



NS Enterprises is a trusted manufacturer and supplier of premium ***non-ferrous metal products and casting solutions***, serving diverse industrial applications across India and global markets ***since 1984***.

Non-Ferrous Material Grades & Specifications

A background image showing a large stack of metal pipes or tubes, arranged in a grid-like pattern. The pipes are dark in color, possibly black or dark grey, and are stacked in several rows. The image is partially obscured by a large red diagonal shape that covers the bottom left and bottom right portions of the page.

With decades of metallurgical expertise and a well-organised production setup, we manufacture non-ferrous castings that comply with internationally recognised material standards and stringent industrial requirements.

This booklet serves as a technical reference to the non-ferrous material grades produced by NS Enterprises, covering ASTM, DIN, IS, SAE, and other global specifications to support accurate and reliable material selection.

All products are manufactured and supplied in all grades as per international and national standards including:

ASTM (American Standard)



Copper Alloys	CU	SN	PB	ZN	FE	NI	P	AL	MN	SI	SB	S	BI
Aluminum Bronze													
C60800	Rem.	-	0.1	-	0.1	-	-	5-6.5	-	-	-	-	-
C61000	Rem.	-	0.02	0.2	0.5	-	-	6-8.5	-	0.1	-	-	-
C61300	Rem.	0.2-0.5	0.01	0.1	2-3	0.15	0.015	6-7.5	0.2	0.1	-	-	-
C61400	Rem.	-	0.01	0.2	1.5-3.5	-	0.015	6-8	1	-	-	-	-
C61500	Rem.	-	0.015	-	-	1.8-2.2	-	7.7-8.3	-	-	-	-	-
C61550	Rem.	0.05	0.05	-	0.2	1.5-2.5	-	5.5-6.5	1	-	-	-	-
C61800	Rem.	-	0.02	0.02	0.5-1.5	-	-	8.5-11	-	0.1	-	-	-
C61900	Rem.	0.6	0.02	0.8	3-4.5	-	-	8.5-10	-	-	-	-	-
C62200	Rem.	-	0.02	0.02	3-4.2	-	-	11-12	-	0.1	-	-	-
C62300	Rem.	0.6	-	-	2-4	1	-	8.5-10	0.5	0.25	-	-	-
C62400	Rem.	0.2	-	-	2-4.5	-	-	10-11.5	0.3	0.25	-	-	-
C62500	Rem.	-	-	-	3.5-5.5	-	-	12.5-13.5	2	-	-	-	-
C62580	Rem.	-	0.02	0.02	3-5	-	-	12-13	-	0.04	-	-	-
C62581	Rem.	-	0.02	0.02	3-5	-	-	13-14	-	0.04	-	-	-
C62582	Rem.	-	0.02	0.2	3-5	-	-	14-15	-	0.04	-	-	-
C63000	Rem.	0.2	-	0.3	2-4	4-5.5	-	9-11	1.5	0.25	-	-	-
C63010	78 Min	0.2	-	0.3	2-3.5	4.5-5.5	-	9.7-10.9	1.5	-	-	-	-
C63020	74.5 Min	0.25	0.03	0.3	4-5.5	4.2-6	-	10-11	1.5	-	-	-	-
C63200	Rem.	-	0.02	-	3.5-4.3	4-4.8	-	8.7-9.5	1.2-2	0.1	-	-	-
C63280	Rem.	-	0.02	-	3-5	4-5.5	-	8.5-9.5	0.6-3.5	-	-	-	-
C63380	Rem.	-	0.02	0.15	2-4	1.5-3	-	7-8.5	11-14	0.1	-	-	-
C95200	86 Min	-	-	-	2.5-4	-	-	8.5-9.5	-	-	-	-	-
C95210	86 Min	0.1	0.05	0.5	2.5-4	1	-	8.5-9.5	1	0.25	-	-	-
C95220	Rem.	-	-	-	2.5-4	2.5	-	9.5-10.5	0.5	-	-	-	-
C95300	86 Min	-	-	-	0.8-1.5	-	-	9-11	-	-	-	-	-
C95400	83 Min	-	-	-	3-5	1.5	-	10-11.5	0.5	-	-	-	-
C95410	83 Min	-	-	-	3-5	1.5-2.5	-	10-11.5	0.5	-	-	-	-
C95420	83.5 Min	-	-	-	2-4.5	0.5	-	10.5-12	0.5	-	-	-	-
C95500	78 Min	-	-	-	3-5	3-5.5	-	10-11.5	3.5	-	-	-	-
C95510	78 Min	0.2	-	0.3	2-3.5	4.5-5.5	-	9.7-10.9	1.5	-	-	-	-
C95520	74.5 Min	0.25	0.03	0.3	4-5.5	4.2-6	-	10.5-11.5	1.5	0.15	-	-	-
C95700	71 Min	-	-	-	2-4	1.5-3	-	7-8.5	11-14	0.1	-	-	-
C95710	71 Min	1	0.05	0.5	2-4	1.5-3	-	7-8.5	11-14	0.15	-	-	-
C95720	73 Min	0.1	0.03	0.1	1.5-3.5	3-6	-	6-8	12-15	0.1	-	-	-
C95800	78 Min	-	0.03	-	3.5-4.5	4-5	-	8.5-9.5	0.8-1.5	0.1	-	-	-
C95810	79 Min	-	0.1	0.5	3.5-4.5	4-5	-	8.5-9.5	0.8-1.5	0.1	-	-	-
C95820	77.5 Min	0.2	0.02	0.2	4-5	4.5-5.8	-	9-10	1.5	0.1	-	-	-
C95900	Rem.	-	-	-	3-5	0.5	-	12-13.5	1.5	-	-	-	-

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ASTM (American Standard)



Copper Alloys	CU	SN	PB	ZN	FE	NI	P	AL	MN	SI	SB	S	BI
Tin Bronze													
C89320	87-91	5-7	0.09	1	0.2	1	0.3	0.005	-	0.005	0.35	0.08	4-6
C40820	94 Min	1-2.5	0.02	0.2-2.5	-	0.1-0.5	0.05	-	-	-	-	-	-
C50100	Rem.	0.5-0.8	0.05	-	0.05	-	0.01-0.05	-	-	-	-	-	-
C50200	Rem.	1-1.5	0.05	-	0.1	-	0.04	-	-	-	-	-	-
C50500	Rem.	1-1.7	0.05	0.3	0.1	-	0.03-0.35	-	-	-	-	-	-
C50510	Rem.	1-1.5	-	0.1-0.25	-	0.15-0.4	0.02-0.07	-	-	-	-	-	-
C50580	Rem.	1-1.7	0.05	0.3	0.05-0.2	0.05-0.2	0.01-0.35	-	-	-	-	-	-
C50590	Rem.	0.5-1.5	0.02	0.5	0.05-0.4	-	0.02-0.15	-	-	-	-	-	-
C50700	Rem.	1.5-2	0.05	-	0.1	-	0.3	-	-	-	-	-	-
C50705	Rem.	1.5-2	0.02	0.5	0.1-0.4	-	0.04-0.15	-	-	-	-	-	-
C50710	Rem.	1.7-2.3	-	-	-	0.1-0.4	0.15	-	-	-	-	-	-
C50715	Rem.	1.7-2.3	0.02	-	0.05-0.15	-	0.03-0.04	-	-	-	-	-	-
C50725	Rem.	1.5-2.5	0.02	1.5-3	0.05-0.2	-	0.02-0.06	-	-	-	-	-	-
C50780	Rem.	1.7-2.3	0.05	0.3	0.05-0.2	0.05-0.2	0.01-0.35	-	-	-	-	-	-
C50900	Rem.	2.5-3.8	0.05	0.3	0.1	-	0.03-0.3	-	-	-	-	-	-
C51000	Rem.	4.2-5.8	0.05	0.3	0.1	-	0.03-0.35	-	-	-	-	-	-
C51080	Rem.	4.8-5.8	0.05	0.3	0.05-0.2	0.05-0.2	0.01-0.35	-	-	-	-	-	-
C51100	Rem.	3.5-4.9	0.05	0.3	0.1	-	0.03-0.35	-	-	-	-	-	-
C51180	Rem.	3.5-4.9	0.05	0.3	0.05-0.2	0.05-0.2	0.01-0.35	-	-	-	-	-	-
C51190	Rem.	3-6.5	0.02	-	0.05-0.15	-	0.03-0.05	-	-	-	-	-	-
C51800	Rem.	4-6	0.02	-	-	-	0.10-0.35	0.01	-	-	-	-	-
C51900	Rem.	5-7	0.05	0.3	0.1	-	0.3-0.35	-	-	-	-	-	-
C51980	Rem.	5.5-7	0.05	0.3	0.05-0.2	0.05-0.2	0.01-0.35	-	-	-	-	-	-
C52100	Rem.	7-9	0.05	0.2	0.1	-	0.03-0.35	-	-	-	-	-	-
C52180	Rem.	7-9	0.05	0.3	0.05-0.2	0.05-0.2	0.01-0.35	-	-	-	-	-	-
C52400	Rem.	9-11	0.05	0.2	0.1	-	0.03-0.35	-	-	-	-	-	-
C52480	Rem.	9-11	0.05	0.3	0.05-0.2	0.05-0.2	0.1-0.35	-	-	-	-	-	-
C53400	Rem.	3.5-5.8	0.8-1.2	0.3	0.1	-	0.03-0.35	-	-	-	-	-	-
C53800	Rem.	13-1-13.9	0.4-0.6	0.1	0.03	0.03	-	-	0.06	-	-	-	-
C89325	84-88	9-11	0.1	1	0.15	1	0.1	0.005	-	0.005	0.5	0.08	2.7-3.7
C89510	86-88	4-6	0.25	4-6	0.2	1	0.05	0.005	-	0.005	0.25	0.08	0.5-1.5
C89520	85-87	5-6	0.25	4-6	0.2	1	0.05	0.005	-	0.005	0.25	0.08	1.6-2.2
C89530	84-89	3.5-6	0.2	7-9	0.3	1	0.05	0.01	-	0.01	0.2	-	1-2
C89831	87-91	2.7-3.7	0.1	2-4	0.3	1	0.05	0.005	-	0.005	0.25	0.08	2.7-3.7
C89833	87-91	4-6	0.1	2-4	0.3	1	0.05	0.005	-	0.005	0.25	0.08	1.7-2.7
C89835	85-89	6-7.5	0.1	2-4	0.2	4-15	0.1	0.005	-	0.005	0.35	0.08	1.7-2.7
C89836	87-91	4-7	0.25	2-4	0.35	0.9	0.06	0.005	-	0.005	0.25	0.08	1.5-3.5
C89837	84-88	3-4	0.1	6-10	0.3	1	0.05	0.005	-	0.005	0.25	0.08	0.7-1.2
C89844	83-86	3-5	0.2	7-10	0.3	1	0.05	0.005	-	0.15	0.25	0.08	2-4
C89940	64-68	3-5	0.01	3-5	0.7-2	20-23	0.1-0.15	0.005	-	0.15	0.2	0.05	4-5.5
C90300	86-89	7.5-9	0.3	3-5	0.2	1	0.05	0.005	-	0.15	0.2	0.05	-

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Leaded Bronze													
C92410	Rem.	6-8	2.5-3.5	1.5-3	0.2	0.2	-	0.005	0.05	0.005	0.25	-	-
C93400	82-85	7-9	7-9	0.8	0.2	1	0.5	0.005	-	0.005	0.5	0.08	-
C93500	83-86	4.3-6	8-10	2	0.2	1	0.05	0.005	-	0.005	0.3	0.08	-
C93600	79-83	6-8	11-13	1	0.2	1	0.15	0.005	-	0.005	0.55	0.08	-
C93700	78-82	9-11	8-11	0.8	0.7	0.5	0.1	0.005	-	0.005	0.5	0.08	-
C93720	83 Min	3.5-4.5	7-9	4	0.7	0.5	0.1	-	-	-	0.5	-	-
C93800	75-79	6.3-7.5	13-16	0.8	0.15	1	0.05	0.005	-	0.005	0.8	0.08	-
C93900	76.5-79.5	5-7	14-18	1.5	0.4	0.8	0.15	0.005	-	0.005	0.5	0.08	-
C94000	69-72	12-14	14-16	0.5	0.25	0.50-1	0.05	0.005	-	0.005	0.5	0.08	-
C94100	72-79	4.5-6.5	18-22	1	0.25	1	0.5	0.005	-	0.005	0.8	0.08	-
C94300	67-72	4.5-6	23-27	0.8	0.15	1	0.08	0.005	-	0.005	0.8	0.08	-
C94310	Rem.	1.5-3	27-34	0.5	0.5	0.25-1	0.05	-	-	-	0.5	-	-
C94320	Rem.	4-7	24-32	-	0.35	-	-	-	-	-	-	-	-
C94330	68.5-75.5	3-4	21-25	3	0.7	0.5	0.1	-	-	-	0.5	-	-
C94400	Rem.	7-9	9-12	0.8	0.15	1	0.5	0.005	-	0.005	0.8	0.08	-
C94500	Rem.	6-8	16-22	1.2	0.25	1	0.05	0.005	-	0.005	0.8	0.08	-
C98200	Rem.	0.6-2	21-27	0.5	0.7	0.5	0.1	-	-	-	0.5	-	-
C98400	Rem.	0.5	26-33	0.5	0.7	0.5	0.1	-	-	-	0.5	-	-
C98600	60-70	0.5	30-40	-	0.35	-	-	-	-	-	-	-	-
C98800	56.5-62.5	0.25	37.5-42.5	0.1	0.35	-	0.02	-	-	-	-	-	-
C98820	Rem.	1-5	40-44	-	0.35	-	-	-	-	-	-	-	-
C98840	Rem.	1-5	44-58	-	0.35	-	-	-	-	-	-	-	-
Brass													
C21000	94-96	-	0.05	Rem.	0.05	-	-	-	-	-	-	-	-
C22000	89-91	-	0.05	Rem.	0.05	-	-	-	-	-	-	-	-
C22600	86-89	-	0.05	Rem.	0.05	-	-	-	-	-	-	-	-
C23000	84-86	-	0.05	Rem.	0.05	-	-	-	-	-	-	-	-
C23400	81-84	-	0.05	Rem.	0.05	-	-	-	-	-	-	-	-
C24000	78.5-81.5	-	0.05	Rem.	0.05	-	-	-	-	-	-	-	-
C24080	78-82	-	0.2	Rem.	-	-	-	0.1	-	-	-	-	-
C25600	71-73	-	0.05	Rem.	0.05	-	-	-	-	-	-	-	-
C26000	68.5-71.5	-	0.07	Rem.	0.05	-	-	-	-	-	-	-	-
C26130	68.5-71.5	-	0.05	Rem.	0.05	-	-	-	-	-	-	-	-
C26200	67-70	-	0.07	Rem.	0.05	-	-	-	-	-	-	-	-
C26800	64-68.5	-	0.15	Rem.	0.05	-	-	-	-	-	-	-	-
C27000	63-68.5	-	0.132	Rem.	0.07	-	-	-	-	-	-	-	-
C27200	62-65	-	0.07	Rem.	0.07	-	-	-	-	-	-	-	-
C27400	61-64	-	0.1	0.8	0.05	-	-	-	-	-	-	-	-
C28000	59-63	-	0.3	Rem.	0.07	-	-	-	-	-	-	-	-
C31200	87.5-90.5	-	0.7-1.2	Rem.	0.1	0.25	-	-	-	-	-	-	-
C31400	87.5-90.5	-	1.3-2.5	Rem.	0.1	0.7	-	-	-	-	-	-	-

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Tin Bronze													
C90200	91-94	6-8	0.3	0.5	0.2	0.5	0.05	0.005	-	0.005	0.2	0.05	-
C90500	86-89	9-11	0.3	1-3	0.2	1	0.05	0.005	-	0.005	0.2	0.05	-
C90700	88-90	10-12	0.5	0.5	0.15	0.5	0.3	0.005	-	0.005	0.2	0.05	-
C90710	Rem.	10-12	0.25	0.05	0.1	0.1	0.05-1.2	0.005	-	0.005	0.2	0.05	-
C90800	85-89	11-13	0.25	0.25	0.15	0.5	0.3	0.005	-	0.005	0.2	0.05	-
C90810	Rem.	11-13	0.25	0.3	0.15	0.5	0.15-0.8	0.005	-	0.005	0.2	0.05	-
C90900	86-89	12-14	0.25	0.25	0.15	0.5	0.05	0.005	-	0.005	0.2	0.05	-
C91000	84-86	14-16	0.2	1.5	0.1	0.8	0.05	0.005	-	0.005	0.2	0.05	-
C91100	82-85	15-17	0.25	0.25	0.25	0.5	1	0.005	-	0.005	0.2	0.05	-
C91300	79-82	18-20	0.25	0.25	0.25	0.5	1	0.005	-	0.005	0.2	0.05	-
C91600	86-89	9.7-10.3	0.25	0.25	0.2	1.2-2	0.3	0.005	-	0.005	0.2	0.05	-
C91700	84-87	11.3-12.5	0.25	0.25	0.2	1.2-2	0.3	0.005	-	0.005	0.2	0.05	-
C92200	86-90	5.5-6.5	1-2	3-5	0.25	1	0.05	0.005	-	0.005	0.25	0.05	-
C92300	85-89	7.5-9	0.3-1	2.5-5	0.25	1	0.05	0.005	-	0.005	0.25	0.05	-
C92310	Rem.	7.5-8.5	0.3-1.5	3.5-4.5	-	1	-	0.005	0.03	0.005	-	-	-
C92400	86-89	9-11	1-2.5	1-3	0.25	1	0.05	0.005	-	0.005	0.25	0.05	-
C92500	85-88	10-12	1-1.5	0.5	0.3	0.8-1.5	0.3	0.005	-	0.005	0.25	0.05	-
C92600	86-88.5	9.3-10.5	0.8-1.5	1.3-2.5	0.2	0.7	0.03	0.005	-	0.005	0.25	0.05	-
C92610	Rem.	9.5-10.5	0.3-1.5	1.7-2.8	0.15	1	-	0.005	0.03	0.005	-	-	-
C92700	86-89	9-11	1-2.5	0.7	0.2	1	0.25	0.005	-	0.005	0.25	0.05	-
C92710	Rem.	9-11	4-6	1	0.2	2	0.1	0.005	-	0.005	0.25	0.05	-
C92800	78-82	15-17	4-6	0.8	0.2	0.8	0.05	0.005	-	0.005	0.25	0.05	-
C92810	78-82	12-14	4-6	0.5	0.5	0.8-1.2	0.05	0.005	-	0.005	0.25	0.05	-
C92900	82-86	9-11	2-3.2	0.25	0.2	2.8-4	0.5	0.005	-	0.005	0.25	0.05	-
C93100	Rem.	6.5-8.5	2-5	2	0.25	1	0.3	0.005	-	0.005	0.25	0.05	-
C93200	81-85	6.3-7.5	6-8	1-4	0.2	1	0.15	0.005	-	0.005	0.35	0.08	-
Gun Metal													
C83300	92-94	1-2	1-2	2-6	-	-	-	0.005	-	-	-	-	-
C83450	87-89	2.2-3	1.5-2.5	5.5-7.5	0.25	0.8-1.5	0.03	0.005	-	0.005	0.25	0.08	-
C83500	86-88	5.5-6.5	3.5-5.5	1-2.5	0.25	0.5-1	0.03	0.005	-	0.005	0.25	0.08	-
C83600	84-86	4.3-6	4.5-7	4.3-6	0.25	1	0.05	0.005	-	0.005	0.25	0.08	-
C83800	82-83.5	3.5-4.2	5.8-6.8	5.5-8	0.25	1	0.03	0.005	-	0.005	0.25	0.08	-
C83810	Rem.	2-3.5	4-6	7.5-9.5	0.5	2	-	0.005	-	0.1	-	-	-
C84200	78-82	4-6	2-3	10-16	0.4	0.8	0.05	0.005	-	0.005	0.25	0.08	-
C84400	79-82	2.5-3.5	6-8	7-10	0.4	0.8	0.02	0.005	-	0.005	0.25	0.08	-
C84410	Rem.	3-4.5	7-9	7-11	-	1	-	0.01	-	0.2	-	-	0.05
C84500	77-79.2	2-4	6-7.5	10-14	0.4	1	0.02	0.005	-	0.005	0.25	0.08	-
C84800	75-76.7	2-3	5.5-7	13-17	0.4	1	0.02	0.005	-	0.005	0.25	0.08	-
C92210	86-89	4.5-5.5	1.7-2.5	3-4.5	0.25	0.7-1	0.03	0.005	-	0.005	0.2	0.05	-
C92220	86-88	5-6	1.5-2.5	3-5.5	0.25	0.5-1	0.05	-	-	-	-	-	-
C54400	Rem.	3.5-4.5	3.5-4.5	1.5-4.5	0.1	-	0.01-0.5	-	-	-	-	-	-

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BS (British Standard) BS - 1400



Copper Alloys	CU	SN	PB	ZN	FE	NI	P	AL	MN	SI	SB	S	BI	Cr	Impurities
Aluminum Bronze															
AB-1	Rem.	0.1	0.03	0.5	1.5-3.5	1	-	8.5-10.5	1	0.25	-	-	-	-	0.3
AB-2	Rem.	0.1	0.03	0.5	4-5.5	4-5.5	-	8.8-10	1.5	0.1	-	-	-	-	0.3
AB-3	Rem.	0.1	0.03	0.4	0.5-0.7	0.1	-	6-6.4	0.5	2-2.4	-	-	-	-	0.8
Tin Bronze and Ni Tin Bronze															
CT-1	Rem.	9-11	0.25	0.05	-	0.25	0.15	-	-	-	-	-	-	-	0.8
CT-2	85-87.3	11.2-13	0.2	0.4	0.15	1.5-2	0.05	0.01	0.2	0.01	0.1	0.05	-	-	0.8
G1(88/10/2)	Rem.	9.5-10.5	1.5	1.75-2.75	0.15	1	-	0.01	-	0.02	0.2	-	0.03	-	0.5
G3	Rem.	6.5-7.5	0.1-0.5	1.5-3	-	5.25-5.75	0.02	0.01	0.2	0.01	0.2	-	0.02	-	0.5
G3WP	Rem.	6.5-7.5	0.1-0.5	1.5-3	-	5.25-5.75	0.5	0.01	0.2	0.01	0.2	-	0.02	-	0.5
PB1	Rem.	10 Min	0.25	0.05	0.1	0.1	0.5Min	0.01	-	0.02	-	-	-	-	0.6
PB2	Rem.	11-13	0.5	0.3	0.15	0.5	0.15Min	0.01	-	0.02	-	-	-	-	0.2
PB4	Rem.	9.5 Min	0.75	0.5	-	0.5	0.4Min	-	-	-	-	-	-	-	0.5
Gun Metal															
LG-1	Rem.	2-3.5	4-6	7-9.5	0.5	2	0.03	0.01	-	0.02	0.25	0.1	0.1	-	1
LG-2	Rem.	4-6	4-6	4-6	0.5	2	-	0.01	-	0.02	-	-	0.05	-	0.8
LG-4	Rem.	6-8.05	2.5-3.5	1.5-3	0.2	2	-	0.01	-	0.01	0.25	-	0.05	-	0.7
Leaded Bronze															
LB-1	Rem.	8-10	13-17	1	-	2	0.1	-	-	0.02	-	-	-	-	0.3
LB-2	Rem.	9-11	8.5-11	1	0.15	2	0.1	0.01	-	0.02	0.5	-	-	-	0.5
LB-4	Rem.	4-6	8-10	2	-	2	0.1	-	-	0.02	0.5	-	-	-	0.5
LB-5	Rem.	4-6	18-23	1	-	2	0.1	-	-	0.01	0.5	-	-	-	0.3
LPB-1	Rem.	6.5-8.5	2-5	2	-	1	0.3-0.6	-	-	-	-	-	-	-	0.5
Brass															
DCB 1	59-63	-	0.25	Rem.	-	-	-	0.5	-	-	-	-	-	-	0.75
DCB 3	58-63	1	0.5-2.5	Rem.	0.8	1	-	0.2-0.8	0.5	0.05	-	-	-	-	2
PCB 1	57-60	0.5	0.5-2.5	Rem.	0.3	-	-	0.5	-	-	-	-	-	-	0.5
SCB 1	70-80	1-3	2-5	Rem.	0.75	1	-	0.01	-	-	-	-	-	-	1
SCB 3	63-70	1-5	1-3	Rem.	0.75	1	-	0.1	-	-	-	-	-	-	1
SCB 4	60-63	1-1.5	0.5	Rem.	-	-	-	0.01	-	-	-	-	-	-	0.75
SCB 6	83-88	-	0.5	Rem.	-	-	-	-	-	-	-	-	-	-	1
High Tensile Brass															
HTB 1	55Min	1	0.5	Rem.	0.7-2	1	0.5-2.5	0.1-3	0.1	-	-	-	-	-	0.2
HTB-3	55Min	0.2	0.2	Rem.	1.5-3.25	1	3-6	1.5-4	0.1	-	-	-	-	-	0.2
Cu Chromium															
CC1-WP	Rem.	-	-	-	-	-	-	-	-	-	-	-	-	0.6-1.2	-
Cu Mn Aluminum															
CMA 1	Rem.	1	0.05	0.5	2-4	1.5-4.5	0.05	7.5-8.5	11-15	0.15	-	-	-	-	0.3
CMA 2	Rem.	1	0.05	0.5	2-4	1.5-4.5	0.05	8.5-9	11-15	0.15	-	-	-	-	0.3

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Copper Alloys	CU	SN	PB	ZN	FE	NI	P	AL	MN	SI	SB	Impurities
Aluminum Bronze IS:305-1981												
AB-1	Rem.	0.1	0.03	0.5	1.5-3.5	1	-	8.5-10.5	1	0.25	-	0.3
AB-2	Rem.	0.1	0.03	0.5	4-5.5	4-5.5	-	8.8-10	1.5	0.10	-	0.3
IS:3091-1963												
Al. Bronze	Rem.	-	-	-	4-5	-	-	9-11	0.1-0.5	-	-	-
IS:8631-1977												
Grade-1	Rem.	0.1	0.05	0.5	4-5.5	4-5.5	-	8.8-10	1	0.1	-	-
Tin Bronze IS:1458-1965												
Ph. Bz. Class-1	Rem.	6-8	0.5	0.5	0.3	-	0.4-0.6	0.01	-	-	0.1	0.6
IS:28-1985												
Phosphorus Bz (Grade-1)	Rem.	6-8	0.25	0.5	0.3	0.7	0.3-0.5	0.01	-	0.02	0.1	1.2
Phosphorus Bz (Grade-2)	Rem.	10Min	0.25	0.05	0.1	0.1	0.5Min	0.01	-	0.02	-	0.6
Phosphorus Bz (Grade-3)	Rem.	6.5-8.5	2-5	2	-	1	0.3Min	-	-	-	-	0.5
Phosphorus Bz (Grade-4)	Rem.	9-11	0.25	0.05	-	0.25	0.15	-	-	-	-	0.8
Phosphorus Bz (Grade-5)	Rem.	11-13.1	0.5	0.3	0.15	0.5	0.15Min	0.01	-	0.02	-	0.2
Gun Metal IS:1458-1965												
Gunmetal Class - 2	Rem.	5-7	1-3	2-3	0.3	-	0.05	0.01	-	-	0.1	0.6
IS:318-1981												
LTB-1	Rem.	6-8	2.5-3.5	1.5-3	0.3	2	-	0.01	-	0.01	0.3	0.7
LTB-2	Rem.	4-6	4-6	4-6	0.35	2	-	0.01	-	0.02	0.4	0.8
Leaded Bronze IS:1458-1965												
Leaded Bz. Class-3	Rem.	6-8	14-16	0.5	0.3	-	0.05	0.01	-	-	0.4	0.7
Leaded Bz. Class-4	Rem.	6-8	9-11	0.5	0.3	-	0.05	0.01	-	-	0.4	0.7
Leaded Bz. Class-5	Rem.	4-6	4-6	4-6	0.3	-	0.05	0.01	-	-	0.3	0.6
IS:318-1981												
LTB-3	Rem.	6-8	9-11	0.75	0.35	2	-	0.01	-	0.02	0.5	0.8
LTB-4	Rem.	6-8	14-16	0.75	0.35	2	-	-	-	0.02	0.5	0.8
LTB-5	Rem.	9-11	8.5-11	1	0.35	2	-	0.01	-	0.02	0.5	0.8
LTB-6	Rem.	4-6	18-23	1	0.35	2	-	-	-	0.02	0.5	0.8
Silicon Bronze IS:1028-1987												
Silicon Bronze	89 Min	1	0.5	5	2.5	-	-	0-1.5	0-1.5	1-5	-	-
Brass IS:8631-1977												
Grade-2	55 Min	1	0.5	Rem.	0.7-2	1	-	0.5-2.5	3	0.1	-	-
IS:292-1983												
LCB-1	70-77	1-3	2-5	Rem.	0.5	-	-	0.01	-	-	-	-
LCB-2	63-67	1.5	1-3	Rem.	0.5	-	-	0.01	-	-	-	-
High Tensile Brass IS:304-1981												
HTB-1	55 Min	1	0.5	Rem.	0.7-2	-	-	0.5-2.5	3	0.1	-	0.2
HTB-2	55 Min	0.2	0.2	Rem.	1.5-3.25	-	-	3-6	4	0.1	-	0.2
Silicon Brass IS 11109-1984												
Silicon Brass (Grade-1)	79 Min	-	0.5	12.5-16	0.3	-	-	0.5	-	3.2-5	-	0.5
Silicon Brass (Grade-2)	89 Min	-	0.5	4.5-7	0.3	-	-	-	-	3.7-5.5	-	0.5
Silicon Brass (Grade-3)	80-83	-	0.4	Rem.	0.3	-	-	0.5	-	4.1-4.7	-	0.5

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DIN (Germany Standard)



Copper Alloys	CU	SN	PB	ZN	FE	NI	P	AL	MN	SI	SB	S	Impurities
Aluminum Bronze 1714													
CuAl10Fe1(CW305G)	Rem.	0.1	0.02	0.5	0.5-1.5	1	-	9-10	0.5	0.2	-	-	0.2
CuAl10Fe3Mn2(CW306G)	Rem.	0.1	0.05	0.5	2-4	1	-	9-11	1.5-3.5	0.2	-	-	0.2
CuAl10Ni5Fe4(CW307G)	Rem.	0.1	0.05	0.4	3-5	4-6	-	8.5-11	1	0.2	-	-	0.2
CuAl11Fe6Ni6(CW308G)	Rem.	0.1	0.05	0.5	5-7	5-7	-	10.5-12.5	1.5	0.2	-	-	0.2
CuAl11Ni6Fe5	Rem.	-	0.15	0.5	4.8-7.3	5-7.5	-	10.5-12.5	1.5	0.2	-	-	0.3
CuAl5	92.5-96	0.3	0.02	0.5	0.4	0.8	-	4-6	0.3	0.2	-	-	0.3
CuAl5As(CW300G)	Rem.	0.05	0.02	0.3	0.2	0.2	-	4-6.5	0.2	-	-	-	0.3
CuAl6Si2Fe(CW301G)	Rem.	0.1	0.05	0.4	0.5-0.7	0.1	-	6-6.4	0.1	2-2.4	-	-	0.2
CuAl7Si2(CW302G)	Rem.	0.2	0.05	0.5	0.3	0.2	-	6.3-7.6	0.2	1.5-2.2	-	-	0.2
CuAl8	Rem.	-	0.02	0.5	0.5	0.8	-	7-9	0.8	0.2	-	-	0.3
CuAl8Fe	Rem.	0.2	0.15	0.5	1.5-3.5	1	-	6.5-9	1	0.2	-	-	0.3
CuAl8Fe3(CW303G)	Rem.	0.1	0.05	0.5	1.5-3.5	1	-	6.5-8.5	1	0.2	-	-	0.2
CuAl9Fe3Mn2	Rem.	-	0.05	0.5	2-4	1	-	9-11	1.5-3.5	0.2	-	-	0.3
CuAl9Mn	Rem.	-	0.15	0.5	1.5	0.8	-	8-10	1.5-3	0.2	-	-	0.3
CuAl9Ni3Fe2(CW304G)	Rem.	0.1	0.05	0.2	1-3	2-4	-	8-9.5	2.5	0.1	-	-	0.3
G-CuAl10Fe	83-89	0.2	0.1	0.4	2-3.8	2.7	-	8.7-10.7	0.8	0.1	-	-	1
G-CuAl10Ni	76-80.5	0.1	0.03	0.2	3.5-5.3	4.5-6.3	-	9-10.6	2.3	0.07	-	-	0.8
G-CuAl11Ni	72-77	0.1	0.03	0.2	4.3-5.8	5.3-6.8	-	9.3-11.3	2.3	0.07	-	-	0.8
G-CuAl8Mn	82-84.5	0.1	0.05	0.15	0.6	1.2-1.8	-	7.3-8.8	5.3-6.5	0.05	-	-	0.8
G-CuAl9Ni	82-86.5	0.2	0.1	0.2	1-2.8	1.5-3.8	-	8.7-9.8	2.3	0.07	-	-	0.8
Tin Bronze 1705													
CuNi44Mn1	Rem.	-	0.01	-	0.2	43-45	-	-	0.5-2	-	-	0.02	0.1
CuSn10	88.5-90.5	9.3-11	0.8	0.5	0.15	1.8	0.05	0.01	0.1	0.01	0.15	0.04	-
CuSn4(CW450K)	Rem.	3.5-4.5	0.02	0.2	0.1	0.2	0.01-0.4	-	-	-	-	-	0.2
CuSn5(CW451K)	Rem.	4.5-5.5	0.02	0.2	0.1	0.2	0.01-0.4	-	-	-	-	-	0.2
CuSn5Pb1(CW458K)	Rem.	3.5-5.5	0.5-1.5	0.3	0.1	0.2	0.01-0.4	-	-	-	-	-	0.2
CuSn6	86-89.5	5.7-6.5	1.2-2	3.2-5	0.25	1	0.03	0.01	-	0.01	-	0.08	-
CuSn6(CW452K)	Rem.	5.5-7	0.02	0.2	0.1	0.2	0.01-0.4	-	-	-	-	-	0.2
CuSn8(CW453K)	Rem.	7.5-8.5	0.02	0.2	0.1	0.2	0.01-0.4	-	-	-	-	-	0.2
CuSn8P(CW459K)	Rem.	7.5-8.5	0.05	0.3	0.1	0.3	0.2-0.4	-	-	-	-	-	0.2
CuSn8PbP(CW460K)	Rem.	7.5-9	0.1-0.5	0.3	0.1	0.3	0.2-0.4	-	-	-	-	-	0.2
CuSn8Pb2P(CW455K)	Rem.	3.5-4.5	1.5-2.5	0.3	0.1	0.2	0.2-0.4	-	-	-	-	-	0.2
GbCuSn12	86-88	11.3-13	0.8	0.5	0.15	1.8	0.05	0.01	0.1	0.01	0.15	0.04	-
GbCuSn12Ni	84-87	11.3-13	0.15	0.3	0.15	1.5-2.4	0.05	0.01	0.1	0.01	0.05	0.04	-
G-CuSn10Zn	86-88.5	9.2-11	1.3	1-3	0.2	1.8	0.03	0.01	0.1	-	0.25	0.06	-
G-CuSn12Pb	84.3-87.3	11.3-13	1.2-2	0.5	0.15	1.8	0.05	0.01	0.1	0.01	0.15	0.04	-
G-SnBZ10	89-91	9-11	-	-	-	-	-	-	-	-	-	-	-
G-SnBZ12	87-89	11-13	-	-	-	-	-	-	-	-	-	-	-
G-SnBZ14	85-87	13-15	-	-	-	-	-	-	-	-	-	-	-
G-SnBZ20	78-80	20-22	-	-	-	-	-	-	-	-	-	-	-
RG-10	85-87	9-11	-	4	-	-	-	-	-	-	-	-	-

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DIN (Germany Standard)



Copper Alloys	CU	SN	PB	ZN	FE	NI	P	AL	MN	SI	SB	S	Impurities
Gun Metal 1705													
G-CuSn2ZnPb	80-85	1.5-3	4-6	7-9	0.3	1.5-2.5	0.03	0.01	0.1	0.01	0.25	0.06	-
G-CuSn5ZnPb	83.5-86	4.3-6	4-6	4.5-6.5	0.2	2.3	0.03	0.01	0.1	0.01	0.25	0.06	-
G-CuSn6ZnNi	83.5-87	5.8-7	2.5-4	1.5-3	0.2	1.5-2.5	0.03	0.01	0.1	0.01	0.3	0.06	-
G-CuSn7ZnPb	81-84.5	6.3-8	5.3-7	3.3-5	0.2	1.8	0.03	0.01	0.1	0.01	0.25	0.06	-
RG-2	83	2	8	5	-	-	-	-	-	-	-	-	-
RG-4	92-94	3-5	1-2	2	-	-	-	-	-	-	-	-	-
RG-5	84-86	4-6	4-6	4-6	0.2	2	0.03	0.01	0.1	0.01	0.25	0.06	-
RG-6	85	6	2	3	-	1	-	-	-	-	-	-	-
RG-7	83-85	6-8	3-5	3-5	-	-	-	-	-	-	-	-	-
RG-A	81-87	5-8	4-6	7	-	-	-	-	-	-	-	-	-
Leaded Bronze 1716													
G-CuPb10Sn	78-81	9.2-11	8.5-10.5	0.8	0.15	1.3	0.03	0.01	0.1	0.01	0.3	0.08	0.5
G-CuPb15Sn	75-78	7.3-9	13.5-16.5	2	0.15	1.8	0.03	0.01	0.1	0.01	0.4	0.08	0.5
G-CuPb20Sn	70-75	3.7-5.5	18.5-23	2	0.15	2.3	0.03	0.01	0.1	0.01	0.4	0.08	0.5
G-CuPb22Sn	70-80	0.5-3	18-26	0.5	0.7	2.5	0.03	-	-	-	0.2	-	1.2
G-CuPb5Sn	84-86.5	9.5-11	4.3-5.8	0.8	0.15	1.3	0.03	0.01	0.1	0.01	0.25	0.08	0.5
G-PbBz25	Rem.	3	18-28	3	0.7	2.5	0.05	-	-	-	0.5	-	1
G-SnPbBz10	Rem.	9-11	8-12	-	-	-	-	-	-	-	-	-	-
G-SnPbBz15	Rem.	6-8	13-18	3	0.25	2	0.05	-	-	-	0.5	-	0.5
G-SnPbBz20	69-77	3.5-5.5	18-23	3	0.25	2.5	0.05	-	-	-	0.5	-	0.5
G-SnPbBz22	Rem.	2-5	18-25	-	-	-	-	-	-	-	-	-	-
G-SnPbBz5	Rem.	9-11	3-7	-	-	-	-	-	-	-	-	-	-
Brass 1705													
CuSn3Zn9(CW454K)	Rem.	1.5-3.5	0.1	7.5-10	0.1	0.2	0.2	-	-	-	-	-	0.2
CuZn10(CW501L)	89-91	0.1	0.05	Rem.	0.05	0.3	-	0.02	-	-	-	-	0.1
CuZn13Al1Ni1Si(CW700R)	81-84	0.1	0.05	Rem.	0.25	0.8-1.4	-	0.7-1.2	0.1	0.8-1.3	-	-	0.5
CuZn15(CW502L)	84-86	0.1	0.05	Rem.	0.05	0.3	-	0.02	-	-	-	-	0.1
CuZn19Sn(CW701R)	80-82	0.2-0.5	0.05	Rem.	0.05	0.3	-	-	-	-	-	-	0.2
CuZn20(CW503L)	79-81	0.1	0.05	Rem.	0.05	0.3	-	0.02	-	-	-	-	0.1
CuZn20Al2	70-72.5	-	0.07	Rem.	0.07	0.1	0.01	1.8-2.3	0.1	-	-	-	0.1
CuZn28(CW504L)	71-73	0.1	0.05	Rem.	0.05	0.3	-	0.02	-	-	-	-	0.1
CuZn28Sn1	70-72.5	0.9-1.3	0.07	Rem.	0.07	0.1	0.01	-	0.1	-	-	-	0.1
CuZn30(CW505L)	69-71	0.1	0.05	Rem.	0.05	0.3	-	0.02	-	-	-	-	0.1
CuZn33(CW506L)	66-68	0.1	0.05	Rem.	0.05	0.3	-	0.02	-	-	-	-	0.1
CuZn35Pb1(CW600N)	62.5-64	0.1	0.8-1.6	Rem.	0.1	0.3	-	0.05	-	-	-	-	0.1
CuZn35Pb2(CW601N)	62-63.5	0.1	1.6-2.5	Rem.	0.1	0.3	-	0.05	-	-	-	-	0.1
CuZn36(CW507L)	63.5-65.5	0.1	0.05	Rem.	0.05	0.3	-	0.02	-	-	-	-	0.1
CuZn36Pb2Sn1(CW711R)	59.5-61.5	0.5-1	1.3-2.2	Rem.	0.1	0.3	-	-	-	-	-	-	0.2
CuZn36Pb3(CW603N)	60-62	0.2	2.5-3.5	Rem.	0.3	0.3	-	0.05	-	-	-	-	0.2
CuZn36Sn1Pb(CW712R)	61-63	1-1.5	0.2-0.6	Rem.	0.1	0.2	-	-	-	-	-	-	0.2
CuZn37(CW508L)	62-64	0.1	0.1	Rem.	0.1	0.3	-	0.05	-	-	-	-	0.1

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Copper-tin and copper-tin-zinc casting alloys (Cast tin bronze and gunmetal) Castings

DIN
1705

Kupfer-Zinn- und Kupfer-Zinn-Zink-Gusslegierungen
(Guss-Zinnbronze und Rotguss); Gussstücke

Supersedes June 1973 edition

As it is current practice in standards published by the International Organization for Standardization (ISO), the comma has been used throughout as a decimal marker.

For connection with Standard ISO 1338-1977, published by the International Organization for Standardization (ISO), see Explanations.

1 Field of application

This standard applies to material properties and to the composition of sand castings (shell mouldings), centrifugal and continuous castings made preferably of copper-tin and copper-tin-zinc casting alloys.

By agreement, the alloy composition applies also to the production of castings using other casting processes, e.g., chill casting, die casting, waste-wax casting.

In addition, this standard specifies the technical delivery conditions for castings of metallic materials according to DIN 1690 Part 1.

2 Application

The table provides information on the preferred application of copper-tin and copper-tin-zinc casting alloys. The examples listed do not claim to be complete.

Beyond that, the specifications of DIN 1690 Part 1 apply.

3 Designation

Copper casting alloys according to this standard must be designated by using the material symbols or the material numbers given in the table.

Example

Designation of a copper casting alloy with material symbol G-CuSn 12 Pb or with material number 2.1061.01:

Casting alloy DIN 1705 — G-CuSn 12 Pb
or Casting alloy DIN 1705 — 2.1061.01

4 Composition (see table)

5 Material properties (see table)

The strength properties specified in the table are binding for acceptance testing.

Desired values deviating from this standard must be agreed in written form between customer and manufacturer.

In the case of sand castings, the values for the separately cast test bar apply; this test bar must be manufactured from the same melt, using the same moulded material as for the casting(s) and it is machined from a rough casting having a cross section of about 100 to 250 mm² *).

Customer and manufacturer may agree that the strength values given in the table, or lower strength values, must be adhered to in an integrally cast test bar or at a specified point in the casting.

In the case of centrifugal and continuous castings, the test bar is taken from the casting. The specimen position — e.g. longitudinal or transverse specimen — must be agreed upon between customer and manufacturer; the values specified in the table apply only to wall thicknesses of up to 50 mm for the rough casting.

In the case of wall thicknesses exceeding 50 mm, the wall thickness of the rough casting being decisive, lower strength values and hardness values must be expected. This fact applies particularly to the 0,2 % proof stress (0,2 limit).

It is not to be expected that the casting exhibits uniform strength values and hardness values at all points. As a rule, the values in the outer layers are higher than in the core.

If castings are produced by casting processes deviating from those specified for each alloy, the values indicated for sand castings apply.

Supplement 1 to DIN 1705 incorporates reference data on mechanical and physical properties.

6 Finish

The specifications of DIN 1690 Part 1 apply.

*) See VDG Instruction Sheet P 378, obtainable from the library of the Verein Deutscher Giessereifachleute (Association of German Foundrymen), Postfach 82 25, D-4000 Düsseldorf 1

Continued on pages 2 to 8

Table.

Material		Form on delivery	Material properties in the test bar according to clause 5				Density kg/dm ³ ≈
symbol	number		0,2-limit $R_{p0,2}$ N/mm ² min.	Tensile strength R_m N/mm ² min.	Elongation at break A_5 % min.	Brinell hardness HB 10 min.	
G-CuSn12 *)	2.1052.01	Sand casting	140	260	12	80	8,6
GZ-CuSn12	2.1052.03	Centrifugal casting	150	280	5	95	
GC-CuSn12	2.1052.04	Continuous casting	140	280	3	90	
G-CuSn12Ni	2.1060.01	Sand casting	160	280	14	90	8,6
GZ-CuSn12Ni	2.1060.03	Centrifugal casting	180	300	8	100	
GC-CuSn12Ni	2.1060.04	Continuous casting	170	300	10	90	

*) See Explanations, last paragraph
 1) For centrifugal and continuous castings a minimum content of 10,5 % Sn is permissible.
 2) Ni to be counted as Cu

Composition Contents in %		Remarks	Notes on application	Previous symbols
Alloying elements	Permissible impurities			
Cu 84,0 to 88,5 Sn 11,0 to 13,0 ¹⁾	Ni 2,0 ²⁾ P 0,4 Pb 1,0 Sb 0,2 Others: 1,2 consisting of Fe 0,2 S 0,05 Zn 1,0	Material with good resistance to wear; corrosion-resistant and sea-water-resistant. From this alloy, the materials G-CuSn12Ni and G-CuSn12Pb were developed which are remarkable because of increased strength and resistance to wear or improved emergency running properties. See G-CuSn12 properties, but more uniform, 0,2 limit, tensile strength and hardness are higher	Tenon blocks and coupling components, spindle nuts moved under load, worm wheels and helical gear wheels Annular and tubular structural components as well as longitudinal profiles, e.g., worm wheel rims, cylinder inserts, highly stressed adjusting and slideway gibs	G-SnBz12 GZ-SnBz12 GC-SnBz12
Cu 84,0 to 87,0 Sn 11,0 to 13,0 ¹⁾ Ni 1,5 to 2,5	Pb 0,3 P 0,2 Sb 0,1 Others: 0,5 consisting of Fe 0,2 S 0,05 Zn 0,4	Construction material with very good resistance to wear; corrosion-resistant and sea-water-resistant to cavitation stresses See G-CuSn12Ni properties, but more uniform, 0,2-limit, tensile strength and hardness are higher	Severely stressed tenon blocks and coupling components, spindle nuts moved under load, higher stressed fast running worm wheel rims and helical gear wheel rims. Severely stressed housings for fittings and pumps, guide wheels, runners and bucket wheels for pumps and water turbines Loading characteristics: for worm wheels for continuous operation depending on the sliding speed: $c = 150$ to 800 N/cm^2 for short-time loading: $c = 2000$ to 2500 N/cm^2 Annular and tubular structural components, nuts moved under load, highest stressed fast running worm wheel rims and helical gear wheel rims Loading characteristics: for worm wheels for continuous operation depending on the sliding speed: $c = 200$ to 1250 N/cm^2 for short-time loading: $c = 4000$ to 4500 N/cm^2	

Table. (continued)

Material		Form on delivery	Material properties in the test bar according to clause 5				Density kg/dm ³ ≈
symbol	number		0,2-limit $R_{p0,2}$ N/mm ² min.	Tensile strength R_m N/mm ² min.	Elongation at break A_5 % min.	Brinell hardness HB 10 min.	
G-CuSn12Pb	2.1061.01	Sand casting	140	260	10	80	8,7
GZ-CuSn12Pb	2.1061.03	Centrifugal casting	150	280	5	90	
GC-CuSn12Pb	2.1061.04	Continuous casting	140	280	7	85	
G-CuSn10	2.1050.01	Sand casting	130	270	18	70	8,7
G-CuSn10Zn (*)	2.1086.01	Sand casting	130	260	15	75	8,7
G-CuSn7ZnPb	2.1090.01	Sand casting	120	240	15	65	8,8
GZ-CuSn7ZnPb	2.1090.03	Centrifugal casting	130	270	13	75	
GC-CuSn7ZnPb	2.1090.04	Continuous casting	120	270	16	70	

*, 1) and 2) see page 2

3) For centrifugal and continuous castings a minimum content of 5,6 % Sn is permissible

Composition Contents in %		Remarks	Notes on application	Previous symbols
Alloying elements	Permissible impurities			
Cu 84,0 to 87,0 Sn 11,0 to 13,0 ¹⁾ Pb 1,0 to 2,0	Ni 2,0 ²⁾ P 0,2 Sb 0,2 Others: 1,2 consisting of Fe 0,2 S 0,05 Zn 1,0	Bearing material with good emergency running proper- ty and resistance to wear; corrosion-resistant and sea-water-resistant See G-CuSn12Pb properties, but more uniform, 0,2-limit, tensile strength and hard- ness are higher	Plain bearings with high load peaks (shock loads up to 6000 N/mm ²), highly stressed slide plates and gibs Plain bearings with high load peaks for p up to 12 000 N/cm ² , e.g., crank and toggle bearings, gudge- on pin bushes, bushes for crane wheels, spindle nuts moved under load with high speed, very highly stressed gibs	— — —
Cu 88,0 to 90,0 Sn 9,0 to 11,0	Pb 1,0 Ni 2,0 ²⁾ P 0,2 Sb 0,2 Others: 0,7 consisting of Fe 0,2 S 0,05 Zn 0,5	Construction material with high ductility, corrosion- resistant and sea-water- resistant	Housings for fittings and pumps, guide wheels, run- ners and bucket wheels for pumps and water turbines	G-SnBz10
Cu 86,0 to 89,0 Sn 9,0 to 11,0 Zn 1,0 to 3,0	Ni 2,0 ²⁾ Pb 1,5 Sb 0,3 Others: 0,5 consisting of Fe 0,25 P 0,05 S 0,1	Hard material of CuSnZn alloys series, sea-water- resistant	Plain bearing shells, mod- erately stressed slide and coupling components, worm wheels with low sliding speeds, stern tubes	Rg10
Cu 81,0 to 85,0 Sn 6,0 to 8,0 ³⁾ Zn 3,0 to 5,0 Pb 5,0 to 7,0	Ni 2,0 ²⁾ Sb 0,3 Others: 0,5 consisting of Fe 0,25 P 0,05 S 0,1	Medium-hard plain bearing material with good emer- gency running properties; sea-water-resistant See G-CuSn7Pb properties, but more uniform and improved resistance to wear	Journal bearing shells and cou- pling rod bearings, plain bearing shells for the general mechanical engineering (load peaks of p up to 4000 N/cm ² are permis- sible); moderately stressed slide plates and gibs. Normally and severely stressed plain bearing bushes and shells if shafts of unhardened structural steels and of surface-hardened steels are used, also for slight edge pres- sures Gudgeon pin bushes for p up to 4000 N/cm ² ; crank bearings and toggle bearings with load peaks of p up to 3000 N/cm ² ; marine shaft sleeves and cylinder liners, bottom and stuffing box bush- ings, medium-stressed to highly stressed slideway and adjusting gibs for machine tools, medium- stressed coupling components, friction rings and friction discs	Rg7 GZ-Rg7 GC-Rg7

Table. (continued)

Material		Form on delivery	Material properties in the test bar according to clause 5				Density kg/dm ³ ≈
			0,2-limit $R_{p0,2}$ N/mm ² min.	Tensile strength R_m N/mm ² min.	Elongation at break A_5 % min.	Brinell hardness HB 10 min.	
G-CuSn6ZnNi	2.1093.01	Sand casting	140	270	15	75	8,7
G-CuSn5ZnPb	2.1096.01	Sand casting	90	220	16	60	8,7
G-CuSn2ZnPb	2.1098.01	Sand casting	90	210	18	60	8,7

²⁾ see page 2

7 Testing

If proof, e.g. of the composition and/or the strength values is required, this must be agreed on ordering. In this case, the type of test to be carried out and of the certificate on materials testing must be specified according to DIN 50 049.

7.1 Testing of composition

The requirement may be either

- a) one analysis for each casting of at least 500 kg or
- b) one analysis for each melt or
- c) one analysis for each lot of 1000 kg.

The sample material must be taken from the sprue or from the test bars or from a simultaneously cast sample.

As a rule, testing of the composition is carried out according to the manufacturer's analysis specifications. In general, the alloying elements are analyzed, the appropriate impurities are only determined in case of objections. Arbitrary analysis or sampling must be carried out according to the latest edition of "Analyse der Metalle" (Analysis of Metals) of the Chemists' Committee of the Gesellschaft Deutscher Metallhütten- und Bergleute e.V. (Association of German Metallurgists and Miners), volume 1: "Schiedsanalysen" (Arbitrary Analyses) or volume 3: "Probenahme" (Sampling) (Berlin — Göttingen — Heidelberg; Springer-Verlag).

The rounding rule (see DIN 1333 Part 2) must be applied to all individual values obtained. The rounded value must not exceed the limiting values stipulated for the composition.

7.2 Testing of strength properties

The tensile test must be carried out according to DIN 50 145 by means of a short proportional bar according to DIN 50 125. The extent of the tensile test must be agreed. However, not more than 2 test bars of each 500 kg casting or lot weight may be demanded. This does not apply for special agreements possible according to clause 5.

The Brinell hardness testing is carried out with a degree of loading of $10 D^2$ (depending on the thickness of the sample HB 10/1000; HB 5/250; HB 2,5/62,5; HB 1/10) and at several — if possible at six — different points of the casting. The average of each casting must reach the value given in the table. The extent of hardness testing may exceed the extent specified for the tensile test.

To compare the individual value obtained with the values specified in this standard, it must be rounded according to the rounding rule (see DIN 1333 Part 2) to the same accuracy as the quoted limiting value.

Composition Contents in %		Remarks	Notes on application	Previous symbols
Alloying elements	Permissible impurities			
Cu 83,5 to 87,5 Sn 5,5 to 7,0 Zn 1,5 to 3,0 Pb 2,5 to 4,0 Ni 1,5 to 2,5	Sb 0,3 Others: 0,5 consisting of Fe 0,25 P 0,05 S 0,10	Construction material with good strength and ductility, good castability, sea-water- resistant	Fittings and pump housings and cast parts which require pressure tightness Is already being used in many cases as construction material (see Explanations)	—
Cu 84,0 to 86,0 Sn 4,0 to 6,0 Zn 4,0 to 6,0 Pb 4,0 to 6,0	Ni 2,5 ²⁾ Sb 0,3 Others: 0,5 consisting of Fe 0,30 P 0,05 S 0,10	Construction material, good castability, solderable and to a limited extent brazable, sea-water-resistant	Housings for water and steam fittings up to 225 °C, normally stressed pump housings and thinwalled complex castings	Rg5
Cu 80,0 to 85,0 Sn 1,5 to 3,0 Zn 7,0 to 9,0 Pb 4,0 to 6,0 Ni 1,5 to 2,5	Sb 0,25 Others: 0,5 consisting of Fe 0,30 P 0,05 S 0,10	Medium-hard construction material, good castability, corrosion-resistant to service waters, also at elevated temperatures	The alloy is especially being used for thinwalled fittings (up to 12 mm wall thick- ness); suitable up to 225 °C	—

Standards referred to and other documents

DIN 1333 Part 2	Presentation of numerical data, rounding
DIN 1690 Part 1	Technical delivery conditions for castings of metallic materials; general conditions
Supplement 1 to DIN 1705	Copper-tin and copper-tin-zinc casting alloys (cast tin bronze and gunmetal); castings; reference data on mechanical and physical properties
DIN 50 049	Certificates on material testing
DIN 50 125	Testing of metallic materials; tensile test specimen, directions for their preparation
DIN 50 145	Testing of metallic materials; tensile test
DIN 50 351	Testing of metallic materials; Brinell hardness testing
VDG Instruction Sheet P 378	Casting of test bars of copper casting alloys for the tensile test (sand casting and chill casting)

Further standards and other documents

DIN 1709	Copper-zinc casting alloys (cast brass and cast high-strength brass); castings
Supplement 1 to DIN 1709	Copper-zinc casting alloys (cast brass and cast high-strength brass); castings; reference data on mechanical and physical properties
DIN 1714	Copper-aluminium casting alloys (cast aluminium bronze); castings
Supplement 1 to DIN 1714	Copper-aluminium casting alloys (cast aluminium bronze); castings; reference data on mechanical and physical properties
DIN 1716	Copper-lead-tin casting alloys (cast tin-lead bronze); castings
Supplement 1 to DIN 1716	Copper-lead-tin casting alloys (cast tin-lead bronze); castings; reference data on mechanical and physical properties
DIN 17 655	Unalloyed and low alloy copper materials for casting; castings
DIN 17 656	Copper casting alloys; ingots; composition

Previous editions

DIN 1705 Part 1 and Part 2: 04.28, 10.32, 04.39x, 12.53; DIN 1705: 01.63, 06.73

Amendments

As compared with the June 1973 edition, the following amendments were made:

- a) Some numerical values for G-CuSn12, G-CuSn12Pb, G-CuSn10 and G-CuSn5ZnPb have been changed, GC-CuSn12Ni was newly included as a continuous casting.
- b) The text was editorially revised, e.g. because of the note relating to DIN 1690 Part 1.

Explanations**Comparison of DIN 1705 with ISO 1338-1977**

From 1972 to 1978 the strength values were checked again by teamwork within the Fachausschuss Schwermetallguss (Special Committee Heavy Metal Castings) in the Verein Deutscher Giessereifachleute (Association of German Foundrymen). This check revealed that the actual strength values in the separately cast test bar have been exceeding the stipulated values by about 10 to 30 %. Therefore, it was not deemed necessary to return to the slightly lower values of ISO 1338.

The following table shows a comparison of DIN 1705 with ISO 1338 (September 1977).

DIN 1705				ISO 1338 – 1977			
Material symbol	0,2-limit $R_{p0,2}$ N/mm ² min.	Tensile strength R_m N/mm ² min.	Elongation A % min.	Material symbol	0,2-limit $R_{p0,2}$ N/mm ² min.	Tensile strength R_m N/mm ² min.	Elongation A % min.
G-CuSn12	140	260	12	CuSn12	130	240	5 to 7
G-CuSn12Ni	160	280	14	CuSn12Ni2	160	280	12
G-CuSn12Pb	140	260	10	CuSn12Pb2	130	240	5 to 7
G-CuSn10	130	270	13	CuSn10	130	240	7 to 12
G-CuSn10Zn	130	260	15	CuSn10Zn2	120	240	12
G-CuSn7ZnPb	120	240	15	CuSn7Pb7Zn3	100	210	12
G-CuSn6ZnPb	140	270	15	—	—	—	—
G-CuSn5ZnPb	90	220	16	CuPb5Sn5Zn5	90	200	13
G-CuSn2ZnPb	90	210	18	—	—	—	—

Selection of alloys

In the June 1973 edition, the G-CuSn12Ni, G-CuSn12Pb, G-CuSn6ZnNi and G-CuSn27ZnPb alloys were newly included, the G-SnBz14 material was deleted due to its decreasing technical significance. To avoid an unnecessary increase in the variety of alloys, already at that time the committee seriously considered to delete the G-CuSn10Zn and G-CuSn12 alloys. As it turned out, it would take more than 10 years to clarify the matter. The users are therefore urgently asked to use G-CuSn12 instead of G-CuSn12Pb and G-CuSn10Zn instead of G-CuSn7ZnPb, so that it might be possible to dispense with these alloys in the next revision of the standard.

BS 1400 : 1973 CHEMICAL COMPOSITION OF GROUP A CASTINGS

Designation	PB4		LPB1		LB2		LB4		LG2		LG4	
Material	Phosphor bronze (Copper-tin phosphorus)		Leaded phosphor bronze		80/10/0/10 leaded bronze		85/5/0/10 leaded bronze		85/5/5/5 leaded gunmetal		87/7/3/3 leaded gunmetal	
Elements	min	max	min.	max.	min.	max.	min.	max.	min.	max.	min.	max
	%	%	%	%	%	%	%	%	%	%	%	%
Copper	REM.		REM.		REM.		REM.		REM.		REM.	
Tin	9.5	—	6.5	8.5	9.0	11.0	4.0	6.0	4.0	6.0	6.0	8.0 ^a
Zinc	—	0.5	—	2.0	—	1.0	—	2.0	4.0	6.0	1.5	3.0
Lead	—	0.75	2.0	5.0	8.5	11.0	8.0	10.0	4.0	6.0	2.5	3.5
Phosphorus	0.4	—	0.3	—	—	0.10	—	0.10	—	—	—	—
Nickel	—	0.5	—	1.0	—	2.0	—	2.0	—	2.0	—	2.0 ^a
Iron	—	—	—	—	—	0.15	—	—	—	—	—	0.20
Aluminium	—	—	—	—	—	0.01	—	—	—	0.01	—	0.01
Manganese	—	—	—	—	—	—	—	—	—	—	—	—
Antimony	—	—	—	—	—	0.5	—	0.5	—	—	—	0.25
Arsenic	—	—	—	—	—	—	—	—	—	—	—	—
Iron + arsenic + antimony	—	—	—	—	—	—	—	—	—	0.50	—	0.40
Silicon	—	—	—	—	—	0.02	—	0.02	—	0.02	—	0.01
Bismuth	—	—	—	—	—	—	—	—	—	0.05	—	0.05
Total Impurities	—	0.50	—	0.50	—	0.50	—	0.50	—	0.80	—	0.70

NOTE 1. Analysis shall be carried out for those elements in heavy type.

NOTE 2. Total impurities include all elements in light type.

Tin + 1/2 nickel content must be within the range 7.0-8.0%

Designation	SCB1		SCB3		SCB6		DCB1†		DCB3‡		PCB1	
Material	Brass for sand castings		Brass for sand castings		Brass for brazable castings		Brass for die castings		Brass for die castings		Brass for pressure die castings	
Elements	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
	%	%	%	%	%	%	%	%	%	%	%	%
Copper	70.0	80.0	63.0	70.0	83.0	88.0	59.0	63.0	58.0	63.0	57.0	60.0
Tin	1.0	3.0	—	1.5	—	—	—	—	—	1.0	—	0.5
Zinc	REM.		REM.		REM.		REM.		REM.		REM.	
Lead	2.0	5.0	1.0	3.0	—	0.5	—	0.25	0.5	2.5	0.5	2.5
Phosphorus	—	—	—	—	—	—	—	—	—	—	—	—
Nickel	—	1.0	—	1.0	—	—	—	—	—	1.0	—	—
Iron	—	0.75	—	0.75	—	—	—	—	—	0.8	—	0.3
Aluminium	—	0.01	—	*0.1	—	—	—	0.5	0.2	0.8	—	0.5
Manganese	—	—	—	—	—	—	—	—	—	0.5	—	—
Antimony	—	—	—	—	—	—	—	—	—	—	—	—
Arsenic	—	—	—	—	0.05	0.20	—	—	—	—	—	—
Iron + arsenic + antimony	—	—	—	—	—	—	—	—	—	—	—	—
Silicon	—	—	—	—	—	—	—	—	—	0.05	—	—
Bismuth	—	—	—	—	—	—	—	—	—	—	—	—
Total Impurities	—	1.0	—	1.0	—	1.0	—	0.75	—	2.0	—	0.5
						(incl.) (Pb.)				(excl.) Ni + Pb + Al)		

* For pressure-tight castings aluminium should not be greater than 0.02%

† DCB1. 0.1% lead if required.

‡ DCB3. Nickel to be counted as copper.

BS 1400 : 1973 CHEMICAL COMPOSITION OF GROUP B CASTINGS

Designation	HCC1†	CCI-TF‡	PB1	PB2	CT1	LB5	LGI
Material	High conductivity copper	Copper chromium	Phosphor bronze (Copper-phosphorus)	Phosphor bronze (Copper-tin-phosphorus)	Copper-tin	75/5/0/20 leaded bronze	83/3/9/5 leaded gunmetal
Elements	min max	min max	min max	min max	min max	min max	min max
	% . %	% %	% %	% %	% %	% %	% %
Copper		REM.	REM.	REM.	REM.	REM.	REM.
Tin		— —	10.0 —	11.0 13.0	9.0 11.0	4.0 6.0	2.0 3.5
Zinc		— —	0.05* —	0.30 —	0.05* —	1.0 7.0	9.5
Lead	Castings shall be made from copper complying with BS 1035 1037	— —	0.25* —	0.50 —	0.25* —	18.0 23.0	4.0 6.0
Phosphorus		— —	0.50 —	0.15 —	0.15 —	0.10 —	—
Nickel		— —	0.10 —	0.50 —	0.25* —	2.0 —	2.0
Iron		— —	0.10* —	0.15* —	— —	— —	—
Aluminium		— —	0.01* —	0.01* —	— —	— —	0.01
Manganese	Added elements and impurities not specified	— —	— —	— —	— —	— —	—
Antimony		— —	— —	— —	— —	0.50 —	—
Arsenic		— —	— —	— —	— —	— —	—
Iron + arsenic + antimony		— —	— —	— —	— —	— —	0.75
Silicon		— —	0.02* —	0.02* —	— —	0.01 —	0.02
Bismuth		— —	— —	— —	— —	— —	0.10
Magnesium		— —	— —	— —	— —	— —	—
Chromium		0.60 1.2	— —	— —	— —	— —	—
Total impurities			0.60	0.20	0.80	0.30	1.0

NOTE 1. Analysis shall be carried out for the elements in heavy type and for the elements in light type marked with an asterisk.

NOTE 2. Total impurities include all elements in light type.

† HCC1. Maximum resistivity—0.019 $\mu\Omega$ m (approximately 90% I.A.C.S.)

‡ CCI-TF. Maximum resistivity—0.022 $\mu\Omega$ m (approximately 80% I.A.C.S.)

Designation	AB1§		AB2§		CMA1		CMA2		HTBI*		HTB3	
Material	Aluminium bronze (Copper aluminium)		Aluminium bronze (Copper aluminium)		Copper manganese aluminium		Copper manganese aluminium		High tensile brass@		High tensile beta brass@	
Elements	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
	%	%	%	%	%	%	%	%	%	%	%	%
Copper	REM.		REM.		REM.		REM.		55.0	—	55.0	—
Tin	—	0.1	—	0.1	—	1.0	—	1.0	—	1.0	—	0.20
Zinc	—	0.50	—	0.50	—	0.50	—	0.50	REM.		REM.	
Lead	—	0.05	—	0.05*	—	0.05*	—	0.05*	—	0.50	—	0.20
Phosphorus	—	—	—	—	—	0.05*	—	0.05*	—	—	—	—
Nickel	—	1.0	4.0	5.5	1.5	4.5	1.5	4.5	—	1.0	—	1.0
Iron	1.5	3.5	4.0	5.5	2.0	4.0	2.0	4.0	0.7	2.0	1.5	3.25
Aluminium	8.5	10.5	8.8	10.0	7.5	8.5	8.5	9.0	0.5	2.5	3.0	6.0
Manganese	—	1.0	—	1.5	11.0	15.0	11.0	15.0	—	3.0	—	4.0
Antimony	—	—	—	—	—	—	—	—	—	—	—	—
Arsenic	—	—	—	—	—	—	—	—	—	—	—	—
Iron + arsenic + antimony	—	—	—	—	—	—	—	—	—	—	—	—
Silicon	—	0.25	—	0.1*	—	0.15*	—	0.15*	—	0.10*	—	0.10*
Bismuth	—	—	—	—	—	—	—	—	—	—	—	—
Magnesium	—	0.05	—	0.05*	—	—	—	—	—	—	—	—
Chromium	—	—	—	—	—	—	—	—	—	—	—	—
Total												
impurities	0.30		0.30		0.30		0.30		0.2		0.2	

§ AB1 and AB2. When castings are to be welded lead not to exceed 0.01 %

* HTBI—Subject also to microstructure requirements (See 4.2.5).

@ Formerly designated in imperial units 30 ton and 45 ton respectively.

NOTE : Copper which has a resistivity of 0.017241 $\mu\Omega\text{m}$ is said to have a conductivity of 100% I.A.C.S.

Phosphor Bronze Ingots and Castings

4. CHEMICAL COMPOSITION

4.1 The material, when analyzed in accordance with IS : 4027-1967† shall have the chemical composition as given in Table 1

TABLE 1 CHEMICAL COMPOSITION

CONSTITUENT	PERCENT			
	Grade 1	Grade 2	Grade 3	Grade 4
Tin	6.0-8.0	10.0 <i>Min</i>	6.5-8.5	9.0-11.0
Phosphorus	0.30-0.50	0.50 <i>Min</i>	0.3 <i>Min</i>	0.15 <i>Max</i>
Lead	0.25 <i>Max</i>	0.25 <i>Max</i>	2.0-5.0	0.25 <i>Max</i>
Zinc	0.50 <i>Max</i>	0.05 <i>Max</i>	2.0 <i>Max</i>	0.05 <i>Max</i>
Silicon	0.02 <i>Max</i>	0.02 <i>Max</i>	—	—
Iron	0.30 <i>Max</i>	0.10 <i>Max</i>	—	—
Aluminium	0.01 <i>Max</i>	0.01 <i>Max</i>	—	—
Antimony	0.10 <i>Max</i>	—	—	—
Nickel	0.70 <i>Max</i>	0.10 <i>Max</i>	1.0 <i>Max</i>	0.25 <i>Max</i>
Total Impurities	1.20 <i>Max</i>	0.60 <i>Max</i>	0.50 <i>Max</i>	0.80 <i>Max</i>
Copper	Remainder	Remainder	Remainder	Remainder

Note — Total impurities include all elements in light type.

*Specification for railway bronze ingots and castings (*revised*).

†General requirements for the supply of metallurgical materials (*first revision*).

‡Methods of chemical analysis of bronzes.

Table 1 Chemical Composition
(Clause 7)

Constituents (1)	Percent					
	CuAl7Fe3Sn (2)	CuAl8Fe3 (3)	CuAl10Fe3 (4)	CuAl10Fe5Ni5 (5)	CuAl10Fe3Mn2 (6)	CuAl7Si2 (7)
Aluminium	6.0 to 7.5	6.5 to 8.0	8.5 to 10.0	8.5 to 11.0	9.0 to 11.0	6.3 to 7.6
Iron	2.0 to 3.0	2.0 to 3.5	4.0 Max	4.0 to 6.0	2.0 to 4.0	0.30 Max
Nickel	0.25 Max	0.50 Max	(iron+nickel)	4.0 to 6.0	1.0 Max	0.25 Max
Manganese	0.25 Max	0.50 Max	0.50 Max	0.50 Max	1.5 to 3.0	0.10 Max
Copper	Remainder	Remainder	Remainder	Remainder	Remainder	Remainder
Tin	0.20 to 0.50	0.10 Max	0.10 Max	0.10 Max	0.10 Max	0.20 Max
Lead	0.05 Max	0.05 Max	0.05 Max	0.05 Max	0.05 Max	0.05 Max
Zinc	0.10 Max	0.40 Max	0.40 Max	0.40 Max	0.50 Max	0.50 Max
Silicon	0.10 Max	0.15 Max	0.10 Max	0.10 Max	0.10 Max	1.5 to 2.2
Magnesium	0.05 Max	0.05 Max	0.05 Max	0.05 Max	0.05 Max	0.05 Max
Total Impurities	0.25 Max	0.50 Max	0.50 Max	0.50 Max	0.50 Max	0.50 Max
	(excluding manganese and nickel)	(excluding manganese and zinc)	(excluding manganese)	(excluding manganese)	(excluding nickel)	(excluding iron nickel and manganese)

Table 2 Mechanical Properties
(Clause 8.1)

Grade Designation (1)	Cross-Sectional Thickness		Condition (4)	Tensile Strength Min MPa (5)	0.2 Percent Proof Stress Min MPa (6)	Elongation on Gauge Length $5.65\sqrt{S_0}$ Percent Min (7)
	Over (2)	Up to and Including (3)				
CuAl7Fe3Sn	6	15	Annealed/as manufactured	540	240	25
	15	50	do	520	220	25
	50	80	do	460	190	30
	80 and above		do	460	—	30
CuAl8Fe3	6	15	do	540	240	25
	15	50	do	520	220	25
	50	80	do	460	190	30
	80 and above		do	460	—	30
CuAl10Fe3	6	15	do	600	230	15
	15	50	do	575	230	25
	50	80	do	540	205	25
	80 and above		do	515	205	25
CuAl10Fe5Ni5	6	15	do	700	400	10
	15	50	do	700	400	12
	50	80	do	680	350	12
	80 and above		do	650	320	12
CuAl10Fe3Mn2	6	15	do	625	275	10
	15	50	do	600	250	12
	50	80	do	680	250	12
	80 and above		do	575	225	15
CuAl7Si2	6	15	do	620	310	9
	15	50	do	575	290	12
	50	80	do	515	240	12
	80 and above		do	485	205	15



5. PHYSICAL PROPERTIES

5.1 Tensile Test — The castings, when tested in accordance with IS : 2654-1964*, shall have the tensile properties as given in Table 2.

TABLE 2 PHYSICAL PROPERTIES OF CASTINGS

DESCRIPTION		TENSILE STRENGTH (N/mm ² kgf/mm ²)	ELONGATION PERCENT ON GAUGE LENGTH OF 5.65 $\sqrt{A}$
		Min	Min
Grade 1	Sand Cast	190 (19.0)	3
	Chill Cast	205 (21.0)	5
	Continuously Cast	275 (28.0)	8
Grade 2	Sand Cast	220 (22.5)	3
	Chill Cast	310 (31.5)	2
	Continuously Cast	360 (36.5)	7
Grade 3	Sand Cast	190 (19.0)	3
	Chill Cast	220 (22.5)	2
	Continuously Cast	270 (27.5)	5
Grade 4	Sand Cast	230 (23.5)	6
	Chill Cast	270 (27.5)	5
	Continuously Cast	310 (31.5)	9

Note — 1 N/mm² = 0.102 kgf/mm².

*Method for tensile testing of copper and copper alloys.

†Recommended procedure for inspection of copper-base alloys sand casting (first revision).

High Conductivity Free Machining Copper Rods

(LEADED COPPER)

CHEMICAL REQUIREMENTS

Copper	..	..	..	Remainder
Lead	..	..	..	0.6 to 1.0%
Impurities	..	..	..	0.2% Max.

PHYSICAL PROPERTIES

*Tensile strength	..	..	...	23 to 35 kgs/mm ²
Elongation	..	..	..	45 to 10%
Electrical conductivity at 20°C	..	...	...	94 to 98% IACS

FABRICATION PROPERTIES

Capacity for being Cold worked	..	..	..	Fair
Hot formed	..	..	..	Good
Machineability rating (Free cutting brass-100)	..	..	..	80
Suitability for Brazing	..	..	..	Good
Soldering	..	..	..	Good

USES

Threaded-machine components and parts requiring high conductivity, extensive machining and corrosion resistance; electrical connectors, motor switch components etc.

(TELLURIUM COPPER)

as per BS 2874 C 109)

CHEMICAL REQUIREMENTS

Copper	..	..	..	Remainder
Tellurium	..	..	..	0.3 to 0.7%
Impurities	..	..	..	0.2%-Max.

PHYSICAL PROPERTIES

**Tensile strength	..	..	...	23 to 35 kg/mm ²
Elongation	..	..	..	45 to 10%
Electrical conductivity at 10°C	..	...	..	94 to 98% IACS

FABRICATION PROPERTIES

Capacity for being cold worked	..	..	..	Fair
Hot formed	..	..	..	Good
Machineability Rating (Free cutting brass-100)	..	..	..	80
Suitability for Brazing	..	..	..	Good
Soldering	...	..	..	Good

USES

Threaded-machine components and parts requiring high conductivity, extensive machining and corrosion resistance, electrical connectors, motor, switch components, etc. requiring high softening temperature.

* Material can be supplied in any temper as required by customers.

** Customers to specify temper required

Copper-Nickel-Alloy Rods

as per ASTM B : 411-64

CHEMICAL REQUIREMENTS

Nickel	..	..	..	1.6 to 2.2%
Silicon	..	..	..	0.4 to 0.8%
Lead	..	..	..	0.1% Max
Iron	..	..	..	0.1% Max
Zinc	..	..	..	0.5% Max
Copper	..	..	..	Balance

PHYSICAL PROPERTIES

Tensile strength	..	...	..	63 kgs/mm ² -Min.
Elongation	..	..	..	8%-Min

FABRICATION PROPERTIES

Capable of being precipitation hardened

USES

Component requiring very high strength and wear resistance qualities.

Free Cutting Brass Rods

as per BS 2874—CZ 124

CHEMICAL REQUIREMENTS

Copper	..	..	..	60.0 to 63.0%
Lead	..	..	..	2.5 to 3.7%
Zinc	..	..	..	Balance

PHYSICAL PROPERTIES

Tensile strength	..	..	..	28 Kgs./mm ² -min.
Elongation	..	..	..	12 % min.

FABRICATION PROPERTIES

Capacity for being cold worked	..	..	..	Poor
Capacity for being hot formed	..	..	..	Fair
Machineability Rating (Free cutting Brass-100)	..	..	..	100
Suitability for Soldering	..	..	..	Excellent
Brazing	..	..	..	Good

USES

Hardware, Gears, Pinions, Automatic High Speed Screw Machine Parts.

as per IS : 319, (BS : 249) BS 2874—CZ 124

CHEMICAL REQUIREMENTS

Copper	..	..	..	55.0 to 60.0%
Lead	..	..	..	2.0 to 3.5%
Zinc	..	..	..	Balance

PHYSICAL PROPERTIES

Tensile strength	..	..	..	39 kgs/mm ² -min. (25 Tons/Sq. in.)
Elongation	..	..	..	15%-min.

FABRICATION PROPERTIES

Capacity for being cold worked	..	..	..	Poor
Capacity for being hot formed	..	..	..	Fair
Machineability Rating (Free cutting Brass-100)	..	..	..	90
Suitability for Soldering	..	..	..	Excellent
Brazing	..	..	..	Good

USES

Architectural Extrusions, Thresholds, Butts, Hinges, Lock bodies, Screws, Nuts and Bolts.

Naval Brass Rods
(Forging Quality)
as per IS 291 — 1961 Gr. 1
(BS : 2874 / 1969 CZ : 112) BS 251 / 1963

CHEMICAL REQUIREMENTS

Copper	..	..	..	61.0 to 64.0%
Tin	..	..	..	1.0 to 1.5%
Zinc	..	..	..	Balance

PHYSICAL PROPERTIES

Tensile strength	..	..	..	35 kgs/mm ² -min. (22-26 Tons/Sq. in.)
Elongation	..	..	..	18% min.

FABRICATION PROPERTIES

Capacity for being cold worked	..	..	..	Fair
Capacity for being hot formed	..	..	..	Good
Hot forgeability Rating (Forging Brass-100)	..	..	..	80
Machineability Rating (Free cutting Brass-100)	..	..	..	30
Suitability for Brazing	..	..	..	Excellent
Soldering	..	..	..	Excellent
Oxy Acetylene Welding	..	..	..	Good

USES

Balls, Bolts, Marine hardware, Nuts, Propeller, Shafts, Rivets, Valve Stems, Welding rods.

(Machining and general purposes other than forging quality)
as per IS 291 — 1961 Gr. 2
(ES 2874 — 1969 CZ 113) BS 252 — 1963

CHEMICAL REQUIREMENTS

Copper	..	..	..	59-62%
Tin	..	..	..	0.5-1%
Lead	..	..	..	0.5-1%
Zinc	..	..	..	Balance

PHYSICAL PROPERTIES

Tensile strength	..	..	..	35 kgs./mm ² -min.
Elongation	..	..	..	16%

FABRICATION PROPERTIES

Capacity for being cold worked	..	..	..	Fair
Capacity for being hot formed	..	..	..	Fair
Machineability rating (Free cutting Brass-100)	..	..	..	70
Suitability for Brazing	..	..	..	Excellent
Soldering	..	..	..	Excellent
Welding	..	..	..	Good

USES

Condenser plates, piston rods, nuts, bolts, rivets and other marine machined hardware not invol forging operation.

Lead Free (Rivetting) Brass Rods

as per BS 2874—CZ 109 (BS 1949)

CHEMICAL REQUIREMENTS

Copper	..	..	..	59-62%
Zinc	..	..	..	Balance

PHYSICAL PROPERTIES

Tensile strength	..	..	..	34 kgs/mm ² -Min. (22 Tons/Sq. in.)
Elongation	..	..	..	26% Min.

FABRICATION PROPERTIES

Machineability Rating (Free cutting Brass-100)	..	..	..	55
Bending	..	..	..	Excellent
Rivetting	..	..	..	Excellent
Forging	..	..	..	Excellent

USES

A ductile alloy with good cold working properties suitable for bending and punching Rivets, boltings valve stems, tubing for heat exchangers, brazing rods and hot forgings.

High Tensile Brass Rods

as per BS 2874 1969 CZ 114 (BS 250)

CHEMICAL REQUIREMENTS

Copper	..	..	..	56.0 to 60.0%
Tin	..	..	..	0.2 to 1.0%
Iron	..	..	..	0.25 to 1.2%
Manganese	..	..	..	0.3 to 2.0%
*Lead	..	..	..	0.5 to 1.5%
Aluminium	..	..	..	1.50% Max.
Zinc	..	..	..	Balance

PHYSICAL PROPERTIES

Tensile Strength	..	..	..	47 kgs/mm ² -Min. (30 Tons/Sq. in.)
Elongation	..	..	..	18%-Min.

FABRICATION PROPERTIES

Capacity for being cold worked	..	..	..	Fair
Capacity for being hot worked	..	..	..	Good
Machineability Rating (Free cutting brass-100)	..	..	..	30
Wearing Properties	..	..	..	Good
Resistance to Corrosion	..	..	..	Excellent
Suitability for Soldering	..	..	..	Fair

USES

Balls, Clutch discs, pump rods, shafts, valve stems and bodies, welding rods and such other components requiring high strength and excellent resistance to corrosion.

* If the material is required with lower lead Content than that specified. it may be ordered with a maximum lead content of either 0.1% (lead-free grade or 0.5%).

High Tensile Forging Brass Suitable for Soldering

as per BS 2872 1969—CZ 115 (BS 1001)

CHEMICAL REQUIREMENTS

Copper	..	..	..	56.0 to 60.0%
Tin	..	..	..	0.6 to 1.1%
Iron	..	..	..	0.25 to 1.2%
Manganese	..	..	..	0.3 to 2.0%
Lead	..	..	..	0.5 to 1.5%
Aluminium	..	..	..	0.2% Max.
Zinc	..	..	..	Balance

PHYSICAL PROPERTIES

Tensile strength	..	..	..	55 kgs/mm ² -Min. (35 Tons/Sq. in.)
Elongation	..	..	..	12% Min.

FABRICATION PROPERTIES

Capacity for being cold worked	..	..	..	Fair
Capacity for being hot worked	..	..	..	Good
Machineability rating (Free cutting brass-100)	..	..	..	30
Wearing properties	..	..	..	Good
Resistance to Corrosion	..	..	..	Excellent
Suitability for Soldering	..	..	..	Excellent

USES

Forgings requiring high tensile strength and soldering properties.

HIGH TENSILE BRASS RODS
as per IS : 320—1962

	Alloy-1 percent	Alloy-2 percent	Alloy-3 percent
CHEMICAL REQUIREMENTS			
Copper	56.0 to 59.0	56.0 to 59.0	57.0 to 61.0
Tin*	0.75 to 1.75	0.5 max	1.0 max
Lead	@0.5 max	@1.0 max	@0.75 to 1.0
Iron	1.25 max	0.7 to 1.2	0.25 to 1.0
Manganese	20.0 max	0.5 to 1.2	0.5 to 1.2
Nickel	—	—	—
Aluminium	0.2 max	0.2 to 1.2	0.5 to 2.0
Other elements	0.5 max	0.5 max	0.5 max
Zinc	Remainder	Remainder	Remainder

PHYSICAL PROPERTIES

Tensile Strength
(Kg/mm²) min.
Elongation (percent) min.

Alloy-1	Alloy-2	Alloy-3
53	47	53
15	20	15

FABRICATION PROPERTIES

Similar to CZ 115

Similar to CZ 114

USES

Alloy 1—suitable for soldering.
Alloy 2—less easily soldered.
Alloy 3—suitable for machining.

*Tin is not to be intentionally added

Leaded Brass Rods
(Drilling and Turning Quality)
as per MS 58—DIN 1756

CHEMICAL REQUIREMENTS

Copper	..	..	..	56.5 to 59.5%
Lead	..	..	..	1 to 3%
Zinc	..	..	..	Remainder

PHYSICAL PROPERTIES

Tensile strength	..	..	..	39 to 50 kgs/mm ²
Elongation	..	..	..	9 to 15%

FABRICATION PROPERTIES

Suitability for cold forming	..	..	..	Fair
Suitability for hot forming	..	..	..	Good
Machining, drilling etc.	..	..	..	Very good
Resistance to wear	..	..	..	Poor
Suitability for soldering	..	..	..	Good

USES

For machined components manufactured at high speeds on automatic Capstan Lathes, drilling, shaping or milling machines and which are not subjected to bending.

Forging Brass Rods
as per IS 3488—66, (BS—218—63)

CHEMICAL REQUIREMENTS

Copper	..	..	..	56.5 to 60.0%
Lead	..	..	..	1.0 to 2.5%
Zinc	..	..	..	Balance

MECHANICAL PROPERTIES

Tensile strength	..	..	..	35 kgs/mm ² -Min (22 Tons/Sq. in.)
Elongation	...	..	..	25% Min.

FABRICATION PROPERTIES

Capacity for being cold worked	..	..	..	Poor
Capacity for being hot formed	..	..	..	Excellent
Hot forgeability Rating (Forging Brass-100)	..	..	..	100
Machineability Rating (Free cutting Brass-100)	..	..	..	80
Suitability for Soldering	..	..	..	Excellent
Brazing	..	..	..	Good

USES

Forgings and pressings of all kinds for components requiring free cutting as well as forging quality.

Brass Tubes 63/37
for General Purposes
as per IS 407—1966 (Alloy 2)

CHEMICAL REQUIREMENTS

Copper + incidental nickel	..	..	..	59.63%
Lead	..	..	..	0.80% max.
Iron	..	..	..	0.07% max.
Arsenic	..	..	..	0.06% max.
Other impurities	..	..	..	0.30% max.
Zinc	..	..	..	Remainder

PHYSICAL PROPERTIES

Tensile strength Annealed	..	..	..	29.38 kg/mm ²
Half hard	..	..	..	38 kg/mm ² -Min.
hard	..	..	..	46 kg/mm ² -Min.
Bending, Drifting.				
Flattening properties:				As per IS 407
Hydraulic & Mercurous				
Nitrate test :				As per IS 407

USES

Heat exchangers

Manganese Bronze Rods
as per ASTM B 138—58

CHEMICAL REQUIREMENTS

	Alloy A	Alloy B
	%	%
Copper	57-60	63-68
Tin	0.5-1.5	0.5 max
Iron	0.8-2	2-4
Aluminium	0.25 max	3-6
Manganese	0.05-0.5	2.5-5
Zinc	Remainder	Remainder

PHYSICAL PROPERTIES

Tensile strength				
Alloy A	..	..	..	53 kg/mm ² -Min.
Alloy B	..	..	..	80 kgs/mm ² -Min.
Elongation				
Alloy A	..	..	..	25%-Min.
Alloy B	..	..	..	10%-Min.

USES

Extra Heavy-duty high strength alloy for large valves, stems, gears bearings, shafting and hydraulic cylinder parts.

Aluminium Bronze Rods
as per BS 2874—CA : 103 (BS 2032)

CHEMICAL REQUIREMENTS

Aluminium	..	..	..	8.8 to 10.0%
Iron + Nickel	..	..	..	4% Max
Manganese	..	..	..	0.5% Max
Copper	..	..	..	Balance

PHYSICAL PROPERTIES

Tensile strength	..	..	..	53 kgs/mm ² -Min. (34 Tons/Sq. in.)
Elongation	..	..	..	22%-Min.

FABRICATION PROPERTIES

Capacity for being Cold worked	..	..	..	Fair
Capacity for being hot formed	..	..	..	Excellent
Machineability Rating (Free machining brass-100)	..	..	..	35
Suitability for Brazing	..	..	..	Poor
Soldering	..	..	..	Poor
Welding (Arc)	..	..	..	Good

USES

1. Acid resisting mine pumps, Bearings, Valve seats etc.
2. Corrosion resistant parts, marine hardware, heat-resistant applications, wear and high strength nuts, bolts, stringers and threaded parts.

as per BS 2874—CA : 104 (BS 2033)

CHEMICAL REQUIREMENTS

Aluminium	..	..	..	8.5 to 11.0%
Nickel	..	..	..	4.0 to 6.0%
Iron	..	..	..	4.0 to 6.0%
Manganese	..	..	..	0.5% Max.
Copper	..	..	..	Balance

PHYSICAL PROPERTIES

Tensile strength	..	..	..	71 kgs/mm ² -Min. (45 Tons/Sq. in.)
Elongation	..	..	..	12% Min.

FABRICATION PROPERTIES

Capacity for being cold formed	..	..	..	Poor
Capacity for being hot formed	..	..	..	Good
Machineability rating (Free machining brass-100)	..	..	..	35
Suitability for Brazing	..	..	..	Fair
Soldering	..	..	..	Poor
Welding	..	..	..	Good

USES

1. Excellent corrosion resistant alloy, mainly used in propeller hubs, blades and other parts in contact with salt water.
2. Valve guides and seats in air-craft engines.
3. Gear blanks and high pressure Valves, Bearings etc.
4. Heat Exchangers.

Aluminium Silicon Bronze Rods

as per ASTM B 283—56

CHEMICAL REQUIREMENTS

Aluminium	..	..	..	6.5 to 8.0%
Silicon	..	..	..	1.5 to 3.0%
Copper	..	..	..	89% Min.

PHYSICAL PROPERTIES

Tensile Strength	..	..	..	67 kgs/mm ² -Min.
Elongation	..	..	..	25%-Min.

FABRICATION PROPERTIES

Machineable Aluminium Bronze with high strength, good corrosion resistance and low co-efficient of friction.

Forgeability Rating	..	..	..	75%
---------------------	----	----	----	-----

USES

Hot forged components, propeller shaft bearings etc.

High Conductivity Electrolytic Copper Rods & Tubes

as per BS 2874—1969, C 101

BS 1977—1963 (Tubes)

CHEMICAL REQUIREMENTS

Copper	..	..	..	99.9%-Min. (inclusive of silver)
Lead	..	..	..	0.005%
Total impurities	..	..	..	0.03% (excluding oxygen)

PHYSICAL PROPERTIES

*Tensile strength	..	..	..	23 to 35 kgs/mm ²
Elongation	..	..	..	55 to 6%
Electrical conductivity at 20°C	..	..	..	101% IACS (annealed)

FABRICATION PROPERTIES

Capacity for being Cold worked	..	..	..	Excellent
Hot formed	..	..	..	Excellent
Machineability	..	..	..	Poor
Suitability for Silver brazing	..	..	..	Good
Soldering	..	..	..	Good

(In an inert or slightly oxidizing condition.)

USES

Electrical conductors switches, terminals, gaskets, radiators, cotter pins, nails, rivets, tubes etc., requiring high electrical/thermal conductivity.

- * Material can be supplied in any temper as required by customers.

**BRITISH STANDARD SPECIFICATIONS* FOR THE PRINCIPAL NON-FERROUS
CASTING ALLOYS—(Contd.)**

Alloy	Specification	Percentage Chemical Composition	Physical Properties	Allied Specifications	Remarks
Aluminium Bronze	B.S. 1400 : 1961 AB1	Al. 8.5-10.5% Fe. 1.5-3.5% Ni. 1.0% max. Zn. 0.5% max. Mn. 1.0% max. Total other elements 0.3% max. Cu. remainder.	Tensile strength 32 tons per sq. in. Elongation 20% min.	B. 150-46T B. 148-45T-9C D.T.D. 174A B.S. 1031/2 D.I.N. 1714 (G. AIMBz 10) S.T.A. 7-CA3	Alloy used for high grade sand and die-castings such as worm and gear wheels. Also for components to withstand the action of superheated steam.
Aluminium Bronze	B.S. 1400 : 1961 AB2	Al. 8.5-10.5% Fe. 3.5-5.5% Ni. 4.5-6.5% Mn. 1.5% max. Zn. 0.5% max. 0.5% max. Total other elements 0.3% max. Cu. remainder	Tensile strength 41 tons per sq. in. Elongation 15% min.	G. AIMBzB Q.Q.B. 671a .A Q.Q.B. 67a C and D. A.M.S. 4640 B. 148-45-T.9D B.30.45T.9D D.T.D. 412 B.S. 1072/3 S.T.A. 7-CA4	Suitable for high duty sand, die and centrifugal castings.
Brass 60/40	B.S. 1400 : 1961 DCB	Cu. 59-63% Al. 0.5% max. Pb. 0.1% max. Total other elements 0.75% max. Zn. remainder.	Tensile strength 18 tons per sq. in (min.) Elongation 25% (min.)	B.S. 932 S.T.A. 7-CZ 14 MIL-C-15345 D Grade 2	General purpose, die-casting alloy. Suitable for electrical switchgear and contact parts brush holders.
Brass 60/40	B.S.S. 249	Cu. 55-60% Pb. 2-3.5% Fe. 0.3% max. Other elements 0.75% max. Zn. remainder	Tensile strength 25 tons per sq. in. Elongation 20%	Ms. 58	A super high speed machining and screw cutting brass. Also suitable for extrusions.
Naval Brass 60/40	B.S. 1400 : 1961 SCB4	Cu. 60% min. Sn. 1.0-1.5% Pb. 0.1% max. Other elements 0.75% max. Zn. remainder.	Tensile strength 16 tons per sq. in. min.	B. 124.45 3 B. 171-42 T.N.B. Q.Q.B. 636 B. A.M.S. 4612 A.M.S. 4611 S.A.E. 73 S.A.E. 76	Suitable for hot and cold rolling, casting. Has better anti-corrosive properties than the usual 60/40 alloy.
Leaded Brass 70/30	B.S. 1400 : 1961 SCB2	Cu. 66-73% Pb 2-5% Sn. 1.5% max. Fe. 0.75% max. Ni. 1.0% max. Al. 0.01% max. Total other elements 1.0% max. Zn. remainder.	Tensile strength 11 tons per sq. in. (min.) Elongation 12% (min.)	ASTM. B146-52 (6A) SAE. 41 DIN 1709 GMS 64	Suitable for pressure right castings up to 200 lb./sq. in at normal temperatures. Plumbers' fittings, general hardware ferrules ships', trimmings, etc. Also for battery lugs and other electrical parts.

* Relating to sand castings unless otherwise stated.

**BRITISH STANDARD SPECIFICATIONS* FOR THE PRINCIPAL NON-FERROUS
CASTING ALLOYS—(Contd.)**

Alloy	Specification	Percentage Chemical Composition	Physical Properties	Allied Specifications	Remarks
Brass 70/30	B.S.S. 267	Cu. 68-72% Sn. 0.015% max. Pb. 0.07% max. Fe. 0.05% max. Ni. 0.10% max. As 0.01% max. Bi. 0.004% max. Zn. remainder.	Tensile strength 19 tons per sq. in.	B. 134.45.6 B. 36.44T.6 B. 134.45.5 B. 36.44T.5 B. 129.44T B. 135.46T.2 B. 19.44T Q.Q.B. 611a.E Q.Q.W. 321c A.M.S. 4505A S.A.E. 70A S.A.E. 74c S.A.E. 80A	Alpha brass giving good ductility and high strength. Can be used for deep drawing. An addition of tin is made if corrosive conditions have to be withstood.
Gilding Metal 90/10	B.S. 713	Cu. 89.91% Pb. 0.3% max. Total impurities including Pb= 0.6% max. Zn. remainder.	Annealed condition tensile strength 16 tons per sq. in. Elongation 30% Brinell hardness 75 max.	B. 131-46T B. 43-46 (2) B. 36-46T B. 121-46T (1)	Alpha high purity brass for casting, pressings, tubings etc. Will stand much work hardening.
Gilding Metal 85/15 80/20	B.S. 712 B.S. 711	B.S. 712 Cu. 84.86% Pb. 0.3% max. Total impurities including Pb= 0.6% Zn. remainder. B.S. 711 Cu. 79-81% Pb. 0.3% max. Total impurities including Pb= 0.6% Zn. remainder	Annealed condition. B.S. 712 Tensile strength 16 tons per sq. in. Elongation 35% Brinell 75 max. B.S. 711 Tensile strength 17 tons per sq. in. Elongation 40% Brinell 75 max	B. 36-46T (3) S.A.E. 79 Grade A B. 36-46T (4) S.A.E. 79 Grade B	These two alloys possess many of the characteristics of the 90/10 range. The increased zinc content provide scope for the designer and architect but reduces the thermal and electrical conductivity. Can be brazed and enamelled.
Gunmetal 83/3/9/5	B.S. 1400 : 1961 LG. 1	Sn. 2-4% Zn. 7-10% Pb. 3-6% Ni. 1% max. Total other elements 1.0% max. Cu. remainder.	Tensile strength 11 tons per sq. in. Elongation 12%	B.S. 1158/9 Rg. 3. B. 30.45T.5A B. 145.45T Q.Q.B. 701. a. 11 Q.Q.B. 701 b. 11 S.T.A. 7-CG6	Used where results superior to brass are needed with respect to corrosion strength at elevated temperatures and bearing properties.
Gunmetal 85/5/5/5	B.S. 1400 : 1961 LG 2	Sn. 4-6% Zn. 4-6% Pb. 4-6% Ni. 2% max. Total other elements 0.5% max. Cu. remainder.	Tensile strength 13 tons per sq. in. Elongation 15%	DIN. 1705 (RGS) W.W.P. 461a.2 W.W.P. 448a.2 A.S.T.M.B. 62-46T B. 30-45T B. 145-46T A.M.S. 4855 S.A.E. 40 U.S. Air Corps 11306 G Dea B.S. 897/8 S.T.A. 7. CGS.	One of the best gunmetal casting alloys. Recommended for pressure resisting casting. Possesses superior machining properties.

* Relating to sand castings unless otherwise stated.

**BRITISH STANDARD SPECIFICATIONS* FOR THE PRINCIPAL NON-FERROUS
CASTING ALLOYS—(Contd.)**

Alloy	Specification	Percentage Chemical Composition	Physical Properties	Allied Specifications	Remarks
Gunmetal 86/7/5/2	B. S. 1400 : 1961 LG. 3	Sn. 6-8% Zn. 3-5% Pb. 1-3% Ni. 2% max. Total other elements 0.5% max. Cu. remainder.	Tensile strength 14 tons per sq. in. Elongation 12%	B. 30.45T.2A B. 61.44 B. 143.44T.2A S.A.E. 622 Q.Q.B. 701a. 1 Q.Q.B. 691b. 1 DIN. 1705 (RG7) S.T.A. 7-CG4 B.S. 1023/4	Possesses high bearing anti-corrosion properties but not suited for stresses such as for un-backed bearings and steam equipment.
Gunmetal Admiralty 88/10/2	B. S. 1400 : 1961 G1	Sn. 9.5-10.5% Zn. 1.5-2.5% Pb. 1.5% max. Ni. 1% max. Other elements 0.2% max. Cu. remainder.	Tensile strength 17 tons per sq. in. Elongation 15%	B.S. 382/3 A.M.S. 4845 S.A.E. 62 B. 30.45.T.1A B. 143.44T-1A S.T.A. 7-CG2.	Standard alloy for marine castings and for resisting pressures up to 4000 lbs. per sq. in.
Leaded Bronze 76/9/0/15	B. S. 1400 : 1961 LB1	Sn. 8-10% Zn. 1% max. Pb. 13-17% Ni. 2% max. Other elements 0.5% max. Cu. remainder.	Tensile strength 11 tons per sq. in. min. Elongation 4% min.	B. 30.45T.3D B. 66.44 11B B. 144.45T-3D B. S. 954/5 Din. 1716 (Pb. Sn. Bz. 13)	Bearing alloy.
Leaded Bronze 80/10/0/10	B. S. 1400 : 1961 LB2	Sn. 9-11% Pb. 8.5-11.0% Zn. 0.75% max. Ni. 2.0% max. P. O. 10% max. Cu. remainder Total other elements 0.5% max.	Tensile strength 12.0 tons per sq. in. (min.) Elongation 5% (min.)	B.S.962/3 S.A.E. 64 S.A.E. 792 A.M.S. 4827B-4842A. ASTM. B144-52-(3A) Castings. DIN. 1716 (G. Sn Pb Bz. 10)	General purpose bearing alloy. Suitable for unlined heavy duty bearings for high shaft speeds.
Leaded Phosphor Bronze 87/7/2/4	B. S. 1400 : 1961 LPB1	Sn. 6-5-8.5% P. 0.3% min. Pb. 2-5% Zn. 2.0% Ni. 1.0 max. Other elements 0.5% max. Cu. remainder.	Tensile strength 12 tons per sq. in. min. Elongation 3% min.	B.S. 1061/1 S.T.A. 7-CP3	Suitable for the production of high grade castings and chill cast solid and cored sticks. Bearing bushes where lubrication is not perfect.
Manganese Bronze or High Tensile Brass.	B. S. 1400 HTB1	Cu. 55% min Mn. 3.0% max. Al. 2.5% max. Fe. 0.5-2.0% Sn. 1.5% max. Ni. 1.0% max. Pb. 0.5% max. Si. 0.1% max. Zn. remainder.	Tensile strength 30 tons per sq. in. Elongation 20%	A.M.S. 4860 B.S. 207/8 S.T.A. 7-CM6 A.S.T.M. B147-48 (8a) B147-46T (7a&8a) B132-46T (a). S.A.E. 43	An alloy with good compromise between strength and ductility.

* Relating to sand castings unless otherwise stated.

BRITISH STANDARD SPECIFICATIONS* FOR THE PRINCIPAL NON-FERROUS CASTING ALLOYS.

Alloy	Specification	Percentage Chemical Composition	Physical Properties	Allied Specifications	Remarks
Manganese Bronze or High Tensile Brass.	B. S. 1400 HTB2	Cu. 55% min. Mn. 3.0% max. Al. 5.0% max. Fe. 0.5-2.5% Ni 2.0% max. Pb. 0.5% max. Sn. 0.5% max. Si. 0.1% max. Zn. remainder.	Tensile strength 38 tons per sq. in. Elongation 15%	B.S. 207/8 S.T.A. 7-CM7A SeMs 58F60	An alloy with high strength.
Manganese Bronze or High Tensile Brass.	B. S. 1400 HTB3	Cu. 55% min. Mn. 4.0% max. Al. 3.0-6.0% Fe. 1.0-2.5% Ni. 1.0% max. Sn. 0.2% max. Pb. 0.2% max. Si. 0.1% max. Zn. remainder.	Tensile strength 48 tons per sq. in. Elongation 12 %	B.S. 207/8 S.T.A. 7-CM7	Extra heavy duty high strength alloy.
Phosphor Bronze 90/10	B. S. 1400 : 1961 PB1	Sn. 10.0% min. Zn. 0.05% max. P. 0.5% min. Pb. 0.25% max. Total other elements including Pb = 0.3% max. Cu. remainder	Tensile strength 14 tons per sq. in. min. Elongation 3% min.	2B8 G.B.Z. 10 S.A.E. 65 B. 103-44D B. 139.46T.D. B. 159.46T.D. B.S. 1058/59 S.T.A. 7-CP5	For high quality and finish solid and cored chill cast sticks. Casting to withstand heavy loading such as gear blanks, worms, side valves, etc.
Phosphor Bronze 88/12	B. S. 1400 : 1961 PB2	Sn. 11-13% P. O. 15% min. Pb. 0.5% max. Ni. 0.5% max. Zn. 0.3% max. Total other elements 0.2% max. Cu. remainder	Tensile strength 14 tons per sq. in. min. Elongation 5% min.	S.A.E. 65 B.S. 421 S.T.A. 7-CP6	Alloy suitable for centrifugal cast gear blanks, worms and slide valves working under loads.
Silicon Bronze	B. S. 1400-SB1	Si. 1.5-5.0% Zn. 5.0% max. Fe. 2.5% max. Mn. 1.5% max. Total other elements 0.5% max. Cu. remainder.	Tensile strength 20 tons per sq. in. Elongation 15%	D.T.D. 355 B. 96.42c P. 98.45c B. 97.44c B. 99.45c B. S. 1029/30 B. S. 1029/30 S.T.A. 7-CS1	Alloy for withstanding corrosion of mineral, vegetable and organic acids, dyes and fruit juices. Also for strength and certain bearings.

* Relating to sand castings unless otherwise stated.

BRASS, BRONZE, ALUMINUM AND OTHER ALLOYS

Cast Brass and Bronze. — The following information on S.A.E. Standard Brass and Bronze Castings includes typical applications of the different alloys in the automotive industry, the composition in percentage, and physical properties based upon standard test bars cast to size with only a minimum amount of machining to remove the fin gate. Standard specimens of wrought material are taken parallel to the direction of rolling and all rods, bars and shapes are tested in full size when practicable.

Red Brass Castings. — S.A.E. Standard No. 40. — Red brass is used for water-pump impellers, fittings for gasoline and oil lines, small bushings, small miscellaneous castings. This is a free-cutting brass with good casting and finished properties.

Composition of No. 40: Copper, 84 to 86; tin, 4 to 6; lead, 4 to 6; zinc, 4 to 6; iron, max., 0.25; nickel, max., 0.75; phosphorus, max., 0.05; aluminum, 0.00; sulphur, max., 0.05; antimony, max., 0.25; other impurities, max., 0.15 per cent.

Physical Properties: Tensile strength, 26,000 pounds per square inch; yield point, 12,000 pounds per square inch; elongation in 2 inches (or proportionate gage length), 15 per cent.

Yellow Brass Castings — S.A.E. Standard No. 41. — Yellow brass is used for radiator parts, fittings for water cooling systems, battery terminals, miscellaneous castings. This alloy is intended for commercial castings when cheapness and good machining properties are essential.

Composition of No. 41: Copper, 62 to 67; lead, 1.50 to 3.50; tin, max., 1; iron, max., 0.75; nickel, max., 0.25; phosphorus, max., 0.03; aluminum, max., 0.30; sulphur, max., 0.05; antimony, max., 0.15; other impurities, max., 0.15 per cent; zinc, remainder.

Physical Properties: Tensile strength, 20,000 pounds per square inch; elongation in 2 inches (or proportionate gage length), 15 per cent.

Manganese Bronze Castings — S.A.E. Standard No. 43. — This alloy is intended for castings requiring strength and toughness. It is used for such automotive parts as gear-shifter forks; counters, spiders; brackets and similar fittings; parts for starting motors; landing-gear and tail-skid castings for airplane.

Composition of No. 43: Copper, 55 to 60; zinc, 38 to 42; tin, max., 1.50; manganese, max., 3.50; aluminum, max., 1.50; iron, max., 2; lead, max., 0.40 per cent.

Physical Properties: Tensile strength, 65,000 pounds per square inch; elongation in 2 inches (or proportionate gage length), 25 per cent.

High Tensile Manganese Bronze Castings — S.A.E. Standard No. 430. — This alloy is intended for use in castings where high strength and toughness are required such as marine propellers, shafts and gears.

Composition of No. 430: Copper, 60 to 68; iron, 2 to 4; aluminum, 3 to 6; manganese, 2.5 to 5; tin, max., 0.50; lead, max., 0.20, and nickel, max., 0.50 per cent; zinc, remainder.

Physical Properties: This alloy is manufactured in two grades, distinguished by chemical composition: Grade A being in the lower, and Grade B in the higher range of manganese, aluminum and iron content. Tensile strength, Grade A, 90,000, and Grade B, 110,000 pounds per square inch; elongation in 2 inches, Grade A, 20, and Grade B, 12 per cent.

Cast Brass to be Brazed — S.A.E. Standard No. 44. — This brass is used for water-pipe fittings which are to be brazed. It begins to melt at about

Hardness and Ultimate Strength of No. 70 Sheet Brass by Tempers

Temper of Brass Sheet (S.A.E. No. 70) and Equivalent Reduction in B. & S. Gage Numbers		Rockwell Hardness Numbers				Ultimate Strength Pounds per Square Inch	
		B Scale 1/16" Ball- 100 kg. Load		Superficial 30-T Scale 1/16" Ball- 30 kg. Load			
Temper	Gage Nos.	Min.	Max.	Min.	Max.	Min.	Max.
Grade A							
Quarter Hard	1	40	65	43	60	49,000	59,000
Half Hard	2	60	77	56	68	57,000	67,000
Three-Quarter Hard	3	74	82	65	72	64,000	74,000
Hard	4	79	86	70	74	71,000	81,000
Extra Hard	6	85	91	74	77	83,000	92,000
Spring	8	89	93	76	78	91,000	100,000
Extra Spring	10	91	95	77	79	95,000	104,000
Grade C							
Quarter Hard	1	40	65	43	60	49,000	59,000
Half Hard	2	57	74	54	66	55,000	65,000
Three-Quarter Hard	3	70	80	65	71	62,000	72,000
Hard	4	76	84	68	73	68,000	78,000
Extra Hard	6	83	89	73	76	79,000	89,000
Spring	8	87	92	75	78	86,000	95,000
Extra Spring	10	88	93	76	79	90,000	99,000

The hardness numbers equivalent to such temper designations as "quarter hard," "half hard," etc., vary over a wide range as shown by the table above. The hardness number represented by a given temper designation depends not only upon the kind of annealing and thickness of a given material, but may be affected decidedly by the composition or type of alloy. "Quarter hard" red brass sheet (S.A.E. No. 79), for example, may have a Rockwell hardness varying from 50 to 95 which differs considerably from the minimum and maximum numbers given in the table above opposite "quarter hard."

Hardness tests of the indentation type, such as Rockwell or Brinell, are generally used for thin materials; however, if the sheet is very thin, the test may be for comparison only with other sheets of the same composition and thickness. When the penetration is deep relative to the thickness, there may be an apparent decrease of hardness due to the flow or punching-through of the material because of lack of lateral support; however, when the penetration is even greater relative to thickness, there may be an apparent increase in hardness due to the pressure of the penetrator on the anvil of the instrument.

Composition of No. 701B: Copper, 80.0 to 93.0; aluminum, 6.5 to 11.0; iron, max., 4.00; nickel, max., 1.00; manganese, max., 1.50; silicon, max., 2.25; tin, max., 0.60; zinc, max., 1.0; tellurium, max., 0.6; other elements, max., 0.50.

Composition of No. 701C: Copper, 78.0; aluminum, 9.0 to 11.0; iron, 2.0 to 4.0; nickel, 4.0 to 5.5; manganese, max., 1.50; silicon, max., 0.25; tin, max., 0.20; other elements, max. 0.50.

Composition of No. 701D: Copper, 88.0 to 92.5; aluminum, 6.0 to 8.0; iron, 1.5 to 3.5; other elements, max., 0.50.

Mechanical Properties: Minimum tensile strengths of the No. 701B alloy grade range from 70,000 to 80,000 psi, minimum yield strengths from 30,000 to 40,000 psi and minimum elongations in 2 inches from 12 to 9 per cent depending on thickness or size of rod or bar. Minimum tensile strengths of the No. 701C alloy grade

Bronze Backing for Lined Bearings — S.A.E. Standard No. 66. — This is an inexpensive but suitable alloy for bronze-backed bearings of connecting-rods or main engine bearings.

Composition: Copper, 83 to 86; tin, 4.50 to 6; lead, 8 to 10; zinc, max., 2; other impurities, max., 0.25 per cent.

Physical Properties: Tensile strength, 25,000 pounds per square inch; yield point, 2,000 pounds per square inch; elongation in 2 inches, 8 per cent.

Bronze Bearing Castings — S.A.E. Standard No. 660. — This composition is widely used for bronze bearings. Typical applications in the automotive industry include such parts as spring bushings, torque tube bushings, steering-knuckle bushings, piston-pin bushings, thrust washers, etc.

Composition of No. 660: Copper, 81 to 85; tin, 6.50 to 7.50; lead, 6 to 8; zinc, 1 to 4; iron, max., 0.20; antimony, max., 0.20; other impurities, max., 0.50 per cent.

Physical Properties: Tensile strength, 30,000 pounds per square inch; yield point, 4,000 pounds per square inch; elongation in 2 inches, 18 per cent.

Cast Aluminum Bronze — S.A.E. Standard No. 68. — This alloy has considerable strength, resistance to corrosion, hardness equal to manganese bronze, and good bearing qualities under certain conditions. It is used for worm-wheels, gears, valve guides, valve seats, and forgings.

Composition of No. 68: Copper, (Grade A) 87 to 89, (Grade B) 89.50 to 90.50; aluminum, (Grade A) 7 to 9, (Grade B) 9.50 to 10.50; iron, (Grade A) 2.50 to 4, (Grade B) not over 1; tin, max., (Grade A) 0.5, (Grade B) 0.2; total other impurities, (Grade A), 1, (Grade B) 0.5 per cent.

Physical Properties: Tensile strength, (Grades A and B) as cast, 65,000 pounds per square inch; tensile strength, (Grade B) as heat-treated, quenched and drawn, 10,000 pounds per square inch; yield point, (Grades A and B) as cast, 25,000 pounds per square inch; yield point, (Grade B) as heat-treated, 50,000 pounds per square inch. Elongation in 2 inches, (Grade A) as cast, 20 per cent; (Grade B) 15 per cent; Grade B as heat-treated, 4 per cent.

Wrought Copper and Copper Alloys

Brass Sheet and Strip — S.A.E. Standard No. 70. — There are two grades designated as 70A (Cartridge Brass) and 70C (Yellow Brass). Tempers range from quarter hard through extra spring. These are given in the accompanying table. The numbers following each temper designation in the table represent the amount of reduction in B. & S. gage numbers when the brass sheets are rolled. The greater the reduction, the harder the brass.

This alloy is used to make radiator cores and tanks in the automotive industry; lead chain, flashlight shells, socket and screw shells in the electrical industry; and eyelets, fasteners, springs and stampings in the hardware industry.

Composition of No. 70A: Copper, 68.5 to 71.5; lead, max., 0.07; iron, max., 0.05; zinc, remainder.

Composition of No. 70C: Copper, 64.0 to 68.5; lead, max., 0.15; iron, max., 0.05; zinc, remainder.

Mechanical Properties: Tensile strengths and Rockwell hardness numbers are given in the accompanying table.

Aluminum Bronze Rods, Bars, and Shapes — S.A.E. Standard No. 701. — This alloy is commonly used for bushings, gears, valve parts, bearings, sleeve pins, and fabricated sections. It is also used where strength at elevated temperatures, a low coefficient of friction against steel, or a combination of strength and corrosion resistance is required. Alloy grades are: 701B, 701C and 701D

Manufacturing Standards & Quality Assurance

All products are manufactured in strict adherence to international quality standards. Our quality assurance process includes:



Material Control System



Process Control System



Machining & Dimensional Control



Certification & Supplementary Testing



Final Inspection & Finishing



Chemical composition is verified using **Spark Absorption Spectrometer** before pouring, ensuring precise metallurgy. Our commitment to quality has made us a trusted casting partner for prestigious OEMs.



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