

JIS

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JAPANESE INDUSTRIAL STANDARD

Hydrogen
H₂ M=2.0160

JIS K 0512-1974
(Reaffirmed: 1988)



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Hydrogen

K 0512-1974
(Reaffirmed: 1988) H_2 $M = 2.0160$ 1. Scope

This Japanese Industrial Standard specifies hydrogen filled in a portable container.

Remark: In this Standard the units and numerical values shown in { } are in accordance with SI and are appended for informative reference.

2. Classification

Hydrogen shall be classified into standard substance and industrial use. Further, the grades shall be of four grades of from Grade 1 to Grade 4.

Further, as standard substance, substances of Grade 1 to Grade 3 shall be used.

3. Refining Method

Grades 1 to 3 are substances manufactured by hydroelectrolytic method or the like and refined by low-temperature adsorption method, palladium diffusion method, etc., and Grade 4 is substance manufactured by hydroelectrolytic method or the like.

4. Quality

Hydrogen shall be tested according to 6. test method and, comply with Table 1.

Table 1

Classification		Industrial use			
		Standard substances			4
Grade		1	2	3	
Characteristics					
Purity (%)		99.9999 min.	99.999 min.	99.99 min.	99.9 min.
Moisture or dew point	Moisture	—	—	—	Not to be condensed
	Dew point (°C)	− 70 max.	− 60 max.	− 50 max.	—
Hydrocarbon	Condensate content	Not to be condensed	Not to be condensed	Not to be condensed	Not to be condensed
	Non-condensate content (other than condensate content as methane) (ppm)	0.3 max.	5.0 max.	10 max.	—
Oxygen (ppm)		0.3 max.	0.5 max.	4.0 max.	100 max.
Nitrogen (ppm)		0.2 max.	5.0 max.	25 max.	400 max.
Carbon dioxide (ppm)		0.1 max.	1.0 max.	10 max.	—
Carbon monoxide (ppm)		0.1 max.	1.0 max.	10 max.	—
Total sulphur compound (as SO ₂) (ppm)		0.00 max.	0.00 max.	2.0 max.	10 max.
Mercury vapour (ppm)		0.000 max.	0.000 max.	0.004 max.	—

Remarks 1. %, and ppm shall, all, be indicated by volumetric ratio.

2. The dew point shall be expressed by °C under the absolute pressure (760 mm Hg{101.32 kPa}). For conversion of ppm and mg/l of moisture amount to dew point temperature, Table 2 shall be used.

3. In total sulphur compound and mercury vapour, the specification of 0.00 and 0.000 are the numerical value where the next place of significant digits is rounded according to JIS Z 8401.

Applicable Standards: See page 20.

Table 2. Dew Point and Moisture Amount

°C	Upper stage %, lower stage mg/l									
	0	1	2	3	4	5	6	7	8	9
- 100	0.000001384 0.00001756									
- 90	0.000009547 0.0001144	0.000007945 0.00009577	0.000006599 0.00007999	0.000005470 0.00006668	0.000004525 0.00005346	0.000003734 0.00004603	0.000003076 0.00003814	0.000002528 0.00003151	0.000002074 0.00002600	0.000001696 0.00002140
- 80	0.00005401 0.0006140	0.00004578 0.0005232	0.00003874 0.0004450	0.00003273 0.0003780	0.00002760 0.0003203	0.00002322 0.0002711	0.00001951 0.0002289	0.00001636 0.0001930	0.00001370 0.0001625	0.00001145 0.0001365
- 70	0.0002581 0.002790	0.0002223 0.002415	0.0001911 0.002086	0.0001640 0.001800	0.0001406 0.001551	0.0001204 0.001334	0.0001028 0.001145	0.00008779 0.0009827	0.00007479 0.0008458	0.00006361 0.0007193
- 60	0.001066 0.01098	0.0009310 0.009635	0.0008117 0.008440	0.0007067 0.007383	0.0006145 0.006451	0.0005336 0.005629	0.0004627 0.004904	0.0004007 0.004268	0.0003465 0.003708	0.0002993 0.003218
- 50	0.003884 0.03822	0.003431 0.03391	0.003027 0.030005	0.002668 0.02660	0.002349 0.02353	0.002065 0.02079	0.001814 0.01834	0.001591 0.01616	0.001394 0.01423	0.001220 0.01251
- 40	0.01266 0.1193	0.01130 0.1069	0.01007 0.09572	0.008981 0.08569	0.007993 0.07658	0.007105 0.06838	0.006310 0.06099	0.005598 0.05434	0.004961 0.04837	0.004391 0.04302
- 30	0.03749 0.3385	0.03377 0.3062	0.03039 0.2767	0.02733 0.2499	0.02456 0.2255	0.02204 0.2032	0.01976 0.1829	0.01770 0.1646	0.01585 0.1480	0.01417 0.1329
- 20	0.1018 0.8834	0.09249 0.8053	0.08392 0.7336	0.07610 0.6678	0.06895 0.6076	0.06241 0.5521	0.05646 0.5015	0.05103 0.4552	0.04609 0.4127	0.04158 0.3739
- 10	0.2563 2.138	0.2345 1.964	0.2144 1.802	0.1958 1.652	0.1787 1.514	0.1630 1.387	0.1486 1.269	0.1353 1.160	0.1231 1.060	0.1120 0.9678
0	0.6028 4.845	0.5550 4.477	0.5106 4.134	0.4695 3.816	0.4315 3.521	0.3963 3.244	0.3637 2.989	0.3335 2.752	0.3057 2.531	0.2800 2.328

Informative reference: This Table is converted from ice vapour pressure table in Smithsonian Meteorological Tables (1966).

$$(\%) = \frac{P}{1013} \times 100, \quad (\text{mg/l}) = \frac{P}{1013} \times \frac{18.01}{22.41} \times \frac{273.1}{273.1 + t}$$

5. Sampling Method

The sampling method shall be in accordance with the following items:

5.1 Draw out containers of number of pieces shown in Table 3 at random from a lot capable of being considered to be same in quality according to random number table or other suitable method, and take the sample from the container. Provided that test results shall satisfy all the numerical values specified in Table 1.

Table 3. Sampling Number of Containers

Number of containers	Sampling number of pieces
100 max.	3
101 to 500	5
501 to 1000	10

5.2 The quantity and pressure of sample shall be sufficient for analysis of sample. However, when the quantity or pressure of sample is not sufficient, other container filled from branch tube may be taken as the analysis sample.

Further, when it is difficult to take out the analysis sample directly from container, hydrogen of sufficient quantity and pressure for conducting analysis is refilled and it may be taken as the analysis sample.

5.3 In the test of micro-quantity component, for prevention of pollution, cares shall be taken to following each item. That is at the sampling, an automatic pressure regulator made of material difficult to adsorb atmospheric component and others or a needle valve for regulation of flow-rate micro-quantity shall be used. Further, for piping those made of metal (for example, copper, stainless steel, etc.) or of glass shall be used, and when for connection or the like, a plastic tube is used, a short tube as far as possible shall be used. Internal parts of these shall be substituted sufficiently by sample gas.

6. Test Methods

6.1 Selection of Test Method The relation between the analysis method used and the objective component is shown in Table 4.

Table 4

Component	Analysis method Grade of hydrogen		Method of judge visually	Gravimetric method	Method using dew point meter and others	Hydrogen carbide analysis method	Infrared spectrophotometry	Infrared gas analysis method	Electrochemical analysis method	White-phosphorus emission type analysis method	Gas chromatography	Absorptiometry	Condensation gasification method	Oxy-hydrogen flame type combustion method	Method using a flame photometer type detector	Non-flame atomic absorption method
Moisture			4	1, 2, 3	1, 2, 3											
Hydrogen carbide (condensate content)			1, 2, 3, 4													
Hydrogen carbide (non-condensate content)						1, 2, 3	1, 2, 3	2, 3								
Oxygen				3, 4					1, 2, 3, 4	1, 2, 3	1, 2, 3, 4	2, 3, 4				
Nitrogen											1, 2, 3, 4					
Carbon dioxide							1, 2, 3	2, 3			1, 2, 3		1, 2, 3			
Carbon monoxide							1, 2, 3	2, 3			1, 2, 3					
Total sulphur compound														3, 4	1, 2, 3	
Mercury vapour																1, 2, 3

6.2 Common Matters General matters common to chemical analysis shall be in accordance with JIS K 0050; to infrared spectrophotometry, with JIS K 0117; to infrared gas analysis method, with JIS K 0151; and to gas chromatography, with JIS K 0114.

6.3 Analyzer and Its Calibration

6.3.1 The analyzer, corresponding to each grade specified in 4. quality, relative to each component concentration, shall have a suitable sensitivity and reproducibility. However, the accuracy of analyzer to be used for measurement of concentration of impurities of hydrogen shall be, as a rule, within $\pm 2\%$ in the case of standard substance, and, within $\pm 5\%$ in the case of industrial use.

6.3.2 The analyzer to measure concentration of impurities shall be calibrated by using a suitable gas for calibration (zero gas and span gas).

6.3.3 The standard value of gas for calibration to be used in 6.3.2 shall be within $\pm 2\%$ of true concentration in difference from the true concentration.

6.4 Purity The purity shall be calculated according to the following formula:

$$P = 100 - \sum_{i=1}^n \left(\frac{A_i}{S_i} \right) \times 100$$

where P : purity (%)

A_i : quantity of i -th impurity excluding moisture or dew point (ml)

S_i : quantity of sample used for measuring of A_i (ml)

6.5 Moisture and Dew Point Judgement of existence of moisture and determination method of moisture concentration shall be in accordance with either one of the following.

6.5.1 Method to Judge Visually At ordinary temperature overturn the container so as the outlet to become downward, after maintaining for 5 min, discharge the hydrogen into a dried clean container at a micro flow rate for 1 min, and judge the condensated moisture visually.

6.5.2 Gravimetric Method

- (1) **Summary** The moisture in sample gas is absorbed in phosphorus pentoxide and the moisture is calculated from its weight increase.
- (2) **Apparatus, Operation and Measurement** The apparatus, operation and measurement shall be in accordance with 3.3 of JIS K 1107. The moisture is converted to dew point to be reported.

6.5.3 Method Using Dew-Point Meter and Others Either one of visual judgement type dew-point meter, photoelectric type dew-point meter, electrolytic type aquameter, electrostatic capacity type aquameter, absorption, desorption heat type aquameter, high frequency oscillating type aquameter and infrared absorption type aquameter may be used. In these cases, the accuracy shall be confirmed preliminarily by comparing with the gravimetric method.

6.6 Hydrocarbon The determination method of hydrocarbon concentration shall be in accordance with either one of the following method.

6.6.1 Visually Judging Method of Existence of Hydrocarbon (Condensate Content) At ordinary temperature overturn the container so as its outlet to become downward, after maintaining for 5 min, discharge hydrogen into a dried clean container at a micro flow rate (it is dangerous to eject in a large amount) for 1 min, and judge visually the condensate of hydrocarbon.

6.6.2 Determination of concentration of total hydrocarbon (as methane) shall be in accordance with either one of the following.

6.6.2.1 Hydrocarbon Analysis Method

- (1) **Summary** When a sample containing hydrocarbon is passed through hydrogen flame, ionization of carbon atom is caused, therefore this ion current is amplified to be measured by

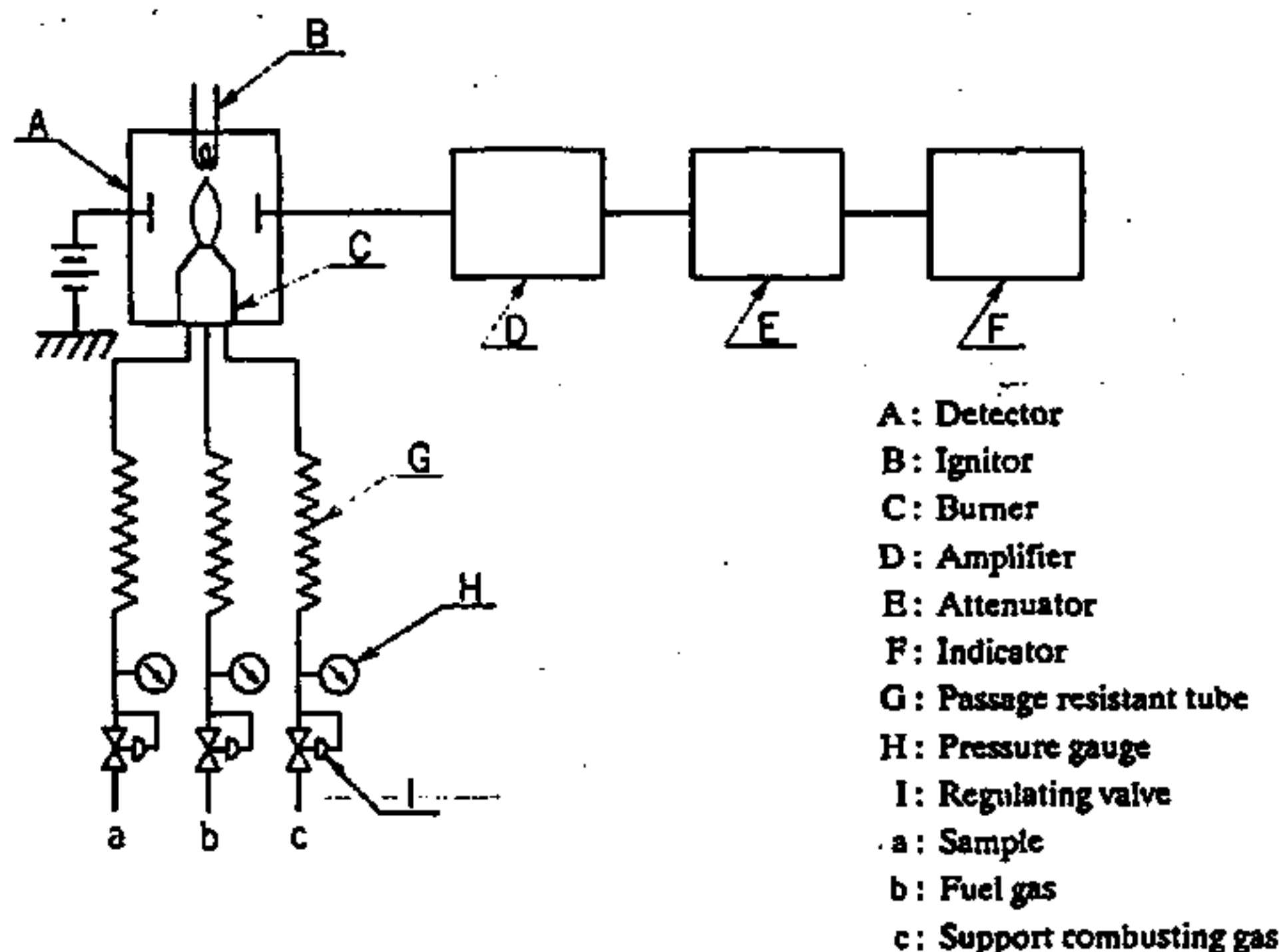
means of an indicator or a recorder and the hydrocarbon concentration in the sample is obtained.

The hydrogen flame is introduced with the sample by using hydrogen or hydrogen diluted by inert gas as fuel gas or by using clean air as support combustion gas.

The flow rate of fuel gas, air and sample are kept at the definite value during the operation.

- (2) **Apparatus** The apparatus is constituted of a passage system, detector and electric circuit. The example is shown in Fig. 1.

Fig. 1. Example of Passage System



- (a) **Passage System** The passage system is divided into each passage of fuel gas⁽¹⁾, air⁽¹⁾ and sample, and each passage shall be provided with a pressure gauge, pressure regulating valve and passage resistant tube to regulate the flow rate.
- (b) **Detector** The detector is assembled with burner-jet-ion collecting cylinder and ignitor. The mixed gas of fuel gas and air is ignited and sample is introduced into this. The hydrocarbon in sample gas is ionized, and ion electric current is generated by ion collecting cylinder.
- (c) **Electric Circuit** The ion electric current is converted to be amplified, its output is regulated by an attenuator and the indicator or recorder is actuated.

Note ⁽¹⁾ The content amount of hydrocarbon shall be not more than the permissible concentration at each grade.

(3) **Operation**

- Connect the fuel gas source and air source with the inlet of apparatus and confirm that there is no leakage.
- Put on the power source switch of measuring instrument to flow electric current into the circuit.
- Flow the fuel gas⁽¹⁾ and air⁽¹⁾ with regulating to the definite pressure.
- Ignite to the burner.
- Regulate the flow rate of fuel gas and air at a definite value.
- Flow the zero gas for calibration in passage of sample to carry out the zero regulation.