Certified Reference Material for Blood Gases

JCCRM 621-4

Handling Instructions

■Properties and Intended Use

This Certified Reference Material (CRM) for Blood Gases is intended for use in verifying the accuracy of blood gas (pH, *p*CO2, *p*O2) analysers in clinical testing. It is prepared from bovine hemoglobin.

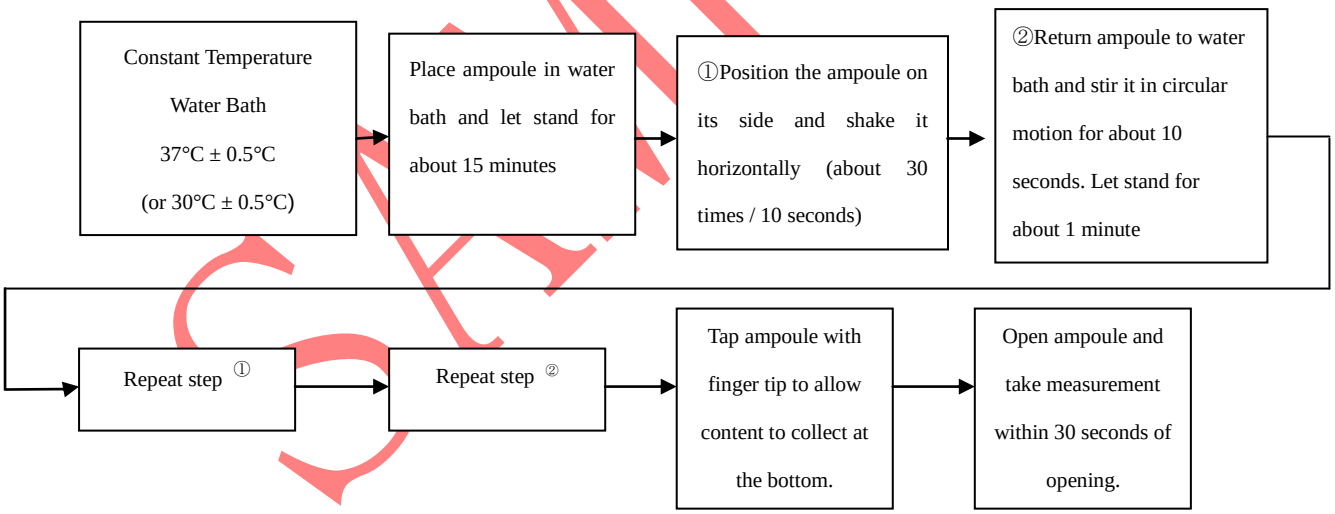
The differences in the oxygen buffering capacities between human whole blood and bovine hemoglobin have been corrected by the mean differences between these two detected by almost all *p*O2 instruments. Therefore using the certified values, you can obtain virtually the same values as you would with human whole blood.

Note: This CRM cannot be used for blood gas analysers not capable of measuring hemolysate.

■Instruction for Use

This CRM is supplied in an air-tight glass ampoule. Measurements of this material must be taken after completely equilibrating gases in the ampoule at 37°C (or at 30°C).

Set the water bath temperature at 37°C (or 30°C) and follow the instructions below .



■Caution

- This CRM is supplied in a glass ampoule. Applying excessive force to the ampoule can result in breaking the ampoule. Exercise careful caution and wear protective gloves to avoid severe injury in case of breakage.
- Although this CRM is prepared from hemoglobin of inspected healthy animals which passed quarantine inspections, exercise caution by treating as if it were human blood and infection.
- **In-Vitro Use Only**

■Storage Temperature and Expiration Date

This CRM is shipped frozen (packed with dry ice). Store the product in a deep freezer or a refrigerator upon receipt. Shelf life is shown below according to the specified storage temperatures. (Ship date is indicated on the product label.)

Frozen (－70°C ~ －90°C): 9 months after the ship date.

Refrigerated (+2°C ~ +10°C): 4 days after placing it in a refrigerator.

■Specifications

Items Measured: pH, *p*CO2, *p*O2

Content: 3 levels, 2 ampoules for each level (1.5 ml / ampoule), total of 6 ampoules

Certified Reference Material for Blood Gas

JCCRM 621-4

Certificate of Analysis

■Certified Values and Expanded Uncertainties

Certified values and expanded uncertainties for this Certified Reference Material for Blood Gas (JCCRM 621-4) are shown below.

The certified values for pH, *p*CO2, *p*O2 differ depending on the gas equilibration temperature. Use the certified values with the gas equilibration temperature of 37°C or 30°C.

Table 1 Gas equilibration temperature for the reference material: 37°C Measured temperature: 37°C

Item	Certified values & Expanded uncertainties			Unit of measure
	Level 1	Level 2	Level 3	
pH	7.339 ± 0.022	7.445 ± 0.023	7.546 ± 0.022	-
*p*CO2	54.5 ± 1.3	38.5± 1.4	27.3± 1.1	mmHg
*p*O2	40.6 ± 1.4	61.7± 2.0	81.4± 3.0	mmHg

Differences in the oxygen buffering capacities of human blood and the bovine hemoglobin liquid by the mean values of the differences detected by various measuring electrodes are corrected (The mean values for correction obtained using 7 blood gas analysers were 0.5 (0.2 ~ 0.8), 0.7 (0.4~1.0), and 1.0 (0.7 ~ 1.3) mmHg for each respective levels, 1, 2, and 3).

Table 2 Gas equilibration temperature for the reference material: 37°C Measured temperature: 37°C

Item	Certified values & Expanded uncertainties			Unit of measure
	Level 1	Level 2	Level 3	
pH	7.299 ± 0.023	7.414 ± 0.024	7.526 ± 0.023	-
*p*CO2	61.3 ± 1.9	41.9 ± 1.7	29.4 ± 1.2	mmHg
*p*O2	47.0 ± 1.1	79.3 ± 2.7	105.1 ± 2.5	mmHg

Differences in the oxygen buffering capacities of human blood and the bovine hemoglobin liquid by the mean values of the differences detected by various measuring electrodes are corrected (The mean values for correction obtained using 7 blood gas analysers were 0.5 (0.2 ~ 0.8), 1.0(0.7~ 1.3), and 2.0 (1.5 ~ 2.5) mmHg for each respective levels, 1, 2, and 3).

The uncertainties shown in Table 1 and Table 2 are expressed as expanded uncertainties (*U*, 95% confidence level) estimated according to ISO GUM: Guide to the Expression of Uncertainty in Measurement. REFERENCE [4]. *U* were calculated by $U = k \times Uc$, where *U*c is the combined standard uncertainty, and *k* is the coverage factor ($k = 2.0$). Here, *U*c represents combined standard uncertainty derived from measurements, homogeneity gas equilibration process, and between ampoule variation, stability during storage, and correction to whole blood.

Note: Please refer to the ADDENDUM on page 4 for the maximum allowable limits of bias from certified values for routine blood gas analysers.

■Measurement Method Used for the Certified Values

The certified values of pH were assayed using a pH electrode with a reference cell. This is the standard reference method prescribed by the IFCC (REFERENCE [2]). The certified values of *p*CO2 and *p*O2 were measured using a standard blood gas analyzer calibrated by the standard tonometry method according to the IFCC's reference method procedure (REFERENCE [3]). Measurements were protormed at the Reference Material Institute for Clinical Chemistry Standards (ReCCS).

■Preparation

Hemoglobin obtained by hemolysis of washed bovine red cells was sealed in an air-tight ampoule after stabilizing its partial gas pressure. Its ionic strength, bicarbonate concentration, BE (Base Excess), and total hemoglobin level were adjusted as to meet the specifications of this CRM (REFERECE [1]).

■Traceability

As a reference material for measuring the certified values of pH, we used a pH standard solution (pH 6.8408 ± 0.010 at 37°C, pH 7.3940 ± 0.010 at 37°C) prepared from the NIST Standard Reference Materials (SRM 186-I-g, KH_2PO_4; SRM 186-II-g, Na_2HPO_4). For the tonometry of *p*CO_2 and *p*O_2, we used 3 levels of primary standard gases (CO_2 + O_2, balance N_2) certified by the accreditation body of JCSS (Japan Calibration Service System). We also used a platinum resistance reference thermometer calibrated by JCSS for standard tonometry and gas equilibration.

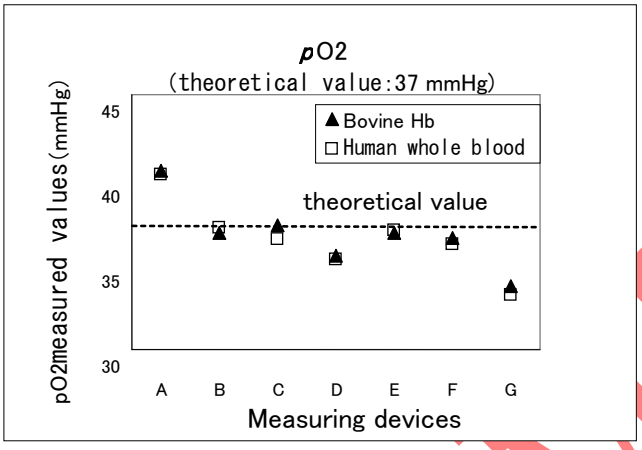
■Date of Certification

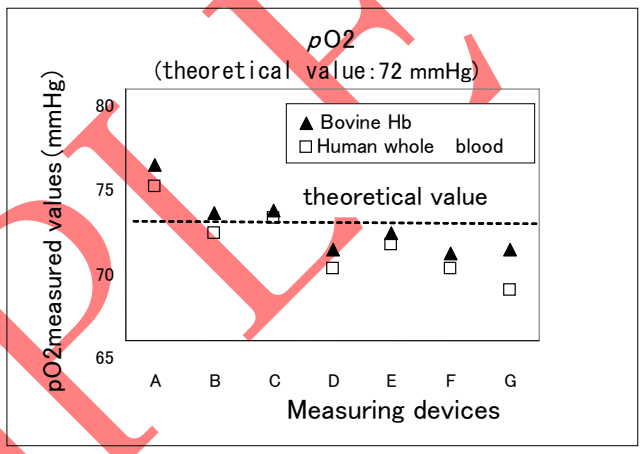
July 27 , 2016

ADDENDUM

■ *p*O2 difference between human whole blood and bovine hemoglobin .

We used 7 different blood gas analysers from 3 different manufacturers (A ~ G). Human whole blood and bovine Hb liquid were tonometered using the same standard gases. These samples were measured and evaluated to determine the effect of the different oxygen buffering capacities on the *p*O2 measuring electrodes. The charts below show the different *p*O2 values from the 2 different tonometry gases. The results indicated that the differences between human whole blood and bovine Hb were 0.3 ~ 0.8 mmHg and 0.5 ~ 2.4 mmHg for the theoretical *p*O2 values of 37 mmHg and 72 mmHg, respectively.





■ Biases range from the certified values of routine blood gas analysers.

Table 3 Bias test results (see Reference [1])

pH	*p*CO2 (mmHg)			*p*O2 (mmHg)		
	≤ 30	30 ~ 50	50 ≤	≤ 40	40 ~ 100	100 ≤
± 0.04	± 2.0	± 3.0	± 4.0	± 3.0	± 5.0	± 6.0

■ Properties

Properties of this CRM are shown in the table below. The values were obtained by measuring the level 2 of this CRM using a routine test method to verify that they meet the specifications for the reference materials (Reference [1]).

Table 4 Properties of JCCRM 621-4

Item	Standards	Reference Value	Unit of Measure	Method Used
Ion Strength	160 ± 20	151	mmol/kg	Calculated from electrolytic concentration
Base Excess	0 ± 4	−1	mmol/L	Nomogram
Total Hb Level	140 ± 20	140	g/L	ICSH method (cyanmethemoglobin method)
MetHb Content Ratio	≤ 6	0.6	%	Absorptiometry

REFERENCES

[1] Committee on Blood Gases and Electrolytes, Japan Society of Clinical Chemistry. Approved Recommendation on JSCC Methods on the Preparation of Working Reference Material and Evaluation and Calibration for the Determination of the Blood Gas Measurement, Clinical Chemistry, 34, 148-159 (2005)

[2] Approved IFCC methods. Reference method (1986) for pH measurement in blood. Clin Chim Acta 165:97-109 (1987)

[3] IFCC Method (1988) for tonometry of blood: Reference materials for PCO_2 and PO_2. J Clin Chem Clin Biochem 27:403-408 (1989)

[4] Guide to the Expression of Uncertainty in Measurement, ISBN 92-67-10188-9, 1st Ed. ISO, Geneva, Switzerland (1995)

Provider of JCCRM 621-4:

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