ENGINEERING ALLOYS

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PREFACE TO FIRST EDITION

This book is the result of a growing demand for a practical and technical reference book on engineering alloys.

The authors of the book have made a careful compilation of the available data and information on practically all proprietary commercial and technical alloys manufactured in the United States of America, and on many alloys made in foreign countries, including England, France, Germany and Sweden. The book is devoted to data on the chemical composition, physical and mechanical properties, uses, and manufacturers of proprietary alloys. No attempt has been made to include alloys conforming to standard specification analyses as such; examples of the common engineering alloys produced to customers' specifications will be found among listed proprietary alloys. However, because of their widespread usage, the Society of Automotive Engineers' specification alloys, as well as a few others of general interest, have been included.

The aim has been to present as large an amount of reliable and up-to-date information on commercial alloys as was consistent with convenience in form and breadth of scope of this book. This information has been obtained by direct correspondence with the alloy manufacturers, and supplemented by data obtained from commercial literature and technical publications.

The book is divided into seven sections, as follows: Section I, which gives an alphabetical listing of all alloys and their corresponding index or serial number; Section II, which gives the trade name, composition, properties, uses, general remarks and a key number designating the manufacturer and the reference for each alloy as listed in serial order; Section III, an index of alloys classified according to typical uses or special characteristics such as corrosion-resistance; Section IV, an alphabetical listing of the manufacturers with a summary of the alloys listed that are produced by each; Section V, which lists the manufacturers, with addresses, in serial order according to the key number (M-number); Section VI, comprising the references, in serial order according to their key number (R-number); and Section VII, an appendix containing useful tables and miscellaneous information pertaining to the properties and testing of alloys.

With this arrangement, data on a particular alloy are located by using the alphabetical index (Section I) to ascertain the alloy serial number, and then turning to that number in Section II for the desired information regarding composition, properties, and uses. The manufacturer's name and address can be located by referring to the appropriate M-number in Section V. Similarly, the source of information is ascertained in Section VI under the appropriate R-number. Where an M-number appears in the reference column of Section II, the information was supplied by the manufacturer. Section IV is intended as an index of manufacturers, and while complete so far as the alloys listed in the second section (excepting discontinued alloys) are concerned, it should not be considered as a listing of all the alloys produced by the particular manufacturer.

Some of the alloys listed are either obsolete or are not in commercial production at the present time, but they have been embodied in the text in order to make it as complete a reference as possible. Some of the blank spaces in the text appear because of the manufacturers' feeling that certain information is either confidential or of no practical interest. The latter comment applies particularly to data on physical properties of tool steels. As it is not feasible to include all the information that could be desired, should more specific data on any particular alloy be wanted by the reader, it is recommended that he refer to the reference or manufacturer cited, or else communicate directly with the authors.

Undoubtedly many important alloys are not listed, despite the authors' best efforts in search of new data. This is especially true in regard to alloys not of American manufacture. The authors will be grateful for any additional information or suggestions for the improvement of this work that may be incorporated at a later time, and they hope that the reader will call to their attention any omissions and errors.

The nature of this compilation is such as to make a critical analysis of the data impracticable, and the authors assume no responsibility for the accuracy or reliability of the quoted values and information; in fact, they have attempted to present the data as impartially and faithfully as possible and have abstained from interjecting their personal judgment or opinion in any respect. It should be borne in mind, also, that the mechanical properties of commercial alloys vary between wide limits, and, therefore, the values assigned in a given instance usually represent the most probable values that would be obtained under the given conditions. Some values are quoted from the manufacturers that refer to a test characterizing but a single specimen. In general, however, all these values should be looked upon as being indicative or suggestive rather than definitive. The same is true of the applications cited. Special care must also be exercised in interpreting remarks relative to the corrosion-resistance of any alloy. Furthermore the reader is cautioned against using the data in such manner as would incur liability for infringement of any patents that may now exist or are pending.

Information was obtained from so many sources in the preparation of this book, that a complete acknowledgment, beyond that noted in the citation of sources of information in the reference column of Section II, is difficult to make. Considering the unprecedented nature of this book, the cooperation of the manufacturers listed was most gratifying and their assistance is as deeply appreciated as it was indispensable. The authors wish to make special acknowledgment to the following: the American Society for Metals, the American Society for Testing Materials, the Society of Automotive Engineers, and the National Research Council for permission to use data appearing in their publications; to Iron Age, Chemical and Metallurgical Engineering, and the Metal Industry (London) for use of information that appeared in these magazines; to the Louis Cassier Company (London) and Verlag Chemie for permission to utilize some of the data published in their respective books, Metals and Alloys and Die Werkstoffe Der Chemischen Apparate (Dr.-Ing. H. Freytag).

The authors wish to acknowledge their appreciation of the services rendered by Professor H. Bluestone of the United States Naval Academy Postgraduate School, who aided in making translations, and by Marie I. Dornblatt, who assisted in checking data and reading proof. In addition the authors are indebted to Dr. F. L. Coonan for his helpful suggestions and criticism during the preparation of the manuscript.

PREFACE TO SECOND EDITION

In the eight years since the publication of the first edition, many new alloys have been developed and marketed by the ferrous and non-ferrous manufacturers.

There have been several changes in the composition, properties, and even trade names of many alloys. Some have become obsolete and are no longer being manufactured. It therefore would seem wise to incorporate the new proprietary trade name alloys, and the changes in the alloys already listed, in a second edition.

The manufacturers included in the first edition were requested to supply any changes in composition and properties of their alloys, as originally published. They were also asked to furnish data and information regarding new alloys put out and marketed by them. Many additional manufacturers supplied data on their alloys for incorporation in the revised edition.

Where the proprietary trade names were changed, an attempt was made to record the old name in Section II under the "Remarks" column. Wherever the alloys have become obsolete and their manufacture has been discontinued, it has been so indicated.

All alloys have been credited to the proper manufacturer, except where this information was unobtainable.

Section VI in the original edition, comprising the references in serial order according to their key number (R-number), has been deleted. Since the alloys covered by these references were checked with the manufacturers, it did not seem necessary to show the source of the original information. Section VII, "Useful Data Appendix," of the first edition, will therefore become Section VI.

Professor Albert Dornblatt, co-author of the first edition, died in 1942. Mr. Rober J. Metzler, formerly Assistant Chief Metallurgist of the Eclipse-Pioneer Division of Bendix Aviation Corporation, and now Chief Metallurgist of the Breeze Corporation, has assumed the responsibilities of co-authorship of this second edition.

PREFACE TO THIRD EDITION

During the seven years since the publication of the second edition we have accumulated information on more than 7000 new proprietary alloys which have been incorporated in this third edition.

The methods used in securing information on the new alloys as well as supplementing and correcting data on previously listed alloys followed very closely those outlined in the prefaces to the first and second editions.

Section III, Uses and Applications, as previously published in the first and second editions has been deleted from the present edition. So numerous have become the applications to which specific alloys can be put and so large the number of alloys appropriate to each use, it was felt that Section III on uses and applications has become of little practical value, the more so since some information regarding the primary uses appears in Section II. Consequently, Section IV on Manufacturers and Their Alloys as published in the previous editions is now Section III in the present edition.

The author is grateful for the continued cooperation of the alloy manufacturers in making possible the completeness and accuracy of the text.

PREFACE TO FOURTH EDITION

Since the publication of the Third Edition in 1952 over 15,000 additional proprietary alloys have been accumulated from sources throughout the world, making a grand total of over 35,000 alloys for the newly revised Fourth Edition. Publication rights to the Fourth Edition have been transferred from the American Society for Metals to the Reinhold Publishing Corporation to take advantage of their international sales capabilities.

As in the previous editions, obsolete and discontinued proprietary alloys have been retained not only for historical value but because many of these alloys can still be found on metal fabricators' and consumers' blueprints and specifications. And, although not necessarily a standard or active product with the alloy mill, the alloy or alloys may continue to be made by the respective mills if ordered in mill lots.

The data and information on all the alloys were brought up to date by sending tear sheets from the Third Edition to all the ferrous and non-ferrous alloy manufacturers, with the request that they make the necessary corrections, changes and additions for their own alloys and submit the approved copies to the author. All these corrections and changes have been incorporated in the Fourth Edition.

The format of the Fourth Edition has been changed to enable the author to include more useful information on the alloys. Instead of the previous tabulated organization where space was limited, each alloy is now abstracted in a separate paragraph showing the chemical composition, mechanical properties, uses, and general characteristics.

SECTION I
ALLOY DATA

This section gives condensed data on proprietary alloys sufficient in most instances to identify the alloy, its salient characteristics and its manufacturer. In order that this information could be presented on all known alloys, it was necessary to condense the data. For this reason some who desire to use this data may not find it up to their expectations. It is evident, however, that no one volume can adequately present all the information that may be desired concerning the 35,000-odd alloys listed here. This book is not encyclopaedic nor will it supersede any handbook or buyer's guide. In the event that the information given here proves inadequate, it is suggested that additional data be obtained from the manufacturer whose address is given.

There are several reasons for suggesting that contact be made with the manufacturer for more detailed information than appears in the book. A pertinent admonition to anyone seeking information on alloys is:

"A little learning is a dang'rous thing;
Drink deep, or taste not the Pierian spring."

Some of the reasons for seeking additional information are discussed below.

In the first place, the alloys listed are for the most part proprietary, and as such may be protected by patents or registration of trade-mark. The absence of any note to such effect does not mean that the alloy is not thus protected, and the user of this book is advised that he may be held accountable for any infringement of such proprietary rights.

In the second place, the manufacturers are always in a position to offer valuable advice if informed of the purpose the alloy is to serve, owing to their experience with related problems.

Finally, it is possible that the data presented may be misinterpreted. This point will be elaborated upon in what follows.

Consider, first, the composition of the alloys. Apparently identical analyses do not necessarily mean equivalent quality or equivalent characteristics. There are, for example, several grades of tool steels marketed that possess practically identical analyses yet divergent characteristics and command prices in proportion to their grade or quality. Inherent grain size, hardenability, fracture, general soundness, manufacturing process, even ingot size and extent of reduction are illustrative of some items other than composition as usually expressed that influence serviceability and performance of tool steel. The compositions as furnished by the manufacturers differ in detail and presentation: Some give nominal analyses, some give typical analyses, some give the composition limits, and others only indicate the important alloy elements present or give no composition data at all. This variation is not due to any inconsistency

so much as to divergence of opinion. Furthermore, some of the compositions may have been altered somewhat since the data was originally received and last checked, or there may be various grades of the same type differing considerably in properties and uses as is the case where certain steels are offered in various grades based on the carbon content.

Next, with regard to the physical properties listed: It is important to appreciate the fact that a given piece of metal will have a wide range of properties dependent on such factors as thermal treatment, mechanical treatment, and mass. All of the details associated with a given set of physical properties could not be listed. In many instances information was lacking, for example, as to whether the piece tested was a fine wire, small bar, or test bar cut from a heavy section, even whether the material was wrought or cast, yet for the same analysis and corresponding treatment in all possible respects, the properties would be materially different for each of these possibilities. A similar criticism applies to details of the heat treatment. For example it may be stated that the piece was tested in the heat treated condition without specifying relevant conditions of quenching temperature and rate or extent of tempering after quenching. Lack of specific and universally accepted terms applicable to the heat treatments given precipitation-hardenable alloys also leads to confusion. Even the type of test piece used influences the values obtained, and it is difficult to compare results quoted on various "standard" test bars such as the diverse types used in the different countries. As an illustration of another source of ambiguity it is sufficient merely to mention "yield point," an indefinite term but one to which much importance is attached.

In regard to the uses cited, it is apparent that this subject could be treated only in the most brief fashion and any one alloy might be suitable for a multitude of uses. The uses cited are intended to indicate the class of service to which the alloy is suited. The majority of manufacturers supplied more data on possible uses than could be recorded here. The adaptability to a given use depends very much on the condition of the alloy as regards heat treatment, etc., and the manufacturer should naturally be consulted.

It will be noted that certain obsolete or discontinued alloys are listed. The reason for this is that a question concerning the alloy may arise in which event it is of value to know that it is obsolete. The fact that an alloy of proprietary nature does not appear in this book shall not be construed to indicate obsolescence or anything other than the fact that the authors have human limitations and the number of proprietary alloys is not constant but increasing.

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SECTION I

ALLOY DATA

1 ACIERAL-1.
M-281; 6 Cu, 0.4 Zn, 0.9 Ni, 0.1 Fe, 0.4 Si, bal Al.
Cast: 20,000 TS.
For automotive engine parts; castings.

3 ADAMANTINE.
M-447; 0.7 C, 0.7 Cr, 0.7 Mn, bal Fe.
Heat treated: 145,000 TS; 77,000 YS; 6.5 El; 16.6 RA; 260-300 Brin.
For heat treat steel balls for grinding mills; wear resistant.

4 ADAMITE.
M-229; high C, 1 Cr, 0.75 Ni, bal Fe.
For press dies, rolls, mill guides, furnace parts, castings; cast iron-pearlitic, wear resistant.

5 ADMIRALTY BRASS.
M-8; 62 Cu, 37 Zn, 1 Sn.
Cast: 56,000 TS; 27,000 YS; 15 El; 25 RA.
Rolled hard: 71,680 TS; 55,500 YS; 20 El; 30 RA.
For pump rods, sheets; obsolete.

6 ADMIRALTY BRONZE.
M-8; 88 Cu, 10 Sn, 2 Zn.
Sand cast: 38,500 TS; 23,300 YS; 14 El; 77 Brin.
For gears, worm wheels, trolley wheels; obsolete.

9 ADMIRO.
M-2; 48 Cu, 10 Ni, 35 Zn, 2 Al, 3 Mn, 2 Fe.
Cast: 57,000-70,000 TS; 40-20 El; 110-130 Brin.
Hot pressed: 63,000-76,000 TS; 40-25 El; 150-170 Brin.
For turbine bearings, tubes; corrosion resistant.

10 ADMOS.
M-2; 40-55 Cu, 3-15 Ni, 1-3 Mn, 1-2 Fe, 0.5-3.0 Al, bal Zn.
Cast: 56,000-71,680 TS; 35-20 El; 80-90 Brin.
Hot pressed: 69,440-85,120 TS; 35-20 El; 90-120 Brin
For bearing bushes, worm wheels, condenser tubes, turbine blading, gear wheels, valves; resists corrosion and erosion of superheated steam.

11 ADNIC.
M-102; 70 Cu, 29 Ni, 1 Sn.
Hard: 113,000 TS; 107,000 YS; 10 El; 56 RA.
Hot rolled: 64,500 TS; 35,600 YS; 46 El; 72 RA.
For condenser tubes, auto head lights, cafeteria ware; corrosion resistant; discontinued.

12 ADVANCE.
M-44; 54-55 Cu, 44-46 Ni.
Rolled: 62,000 TS; 40,000 YS; 40 El; 75 RA.
For rheostats, electrical instrument work, resistance metal; similar to Constantan and Ideal.

14a AERO METAL (Cast).
M-287; 4.2 Cu, 27.8 Zn, 0.5 Fe, 0.5 Si, 67 Al.
Cast: 25,000 TS.
For automotive engine parts; cast.

14b AERO METAL (Sheet).
M-287; 0.2-0.6 Cu, 2.1-2.9 Mg, 96 Al, 0.3-1.3 Fe.
Rolled: 20,000 TS.
For automotive engine parts; sheet.

15 AEROMIN.
Germ.; 92.7 Al, 6.2 Mn, 0.8 Fe, 0.3 Si.
For light alloy parts.

16 AERON.
M-584; 4.5 Cu, 0.75 Si, 0.75 Mn, bal Al.
Annealed: 23,000-35,000 TS; 7,000-12,000 YS; 12-20 El; 45-55 Brin.
Quenched: 45,000-53,000 TS; 15,000-30,000 YS; 15-22 El; 68-85 Brin.
For light anti-corrosive alloy parts; light anti-corrosion alloy. Similar to Alcoa No. 25S.

17 AGRILITE NO. 5.
M-128; 70.49 Cu, 5.39 Sn, 24.0 Pb, 0.09 Ni, 0.005 P.
For connecting rod bearings for aero engines, rolling mill bearings; self lubricating bearing bronze.

18 AGRILITE BEARING METAL.
M-128; 70 Cu, 5 Sn, 25 Pb.
25,000 TS; 16,350 YS; 50 Brin.
For bearings for rolling mill, thrust bearings on steam boats, bearings for washing and ironing machines; self lubricating bearing bronze.

19 AICH METAL.
Eng.; 59.37 Cu, 39.68 Zn; 0.95 Fe.
Cast: 60,000 TS; 21,000 YS; 44 El; 45 RA; 90 Brin.
Forged: 64,500 TS; 31,000 YS; 44 El; 64 RA; 107 Brin.
For hydraulic cylinders and forgings; resists oxidation; similar to "Sterro."

20 AJAX.
M-123; 78.3 Cu, 11 Sn, 10 Pb, 0.7 P.
For bearings; discontinued.

22 AJAX HONEST SOLDER.
M-123; 50 Sn, 50 Pb.
For solder.

23 AJAX MANGANESE BRONZE.
M-123; 57 Cu, 40 Zn, 3 Mn.
Normalized: 70,000 TS; 35,000 YS; 20 El; 20 RA.
Annealed: 60,000 TS; 30,000 YS; 15 El; 25 RA.
For valve stems, propellers, golf clubs, nuts; strong, tough, corrosion resistant.

24 AJAX PHOSPHOR BRONZE.
M-123; 79.7 Cu, 9.5 Pb, 10 Sn, 0.7 P.
Cast: 24,000 TS; 2.9 El; 55 Brin.
For bearings; P.L.-19,000.

25a AJAX PLASTIC BRONZE-A.
M-123; 64 Cu, 31 Pb, 5 Sn.
40,000 TS; 34 El.
For bearings.

25b AJAX PLASTIC BRONZE-B.
M-123; 64 Cu, 30 Pb, 5 Sn, 1 Ni.
For bearings.

26 AJAX WIPING SOLDER.
M-123; 40 Sn, 60 Pb.
For solders.

28 ALBANY.
M-1; 0.75 C, 0.90 Cr, 0.20 V, 0.60 Mn, bal Fe.

For shear blades, dies, punches, knives, collets, cutlery dies, machine tool parts; great toughness and resistance to impact.

32 ALCUMITE.
M-46; 88.92 Cu, 7.65 Al, 2.02 Fe, 1.41 Ni.
Sand Cast: 75,000 TS; 25,000 YS; 30 El; 35 RA; 116 Brin.
Hot rolled: 100,000 TS; 52,000 YS; 10 El; 18 RA; 187 Brin.
Annealed: 90,000 TS; 47,000 YS; 25 El; 38 RA; 132 Brin.
For blowers, pumps, ventilator tanks to resist weak acids and other corrosives; obsolete.

33 ALCUNIC.
M-102; 80 Cu, 1 Ni, 2 Al, 17 Zn.
Hard: 103,000-112,000 TS; 94,000-106,000 YS; 3.5-3.0 El; 200-220 Brin.
For condenser tubing, belt buckles; corrosion resistant.

35 ALDURBRA.
M-282, M-150; 76 Cu, 22 Zn, 2 Al.
80,000 TS; 44,000 YS; 16 El; 130 Brin.
For condenser tubes; corrosion resistant.

36 ALLAN RED METAL.
M-124; 50 Pb, 50 Cu.
13.5 Brin.
For bearings, crank-pins for facing pistons; not a true alloy but a mechanical mixture.

37 ALLEGHENY METAL.
M-1; 0.20 C, 0.50 max Mn, 17-20 Cr, 7-10 Ni, bal Fe.
Unannealed: 120,000 TS; 86,000 YS; 36 El; 52 RA; 253 Brin.
Annealed: 90,000 TS; 45,000 YS; 61 El; 75 RA; 135 Brin.
At 500°C: 72,730 TS; 20,880 YS; 47 El; 69.5 RA.
At 900°C: 24,560 TS; 13,580 YS; 36 El; 57 RA.
For hardware, fittings, bumpers, automobile radiator shells, dairy and hospital equipment; corrosion resistant, austenitic.

38 ALLEGHENY NO. 66.
M-1; 0.12 max C, 16-18 Cr, bal Fe.
Annealed: 85,000-70,000 TS; 55,000-40,000 YS; 20-35 El; 85-75 RA; 156 Brin.
For hardware, steam engine parts, fans, blowers, condensers, evaporators; corrosion resistant to HNO_3.

39 ALMASILIUM.
M-767; 2 Si, 1 Mg, bal Al.
50,000 TS; 6 El; 90 Brin.
For light alloy parts; corrosion resistant.

40 ALMELEC.
M-979; 0.4-1.2 Mg, 0.5-1.2 Si, 0-0.3 Fe, bal Al.
44,600 TS; 6-8 El; 90 Brin.
For electrical transmission lines; heat treated wrought French alloy.

41 ALMO NO. 1.
M-38; C, Mo, Cr, bal Fe.
Annealed: 110,600 TS; 88,600 YS; 26 El; 71.2 RA; 187 Brin.
Heat treated: 167,500 TS; 141,500 YS; 17.5 El; 58.7 RA; 340 Brin.
For crankshafts, axles, connecting rod; discontinued.

42 ALMO NO. 1 C.H.
M-38; low C, Mo, Cr, bal Fe.
Oil treated: 110,800 TS; 110,000 YS; 20.5 El; 72.9 RA; 212 Brin.
For gears; discontinued.

43 ALMO NO. 2.
M-38; C, Mo, Cr, bal Fe.
Annealed: 105,000-138,800 TS; 84,700-130,000 YS; 24-17 El; 71.6-62.6 RA; 174-269 Brin.
For general use, axles, crankshafts; discontinued.

44 ALMO NO. 2 C.H.
M-38; low C, Mo, Cr, bal Fe.
Case-hard: 105,000 TS; 95,000 YS; 22.5 El; 72.3 RA; 217 Brin.
For general use, gears; discontinued.

45 ALMO NO. 3.
M-38; C, Mo, Cr, bal Fe.
Annealed: 94,500 TS; 79,500 YS; 30.5 El; 69.8 RA; 166 Brin.
Hardened: 134,400 TS; 114,100 YS; 15 El; 57.8 RA; 277 Brin.
For crankshafts, axles; discontinued.

46 ALMO NO. 3 C.H.
M-38; low C, Mo, Cr, bal Fe.
Rolled: 95,400 TS; 63,800 YS; 34 El; 82.5 RA.
For gears; discontinued.

47 ALNEON.
M-283; 70-90 Al, 2-3 Cu, 7-22 Zn, 0.4-1.0 other elements. 28,000-48,500 TS; 10,700-17,000 YS; 1-3 El; 100-150 Brin.
For light alloy parts; age-hardening, high endurance limit.

49 ALPAKKA (Alpaca).
Eng.; 60 Cu, 19 Zn, 15 Ni, 2 Ag.
For base metal for silver plated tableware; resists corrosion.

51 ALPHA.
M-33; 64-68 Cu, 0.80 max Pb, 0.07 max Fe, bal Zn.
Annealed: 50,000 TS; 40 El.
For condenser tubes, pipes; resists corrosion of natural water; discontinued.

52 ALPRO NO. 220.
M-126; 10 Al, 90 Cu.
For gears, cams, valves; resists abrasion, wear and shock.

53 ALPRO NO. 221.
M-126; 10 Al, 89 Cu, 1 Fe.
For ball bearings; resists abrasion, wear and shock.

54 ALPRO NO. 223.
M-126; 10 Al, 87 Cu, 3 Fe.
For bearings.

55 ALPRO NO. 224.
M-126; 10 Al, 86 Cu, 4 Fe.
For bearings.

56 ALUDUR.
M-284; 0.5 Mg, 0.7 Si, 0.45 Fe, bal Al.
Heat treated: 50,000 TS; 6 El; 90 Brin.
For overhead transmission lines; self-aging alloy; high corrosion resistant.

57 ALUMAC NO. 85.
Eng.; 4 Cu, 5 Si, bal Al.
30,000 TS; 4.0 El; 70 Brin.
For die casting; die casting alloy; discontinued.

58 ALUMALUN.
M-250; Al, Si alloy plus abrasive grains imbedded in wearing surface.
For floor plates, stair treads, car steps; wear resistant; anti-slip.

59 ALUMBRO.
M-188, M-282; 76 Cu, 22 Zn, 2 Al.
Drawn: 88,000 TS; 67,000 YS; 10 El; 175 Brin.
Annealed: 54,000 TS; 50 El; 65 Brin.
For condenser tubing to resist sea water corrosion, plates; high resistance to corrosion.

60 ALUMEL.
M-65; 95 Ni, bal Si, Mn, Al.
Drawn: 85,000 TS; 30 El.
For negative thermocouple wire; max 2400°F.

61 SUPER RAPID EXTRA.
M-1182; 0.7 C, 18 W, 4 Cr, 1 V, bal Fe. For cutters, taps, broaches, drills; high speed steel.

64 ALCOA 6.
M-4; 12.5-14.5 Zn, 2.5-3.0 Cu, 0.8 max Fe, 0.7 max Si, bal Al.
Sand cast: 24,600 TS; 14,000 YS; 3 El.
For light alloy parts; discontinued.

65 ALCOA 12.
M-4; 7-8 Cu, 0.4 max Fe, 0.5 max Si, bal Al.
Sand cast: 24,000 TS; 15,000 YS; 1.5 El; 70 Brin.
For household articles, aircraft and automotive industry, ship building, ornamental work; casting alloy; obsolete.

66 ALCOA 13.
M-4; 12 Si, 88 Al.
Die cast: 43,000 TS; 21,000 YS; 2.5 El; 80 Brin.
For carburetor frames, brake shoes, adding machine frames; die casting M.E.-10,000,000.

70 ALCOA B-17S.
M-4; 3.5 Cu, 0.50 Fe, 0.60 Si, 0.56 Mn, 0.55 Mg, bal Al.
O-Temp: 20,000-25,000 TS; 20-28 El; 30-40 Brin.
T-Temp: 42,000-50,000 TS; 20,000-25,000 YS; 20-28 El; 65-85 Brin.
For airplane structures, floats, dirigibles; age-hardening; discontinued.

71 ALCOA C-17S.
M-4; 4.07 Cu, 0.50 Fe, 0.60 Si, 0.56 Mn, 0.55 Mg, bal Al.
O-Temp: 25,000-35,000 TS; 7,000-10,000 YS; 12-20 El; 42-55 Brin.
T-Temp: 63,000-90,000 TS; 50,000-55,000 YS; 8-14 El; 95-125 Brin.
For airplane structures, floats, dirigibles; age-hardening, discontinued.

74 ALCOA 45.
M-4; 10 Si, 0.6 max Fe, 0.5 max Mn, 0.6 max Cu, bal Al.
Sand cast: 22,000 TS; 10,000 YS; 4 El; 50 Brin.
For light alloy parts and castings requiring very fluid alloy; sand and permanent mould casting; discontinued.

75 ALCOA 47.
M-4; 0.13 Cu, 0.40 Fe, 12.5 Si, 0.09 Mn, 0.05 Na, bal Al.
Sand cast: 24,000-31,000 TS; 9,000 YS; 5-15 El; 55 Brin.
For light alloy parts and leak-proof castings; castings; discontinued.

76 ALCOA 51.
M-4; 1.9 Cu, 0.6 Mg, 1.0 Si, 96.5 Al.
O-Temp: 14,000-18,000 TS; 4,000-6,000 YS; 15-30 El; 25-32 Brin.
W-Temp: 30,000-40,000 TS; 15,000-20,000 YS; 20-30 El; 55-70 Brin.
T-Temp: 45,000-50,000 TS; 30,000-40,000 YS; 10-18 El; 85-100 Brin.
For airplane propellers, pistons, crank cases, connecting rods; strain hardened when cold worked; obsolete.

77 ALCOA 83.
M-4; 3.0 Si, 2.0 Cu, bal Al.
Die cast: 25,000-30,000 TS; 14,000 YS; 3-6 El; 55-65 Brin.
For pressure die castings for small machine and ornamental parts; die castings; discontinued.

78 ALCOA 93.
M-4; 2.0 Si, 4.0 Ni, 4.0 Cu, bal Al.
Die cast: 33,000 TS; 28,000 YS; 1-0.5 El; 80 Brin.
For light alloy parts and castings for small machines; die castings; discontinued.

79 ALCOA 100.
M-4; 1.0 Fe+Si, 99 Al.
Sand cast: 10,000 TS; 4,000 YS; 15 El; 25 Brin.
For foundry alloys; light alloy parts, sand castings, commercial ingot.

80 ALCOA 406.
M-4; 2 Mn, bal Al.
Sand cast: 20,000 TS; 9,000 YS; 12 El; 35 Brin.
For cast fittings; resists corrosion of S gases; obsolete.

81 HOLLUP GR. NO. 30-X.
M-844; 0.10-0.15 C, bal Fe.
For welding electrode; coated.

82 ALCOA 109.
M-4; 12 Cu, 88 Al.
Sand cast: 20,000-28,000 TS; 18,000 YS; 0.5-1.5 El; 1.0 RA; 75 Brin.
For pump parts, automobile engine manifolds; castings (sand); discontinued.

83 ALCOA 112.
M-4; 7.0 Cu, bal Al.
Sand cast: 24,000 TS; 15,000 YS; 1.5 El; 70 Brin.
For crank cases, oil pans, motor housing, vacuum sweeper parts; casting alloy.

84 ALCOA 122.
M-4; 0.5 Si, 10 Cu, 1.2 Fe, 0.2 Mg, bal Al.
T-61 Temp: 41,000 TS; 40,000 YS; 0.5 El; 115 Brin.
T-65 Temp: 48,000 TS; 36,000 YS; 0.5 El; 140 Brin.
T-551 Temp: 37,000 TS; 25,000 YS; 0.5 El; 115 Brin.
For pistons, valve guides, cam shaft bearings; wear resist castings, age-hardenable.

85 ALCOA 142.
M-4; 4 Cu, 2 Ni, 1.5 Mg, 0.7 Si, bal Al.
Sand cast T-21: 27,000 TS; 18,000 YS; 1 El; 70 Brin.
Sand cast T-571: 32,000 TS; 30,000 YS; 0.5 El; 85 Brin.
Permanent mold T-61: 47,000 TS; 42,000 YS; 0.5 El; 110 Brin.
Permanent mold T-571: 40,000 TS; 34,000 YS; 1 El; 105 Brin.
For pistons, air cooled cylinder heads, bearings; retains strength at high temperatures, age-hardenable.

86 ALCOA 145.
M-4; 10 Zn, 2.5 Cu, 1.2 Fe, bal Al.
Sand cast: 25,000-37,000 TS; 12,000 YS; 6-3 El; 65 Brin. For aircraft and auto engine parts; shock resistant; obsolete.

87 ALCOA 195.
M-4; 4.5 Cu, 0.75 Si, 0.5 Fe, 0.2 Zn, bal Al.
T-4 Temp: 32,000 TS; 16,000 YS; 8.5 El; 60 Brin.
T-6 Temp: 36,000 TS; 24,000 YS; 5.0 El; 75 Brin.
T-62 Temp: 41,000 TS; 32,000 YS; 2.0 El; 90 Brin.
For crankcases, general castings, housings, gear cases; age-hardenable.

88 ALCOA 196.
M-4; 4 Cu, 0.2 Mg, bal Al.
Sand cast: 33,000 TS; 27,000 YS; 0.2 El; 110 Brin.
T-Temp: 45,000 TS; 40,000 YS; 2.5 El; 115 Brin.
For special fittings for high strength; casting alloy; low shock resistance; discontinued.

89 ALCOA 212.
M-4; 7-8.5 Cu, 1-1.5 Si, 0.8-1.2 Fe, bal Al.
Sand cast: 19,000-24,000 TS; 11,000-14,000 YS; 1.0-2.5 El; 50-65 Brin.
For commercial castings for general utility; corrosion resistant.

90 ALCOA 355.
M-4; 5 Si, 1.3 Cu, 0.5 Mg, bal Al.
Sand cast T-7: 38,000 TS; 36,000 YS; 0.5 El; 85 Brin.
Sand cast T-6: 35,000 TS; 25,000 YS; 3.0 El, 80 Brin.
Permanent mold T-71: 36,000 TS; 31,000 YS; 3.0 El; 85 Brin.
Permanent mold T-62: 45,000 TS; 40,000 YS; 1.5 El; 105 Brin.
For liquid cooled engine parts; retains strength to 400°F; age hardenable.

91 ALCOA 356.
M-4; 0.2 Cu, 7 Si, 0.3 Mg, bal Al.
Sand cast T-7: 34,000 TS; 30,000 YS; 2.0 El; 75 Brin.
Sand cast T-6: 33,000 TS; 24,000 YS; 3.5 El; 70 Brin.
Permanent mold T-6: 38,000 TS; 27,000 YS; 5 El; 80 Brin.
For leak proof castings, aircraft parts; corrosion resistant; age hardenable.

93 CYCLOPS K-R.
M-114; 0.6 C, 8 Cr, 8 W, bal Fe.
Heat treated: 215,000 TS.
For cutlery, valves, propeller shafts, ball races, dies; corrosion resistant.

94 CYCLOPS B-6.
M-114; 0.75 C, 18 W, 4 Cr, 1 V, bal Fe.
For lathe tools, taps, reamers, twist drills, milling cutters, dies, lathe centers; high speed steel; wear and abrasion resistant.

95 CYCLOPS B-7.
M-114; 0.7 C, 18 W, 4 Cr, 1 V, 5 Co, 0.5 Mo, bal Fe.
For lathe tools, planer tools for high speed cuts; high speed steel

96 CYCLOPS 17-A.
M-114; 0.4 C, 1.2 Si, 0.6 Mn, 7-10 Cr, 19-23 Ni, bal Fe.
Forged: 141,000-108,000 TS; 27-50 El; 50-64 RA; 248-167 Brin.
For applications where super-heated steam, hot oils, sulfides, hot sulfur are encountered; non-corrosive and heat resistant; resists scaling up to 1500°F.

97 CYCLOPS 17-B.
M-114; 0.10-0.20 C, 1.2 Si, 0.6 Mn, 7-10 Cr, 19-23 Ni, bal Fe.
Forged: 80,000 TS; 42 El; 63 RA; 160 Brin.
Rolled: 71,000 TS; 52 El; 68 RA; 128 Brin.
For applications where super-heated steam, hot oils, sulfur oils and sulfides are encountered; non-corrosive and heat resistant.

99 B.A./40D ALLOY.
M-28; 10-13 Si, bal Al.
Sand cast: 23,500-24,000 TS; 11,000-13,500 YS; 8-5 El; 50-55 Brin.
Chill cast: 29,000-31,300 TS; 12,000-14,500 YS; 15-8 El; 55-60 Brin.
For light alloy parts, wrought forms, corrosion resistant castings; resists sea water corrosion; modified alloy.

100 Al-L-24.
M-28; 4 Cu, 2 Ni, 1.5 Mn, 0.75 Si, bal Al.
Cast and treated: 36,000 TS; 1.5 El; 90 Brin.
Chill cast and treated: 40,000-46,000 TS; 4-7 El.
For pistons, valves, cylinder heads, internal combustion engines; resists high temperature; discontinued.

102 ALUMINUM BRASS.
M-8; 1-6 Al, 24-42 Zn, 55-71 Cu.
85,000-45,000 TS; 73,000-32,000 YS; 6-50 El; 8-33 RA; 193-114 Brin.
For bushings, hardware; obsolete.

103a ALUMINUM BRONZE.
M-285; 91-94 Cu, 0-1.2 Fe, 6.6-7.0 Al, 0-1.0 Mn.
Sand cast: 71,000-112,000 TS; 25,300-50,000 YS; 21.7-3.0 El.
For bearing metals, ball bearings, pin pivots, pump, propeller blades, bearings, gears; very close-grained castings; corrosion resistant. obsolete.

103b ALUMINUM BRONZE.
M-129; 87.5 Cu, 12.5 Al.
Chill cast: 57,000-86,000 TS; 27,800-39,000 YS; 30.5-22 El.
For bearing metals, ball bearings, pin pivots, pump, propeller blades, bearings, gears; very close-grained castings; corrosion resistant. obsolete.

103c ALUMINUM BRONZE.
M-129; 87.5 Cu, 4.1 Al, 1.7 Fe, 6.6 Zn.
Hot rolled: 63,900 TS; 35,000 YS; 6.5 El.
Cold drawn: 98,000 TS; 90,500 YS; 13.0 El; 14.0 RA.
For bearings, gears; heavy duty.

104 ALUMINUM BRONZE.
M-8; 7-9 Al, 2.5-4 Fe, 0.5 Sn, bal Cu.
70,000 TS; 2.5 El.
For bearings, gears; corrosion resistant, obsolete.

105 WEST NO. 1.
M-465; 0.28-0.20 C, 0.6-0.8 Mn, 0.3-0.4 Si, bal Fe.
Annealed: 38,000-65,000 TS; 112-149 Brin.
For machinery parts, shafts; S.A.E. 1225.

106 WEST NO. 2.
M-465; 0.4-0.5 C, 0.6-0.8 Mn, 0.3-0.4 Si, bal Fe.
Annealed: 45,000-80,000 TS; 156-196 Brin.
For machinery parts, gears, shafts, axles, tough; S.A.E. 1245.

107 WEST NO. 3.
M-465; 0.15-0.20 C, 0.3-0.5 Mn, 2.0-3.0 Si, bal Fe.
70,000 TS; 170 Brin.
For heat treating boxes; cannot be welded.

108 WEST NO. 3A.
M-465; 0.15-0.20 C, 0.3-0.5 Mn, 1.5-2.0 Si, bal Fe.
Special: 70,000 TS; 156 Brin.
For heat resisting parts; heat resistant.

109 WEST NO. 4.
M-465; 0.20 max C, 0.3-0.5 Mn, 0.3-0.4 Si, bal Fe.
Annealed: 30,000-55,000 TS; 103-131 Brin.
For electrical and magnetic parts; S.A.E. 1215.

110 WEST NO. 4A.
M-465; 0.20 max C, 0.6-0.8 Mn, 0.3-0.4 Si, bal Fe.
Annealed: 35,000-60,000 TS; 103-137 Brin.
For machinery parts, case-hardened parts; carburizing steel; S.A.E. 1215.

111 WEST NO. 5.
M-465; 0.28-0.35 C, 0.6-0.8 Mn, 0.3-0.4 Si, bal Fe, Ti.
Annealed: 42,000-75,000 TS; 137-156 Brin.
For machinery parts; S.A.E. 1230

112 ALUMINUM IRON BRONZE.
M-8; 85-89 Cu, 6-9.5 Al, 3.5-7.5 Fe.
74,000 TS; 23 RA; 100 Brin.
For propeller blades, pump parts, bearings; obsolete.

114 AMBRAC A.
M-8; 20 Ni, 5 Zn, 75 Cu.
Cast: 44,400 TS; 14,800 YS; 19.4 El.
Hot rolled: 50,000 TS; 16,000 YS; 29.0 El.

Cold rolled: 80,000 TS; 70,000 YS; 13.0 El; 55.0 RA.
Wire: 55,000-125,000 TS; 20,000 YS; 1.0 El.
For laundry and paper machinery; resists corrosion; obsolete.

115 AMERICAN BLACK HEART MALLEABLE IRON.
M-113, M-24; 2.8-3.5 C, 0.6-0.8 Si, Mn, bal Fe.
20,000-46,000 TS; 0.2-15 El; 105-220 Brin.
For plumbing, hardware, fittings, pipes; castings.

116 IMPHY AMF.
M-104; 55-60 Ni, 0.3 Mn, 0.2-0.4 C, bal Fe.
Annealed: 100,000 TS; 62,000 YS; 40 El; 50 RA.
Liquid air T: 102,000 TS; 50,000 YS; 40 El; 55 RA.
For valves of expansion engines used in liquid air plants, refrigeration machines; great ductility at low temperature.

117 AMPCO METAL.
M-285; 82-88 Cu, 9-12 Al, 3.4-5.3 Fe.
Cast: 75,000 TS; 20 El; 18 RA; 149 Brin.
Forged: 116,000 TS; 4 El; 16 RA; 340 Brin.
Hot rolled: 100,000 TS; 20 El; 18 RA; 149 Brin.
For gears, forming dies, valves, bushings, tools, trolley shoes, and wheels; resists corrosion; shock resisting.

118 SLOCRODE.
M-494; 3.2 C, 0.75-1.25 Ni, 0.5-0.75 Cr, bal Fe.
Oil treated: 36,000-40,000 TS; 200-500 Brin.
For castings for high duty purposes; cast iron.

119 AMSCO MANGANESE STEEL.
M-9, M-231; 10-14 Mn, 1-1.4 C, 0.2-1.0 Si, bal Fe.
Heat treated: 100,000-145,000 TS; 50,000-57,000 YS; 60-30 El; 40-30 RA; 155-200 Brin.
For steam shovel teeth rolls, ball mill liners, wheels, gears and pinions; tough and shock resisting; resists abrasion.

120 PHOSPHOR BRONZE (A) 351.
M-8; 5 Sn, 0.25 P, bal Cu.
Hard drawn: 130,000 TS.
Soft: 45,000 TS; 50 El.
For tubes, sheets, wire, general parts; resists fatigue and corrosion and abrasion.

121 LEADED PHOSPHOR BRONZE (B) 379.
M-8; 5 Sn, 1 Pb, 0.10 P, bal Cu.
Hard: 65,000 TS; 55,000 YS; 25 El.
For tubes, bushings, perforated sheets, clutch plate; resists fatigue and corrosion.

122 PHOSPHOR BRONZE (C) 353.
M-8; 8 Sn, 0.25 P, bal Cu.
Hard drawn: 130,000 TS.
Hard sheet: 110,000 TS; 3 El.
For tubes, sheets, wire general parts; resists fatigue and corrosion.

123 PHOSPHOR BRONZE (D) 354.
M-8; 10 Sn, 0.25 P, bal Cu.
Hard: 130,000 TS; 5 El.
Soft: 60,000 TS; 65 El.
For tubes, sheets, wire, general parts; resists fatigue and corrosion.

124 ANNITE.
M-38, M-334; 1.5 C, 4 Cr, 1 Co, 1 Mo, bal Fe.
For dies, tools, punches, rotary shears, blanking dies; resists abrasion, obsolete.

125 ANTIMONIAL LEAD.
M-88; 0-25 Sb, 75-100 Pb.
For storage battery plates, fuses, bullets, type metal, pipes.

126 U. S. ULTRA.
M-1182; 2 C, alloy, bal Fe.
For dies, tools; air hardening.

127 MIDLING HARD 115.
M-1182; 1.1 C, 0.25 Si, bal Fe.
For tools; drill rod.

128 APOLLOY.
M-131; 0.08 C, 0.25 Cu, bal Fe.
For building construction; corrosion resisting to weather.

129 ARBOGA.
Eng; Tungsten carbide.
For tools, hard cutting tools; sintered alloy.

130 AREMITE.
M-195; Synthetic cast iron.
30,000-50,000 TS; 165 Brin.
For pipes, fittings, hardware.

131a ARGENTAN.
U. S.; 50-90 Cu, 3-40 Ni, 0-10 Al, 0-40 Zn.
For cutlery; corrosion resistant.

131b ARGENTAN.
Eng.; 48.35 Cu, 34.05 Zn, 17.60 Ni.
For table cutlery, ornaments; high resistance to corrosion.

131c ARGENTAN (NEUSILBER.)
Germ.; 26 Ni, 56 Cu, 18 Zn.
For chemical equipment construction; substitute for Ag, a nickel silver.

132 ARGENTINE METAL.
U. S.; 85.5 Sn, 14.5 Sb.
For statuettes and small ornaments; expands on cooling.

133 ARGILITE.
French; 90 Al, 6 Cu, 2 Si, 2 Bi.
For automotive engine parts.

134 ARKIT.
French; 38 Co, 30 Cr, 16 W, 10 Ni, 4 Mo, 2.5 C.
For high speed cutting tips of lathe tools; high heat resistance.

135 ARMCO INGOT IRON.
M-10; 0.012 C, 0.017 Mn, 0.005 P, 0.025 S, bal Fe.
Treated: 38,000-45,000 TS; 20,000-25,000 YS; 40 El; 50 RA; 85 Brin.
Annealed: 38,000 TS; 19,000 YS; 40 El; 50 RA; 85 Brin.
For pipes, roofing, tanks, culverts, stoves, metal furniture; ductile.

136 ARMIDE.
M-132; Carbide alloy TaC.
250,000 TS.
For tipped cutters and tools; hard, tough and wear resisting.

137 ARMSTRONG.
U. S.; 12 Cr, 5 Si, 0.5 C, bal Fe.
For heat resisting steel parts; heat resisting stainless steel.

138 BEAUCALLOY.
M-1183; 1.4 C, Ni, Cr, bal Fe.
Hardened: 175,000 TS; 150,000 YS; 400 Brin.
For conveyor chains; casting.

139 ARSENIC BRONZE.
U. S.; 80 Cu, 10 Sn, 9.2 Pb, 0.8 As.
30,000 TS; 60 Brin.
For bearings; heavy duty.

140 ART DIE.
M-35; 0.95 C, 0.30 Cr, 0.02 V, 0.25 Mn, bal Fe.
Annealed: 170 Brin.
For jewelers' dies; deep hardening.

141 ALLEGHENY NO. 33.
M-1; 0.12 C, 0.50 Mn, 12-14 Cr, bal Fe.
Annealed: 73,000 TS; 35 El; 75 RA; 150 Brin.

For furnace and stack dampers, kiln linings; formerly Ascoloy No. 33.

142a ASHBERRY METAL-A.
Eng.; 80 Sn, 1 Zn, 14 Sb, 2 Cu, 2 Ni, 1 Al.
For tableware and utensils; same as "Brittania."

142b ASHBERRY METAL-B.
Eng.; 78-80 Sn, 0-2.8 Zn, 14-19 Sb, 0-3 Cu.
For utensils, bearings; Babbitt.

142c ASHBERRY METAL-C.
Eng.; 80 Sn, 14 Sb, 2 Cu, 1 Zn, 3 Ni.
For utensils, bearings; Babbitt.

142d ASHBERRY METAL-D.
Eng.; 79 Sn, 15 Sb, 3 Cu, 2 Zn, 1 Ni.
For utensils, bearings; Babbitt.

143a ATERITE.
M-19; 10 Ni, 65 Cu, 2 Fe, 23 Zn.
Rolled: 53,000-163,000 TS; 40,000-110,000 YS; 59-1 El; 62-17 RA.
Cast: 55,000-110,000 TS; 35,000-110,000 YS; 45-0.6 El; 36-10 RA.
For hardware, valves, plumbing fixtures, cocks, chemical equipment; corrosion resistant; discontinued.

143b ATERITE.
M-19; 35-44 Ni, 55-36 Cu, 5-20 Fe, 5-0 Zn.
For hardware, valves, fixtures; discontinued.

143c ATERITE.
M-19; 62.40 Cu, 18.9 Zn, 12.6 Ni, 2 Pb, 2.9 Fe.
For hardware, chemical equipment; discontinued.

144a ATHA NO. 2500.
M-38; 22.9 Ni, 5.42 Cr, 1.65 Si, 0.78 Cu, 0.8 Mn, 0.24 C, bal Fe.
98,000 TS; 32.3 El; 58.6 RA.
For furnace parts; resists high temperatures. (Discontinued.)

144b ATHA NO. 2600.
M-38; 22 Ni, 8 Cr, 1.75 Si, 1.0 Cu, bal Fe.
For furnace parts, heat treating boxes; heat resistant. (Discontinued.)

147 ATLAS IRON NO. 1.
M-285; 2.9-3.0 graphitic carbon, 0.5-0.6 combined carbon, 2.0-2.15 Si, bal Fe.
200-250 Brin.
For dies; high test iron Tr.S.-6900. (Discontinued.)

148 ATLAS IRON NO. 2.
M-285; 2.75 graphitic carbon, 0.50 combined C, 1.85-1.95 Si, bal Fe.
200 Brin.
For valves; high test iron Tr.S.-6100. (Discontinued.)

149 ATLAS IRON NO. 3.
M-285; 2.7 graphitic carbon, 0.6 combined C, 1.5-1.75 Si, bal Fe.
350 Brin.
For abrasion iron hammers; high test iron Tr.S-5000; discontinued.

150a AUER METAL-A.
Germ.; 35 Fe, 65 Ce.
For gas and cigarette lighters; pyrophoric.

150b AUER METAL-B.
Germ.; 53 Fe, 30 Mn, 10 Sb, 7 Misch metal.
For gas and cigarette lighters; pyrophoric, sparking alloy.

150c AUER METAL-C.
Germ.; 35 Fe, 35 Ce, 29 Misch metal.
For gas and cigarette lighters; pyrophoric.

150d AUER METAL-D.
Germ.; 35 Fe, 35 Ce, 24 La, 3 Yb, 2 Er.
For gas and cigarette lighters; pyrophoric.

155 AVIALITE – 915.
M-8; 89.25 Cu, 9.25 Al, 0.4 Sn, 0.5 Ni, 0.6 Fe.
Soft: 80,000 TS; 40,000 YS; 22 El.
Hard: 95,000 TS; 55,000 YS; 16 El.
For valve seats, spark-plug bushings in aircraft engines; same as "Millard Metal."

156 WEST NO. 6.
M-465; 0.30-0.40 C, 1.25-1.50 Mn, 0.30-0.40 Si, 0.12 V, bal Fe.
Annealed: 60,000-95,000 TS; 126-228 Brin.
For cylinders, housings, valves; tough, close grained.

157 BADGER STEEL.
M-253; 0.9-1.2 C, bal Fe.
For taps, reamers, threading dies.

158 BARBERITE.
M-19; 88.0 Cu, 5 Ni, 5 Sn, 1.5 Si, 0.50 Mn, 0.04 C, 0.50 Fe.
Cast: 56,800-60,000 TS; 41,500-48,000 YS; 6.6-6.0 El; 6.6-6.8 RA; 77 Brin.
For marine parts, ornaments, fixtures; corrosion resisting casting; discontinued.

159 ALLOY 349.
78 Fe, 14 Ni, 8 Al.
For permanent magnet.

160 BARRONIA METAL.
M-20; 83 Cu, 0.5 Pb, 4 Sn, bal Zn.
Cast: 42,400 TS; 20;400 YS; 38 El; 33 RA; 72 Brin.
Drawn: 84,000 TS; 74,000 YS; 18 El; 46 RA; 171 Brin.
For condenser tubes, heat exchangers, evaporators, fittings; for superheated steam work.

161 BATTERIUM.
M-21; 89 Cu, 9 Al, 1 Ni, and 1 other metal.
78,000-101,000 TS; 35-48 El; 158-168 Brin.
For chemical apparatus, valves, plug cocks, plate terminals; non-corrodible, acid resistant.

163 MC KAY TOOL & DIE.
M-849; 0.48 C, 3.7 Cr, 0.4 Mn, 9 Mo, 1.6 W, 1.1 V, bal Fe.
550-625 Brin.
For welding rod, hard surfacing; shielded arc, obsolete.

164 BEARITE.
M-214; 80.1 Pb, 0.37 Cu, 0.13 Bi, 16.75 Sb. 2.65 hardener.
At 70°F.: 9750 TS; 1.5 El; 29.1 Brin.
At 212°F.: 24.5 Brin.
For bearings not subject to vibration or pounding; high compressive value, low coef. fric.

165 BEAVER.
M-253; 0.7 C, 18 W, 4 Cr, bal Fe.
For high speed tools; discontinued.

166a BELL METAL-1.
Eng.; 83 Al, 10 Mn, 7 Cd.
For bells, chimes, whistles, ornaments.

166b BELL METAL-2.
Eng.; 85-60 Cu, 15-40 Sn.
For bells, chimes; hard bronze.

167a BEMAL-1.
M-286; 70.11 Cu, 0.32 Pb, 29.43 Zn.
For condenser tubes; discontinued.

167b BEMAL-2.
M-286; 70 Cu, 29 Zn, 0.45 P, 0.15 Fe.
For condenser tubes; discontinued.

168 CERROBEND.
M-216; 50 Bi, 26.7 Pb, 13.3 Sn, 10 Cd.
Cast: 5990 TS; 200 El; 9.2 Brin.
For filler for bending tube, low melting solder, sealing glass to metal; formerly called Bendalloy, M. P. -158°F.

170 BERDO ALLOY NO. 1.
M-20; Cu, Sn, Pb, Ni.
30,000 TS; 20,000 YS; 1.5 El; 2.6 RA; 99 Brin.
For bearings; heavy service; C.Y.P.-38,000.

171 BERDO ALLOY NO. 2.
M-20; Cu, Sn, Pb, Ni.
75 Brin.
For bearings; general service; C.Y.P.-28,000.

172 BERDO ALLOY NO. 3.
M-20; Cu, Sn, Pb, Ni.
44 Brin.
For bearings; light service; C.P.Y.-14,000.

173 BERSCH METAL.
Germ.; 93 Al, 7 Ni.
For bearings.

174 ALLOY 348.
Germ.; 46 Fe, 38 Ni, 16 Al.
For permanent magnet.

175 BERYLLIUM BRONZE 2.5% Be.
M-198, M-199, M-296; 97.5 Cu, 2.5 Be.
Soft: 62,000 TS; 20,000 YS; 52 El; 66 RA; 98 Brin.
Hard: 176,000 TS; 160,000 YS; 0.6 El; 396 Brin.
For springs and parts subjected to frictional wear; wear resistant.

176 BOHLER 5 NW.
M-27; 0.12 C, 5 Ni, bal Fe.
Oil treated: 105,000-143,000 TS; 75,000-118,000 YS; 20-18 El; 60-57 RA; 210-288 Brin.
For gears, shafts, turbine blades; carburizing steel.

177 BETHADUR NO. 302.
M-24; 0.12 C, 17-19 Cr, 9-10 Ni, bal Fe.
Water quench: 95,000 TS; 57,000 YS; 42 El; 75 RA; 152 Brin.
For ship fittings, food containers, ornamental trim; non-magnetic, austenitic, corrosion resistant.

178 BETHADUR NO. 3.
M-24; 0.12 C, 19 Ni, 9 Cr, bal Fe.
Annealed: 76,500 TS; 54,000 YS; 42 El; 50 RA; 128 Brin.
For chemical plants; not used for atmospheric corrosion; corrosion resistant to H_2SO_4 and HCl; discontinued.

179 BETHADUR NO. 486.
M-24; 0.25 C, 25 Cr, bal Fe.
Water quench: 95,000 TS; 50,000 YS; 15 El; 20 RA; 187 Brin.
For protection tubes, conveyor chains, furnace parts, bolts, nuts, racks; corrosion and heat resistant to S-atm; discontinued.

180 BETHALON NO. 416.
M-24; 0.10 C, 13 Cr, 0.07 min P, S, Sc, 0.6 max Zr, Mo, bal Fe.
For automatic and screw machine parts; not to be welded, free cutting.

181 BETHLEHEM STAINLESS TYPE "A."
M-24; 0.35 C, 0.30 Mn, 14 Cr, bal Fe.
Hot rolled: 95,000 TS; 65,000 YS; 30 El; 55 RA; 179 Brin.
For stainless steel parts; discontinued.

182 BETHLEHEM SUPERIOR HOLLOW DRILL.
M-24; 0.8 C, low P and S, bal Fe.
For hollow drills and bits; resistance to abrasion, shock and vibration; discontinued.

183 BETHLEHEM SUPERIOR.
M-24; 0.7-1.3 C, 0.15-0.25 V, bal Fe.
For taps, reamers, cutters, punches, dies, broaches, chisels; tool steel, extra quality.

184 BETHLEHEM 6 Ni.
M-24; 0.3 C, 3.4-3.6 Ni, 1.05 Mn, 0.25 Cr, 0.2 S, bal Fe.
For tools, gears, shafts; oil hardening; discontinued.

185 BETHLEHEM 57.
M-24; 0.35 C, 3.25 Cr, 0.3 V, 9 W, bal Fe.
For dies, trimmers, pliers, punches, shear blades, forming dies; hot work tool steel.

187 BETHLEHEM 71.
M-24; 0.60 C, 0.25 Ni, 0.9 Mn, 0.25 max Cr, 2 Si, bal Fe.
For tools, hand and pneumatic chisels, shear blades, punches; resists shock.

188 BETHLEHEM 445.
M-24; 0.85 C, 3.75 Cr, 0.3 Mn, 0.15 max Ni, 0.25 Si, bal Fe.
For spike dies, forming dies, heading tools; for forming and shaping of hot metals; high toughness and hardness; discontinued.

189 BETHLEHEM X.
M-24; 0.7-1.1 C, bal Fe.
For general tools, quarrying tools, crow bars, soft rock drills, chisels; water hardening.

191 BETHLEHEM XXX.
M-24; 0.9-1.35 C, bal Fe.
For finishing tools and cutters; special quality; discontinued.

192 BETHLEHEM XLC.
M-24; 0.8-1.2 C, bal Fe.
For dies, cold cutters, chisels, punches, shear blades; regular quality carbon tool steel.

194 BIRDSBORO NO. 30.
M-136; 0.30 C, 0.20 Mo, 1.0 Cu, bal Fe.
85,000 TS; 55,000 YS; 22 El; 40 RA; 180 Brin.
For engineering construction; corrosion and fatigue resisting.

195 BIRMIDIUM "Y" ALLOY.
M-325, M-137; 3.5-4.5 Cu, 1.8-2.3 Ni, 1.2-1.7 Mg, bal Al.
Heat treated: 35,000-42,000 TS; 2-3 El.
For automobile pistons, piston heads, crank cases; corrosion resistant.

196 FECHRAL.
Russia; 0.06-0.15 C, 17-25 Cr, 4-7 Al, bal Fe.
For resistance wire; heat resistant.

197 BLACKOR.
M-26; 87 W, 9 C.
For oilwell core bits, cutters, tools; W_2C hard facing compound.

198 BLUE CHIP.
M-57; 0.70 C, 0.25 Mn, 4 Cr, 18 W, 1 V, bal Fe.
Annealed: 105,100 TS; 75,000 YS; 14 El; 17 RA; 230 Brin.
For tools, cutters, reamers, drills, punches, dies, shears, taps; high speed steel.

199 REKORD SELECT.
M-336; C, Mn, Cr, W, V, Mo, Cu, bal Fe.
For tools, dies.

200 BF-MM.
M-139; 0.25-0.35 C, 0.20-0.25 Mo, 1.0-1.25 Mn, 0.30 Si, bal Fe.
Heat treated: 90,000-210,000 TS; 65,000-183,000 YS; 25-7 El; 55-25 RA; 196-480 Brin.
For power shovels, tractor tread steel, mine car wheels; resists shock and wear; IZ-3-56.

201 BORCHER ALLOY.
Eng.; 24 Ni, 32.5 Cr, 0.5 Ag, 1.8 Mo, bal Fe.
For chemical apparatus, crucibles, pyrometer tubes; heat and corrosion resistant.

207 BRASS, COMMON HIGH.
M-8; 65 Cu, 35 Zn.
Annealed: 45,000 TS; 20,000 YS; 50 El.

Hard: 70,000 TS; 65,000 YS; 3 El.
For lamp fixtures, automobile parts, ornaments; deep drawing; obsolete.

208 BRASS, DEEP DRAWING.
M-8; 70 Cu, 30 Zn.
Wire: 50,000-125,000 TS; 50-2 El.
For seamless tubes, cartridges, primers, shot shells; deep drawing; obsolete.

209 BRASS, DRAWING.
M-8; 67-70 Cu, 30-33 Zn.
Sand cast: 40,000 TS; 23,000 YS; 35 El; 35 RA; 45 Brin.
Hard rolled: 67,200 TS; 67,000 YS; 15 El; 50 RA; 145 Brin.
For seamless tubes; deep drawing.

210 BRASS, HIGH.
M-8; 65 Cu, 35 Zn.
Cold rolled: 47,000-75,000 TS; 20,000-60,000 YS; 5-60 El; 5-75 RA; 45-180 Brin.
Used for drawing, forming and spinning parts; high strength.

211 BRASS, LEADED HIGH.
M-8; 65 Cu, 0.5-1.5 Pb, bal Zn.
For cupped, formed or drawn parts; does not foul cutting tools.

212 LOW BRASS.
M-33, M-8; 80 Cu, 20 Zn.
Annealed: 44,000 TS; 10,000 YS; 60 El.
Rolled: 65,000 TS; 45,000 YS; 12 El.
For formed and drawn parts requiring high finish; high ductility.

213 PERCUSSION CAP BRASS.
M-33; 90 Cu, 9.6 Zn, 0.4 Pb.
Soft: 35,000 TS; 40 El; 52 Brin.
Hard: 55,000 TS; 39,000 YS; 4 El; 135 Brin.
For percussion caps, gilding, electrical parts; gilding metal; discontinued.

216a BRIDGE BRONZE A.
English; 80 Cu, 20 Sn, 0.1 P.
3 El; 1.8 RA; 80 Brin.
For tubes; P-Bronze.

216b BRIDGE BRONZE B.
English; 85 Cu, 15 Sn, 0.1 P.
50 Brin.
For springs, electrical parts; P-Bronze.

216c BRIDGE BRONZE C.
English; 80 Cu, 10 Sn, 0.7-1.0 P, 10 Pb.
15 El; 74 Brin.
For bearings; heavy duty P-Bronze.

216d BRIDGE BRONZE D.
English; 88 Cu, 10 Sn, 0.3 P, 2 Zn.
For bearings, gears, worm wheels; P-Bronze.

217 BRIGHTRAY A.
M-121; 80 Ni, 20 Cr.
118,000 TS.
For electrical resistances; can be used up to 1150°C.

218a BRITTANIA METAL-1.
M-332; 94-80 Sn, 1.5-5 Zn, 0.9 Cu, 4-16.2 Sb, 1-8.5 Pb, 2-8 Bi,
10,000 TS; 19-11 El; 25-10 RA.
For bearings, table ware; heavy duty.

218b BRITTANIA METAL-2.
M-332; 91 Sn, 1.5 Cu, 7-5 Sb.
80,000 TS; 50 El; 8 Brin.
For bearings, pewter, table ware; corrosion resistant.

218c BRITTANIA METAL-3.
M-332; 91-85 Sn, 0-3 Zn, 0.2-1 Cu, 9-11 Sb.
For bearings, table ware.

218d BRITTANIA, ENGLISH.
Eng.; 90-85 Sn, 0-3 Zn, 1.3 Cu, 5-10 Sb.
For bearings, table ware; corrosion resistant.

218e BRITTANIA, GERMAN.
Germ.; 70-94 Sn, 0-5 Zn, 1.8-5 Cu, 3.7-5 Sb, 0-9 Pb.
For bearings; Babbitt.

219 BRONZALUN.
M-250; a bronze with abrasive grains cast in the metal 85 Cu, 15 alumina or carborundum.
For floor plates, stair treads, car steps and door saddles; wear resistant and "anti-slip."

220 COMMERCIAL BRONZE.
M-33; 90 Cu, 10 Zn.
Sheets: 32,000 TS; 10,000 YS; 40 El; 50 Brin.
Wire: 100,000 TS; 50,000 YS; 1 El.
For window screen wire, automobile radiators, hardware, ornaments.

221 CARBOLOY 831.
M-31; 61 WC, 32 TC, 7 Co.
For cutting tools, dies; cemented carbide.

222 CARBOLOY 715.
M-31; WC + Co.
For cutting tools, dies; cemented carbide.

223 CARBOLOY A-44.
M-31; 94 WC, 6 Co.
For cutting tools, dies; cemented carbide.

224 CARBOLOY 119-A.
M-31; WC + Co.
For cutting tools, dies; cemented carbide.

226 KROMAL.
M-69; 0.7 C, 9 Mo, 4 Cr, 1.25 V, bal Fe.
Annealed: 228-241 Brin.
For high speed tools and cutters; high speed steel; obsolete.

230 FRONTIER ALLOY NO. 24.
M-58; 70 Cu, 1 Sn, 27 Zn, 2 Pb.
29,500 TS; 10,500 YS; 26 El; 29 RA; 53 Brin.
For bearings; formerly Bronze No. 24; discontinued.

231 McKAY 18-8 Mo-ELC.
M-849; 0.038 max C, 17-19 Cr, 12-14 Ni, 2.5 Mo, bal Fe.
Weld: 80,000 TS; 55,000 YS; 40 El.
For welding rod; shielded arc.

232a HARD BRONZE-1.
M-165; 88 Cu, 2 Pb, 7 Sn, 3 Zn.
30,000 TS; 12 El.
For gears, bushings; tough.

232b HARD BRONZE-2.
M-165; 88 Cu, 10 Sn, 2 Zn.
For gears, bushings; G.M. No. 4048 M.

233 M.H. ALLOY NO. 6.
M-212; 77.5 Cu, 7 Sn, 14 Pb, 1.5 Ni.
30,000-36,000 TS; 17,000-19,000 YS; 20-28 El; 21-25 RA; 64 Brin.
For machinery bearings for high speed and medium pressures; "Bar Alloy No. 6"; acid resistant.

234 TRANCOR 3 W.
M-10; Si, bal Fe.
For transformer cores; oriented grains.

235 TRANCOR 4 W.
M-10; Si, bal Fe.
For transformer cores; oriented grains.

236 B.T.G. STEEL.
Eng.; 60 Ni, 25 Fe, 12 Cr, 2 Mn, 0.5 C, 3 W.
Sand cast: 50,000-70,000 TS; 40,000-61,000 YS; 2-10 El; 130-180 Brin.
Rolled: 90,000-109,000 TS; 50,000-70,000 YS; 25-45 El; 50-70 RA; 180-200 Brin.
For heating elements; heat and corrosion resistant.