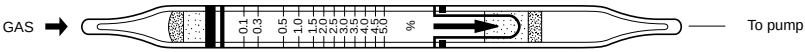
FIG.1 Influence of Trichlorocthylene

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)						
	0℃ (32°F)	5℃ (41°F)	10℃ (50°F)	15℃ (59°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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

Tube No.
111SA

ETHYL ACETATE



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 : 10 ppm
4) Shelf life : 3 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 : Orange → Brownish green

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

Chromium oxide is reduced.

$$CH_3CO_2C_2H_5 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

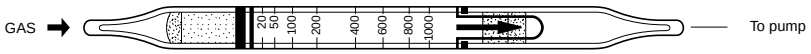
Substance	Interference	ppm	Coexistence
Acetylene		3%	Whole reagent is discoloured to Brown.
Propane		0.2%	〃
Other organic or vapours except Halogenated hydro-carbons	Similar stain is produced.	50	Higher reading are given.

TEMPERATURE CORRECTION TABLE

Scale Readings (%)	True Concentration (%)				
	0℃ (32˚F)	10℃ (50˚F)	20℃ (68˚F)	30℃ (86˚F)	40℃ (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

Tube No.
111U

ETHYL ACETATE



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℃
6) Temperature compensation : Necessary（See "TEMPERATURE CORRECTION 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.

$$CH_3CO_2C_2H_5 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

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	〃	〃
Paraffin hydrocarbons	Whole reagent is discoloured to Pale brown.	It the top of brown stain is clear, the accuracy of readings is not affected.
Halogenated hydrocarbons FIG.1	〃	〃

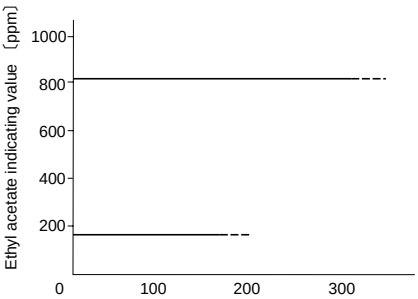


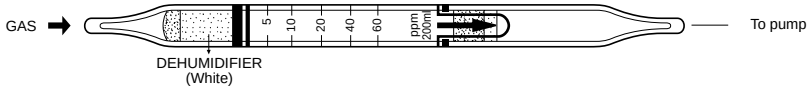
FIG.1 Influence of Trichloroethylene

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)						
	10℃ (50˚F)	15℃ (59˚F)	20℃ (68˚F)	25℃ (77˚F)	30℃ (86˚F)	35℃ (95˚F)	40℃ (104˚F)
1,000	1,330	1,200	1,000	830	700	600	500
800	1,080	950	800	670	550	470	400
600	830	720	600	500	420	380	300
400	570	480	400	330	280	240	200
200	280	240	200	170	140	120	100
100	150	120	100	80	70	60	50
50	70	60	50	40	30	20	10
20	30	25	20	15	10	7	4

Tube No.
211U©

ETHYL ACRYLATE



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℃
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.

$$CH_2 = CHCO_2CH_2CH_3 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher reading are given.
Paraffin hydrocarbons (more than C_3)	Whole reagent is discoloured to Dark brown.	〃
Halogenated hydrocarbons	〃	〃
Esters	〃	〃
Aromatic hydrocarbons FIG.1,2	〃	〃

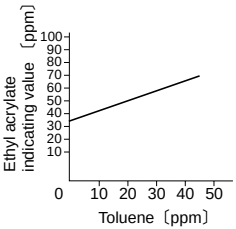


FIG.1 Influence of Toluene

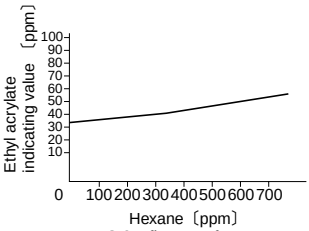
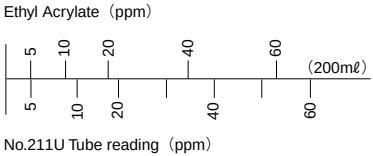


FIG.2 Influence of Hexane

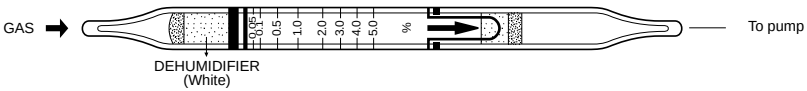


TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32˚F)	10℃ (50˚F)	20℃ (68˚F)	30℃ (86˚F)	40℃ (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

Tube No.
104SA

ETHYL ALCOHOL (ETHANOL)



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 : 100 ppm
4) Shelf life : 3 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 : Yellowish orange → Pale green (The top of discoloured lauer is Brown, but read at the top Pale green.)

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

Chromium oxide is reduced.

$$C_2H_5OH + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

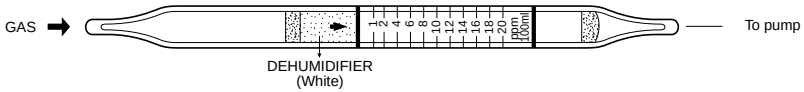
Substance	Interference	Coexistence
Paraffin hydrocarbons (over C_3)	Similar stain is produced.	Higher reading are given.
Alcohols	〃	〃
Esters	〃	〃
Ketones	〃	〃
Aromatic hydrocarbons	〃	〃
Halogenated hydrocarbons	Pale brown stain is produced.	If the top of discolouration by Ethanol can be obtained, the accuracy of readings is not affected.

TEMPERATURE CORRECTION TABLE

Scale Readings (%)	True Concentration (%)				
	0 ℃ (32 ° F)	10 ℃ (50 ° F)	20 ℃ (68 ° F)	30 ℃ (86 ° F)	40 ℃ (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

Tube No.
227S

ETHYL AMINE



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℃
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.

$CH_3CH_2NH_2 + H_3PO_4 \rightarrow (CH_3NH_3)_2HPO_4$

4. CALIBRATION OF THE TUBE

COLOURIMETRY METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

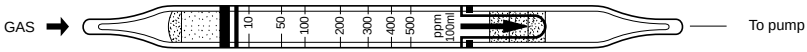
Substance	Interference	Coexistence
Ammonia	Similar stain is produced.	Higher reading are given.
Other amines	〃	〃

(NOTE)

This tube scale is calibrated based on Methyl amine and the same scale is available for Ethyl amine.

Tube No.
179S

ETHYL BENZENE



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 : 2 ppm
4) Shelf life : 1.5 years
5) Operating temperature : 0 ~ 40 ℃
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.

$C_6H_5C_2H_5 + I_2O_5 + H_2SO_4 \rightarrow I_2$

4. CALIBRATION OF THE TUBE

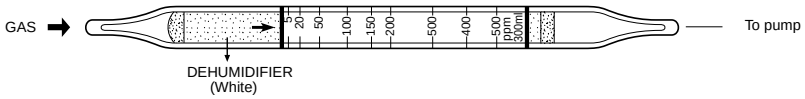
GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Benzene	Similar stain is produced.	10	Higher readings are given.
Toluene	〃	25	〃
Xylene	〃	50	〃
Methanol	The accuracy of readings is not affected.	1 %	〃
Hexane	Pale brown stain is produced.	0.1 %	〃

Tube No.
190U

ETHYL CELLOSOLVE



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 ℃
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.

$C_2H_5OCH_2CH_2OH + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

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	〃	〃
Paraffin hydrocarbons (more than C_3)	Whole reagent is changed to Brown.	〃
Aromatic hydrocarbons	〃	〃
Esters	〃	〃
Ketones	〃	〃
Halogenated hydrocarbons FIG.2	〃	〃

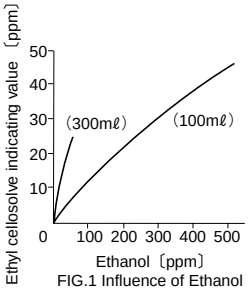


FIG.1 Influence of Ethanol

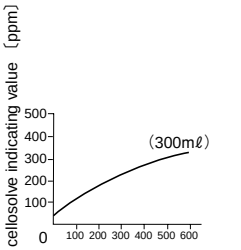


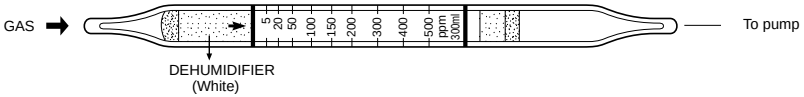
FIG.2 Influence of 1,1,1-Trichloroethane

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)					
	10 ℃ (50 ˚ F)	15 ℃ (59 ˚ F)	20 ℃ (68 ˚ F)	25 ℃ (77 ˚ F)	30 ℃ (80 ˚ F)	35 ℃ (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

Tube No.
190Uⓒ

ETHYL CELLOSOLVE ACETATE



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 ℃
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.

$$CH_3CO_2CH_2CH_2OC_2H_5 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

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	〃	〃
Paraffin hydrocarbons（more than C_3）	Whole reagent is changed to Pale Brown.	〃
Aromatic hydrocarbons	〃	〃
Esters	〃	〃
Ketones	〃	〃
Halogenated hydrocarbons	〃	〃

FIG.1

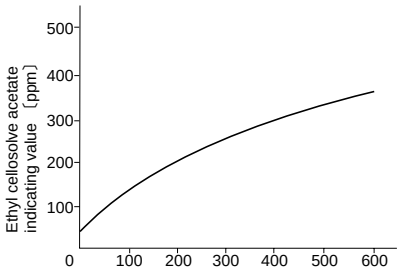
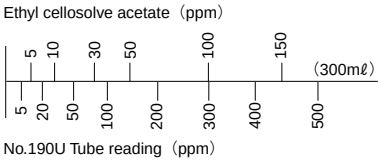


FIG.1 Influence of 1,1,1-Trichloroethane

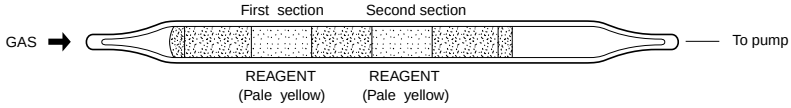


TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)					
	10℃ (50°F)	15℃ (59°F)	20℃ (68°F)	25℃ (77°F)	30℃ (80°F)	35℃ (95°F)
150	225	190	150	115	90	75
100	160	130	100	80	65	55
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

Tube No.
108B

ETHYLENE



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℃
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.

$H_2C=CH_2+PdSO_4+(NH_4)_2MoO_4 \rightarrow Mo_3O_8$

4. CALIBRATION OF THE TUBE

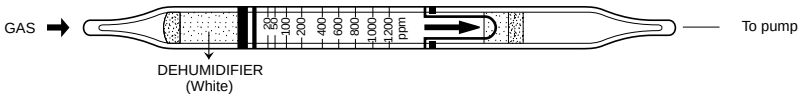
STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Hydrogen (over 40℃)	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.		〃
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 is faded.		Lower readings are given.

Tube No.
108SA

ETHYLENE



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℃
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.

$H_2C = CH_2 + PdSO_4 + (NH_4)_2MoO_4 \rightarrow Mo_3O_8$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

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		〃	〃

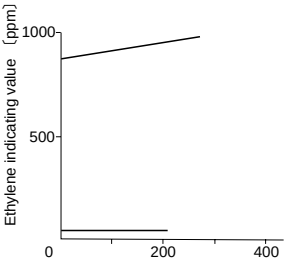


FIG.1 Influence of Carbon monoxide

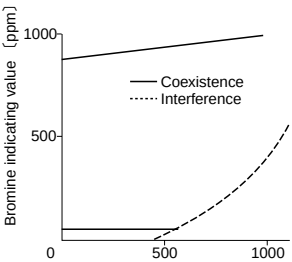


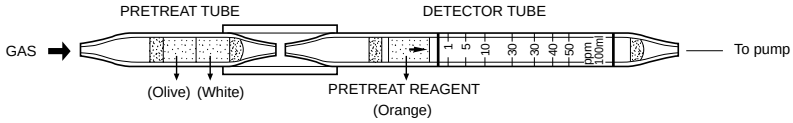
FIG.2 Influence of Hydrogen sulphide

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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	650	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	—	—

Tube No.
166S

ETHYLENE DIBROMIDE



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 a refrigerated place ; 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 : 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

$BrCH_2CH_2Br + I_2O_4 + CrO_3 + H_2SO_4 \rightarrow Br_2$

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

Scale Readings (ppm)	True Concentration (ppm)					
	10 ℃ (50 ° F)	15 ℃ (59 ° F)	20 ℃ (68 ° F)	25 ℃ (77 ° F)	30 ℃ (80 ° F)	35 ℃ (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

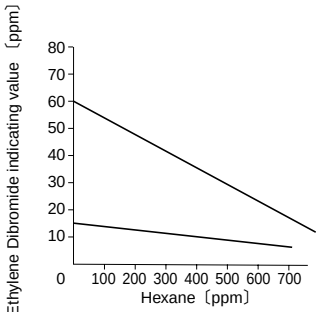
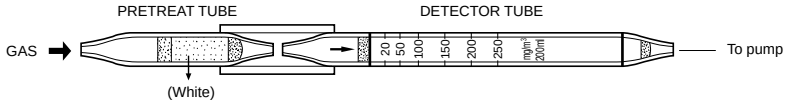


FIG.1 Influence of Hexane

Tube No.
232SA

ETHYLENE GLYCOL



1. PERFORMANCE

1) Measuring range : 20-250mg/m^3
   Number of pump strokes : 2 (200mℓ)
2) Sampling time : 1.5 minutes/1 pump stroke
3) Detectable limit : 5mg/m^3
4) Shelf life : 2 years
5) Operating temperature : 20 ~ 40 ℃
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.

$HOCH_2CH_2OH + HIO_4 \rightarrow 2HCHO + HIO_3 + H_2O$

$HCHO + HIO_4 + H_2SO_4 \rightarrow HCOOH + HIO_3$

$HCOOH + NaOH \rightarrow Na(HCOO) + H_2O$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

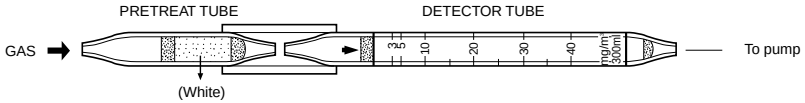
Substance	Interference	Coexistence
Aldehydes	Similar stain is produced.	Higher readings are given.
Sulphur dioxide	〃	〃
Ethylene oxide	〃	〃
Hydrogen sulphide	Orange/Pink stain is produced.	Accurate measurement can not be done.

TEMPERATURE CORRECTION TABLE

Scale Readings (mg/m^3)	True Concentration (mg/m^3)				
	20 ℃ (68 ˚ F)	22 ℃ (71.6 ˚ F)	25 ℃ (77 ˚ F)	30 ℃ (86 ˚ F)	40 ℃ (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
30	23	20	20	18	15

Tube No.
232SB

ETHYLENE GLYCOL



1. PERFORMANCE

1) Measuring range : 3-40mg/m^3
   Number of pump strokes : 3(300mℓ)
2) Sampling time : 4.5 minutes/3 pump strokes
3) Detectable limit : 1mg/m^3
4) Shelf life : 3 years
5) Operating temperature : 15 ~ 40 ℃
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.

$HOCH_2CH_2OH + HIO_4 \rightarrow 2HCHO + HIO_3 + H_2O$

$HCHO + HIO_4 + H_2SO_4 \rightarrow HCOOH + HIO_3$

$HCOOH + NaOH \rightarrow Na(HCOO) + H_2O$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

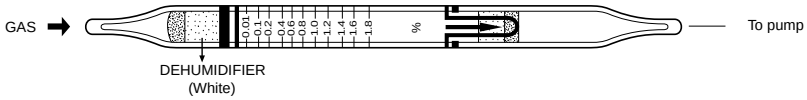
Substance	Interference	Coexistence
Aldehydes	Similar stain is produced.	Higher readings are given.
Sulphur dioxide	Brownish yellow stain is produced.	〃
Hydrogen sulphide	〃	〃

TEMPERATURE CORRECTION TABLE

Scale Readings (mg/m^3)	True Concentration (mg/m^3)			
	15℃ (68°F)	20℃ (71.6°F)	30℃ (77°F)	40℃ (86°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

Tube No.
122SA

ETHYLENE OXIDE



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 : 50 ppm
4) Shelf life : 3 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 : Orange → Dark brown

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

Potassium dichomate is reduced.

$$\underbrace{CH_2CH_2O} + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

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.

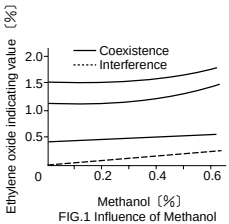


FIG.1 Influence of Methanol

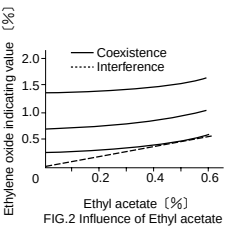
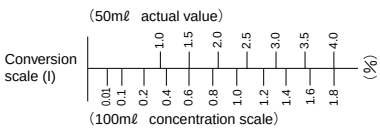


FIG.2 Influence of Ethyl acetate

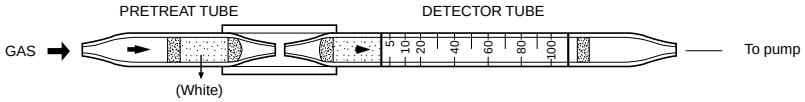
TEMPERATURE CORRECTION TABLE

Scale Readings (%)	True Concentration (%)				
	0℃ (32˚F)	10℃ (50˚F)	20℃ (68˚F)	30℃ (86˚F)	40℃ (104˚F)
1.8	—	2.00	1.80	1.70	1.64
1.6	2.06	1.78	1.60	1.50	1.46
1.4	1.84	1.58	1.40	1.35	1.28
1.2	1.60	1.34	1.20	1.14	1.09
1.0	1.31	1.12	1.00	0.93	0.88
0.8	1.08	0.91	0.80	0.73	0.68
0.6	0.86	0.70	0.60	0.54	0.49
0.4	0.63	0.49	0.40	0.34	0.30
0.2	0.36	0.26	0.20	0.16	0.13
0.1	0.20	0.14	0.10	0.08	0.06
0.01	0.05	0.02	0.01	0.01	0.01



Tube No.
122SB

ETHYLENE OXIDE



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 : 0.5 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 2 pump strokes
8) Colour change : 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.

$$\underbrace{CH_2CH_2O} + H_2SO_4 \rightarrow HOCH_2CH_2OH$$

$$HOCH_2CH_2OH + HIO_4 \rightarrow 2HCHO + HIO_3 + H_2O$$
$$HCHO + HIO_4 + H_2SO_4 \rightarrow HCO_2H + HIO_3$$
$$HCO_2H + NaOH \rightarrow Na(HCOO) + H_2O$$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

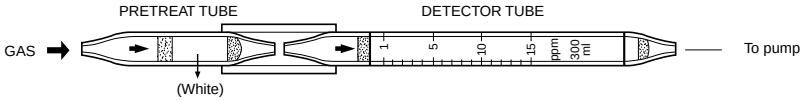
Substance	Interference	Coexistence
Formaldehyde	Similar stain is produced.	Higher readings are given.
Propylene	〃	〃
Acetone	Yellow stain is produced a little on the gas inlet edge.	Lower readings are given.
Diethyl ether	Pale orange stain is produced a little on the gas inlet edge.	〃

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	Corrected Concentration (ppm)				
	0 ℃ (32 ° F)	10 ℃ (50 ° F)	20 ℃ (68 ° F)	30 ℃ (86 ° F)	40 ℃ (104 ° F)
100	—	125	100	80	70
80	—	100	80	64	56
60	140	75	60	48	42
40	80	50	40	32	28
20	32	25	20	17	14
10	15	12	10	9	7
5	7	6	5	5	4

Tube No.
122SC

ETHYLENE OXIDE



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 : 3 years
5) Operating temperature : 10 ～ 40 ℃
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.

$CH_2CH_2O + H_2SO_4 \rightarrow HOCH_2CH_2OH$

$HOCH_2CH_2OH + HIO_4 \rightarrow 2HCHO + HIO_3 + H_2$

$HCHO + HIO_4 + H_2SO_4 \rightarrow HCOOH + HIO_3$

$HCOOH + NaOH \rightarrow Na(HCOO) + O2$

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	〃	〃

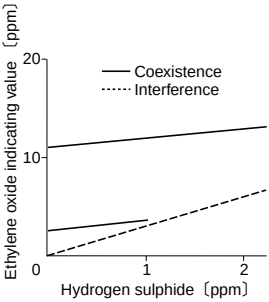


FIG.1 Influence of Hydrogen sulphide

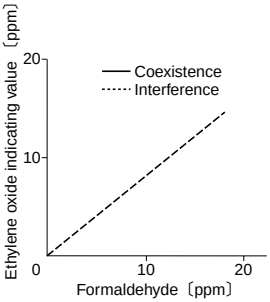


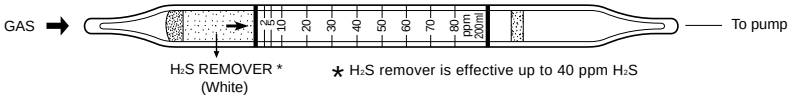
FIG.2 Influence of Formaldehyde

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)			
	10℃ (50˚F)	15-25℃ (59˚F)	30℃ (86˚F)	40℃ (77˚F)
15	19	15	13	10
10	12.5	10	8.5	7
5	6	5	4	3.5
1	1	1	1	1

Tube No.
165SA

ETHYL MERCAPTAN



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℃
6) Temperature compensation : Necessary (0 ~ 20℃) (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.

$$C_2H_5SH + PdSO_4 \rightarrow (C_2H_5S)_2Pd + H_2SO_4$$

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		Pale brown stain is produced		
Methyl mercaptan		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.

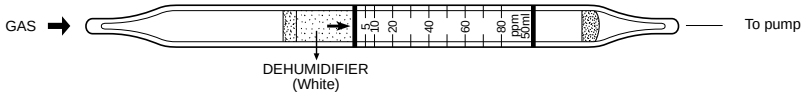
$$\text{Actual concentration} = \text{Temperature corrected value} \times \frac{2}{\text{Number of strokes}}$$

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)		
	0℃ (32˚F)	10℃ (50˚F)	20-40℃ (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

Tube No.
165SB

ETHYL MERCAPTAN



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 minutes/ 1/2 pump strokes
3) Detectable limit : 1 ppm (100mℓ)
4) Shelf life : 2 years
5) Operating temperature : 0 ~ 40 ℃
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.

$C_2H_5SH + HgCl_2 \rightarrow C_2H_5S(HgCl) + HCl$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

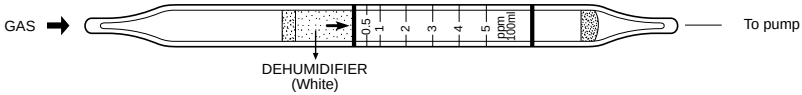
5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	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	〃		

(NOTE)
In case of 1 pump strokes, divide the tube reading by 2.

Tube No.
130U

ETHYL MERCAPTAN



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℃
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 cholride, Hydrogen chloride is produced and PH indicator is discoloured.

$C_2H_5SH + HgCI_2 \rightarrow RS(HgCI) + HCI$

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.
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.

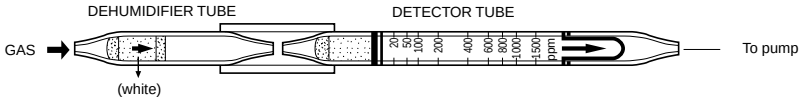
（NOTE）

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

Actual concentration＝2×Reading value

Tube No.
171SA

FORMALDEHYDE



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 : 5 ppm
4) Shelf life : 2 years (Necessary to store in a refrigerated place ; 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 : 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.

$HCHO + (NH_2OH)_3 \cdot H_3PO_4 \rightarrow H_3PO_4 + HCH = NOH + H_2O$

4. CALIBRATION OF THE TUBE

COLOURIMETRY METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

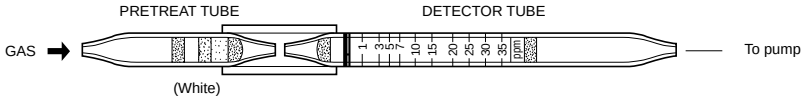
Substance	Interference	ppm	Coexistence
Other Aldehydes	Similar stain is produced.		Higher readings are given.
Ketones	〃		〃
Methanol		Formal-dehyde conc. ×1/2	Lower readings are given.

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)						
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	25℃ (77°F)	30℃ (86°F)	35℃ (95°F)	40℃ (104°F)
1,500	—	—	1,500	900	690	530	410
1,000	—	—	1,000	700	550	430	340
800	—	1,300	800	600	490	390	300
600	1,200	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

Tube No.
171SB

FORMALDEHYDE



1. PERFORMANCE

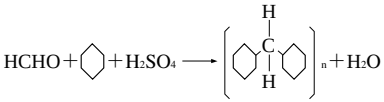
1) Measuring range : 1-35 ppm
   Number of pump strokes : 3 (300mℓ)
2) Sampling time : 3 minutes/3 pump strokes
3) Detectable limit : 0.5 ppm
4) Shelf life : 3 years
5) Operating temperature : 0 ~ 40℃
6) Reading : Direct reading from the scale calibrated by 3 pump strokes
7) Colour change : White → Brownish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

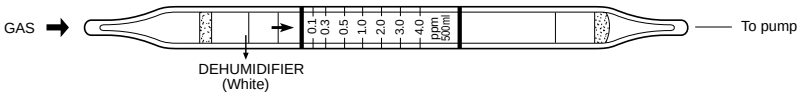
COLOURIMETRY METHOD

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	〃

Tube No.
171SC

FORMALDEHYDE



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 a refrigerated place ; 0 ~ 10 ℃)
5) Operating temperature : 10 ~ 40 ℃
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

By reaction with Hydroxylamine phosphate acid is liberated and PH indicator is discoloured.

$HCHO + (NH_3OH)_3 \cdot H_3PO_4 \rightarrow H_3PO_4 + HCH = NOH + H_2O$

4. CALIBRATION OF THE TUBE

COLOURIMETRY 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.		

TEMPERATURE CORRECTION TABLE

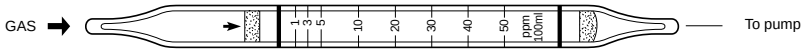
Tube Readings (ppm)	Corrected Concentration (ppm)			
	10 ℃ (50 ° F)	20 ℃ (68 ° F)	30 ℃ (86 ° F)	40 ℃ (104 ° F)
4.0	6.4	4.0	2.4	1.6
3.5	5.6	3.5	2.1	1.4
3.0	4.8	3.0	1.8	1.2
2.5	4.0	2.5	1.5	1.0
2.0	3.2	2.0	1.2	0.8
1.5	2.4	1.5	0.9	0.6
1.0	1.6	1.0	0.6	0.4
0.5	0.8	0.5	0.3	0.2
0.3	0.5	0.3	0.18	0.12
0.1	0.16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

Tube No.
216S

FORMIC ACID



1. PERFORMANCE

1) Measuring range : 1-50 ppm
   Number of pump strokes : 1 (100mℓ)
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℃
6) Temperature compensation : Necessary (0 ~ 20℃) (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.

$HCO_2H + NaOH \rightarrow HCO_2Na + H_2O$

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_2H 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_2H conc. ×2	Higher readings are given.
Chlorine FIG.2		Blueish yellow stain is produced.	5	〃
Acetic acid		Similar stain is produced.		〃

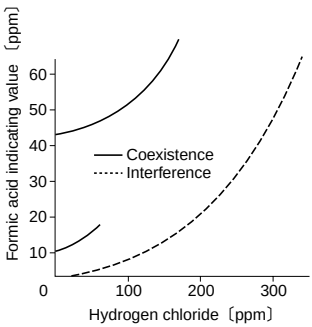


FIG.1 Influence of Hydrogen chloride

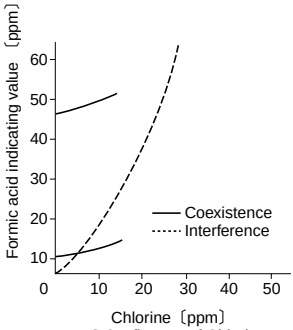


FIG.2 Influence of Chlorine

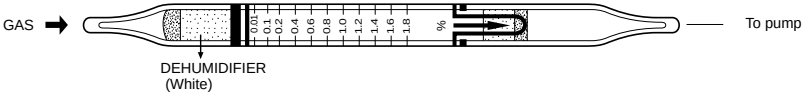
TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)		
	0℃ (32°F)	10℃ (50°F)	20～40℃ (68°F)
50	82	60	50
40	57	45	40
30	36	32	30
20	22	21	20
10	10	10	10
5	5	5	5
2	2	2	2

(NOTE)

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

Tube No.
122SA© FURAN



1. PERFORMANCE

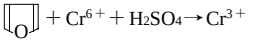
1) Measuring range : 0.2-2.0 % 0.01-0.9 %
Number of pump strokes 1/2 (50mℓ) 1 (100mℓ)
2) Sampling time : 1.5 minutes/1 pump stroke
3) Detectable limit : 10 ppm
4) Shelf life : 3 years
5) Operating temperature : 0 ~ 40 ℃
6) Reading : Graduations printed on the tube are calibrated by Ethylene oxide at 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.



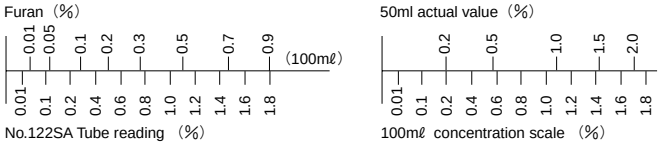
4. CALIBRATION OF THE TUBE

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 stroke, following conversion scale is available for the actual concentration.



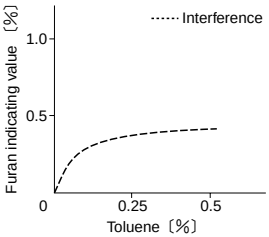


FIG.1 Influence of Toluene

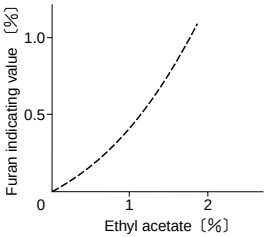


FIG.2 Influence of Ethyl acetate

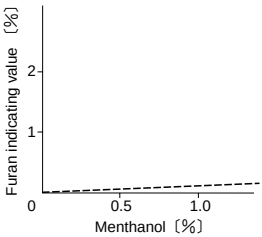
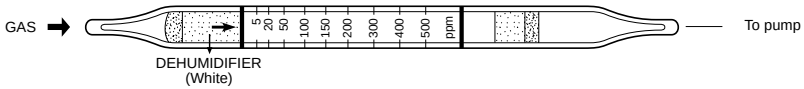


FIG.3 Influence of Menthanol

Tube No.
190U©

FURFURAL



1. PERFORMANCE

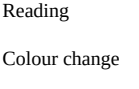
1) Measuring range : 2-60 ppm
   Number of pump strokes 3 (300 mℓ)
2) Sampling time : 4.5 minutes / 3 pump strokes
3) Detectable limit : 0.5 ppm
4) Shelf life : 3 years
5) Operating temperature : 0 ~ 40 ℃
6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
7) Reading : Graduations 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.



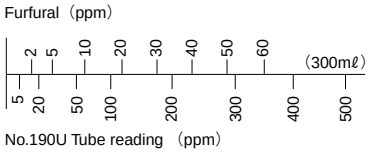
$$CH=CH \;|\; CH=C-CHO \;>O \quad + H_2SO_4 + Cr^{6+} \rightarrow Cr^{3+}$$

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.

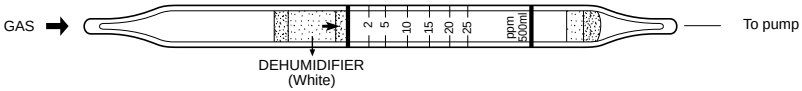


TEMPERATURE CORRECTION TABLE

Conver. value (ppm)	Corrected Concentration (ppm)				
	0 ℃ (32 ° F)	10 ℃ (50 ° F)	20 ℃ (68 ° F)	30 ℃ (86 ° F)	40 ℃ (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

Tube No.
238S

FURFURYL ALCOHOL



1. PERFORMANCE

1) Measuring range : 2-25 ppm
   Number of pump strokes 5 (500mℓ)
2) Sampling time : 5 minutes/5 pump strokes
3) Detectable limit : 0.5 ppm
4) Shelf life : 1 year
5) Operating temperature : 10 ~ 40 ℃
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

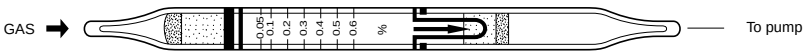
DIFFUSION TUBE METHOD

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0 ℃ (32 °F)	10 ℃ (50 °F)	20 ℃ (68 °F)	30 ℃ (86 °F)	40 ℃ (104 °F)
60	—	—	60	35	25
50	—	—	50	30	22
40	—	80	40	25	15
30	—	50	30	20	10
20	50	30	20	14	7
15	30	20	15	10	5
10	15	12	10	7	3
5	7	6	5	4	2
2	2	2	2	2	2

Tube No.
110S

GASOLINE



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 : 50 ppm
4) Shelf life : 3 years
5) Operating temperature : 10 ~ 40 ℃
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.

$$\text{Gasoline} + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance		Interference	ppm	Coexistence
Benzene	FIG.1	Similar 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.		〃
Cyclohexane		〃		〃
Paraffin hydrocarbons		〃		〃

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

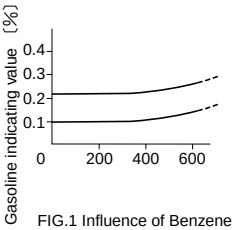


FIG.1 Influence of Benzene

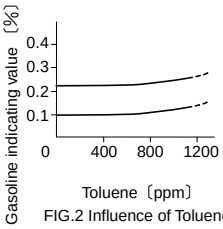


FIG.2 Influence of Toluene

TEMPERATURE CORRECTION TABLE

Scale Readings (%)	True Concentration (%)				
	10 ℃ (50 ° F)	15 ℃ (59 ° F)	20 ℃ (68 ° F)	30 ℃ (86 ° F)	40 ℃ (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

Tube No.
187S

GENERAL HYDROCARBONS

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 tupentine 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 ℃
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.

$$CH_3(CH_2)_4CH_3 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

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.

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 ℃ standard)

Readings	0 ℃	10 ℃	20 ℃	30 ℃	40 ℃
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 ℃ 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℃
Reading Concentration 600 ppm
Concentration on temperature correction 500 ppm
Concentration of mineral tupentine 16mg/ℓ

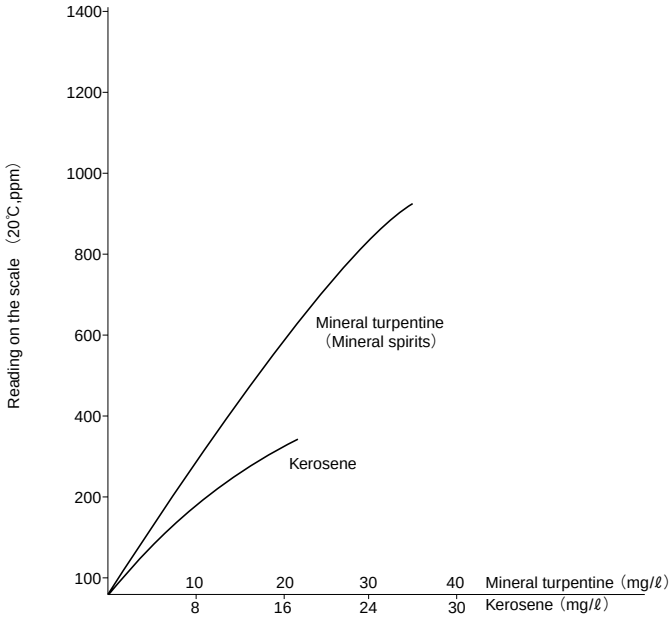


FIG.1 Conversion graph

Tube No.
113SBⓒ HEPTANE

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℃
6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
7) Reading : Graduations printed on the tube are calibrated by Hexane at 1 pump stroke and Heptane concentration is determined by using a conversion chart at 3 pump strokes.
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.

$CH_3(CH_2)_5CH_3 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Alcohols	Similar stain is produced.	6%	
Ketones	〃	〃	〃
Esters	〃	〃	〃
Aromatic hydrocarbons FIG.1,2	〃		The bottom of the discoloured layer is stained to Black and higher readings are given.
Paraffin hydrocarbons (more than C_3)	〃		Higher readings are given.

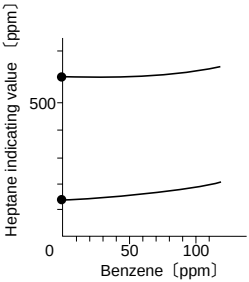


FIG.1 Influence of Benzene

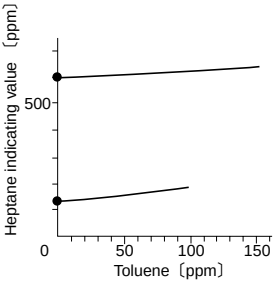
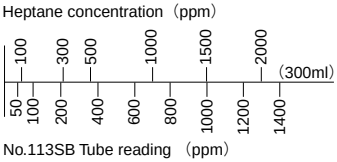


FIG.2 Influence of Toluene



TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (104°F)
2,000	—	—	2,000	1,680	1,460
1,600	—	2,000	1,600	1,380	1,200
1,200	2,000	1,160	1,200	1,040	920
800	1,200	940	800	720	660
400	520	460	400	360	320
200	260	230	200	180	160
100	100	100	100	100	100

Tube No.
113SA

n-HEXANE

1. PERFORMANCE

1) Measuring range : 0.1-1.32 % 0.05-0.6 %
   Number of pump strokes 1/2 (50mℓ) 1 (100mℓ)
2) Sampling time : 1 minute/1 pump stroke
3) Detectable limit : 50 ppm
4) Shelf life : 3 years
5) Operating temperature : 10 ~ 40 ℃
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.

$CH_3(CH_2)_4CH_3 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance		Interference	ppm	Coexistence
Paraffin hydrocarbons		Similar stain is produced.		Higher readings are given.
Acetylene		〃		〃
Ethylene		〃		〃
Cyclohexane		〃		〃
Benzene	FIG.1	Black stain is produced.	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.

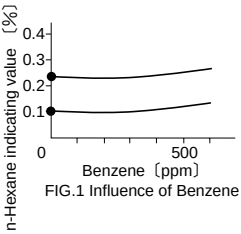


FIG.1 Influence of Benzene

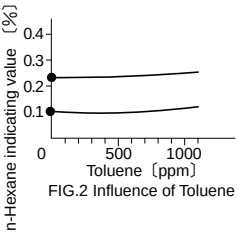


FIG.2 Influence of Toluene

TEMPERATURE CORRECTION TABLE

Scale Readings (%)	True Concentration (%)				
	10℃ (50°F)	15℃ (59°F)	20℃ (68°F)	30℃ (86°F)	40℃ (104°F)
0.6	0.78	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

(NOTE)

In case of 1/2 strokes, following formula is available for the actual concentration.
Actual concentration = 2.2 × Tmperature corrected value

Tube No.
113SB n-HEXANE

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℃
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.

$CH_3(CH_2)_4CH_3 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

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.
Paraffin hydrocarbons (more than C_3)	Similar stain is produced.	〃

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

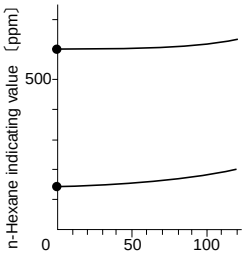


FIG.1 Influence of Benzene

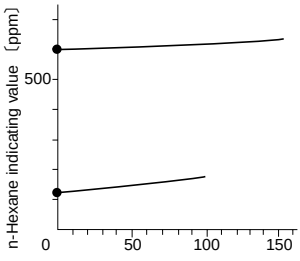
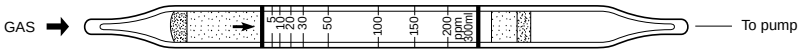


FIG.2 Influence of Toluene

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32˚F)	10℃ (50˚F)	20℃ (68˚F)	30℃ (86˚F)	40℃ (104˚F)
1,400	1,730	1,530	1,400	1,270	1,180
1,200	1,470	1,320	1,200	1,090	1,010
1,000	1,230	1,100	1,000	910	840
800	980	870	800	720	670
600	740	660	600	550	500
400	470	430	400	360	330
200	220	210	200	180	170
100	100	100	100	100	100

Tube No.
113SC n-HEXANE



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℃
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 deoxidized.

$CH_3(CH_2)_4CH_3 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

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)

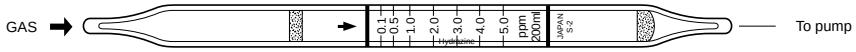
In case of 1 pump stroke, following equation is available for the actual concentration.
Actual concentration = Temperature corrected value × 4

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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

Tube No.
219S

HYDRAZINE



1. PERFORMANCE

1) Measuring range	: 0.2-10 ppm	0.1-5 ppm	0.05-2.5 ppm
Number of pump strokes	1 (100mℓ)	2 (200mℓ)	4 (400mℓ)

2) Sampling time : 2 minutes/2 pump strokes
3) Detectable limit : 0.02 ppm (400mℓ)
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 2 pump strokes
8) Colour change : Yellow → Blue

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

$NH_2NH_2 + H_2SO_4 \rightarrow NH_2NH_2 \cdot H_2SO_4$

4. CALIBRATION OF THE TUBE

COLOURIMETRY METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

(NOTE)

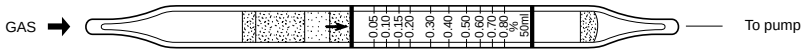
In case of 1 or 4 pump strokes, following formula is available for the actual concentration.
Actual concentration = Temperature corrected value × 2/Number of strokes

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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

Tube No.
137U

HYDROGEN



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 ℃
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 → Green

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

By reacting with Oxygen in Atomsphere, water vapour is produced. This Water vapour reacts with Magnesium perchlorate and PH indicator is discoloured.

$H_2 + O_2 \rightarrow H_2O$

$H_2O + Mg(ClO_4)_2 \rightarrow Mg(ClO_4)_2 \cdot H_2O$

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 accurate readings are 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.

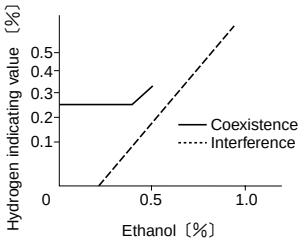


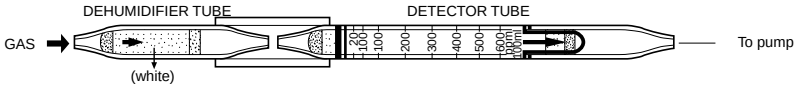
FIG.1 Influence of Ethanol

TEMPERATURE CORRECTION TABLE

Scale Readings (%)	True Concentration (%)								
	0 ℃ (32 ˚ F)	5 ℃ (41 ˚ F)	10 ℃ (50 ˚ F)	15 ℃ (59 ˚ F)	20 ℃ (68 ˚ F)	25 ℃ (77 ˚ F)	30 ℃ (86 ˚ F)	35 ℃ (95 ˚ F)	40 ℃ (104 ˚ F)
0.8	—	—	—	—	0.8	0.68	0.58	0.51	0.45
0.7	—	—	—	1.00	0.7	0.60	0.52	0.45	0.40
0.6	—	—	1.00	0.80	0.6	0.52	0.44	0.39	0.35
0.5	—	—	0.80	0.65	0.5	0.44	0.37	0.33	0.30
0.4	—	—	0.62	0.51	0.4	0.35	0.30	0.27	0.25
0.3	—	0.70	0.46	0.37	0.3	0.28	0.23	0.21	0.19
0.2	0.65	0.47	0.30	0.25	0.2	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	0.1	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

Tube No.
173SA

HYDROGEN CHLORIDE



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
4) Shelf life : 2 years
5) Operating temperature : 0～40℃
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

By reacting witl alkali, PH indicator is discoloured.

$HCI + NaOH \rightarrow NaCI + H_2O$

4. CALIBRATION OF THE TUBE

COLOURIMETRY 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

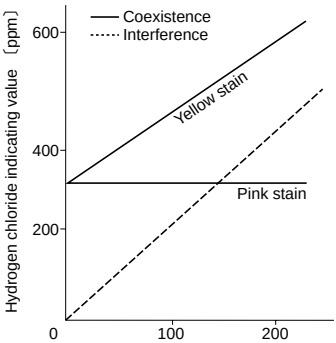
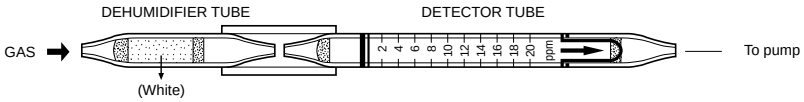


FIG.1 Influence of Sulphur dioxide

Tube No.
173SB

HYDROGEN CHLORIDE



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 ℃
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 may be distinguished from clear discoloration by Hydrogen chloride.	The accuracy of readings is not affected.
Nitric acid	High conc.	〃	〃
Nitrogen dioxide	100	〃	〃
Chlorine		Similar stain is produced.	Higher readings are given.

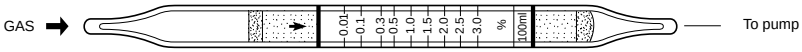
(NOTE)

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

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

Tube No.
112SA

HYDROGEN CYANIDE



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 : 10 ppm
4) Shelf life : 3 years
5) Operating temperature : 0 ~ 40 ℃
6) Reading : Direct reading from the scale calibrated by 1 pump stroke
7) Colour change : Yellow → Brownish red

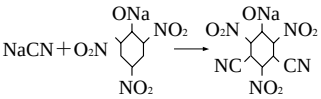
2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

Hydrogen cyanide reacts with Sodium picrate.

$HCN + NaOH \rightarrow NaCN + H_2O$



4. CALIBRATION OF THE TUBE

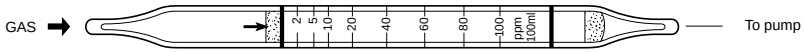
COLOURIMETRY METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Sulphur dioxide	Similar stain is produced.	200	Higher readings are given.
Hydrogen sulphide	〃	100	〃
Dicyanide	〃		〃
Carbon disulphide	〃		〃
Acetone	〃		〃

Tube No.
112SB

HYDROGEN CYANIDE



1. PERFORMANCE

1) Measuring range : 2-100 ppm 0.2-25 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 a refrigerated place ; 0 ~ 10℃)
5) Operating temperature : 0 ~ 40℃
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 sulphide is liberated and PH indicator is discoloured.

$HCN + HgCI_2 \rightarrow HCI$

4. CALIBRATION OF THE TUBE

COLOURIMETRY METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Sulphur dioxide	Similar stain is produced.	1	Higher readings are given.
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.

$$\text{Actual concentration} = \text{Reading value} \times \frac{1}{4}$$

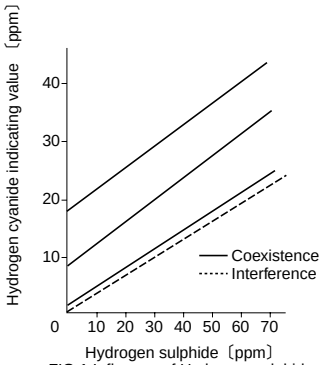
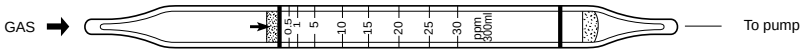


FIG.1 Influence of Hydrogen sulphide

Tube No.
156S

HYDROGEN FLUORIDE



1. PERFORMANCE

1) Measuring range : 0.5-30 ppm 0.25-15 ppm
   Number of pump strokes 3(300mℓ) 6(600mℓ)
2) Sampling time : 1 minute/1 pump stroke
3) Detectable limit : 0.2 ppm(300mℓ)
4) Shelf life : 3 years
5) Operating temperature : 0～40℃
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

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)

1) 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
2) In case of 6 pump strokes, following formula is available for the actual concentration.
   Actual concentration = 1/2 × Temp./R.H. corrected value

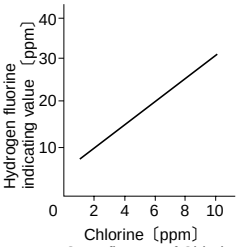


FIG.1 Influence of Chlorine

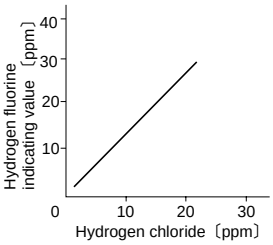


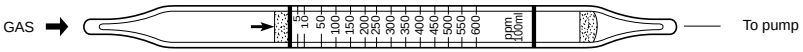
FIG.2 Influence of Hydrogen chloride

TEMP./R.H.CORRECTION COEFFICIENT TABLE

Relative Humidity (%)	Temperature				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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	0.7	0.7
60	—	2.2	1.5	1.1	0.8
70	—	—	2.7	1.6	0.9
80	—	—	—	2.9	1.1

Tube No.
167S

HYDROGEN SELENIDE



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℃
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(III), Colloidal gold is liberated.

$H_2Se + AuCl_3$ (III) → Au

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

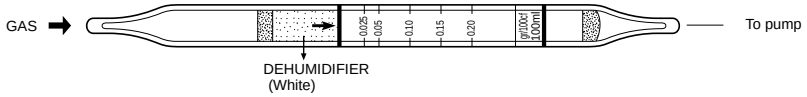
Substance	ppm	Interference	ppm	Coexistence
Acetylene			3%	Higher readings are given.
Carbon monoxide			0.1%	〃
Sulphur dioxide		Pale blue stain is produced.		〃
Hydrogen sulphide	10	Brown stain is produced.		〃
Mercury vapours		Similar stain is produced.		
Arsine		〃	10	〃
Iron carbonyl		〃	10	〃
Nickel carbonyl		〃	10	〃

(NOTE)

When the concentration is below 5 ppm, 5 pump strokes can be used to determine the lower concentration.
Following formula is available for the actual concentration.
Actual concentration = 1/5 × Reading value

Tube No.
120GR

HYDROGEN SULPHIDE



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℃
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.

$H_2S + HgCl_2 \rightarrow HgS + HCl$

4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

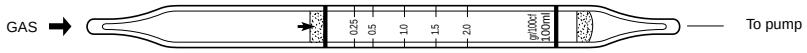
Substance	Interference	Coexistence
Sulphur dioxide	Whole reagent is changed to Pale red, but Purplish red stain is indicated H_2S concentration.	Higher readings are given.
Hydrogen seleenide	Similar stain is produced.	〃
Arsine	〃	〃
Mercaptans	〃	〃
Phosphine	〃	〃
Hydrogen cyanide	Whole reagent is changed to red.	〃

(NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.
Actual concentration = 2 × Reading value

Tube No.
120GT

HYDROGEN SULPHIDE



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 ℃	
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

$H_2S + Pb(CH_3COO)_2 \rightarrow PbS + 2CH_3COOH$

4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

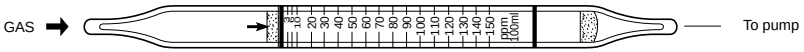
Substance	Interference	Coexistence
Sulphur dioxide	The accuracy of readings is not affected.	Higher readings are given.
Mercaptans	〃	〃
Nitrogen dioxide	〃	〃

(NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.
Actual concentration = 2 × Reading value

Tube No.
120SB

HYDROGEN SULPHIDE



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 minutes/1 pump stroke
3) Detectable limit : 0.3 ppm (300mℓ)
4) Shelf life : 3 years
5) Operating temperature : 0 ~ 40 ℃
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.

$$H_2S + Pb(CH_3CO_2)_2 \rightarrow PbS + 2CH_3CO_2H$$

4. CALIBRATION OF THE TUBE

PERMEATION TUBE 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, 2, 3 or 4 pump strokes, following formula is available for the actual concentration.

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

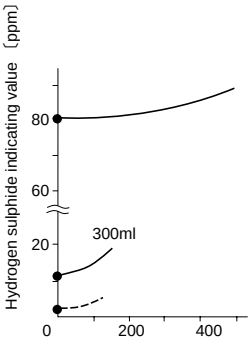


FIG.1 Influence of Sulphur dioxide

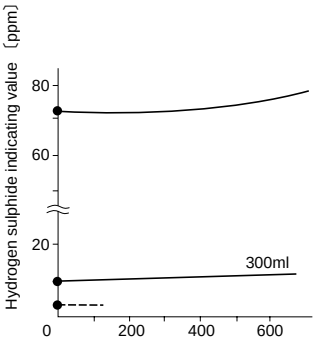


FIG.2 Influence of Ethyl mercaptan

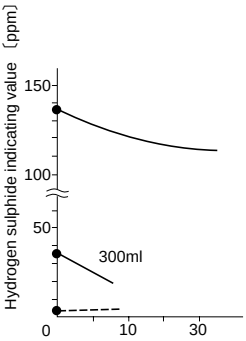
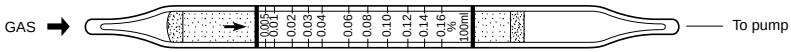


FIG.3 Influence of Nitrogen dioxide

Tube No.
120SC

HYDROGEN SULPHIDE



1. PERFORMANCE

1) Measuring range : 0.005-0.16 %
   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 ℃
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 sulphate is produced.

$H_2S + PdSO_4 + (NH_4)_2MoO_4 \rightarrow PdS$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Carbon monoxide		10	Blue stain is produced and higher readings are given.
Ethylene		5	Higher readings are given.
Propylene		5	〃
Butylene		5	〃
Acetylene		5	〃
Methyl mercaptan		5	〃
Hydrogen cyanide			White stain is produced and the discoloration by Hydrogen sulphide is interfered.
Ammonia			〃

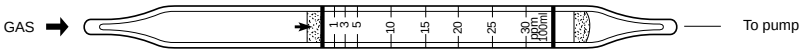
If there is coexistence of Sulphur dioxide less than 6 %, the accuracy of readings is not affected.

TEMPERATURE CORRECTION TABLE

Scale Readings (%)	True Concentration (%)				
	0 ℃ (32 ˚ F)	10 ℃ (50 ˚ F)	20 ℃ (68 ˚ F)	30 ℃ (86 ˚ F)	40 ℃ (104 ˚ F)
0.16	0.14	0.15	0.16	0.17	0.17
0.14	0.13	0.13	0.14	0.15	0.15
0.12	0.11	0.12	0.12	0.13	0.13
0.10	0.09	0.10	0.10	0.10	0.11
0.08	0.07	0.08	0.08	0.08	0.09
0.06	0.05	0.06	0.06	0.06	0.07
0.04	0.04	0.04	0.04	0.04	0.04
0.03	0.03	0.03	0.03	0.03	0.03
0.02	0.02	0.02	0.02	0.02	0.02

Tube No.
120SD

HYDROGEN SULPHIDE



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 ℃	
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.

$H_2S + Pb(CH_3COO)_2 \rightarrow PbS + 2CH_3COOH$

4. CALIBRATION OF THE TUBE

PERMEATION TUBE 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)

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

Actual concentration = 2 × Reading value

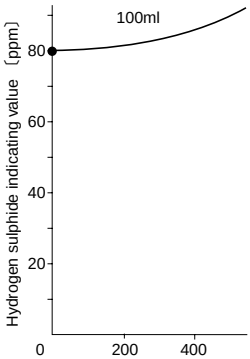


FIG.1 Influence of Sulphur dioxide

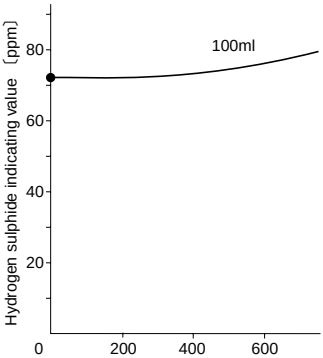


FIG.2 Influence of Ethyl mercaptan

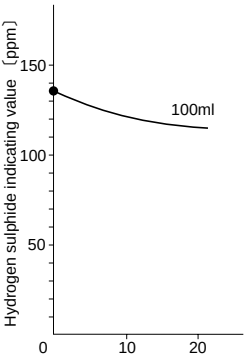
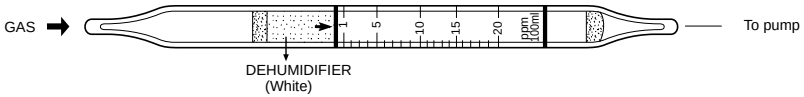


FIG.3 Influence of Nitrogen dioxide

Tube No.
120SE

HYDROGEN SULPHIDE



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 ℃
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.

$H_2S + HgCl_2 \rightarrow HgS + 2HCl$

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	〃	〃
Nitrogen dioxide	Not affected.	Lower readings are given.
Ammonia	〃	〃
Arsine		Higher readings are given.
Hydrogen selenide		〃
Hydrogen cyanide		〃
Sulphur dioxide		If possible to read, not affected.

(NOTE)

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

1/2 pump stroke : Actual concentration = Reading value × 2
2 pump strokes : Actual concentration = Reading value ÷ 2

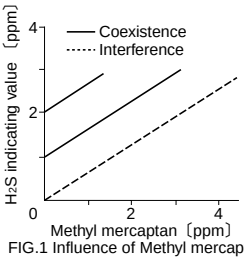


FIG.1 Influence of Methyl mercaptan

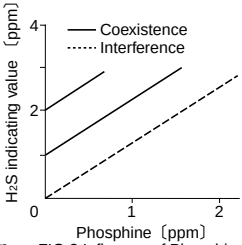
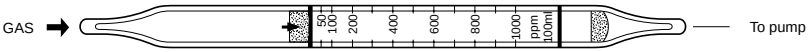


FIG.2 Influence of Phosphine

Tube No.
120SF

HYDROGEN SULPHIDE



1. PERFORMANCE

1) Measuring range	: 50-1000 ppm	100-2000 ppm
Number of pump strokes	1 (100mℓ)	1/2 (50mℓ)
2) Sampling time	: 1 minute/1 pump stroke	
3) Detectable limit	: 0.5 ppm (100mℓ)	
4) Shelf life	: 3 years	
5) Operating temperature	: 0 ~ 40 ℃	
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

$H_2S + 2AgNO_3 \rightarrow Ag_2S$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

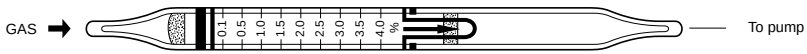
5. INTERFERENCE AND CROSS SENSITIVITY

(NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.
Actual concentration = 2 × Reading value

Tube No.
120SH

HYDROGEN SULPHIDE



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 : 50 ppm
4) Shelf life : 3 years
5) Operating temperature : 0 ~ 40 ℃
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.

$H_2S + CuSO_4 \rightarrow CuS$

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.

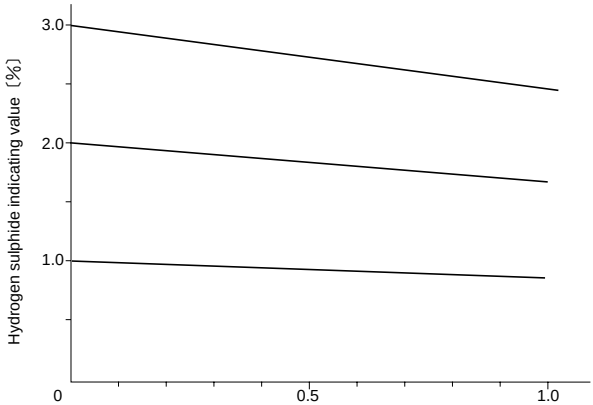
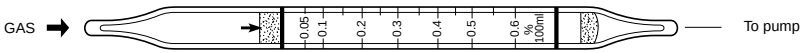


FIG.1 Influence of Sulphur dioxide

Tube No.
120SM

HYDROGEN SULPHIDE



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 % (100mℓ)
4) Shelf life : 2 years
5) Operating temperature : 0 ~ 40 ℃
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.

$H_2S + CuSO_4 \rightarrow CuS$

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

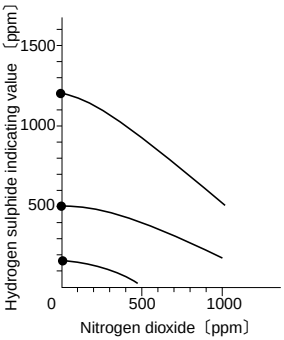


FIG.1 Influence of Nitrogen dioxide

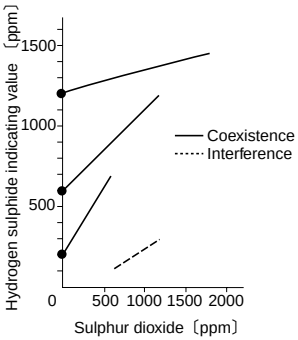
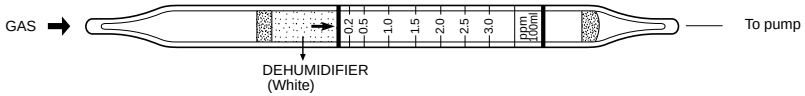


FIG.2 Influence of Sulphur dioxide

Tube No.
120U

HYDROGEN SULPHIDE



1. PERFORMANCE

1) Measuring range : 0.4-6.0 ppm 0.2-3.0 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℃
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.

$H_2S + HgCl_2 \rightarrow HgS + HCl$

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_2S 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

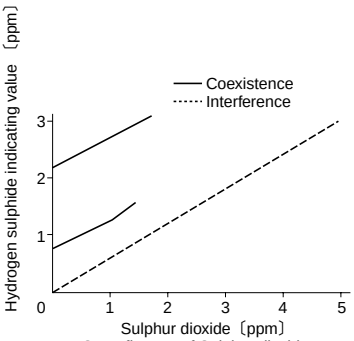


FIG.1 Influence of Sulphur dioxide

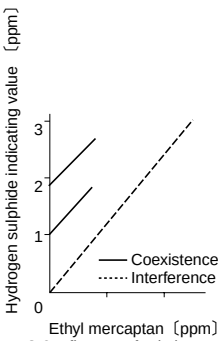
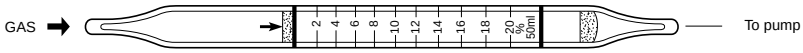


FIG.2 Influence of Ethyl mercaptan

Tube No.
120UH

HYDROGEN SULPHIDE



1. PERFORMANCE

1) Measuring range : 2-20 %
   Number of pump strokes 1/2 (50mℓ)
2) Sampling time : 1 minute/1/2 pump stroke
3) Detectable limit : 0.05 %
4) Shelf life : 3 years
5) Operating temperature : 0 ~ 40 ℃
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.

$H_2S + CuSO_4 \rightarrow CuS$

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.	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.

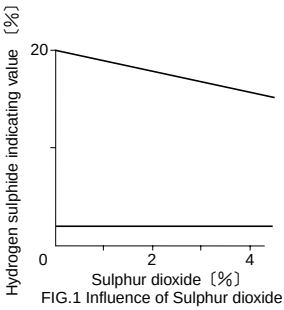
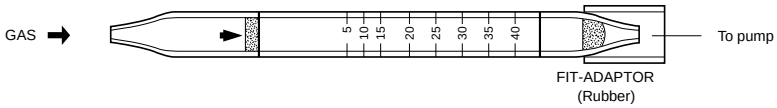


FIG.1 Influence of Sulphur dioxide

Tube No.
120UT

HYDROGEN SULPHIDE



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 stroke	
3) Shelf life	: 3 years	
4) Operating temperature	: 0 ～ 40 ℃	
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.

$H_2S + CuSO_4 \rightarrow CuS$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

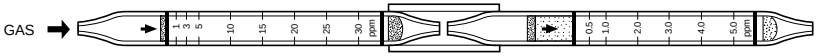
Substance	Interference	Coexistence	
Sulphur dioxide	Not affected.	8 %	Lower readings are given.
Carbon dioxide	Not affected.	Not affected.	

(NOTE)

In case of 1 pump stroke, divide the tube reading by 2.

Tube No.
282S

HYDROGEN SULPHIDE · MERCAPTANS



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℃
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

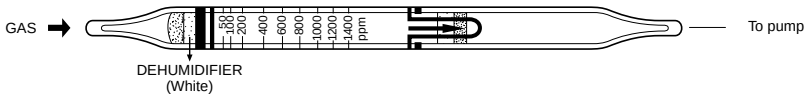
Hydrogen sulphide detector tube：$H_2S + Pb(CH_3CO_2)_2 \rightarrow PbS + 2CH_3CO_2H$
Mercaptans detector tube：$R\text{-}SH + HgCI_2 \rightarrow RS(HgCI) + HCI$

4. CALIBRATION OF THE TUBE

Hydrogen sulphide	PERMEATION TUBE METHOD
Mercaptans	STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

Tube No.
113SBⓒ ISOBUTANE



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℃
6) Reading : Graduations printed on the tube are calibrated by 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.
Paraffin hydrocarbons (more than C_3)	Similar stain is produced.		Higher readings are given.

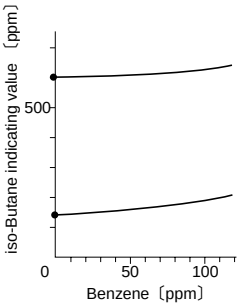


FIG.1 Influence of Benzene

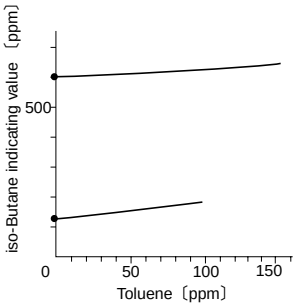
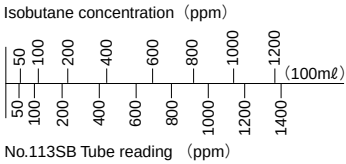
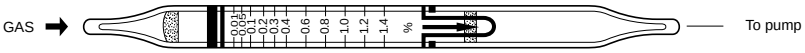


FIG.2 Influence of Toluene



Tube No.
139SBⓒ

ISOBUTYL ACETATE



1. PERFORMANCE

1) Measuring range : 0.01-1.4 %
   Number of pump strokes 2 (200mℓ)
2) Sampling time : 4 minutes/2 pump strokes
3) Detectable limit : 10 ppm
4) Shelf life : 3 years
5) Operating temperature : 0 ~ 40 ℃
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

Potassium dichromate is reduced

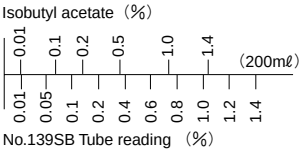
$$CH_3CO_2CH_2CH(CH_3)_2 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

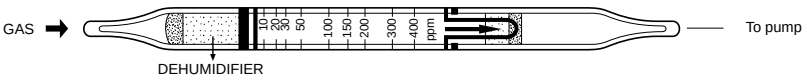
5. INTERFERENCE AND CROSS SENSITIVITY

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.



Tube No.
153U

ISOBUTYL ACETATE



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 ℃
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.

$CH_3CO_2CH_2(CH_3)_2 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

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	〃	〃
Halogenated hydrocarbons FIG.1	Whole reagent is changed to Brown.	〃

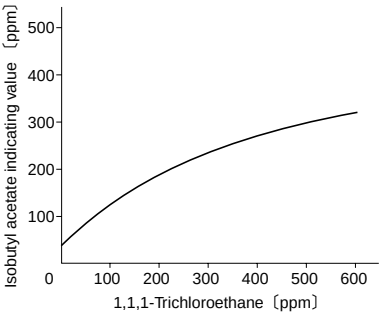


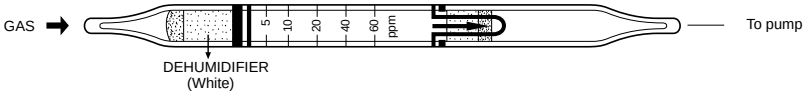
FIG.1 Influence of 1,1,1-Trichloroethane

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)						
	10℃ (50°F)	15℃ (59°F)	20℃ (68°F)	25℃ (77°F)	30℃ (86°F)	35℃ (95°F)	40℃ (104°F)
400	—	—	400	285	240	210	190
300	—	—	300	225	190	170	160
200	—	275	200	165	140	130	120
150	—	195	150	125	110	103	95
100	—	120	100	90	80	75	70
50	70	55	50	45	40	40	35
30	40	35	30	25	20	20	20
15	20	15	15	15	10	10	10

Tube No.
211U©

ISOBUTYL ACRYLATE



1. PERFORMANCE

1) Measuring range : 5-60 ppm
   Number of pump strokes 2 (200mℓ)
2) Sampling time : 1.5 minutes/1 pump stroke
3) Detectable limit : 0.5 ppm
4) Shelf life : 2 years
5) Operating temperature : 0 ~ 40℃
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.

$CH_2=CHCO_2CH_2CH(CH_3)_2 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

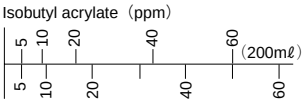
4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Other Esters	Brown stain is produced.	〃
Aromatic hydrocarbons	〃	〃
Aliphatic hydrocarbons (more than C_3)	〃	〃
Halogenated hydrocarbons	〃	〃

Isobutyl acrylate (ppm)



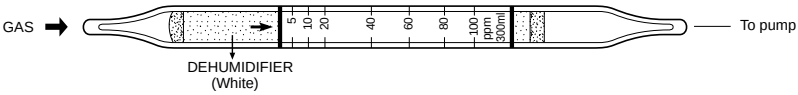
No.211U Tube reading (ppm)

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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

Tube No.
208U

ISOBUTYL ALCOHOL



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℃
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.

$$(CH_3)_2CHCH_2OH + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

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	〃	〃

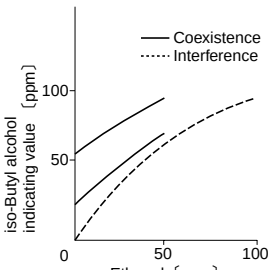


FIG.1 Influence of Ethanol

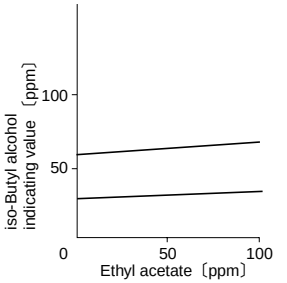


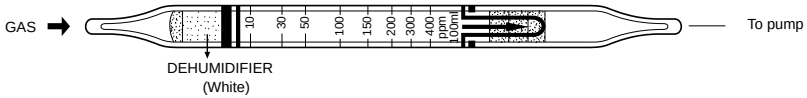
FIG.2 Influence of Ethyl acetate

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32˚F)	10℃ (50˚F)	20℃ (68˚F)	30℃ (86˚F)	40℃ (104˚F)
100	—	—	100	85	80
80	—	100	80	75	60
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

Tube No.
188U

ISOPENTYL ACETATE



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 ℃
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

$$CH_3CO_2(CH_2)_2CH(CH_3)_2 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

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.	〃

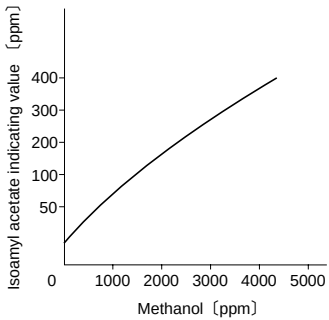


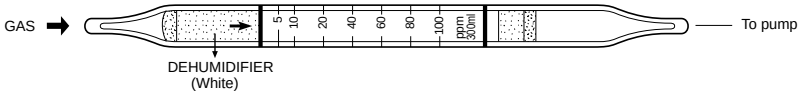
FIG.1 Influence of Methanol

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)						
	10℃ (50°F)	15℃ (59°F)	20℃ (68°F)	25℃ (77°F)	30℃ (86°F)	35℃ (95°F)	40℃ (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

Tube No.
209U

ISOPENTYL ALCOHOL



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℃
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.

$(CH_3)_2CHCH_2OH + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

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	The accuracy of readings is not affected.	The accuracy of readings is not affected.
Trichloroethylene	〃	〃	〃
Ethyl acetate	〃	〃	〃

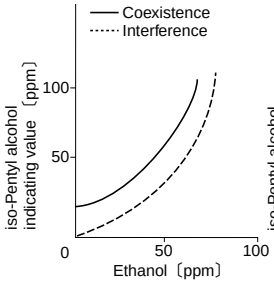


FIG.1 Influence of Ethanol

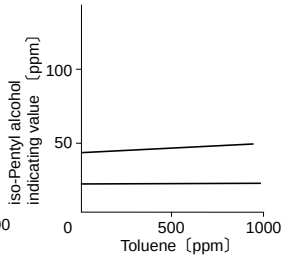


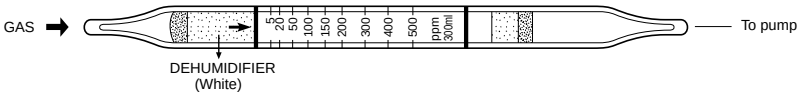
FIG.2 Influence of Toluene

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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

Tube No.
190U Ⓒ

ISOPRENE



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℃
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.

$CH = C(CH_3)CH = CH_2 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

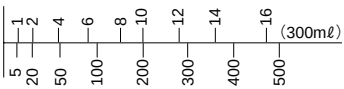
4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Ethers	〃	〃
Aliphatic hydrocarbons (over C_3)	Whole reagent is changed to Pale brown.	〃
Aromatic hydrocarbons	〃	〃
Esters	〃	〃
Ketones	〃	〃
Halogenated hydrocarbons	〃	〃

Isoprene (ppm)



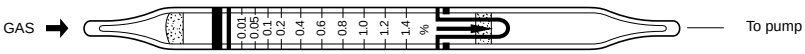
No.190U Tube reading (ppm)

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	Corrected Concentration (ppm)				
	0℃ (32˚F)	10℃ (50˚F)	20℃ (68˚F)	30℃ (86˚F)	40℃ (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

Tube No.
139SB Ⓒ

ISOPROPYL ACETATE



1. PERFORMANCE

1) Measuring range : 0.01-1.2 %
   Number of pump strokes 2 (200mℓ)
2) Sampling time : 1.5 minutes/1 pump stroke
3) Detectable limit : 10 ppm
4) Shelf life : 3 years
5) Operating temperature : 0 ～ 40 ℃
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

Potassium dichromate is reduced

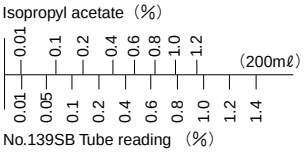
$CH_3CO_2CH(CH_3)_2 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

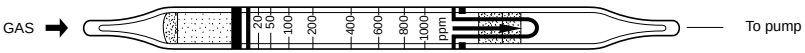
5. INTERFERENCE AND CROSS SENSITIVITY

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.



Tube No.
111U

ISOPROPYL ACETATE



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 ℃
6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
7) Reading : Direct reading from the scale calibrated with Ethyl acetate concentration by 1 pump stroke.The sensitivity of Isopropyl acetate is the same as Ethyl acetate.
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.

$$CH_3CO_2CH(CH_3)_2 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

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	〃	〃
Paraffin hydrocarbons FIG.1	Whole reagent is changed to Brown.	If the top of Brown stain is clear, the accuracy of readings is not affected.

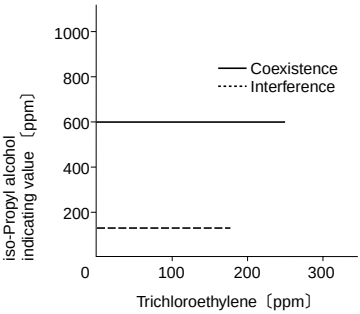


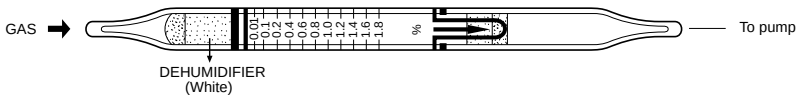
FIG.1 Influence of Trichloroethylene

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)						
	10 ℃ (50 ˚F)	15 ℃ (59 ˚F)	20 ℃ (68 ˚F)	25 ℃ (77 ˚F)	30 ℃ (86 ˚F)	35 ℃ (95 ˚F)	40 ℃ (104 ˚F)
1,000	1,300	1,200	1,000	830	700	600	500
800	1,080	950	800	670	550	470	400
600	830	720	600	500	420	380	300
400	570	480	400	330	280	240	200
200	280	240	200	170	140	120	100
100	150	120	100	80	70	60	50
50	70	60	50	40	30	20	10
20	30	25	20	15	10	7	4

Tube No.
122SA©

ISOPROPYL ALCOHOL



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 ℃
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.

$CH_3CH(OH)CH_3 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

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		〃		〃
Paraffin 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.

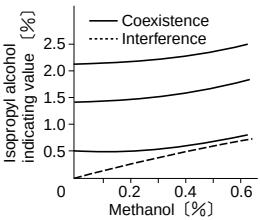


FIG.1 Influence of Methanol

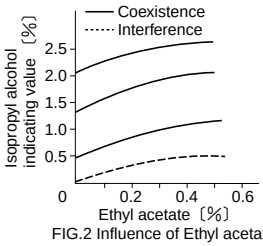
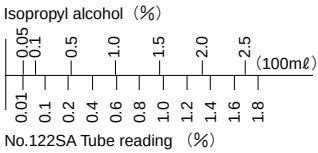


FIG.2 Influence of Ethyl acetate

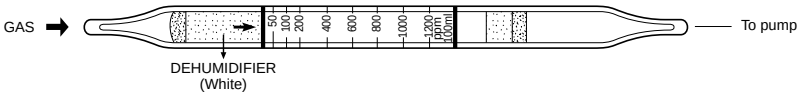
TEMPERATURE CORRECTION TABLE

Scale Readings (%)	True Concentration (ppm)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (104°F)
2.5	—	—	2.50	2.10	2.00
2.0	—	—	2.00	1.70	1.62
1.5	—	—	1.50	1.28	1.21
1.0	—	1.43	1.00	0.85	0.80
0.5	1.00	0.62	0.50	0.42	0.38
0.1	0.16	0.14	0.10	0.09	0.08
0.05	0.09	0.06	0.05	0.04	0.03



Tube No.
150U

ISOPROPYL ALCOHOL



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 : 10 ppm(100mℓ)
4) Shelf life : 2 years
5) Operating temperature : 10 ~ 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→Pale blue

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

Potassium dichromate is reduced.

$CH_3CH(OH)CH_3 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

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	〃	〃
Paraffin hydrocarbons (more than C_3)	Whole reagent is discoloured to 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 × Temperature corrected value

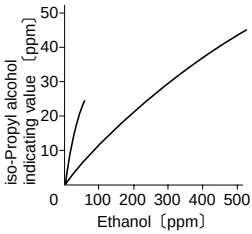


FIG.1 Influence of Ethanol

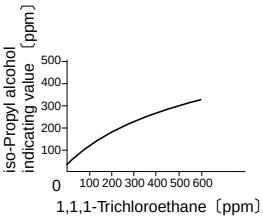


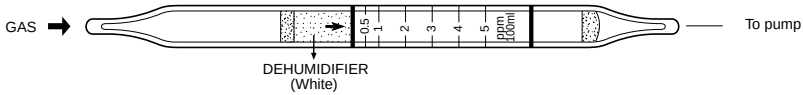
FIG.2 Influence of 1,1,1-Trichloroethane

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)			
	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (104°F)
1200	1680	1200	830	530
1000	1380	1000	690	430
800	1070	800	550	330
600	780	600	400	240
400	1500	400	250	150
200	240	200	130	70
100	120	100	65	45
40	40	40	30	20

Tube No.
130U

ISOPROPYL MERCAPTAN



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℃
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.

$RSH + HgCI_2 \rightarrow RS(HgCI) + CI$

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.
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
This tube scale is calibrated based on Methyl mercaptan and the same scale is available for Isopropyl mercaptan.

Tube No.
142S

MERCURY VAPOUR

1. PERFORMANCE

1) Measuring range	: 0.5-10mg/m³	0.1-2.0mg/m³
Number of pump strokes	1 (100mℓ)	5 (500mℓ)
2) Sampling time	: 5 minutes/5 pump strokes	
3) Detectable limit	: 0.02 mg/m³ (500mℓ)	
4) Shelf life	: 3 years	
5) Operating temperature	: 0 ~ 40 ℃	
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.

$Hg + CuI \rightarrow Cu_2 (HgI_4)$

4. CALIBRATION OF THE TUBE

VAPOUR PRESSURE METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

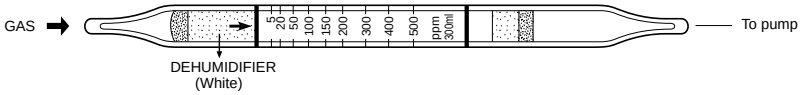
Substance	Interference	ppm	Coexistence
Chlorine	The accuracy of readings is not affected.	0.1	Lower readings are given.
Hydrogen chloride	〃	0.5	〃
Nitrogen dioxide	Brown stain is produced.	0.1	〃
Hydrogen Sulphide	〃	0.5	〃

(NOTE)

In case of 1 pump stroke, actual concentration is calculated with five times of reading value.

Tube No.
190U©

MESITYL OXIDE



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 ℃
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 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.

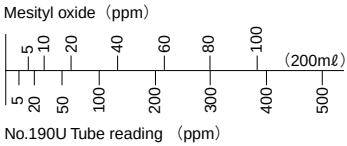
$CH_3COCH=C(CH_3)_2 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

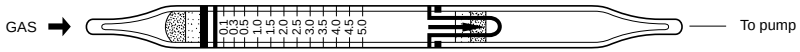
Substance	ppm	Interference	ppm	Coexistence
Alcohols		Similar stain is produced.		Higher readings are given.
Toluene	200	Whole reagent is discoloured to Brown.	500	The top of discoloured layer becomes unclear.
Hexane		The accracy of reading is not affected.	less than 1,000ppm	The accracy of reading is not affected.
Ethyl Acetate		〃		〃
Trichloroethylene		〃		〃



TEMPERATURE CORRECTION TABLE

Conver. value (ppm)	Corrected Concentration (ppm)		
	0 ℃ (32 ° F)	10 ℃ (50 ° F)	20 ℃ ~ 40 ℃ (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

Tube No.
111SA Ⓒ METHYL ACETATE



1. PERFORMANCE

1) Measuring range : 0.01-3.0 %
   Number of pump strokes 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 ℃
6) Reading : Graduations printed on the tube are calibrated by Ethyl acetate at 1 pump stroke and Methyl acetate is determined by using a conversion chart.
7) Colour change : Orange → Dark green

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

Chomium oxide is reduced.

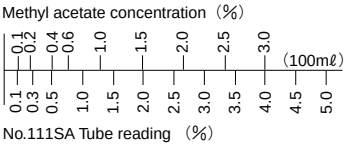
$CH_3CO_2CH_3 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	%	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.

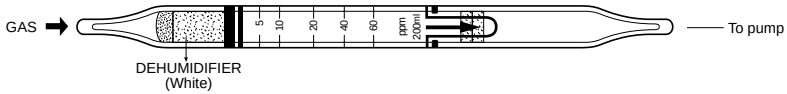


TEMPERATURE CORRECTION TABLE

Tube Reading (%)	Corrected Concentration (%)				
	0 ℃ (32 ° F)	10 ℃ (50 ° F)	20 ℃ (68 ° F)	30 ℃ (86 ° F)	40 ℃ (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

Tube No.
211U

METHYL ACRYLATE



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℃
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.

$CH_2 = CHCO_2CH_3 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Paraffin hydrocarbons (more than C_3) FIG.2	Whole reagent is changed to dark Brown.	〃
Halogenated hydrocarbons	〃	〃
Esters	〃	〃
Aromatic hydrocarbons FIG.1	〃	〃

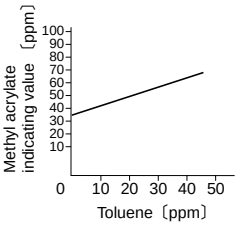


FIG.1 Influence of Toluene

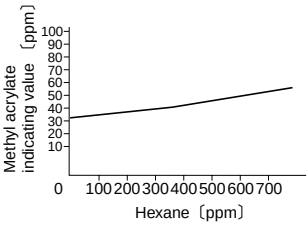


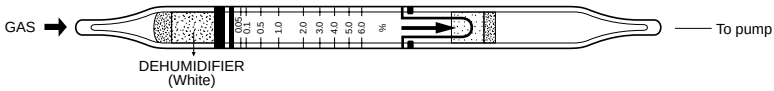
FIG. 2 Influence of Hexane

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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

Tube No.
119SA

METHYL ALCOHOL (METHANOL)



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 : 100 ppm
4) Shelf life : 3 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 orange → Pale green

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

Potassium dichromate is reduced

$$CH_3OH + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Paraffin hydrocarbons (more than C_3) 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.

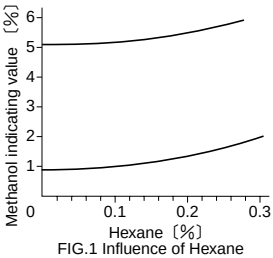


FIG.1 Influence of Hexane

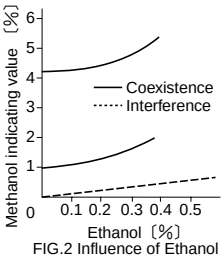


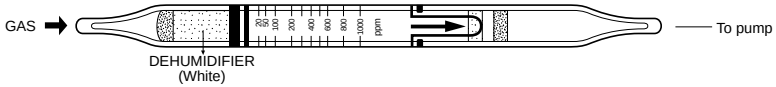
FIG.2 Influence of Ethanol

TEMPERATURE CORRECTION TABLE

Scale Readings (%)	True Concentration (%)				
	0℃ (32˚F)	10℃ (50˚F)	20℃ (68˚F)	30℃ (86˚F)	40℃ (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

Tube No.
119U

METHYL ALCOHOL (METHANOL)



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℃
6) Temperature compensation : Necessary(0 ~ 20℃)(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

Potassium dichromate is reduced

$$CH_3OH + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

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		〃
Paraffin hydrocarbons (more than C_3)	Whole reagent is changed to Brown.	〃
Aromatic hydrocarbons	〃	〃
Ketones	〃	〃
Halogenated hydrocarbons	〃	〃

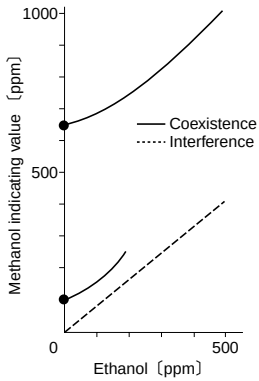


FIG.1 Influence of Ethanol

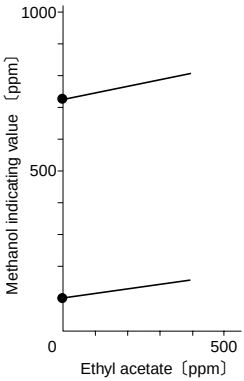


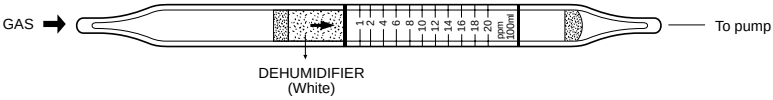
FIG.2 Influence of Ethyl acetate

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)		
	0℃ (32°F)	10℃ (50°F)	20-40℃ (68-104°F)
1000	1200	1100	1000
800	960	880	800
600	600	660	600
400	480	440	400
200	240	220	200
100	120	110	100
50	60	50	50
20	24	20	20

Tube No.
227S

METHYL AMINE



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 ℃
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.

$CH_3NH_2 + H_3PO_4 \rightarrow (CH_3NH_3)_2HPO_4$

4. CALIBRATION OF THE TUBE

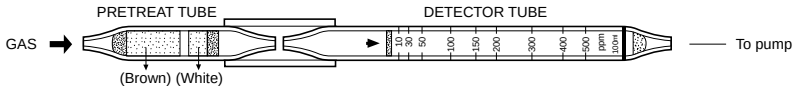
COLOURIMETRY METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Ammonia	Similar stain is produced.	Higher readings are given
Other amines	〃	〃

Tube No.
157SA

METHYL BROMIDE



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 a refrigerated place ; 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 : 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.

$CH_3Br + I_2O_5 + CrO_3 + H_2SO_4 \rightarrow Br_2$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

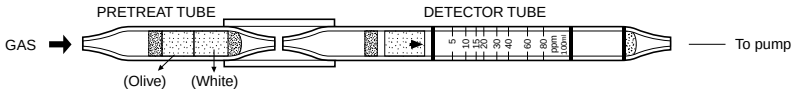
Substance	ppm	Interference	ppm	Coexistence
Chlorine	1	Similar stain is produced.	1	Higher readings are given.
Bromine	1	〃	1	〃
Nitrogen dioxide	1	〃	1	〃
Dichloromethane	500	〃	500	〃
Chloroform	50	〃	50	〃
Ethylene dibromide	50	〃	50	〃
Trichloroethylene	50	〃	50	〃
Tetrachloroethylene	50	〃	50	〃

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)						
	0℃ (32°F)	5℃ (41°F)	10℃ (50°F)	15℃ (59°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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

Tube No.
157SB

METHYL BROMIDE



1. PERFORMANCE

1) Measuring range	: 5-80 ppm	2.5-40 ppm	0.9-7.3 ppm
Number of pump strokes	1 (100mℓ)	2 (200mℓ)	4 (400mℓ)

2) Sampling time : 1.5 minutes/1 pump stroke
3) Detectable limit : 1 ppm (200mℓ)
4) Shelf life : 3 years (Necessary to store in a refrigerated place ; 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 : White → Yellow

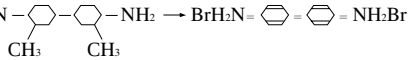
2. RELATIVE STANDARD DEVIATION

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.

$$CH_3Br + I_2O_5 + CrO_3 + H_2SO_4 \rightarrow Br_2$$



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		200	Lower readings are given.

(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

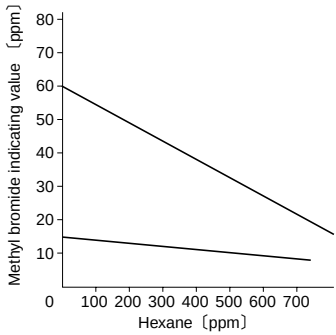


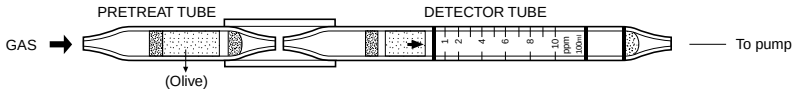
FIG.1 Influence of Hexane

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)					
	0℃ (32°F)	5℃ (41°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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

Tube No.
157SC

METHYL BROMIDE



1. PERFORMANCE

1) Measuring range : 1-10 ppm 0.5-1 ppm
   Number of pump strokes 1(100mℓ) 2(200mℓ)
2) Sampling time : 2 minutes/1 pump stroke
3) Detectable limit : 0.2 ppm(200mℓ)
4) Shelf life : 1 year(Necessary to store in a refrigerated place ; 0 ~ 10℃)
5) Operating temperature : 0 ~ 40℃
6) Temperature compensation : Necessary(0 ~ 20℃)(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 : 10%

3. CHEMICAL REACTION

Bromine is produced by decomposing with an Oxidizer firstly.
By this Bromine, 3, 3'-Dimethylnaphthidine is discoloured to purple.

$CH_3Br + CrO_3 + H_2SO_4 \rightarrow Br_2$

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	〃		〃
Hexane FIG.1	The accuracy of readings is not affected.	50	Lower readings are given.
Alcohols	〃		
Aromatic hydrocarbons	〃		

(NOTE)

When the concentration is below 1 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

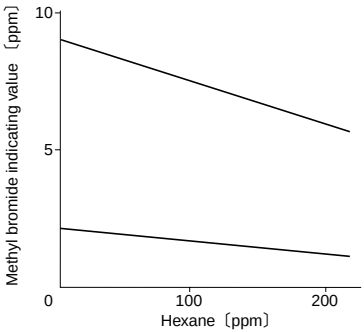


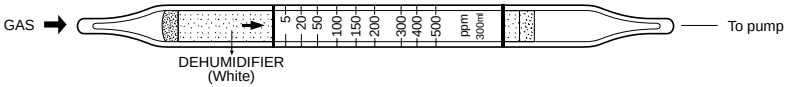
FIG.1 Influence of Hexane

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)		
	0℃ (32°F)	10℃ (50°F)	20-40℃ (68-104°F)
10	15	12	10
8	12	9	8
6	8.5	7	6
4	5	4.5	4
2	2.2	2	2
1	1	1	1

Tube No.
190U

METHYL CELLOSOLVE



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 ℃
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.

$$HOCH_2CH_2OCH_3 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

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	〃	〃
Paraffin hydrocarbons (more than C_3)	Whole reagent is changed to Brown.	〃
Aromatic hydrocarbons	〃	〃
Esters	〃	〃
Ketones	〃	〃
Halogenated hydrocarbons	〃	〃

FIG.1

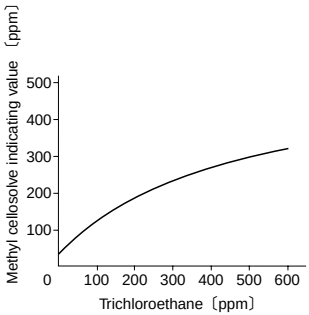


FIG.1 Influence of Trichloroethane

TEMPERATURE CORRECTION TABLE

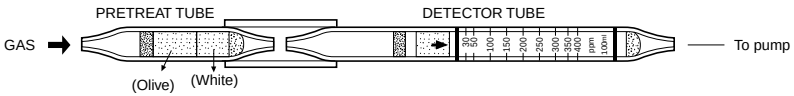
Scale Readings (ppm)	True Concentration (ppm)					
	10℃ (50˚F)	15℃ (59˚F)	20℃ (68˚F)	25℃ (77˚F)	30℃ (86˚F)	35℃ (95˚F)
500	800	620	500	410	335	265
400	620	490	400	325	260	200
300	450	365	300	245	195	145
200	290	245	200	160	125	95
150	215	185	150	120	90	70
100	145	125	100	80	60	45
50	75	65	50	40	30	25
20	30	25	20	15	12	10
5	10	7	5	4	3	2

(NOTE)

This tube scale is calibrated based on Ethyl cellosolve and the same scale is available for Methyl cellosolve.

Tube No.
160S

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 a refrigerated place ; 0 ~ 10℃)
5) Operating temperature : 0 ~ 40℃
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.

$CH_3CCl_3 + Cr_3O_3 + H_2SO_4 \rightarrow Cl_2$

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 detremine the lower concentration.
Following formula is available for the actual concentration.
Actual concentration = 1/2 × Reading value

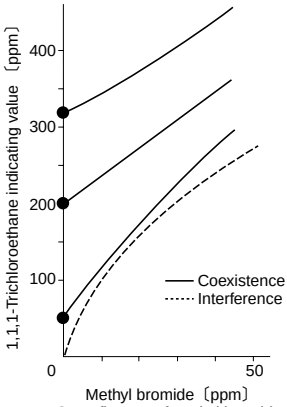


FIG.1 Influence of Methyl bromide

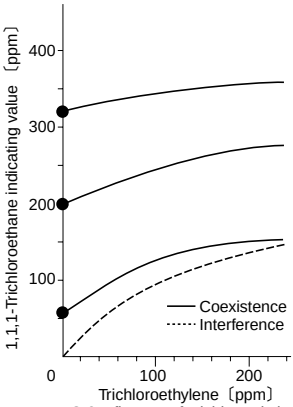
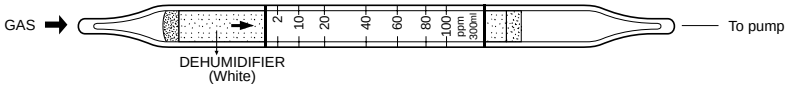


FIG.2 Influence of Trichloroethylene

Tube No.
198U

METHYL CYCLOHEXANONE



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℃
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.

$$CH_3C_6H_9 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Aliphatic hydrocarbons	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.

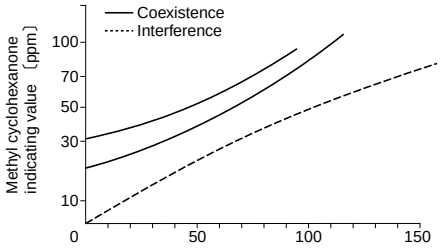


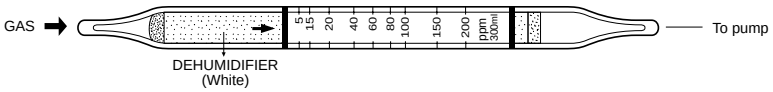
FIG.1 Influence of Ethanol

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)			
	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (104°F)
100	130	100	80	66
80	105	80	65	52
60	80	60	48	36
40	54	40	30	22
20	26	20	14	10
10	14	10	7	5
2	3.2	2	1.4	1.0

Tube No.
199U

METHYL CYCLOHEXANOL



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 ℃
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.

$$CH_3C_6H_{10}OH + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Aliphatic hydrocarbons	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.

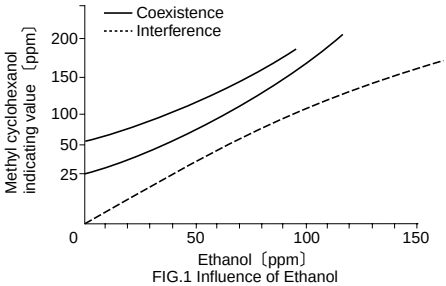


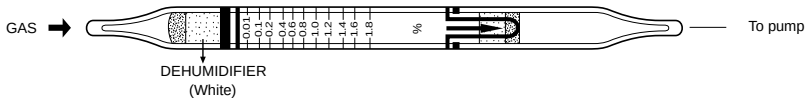
FIG.1 Influence of Ethanol

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)			
	10 ℃ (50 ° F)	20 ℃ (68 ° F)	30 ℃ (86 ° F)	40 ℃ (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

Tube No.
122SAⓒ

METHYL ETHYL KETONE



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 ℃
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.

$CH_3COC_2H_5 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

4. CALIBRATION OF THE TUBE

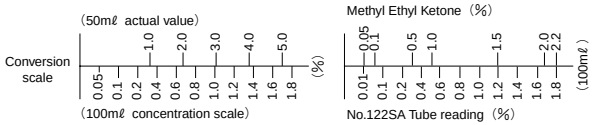
GAS CHROMATOGRAPHY

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 %	〃

(NOTE)

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



TEMPERATURE CORRECTION TABLE

Conversion Value (%)	Corrected Concentration (ppm)				
	0 ℃ (32 ˚ F)	10 ℃ (50 ˚ F)	20 ℃ (68 ˚ F)	30 ℃ (86 ˚ F)	40 ℃ (104 ˚ F)
2.5	—	2.88	2.50	2.34	2.26
2.0	2.70	2.30	2.00	1.84	1.76
1.5	2.36	1.74	1.50	1.35	1.26
1.0	1.52	1.16	1.00	0.88	0.80
0.5	0.70	0.58	0.50	0.42	0.38
0.1	0.14	0.12	0.10	0.08	0.06
0.05	0.07	0.05	0.05	0.03	0.03
0.01	0.01	0.01	0.01	0.01	0.01

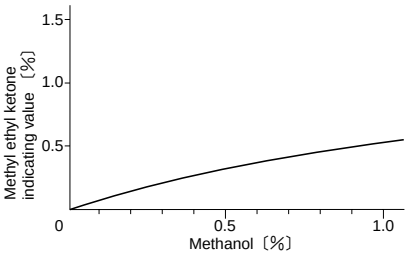


FIG.1 Influence of Methanol

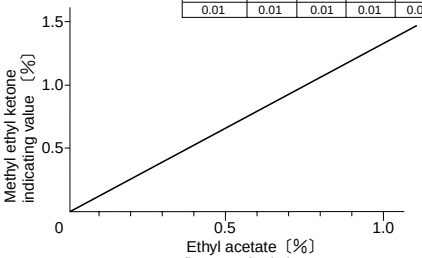
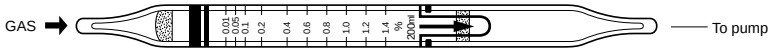


FIG.2 Influence of Ethyl acetate

Tube No.
139SB

METHYL ETHYL KETONE



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℃
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

Potassium dichromate is reduced.

$CH_3COC_2H_5 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

4. CALIBRATION OF THE TUBE

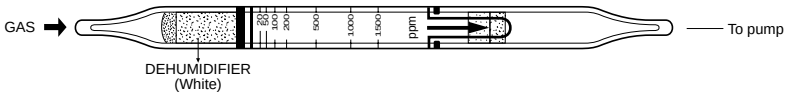
GAS CHROMATOGRAPHY

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.

Tube No.
139U

METHYL ETHYL KETONE



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 ℃
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.

$$CH_3COC_2H_5 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

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.
Paraffin hydrocarbons FIG.1		〃

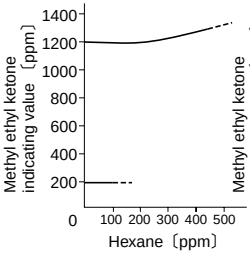


FIG.1 Influence of Hexane

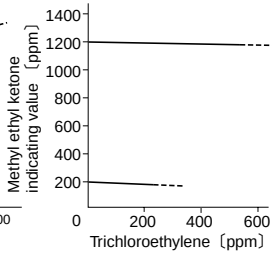


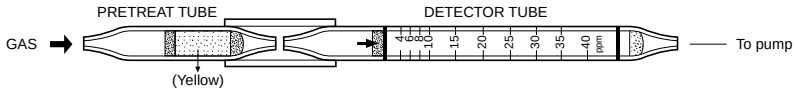
FIG.2 Influence of Trichloroethylene

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)						
	10℃ (50˚F)	15℃ (59˚F)	20℃ (68˚F)	25℃ (77˚F)	30℃ (86˚F)	35℃ (95˚F)	40℃ (104˚F)
1,500	2,050	1,750	1,500	1,280	1,100	940	820
1,000	1,430	1,200	1,000	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

Tube No.
176S

METHYL IODIDE



1. PERFORMANCE

1) Measuring range : 4-40 ppm 2-20 ppm
   Number of pump strokes 2(200mℓ) 4(400mℓ)
2) Sampling time : 4 minutes/2 pump strokes
3) Detectable limit : 0.5 ppm(400mℓ)
4) Shelf life : 8 months
5) Operating temperature : 10 ~ 40℃
6) Temperature compensation : Necessary(See "TEMPERATURE CORRECTION TABLE")
7) Reading : Direct reading from the scale calibrated by 2 pump strokes
8) Colour change : White→Grey

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

Iodine pentoxide is reduced.

$$CH_3I + I_2O_5 + H_2SO_4 \rightarrow I_2 + CO_2 + H_2O$$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Acetone	Similar stain is produced.	700	Higher readings are given.
Hydrogen sulphide FIG.1	〃	7	〃
Hexane FIG.2	〃	500	〃
Benzene		2	Lower readings are given.
Toluene		2	〃
Xylene		2	〃
Halogenated hydrocarbons			Double-layer stain is produced and accurate readings are affected.

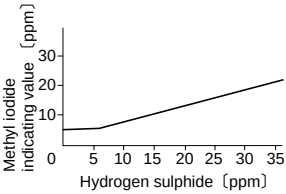


FIG.1 Influence of Hydrogen sulphide

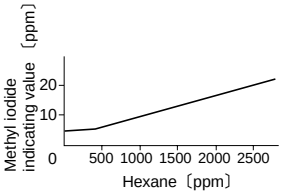


FIG.2 Influence of Hexane

TEMPERATURE CORRECTION TABLE

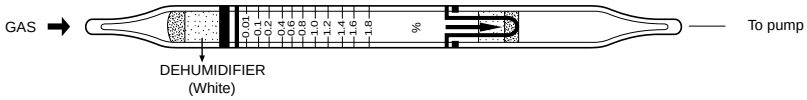
Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (104°F)
40	—	—	40	46	52
35	—	52	35	42	49
30	54	39	30	37	44
25	37	27	25	25	23
20	30	22	20	23	30
15	24	17	15	17	24
10	17	11	10	12	17
5	10	5	5	5	10

(NOTE)

In case of 4 pump strokes, following formula is available for the actual concentration.
Actual concentration = 1/2 × Tmperature corrected value

Tube No.
122SA©

METHYL ISOBUTYL KETONE



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 ℃
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 isobuty 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.

$H_3COCH_2CH(CH_3)_2 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

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 %	〃

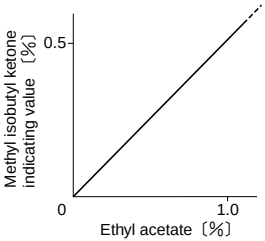


FIG.1 Influence of Ethyl acetate

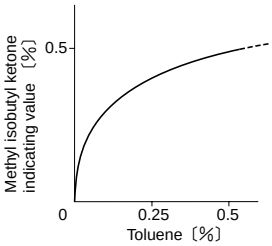
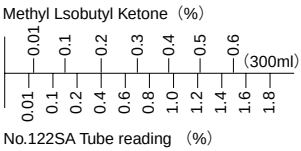


FIG.2 Influence of Toluene

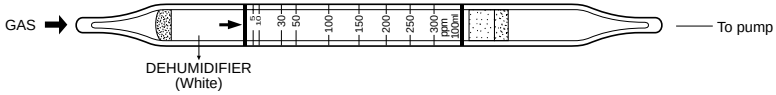
TEMPERATURE CORRECTION TABLE

Scale Readings (%)	True Concentration (%)				
	0 ℃ (32 ˚F)	10 ℃ (50 ˚F)	20 ℃ (68 ˚F)	30 ℃ (86 ˚F)	40 ℃ (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



Tube No.
155U

METHYL ISOBUTYL KETONE



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 ℃
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.

$$(CH_3)CHCH_2COCH_3 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

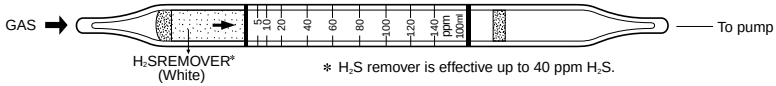
Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Ethers	〃	〃
Aliphatic hydrocarbons (more than C_3)	Whole reagent is changed to Pale brown.	〃
Aromatic hydrocarbons	〃	〃
Esters	〃	〃
Ketones	〃	〃
Halogenated hydrocarbons	〃	〃

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0 ℃ (32 ˚F)	10 ℃ (50 ˚F)	20 ℃ (68 ˚F)	30 ℃ (86 ˚F)	40 ℃ (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
15	15	10	15	8	8
5	7	5	5	5	5

Tube No.
164SA

METHYL MERCAPTAN



＊ H_2S remover is effective up to 40 ppm H_2S.

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℃
6) Temperature compensation : Necessary（0～20℃）（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.

$$CH_3SH + PdSO_4 \rightarrow (CH_3S)_2Pd + H_2SO_4$$

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	〃		
Ethyl mercaptan	1	Yellow stain is produced.		
Methyl sulphide			1	Lower readings are given.
Chlorine			0.2	〃

（NOTE）

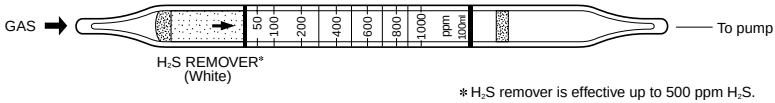
Max. 40 ppm Hydrogen sulphide is eliminated by pretreat reagent.

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)		
	0℃ (32°F)	10℃ (50°F)	20-40℃ (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

Tube No.
164SH

METHYL MERCAPTAN



＊H_2S remover is effective up to 500 ppm H_2S.

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℃
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.

$CH_3SH + PdSO_4 \rightarrow (CH_3S)_2Pd + H_2SO_4$

4. CALIBRATION OF THE TUBE

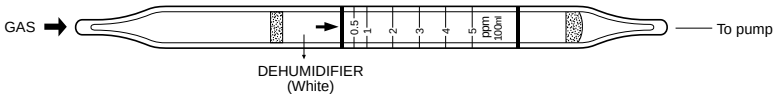
STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	Coexistence
Chlorine			Lower readings are given.
Carbon monoxide	500	Deep grey stain is produced.	
Ethylene	500	〃	

Tube No.
130U

METHYL MERCAPTAN



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 ℃
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.

$CH_3SH + HgCI_2 \rightarrow CH_3S(HgCI) + HCI$

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.
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.

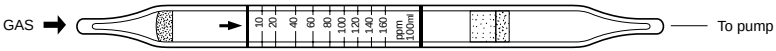
(NOTE)

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

Actual concentration = 2 × Reading value

Tube No.
184S

METHYL METHACRYLATE



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℃
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

Chromium oxide is reduced.

$H_2C=C(CH_3)CO_2CH_3 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

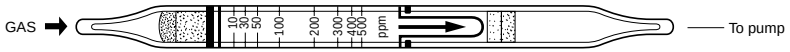
Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Esters	Whole layer is discoloured to Black.	〃
Ketones	〃	〃
Aromatic hydrocarbons	〃	〃

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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

Tube No.
193S

METHYL STYRENE



1. PERFORMANCE

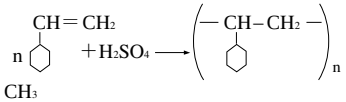
1) Measuring range : 10-500 ppm
   Number of pump strokes 1 (100mℓ)
2) Sampling time : 1 minute/1 pump stroke
3) Detectable limit : 1 ppm
4) Shelf life : 3 years
5) Operating temperature : 0 ~ 40 ℃
6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
7) Reading : Direct reading 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

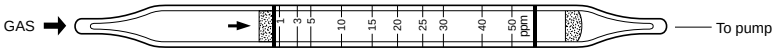
Substance	Interference	Coexistence
Alcohols	The accracy of readings is not affected.	The accracy of readings is not affected.
Esters	〃	〃
Aromatic hydrocarbons	〃	〃
Halogenated hydrocarbons	〃	〃
Aliphatic hydrocarbons	〃	〃

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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	60	10	12	18

Tube No.
224SA

MONOETHANOL AMINE



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℃
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

3. CHEMICAL REACTION

By reacting with Sulphuric acid, PH indicator is discoloured.

$H_2NCH_2CH_2OH + H_2SO_4 \rightarrow (HOC_2N_5NH_3)_2SO_4$

4. CALIBRATION OF THE TUBE

COLOURIMETRY 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.
ammonia FIG.2	Similar stain is produced.	Double-stain layer (Yellow and Pale purple) is produced.
Hydrazine	〃	〃
Atmospheric air ($CO_2 + H_2O$)	〃	

(NOTE)

1) In case of 2 pump strokes, following formula is available for the actual concentration.
   Actual concentration = 1/2 × Temperature corrected value
2) In any case, Pale purple stain only is indicated concentration of Monoethanal amine. Other discolourations may be disregarded.

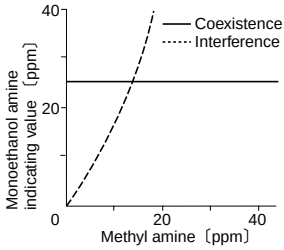


FIG.1 Influence of Methyl amine

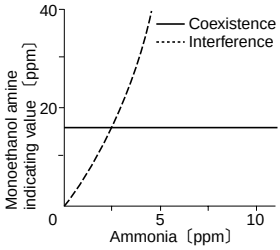
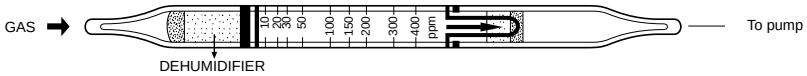


FIG.2 Influence of Ammonia

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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

Tube No.
153U© NAPHTHALENE



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℃
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.

$C_{10}H_8 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

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_3）	〃	〃
Esters	〃	〃

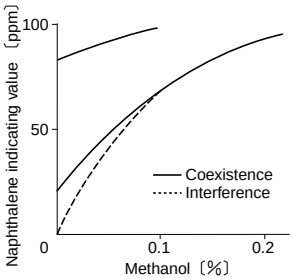


FIG.1 Influence of Methanol

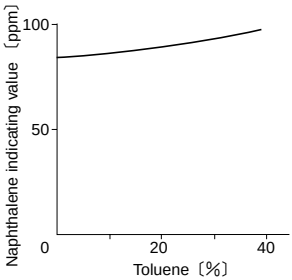
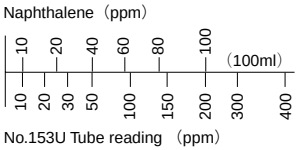
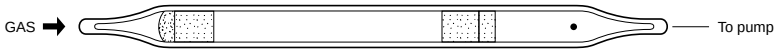


FIG.2 Influence of Toluene



Tube No.
129

NICKEL CARBONYL



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℃
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.

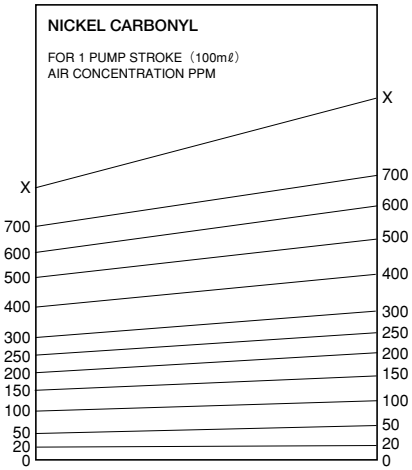
$Ni(CO)_4 + AuCl_3 \rightarrow Au$

4. CALIBRATION OF THE TUBE

STANDARD GAS GYLINDER METHOD

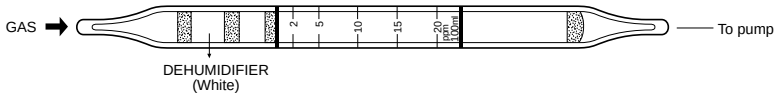
5. INTERFERENCE AND CROSS SENSITIVITY

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		1,000	〃



Tube No.
233S

NITRIC ACID VAPOUR



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 a refrigerated place ; 0 ~ 10℃)
5) Operating temperature : 5 ~ 40℃
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

COLOURIMETRY 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 × Temperature corrected value

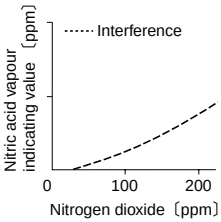


FIG.1 Influence of Nitrogen dioxide

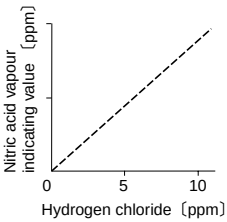


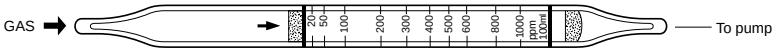
FIG.2 Influence of Hydrogen chloride

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)					
	0℃ (41°F)	10℃ (50°F)	15℃ (59°F)	20℃ (68°F)	30℃ (86°F)	40℃ (104°F)
20	—	35	25	20	15	13
15	43	25	19	15	12	10
10	27	17	12	10	8	7
5	14	9	6	5	4	4
2	6	4	3	2	2	2

Tube No.
117SA

NITROGEN DIOXIDE



1. PERFORMANCE

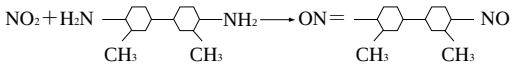
1) Measuring range : 20-1,000 ppm
   Number of pump strokes 1(100mℓ)
2) Sampling time : 2 minutes/1 pump stroke
3) Detectable limit : 5 ppm
4) Shelf life : 3 years
5) Operating temperature : 0 ~ 40℃
6) Temperature compensation : Necessary(See "TEMPERATURE CORRECTION TABLE")
7) Reading : Direct reading 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

STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

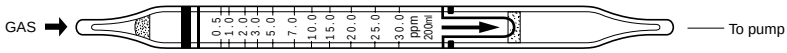
Substance	Interference	ppm	Coexistence
Chlorine	Similar stain is produced.	5	Higher readings are given.
Bromine	〃	5	〃
Iodine	〃	5	〃
Nitrogen monoxide	The accuracy of readings is not affected.	10	The accuracy of readings is not affected.
Ozone	〃	5	〃

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)						
	0℃ (32°F)	5℃ (41°F)	10℃ (50°F)	15℃ (59°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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

Tube No.
117SB

NITROGEN DIOXIDE



1. PERFOMANCE

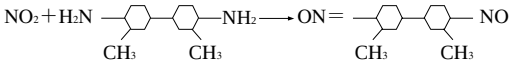
1) Measuring range : 0.5-30 ppm
   Number of pump strokes 2 (200mℓ)
2) Sampling time : 1.5 minutes/2 pump strokes
3) Detectable limit : 0.1 ppm
4) Shelf life : 1 year
5) Operating temperature : 0 ~ 40 ℃
6) Reading : Direct reading from the scale calibrated by 2 pump strokes
7) Colour change : White → 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	〃

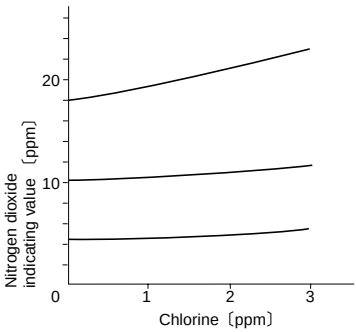


FIG.1 Influence of Chlorine

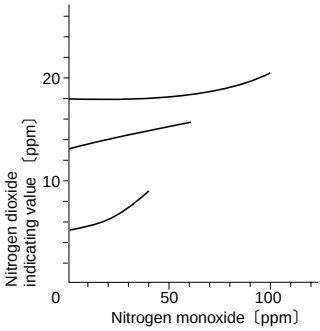
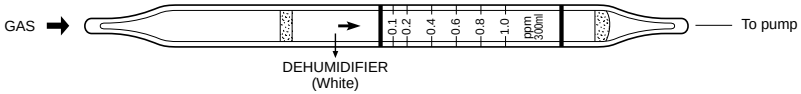


FIG.2 Influence of Nitrogen monoxide

Tube No.
117SC

NITROGEN DIOXIDE



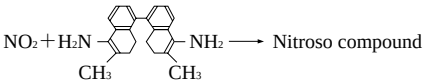
1. PERFORMANCE

1) Measuring range : 0.1-1.0 ppm
   Number of pump strokes 3 (300mℓ)
2) Sampling time : 2.25 minutes/3 pump strokes
3) Detectable limit : 0.01 ppm (300mℓ)
4) Shelf life : 1.5 years
5) Operating temperature : 0 ~ 40 ℃
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



4. CALIBRATION OF THE TUBE

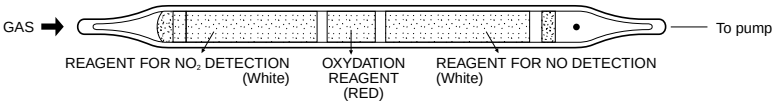
PERMEATION TUBE METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Ozone	The accuracy of readings is not affected.	2	Higher readings are given.
Sulphur dioxide	〃	7	Lower readings are given.
Chlorine	Similar stain is produced.		Higher readings are given.
Formaldehyde	The accuracy of readings is not affected.		
Formic acid	〃		
Carbon monoxide	〃		
Carbon dioxide	〃		
Ethanol	〃		

Tube No.
174A,B

NITROGEN OXIDE / NITROGEN DIOXIDE



1. PERFORMANCE

1) Measuring range : NO ; 10 − 300 ppm NO_2 ; 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_2 ; 0.5 ppm
4) Shelf life : 2 years
5) Operating temperature : 10 ~ 30 ℃
6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
7) Reading : Concentration chart method
8) Colour change : NO ; White → Yellowish orange
   NO_2; White → Pale yellowish orange

2. RELATIVE STANDARD DEVIATION

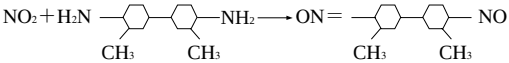
NO ; RSD-low : 10 % RSD-mid. : 10 % RSD-high : 10 %
NO_2 ; RSD-low : 10 % RSD-mid. : 10 % RSD-high : 5 %

3. CHEMICAL REACTION

NO ; By reacting with an Oxidizer, NO_2 is produced.

$$NO + CrO_3 + H_2SO_4 \rightarrow NO_2$$

NO_2 ; By reacting with *o*-Toluidine, Nitroso-*o*-Toluidine is produced.



4. CALIBRATION OF THE TUBE

NO ; STANDARD GAS CYLINDER METHOD
NO_2 ; PERMEATION TUBE METHOD

(III) CORRECTION TABLE OF NO_2 CONCENTRATION COEXISTING WITH NO

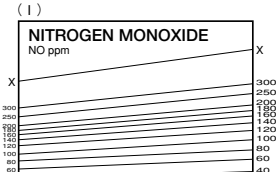
(II) NO_2 Temperature Corrected Concentration (ppm)	NO_2 Actual Concentration (ppm)						
	(I) NO Temperature Corrected Concentration (ppm)						
	20	60	100	150	200	250	300
40			34	33	32	31	30
38			32	31	30	29	28
36			30	29	28	27	26
34			28	27	26	25	24
32			26	25	24	23	22
30		25	24	23	22	21	20
28		23	22	21	20	20	19
26		20	20	20	19	19	18
24		18	18	18	17	17	16
22		16	16	16	15	15	15
20		15	15	15	14	14	14
18		13	13	13	12	12	12
16		12	12	12	11	11	11
14		10	10	10	9	9	9
12		9	9	9	8	8	8
10	8	7	7	7	6	6	6
8	6	5	5	5	5	5	5
6	5	4	4	4	4	4	4
4	3	3	3	3	3	3	3
2	2	2	2	2	2	2	2

5. INTERFERENCE AND CROSS SENSITIVITY

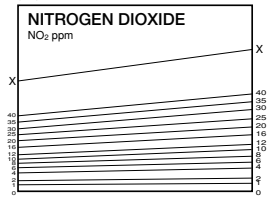
Substance	Interference	ppm	Coexistence
Chlorine	Similar stain is produced.	1	Higher readings are given.

NITROGEN OXIDES CONCENTRATION CHART
Sampling Gas Volum 100mℓ

(I)



(II)



(I) NO TEMPERATURE CORRECTION TABLE

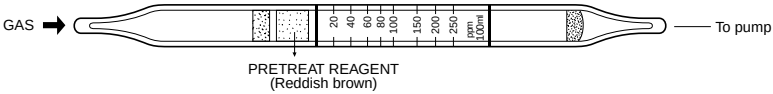
Chart Readings (ppm)	NO True Concentration (ppm)									
	10 ℃ 50 ˚F	12 ℃ 53.6 ˚F	14 ℃ 57.2 ˚F	16 ℃ 60.8 ˚F	18 ℃ 64.4 ˚F	20 ℃ 68 ˚F	22 ℃ 71.6 ˚F	24 ℃ 75.2 ˚F	26 ℃ 78.8 ˚F	28 ℃ 82.4 ˚F	30 ℃ 86 ˚F
300	—	—	—	—	—	300	270	245	220	200	190
280	—	—	—	—	—	280	250	230	210	190	180
260	—	—	—	—	300	260	235	215	195	180	170
240	—	—	—	—	280	240	215	195	180	170	160
220	—	—	—	300	250	220	195	180	170	160	150
200	—	—	—	290	230	200	180	165	155	145	140
180	—	—	300	250	200	180	165	150	140	135	130
160	—	310	260	215	180	160	150	140	130	125	120
140	310	260	220	185	155	140	130	122	117	113	110
120	260	215	180	155	135	120	112	106	101	98	95
100	210	185	150	130	110	100	95	90	86	83	80
80	160	140	120	100	87	80	77	75	72	71	70
60	100	90	80	70	64	60	57	54	52	51	50
40	60	56	52	48	43	40	38	37	36	35	35
20	30	28	26	24	22	20	20	20	20	20	20
10	10	10	10	10	10	10	10	10	10	10	10

(II) NO_2 TEMPERATURE CORRECTION TABLE

Chart Readings (ppm)	NO_2 True Concentration (ppm)										
	10 ℃ 50 ˚F	12 ℃ 53.6 ˚F	14 ℃ 57.2 ˚F	16 ℃ 60.8 ˚F	18 ℃ 64.4 ˚F	20 ℃ 68 ˚F	22 ℃ 71.6 ˚F	24 ℃ 75.2 ˚F	26 ℃ 78.8 ˚F	28 ℃ 82.4 ˚F	30 ℃ 86 ˚F
40	—	—	—	—	—	40	39	38	37	37	36
38	—	—	—	—	39	38	37	36	35	35	34
36	—	—	—	38	37	36	35	34	34	33	33
34	—	39	37	36	35	34	33	33	32	32	31
32	39	37	35	34	33	32	31	31	30	30	30
30	36	34	33	32	31	30	30	29	29	28	28
28	33	32	31	30	29	28	28	27	27	26	26
26	31	30	29	28	27	26	26	25	25	25	24
24	28	27	26	25	25	24	24	24	23	23	22
22	26	25	24	23	23	22	22	22	21	21	21
20	24	23	22	21	21	20	20	20	19	19	19
18	21	21	20	19	19	18	18	18	18	17	17
16	19	18	18	17	17	16	16	16	16	16	15
14	17	16	15	15	14	14	14	14	14	14	14
12	14	14	13	13	12	12	12	12	12	12	12
10	12	12	11	11	10	10	10	10	10	10	10
8	10	9	9	8	8	8	8	8	8	8	8
6	7	7	6	6	6	6	6	6	6	6	6
4	4	4	4	4	4	4	4	4	4	4	4
2	2	2	2	2	2	2	2	2	2	2	2

Tube No.
175SA

NITROGEN OXIDES



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 ℃
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_2 is produced.

$NO + CrO_3 + H_2SO_4 \rightarrow NO_2$

$NO_2 + (C_6H_5)_2NH \rightarrow (C_6H_5)_2NNO$

NO_2 ; By reacting with Diphenylamine, N-Nitroso-diphylamine is produced.

$NO_2 + (C_6H_5)_2NH \rightarrow (C_6H_5)_2NNO$

4. CALIBRATION OF THE TUBE

NO ; STANDARD GAS CYLINDER METHOD

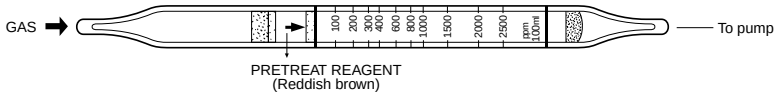
NO_2 ; PERMEATION TUBE METHOD

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	〃

Tube No.
175SH

NITROGEN OXIDES



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 : 1 year
5) Operating temperature : 5 ~ 45 ℃
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_2 is produced.

$NO + CrO_3 + H_2SO_4 \rightarrow NO_2$

$NO_2 + (C_6H_5)_2NH \rightarrow (C_6H_5)_2NNO$

NO_2 ; By reacting with Diphenylamine ,N- Nitroso-diphylamine is produced.

$NO_2 + (C_6H_5)_2NH \rightarrow (C_6H_5)_2NNO$

4. CALIBRATION OF THE TUBE

NO ; STANDARD GAS CYLINDER METHOD

NO_2 ; PERMEATION TUBE METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

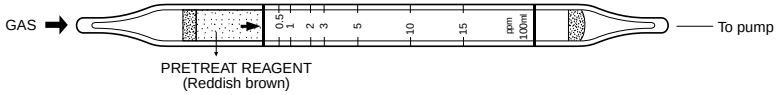
Substance	Interference	ppm	Coexistence
Hydrogen chloride	The bottom of discoloured layer is changed to Dark blue.	500	Higher readings are given.
Sulphur dioxide			The accurecy of reading is not affected.

(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.

Tube No.
175U

NITROGEN OXIDES



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(Necessary to store in a refrigerated place ; 0 ~ 10℃)
5) Operating temperature : 0 ~ 40℃
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_2 is produced.

$NO + CrO_3 + H_2SO_4 \rightarrow NO_2$

NO_2 + 3, 3'-Dimethylnaphthidine→Nitroso-compound

NO_2 ; By reacting with 3, 3'-Dimethylnaphthidine, Nitroso-compound is produced.

NO_2 + 3, 3'-Dimethylnaphthidine→Nitroso-compound

4. CALIBRATION OF THE TUBE

NO ; STANDARD GAS CYLINDER METHOD

NO_2 ; PERMEATION TUBE METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Chlorine	Similar stain is produced.		The accurecy of reading is not affected.
Hydrogen chloride	〃		〃
Sulphur dioxide	The accuracy of reading is not affected.	500	Lower readings are given.
Hydrogen sulphide	〃	5	〃
Ozone	〃		
Hexane	〃		
Laughing gas	〃		

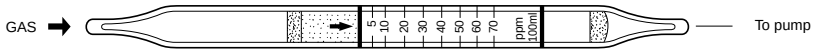
(NOTE)

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

Actual concentration = 2 × Reading value

Tube No.
229S

N, N-DIMETHYL ACETAMIDE



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 ℃
6) Temperature compensation : Necessary under 20 ℃ (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.

$CH_3CON(CH_3)_2 \rightarrow HN(CH_3)_2$

$2HN(CH_3)_2 + H_3PO_4 \rightarrow [(CH_3)_2NH_2]_2HPO_4$

4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence	
Carbon dioxide	Not affected.	0.17 %	Lower readings are given.
Ammonia	Similar stain is produced.		Higher readings are given.
Amines	〃		〃
Hydrazine	〃		〃

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)		
	10 ℃ (50 ° F)	15 ℃ (59 ° F)	20-40 ℃ (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

Tube No.
196S

N, N-DIMETHYL FORMAMIDE

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 ℃
6) Temperature compensation : Necessary(0 ~ 20 ℃)(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.

$HCON(CH_3)_2 + NaOH \rightarrow HN(CH_3)_2$

$HN(CH_3)_2 + H_3PO_4 \rightarrow [(CH_3)_2NH_2]_2HPO_4$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

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%	〃
Ammonia	Similar stain is produced.		Higher readings are given.
Amines	〃	〃	〃
Hydrazine	〃	〃	〃

(NOTE)

When the concectration 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

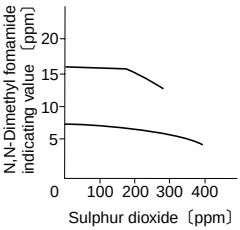


FIG.1 Influence of Sulphur dioxide

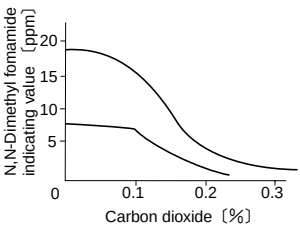


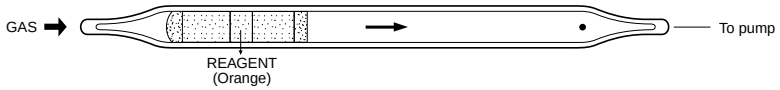
FIG.2 Influence of Carbon dioxide

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)		
	10 ℃ (50 ˚ F)	15 ℃ (59 ˚ F)	20-40 ℃ (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

Tube No.
186

ORGANIC GAS CHECKER



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 : 2 years
4) Operating temperature : 0 ~ 40℃
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.

$C_nH_m + H_2SO_4 + Cr^{6+} \rightarrow Cr^{3+}$

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.

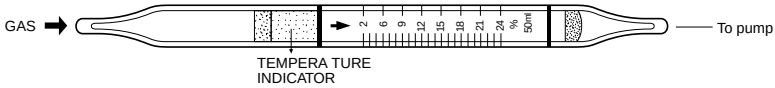
6. DETECTABLE GAS CONCENTRATION TABLE

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	2500	—
		Ethylene	100	—
		Propylene	10	—
6	Chlorination Hydrocarbon	Trichloroethylene	25	50 (A, J), 100 (B)
		Tetrachloroethylene	200	50 (A, J), 100 (B)
7	Mixed solvent	Gasoline (motor fuel)	10	300 (A), 100 (J)
		Kerosene	8 (mg/m3)	
		Mineral Turpentine	8 (mg/m3)	
8	Others	Ethyl acrylate	10	5 (A), 25 (B)
		Ether (ethyl)	10	400 (A, B)
		Ethylene oxide	50	1 (A), 5 (B)

Tube No.
159SA,SB

OXYGEN



1. PERFORMANCE

1) Measuring range : 2-24 %
   Number of pump strokes 1/2 (50mℓ)
2) Sampling time : 2 minutes/1/2 pump stroke
3) Shelf life : 2 years
4) Operating temperature : 0 ~ 40 ℃
5) Reading : Direct reading from the scale calibrated by 1/2 pump stroke
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	ppm	Coexistence
Hydrogen sulphide		2%	Higher readings are given.
Nitrogen dioxide		2%	〃
Sulphur dioxide	Similar stain is produced.	2%	〃
Carbon dioxide	〃	5%	〃

6.NOTE

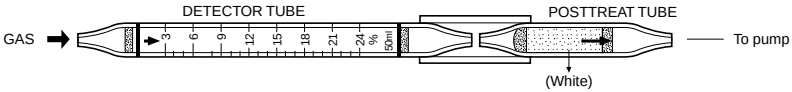
1) Coexistence of more than 5% of Carbon dioxide (CO_2) gives higher reading and the reading from the scale should be corrected with the following correction table.
2) The No.159SA and SB tubes are necessary to heat the part of the temperature indicator until the indicator discolours from Red to Purple 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. There, the No.159SB is possible to use in a hazardous area.

CO_2 CORRECTION TABLE

Scale Readings (%)	True Concentration (%)			
	CO_2 5%	CO_2 10%	CO_2 15%	CO_2 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

Tube No.
159SC

OXYGEN



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 stroke
   1.5 minutes/1 pump stroke
3) Shelf life : 2 years
4) Operating temperature : 0 ~ 45 ℃
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 REACTI0N

Titanium trichloride is oxidized and Titanium oxide is produced.

$O_2 + TiCl_3 \rightarrow TiO_2$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

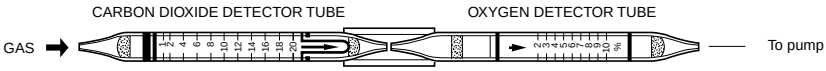
Substance	Interference	Coexistence
Sulphur dioxide		The accuracy of readings is not affected.
Carbon dioxide		〃
Nitrogen dioxide		〃
Hydrogen sulphide		〃

(NOTE)

When the concentration is below 3%, 1 pump stroke can be used to determine the lower concentration.
Following formula is available for the actual concentration.
Actual concentration = 1/2 × Reading value

Tube No.
281S

OXYGEN · CARBON DIOXIDE



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 ：0.001 %
4) Shelf life ：1.5 years
5) Operating temperature ：0～40℃
6) Temperature compensation：
   - Oxygen Necessary（See "Temperature CorrectionTable"）
   - 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：$CO_2 + 2KOH \rightarrow K_2CO_3 + H_2O$

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.

5. CONCENTRATION CORRECTION

On account of interaction of indication between carbon dioxide and oxygen, the true concentration is calculated by the following equations.

$$CO_2\,\% = (CO_2) - \frac{(O_2) \times (CO_2)}{100} \quad \text{---------- equation (1)}$$

$$O_2\,\% = (O_2) - \frac{(O_2) \times (CO_2)}{100} \quad \text{---------- equation (2)}$$

Where
(CO_2)：indication of carbon（%）
(O_2)：corrected oxygen concentration（%）

[EXANPLE]

At the measuring temperature of 30℃, when oxygen indication is 5 %（temperature corrected value 5.3 %）and carbon dioxide indication is 10 %, each true concentration is calculated as bellow.

$$CO_2\,\% = 10 - \frac{5.3 \times 10}{100} = 10 - 0.53 = 9.47$$

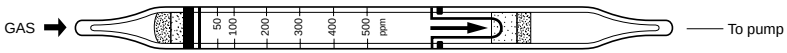
$$O_2\,\% = 5.3 - \frac{5.3 \times 10}{100} = 5.3 - 0.53 = 4.77$$

Accordingly true concentration :
- Carbon dioxide 9.47 %
- Oxygen 4.77 %

TEMPERATURE CORRECTION TABLE

Scale Readings (%)	True Oxygen Concentration (%)			
	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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

OZONE



1. PERFORMANCE

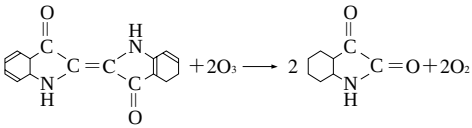
1) Measuring range	: 100-1,000 ppm	50-500 ppm
Number of pump strokes	1/2 (50mℓ)	1 (100mℓ)
2) Sampling time	: 1 minute/1 pump stroke	
3) Detectable limit	: 5 ppm (100mℓ)	
4) Shelf life	: 2 years	
5) Operating temperature	: 0 ~ 40 ℃	
6) Reading	: Direct reading from the scale calibrated by 1 pump stroke	
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	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

Tube No.
182SB

OZONE

1. PERFORMANCE

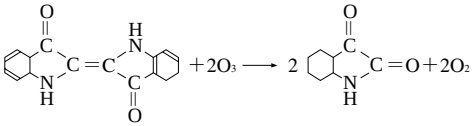
1) Measuring range	: 10-100 ppm	5-50 ppm	2.5-25 ppm
Number of pump strokes	1/2 (50mℓ)	1 (100mℓ)	2 (200mℓ)
2) Sampling time	: 1.5 minutes/1 pump stroke		
3) Detectable limit	: 1 ppm (100mℓ)		
4) Shelf life	: 2 years		
5) Operating temperature	: 0 ~ 40 ℃		
6) Reading	: Direct reading from the scale calibrated 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.

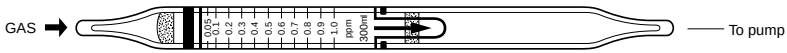
(NOTE)

1) In case of 1/2 pump strokes, following formula is available for actual concentration.
   Actual concentration = 2 × Reading value

2) In case of 2 pump strokes, following formula is available for actual concentration.
   Actual concentration = 1/2 × Reading value

Tube No.
182U

OZONE



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)

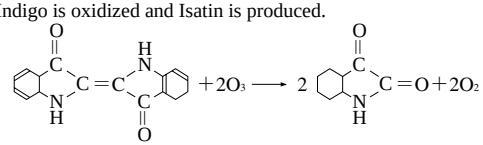
2) Sampling time : 3 minutes/3 pump strokes
3) Detectable limit : 0.01 ppm (600mℓ)
4) Shelf life : 2 years
5) Operating temperature : 0 ~ 40 ℃
6) Reading : Direct reading from the scale calibrated by 3 pump strokes
7) Colour change : Blue → White

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.

$$\text{Actual concentration} = \text{Reading value} \times \frac{3}{\text{Number of strokes}}$$

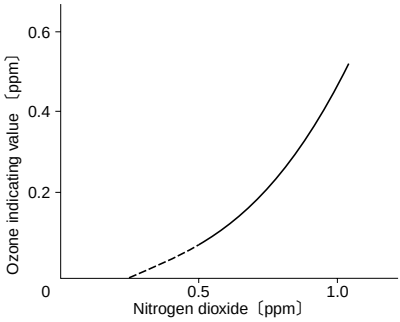
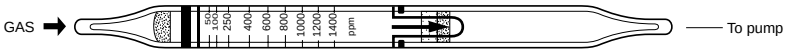


FIG.1 Influence of Nitrogen dioxide

Tube No.
113SBⓒ PENTANE



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℃
6) Reading : Graduations printed on the tube are calibrated by 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

$CH_3(CH_2)_3CH_3 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

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 bottom of the discoloured layer is stained to Black and higher readings are given.
Paraffin Hydrocarbons (more than C_3)	〃		Higher readings are given.

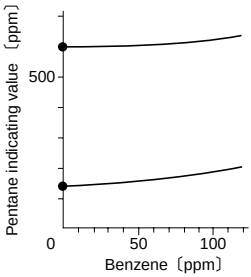


FIG.1 Influence of Benzene

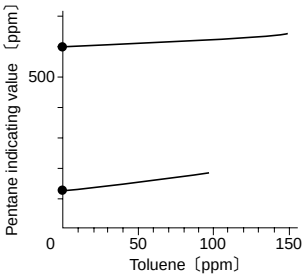
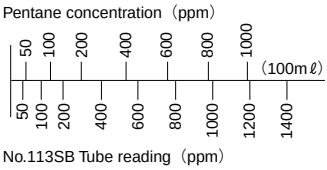
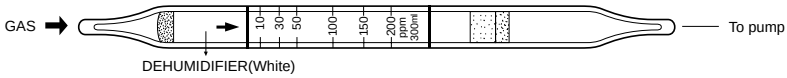


FIG.2 Influence of Toluene



Tube No.
210U

PENTYL ACETATE



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 ℃
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.

$CH_3CO_2CH_2(CH_2)_3CH_3 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

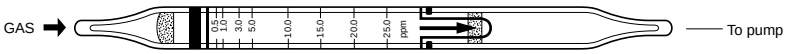
Substance	Interference	Coexistence
Alcohols	Similar or Blue stain is produced.	Higher readings are given.
Esters	〃	〃
Ketones	〃	〃
Aliphatic hydrocarbons	〃	〃
Aromatic hydrocarbons	The accuracy of readings is not affected.	Whole reagent is changed to Brown.

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)			
	10 ℃ (50 ° F)	20 ℃ (68 ° F)	30 ℃ (86 ° F)	40 ℃ (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

Tube No.
183U

PHENOL



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 ℃
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.

$$C_6H_5OH + Ce^{4+} \rightarrow C_6H_5O\cdot \rightarrow (C_6H_5O)_n$$

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 read ings are given.

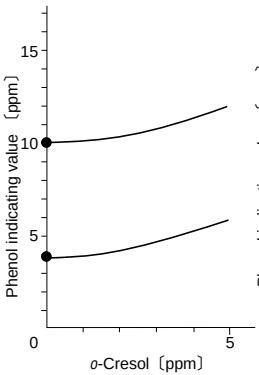


FIG.1 Influence of *o*-Cresol

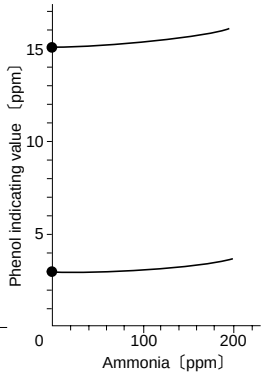


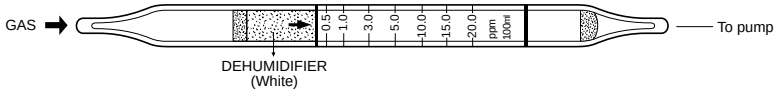
FIG.2 Influence of Ammonia

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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

Tube No.
146S

PHOSGENE



1. PERFORMANCE

1) Measuring range : 0.5-20 ppm 0.1-0.5 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 a refrigerated place ; 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 : 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

COLOURIMETRY 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	Discolouration is faded from the gas inlet edge.
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.
Following formula is available for the actual concentration.
Actual concentration = 1/5 × Temperature corrected value

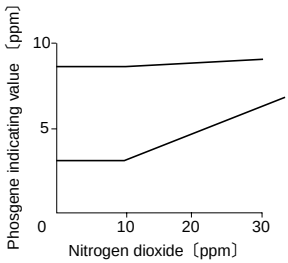


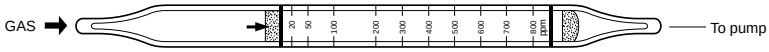
FIG.1 Influence of Nitrogen dioxide

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0 ℃ (32 °F)	10 ℃ (50 °F)	20 ℃ (68 °F)	30 ℃ (86 °F)	40 ℃ (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

Tube No.
121SA

PHOSPHINE IN ACETYLENE



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℃
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.

$PH_3 + HgCI_2 + H_2O \rightarrow Hg_3P_2 \cdot 3HgCI \cdot 3H_2O$

$PH_3 + CuSO_4 \rightarrow Cu_3P_2 + H_2O$

$Cu_3P_2 + HC \equiv CH \rightarrow CuC \equiv CCu$

4. CALIBRATION OF THE TUBE

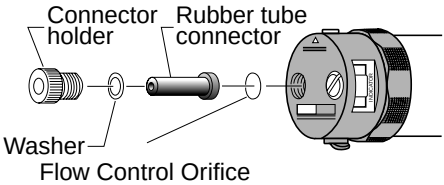
COLOURIMETRY METHOD

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.



Tube No.
121SB

PHOSPHINE IN ACETYLENE

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 ℃
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.

$PH_3 + HgCl_2 + H_2O \rightarrow Hg_3P_2 \cdot 3HgCl \cdot 3H_2O$

$PH_3 + CuSO_4 \rightarrow Cu_3P_2 + H_2O$

$Cu_3P_2 + HC \equiv CH \rightarrow CuC \equiv CCu$

4. CALIBRATION OF THE TUBE

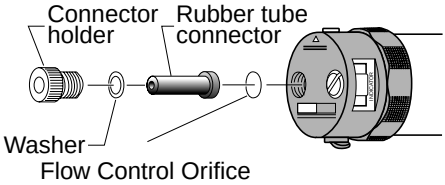
COLOURIMETRY METHOD

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	〃

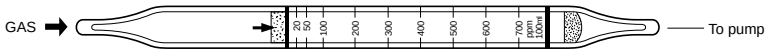
6.NOTE

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.



Tube No.
121SC

PHOSPHINE



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
4) Shelf life : 3 years
5) Operating temperature : 0 ~ 40 ℃
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.

$$PH_3 + HgCl_2 + H_2O \rightarrow Hg_3P_2 \cdot HgCl_2 \cdot H_2O$$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

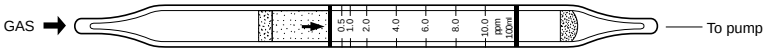
Substance	Interference	ppm	Coexistence
Arsine	Brown stain is produced.	30	Higher readings are given.
Hydrogen selenide	〃	50	〃
Hydrogen sulphide	〃	40	〃

(NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.
Actual concentration = 2 × Reading value

Tube No.
121SD

PHOSPHINE



1. PERFORMANCE

1) Measuring range	: 0.5-10.0 ppm	0.25-0.5 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 ℃
6) Reading : Direct reading from the scale calibrated by 1 pump stroke
7) Colour change : Pale orange → Brownish purple

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.

$PH_3 + 3HgCl_2 \rightarrow P(HgCl)_3 + 3HCl$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Ammonia		60	From gas inlet side of discoloured layer, the discolouration is faded.
Hydrogen selenide	Similar stain is produced.		Higher readings are given.
Nickel carbonyl	〃		〃
Arsine	〃		〃

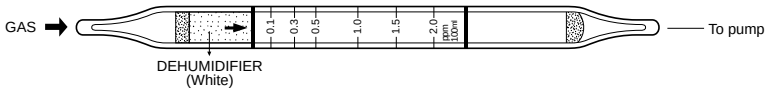
(NOTE)

1) When the concentration is below 0.5ppm, 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
In case of 1/2 pump strokes, following formula is available for actual concentration.
Actual = 2 × Reading value

2) Read the concentration rapidly because the discoloured layer will be faded gradually.

Tube No.
121U

PHOSPHINE



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℃
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.

$PH_3 + HgCl_2 \rightarrow P(HgCl)_3 + HCl$

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.
Following formula is available for the actual concentration.
Actual concentration = 1/2 × Reading value

Tube No.
125SA

PROPANE

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 : 20 ppm
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 : Orange → Brown

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

Chromium oxide is reduced.

$$CH_3CH_2CH_3 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

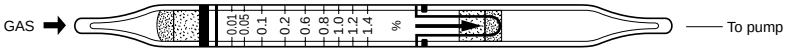
Substance	Interference	Coexistence
Toluene	Similar stain is produced.	Higher readings are given.
Hexane	〃	〃
Trichloroethylene	〃	〃

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32˚F)	10℃ (50˚F)	20℃ (68˚F)	30℃ (86˚F)	40℃ (104˚F)
0.50	0.40	0.45	0.50	0.50	—
0.40	0.33	0.37	0.40	0.35	—
0.30	0.26	0.28	0.30	0.28	0.42
0.25	0.21	0.23	0.25	0.22	0.32
0.20	0.17	0.19	0.20	0.16	0.26
0.15	0.13	0.14	0.15	0.22	0.19
0.10	0.09	0.10	0.10	0.11	0.13
0.05	0.05	0.06	0.05	0.05	0.05

Tube No.
139SB Ⓒ

PROPYL ACETATE



1. PERFORMANCE

1) Measuring range : 0.01-1.4 %
   Number of pump strokes 2 (200mℓ)
2) Sampling time : 1.5 minutes/1 pump stroke
3) Detectable limit : 10 ppm
4) Shelf life : 3 years
5) Operating temperature : 0 ~ 40 ℃
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

Potassium dichromate is reduced.

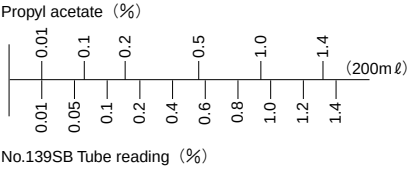
$$CH_3CO_2(CH_2)_2CH_3 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

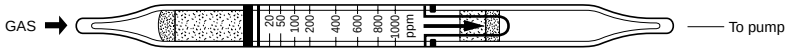
5. INTERFERENCE AND CROSS SENSITIVITY

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.



Tube No.
151U

PROPYL ACETATE



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 ℃
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 brown

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

Chromium oxide is reduced.

$CH_3CO_2(CH_2)_2CH_3 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

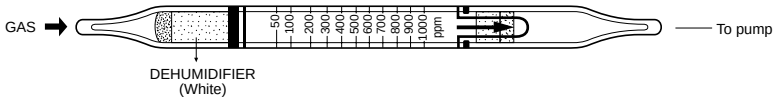
Substance	Interference	Coexistence
Alcohols	Similar stains or Blue stains are produced.	Higher readings are given.
Esters	〃	〃
Ketones	〃	〃
Aromatic hydrocarbons	〃	〃
Paraffin hydrocarbons	〃	Whole reagent is changed to Brown.

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)			
	10 ℃ (50 ° F)	20 ℃ (68 ° F)	30 ℃ (86 ° F)	40 ℃ (104 ° F)
1,000	—	1,000	480	320
800	—	800	420	280
600	1,450	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

Tube No.
185S

PROPYLENE



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 ℃
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.

$$CH_3CH=CH_2 + PdSO_4 + (NH_4)_2MoO_4 \rightarrow Mo_3O_8$$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

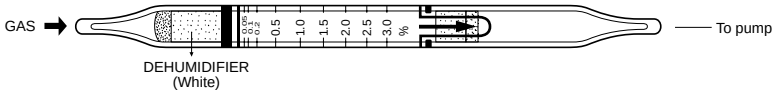
Substance	ppm	Interference	ppm	Coexistence
Carbon monoxide	45	Similar stain is produced.	200	Higher readings are given.
Acetylene		Brown stain is produced.	50	〃
Ethyene		Similar stain is produced.		〃
Hydrogen sulphide	10	Black stain is produced.	50	Double-layer stain is produced and higher readings are given.

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)			
	10 ℃ (50 ˚F)	20 ℃ (68 ˚F)	30 ℃ (86 ˚F)	40 ℃ (104 ˚F)
1,000	870	1,000	—	—
800	760	800	900	1,000
600	540	600	660	720
400	380	400	420	440
200	200	200	200	200

Tube No.
163SA

PROPYLENE OXIDE



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 : 20 ppm
4) Shelf life : 3 years
5) Operating temperature : 0 ~ 40 ℃
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

Potassium dichromate is reduced.

$CH_3CHCH_2O + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

4. CALIBRATION OF THE TUBE

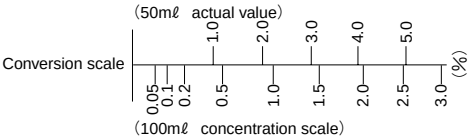
GAS CHROMATOGRAPHY

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 Brown.	0.5 %	〃

(NOTE)

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



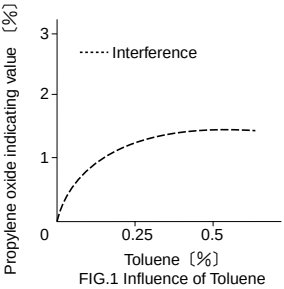


FIG.1 Influence of Toluene

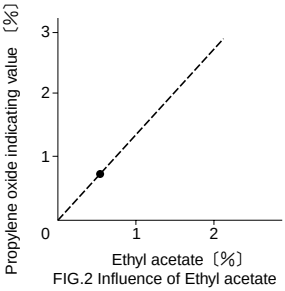


FIG.2 Influence of Ethyl acetate

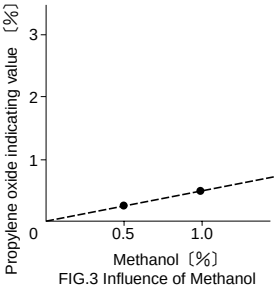
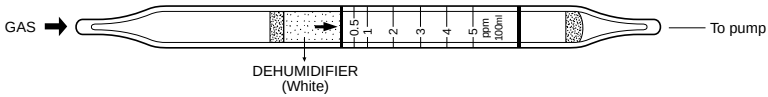


FIG.3 Influence of Methanol

Tube No.
130U

n-PROPYL MERCAPTAN



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℃
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 Mercuric chloride, Hydrogen chloride is produced and PH indicator is discoloured.

$RSH + HgCI_2 \rightarrow RS(HgCI) + HCI$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

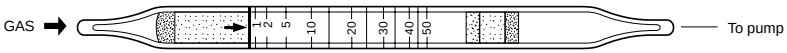
Substance	Interference	Coexistence
Arsine	Similar stain is produced.	Higher readings are given.
Hydrogen selenide	〃	〃
Phosphine	〃	〃
Hydrogen sulphide		〃
Hydrogen cyanide	Whole reagent is changed to Red.	〃
Sulphur dioxide		Whole reagent is changed to Pale red,but Pink stain indicates Mercaptans conc.

(NOTE)

This tube scale is calibratde based on Methyl mercaptan and the same scale is available for n-Propyl mercaptan.
In case of 1/2 pump strokes, following formula is available for actual concentration.
Actual concentration = 2 × Reading value

Tube No.
240S

SILANE



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 a refrigerated place ; 0 ~ 10℃)
5) Operating temperature : 0 ~ 40℃
6) Temperature compensation : Necessary under 20℃(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.

$SiH_4 + HgCI_2 \rightarrow HCI$

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 are not affected by Sulphur dioxide if the top of the stained layer is clear.	
IPA		Not affected.	
Hydrogen		〃	
Hydrogen chloride		250	Not affected.
Dichlorosilane		200	〃

(NOTE)

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

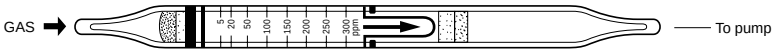
Actual concentration = Temperature corrected value × 1/2

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)		
	0℃ (32°F)	10℃ (50°F)	20-40℃ (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

Tube No.
158S

STYRENE



1. PERFORMANCE

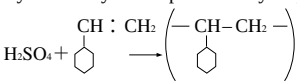
1) Measuring range : 5-300 ppm 2.5-150 ppm
Number of pump strokes 1(100mℓ) 2(200mℓ)
2) Sampling time : 1 minute/1 pump stroke
3) Detectable limit : 0.5 ppm(200mℓ)
4) Shelf life : 3 years
5) Operating temperature : 0 ~ 40℃
6) Reading : Direct reading from the scale calibrated by 1 pump stroke
7) Colour 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.

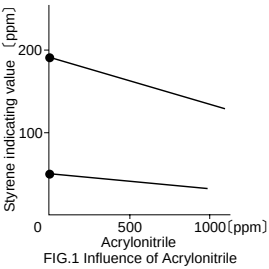


FIG.1 Influence of Acrylonitrile

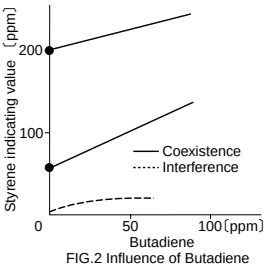


FIG.2 Influence of Butadiene

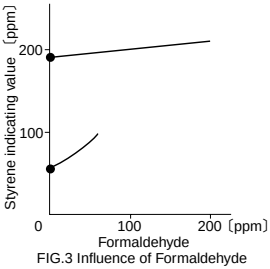
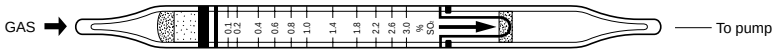


FIG.3 Influence of Formaldehyde

Tube No.
103SA

SULPHUR DIOXIDE



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 : 100 ppm
4) Shelf life : 3 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 → Blue

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

Chromium oxide is reduced.

$SO_2 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

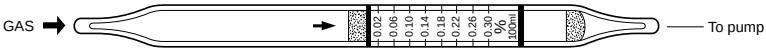
Substance	Interference	ppm	Coexistence
Hydrogen sulphide		400	Brown stain is produced and higher readings are given.

TEMPERATURE CORRECTION TABLE

Scale Readings (%)	True Concentration (%)				
	0 ℃ (32 ° F)	10 ℃ (50 ° F)	20 ℃ (68 ° F)	30 ℃ (86 ° F)	40 ℃ (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

Tube No.
103SB

SULPHUR DIOXIDE



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 : 10 ppm
4) Shelf life : 3 years
5) Operating temperature : 0 ~ 40 ℃
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 iodide is reduced.

$SO_2 + KIO_3 + H_2O \rightarrow I_2$

4. CALIBRATION OF THE TUBE

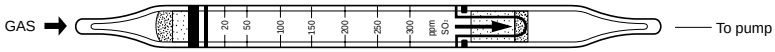
STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Hydrogen sulphide	The accuracy of readings is not affected.	100	Higher readings are given.

Tube No.
103SC

SULPHUR DIOXIDE



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℃
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.

$SO_2 + 2NaOH \rightarrow Na_2SO_3 + H_2O$

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_2 conc. ×1/5	Higher readings are given.
Nitrogen dioxide FIG.2	100	Pink stain is produced.	〃	〃
Hydrogen Sulphide FIG.3			SO_2 conc. ×100	Lower readings are given.

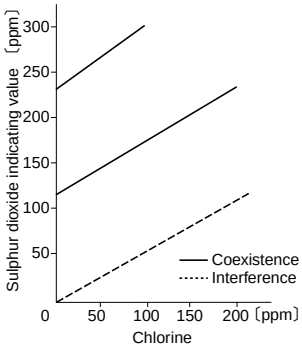


FIG.1 Influence of Chlorine

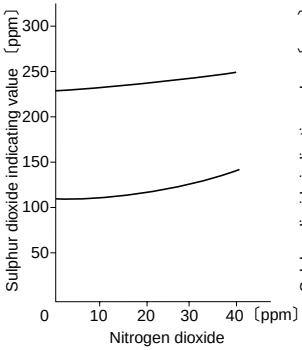


FIG.2 Influence of Nitrogen dioxide

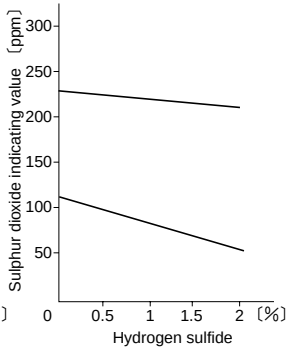
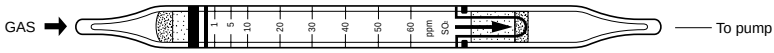


FIG.3 Influence of Hydrogen sulfide

Tube No.
103SD

SULPHUR DIOXIDE



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℃
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.

$SO_2 + 2NaOH \rightarrow Na_2SO_3 + H_2O$

4. CALIBRATION OF THE TUBE

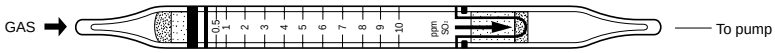
PERMEATION TUBE METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	ppm	Coexistence
Chlorine		Pale pink stain is produced.	SO_2 conc. ×2	Higher readings are given.
Nitrogen dioxide	20	〃	SO_2 conc. ×1	The top of discoloured layer becomes un clear and higher readings are given.

Tube No.
103SE

SULPHUR DIOXIDE



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 a refrigerated place ; 0 ~ 10℃)
5) Operating temperature : 0 ~ 40℃
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 an Alkali, PH indicator is discoloured.

$SO_2 + 2NaOH \rightarrow Na_2SO_3 + H_2O$

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	The top of discoloured layer becomes un clear and higher readings are given.
Hydrogen chloride	〃		Higher readings are given.

(NOTE)

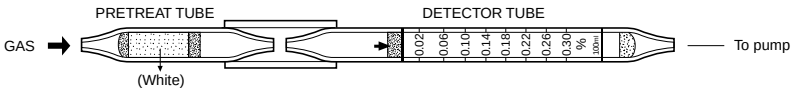
1) This detector tube is affected by abmbient relative humidity,therefore,it is necessary to compensate the reading of gas detector tube with the following formula and correction confficient table.
   Actual concentration = Reading Value(ppm) × Correction Coefficient
2) In case of 2 pump strokes, following 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	1.1	1.2	1.3	1.4

Tube No.
103SF

SULPHUR DIOXIDE IN FLUE GAS



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 : 10 ppm
4) Shelf life : 3 years
5) Operating temperature : 0 ~ 40 ℃
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.

$SO_2 + KIO_3 + H_2O \rightarrow I_2$

4. CALIBRATION OF THE TUBE

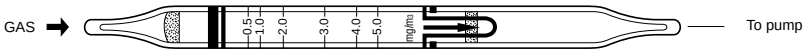
STANDARD GAS CYLINDER METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Hydrogen sulphide	The accuracy of readings is not affected.	100	Higher readings are given.

Tube No.
244U

SULPHURIC ACID



1. PERFORMANCE

1) Measuring range : 0.5-5 mg/m^3
   Number of pump strokes 5 (500mℓ)
2) Sampling time : 100 seconds/5 pump strokes
3) Detectable limit : 0.2 mg/m^3
4) Shelf life : 1 year (Necessary to store in a refrigerated place ; 0 ~ 10 ℃)
5) Operating temperature : 5 ~ 40 ℃
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

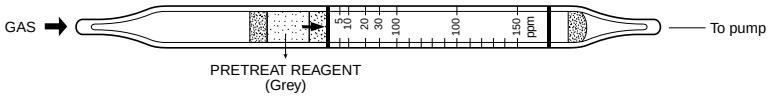
Substance	Interference	Coexistence
Hydrogen chloride	Similar stain is produced.	Higher readings are given.
Hydrogen flouride	〃	〃
Nitrogen dioxide	〃	〃
Chlorine	〃	〃
Acetaldehyde	〃	〃
Hydrogen sulphide	The accuracy of readings is not affected.	〃
Sulphur dioxide	〃	〃

TEMPERATURE CORRECTION TABLE

Temperature	5℃ (41˚F)	10℃ (50˚F)	20℃ (68˚F)	30℃ (86˚F)	40℃ (104˚F)
Correction Factor	7.0	6.0	5.0	4.5	4.0

Tube No.
135SA

TETRACHLOROETHYLENE



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 a refrigerated place ; 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 : 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.

$CCl_2 = CCl_2 + PbO_2 + H_2SO_4 \rightarrow HCl$

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 or 2 pump strokes, following formula is available for the actual concentration.
Actual concentration = 2 × Temperature corrected value

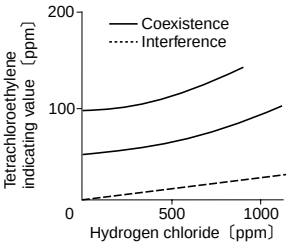


FIG.1 Influence of Hydrogen chloride

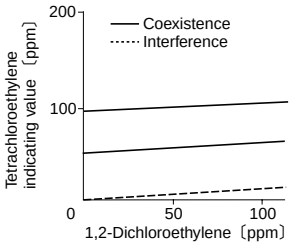


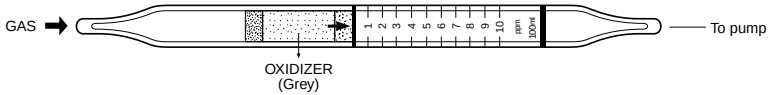
FIG.2 Influence of 1,2-Dichloroethylene

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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

Tube No.
135SB

TETRACHLOROETHYLENE



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 a refrigerated place ; 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 : 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.

$CI_2C = CCI_2 + PbO_2 + H_2SO_4 \rightarrow HCI$

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 × Temperature corrected value

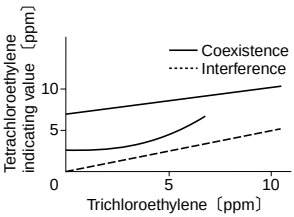


FIG.1 Influence of Trichloroethylene

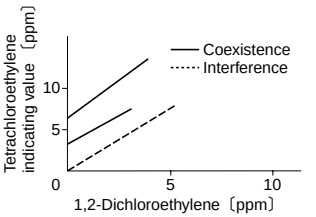


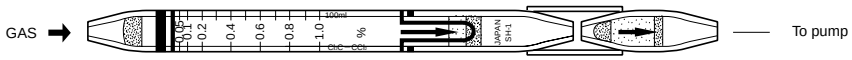
FIG.2 Influence of 1,2-Dichloroethylene

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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

Tube No.
135SH

TETRACHLOROETHYLENE



1. PERFORMANCE

1) Measuring range	: 0.05-1.0 %	0.1-2.0 %
Number of pump strokes	1 (100mℓ)	1/2 (50mℓ)
2) Sampling time	: 2.5 minutes/1 pump stroke	
3) Detectable limit	: 0.01 % (100mℓ)	
4) Shelf life	: 2 years	
5) Operating temperature	: 0 ～ 40 ℃	
6) Reading	: Direct reading from the scale calibrated by 1 pump stroke	
7) Colour change	: White → Brown (The top of discoloued layer is pale green.)	

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTI0N

$CI_2C = CCI_2 + I_2O_5 + H_2SO_4 \rightarrow I_2$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

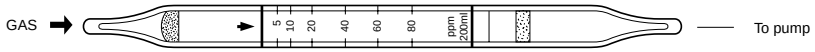
5. INTERFERENCE AND CROSS SENSITIVITY

(NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.
Actual concentration = 2 × Reading value

Tube No.
243U

TETRAETHOXYSILANE



1. PERFORMANCE

1) Measuring range : 12.5-200 ppm 5-80 ppm
   Number of pump strokes 1 (100mℓ) (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 ℃
6) Temperature compensation : Necessary (refer to "Table 2. Temperature CorrectionTable")
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

$Si(OC_2H_5)_4 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

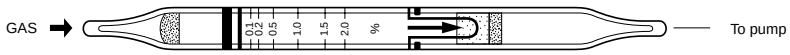
(NOTE)

In case of 1 pump stroke, following formula is available for the actual concentration.
Actual concentration = 2.5 × Temperature corrected value

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)					
	0 ℃ (32 ° F)	5 ℃ (41 ° F)	10 ℃ (50 ° F)	20 ℃ (68 ° F)	30 ℃ (86 ° F)	40 ℃ (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

Tube No.
102SA ⓒ TETRAHYDROFURAN



1. PERFORMANCE

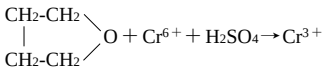
1) Measuring range : 2.0-5.0 % 0.2-3.0 %
Number of pump strokes 1/2 (50mℓ) 1 (100mℓ)
2) Sampling time : 1.5 minutes/1 pump stroke
3) Detectable limit : 20 ppm
4) Shelf life : 3 years
5) Operating temperature : 0 ~ 40 ℃
6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
7) Reading : 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

Potassium dichromate is reduced.



4. CALIBRATION OF THE TUBE

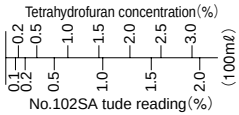
GAS CHROMATOGRAPHY

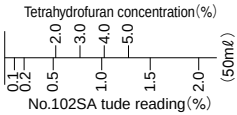
5. INTERFERENCE AND CROSS SENSITIVITY

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

(NOTE)

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





TEMPERATURE CORRECTION TABLE

Scale Readings (%)	True Concentration (%)				
	0℃ (32˚F)	10℃ (50˚F)	20℃ (68˚F)	30℃ (86˚F)	40℃ (104˚F)
3.0	—	3.2	3.0	2.8	2.7
2.5	3.0	2.7	2.5	2.4	2.2
2.0	2.4	2.1	2.0	1.9	1.8
1.5	1.8	1.6	1.5	1.4	1.3
1.0	1.1	1.1	1.0	1.0	0.9
0.5	0.6	0.5	0.5	0.5	0.5

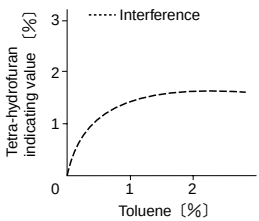


FIG.1 Influence of Toluene

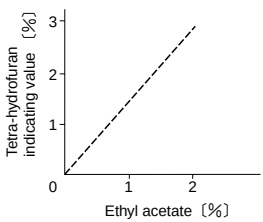
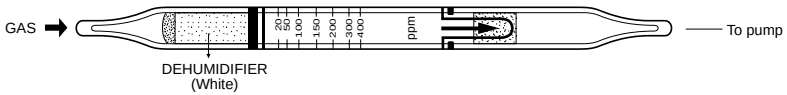


FIG.2 Influence of Ethyl acetate

Tube No.
162U

TETRAHYDROFURAN



1. PERFORMANCE

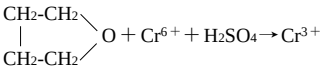
1) Measuring range : 20-400 ppm
   Number of pump strokes 1 (100mℓ)
2) Sampling time : 1.5 minutes/1 pump stroke
3) Detectable limit : 10 ppm
4) Shelf life : 2 years
5) Operating temperature : 0 ~ 40℃
6) Temperature compensation : Necessary (See "TEMPERATURE CORRECTION TABLE")
7) Reading : Direct reading from the scale calibrated by 1 pump stroke
8) Colour change : Pale yellow → Pale blue

2. RELATIVE STANDARD DEVIATION

RSD-low : 10 % 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

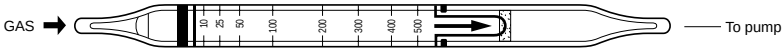
Substance	Interference	Coexistence
Alcohols	Similar stain is produced.	Higher readings are given.
Esters	Whole reagent is changed to Black.	〃
Ketones	〃	〃
Aromatic hydrocarbons	〃	〃

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)			
	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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

Tube No.
124SA

TOLUENE



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 : 2 ppm
4) Shelf life : 3 years
5) Operating temperature : 0～40℃
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.

$C_6H_5CH_3 + I_2O_5 + H_2SO_4 \rightarrow I_2$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	ppm	Interference	ppm	Coexistence
Benzene		Brownish green stain is produced.	10	The top of discoloured layer becomes unclear and higher readings are given.
Xylene FIG.1	5	Similar stain is produced.	20	Higher readings are given.
Ethyl benzene FIG.2	5	〃	10	〃
Hexane	0.1％	Whole layer is discoloured to Pale brown.	0.1％	〃
Methyl alcohol		The accuracy of readings is not affected.	1％	〃

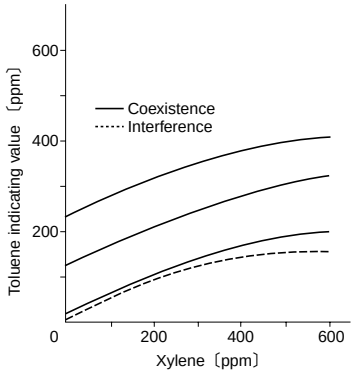


FIG.1 Influence of Xylene

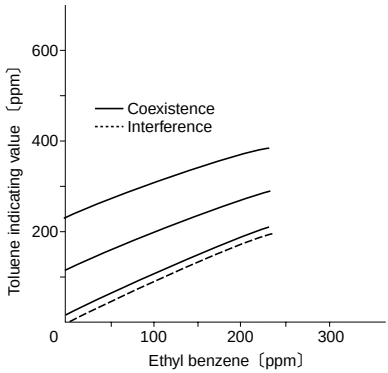
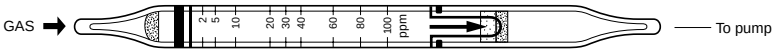


FIG.2 Influence of Ethyl benzene

Tube No.
124SB

TOLUENE



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 ℃
6) Temperature compensation : Necessary (0 ~ 10 ℃) (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.

$$C_6H_5CH_3 + I_2O_5 + H_2SO_4 \rightarrow I_2$$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Aromatic hydrocarbons FIG.1,FIG.2	Similar stain is produced.	Higher readings are given.
Hexane		Double-layer stain is produced. If the brown stain is clear, the readings can be obtained by it.

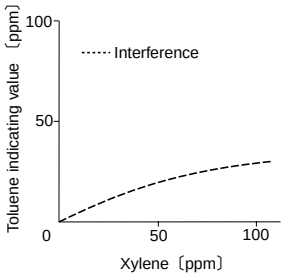


FIG.1 Influence of Xylene

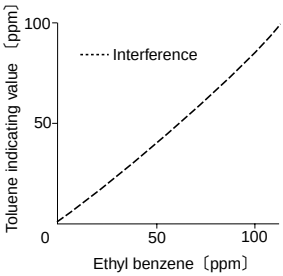
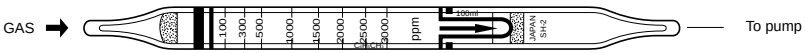


FIG.2 Influence of Ethyl benzene

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)		
	0 ℃ (32 ° F)	5 ℃ (80 ° F)	15-40 ℃ (95-104 ° 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

Tube No.
124SH TOLUENE



1. PERFORMANCE

1) Measuring range : 100-3000 ppm
   Number of pump strokes 1 (100mℓ)
2) Sampling time : 1 minute/1 pump stroke
3) Detectable limit : 10 ppm (100mℓ)
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 : White → Dark brown

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

Iodine pentoxide is reduced.

$C_6H_5CH_3 + I_2O_5 + H_2SO_4 \rightarrow I_2$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

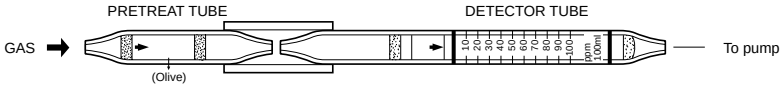
5. INTERFERENCE AND CROSS SENSITIVITY

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)				
	0 ℃ (32 ° F)	10 ℃ (50 ° F)	20 ℃ (68 ° F)	30 ℃ (86 ° F)	40 ℃ (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

Tube No.
236S

1,1,2-TRICHLOROETHANE



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 a refrigerated place ; 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 : 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 reading between this Chlorine and 3, 3'-Dimethylnaphthidine, Nitroso-compound is produced.

$CI_2CHCH_2CI + CrO_3 + H_2SO_4 \rightarrow CI_2$

CI_2 + 3, 3'-Dimethylnaphthidine → Nitroso-compound

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Nitrogen oxides	Similar stain is produced.		Higher readings are given.
Halogens	〃		〃
Halogenated hydrocarbons	〃		〃
Hexane FIG.1		100	Lower readings are given.

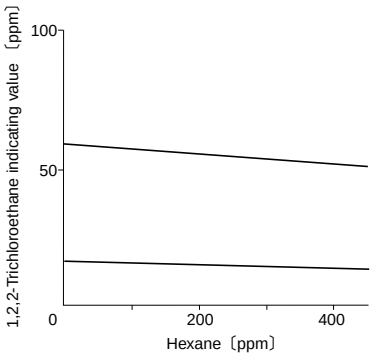


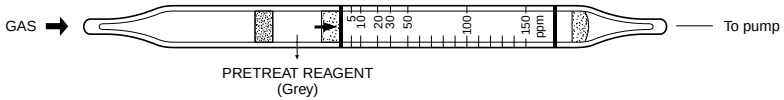
FIG.1 Influence of Hexane

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (104°F)
100	84	92	100	105	114
90	73	82	90	96	105
80	63	72	80	88	96
70	53	61	70	78	86
60	44	51	60	68	75
50	35	42	50	58	64
40	27	33	40	47	53
30	20	25	30	36	42
20	13	16	20	25	30
10	6	8	10	14	18

Tube No.
134SA

TRICHLOROETHYLENE



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 a refrigerated place ; 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 : Yellow → Red

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTI0N

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

$CI_2C = CHCI + PbO_2 + H_2SO_4 \rightarrow HCI$

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

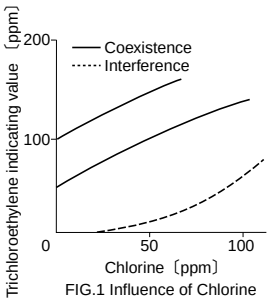


FIG.1 Influence of Chlorine

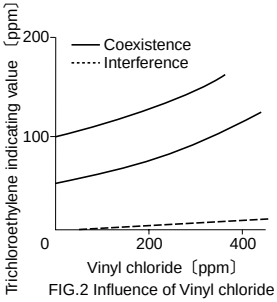


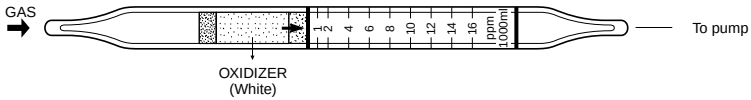
FIG.2 Influence of Vinyl chloride

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)				
	0℃ (32°F)	10℃ (50°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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

Tube No.
134SB

TRICHLOROETHYLENE



1. PERFORMANCE

1) Measuring range : 1-16 ppm 0.2-3.2 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 a refrigerated place ; 0 ~ 10℃)
5) Operating temperature : 0 ~ 40℃
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.

$CI_2C = CHCI + PbO_2 + H_2SO_4 \rightarrow HCI$

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	〃	40	〃

(NOTE)

In case of 4 pump strokes, following formula is available for the actual concentration.
Actual concentration = 1/5 × Reading value.

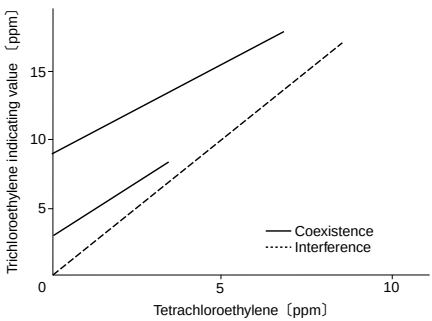


FIG.1 Influence of Tetrachloroethulene

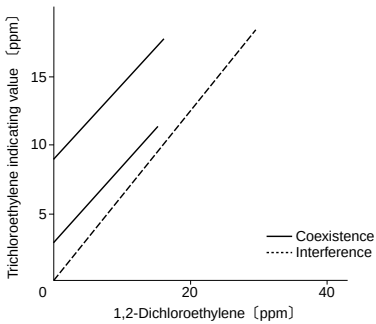
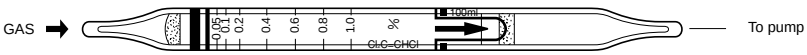


FIG.2 Influence of 1,2-Dichloroethylene

Tube No.
134SH

TRICHLOROETHYLENE



1. PERFORMANCE

1) Measuring range : 0.05-1.0 % 0.1-2.0 %
Number of pump strokes 1(100mℓ) 1/2(50mℓ)
2) Sampling time : 1.5 minutes/1 pump stroke
3) Detectable limit : 0.005 %(100mℓ)
4) Shelf life : 2 years
5) Operating temperature : 0 ~ 40 ℃
6) Temperature compensation : Necessary(0 ~ 20 ℃)(See "TEMPERATURE CORRECTION TABLE")
7) Reading : Direct reading from the scale calibrated by 1 pump stroke
8) Colour change : White → Yellow(The top of discoloued layer is pale green.)

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTI0N

$CI_2C = CHCI + I_2O_5 + H_2SO_4 \rightarrow I_2$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

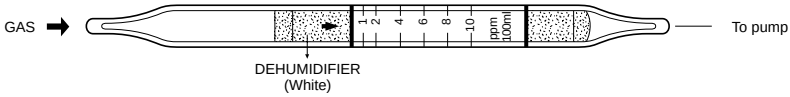
(NOTE)
In case of 1/2 pump strokes, following formula is available for the actual concentration.
Actual concentration = 2 × Tmperature corrected value

TEMPERATURE CORRECTION TABLE

Tube Readings (%)	Corrected Concentration (%)			
	0℃ (32°F)	5℃ (41°F)	10℃ (50°F)	20℃-40℃ (68-104°F)
1.0	1.45	1.3	1.2	1.0
0.8	1.2	1.05	0.95	0.8
0.4	0.65	0.55	0.45	0.4
0.2	0.3	0.25	0.22	0.2
0.1	0.13	0.11	0.11	0.1
0.05	0.05	0.05	0.05	0.05

Tube No.
213S

TRIETHYL AMINE



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	
4) Shelf life	: 3 years	
5) Operating temperature	: 0 ~ 40 ℃	
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.

$$2(C_2H_5)_3N + H_3PO_4 \rightarrow [(C_2H_5)_3NH]_2HPO_4$$

4. CALIBRATION OF THE TUBE

VAPOUR PRESSURE METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

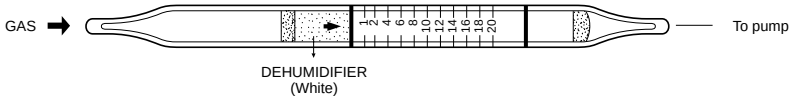
Substance	Interference	Coexistence
Ammonia	Similar stains are produced and higher readings are given.	Higher readings are given.
Other amines	〃	〃

(NOTE)

In case of 1/2 pump strokes, following formula is available for the actual concentration.
Actual concentration = 2 × Reading value.

Tube No.
222S

TRIMETHYL AMINE



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℃
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.

$$2(CH_3)_3N + H_3PO_4 \rightarrow [(CH_3)_3NH]_2HPO_4$$

4. CALIBRATION OF THE TUBE

VAPOUR PRESSURE METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

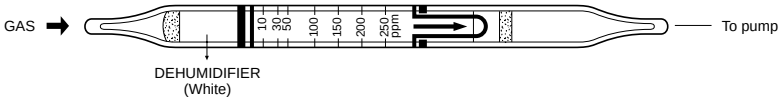
Substance	Interference	Coexistence
Ammonia	Similar stains are produced	Higher readings are given.
Other amines	〃	〃

(NOTE)

This tube scale is calibrated based on Diethyl amine and same scale is available for Trimethyl amine.

Tube No.
111Uⓒ

1,2,4-TRIMETHYL BENZENE



1. PERFORMANCE

1) Measuring range : 10-250 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℃
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.

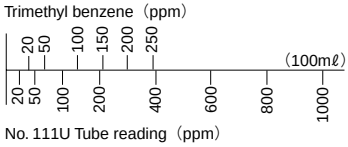
$C_6H_3(CH_3)_3 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

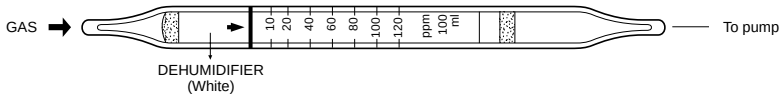
5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols	Brown stain is produced.	Higher readings are given.
Esters	〃	〃
Ketones	〃	〃
Aromatic hydrocarbons	〃	〃
Aliphatic hydrocarbons (more than C_3)		Double-layer stain is produced. If the dark brown stain is clear, the readings can be obtained by it.
Halogenated hydrocarbons		〃



Tube No.
237S

VINYL ACETATE



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℃
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.

$CH_3CO_2CH = CH_2 + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

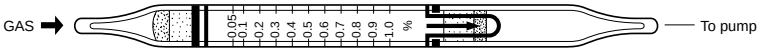
Substance	Interference	ppm	Coexistence
Acetic acid			The accuracy of readings is not affected.
Ethylene		150	The top of discoloured layer becomes unclear.
Alcohols	Similar stain is produced.		Higher readings are given.
Ethers	〃		〃
Aliphatic hydrocarbons (more than C_3)	Whole layer is discoloured to Brown.		〃
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

Tube No.
132SA

VINYL CHLORIDE



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 ℃
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.

$CH_2 = CHCl + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$

4. CALIBRATION OF THE TUBE

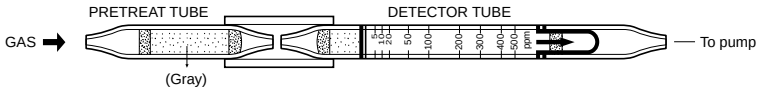
STANDARD GAS CYLINDER METHOD

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.

Tube No.
132SB

VINYL CHLORIDE



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 a refrigerated place ; 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 : White → Reddish orange

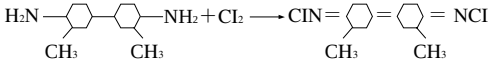
2. RELATIVE STANDARD DEVIATION

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.

$CH_2 = CHCl + PbO_2 \rightarrow Cl_2$



4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

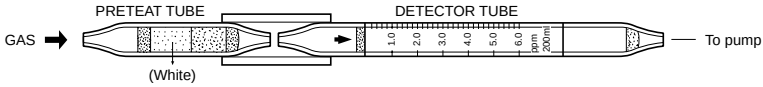
Substance	Interference	ppm	Coexistence
Hydrogen chloride	Similar stain is produced.		Higher readings are given.
Chlorine	〃		〃
Other halogens or Halogenated hydrocarbons	〃		〃

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)						
	0℃ (32°F)	5℃ (41°F)	10℃ (50°F)	15℃ (59°F)	20℃ (68°F)	30℃ (86°F)	40℃ (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	10	5
5	15	10	10	5	5	5	5

Tube No.
132SC

VINYL CHLORIDE



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℃
6) Temperature compensation : Necessary (0 ~ 15℃) (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.

$CH_2 = CHCl + CrO_3 + H_2SO_4 \rightarrow HCl$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Acetylene		1%	Lower readings are given.
Ethylene FIG.1		300	〃
Hydrogen chloride		200	Higher readings are given.
Chlorine	Similar stain is produced.	10 × Vinyl chloride conc.	〃

(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

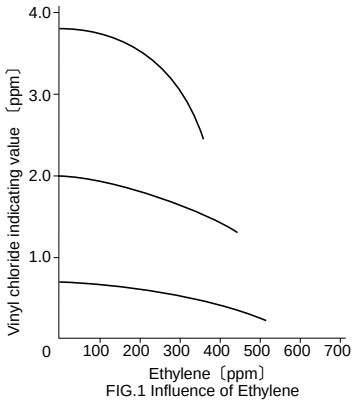


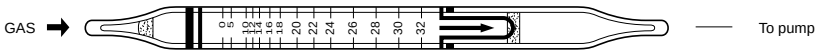
FIG.1 Influence of Ethylene

TEMPERATURE CORRECTION TABLE

Scale Readings (ppm)	True Concentration (ppm)			
	0℃ (32°F)	5℃ (41°F)	10℃ (50°F)	15—40℃ (59°F)(104°F)
6.0	10.0	8.2	7.0	6.0
5.0	8.2	6.8	5.7	5.0
4.0	6.7	5.5	4.7	4.0
3.0	4.9	4.1	3.5	3.0
2.0	3.3	2.7	2.3	2.0
1.0	1.6	1.3	1.2	1.0

Tube No.
177SA

WATER VAPOUR



1. PERFORMANCE

1) Measuring range : 1.7-33.8 mg/ℓ
Number of pump strokes 1(100mℓ)
From 10 % RH(20 ℃ = 68 ° F) to 100 % RH(32 ℃ = 90 ° F)
〔40 % RH (40 ℃ = 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 ℃
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 perchlomate, PH indicator is discoloured.

$H_2O + Mg(ClO_4)_2 \rightarrow Mg(ClO_4)_2H_2O$

4. CALIBRATION OF THE TUBE

VAPOR PRESSURE METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

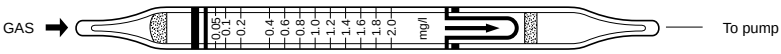
Substance	Interference	ppm	Coexistence
Methanol		0.3%	Unclear stain is produced.
Ethanol		0.3%	〃
Ethyl acetone		0.3%	〃
Acetone		0.5%	〃
Ammonia		0.2%	Purple and purplish red stains are produced and higher readings are given.
Nitrogen dioxide		0.2%	Unclear stain is produced.

TEMPERATURE CORRECTION TABLE

Scale Readings	True Concentration																		
	0℃ 32°F	5℃ 41°F	10℃ 50°F	12℃ 54°F	14℃ 57°F	16℃ 61°F	18℃ 64°F	20℃ 68°F	22℃ 72°F	24℃ 75°F	26℃ 79°F	28℃ 82°F	30℃ 86°F	32℃ 90°F	34℃ 93°F	36℃ 97°F	38℃ 100°F	40℃ 104°F
0	100 4.8	50 3.4	30 2.8	20 2.1	18 2.2	15 2.0	12 1.8	10 1.7	9 1.7	8 1.7	7.5 1.8	7 1.9	6.5 2.0	6 2.0	5.5 2.1	5 2.1	5 2.3	4 2.0
5		100 6.8	50 4.7	30 3.2	26 3.1	20 2.7	18 2.8	15 2.5	12 2.3	9 1.9	8 2.0	8 2.2	7.5 2.3	7 2.4	6.5 2.4	6 2.5	5.5 2.5	5 2.6
10			100 9.4	70 7.5	48 5.8	35 4.8	28 4.3	24 4.2	18 3.5	15 3.3	13 3.2	10 2.7	9 2.7	8.5 2.9	8 3.0	7.5 3.1	7 3.2	3.3
12				100 10.7	80 9.6	50 6.8	40 6.2	30 5.2	25 4.9	20 4.4	17 4.1	14 3.8	12 3.6	10 3.4	9.5 3.6	9 3.8	8 3.5	6 3.1
14					100 12.0	80 10.9	55 8.5	40 6.9	35 6.8	26 5.7	20 4.9	18 4.9	15 4.5	13 4.4	11 4.1	10 4.2	9 4.2	9 4.6
16						100 13.6	80 12.3	55 9.5	45 8.7	35 7.6	26 6.6	20 5.7	18 5.5	15 5.4	13 5.3	11 5.0	9 5.1	9 5.1
18							100 15.4	80 13.8	55 10.7	45 9.8	35 8.5	27 7.3	22 6.7	19 6.4	17 6.4	15 6.3	13 6.0	12 6.1
20								100 17.2	80 15.5	60 13.1	48 11.7	38 10.3	29 8.8	24 8.1	20 7.5	18 7.5	16 7.4	14 7.2
22									100 19.4	80 17.4	62 15.1	50 13.6	40 12.1	30 10.1	25 9.4	22 9.2	19 8.8	17 8.7
24										100 21.8	80 19.5	62 16.9	50 15.2	40 13.5	30 11.3	27 11.3	23 10.6	20 10.2
26											100 24.4	80 21.8	64 19.4	50 17.0	40 15.0	32 13.3	28 12.9	25 12.8
28												100 27.1	80 24.2	64 21.6	50 18.8	40 16.7	32 14.8	28 14.3
30													100 30.3	80 27.0	64 24.1	50 20.1	40 18.5	34 17.4
32														100 33.8	80 30.1	64 26.7	48 22.2	40 20.4

Tube No.
177U

WATER VAPOUR



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 ℃
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 or Yellowish green

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

By reacting with Magnesium perchlomate, PH indicator is discoloured.

$H_2O + Mg(ClO_4)_2 \rightarrow Mg(ClO_4)_2H_2O$

4. CALIBRATION OF THE TUBE

DIFFUSION TUBE METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	Coexistence
Alcohols FIG.1	Similar stain is produced.	Higher readings are given.
Paraffinic hydrocarbons	The accuracy of readings is not affected.	The accuracy of readings is not affected.

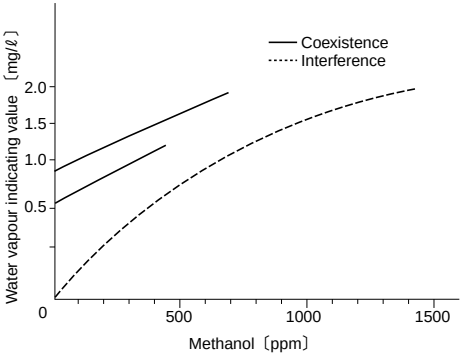


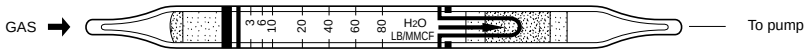
FIG.1 Influence of Methanol

TEMPERATURE CORRECTION TABLE

Scale Readings (mg/ℓ)	True 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	2.48	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	0.08	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	0.50	0.04

Tube No.
177UL

WATER VAPOUR



1. PERFORMANCE

1) Measuring range : 3-80 LB/MMCF
   Number of pump strokes 1(100mℓ)
2) Sampling time : 1 minute
3) Detectable limit : 2 LB/MMCF
4) Shelf life : 3 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 → Blue, Yellowish green (below 40 LB/MMCF)

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

$H_2O + Mg(ClO_4)_2 \rightarrow Mg(ClO_4) \cdot H_2O$

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.	
Toluene	〃	
Hexane	〃	
Sulphur oxide	〃	
Hydrogen sulphide	〃	

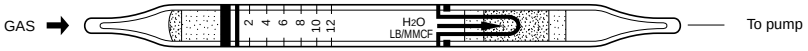
TEMPERATURE CORRECTION TABLE

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

Temperature (℃)	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Correction Factor	1.85	1.81	1.77	1.72	1.68	1.63	1.59	1.54	1.49	1.45
Temperature (℃)	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
Correction Factor	1.40	1.36	1.31	1.27	1.23	1.19	1.15	1.11	1.07	1.03
Temperature (℃)	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**
Correction Factor	1.00	0.96	0.93	0.90	0.87	0.84	0.81	0.78	0.76	0.73
Temperature (℃)	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**
Correction Factor	0.71	0.68	0.66	0.64	0.62	0.60	0.58	0.56	0.55	0.53
Temperature (℃)	**40**									
Correction Factor	0.51									

Tube No.
177UR

WATER VAPOUR



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 ℃
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

$H_2O + Mg(ClO_4)_2 \rightarrow Mg(ClO_4) \cdot H_2O$

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.	
Toluene	〃	
Hexane	〃	
Sulphur oxide	〃	
Hydrogen sulphide	〃	

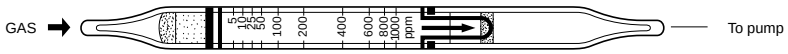
TEMPERATURE CORRECTION TABLE

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

Temperature (℃)	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 (℃)	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 (℃)	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 (℃)	30	31	32	33	34	35				
Correction Factor	0.75	0.73	0.71	0.69	0.67	0.65				

Tube No.
143SA

XYLENE



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 ℃
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.

$$C_6H_4(CH_3)_2 + I_2O_5 + H_2SO_4 \rightarrow I_2$$

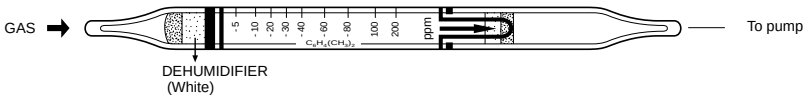
4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

Substance	Interference	ppm	Coexistence
Benzene	Similar stain is produced.	5	Higher readings are given.
Toluene	〃	5	〃
Methyl alcohol	The accuracy of readings is not affected.	1%	〃
Hexane	Pale brown stain is produced.	0.1%	The top of discoloured layer becomes unclear and higher readings are given.

Tube No.
143SB XYLENE



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℃
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.

$C_6H_4(CH_3)_2 + I_2O_5 + H_2SO_4 \rightarrow I_2$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

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.	
Methyl isobutyl ketone		〃	
Isobutyl alcohol		〃	

TEMPERATURE CORRECTION TABLE

Tube Readings (ppm)	Corrected Concentration (ppm)		
	20℃ (68°F)	30℃ (86°F)	40℃ (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

3.2A 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℃（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)	
Acetic anhydride	$(CH_3CO)_2O$	1-15 ppm	216S	(24)
Acrylic acid	$CH_2=CHCOOH$	1-50 ppm	216S	(24)
Allyl chloride	CH_2CHCH_2Cl	1-40 ppm	132SC	(265)
Benzyl chloride	$C_6H_5CH_2Cl$	1-16 ppm	132SC	(265)
Bromochloromethane	CH_2BrCl	5-400 ppm	157SB	(185)
Bromoform	$CHBr_3$	0.5-20 ppm	157SB	(185)
n-Butyl amine	$C_4H_9NH_2$	1-20 ppm	105SD	(39)
Butyl ether	$(CH_3CH_2CH_2CH_2)_2O$	10-1,200 ppm	111U	(111)
Butyl methacrylate	$CH_2=C(CH_3)CO_2C_4H_9$	20-1,000 ppm	111U	(111)
tert-Butyl methyl ether	$CH_3OC(CH_3)_3$	25-500 ppm	111U	(111)
Butyric acid	$CH_3CH_2CH_2COOH$	3-60 ppm	216S	(24)
m-Chlorotoluene	$C_6H_4Cl(CH_3)$	1-10 ppm	132SC	(265)
o-Chlorotoluene	$ClC_6H_4CH_3$	3-80 ppm	132SC	(265)
p-Chlorotoluene	$ClC_6H_4CH_3$	2-60 ppm	132SC	(265)
Crotonaldehyde	$CH_3CH=CHCHO$	2-40 ppm	190U	(116)
Cumene	$C_6H_5CH(CH_3)_2$	20-140 ppm	111U	(111)
Cyclohexene	C_6H_{10}	20-300 ppm	111U	(111)
Cyclohexyl amine	$C_6H_{11}NH_2$	1-20 ppm	105SD	(39)
Decahydronaphthalene	$C_{10}H_{18}$	20-200 ppm	111U	(111)
n-Decane	$CH_3(CH_2)_8CH_3$	5-90 ppm	111U	(111)
Di-n-Butyl amine	$(C_4H_9)_2NH$	2-20 ppm	105SD	(39)
Di-n-Propyl amine	$[CH_3(CH_2)_2]_2NH$	1-14 ppm	105SD	(39)
Diispropyl amine	$[(CH_3)_2CH]_2NH$	1-16 ppm	105SD	(39)
N,N-Dimethyl amine	$C_6H_5N(CH_3)_2$	0.5-9 ppm	105SD	(39)
1,1-Dichloroethylene	$CH_2=CCl_2$	1-22 ppm	132SC	(265)
1,2-Dichloropropane	$CH_3CHClCH_2Cl$	20-250 ppm	157SB	(185)
1,3-Dichloropropane	$CHCl=CHCH_2Cl$	1-10 ppm	132SC	(265)
Dicyclopentadiene	$C_{10}H_{12}$	2-60 ppm	190U	(116)
Diethyl benzene	$C_6H_4(C_2H_5)_2$	10-180 ppm	111U	(111)
Diisobutyl ketone	$[(CH_3)_2CHCH_2]_2CO$	20-1,000 ppm	139U	(193)
Disilane	Si_2H_6	1-50 ppm	240S	(237)
Ethyl bromide	C_2H_5Br	5-400 ppm	157SB	(185)
Ethyl methacrylate	$CH_2=C(CH_3)CO_2C_2H_5$	20-500 ppm	111U	(111)
Hydrogen selenide	H_2Se	0.5-20 ppm	242S	(93)
Isobutylene	$(CH_3)_2C=CH_2$	0.03-2.0%	113SB	(141)
Isobutyric acid	$CH_3CH_2CH_2COOH$	3-50 ppm	216S	(24)
Isophorone	$C_9H_{14}O$	5-80 ppm	197U	(91)
Isopropyl amine	$(CH_3)_2CHNH_2$	1-12 ppm	222S	(260)
Isopropyl cellosolve	$(CH_3)_2HCO(CH_2)_2COH$	5-350 ppm	190U	(116)
Isopropyl ether	$[(CH_3)_2CH]_2O$	30-800 ppm	111U	(111)
Isovaleric acid	$(CH_3)_2CHCH_2COOH$	3-50 ppm	216S	(24)
Maleic anhydride	$C_4H_2O_3$	0.2-10 ppm	216S	(24)
Methacrylic acid	$CH_2=C(CH_3)COOH$	1-50 ppm	216S	(24)
n-Methyl aniline	$C_6H_5NHCH_3$	0.5-6 ppm	105SD	(39)
Methyl butyl ketone	$CH_3(CH_2)_3COCH_3$	5-80 ppm	237S	(262)
Methyl cyclohexane	$C_6H_{11}(CH_3)$	100-1,600 ppm	113SB	(141)
Methyl isothiocyanate	C_2H_3NS	10-200 ppm	111U	(111)
Mineral turpentine	—	4-200 ppm	111U	(111)
Morpholine	C_4H_9NO	2-22 ppm	105SD	(39)
n-Nonane	$CH_3(CH_2)_7CH_3$	5-160 ppm	111U	(111)
Pentyl amine	$CH_3(CH_2)_3CH_2NH_2$	2-22 ppm	105SD	(39)
α-Pinene	$C_{10}H_{16}$	20-300 ppm	158S	(238)

SUBSTANCE	CHEMICAL FORMULA	MEASURING RANGE	USING TUBE (PAGE)	
1-Propanol	$CH_3CH_2CH_2OH$	20-300 ppm	190U	(116)
Propionic acid	CH_3CH_2COOH	3-50 ppm	216S	(24)
Propyl amine	$CH_3CH_2CH_2NH_2$	1-20 ppm	105SD	(39)
Propylene oxide	CH_3CHCH_2O	3-70 ppm	122SC	(125)
Pyridine	C_5H_5N	0.2-5 ppm	219S	(143)
Tetrahydrothiophen	C_4H_8S	4-100 ppm	190U	(116)
o-Toluidine	$C_6H_4(CH_3)(NH_2)$	2-22 ppm	105SD	(39)
p-Toluidine	$C_6H_4(CH_3)(NH_2)$	2-20 ppm	105SD	(39)
Trichlorotoluene	$C_6H_5CCl_3$	0.2-4 ppm	132SC	(265)
2,2,4-Trimethyl pentane	$(CH_3)_3CCH_2CH(CH_3)_2$	100-4,000 ppm	113SB	(141)
n-Valerianic acid	$CH_3(CH_2)_3CO_2H$	3-70 ppm	216S	(24)
* Benzaldehyde	C_6H_5CHO	5-70 ppm	190U	(116)
* 1,1,2,2-Tetrachloroethane	$CHCl_2CHCl_2$	20-60 ppm	236S	(255)
* Propylene glycol	$CH_3CH(OH)CH_2OH$	20-300 ppm	122SC	(125)

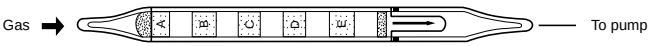
* N.B.)

Upon these three 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

Tube No.
131

INORGANIC GAS QUALITATIVE DETECTOR TUBE



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 * Metyl mercaptan (*: Organic gas)
2) Tube per box : 10tubes (10-time use)
3) Pump stroke : 1 (100mℓ)
4) Sampling time : 20 seconds
5) Shelf life : 1 year
6) Operating temperature : 0 ~ 40 ℃
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. $2NH_3 + H_3PO_4 \rightarrow (NH_4)_2HPO_4$
B	By reacting with an Alkaline, PH indicator is discoloured. $SO_2 + 2NaOH \rightarrow Na_2SO_3 + H_2O$
C	By reacting with o-Toluidine, Nitro-*o*-Toluidine (Dyestuff) is liberated.
D	By reacting with Lead Acetate (II), Lead sulphide is produced. $H_2S + Pd(CH_3COO)_2 \rightarrow PdS + 2CH_3COOH$
E	Potasium disulphide palladate (II) is reduced and Palladium is liberated. $CO + K_2Pd(SO_3)_2 \rightarrow K_2(SO_3)_2PdCO$ $K_2(SO_3)_2PdCO \rightarrow CO_2 + SO_2 + K_2SO_3$

3. DISCOLOURATION / QUALITATIVE CHART

CHART 1. INORGANIC GAS QUALITATIVE 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_2（10） 4) Acetic Acid（15）
	Pink	——	——	——	5)Hydrogen chloride（20）
	White	Yellowish orange	——	——	6) Chlorine（5）
	——	Yellow	——	——	7) Nitrogen dioxide（5）
		——	Brown	——	8) H_2S（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） Sybstance No.4）,11）and 12）are organic substances.

CHART 2. CHART FOR GAS-CONCENTRATION LEVEL AND DISCOLOURATION

INORGANIC SUBSTANCES	GAS CONCEN TRATION (PPM)	SECTION				
		A (Pale purple)	B (Reddish purple)	C (White)	D (White)	E (Yellow)
1) Ammonia	50	Yellow (I)	——	——	——	——
	5	Yellow (III)	——	——	——	——
2) Amines	50	Yellow (I)	——	——	——	——
	5	Yellow (III)	——	——	——	——
3) Sulphur dioxide (SO_2)	50	——	Yellow (I)	——	——	——
	10	——	Yellow (III)	——	——	——
4) Acetic Acid	30	——	Yellow (II)	——	——	——
	15	——	Yellow (III)	——	——	——
5) Hydrogen chloride	50	——	Pink (II)	——	——	——
	20	——	Pink (III)	——	——	——
6) Chlorine	20	——	White (I)	Yellowish orange (I)	——	——
	5	——	White & Pale purple (II)	——	——	——
7) Nitrogen dioxide	20	——	——	Yellow (I)	——	——
	5	——	——	Yellow (I)	——	——
8) Hydrogen sulphide (H_2S)	100	——	——	——	Brown (II)	Brown (II)
	10	——	——	——	Brown (II)	——
9) Carbon monoxide (CO)	50	——	——	——	——	Blackish brown (I)
	10	——	——	——	——	Pale blackish brown (I)
10) Phosphine	30	——	——	——	——	Black (II)
	2	——	——	——	——	Pale black (III)
11) Acetylene	50	——	——	——	——	Yellowish green (I)
	10	——	——	——	——	Pale yellowish green (I)
12) Methyl mercaptan	100	——	——	——	——	Pale yellow (I)
	10	——	——	——	——	Dark yellow (II)

NOTES : —

1) ——: Undiscoloured

2) Discolouration level : I ; The whole layer is discoloured. II ; A half layer is discoloured. III ; Approx. 0.5-1.0mm of the layer is discoloured.

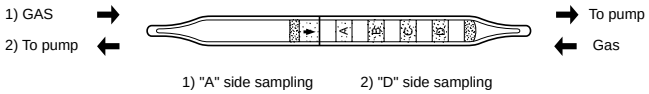
3) Sybstance No.4) ,11) and 12) are organic substances.

NON-DISCOLOURATION CONFIRMED SUBSTANCES

1) Hydrogen cyanide (HCN) 2) Carbon dioxide (CO_2) 3) Ethylene (Organic substance) 4) Nitric oxide (NO)

Tube No.
186B

ORGANIC GAS QUALITATIVE DETECTOR TUBE



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 isobutylketone, 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 : 10tubes (5-time use)
3) Pump stroke : 1 (100mℓ) + 1 (100mℓ)
4) Sampling time : 30 + 30 seconds
5) Shelf life : 1 year
6) Operating temperature : 0 ~ 40 ℃
7) Colour change : Refer to following "3. DISCOLOURATION / QUALITATUVE 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. $CH_3(CH_2)_4CH_3 + Cr^6 + H_2SO_4 \rightarrow Cr^{3+}$
B	Molybdate is reduced and Molybdeum blue is produced. $H_2C = CH_2 + PdSO_4 + (NH_4)_2MoM_4 \rightarrow Mo_3O_8$
C	Iodine pent-oxide is reduced. $C_2H_5CH_3 + I_2O_5 + H_2SO_4 \rightarrow I_2$
D	Phenol is oxidized and the polymer is produced. $C_6H_5OH + Ce^{4+} \rightarrow C_6H_5O \cdot \rightarrow (C_6H_5O)n$

3. DISCOLOURATION / QUALITATIVE CHART

CHART 1. ORGANIC GAS QUALITATIVE QUALITATIVE DETECTION CHART

“A” side sampling	“D” side sampling				* 1) Substances
Selection	Selection				ー＊2（X）ー ー＊3（X/Y）ー
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) Ethylene 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	“D” side sampling				*1) Substances
Selection	Selection				—*2（X）—
A（Orange）	A（Orange）	B（White）	C（Yellow）	D（Yellow）	—*3（X/Y）—
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	SECTION			
		A (Orange)	A (Orange)	B (White)	C (Yellow)	D (Yellow)
1) Propane	H	Dark brown (I)	Dark brown (I)	——	——	——
	M	Dark brown (I)	Dark brown (I)	——	——	——
	L	——	——	——	——	——
2) Butane	H	Dark brown (I)	Dark brown (I)	——	——	——
	M	Dark brown (I)	Dark brown (I)	——	——	——
	L	Dark brown (III)	Dark brown (III)	——	——	——
3) Pentane	H	Greenish brown (I)	Greenish brown (I)	——	——	——
	M	Dark brown (I)	Dark brown (I)	——	——	——
	L	Dark brown (III)	Dark brown (III)	——	——	——
4) Hexane	H	Greenish brown (I)	Greenish brown (I)	——	——	——
	M	Dark brown (II)	Dark brown (II)	——	——	——
	L	Dark brown (III)	Dark brown (III)	——	——	——
5) Trichloroethylene	H	Dark brown (I)	Dark brown (I)	——	——	——
	M	Dark brown (II)	Dark brown (II)	——	——	——
	L	Dark brown (III)	Dark brown (III)	——	——	——
6) Tetrachloroethylene	H	Dark brown (I)	Dark brown (I)	——	——	——
	M	Dark brown (III)	Dark brown (III)	——	——	——
	L	——	——	——	——	——
7) Vinyl chloride	H	Dark brown (I)	Dark brown (I)	——	——	——
	M	Dark brown (II)	Dark brown (II)	——	——	——
	L	Dark brown (III)	Dark brown (III)	——	——	——
8) Butadiene	H	Dark brown (II)	Dark brown (II)	Yellow orange (I)	Brown (I)	——
	M	Dark brown (III)	Dark brown (III)	——	White (II)	
	L	——	——	——	——	——
9) Gasoline	H	Dark brown (I)	Greenish brown (II)	Brown (I)	Pale blue (I)	——
	M	Dark brown (III)	Greenish brown (III)	Brown (I)	Pale blue (I)	——
	L	Dark brown (III)	Greenish brown (III)		Pale blue (II)	
10) Benzene	H	Dark brown (I)	Dark brown (III)	Pale brown (I)	——	——
	M	Dark brown (II)	——	Pale brown (I)	——	——
	L	Dark brown (III)	——	——	——	——
11) Toluene	H	Dark brown (I)	Dark brown (III)	Brown (I)	——	——
	M	Dark brown (III)	——	Pale brown (I)	——	——
	L	Dark brown (III)	——	——	——	——

ORGANIC SUBSTANCES	CONC. LEVEL	"A" side sampling	"D" side sampling			
		SECTION	SECTION			
		A (Orange)	A (Orange)	B (White)	C (Yellow)	D (Yellow)
12) Xylene	H	Dark brown (II)	——	Pale brown (II)	——	——
	M	Dark brown (III)	——	——	——	——
	L	——	——	——	——	——
13) Ethyl benzene	H	Dark brown (II)	——	Brown (I)	——	——
	M	Dark brown (III)	——	Pale brown (II)	——	——
	L	——	——	——	——	——
14) Ethylene	H	Dark brown (I)	Dark brown (I)	——	Deep blue (II)	——
	M	Dark brown (I)	Dark brown (II)	——	Deep blue (II)	——
	L	Dark brown (III)	——	——	Pale blue (II)	——
15) Acetylene	H	Dark brown (I) Section"C"is also discoloured to Brown(III).	Dark brown (I)	——	Deep blue (II)	——
	M	——	——	——	Pale blue (II)	——
	L	——	——	——	——	——
16) Styrene	H	Dark brown (III)	——	Dark brown (III)	Yellowish orange (I)	——
	M	Dark brown (III)	——	——	Yellowish orange (I)	——
	L		——	——	——	——
17) Acetone	H	Dark brown (III)	——	——	——	——
	M		——	——	——	——
18) Methyl ethyl ketone	H	Dark brown (III)	——	——	——	——
	M	Dark brown (III)	——	——	——	——
	L	——	——	——	——	——
19) Ethyl acetate	H	Dark brown (III)	——	——	——	——
	M	——	——	——	——	——
20) Butyl acetate	H	Dark brown (III)	——	——	——	——
	M	Dark brown (III)	——	——	——	——
	L	——	——	——	——	——
21) Ethylene oxide	H	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	——	——	——	——	——
26) Methyl mercaptan	M	Greenish brown (III)	——	——	Deep blue (II)	——
	L	——	——	——	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	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_2S)	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	——	——	——	——	Pale blue (III)
	L	——	——	——	——	——

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.

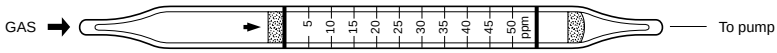
NON-DISCOLOURATION CONFIRMED SUBSTANCES

1) Carbon tetrachloride 2) Pyridine 3) Methyl bromide
4) Acetic acid 5) Methane 6) Ethane

3.4 KITAGAWA TIME-WEIGHTED AVERAGE DETECTOR TUBES

Tube No.
501

TWA-AMMONIA



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 : 1 year
4) Operating temperature : 10 ~ 30℃
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.

$2NH_3 + H_3PO_4 \rightarrow (NH_4)_2HPO_4$

4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

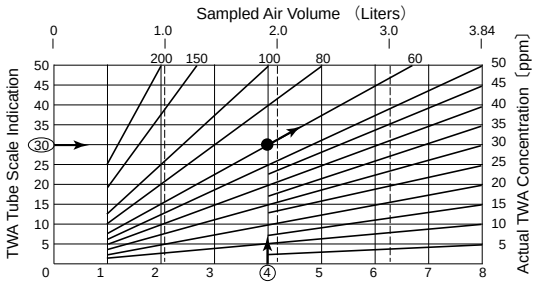
Substance	Interference	ppm	Coexistence
Sulphur dioxide		20	Lower readings are given.

(NOTE)

1) Model PM-2 personal sampler(option)ia available 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.)]

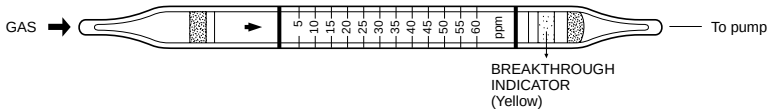


SCALE CONVERSION CHART

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 concentrationis 9.6 ppm.

Tube No.
500

TWA-CARBON MONOXIDE



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 : 0 ~ 40 ℃
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 pent-oxide 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

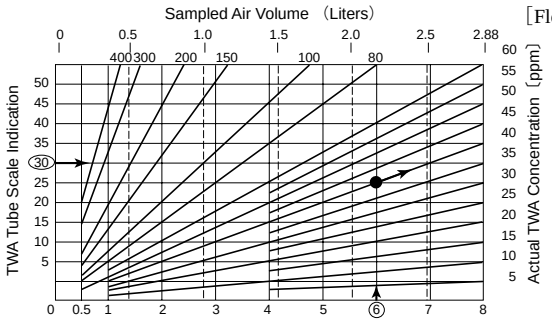
Substance	Interference	ppm	Coexistence
Butane		50	Higher readings are given.
Hexane		50	〃

(NOTE)

1) Model PM-2 personal sampler (option) ia available 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.)]

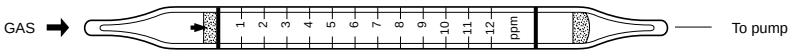


SCALE CONVERSION CHART

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 concentrationis 19.2 ppm.

Tube No.
502

TWA-HYDROGEN SULPHIDE



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℃
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.

$H_2S + Pb(CH_3CO_2)_2 \rightarrow PbS + 2CH_3CO_2H$

4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

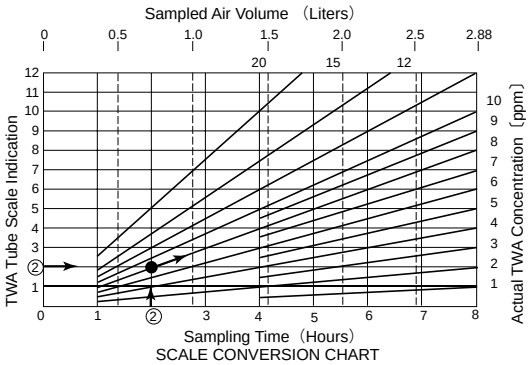
Substance	Interference	ppm	Coexistence
Sulphur dioxide		10	Higher readings are given.

(NOTE)

1) Model PM-2 personal sampler(option)ia available 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.)]

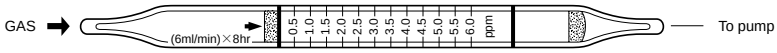


SCALE CONVERSION CHART

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 concentrationis 7 ppm.

Tube No.
503

TWA-SULPHUR DIOXIDE



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 ℃
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.

$SO_2 + 2NaOH \rightarrow Na_2SO_3 + H_2O$

4. CALIBRATION OF THE TUBE

PERMEATION TUBE METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

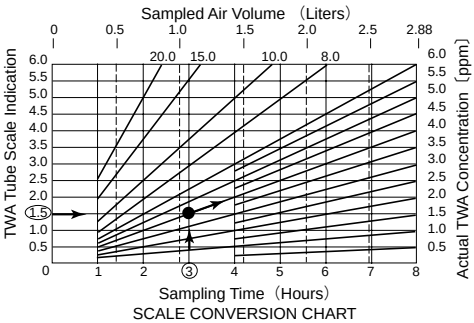
Substance	Interference	ppm	Coexistence
Carbon dioxide		1,000	Higher readings are given.
Nitrogen dioxide	Original colour is faded.		

(NOTE)

1) Model PM-2 personal sampler(option)ia available 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.

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

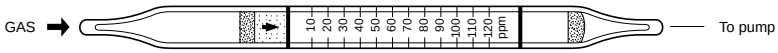
Example :
(a) If sampling time is 3 hours and corrected value by Table 1 is 1.5, the actual TWA concentration is 4.0 ppm.
(b) If sampled air volume is 2.0ℓ and corrected value by Table 1 is 3.5, the actual TWA concentration is 5.0 ppm

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

Tube No.
504

TWA-TOLUENE



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 ℃
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.

$C_6H_5CH_3 + I_2O_5 + H_2SO_4 \rightarrow I_2$

4. CALIBRATION OF THE TUBE

GAS CHROMATOGRAPHY

5. INTERFERENCE AND CROSS SENSITIVITY

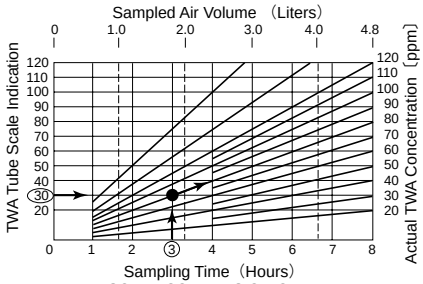
Substance	Interference	ppm	Coexistence
Acetone	Similar stain is produced		Higher readings are given.
Xylene	〃		〃
Benzene	〃		〃
Methyl ethyl ketone	〃		〃
Hexane	Whole regent is discoloured to Brown.	50	Whole reagent is discoloured and readings are not be obtained.

(NOTE)

1) Model PM-2 personal sampler (option) ia available 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.

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.)]



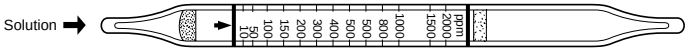
SCALE CONVERSION CHART

Example :
(a) If sampling time is 5 hours and scale reading is 50, the actual TWAconcentration 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

Tube No.
201SA

CHLORIDE ION



1. PERFORMANCE

1) Sampling method : Immersion method (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 : 5 ppm
6) Shelf life : 3 years
7) Operating temperature : 5 ~ 80 ℃
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.

$CI^- + Ag_2CrO_4 \rightarrow AgCI$

4. CALIBRATION OF THE TUBE

SODIUM CHLORIDE STANDARD SOLUTION METHOD

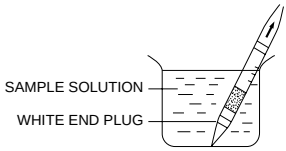
5. INTERFERENCE AND CROSS SENSITIVITY

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

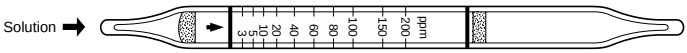
(Immersion method)

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.



Tube No.
201SB

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 ℃
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.

$CI^- + Ag_2CrO_4 \rightarrow AgCI$

4. CALIBRATION OF THE TUBE

SODIUM CHLORIDE STANDARD SOLUTION METHOD

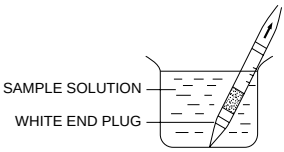
5. INTERFERENCE AND CROSS SENSITIVITY

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

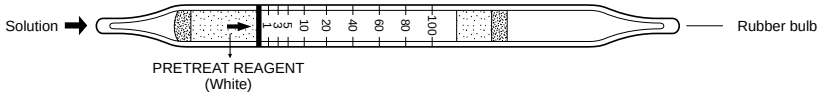
(Immersion method)

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.



Tube No.
203S

COPPER ION



1. PERFORMANCE

1) Sampling method : Direct sampling method (Refer to Page 17)
2) Measuring range : 1-100mg/ℓ
3) Sampling time : 1 minute
4) Sample volume : over 5 mℓ
5) Detectable limit : 0.5mg/ℓ
6) Shelf life : 1 year
7) Operating temperature : 0 ~ 40 ℃
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-Dipheny l-1, 10-phenanthroline and Chelate is produced.

$Cu^{2+} + NH_2OH + H_2SO_4 \rightarrow Cu^{+}$

$Cu^{+} + C_{12}H_4N_2(CH_3)_2(C_6H_5)_2 \rightarrow$ Orange Chelate compound

4. CALIBRATION OF THE TUBE

CUPRIC SULPHATE STANDARD SOLUTION METHOD

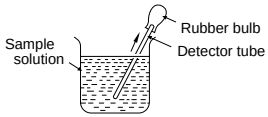
5. INTERFERENCE AND CROSS SENSITIVITY

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)

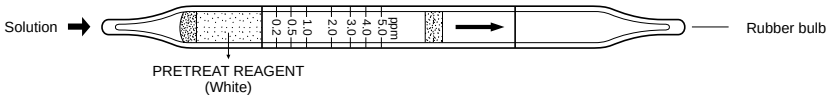
6. SAMPLING METHOD

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 thesample 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.



Tube No.
204S

CYANIDE ION



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 ℃
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

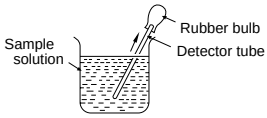
POTASSIUM CYANIDE STANDARD SOLUTION METHOD

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			〃

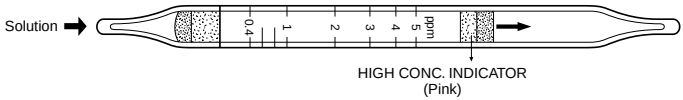
6. SAMPLING METHOD

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 thesample 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.



Tube No.
234SA

FREE RESIDUAL CHLORINE



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 ℃
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.

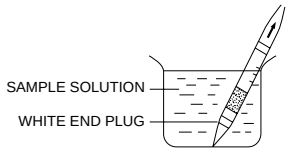
(NOTE)

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

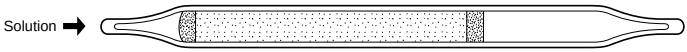
(Immersion method)

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.



Tube No.
202

IRON ION



1. PERFORMANCE

1) Sampling method	: Injection method (Refer to Page 17)
2) Measuring range	: 50-400 ppm
3) Sampling time	: 250 seconds (1.0mℓ/250 sec. By injection)
4) Sample volume	: 1.0 mℓ
5) Detectable limit	: 10 ppm
6) Shelf life	: 1 year
7) Operating temperature	: 5 ~ 30 ℃
8) Operating PH	: 2-3
9) Reading	: Concentration chart method
10) Colour change	: Pale yellow → Brown

2. RELATIVE STANDARD DEVIATION

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

3. CHEMICAL REACTION

By reacting with Kperone, Chelate compound is produced.

4. CALIBRATION OF THE TUBE

IRON CHLORIDE (II) STANDARD SOLUTION METHOD

5. INTERFERENCE AND CROSS SENSITIVITY

Substancxe	Interference	μg/mℓ	Coexistence
Copper ion		10	Higher readings are given.
Aluminium ion		10	〃
Cobalt ion		10	〃
Mercuric ion		100	〃

6. SAMPLING METHOD

(Injection method)

A glass syringe of 1mℓ capacity (an extra option) is required for measurement by this method.(Refer to FIG.1)

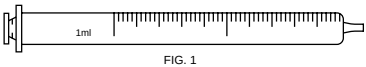


FIG. 1

1) Make the sample solution at pH 2-3 with Nitric acid before test.
2) Cut both ends of a fresh detector tube with a file.
3) Take 1mℓ sample solution into the syringe.
4) Connect the detector tube to the syringe by using the rubber connecting tube as shown in FIG.2.
5) Inject the sample solution into the detector tube at constant speed, so that the 1.0mℓ sample solution will go through the tube at exactly 250sec. If Iron ion is exised 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 Iron ion.

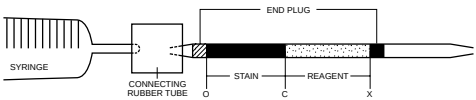
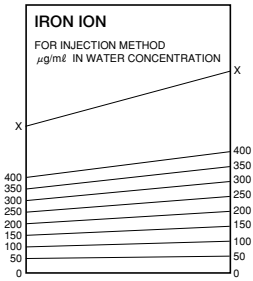
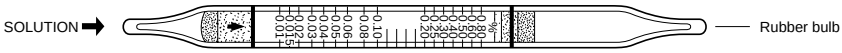


FIG. 2



Tube No.
205SL

SALINITY



1. PERFORMANCE

1) Sampling method : Direct sampling method (Refer to Page 17)
2) Measuring range : 0.01-0.8 %
3) Sampling time : 30 sec.
4) Sample volume : Over 5 mℓ
5) Detectable limit : 0.002 %
6) Shelf life : 2 years
7) Operating temperature : 5 ~ 80 ℃
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.

$CI^- + Ag_2CrO_4 \rightarrow AgCI$

4. CALIBRATION OF THE TUBE

SODIUM CHLORIDE STANDARD SOLUTION METHOD

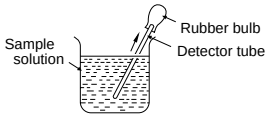
5. INTERFERENCE AND CROSS SENSITIVITY

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

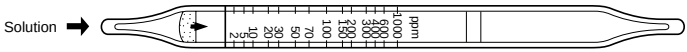
(Direct sampling method)

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.



Tube No.
200SA

SULPHIDE ION



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.

$S_2 + Pb(NO_3)_2 \rightarrow PbS$

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		1.5 %	The accuracy of readings is not affected.
Iron ion		0.2 %	〃
Chloride ion FIG.1		2.5 %	〃
Carbonic ion		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.

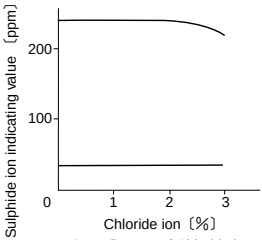
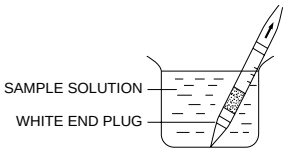
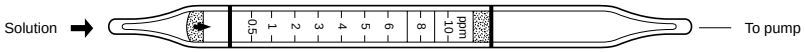


FIG.1 Influence of Chloride ion



Tube No.
200SB

SULPHIDE ION



1. PERFORMANCE

1) Sampling method : Immersion method
(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 ℃
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.

$S^{2-} + (CH_3CO_2)_2Pb \rightarrow PbS$

4. CALIBRATION OF THE TUBE

SODIUM SULPHIDE STANDARD SOLUTION METHOD

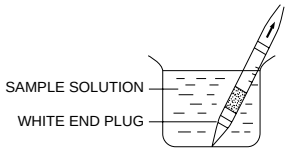
5. INTERFERENCE AND CROSS SENSITIVITY

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 Femail 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.**

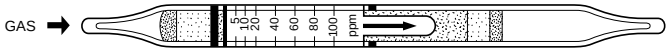
Optional Accessiry for 604SP only

① **50ml plastic syringe**

② **1m vinyl tube**

Tube No.
600SP

COMPRESSED BREATHING AIR TEST TUBE FOR
CARBON MONOXIDE



1. PERFORMANCE

1) Measuring range : 5-100 ppm
2) Detectable limit : 3 ppm
3) Shelf life : 2 years
4) Operating temperature : 0 ~ 40 ℃
5) Reading : Direct reading from the scale printed on the tube
6) 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.

$CO + K_2Pd(SO_3)_2 \rightarrow Pd$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

5. PRESET / MEASUREMENT CONDITIONS

PRESET CONDITION

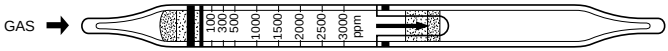
1) 2nd pressure : 0.6 kg/cm^2 (60 Kpa)
2) Flow rate : 2.0 ℓ/min.

MEASUREMENT CONDITION

Sampling time : 2.0 minutes

Tube No.
601SP

COMPRESSED BREATHING AIR TEST TUBE FOR
CARBON DIOXIDE



1. PERFORMANCE

1) Measuring range : 100-3,000 ppm
2) Detectable limit : 20 ppm
3) Shelf life : 2 years
4) Operating temperature : 0 ～ 40 ℃
5) Reading : Direct reading from the scale printed on the tube
6) 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.

$CO_2 + NaOH \rightarrow Na_2CO_3$

4. CALIBRATION OF THE TUBE

STANDARD GAS CYLINDER METHOD

5. PRESET / MEASUREMENT CONDITIONS

PRESET CONDITION

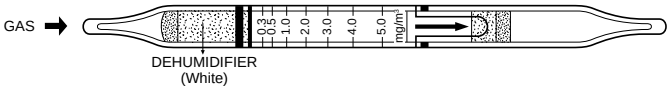
1) 2nd pressure : 1.0 kg/cm^2 (100 Kpa)
2) Flow rate : 2.0 ℓ/min.

MEASUREMENT CONDITION

Sampling time : 2.0 minutes

Tube No.
602SP

COMPRESSED BREATHING AIR TEST TUBE FOR OIL MIST



1. PERFORMANCE

1) Measuring range : 0.3-5 mg/m^3
2) Detectable limit : 0.1 mg/m^3
3) Shelf life : 2 years
4) Operating temperature : 0 ~ 40 ℃
5) Reading : Direct reading from the scale printed on the tube
6) 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.

$$\text{Oil} + Cr^{6+} + H_2SO_4 \rightarrow Cr^{3+}$$

4. CALIBRATION OF THE TUBE

INFRARED SPECTOPHOTOMETRY

5. PRESET / MEASUREMENT CONDITIONS

PRESET CONDITION

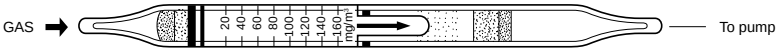
1) 2nd pressure : 1.0 kg/cm^2 (100Kpa)
2) Flow rate : 3.0 ℓ/min.

MEASUREMENT CONDITION

Sampling time : 25.0 minutes

Tube No.
603SPA

COMPRESSED BREATHING AIR TEST TUBE FOR WATER VAPOUR



1. PERFORMANCE

1) Measuring range : 20-160 mg/m^3
2) Detectable limit : 15 mg/m^3
3) Shelf life : 2 years
4) Operating temperature : 0 ~ 40 ℃
5) Reading : Direct reading from the scale printed on the tube
6) 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.

$H_2O + Mg(ClO_4)_2 \rightarrow Mg(ClO_4)_2 + H_2O$

4. CALIBRATION OF THE TUBE

DEW-POINT METER

5. PRESET / MEASUREMENT CONDITIONS

PRESET CONDITION

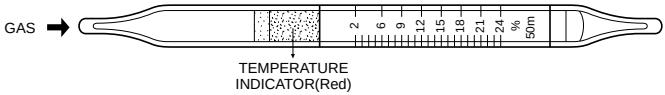
1) 2nd pressure : 1.0 kg/cm^2 (100 Kpa)
2) Flow rate : 2.0 ℓ/min.

MEASUREMENT CONDITION

Sampling time : 1.0 minutes

Tube No.
604SP

COMPRESSED BREATHING AIR TEST TUBE FOR OXYGEN



1. PERFORMANCE

1) Measuring range : 2-24 %
2) Shelf life : 2 years
3) Operating temperature : 0 ～ 40 ℃
4) Temperature compensation : (Necessary (0 ～ 10/30 ～ 40 ℃) (Refer to"SPECIAL NOTE")
5) Reading : Direct reading from the scale printed on the tube
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. PRESET / MEASUREMENT CONDITIONS

PRESET CONDITION

1) 2nd pressure : 0.6 kg/cm^2 (60 Kpa)
2) Flow rate : 2.0 ℓ/min.

MEASUREMENT CONDITION

1) Sampling amount : 50 mℓ

SPECIAL NOTE

1) TEMPERATURE COMPENSATION :
At 0 ℃ (32 ℃) to 10 ℃ (86 ℃), multiply the reading value by 1.05.
At 30 ℃ (86 ℃) to 40 ℃ (104 ℃), 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.

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^3 : 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℃ under a pressure of p mmHg is derived from the volume, Vo at 0℃ under 1 atmospheric pressure (760 mmHg) according to the following formula :

$$V = Vo \times \frac{273 + t}{273} \times \frac{760}{p}$$

For example, volume of gas, V at 20℃ under 1 atm. is 1.073V.

(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℃ 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 :

$$C = \frac{x}{M} \times \frac{22.4}{V} \times \frac{273 + t}{273} \times \frac{760}{p} \times 100$$

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℃ under 1 atm. is as follows :

$$0.1 = \frac{x}{92.14} \times \frac{22.4}{1} \times \frac{273 + 20}{273} \times \frac{760}{760} \times 100$$

Then, x = 0.00383〔g〕
= 3.83〔mg〕

(3) Conversion of concentration

The relationship in gaseous state of a substance (molecular weight = M) between ppm and mg/m^3 at t℃ under p mmHg is as follows :

$$ppm = mg/m^3 \times \frac{22.4}{M} \times \frac{273 + t}{273} \times \frac{760}{p}$$

$$mg/m^3 = ppm \times \frac{M}{22.4} \times \frac{273}{273 + t} \times \frac{760}{p}$$

(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 :

$$C = \frac{Pt}{760} \times 100$$

where Pt = standard vapour pressure of substance at t℃〔mmHg〕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 nomal 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, uniformaly 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 (μ)	EXAMPLES
Gas	Gas at 25℃ under I atm. (critical temperature or higher)	Gas	Molecules	Ammonia, Chlorine, Ozone, Carbon dioxide, Sulphur dioxide
Vapour	Solid (critical temperature or lower) or liquid at 25℃ 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 μ), Chromic acid , Sodium hydroxide , Cyanide , Hydrochloric acid, Fog (50 μ)
Fog	Finer particles than mist (5-50 μ particles condensed in air)			
Dust	Suspended fine particles of solid	Solid	1-150	Pigment (1-4 μ). Talc (10 μ), Coal dust (10 μ), Grain flour (15-20 μ), Cement mill dust (exhaust from kiln, 10 μ) , Dust in grain flour elevator (15 μ), P.C.P., Mica, Asbestos
Fume	Suspended fine particulate compound derived from gas in air		0.1-1	Zinc oxide (0.05 μ), Ammonium chloride (0.1 μ)
Smoke	Originally meaning of organic particles with a certain black colour	Mixed	0.01-1	Tobacco smoke (0. 25 μ)

(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^3 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 eftect.

(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.

$$C_1/T_1 + C_2/T_2 + C_3/T_3 \cdots + C_n/T_n$$

where C_1, C_2, $C_3 \cdots$ and C_n = concentration of each component and T_1, T_2, $T_3 \cdots$ 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

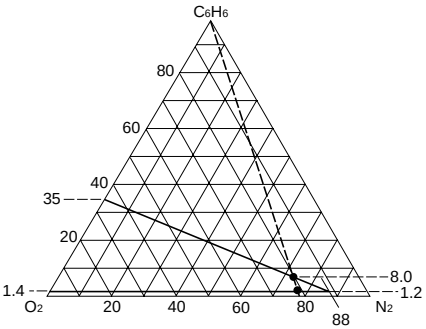


FIG. 4.1 EXPLOSION RANGE OF MIXED GASES（BENZENE, O_2,N_2）

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.

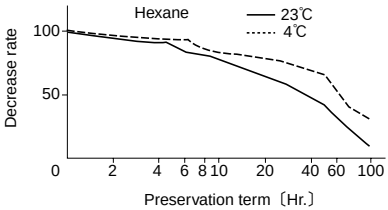


FIG.4.2 DECREASE IN A GLASS SYRINGE

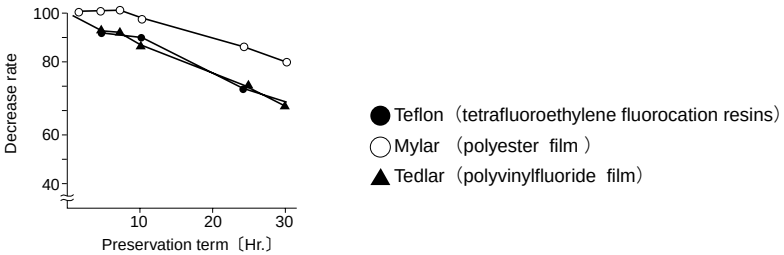


FIG.4.3 DECREASE IN A SAMPLING BAG

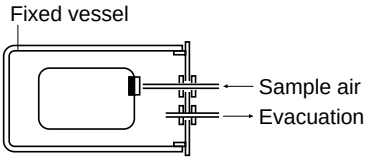


FIG 4.4 COLLECTION BY BAG

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

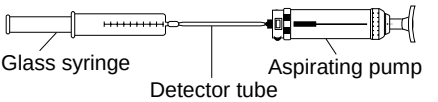


FIG.4.6 MEASUREMENT

(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

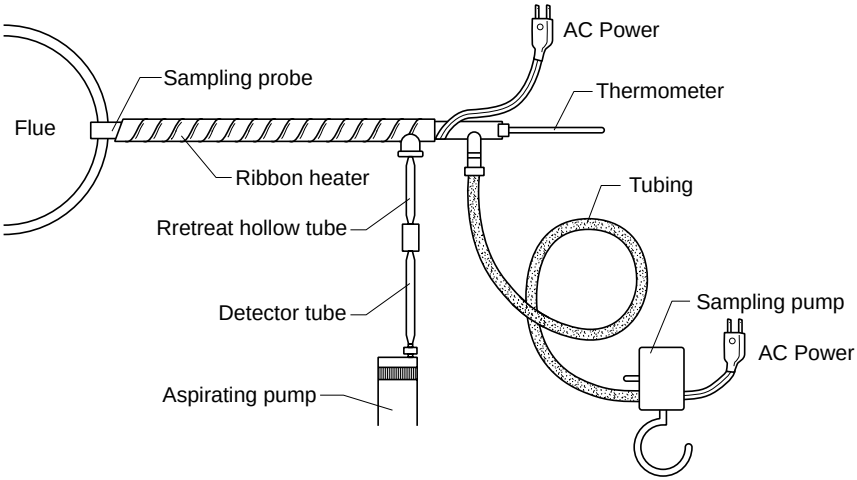


FIG.4.9 FLUE GAS MONITOR

TABLE 4.5 PAINTS AND MAIN SOLVENTS

PAINTS AND MATERIALS	MAIN SOLVENTS
①OIL PAINTS	
● Compounding paint	Mineral turpentine
● Corrosion-resistant paint	Xylene, Mineral Turpentine
● Ship-hull paint	Mineral turpentine, Solvent naphtha
● Others	Xylene, Mineral turpentine
②LACQUER	Toluene, Xylene, Methanol, Isopropanol, Butanol, Ethyl acetate, Butyl acetate, Methyl isobutyl ketone, Cellosolve
③SYNTHETIC RESIN PAINTS	
● Phenolic resins	Xylene, Mineral turpentine
● Alkyd resins	Xylene, Mineral turpentine
● Aminoalkyd resins	Toluene, Xylene, Methanol, Butanol, Butylacetate
● Vinyl resins	Toluene, Xylene, Ethanol, Isopropanol, Butanol,Ethyl acetate, Butyl acetate, Methyl isobutyl ketone, Cellosolve
● Epoxy resins	Toluene, Xylene, Isopropanol, Methyl isobutyl ketone, Cellosolve
● Urethane resins	Toluene, Ethyl acetate, Butyl acetate, Metyl ethyl ketone, Cellosolve
● Corrosion-Resist paint	Toluene, Xylene, Mineral turpentine
● Soluble resins	Isopropanol, Butanol, Cellosolve