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Certificate of Analyses

Spectroscopic Standards Nos. 551-556

PHOSPHOR BRONZES

(COVERING B.S. 1400: 1961 PB1, PB2, PB3 and PB4)

Prepared under rigorous laboratory conditions and, AFTER STANDARDIZATION BY ANALYSTS IN GREAT BRITAIN and the U.S.A., issued by the Bureau of Analysed Samples, Ltd.

These alloys were specially prepared in the form of continuously cast bar to ensure maximum homogeneity, and were supplied by Kent Alloys Ltd., Rochester.

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[P.T.O.

ANALYSES

Analyst No.	Sn %	P %	Pb %	Ni %	Zn %	Cu %	Si %	Fe %	Al %	Sb %	Bi %
1	8·82	1·00	0·78	0·75	0·74	87·47	0·019	0·20	0·051	*0·01*	*0·010*
2	8·99	..	..	0·74	0·75	87·42	..	..	0·046	..	..
3	9·02	1·00	0·82	0·81	0·72	..	..	..	..	..	..
4	..	..	0·82	0·75	0·74	..	0·016	..	0·050	..	..
5	8·83	1·00	0·77	0·78	0·76	..	0·018	0·18	0·051	*0·01*	..
6	8·95	1·02	0·79	0·74	0·72	..	..	..	..	..	..
7	..	..	..	..	..	..	..	0·20	..	..	..
8	..	..	..	0·75	0·74	87·35	0·019	0·20	..	..	..
9	..	1·01	0·80	..	..	..	0·016	0·20	0·056	..	..
10	..	0·99	..	..	..	87·38	0·021	0·21	0·058	..	..
11	8·94	1·02	0·77	0·76	0·72	87·36	..	..	..	..	..
Average	**8·92**	**1·01**	**0·79**	**0·76**	**0·74**	**87·4–**	**0·018**	**0·20**	**0·052**	..	..
1	9·76	0·75	0·63	0·56	0·34	87·77	0·019	0·10	0·022	*0·01*	*0·009*
2	9·72	..	..	0·54	0·35	87·74	..	..	0·021	..	..
3	9·88	0·78	0·65	0·59	0·34	..	..	..	..	..	..
4	..	..	0·62	0·55	0·35	..	0·019	..	0·020	..	..
5	9·92	0·78	0·61	0·55	0·36	..	0·019	0·10	0·023	*0·01*	..
6	9·65	0·76	0·62	0·55	0·35	..	..	..	..	..	..
7		..	..	..	..	..	..	0·10	..	..	..
8	..	..	0·64	0·56	0·35	87·70	0·019	0·12	..	..	..
9	..	0·75	0·63	..	..	..	0·020	0·10	0·026	..	..
10	..	0·78	..	..	..	87·78	0·019	0·10	0·024	..	..
11	9·76	0·80	0·64	0·56	0·34	87·64	..	..	..	..	..
Average	**9·78**	**0·77**	**0·63**	**0·56**	**0·35**	**87·7–**	**0·019**	**0·10**	**0·023**	..	
1	10·69	0·67	0·48	0·43	0·48	87·08	0·023	0·059	0·018	*0·01*	*0·010*
2	10·70	..	..	0·41	0·49	87·00	..	..	0·015	..	..
3	10·90	0·66	0·48	0·49	0·47	..	..	..	..	..	..
4	..	..	0·45	0·42	0·50	..	0·024	..	0·014	..	..
5	10·86	0·70	0·46	0·42	0·49	..	0·022	0·052	0·018	*0·01*	..
6	10·72	0·67	0·46	0·40	0·50	..	..	..	..	..	..
7	..	..	..	..	..	..	..	0·056	..	..	..
8	..	..	0·47	0·46	0·49	87·00	0·023	0·059	..	..	..
9	..	0·66	0·47	..	..	..	0·020	0·055	0·019	..	..
10	..	0·67	..	..	..	87·06	0·020	0·052	0·018	..	..
11	10·89	0·70	0·48	0·47	0·53	86·98	..	..	..	..	..
Average	**10·8–**	**0·68**	**0·47**	**0·44**	**0·49**	**87·0–**	**0·022**	**0·056**	**0·017**	..	..

Sample No.	Analyst No.	Sn %	P %	Pb %	Ni %	Zn %	Cu %	Si %	Fe %	Al %	Sb %	Bi %
554	1	11·22	0·40	0·33	0·22	0·23	87·40	0·039	0·024	0·005	*0·02*	*0·010*
	2	11·27	..	..	0·22	0·23	87·41	..	..	0·005	..	..
	3	11·44	0·40	0·33	0·21	0·22	..	..	..	..	..	..
	4	..	..	0·34	0·22	0·21	..	0·039	..	0·005	..	..
	5	11·21	0·42	0·34	0·19	0·22	..	0·037	0·020	0·006	*0·01*	..
	6	11·35	0·40	0·33	0·22	0·23	..	..	..	..	..	..
	7	..	..	..	..	..	..	..	0·024	..	..	..
	8	..	..	0·34	0·23	0·23	87·35	0·038	0·021	..	..	..
	9	..	0·39	0·33	..	..	..	0·037	0·023	0·006	..	..
	10	..	0·41	..	..	..	87·40	0·040	0·018	0·005	..	..
	11	11·33	0·42	0·34	0·24	0·23	87·29	..	..	..	..	..
	Average	**11·3–**	**0·41**	**0·34**	**0·22**	**0·22**	**87·4–**	**0·038**	**0·022**	**0·005**	..	..
555	1	12·07	0·17	0·24	0·12	0·15	87·16	0·036	0·011	<0·005	*0·02*	*0·012*
	2	12·05	..	..	0·11	0·17	87·15	..	..	<0·005	..	..
	3	12·17	0·19	0·25	0·11	0·15	..	..	..	..	..	..
	4	..	..	0·23	0·10	0·16	..	0·038	..	0·005	..	..
	5	12·05	0·18	0·24	0·11	0·15	..	0·037	0·011	0·005	*0·02*	..
	6	11·96	0·18	0·23	0·11	0·16	..	..	..	..	..	..
	7	..	..	..	..	..	..	..	0·011	..	..	..
	8	..	..	0·25	0·13	0·16	87·11	0·036	0·009	..	..	..
	9	..	0·17	0·24	..	..	..	0·031	0·011	<0·001	..	..
	10	..	0·16	..	..	..	87·15	0·035	0·010	0·005	..	..
	11	12·23	0·18	0·25	0·12	0·17	87·01	..	..	..	..	..
	Average	**12·1–**	**0·13**	**0·24**	**0·11**	**0·16**	**87·1–**	**0·036**	**0·010**	**<0·005**	..	..
556	1	13·16	0·098	0·16	0·016	0·09–	86·42	<0·005	0·005	<0·005	*0·02*	*0·013*
	2	13·18	..	..	0·013	0·10–	86·44	..	..	<0·005	..	..
	3	13·39	0·10–	0·16	0·012	0·09–	..	..	..	..	..	..
	4	..	..	0·15	0·016	0·10–	..	0·004	..	0·005	..	..
	5	13·35	0·101	0·15	0·011	0·088	..	<0·005	0·005	0·004	*0·02*	..
	6	13·10	0·10–	0·16	0·014	0·090	..	..	..	..	..	..
	7	..	..	..	..	..	..	..	0·004	..	..	..
	8	..	..	0·15	0·017	0·084	86·38	<0·005	0·004	..	..	..
	9	..	0·096	0·16	..	..	..	<0·002	0·004	<0·001	..	..
	10	..	0·11–	..	..	..	86·42	<0·005	0·004	<0·005	..	..
	11	13·22	0·101	0·16	0·017	0·10–	86·43	..	..	..	..	..
	Average	**13·2–**	**0·10–**	**0·16**	**0·014**	**0·09–**	**86·4–**	**<0·005**	**0·004**	**<0·005**	..	..

The above figures are those which each analyst has decided upon after careful verification.
Figures in bold type standardised, figures in small italic type only approximate

S.S. Nos. 551-556 PHOSPHOR BRONZES

NOTES ON METHODS USED

TIN

All analysts determined tin by titration. Nos. 1, 2, 3 and 6 carried out a preliminary separation of the tin and reduced with metallic nickel according to the Standard method B.S. 1748: Part 6: 1960. Nos. 5 and 11 reduced with hypophosphorous acid.

Analyst No. 2 also determined tin by atomic absorption spectroscopy and obtained the following results: No. 551 8·91%, No. 552 9·74%, No. 553 10·58%, No. 554 11·27%, No. 555 12·07%, No. 556 13·19%.

PHOSPHORUS

Analysts Nos. 1, 3, 5, 6 and 11 determined phosphorus by titration after precipitation of ammonium phosphomolybdate. Nos. 1, 5 and 6 used the Analoid method No. 28. Nos. 9 and 10 determined phosphorus colorimetrically as phosphovanadomolybdic acid; No. 9 used the A.S.T.M. method Designation E62, No. 10 used the Standard method B.S. 1748: Part 8: 1960.

LEAD

Analyst No. 1 determined lead polarographically. Tin was first removed by volatilisation as the bromide and lead was separated from copper by precipitation with ammonia solution after the addition of an iron carrier; the hydroxide precipitate was dissolved in hydrochloric acid and the iron reduced with ascorbic acid before polarographing. Nos. 3, 5, 6, 8 and 9 determined lead by atomic absorption spectroscopy. No. 4 determined lead electrolytically as lead dioxide according to the Standard method B.S. 1748: Part 2: 1961. No. 11 separated the lead electrolytically and determined it gravimetrically after conversion to lead molybdate.

NICKEL

Analysts Nos. 1, 4 and 11 determined nickel colorimetrically with dimethylglyoxime after separation of copper by electrolysis; No. 4 used the Standard method B.S. 1748: Part 5: 1961. Nos. 2, 5, 6 and 8 determined nickel by atomic absorption spectroscopy. No. 3 used atomic absorption spectroscopy for all samples except No. 556 in which nickel was determined colorimetrically according to the British Standard method.

Analyst No. 2 also determined nickel gravemetrically with dimethylglyoxime in some of the samples and obtained the following results: No. 553 0·39%, No. 555 0·11%, No. 556 0·014%.

ZINC

Analyst No. 1 separated zinc by ion-exchange according to the Standard method B.S. 1748: Part 9: 1963; Nos. 551, 552 and 553 were completed by titration with EDTA, Nos. 554, 555 and 556 polarographically. Nos. 2, 3, 5, 6 and 8 determined zinc by atomic absorption spectroscopy. Nos. 4 and 11 titrated with EDTA after separation of copper by electrolysis (No. 4) or after separation of zinc by ion-exchange (No. 11).

COPPER

All analysts determined copper electrolytically. Nos. 1 and 10 carried out a preliminary separation of the tin by evaporation with hydrobromic acid/bromine according to the Standard method B.S. 1748: Part 1: 1961. No. 2 electrolysed from a nitro-fluoroboric sulphuric acid electrolyte. No. 8 dissolved the sample in nitric acid, filtered off the metastannic acid and determined copper in the filtrate; the copper occluded in the metastannic acid was determined by atomic absorption spectroscopy after dissolving in hydrochloric acid and this was added to the copper determined by electro-deposition.

Analyst No. 10 also determined copper electrolytically using a nitric/hydrofluoric acid solution followed by dissolution of the deposit and re-deposition from a solution containing ammonium nitrate. The results were: No. 551 87·38%, No. 552 87·75%, No. 553 87·00%, No. 554 87·30%, No 555 87·06%, No. 556 86·34%.

SILICON

Analysts Nos. 1, 4, 5, 8 and 10 determined silicon colorimetrically as the molybdenum-blue complex in accordance with the Standard method B.S. 1748: Part 7: 1960. No. 9 determined silicon by atomic absorption spectroscopy after extraction as the molybdate into methyl *iso*-butyl ketone.

IRON

Analysts Nos. 1, 7, 9 and 10 determined iron colorimetrically with 1,10-phenanthroline Nos. 1 and 10 carried out a preliminary separation of tin and copper by treatment with hydrobromic acid/bromine followed by electrolysis. No. 7 separated tin, lead and copper with hydrogen sulphide. No. 9 separated iron by extraction into methyl *iso*-butyl ketone. Nos. 5 and 8 determined iron by atomic absorption spectroscopy.

ALUMINIUM

Analysts Nos. 1, 4 and 10 carried out a preliminary mercury-cathode separation and determined aluminium colorimetrically with aluminon (Elwell and Scholes, Analysis of Copper and its Alloys, Pergamon Press, 1967). Nos. 2 and 5 used atomic absorption spectroscopy. No. 9 carried out a mercury-cathode separation and determined aluminium colorimetrically after extraction of the oxinate from cyanide solution.

ANTIMONY

Analyst No. 1 separated copper as cuprous iodide and determined antimony colorimetrically as the iodoantimonite complex. No. 5 used atomic absorption spectroscopy.

BISMUTH

Bismuth was determined colorimetrically as the iodide after separation of copper as cuprous iodide.

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For BUREAU OF ANALYSED SAMPLES LTD.
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