CORROSION DATA SURVEY

Metals Section
Sixth Edition

AN OFFICIAL
NACE
PUBLICATION

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PREFACE TO THE SIXTH EDITION

A number of changes have been made in the Sixth Edition of this book to improve its accuracy and utility. Since the original edition of the *Corrosion Data Survey* was published some thirty years ago, new or modified alloys have been introduced and a separate survey on nonmetallic materials was published in 1975. An effort has been made in this edition to incorporate as much new data (current to 1980) as possible and to revise and update the data on existing metallic materials wherever data could be obtained.

The earlier editions reported the highest corrosion rates for a given environment-alloy combination in cases where multiple references were found for the same conditions. This was considered to be the best practice for earlier editions where many duplicate references were not found. However, where a large number of data are available, the highest reported corrosion rate may not be representative of the expected performance of the environment-alloy combination. Consequently, the editor of this Sixth Edition used his engineering judgment in reporting corrosion rates from conflicting data in the literature.

A number of alloys have evolved since the earlier editions were published. For example, alloy 20, alloy B, alloy C have been replaced, mostly by alloy 20Cb3, alloy B-2, and alloy C-276 respectively. These newer alloys can have corrosion resistance that is different from their predecessors. Whenever information was found on the new alloys, it was included in this edition. When no information was available on the newer alloys, the data on the older alloys were retained. No effort was made to verify the data carried over from previous editions.

Some format changes have also been made. Most of the data from the short tables of previous editions have been incorporated into the main tables. New categories of ferritic stainless steels (alloy 26-1 and 430) and austenitic stainless steels (20Cr-25Ni-4.5Mo) have been added. Since the corrosion rates of different copper base alloys were quite similar in most of the environments, these were grouped into fewer alloy categories. Alloys G, G-3, 20, and 825 have been grouped together into a single family where previously only data from alloy 20 and CN20 were included. A number of tables such as those for corrosion by waters, soils, atmospheric corrosion, low temperature corrosion, and stress corrosion cracking were eliminated since these were no longer considered adequate to cover the topic areas of interest. Finally, the footnotes for corrosives have been deleted from the tables. References concerning hazards of corrosives can be found at the end of the introduction.

It is believed that these changes improve and update the available information on corrosion of metals in various environments. However, neither NACE nor the editor believe that corrosion performance of alloys can be specified on the basis of data presented in this survey alone. Materials selection requires sound engineering judgment for each application. Additional information is required for making the proper choice of materials.

D. L. Graver
Editor

INTRODUCTION

In the development of new chemical processes, questions invariably arise concerning the choice of materials for certain equipment. However, since available corrosion information is scattered widely throughout the literature, these questions frequently are difficult to answer.

This survey summarizes both published and previously unpublished data in a group of tables for ready reference in determining suitability of materials for possible use. These tables should serve only as a guide, and it is to be expected that in most cases additional information will be necessary. The tables have been checked against actual plant conditions and a good correlation has been found. In cases of doubt, representatives of metal and other material suppliers often can be helpful in supplying additional information. Also, the services of a corrosion engineer, to aid in precise interpretation of the data, combined with supplemental information will be most beneficial.

Much of the data in this edition are taken from the Fourth and Fifth Editions, although numerous new data points have been added and many data points from previous editions have been changed or deleted. A list of data sources and individuals who have helped review the data from previous editions appears at the end of this introduction. Many other individuals have contributed information and materials which was carefully considered. Their help was appreciated and is gratefully acknowledged.

How to Use the Survey

Persons using the survey are reminded that the data given are indicative only and are not to be interpreted as absolutes with respect to specific applications. The primary values of the survey are that it (1) identifies materials which are manifestly unsuitable, (2) locates those which may have satisfactory performance and are candidates for further consideration, and (3) gives limited information other than corrosion rates concerning performance which may be helpful. A list of related NACE publications and other related references may be found at the end of this introduction.

Throughout this book, materials are arranged along the horizontal axis of each page of tables. Corrosives are listed alphabetically along the vertical axis. The data representing average penetration per year are plotted on a matrix of variable temperatures and concentrations in water. A key to the matrix used in the tables, a key to the data points, footnotes to the data tables, and a table identifying the metals and alloys are located on the fold-out page immediately following this introduction for convenient reference. For comparison of penetration rates, some typical rates are given in the Average Penetration Rate per Year Compared to Weight Loss table also located on the fold-out page. Penetration rates are not an unqualified indication of performance. Materials with low penetration rates in a given corrosive may be unsuitable, or failure may occur by some mode irrelevant to penetration. For example, fish liver oil may be catalyzed by some copper alloys, thus making copper unsuitable for this corrosive. Also, nickel, which has a low corrosion rate in mercury, may stress crack.

Locating Data

To find data on a particular material in a particular corrosive, refer to the subject index at the back of the book. Locate the corrosive of interest. The number following the entry represents the page and line on which the data will be found. Many synonyms for the corrosives have been cross referenced in the index, although only one name will be given in the tables. If the corrosive of interest cannot be found in the index, locate synonyms or another similar corrosive if possible. If an alloy of interest is not among those listed, data for a similar alloy may apply.

In reading the data tables, reference should be made to the temperature/concentration matrix shown on the fold-out page. This illustrates the method by which concentration and temperature are compared against corrosion rates. The abscissa designation "Percent Concentration in Water" does not necessarily mean "percent solution," but often pertains to slurries or mixtures above saturation percentages. Data do not invariably conform to the actual boiling points of mixtures. When reactions at temperatures above boiling points are noted it is assumed that there is a pressure factor even though this is not denoted in the matrix.

How the Data Are Posted

Data taken from the literature are adjusted to fit the increments of the temperature/concentration matrix and therefore cannot be considered exact. For example, a posting at the intersection of the 40% concentration line and the 100 F (38 C) temperature line actually represents a concentration of 35 to 45% and a temperature of 50 to 150 F (10 to 66 C).

No data are posted on zero concentration lines; therefore, any posting on the shared line between data squares represents 100% concentration. Postings on the 100% lines usually refer to anhydrides but also may refer to some concentrations in which a small percentage of water is present as may be the case in everyday plant operations. In some instances, special arrays of data on anhydrides are posted. Data on mixtures of unknown proportions are posted on the 100% line. Thus, beer is posted as "100% beer."

In this edition as in earlier editions, the relative imprecision of the corrosives is acknowledged. Sometimes data are posted which are derived from exposures of materials to reagent grade corrosives. However, many of the data come from reports of actual operating systems where reagent grade corrosives are rarely, if ever, encountered.

The following comments enlarge on the means used to present the data and emphasize the importance of many additional factors in determining the corrosion resistance of a material, since these cannot always be expressed in simple, graphic form. Consequently, IT IS IMPORTANT THAT THE FOLLOWING NUMBERED SECTIONS BE READ CAREFULLY.

1. Corrosives

Although corrosives are listed alphabetically in the main tables, a series of other tables and graphs listed in the Table of Contents presents additional information on special topics and on certain generally encountered corrosives. Previous experience has revealed that grouping corrosion rates by similar compounds is helpful. When information on the particular corrosive under consideration is insufficient or lacking, there may be others in the same general group which could be expected to react with materials in a similar manner.

2. Materials of Construction

Materials of construction available at reasonable cost and in a wide variety of forms have been selected for general corrosion rating. In special cases, other materials also are

plotted. Materials have been grouped under general classification headings according to the major base metal. Within each classification are a number of materials frequently considered to have comparably similar corrosion resistances. For example:

a. In carbon steels, carbon content up to 0.30% is not considered to alter appreciably the corrosion rate.

b. Silicon bronze, aluminum bronze, and tin bronze are considered to have similar corrosion resistances in most media, but it is recognized they can differ markedly in specific environments.

c. In stainless steels, Types 302, 304, 304L, 321 and 347 are expected to have similar corrosion resistance and are grouped as 18Cr-8Ni austenitic stainless in the corrosion tables.

d. In aluminum alloys, the following types are expected to have equivalent corrosion resistance: 1100, 3003, 3004, 5052, 6061, 6062, and cast 43, B214, 356, and 406. No aluminum alloy containing over 1.0% copper should be considered to have corrosion resistance equal to these.

Thus where data on any of the above are shown in the data tables, other materials in the same group usually can be expected to perform in a like manner.

3. Concentration of Corrosives

Concentrations in all cases (except in certain solutions and gases, either desiccated or essentially so) are considered to be water dilutions of pure compounds. Although it is fully understood that small quantities of contaminants may have a profound effect on corrosion rates, this factor is not ordinarily taken into account in the tables, often because the specific contaminants are not reported in the references from which data are taken. In instances where a metal was designated as being unaffected by a chemical and no mention was made of concentration or temperature, the tables show the metal as satisfactory at the 100% line at room temperature. This indicates that the metal has a possible use and could be considered.

4. Temperature

Temperature may affect the corrosion rate through its effect on oxygen solubility and availability. As temperature rises, oxygen solubility in an aqueous solution decreases and at the boiling point most oxygen is removed. On the contrary, the diffusion rate of oxygen increases with temperature. The corrosion rate may increase with temperature to some maximum and then decreases to some low value at the boiling point.

Temperature also may affect corrosion through its effect on pH, with increasing temperature often resulting in decreasing pH.

Temperature also may affect corrosion rates through its effect on films. It may increase the solubility of protective corrosion products, as in the case of lead in hydrochloric acid. A change in temperature also may bring about changes in the physical nature or the chemical composition of corrosion products which may make them considerably more or less protective. The behavior of zinc in water is an example. Another effect of rising temperatures on films is caused by precipitation of protective coatings on metallic surfaces, as in waters containing calcium sulfate and calcium carbonate.

In solutions under pressure at temperatures above their normal boiling points, corrosion rates may increase quite rapidly with temperature, possibly because many of the factors (such as diffusion, which normally acts to limit corrosion) are no longer controlling. The limiting effect of diffusion also can be overcome by rapid movement.

The effect of heat flux on the corrosion rate must be recognized. Maintaining a liquid at a bulk temperature of 248 F (120 C) in a vessel can produce no corrosion, whereas the same temperature on the heating side of a metal surface may result in catastrophic corrosion.

Temperatures are plotted in degrees Fahrenheit from 0 to 500 (−18 to 260 Celsius) on the vertical axis of the matrix shown on the fold-out page. This matrix makes up the data tables throughout the book.

5. Corrosion Rates

An arbitrary set of corrosion rates has been established for this survey to meet the requirements of instrument, design, and maintenance engineers. (See the Key to Data Points on fold-out page.) The ideal rating (denoted in the tables by a solid circle) has been assigned when corrosion is less than 2 mils (50 μm) per year. Many materials have this property and may be used for some pieces of equipment, although they may be ruled out for others because of other failings, such as contamination of product, brittleness, temperature limitations, or unavailability in suitable form.

When this highest degree of corrosion cannot be indicated, a secondary rating (an open circle) representing less than 20 mils (508 μm) per year corrosion rate is used. In the development of this category, considerable difficulty has been encountered due to the various methods of reporting corrosion data. Materials reported as "recommended" or "completely resistant" may have corrosion rates less than 2 mils per year, but without actual figures, they have been placed in the second category (20 mils per year) rather than the ideal one. For the majority in this category, the corrosion rates probably will be below 5 mils per year. The rating of 20 mils per year indicates those materials which normally would be specified where a corrosion allowance of 60 - 120 mils is added for protection against possible mild corrosion.

A third classification (an open square) is provided to indicate a corrosion rate between 20 and 50 mils (508 and 1270 μm) per year. These materials can be used only in special cases where such a rate can be tolerated, but are not considered adequate for general plant construction.

The final rating (an X) is given where the corrosion rate is probably too high (over 50 mils per year) to merit consideration.

6. Additional Factors Influencing Corrosion Rates

There are many factors besides concentration and temperature which influence corrosion rates and, while they are often extremely important, it is impossible to list them all in a survey of this type. For example, velocity, aeration, heat flux, the presence of oxidizing agents, and other chemical contaminants can either increase or decrease the corrosion rate. The effect of galvanic coupling is also important in assessing the useful life of a piece of equipment and should be considered.

Welding is another factor which may influence service life. Aside from intergranular corrosion, which is discussed below, there are instances where as-deposited weld metal is attacked in preference to the base metal; conversely, there are occasions when the weldment is more resistant. Additionally, localized stresses due to welding often make zones adjacent to welds susceptible to stress corrosion cracking. For these reasons, selection of the correct welding material is as important as selection of the base material.

Many alloy systems show variations in corrosion resistance as a result of being heated or cooled in a certain way. It is important that fabrication and heat treatment are such that an alloy's corrosion resistance is not impaired if the fabricated part is intended for corrosive service. Generally the solution annealed condition is preferred, but the manufacturer of the alloy should be consulted for his recommendations.

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The NACE Book of Standards.
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The Role of Bacteria in the Corrosion of Oil Field Equipment (TPC-3), 1976.

Additional References

Handbook of Reactive Chemical Hazards, L. Bretherick, Ed., 1984, Van Nostrand Reinhold Company, Inc., New York, New York.
Dangerous Properties of Industrial Materials, 6th Edition, N. I. Sax, 1984, Van Nostrand Reinhold Co., Inc., New York, New York.
Toxic and Hazardous Industrial Chemicals Safety Manual, 1982, International Technical Information Institute, Tokyo, Japan.
Material Safety Data Sheets, J. M. Nielsen, Ed., 1980, Technology Marketing Operation, General Electric Co., Schenectady, New York.
The Merck Index - An Encyclopedia of Chemicals and Drugs, 9th Edition, M. Windholz, Ed., 1976, Merck & Co., Inc.

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7. Effect of Stress on Corrosion Rates

Two very important instances when stress and corrosion operating simultaneously will not cause increased general attack but will produce fracture are corrosion fatigue and stress corrosion cracking. While corrosion fatigue may occur in any corrosive medium, stress corrosion cracking requires a specific combination of alloy and environment. Quite often the stress which causes stress corrosion cracking is due not only to operating conditions but also to locked-in stress due to fabrication. Welding, in particular, often induces stresses sufficient to cause failure. For this reason, post fabrication heat treatments often are specified. When stress cracking is indicated in the tables, the materials definitely should be stress relieved after fabrication, or a metal not susceptible to stress cracking should be selected. For stress relieving times and temperatures, the manufacturer of the alloy should be consulted.

Generally, stressing metals at less than their elastic limit does not markedly increase corrosion rates. Under some circumstances this may not be true. Occasionally alternating stresses result in faster corrosion rates than static stress in one direction alone. Markedly different corrosion rates have been experienced with certain metals when they were stressed after exposure in an environment rather than before. There also may be a differential in corrosion rates between that side of a material under compressive stress and the one under extension.

8. Intergranular Corrosion

Intergranular corrosion attacks grain boundaries of materials and can be particularly aggressive when certain chemical solutions are in contact with austenitic stainless steels which have precipitated carbides at grain boundaries (sensitization). This precipitation is produced when the steel has been subjected to temperatures between 800 and 1400 F (426 and 760 C) and is often present adjacent to welded areas. Various methods have been developed to eliminate this undesirable condition. However, because intergranular corrosion is not produced by all corrosive media, special heat treatments or specification of stabilized types of austenitic stainless steels often are unnecessary.

Certain other metals and alloys are subject to intergranular attack when exposed to specific media under some environmental conditions and others after an adverse heat treatment. In such cases the manufacturer should be consulted for information relating to his product.

9. Corrosion Inhibitors

Also not considered in this survey are the electrical techniques of cathodic and anodic protection, both of which have benefits under some conditions. Those who are interested in investigating these techniques may get good advice from manufacturers and consultants in these fields.

The technology of inhibition is well developed, but is not considered in this book. Consult the reference list below for sources of published information on inhibition.

Sources of Data

The majority of data for all editions of this book has been collected from the following publications:

Atmospheric Corrosion of Metals, I. L. Rozenfeld, 1973, English Edition, NACE, Houston, Texas.

Book of Stainless Steels, E. E. Thum.

Chemical Engineering, McGraw-Hill Publishing Co., New York, New York.

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Corrosion Guide, 2nd Edition, Eric Rabalt, 1968. Elsevier Publishing Co., New York, New York.

Corrosion Handbook, H. H. Uhlig, Wiley & Sons Publishing Co., New York, New York.

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Guide to Corrosion Resistance, J. P. Polar, 1962, Climax Molybdenum Co., Div. Am. Metal Climax, Inc., New York, New York.

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Proceedings, 3rd International Congress on Metallic Corrosion, 1966, Swets-Zeitlinger, Amsterdam, The Netherlands, (English Edition).

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Silver in Industry, L. Addicks, A. Butts, J. M. Thomas.

Underground Corrosion, Circular 579, Melvin Romanoff, 1957, National Bureau of Standards, Washington, DC.

Zinc: Its Corrosion Resistance, C. I. Slunder and W. K. Boyd, 1971, Zinc Development Association, London, England.

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Atlas of Electrochemical Equilibria in Aqueous Solutions, Marcel Pourbaix, 1974.

Bibliography of Corrosion by Chlorine (TPC-4), 1976.

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Corrosion Control in Petroleum Production (TPC-5), 1979.

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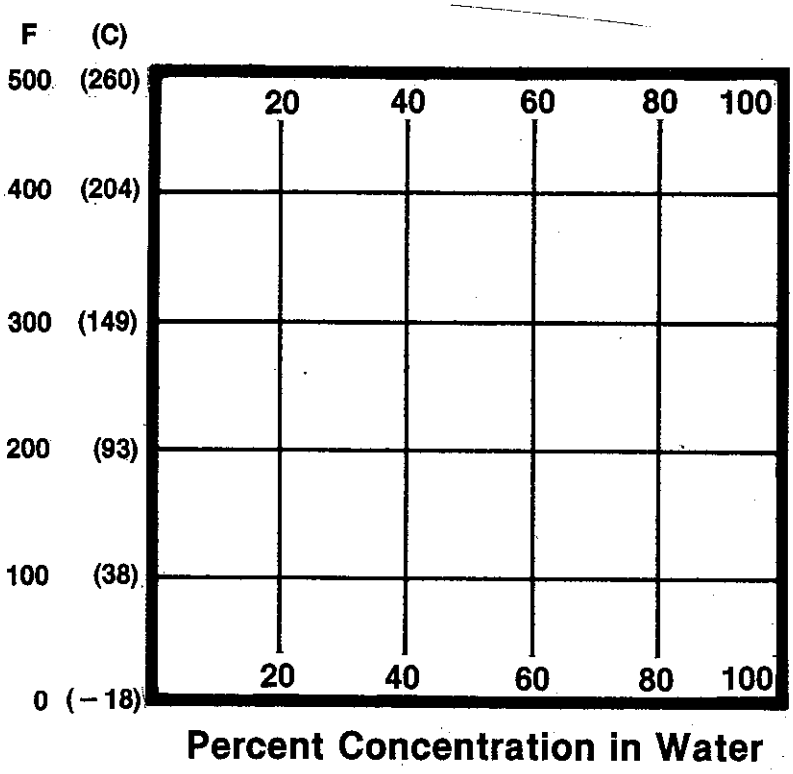
Corrosion Fatigue (NACE Reference Book 2), O. F. Devereux, A. J. McEvily, R. W. Staehle, Eds., 1972.

Keys to Data Tables
(Fold out)

Keys to Data Tables



Matrix Key

Throughout the data tables in this book, data points representing average penetration per year (key below) are plotted on the matrix enlarged here. The horizontal grid represents percent concentration in water and the vertical grid represents temperature. For more information on how to use this data survey, consult the preceding introduction.

Average Penetration Rate Per Year

Code		Mils	Inches	mm $\times 10^{-3}$
●	<	2	0.002	50
○	<	20	0.020	508
□	{	20-50	0.020-0.050	508-1270
X	>	50	0.050	1270

Key to Data Points

Footnotes for Data Squares

1. Pitting
2. Stress Corrosion Cracking
3. Intergranular Attack
4. Crevice Attack

Key to Footnotes

IDENTIFICATION AND NOMINAL ANALYSES OF METALS AND ALLOYS

FERROUS ALLOYS Common Name or Type	Nominal Analysis (Percent) Chromium	Nickel	Silicon	Iron	Carbon	Manganese	Phosphorus	Sulfur
Steel, Carbon, Mild	<0.6	<2.25		bal		<1.75		
Iron, Gray Cast			1.1-2.8	bal	<3.80		0.15	0.10
Iron, High Nickel Cast		14-32		bal				
STEEL, Stainless, Martensitic and Ferritic								
AISI Type[1]								
405	11.5-14.5			bal		<1		
410	11.5-13.5		<1	bal		<1		
STEEL, Stainless, Ferritic								
17Cr	17	0.5*	1*	bal	0.12*	1*	0.04*	0.03*
26-1	25-27			bal	0.005		Mo = 0.75-1.5 Cu ≤ 0.20 N = 0.015 Cu + Ni ≤ 0.50	
STEEL, Stainless, Austenitic								
AISI Type								
302	17-19	8-10	<1	bal	<0.15	<2.0		
304/304L[2]	18-20	8-12	<1	bal	<0.08	<2.0		
321	17-19	9-12		bal		<2.0	Ti = C × 10	
347	17-19	9-13		bal			Cb + Ta = C × 10	
AISI Type								
316/316L[2]	16-19	10-14	<1	bal	<0.1	<2.0	Mo = 2 ~ 3	
317/317L[2]	18-20	11-15	<1	bal	<0.1	<2.0	Mo = 3 – 4	
20-25-4.5								
904L	20	25		bal			Mo = 4.5 Cu = 1.5	

COPPER BASE ALLOYS CDA Number[3]	Name	Nominal Analysis (Percent) Copper	Zinc	Tin	Lead	Arsenic	Iron	Nickel	Other
100-150	Electrolytic copper	99.9							
210	Gilding metal	95.0	5						
220	Bronze, commercial	90.0	10						
230	Brass, red	85.0	15						
502-546	Bronze, phosphorus	91-99		1-8					Also phosphorus
240	Brass, low leaded	80	20						
260	Brass, cartridge	70	30						
442-445	Admiralty	70-73	28	1	Tr	Tr			Also Sb,P
268	Brass, yellow	64-68	32		Tr		Tr		
270	Brass, yellow	63-68	32		Tr		Tr		
280	Muntz metal	59-63	37				Tr		
464-467	Brass, naval	59-62	38	Tr	Tr		Tr		Al = <8
612	Brass, aluminum	92.8					Tr		
706	Cupro-nickel	88.5	1		0.05		1.3	9-11	Mn = 1
710	Cupro-nickel	76.5	1		0.05		1.0	19-23	Mn = 1
715	Cupro-nickel	66.5	1		0.05		0.4-0.7	29-33	Mn = 1

NICKEL BASE ALLOYS Designation	Nominal Analysis (Percent) Chromium	Nickel	Copper	Molybdenum	Manganese	Iron	Silicon	Carbon	Other
200 + 200L[4]		99.5	0.05		0.25	0.15	0.05	0.06	Co trace
Monel 400		66	31.5			1.4			1.1
Inconel 600	15.8	76				7.2			1.0
Ni-Cr-Fe-Mo Alloys									
Incoloy 825	21.5	bal	2.0	3.0	1.0*	29.0	0.05*	0.05*	1.0 Ti
Hastelloy G/G-3	22.0	bal	2.0	7.0		19.5	1.0*		
20 Cb-3	19-21	30-34				bal	Mo = 2 – 3; Cu = 3 – 4; Cb 1		
ACI Type[5]									
Alloy 20	19-20	28-30			0.75*	bal	Mo = 2; Cu = 3 – 4.5		
CN 20	19-20	28-30				bal	Mo = 3; Cu = 1.75		
Hastelloy B		62		28		6.0			
Hastelloy B-2		69		28		1.0			
Hastelloy C	16	57		16		5		0.08*	4 W
Hastelloy C-276	16	57		16		5		0.01*	4 W

MISCELLANEOUS ALLOYS Designation	Purity and Alloying Elements	Designation	Purity and Alloying Elements
Aluminum	Low copper, iron	Silver	90% + Cu, Au, or Sn
Gold Platinum	+ Ag, Ir, Pd, Pt, In >99% + Ni, Os, Ru, Cu, Rh	Tantalum	>99.99 +
		Titanium	+ Pd, Al, Sn, or V
Lead	>99.73% + Ag, Cu	Zirconium	+ Ta, Mo, Mn, or Al

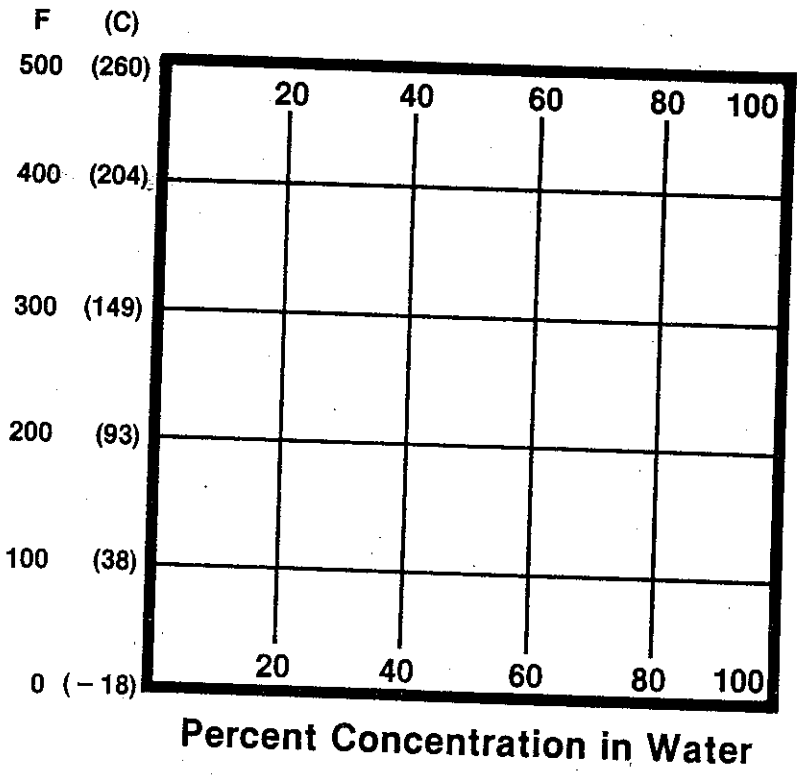
[1]American Iron and Steel Institute (AISI), Washington, DC.
[2]Low carbon grade: C = 0.03 maximum.
[3]Copper Development Association (CDA), New York, NY. See also *The Corrosion of Copper, Tin, and Their Alloys*, Henry Leidheiser, Wiley & Sons, NY, NY, 1971.
[4]Low carbon = 0.02 C, Type 201.
[5]Alloy Casting Institute (ACI; now Steel Founders' Society of America), Des Plaines, IL.
*Maximum

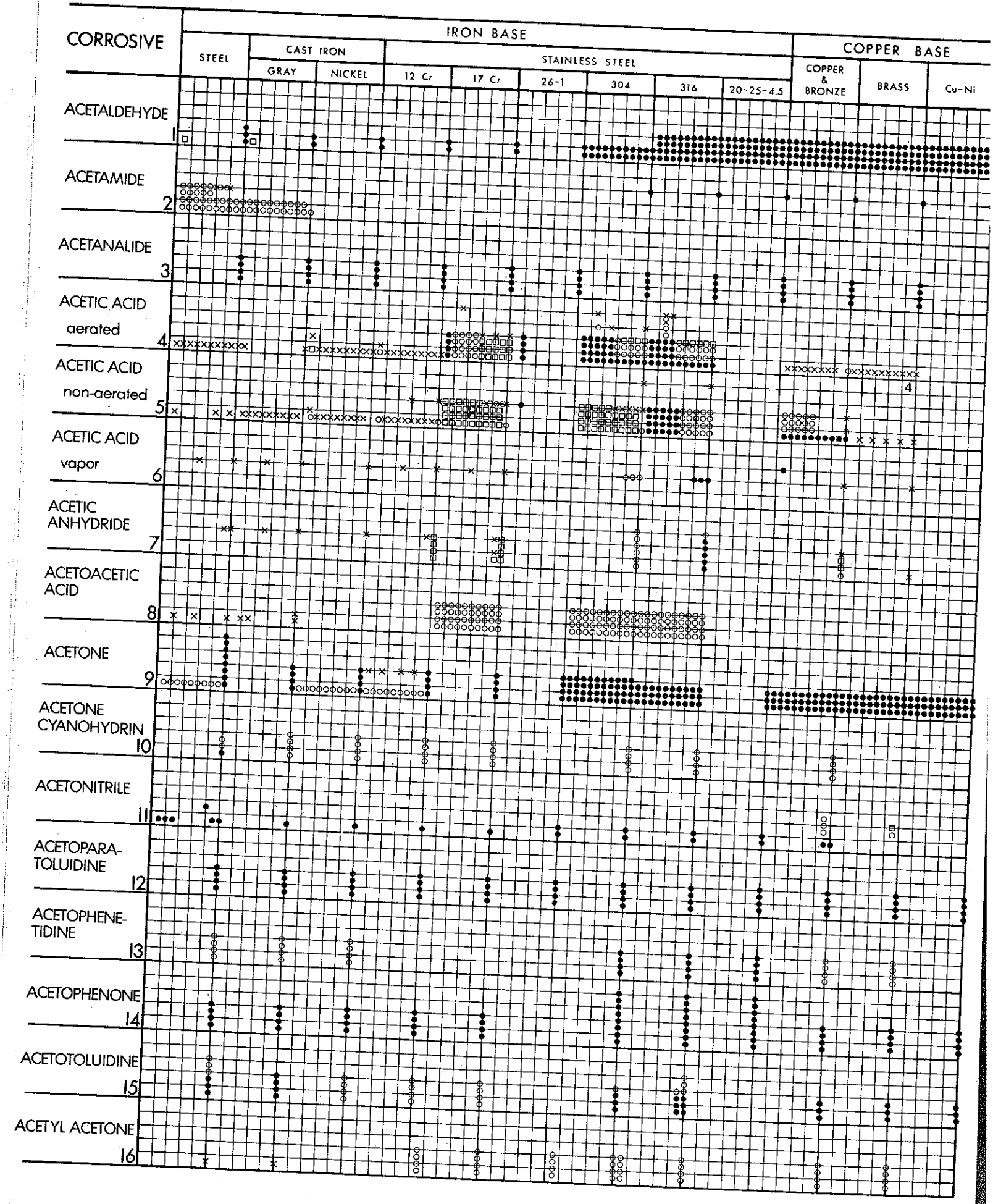
Section 1
Main Tables

The following tables contain the majority of data found in this volume. All data in this section pertain to the same four alloy groups (iron base, copper base, nickel base, and other) and represent exposure to corrosives in the 0 to 500 F (-18 to 260 C) temperature range. The data are of the same kind and reliability and come from the same sources as other data found in this volume.

The reader is advised to examine the following matrix upon which the tables in this section are based before attempting to use the tables. A replica of this matrix appears on the adjacent fold-out page for ready reference when reading the tables. A key to the data points (giving average penetration rates per year), a key to footnotes, and a table of identifications and nominal analyses of metals and alloys are also located on the adjacent fold-out page.

Consult the preceding introduction for further instructions on how to use this data survey.

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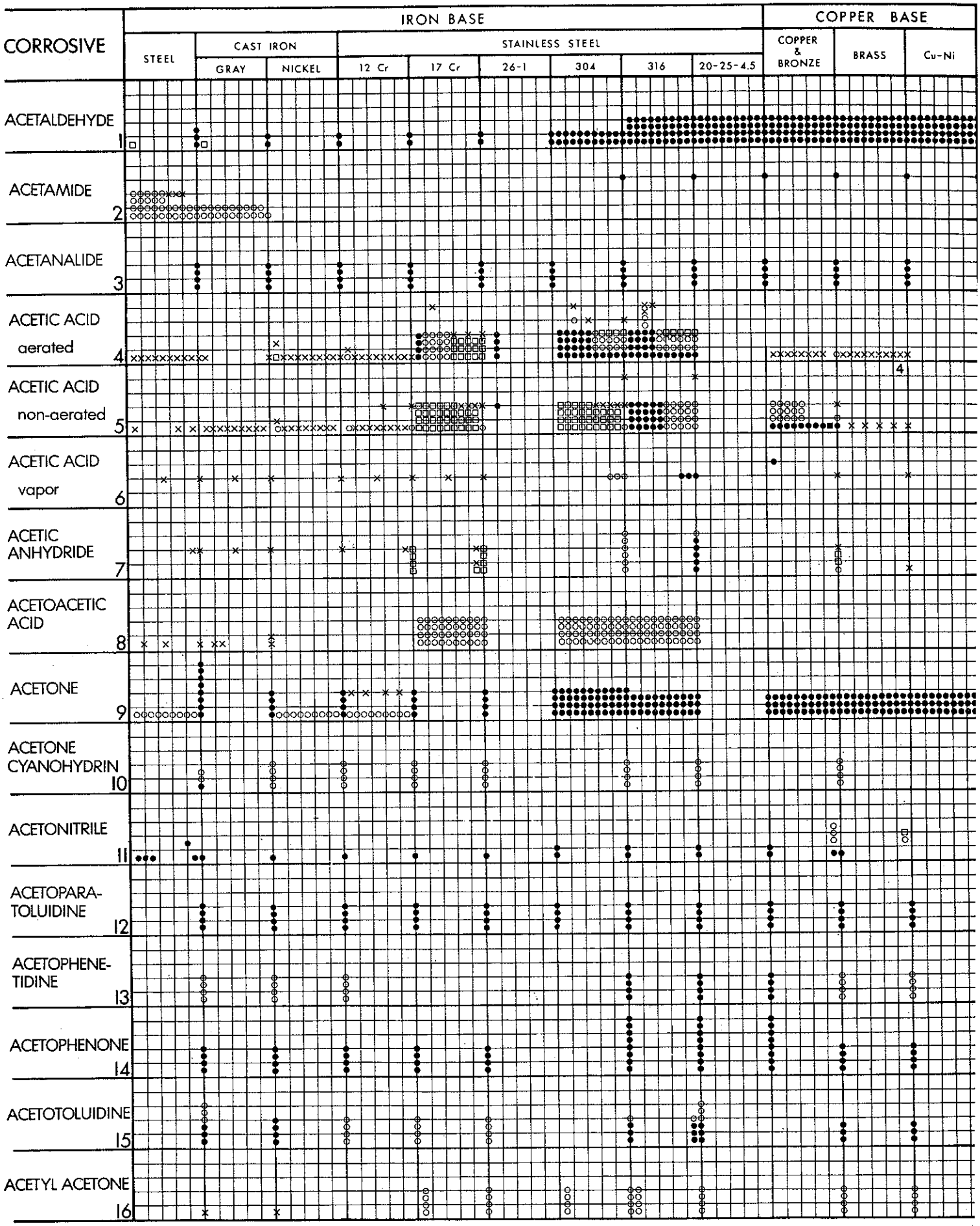
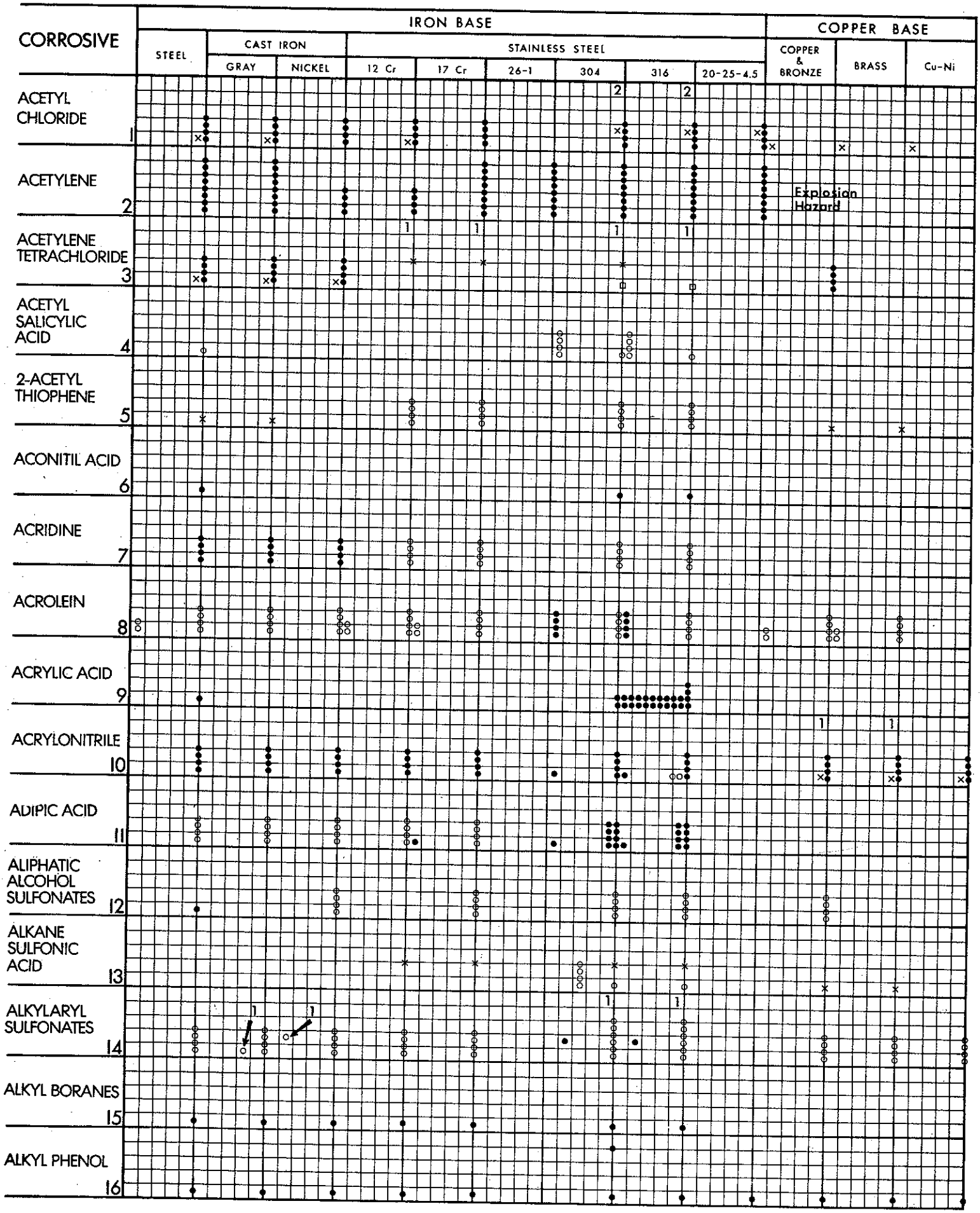
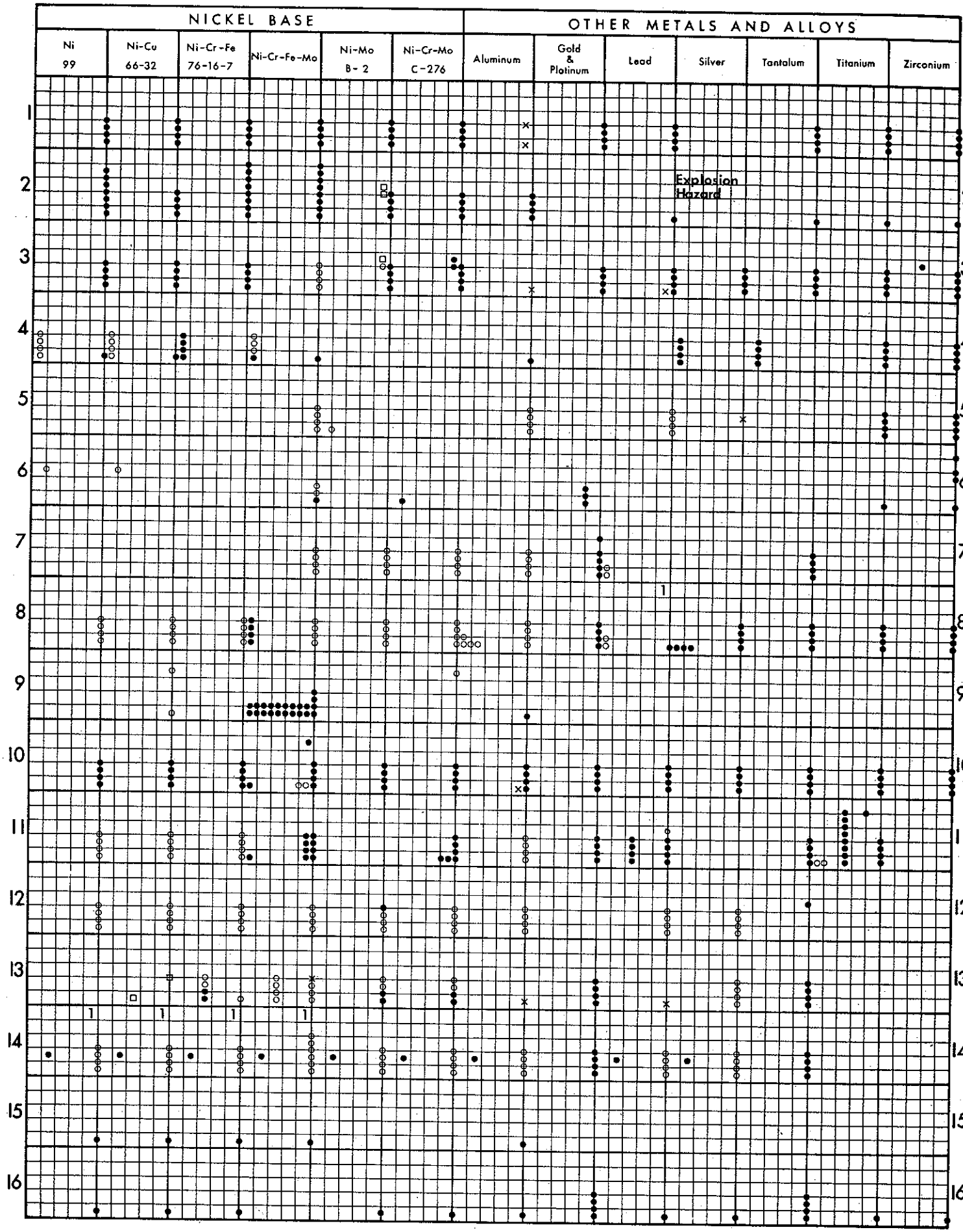
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER BASE
COPPER & BRONZE
BRASS
Cu-Ni
ACETALDEHYDE 1
ACETAMIDE 2
ACETANALIDE 3
ACETIC ACID aerated 4
ACETIC ACID non-aerated 5
ACETIC ACID vapor 6
ACETIC ANHYDRIDE 7
ACETOACETIC ACID 8
ACETONE 9
ACETONE CYANOHYDRIN 10
ACETONITRILE 11
ACETOPARA-TOLUIDINE 12
ACETOPHENE-TIDINE 13
ACETOPHENONE 14
ACETOTOLUIDINE 15
ACETYL ACETONE 16


CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
ACETALDEHYDE 1
ACETAMIDE 2
ACETANALIDE 3
ACETIC ACID aerated 4
ACETIC ACID non-aerated 5
ACETIC ACID vapor 6
ACETIC ANHYDRIDE 7
ACETOACETIC ACID 8
ACETONE 9
ACETONE CYANOHYDRIN 10
ACETONITRILE 11
ACETOPARA-TOLUIDINE 12
ACETOPHENE-TIDINE 13
ACETOPHENONE 14
ACETOTOLUIDINE 15
ACETYL ACETONE 16


CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
ACETYL CHLORIDE 1
ACETYLENE 2
Explosion Hazard
ACETYLENE TETRACHLORIDE 3
ACETYL SALICYLIC ACID 4
2-ACETYL THIOPHENE 5
ACONITIL ACID 6
ACRIDINE 7
ACROLEIN 8
ACRYLIC ACID 9
ACRYLONITRILE 10
ADIPIC ACID 11
ALIPHATIC ALCOHOL SULFONATES 12
ALKANE SULFONIC ACID 13
ALKYLARYL SULFONATES 14
ALKYL BORANES 15
ALKYL PHENOL 16


NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
Explosion Hazard
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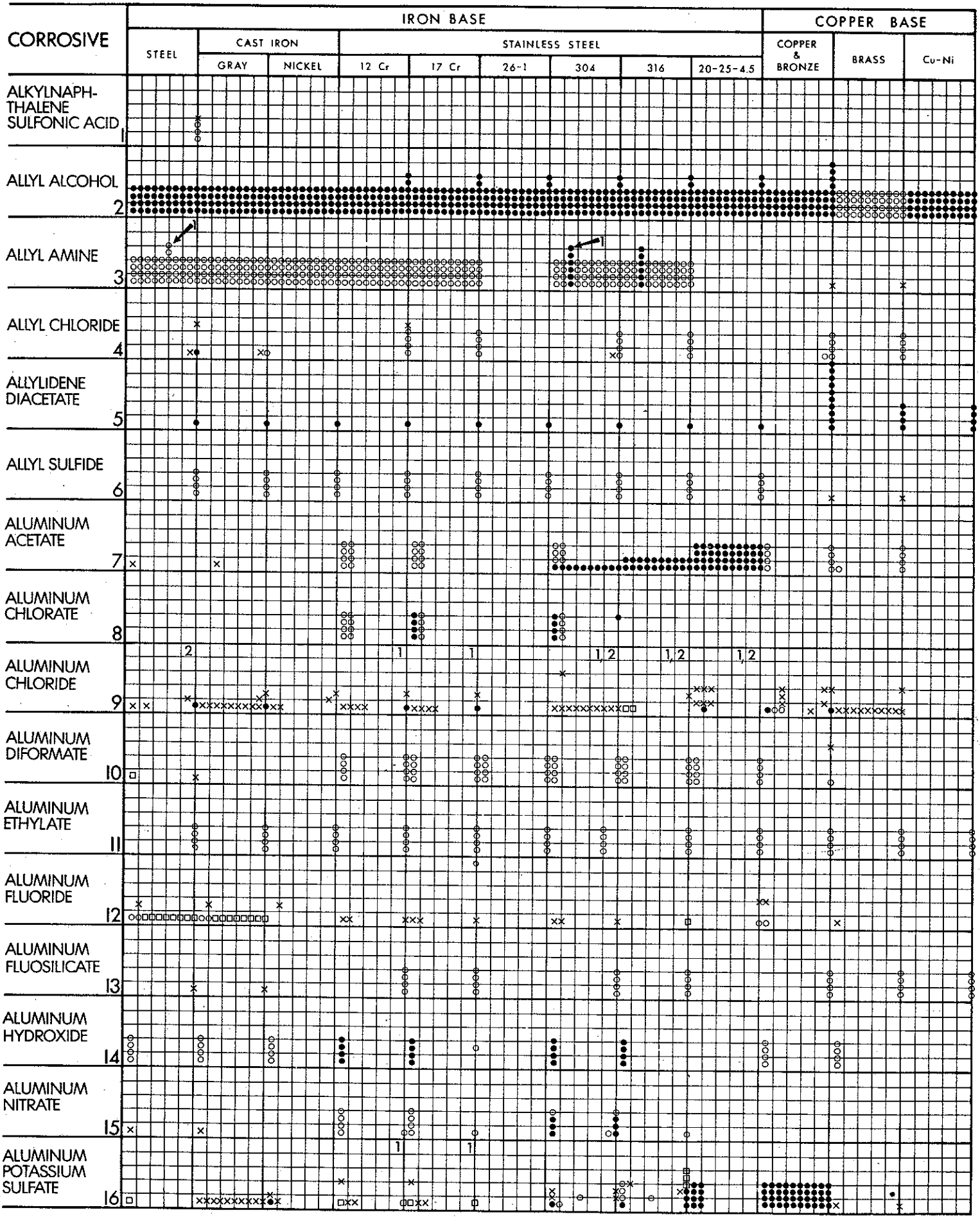
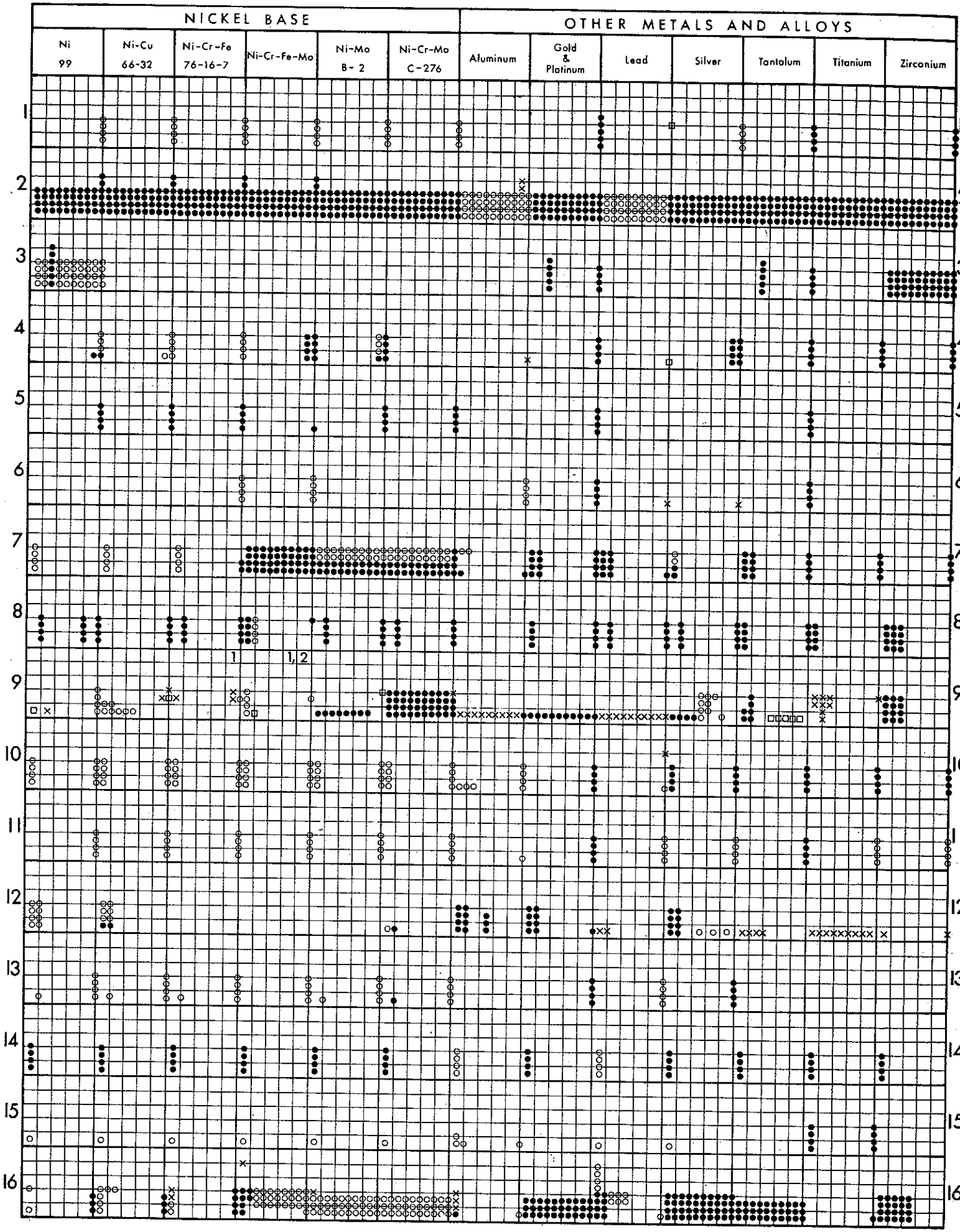

CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
ALKYLNAPHTHALENE SULFONIC ACID 1
ALLYL ALCOHOL 2
ALLYL AMINE 3
ALLYL CHLORIDE 4
ALLYLIDENE DIACETATE 5
ALLYL SULFIDE 6
ALUMINUM ACETATE 7
ALUMINUM CHLORATE 8
ALUMINUM CHLORIDE 9
ALUMINUM DIFORMATE 10
ALUMINUM ETHYLATE 11
ALUMINUM FLUORIDE 12
ALUMINUM FLUOSILICATE 13
ALUMINUM HYDROXIDE 14
ALUMINUM NITRATE 15
ALUMINUM POTASSIUM SULFATE 16


NICKEL BASE
OTHER METALS AND ALLOYS
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Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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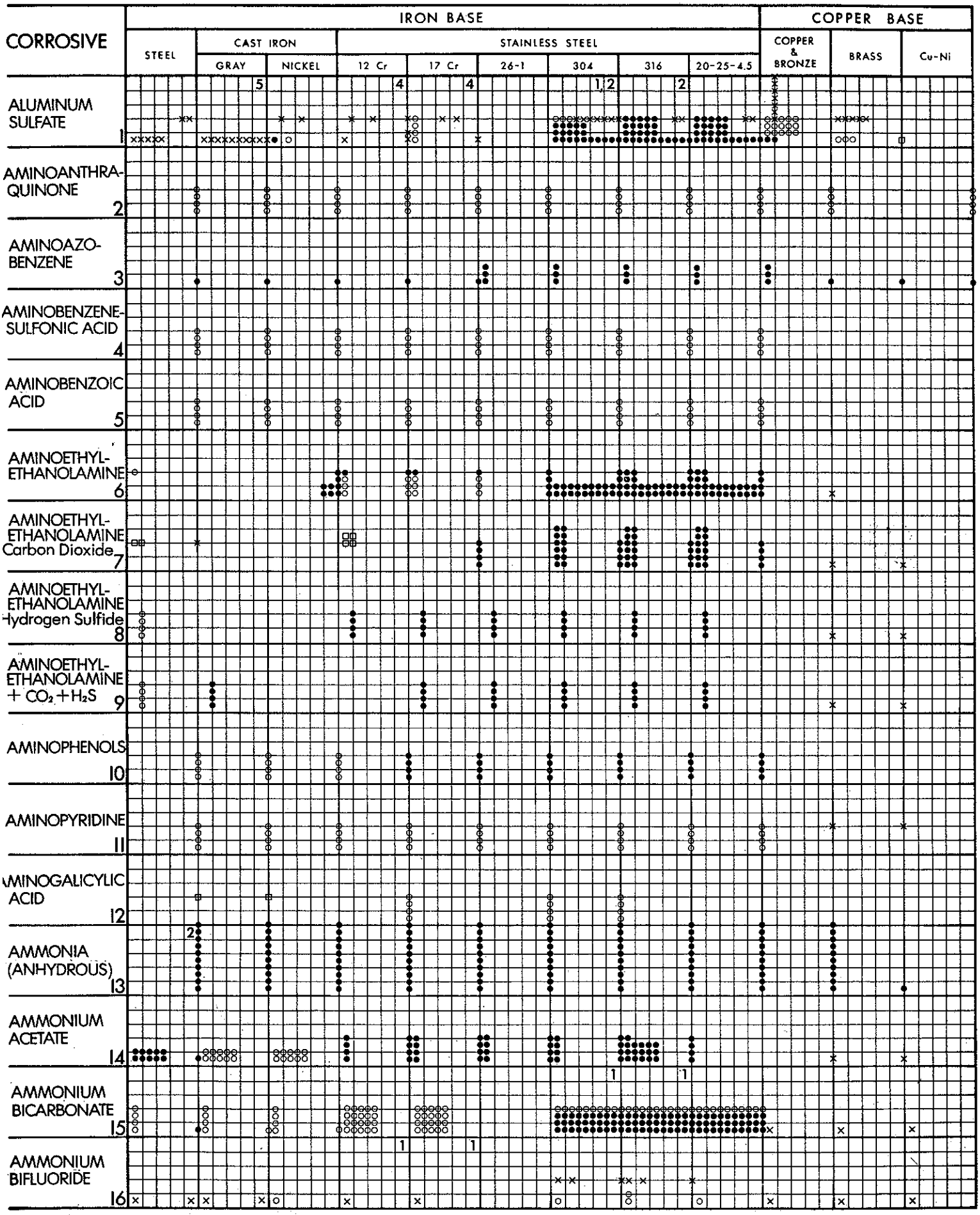
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
ALUMINUM SULFATE 1
AMINOANTHRAQUINONE 2
AMINOAZOBENZENE 3
AMINOBENZENESULFONIC ACID 4
AMINOBENZOIC ACID 5
AMINOETHYLETHANOLAMINE 6
AMINOETHYLETHANOLAMINE Carbon Dioxide 7
AMINOETHYLETHANOLAMINE Hydrogen Sulfide 8
AMINOETHYLETHANOLAMINE + CO_2 + H_2S 9
AMINOPHENOLS 10
AMINOPYRIDINE 11
AMINOSALICYLIC ACID 12
AMMONIA (ANHYDROUS) 13
AMMONIUM ACETATE 14
AMMONIUM BICARBONATE 15
AMMONIUM BIFLUORIDE 16


NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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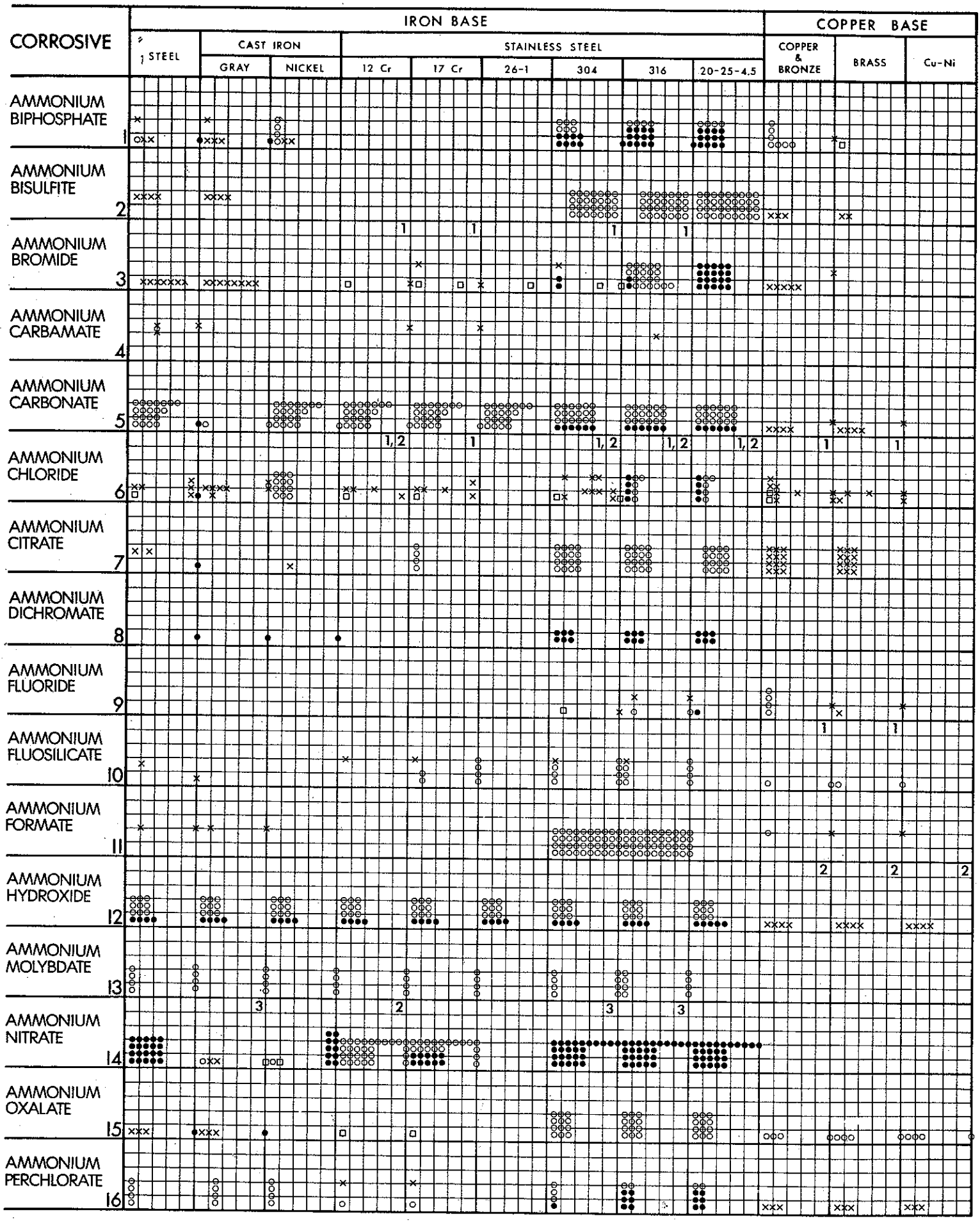
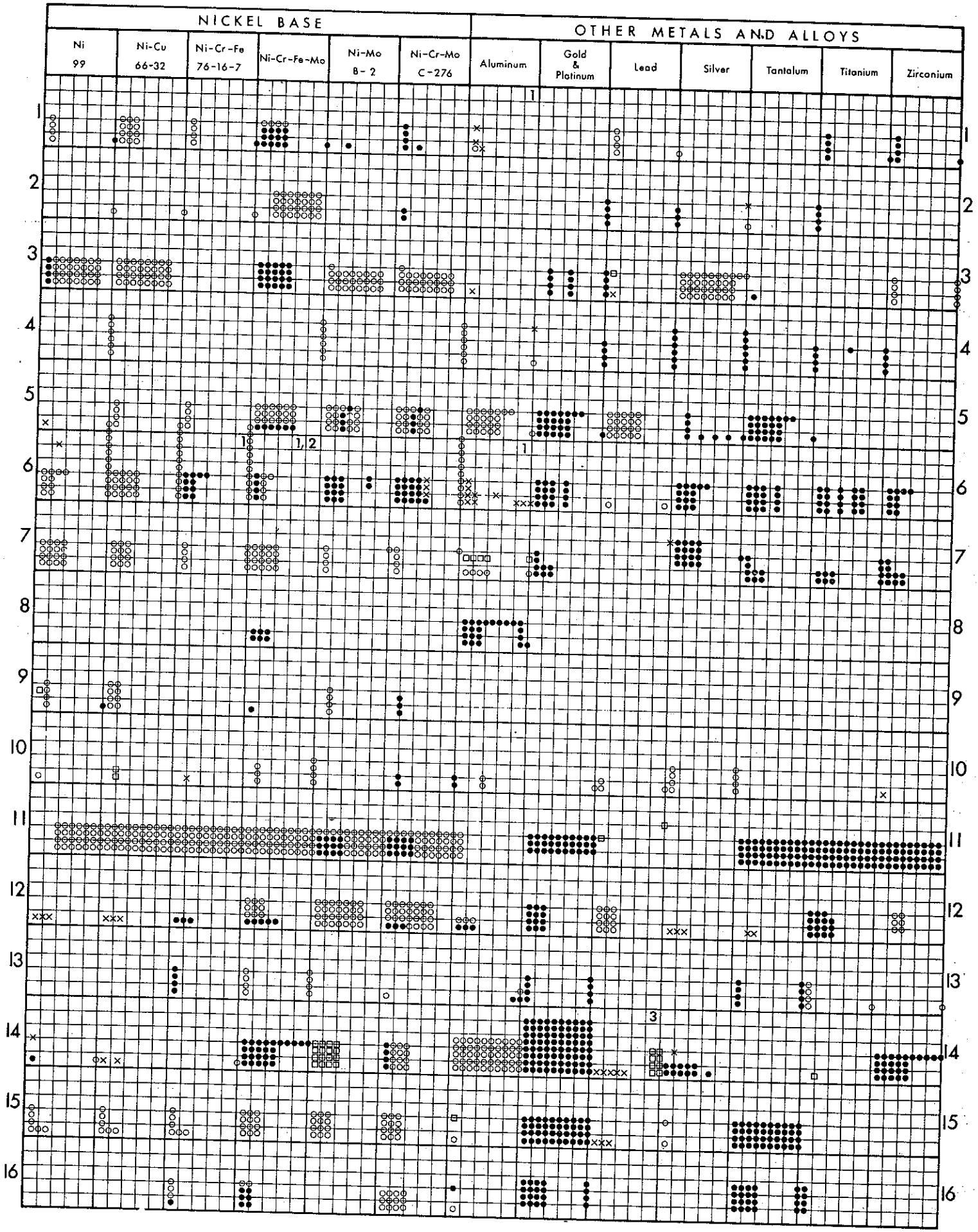

CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
AMMONIUM BIPHOSPHATE 1
AMMONIUM BISULFITE 2
AMMONIUM BROMIDE 3
AMMONIUM CARBAMATE 4
AMMONIUM CARBONATE 5
AMMONIUM CHLORIDE 6
AMMONIUM CITRATE 7
AMMONIUM DICHROMATE 8
AMMONIUM FLUORIDE 9
AMMONIUM FLUOSILICATE 10
AMMONIUM FORMATE 11
AMMONIUM HYDROXIDE 12
AMMONIUM MOLYBDATE 13
AMMONIUM NITRATE 14
AMMONIUM OXALATE 15
AMMONIUM PERCHLORATE 16


NICKEL BASE
OTHER METALS AND ALLOYS
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Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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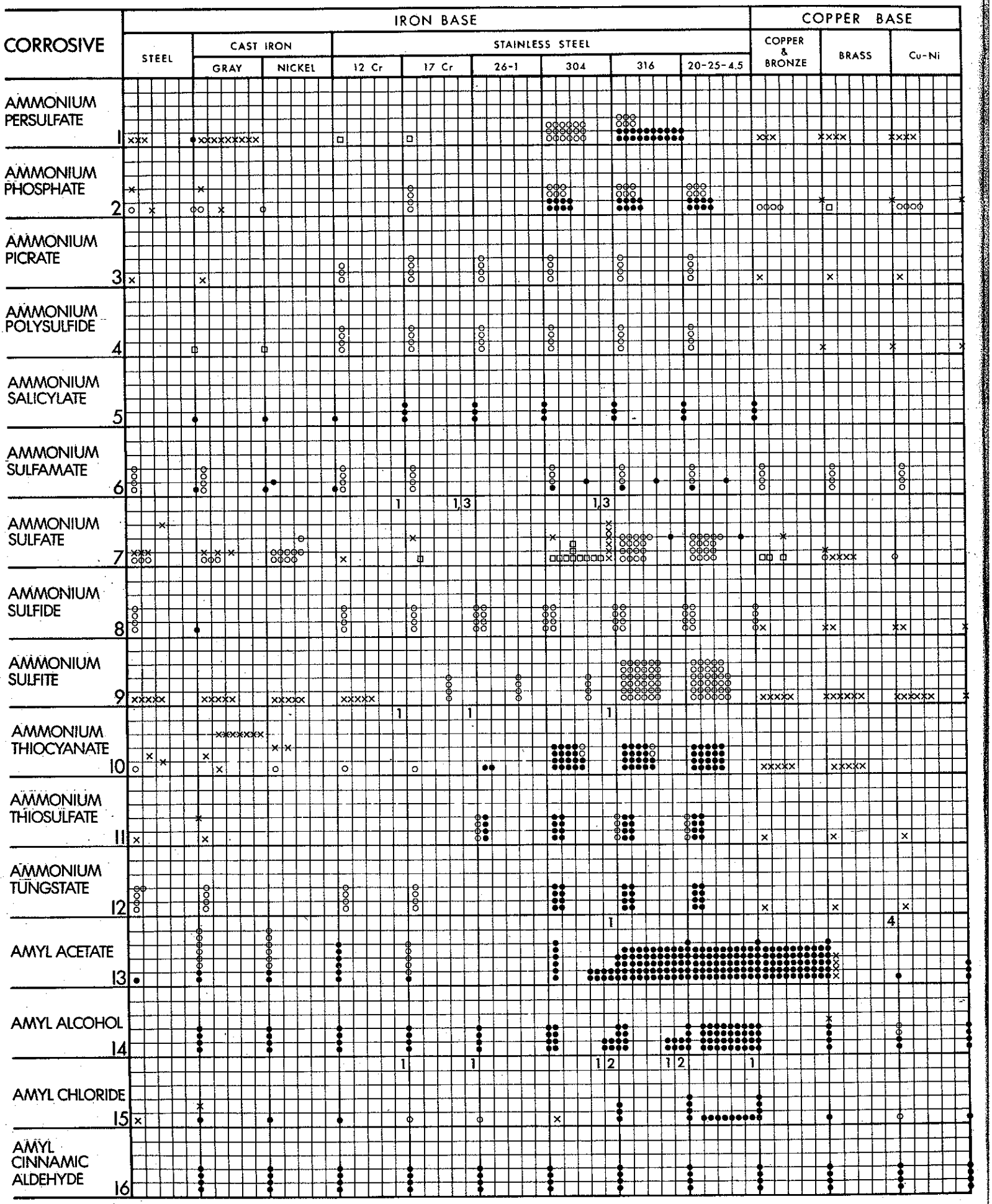
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
AMMONIUM PERSULFATE 1
AMMONIUM PHOSPHATE 2
AMMONIUM PICRATE 3
AMMONIUM POLYSULFIDE 4
AMMONIUM SALICYLATE 5
AMMONIUM SULFAMATE 6
AMMONIUM SULFATE 7
AMMONIUM SULFIDE 8
AMMONIUM SULFITE 9
AMMONIUM THIOCYANATE 10
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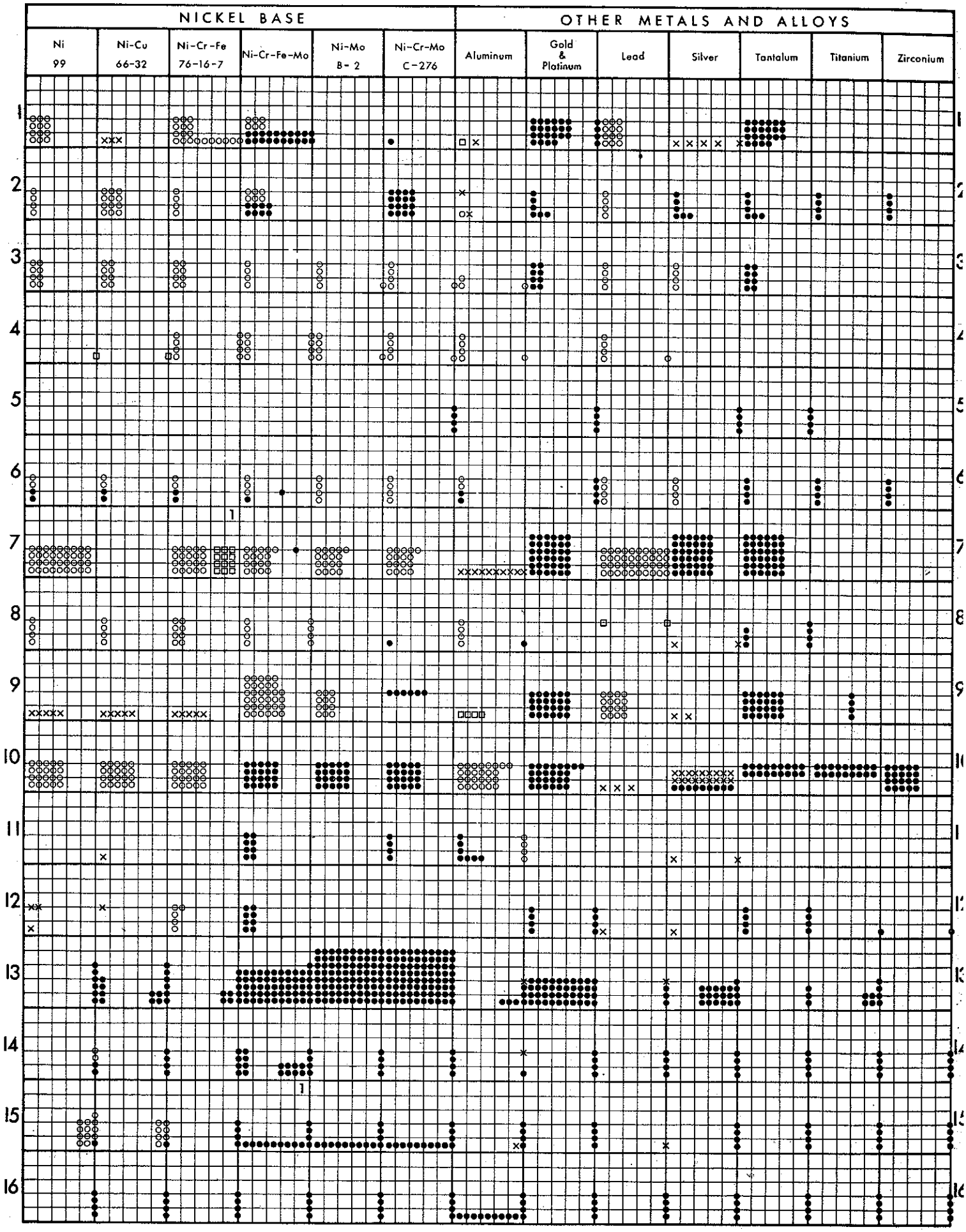
NICKEL BASE
OTHER METALS AND ALLOYS
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Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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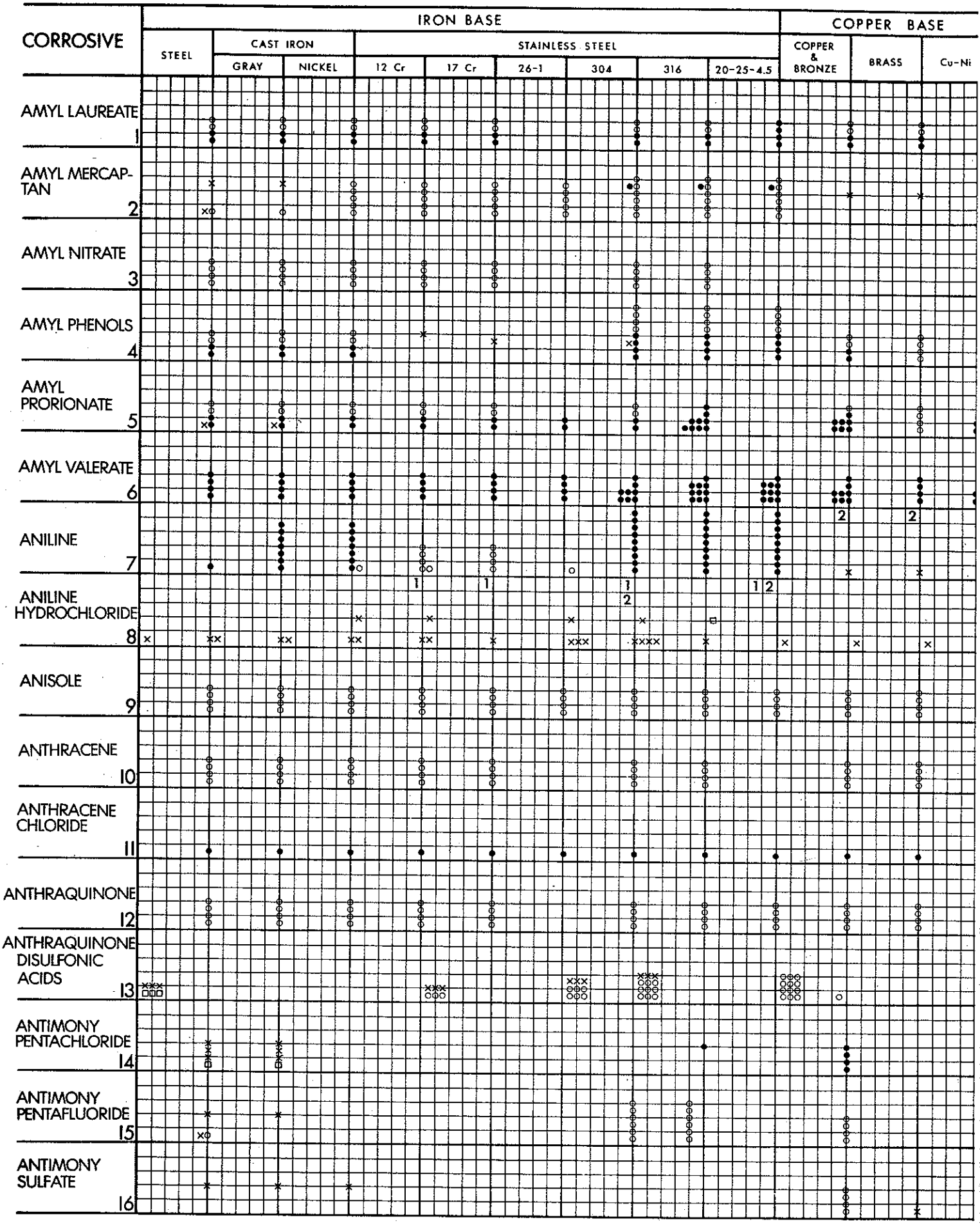
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
AMYL LAUREATE 1
AMYL MERCAPTAN 2
AMYL NITRATE 3
AMYL PHENOLS 4
AMYL PRORIONATE 5
AMYL VALERATE 6
ANILINE 7
ANILINE HYDROCHLORIDE 8
ANISOLE 9
ANTHRACENE 10
ANTHRACENE CHLORIDE 11
ANTHRAQUINONE 12
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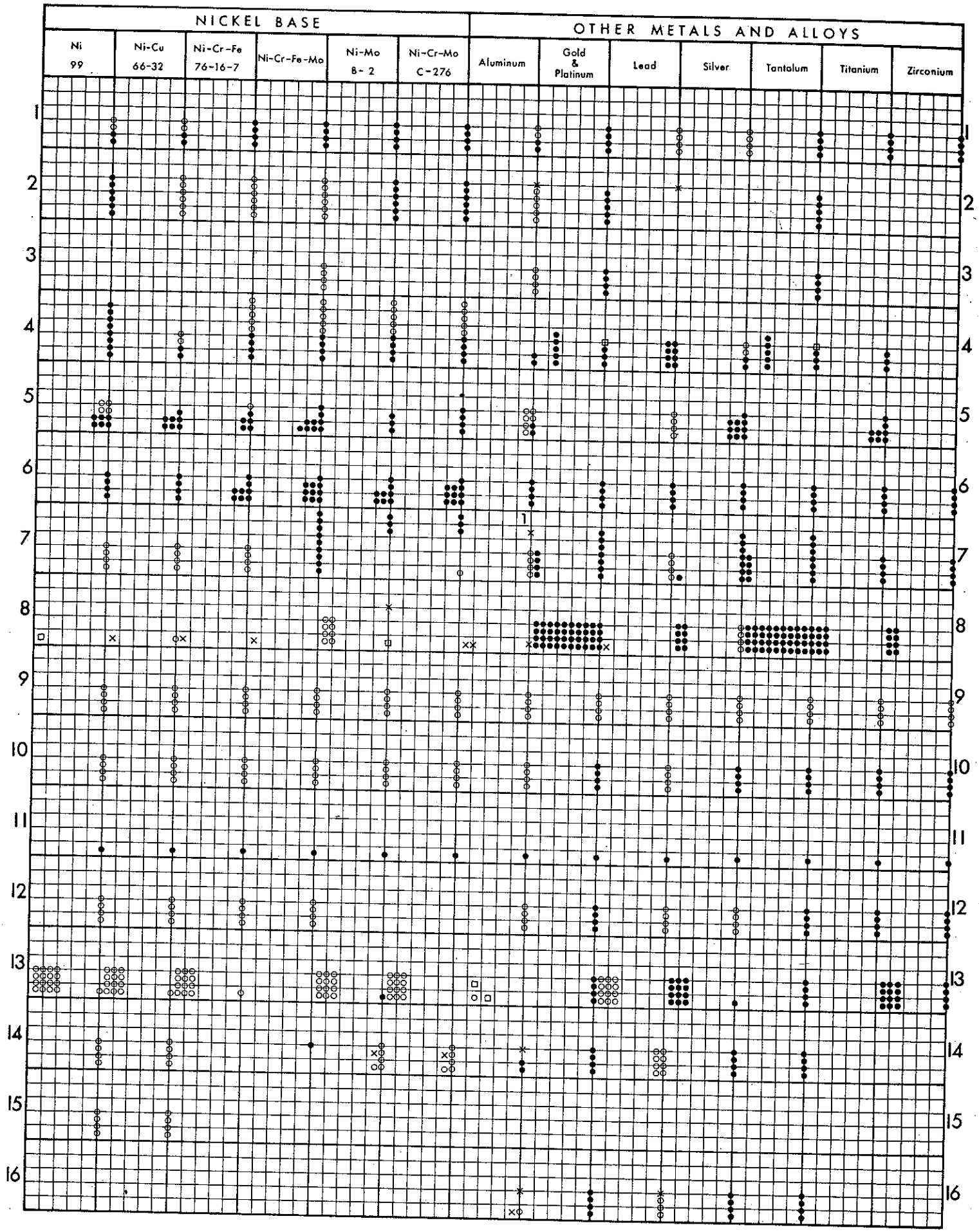
ANTIMONY PENTACHLORIDE 14
ANTIMONY PENTAFLUORIDE 15
ANTIMONY SULFATE 16


NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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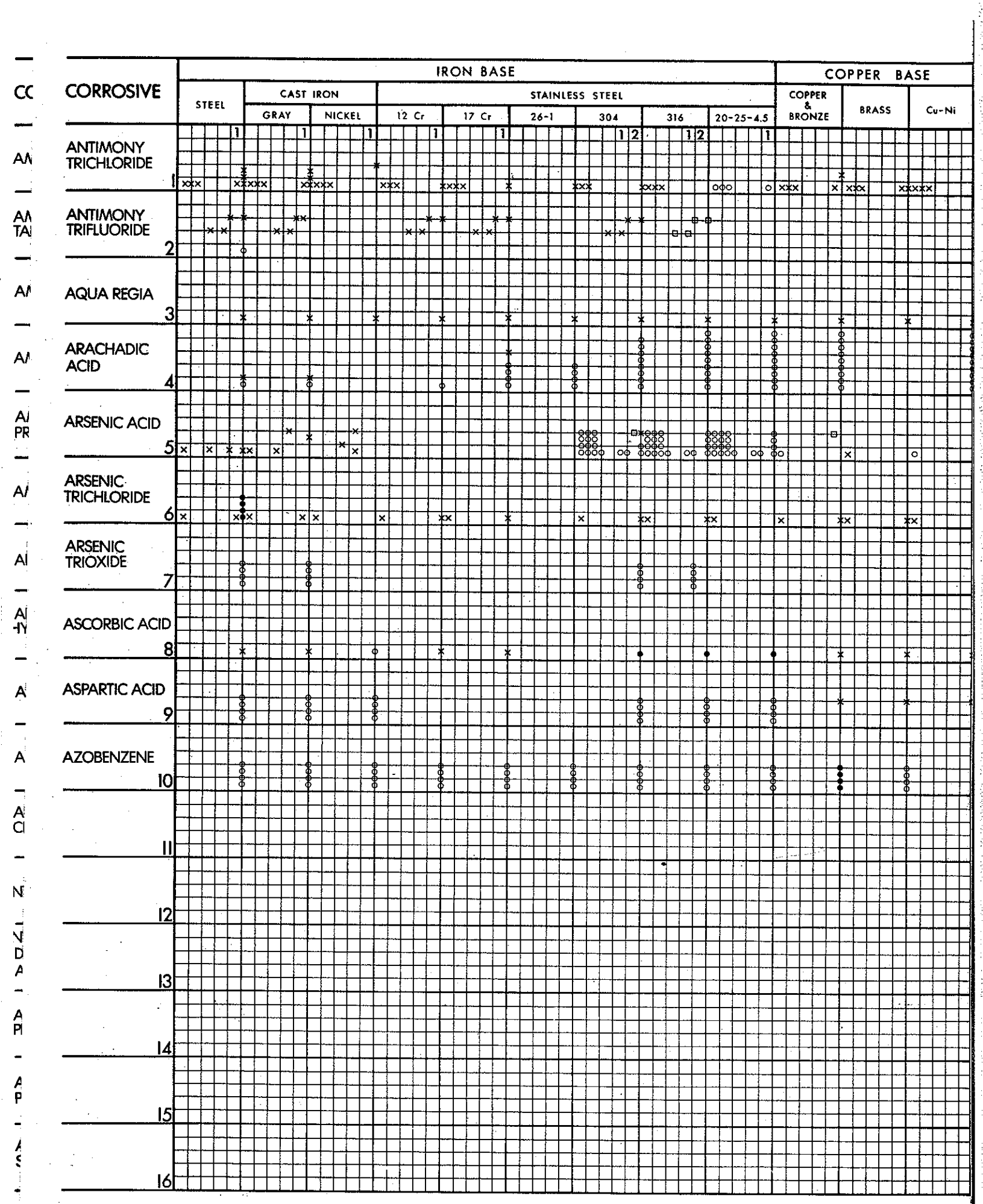
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
ANTIMONY TRICHLORIDE 1
ANTIMONY TRIFLUORIDE 2
AQUA REGIA 3
ARACHADIC ACID 4
ARSENIC ACID 5
ARSENIC TRICHLORIDE 6
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ASPARTIC ACID 9
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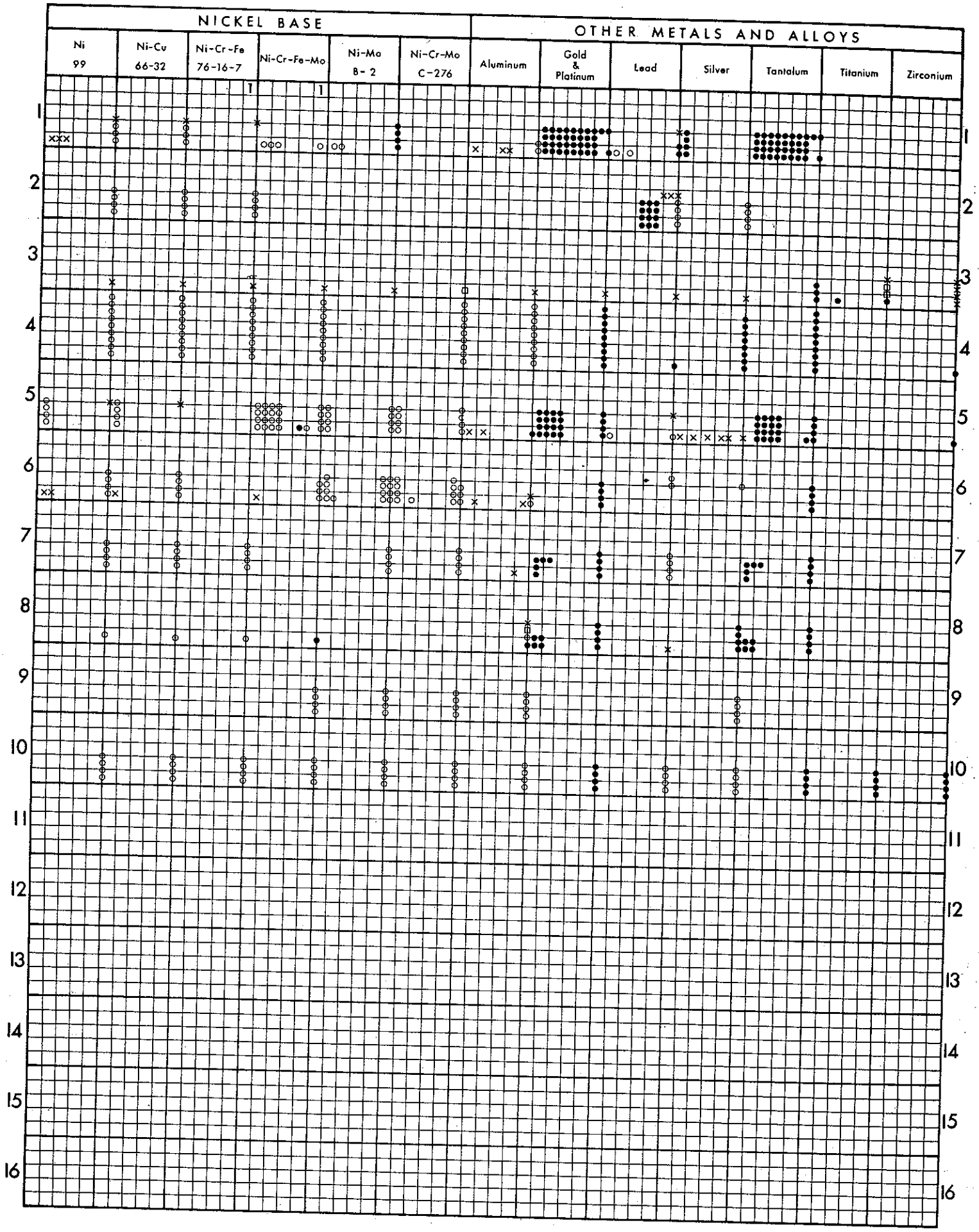
NICKEL BASE
OTHER METALS AND ALLOYS
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Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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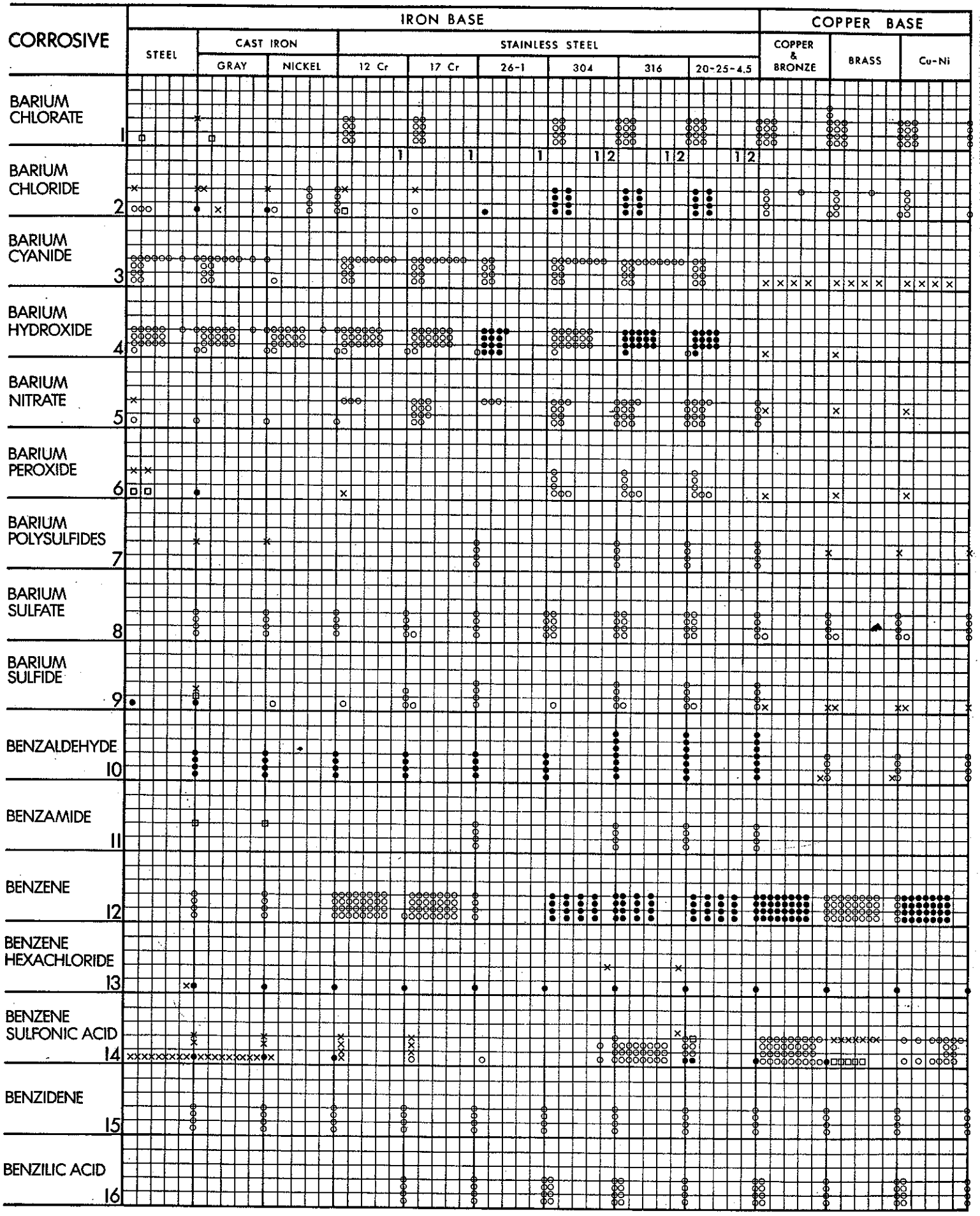
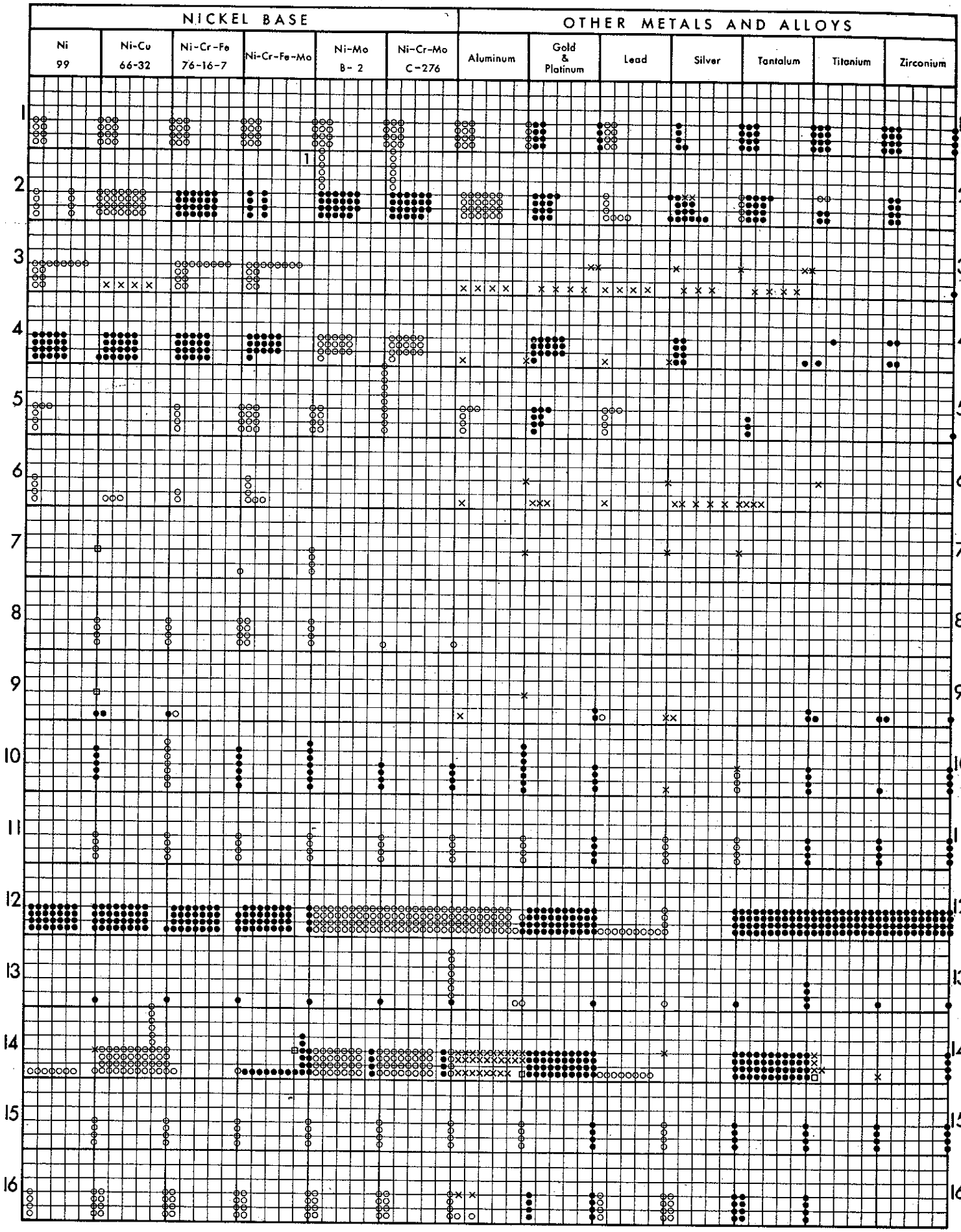

CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
BARIUM CHLORATE 1
BARIUM CHLORIDE 2
BARIUM CYANIDE 3
BARIUM HYDROXIDE 4
BARIUM NITRATE 5
BARIUM PEROXIDE 6
BARIUM POLYSULFIDES 7
BARIUM SULFATE 8
BARIUM SULFIDE 9
BENZALDEHYDE 10
BENZAMIDE 11
BENZENE 12
BENZENE HEXACHLORIDE 13
BENZENE SULFONIC ACID 14
BENZIDENE 15
BENZILIC ACID 16


NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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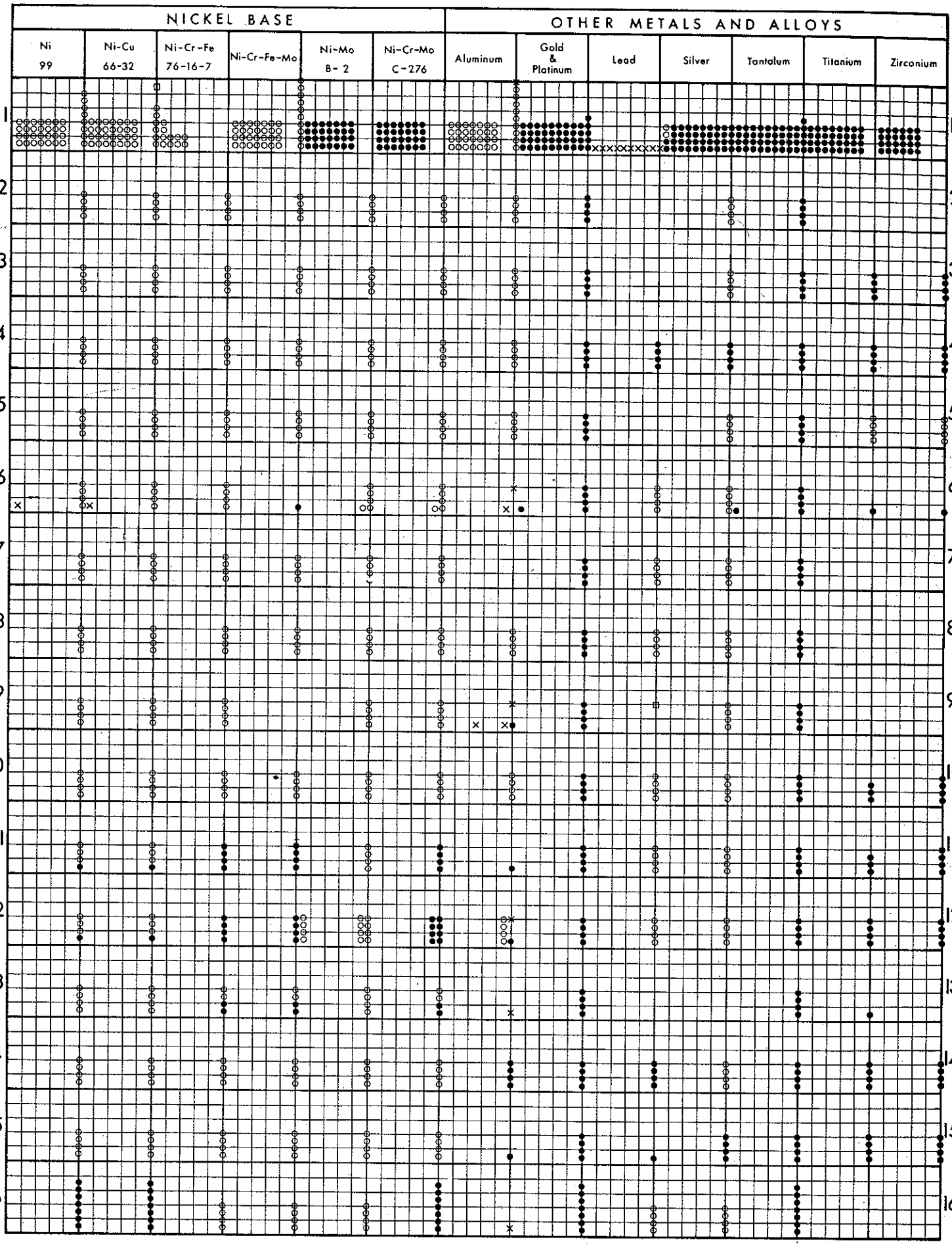
CORROSIVE	IRON BASE									COPPER BASE		
	STEEL	CAST IRON		STAINLESS STEEL						COPPER & BRONZE	BRASS	Cu-Ni
		GRAY	NICKEL	12 Cr	17 Cr	26-1	304	316	20-25-4.5			
BENZOIC ACID 1												
BENZOIC ANHYDRIDE 2												
BENZOIN 3												
BENZONITRILE 4												
BENZOPHENONE 5												
BENZOTRI-CHLORIDE 6												
BENZOTRI-FLUORIDE 7												
BENZOYL BENZOIC ACID 8												
BENZOYL CHLORIDE 9					1		1	1				
BENZOYL PEROXIDE 10												
BENZYL ACETATE 11												
BENZYL ALCOHOL 12												
BENZYL AMINE 13												
BENZYL BENZOATE 14												
BENZYL BROMIDE 15												
BENZYL CHLORIDE 16												


NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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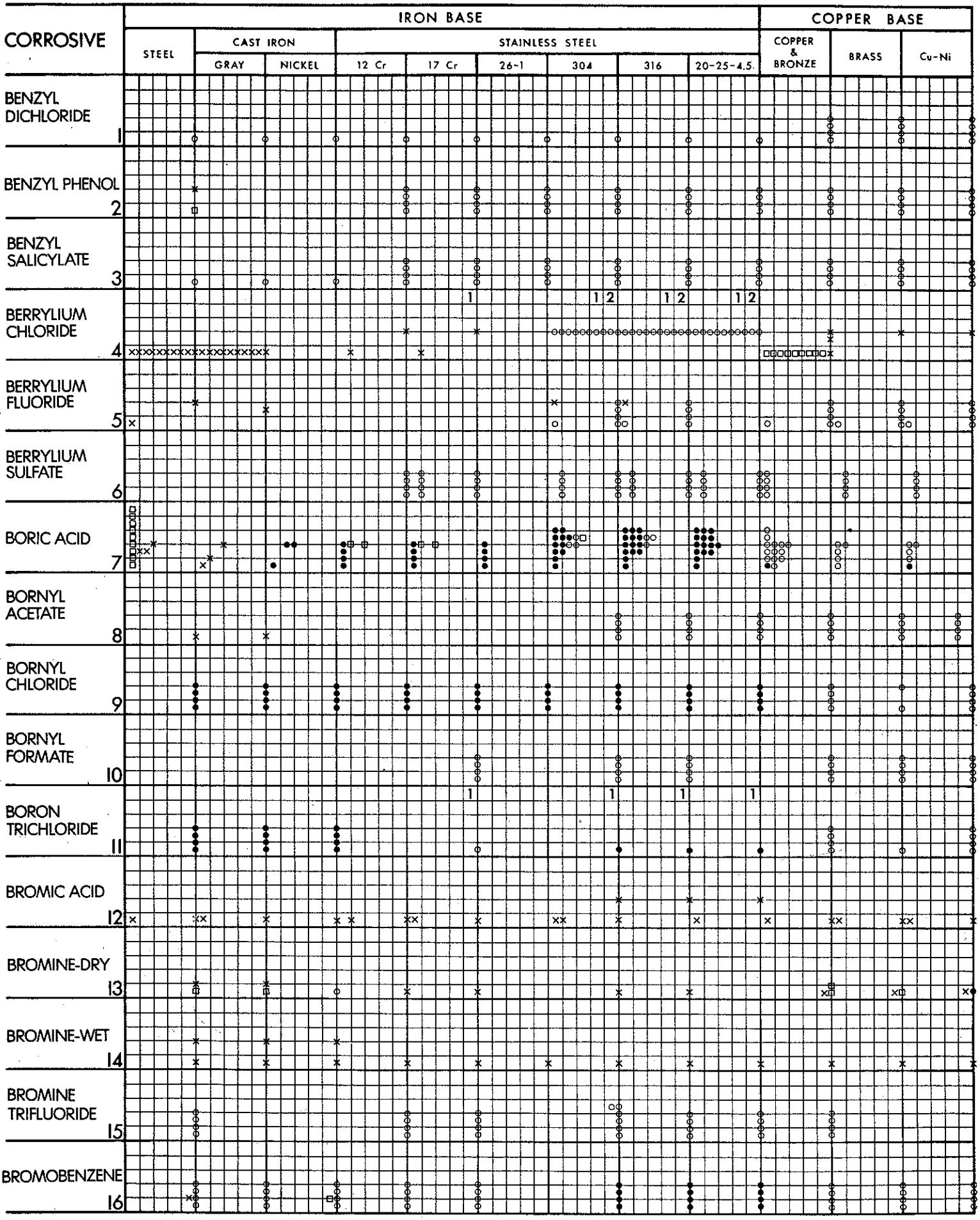
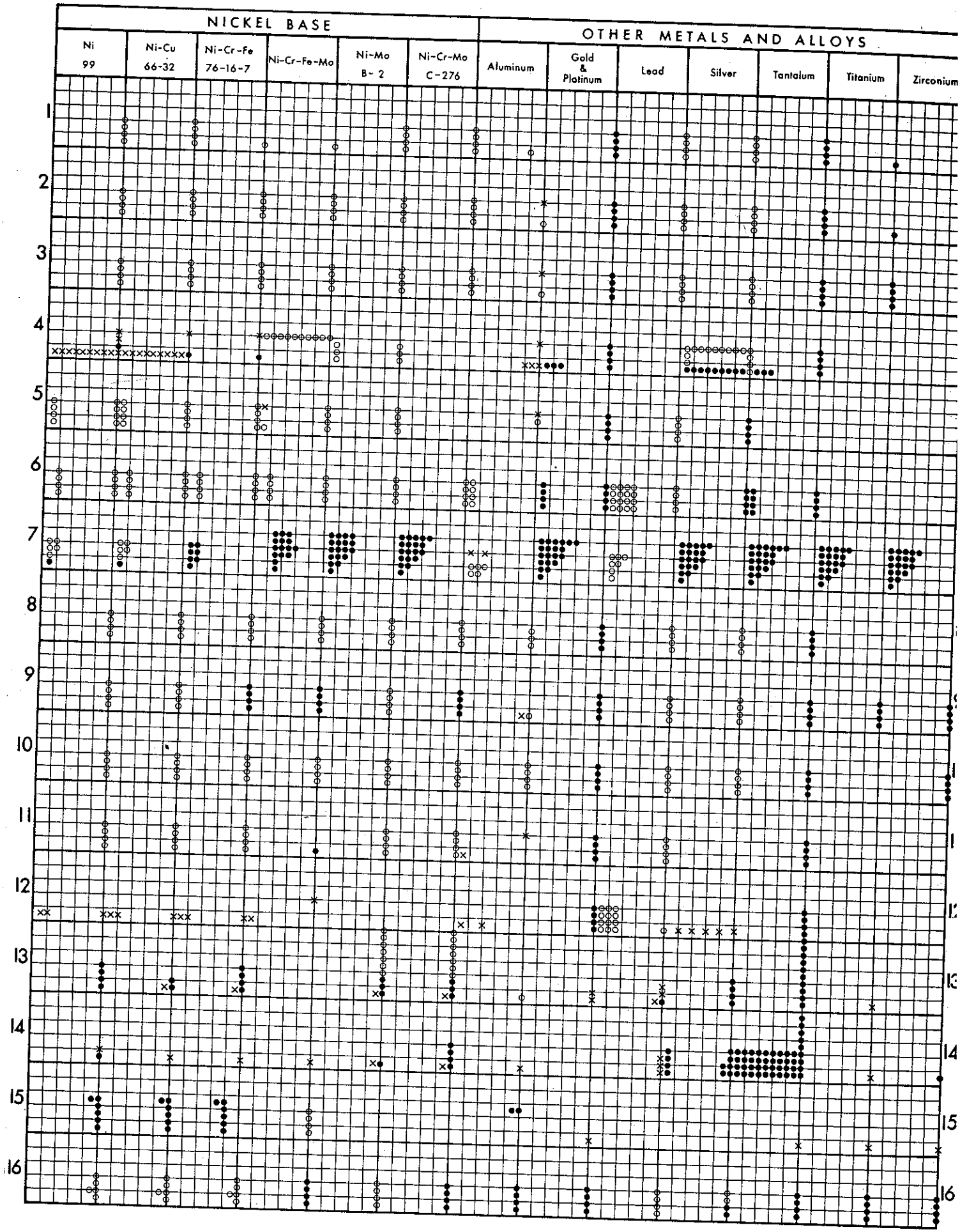

CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
BENZYL DICHLORIDE 1
BENZYL PHENOL 2
BENZYL SALICYLATE 3
BERRYLIUM CHLORIDE 4
BERRYLIUM FLUORIDE 5
BERRYLIUM SULFATE 6
BORIC ACID 7
BORNYL ACETATE 8
BORNYL CHLORIDE 9
BORNYL FORMATE 10
BORON TRICHLORIDE 11
BROMIC ACID 12
BROMINE-DRY 13
BROMINE-WET 14
BROMINE TRIFLUORIDE 15
BROMOBENZENE 16


NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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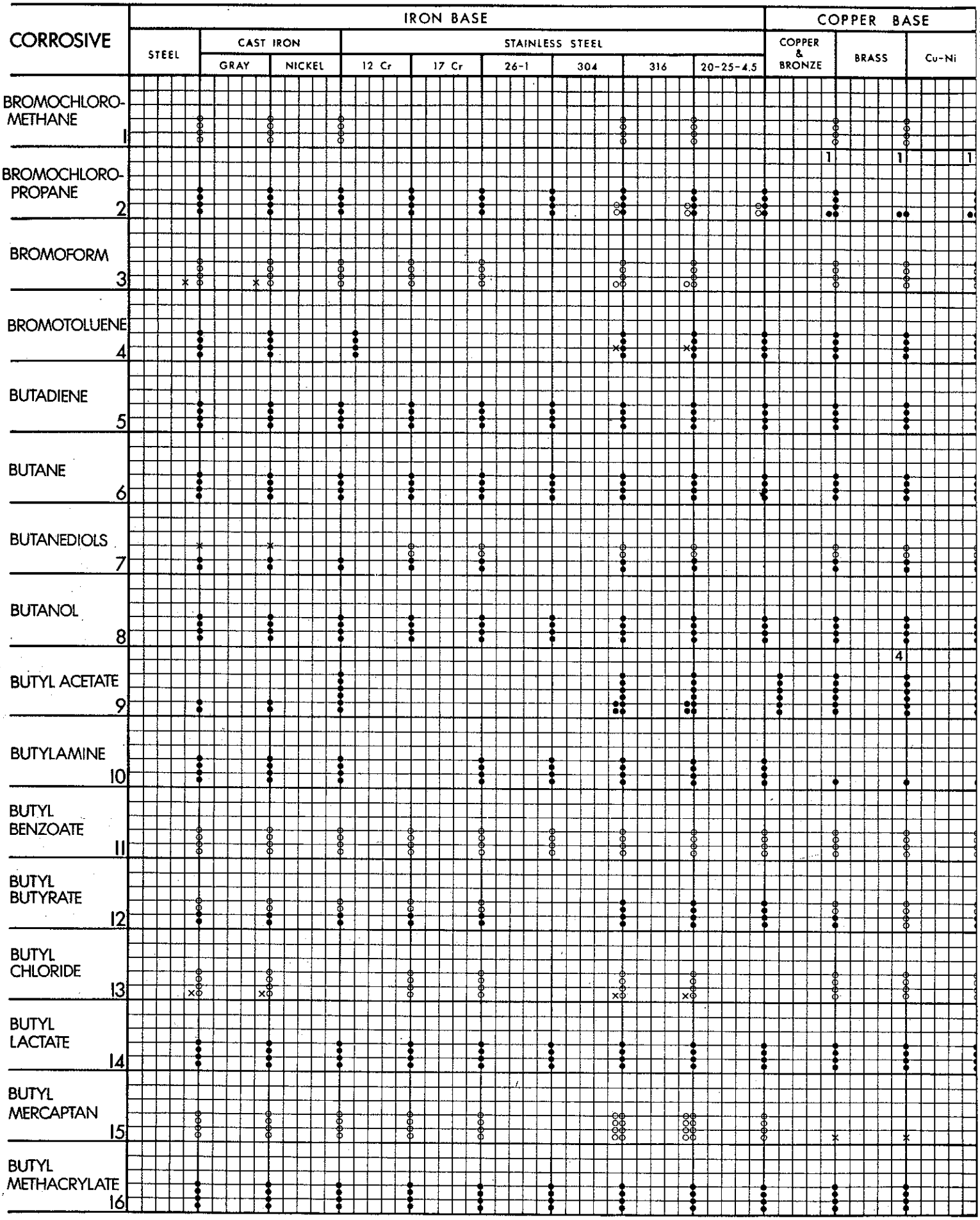
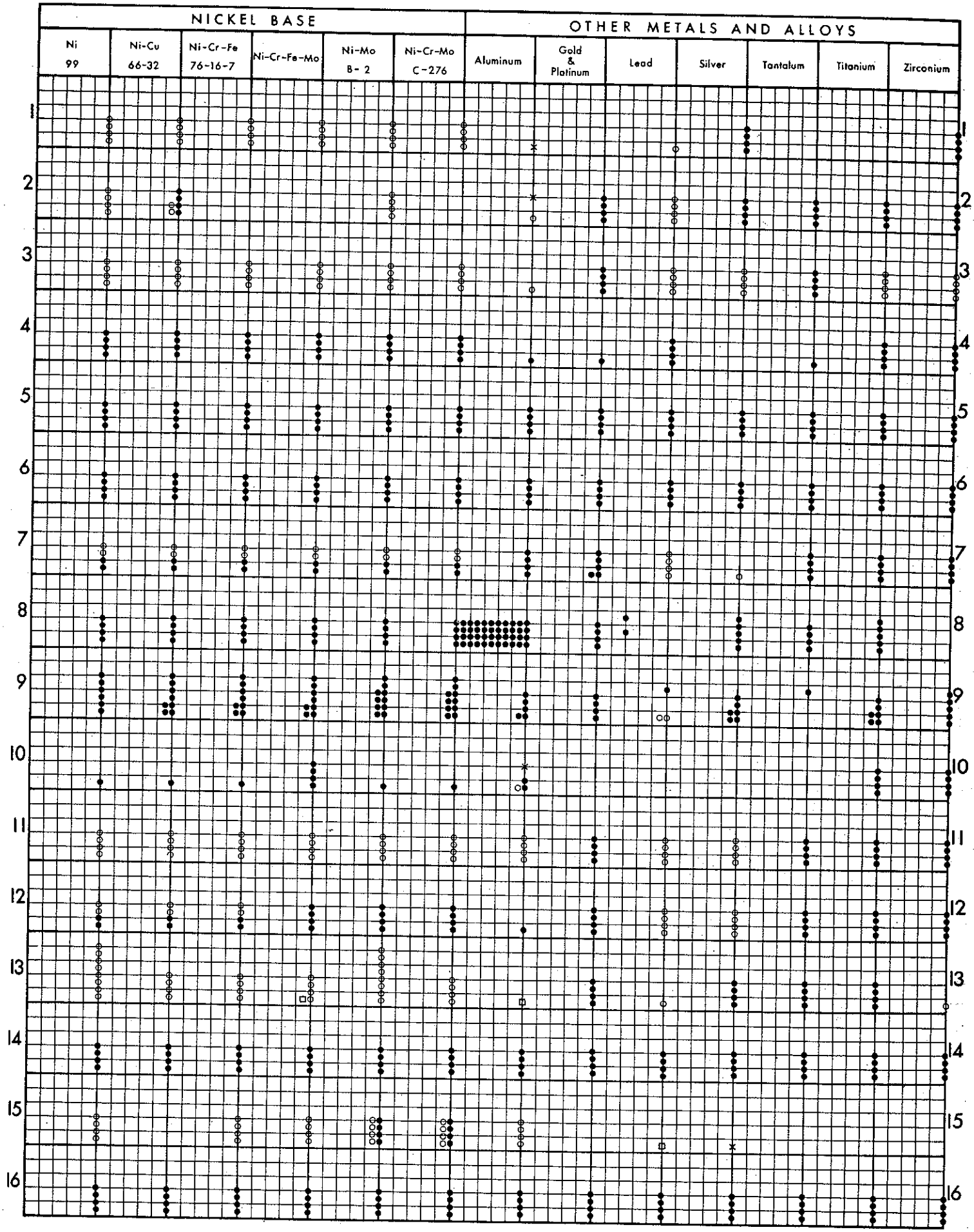

CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
BROMOCHLORO-METHANE 1
BROMOCHLORO-PROPANE 2
BROMOFORM 3
BROMOTOLUENE 4
BUTADIENE 5
BUTANE 6
BUTANEDIOLS 7
BUTANOL 8
BUTYL ACETATE 9
BUTYLAMINE 10
BUTYL BENZOATE 11
BUTYL BUTYRATE 12
BUTYL CHLORIDE 13
BUTYL LACTATE 14
BUTYL MERCAPTAN 15
BUTYL METHACRYLATE 16


NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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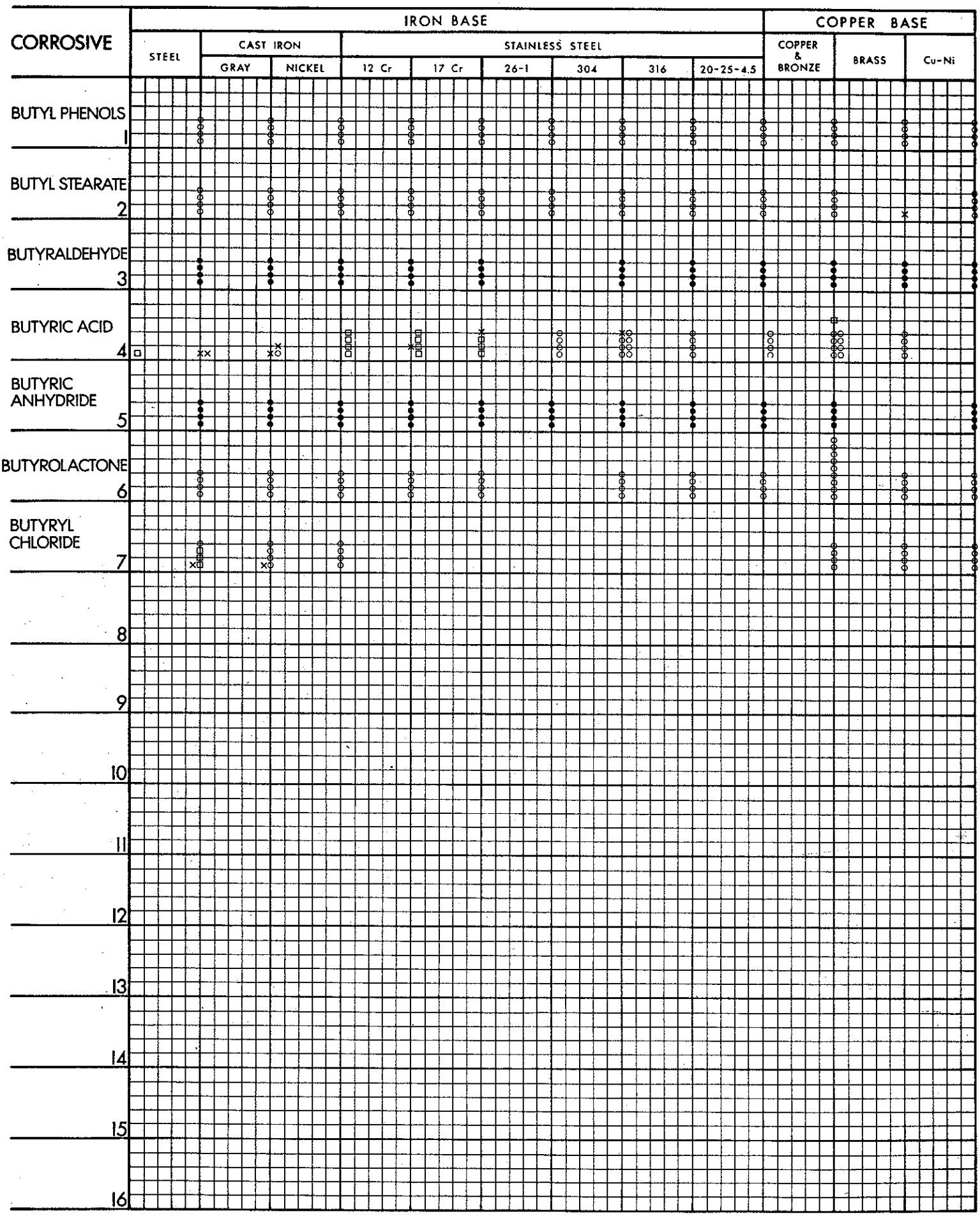
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
BUTYL PHENOLS 1
BUTYL STEARATE 2
BUTYRALDEHYDE 3
BUTYRIC ACID 4
BUTYRIC ANHYDRIDE 5
BUTYROLACTONE 6
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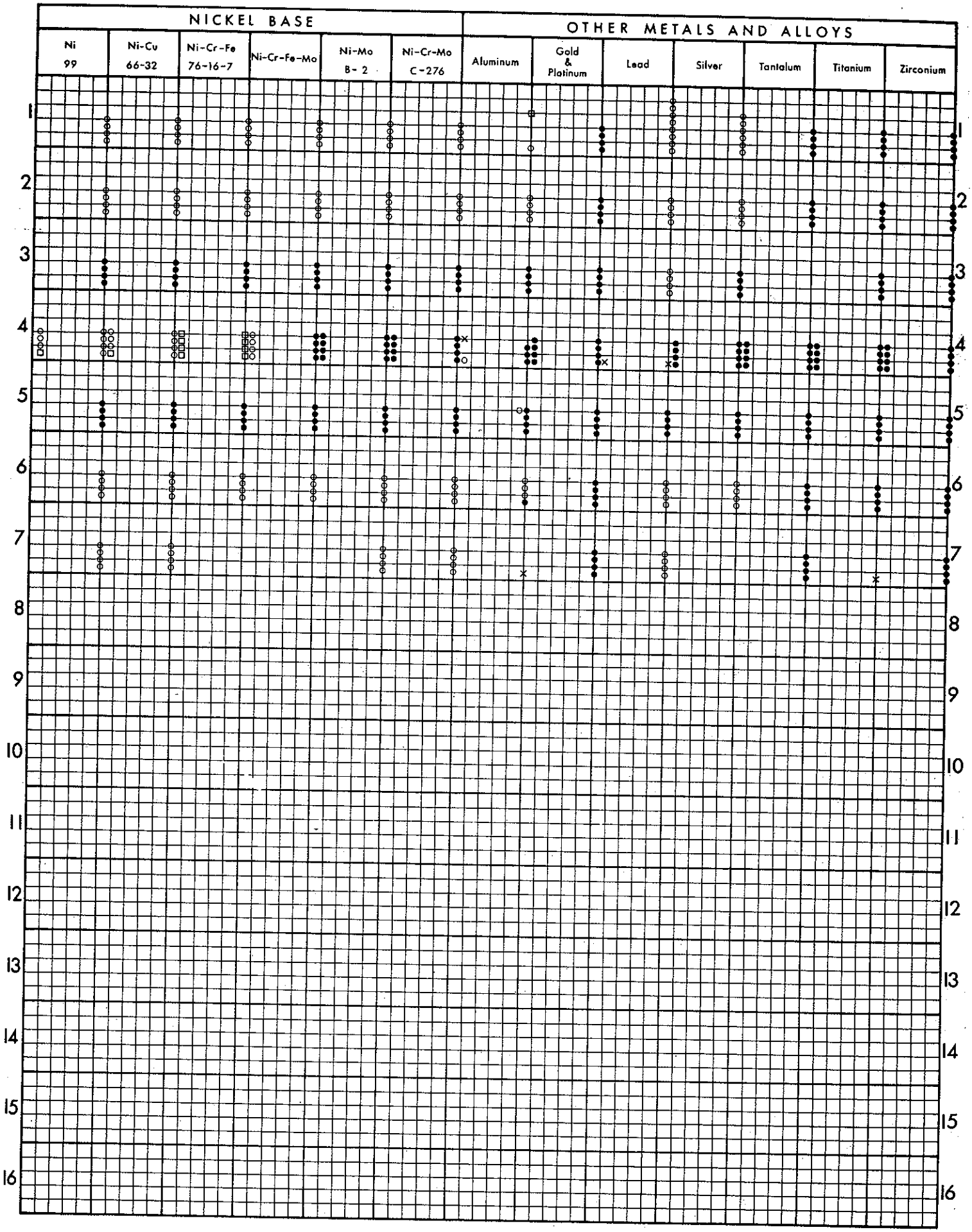
NICKEL BASE
OTHER METALS AND ALLOYS
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Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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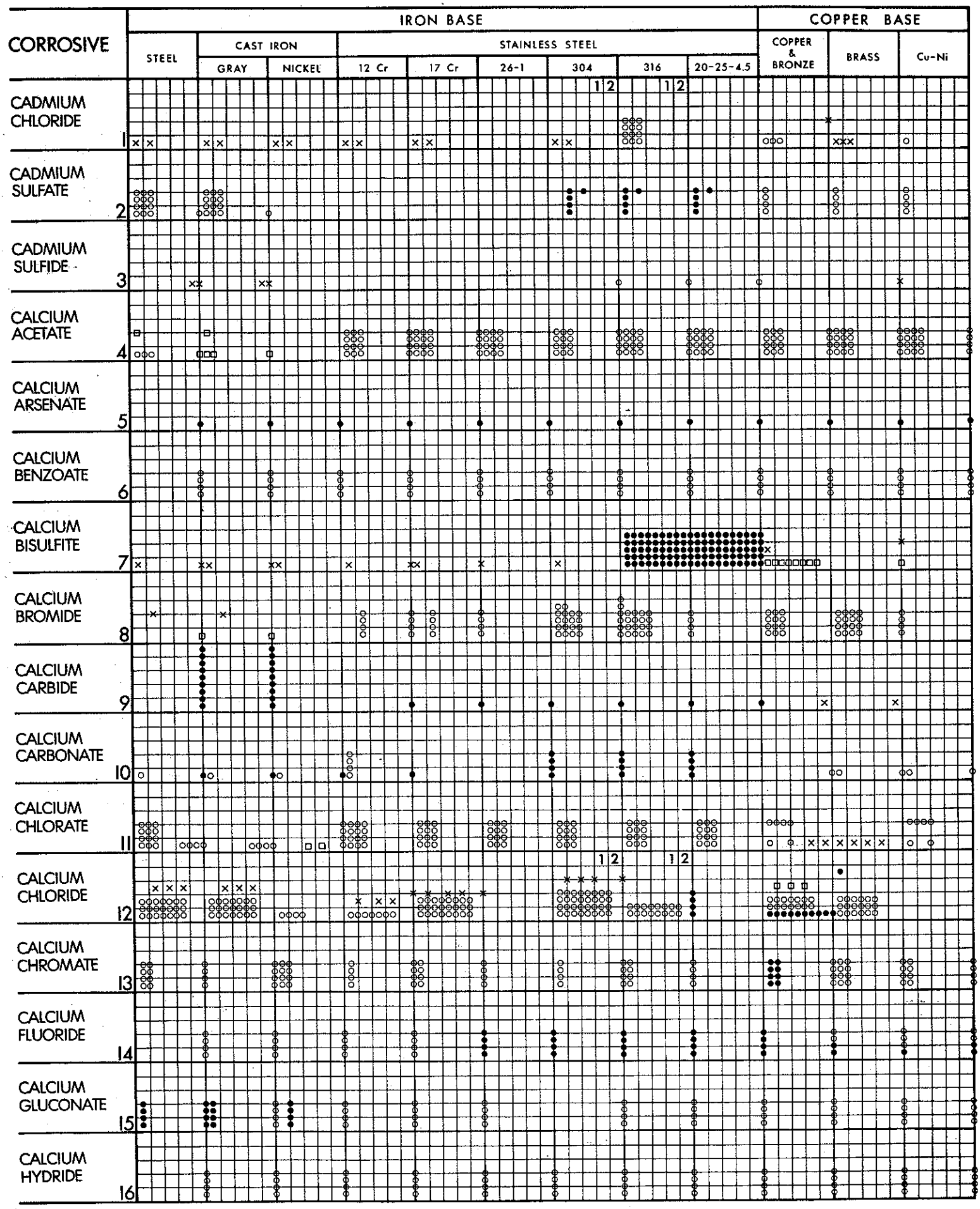
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
1 CADMIUM CHLORIDE
2 CADMIUM SULFATE
3 CADMIUM SULFIDE
4 CALCIUM ACETATE
5 CALCIUM ARSENATE
6 CALCIUM BENZOATE
7 CALCIUM BISULFITE
8 CALCIUM BROMIDE
9 CALCIUM CARBIDE
10 CALCIUM CARBONATE
11 CALCIUM CHLORATE
12 CALCIUM CHLORIDE
13 CALCIUM CHROMATE
14 CALCIUM FLUORIDE
15 CALCIUM GLUCONATE
16 CALCIUM HYDRIDE
1 2
1 2
1 2


NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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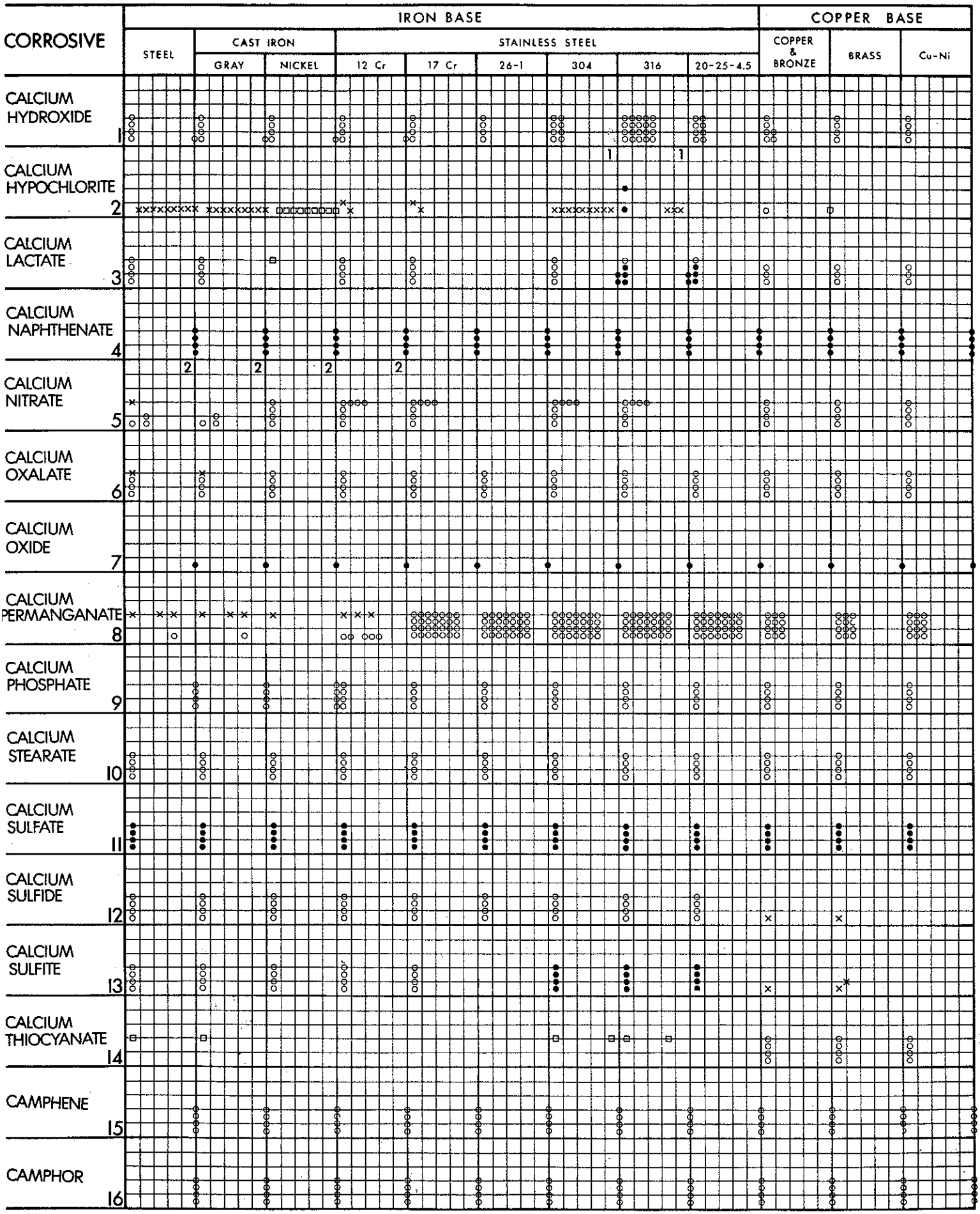
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
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17 Cr
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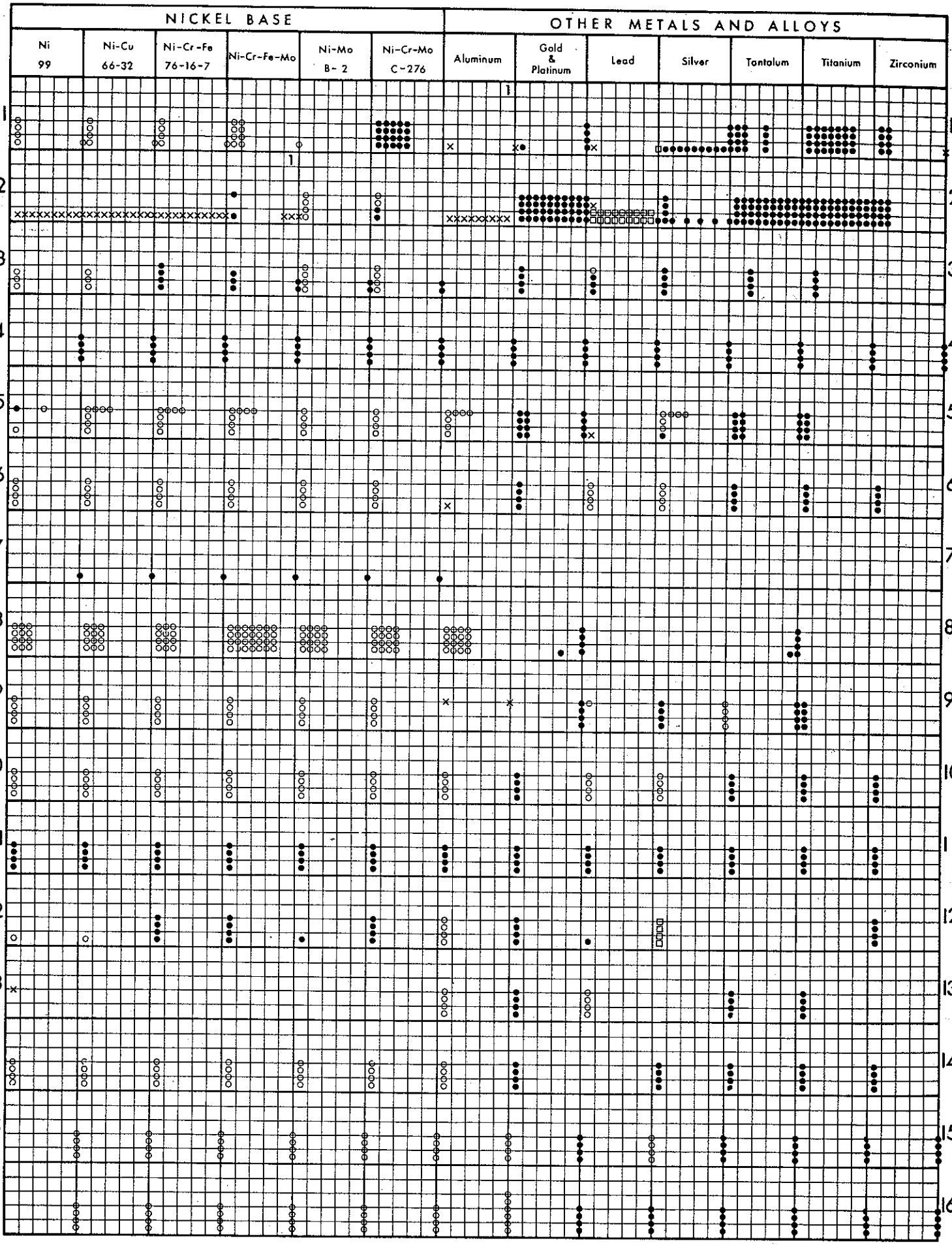
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
CALCIUM HYDROXIDE 1
CALCIUM HYPOCHLORITE 2
CALCIUM LACTATE 3
CALCIUM NAPHTHENATE 4
CALCIUM NITRATE 5
CALCIUM OXALATE 6
CALCIUM OXIDE 7
CALCIUM PERMANGANATE 8
CALCIUM PHOSPHATE 9
CALCIUM STEARATE 10
CALCIUM SULFATE 11
CALCIUM SULFIDE 12
CALCIUM SULFITE 13
CALCIUM THIOCYANATE 14
CAMPHENE 15
CAMPHOR 16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OTHER METALS AND ALLOYS
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Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
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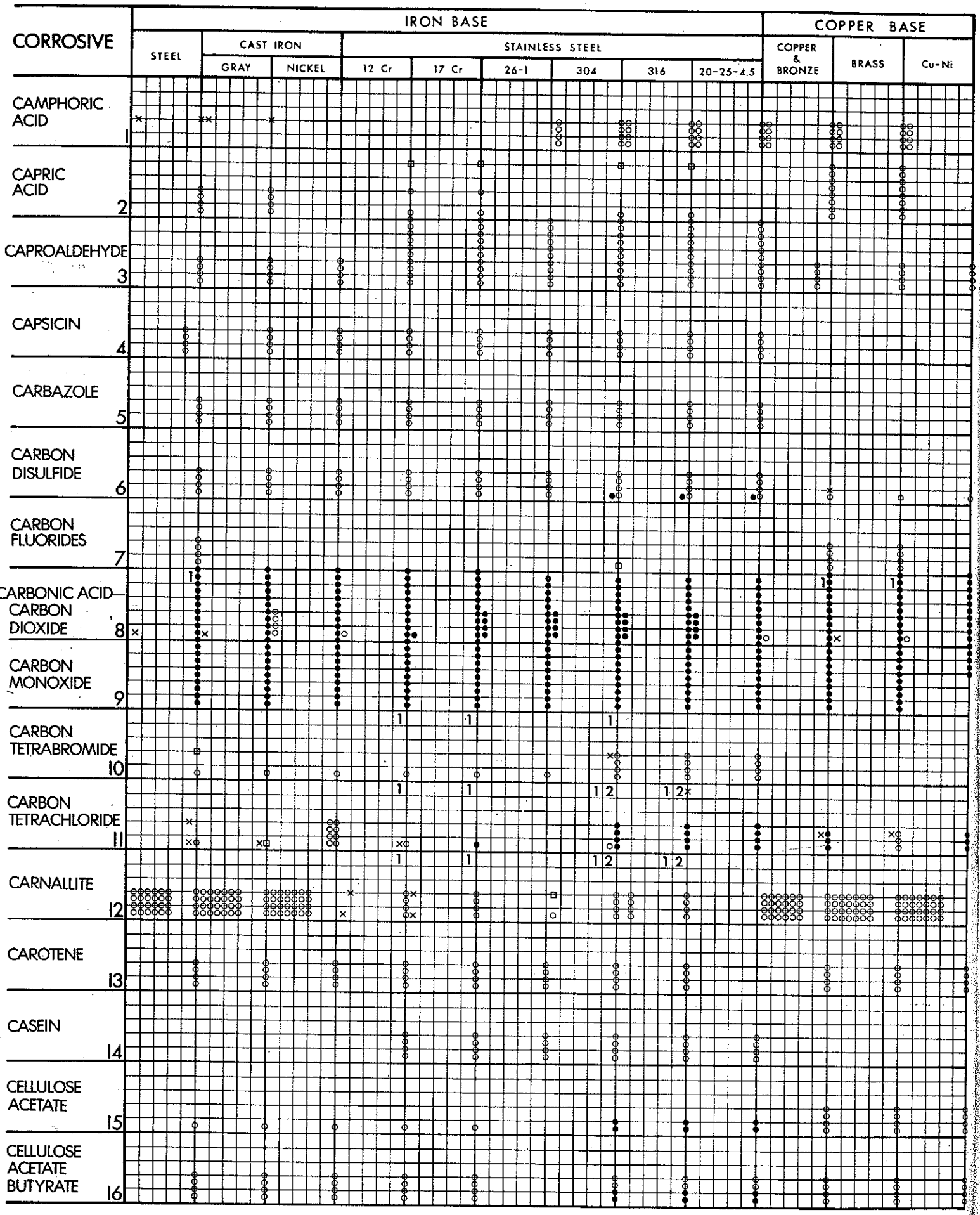
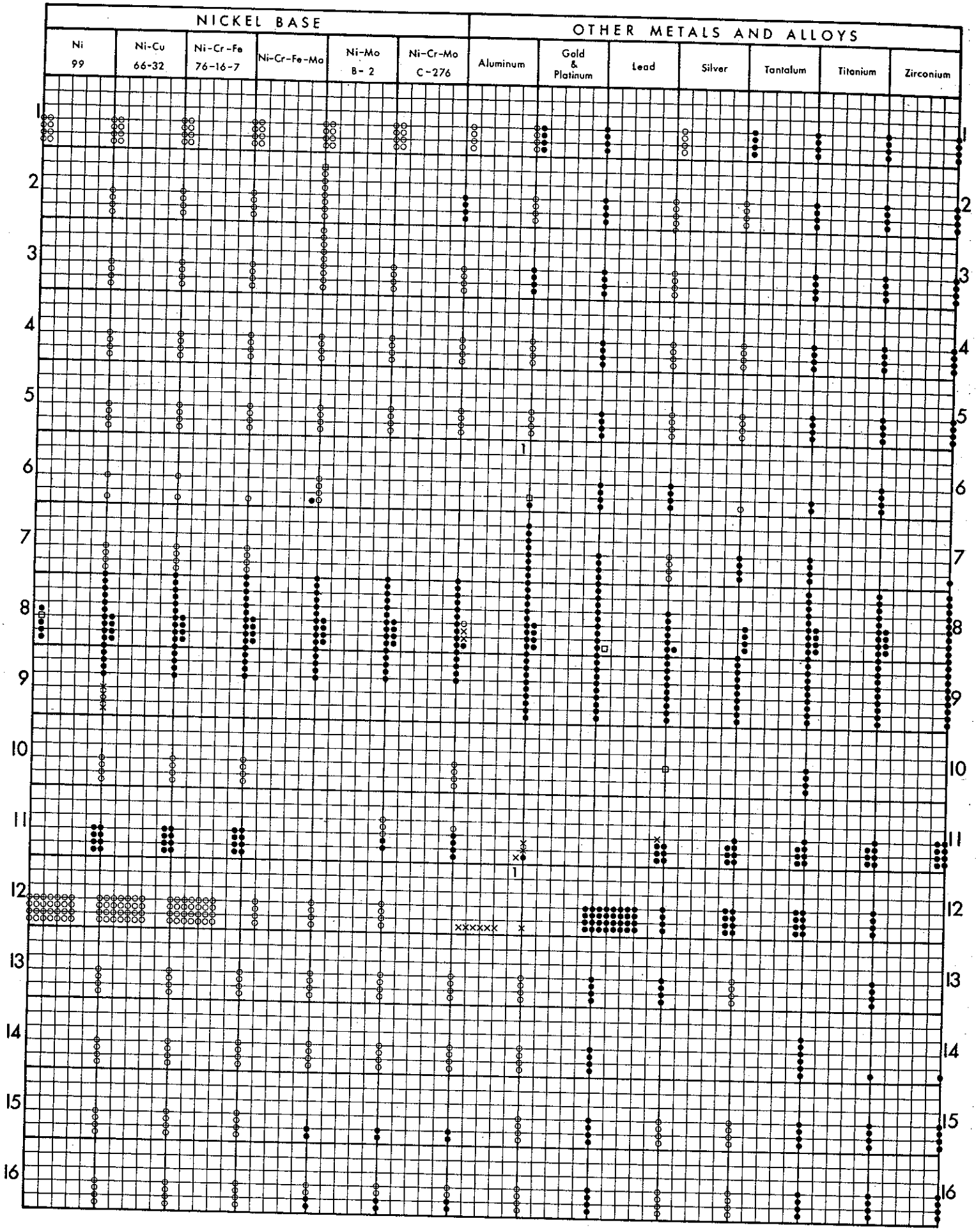
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium


CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
CAMPHORIC ACID 1
CAPRIC ACID 2
CAPROALDEHYDE 3
CAPSICIN 4
CARBAZOLE 5
CARBON DISULFIDE 6
CARBON FLUORIDES 7
CARBONIC ACID—CARBON DIOXIDE 8
CARBON MONOXIDE 9
CARBON TETRABROMIDE 10
CARBON TETRACHLORIDE 11
CARNALLITE 12
CAROTENE 13
CASEIN 14
CELLULOSE ACETATE 15
CELLULOSE ACETATE BUTYRATE 16


NICKEL BASE
OTHER METALS AND ALLOYS
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Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
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Titanium
Zirconium
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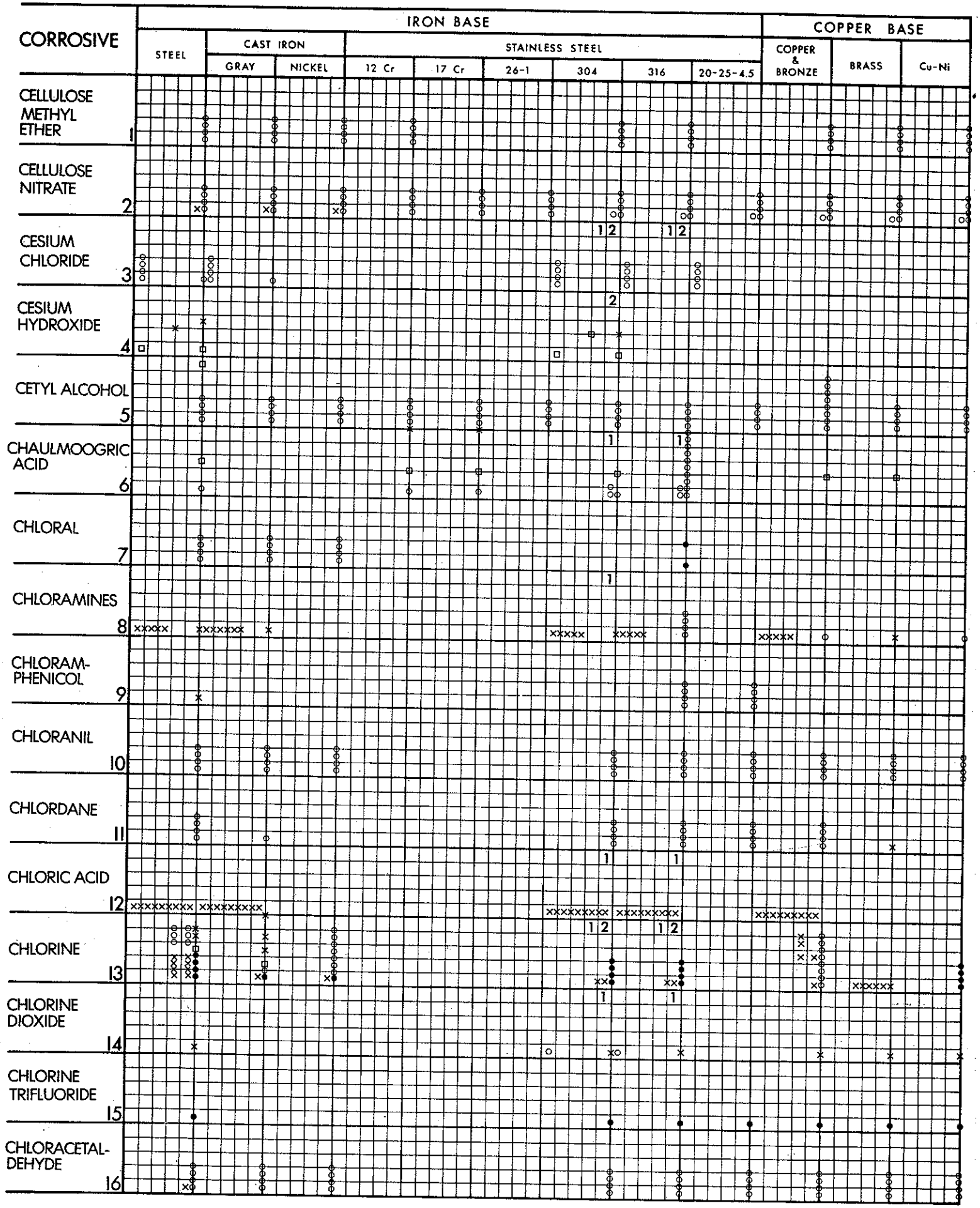
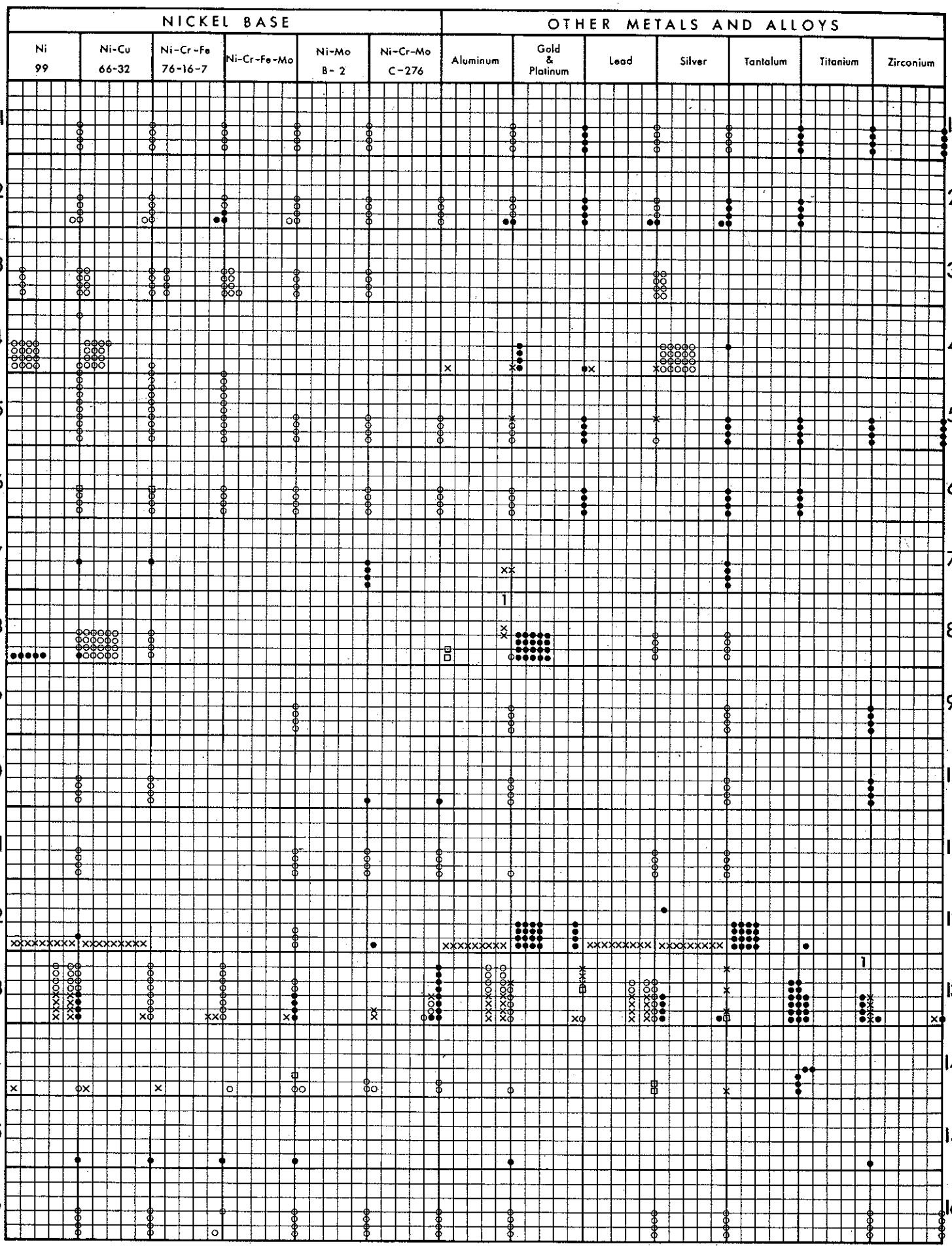

CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
CELLULOSE METHYL ETHER 1
CELLULOSE NITRATE 2
CESIUM CHLORIDE 3
CESIUM HYDROXIDE 4
CETYL ALCOHOL 5
CHAULMOOGRIC ACID 6
CHLORAL 7
CHLORAMINES 8
CHLORAM-PHENICOL 9
CHLORANIL 10
CHLORDANE 11
CHLORIC ACID 12
CHLORINE 13
CHLORINE DIOXIDE 14
CHLORINE TRIFLUORIDE 15
CHLORACETAL-DEHYDE 16


NICKEL BASE
OTHER METALS AND ALLOYS
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Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
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Zirconium
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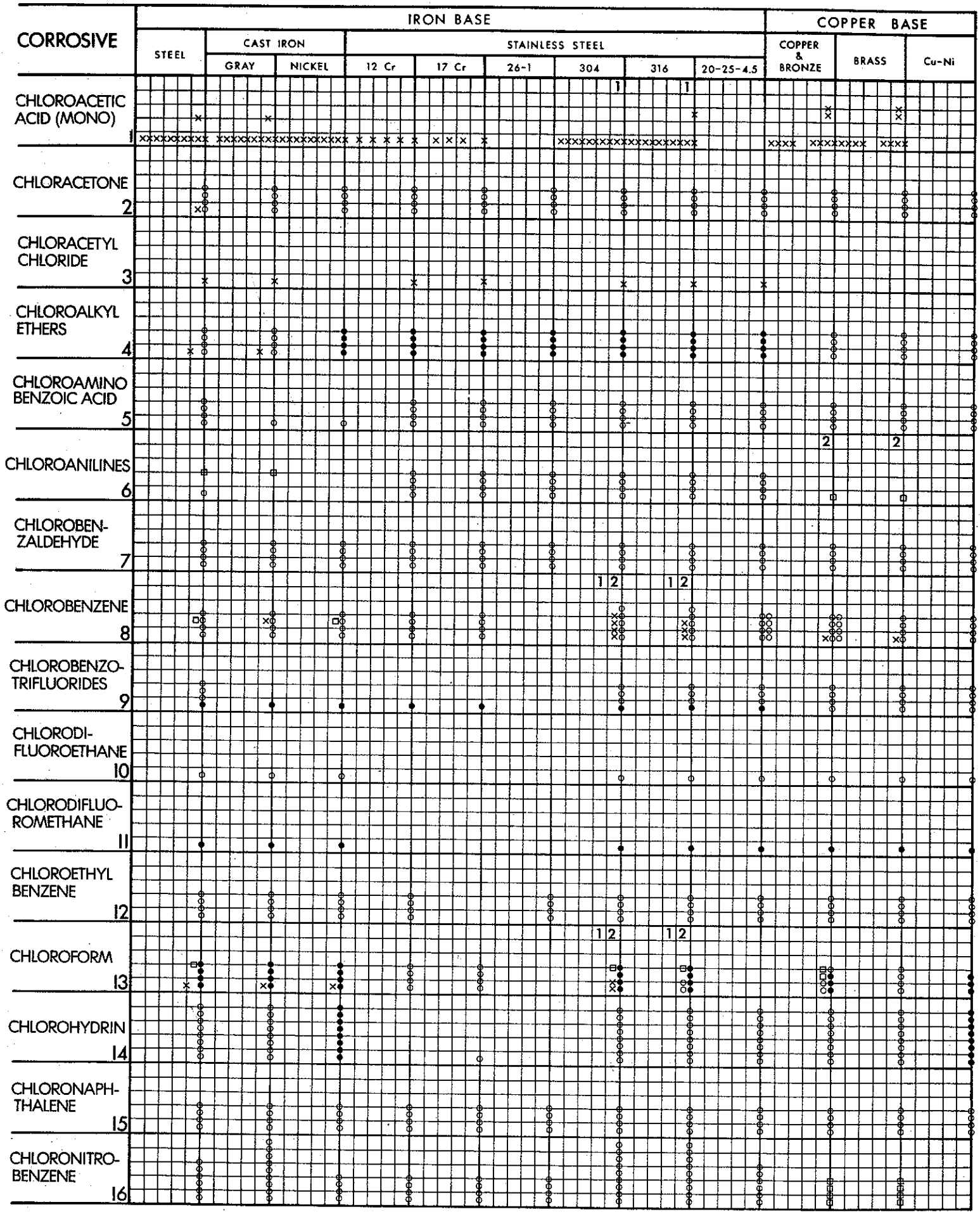
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
CHLOROACETIC ACID (MONO) 1
CHLORACETONE 2
CHLORACETYL CHLORIDE 3
CHLOROALKYL ETHERS 4
CHLOROAMINO BENZOIC ACID 5
CHLOROANILINES 6
CHLOROBEN-ZALDEHYDE 7
CHLOROBENZENE 8
CHLOROBENZO-TRIFLUORIDES 9
CHLORODI-FLUOROETHANE 10
CHLORODIFLUO-ROMETHANE 11
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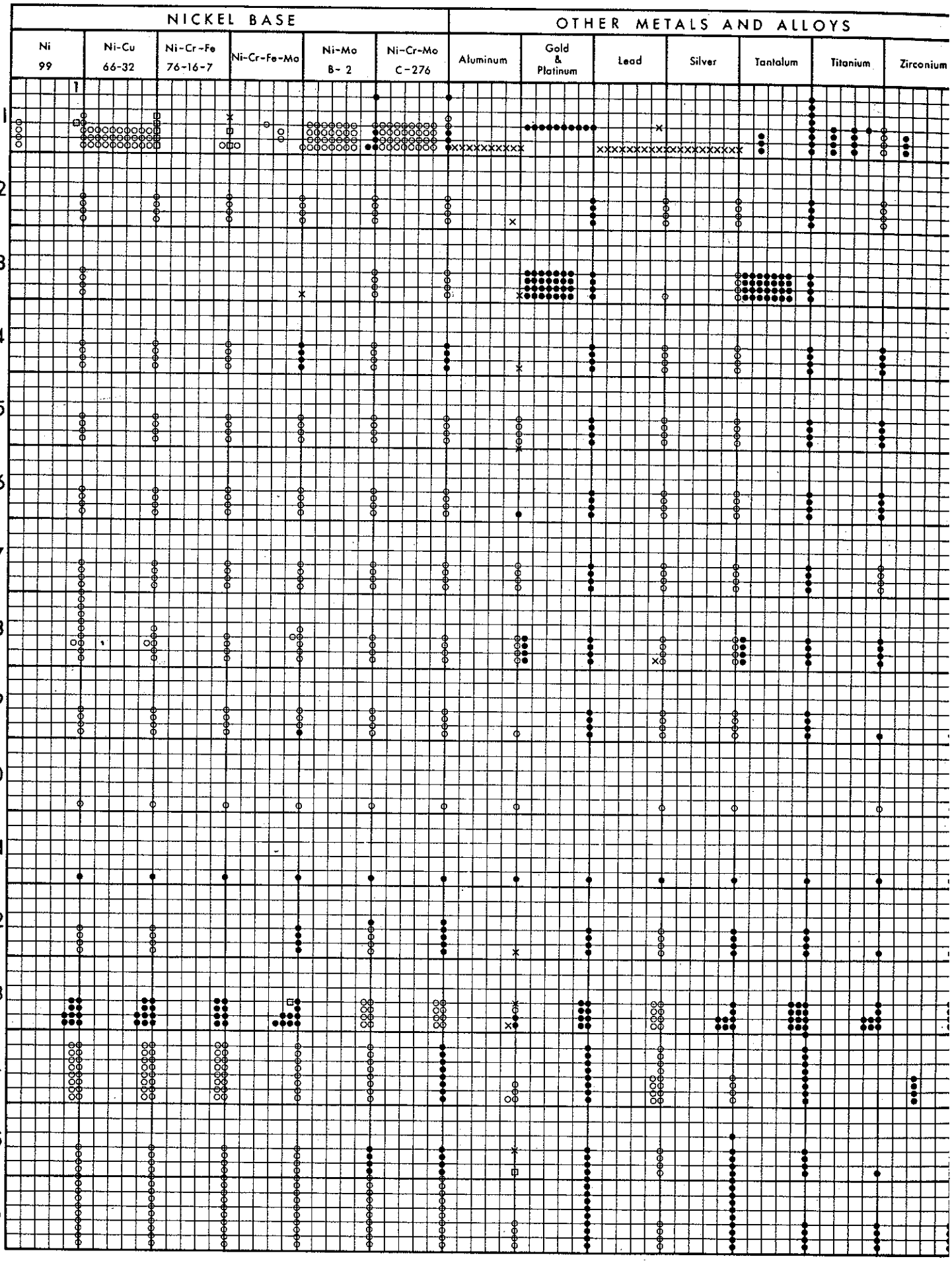
CHLOROFORM 13
CHLOROHYDRIN 14
CHLORONAPH-THALENE 15
CHLORONITRO-BENZENE 16


NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B- 2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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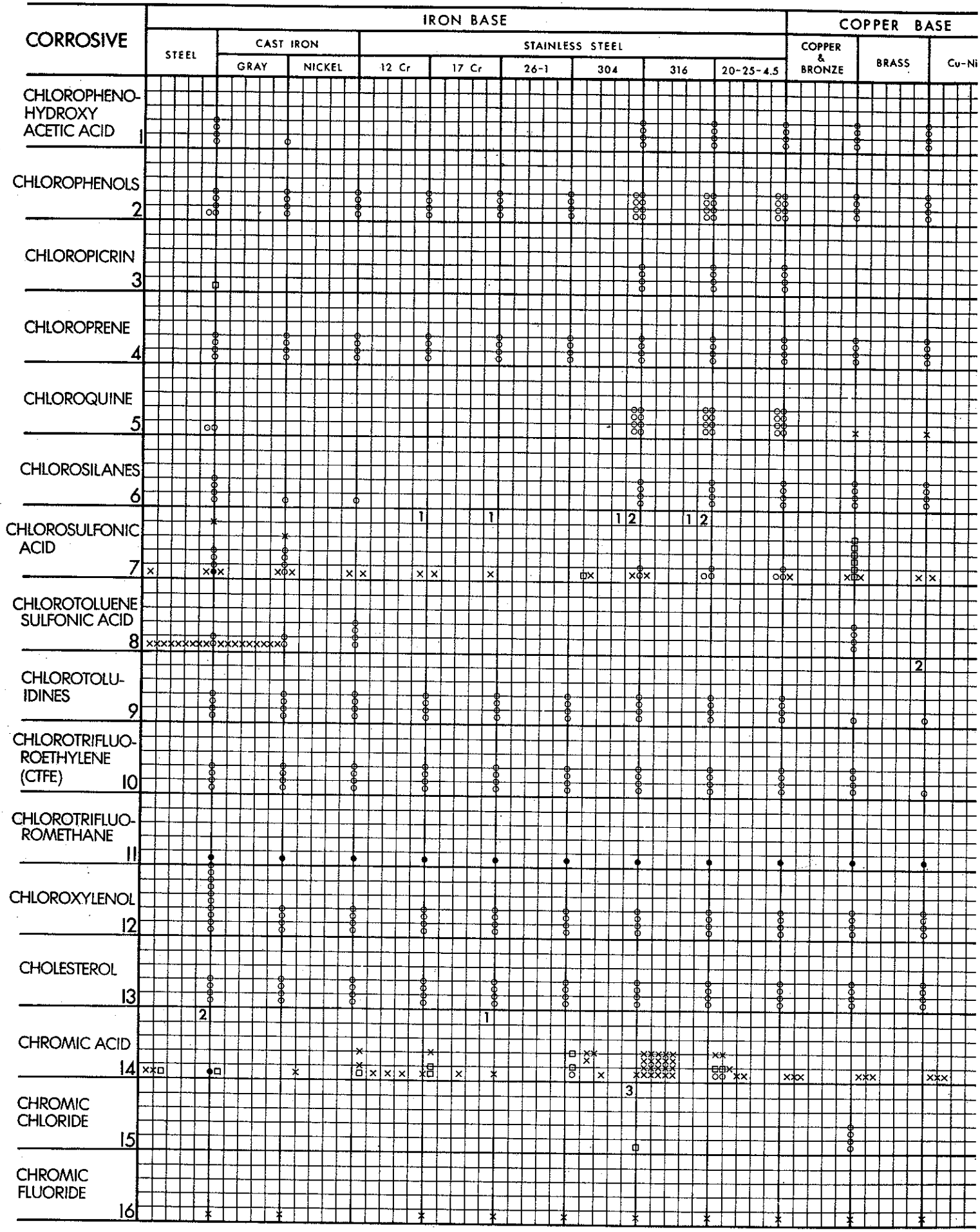
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
CHLOROPHENO-HYDROXY ACETIC ACID 1
CHLOROPHENOLS 2
CHLOROPICRIN 3
CHLOROPRENE 4
CHLOROQUINE 5
CHLOROSILANES 6
CHLOROSULFONIC ACID 7
CHLOROTOLUENE SULFONIC ACID 8
CHLOROTOLU-IDINES 9
CHLOROTRIFLUO-ROETHYLENE (CTFE) 10
CHLOROTRIFLUO-ROMETHANE 11
CHLOROXYLENOL 12
CHOLESTEROL 13
CHROMIC ACID 14
CHROMIC CHLORIDE 15
CHROMIC FLUORIDE 16


NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
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Aluminum
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Lead
Silver
Tantalum
Titanium
Zirconium
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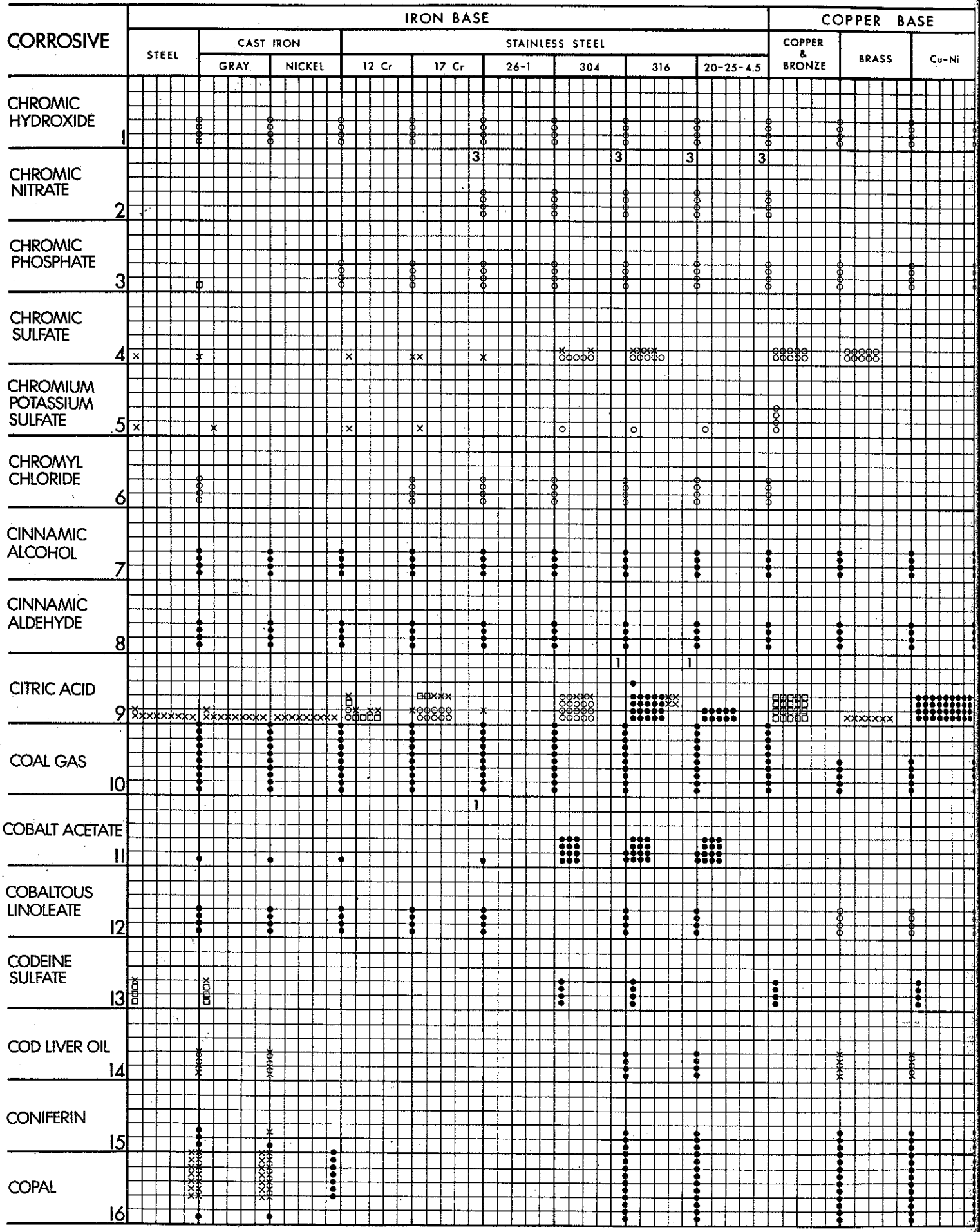
CORROSIVE
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COPPER BASE
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GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
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316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
CHROMIC HYDROXIDE 1
CHROMIC NITRATE 2
CHROMIC PHOSPHATE 3
CHROMIC SULFATE 4
CHROMIUM POTASSIUM SULFATE 5
CHROMYL CHLORIDE 6
CINNAMIC ALCOHOL 7
CINNAMIC ALDEHYDE 8
CITRIC ACID 9
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CODEINE SULFATE 13
COD LIVER OIL 14
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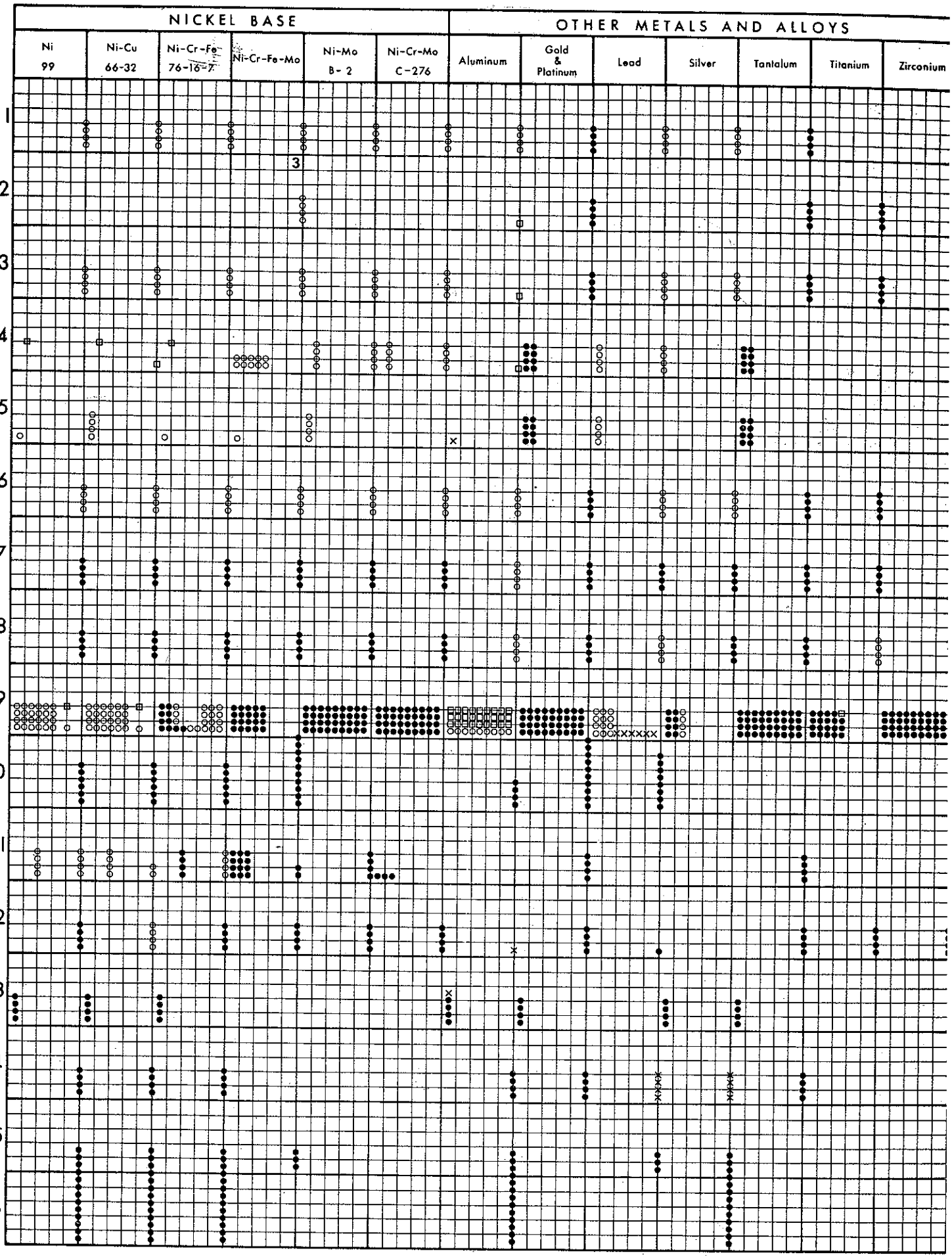
COPAL 16


NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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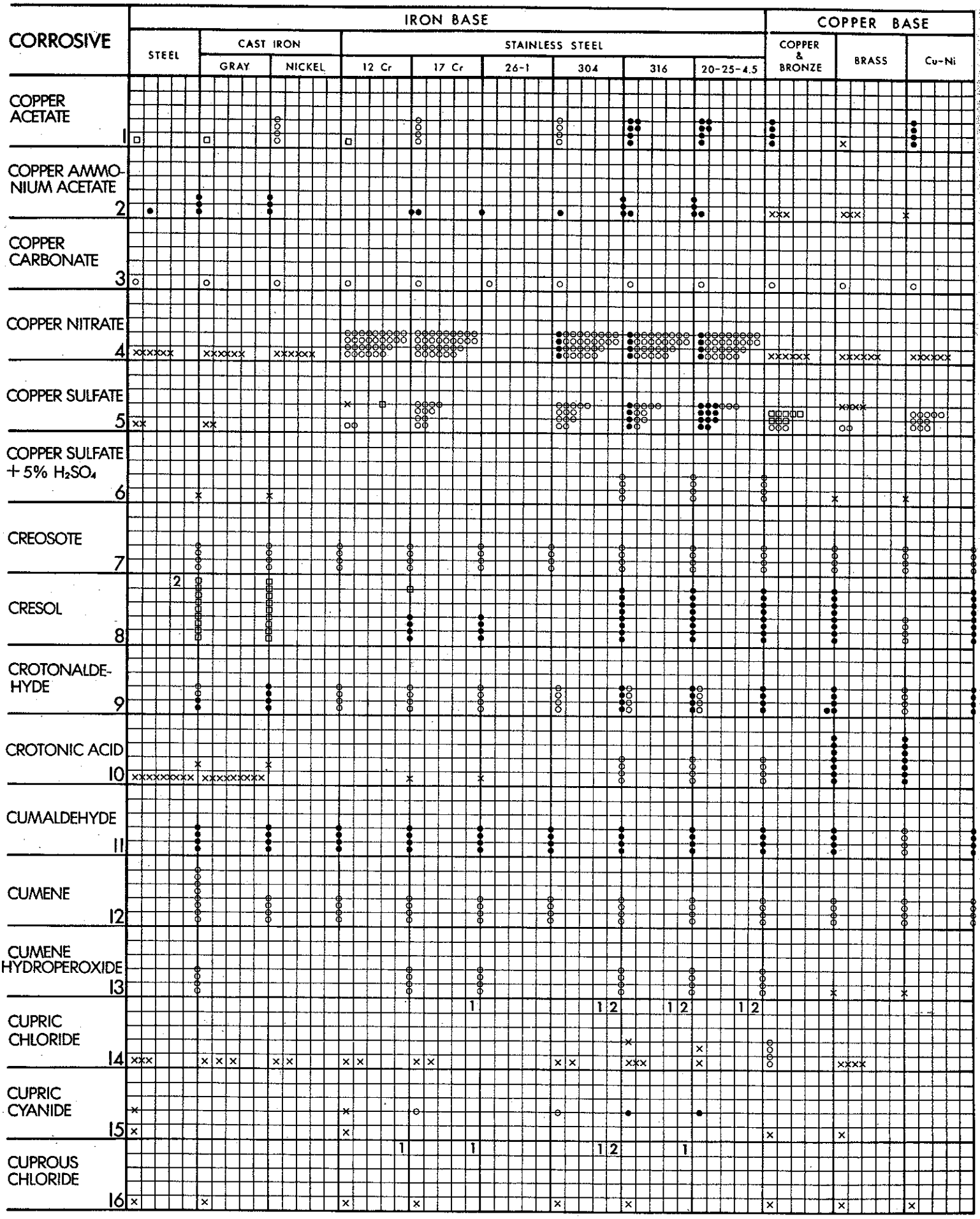
CORROSIVE
IRON BASE
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NICKEL
STAINLESS STEEL
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17 Cr
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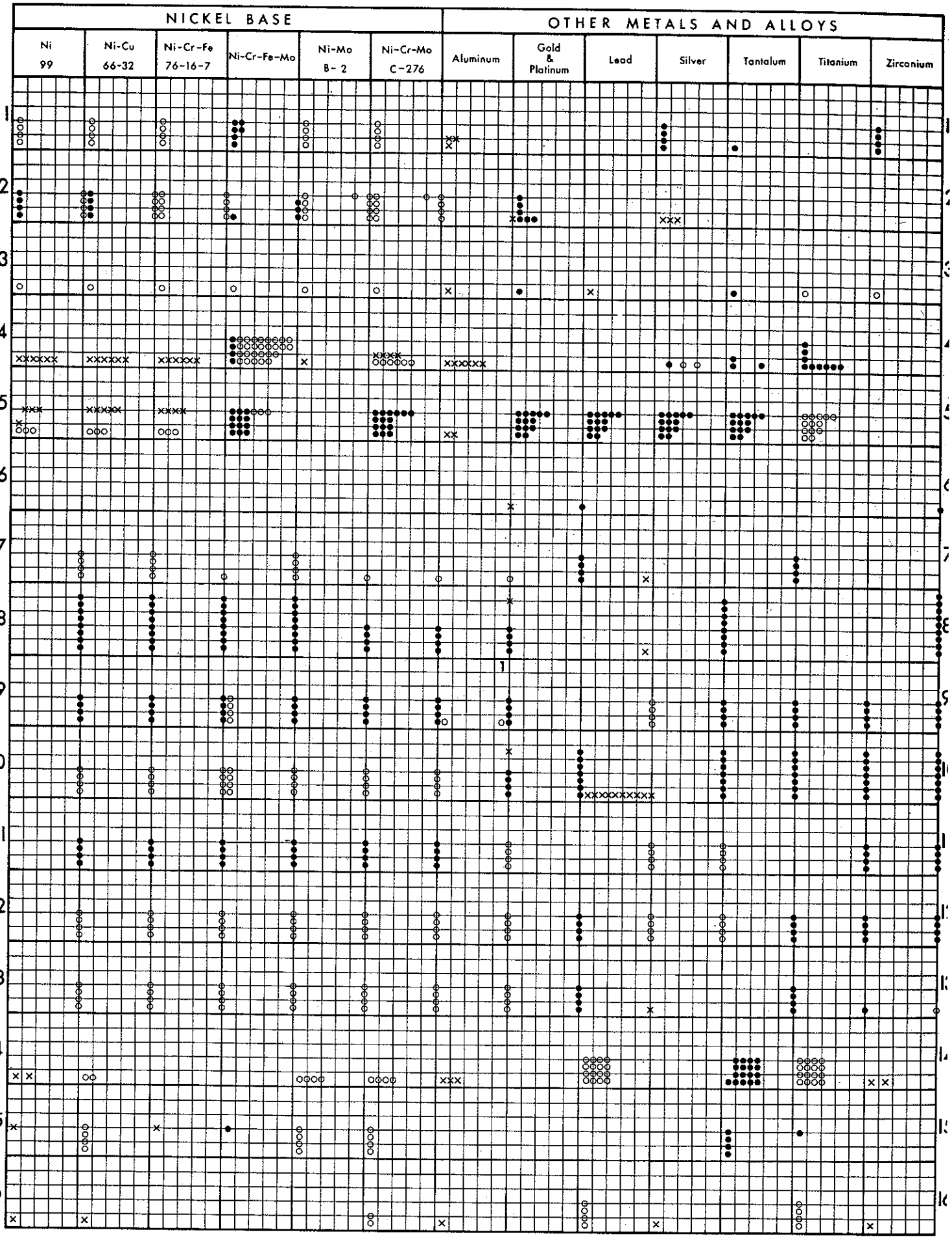
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
COPPER ACETATE 1
COPPER AMMONIUM ACETATE 2
COPPER CARBONATE 3
COPPER NITRATE 4
COPPER SULFATE 5
COPPER SULFATE + 5% H_2SO_4 6
CREOSOTE 7
CRESOL 8
CROTONALDEHYDE 9
CROTONIC ACID 10
CUMALDEHYDE 11
CUMENE 12
CUMENE HYDROPEROXIDE 13
CUPRIC CHLORIDE 14
CUPRIC CYANIDE 15
CUPROUS CHLORIDE 16


NICKEL BASE
OTHER METALS AND ALLOYS
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Ni-Cu 66-32
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Silver
Tantalum
Titanium
Zirconium
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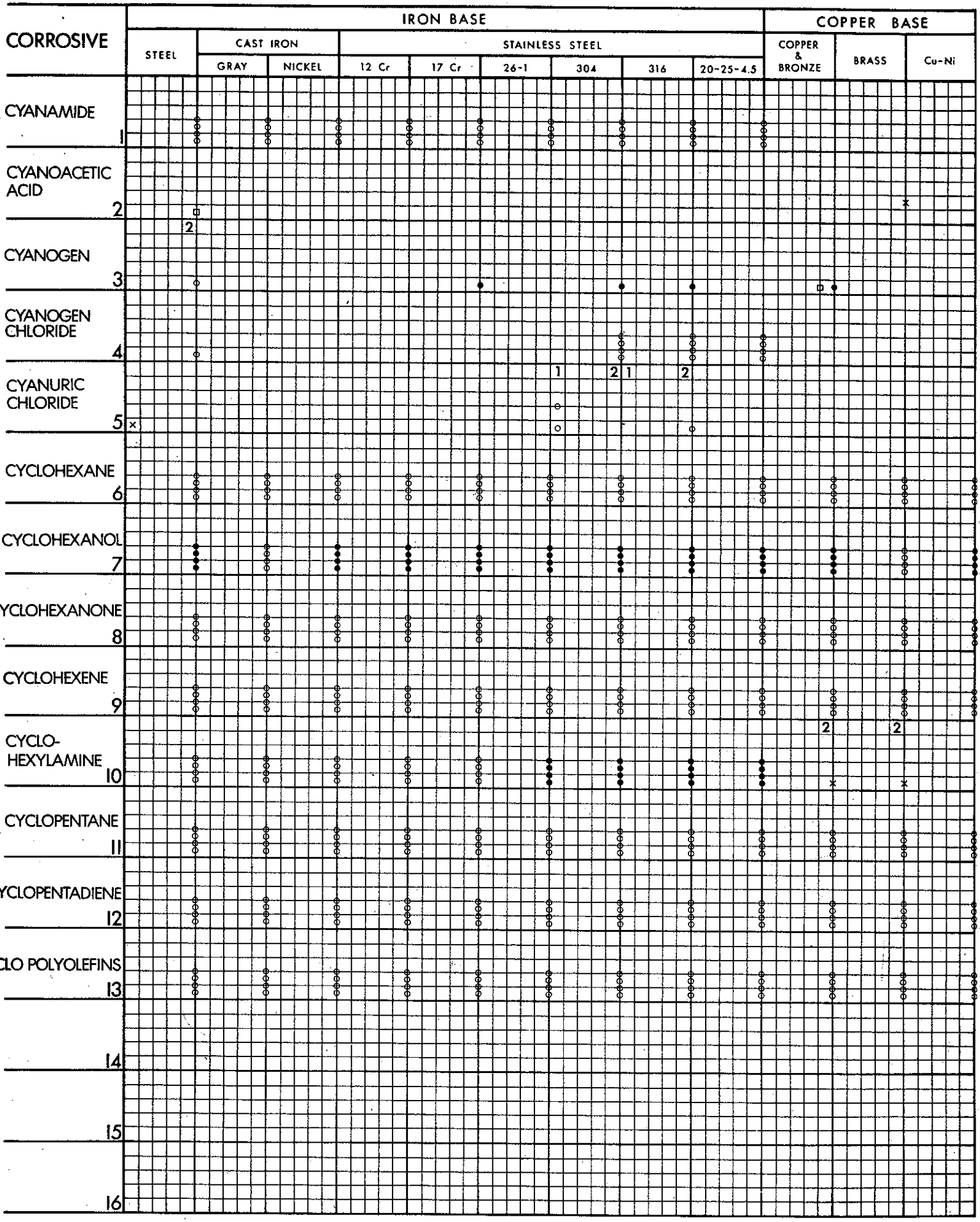
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
CYANAMIDE 1
CYANOACETIC ACID 2
CYANOGEN 3
CYANOGEN CHLORIDE 4
CYANURIC CHLORIDE 5
CYCLOHEXANE 6
CYCLOHEXANOL 7
CYCLOHEXANONE 8
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CYCLO POLYOLEFINS 13
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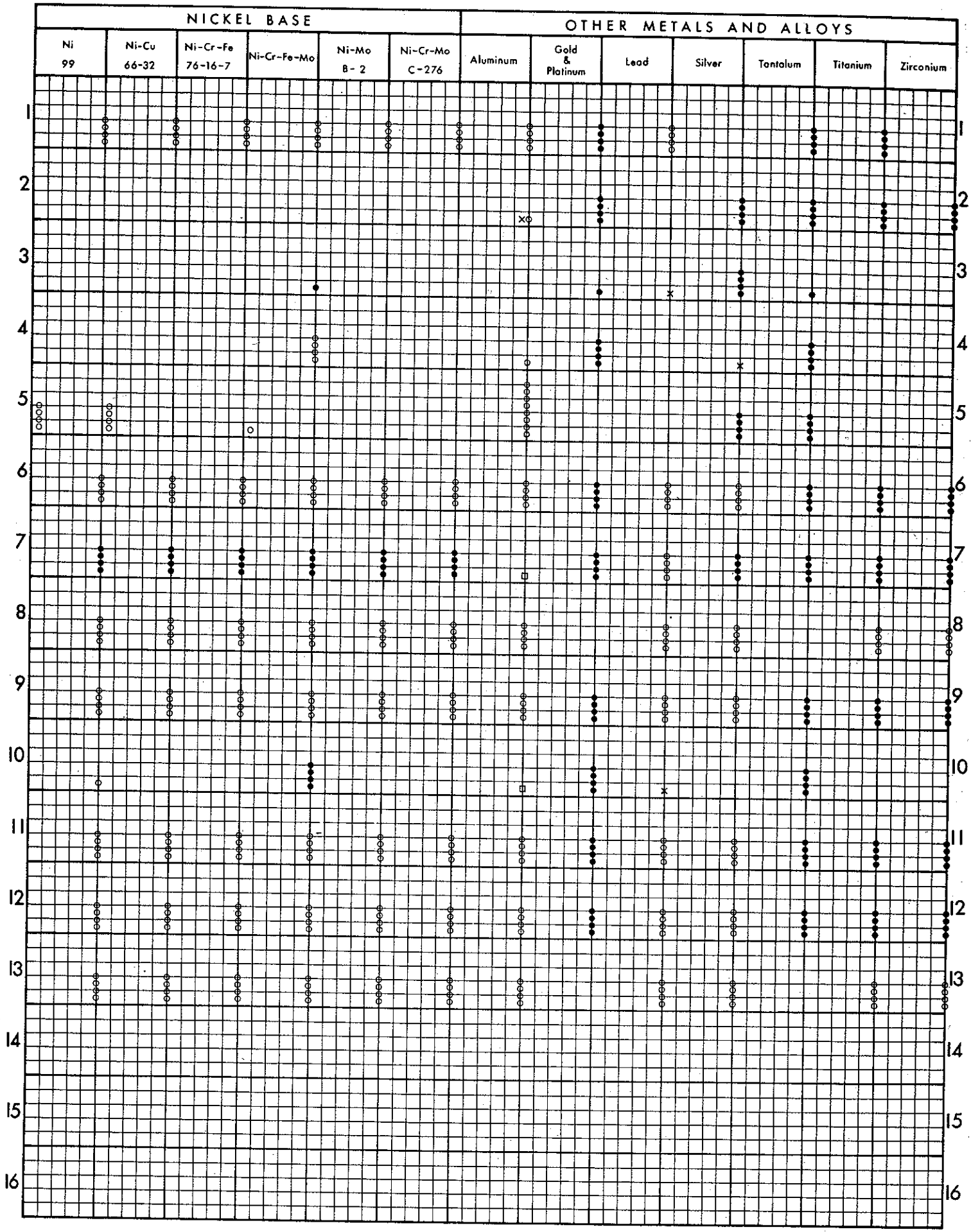
NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
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Ni-Mo B-2
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Silver
Tantalum
Titanium
Zirconium
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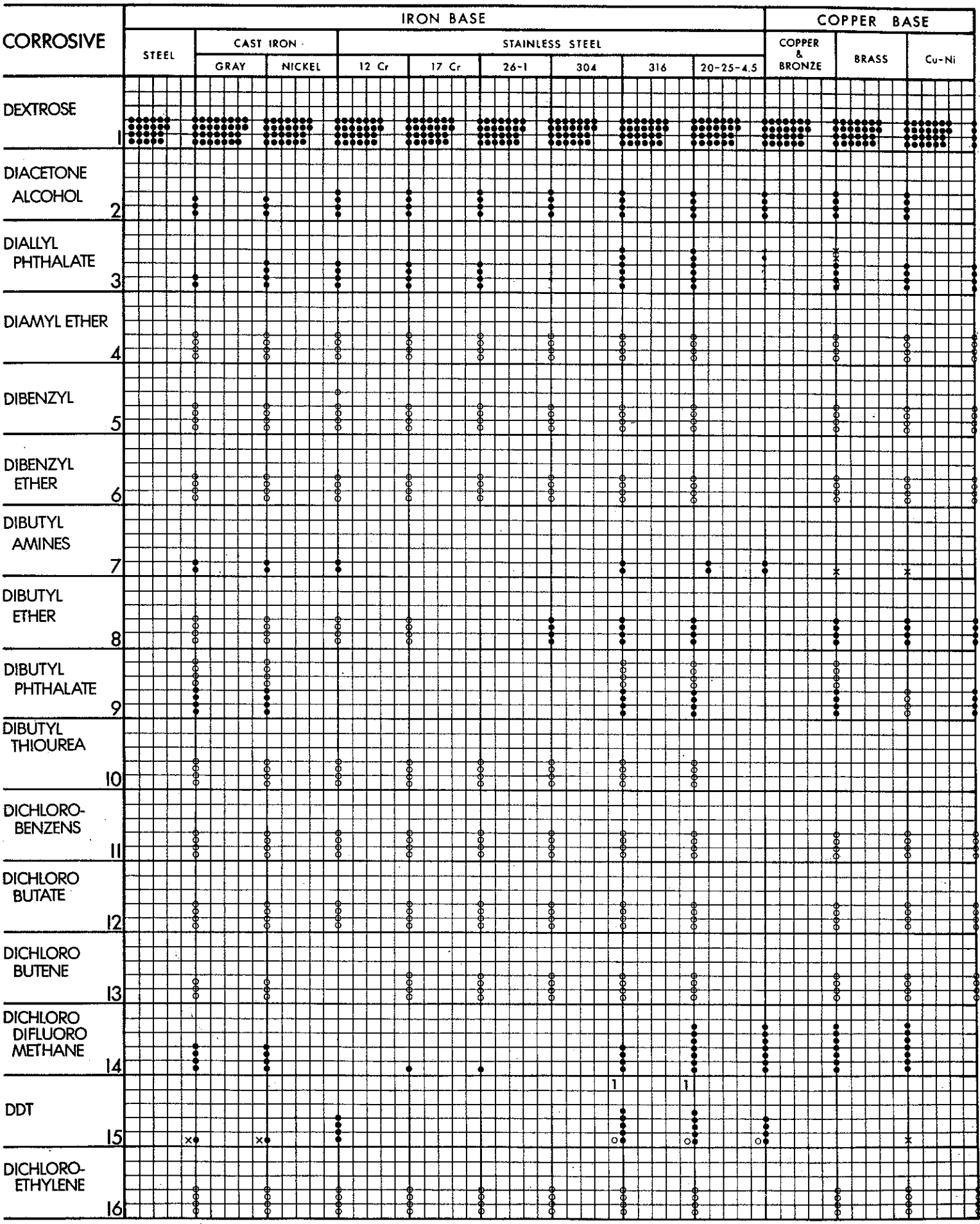
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
DEXTROSE 1
DIACETONE ALCOHOL 2
DIALLYL PHTHALATE 3
DIAMYL ETHER 4
DIBENZYL 5
DIBENZYL ETHER 6
DIBUTYL AMINES 7
DIBUTYL ETHER 8
DIBUTYL PHTHALATE 9
DIBUTYL THIOUREA 10
DICHLORO-BENZENS 11
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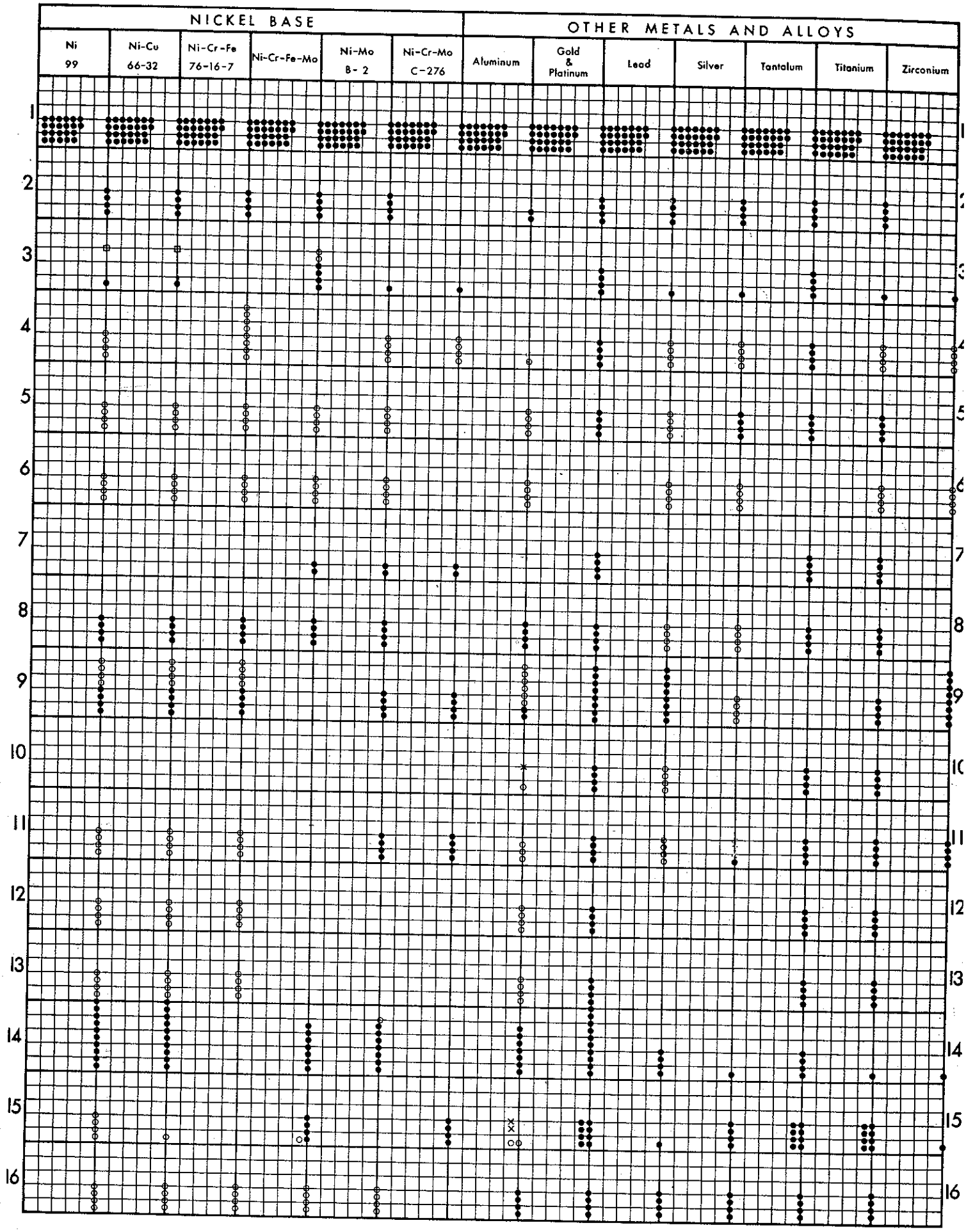
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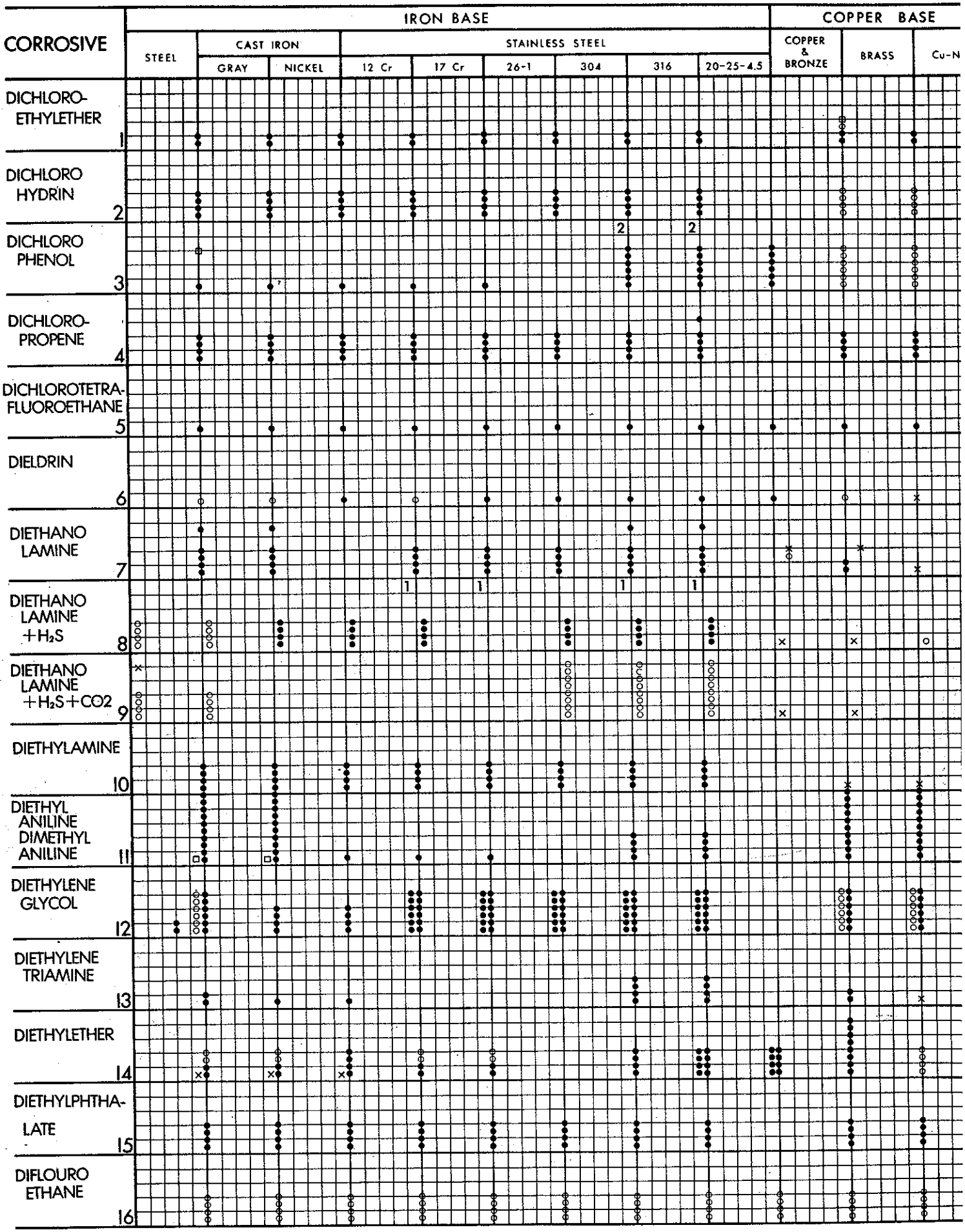
CORROSIVE
IRON BASE
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COPPER & BRONZE
BRASS
Cu-N
DICHLORO-ETHYLETHER 1
DICHLORO HYDRIN 2
DICHLORO PHENOL 3
DICHLORO-PROPENE 4
DICHLOROTETRA-FLUOROETHANE 5
DIELDRIN 6
DIETHANO LAMINE 7
DIETHANO LAMINE +H2S 8
DIETHANO LAMINE +H2S+CO2 9
DIETHYLAMINE 10
DIETHYL ANILINE DIMETHYL ANILINE 11
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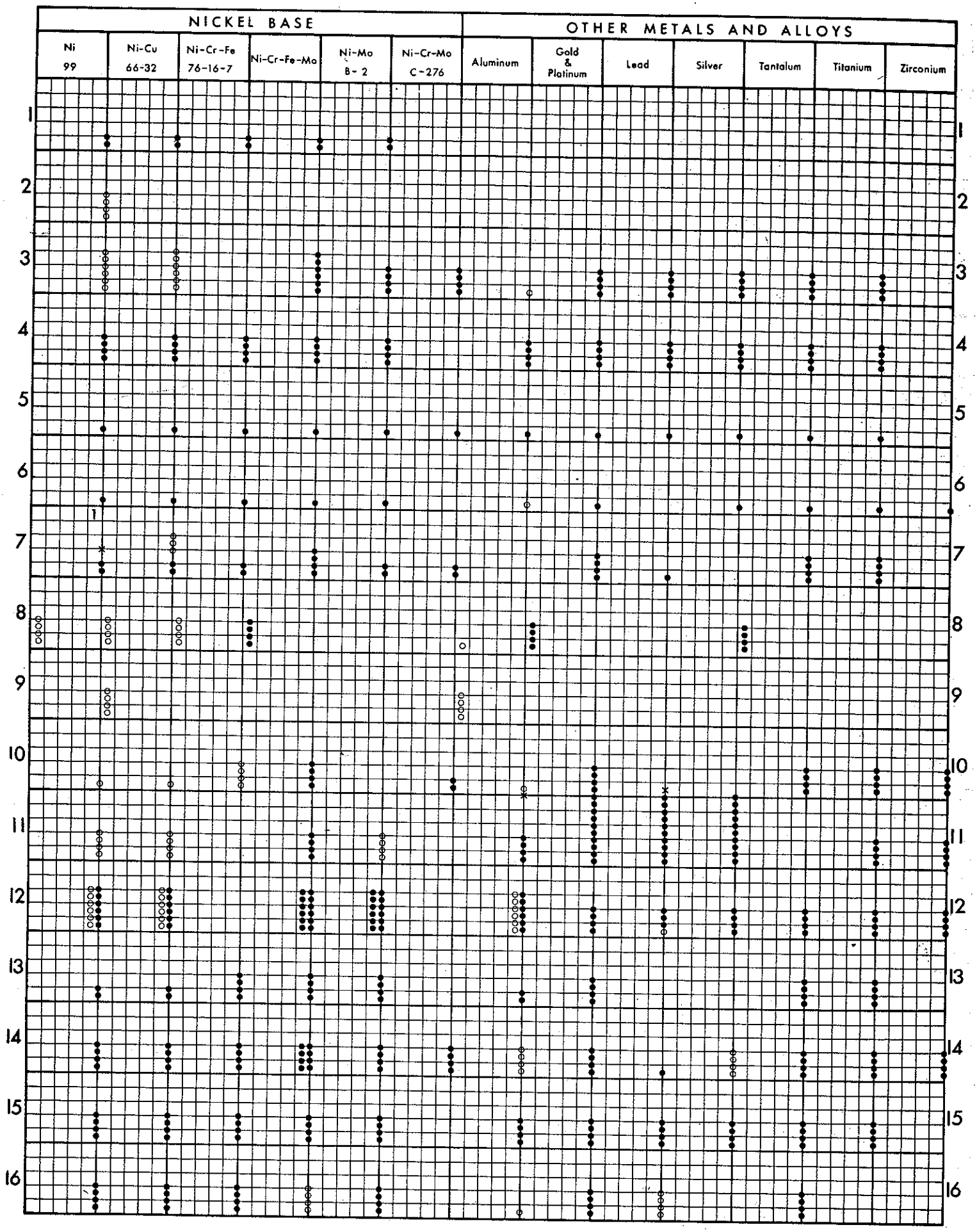
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Ni-Mo B-2
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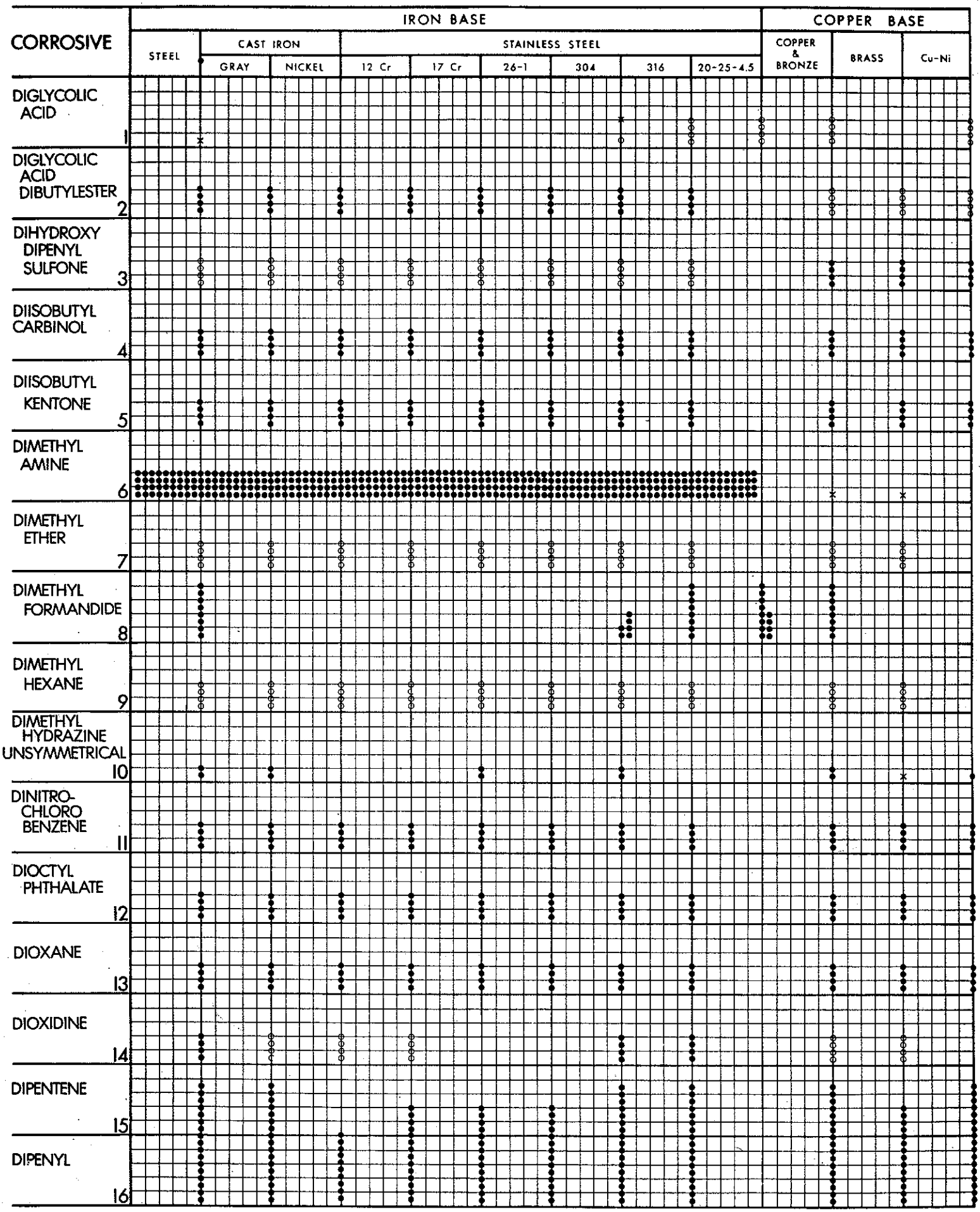
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IRON BASE
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COPPER & BRONZE
BRASS
Cu-Ni
DIGLYCOLIC ACID 1
DIGLYCOLIC ACID DIBUTYLESTER 2
DIHYDROXY DIPENYL SULFONE 3
DIISOBUTYL CARBINOL 4
DIISOBUTYL KENTONE 5
DIMETHYL AMINE 6
DIMETHYL ETHER 7
DIMETHYL FORMANDIDE 8
DIMETHYL HEXANE 9
DIMETHYL HYDRAZINE UNSYMMETRICAL 10
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DIOCTYL PHTHALATE 12
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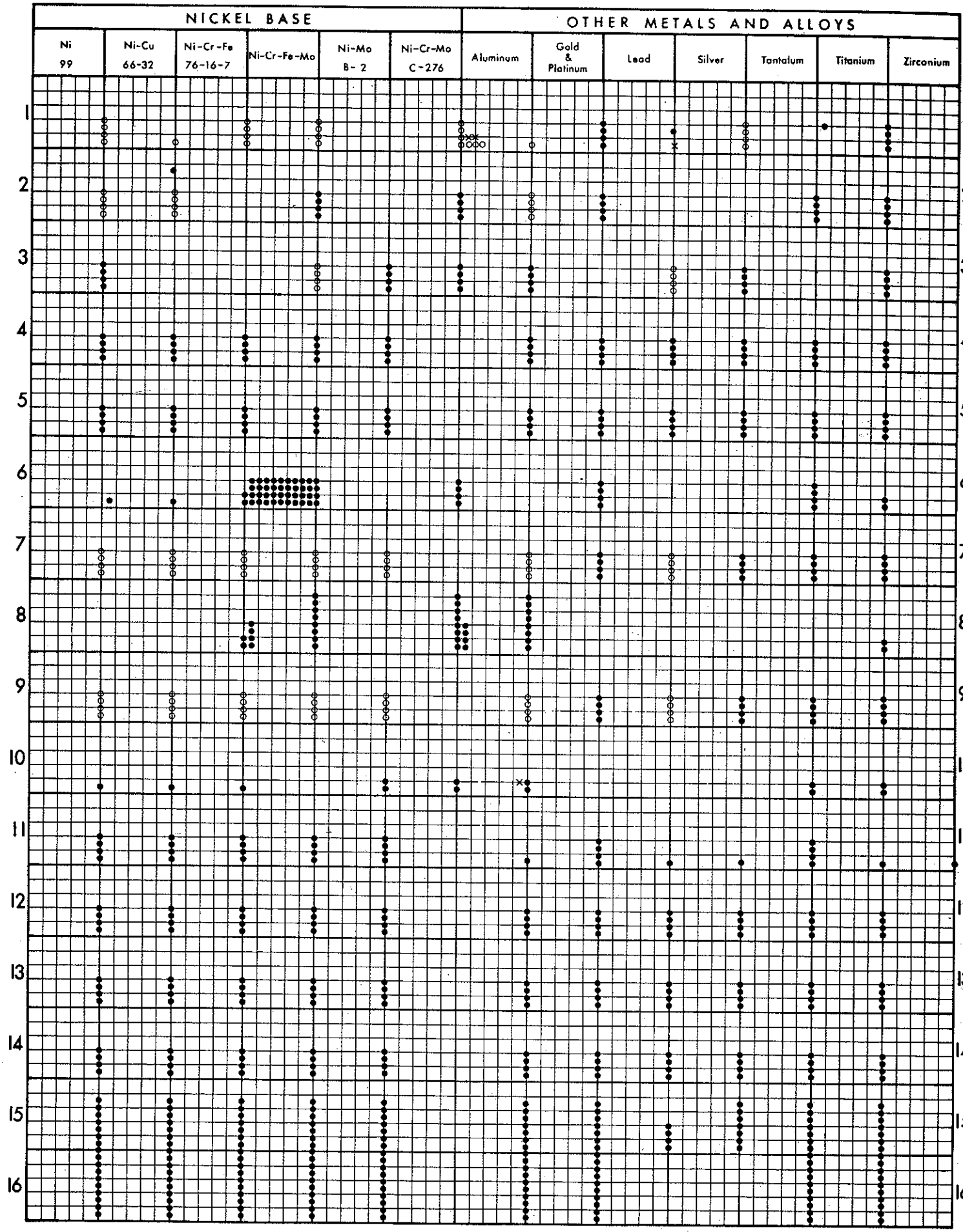
DIOXIDINE 14
DIPENTENE 15
DIPENYL 16


NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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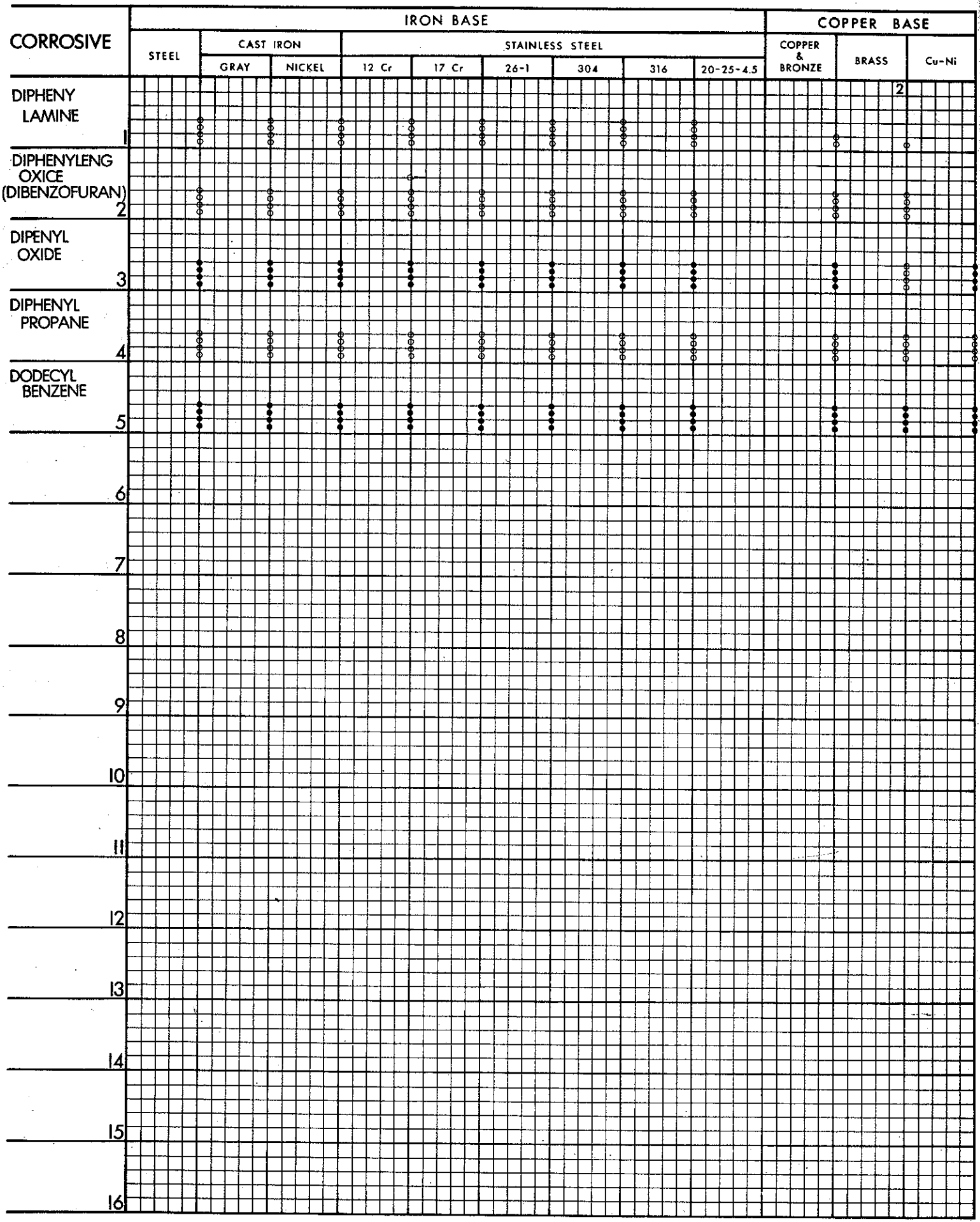
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IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
DIPHENY LAMINE 1
DIPHENYLENG OXICE (DIBENZOFURAN) 2
DIPENYL OXIDE 3
DIPHENYL PROPANE 4
DODECYL BENZENE 5
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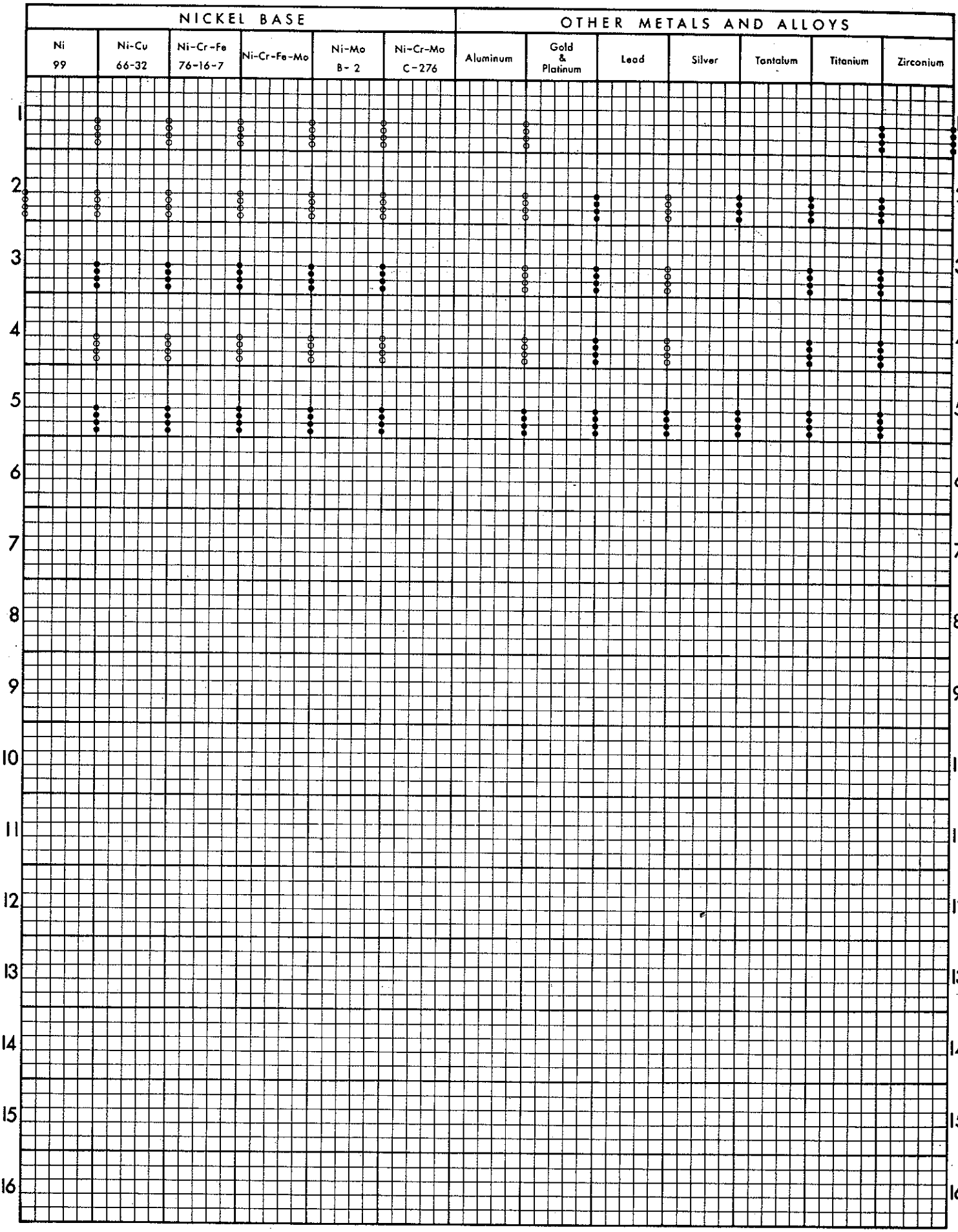
NICKEL BASE
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Ni-Cu 66-32
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Ni-Mo B-2
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Tantalum
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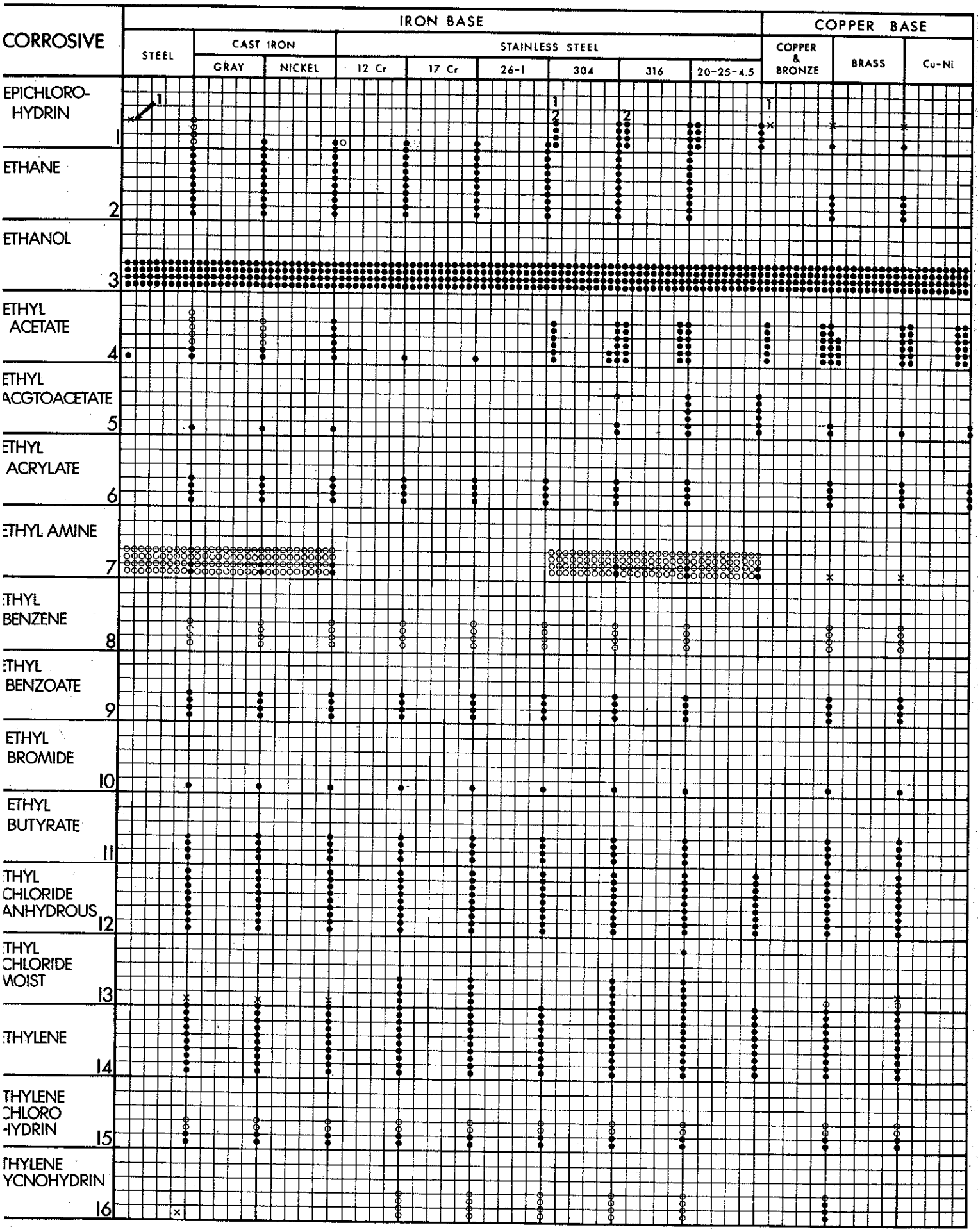
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COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
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26-1
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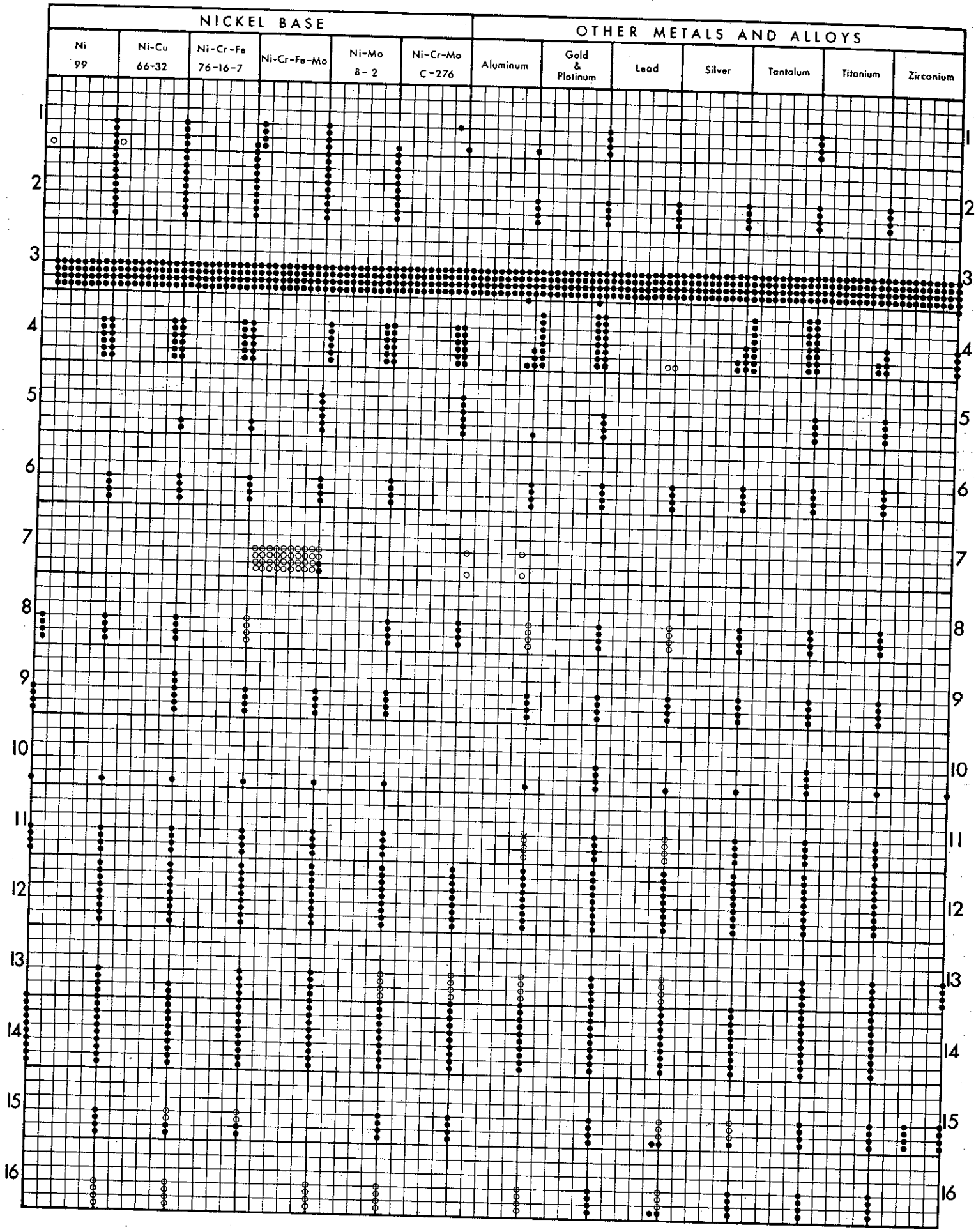
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
EPICHLORO-HYDRIN 1
ETHANE 2
ETHANOL 3
ETHYL ACETATE 4
ETHYL ACGTOACETATE 5
ETHYL ACRYLATE 6
ETHYL AMINE 7
ETHYL BENZENE 8
ETHYL BENZOATE 9
ETHYL BROMIDE 10
ETHYL BUTYRATE 11
ETHYL CHLORIDE ANHYDROUS 12
ETHYL CHLORIDE MOIST 13
ETHYLENE 14
ETHYLENE CHLORO HYDRIN 15
ETHYLENE CYCNOHYDRIN 16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Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
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Silver
Tantalum
Titanium
Zirconium
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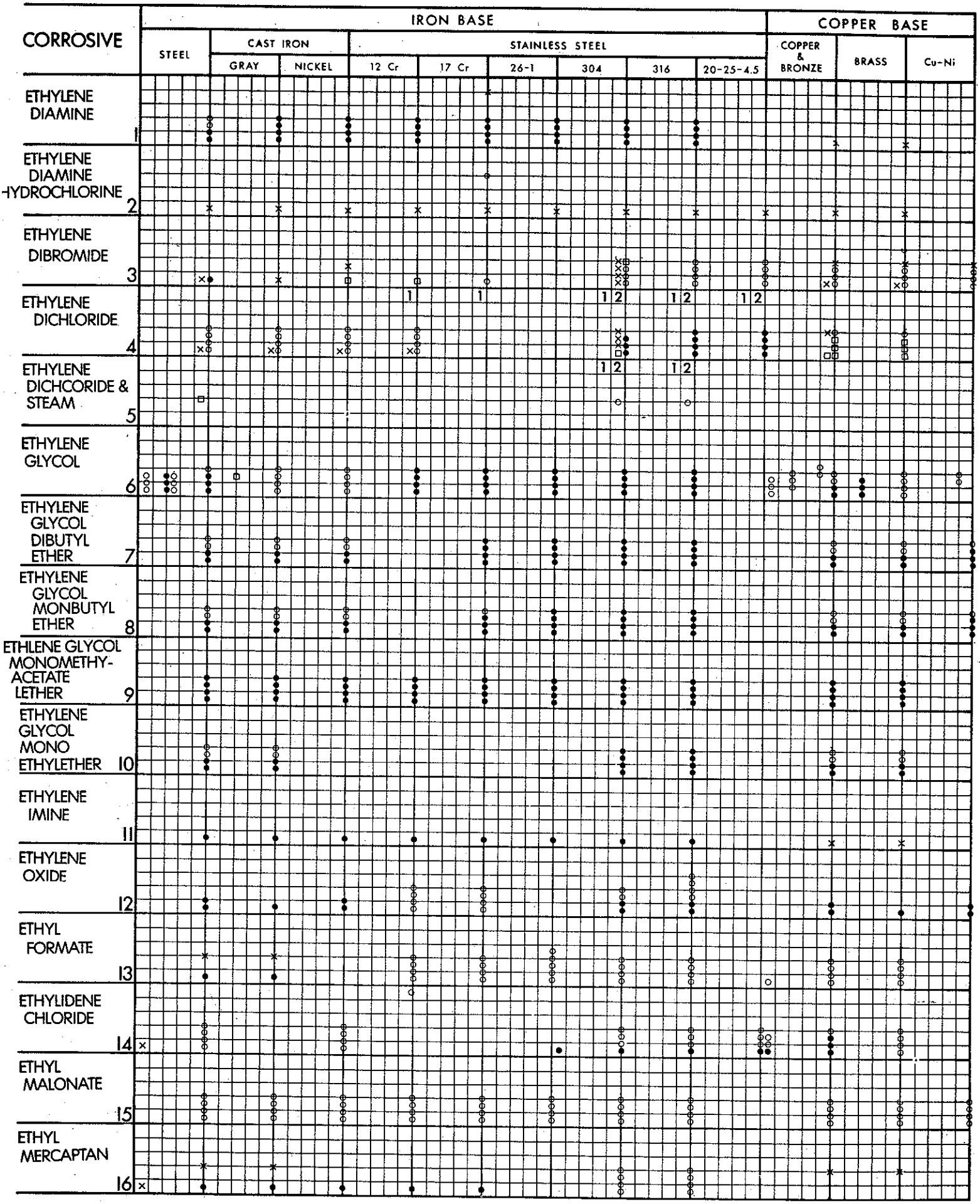
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
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316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
ETHYLENE DIAMINE 1
ETHYLENE DIAMINE HYDROCHLORINE 2
ETHYLENE DIBROMIDE 3
ETHYLENE DICHLORIDE 4
ETHYLENE DICHCORIDE & STEAM 5
ETHYLENE GLYCOL 6
ETHYLENE GLYCOL DIBUTYL ETHER 7
ETHYLENE GLYCOL MONBUTYL ETHER 8
ETHLENE GLYCOL MONOMETHY-ACETATE LETHER 9
ETHYLENE GLYCOL MONO ETHYLETHER 10
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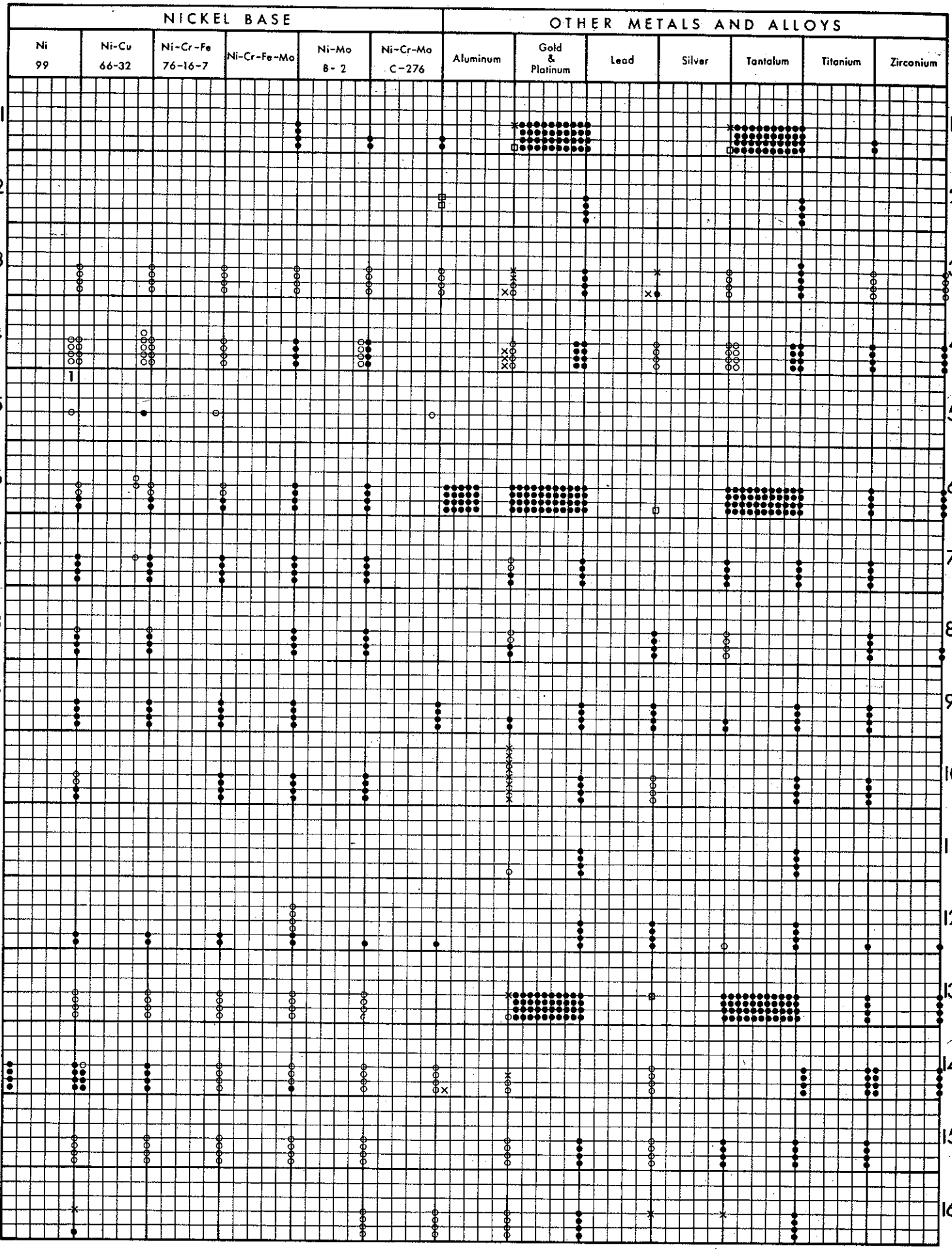
ETHYLENE OXIDE 12
ETHYL FORMATE 13
ETHYLIDENE CHLORIDE 14
ETHYL MALONATE 15
ETHYL MERCAPTAN 16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OTHER METALS AND ALLOYS
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Ni-Cr-Fe 76-16-7
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Tantalum
Titanium
Zirconium
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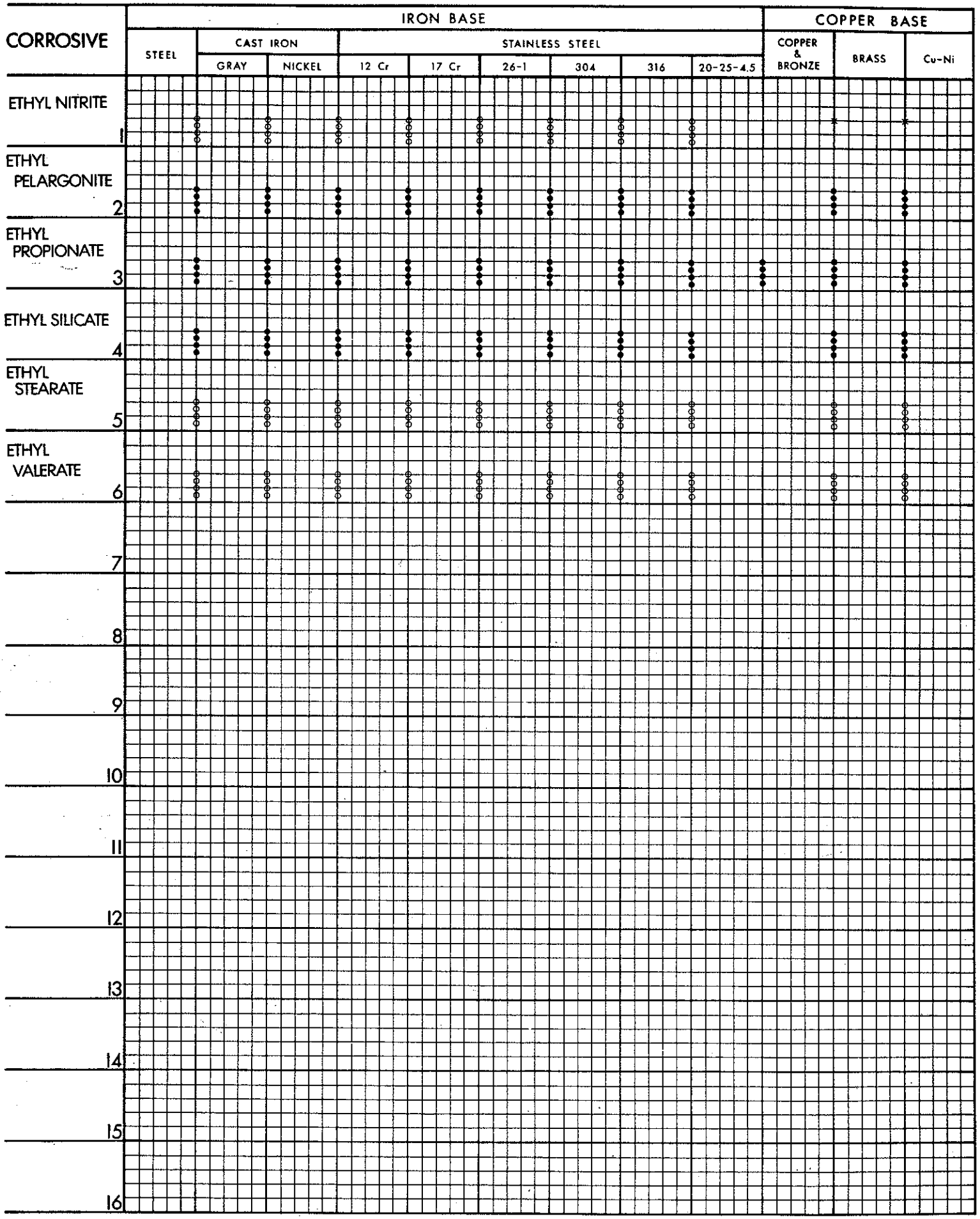
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
ETHYL NITRITE
1
ETHYL PELARGONITE
2
ETHYL PROPIONATE
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ETHYL SILICATE
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ETHYL STEARATE
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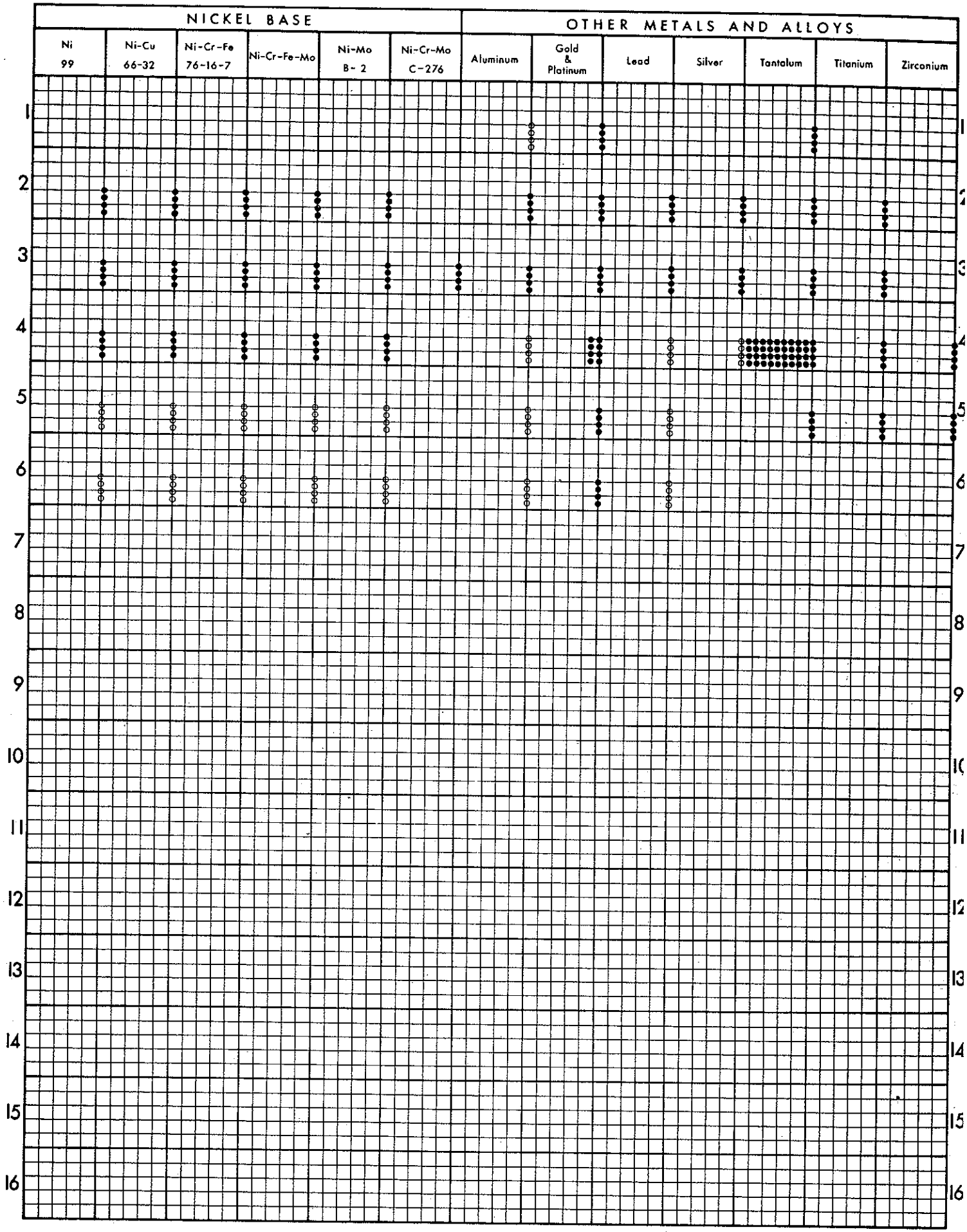
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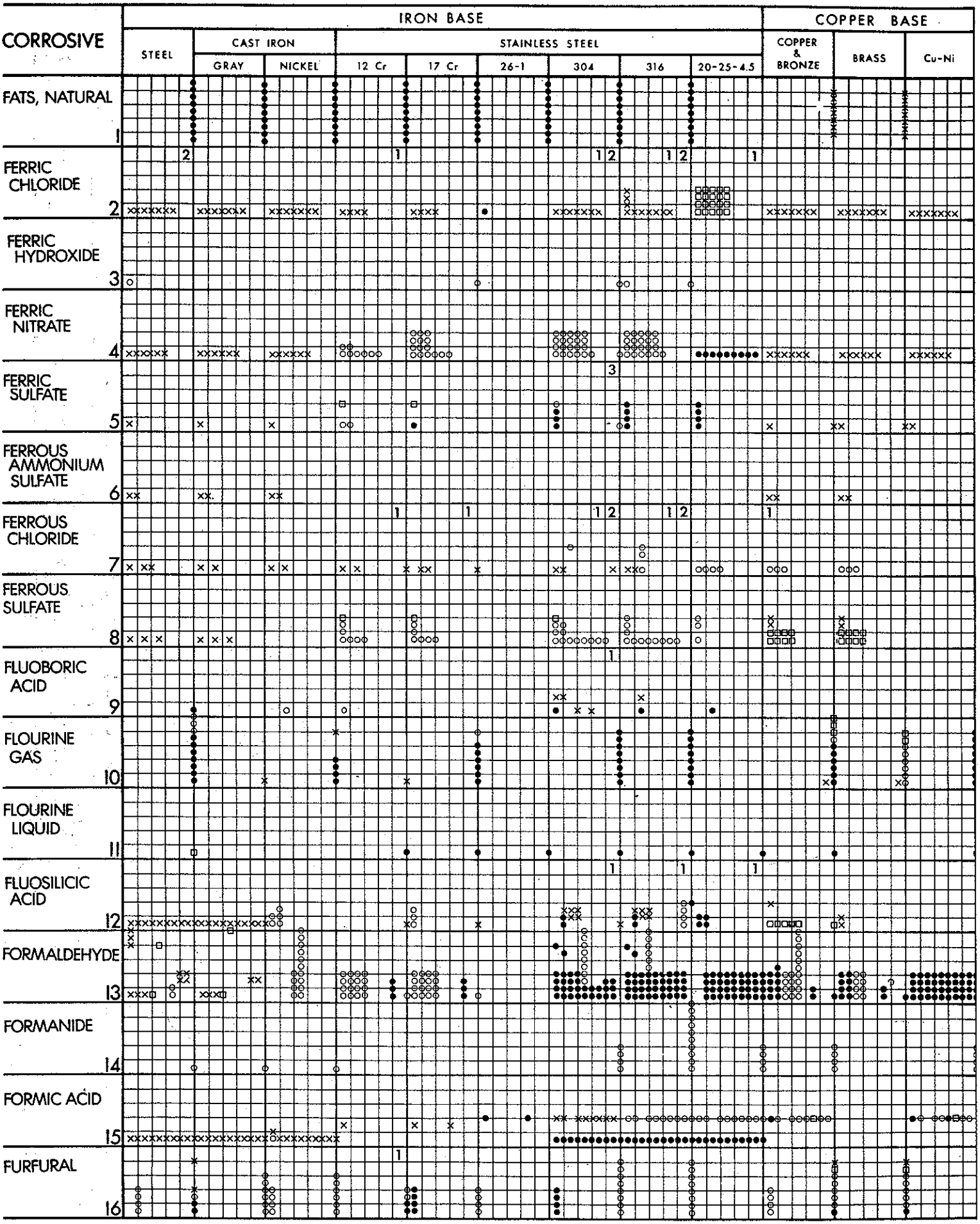
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
FATS, NATURAL
1
FERRIC CHLORIDE
2
FERRIC HYDROXIDE
3
FERRIC NITRATE
4
FERRIC SULFATE
5
FERROUS AMMONIUM SULFATE
6
FERROUS CHLORIDE
7
FERROUS SULFATE
8
FLUOBORIC ACID
9
FLOURINE GAS
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FLOURINE LIQUID
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FLUOSILICIC ACID
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FORMALDEHYDE
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FORMANIDE
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FORMIC ACID
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FURFURAL
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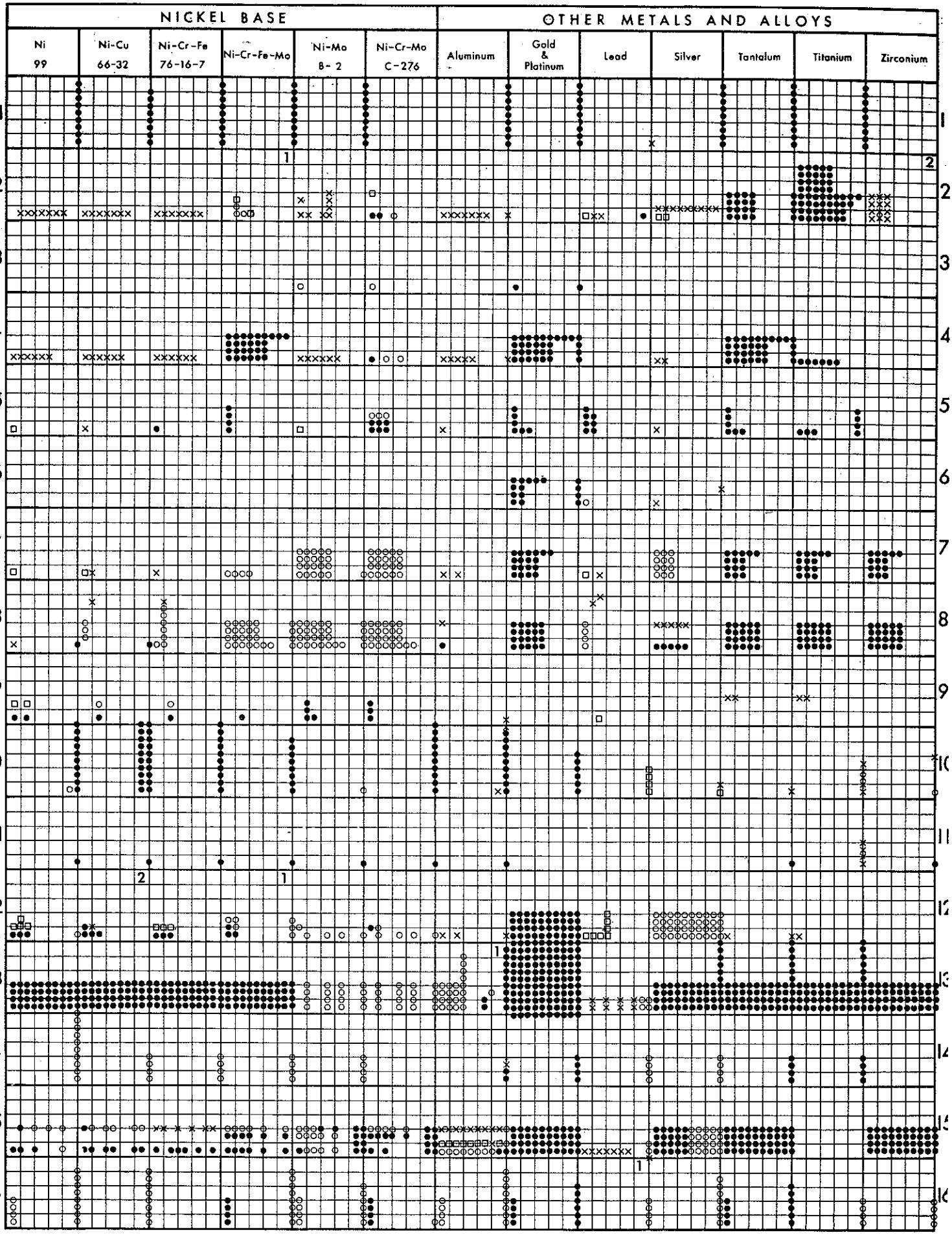
NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
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Titanium
Zirconium
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CORROSIVE	IRON BASE									COPPER BASE		
	STEEL	CAST IRON		STAINLESS STEEL						COPPER & BRONZE	BRASS	Cu-Ni
		GRAY	NICKEL	12 Cr	17 Cr	26-1	304	316	20-25-4.5			
FURFUAL ALCOHOL 1												
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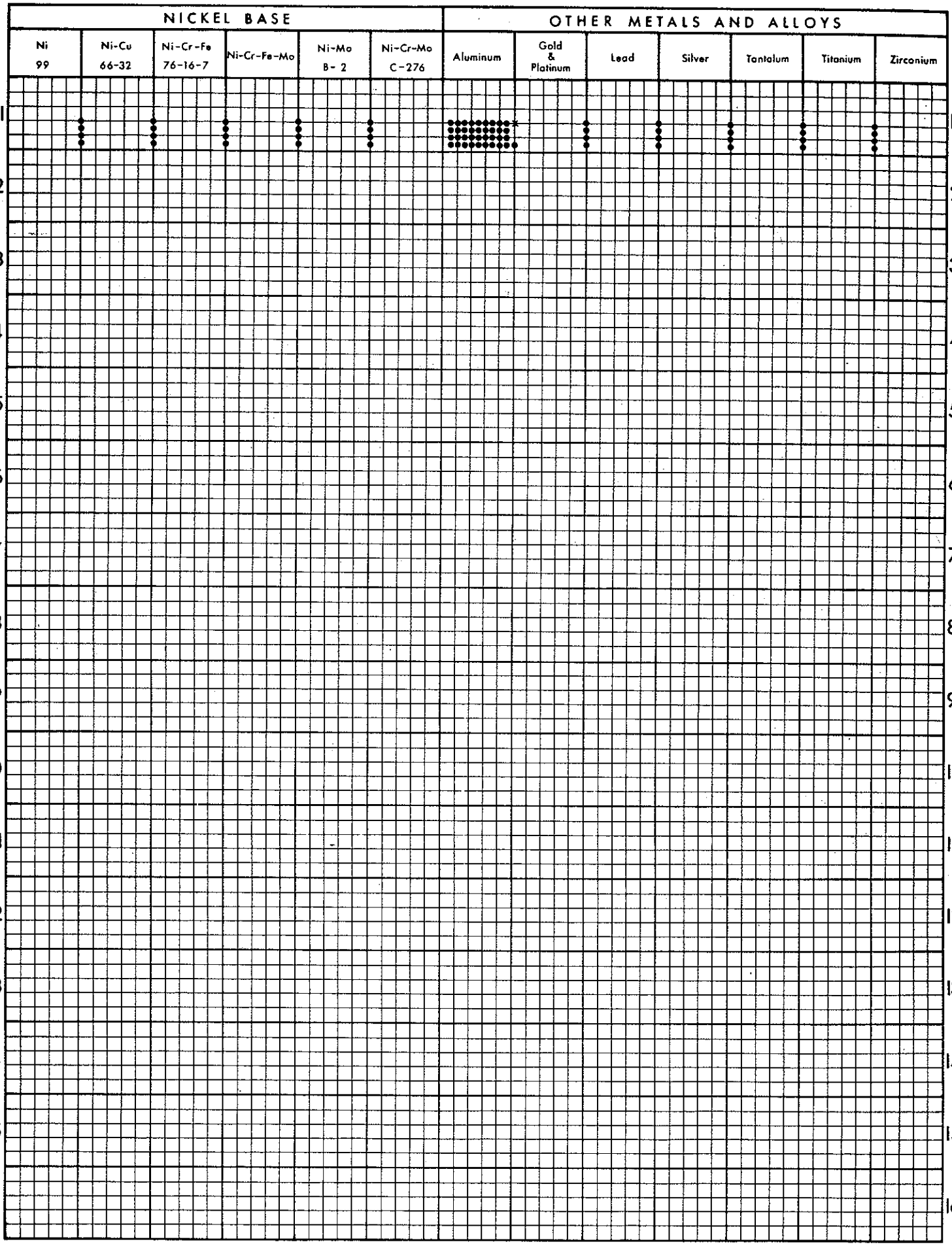
NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
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Tantalum
Titanium
Zirconium
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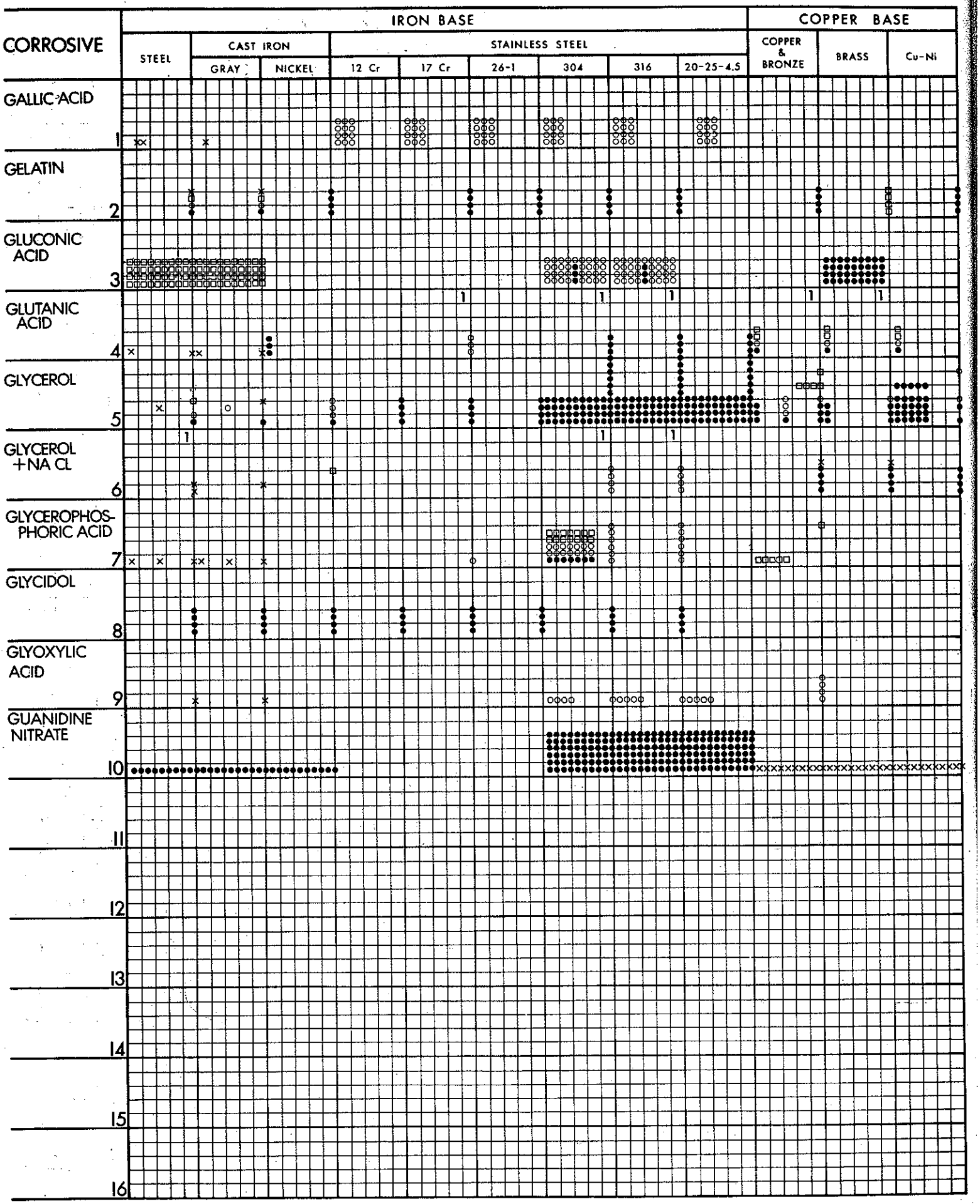
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
GALLIC ACID
1
GELATIN
2
GLUCONIC ACID
3
GLUTANIC ACID
4
GLYCEROL
5
GLYCEROL + NA CL
6
GLYCEROPHOSPHORIC ACID
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GLYCIDOL
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GLYOXYLIC ACID
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GUANIDINE NITRATE
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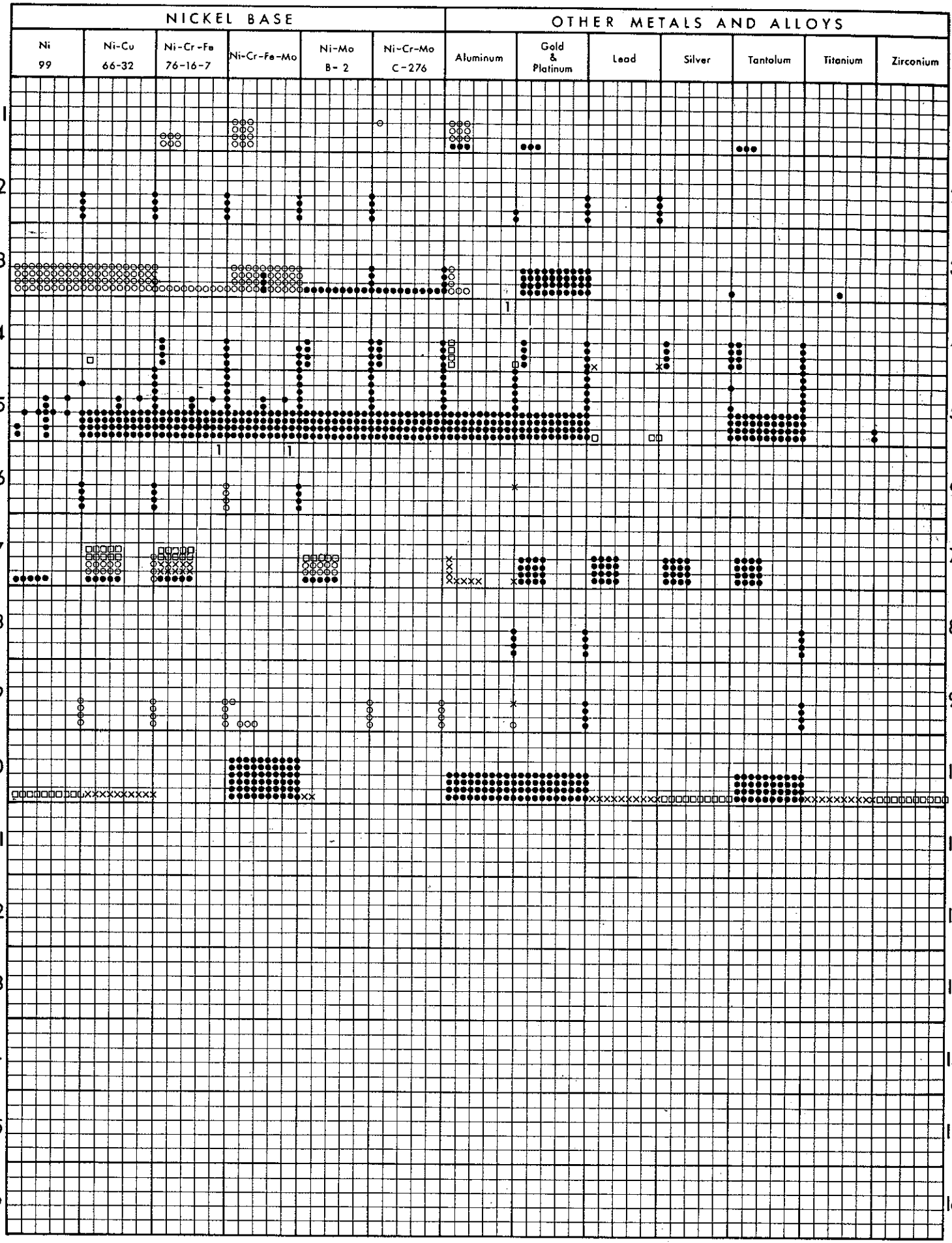
NICKEL BASE
OTHER METALS AND ALLOYS
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Ni-Cr-Fe 76-16-7
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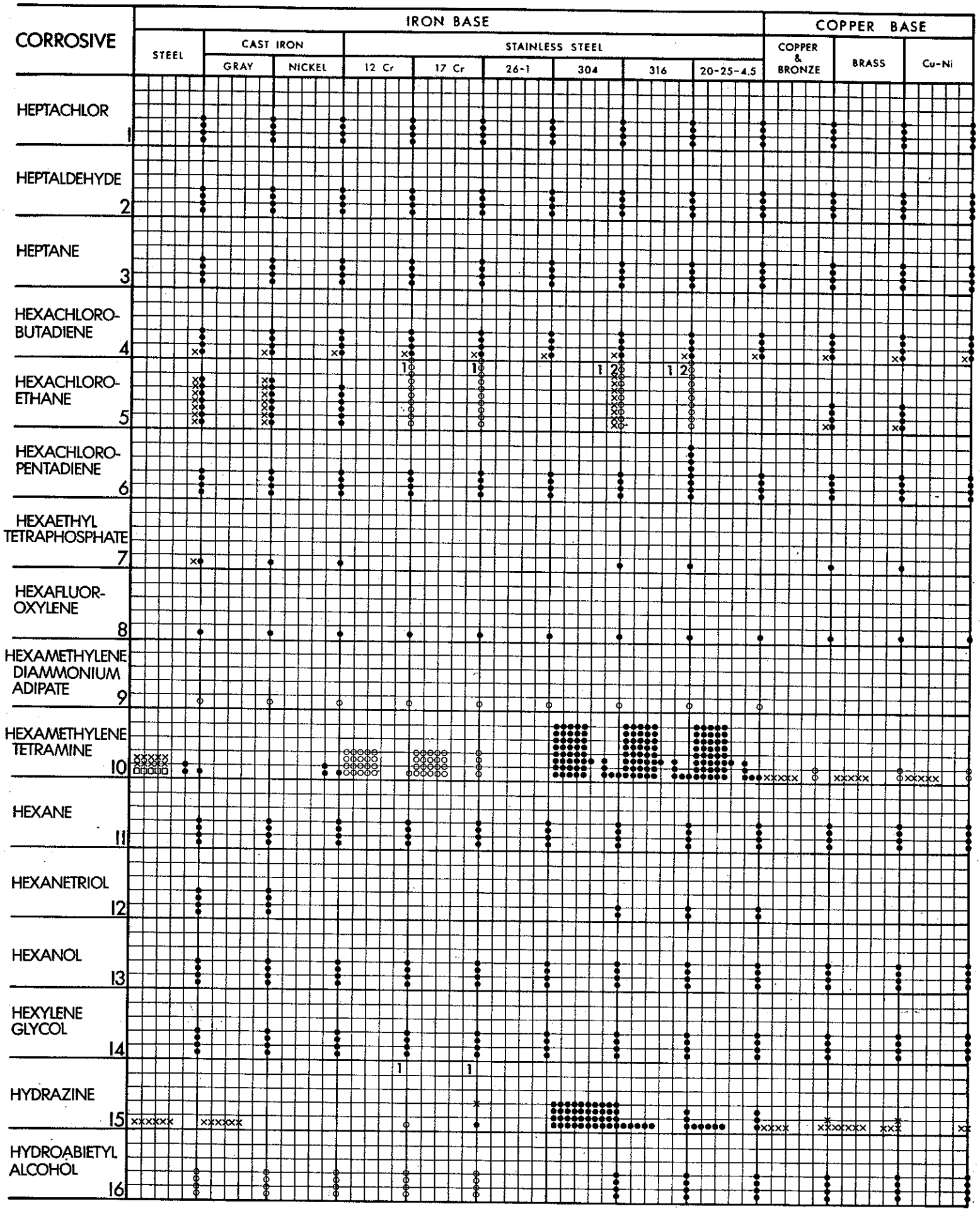
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
HEPTACHLOR 1
HEPTALDEHYDE 2
HEPTANE 3
HEXACHLORO-BUTADIENE 4
HEXACHLORO-ETHANE 5
HEXACHLORO-PENTADIENE 6
HEXAETHYL TETRAPHOSPHATE 7
HEXAFLUOR-OXYLENE 8
HEXAMETHYLENE DIAMMONIUM ADIPATE 9
HEXAMETHYLENE TETRAMINE 10
HEXANE 11
HEXANETRIOL 12
HEXANOL 13
HEXYLENE GLYCOL 14
HYDRAZINE 15
HYDROABIETYL ALCOHOL 16


NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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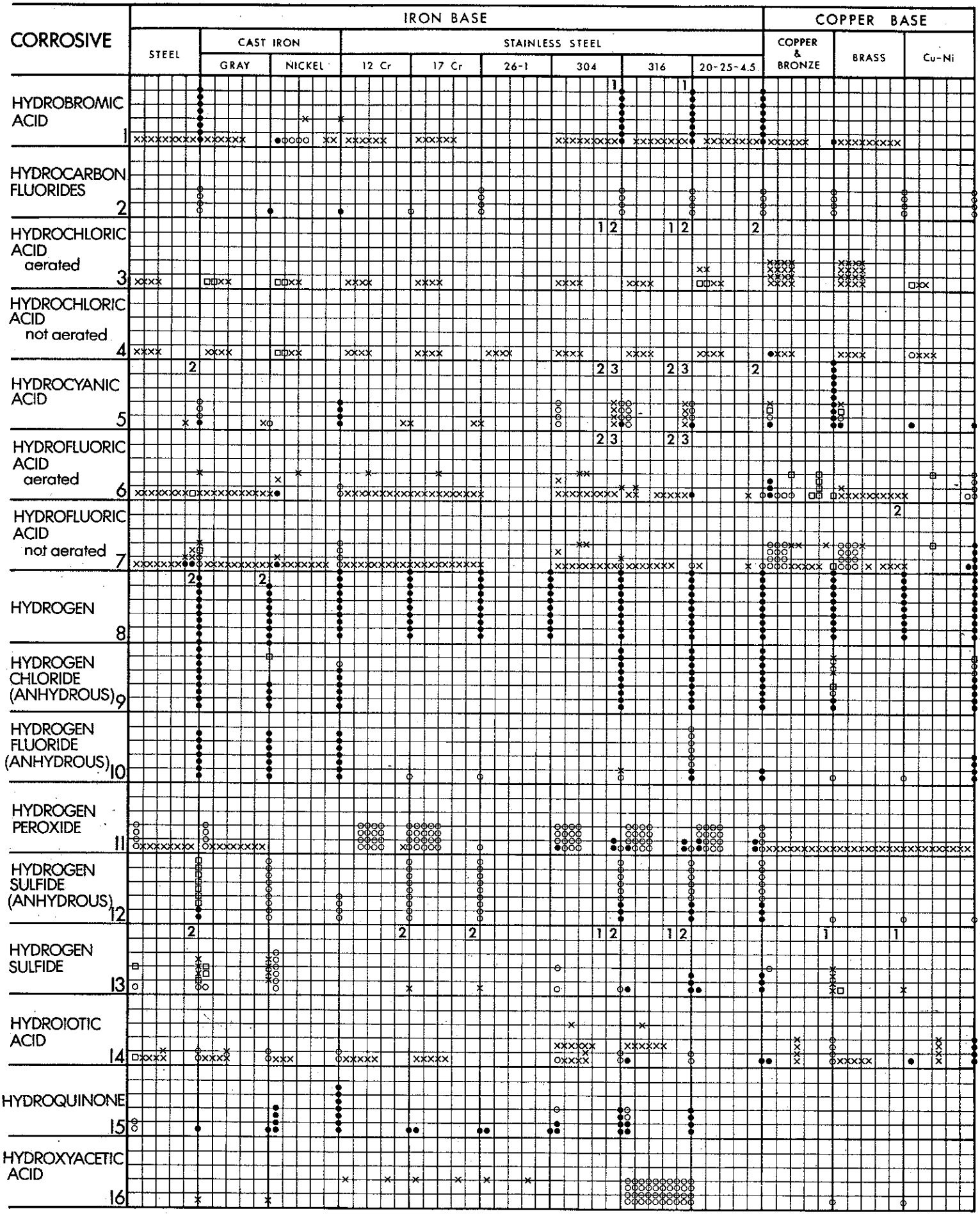
CORROSIVE
IRON BASE
COPPER BASE
STEEL
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GRAY
NICKEL
STAINLESS STEEL
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17 Cr
26-1
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20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
HYDROBROMIC ACID 1
HYDROCARBON FLUORIDES 2
HYDROCHLORIC ACID aerated 3
HYDROCHLORIC ACID not aerated 4
HYDROCYANIC ACID 5
HYDROFLUORIC ACID aerated 6
HYDROFLUORIC ACID not aerated 7
HYDROGEN 8
HYDROGEN CHLORIDE (ANHYDROUS) 9
HYDROGEN FLUORIDE (ANHYDROUS) 10
HYDROGEN PEROXIDE 11
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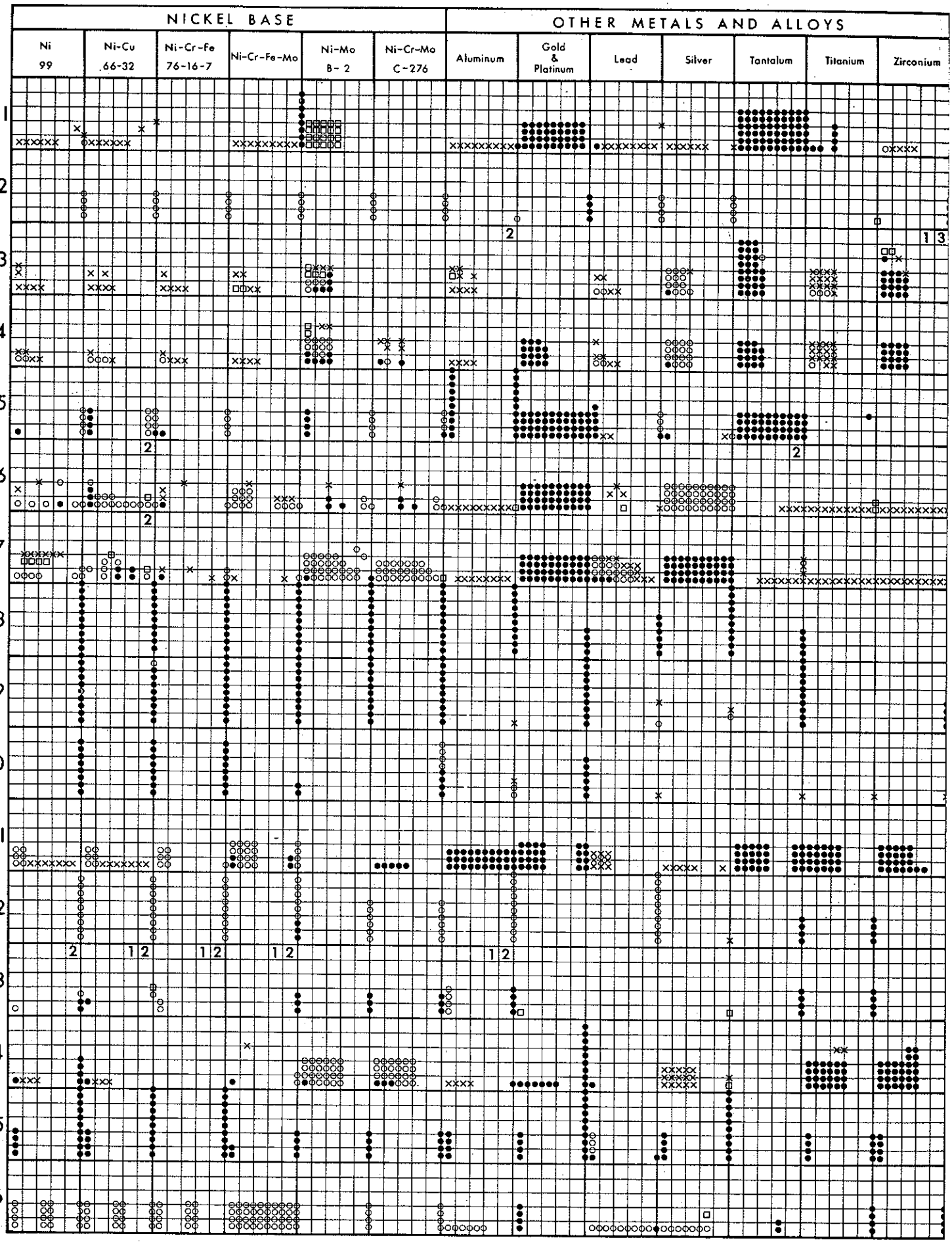
HYDROQUINONE 15
HYDROXYACETIC ACID 16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Ni 99
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Tantalum
Titanium
Zirconium
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CORROSIVE	IRON BASE									COPPER BASE		
	STEEL	CAST IRON		STAINLESS STEEL						COPPER & BRONZE	BRASS	Cu-Ni
		GRAY	NICKEL	12 Cr	17 Cr	26-1	304	316	20-25-4.5			
HYDROXYCITRONELLA 1												
HYPOCHLOROUS ACID 2												
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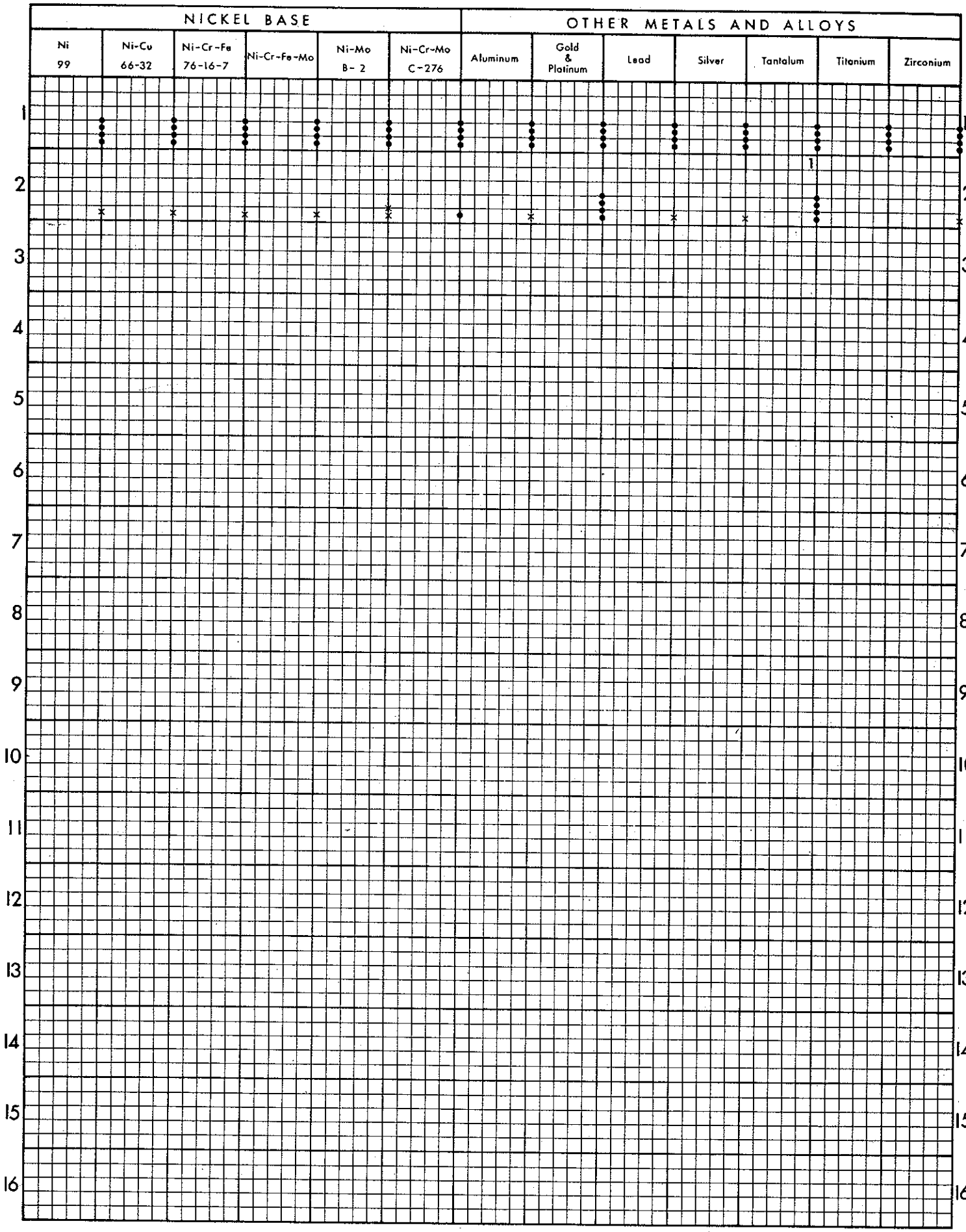
NICKEL BASE
OTHER METALS AND ALLOYS
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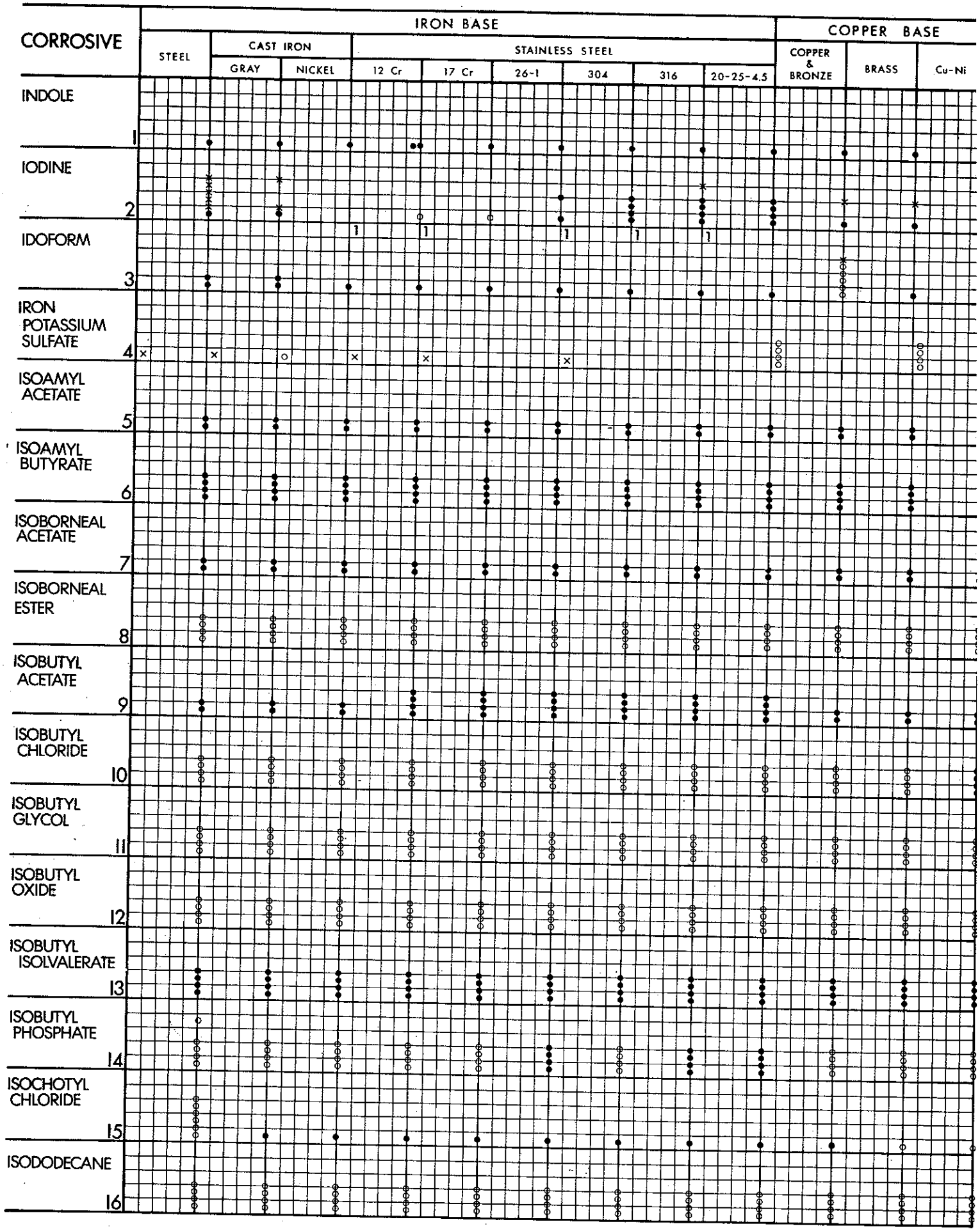
CORROSIVE
IRON BASE
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NICKEL
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12 Cr
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26-1
304
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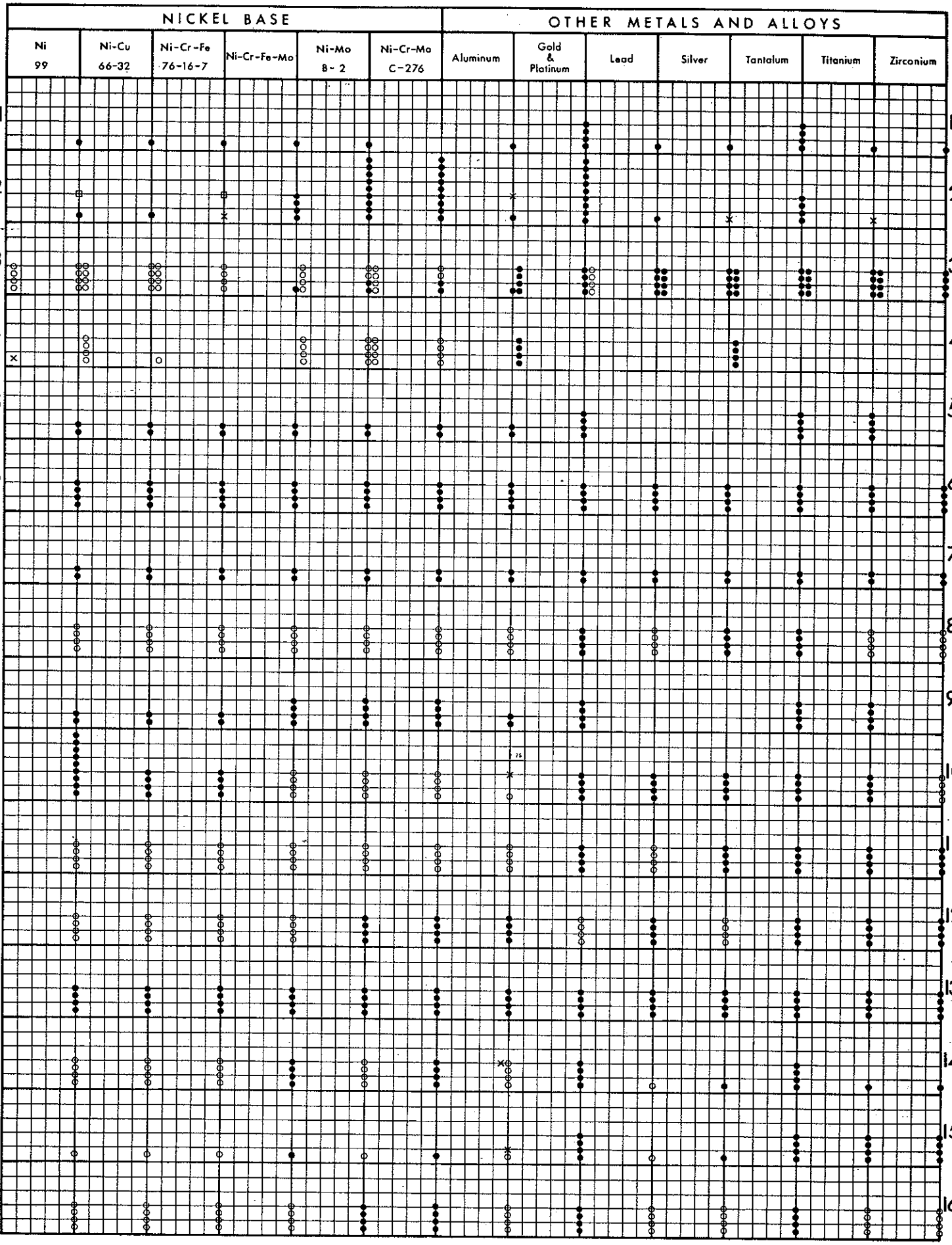
COPPER & BRONZE
BRASS
Cu-Ni
INDOLE 1
IODINE 2
IDOFORM 3
IRON POTASSIUM SULFATE 4
ISOAMYL ACETATE 5
ISOAMYL BUTYRATE 6
ISOBORNEAL ACETATE 7
ISOBORNEAL ESTER 8
ISOBUTYL ACETATE 9
ISOBUTYL CHLORIDE 10
ISOBUTYL GLYCOL 11
ISOBUTYL OXIDE 12
ISOBUTYL ISOLVALERATE 13
ISOBUTYL PHOSPHATE 14
ISOCHOTYL CHLORIDE 15
ISODODECANE 16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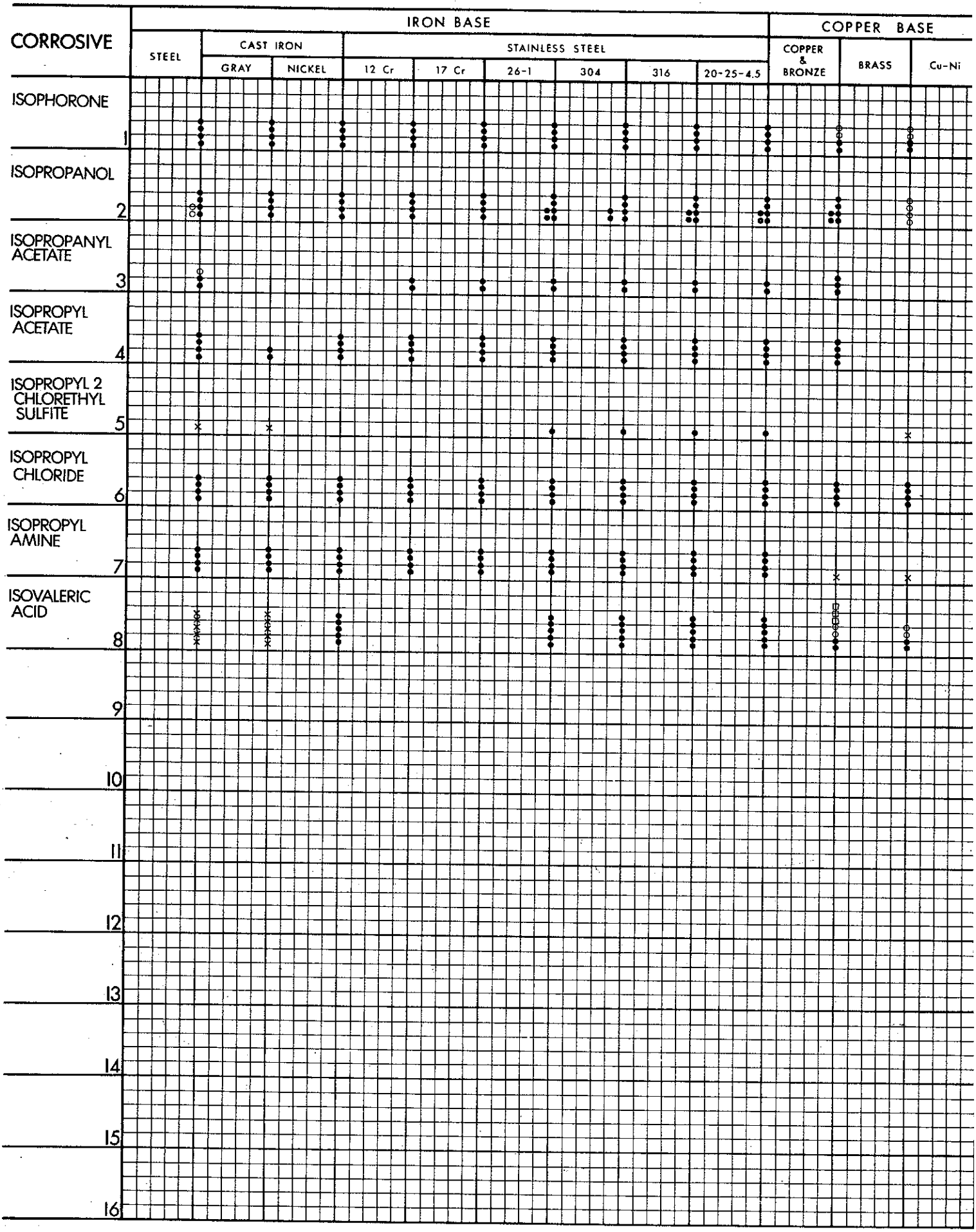
CORROSIVE
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ISOPHORONE 1
ISOPROPANOL 2
ISOPROPANYL ACETATE 3
ISOPROPYL ACETATE 4
ISOPROPYL 2 CHLORETHYL SULFITE 5
ISOPROPYL CHLORIDE 6
ISOPROPYL AMINE 7
ISOVALERIC ACID 8
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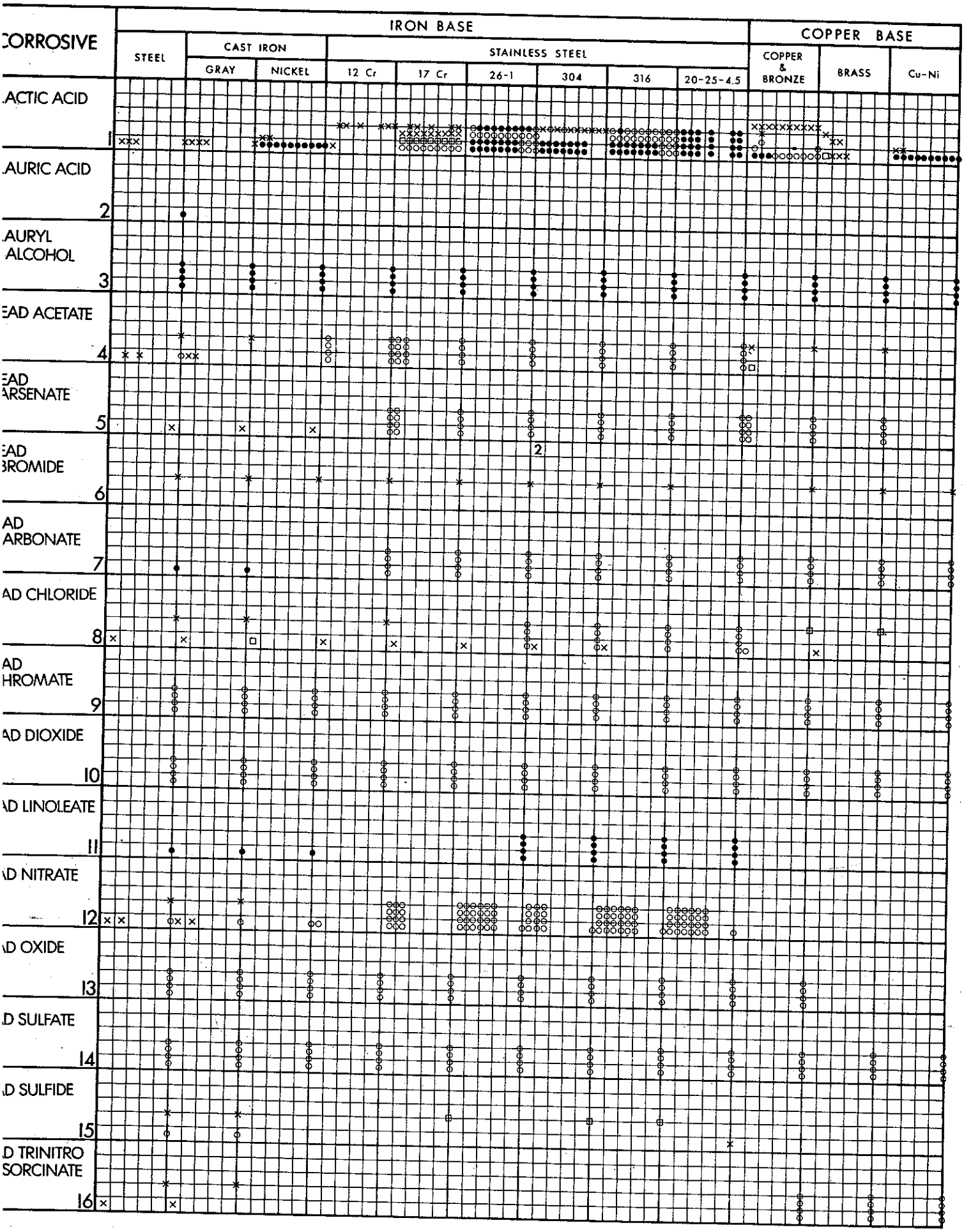
CORROSIVE
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BRASS
Cu-Ni
ACTIC ACID 1
AURIC ACID 2
AURYL ALCOHOL 3
EAD ACETATE 4
EAD ARSENATE 5
EAD BROMIDE 6
AD ARBONATE 7
AD CHLORIDE 8
AD HROMATE 9
AD DIOXIDE 10
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D OXIDE 13
D SULFATE 14
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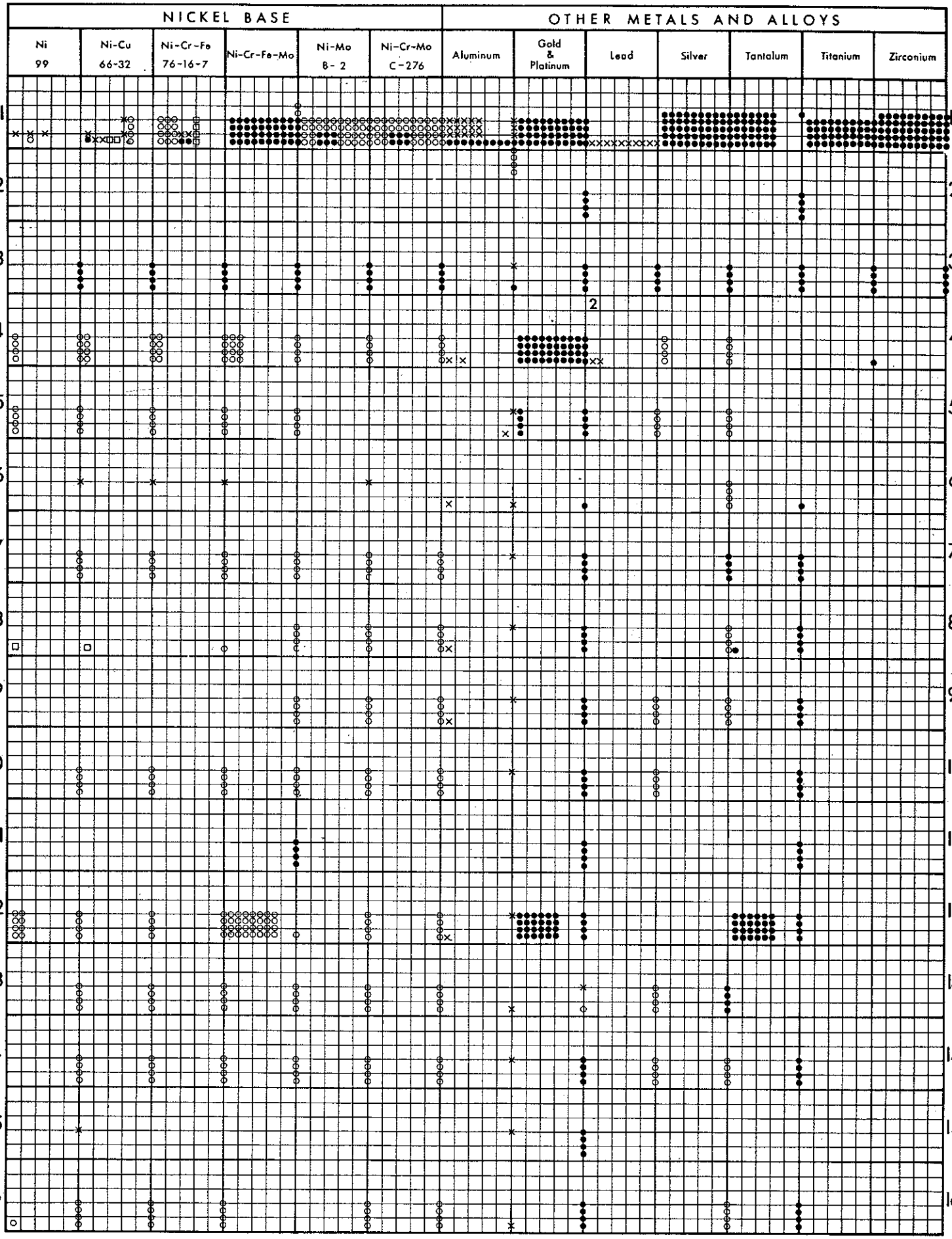
D TRINITRO SORCINATE 16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Ni-Mo B-2
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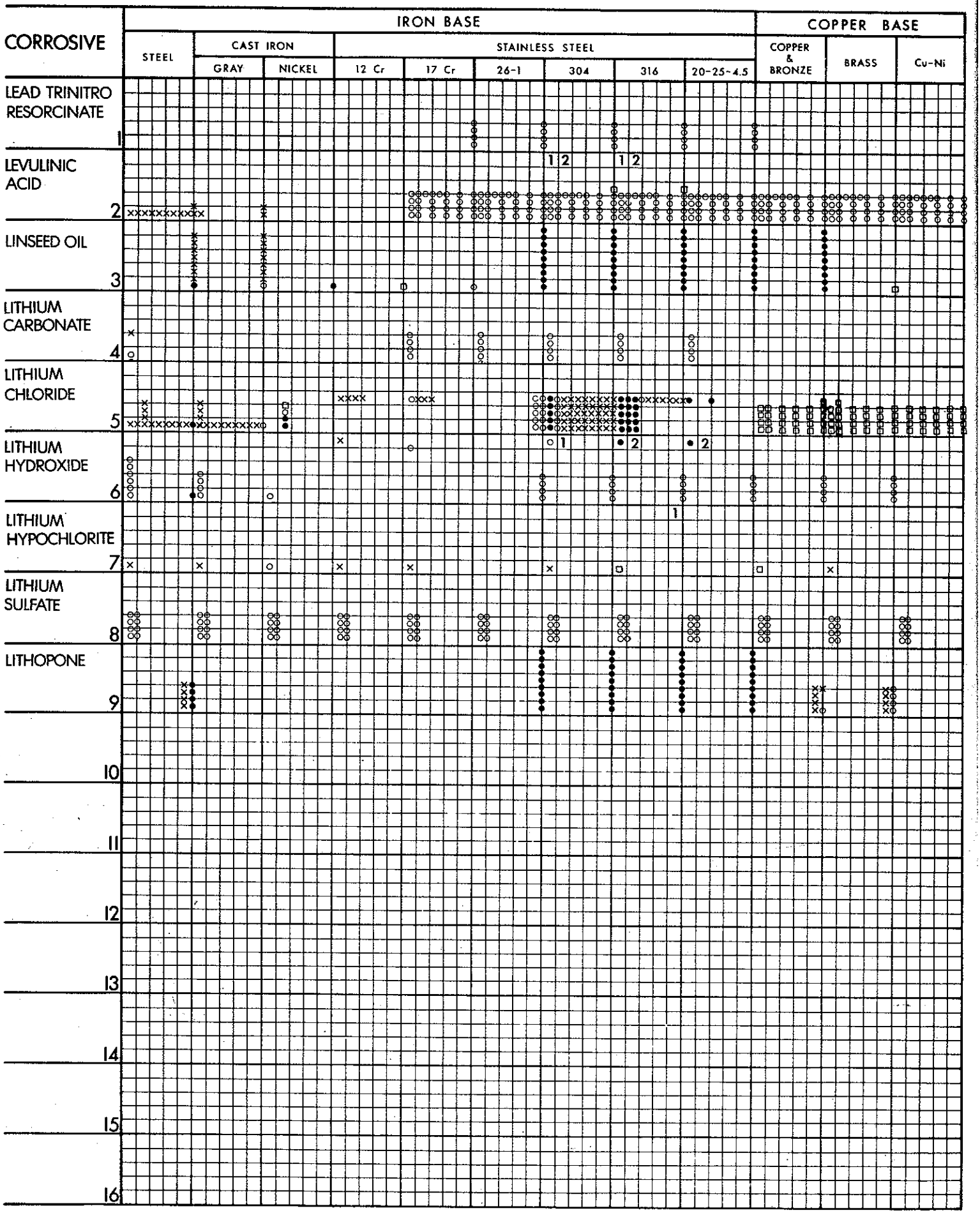
CORROSIVE
IRON BASE
COPPER BASE
STEEL
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GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
LEAD TRINITRO RESORCINATE 1
LEVULINIC ACID 2
LINSEED OIL 3
LITHIUM CARBONATE 4
LITHIUM CHLORIDE 5
LITHIUM HYDROXIDE 6
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LITHIUM SULFATE 8
LITHOPONE 9
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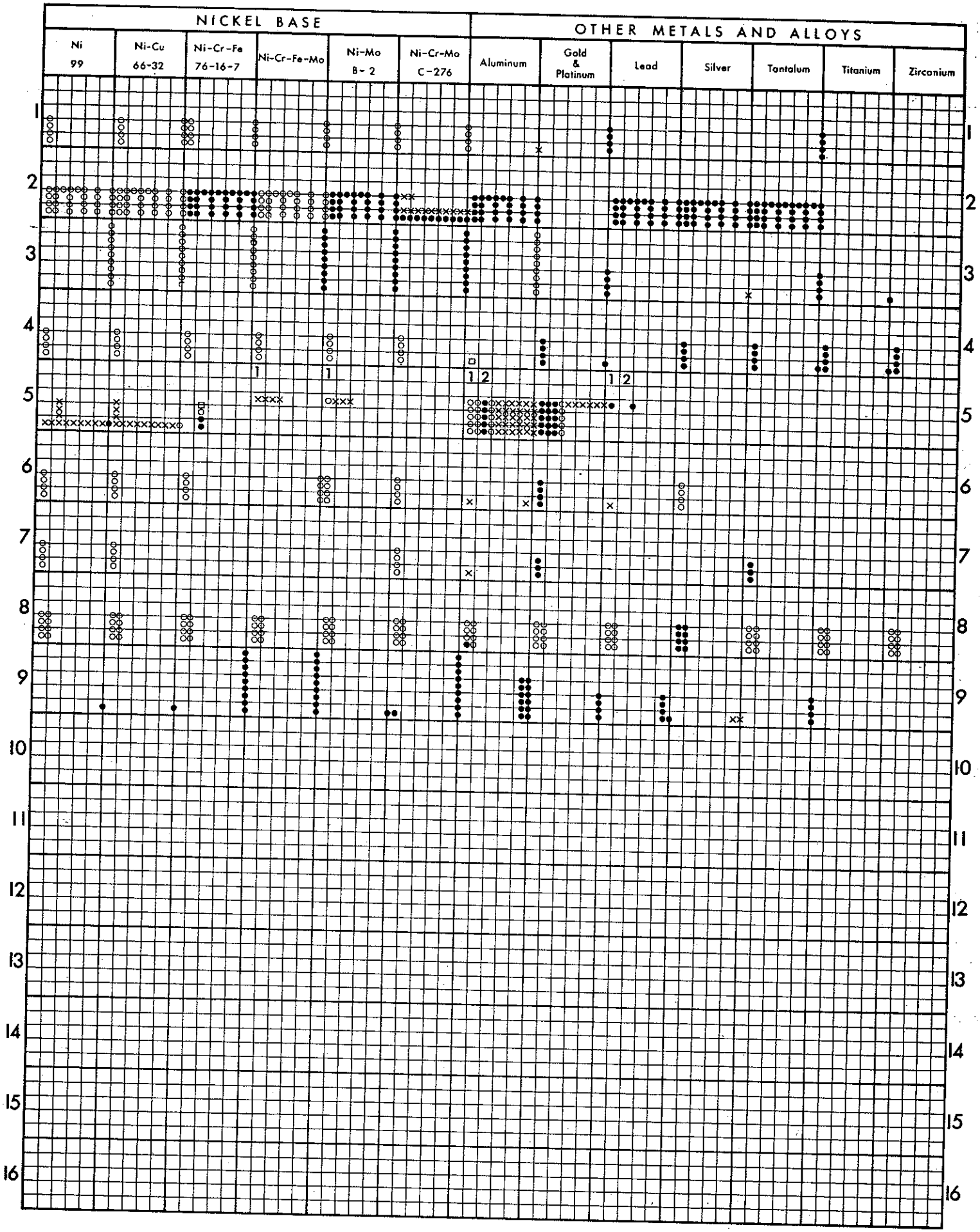
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OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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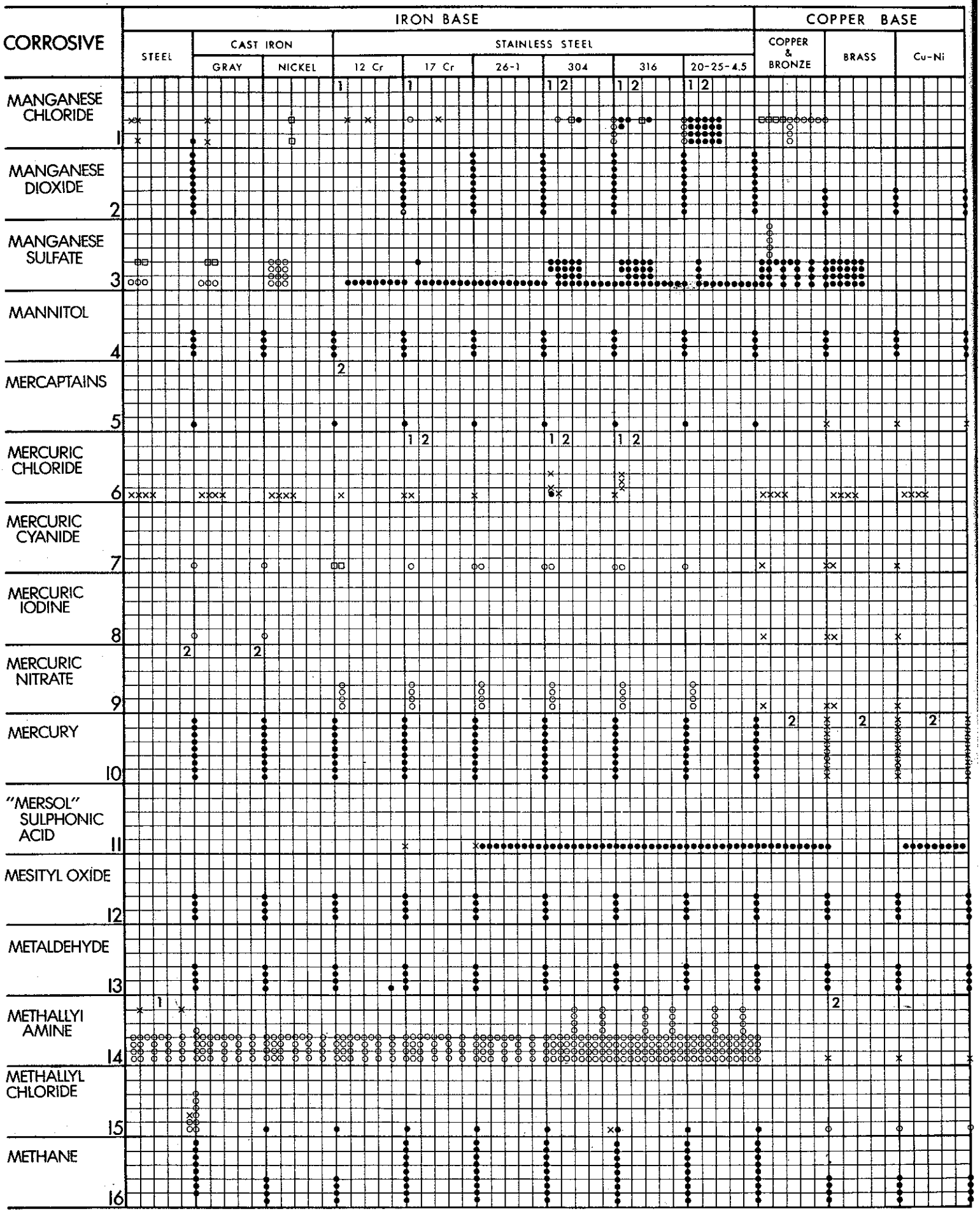
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IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
MANGANESE CHLORIDE 1
MANGANESE DIOXIDE 2
MANGANESE SULFATE 3
MANNITOL 4
MERCAPTAINS 5
MERCURIC CHLORIDE 6
MERCURIC CYANIDE 7
MERCURIC IODINE 8
MERCURIC NITRATE 9
MERCURY 10
"MERSOL" SULPHONIC ACID 11
MESITYL OXIDE 12
METALDEHYDE 13
METHALLYI AMINE 14
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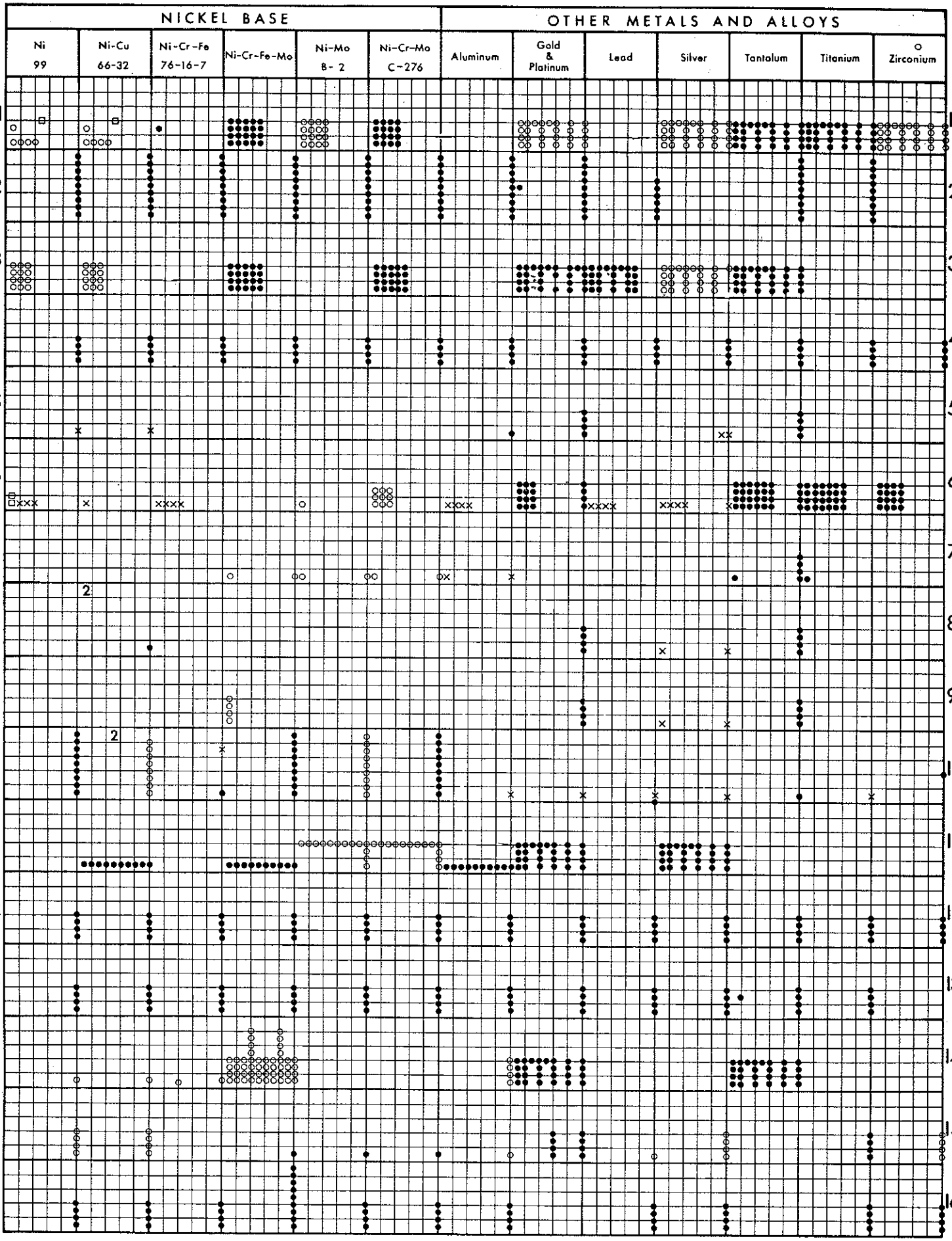
METHANE 16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OTHER METALS AND ALLOYS
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Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
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Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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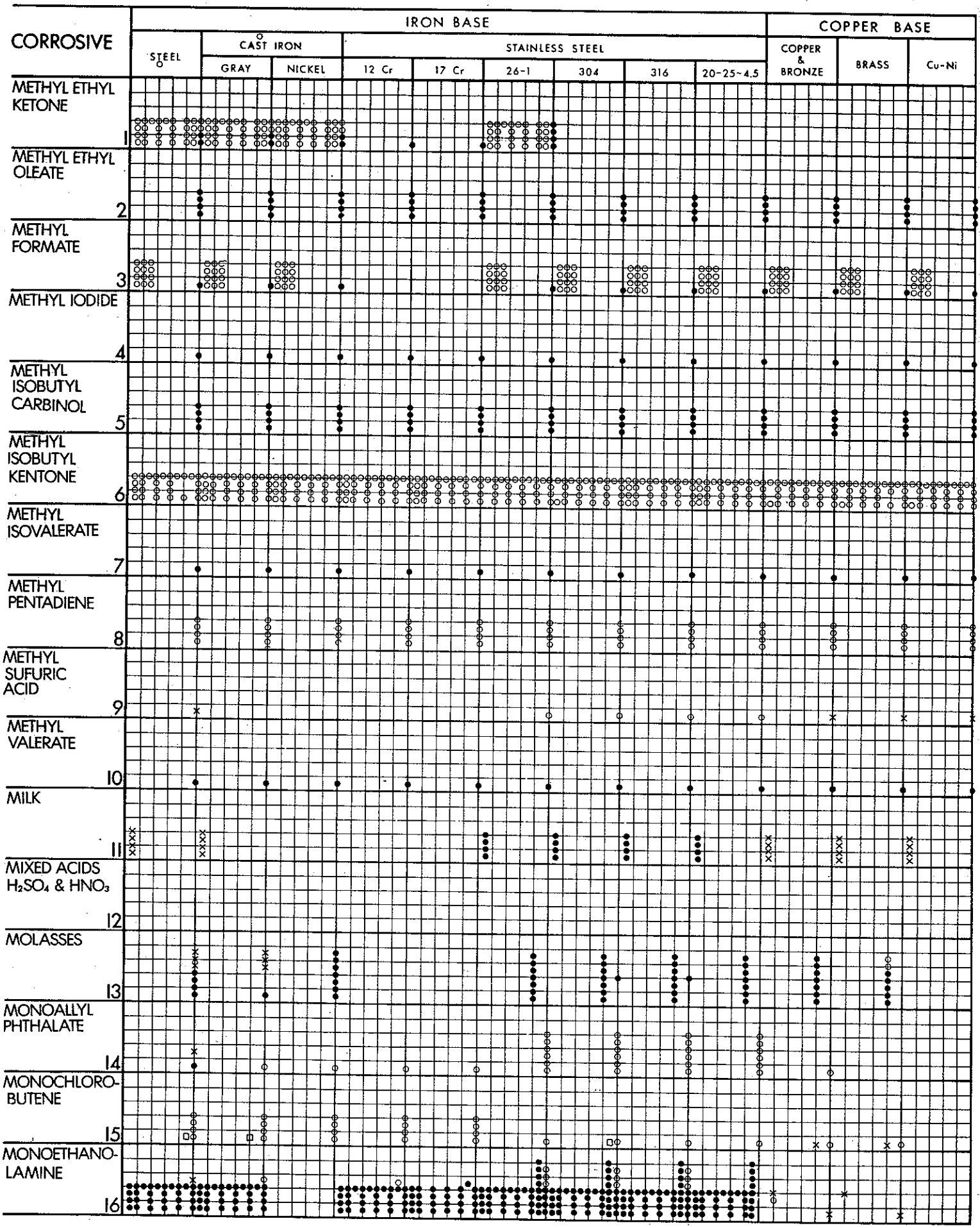
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
METHYL ETHYL KETONE 1
METHYL ETHYL OLEATE 2
METHYL FORMATE 3
METHYL IODIDE 4
METHYL ISOBUTYL CARBINOL 5
METHYL ISOBUTYL KENTONE 6
METHYL ISOVALERATE 7
METHYL PENTADIENE 8
METHYL SUFURIC ACID 9
METHYL VALERATE 10
MILK 11
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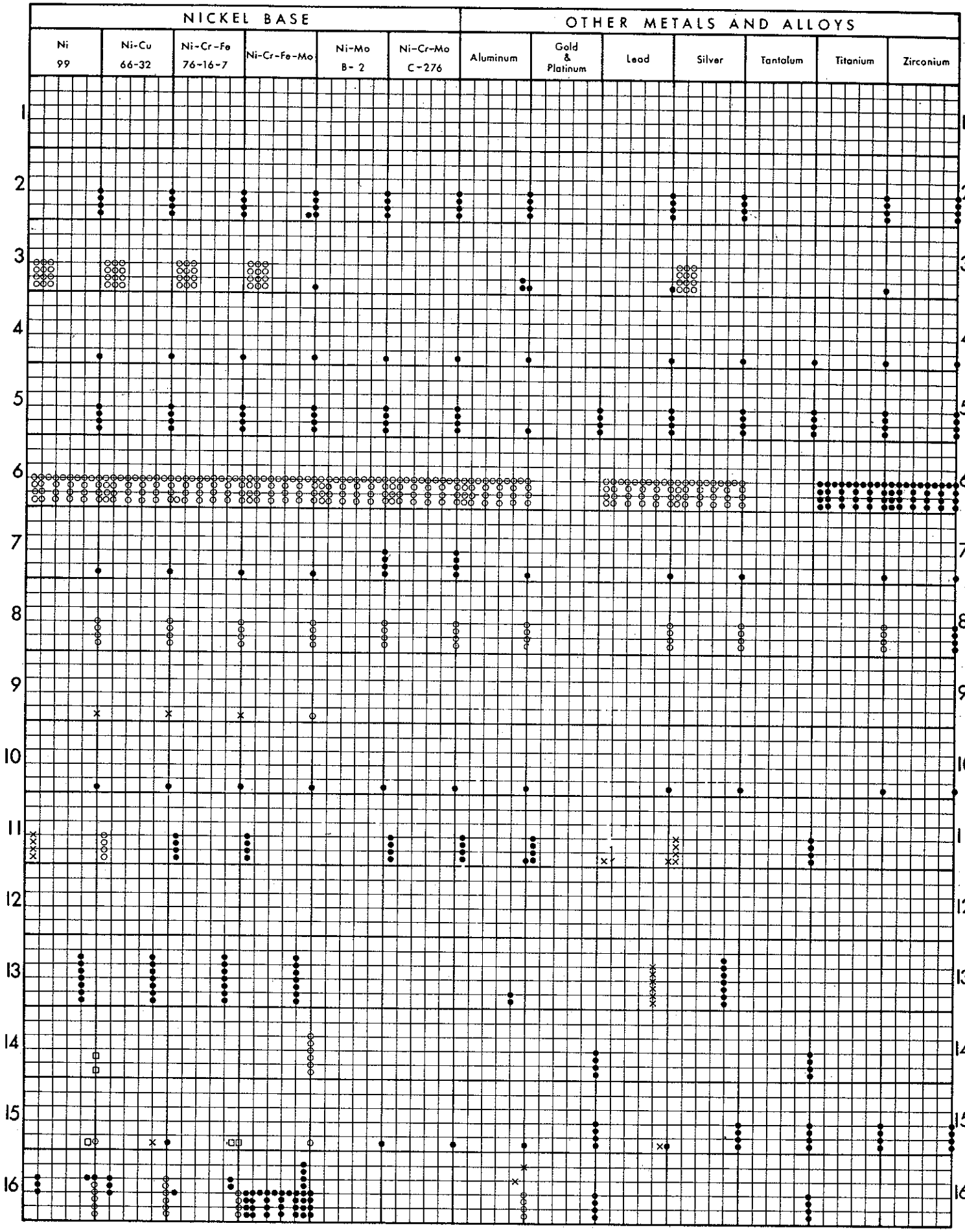
MOLASSES 13
MONOALLYL PHTHALATE 14
MONOCHLORO-BUTENE 15
MONOETHANO-LAMINE 16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OTHER METALS AND ALLOYS
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Ni-Cu 66-32
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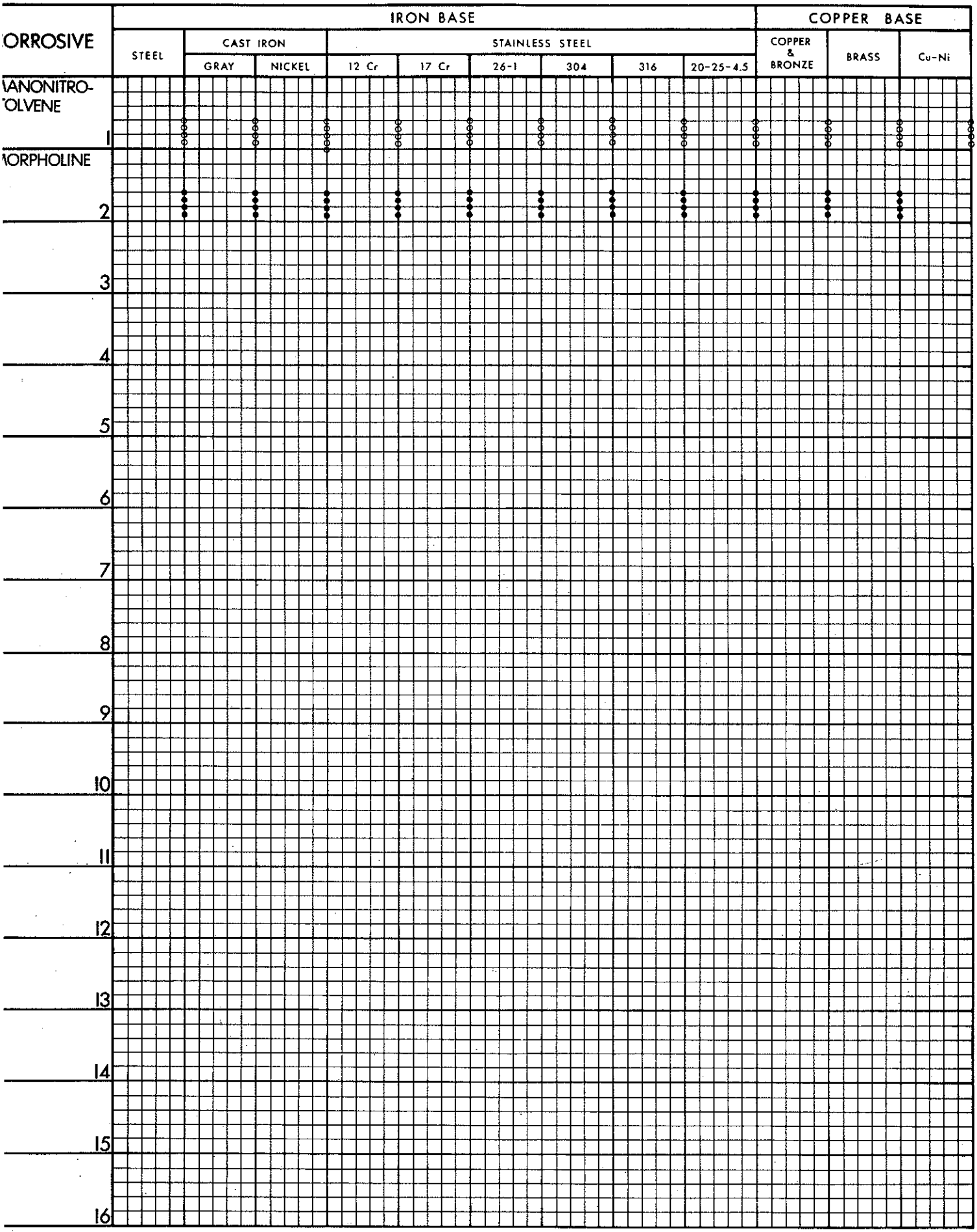
IRON BASE
COPPER BASE
ORROSIVE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
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17 Cr
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304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
ANONITRO-
OLVENE
ORPHOLINE
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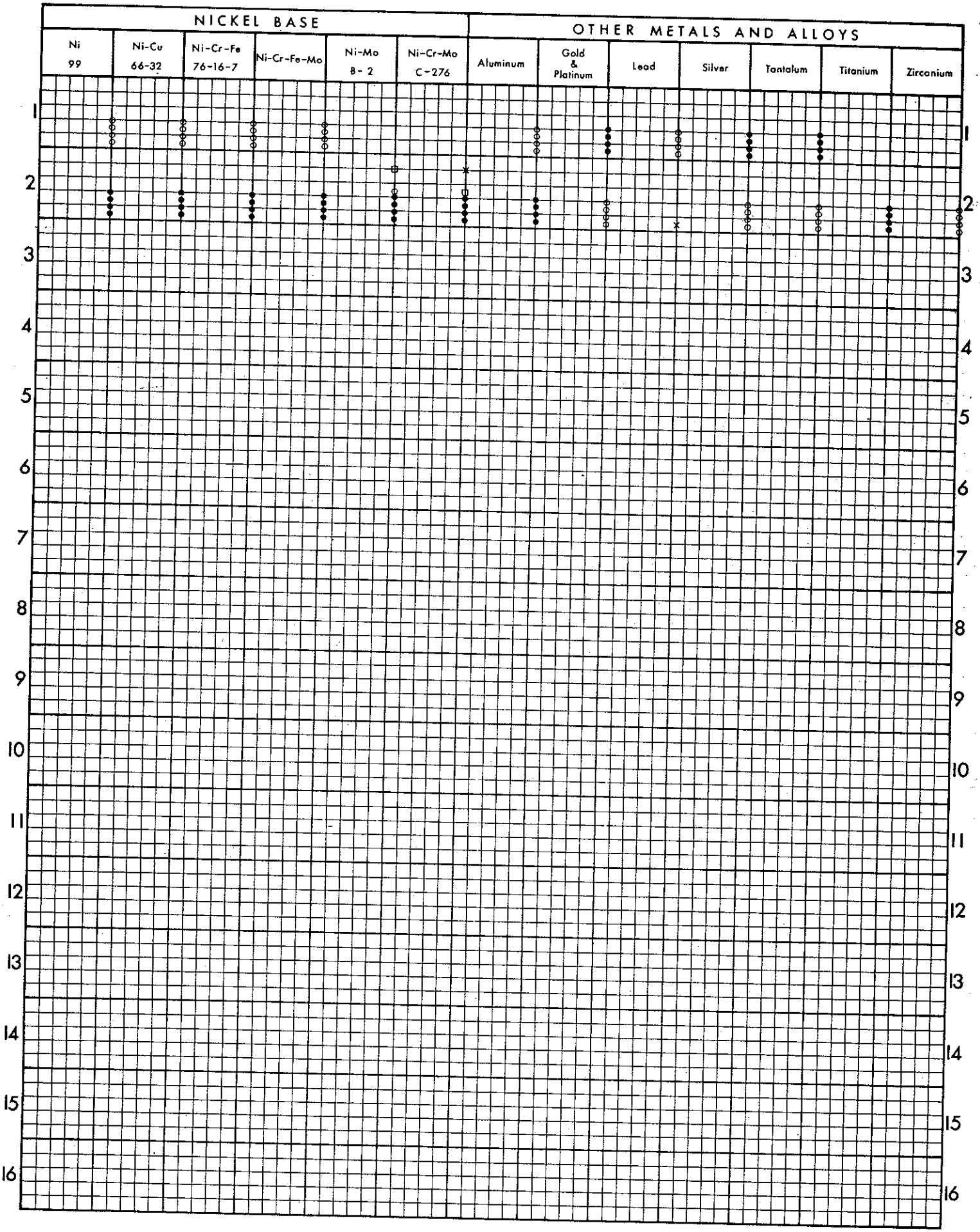
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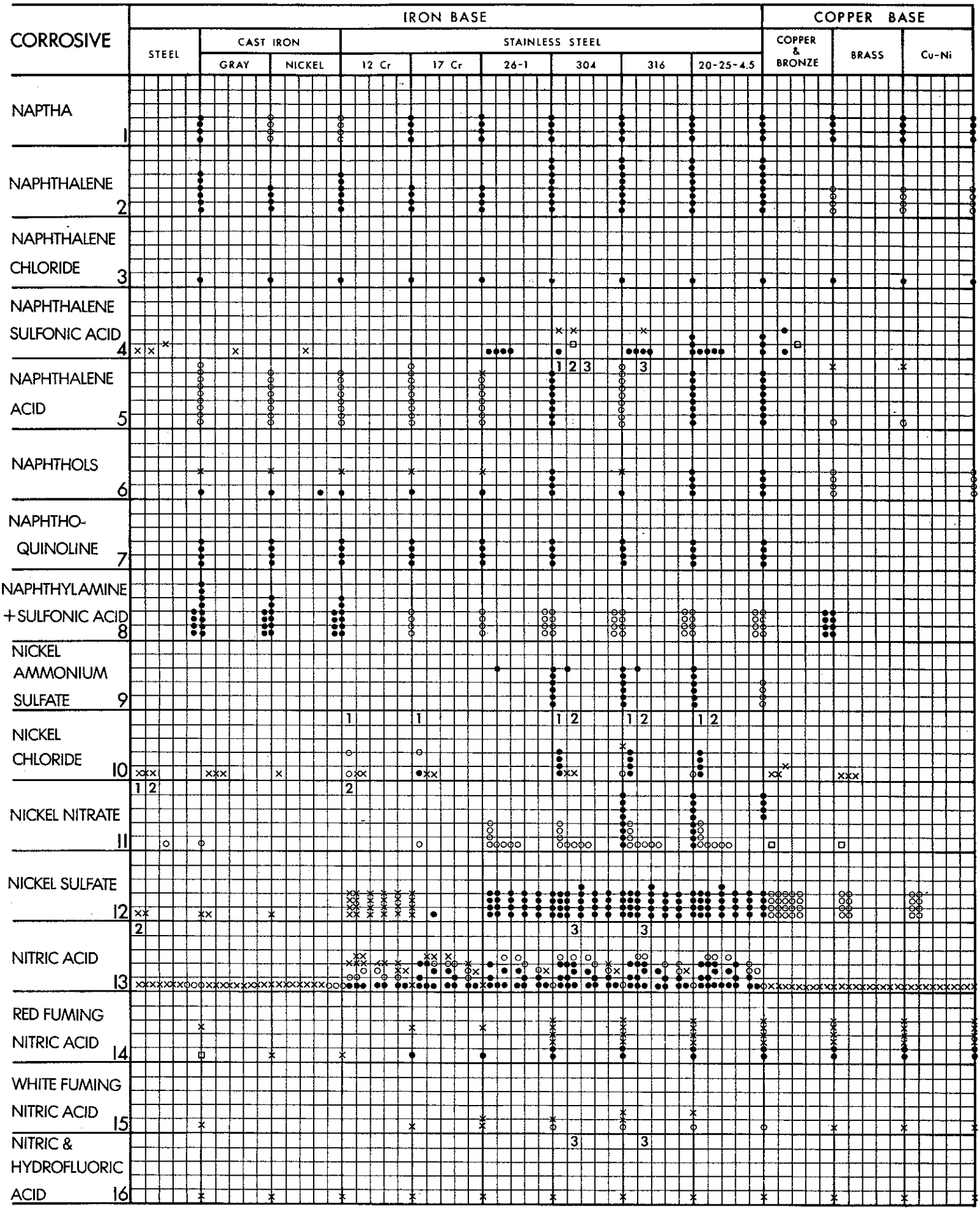
CORROSIVE
IRON BASE
COPPER BASE
STEEL
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GRAY
NICKEL
STAINLESS STEEL
12 Cr
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26-1
304
316
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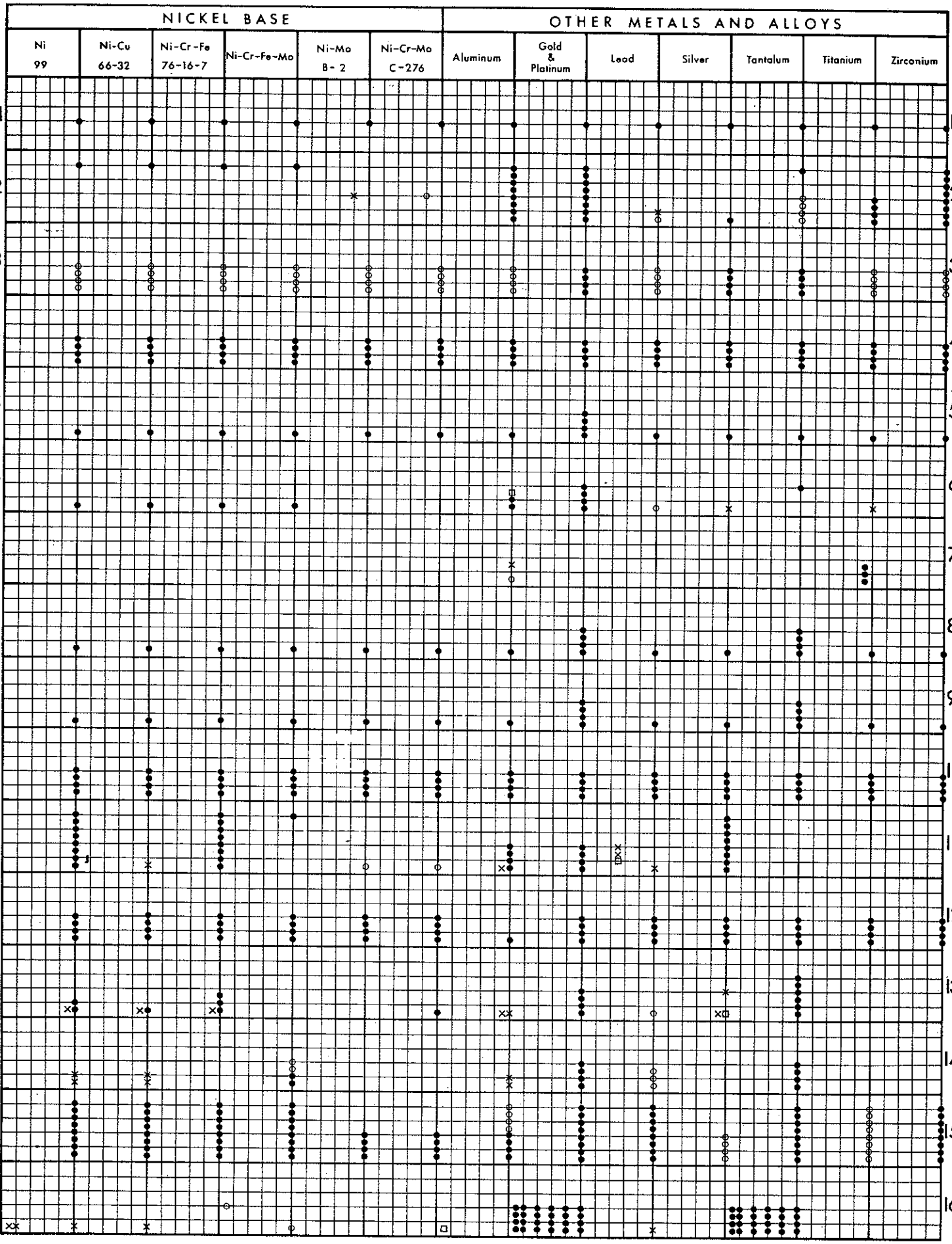
COPPER & BRONZE
BRASS
Cu-Ni
NAPTHA 1
NAPHTHALENE 2
NAPHTHALENE CHLORIDE 3
NAPHTHALENE SULFONIC ACID 4
NAPHTHALENE ACID 5
NAPHTHOLS 6
NAPHTHO-QUINOLINE 7
NAPHTHYLAMINE + SULFONIC ACID 8
NICKEL AMMONIUM SULFATE 9
NICKEL CHLORIDE 10
NICKEL NITRATE 11
NICKEL SULFATE 12
NITRIC ACID 13
RED FUMING NITRIC ACID 14
WHITE FUMING NITRIC ACID 15
NITRIC & HYDROFLUORIC ACID 16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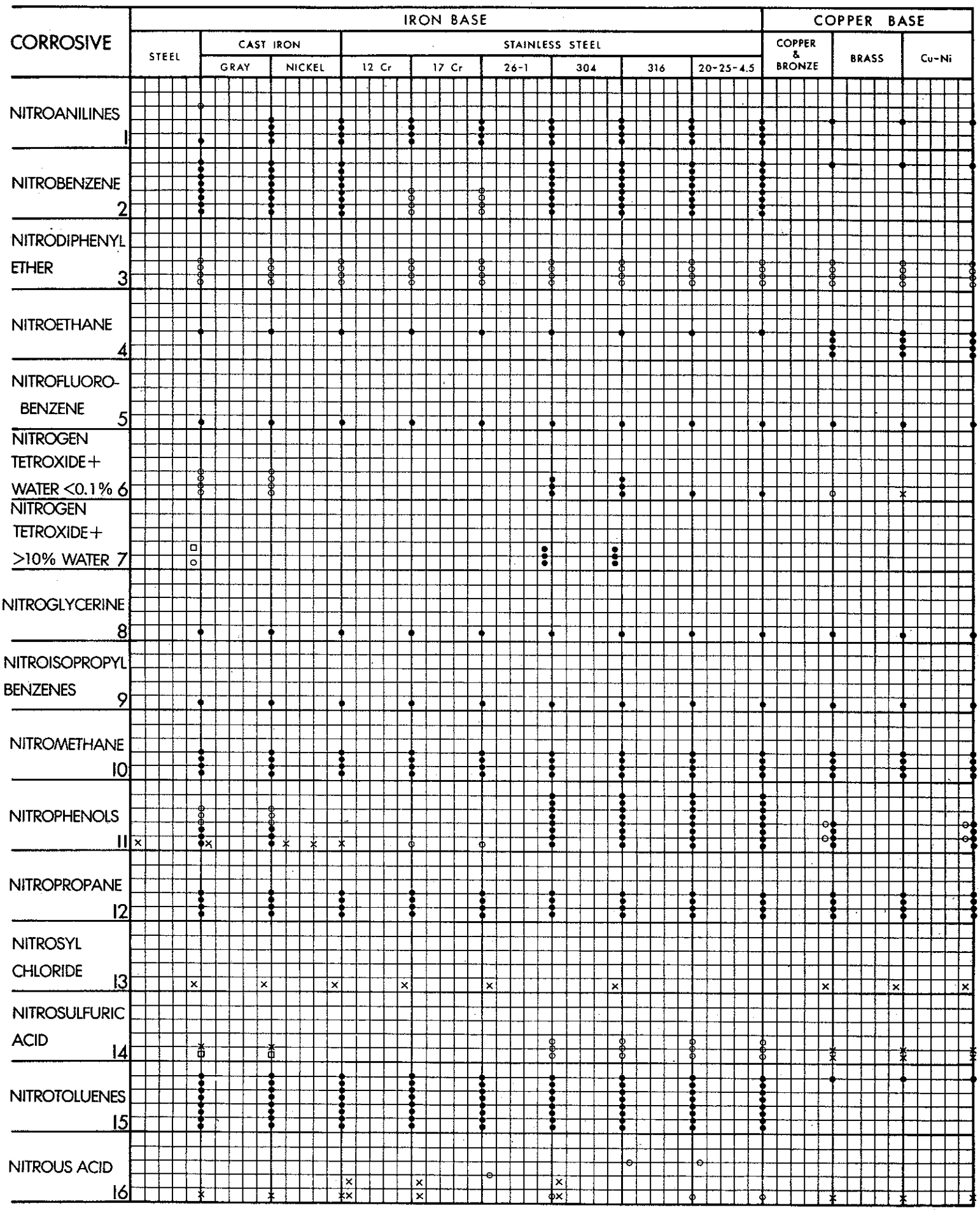
CORROSIVE
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STEEL
CAST IRON
GRAY
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STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
NITROANILINES 1
NITROBENZENE 2
NITRODIPHENYL ETHER 3
NITROETHANE 4
NITROFLUORO-BENZENE 5
NITROGEN TETROXIDE + WATER <0.1% 6
NITROGEN TETROXIDE + >10% WATER 7
NITROGLYCERINE 8
NITROISOPROPYL BENZENES 9
NITROMETHANE 10
NITROPHENOLS 11
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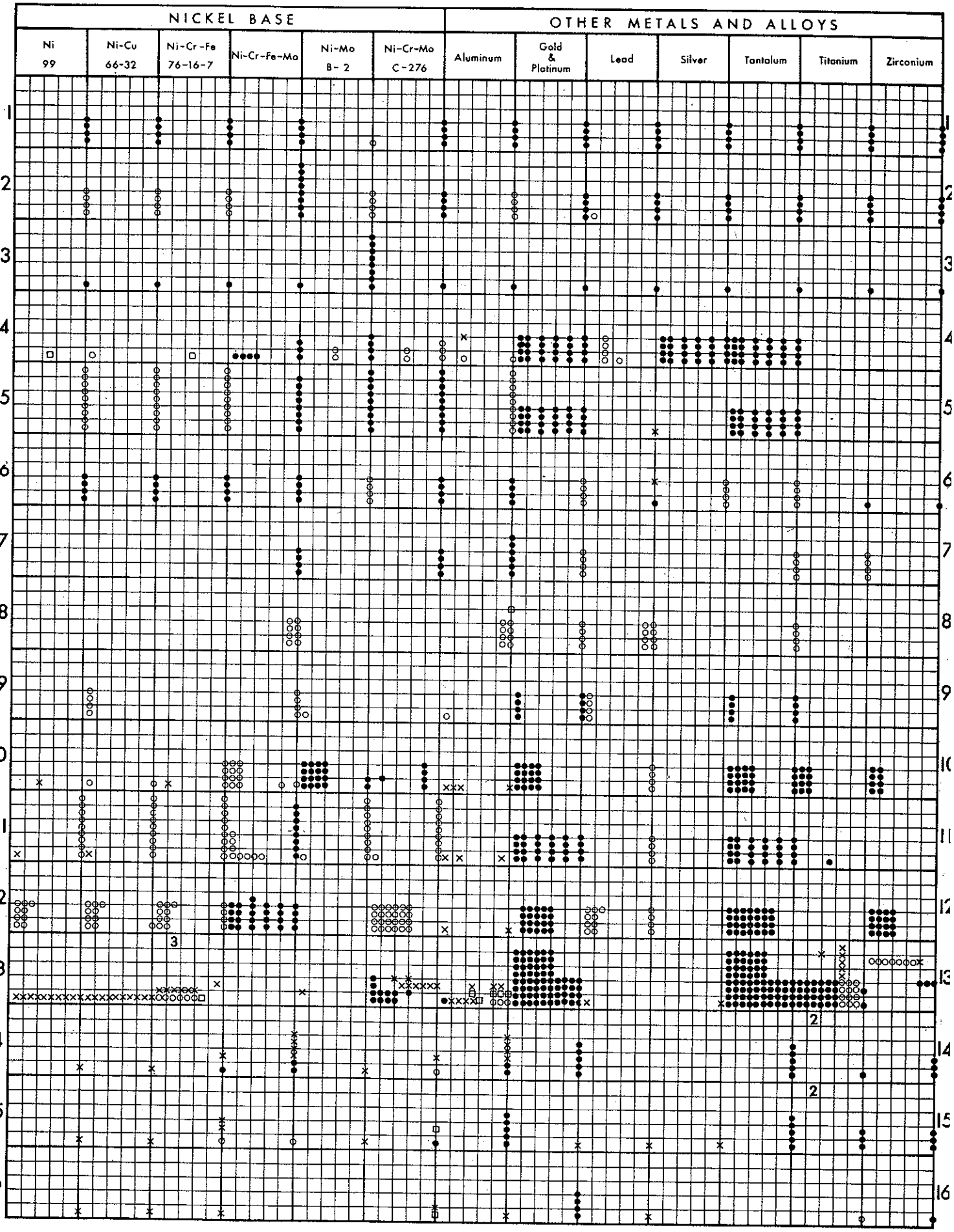
NITROSULFURIC ACID 14
NITROTOLUENES 15
NITROUS ACID 16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Ni-Cu 66-32
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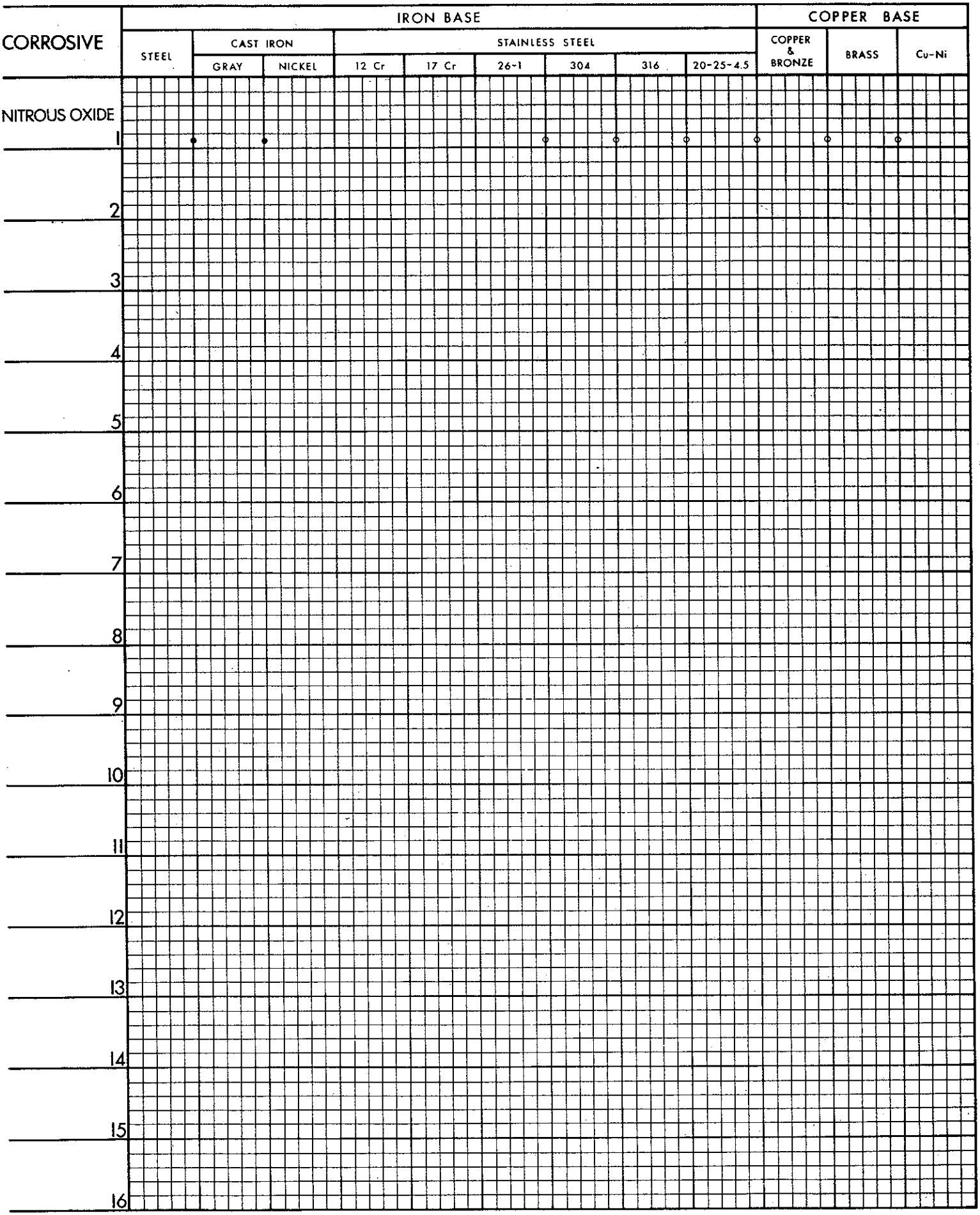
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
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316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
NITROUS OXIDE
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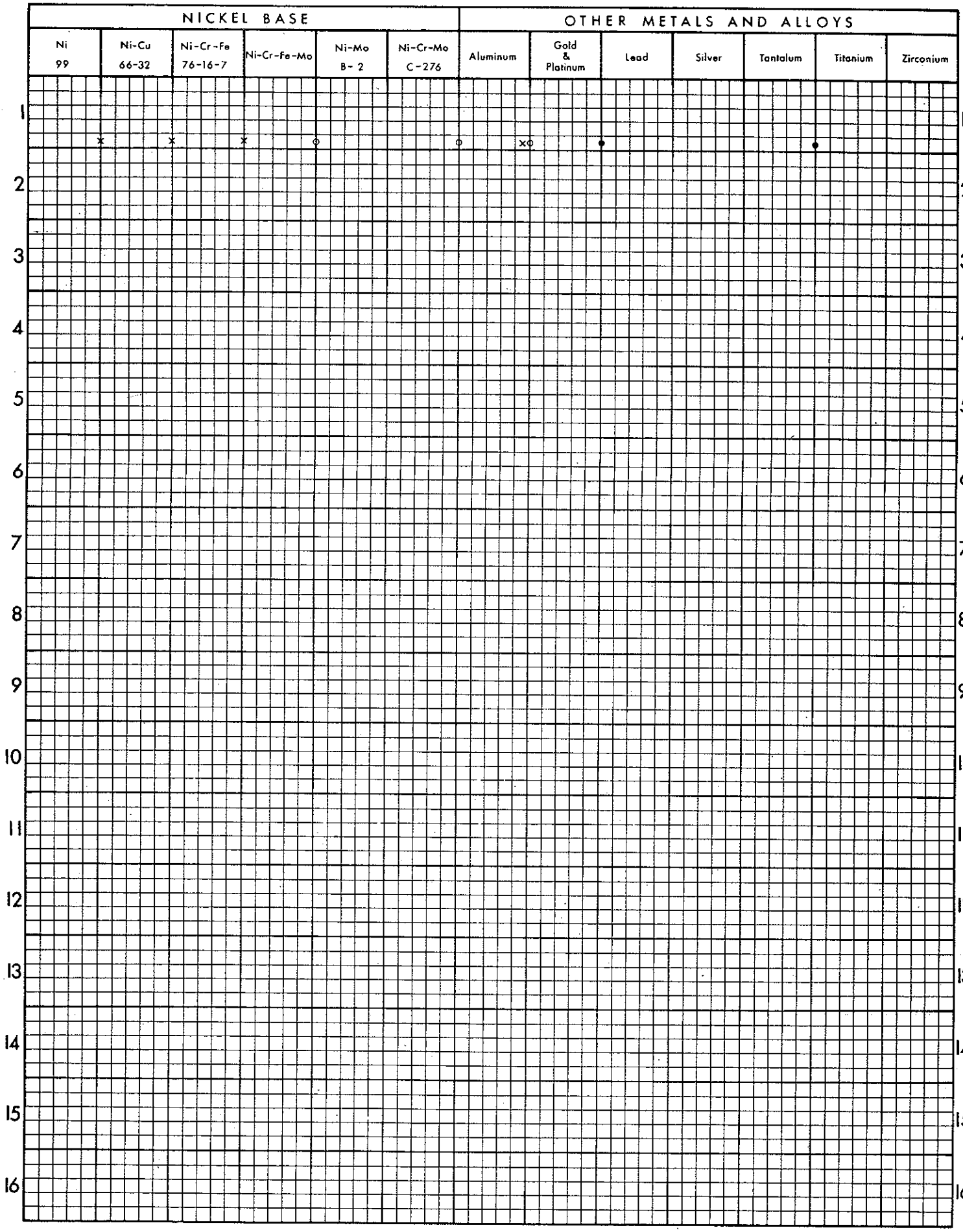
NICKEL BASE
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Ni-Mo B-2
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Tantalum
Titanium
Zirconium
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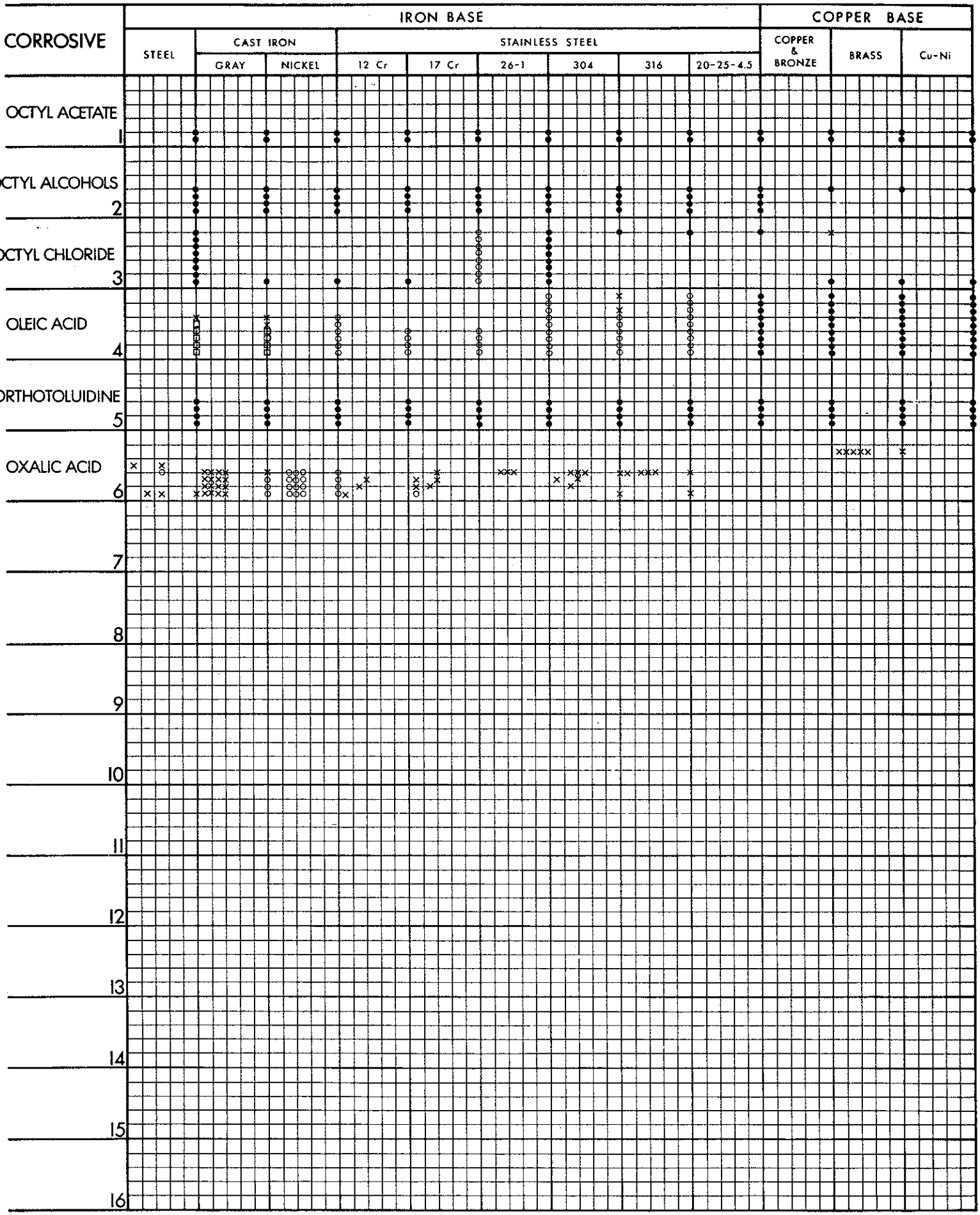
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
OCTYL ACETATE
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OCTYL ALCOHOLS
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OCTYL CHLORIDE
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OLEIC ACID
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OXALIC ACID
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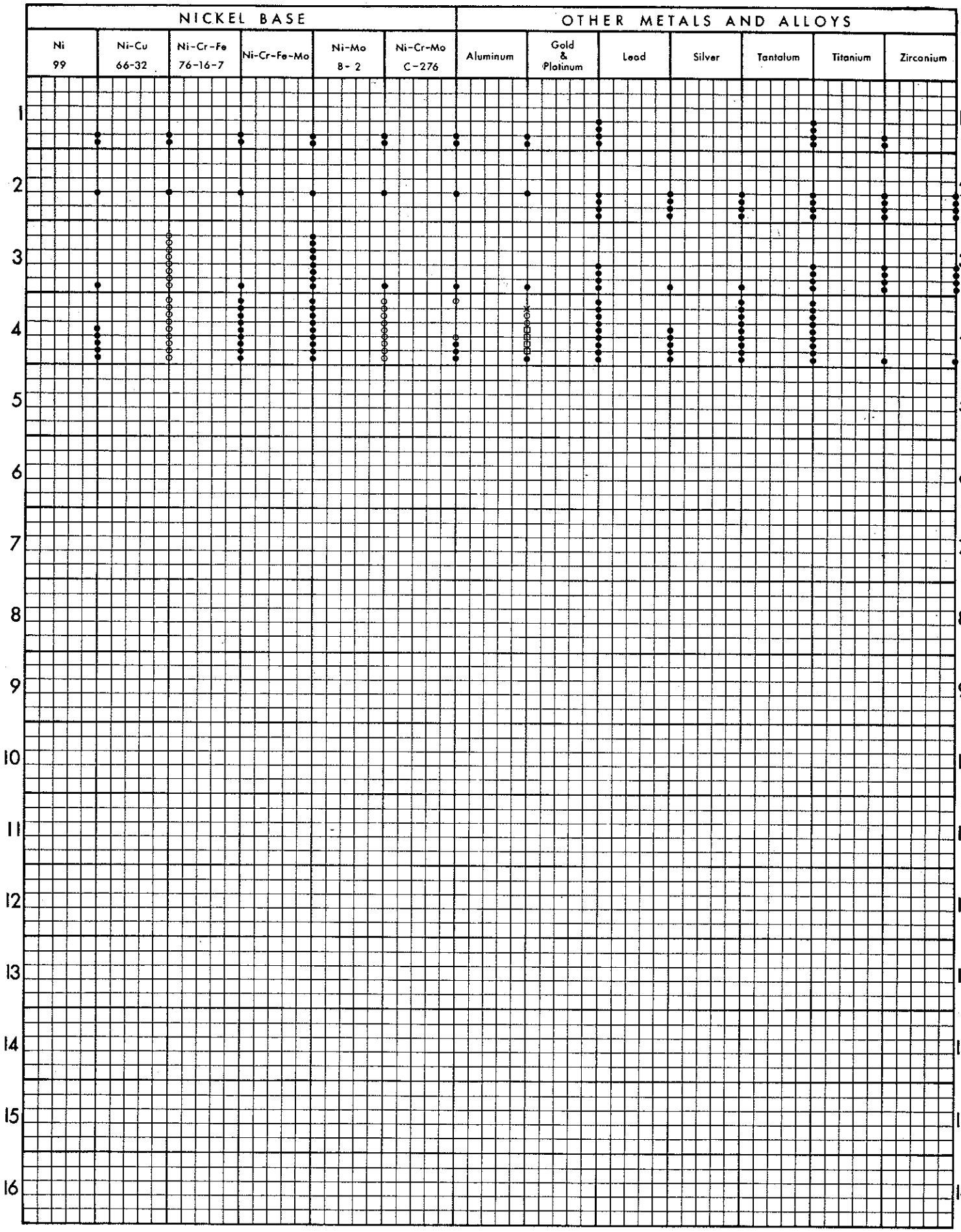
NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo 8- 2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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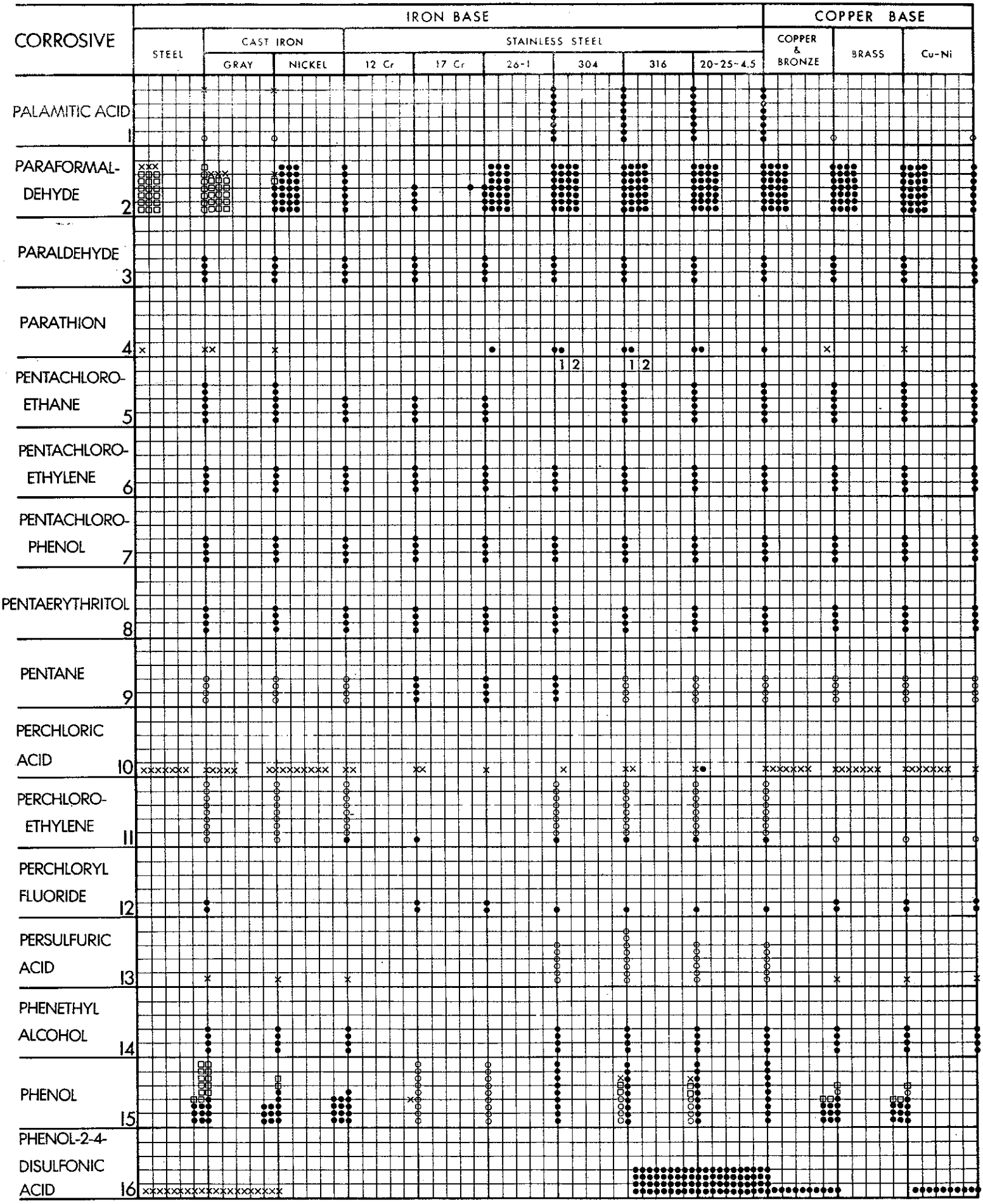
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
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316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
PALAMITIC ACID 1
PARAFORMAL-DEHYDE 2
PARALDEHYDE 3
PARATHION 4
PENTACHLORO-ETHANE 5
PENTACHLORO-ETHYLENE 6
PENTACHLORO-PHENOL 7
PENTAERYTHRITOL 8
PENTANE 9
PERCHLORIC ACID 10
PERCHLORO-ETHYLENE 11
PERCHLORYL FLUORIDE 12
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PHENOL-2-4-DISULFONIC ACID 16
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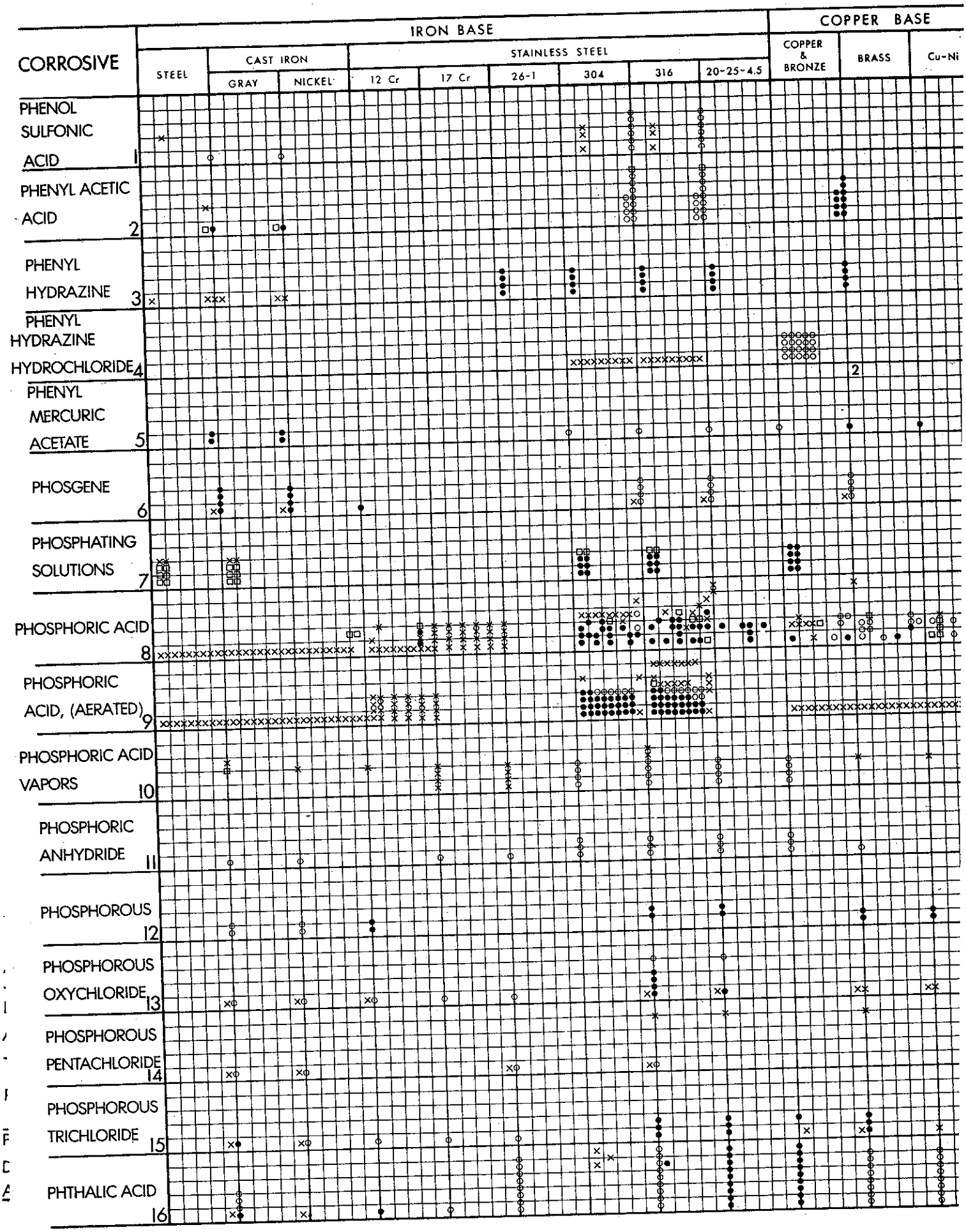
1 2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COPPER BASE
STEEL
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12 Cr
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316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
PHENOL SULFONIC ACID 1
PHENYL ACETIC ACID 2
PHENYL HYDRAZINE 3
PHENYL HYDRAZINE HYDROCHLORIDE 4
PHENYL MERCURIC ACETATE 5
PHOSGENE 6
PHOSPHATING SOLUTIONS 7
PHOSPHORIC ACID 8
PHOSPHORIC ACID, (AERATED) 9
PHOSPHORIC ACID VAPORS 10
PHOSPHORIC ANHYDRIDE 11
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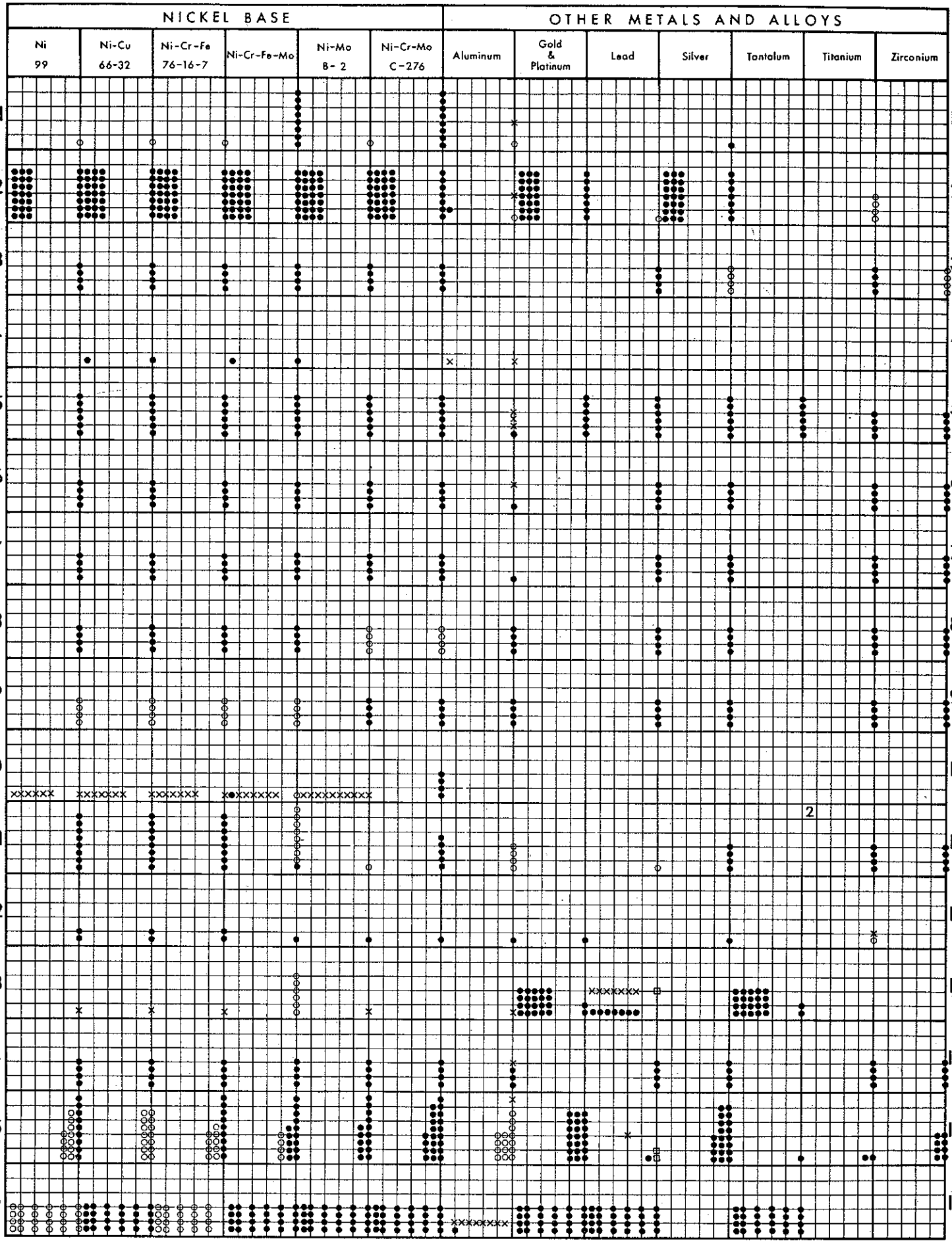
NICKEL BASE
OTHER METALS AND ALLOYS
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Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
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Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
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Silver
Tantalum
Titanium
Zirconium
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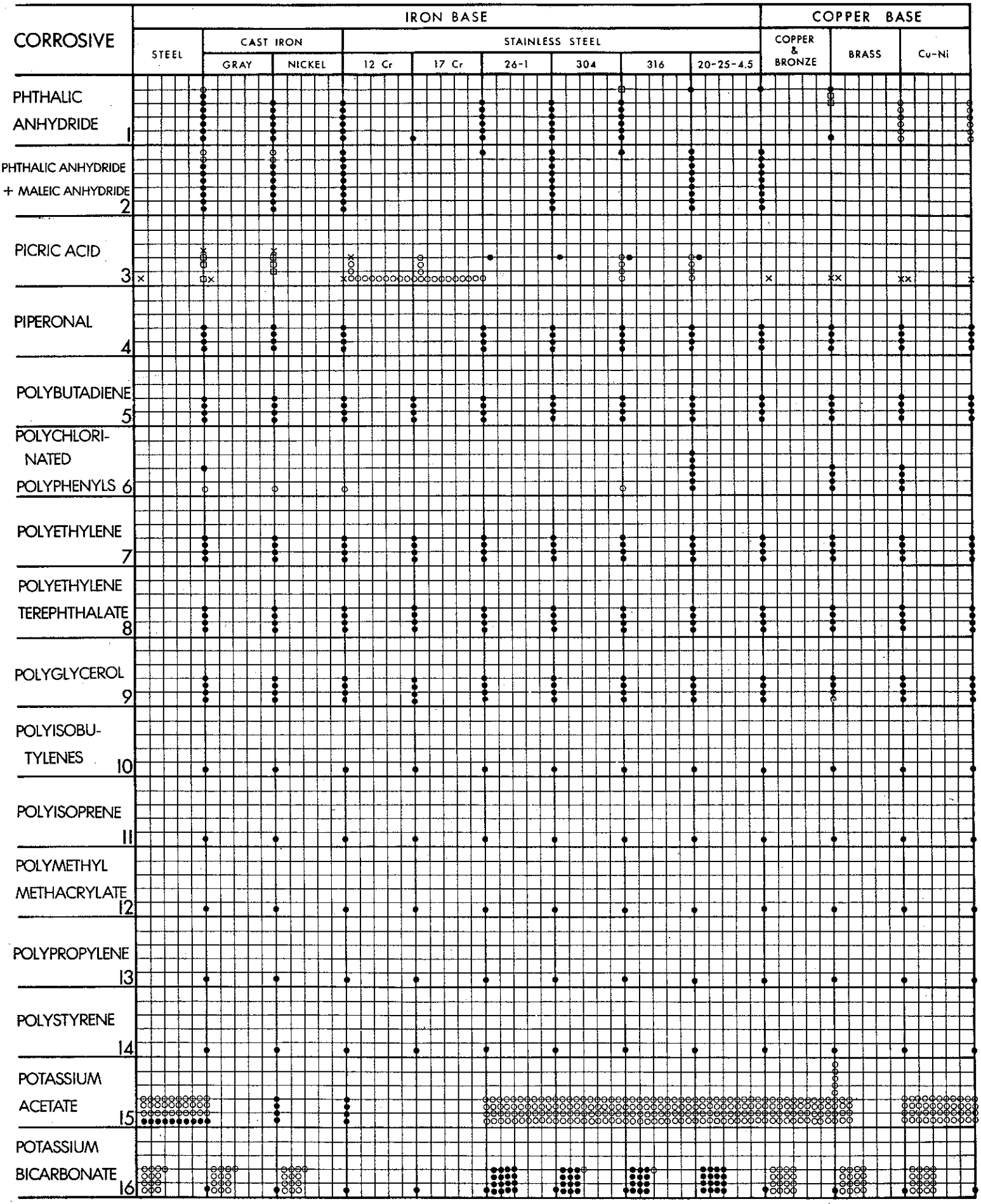
CORROSIVE
IRON BASE
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NICKEL
STAINLESS STEEL
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17 Cr
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316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
PHTHALIC ANHYDRIDE 1
PHTHALIC ANHYDRIDE + MALEIC ANHYDRIDE 2
PICRIC ACID 3
PIPERONAL 4
POLYBUTADIENE 5
POLYCHLORINATED POLYPHENYLS 6
POLYETHYLENE 7
POLYETHYLENE TEREPHTHALATE 8
POLYGLYCEROL 9
POLYISOBUTYLENES 10
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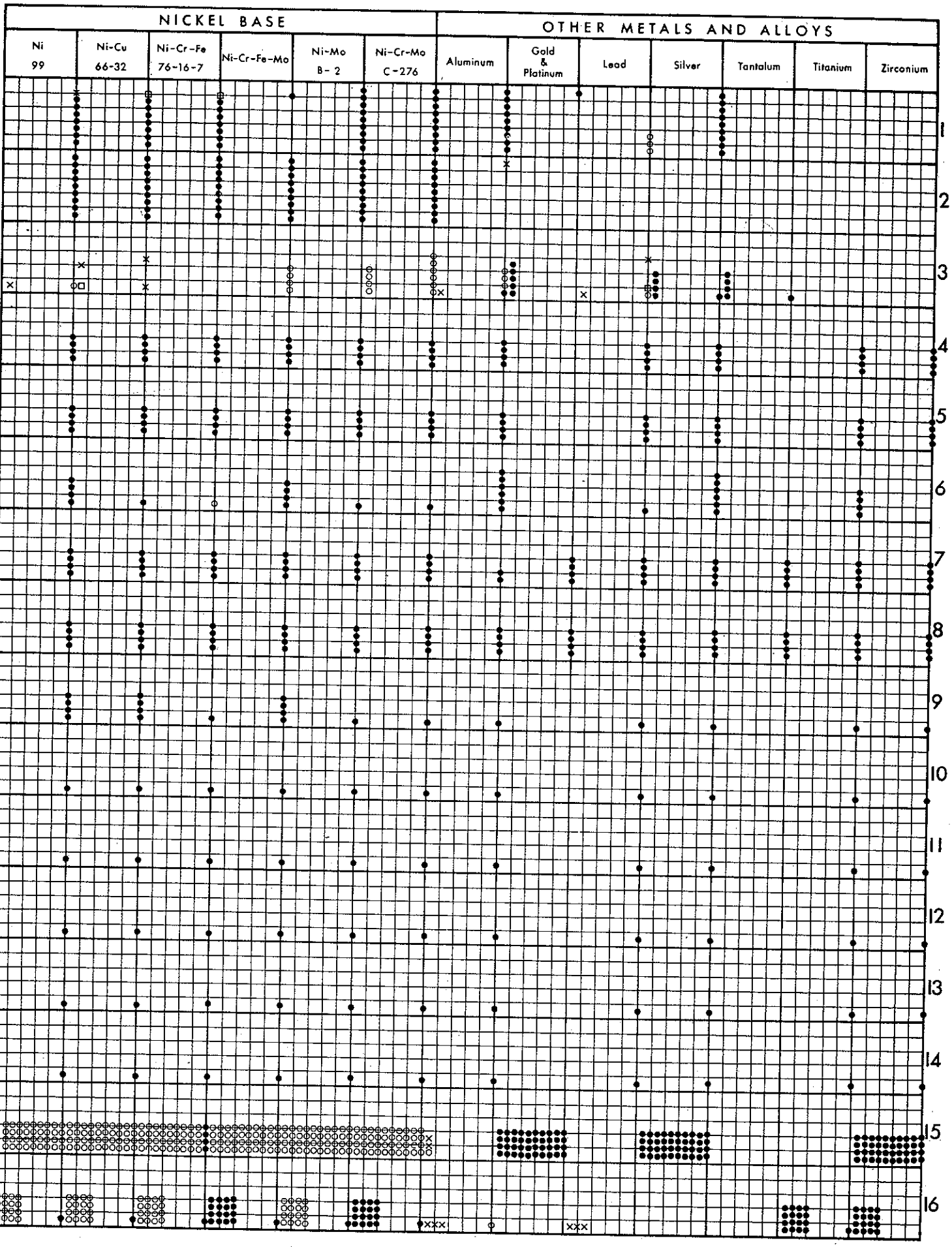
NICKEL BASE
OTHER METALS AND ALLOYS
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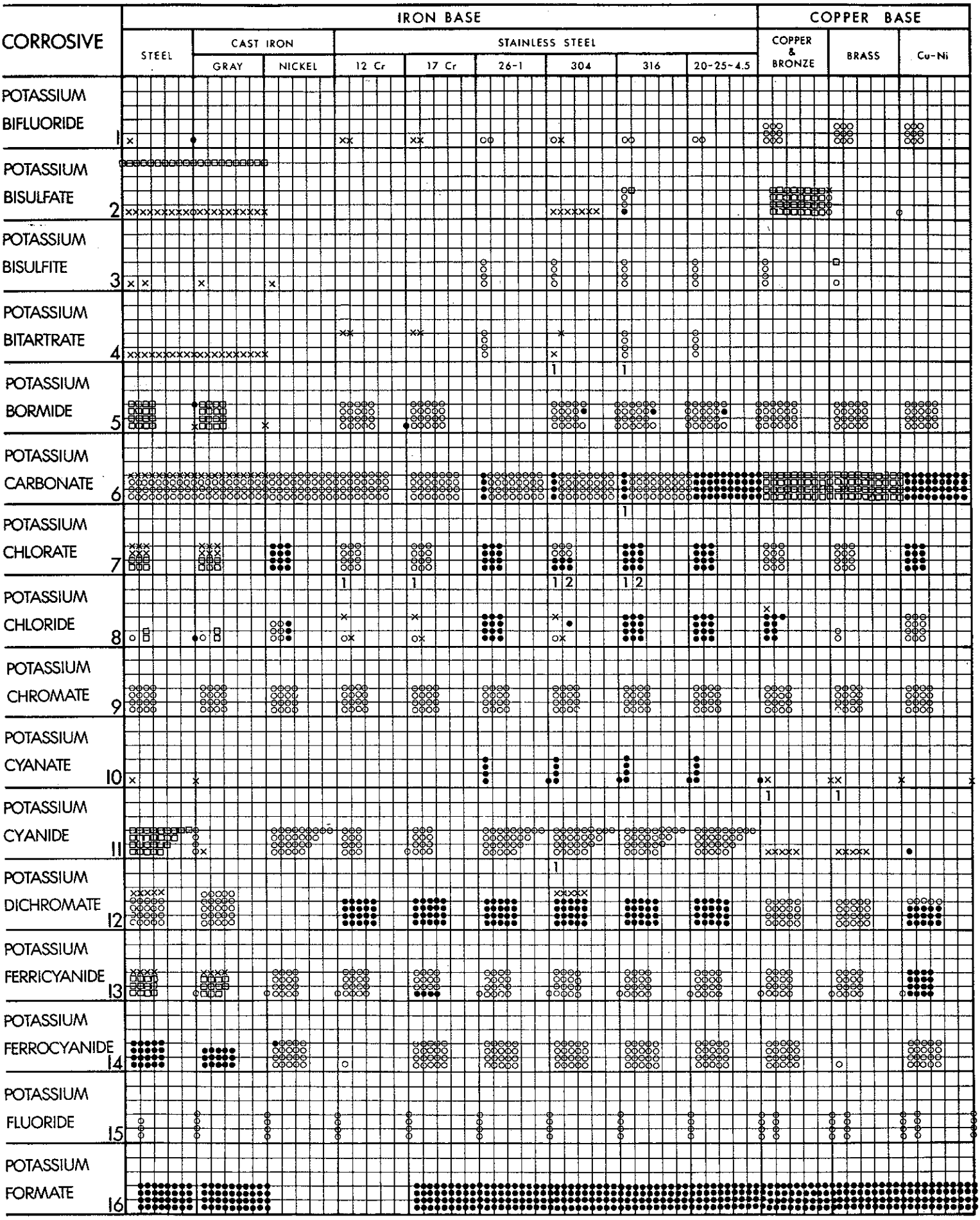
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COPPER & BRONZE
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Cu-Ni
POTASSIUM BIFLUORIDE 1
POTASSIUM BISULFATE 2
POTASSIUM BISULFITE 3
POTASSIUM BITARTRATE 4
POTASSIUM BORMIDE 5
POTASSIUM CARBONATE 6
POTASSIUM CHLORATE 7
POTASSIUM CHLORIDE 8
POTASSIUM CHROMATE 9
POTASSIUM CYANATE 10
POTASSIUM CYANIDE 11
POTASSIUM DICHROMATE 12
POTASSIUM FERRICYANIDE 13
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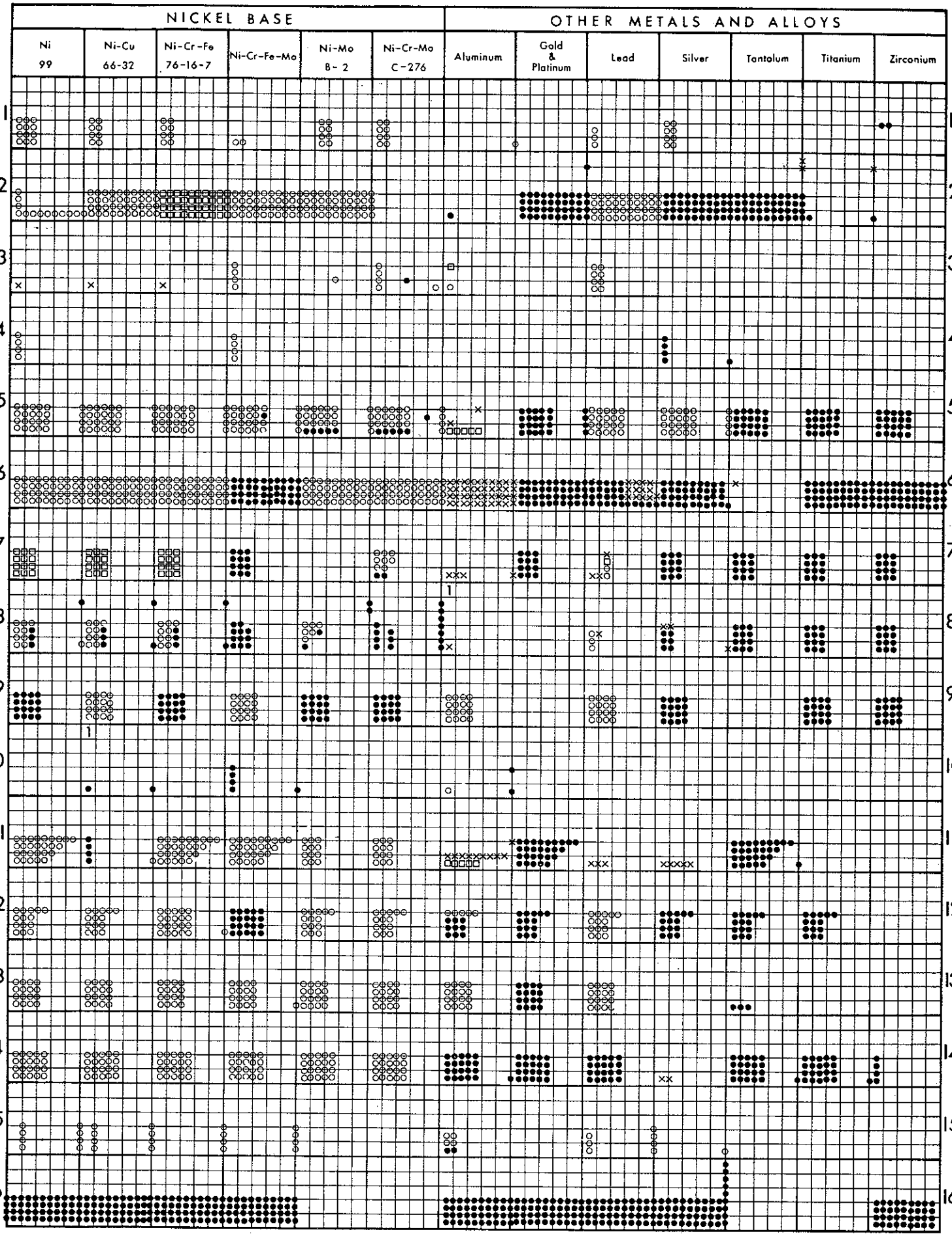
POTASSIUM FLUORIDE 15
POTASSIUM FORMATE 16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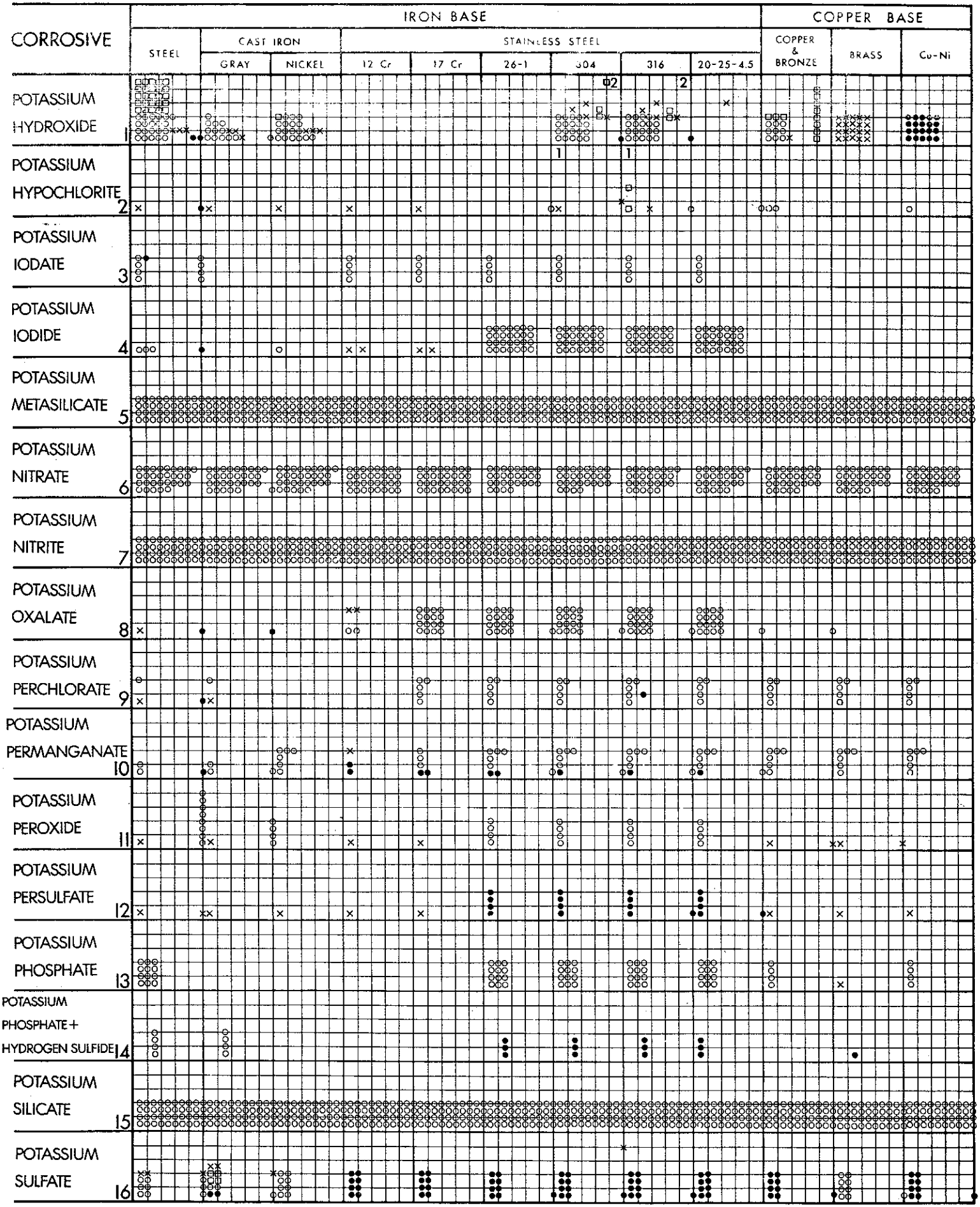
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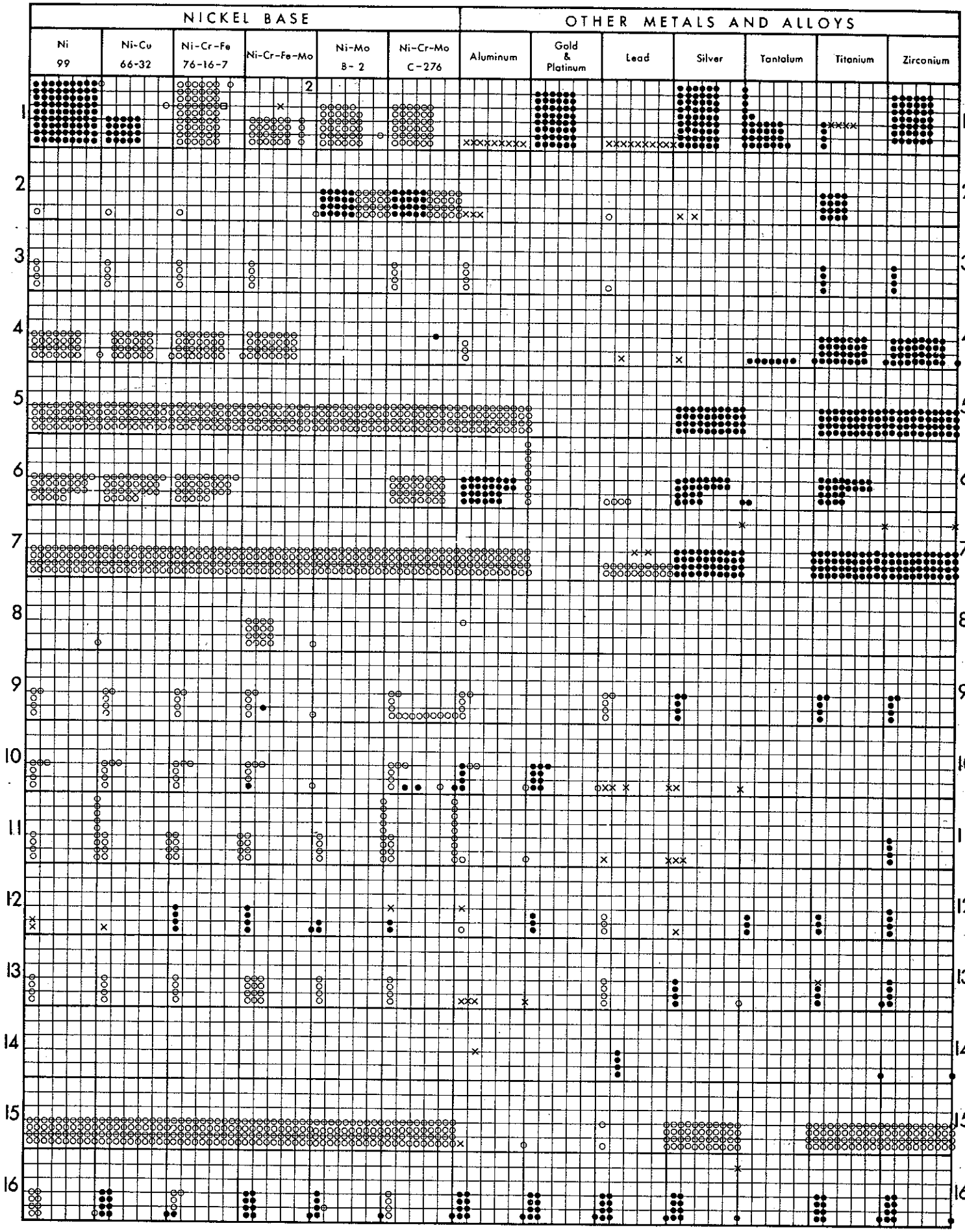
POTASSIUM METASILICATE 5
POTASSIUM NITRATE 6
POTASSIUM NITRITE 7
POTASSIUM OXALATE 8
POTASSIUM PERCHLORATE 9
POTASSIUM PERMANGANATE 10
POTASSIUM PEROXIDE 11
POTASSIUM PERSULFATE 12
POTASSIUM PHOSPHATE 13
POTASSIUM PHOSPHATE + HYDROGEN SULFIDE 14
POTASSIUM SILICATE 15
POTASSIUM SULFATE 16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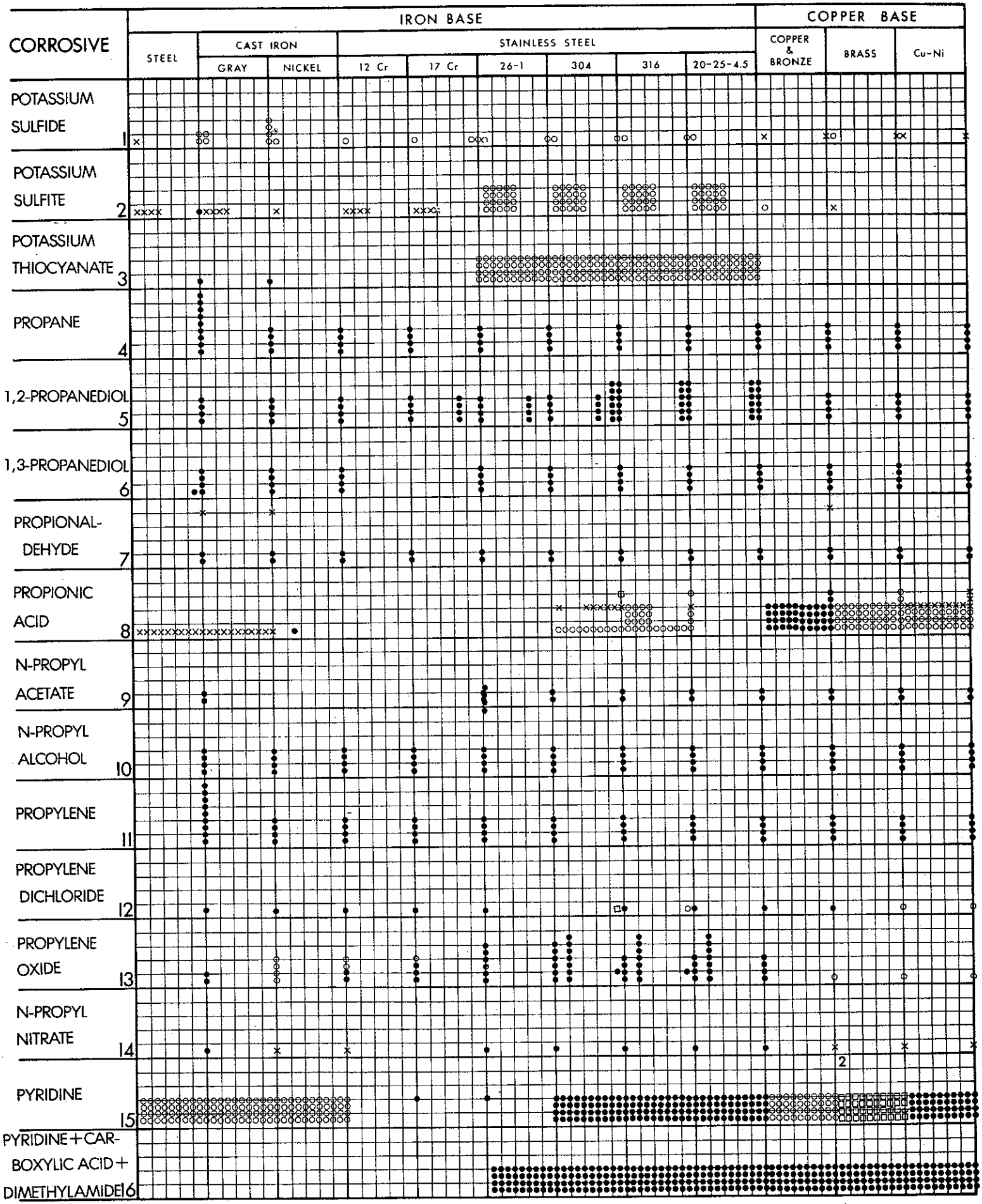
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
POTASSIUM SULFIDE 1
POTASSIUM SULFITE 2
POTASSIUM THIOCYANATE 3
PROPANE 4
1,2-PROPANEDIOL 5
1,3-PROPANEDIOL 6
PROPIONAL-DEHYDE 7
PROPIONIC ACID 8
N-PROPYL ACETATE 9
N-PROPYL ALCOHOL 10
PROPYLENE 11
PROPYLENE DICHLORIDE 12
PROPYLENE OXIDE 13
N-PROPYL NITRATE 14
PYRIDINE 15
PYRIDINE + CARBOXYLIC ACID + DIMETHYLAMIDE 16
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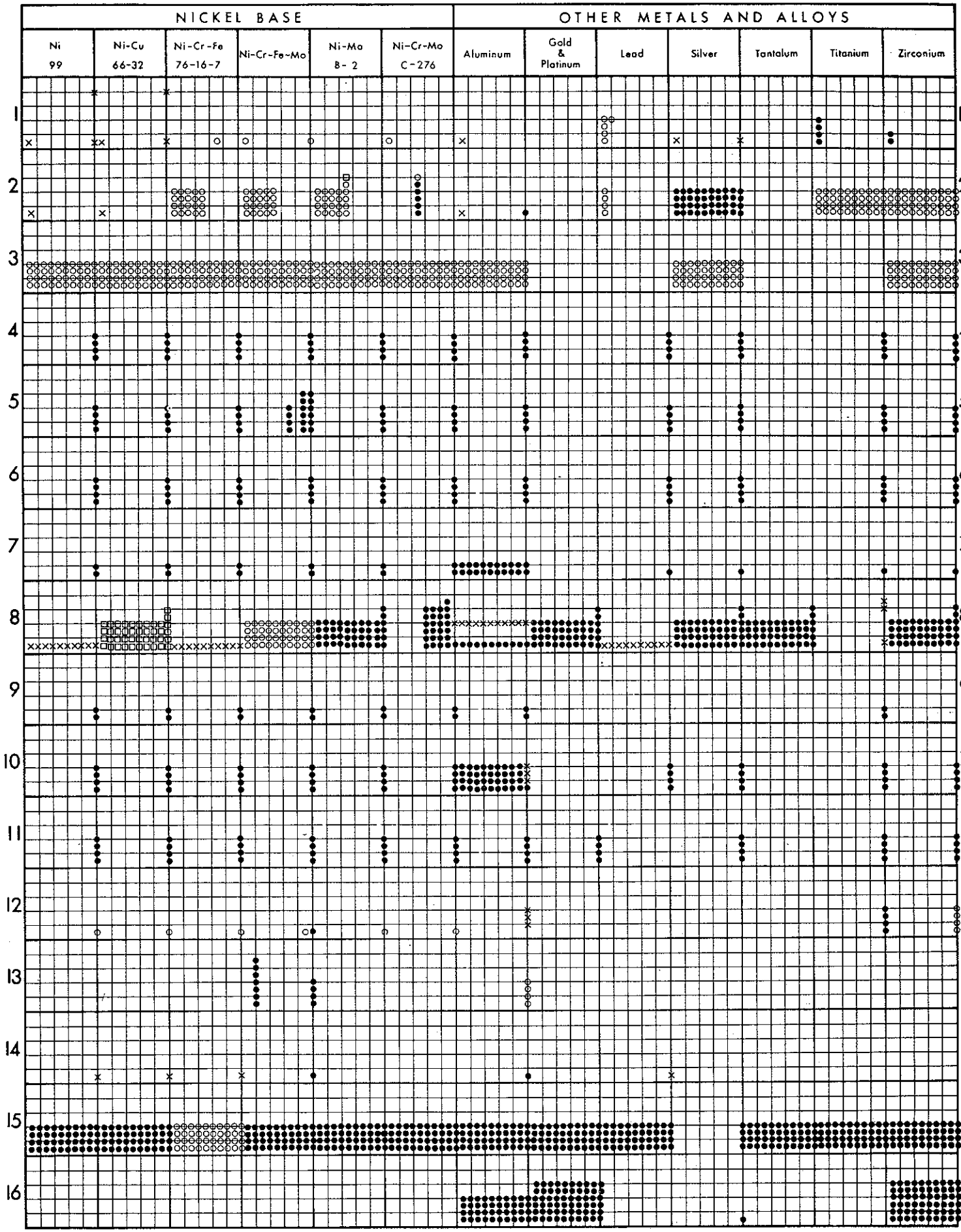
NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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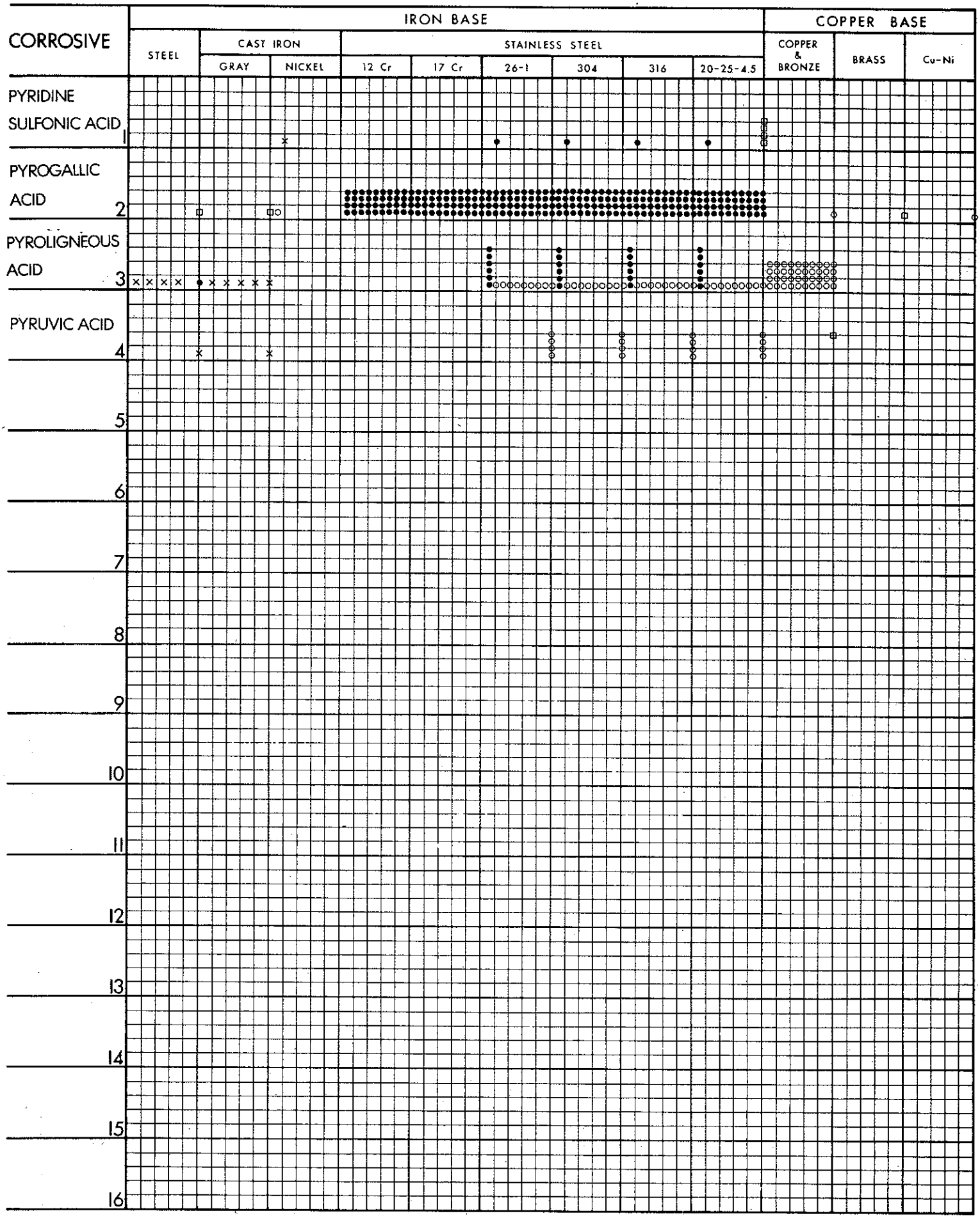
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
PYRIDINE SULFONIC ACID 1
PYROGALLIC ACID 2
PYROLIGNEOUS ACID 3
PYRUVIC ACID 4
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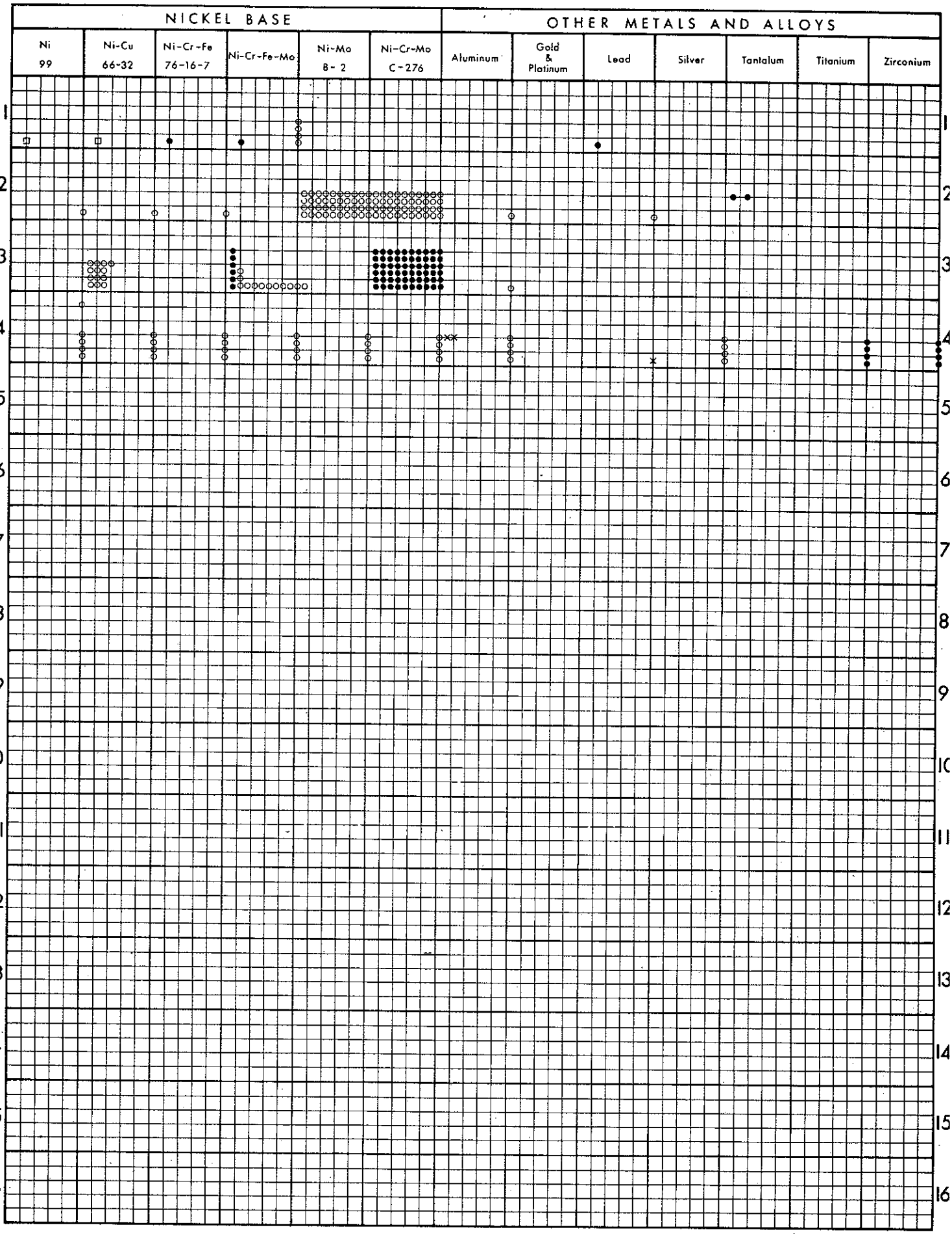
NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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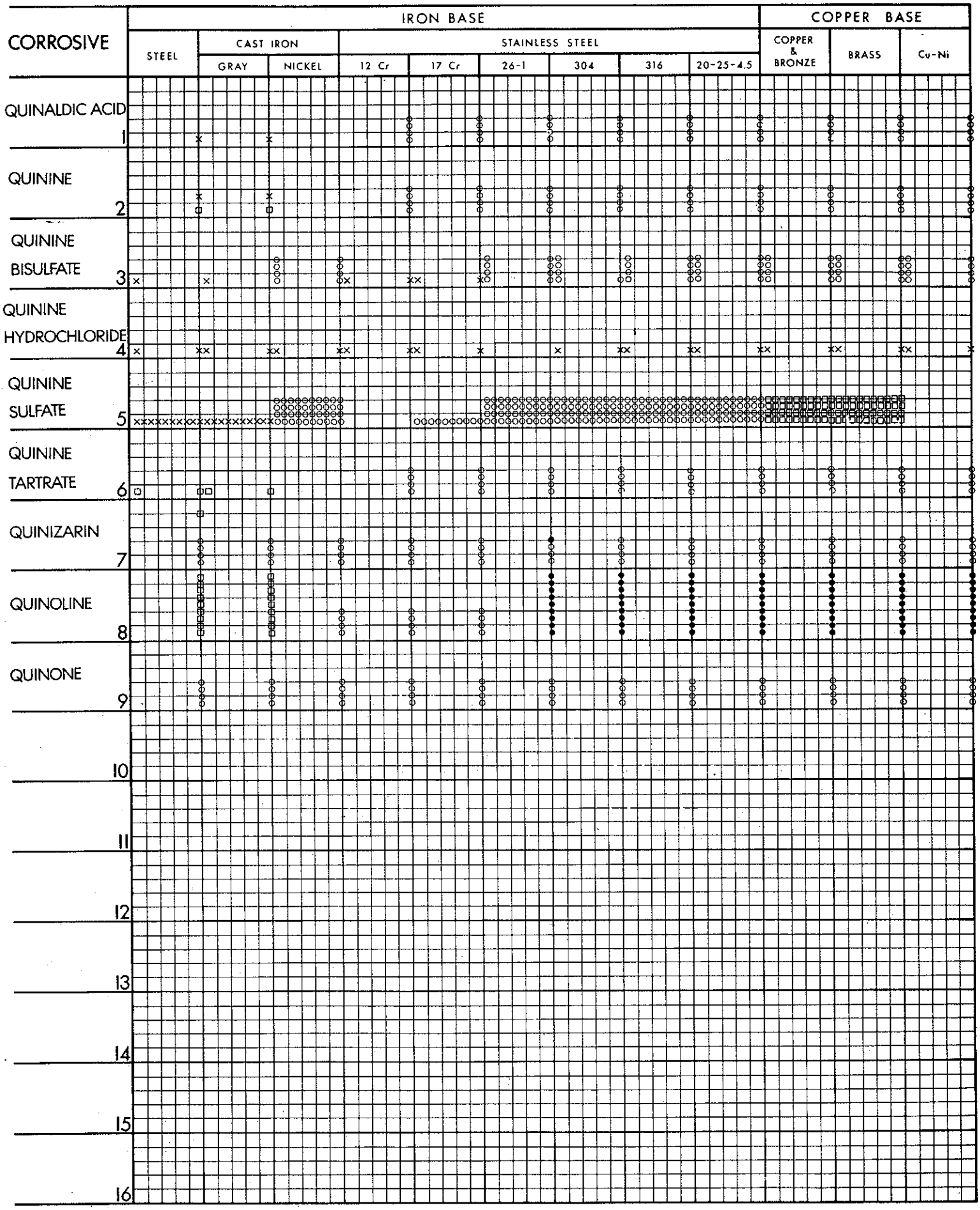
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
QUINALDIC ACID 1
QUININE 2
QUININE BISULFATE 3
QUININE HYDROCHLORIDE 4
QUININE SULFATE 5
QUININE TARTRATE 6
QUINIZARIN 7
QUINOLINE 8
QUINONE 9
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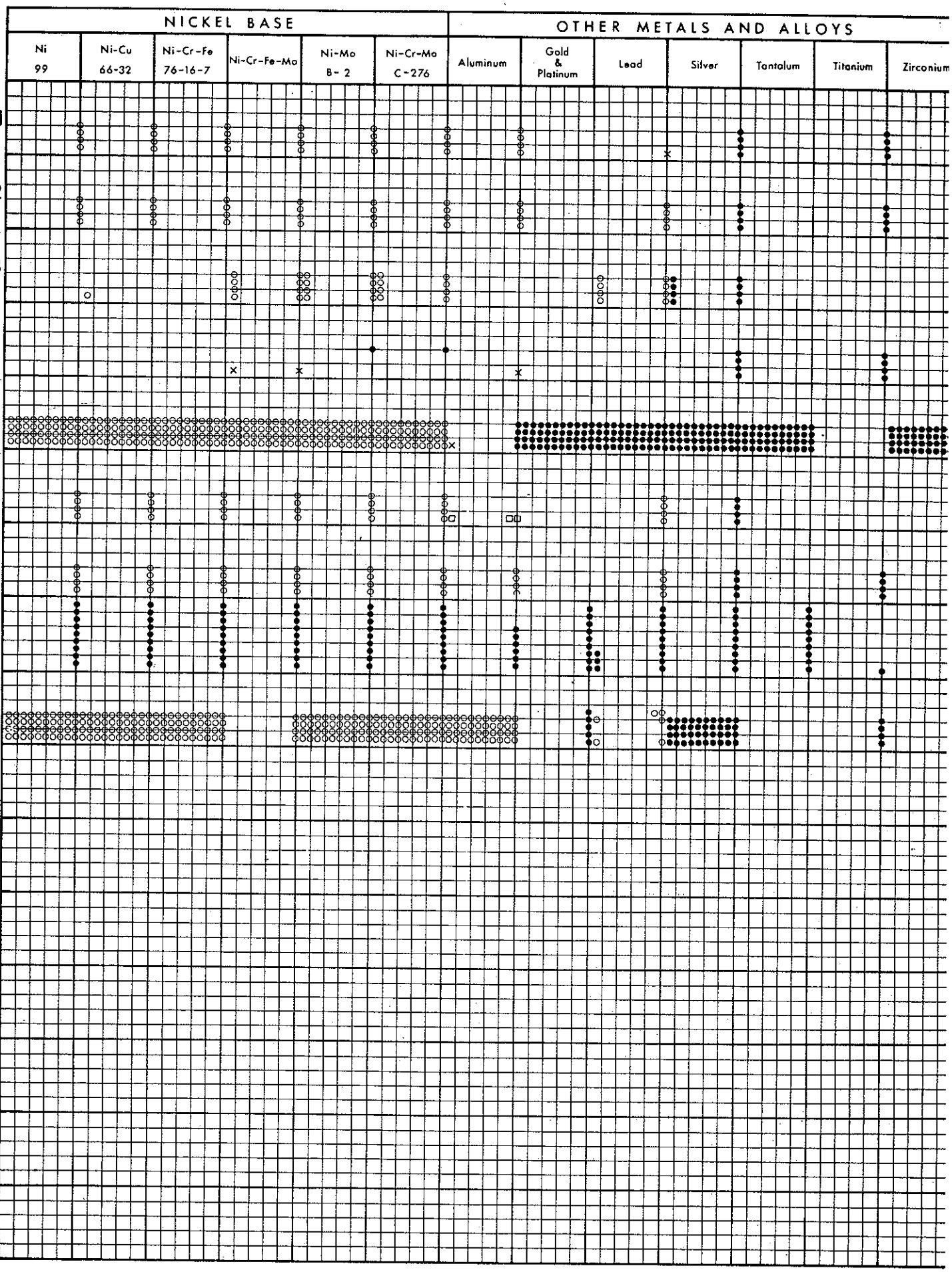
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OTHER METALS AND ALLOYS
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Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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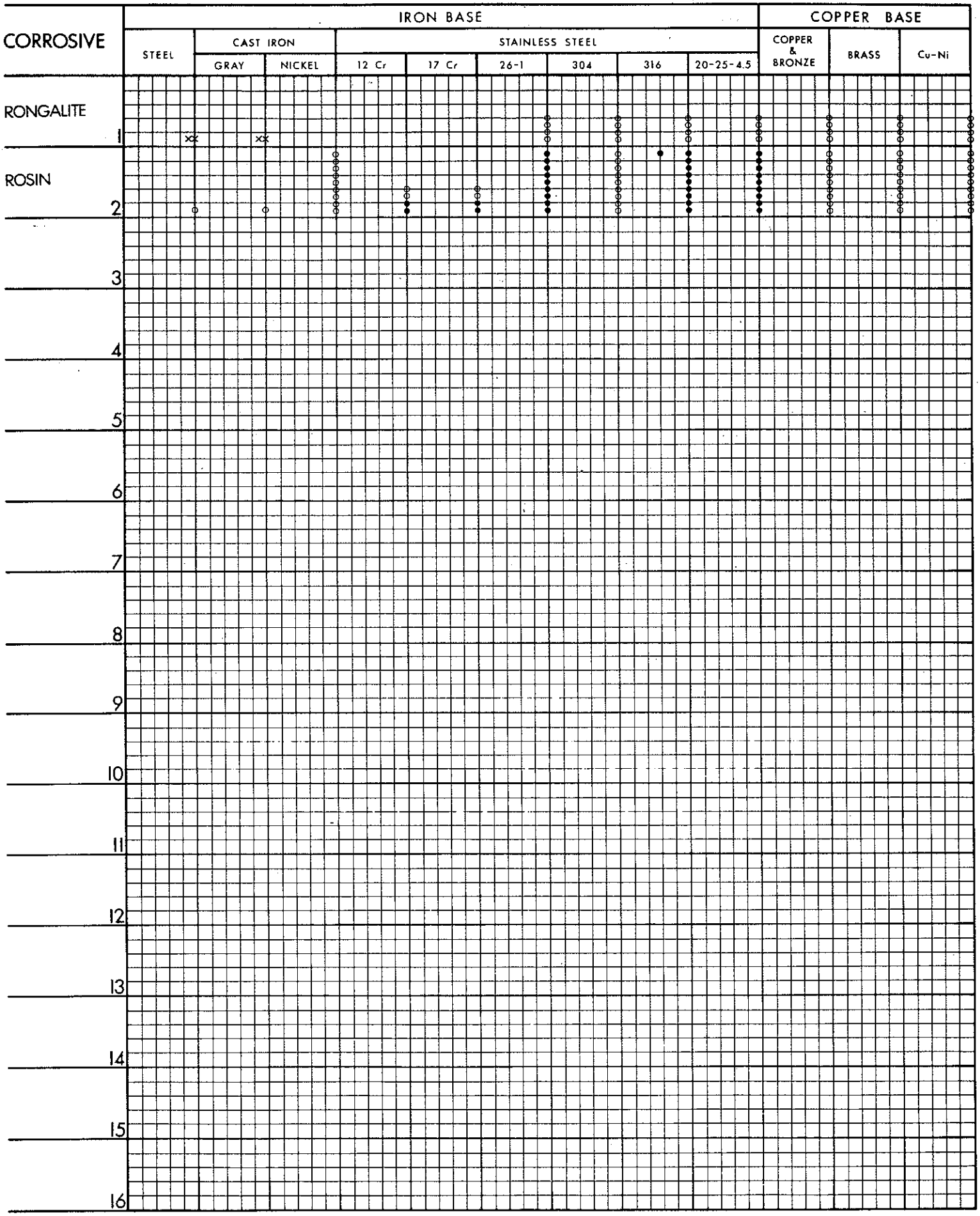
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
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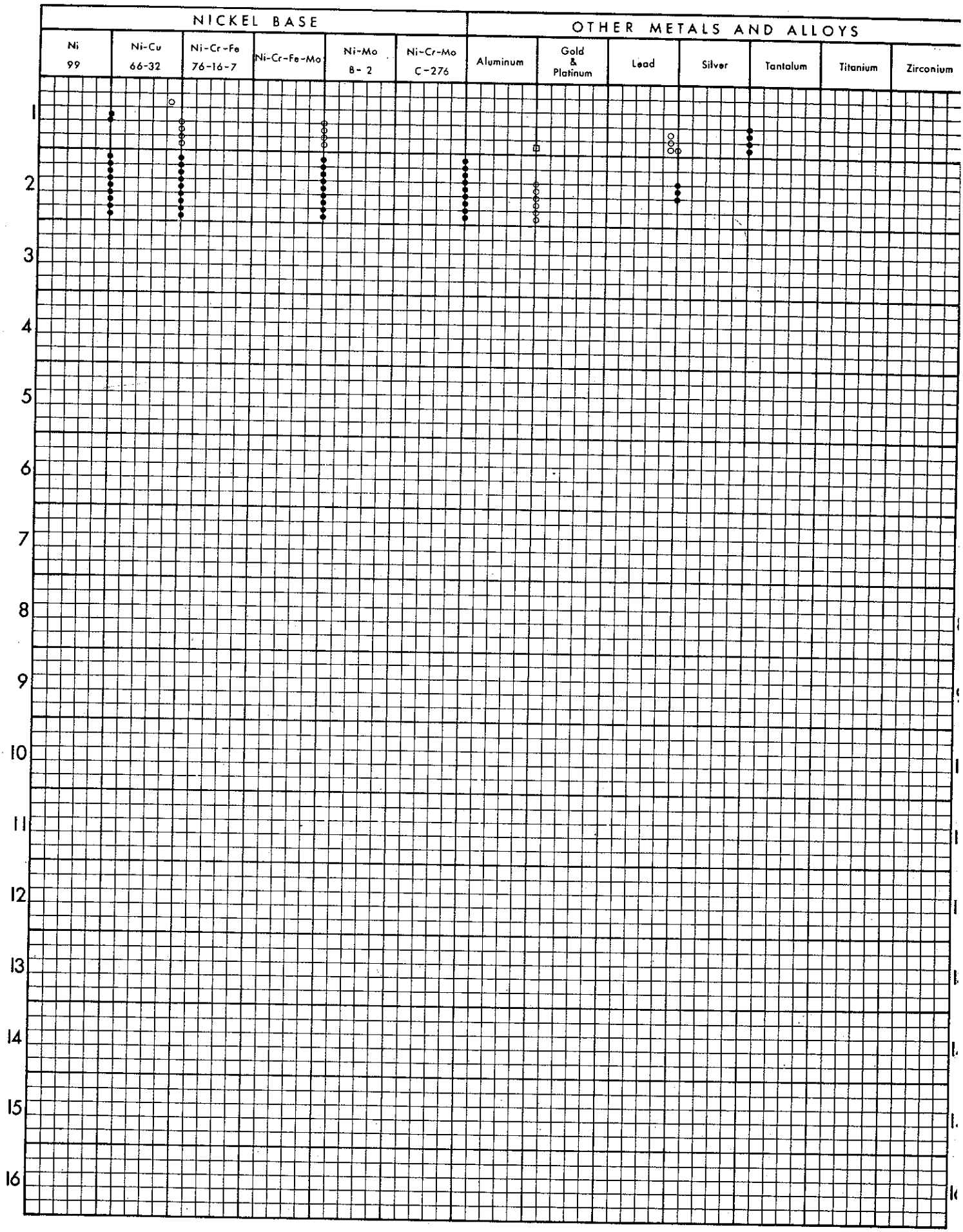
NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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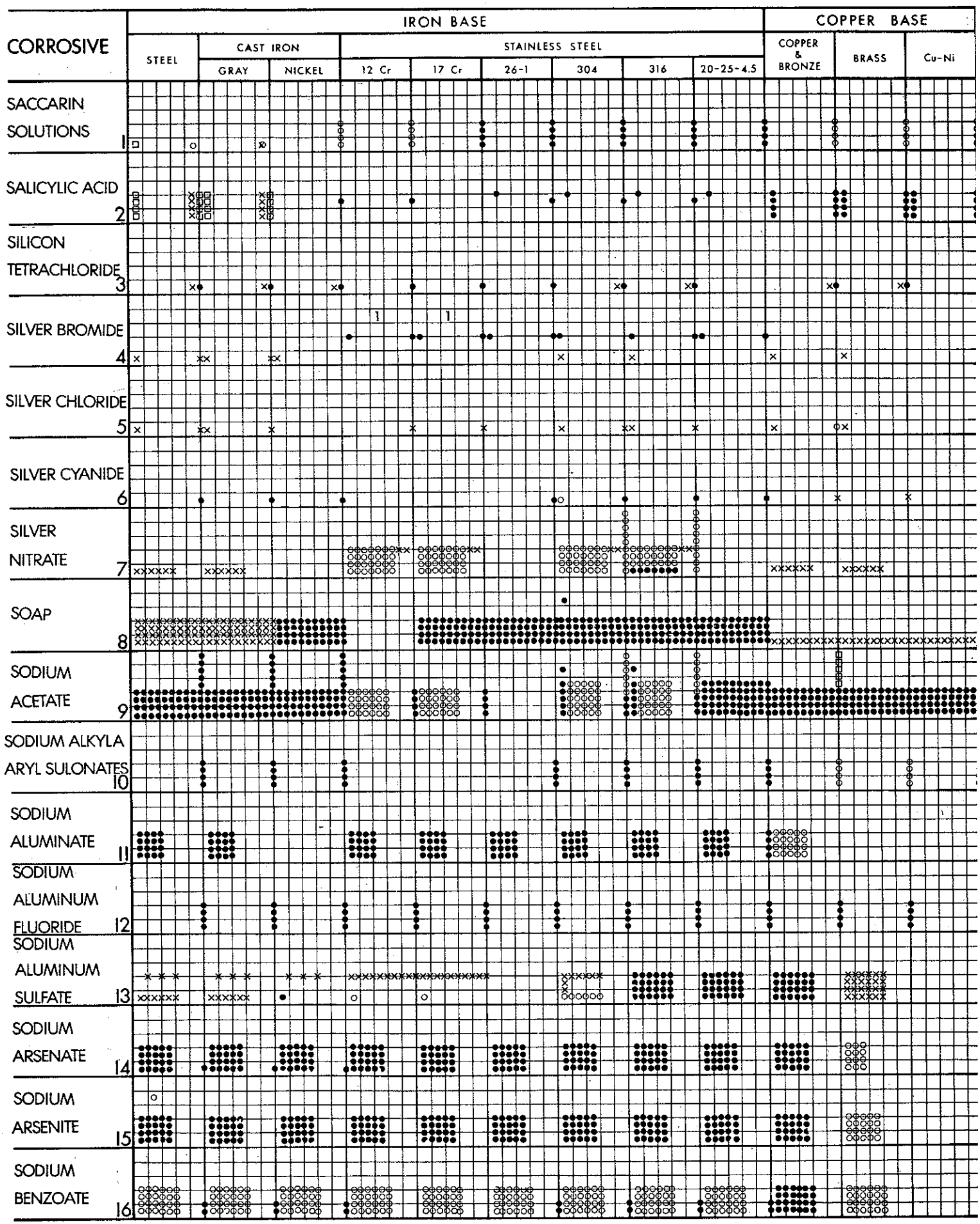
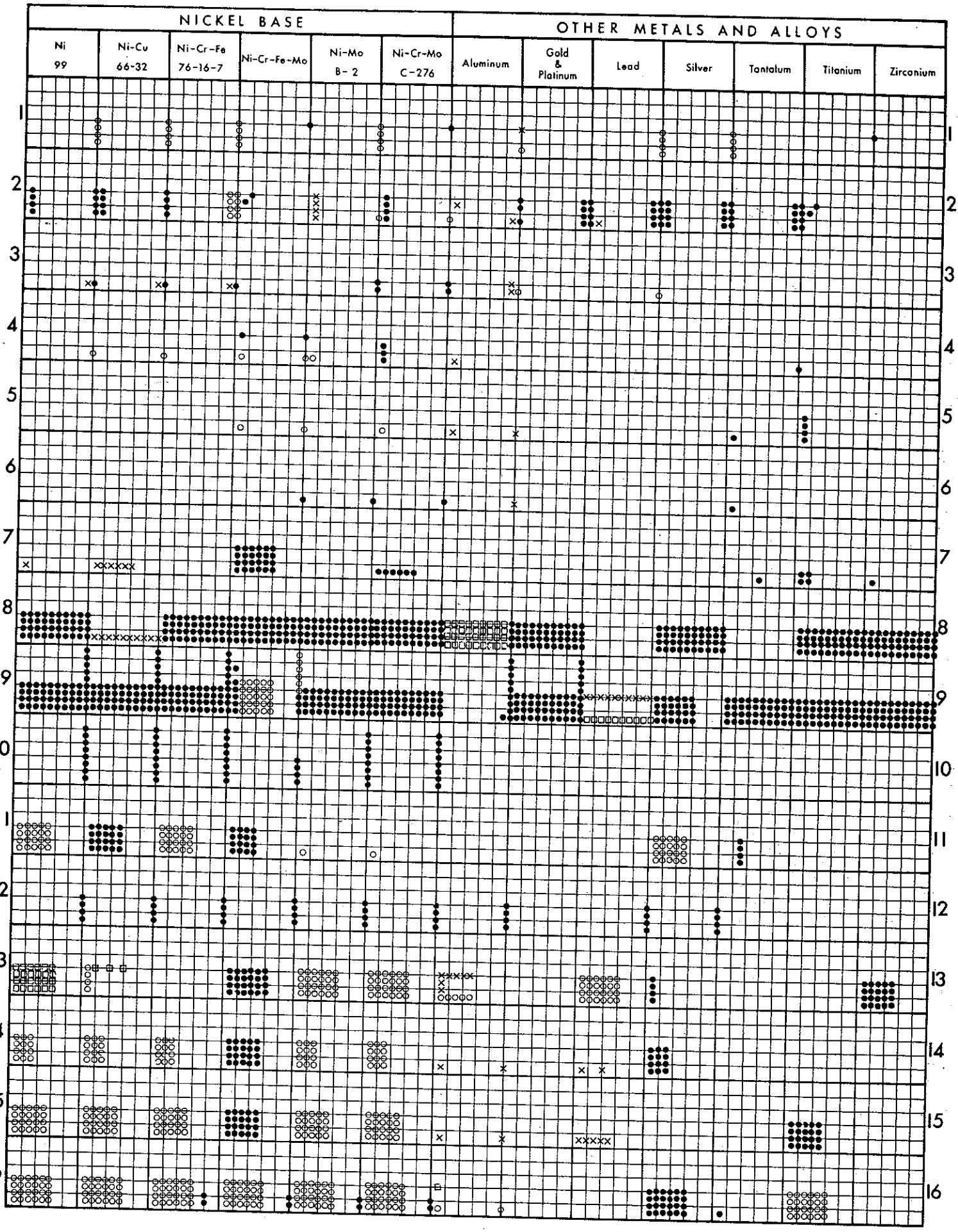

CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
SACCARIN SOLUTIONS 1
SALICYLIC ACID 2
SILICON TETRACHLORIDE 3
SILVER BROMIDE 4
SILVER CHLORIDE 5
SILVER CYANIDE 6
SILVER NITRATE 7
SOAP 8
SODIUM ACETATE 9
SODIUM ALKYLA ARYL SULONATES 10
SODIUM ALUMINATE 11
SODIUM ALUMINUM FLUORIDE 12
SODIUM ALUMINUM SULFATE 13
SODIUM ARSENATE 14
SODIUM ARSENITE 15
SODIUM BENZOATE 16


NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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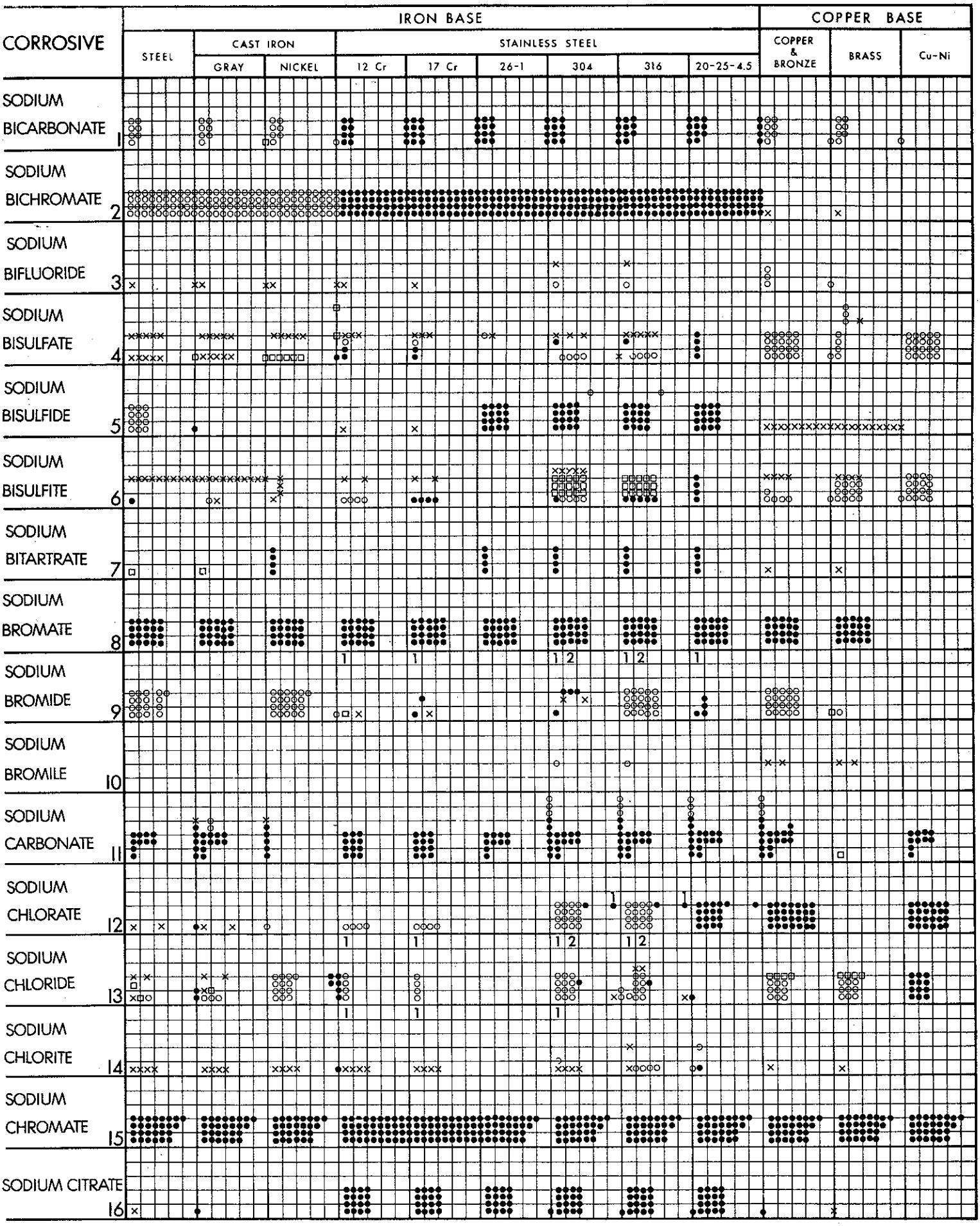
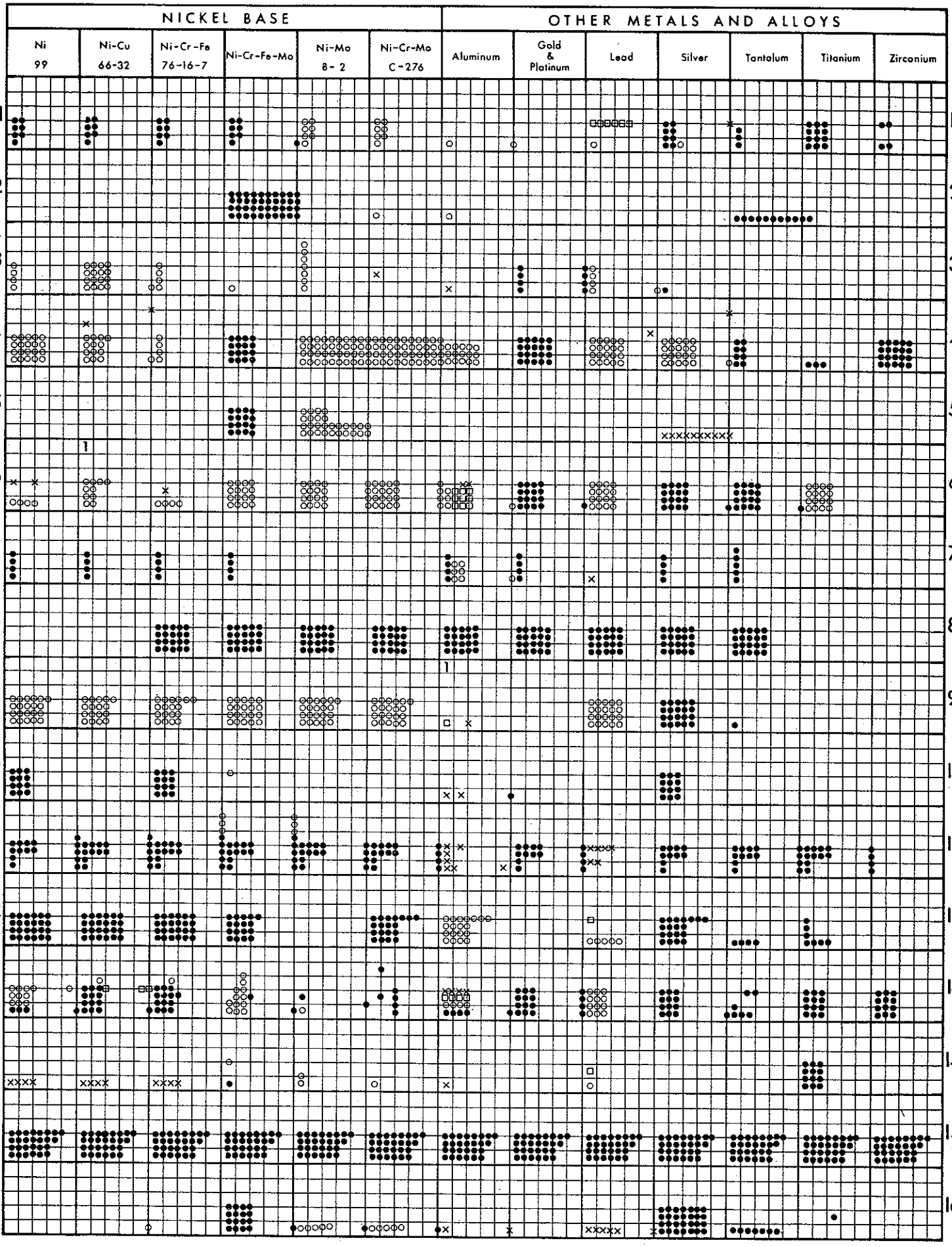

CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
SODIUM BICARBONATE 1
SODIUM BICHROMATE 2
SODIUM BIFLUORIDE 3
SODIUM BISULFATE 4
SODIUM BISULFIDE 5
SODIUM BISULFITE 6
SODIUM BITARTRATE 7
SODIUM BROMATE 8
SODIUM BROMIDE 9
SODIUM BROMILE 10
SODIUM CARBONATE 11
SODIUM CHLORATE 12
SODIUM CHLORIDE 13
SODIUM CHLORITE 14
SODIUM CHROMATE 15
SODIUM CITRATE 16


NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo 8-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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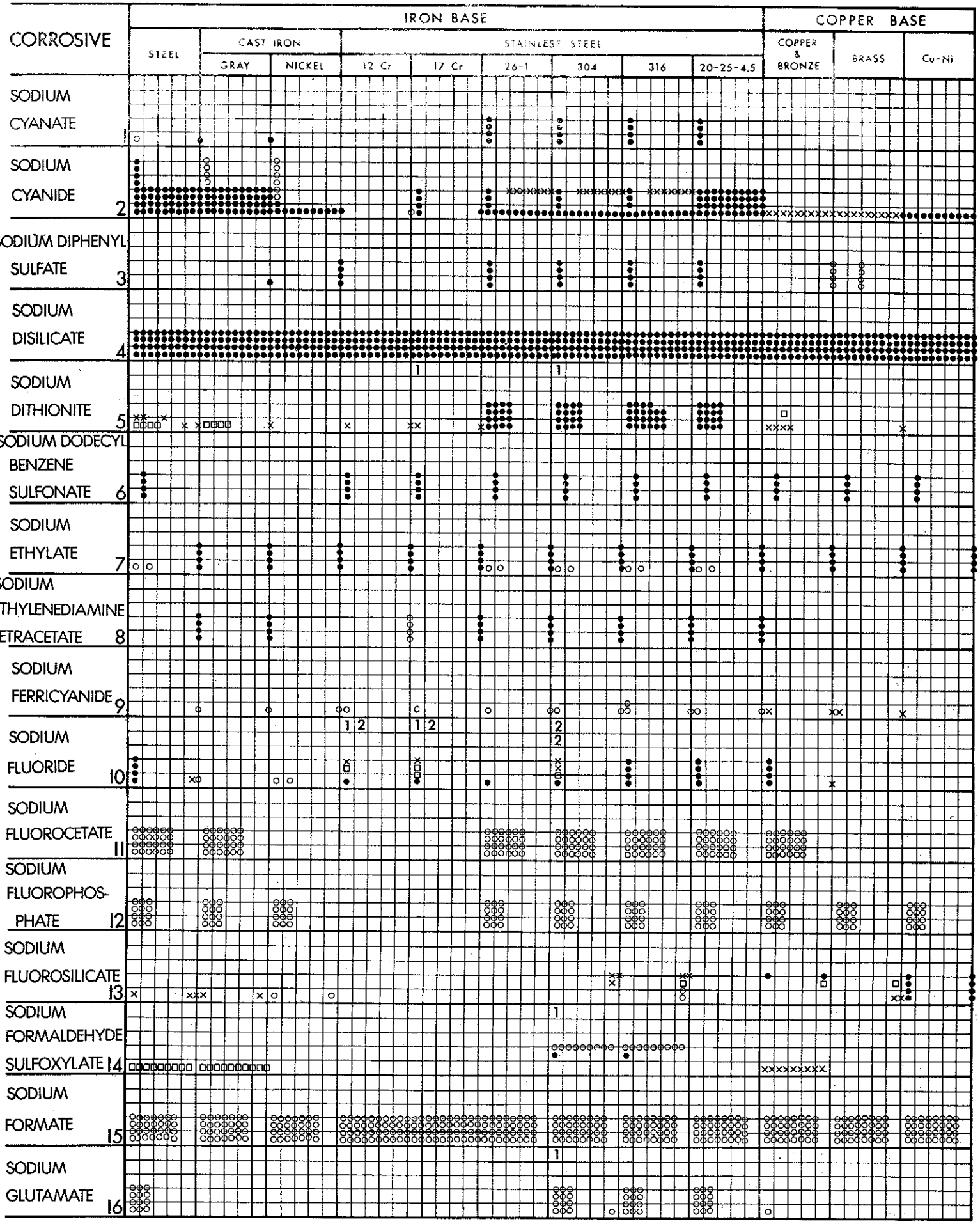
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
SODIUM CYANATE 1
SODIUM CYANIDE 2
SODIUM DIPHENYL SULFATE 3
SODIUM DISILICATE 4
SODIUM DITHIONITE 5
SODIUM DODECYL BENZENE SULFONATE 6
SODIUM ETHYLATE 7
SODIUM ETHYLENEDIAMINE TETRACETATE 8
SODIUM FERRICYANIDE 9
SODIUM FLUORIDE 10
SODIUM FLUOROCETATE 11
SODIUM FLUOROPHOSPHATE 12
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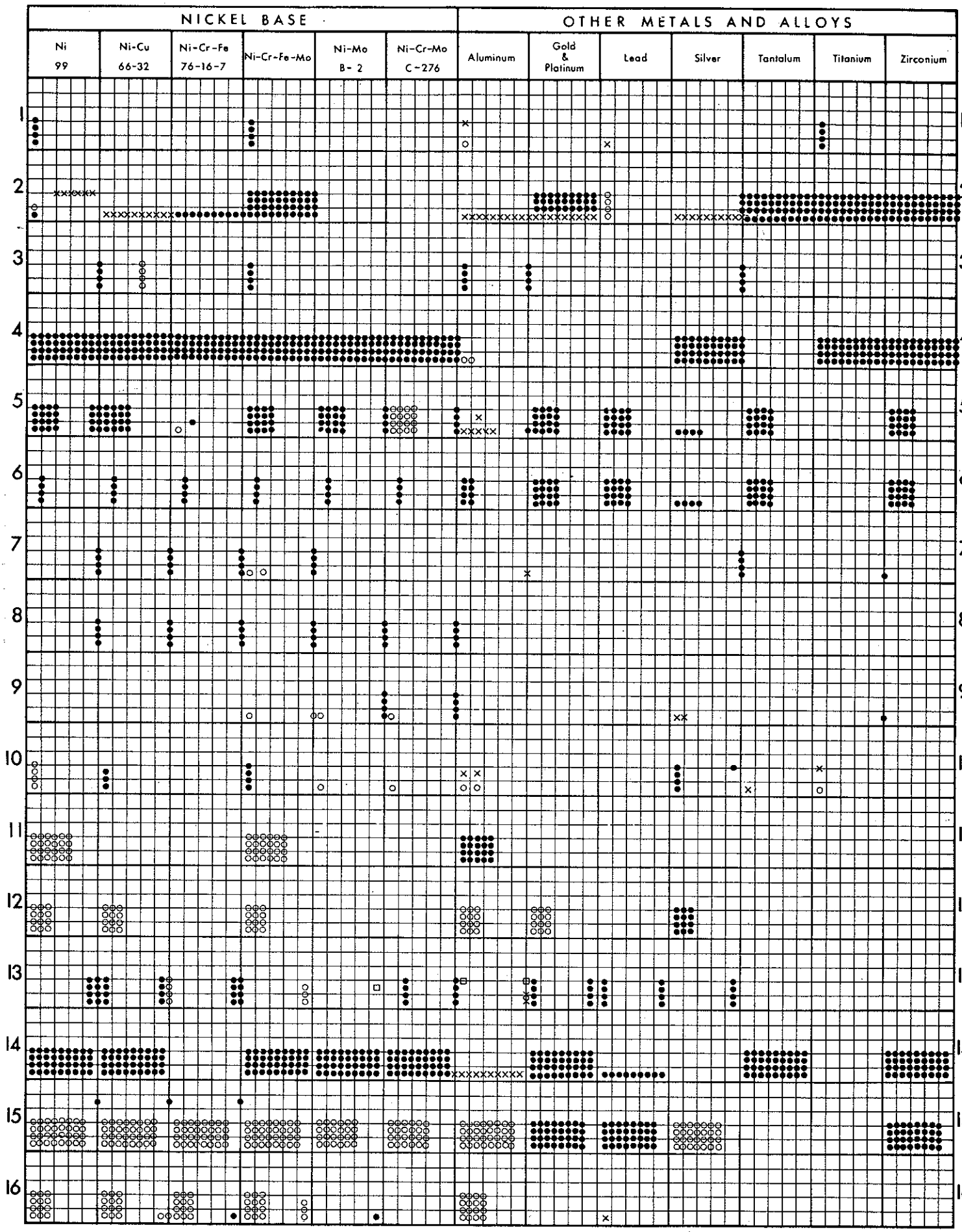
SODIUM FORMALDEHYDE SULFOXYLATE 14
SODIUM FORMATE 15
SODIUM GLUTAMATE 16


NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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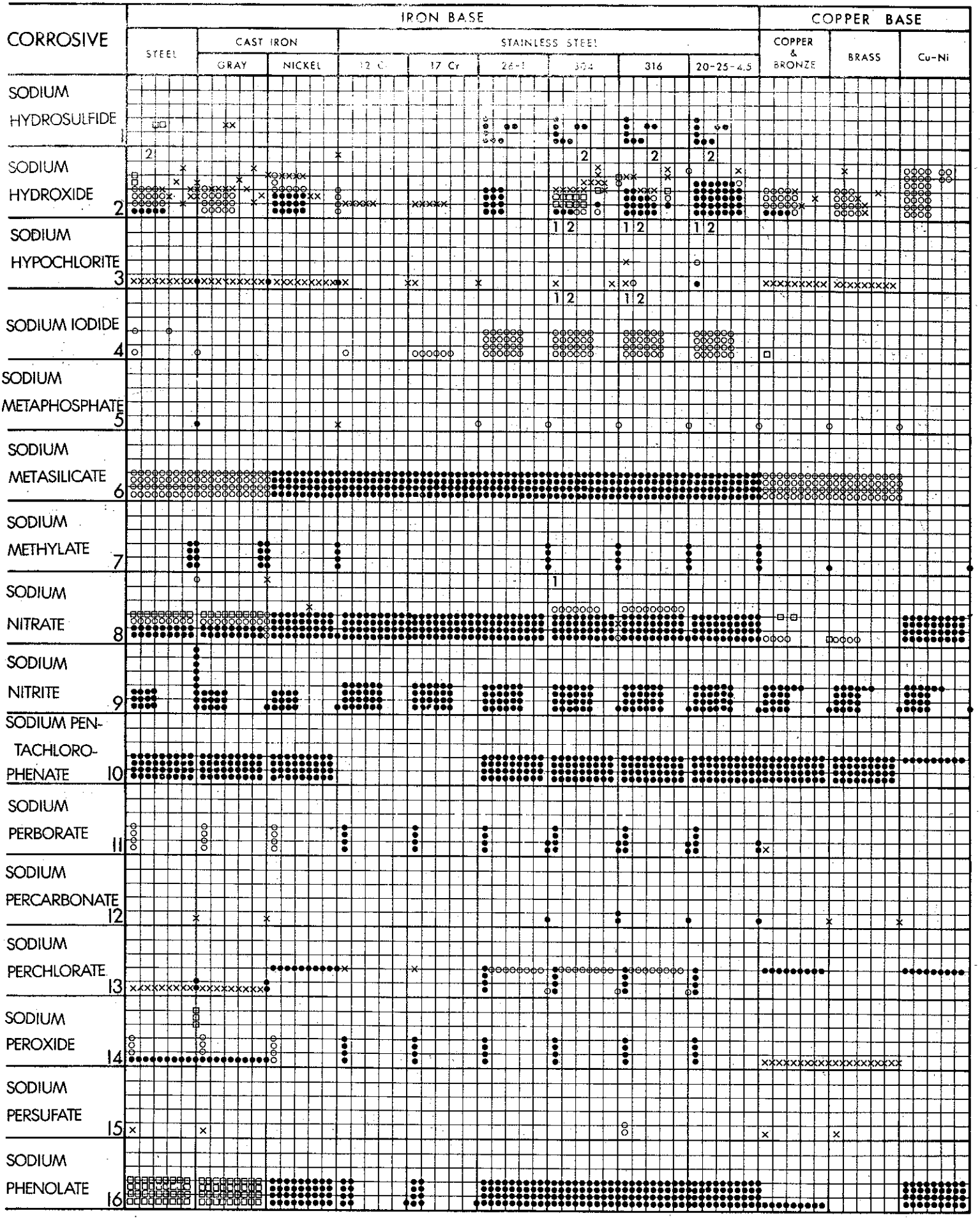
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
SODIUM HYDROSULFIDE 1
SODIUM HYDROXIDE 2
SODIUM HYPOCHLORITE 3
SODIUM IODIDE 4
SODIUM METAPHOSPHATE 5
SODIUM METASILICATE 6
SODIUM METHYLATE 7
SODIUM NITRATE 8
SODIUM NITRITE 9
SODIUM PENTACHLOROPHENATE 10
SODIUM PERBORATE 11
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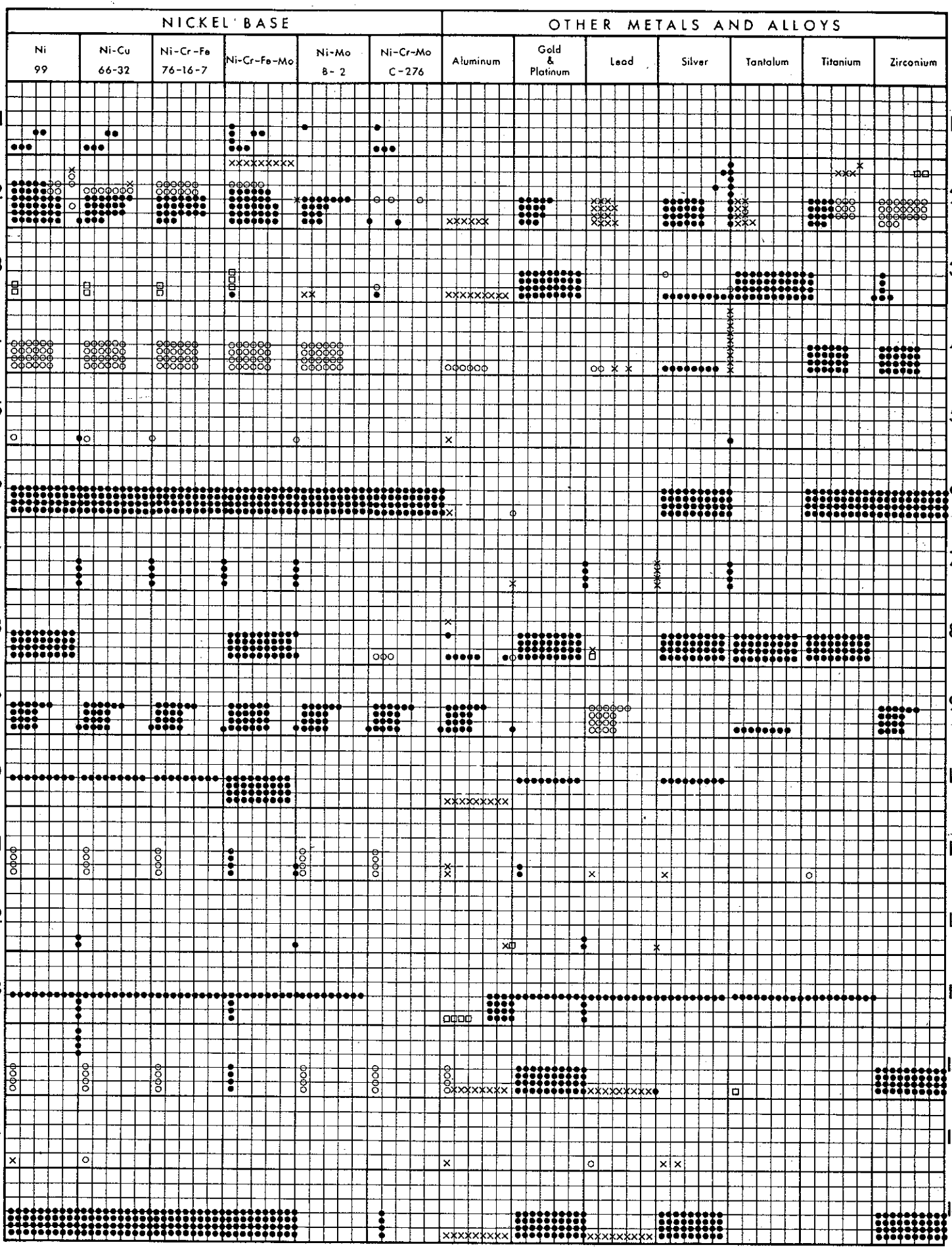
SODIUM PEROXIDE 14
SODIUM PERSUFATE 15
SODIUM PHENOLATE 16


NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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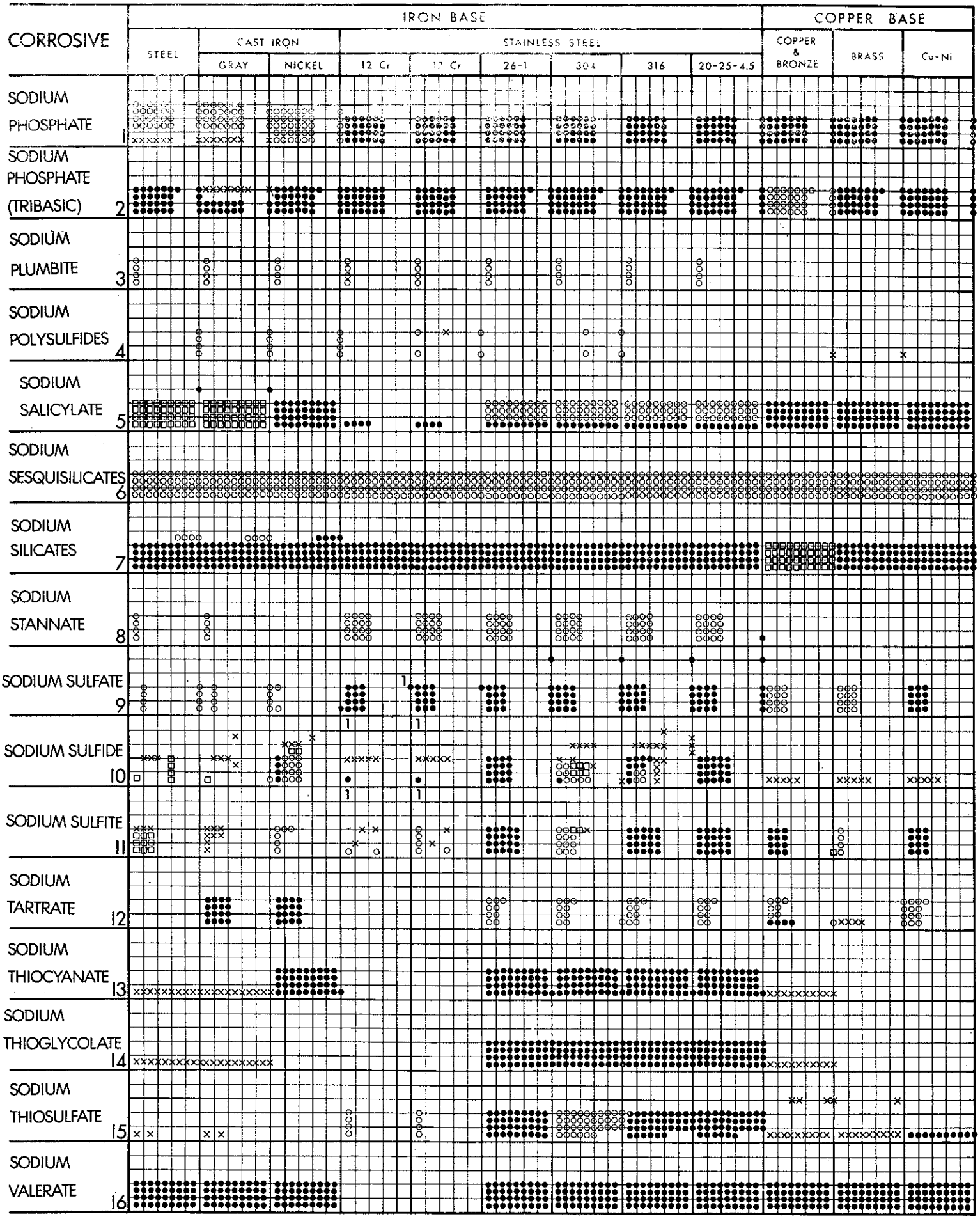
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
SODIUM PHOSPHATE 1
SODIUM PHOSPHATE (TRIBASIC) 2
SODIUM PLUMBITE 3
SODIUM POLYSULFIDES 4
SODIUM SALICYLATE 5
SODIUM SESQUISILICATES 6
SODIUM SILICATES 7
SODIUM STANNATE 8
SODIUM SULFATE 9
SODIUM SULFIDE 10
SODIUM SULFITE 11
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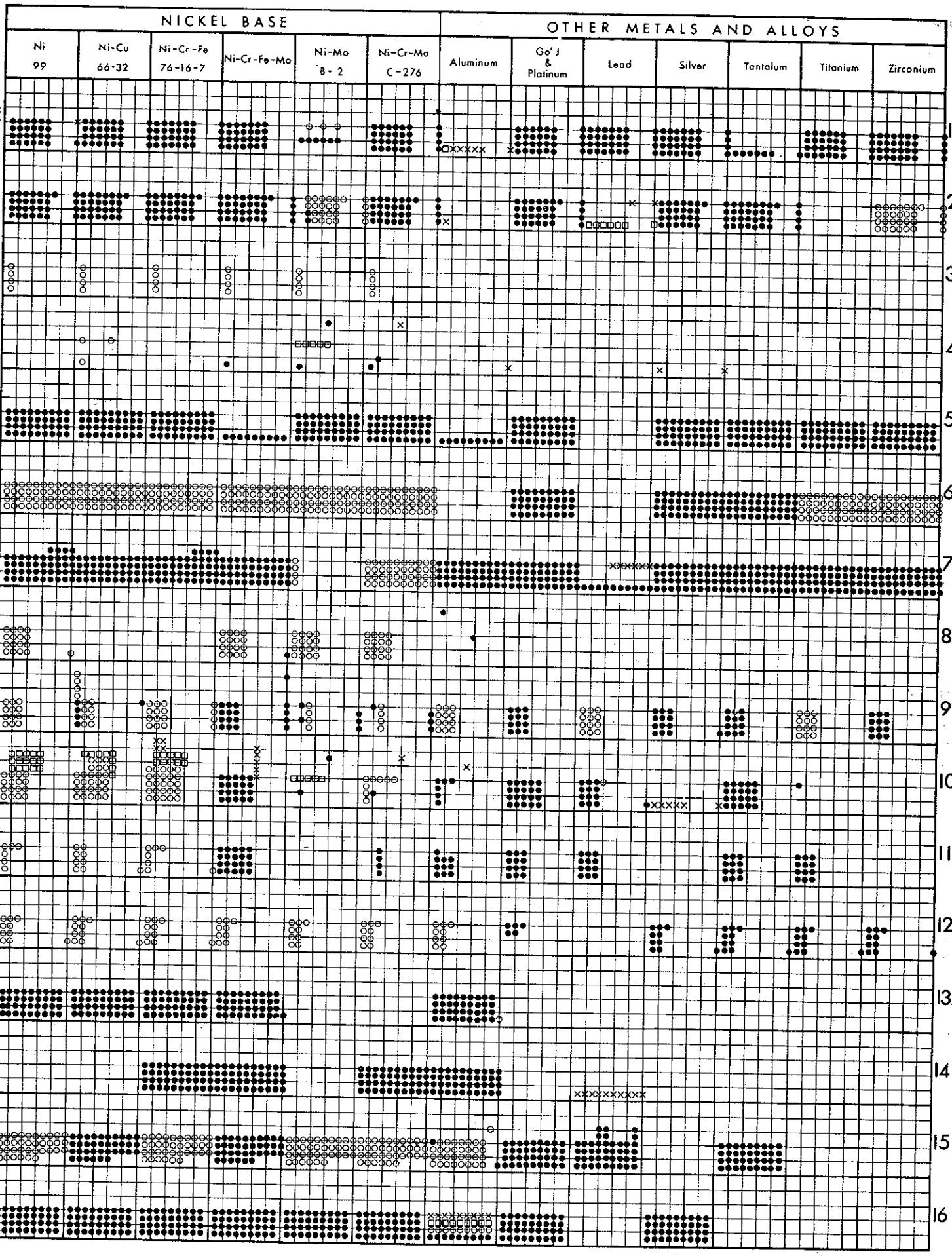
SODIUM VALERATE 16


NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Go'l & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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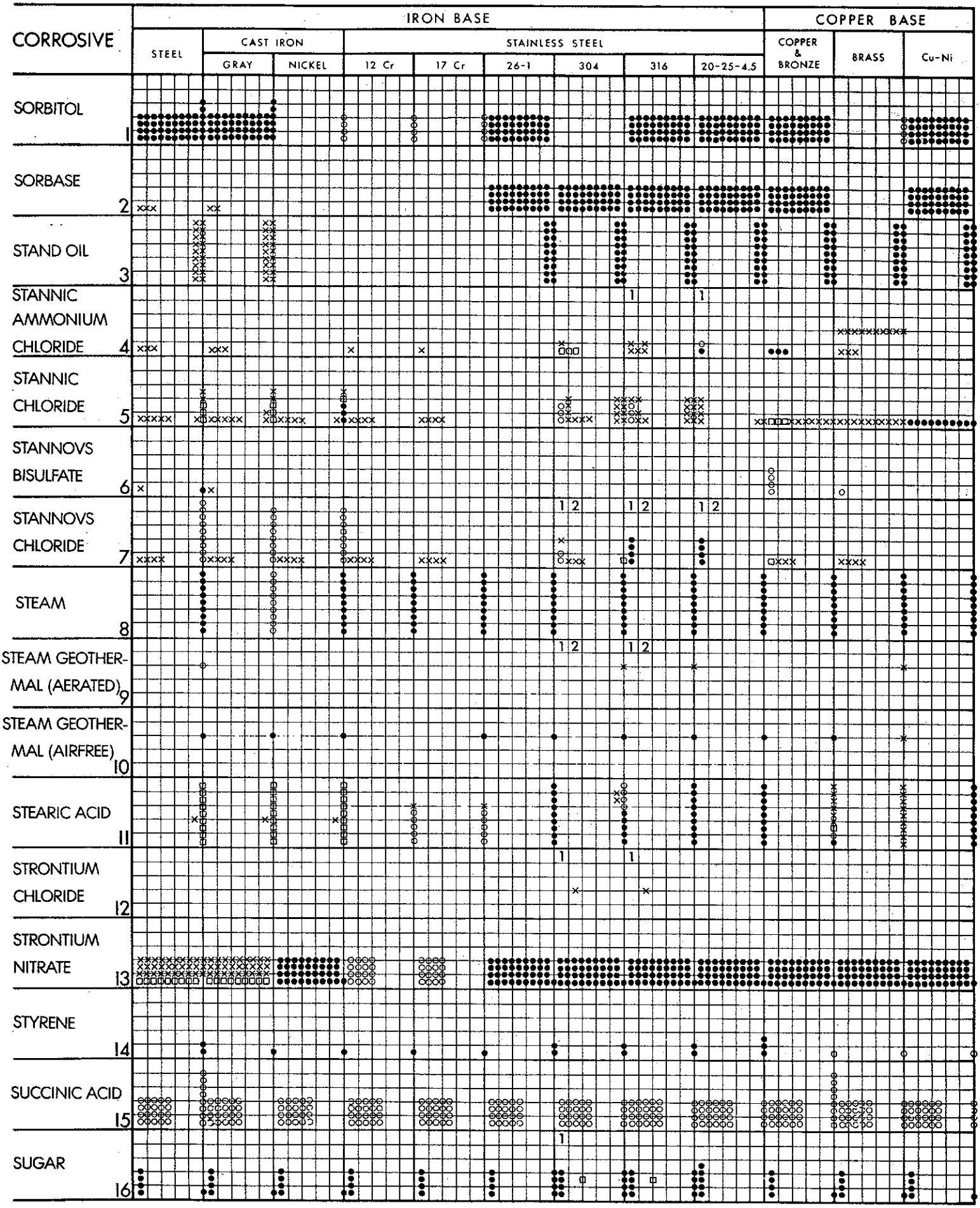
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
SORBITOL 1
SORBASE 2
STAND OIL 3
STANNIC AMMONIUM CHLORIDE 4
STANNIC CHLORIDE 5
STANNOVS BISULFATE 6
STANNOVS CHLORIDE 7
STEAM 8
STEAM GEOTHERMAL (AERATED) 9
STEAM GEOTHERMAL (AIRFREE) 10
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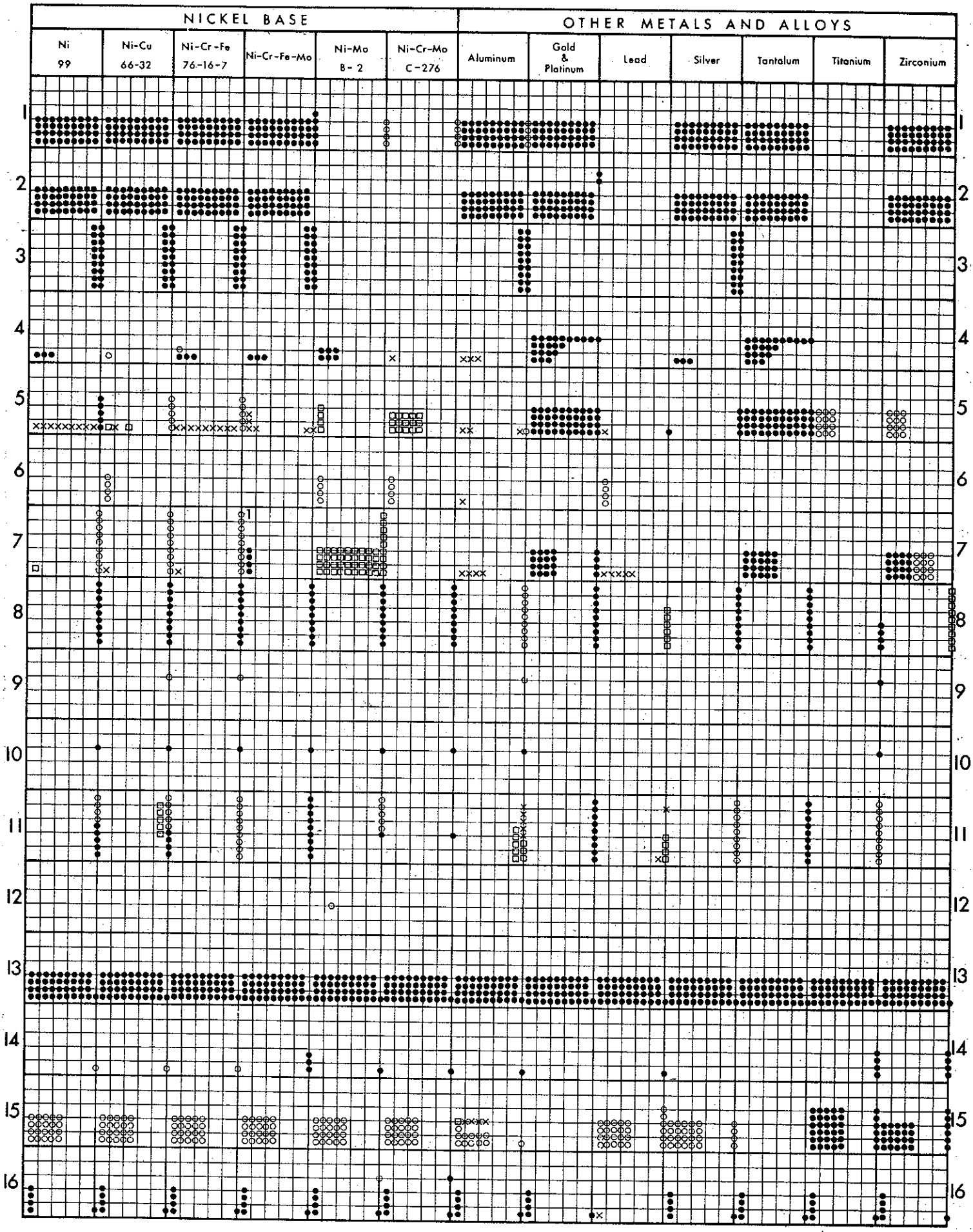
SUGAR 16


NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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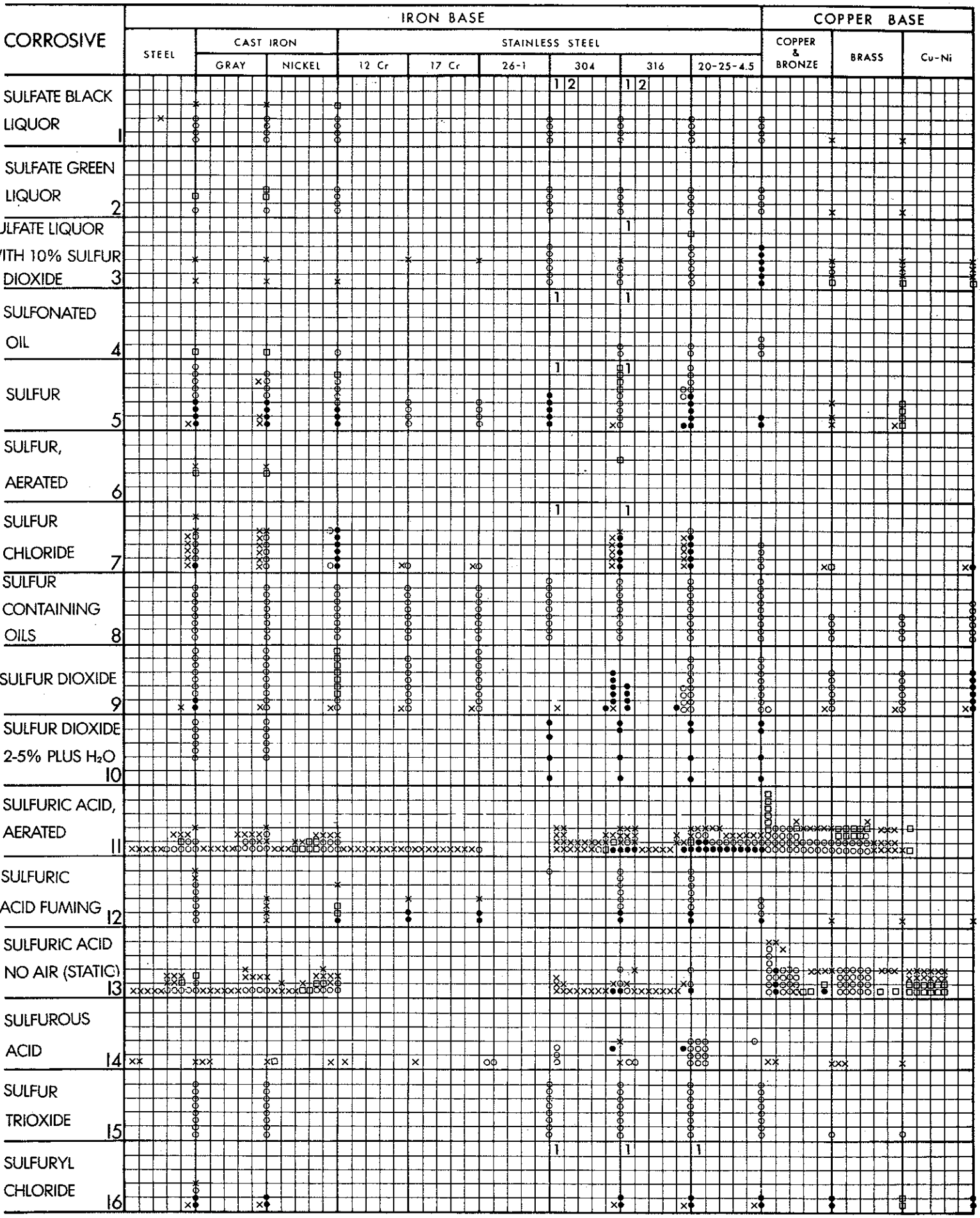
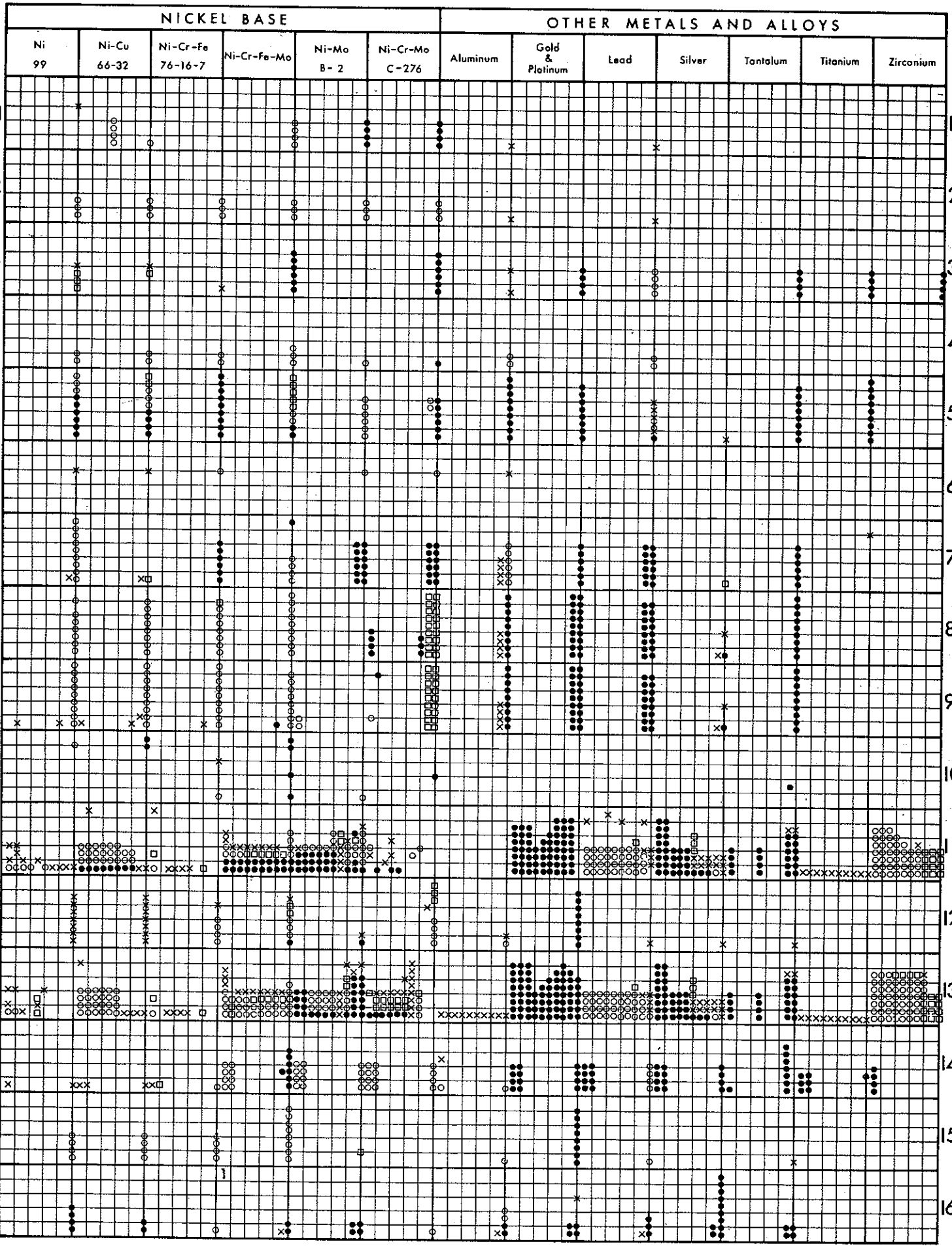

CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
SULFATE BLACK LIQUOR 1
SULFATE GREEN LIQUOR 2
SULFATE LIQUOR WITH 10% SULFUR DIOXIDE 3
SULFONATED OIL 4
SULFUR 5
SULFUR, AERATED 6
SULFUR CHLORIDE 7
SULFUR CONTAINING OILS 8
SULFUR DIOXIDE 9
SULFUR DIOXIDE 2-5% PLUS H_2O 10
SULFURIC ACID, AERATED 11
SULFURIC ACID FUMING 12
SULFURIC ACID NO AIR (STATIC) 13
SULFUROUS ACID 14
SULFUR TRIOXIDE 15
SULFURYL CHLORIDE 16


NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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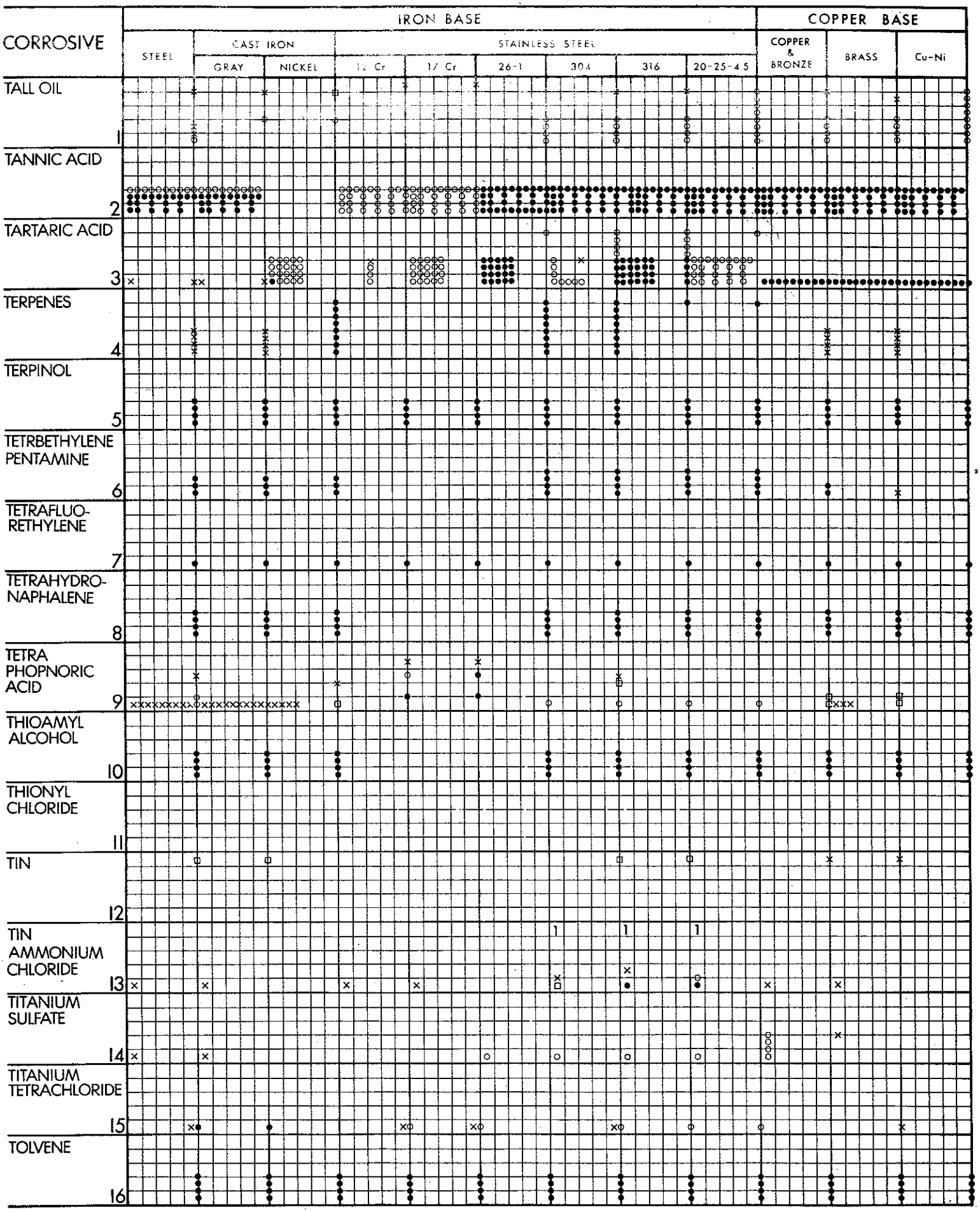
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
TALL OIL 1
TANNIC ACID 2
TARTARIC ACID 3
TERPENES 4
TERPINOL 5
TETRBETHYLENE PENTAMINE 6
TETRAFLUO-RETHYLENE 7
TETRAHYDRO-NAPHALENE 8
TETRA PHOPNORIC ACID 9
THIOAMYL ALCOHOL 10
THIONYL CHLORIDE 11
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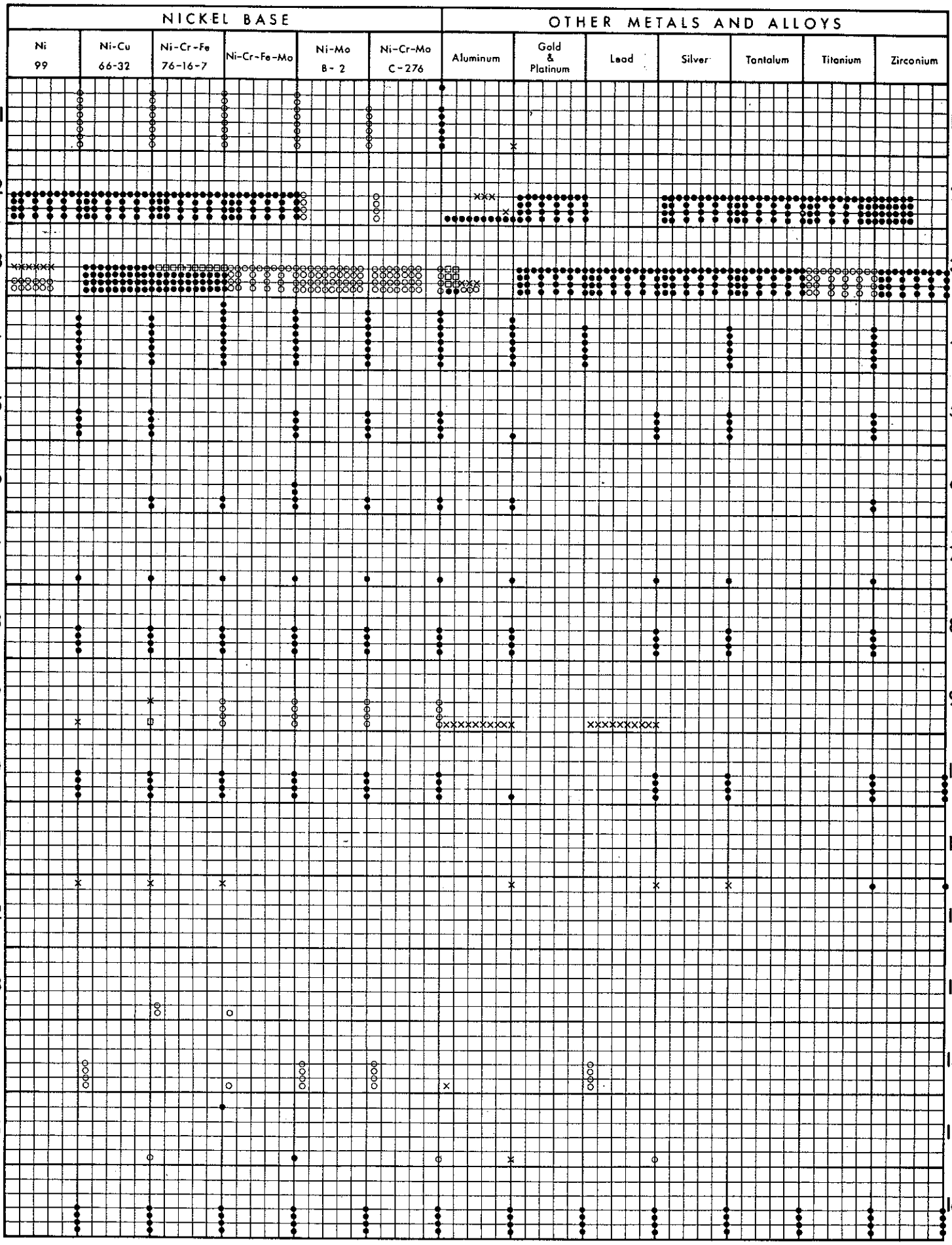
TITANIUM TETRACHLORIDE 15
TOLVENE 16


NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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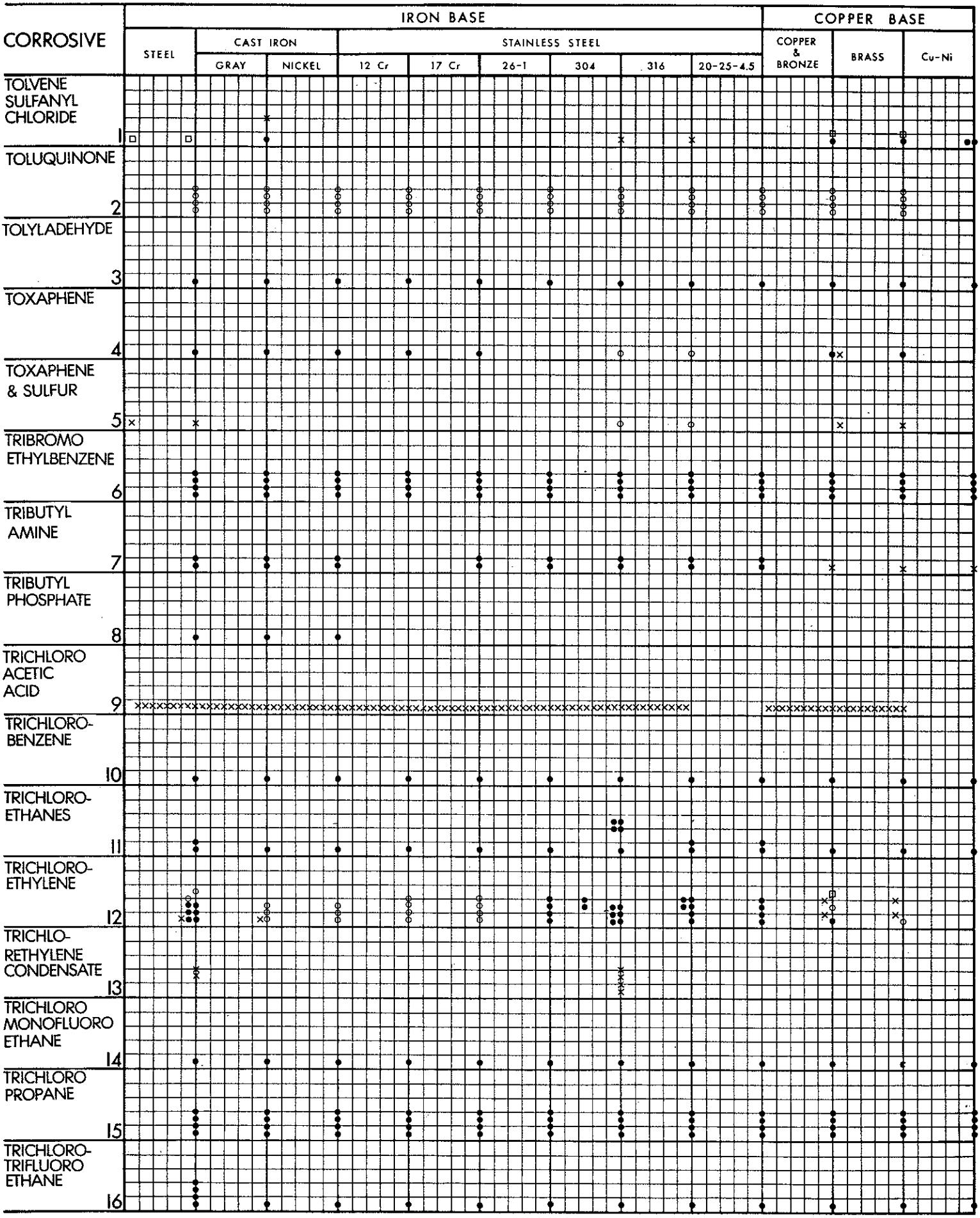
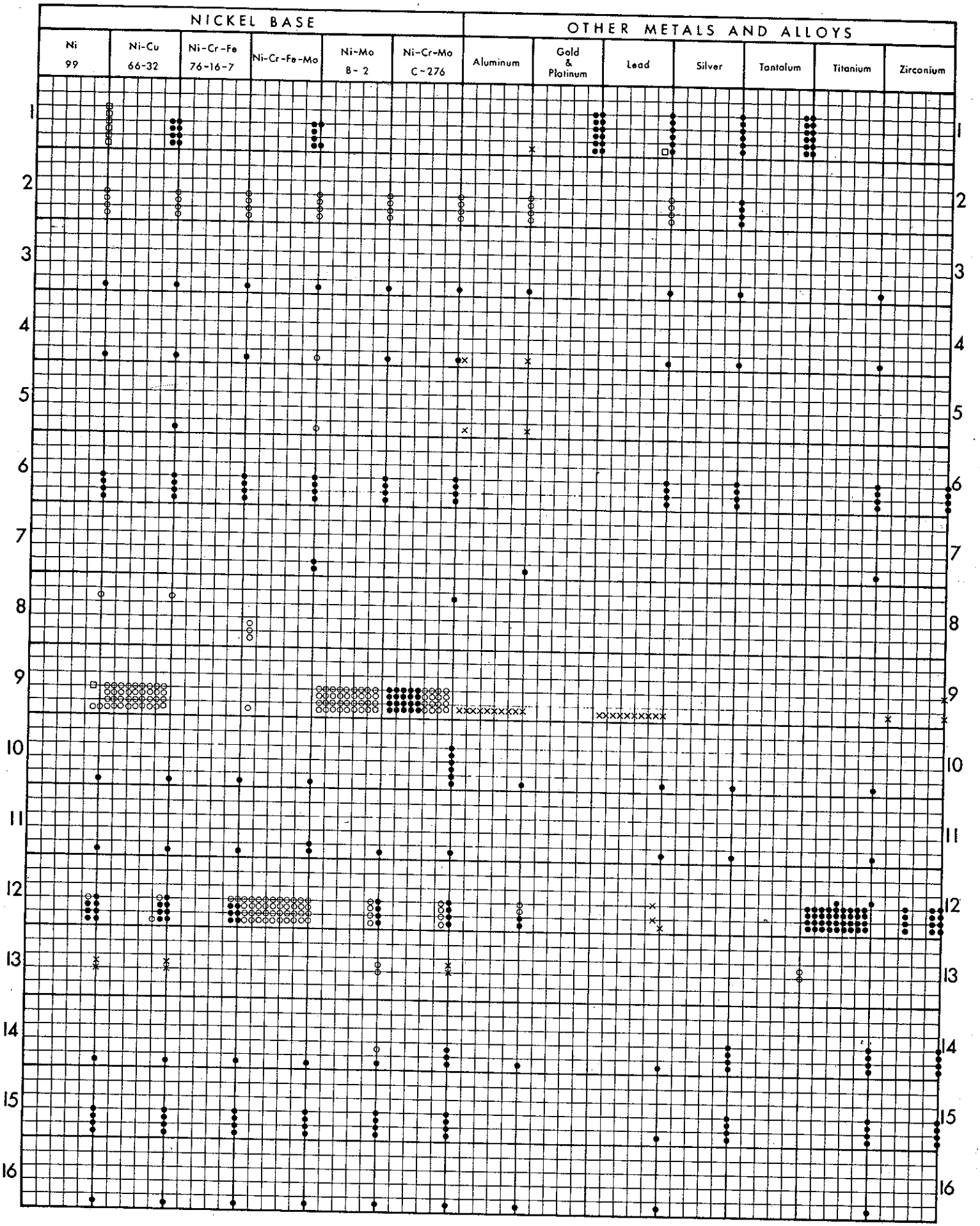

CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
TOLVENE SULFANYL CHLORIDE 1
TOLUQUINONE 2
TOLYLADEHYDE 3
TOXAPHENE 4
TOXAPHENE & SULFUR 5
TRIBROMO ETHYLBENZENE 6
TRIBUTYL AMINE 7
TRIBUTYL PHOSPHATE 8
TRICHLORO ACETIC ACID 9
TRICHLORO-BENZENE 10
TRICHLORO-ETHANES 11
TRICHLORO-ETHYLENE 12
TRICHLO-RETHYLENE CONDENSATE 13
TRICHLORO MONOFLUORO ETHANE 14
TRICHLORO PROPANE 15
TRICHLORO-TRIFLUORO ETHANE 16


NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
1
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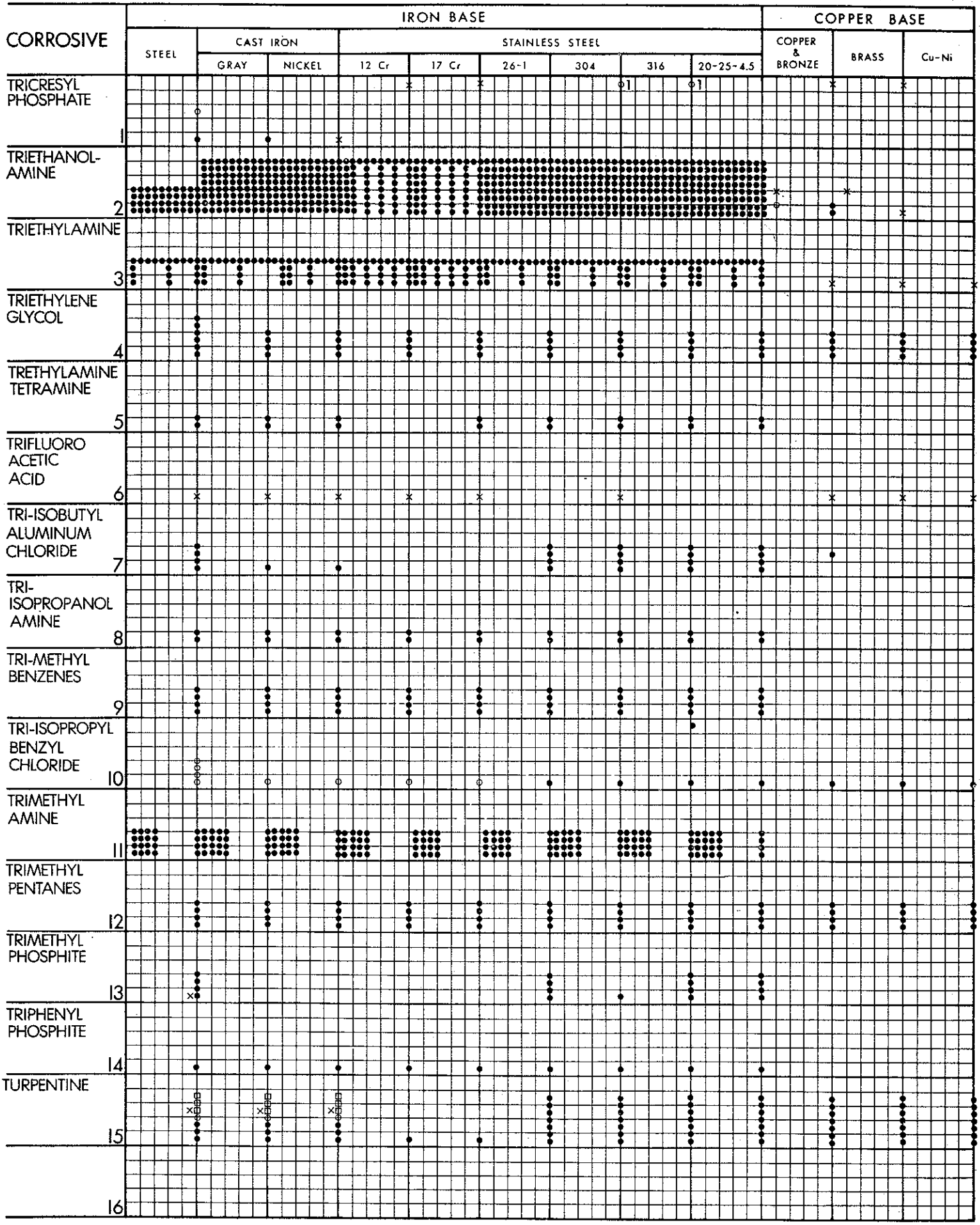
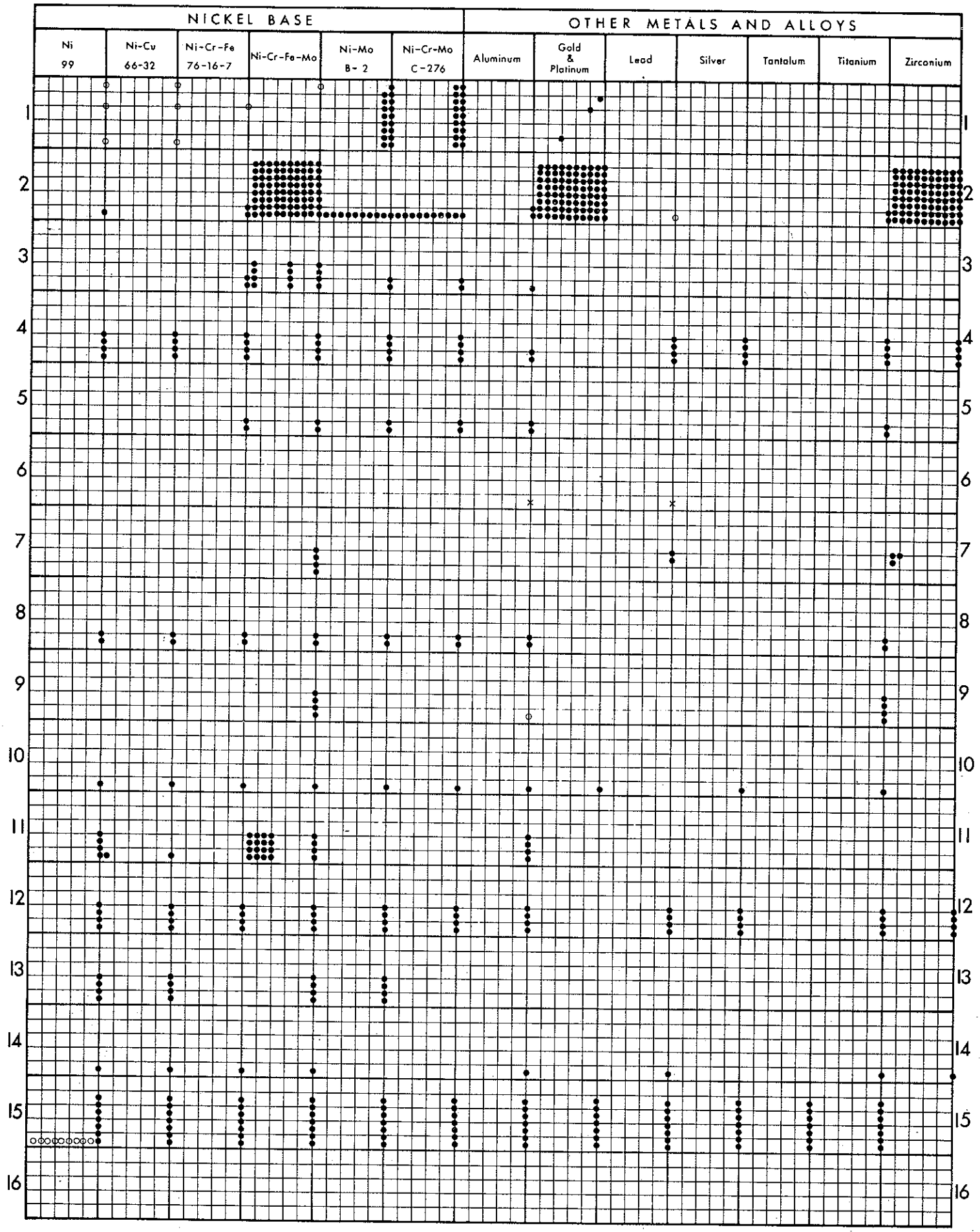
16


CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
TRICRESYL PHOSPHATE 1
TRIETHANOL-AMINE 2
TRIETHYLAMINE 3
TRIETHYLENE GLYCOL 4
TRETHYLAMINE TETRAMINE 5
TRIFLUORO ACETIC ACID 6
TRI-ISOBUTYL ALUMINUM CHLORIDE 7
TRI-ISOPROPANOL AMINE 8
TRI-METHYL BENZENES 9
TRI-ISOPROPYL BENZYL CHLORIDE 10
TRIMETHYL AMINE 11
TRIMETHYL PENTANES 12
TRIMETHYL PHOSPHITE 13
TRIPHENYL PHOSPHITE 14
TURPENTINE 15
16


NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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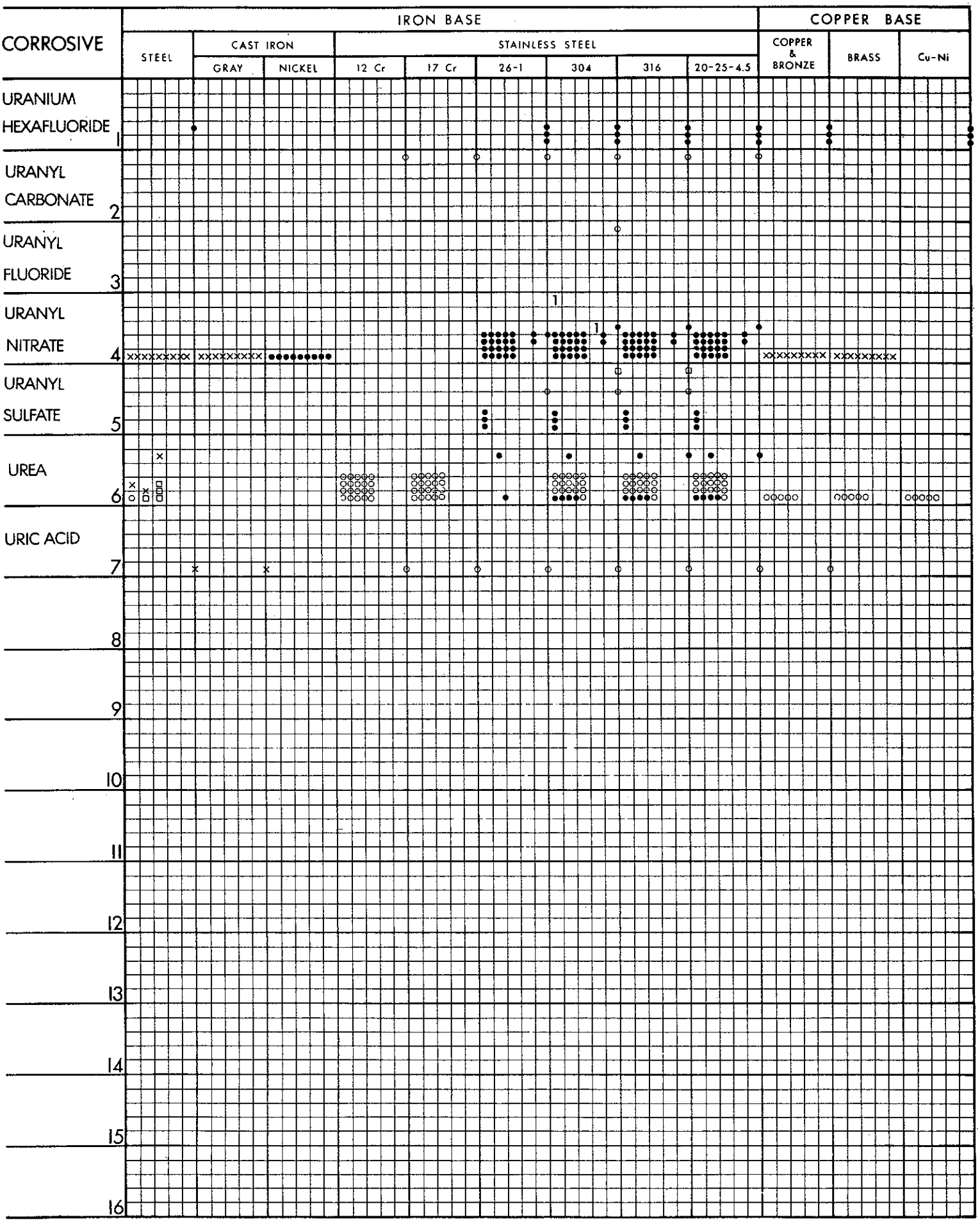
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
URANIUM HEXAFLUORIDE 1
URANYL CARBONATE 2
URANYL FLUORIDE 3
URANYL NITRATE 4
URANYL SULFATE 5
UREA 6
URIC ACID 7
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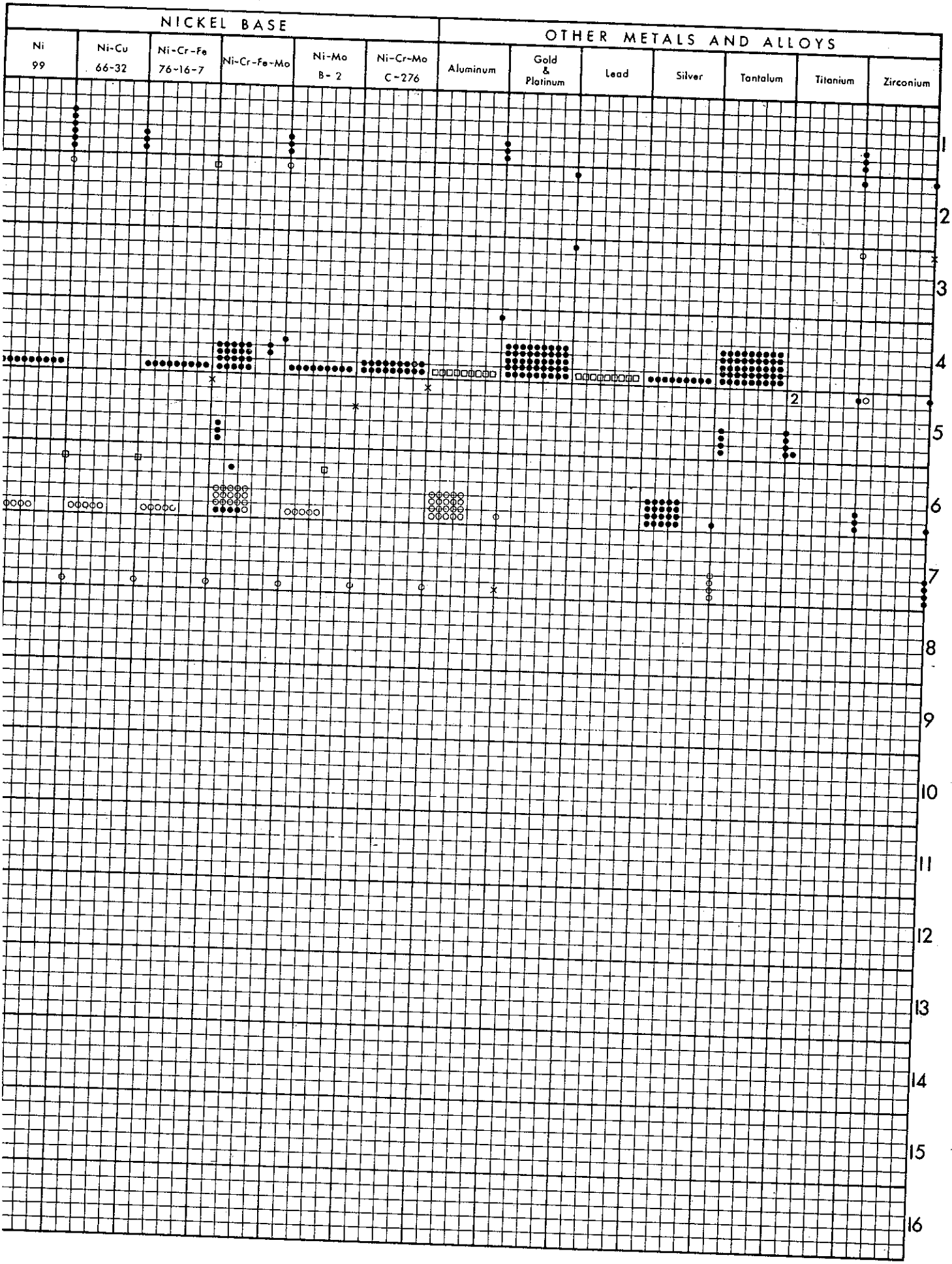
NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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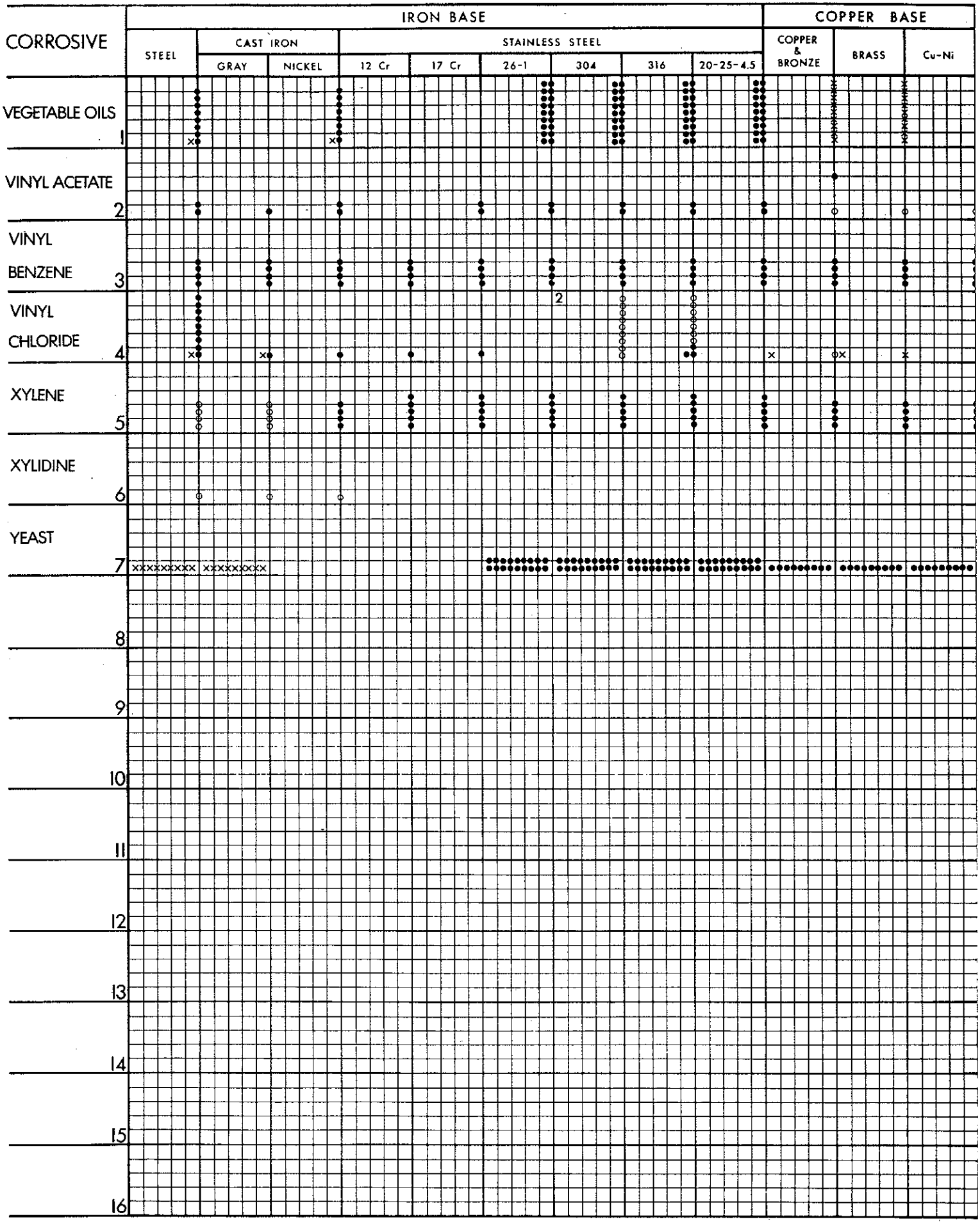
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
VEGETABLE OILS 1
VINYL ACETATE 2
VINYL BENZENE 3
VINYL CHLORIDE 4
XYLENE 5
XYLIDINE 6
YEAST 7
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16
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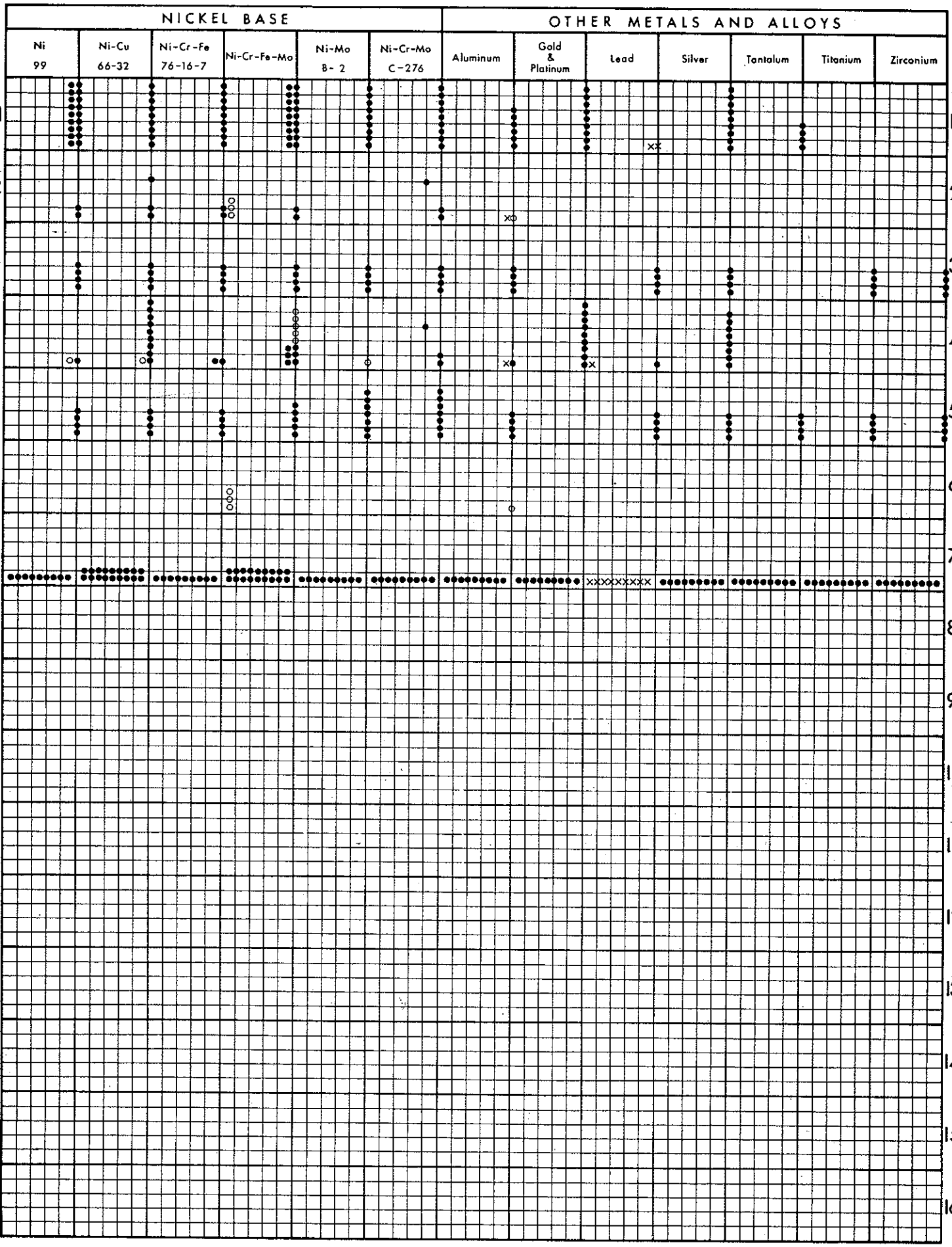
NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo B-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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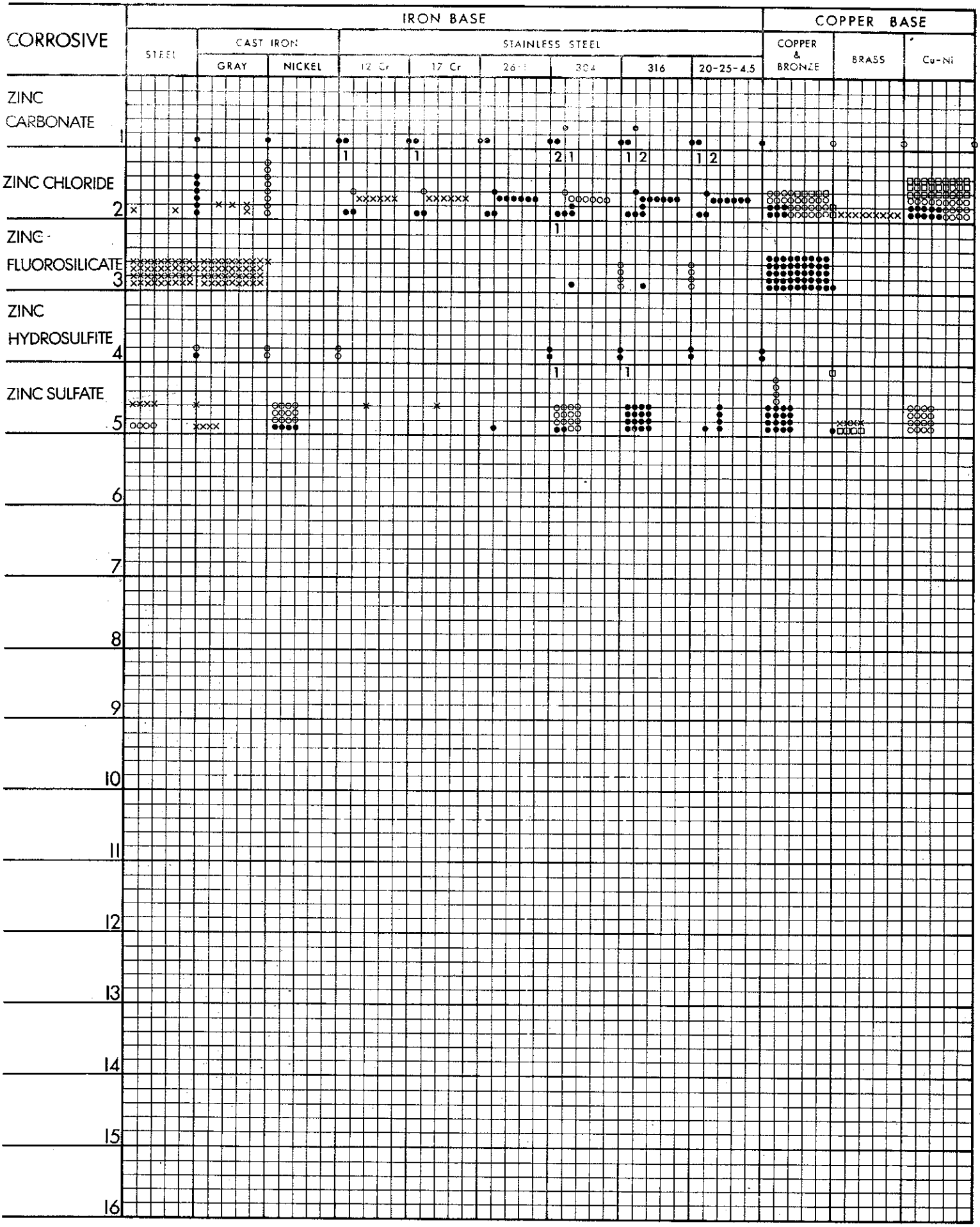
CORROSIVE
IRON BASE
COPPER BASE
STEEL
CAST IRON
GRAY
NICKEL
STAINLESS STEEL
12 Cr
17 Cr
26-1
304
316
20-25-4.5
COPPER & BRONZE
BRASS
Cu-Ni
ZINC CARBONATE 1
ZINC CHLORIDE 2
ZINC FLUOROSILICATE 3
ZINC HYDROSULFITE 4
ZINC SULFATE 5
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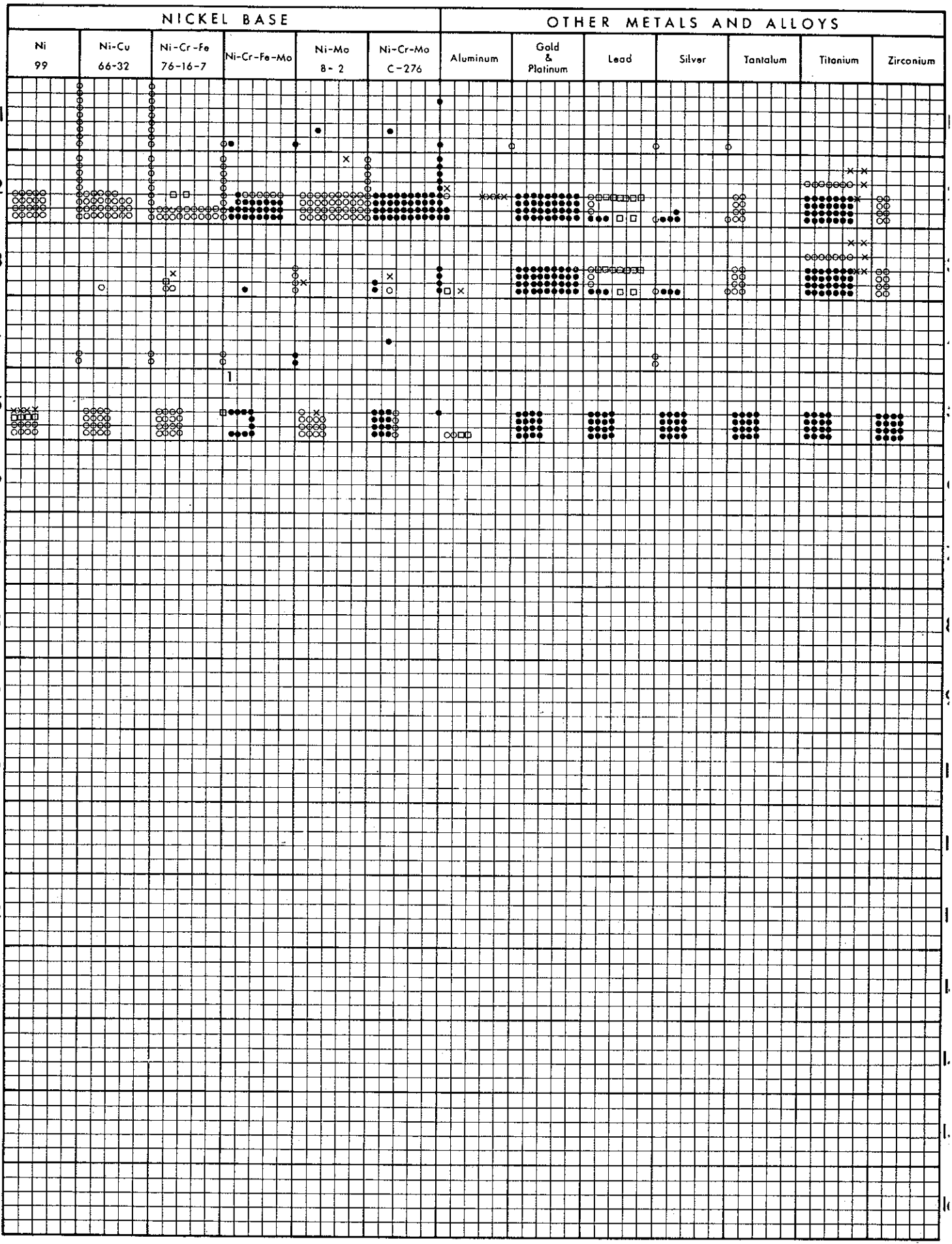
NICKEL BASE
OTHER METALS AND ALLOYS
Ni 99
Ni-Cu 66-32
Ni-Cr-Fe 76-16-7
Ni-Cr-Fe-Mo
Ni-Mo 8-2
Ni-Cr-Mo C-276
Aluminum
Gold & Platinum
Lead
Silver
Tantalum
Titanium
Zirconium
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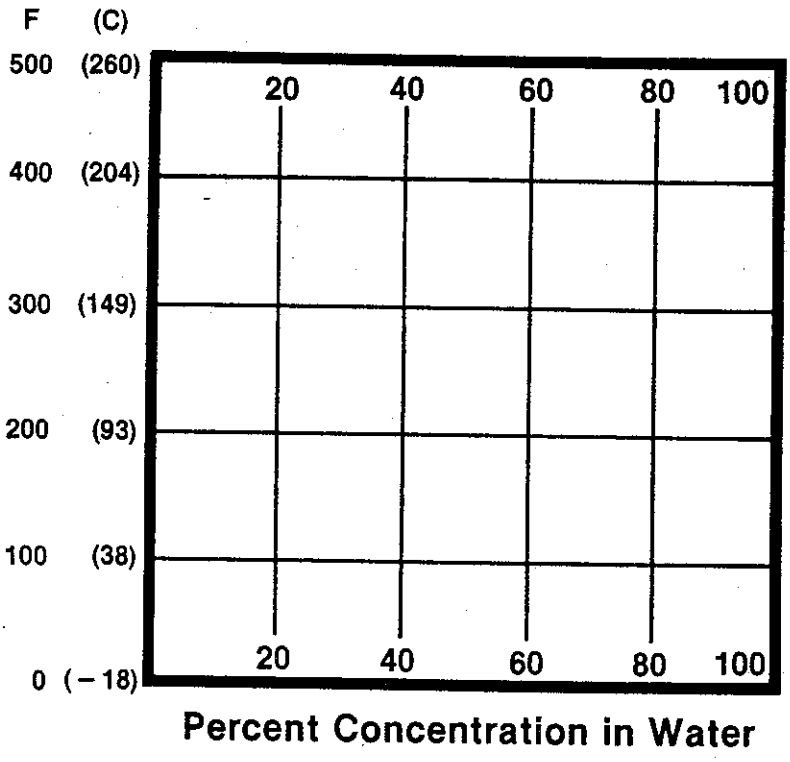
Section 2
Short Tables

The following "short" tables contain data on additional materials not found in the main tables and are organized separately to conserve space. Data in this section also represent exposure in the 0 to 500 F (-18 to 260 C) corrosive temperature range, are of the same kind and reliability as other data found in this volume, and come from the same sources.

Data are plotted in the same matrix used in the main tables (shown below). The reader is advised to examine this matrix before attempting to use the talbes. A replica of the matrix also appears on the fold-out page immediately following the introduction for ready reference when reading the tables. A key to the data points (giving average penetration rates per year), a key to footnotes, and a table of identifications and nominal analyses of metals and alloys are also located on the fold-out page.

Consult the introduction for further instructions on how to use this data survey.



CORROSIVE	MISCELLANEOUS METALS AND ALLOYS										
	Steel	Gray Cast Iron	Aluminum								
ALLYL BROMIDE 1											
	304	316	Ni-Cr-Fe-Mo	Ni 99	Ni-Cu 66-32	Ni-Cr-Fe 76-16-7	Ni-Cr-Mo C-276				
ALUMINUM FLUOROSULFATE 2											
	Copper & Bronze	Ni-Cu 66-32	Ni-Mo B-2	Ni-Cr-Mo C-276							
ALUMINUM OXALATE 3											
	Steel	Gray Cast Iron	316	Ni-Cr-Fe-Mo							
ALUMINUM STEARATE 4											
	Silicon Cast Iron	304	316	Ni-Cr-Fe-Mo							
AMMONIUM ARSENATE 5											
	Steel	Silicon Cast Iron	Copper & Bronze	Ni 99	Aluminum	Lead					
AMMONIUM AZIDE 6											
	Steel	Gray Cast Iron	Nickel Cast Iron	Silicon Cast Iron							
AMMONIUM BENZOATE 7											
	Steel	Gray Cast Iron	Nickel Cast Iron	316	Ni-Cr-Fe-Mo						
AMMONIUM BORATE 8											
	Silicon Cast Iron	316	Copper								
AMMONIUM IODIDE 9											
	Silicon Cast Iron	Aluminum									
AMMONIUM LACTATE 10											

CORROSIVE	MISCELLANEOUS METALS AND ALLOYS
AMMONIUM THIOGLYCOLATE 1	Steel, Aluminum
ANTHRANILIC ACID 2	Steel, Silicon Cast Iron, Aluminum
ARSENIC PENTOXIDE & 62% SULFURIC 3	304, 316, Ni 99, Ni-Cu 66-32, Ni-Cr-Fe 76-16-7
ARSENIC DISULFIDE 4	Steel, Gray Cast Iron, Copper, Aluminum, Silver
ARSENIC TRIOSULFIDE 5	Steel, Gray Cast Iron, Copper, Brass, Silver
BEER 6	304, 316
BERYLIUM OXIDE 7	Ni 99, Ni-Cu 66-32, Ni-Cr-Fe 76-16-7, Titanium, Zirconium
BISMUTH SUBCARBONATE 8	Steel, Silicon Cast Iron, 304, 316, Ni-Cr-Fe-Mo, Ni-Cu 66-32
BISMUTH NITRATE 9	Steel, Silicon Cast Iron, Ni-Cr-Fe-Mo
BROMOBENZYL CYANIDE 10	Steel, Gray Cast Iron, Ni 99, Ni-Cu 66-32, Lead

CORROSIVE	MISCELLANEOUS METALS AND ALLOYS										
	304	316	Ni-Cr-Fe-Mo	Ni 99	Ni-Cu 66-32	Silver					
BROMOISOVALERYL UREA 1	●	●	●	●	●	●					
	Steel	Silicon Cast Iron	Gray Cast Iron	304	Ni 99	Aluminum					
BUTYL BENZOIC ACID 2	×	⊖	×	●	1 ⊖	⊖					
	Steel	Silicon Cast Iron	Gray Cast Iron	Nickel Cast Iron							
CALCIUM CYANAMIDE 3	⊖	●	⊖	⊖							
	Steel	Gray Cast Iron	Nickel Cast Iron	Gold	Platinum						
CALCIUM CYANIDE 4	●	●	●	●	●						
	304	316	Ni-Cr-Fe-Mo	Aluminum							
CALCIUM HYDROSULFIDE 5	●	●	●	⊖							
	Steel	Gray Cast Iron	304	316	Ni-Cr-Fe-Mo	Aluminum					
CALCIUM PEROXIDE 6	×	⊖	×	⊖	⊖	⊖					
	Steel	Silicon Cast Iron	Gray Cast Iron								
CALCIUM PHENOSULFATE 7	●	●	●								
	Silicon Cast Iron	Gray Cast Iron	Nickel Cast Iron	Ni-Cr-Fe-Mo	Aluminum						
CALCIUM PROPIONATE 8	●	●	●	●	●						
	Silicon Cast Iron	Ni-Cr-Fe-Mo	Ni-Cr-Mo C-276								
CALCIUM PYRIDINE SULFONATE 9	●	●	●								
	Steel	304	316	Copper	Nickel						
CEROUS CHLORIDE 10	●	1 2	1 2	●	●						

CORROSIVE	MISCELLANEOUS METALS AND ALLOYS
CEROUS FLUORIDE 1	Steel, Copper, Aluminum, Lead, Silver
CEROUS SULFATE 2	Steel, Silicon Cast Iron, Lead, Silver
CHLOROBENZENE 60% CHLORAL 40% 3	Ni 99, Ni-Cu 68-32, Ni-Cr-Fe 76-16-7, Ni-Cr-Mo C-276
CHLOROBENZOYL CHLORIDE 4	Steel, 304, Copper, Ni-Cr-Mo C-276, Aluminum, Lead, Silver
CHLOROPICRIN 5	304, 316
CINNAMIC ACID 6	Steel, Silicon Cast Iron, Gray Cast Iron
COBALTOUS SULFATE 7	Steel, Silicon Cast Iron, 316, Aluminum, Lead
COPPER GLUCONATE 8	Steel, Silicon Cast Iron, Gray Cast Iron, Nickel Cast Iron, Aluminum
COPPER NAPHTHENATE 9	Steel, Silicon Cast Iron, Gray Cast Iron, Nickel Cast Iron, Aluminum
CYANOHYDRIN 10	Steel, Silicon Cast Iron, Gray Cast Iron, Nickel Cast Iron, 304, 316, Ni-Cr-Fe-Mo

CORROSIVE	MISCELLANEOUS METALS AND ALLOYS										
	Steel	Silicon Cast Iron	Gray Cast Iron	Nickel Cast Iron	304	316	Ni-Cr-Fe-Mo	Ni 99			
DIBUTYL SEBACATE 1	●	●	●	●	●	●	●	●		●	
	304	316	Ni-Cu 66-32								
DIBUTYL SULFATE 2	×	×	○								
	304	Tantalum	Titanium	Zirconium							
DICHLOROACETIC ACID 3	●	●	●	○							
	Steel	Silicon Cast Iron	Gray Cast Iron	Nickel Cast Iron							
DIETHYLCARBONATE 4	●	●	○	●	●						
	Steel	Gray Cast Iron	304	316	Ni-Cr-Fe-Mo	Ni-Mo B-2					
DIISOBUTYL ALUMINUM CHLORIDE 5	●	●	●	●	●	●					
	304	316	Ni 99	Ni-Cu 66-32	Ni-Mo B-2	Aluminum					
DIMETHYL CHLORACETO ACETAMIDE 6	×	×	●	●	●	●	●	×			
	Steel	304	316	Ni-Cr-Fe 76-16-7	Aluminum	Titanium					
DIMETHYL (UNS) HYDRAZINE + HYDRAZINE 50%-50% 7	○	●	●	×	●	○	●				
	Steel	Silicon Cast Iron	Gray Cast Iron								
DIMETHYL SULFATE 8	●	○	○								
	Silicon Cast Iron	Ni-Cu 66-32	Ni-Cr-Fe-Mo								
FERRIC FERROCYANIDE 9	●●●●	●	○								
	Silicon Cast Iron	Ni-Cr-Fe 76-16-7	Ni-Mo B-2	Ni-Cr-Mo C-276							
FERROUS AMMONIUM CITRATE 10	●	○	○	○							

CORROSIVE	MISCELLANEOUS METALS AND ALLOYS										
	304	316	Ni-Cr-Fe-Mo	Ni-Cr-Mo C-276							
FERROUS IODIDE 1	○	○	●	●							
	Steel	Silicon Cast Iron	Gray Cast Iron	Nickel Cast Iron							
GLYCEROL MONOCHLORO HYDRIN 2	○	◎	●	○							
	304	316	Ni-Cr-Fe-Mo	Tantalum							
GOLD CYANIDE PLATING SOLUTION 3	●	●	●	●							
	Silicon Cast Iron	316	Ni-Cr-Fe-Mo								
IRON SULFAMATE 4	◎	◎	◎								
	Steel	Silicon Cast Iron	Gray Cast Iron	Nickel Cast Iron							
ISOBUTYLENE CHLOROHYDRIN 5	○	◎	○	○							
	Steel	Silicon Cast Iron	Ni-Cr-Fe-Mo	Aluminum							
ISOBUTYRIC ACID 6	□	◎	◎	●							
	Silicon Cast Iron	Titanium									
ISOPROPYL NITRATE 7	◎	○									
	304	316	Ni-Cr-Fe-Mo								
LEAD FLUOSILICATE + 8.5% H_2-Si-Fe + 6.9% Pb-Si-F_6 8	○	○	○								
	Steel	Silicon Cast Iron	Gray Cast Iron	Nickel Cast Iron	Copper						
LEAD NAPHTHENATE 9	●	●	●	●	●						
	Steel	Silicon Cast Iron	Gray Cast Iron	Nickel Cast Iron	304	316	Ni-Cr-Fe-Mo				
LEAD PATHALATE 10	●	●	●	●	●	●	●				

CORROSIVE	MISCELLANEOUS METALS AND ALLOYS										
	Steel	Silicon Cast Iron	Gray Cast Iron	Nickel Cast Iron							
LEAD SALICYLATE 1											
	Steel	Silicon Cast Iron	Gray Cast Iron	304	316	Ni-Cr-Fe-Mo	Ni-Mo B-2				
LEAD STEARATE 2											
	Steel	Silicon Cast Iron	Gray Cast Iron	304	316	Ni-Cr-Fe-Mo	Ni-Mo B-2				
LEAD TETRA-ACETATE 3											
	Silicon Cast Iron	304	316	Ni-Cr-Fe-Mo	Ni-Cu 66-32	Aluminum					
LINALYL ACETATE 4											
	Steel	Silicon Cast Iron	Gray Cast Iron	Nickel Cast Iron							
LITHIUM BENZOATE 5											
	304	316	99	Ni-Cu 66-32	Ni-Cr-Fe						
LITHIUM BROMIDE 6											
	Steel	Silicon Cast Iron	Gray Cast Iron	Nickel Cast Iron							
LITHIUM SALICYLATE 7											
	Steel	Silicon Cast Iron	Gray Cast Iron	Nickel Cast Iron	Titanium						
MAGNESIUM GLUCONATE 8											
	Steel	Silicon Cast Iron	Gray Cast Iron	Nickel Cast Iron							
MAGNESIUM GLYCEROPHOSPHATE 9											
	Steel	Silicon Cast Iron	Gray Cast Iron	Nickel Cast Iron							
MAGNESIUM HYPOPHOSPHITE 10											

CORROSIVE	MISCELLANEOUS METALS AND ALLOYS										
	Silicon Cast Iron	304	Aluminum								
MAGNESIUM PERCHLORATE 1	•	••	••								
	Silicon Cast Iron	304	316	Ni-Cr-Fe-Mo	Copper						
MANGANESE CARBONATE 2	o	oo	oo	oo	oo	o					
	Steel	Silicon Cast Iron	Gray Cast Iron	Nickel Cast Iron							
MANGANESE LINOLEATE 3	•	•	•	•							
	Steel	Silicon C. I.	Gray C. I.	Nickel C. I.	304	316	Ni-Cr-Fe-Mo				
MANGANESE NAPHTHENATE 4	•	•	•	•	•	•	•				
	304	316	Ni-Cr-Fe-Mo								
MERCURIC ACETATE 5	ooo	ooo	ooo								
	Silicon Cast Iron	304	316	Ni-Cr-Fe-Mo	Ni-Cr-Fe 76-16-7	Lead					
MERCURIC SULFATE 6	•o	ooo	oooo	o	ooo						
	Steel	Silicon Cast Iron	Gray Cast Iron	Nickel Cast Iron	304	316					
METHACRYLIC ACID 7	•	•	•	•	•	•					
	Steel	Silicon Cast Iron	Gray Cast Iron	Nickel Cast Iron	304	316	Ni-Cr-Fe-Mo				
METHYL ABIETATE 8	•	•	•	•	•	•	•				
	Steel	Silicon Cast Iron	Gray Cast Iron	Nickel Cast Iron	304	316					
METHYL ACRYLATE 9	•	•	•	•	•	•					
	Steel	Silicon Cast Iron	Gray Cast Iron	Nickel Cast Iron	Copper						
METHYLAMYL ACETATE 10	•	•	•	•							

CORROSIVE	MISCELLANEOUS METALS AND ALLOYS										
	Steel	Silicon Cast Iron	Gray Cast Iron	Nickel Cast Iron							
METHYL LACTATE 1											
	Steel	Silicon Cast Iron	304	316	Ni-Cr-Fe-Mo	Aluminum					
METHYL METHACRYLATE 2											
	Steel	Silicon Cast Iron	Gray Cast Iron	Copper							
METHYL PROPIONATE 3											
	Steel	Silicon Cast Iron	Gray Cast Iron	Copper	Ni-Cu 66-32	Aluminum	Silver				
METHYL SALICYLATE 4											
	Steel	304	Ni-Cr-Fe-Mo	Aluminum							
MONOMETHYL HYDRAZINE 5											
	Steel	304	316	Ni-Cu 66-32	Ni-Cr-Fe 76-16-7						
NAPHTHENIC ACIDS 6											
	Silicon Cast Iron	304	316	Ni-Cr-Fe-Mo	Ni-Cu 66-32	Aluminum					
NICKEL ACETATE 7											
	Steel	304	316	Aluminum							
NICOTINE 8											
	304	316	Ni-Cr-Fe-Mo	Ni-Cr-Fe 76-16-7	Ni-Cr-Mo C-276						
NITRIC ACID (25-35%) +515 ppm CHLORIDES 9											
	Steel	Gray Cast Iron	Nickel Cast Iron	Aluminum							
NITROXYLENE 10											

CORROSIVE	MISCELLANEOUS METALS AND ALLOYS										
	Steel	Gray Cast Iron	304	Copper	Ni-Cr-Fe 76-16-7						
PENICILLIN NUTRIENT 1											
	Silicon Cast Iron	316	Aluminum								
PERACETIC ACID 2											
	Silicon Cast Iron	316	Ni-Cr-Fe-Mo								
PERMANGANIC ACID 3											
	Steel	Silicon Cast Iron	304	Copper	Brass	Ni-Mo B-2					
PHENOL + 3-5% SULFURIC ACID 4											
	Silicon Cast Iron	N, 99	Aluminum								
PHENYL GLYCINE 5											
	Silicon Cast Iron	Lead	Titanium	Zirconium							
PHOSPHORUS TRIBROMIDE 6											
	Steel	Silicon Cast Iron	Gray Cast Iron	Nickel Cast Iron							
POTASSIUM CITRATE 7											
	Steel	Silicon Cast Iron	Gray Cast Iron	Nickel Cast Iron	Silver						
POTASSIUM GLUCONATE 8											
	Steel	Silicon Cast Iron	316	Ni-Cr-Fe-Mo	Lead						
POTASSIUM METABISULFITE 9											
	Steel	Silicon Cast Iron	Gray Cast Iron	Nickel Cast Iron							
POTASSIUM STANNATE 10											

CORROSIVE	MISCELLANEOUS METALS AND ALLOYS										
	Steel	Silicon Cast Iron	Ni-Cr-Fe-Mo	Aluminum							
RESORCINOL 1											
	Silicon Cast Iron	Aluminum	Titanium								
RICINOLEIC ACID 2											
	Steel	Silicon Cast Iron	Aluminum	Gold	Silver						
SELENIC ACID 3											
	304	316	Ni-Cr-Fe-Mo	Titanium	Zirconium						
SELENOUS ACID 4											
	Silicon Cast Iron	304	Copper								
SILICOTUNGSTIC ACID 5											
	Silicon Cast Iron	Ni-Cr-Fe-Mo									
SILVER SULFATE 6											
	304	316	Ni-Cr-Fe-Mo								
SODIUM BOROHYDRIDE 7											
	Steel	Silicon Cast Iron	304	316	Ni-Cr-Fe-Mo	Brass	Aluminum				
SODIUM CYANIMIDE 8											
	Steel	Gray Cast Iron	Nickel Cast Iron								
SODIUM GLUCONATE 9											
	304	316	Ni-Cr-Fe-Mo								
SODIUM HYPOPHOSPHATE 10											

CORROSIVE	MISCELLANEOUS METALS AND ALLOYS
SODIUM HYPOPHOSPHITE 1	Steel; Gray Cast Iron; Nickel Cast Iron; Ni-Cu
SODIUM OLEATE 2	Steel; Silicon Cast Iron; 304; 316; Ni-Cr-Fe-Mo; Titanium
SODIUM OXALATE 3	Steel; 304; Aluminum; Titanium
SODIUM PROPIONATE 4	Steel; 304; 316; Aluminum
SODIUM PYROSULFITE 5	304; 316; Ni-Cr-Fe-Mo; Copper; Ni-Cu; Aluminum; Lead; Silver
SODIUM RESINATE 6	Steel; Gray C; Nickel Cast Iron; 304; 316; Ni-Cr-Fe-Mo
SODIUM STANNATE 7	Steel; 304; 316; Aluminum
SODIUM TETRASULFIDE 8	Steel; Gray Cast Iron
SODIUM TRICHLOROACETATE 9	Steel; Gray Cast Iron; Nickel Cast Iron
STANNOUS FLUORIDE 10	316; Ni-Cr-Fe-Mo

CORROSIVE	MISCELLANEOUS METALS AND ALLOYS										
	304	Ni-Cr-Fe-Mo	Ni-Mo	Aluminum							
STREPTOMYCIN 1	○	○	●	●							
	Steel	Gray Cast Iron	Nickel Cast Iron								
STRONTIUM CARBONATE 2	●	●	●								
	Steel	304	316	Ni	Ni-Cu	Ni-Cr-Fe	Ni-Mo				
STRONTIUM CHLORIDE 3	×	×	×	×	×	×	⊡				
	Steel	Gray Cast Iron	304	316	Copper	Brass	Aluminum	Titanium			
SULFAMIC ACID 4	××	●×	×	×	●	●	×●	×			
	Gray Cast Iron	Nickel Cast Iron	Titanium	Zirconium							
SULFANILIC ACID 5	●	●●	●	●							
	Steel	Gray Cast Iron	304	Ni-Cr-Fe-Mo	Aluminum						
SULFONIC ACIDS 6	×××	×××	○○○	○○○	×××						
	Gray Cast Iron	Nickel Cast Iron	Nickel	Ni-Cu	Aluminum						
TERPINYL ACETATE 7	●	●	●	●	●						
	Steel	316	Ni-Cr-Fe-Mo	Ni-Cr-Mo C-276	Aluminum						
THIOGLYCOLIC ACID 8	●●	●●	●●	●●	●●						
	Ni-Cr-Fe-Mo	Nickel	Ni-Cu	Lead							
THIOPHOSPHORYL CHLORIDE 9	●	●	●	●	●						
	316	Ni-Cr-Fe-Mo									
THIOUREA 10	●●	●●	●								

CORROSIVE	MISCELLANEOUS METALS AND ALLOYS									
	304	316	Ni-Cr-Fe-Mo	Nickel	Ni-Cu	Ni-Cr-Fe	Ni-Cr-Mo C-276			
ZINC DIHYDROGEN PHOSPHATE 1	○	○	○ ◻	◻	◻	○				
	Steel	Gray Cast Iron	Nickel Cast Iron							
ZINC NAPHTHENATE 2	●	○	○							
	Aluminum	Silver								
ZINC OXIDE 3	● ● ●	●								
	Steel	Gray Cast Iron	Nickel Cast Iron							
ZINC PHENOLSULFONATE 4	●	●	●							
5										
6										
7										
8										
9										
10										

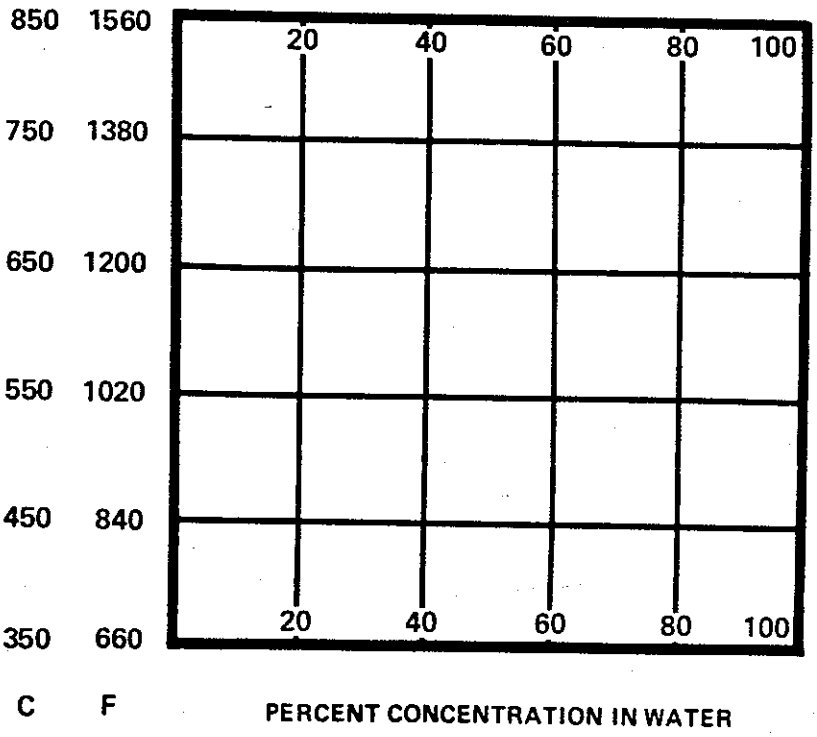
CORROSIVE	MISCELLANEOUS METALS AND ALLOYS										
	304	316	Aluminum								
THORIUM NITRATE 1	•	••	•	x							
	Steel	Aluminum									
TRIACETIN 2	•	o									
	Steel	Gray Cast Iron	Nickel Cast Iron	Copper	Brass						
TRIALLYAMINE 3	•	•	•	x	x						
	Steel	Gray Cast Iron	Copper	Brass							
TRICHLOROETHANOL AMINE 4	•	•	x	x							
	Steel	Gray Cast Iron	Nickel Cast Iron	Copper	Brass						
TRIETHYL PHOSPHATE 5	•	•	•	•	•						
	Steel	Copper	Aluminum								
TUNGSTIC ACID 6	•	o	x								
	Steel	316	Ni-Cr-Fe-Mo	Aluminum							
UNDECYLENIC ACID 7	•	••	••	o							
	304	316	Ni-Cr-Fe-Mo								
URANIUM CHLORIDES 8	x	xx	xx	x							
	Aluminum	Zirconium									
VALERIC ACID 9	x o o o o o	•	•								
	Steel	Gray Cast Iron	Nickel Cast Iron	304	316	Ni-Cr-Fe-Mo					
ZINC CYANIDE 10	xx	•	•	•	o•	o•	o•				

Section 3
High Temperature Tables

The following tables contain data representing exposure of materials to corrosives in the 660 to 1560 F (350 to 850 C) temperature range which could not easily be accommodated in the main tables. The data are of the same kind and reliability and come from the same sources as other data found in this volume.

The reader is advised to examine the following matrix upon which the tables in this section are based (and which differs from the matrix used in two preceding sections) before attempting to use the tables. A replica of the matrix appears at the bottom of each page in this section along with a key to data points (giving average penetration rates per year), footnotes, and a table of average penetration rates per year compared to weight loss.

Consult the introduction for further instructions on how to use this data survey.



CORROSIVE

MISCELLANEOUS METALS AND ALLOYS

ALIPHATIC DICARBOXYLIC ACID — 1

Silicon Cast Iron | Stainless 302-347 | Stainless 316-317 | ACI 20Cr30Ni | Nickel | Ni-Cu | NiCrFe

ALUMINUM — 2

Gray Cast Iron | Silicon Cast Iron | Mild Steel | Stainless 302-347 | Stainless 316-317 | ACI 20Cr30Ni | Copper | Brass 70-80 | Brass 59-93 | Nickel | Ni-Cu

NiCrFe | Tantalum | Titanium | Aluminum Oxide | Columbium | Fosterite | $FeO\ Cr_2O_3$ | Magnesia | Molybdenum | Silicon Carbide | Tungsten

Zircon

AMMONIA — 3

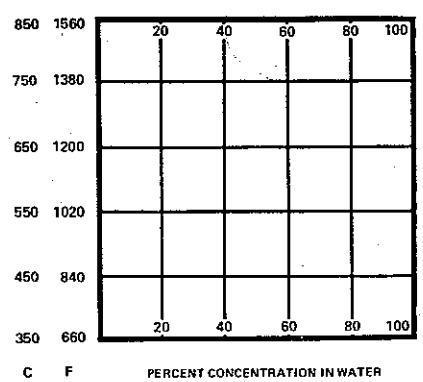
Nickel | NiCrFe | Platinum

AMMONIUM CHLORIDE — 4

NiMo | NiCrMo

BARIUM CHLORIDE — 5

Stainless 302-347 | NiCrFe | Platinum | Titanium



AVERAGE PENETRATION PER YEAR

Code		Mils	1 inch / 1000	Microns
●	<	2	0.002	50.8
○	<	20	0.020	508.0
□	{	20–50	0.020	508.0
□	{	20–50	0.050	1270.0
x	>	50	0.050	1270.0

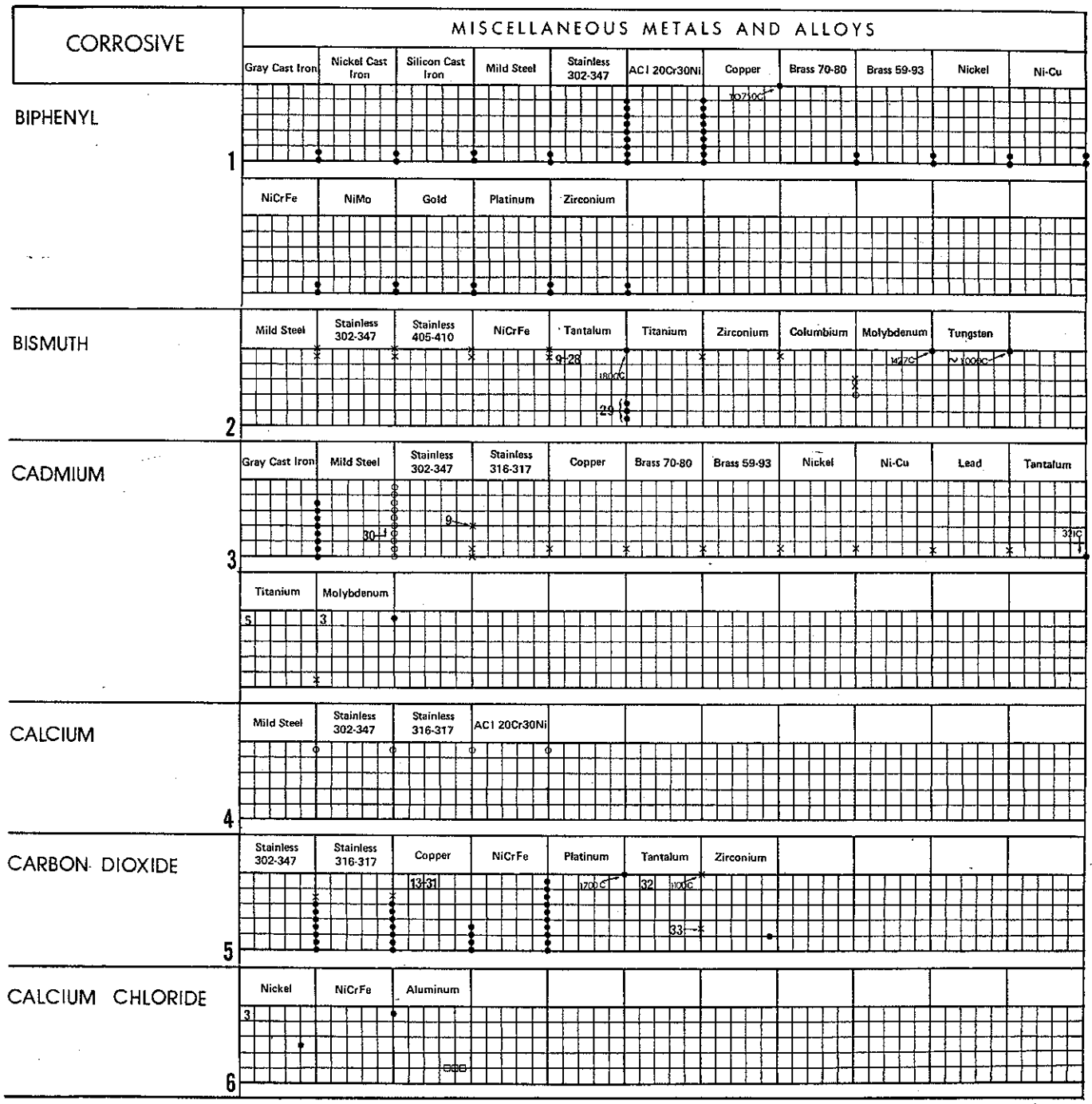
SOME CONVERSION FACTORS

Steel: mpy = $lb/ft^2/yr$ x 24.5
ipy x 696 x density = mdd
$g/m^2/d$ x 0.0144 ÷ density = ipy
1 micron = 0.03937 mil
Parts per million = 0.001 g/liter
Normal = 1 g equiv. liter (wt)

AVERAGE PENETRATION RATE/YR COMPARED TO WEIGHT LOSS

CDS	$mg/dm^2/day$	$g/m^2/yr$	$lb/ft^2/yr$
ALUMINUM			
●	<3.79	<138	<0.0284
○	<37.90	<1380	<0.284
□	37.9-945.5	1380-3450	0.284-0.71
X	>945.5	>3450	>0.71
COPPER, NICKEL or IRON			
●	<11.9	<435	<0.0896
○	<119.0	<4350	<0.896
□	119.0-297.5	4350-10875	0.896-2.24
X	>297.5	> 10875	>2.24

CDS	$mg/dm^2/day$	$g/m^2/yr$	$lb/ft^2/yr$
LEAD			
●	<15.75	<576	<0.1178
○	<31.50	<5760	<1.178
□	31.5-393.75	5760-14,400	1.178-2.945
X	>393.75	>14,400	>2.945
TANTALUM			
●	<23.06	<843	<0.172
○	<230.6	<8430	<1.72
□	230.6-576.5	8430-21,075	1.72-4.3
X	>576.5	>21,075	>4.3



FOOTNOTES FOR DATA SQUARES

1. No water
2. No air, oxygen
3. Low air, oxygen
4. Pits
5. Stress cracks
6. Stress corrosion
7. Discolors
8. Crevice attack
9. Intergranular attack
10. No chlorides
11. May discolor
12. May catalyze
13. May pit
14. May stress crack
15. Transgranular attack
16. Vapor
17. Aerated
18. Catalyzes
19. Static
20. Agitated
21. ~ 7 pH
22. < 7 pH
23. > 7 pH
24. 25 to 100 C
25. Graphitizes
26. Embrittles
27. > 538 C = nitriding
28. Over 1000 C
29. 8 fps
30. Oxide
31. When wet
32. Weight gain
33. 125 psi

CORROSIVE — MISCELLANEOUS METALS AND ALLOYS

1 CARBON MONOXIDE

Gray Cast Iron	Nickel Cast Iron	Silicon Cast Iron	Stainless 302-347	Stainless 316-317	ACI 20Cr30Ni	Copper	Brass 70-80	Brass 59-93	Nickel	Ni-Cu
			26				17	17	>1000°C	24

NiCrFe	NiMo	NiCrMo	Aluminum	Platinum
25	1100°C		27	<1400°C

2 CARBON TETRACHLORIDE

Stainless 302-347	NiMo	NiCrMo	Gold	Platinum
17	17	17	17	17

3 CHLORINE

Mild Steel	Stainless 302-347	Stainless 316-317	Brass 70-80	Nickel	Ni-Cu	NiCrFe	NiMo	NiCrMo	Platinum	Magnesium

4 CHLORINE + STEAM

Stainless 302-347	NiCrFe	NiCrMo

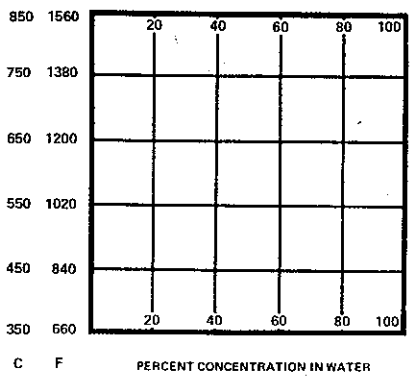
5 CESIUM

Mild Steel	Stainless 302-347	Stainless 316-317	Copper	Gold	Platinum	Silver	Tantalum	Titanium	Zirconium	Columbium
815°C	16 870°C	30			1000°C 20 Torr		980–>1500°C	2 29	2 871°C	3
	31			300°C			2		29	

Hafnium	Molybdenum	Tungsten	Vanadium
2 871°C	2 1371°C	1 <1700°C	28
29		30	

6 COPPER SULFIDE

Mild Steel	Stainless 302-347



AVERAGE PENETRATION PER YEAR

Code		Mils	1 inch / 1000	Microns
●	<	2	0.002	50.8
○	<	20	0.020	508.0
□	20–50	20	0.020	508.0
		50	0.050	1270.0
x	>	50	0.050	1270.0

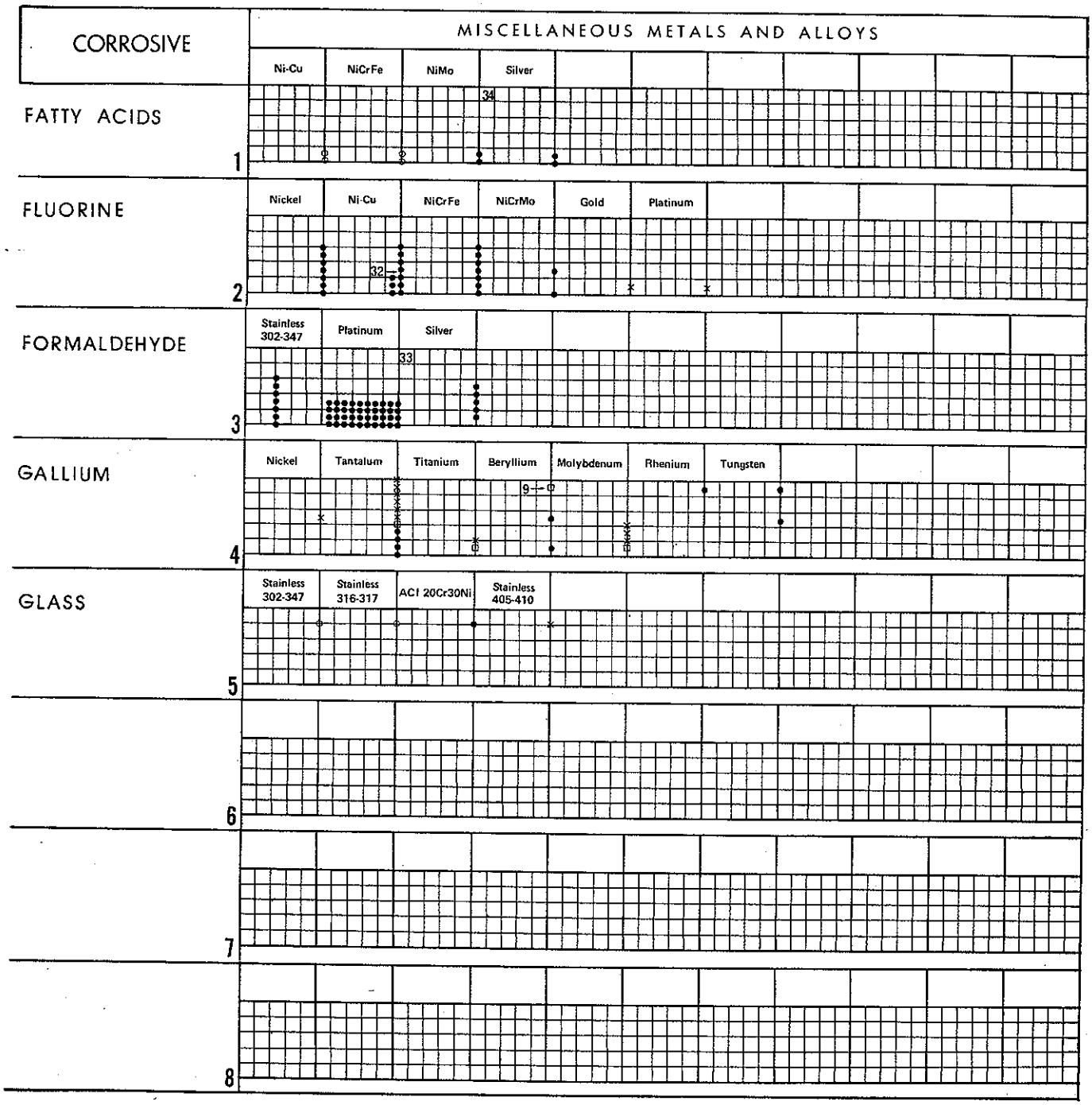
SOME CONVERSION FACTORS

Steel: mpy = $lb/ft^2/yr$ x 24.5
ipy x 696 x density = mdd
$g/m^2/d$ x 0.0144 ÷ density = ipy
1 micron = 0.03937 mil
Parts per million = 0.001 g/liter
Normal = 1 g equiv. liter (wt)

AVERAGE PENETRATION RATE/YR COMPARED TO WEIGHT LOSS

CDS	$mg/dm^2/day$	$g/m^2/yr$	$lb/ft^2/yr$
ALUMINUM			
●	<3.79	<138	<0.0284
○	<37.90	<1380	<0.284
□	37.9-945.5	1380-3450	0.284-0.71
x	>945.5	>3450	>0.71
COPPER, NICKEL or IRON			
●	<11.9	<435	<0.0896
○	<119.0	<4350	<0.896
□	119.0-297.5	4350-10875	0.896-2.24
x	>297.5	>10875	>2.24

CDS	$mg/dm^2/day$	$g/m^2/yr$	$lb/ft^2/yr$
LEAD			
●	<15.75	<576	<0.1178
○	<31.50	<5760	<1.178
□	31.5-393.75	5760-14,400	1.178-2.945
x	>393.75	>14,400	>2.945
TANTALUM			
●	<23.06	<843	<0.172
○	<230.6	<8430	<1.72
□	230.6-576.5	8430-21,075	1.72-4.3
x	>576.5	>21,075	>4.3

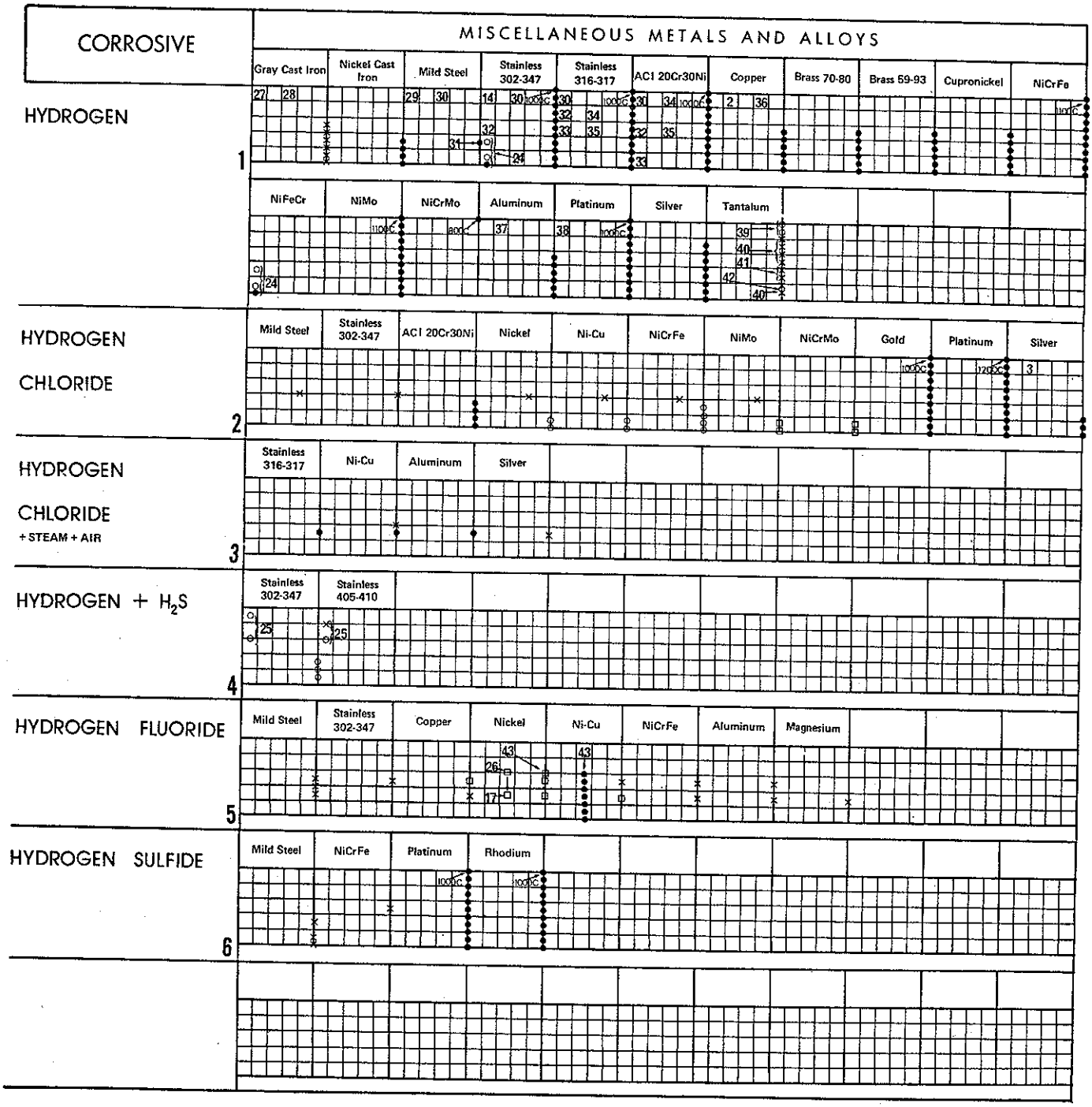


FOOTNOTES FOR DATA SQUARES

1. No water
2. No air, oxygen
3. Low air, oxygen
4. Pits
5. Stress cracks
6. Stress corrosion
7. Discolors
8. Crevice attack
9. Intergranular attack
10. No chlorides
11. May discolor
12. May catalyze
13. May pit
14. May stress crack
15. Transgranular attack
16. Vapor
17. Aerated
18. Catalyzes
19. Static
20. Agitated
21. ~ 7 pH
22. < 7 pH
23. > 7 pH
24. No sulfur
25. With sulfur
26. No hydrogen sulfide
27. No quartz
28. Embrittled by O_2 or N
29. No nitrogen
30. Liquid or vapor
31. Decarburizing
32. With steam
33. As catalyst
34. No solder

CORROSIVE

MISCELLANEOUS METALS AND ALLOYS



850 1560
750 1380
650 1200
550 1020
450 840
350 660
C F

20 40 60 80 100

PERCENT CONCENTRATION IN WATER

AVERAGE PENETRATION PER YEAR

Code		Mils	1 inch / 1000	Microns
●	<	2	0.002	50.8
○	<	20	0.020	508.0
□	{	20-50	0.020-0.050	508.0-1270.0
x	>	50	0.050	1270.0

SOME CONVERSION FACTORS

Steel: mpy = $lb/ft^2/yr$ x 24.5
ipy x 696 x density = mdd
$g/m^2/d$ x 0.0144 ÷ density = ipy
1 micron = 0.03937 mil
Parts per million = 0.001 g/liter
Normal = 1 g equiv. liter (wt)

AVERAGE PENETRATION RATE/YR COMPARED TO WEIGHT LOSS

CDS	$mg/dm^2/day$	$g/m^2/yr$	$lb/ft^2/yr$
ALUMINUM			
●	<3.79	<138	<0.0284
○	<37.90	<1380	<0.284
□	37.9-945	1380-3450	0.284-0.71
x	>945.5	>3450	>0.71
COPPER, NICKEL or IRON			
●	<11.9	<435	<0.0896
○	<119.0	<4350	<0.896
□	119.0-297.5	4350-10875	0.896-2.24
x	>297.5	> 10875	>2.24

CDS	$mg/dm^2/day$	$g/m^2/yr$	$lb/ft^2/yr$
LEAD			
●	<15.75	<576	<0.1178
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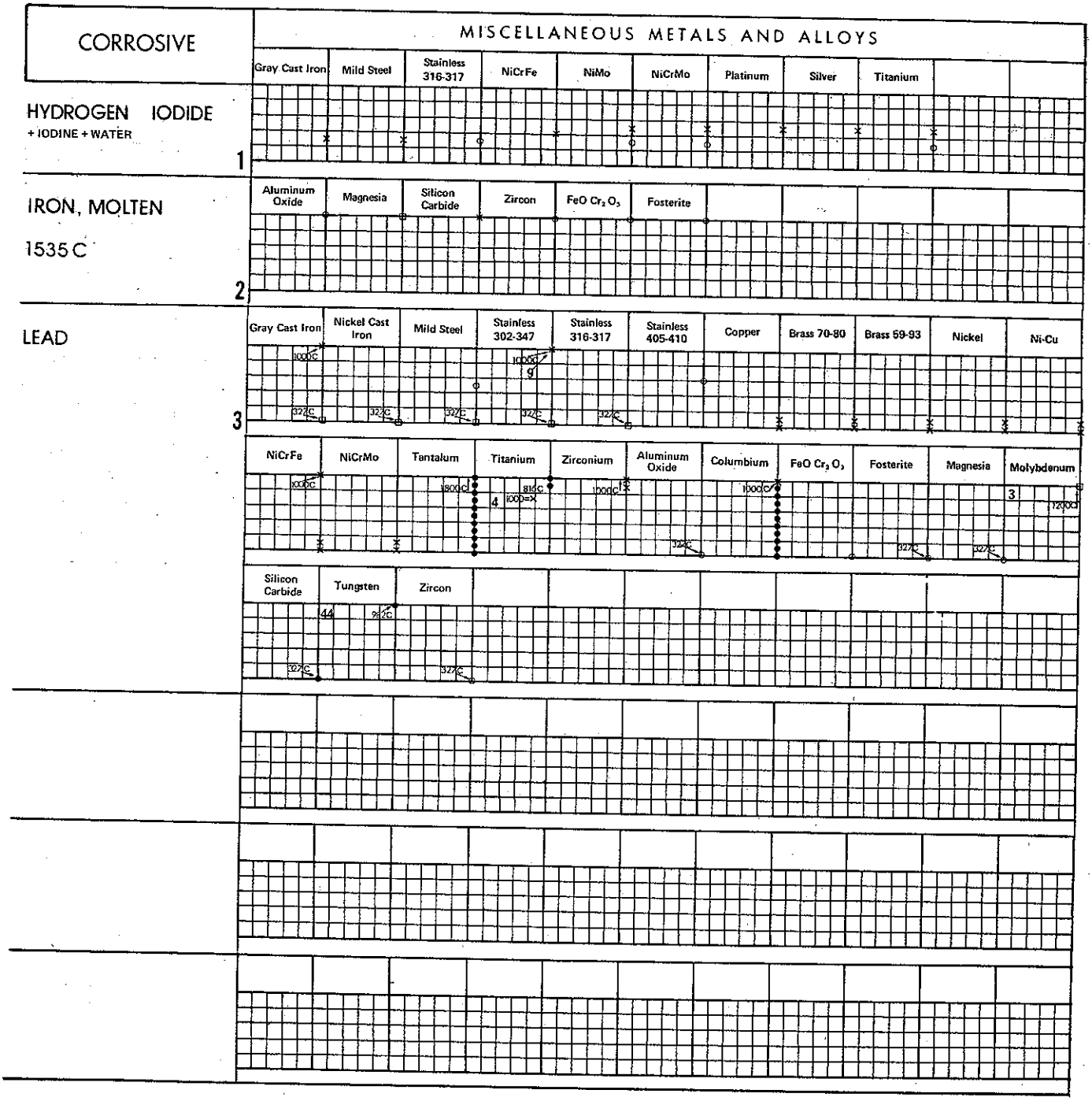
●	<23.06	<843	<0.172
○	<230.6	<8430	<1.72
□	230.6-576.5	8430-21,075	1.72-4.3
x	>576.5	>21,075	>4.3



FOOTNOTES FOR DATA SQUARES

1. No water
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3. Low air, oxygen
4. Pits
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6. Stress corrosion
7. Discolors
8. Crevice attack
9. Intergranular attack
10. No chlorides
11. May discolor
12. May catalyze
13. May pit
14. May stress crack
15. Transgranular attack
16. Vapor
17. Aerated
18. Catalyzes
19. Static
20. Agitated
21. ~ 7 pH
22. < 7 pH
23. > 7 pH
24. + 7% H_2S, 2000 psig
25. < 7% H_2S, 500 psig
26. + Steam
27. Embrittles
28. May carburize
29. < 0.04% P + S, < 0.35 C
30. < Rc 22
31. 1500 psi
32. < 60,000 psi UYS
33. Low H_2S
34. Annealed
35. No cold work
36. Brittle
37. ~ Impervious
38. No silica
39. Hydrogen purges
40. Weight gained
41. Weight lost
42. Loses ductility > 150 vol/o
43. Anhydrous, 100%
44. 50 hours

CORROSIVE

MISCELLANEOUS METALS AND ALLOYS

LITHIUM — 1

Silicon Cast Iron	Mild Steel	Stainless 302-347	Stainless 316-317	ACI 20Cr30Ni	Copper	Brass 70-80	Brass 59-93	Nickel	Ni-Cu	NiCrFe
	5 9	9				5	5	9	9 19	1000C WT GAIN 9
200C		260C	200C	200C	200C	200C	200C			

NiMo	Aluminum	Lead	Platinum	Silver	Tantalum	Titanium	Zirconium	Hafnium	Molybdenum	Tungsten
19			24		25 1000C	26 1500C	26 1500C		1540C	1370C
	200C	200C		200C	24	24				

Vanadium
26

MAGNESIUM — 2

Silicon Cast Iron	Mild Steel	Stainless 302-347	Stainless 316-317	ACI 20Cr30Ni	Copper	Brass 70-80	Brass 59-93	Nickel	Ni-Cu	NiCrFe

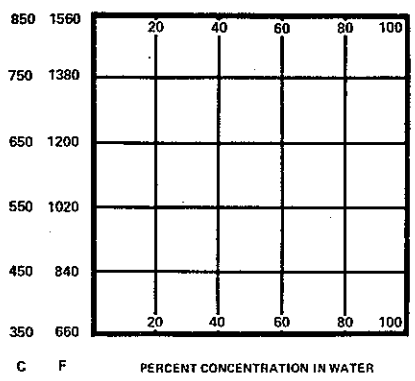
Aluminum	Lead	Tantalum	Titanium	Aluminum Oxide	$FeO\ Cr_2O_3$	Fosterite	Magnesia	Silicon Carbide	Zircon	
		1150C								

MERCURY — 3

Gray Cast Iron	Mild Steel	Stainless 302-347	Stainless 405-410	Nickel	Ni-Cu	Tantalum	Molybdenum			
				9		19				

NAPHTHENIC ACIDS — 4

Mild Steel	Stainless 302-347	Stainless 316-317	Ni-Cu	NiCrFe						
		43								



AVERAGE PENETRATION PER YEAR

Code		Mils	1 Inch / 1000	Microns
●	<	2	0.002	50.8
○	<	20	0.020	508.0
□	{	20–50	0.020	508.0
□	{	20–50	0.050	1270.0
X	>	50	0.050	1270.0

SOME CONVERSION FACTORS

Steel: $mpy = lb/ft^2/yr \times 24.5$
$ipy \times 696 \times density = mdd$
$g/m^2/d \times 0.0144 \div density = ipy$
1 micron = 0.03937 mil
Parts per million = 0.001 g/liter
Normal = 1 g equiv. liter (wt)

AVERAGE PENETRATION RATE/YR COMPARED TO WEIGHT LOSS

CDS	$mg/dm^2/day$	$g/m^2/yr$	$lb/ft^2/yr$
	ALUMINUM		
●	<3.79	<138	<0.0284
○	<37.90	<1380	<0.284
□	37.9-945.5	1380-3450	0.284-0.71
X	>945.5	>3450	>0.71
	COPPER, NICKEL or IRON		
●	<11.9	<435	<0.0896
○	<119.0	<4350	<0.896
□	119.0-297.5	4350-10875	0.896-2.24
X	>297.5	> 10875	>2.24

CDS	$mg/dm^2/day$	$g/m^2/yr$	$lb/ft^2/yr$
	LEAD		
●	<15.75	<576	<0.1178
○	<31.50	<5760	<1.178
□	31.5-393.75	5760-14,400	1.178-2.945
X	>393.75	>14,400	>2.945
	TANTALUM		
●	<23.06	<843	<0.172
○	<230.6	<8430	<1.72
□	230.6-576.5	8430-21,075	1.72-4.3
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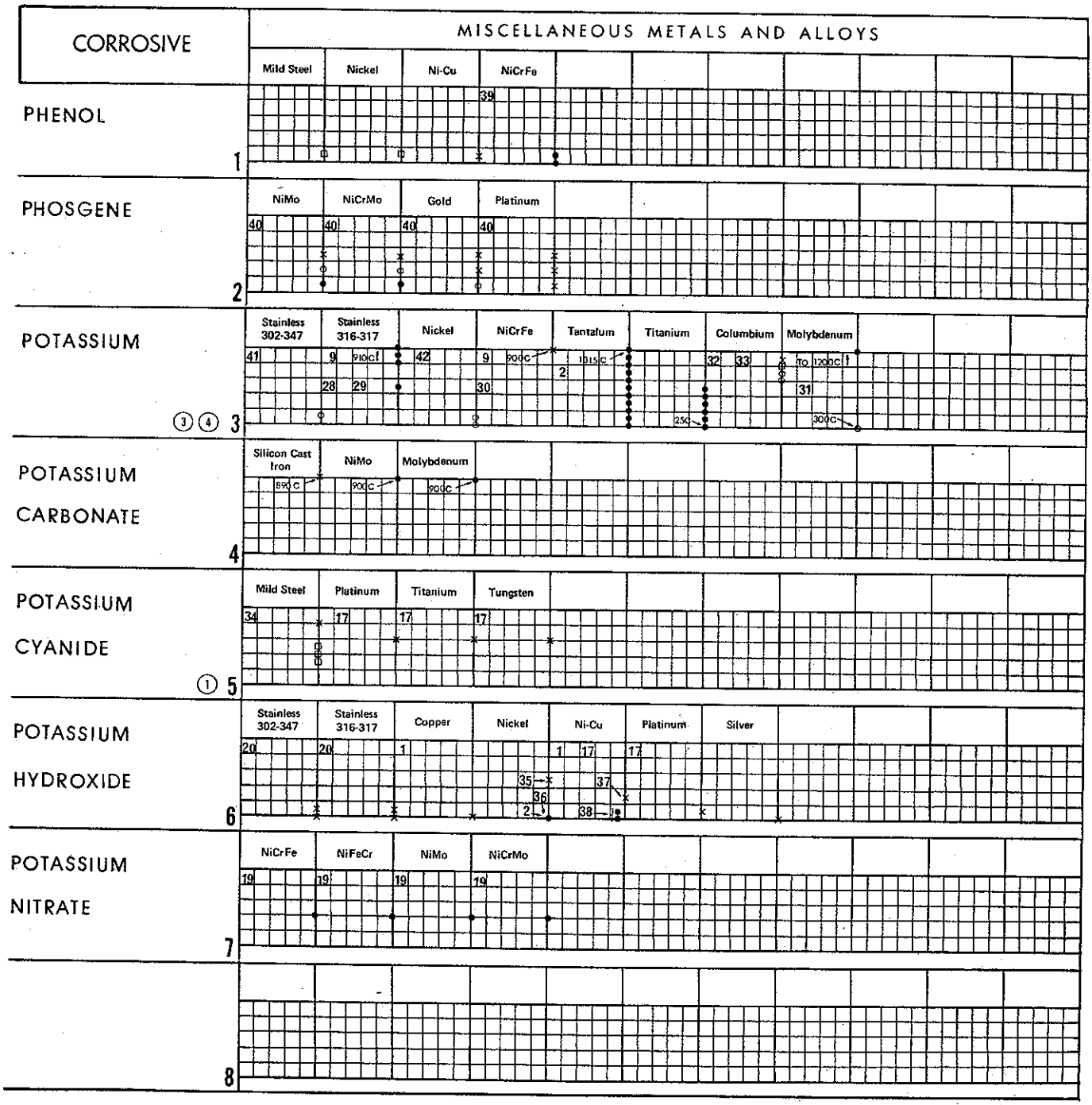

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12. May catalyze
13. May pit
14. May stress crack
15. Transgranular attack
16. Vapor
17. Aerated
18. Catalyzes
19. Static
20. Agitated
21. ~ 7 pH
22. < 7 pH
23. > 7 pH
24. Lithium chloride
25. < 100 ppm oxygen
26. Embrittled by oxygen
27. Stressed
28. Flowing
29. 32-38 ppm oxygen
30. Decarburization
31. < 50 ppm oxygen
32. < 10 ppm oxygen
33. 15 fps
34. Stress relieved
35. Mass transfer
36. No sulfur
37. Phase boundary
38. Vacuum
39. 4200 psi
40. 15 psig
41. Type 347
42. Low carbon
43. Low velocity

CORROSIVE

MISCELLANEOUS METALS AND ALLOYS

POTASSIUM PEROXIDE — 1

Gray Cast Iron	Mild Steel	Stainless 302-347	Stainless 316-317	Copper	Nickel	Ni-Cu	NiCrFe	Aluminum	Gold	Platinum

Tantalum	Titanium	Molybdenum

POTASSIUM THIOSULFATE — 2

Silicon Cast Iron	Stainless 302-347	Stainless 316-317	Nickel	NiCrFe

120C

POTASSIUM TITANIUM FLUORIDE — 3

Stainless 302-347	Stainless 316-317	Nickel	NiCrFe

SODIUM — 4

Gray Cast Iron	Mild Steel	Stainless 302-347	Stainless 316-317	ACI 20Cr30Ni	Stainless 405-410	Copper	Brass 59-93	Nickel	Ni-Cu	NiCrFe
26	26	2		26				2 24	2	2

316C 260C 320C 204C

Silver	Tantalum	Titanium	Zirconium	Aluminum Oxide	$FeO\ Cr_2O_3$	Columbium	Fosterite	Magnesia	Silicon Carbide	Vanadium
2			25							

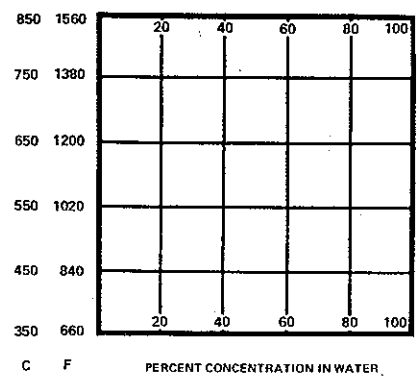
900C 98C 98C 98C 98C

Zircon

98C

SODIUM ACETATE — 5

Nickel	NiCrFe	Platinum	Silver	Molybdenum



AVERAGE PENETRATION PER YEAR

Code		Mils	1 inch / 1000	Microns
●	<	2	0.002	50.8
○	<	20	0.020	508.0
□	20-	50	0.020	508.0
□	20-	50	0.050	1270.0
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SOME CONVERSION FACTORS

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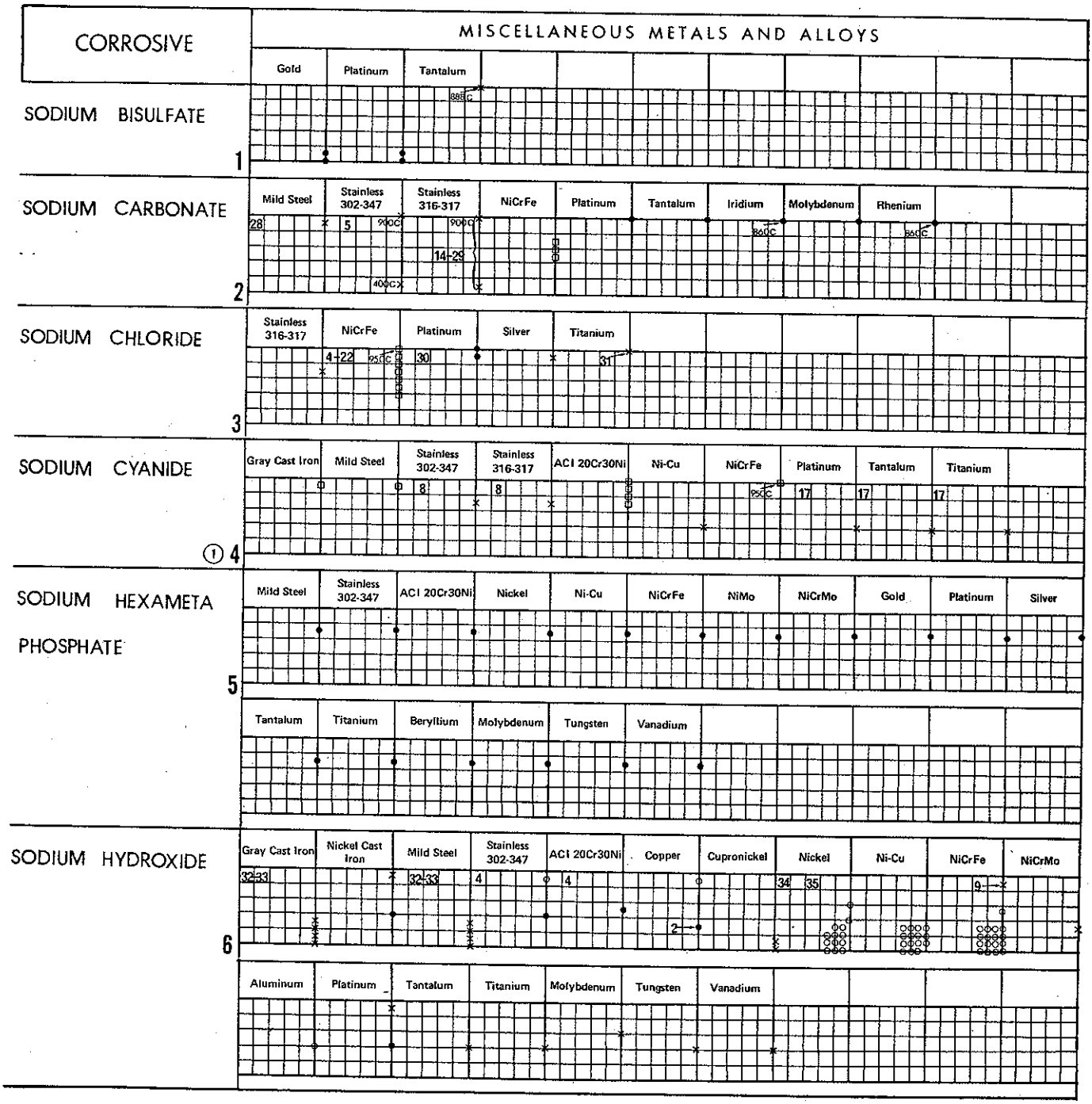
●	<11.9	<435	<0.0896
○	<119.0	<4350	<0.896
□	119.0-297.5	4350-10875	0.896-2.24
x	>297.5	>10875	>2.24

CDS	$mg/dm^2/day$	$g/m^2/yr$	$lb/ft^2/yr$
LEAD			
●	<15.75	<576	<0.1178
○	<31.50	<5760	<1.178
□	31.5-393.75	5760-14,400	1.178-2.945
x	>393.75	>14,400	>2.945
TANTALUM			
●	<23.06	<843	<0.172
○	<230.6	<8430	<1.72
□	230.6-576.5	8430-21,075	1.72-4.3
x	>576.5	>21,075	>4.3



FOOTNOTES FOR DATA SQUARES

1. No water
2. No air, oxygen
3. Low air, oxygen
4. Pits
5. Stress cracks
6. Stress corrosion
7. Discolors
8. Crevice attack
9. Intergranular attack
10. No chlorides
11. May discolor
12. May catalyze
13. May pit
14. May stress crack
15. Transgranular attack
16. Vapor
17. Aerated
18. Catalyzes
19. Static
20. Agitated
21. ~ 7 pH
22. < 7 pH
23. > 7 pH
24. Low carbon
25. Flowing
26. < 100 ppm oxygen
27. ~ 10 ppm oxygen
28. Decarburizes
29. > 400 C
30. No ammonia salts
31. With fluorides
32. Hydrogen embrittles
33. If stressed
34. Mass transfer > 500 C
35. 30 ft/min

CORROSIVE — MISCELLANEOUS METALS AND ALLOYS

1 SODIUM NITRATE

Mild Steel	Stainless 302-347	Stainless 405-410	Copper	Nickel	Ni-Cu	Gold	Platinum	Silver
40				5	5			

2 SODIUM PERCHLORATE

Gold	Platinum	Silver	Tantalum	Titanium	Zirconium	Molybdenum	Palladium	Tungsten
		24						

3 SODIUM PEROXIDE

Silver	Titanium
	24

4 SODIUM POTASSIUM

Mild Steel	Stainless 302-347	Stainless 316-317	NiCrFe	Tantalum	Zirconium	Beryllium	Columbium
		3	LIQUID METAL INTERFACE	2 900C			3 1400C

5 SODIUM SILICATES

Gray Cast Iron	Mild Steel	Stainless 302-347	Stainless 316-317	ACI 20Cr30Ni	NiCrFe	Platinum
1100C	1100C	1100C	1100C	1100C	900 – 1000C	1000C

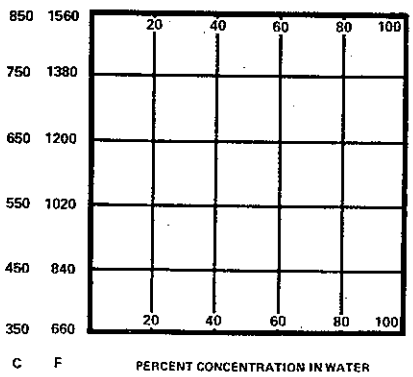
6 SODIUM SULFATE

ACI 20Cr30Ni	NiCrFe	Gold	Platinum	Silver	Titanium	Zirconium
950C	1000C	900C	900C	885C	900C	900C

7 SODIUM SULFIDE

Stainless 316-317	Platinum	Tantalum
9 920C	920C	

8



AVERAGE PENETRATION PER YEAR

Code		Mils	1 Inch / 1000	Microns
●	<	2	0.002	50.8
○	<	20	0.020	508.0
□	{	20-50	0.020-0.050	508.0-1270.0
x	>	50	0.050	1270.0

SOME CONVERSION FACTORS

Steel: mpy = lb/ft²/yr x 24.5
ipy x 696 x density = mdd
g/m²/d x 0.0144 ÷ density = ipy
1 micron = 0.03937 mil
Parts per million = 0.001 g/liter
Normal = 1 g equiv. liter (wt)

AVERAGE PENETRATION RATE/YR COMPARED TO WEIGHT LOSS

CDS	mg/dm²/day	g/m²/yr	lb/ft²/yr
ALUMINUM			
●	<3.79	<138	<0.0284
○	<37.90	<1380	<0.284
□	37.9-945.5	1380-3450	0.284-0.71
x	>945.5	>3450	>0.71
COPPER, NICKEL or IRON			
●	<11.9	<435	<0.0896
○	<119.0	<4350	<0.896
□	119.0-297.5	4350-10875	0.896-2.24
x	>297.5	>10875	>2.24

CDS	mg/dm²/day	g/m²/yr	lb/ft²/yr
LEAD			
●	<15.75	<576	<0.1178
○	<31.50	<5760	<1.178
□	31.5-393.75	5760-14,400	1.178-2.945
x	>393.75	>14,400	>2.945
TANTALUM			
●	<23.06	<843	<0.172
○	<230.6	<8430	<1.72
□	230.6-576.5	8430-21,075	1.72-4.3
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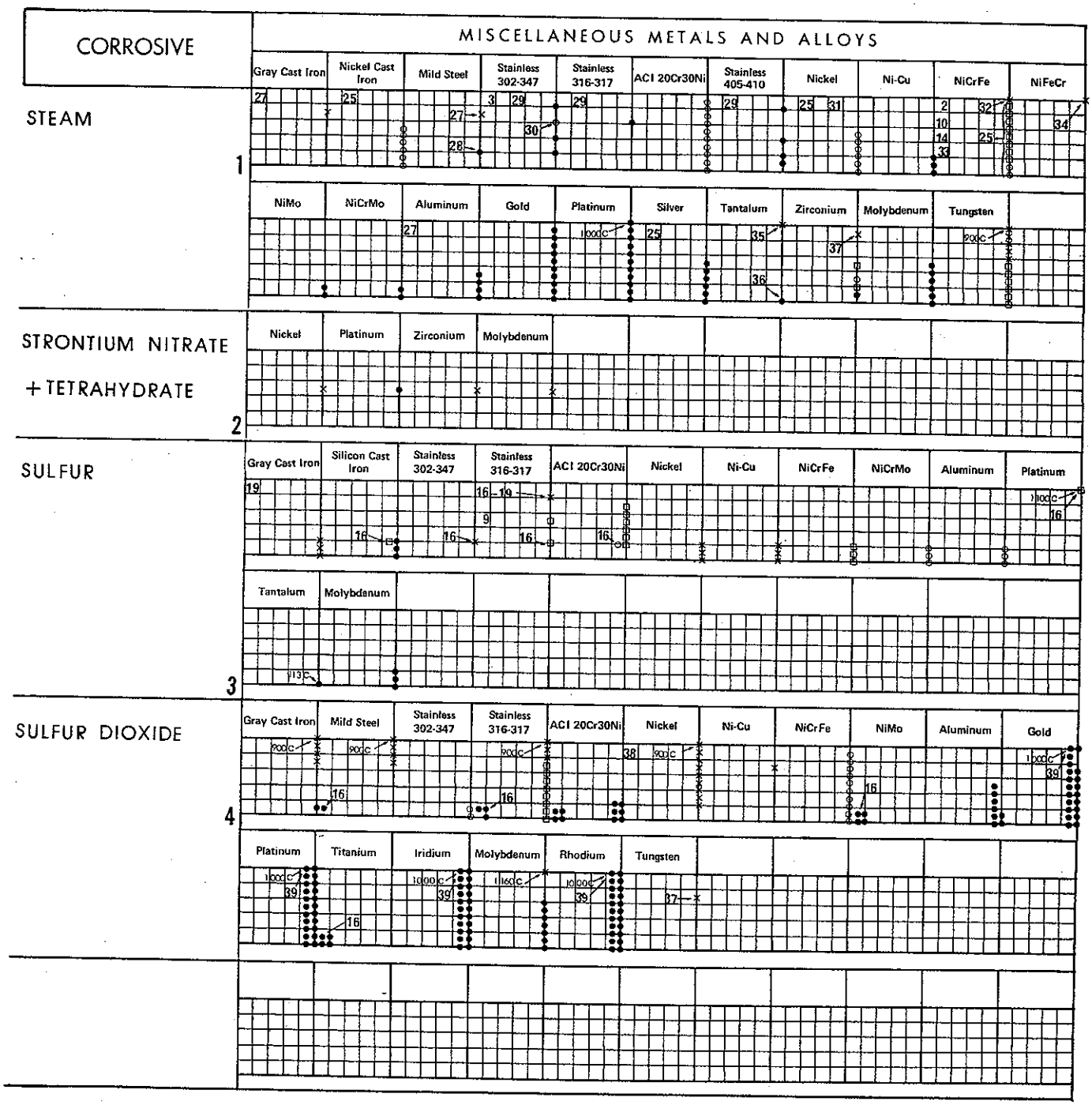

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7. Discolors
8. Crevice attack
9. Intergranular attack
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12. May catalyze
13. May pit
14. May stress crack
15. Transgranular attack
16. Vapor
17. Aerated
18. Catalyzes
19. Static
20. Agitated
21. ~ 7 pH
22. < 7 pH
23. > 7 pH
24. Explosive
25. No pressure
26. + Vanadium pentoxide
27. Flowing, no pressure
28. 4400 psig
29. 5000 psig
30. May sensitize > 1400 psi
31. May embrittle
32. 268 mpy, 1204 C
33. 8-mil pits, 1095 C
34. 125 mpy, 1204 C
35. H_2 evolved > 1127 C
36. 198 C, < 200 psig
37. Weight gain
38. Embrittles
39. No sulfur
40. May explode if wet under pressure
41. Low carbon

CORROSIVE — MISCELLANEOUS METALS AND ALLOYS

SULFUR TRIOXIDE — 1

Nickel Cast Iron	Mild Steel	Stainless 302-347	Stainless 316-317	ACI 20Cr30Ni	Nickel	NiCrFe	NiCrMo	Aluminum

TIN — 2

Gray Cast Iron	Tantalum	Titanium	Columbium	Molybdenum	Tungsten

URANIUM FLUORIDE — 3

Mild Steel	Nickel	Ni-Cu	NiCrFe

VANADIUM PENTOXIDE — 4

Stainless 302-347	Stainless 316-317	ACI 20Cr30Ni	Nickel	NiCrFe	NiFeCr	NiMo	NiCrMo

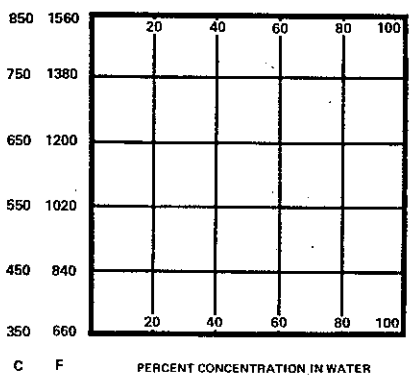
VINYL CHLORIDE — 5

Stainless 302-347	ACI 20Cr30Ni	Ni-Cu	Platinum

WATER GAS — 6

Gray Cast Iron	Nickel Cast Iron	Mild Steel	Stainless 302-347	Stainless 316-317	ACI 20Cr30Ni	Copper	Nickel	NiCrFe	Aluminum	Gold

Platinum



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Code		Mils	1 inch / 1000	Microns
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CDS	mg/dm²/day	g/m²/yr	lb/ft²/yr
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x	>576.5	>21,075	>4.3

CORROSIVE	MISCELLANEOUS METALS AND ALLOYS										
	Mild Steel	Nickel	Ni-Cu	NiCrFe	Tantalum	Titanium	Aluminum Oxide	FeO Cr_2O_3	Columbium	Fosterite	Magnesia
ZINC											
1					25				33		
	Molybdenum	Silicon Carbide	Tungsten	Zircon							
	33										

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12. May catalyze
13. May pit
14. May stress crack
15. Transgranular attack
16. Vapor
17. Aerated
18. Catalyzes
19. Static
20. Agitated
21. ~ 7 pH
22. < 7 pH
23. > 7 pH
24. Mass transfer
25. Variable
26. With sodium
27. With sodium sulfate
28. Stress relieve pressure vessels
29. Except deoxidized CDA 110
30. In sulfur reducing atm.
31. No sulfur
32. Stellite
33. Diffuses into

Section 4
Graphs

References and Comments for Figure 1

The data points in Figure 1 are labeled with the reference numbers of their sources as listed below. The letter symbols in the figure refer to the comments following the references.

REFERENCES:

1. Shell Oil Company, private communication to API Subcommittee on Corrosion.
2. Timkin Roller Bearing Company, private communication to API Subcommittee on Corrosion.
3. Naumann, F. K., "Influence of Alloy Additions to Steel upon Resistance to Hydrogen Under High Pressure," *Technische Mitteilungen Krupp*, 1938, Vol. 1, No. 12, pp. 223–34.
4. Inglis, N. P., and Andrews, W., "The Effect on Various Steels of Hydrogen at High Pressure and Temperature," *Journal of the Iron and Steel Institute*, 1933, Vol. 128, No. 2, pp. 383–97.
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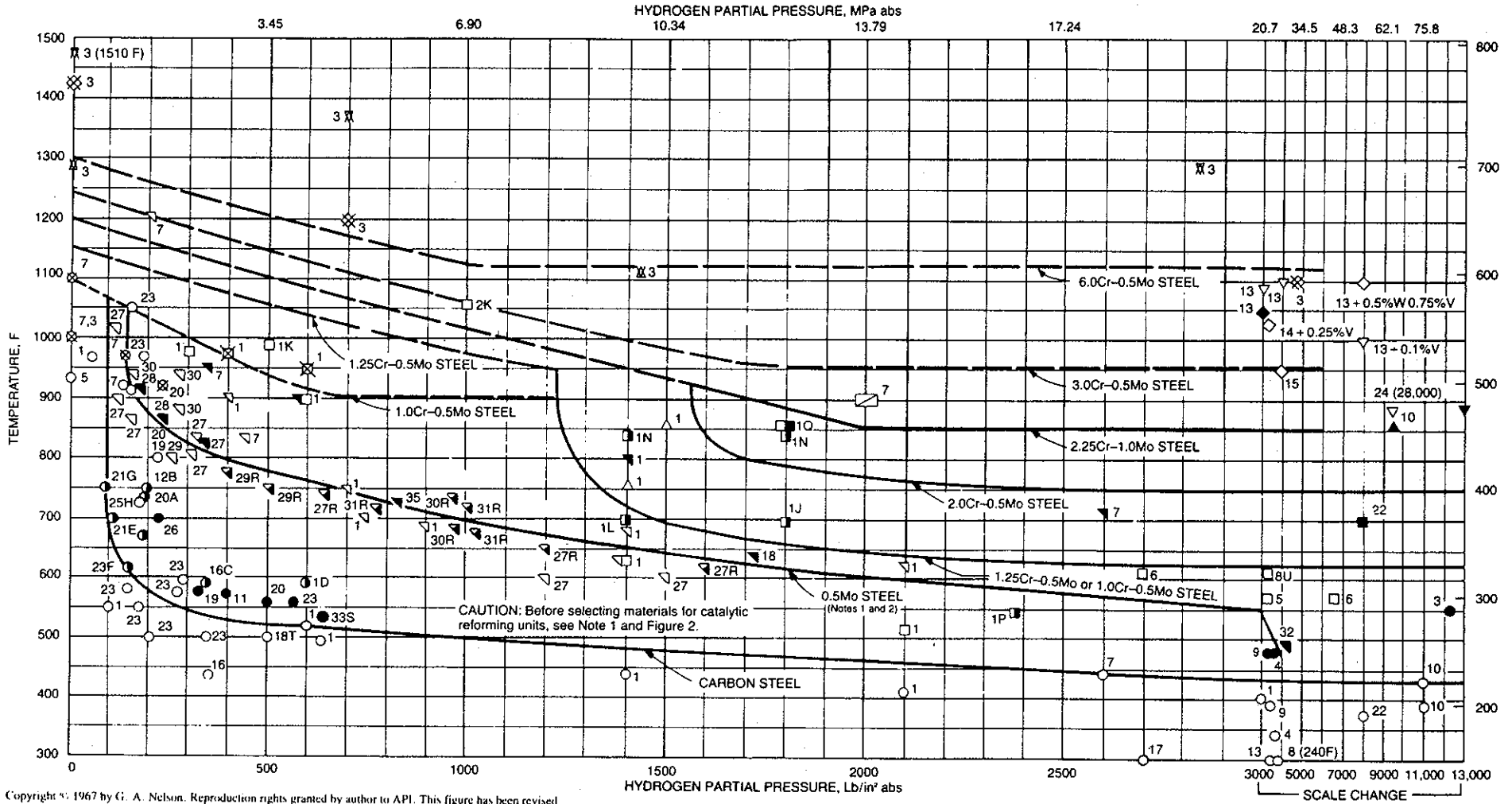
25. Hasegawa, M., and Fujinaga, S., "Attack of Hydrogen on Oil Refinery Steels," *Tetsu To Hagane*, 1960, Vol. 46, No. 10, pp. 1349–52.
26. Moore, K. L., and Bird, D. B., "How to Reduce Hydrogen Plant Corrosion," *Hydrocarbon Processing*, 1965, Vol. 44, No. 5, pp. 179–84.
27. Union Oil Company of California, private communication to API Subcommittee on Corrosion, 1976.
28. Amoco Oil Company, private communication to API Subcommittee on Corrosion, 1976.
29. Standard Oil Company of California, private communication to API Subcommittee on Corrosion, 1976.
30. Exxon Corporation, private communication to API Subcommittee on Corrosion, 1976.
31. Shell Oil Company, private communication to API Subcommittee on Corrosion, 1976.
32. Cities Service Company, private communication to API Subcommittee on Corrosion, 1976.
33. Gulf Oil Corporation, private communication to API Subcommittee on Corrosion, 1976.
34. Koch Refining Company, private communication to API Subcommittee on Corrosion, 1980.

COMMENTS:

A. A section made of A 106 pipe was found to be attacked to 27 percent of its thickness after 5745 hours. Other pieces of pipe in the same line were unaffected.
B. The attack was concentrated in the overheated section of a hot bent steel elbow. The unheated straight portions of the elbow were not attacked.
C. In a series of 29 steel samples, 12 were attacked while 17 were not.
D. After 2 years' exposure, five out of six pieces of carbon steel pipe were attacked. One piece of pipe was unaffected.
E. Attack was concentrated in the weld and heat-affected sections of A 106 pipe. Metal on either side of this zone was unaffected.
F. After 11 years' service, attack was found in the hot bend section of A 106 pipe. Unheated straight sections were not affected.
G. After 2 years' service, all parts of carbon steel pipe, including weld and heat-affected zones, were satisfactory.
H. After 4 years' service, weld and heat-affected zones of A 106 pipe showed cracks.
J. After 31 years' service, a forging of 0.3C-1.3Cr-0.25Mo steel showed cracks 0.007 inch (0.2 millimeter) deep.
K. Pipes of 1.25Cr-0.25Mo steel.
L. After 4 years' service, a forging of 0.3C-1.3Cr-0.25Mo steel was unaffected.
M. After 4 years' service, a forging of 0.2C-1.2Cr-0.35Mo steel showed cracks 0.032 inch (0.8 millimeter) deep.
N. After 7 years' service, a forging of 0.3C-1.52Cr-0.50Mo steel showed cracks 0.050 inch (1.3 millimeters) deep.
P. After 30 years' service, a forging of 0.30C-0.74Cr-0.43Ni steel was unaffected.
Q. After 15 years in ammonia service, a pipe of 0.15C-2.25Cr-1.00Mo steel showed no hydrogen cracks but was nitrided to a depth of 0.012 inch (0.3 millimeter).
R. Stainless steel cladding on 0.5Mo steel. No known hydrogen attack.
S. After 8 years, carbon steel cracked.
T. After 18 years, carbon steel did not show hydrogen attack.
U. After 450 days' exposure, 1.25Cr-0.5Mo valve body was not damaged by hydrogen.

Operating Limits for Steels in Hydrogen Service to Avoid Decarburization and Fissuring*



NOTES.

1. After approximately 9–18 years' service, eight occurrences of hydrogen attack have been reported in C-0.5Mo steels operating below the 1977 0.5Mo curve in catalytic reforming units. These steels experienced hydrogen attack under conditions in which extensive decarburization or carbon migration to grain boundaries was not documented or reported prior to 1980. Further use of 0.5Mo steel in catalytic reforming units to resist internal fissuring should be evaluated rigorously until information is available to explain this phenomenon. Refer to 2.3 in the text, Table 1, and Figure 2.
2. The curve for 0.5Mo steel can apply to either C-0.5Mo or Mn-0.5Mo steels.
3. Austenitic stainless steels are generally not decarburized in hydrogen at any temperature or hydrogen pressure.
4. Effect of trace alloying elements (up to 1000 pounds per square inch absolute [6.90 megapascals] hydrogen partial pressure and below 1000 F [538 C]):
   a. Mo has four times the resistance of Cr to hydrogen attack.
   b. Mo is equivalent to V, Ti, or Nb up to 0.1 percent.
   c. Si, Ni, Cu, P, and S do not increase resistance.
5. The limits described by these curves are based on experience with cast steel as well as annealed and normalized steels at stress levels defined by the ASME *Boiler and Pressure Vessel Code*, Section VIII, Division 1. Refer to 2.5 and 2.6 in the text for additional information.

LEGEND

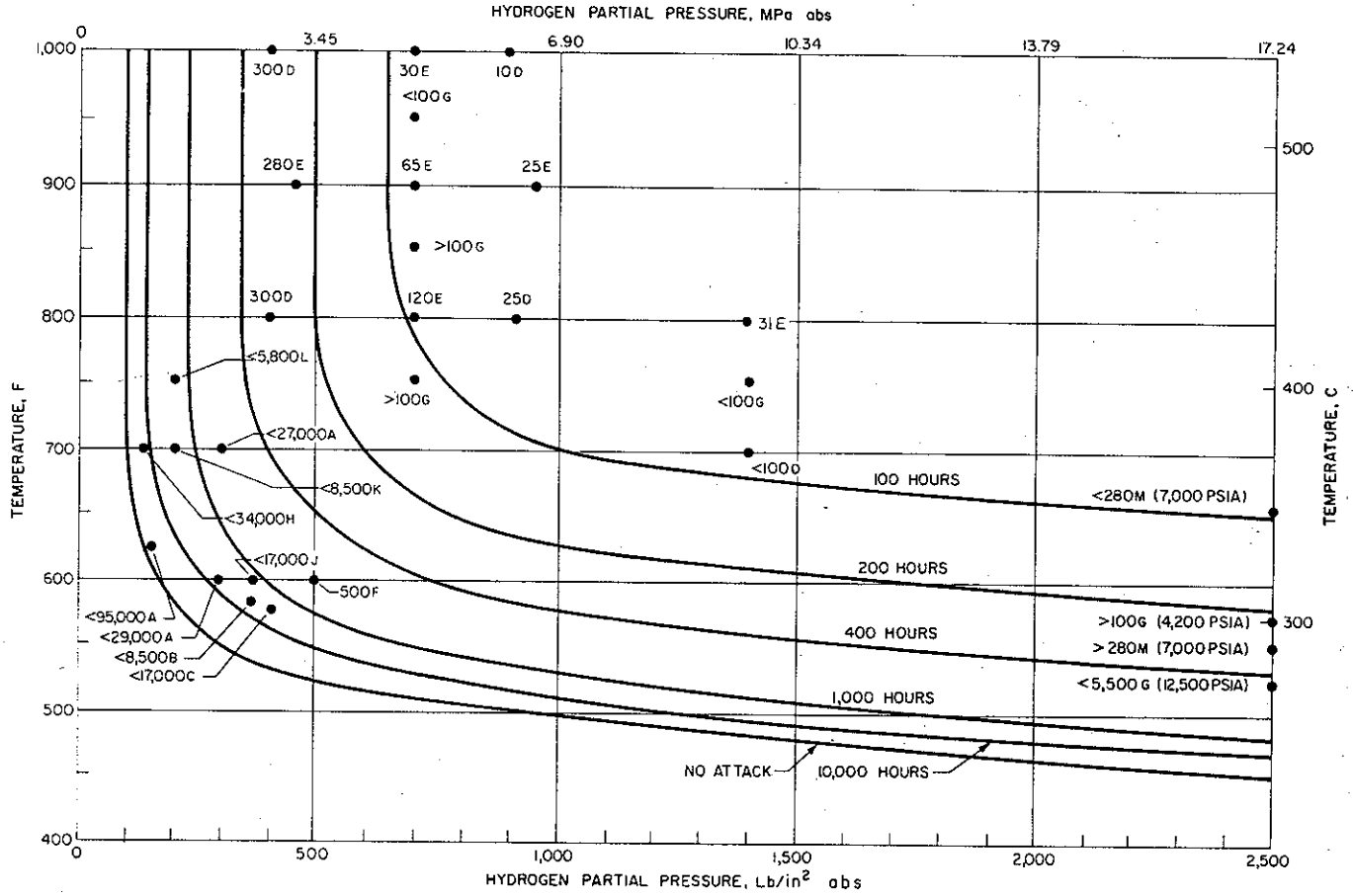
SURFACE DECARBURIZATION — — — —

INTERNAL DECARBURIZATION ——— (HYDROGEN ATTACK)

	LOW CARBON	0.5 Mo	1.0 Cr 0.5 Mo	2.0 Cr 0.5 Mo	2.25 Cr 1.00 Mo	3.0 Cr 0.5 Mo	6.0 Cr 0.5 Mo
SATISFACTORY	○	◹	□	△	▭	◇	▽
HYDROGEN ATTACK	●	◥	■	▲	▬	◆	▼
SURFACE DECARBURIZATION	✖	◹	✖	✖	▱	✖	✖
SEE COMMENTS	❍	◥	◨	▲	▬	◆	▼

*Figure 1 of "Steels for Hydrogen Service at Elevated Temperatures and Pressures in Petroleum Refineries and Petrochemical Plants, API Publication 941, Third Edition, May 1983. Reprinted with permission from the American Petroleum Institute, Washington, DC.

Time for Incipient Attack of Carbon Steel in Hydrogen Service



REFERENCES:

A. Amoco Oil Company, private communication to API Subcommittee on Corrosion, 1960.

B. Ciuffreda, A. R., and Rowland, W. D., "Hydrogen Attack of Steel in Reformer Service," *API Proceedings*, Volume 37, pp. 116–28, American Petroleum Institute, Washington, D.C., 1957.

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D. Allen, R. E., Jansen, R. J., Rosenthal, P. C., and Vitovec, F. H., "The Rate of Irreversible Hydrogen Attack of Steel at Elevated Temperatures," *API Proceedings*, Vol. 41, pp. 74–84, American Petroleum Institute, Washington, D.C., 1961.

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F. Hur, J. J., Deichler, J. K., and Worrell, G. R., "Building a Catalytic Reformer?" *Oil & Gas Journal*, October 29, 1956, Vol. 54, No. 78, pp. 103–7.

G. Naumann, F. K., "Influence of Alloy Additions to Steel upon Resistance to Hydrogen Under High Pressure," *Technische Mitteilungen Krupp*, 1938, Vol. 1, No. 12, pp. 223–34.

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J. Evans, T. C., "Hydrogen Attack on Carbon Steels," *Mechanical Engineering*, 1948, Vol. 70, pp. 414–16.

K. Air Products, Incorporated, private communication to API Subcommittee on Corrosion, March, 1960.

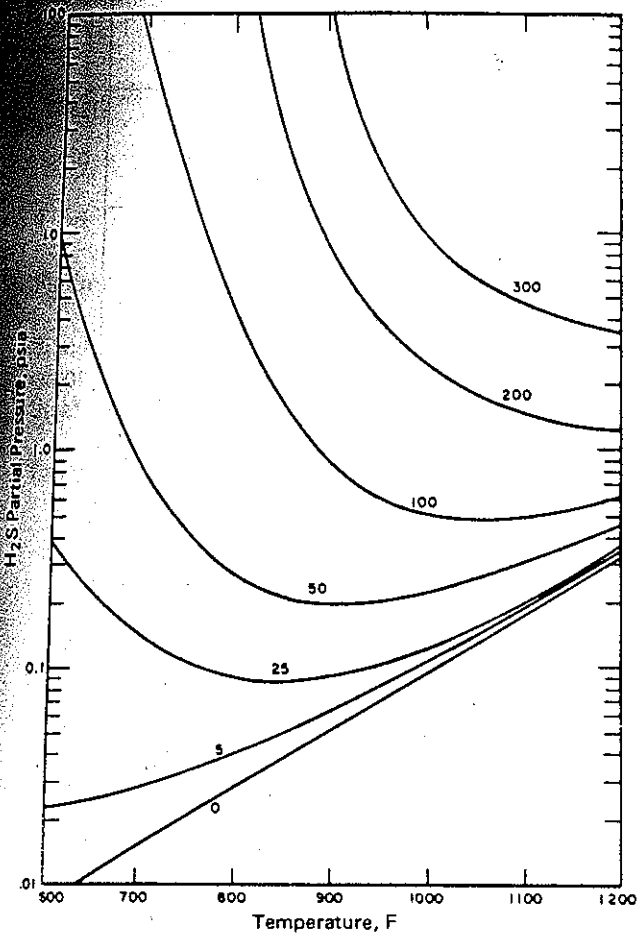
L. API Refinery Corrosion Committee Survey, 1957.

M. Class, I., "Present State of Knowledge in Respect to the Properties of Steels Resistant to Hydrogen Under Pressure," *Stahl und Eisen*, August 18, 1960.

*Figure 4 of "Steels for Hydrogen Service at Elevated Temperatures and Pressures in Petroleum Refineries and Petrochemical Plants, API Publication 941, Third Edition, May 1983. Reprinted with permission from the American Petroleum Institute, Washington, DC.

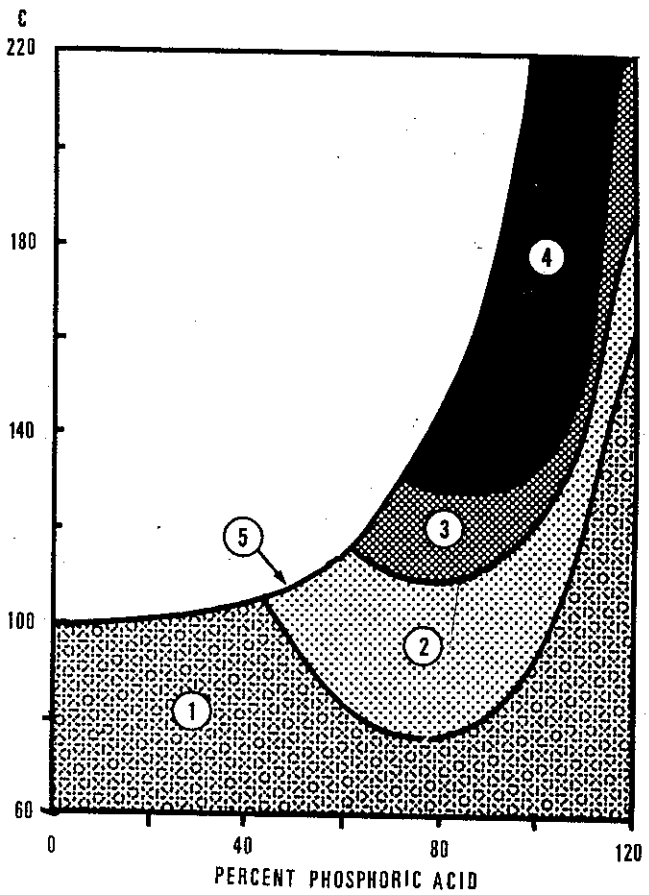
HYDROGEN SULFIDE and PHOSPHORIC ACID

Hydrogen Sulfide vs Low Cr Steels



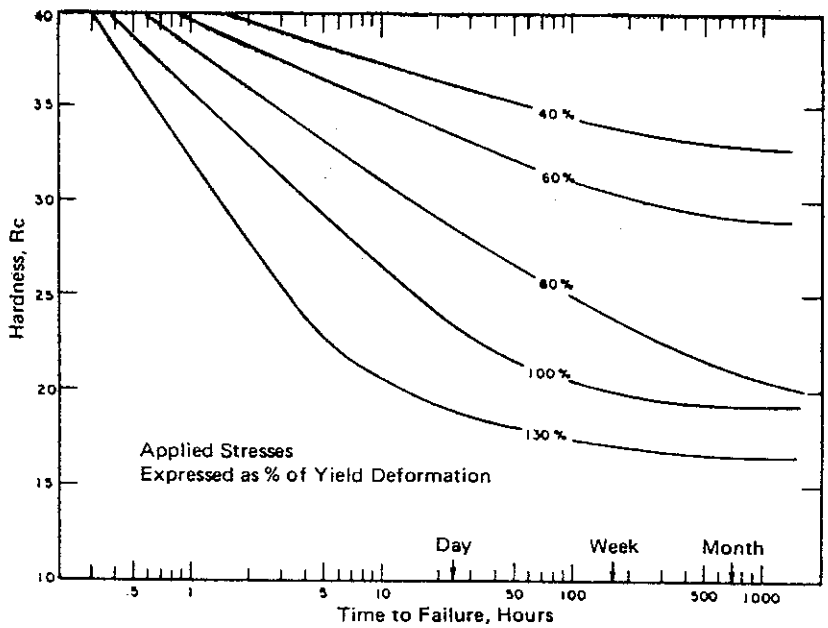
Predicted long-term corrosion rates (mpy) of low chromium steels as a function of temperature and hydrogen sulfide pressure.

Phosphoric Acid vs Type 316 Steel



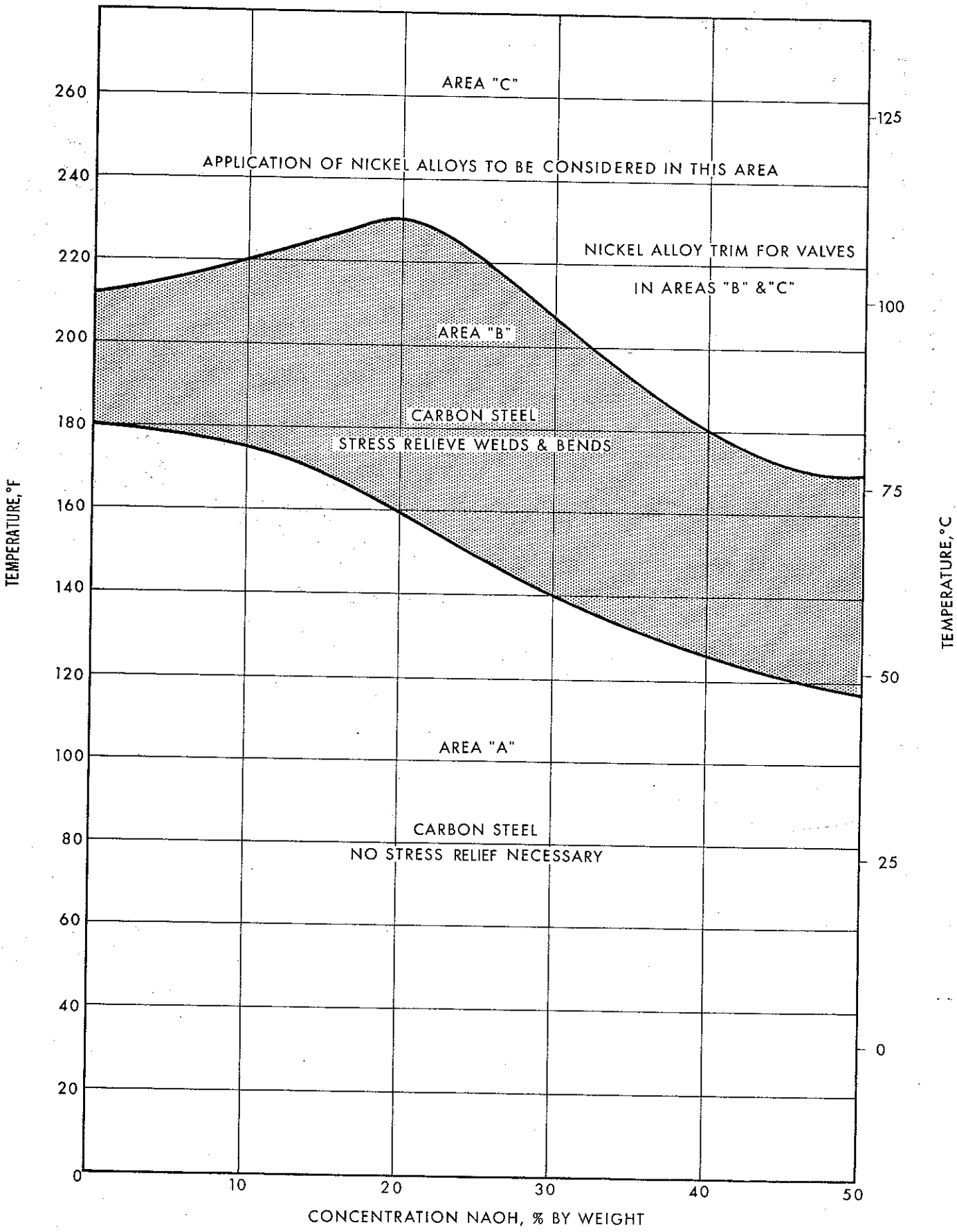
Isocorrosion of Type 316 steel in furnace grade phosphoric acid under mildly agitated conditions. Mils per year averages: 1 = 0 to 1. 2 = 1 to 10. 3 = 10 to 50. 4 = >50. 5 = Boiling point curve.

Carbon Steels vs 3000 ppm Hydrogen Sulfide in 5% Sodium Chloride



Approximate correlation of hardness, time to failure, and applied stress for carbon steels (3000 ppm H_2S in 5% NaCl).

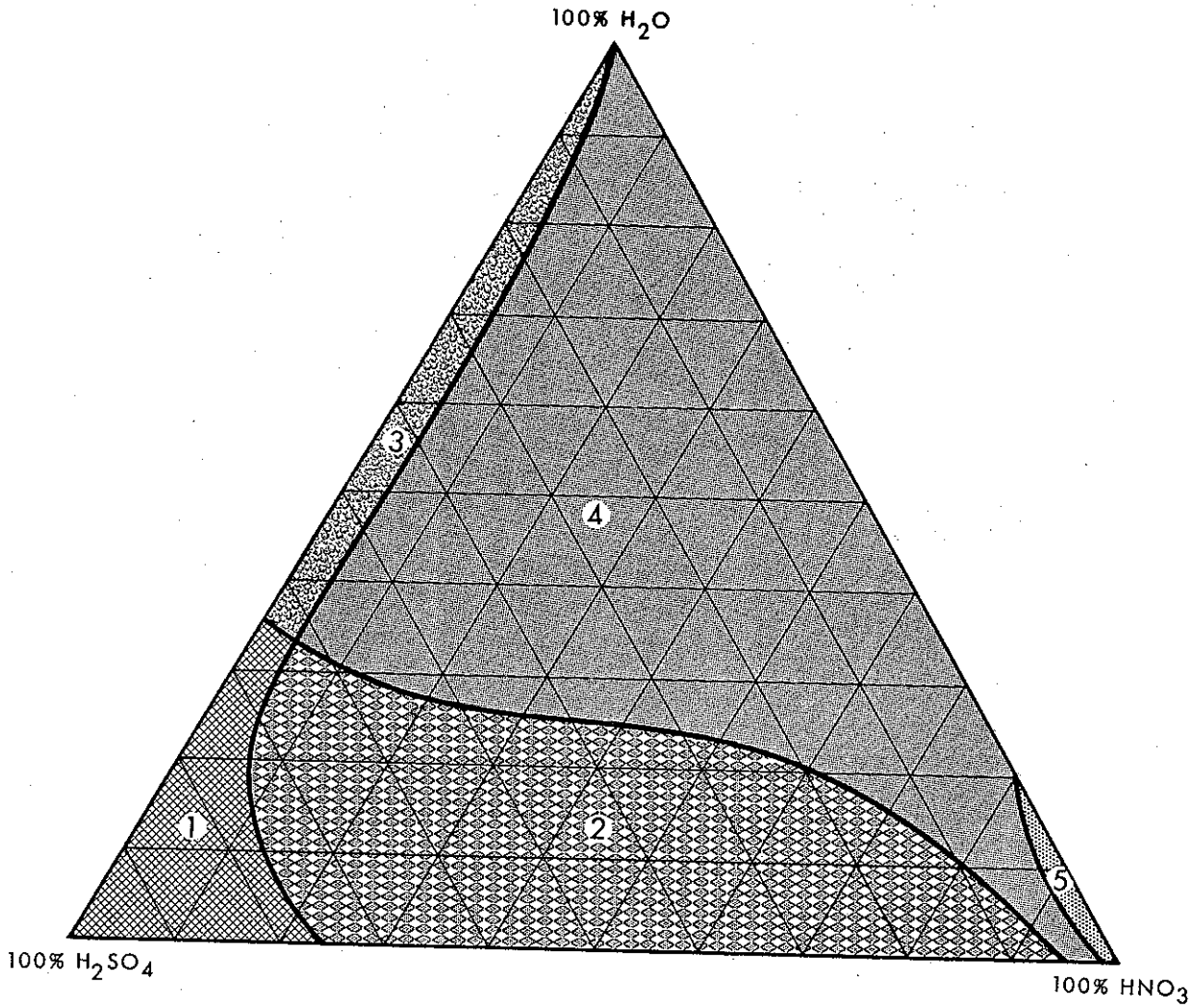
CAUSTIC SODA SERVICE GRAPH



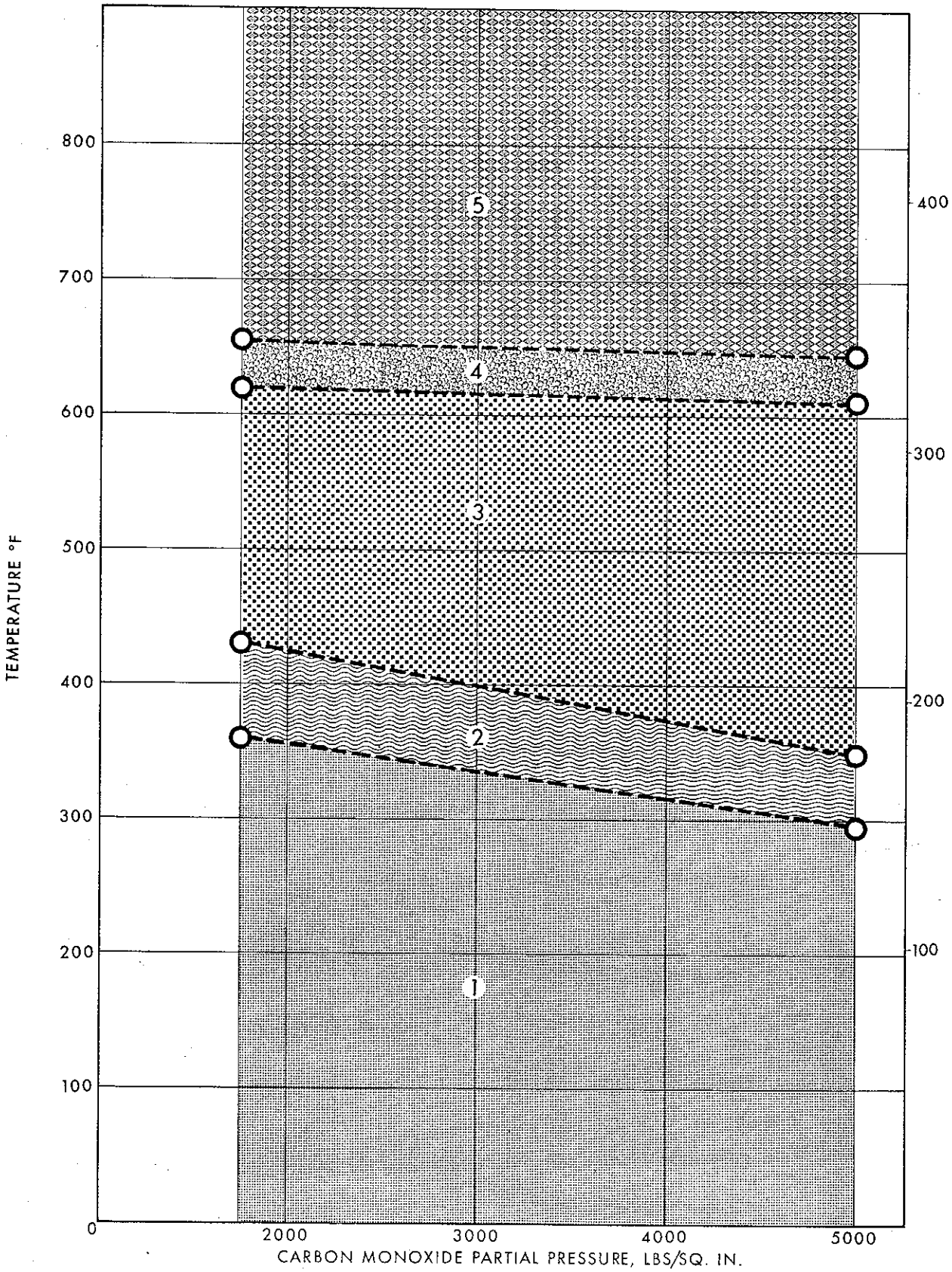
CODE FOR MIXED ACIDS GRAPH

Materials in shaded zones have reported corrosion rates of <20 mpy

ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
20Cr 30Ni	18Cr 8Ni	20Cr 30Ni	18Cr 8Ni	18Cr 8Ni
Gold	20Cr 30Ni	Gold	20Cr 30Ni	20Cr 30Ni
Lead	Cast Iron	Platinum	Gold	Aluminum
Platinum	Gold	Silicon Iron	Platinum	Gold
Silicon Iron	Lead	Tantalum	Silicon iron	Platinum
Steel	Platinum		Tantalum	Silicon Iron
Tantalum	Silicon Iron			Tantalum
	Tantalum			



CORROSION RESISTANCE OF MATERIALS TO MIXED ACIDS AT ROOM TEMPERATURE


TEMPERATURE °F
800
700
600
500
400
300
200
100
0
400
300
200
100
TEMPERATURE, °C
5
4
3
2
1
2000
3000
4000
5000
CARBON MONOXIDE PARTIAL PRESSURE, LBS/SQ. IN.

CODE FOR CARBON MONOXIDE GRAPH

Materials in shaded zones have reported corrosion rate <20 mpy

ZONE 1

5Cr 0.5Mo steel

12Cr, Types 405, 410

17Cr, Type 430

18Cr 8Ni, Types 321, 347

25 Cr 20Ni, Type 310

5Mn Bronze

Carbon Steel

ZONE 2

12Cr Steel, Type 405, 410

17Cr Steel, Type 430

27Cr Steel, Type 446

18Cr 8Ni, Types 321, 347

25Cr 20Ni Steel, Type 310

5% Manganese Bronze

ZONE 3

18Cr 8Ni, Types 321, 347

25Cr 20Ni, Type 310

27Cr, Type 446

5Mn Bronze

ZONE 4

12Cr, Types 405, 410

17Cr, Type 430

18Cr 8Ni, Types 321, 347[1]

25Cr, 20Ni, Type 310

27Cr, Type 446

5Mn Bronze

ZONE 5

5Cr 0.5Mo

12Cr, Types 405, 410

17Cr, Type 430

18Cr 8Ni, Types 321, 347[1]

25Cr 20Ni, Type 310

27Cr, Type 446

5Mn Bronze

Carbon Steel

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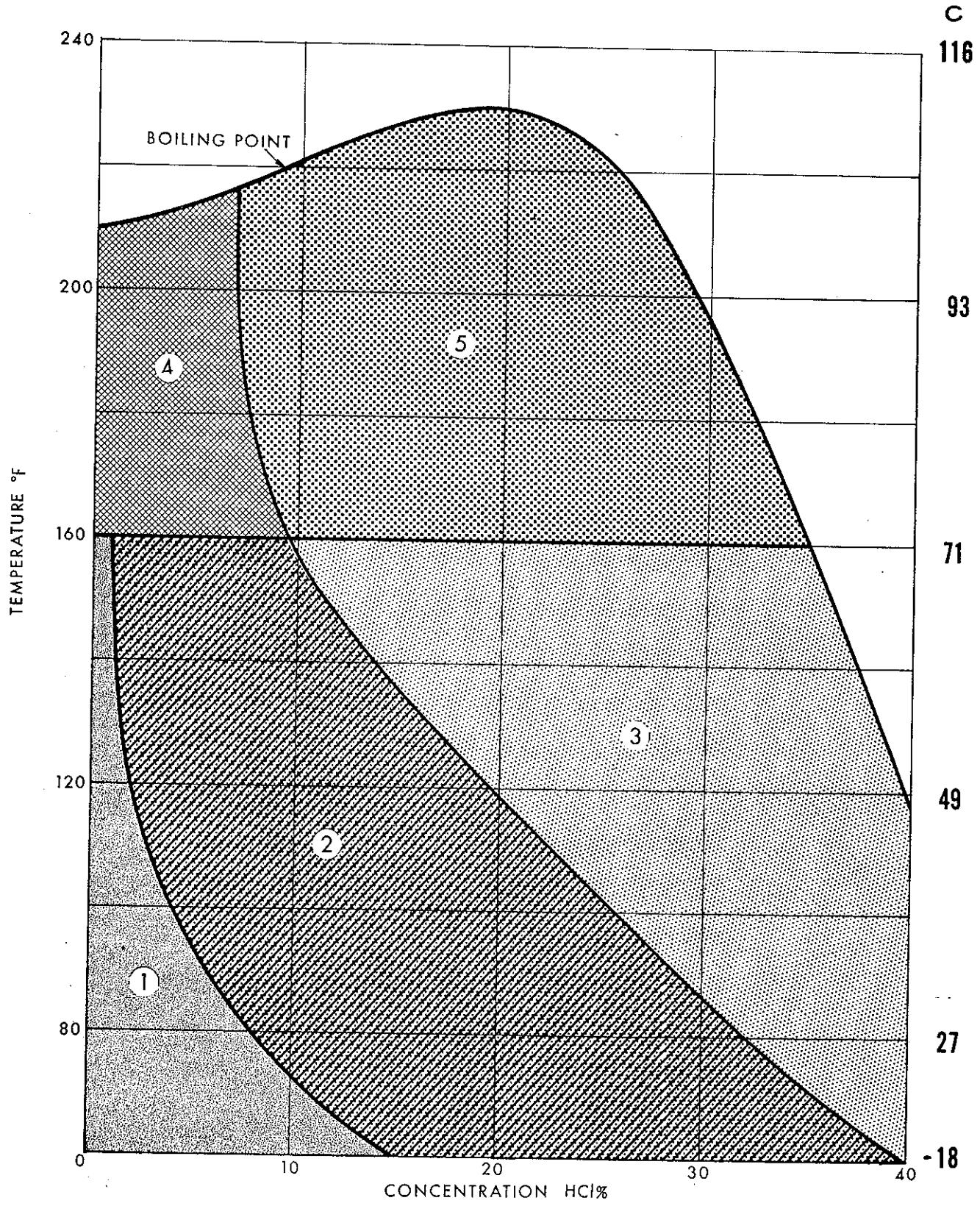
1. Low pressure end only.
2. (Ref: Technical Oil Mission–Reel 87, Bag 3979, Item 115, Pages 1846, 1860)


C
240
116
BOILING POINT
200
93
5
4
TEMPERATURE °F
160
71
3
120
49
2
1
80
27
0
10
20
30
40
-18
CONCENTRATION HCl%

CODE FOR HYDROCHLORIC ACID GRAPH

Materials in shaded zones have reported corrosion rates of <20 mpy.

ZONE 1

20Cr 30Ni[1]

66Ni 32Cu[2]

62Ni 28Mo

Copper[2]

Nickel[2]

Platinum

Silicon bronze[2]

Silicon cast iron[3]

Silver

Tantalum

Titanium[4]

Tungsten

Zirconium

ZONE 2

62Ni 32Cu

Molybdenum

Platinum

Silicon bronze[2]

Silicon cast iron[3]

Silver

Tantalum

Zirconium

ZONE 3

62Ni 28Mo[5]

Molybdenum

Platinum

Silver

Tantalum

Zirconium

ZONE 4

66Ni 32Cu[2,6]

62Ni 28Mo[5]

Platinum

Silver

Tantalum

Tungsten

Zirconium

ZONE 5

62Ni 28Mo[5]

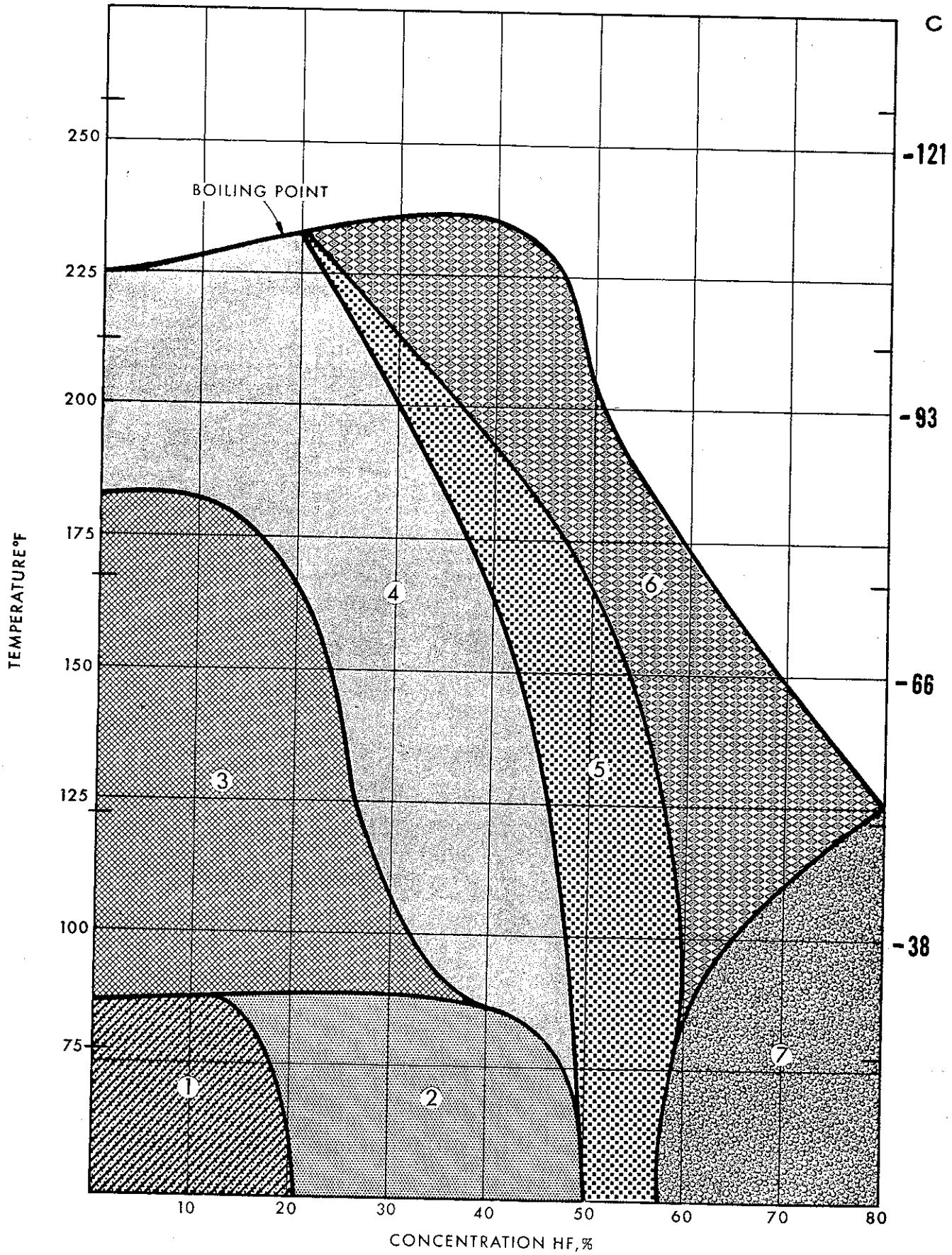
Platinum

Silver

Tantalum

Zirconium

1. <2% at 25 C
2. No air
3. No $FeCl_3$
4. <10% at 25 C
5. No chlorine
6. <0.05%


C
250
-121
BOILING POINT
225
200
-93
175
TEMPERATURE°F
150
-66
125
100
-38
75
1
2
3
4
5
6
7
10
20
30
40
50
60
70
80
CONCENTRATION HF,%

CODE FOR HYDROFLUORIC ACID GRAPH

Materials in shaded zone have reported corrosion rate of <20 mpy

ZONE 1

20Cr 30 Ni

25Cr 20Ni Steel

70Cu 30Ni[1]

66Ni 32Cu[1]

54Ni 15Cr 16Mo

Copper[1]

Gold

Lead[1]

Nickel[1]

Nickel cast iron

Platinum

Silver

ZONE 2

20Cr 30Ni

70Cu 30Ni[1]

54Ni 15Cr 16Mo

66Ni 32Cu[1]

Copper[1]

Gold

Lead[1]

Nickel[1]

Platinum

Silver

ZONE 3

20Cr 30Ni

70Cu 30 Ni[1]

54Ni 15Cr 16Mo

66Ni 32Cu[1]

Copper[1]

Gold

Lead[1]

Platinum

Silver

ZONE 4

70Cu 30Ni[1]

66Ni 32Cu[1]

54Ni 15Cr 16Mo

Copper[1]

Gold

Lead[1]

Platinum

Silver

ZONE 5

70Cu 30Ni[1]

66Ni 32Cu[1]

54Ni 15Cr 16Mo

Gold

Lead[1]

Platinum

Silver

ZONE 6

66Ni 32Cu[1]

54Ni 15Cr 16Mo

Gold

Platinum

Silver

ZONE 7

66Ni 32Cu[1]

54Ni 15Cr 16Mo

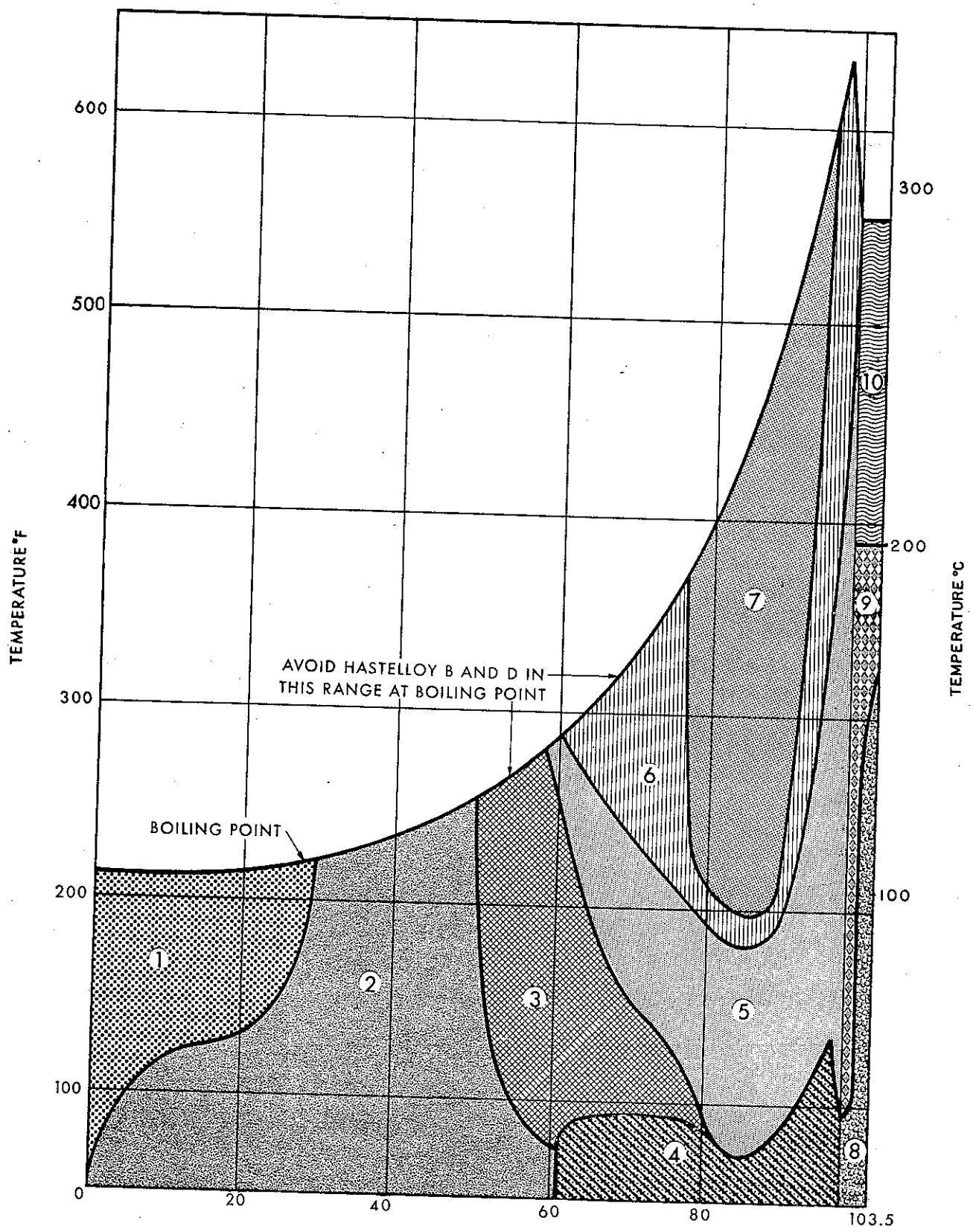
Carbon steel

Gold

Platinum

Silver

1. No air


600
500
400
300
200
100
0
TEMPERATURE °F
300
200
100
TEMPERATURE °C
AVOID HASTELLOY B AND D IN THIS RANGE AT BOILING POINT
BOILING POINT
1
2
3
4
5
6
7
8
9
10
20
40
60
80
103.5
PERCENT CONCENTRATION IN WATER

CODE FOR SULFURIC ACID GRAPH

Materials in shaded zones have reported corrosion rate <20 mpy

ZONE 1

20Cr 30Ni

66Ni 32Cu[1]

62Ni 28Mo

Type 316[2]

Al bronze 10%[1]

Copper[1]

Gold

Lead

Molybdenum

Nickel cast iron

Platinum

Silver

Tantalum

Zirconium

ZONE 2

20Cr 30Ni[3]

66Ni 32Cu[1]

62Ni 28Mo

Type 316[5]

Al bronze 10%[1]

Copper[1]

Gold

Lead

Molybdenum

Nickel cast iron[4]

Platinum

ZONE 3

20Cr 30Ni[3]

66Ni 32Cu[1]

62Ni 28Mo

Gold

Lead

Molybdenum

Platinum

Silicon iron

Tantalum

Zirconium

Silicon cast iron

Silver

Tantalum

Zirconium

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1. No air
2. <10% aerated
3. <75 C
4. <20% at 25 C
5. <25% aerated at 25 C
6. <96% concentration
7. >80% concentration
8. <80% aerated
9. <75C, <96%
10. 20 to 50 mpy

ZONE 4

20Cr 30Ni

62Ni 28Mo

Type 316[7]

Gold

Lead[6]

Nickel cast iron

Platinum

Silicon iron

Steel

Tantalum

Zirconium[8]

ZONE 5

20Cr 30Ni[3]

62Ni 28Mo

Gold

Lead[9]

Platinum

Silicon iron

Tantalum

ZONE 6

62Ni 28Mo[10]

Gold

Platinum

Silicon iron

Tantalum

ZONE 7

Gold

Platinum

Silicon iron

Tantalum

ZONE 8

20Cr 30Ni

18Cr 8Ni

54Ni 15Cr 16Mo

Gold

Platinum

Steel

ZONE 9

20Cr 30Ni

18Cr 8Ni

Gold

Platinum

ZONE 10

Gold

Platinum

SUBJECT INDEX

C

D

E

F

G

H

Q

R

S

T

U

V

X

Y

Z