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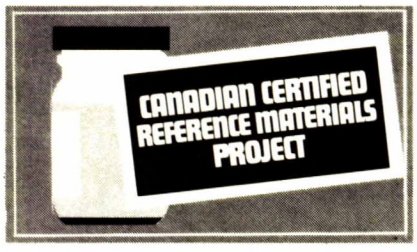
Canada Centre for Mineral and Energy Technology | Centre canadien de la technologie des minéraux et de l'énergie

CERTIFIED AND PROVISIONAL REFERENCE MATERIALS AVAILABLE FROM THE CANADA CENTRE FOR MINERAL AND ENERGY TECHNOLOGY AS OF 1976

Compiled by
G.H. Faye



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G. H. Faye*

PREFACE

The Canadian Certified Reference Materials Project (CCRMP) is a current activity of the Canada Centre for Mineral and Energy Technology (CANMET). In this project, compositional reference materials, for use in analytical laboratories associated with mining, metallurgy and the earth sciences, are prepared. The CCRMP is an off-shoot of activities of several outside technical organizations which, in 1955, undertook the preparation of some metals and alloys for spectrographic purposes. During the mid-sixties this activity was transferred gradually to the predecessor of CANMET, the Mines Branch of the Department of Energy, Mines and Resources, because the Branch has the personnel and equipment necessary not only for production but also for storage, distribution and sales. Furthermore, the Branch (CANMET), because of its impartiality, is an appropriate organization to coordinate the inter-laboratory programs for the certification of compositional reference materials.

As a response, in the early seventies, to a demand from a number of Canadian commercial and industrial analytical laboratories, the production of certified reference ores and related products was emphasized. Other recent activities of the CCRMP relate to the certification of three rock samples and to the establishment of task forces for the certification of copper and copper alloys, various ferrous materials and a suite of four Canadian soil samples.

This catalogue describes all of the certified and provisional reference materials that may be purchased from CANMET through the Chairman of the CCRMP. Where possible, the source, chemical composition, the recommended values of the certified elements, and the price are given for each available material. Also included are brief descriptions of materials that are being processed and their approximate date of availability.

It is anticipated that new catalogues will be prepared periodically as new certified reference materials are added to the list.

It is to be noted that it is the practice of the CCRMP to use the term 'certified' to describe reference materials. It is considered that 'certified' can be translated to other languages with less ambiguity than 'standard'.

*Chairman, Canadian Certified Reference Materials Project, Mineral Sciences Laboratories, Canada Centre for Mineral and Energy Technology, Department of Energy, Mines and Resources, Ottawa, Canada.

MATÉRIAUX DE RÉFÉRENCE CERTIFIÉS ET PROVISOIRES DISPONIBLES AU CENTRE CANADIEN DE LA TECHNOLOGIE DES MINÉRAUX ET DE L'ÉNERGIE À COMPTER DE 1976

Compilé par

G. H. Faye*

AVANT-PROPOS

Le Programme canadien de matériaux de référence certifiés (CCRMP) est présentement une des activités du Centre canadien de la technologie des minéraux et de l'énergie (CANMET). Dans ce programme, des matériaux de référence à l'usage des laboratoires analytiques en rapport avec l'exploitation minière, la métallurgie et les sciences de la Terre sont préparés. Le CCRMP est né des activités de plusieurs organismes techniques extérieurs qui, en 1955, entreprirent la préparation de certains métaux et alliages à des fins spectrographiques. Vers le milieu des années 60, cette activité était transmise graduellement au prédécesseur de CANMET, la direction des Mines du ministère de l'Énergie, des Mines et des Ressources, à cause du personnel et de l'équipement nécessaires, non seulement à la production mais aussi à l'emmagasinage, la distribution et la vente. De plus, la Direction (CANMET) de par son impartialité se trouve l'organisme tout désigné pour coordonner les programmes inter-laboratoires de certification des matériaux de référence.

Comme suite à la demande d'un certain nombre de laboratoires analytiques commerciaux et industriels canadiens, au début des années 70, la production de minerais de référence certifiés et de produits apparentés a été augmentée. Parmi d'autres activités récentes du CCRMP, il y a la certification de trois échantillons de roche et la création de trois équipes de travail affectées à la certification du cuivre et de ses alliages, de différents matériaux ferreux ainsi qu'une suite de quatre échantillons du sol canadien.

Ce catalogue décrit tous les matériaux de référence certifiés et provisoires qui peuvent être achetés de CANMET par l'entremise du président du CCRMP. Lorsque c'est possible, l'origine, la composition chimique, les valeurs recommandées des éléments certifiés, et le prix sont donnés pour chacun des matériaux disponibles. Il y a également inclues, de brèves descriptions des matériaux sous traitement et la date approximative de leur disponibilité.

De nouveaux catalogues devraient être préparés périodiquement à mesure que de nouveaux matériaux de référence certifiés viennent s'ajouter à la liste.

Il est à noter que le CCRMP utilise le terme 'certifié' dans la description de ces matériaux de référence. Le mot 'certifié' est moins ambigu lorsqu'il doit être traduit dans d'autres langues.

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ORES AND RELATED MATERIALS

Molybdenum Ore, PR-1

Molybdenum ore, PR-1, was obtained from the Preissac molybdenum mine near Cadillac, Quebec, in 1970. The Preissac ore is from a vein-type deposit in a sericite granite. The calculated mineralogical composition and the approximate chemical composition of PR-1 are given in the following tables.

Mineralogical Composition of PR-1

Minerals	Calculated mineralogical composition of PR-1 (wt. %)
Fluorite	0.96
Calcite	2.37
Garnet	0.07
Chlorite	1.29
Muscovite	2.30
Feldspar	
Na-feldspar	6.17
K-feldspar	12.29
Quartz	70.27
Rutile	0.05
Molybdenite	1.02
Sphalerite	0.03
Galena	0.04
Chalcopyrite	0.03
Bismuth	0.06
Bismuthinite	0.08
Pyrite	0.58
Pyrrhotite	not calculated
Hematite	"
Magnetite	"
Fe+O+Ni+H_2O	1.26
Total	98.87

Approximate Chemical Composition of PR-1

O	— 49.2 Wt %		Bi	— 0.11* Wt %
Si	— 39.2		Ti	— 0.03
Al	— 2.39		Pb	— 0.04
Fe	— 1.24*		Zn	— 0.02
Ca	— 1.44		Mn	— 0.02
Mg	— 0.09		Ni	— 0.01
Na	— 0.54		Cu	— 0.01
K	— 1.95		F	— 0.47
S	— 0.79*		H_2O	— 0.29
Mo	— 0.59*	Total C as CO_2		— 1.08
		actual CO_2		— 1.04

*Recommended value (see below).

Nineteen laboratories participated in the program to certify PR-1 for molybdenum, bismuth, iron, and sulphur. A statistical evaluation of the analytical results for these elements yielded the recommended values tabulated below.

RECOMMENDED VALUES AND THEIR CONFIDENCE INTERVALS FOR SELECTED ELEMENTS IN PR-1

	Mo	Bi	Fe	S
	(Wt %)			
Recommended Values	**0.594**	**0.111**	**1.244**	**0.793**
95% Confidence Interval				
Low	**0.578**	**0.107**	**1.225**	**0.777**
High	**0.610**	**0.114**	**1.263**	**0.809**

A full account of the work done on PR-1 is given in the Mines Branch Technical Bulletin TB 139, entitled "Molybdenum Ore, PR-1: Its Characterization and Preparation for Use as a Standard Reference Material". A copy of this bulletin will be forwarded with each order of PR-1.

Zinc-Tin-Copper-Lead Ore, MP-1

The material for reference ore MP-1 was obtained from the deposit of Brunswick Tin Mines Limited in southwestern New Brunswick in 1971. It consists of material from two sulphide veins blended with a small amount of mineralized rock. The calculated mineralogical composition and the approximate chemical composition of MP-1 are given in the following tables:

Calculated Mineralogical Composition of MP-1

Minerals		Calculated Mineralogical Composition (Wt %)
sphalerite*	ZnS-24.0, FeS-0.8, CdS-0.1, InS-0.1, MnS-0.07	25.1
chalcopyrite	Cu-1.3, Fe-1.2, S-1.3	3.8
stannite-kesterite	Cu-0.8, Sn-0.8, Fe-0.2, S-0.9	2.9
galena	Pb-1.9, S-0.3	2.2
cassiterite	Sn-1.6, 0-0.4	2.0
arsenopyrite	As-0.8, Fe-0.6, S-0.3	1.7
pyrite	Fe-0.6, S-0.7	1.3
bismuth		0.03
wolframite	WO_3-0.03, FeO+MnO-0.01	0.04
molybdenite	Mo-0.01, S-0.01	0.02
quartz	SiO_2-34.7	34.7
chlorite	SiO_2-1.9, Al_2O_3-1.7, FeO-3.0, MgO-0.1, H_2O-0.3	7.0
fluorite	Ca-3.4, F-3.2	6.6
topaz	SiO_2-1.8, Al_2O_3-2.9, F-0.9, H_2O-0.5	6.1
kaolinite	SiO_2-2.7, Al_2O_3-2.3, H_2O-0.8	5.8
feldspar	SiO_2-0.5, Al_2O_3-0.1, K_2O-0.1, Na_2O-0.1	0.8
rutile	TiO_2-0.05	0.05
TOTAL		100.14

*The metals Fe, Cd, In, and Mn are incorporated in the lattice of sphalerite, but some In also occurs as the mineral roquesite.

Approximate Chemical Analysis of MP-1

(Wt %)

O	— 26.8	Zn	— 16.3*
Si	— 19.4	Sn	— 2.50*
Al	— 3.63	Cu	— 2.15*
Fe	— 5.68	Pb	— 1.93*
Mg	— 0.04	As	— 0.79*
Ca	— 3.36	In	— 0.071*
K	— 0.10	Bi	— 0.025*
Na	— 0.01	Mo	— 0.014*
Ti	— 0.07	Cd	— 0.07
Mn	— 0.05	W	— 0.02
S	— 11.8		
H_2O at 980°C	— 1.57		
C	— 0.10		
F	— 4.04		
	Total	—	100.5
	Corrected for O in H_2O	—	1.4
	Corrected Total	—	99.1

*Recommended value (see below).

Nineteen laboratories participated in the program to certify MP-1 for the nine selected elements. A statistical evaluation of the analytical results yielded the recommended values tabulated below.

RECOMMENDED VALUES AND THEIR CONFIDENCE LIMITS FOR SELECTED ELEMENTS IN MP-1

	Recommended Values (Wt %)	95% Confidence Limits
Zn	**16.33**	**16.20 – 16.45**
Sn	**2.50**	**2.39 – 2.61**
Cu	**2.15**	**2.12 – 2.18**
Pb	**1.93**	**1.90 – 1.96**
Mo	**0.014**	**0.013 – 0.015**
In	**0.071**	**0.068 – 0.074**
Bi	**0.025**	**0.023 – 0.027**
As	**0.791**	**0.768 – 0.814**
Ag	**59.5 (ppm)**	**56.3 – 60.6**

Copper-Molybdenum Ore, HV-1

HV-1 is a mixture of materials taken from large, low-grade copper-molybdenum porphyry deposits in the Highland Valley area of British Columbia; it is intended to be representative of samples analyzed in large numbers by enterprises associated with the exploitation of these deposits. The calculated mineralogical composition and approximate chemical composition of HV-1 are given in the following tables:

Calculated Mineralogical Composition of HV-1

Minerals	Calculated Mineral Composition (Wt %)
bornite	0.6
chalcopyrite	0.3
pyrite	0.1
molybdenite	0.1
quartz	40.7
plagioclase	26.9
orthoclase	10.6
sericite	12.3
biotite	2.3
amphibole and pyroxene	2.0
clay minerals	1.0
zircon	trace
calcite	1.5
hematite and magnetite	0.6
rutile	0.3
barite	0.1
tramp iron (presence indicated from polished section; calculated by difference)	0.4
TOTAL	99.8

Approximate Chemical Analysis of HV-1

O	—	49.2 Wt %
Si	—	33.9
Al	—	6.61
Fe (total)	—	1.88
Ca	—	1.40
Mg	—	0.34
Na	—	2.26
K	—	2.82
Ti	—	0.16
Mn	—	0.03
Cu	—	0.52*
Mo	—	0.058*
S (comb)	—	0.34
S (grav)	—	0.35
C (total)	—	0.20
H_2O (980°C)	—	1.42
TOTAL	—	101.1
Correction for O in H_2O	—	1.3
Adjusted TOTAL	—	99.8

*Recommended value (see below).

For the certification of HV-1, twenty-three laboratories provided analytical results for copper and molybdenum; the recommended values and their 95% confidence limits are given in the following table:

RECOMMENDED VALUES AND THEIR CONFIDENCE LIMITS FOR SELECTED ELEMENTS IN HV-1

	Cu (Wt %)	Mo (Wt %)
Recommended Value	**0.522**	**0.058**
95% Confidence Limits		
Low	**0.517**	**0.056**
High	**0.526**	**0.059**

A full account of the work done on HV-1 is given in the Mines Branch Technical Bulletin TB 167, entitled "Copper-Molybdenum Ore, HV-1: Its Characterization and Preparation for Use as a Standard Reference Material". A copy of this bulletin will be forwarded with each order of HV-1.

Nickel-Copper-Cobalt Ore, SU-1

SU-1 is a composite of sample rejects collected in 1958 at the Falconbridge Nickel Mines Limited, Falconbridge, Ontario[1] and is, therefore, representative of the Sudbury nickel-copper ores. SU-1 was originally intended as a reference material primarily for spectroscopists[1]. It has been widely distributed to laboratories throughout the world and a large number of analytical results for minor and trace elements have been accumulated[2,3]. Most of these analyses, however, were obtained by emission spectroscopy and only single values for each element were received from each laboratory. Because of the wide range in the results for most elements, it was not possible to assign recommended values previously. However, through recently-completed work within the CCRMP, SU-1 has now been certified for nickel, copper, and cobalt.

The approximate chemical analysis of SU-1 is given in the following table:

Approximate Chemical Analysis of SU-1

O	—	31.2 Wt %
Si	—	16.2
Al	—	5.01
Fe	—	22.9
Ca	—	2.86
Mg	—	2.47
Na	—	0.77
K	—	0.53
Ti	—	0.50
Mn	—	0.08
Ni	—	1.51*
Cu	—	0.87*
Co	—	0.063*
Zn	—	0.03
S	—	12.1
P	—	0.04
H (from H_2O)	—	0.33

*Recommended value (see below).

For the certification of SU-1, twenty-five laboratories provided analytical results for nickel, copper, and cobalt; the recommended values and their 95% confidence limits are given in the following table:

RECOMMENDED VALUES AND THEIR CONFIDENCE LIMITS FOR SELECTED ELEMENTS IN SU-1

	Ni	Cu (Wt %)	Co
Recommended Value	**1.51**	**0.87**	**0.063**
95% Confidence Limits			
Low	**1.50**	**0.86**	**0.061**
High	**1.52**	**0.88**	**0.065**

A full account of the work done on SU-1 is given in the Mines Branch Technical Bulletin TB 177, entitled "Nickel-Copper-Cobalt Ores SU-1 and UM-1: Their Characterization and Preparation for Use as Standard Reference Materials". A copy of this bulletin will be forwarded with each order of SU-1.

REFERENCES

(1) Report of Non-metallic Standards Committee Canadian Association for Applied Spectroscopy, Appl. Spectrosc., *15*, 159-161 (1961).

(2) Second Report of Analytical Data for CAAS Syenite and Sulphide Standards, by G. R. Webber, Geochim, Cosmochim. Acta, *29*, 229-248 (1965).

(3) Third Report of Analytical Data for CAAS Sulphide Ore and Syenite Rock Standards, by N. M. Sine, W. O. Taylor, G. R. Webber and C. L. Lewis, Geochim, Cosmochim. Acta, *33*, 121-131 (1969).

Nickel-Copper-Cobalt Ore, UM-1

Although UM-1 is termed an ore because of its relatively high base-metal sulphide content, it is an ultramafic rock from the Giant Mascot Mine at Hope, British Columbia. UM-1 is one of a suite of three ultramafic rock (the others being coded as UM-2 and UM-4) that have been termed geochemical standards for the determination of ascorbic acid/hydrogen peroxide-soluble nickel, copper, and cobalt (see p. 20). Because UM-1 contains ore-grade concentrations of nickel, copper, and cobalt, and it was available to the CCRMP in a comminuted condition, it was chosen, along with SU-1, for the certification of these three elements.

Details of the mineralogy of UM-1 are given in the reference below and approximate chemical analyses for UM-1 are given in the following table:

Approximate Chemical Analysis of UM-1

O	—	36.5 Wt %
Si	—	17.6
Al	—	0.53
Fe	—	13.4
Ca	—	1.67
Mg	—	21.7
Na	—	0.06
K	—	0.02
Ti	—	0.06
Cr	—	0.31
Mn	—	0.12
Ni	—	0.88*
Cu	—	0.43*
Co	—	0.035*
S	—	3.53
H (from H_2O)	—	0.05
C (from CO_2)	—	0.07

*Recommended value (see below).

For the certification of UM-1, twenty-five laboratories provided analytical results for nickel, copper, and cobalt; the recommended values and their 95% confidence limits are given in the following table:

RECOMMENDED VALUES AND THEIR CONFIDENCE LIMITS FOR SELECTED ELEMENTS IN UM-1

	Ni	Cu (Wt %)	Co
Recommended Value	**0.88**	**0.43**	**0.035**
95% Confidence Limits			
Low	**0.87**	**0.43**	**0.034**
High	**0.89**	**0.44**	**0.035**

A full account of the work done on UM-1 is given in the Mines Branch Technical Bulletin TB 177, entitled "Nickel-Copper-Cobalt Ores SU-1 and UM-1: Their Characterization and Preparation for Use as Standard Reference Materials". A copy of this bulletin will be forwarded with each order of UM-1.

REFERENCE

Three Geochemical Standards of Sulphide-bearing Ultramafic Rock: UM-1, UM-2, UM-4, compiled by E. M. Cameron, Geological Survey of Canada, Paper 71-35 (1972).

Zinc-Lead-Tin-Silver Ore, KC-1

KC-1 was prepared from material that was hand-picked at the Kidd Creek deposit of Ecstall Mining Company Limited, and was chosen to represent a typical high-grade base-metal ore. KC-1 also acts as a complement to the certified base-metal ore MP-1 (see p. 4), which contains lower zinc, lead and silver values but higher copper and tin values than KC-1. The mineralogical and approximate chemical composition of KC-1 are given in the following tables:

Calculated Mineralogical Composition of KC-1

Minerals		Composition (Wt %)
sphalerite	Zn-20.4, Fe-1.4, Cd-0.08, Mn-0.02, S-10.8	32.7
pyrite	Fe-13.9, S-16.0	29.9
galena	Pb-7.0, S-1.1	8.1
cassiterite	Sn-0.7, O-0.2	0.9
siderite	Fe-0.24, CO_2-0.15	0.4
pyrrhotite	Fe-0.2, S-0.1	0.3
chalcopyrite	Cu-0.1, Fe-0.1, S-0.1	0.3
silver		0.1
tetrahedrite+stephanite		0.05
quartz		20.6
feldspar	K_2O-0.1, Na_2O-0.3, CaO-0.4, Al_2O_3-1.3, SiO_2-2.9	5.0
chlorite	FeO-0.3, MgO-0.1, Al_2O_3-0.15, SiO_2-0.25, H_2O-0.1	0.9
carbon		0.2
	TOTAL	99.5

Approximate Chemical Composition of KC-1

O	— 14[a] Wt%	S	— 28
Si	— 11	C	— 0.2
Al	— 0.8	Zn	— 20.37*
Fe	— 16	Pb	— 6.98*
Ca	— 0.3	Sn	— 0.68*
Mg	— 0.05	Cu	— 0.114*
Na	— 0.2	Ag	— 0.114*
K	— 0.1	H_20 (1800°F)	— 0.7
Mn	— 0.05		

[a]Determined by neutron-activation analysis in the Mineral Sciences Laboratories (CANMET).

*Recommended value (see below).

For the certification of KC-1, twenty-five laboratories provided analytical results for one or more of zinc, lead, tin, copper and silver; the recommended values and their 95% confidence limits are given in the following table:

RECOMMENDED VALUES AND THEIR CONFIDENCE LIMITS FOR SELECTED ELEMENTS IN KC-1

	Zn	Pb	Sn	Cu	Ag
			(Wt %)		
Recommended Values	**20.37**	**6.98**	**0.68**	**0.114**	**0.114**
95% Confidence Limits					
Low	**20.31**	**6.94**	**0.67**	**0.112**	**0.112**
High	**20.43**	**7.02**	**0.69**	**0.116**	**0.115**

A full account of the work done on KC-1 is given in Mines Branch Technical Bulletin TB 193, entitled "Zinc-Lead-Tin-Silver Ore KC-1: Its Preparation and Characterization for Use as a Certified Reference Material". A copy of this bulletin will be forwarded with each order of KC-1.

REFERENCE

An Evaluation of the Titrimetric and Atomic Absorption Determination of Tin in the Certified Reference Materials MP-1 and KC-1, by H. F. Steger, Mines Branch Technical Bulletin TB 196.

Iron Ore, SCH-1

The material for reference ore SCH-1 was donated to the CCRMP by the Iron Ore Company of Canada in 1973. The ore is from the Schefferville, Quebec area and is hematite with a mixture of unidentified hydrous oxides of iron, minor magnetite and trace pyrolusite. The gangue consists mainly of quartz with minor amounts of feldspar and traces of biotite, chlorite and amphibole.

Twenty-four laboratories provided analytical results for one or more of the selected elements in SCH-1; the recommended values and their 95% confidence limits are given in the following table:

A full account of the work done on iron ore SCH-1 is given in Canada Centre for Mineral and Energy Technology technical report MSL 75-168(TR), entitled "Iron Ore SCH-1: Its Characterization and Preparation for Use as a Certified Reference Material". A copy of this report will be forwarded with each order of SCH-1.

RECOMMENDED VALUES AND THEIR CONFIDENCE LIMITS FOR SELECTED ELEMENTS IN SCH-1

	% Fe	% Si	% Al	% Ca	% Mg	% Mn	% Ti	% S	% P
Recommended Value	60.73	3.78	0.509	0.029	0.020	0.777	0.031	0.007	0.054
95% Confidence Limits									
Low	60.65	3.74	0.500	0.027	0.019	0.769	0.029	0.007	0.051
High	60.82	3.81	0.517	0.032	0.021	0.785	0.033	0.008	0.057

Tungsten Ores, CT-1, BH-1, and TLG-1

CT-1 is a sample of a scheelite ore obtained in 1973, from Canada Tungsten Corporation, Tungsten, N.W.T. In decreasing order of abundance, the minerals present in CT-1 are: pyroxene, quartz, pyrrhotite, amphibole, calcite, mica, dolomite, feldspar, scheelite, chalcopyrite, and clay minerals.

BH-1 is a sample of a wolframite ore, hand-picked in 1973 from a stock-pile at the Burnt Hill deposit near Fredericton, New Brunswick; the deposit being owned by the International Paper Company Limited. The minerals present in BH-1, in decreasing order of abundance, are: quartz, biotite, chlorite, muscovite, feldspar, pyrrhotite, beryl and topaz, wolframite, cassiterite and rutile, pyrite, molybdenite, bismuth, bismuthinite and galena, and chalcopyrite.

TLG-1 is a sample of a low-grade scheelite ore from Browne's Lake Mine, Beaverhead County, Montana, and was donated by the General Electric Company, Cleveland, Ohio. In decreasing order of abundance the minerals present in TLG-1 are: quartz, calcite, hydrogarnet, amphibole dolomite, chlorite, feldspar, mica, clay minerals, scheelite, hematite, magnetite, sphalerite and chalcopyrite.

The recommended tungsten values and their confidence limits for the three tungsten ores are given below.

RECOMMENDED TUNGSTEN VALUES AND THEIR CONFIDENCE LIMITS FOR TUNGSTEN IN CT-1, BH-1 and TLG-1

	CT-1	BH-1 (Wt %)	TLG-1
Recommended Value	**1.04**	**0.42**	**0.083**
95% Confidence Limits			
Low	**1.025**	**0.415**	**0.080**
High	**1.058**	**0.430**	**0.087**

A full account of the work done on CT-1, BH-1 and TLG-1 is given in CANMET REPORT 76-5 entitled "Tungsten Ores CT-1, BH-1 and TLG-1: Their Characterization and Preparation for Use as Certified Reference Materials". A copy of this report will be forwarded with each order of CT-1, BH-1 or TLG-1.

Gold Ore, MA-1

MA-1 was prepared from head ore obtained from Wilroy Mines Limited, Macassa Division, Kirkland Lake, Ontario. It was chosen because a demand exists for a relatively simple siliceous ore containing elemental gold. Although the CCRMP has issued several certified gold-bearing materials (see PTM-1, p. 13 and PTC-1, p. 14), these are rich in one or more of copper, nickel, and iron, and contain platinum-group metals; consequently they are not satisfactory for laboratories wanting a simple gold ore as a reference material.

The approximate chemical composition of MA-1 is given in the following table:

Approximate Chemical Composition of MA-1

O*	—	45 wt %	S	—	1.5
Si	—	24.9	Total C	—	2.1
Al	—	5.7	C from CO_2	—	1.8
Fe	—	5.3	H_2O (1000°C)	—	2.0
Ca	—	4.4	H_2O (105°C)	—	0.1
Na	—	1.5	L.O.I.	—	6.5
K	—	4.2			

*Determined by neutron activation analysis in the Mineral Sciences Laboratories.

Twenty-four laboratories provided gold results by one or more of three methods; the recommended gold value and its 95% confidence limits are given in the following table:

RECOMMENDED GOLD VALUE AND ITS CONFIDENCE LIMITS

	oz/ton	ppm
Recommended Value	**0.518**	**17.8**
95% Confidence Limits		
Low	**0.513**	**17.6**
High	**0.523**	**17.9**

A full account of the work done on MA-1 is given in Canada Centre for Mineral and Energy Technology (CANMET) Internal Report MSL 75-29(TR), (formerly Mines Branch Technical Bulletin category), entitled "Gold Ore, MA-1: Its Preparation and Characterization for Use as a Certified Reference Material". A copy of this bulletin will be forwarded with each order of MA-1.

Platiniferous Black Sand, PTA-1

The material used to prepare PTA-1 was supplied by B. H. Levelton and Associates, Vancouver, British Columbia. It is from the Tulameen River area of British Columbia. Careful mineralogical examination of material similar to PTA-1 revealed the presence of at least ten minerals known to contain platinum-group elements, with an iron-bearing platinum alloy being predominant. Approximate chemical analyses for the major constituents of PTA-1 gave the following values: Fe-63.0%; Ca-1.2%; Al-2.9%; SiO_2-3.6%; and Mg-0.6%.

Nine laboratories provided platinum analyses for the certification of PTA-1. A statistical evaluation of these results yielded the recommended platinum value and 95% confidence limits given in the following table:

RECOMMENDED VALUE AND THE CONFIDENCE LIMITS FOR PLATINUM IN PTA-1

	(ppm)	(troy oz/ton)
Recommended Value	**3.05**	**0.089**
95% Confidence Limits		
Low	**2.91**	**0.085**
High	**3.17**	**0.092**

An account of the work done on PTA-1 is given in Mines Branch Technical Bulletin TB 138, entitled "Characterization and Preparation of Standard Reference Materials that Contain Noble Metals: (A) PTA (Ores) and (B) PTM (Nickel-Copper-Matte)". A copy of this bulletin will be forwarded with each order of PTA-1.

Noble-Metals-Bearing Nickel-Copper Matte, PTM-1

Matte PTM-1 was produced from Sudbury ore and was provided by Falconbridge Nickel Mines Limited. This material was chosen for preparation as a reference material because it contains appreciable concentrations of most members of the platinum group of metals. Approximate chemical analyses for the major constituents of PTM-1 gave the following values: Ni-44.8%; Cu-30.2%; Fe-1.58%; S-21.6%.

An account of the work done on PTM-1 is given in Mines Branch Technical Bulletin TB 182, entitled "Noble Metals-Bearing Nickel-Copper Matte PTM: Its Characterization and Preparation for Use as a Standard Reference Material". The recommended values for platinum, palladium, rhodium, gold and silver, and their 95% confidence limits are given in the following table. A copy of Technical Bulletin TB 182 will be forwarded with each order of PTM-1.

RECOMMENDED VALUES AND THEIR CONFIDENCE LIMITS FOR SELECTED ELEMENTS IN PTM-1

	Pt		Pd		Rh		Au		Ag	
	(oz/ton)	(ppm)	(oz/ton)	(ppm)	(oz/ton)	(ppm)	(oz/ton)	(ppm)	(oz/ton)	(ppm)
Recommended Value	0.17	5.8	0.24	8.1	0.026	0.9	0.052	1.8	1.9	66
95% Confidence Limits										
Low	0.16	5.5	0.22	7.4	0.021	0.7	0.047	1.6	1.7	59
High	0.18	6.2	0.26	8.8	0.030	1.0	0.057	1.9	2.1	73

Noble-Metals-Bearing Sulphide Concentrate, PTC-1

PTC-1, together with the previously described materials PTA-1 (p. 12) and PTM-1 (p. 13), completes a suite of certified reference materials containing the platinum-group metals. PTC-1 is a flotation concentrate of the Sudbury ore; its principal constituents are: Cu-5.2%; Ni-9.4%; Fe-26.9%; and S-23.5%.

Ten laboratories provided analyses for the certification of the selected elements. A statistical evaluation of these results yielded the recommended values and their 95% confidence limits given in the following table:

A full account of the work done on PTC-1 is given in Mines Branch Technical Bulletin TB 176, entitled "Noble-Metals-Bearing Sulphide Concentrate, PTC: Its Characterization and Preparation for Use as a Standard Reference Material". A copy of this bulletin will be forwarded with each order of PTC-1.

RECOMMENDED VALUES AND THEIR CONFIDENCE LIMITS FOR SELECTED ELEMENTS IN PTC-1

	Pt		Pd		Rh		Au		Ag	
	(oz/ton)	(ppm)	(oz/ton)	(ppm)	(oz/ton)	(ppm)	(oz/ton)	(ppm)	(oz/ton)	(ppm)
Recommended Value	0.087	3.0	0.37	12.7	0.018	0.62	0.019	0.65	0.17	5.8
95% Confidence Limits										
Low	0.081	2.8	0.35	12.0	0.016	0.55	0.016	0.55	0.16	5.5
High	0.093	3.2	0.38	13.0	0.020	0.69	0.021	0.72	0.18	6.2

Radioactive Ores, DH-1, DL-1, BL-1, BL-2, BL-3, and BL-4

These materials have been prepared to replace the previous reference materials of the Canadian Uranium Producers Analytical Sub-committee, the major supply of which is now exhausted. Materials from both of the uranium-producing areas of Canada have been selected. Two of the samples, DH-1 and DL-1 consist of ore-grade and waste-grade materials, respectively, from the Elliot Lake area of Ontario and contain both thorium and uranium. Four samples designated BL-1, BL-2, BL-3, and BL-4, from the Beaverlodge area of northwestern Saskatchewan, are relatively free of thorium, are in radioactive equilibrium, and cover a range of concentrations that should make them useful as reference materials for radiometric methods of analysis. The recommended values for uranium and thorium and their 95% confidence intervals are given in the following table:

RECOMMENDED VALUES FOR URANIUM AND THORIUM AND THEIR 95% CONFIDENCE INTERVALS

Designation	Description	Thorium, as Th Wt %	Based on	Uranium, as U Wt %	Based on
DH-1	Brannerite, Elliot Lake, Ont. Ore-Grade Material	0.104 ± 0.005	7 out of 8 Labs. (73 Observations)	0.117 ± 0.003	12 out of 12 Labs. (138 Observations)
DL-1	Brannerite, Elliot Lake, Ont. Waste Rock Material	ppm 83 ± 5	6 out of 8 Labs. (70 Observations)	0.0041 ± 0.0002	9 out of 10 Labs. (107 Observations)
BL-1	Pitchblende, Beaverlodge, Sask. Radiometric Reference Material	15 ± 1	5 out of 6 Labs. (59 Observations)	0.022 ± 0.001	8 out of 10 Labs. (90 Observations)
BL-2	Pitchblende, Beaverlodge, Sask. Radiometric Reference Material	(16 ± 4)*	5 out of 7 Labs. (45 Observations)	0.453 ± 0.005	10 out of 11 Labs. (110 Observations)
BL-3	Pitchblende, Beaverlodge, Sask. Radiometric Reference Material	(15 ± 6)*	3 out of 6 Labs. (33 Observations)	1.02 ± 0.01	10 out of 11 Labs. (110 Observations)
BL-4	Pitchblende, Beaverlodge, Sask. Radiometric Reference Material	(14 ± 3)*	4 out of 6 Labs. (41 Observations)	0.173 ± 0.004	12 out of 12 Labs. (140 Observations)

*Because of excessive between-laboratory variation, these values are for information only.

ROCKS

Syenites, SY-2 and SY-3

SY-2 is a syenite from the Bancroft area of Eastern Ontario. At the time of its preparation, in 1968, it was known that SY-2 contained "minor to trace" amounts of uranium, thorium, and rare earths, however analyses showed subsequently that the concentration of these constituents was lower than desired. Therefore, to produce a material having concentrations closer to the target values, a batch of syenite from the same source as SY-2 was ground, autogenously, with lumps of a "concentrate" containing uraninite, allanite and betafite; subsequently, this material was coded as SY-3.

Although SY-2 and SY-3 were prepared several years ago, and samples that were distributed internationally were analyzed on a rather casual basis to provide provisional values for a number of constituents, only recently were they analyzed in a systematic round-robin program to certify them as compositional reference materials. The recommended values for the major and minor constituents of SY-2 and SY-3 are given in the table below. An account of the certification program for SY-2 and SY-3 is given in CANMET Technical Report MSL 75-132 (TR) entitled "SY-2, SY-3 and MRG-1: A Report on the Collaborative Analysis of Three Canadian Rock Samples for Use as Certified Reference Materials". A copy of this report will be forwarded with each order for SY-2 and SY-3.

Gabbro, MRG-1

MRG-1 is an augite-olivine gabbro from Mount Royal (Montreal, Quebec) that was intruded into sedimentary rocks of the lower Paleozoic. MRG-1 is compositionally different from other certified reference rock samples and the recommended values given in the following table should be of interest to rock analysts. An account of the certification program for MRG-1 is given in CANMET Technical Report MSL 75-132 (TR) entitled "SY-2, SY-3 and MRG-1: A Report on the Collaborative Analysis of Three Canadian Rock Samples for Use as Certified Reference Materials". A copy of this report will be forwarded with each order for MRG-1.

RECOMMENDED VALUES FOR MAJOR AND MINOR CONSTITUENTS IN SY-2, SY-3 AND MRG-1

	SY-2	SY-3 (Wt %)	MRG-1
SiO_2	60.07	59.71	39.22
Al_2O_3	12.15	11.70	8.51
Fe_2O_3	2.31	2.46	8.36
FeO	3.61	3.61	8.61
MgO	2.66	2.63	13.49
CaO	8.03	8.30	14.68
Na_2O	4.37	4.17	0.72
K_2O	4.52	4.20	0.18
H_2O^+	0.41?	0.49?	1.02
CO_2	0.49?	0.36?	1.04
TiO_2	0.15	0.15	3.69
ZrO_2	0.04	0.04	0.01?
ThO_2	0.04?	0.11?	
RE_2O_3T*	0.09?	0.75?	0.01?
Sc_2O_3			0.01?
B_2O_3	0.03?	0.04?	
P_2O_5	0.44	0.55	0.08
V_2O_5	0.01	0.01	0.09
Nb_2O_5		0.02?	0.01?
F	0.47?	0.66	0.03?
S	0.01	0.05	0.06
Cr_2O_3			0.07
NiO			0.02
CoO			0.01
CuO			0.02
MnO	0.32	0.33	0.17
BaO	0.05	0.05	0.01
SrO	0.03	0.04	0.03
PbO	0.01	0.01	
ZnO	0.03	0.03	0.02
Li_2O	0.02	0.02	
Rb_2O	0.02	0.02	
U_3O_8	0.03	0.08	
Σ	100.41?	100.59?	100.20?
O/F,S	0.20?	0.30	0.04?
Σ (corrected)	100.21?	100.29?	100.16?
Fe_2O_3TR**	6.34	6.45	17.84
Fe_2O_3TC***	6.32	6.47	17.93

*RE_2O_3T: Total rare earth oxides.
**Fe_2O_3TR: Total iron, expressed as ferric oxide, reported as such.
***Fe_2O_3TC: Total iron, expressed as ferric oxide, calculated from FeO and Fe_2O_3.

METALS AND ALLOYS

Commercial Purity Copper Rods, SSC-1, SSC-2, SSC-3, and SSC-4

The copper rods are intended as reference materials for spectrographic purposes. They were prepared and tested for homogeneity in the Mines Branch during the period 1964-1966; the starting materials were donated by Canadian Copper Refiners Limited, Montreal, Quebec and Metals and Alloys Limited, Leaside, Ontario.

To dope the copper matrix, the "impurities", in granulated form, were mixed with high-purity anode swarf, the mixture was cold-pressed into pellets one inch in diameter, and then the pellets were added to molten high-purity copper in appropriate quantites.

For the certification of copper rods SSC-1 to SSC-4, ten laboratories provided analytical results for one or more of the "impurity" elements listed in the following table which gives the recommended values and their standard deviations.

CERTIFIED COMMERCIAL PURITY RODS SSC-1, SSC-2, SSC-3 and SSC-4

Element	SSC-1		SSC-2		SSC-3		SSC-4	
	Recommended Value	Standard Deviation	Recommended Value	Standard Deviation	Recommended Value	Standard Deviation	Recommended Value	Standard Deviation
				Concentration in ppm				
Ag	18.8	5.81	13.9	3.38	16.1	3.59	21.0	4.83
As	1.16	0.483	1.18	0.612	5.45	1.93	2.81	0.507
Bi	1.15	0.325	0.097	0.044	0.59	0.012	0.23	0.05
Cd	N.F.	—	10.0	1.05	N.F.	—	19.2	3.27
Fe	39.2	7.18	31.9	7.05	40.0	8.82	50.4	8.85
Ni	17.6	3.36	3.17	1.04	48.0	7.68	24.5	3.76
O	216	68.3	176	59.3	176	46.7	48.5	17.6
Pb	65.3	7.02	6.12	1.20	4.58	1.51	15.8	1.37
S	19.6	6.79	28.9	8.53	16.7	8.93	88.0	14.7
Sb	2.64	0.543	5.80	0.662	1.63	0.989	10.8	1.26
Se	7.28	1.61	2.58	0.821	3.87	0.744	2.87	0.79
Sn	54.9	6.70	10.0	1.93	12.0	1.68	21.4	2.60
Te	4.57	0.775	1.24	0.514	2.53	0.629	1.35	0.425
Zn	33.3	7.91	16.3	5.15	15.3	3.60	30.3	6.76
For information only								
Mn	2.18		2.75					
H	0.4		1.3					
N	5.2		7.1					

N.F. — Not Found.

1. The materials are in the form of hot-rolled rods, 12 x 5/6 in. dia. (30 x 0.8 cm).
2. Although some laboratories did not determine all the elements listed above, the results are based on the figures from a minimum of four and a maximum of eleven laboratories. The minimum number of determinations per element was seven, and the maximum fifty-one. The coefficient of variation ranged from 5.4% to 60.7%, with an overall mean of 25% at the 10 ppm level.

Phosphor Bronze Discs, 293, 304 and 477

These 6 cm x 0.7 cm phosphor bronze discs, weighing 160g each, are intended as reference alloys for spectrographic purposes; they were cast and tested for homogeneity in the Mines Branch in 1962.

For each phosphor bronze, a composite of chips from 10 randomly selected discs was prepared and a 100g sample of this material was sent to each of five participating laboratories for analysis. The recommended values for the constituents were determined mainly by chemical methods and are given in the following table:

RECOMMENDED VALUES FOR PHOSPHOR BRONZES

	293	304 (Wt %)	477
Cu	94.89	86.48	91.24
Sn	4.96	9.67	7.15
Fe	0.026	0.035	0.071
Pb	0.01	0.46	0.053
Zn	0.037	2.99	0.75
P	0.030	0.007	0.43
Al	—	0.05 (provisional)	—
Ni	—	—	0.12

MATERIALS WITH PROVISIONAL VALUES FOR SELECTED ELEMENTS

Sulphide-Bearing Ultramafic Rocks, UM-1, UM-2, and UM-4

Note: See page 7 for the certification of UM-1 for nickel, copper and cobalt.

UM-1 is a sulphide-bearing ultramafic rock from the Giant Mascot Mine at Hope, British Columbia. Materials UM-2 and UM-4 are similar to UM-1 but are from the Werner Lake-Gordon Lake district of northwestern Ontario. Although these rock samples are classified as reference materials, it is to be emphasized that they are intended for a rather special purpose, viz., as reference materials for the determination of ascorbic acid/hydrogen peroxide-soluble copper, nickel, and cobalt in ultramafic rocks. Such materials are useful in the evaluation of the ore potential of ultramafic rocks[1].

The details of the mineralogy of UM-1, UM-2, and UM-4 are given in Geological Survey of Canada Paper 71-35, entitled "Three Geochemical Standards of Sulphide-Bearing Ultramafic Rock: UM.1, UM.2 and UM.4[1]. Analyses, from this paper, for the major and minor elements are given in the following table. Note that these values are for information only and are not to be considered as a contribution toward the certification of UM-1, UM-2 and UM-4 as reference rocks which is not planned.

REFERENCE

1. Three Geochemical Standards of Sulphide-Bearing Ultramafic Rock: UM.1, UM.2, UM.4, compiled by E. M. Cameron, Geological Survey of Canada, Paper 71-35 (1972).

Constituent	UM-1	UM-2 (Wt %)	UM-4
SiO_2	37.6	39.2	39.35
TiO_2	0.10	0.24	0.35
Al_2O_3	1.00	7.23	8.98
Total Fe as FeO	17.2	12.95	12.8
MnO	0.16	0.08	0.15
MgO	36.05	25.45	22.5
CaO	2.34	4.68	6.27
Na_2O	0.08	0.32	0.45
K_2O	0.03	0.11	0.18
P_2O_5	0.00	0.02	0.02
H_2O	0.42	6.27	4.86
CO_2	0.26	0.10	0.26
S	3.53	0.94	0.44
Cr_2O_3	0.45	1.51	2.59
ZnO	0.012	0.004	0.008

G.S.C. Values for Copper, Nickel, and Cobalt by Ascorbic Acid/Hydrogen Peroxide Method.

Sample	Cu	Ni (Wt %)	Co
UM-1	0.41	0.83	0.029
UM-2	0.095	0.29	0.012
UM-4	0.054	0.19	0.007

MATERIALS BEING PROCESSED

The following are descriptions of materials that are being characterized and prepared for use as certified reference materials by the CCRMP as of January, 1976.

Zinc-Copper Ore RU-1

RU-1 was donated to the CCRMP by the Mining and Milling Division of Sherritt Gordon Mines Limited, Lynn Lake, Manitoba, and is from the Ruttan mine. Its approximate mineralogical composition is:

pyrite	—	60%
pyrrhotite	—	15%
chalcopyrite	—	3%
magnetite	—	15%
sphalerite	—	3%
pentlandite	—	1%

RU-1 has been ground to –200 mesh and blended, in one lot, in a conical blender. By means of X-ray fluorescence and chemical analyses it has been found to be suitably homogeneous. The ore has been bottled in 200g units and samples have been randomly selected for distribution to participating laboratories. RU-1 will be certified for zinc, copper, iron and sulphur.

Antimony Ore CD-1

CD-1 was donated to the CCRMP by Consolidated Durham Mines and Resources Limited, Fredericton, New Brunswick and is from the Lake George antimony deposit. The main ore mineral is stibnite and gangue sulphides are arsenopyrite and pyrite; some minor lead and copper sulphantimonides are also present.

CD-1 has been ground to –200 mesh and blended, in one lot, in a conical blender. By means of X-ray fluorescence and chemical analyses it has been found to be suitably homogeneous. The ore has been bottled in 200g units and samples have been randomly selected for distribution to participating laboratories. CD-1 will be certified for antimony and arsenic.

Canadian Soils SO-1, SO-2, SO-3, and SO-4

The Soil Research Institute, Agriculture Canada, with the assistance of the CCRMP, has organized an international program for the certification of four Canadian soil samples SO-1 to SO-4. The samples were obtained from the Canada Soil Survey Committee and their descriptions are: SO-1: a sample of the C horizon of Rideau clay, a Regosolic soil; SO-2: a sample of the B horizon of a Ferro-Humic Podzol; SO-3: a sample of calcareous glacial till parent material of the Guelph series, a Gray Brown Luvisol; and SO-4: a sample of the A horizon of a Black Chernozemic soil.

Each soil sample has been ground to –200 mesh, sterilized by dry heating, and blended, in one lot, in a conical blender. By means of X-ray fluorescence analysis, the soils have been found to be suitably homogeneous for bottling (200g units) and distribution to participating laboratories. It is hoped to certify the four soil samples for total content of as many elements as possible. In particular, data are sought for B, Cr, Mn, Co, Ni, Cu, Zn, Se, Mo, Cd, Pb and Hg.

Ferrous Materials

High-Purity Iron and Low-Alloy Steel (Secondary Reference Materials)

These materials, for use in the periodic checking of calibrations of optical emission spectrometers, are often referred to as "setting-up standards". They will be prepared with nominal analyses for: C, Mn, Si, S, P, Al, Sn, Cu, Ni, Cr, Mo, V, Co, Ti, Nb, Zr, and B. For the high-purity iron, the metal values will range from <0.001% to ~0.01%, and for the low-alloy steels, the range will be from ~0.03% to ~1.0%.

Blast Furnace Slag

An interlaboratory program is being established for the certification of a blast furnace slag for CaO, SiO, MgO, Al_2O_3, TiO_2, Cr_2O_3, V_2O_5, Na_2O, K_2O, MnO, P_2O_5, S and Fe.

PRICE LIST

(Shipping Costs Included)

ORES AND RELATED MATERIALS	Quantity (g)	Price $Can.
Molybdenum ore PR-1 (Mo-0.59%, Bi-0.11%, Fe-1.24%, S-0.79%)	200	$ 50.00
Zinc-Tin-Copper-Lead ore MP-1 (Zn-16.3%, Sn-2.50%, Cu-2.15%, Pb-1.93%, Mo-0.014%, In-0.071%, Bi-0.025, As-0.79%, Ag-59.5 ppm.)	200	50.00
Copper-Molybdenum ore HV-1 (Cu-0.52%, Mo-0.058%)	200	50.00
Nickel-Copper-Cobalt ore SU-1 (Ni-1.51%, Cu-0.87%, Co-0.063%)	100	25.00
Nickel-Copper-Cobalt ore UM-1* (Ni-0.88%, Cu-0.43%, Co-0.035%)	100	25.00
Zinc-Lead-Tin-Copper-Silver ore KC-1 (Zn-20.37%, Pb-6.98%, Sn-0.68%, Cu-0.114%, Ag-0.114%)	200	50.00
Iron ore SCH-1 (Fe-60.73%, Si-3.78%, Al-0.509%, Ca-0.029%, Mg-0.020%, Mn-0.777%, Ti-0.031%, S-0.007%, P-0.054%)	200	50.00
Tungsten ores CT-1 (W-1.04%), BH-1 (W-0.42%) and TLG-1 (W-0.083)	200	50.00
Gold ore MA-1 (Au-0.519 troy oz/ton (17.8 ppm)	200	50.00
Platiniferous black sand PTA-1 (Pt-0.09 oz/ton)	400	50.00
Noble-Metals-Bearing Copper-Nickel Matte PTM-1 (Pt-0.17, Pd-0.24, Rh-0.03, Au-0.05, Ag-1.9 oz/ton)	400	100.00
Noble-Metals-Bearing Sulphide Concentrate PTC-1 (Pt-0.09, Pd-0.37, Rh-0.02, Au-0.02, Ag-0.17 oz/ton)	200	50.00
Brannerite Elliot Lake DH-1 (U-0.177%, Th-0.104%)	200	50.00
Brannerite Elliot Lake DL-1 (U-0.0041%, Th-0.0083%)	200	50.00
Pitchblende Beaverlodge BL-1 (U-0.022%, Th-15 ppm)	100	25.00
Pitchblende Beaverlodge BL-2 (U-0.453%)	100	25.00
Pitchblende Beaverlodge BL-3 (U-1.02%)	100	25.00
Pitchblende Beaverlodge BL-4 (U-0.173%)	200	50.00

*Also issued as one of a suite of ultramafic rocks, UM-1, UM-2, and UM-4 with provisional values for hydrogen peroxide/ascorbic acid-soluble Ni, Cu and Co (see p. 20).

ROCKS	Quantity(g)	Price $Can.
Syenite SY-2	100	$ 25.00
Syenite SY-3 (enriched in radioactive minerals)	100	25.00
Gabbro MRG-1	100	25.00
Ultramafic Rock UM-1, UM-2, UM-4, each (provisional values for ascorbic acid-hydrogen peroxide soluble Cu, Ni, and Co)	100	25.00
METALS AND ALLOYS		
Phosphor-Bronze Discs (5.7 x 0.95 cm) (Sn-5, 7 and 10% nominal)	Set of three	60.00
Commercial Purity Copper Rods SSC-1-4 (30 x 0.79 cm)	Set of four	160.00

PURCHASE PROCEDURE

Purchase orders for certified reference materials should be addressed to:

Chairman
Canadian Certified Reference Materials Project
C/O Mineral Sciences Laboratories
Canada Centre for Mineral and Energy Technology
555 Booth Street
Ottawa, Ontario
K1A 0G1

Prices are subject to revision; when possible, customers will be notified of such change before their orders are dispatched. Payment is expected within 30 days of receipt of the CCRMP invoice. Payment on foreign invoices can be made by:

(a) banker's draft against a Canadian bank,
(b) bank to bank transfer to a Canadian bank,
(c) letter of credit on a Canadian bank,
(d) International Money Order, or
(e) UNESCO coupons.

Please make cheques, drafts, etc., payable to "Receiver General for Canada (re: Canadian Certified Reference Materials Project)". No discounts are available.

Shipments in Canada and to the U.S.A. will be made by first-class mail; those to South America and overseas by non-priority air-mail when possible, otherwise by surface mail.

Revised schedules, when issued, will be sent to customers who have made purchases during the previous twelve months and to persons and organizations who request them.