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A Manual of Stainless Steel Data for Meat and Poultry Processing Equipment

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Mechanical Properties Section
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Institute for Materials Research
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Prepared for

Technical Services, Animal and Plant Health Inspection Service, Meat and Poultry Inspection Program U.S. Department of Agriculture

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ABSTRACT

This manual presents selected data identifying wrought and cast stainless steel alloys commonly used for meat and poultry processing equipment. Essential material requirements for meat and poultry processing equipment are given. Alloy compositions and characteristics are described, and alternative materials are suggested.

Disclaimer:

Certain trade names and company products are identified in order to adequately specify the materials. In no case does such identification imply recommendation or endorsement by the National Bureau of Standards.

A MANUAL OF STAINLESS STEEL DATA FOR MEAT AND POULTRY PROCESSING EQUIPMENT

1. INTRODUCTION

Problems of fabricators or vendors concerned with stainless steel equipment applications in meat and poultry processing are frequently directed to Technical Services, Equipment Group, Meat and Poultry Inspection Program, of the United States Department of Agriculture, Animal and Plant Health Inspection Service. In the maintenance of rigid sanitary standards, Technical Services also supplies information about stainless steel alloy properties and usage to Department of Agriculture inspectors in meat and poultry processing plants.

The purpose of this document is to provide data which identify and describe stainless steels and which may assist Technical Services in dealing with problems involving these steels. Whereas these data are primarily intended for meat and poultry processing equipment applications, most of the data are quite general and may find application in other areas.

2. EQUIPMENT MATERIAL REQUIREMENTS AND APPLICABLE MATERIALS

Table 1 gives material requirements for components of meat and poultry processing equipment. Stainless steel alloys and other materials currently used in the manufacture of specific components are also listed in the table. This latter information was obtained from data supplied by equipment manufacturers. Alternative stainless steel alloys which meet essential material requirements are also suggested for those cases where currently specified alloys are unavailable or deviations from these alloys are considered.

3. NATURE OF STAINLESS STEELS

3.1 Stainless and Heat Resisting Steel Defined

Stainless steels are alloys in which iron is the predominant element. The stainless grades contain at least 10 percent chromium, and the heat resisting grades contain at least 4 percent chromium, with or without additions of other elements. The principal use of both of these steels is in applications requiring resistance to oxidation and/or corrosion. Stainless steels are also frequently referred to as corrosion resistant alloys.

3.2 Classification and Characteristics of Stainless Steels

3.2.1 Classification

Stainless steel alloys may be subdivided into the following classes:

Class I - Martensitic. Representative steels are S41000, S42000, S431000 and S44004.

Class II - Ferritic. Representative steels are S40500, S42900 and S43000.

Class III - Austenitic. Representative steels are S20100, S30400, S30500 and S31600.

Class IV - Precipitation Hardening. Representative steels are S31800, S15500, S35000 and S35500.

3.2.2 General Characteristics

Class I - Martensitic. These straight chromium steels are so designated because they can be hardened by a quench and temper heat treatment similar to that applied to ordinary carbon steels. Carbon content of these steels ranges from about 0.10 to about 1.20 percent. As carbon content increases, heat treatment can result in increased hardness and decreased ductility. Hardening results from a transformation. The Class I steels are not used where severe corrosion conditions exist, as is the case in many chemical processes. Brine and chlorides will pit these materials. The corrosion resistance generally increases with chromium content and corrosion resistance of Class I steels is better in the hardened condition than in the annealed or soft condition.

Class II - Ferritic. These straight chromium steels generally are not hardenable by heat treatment because phase changes amenable to hardening do not occur on cooling these materials from selected temperatures. Carbon content of these steels ranges from about 0.08 to about 0.20 percent. They are hardenable only by cold working. These steels are quite resistant to stress corrosion and have been found to do well in many cases where Class III alloys fail, particularly in chloride-containing waters.

Class III - Austenitic. These are iron chromium-nickel alloys and iron-chromium-nickel-manganese alloys. The iron-chromium-nickel type alloys are the most widely used in meat processing. Carbon content of these steels ranges from about 0.03 to about 0.25 percent. Class III steels are hardenable only by cold working. They are essentially nonmagnetic, but become somewhat magnetic after severe cold working due to transformation. Most Class III steels contain nickel as a principal alloying element, but

relatively new ones like S20100 and S20200 contain less nickel and substantial amounts of manganese. The Class III steels possess better corrosion resistance than the straight chromium (Class I and Class II) steels; indeed, the iron-chromium-nickel type Class III steels are regarded as having the best corrosion resistance of the four classes. Corrosion resistance and oxidation resistance generally increase with increased nickel and chromium contents.

Class IV - Precipitation Hardening. The precipitation-hardened or age-hardened steels are so designated because they are hardened and strengthened by precipitation hardening with high strength attainable. Precipitation hardening procedures vary with alloy composition and mechanical properties desired. The procedures generally involve a solution anneal and selected cooling or quenching from solution annealing temperatures; followed by heating (aging) for substantial times at temperatures in the range of 800 to 1000 F. The corrosion resistance of this class is generally inferior to that of Class III, stainless steels.

4. IDENTIFICATION OF STAINLESS STEEL ALLOYS

A large number of wrought (1) stainless steel alloys differing in composition are in use nationally. To facilitate their identification, numbering systems have been devised by both Government agencies and technical societies. Numbering systems administered by particular organizations are identified by the prefixes listed in Table 2.

TABLE 2

Wrought Alloy Numbering Systems

System Prefix	
UNS (Unified numbering system) (2)	Joint Activity of the Society of Automotive Engineers and the American Society for Testing and Materials.

(1) Stainless steels are available in semifinished forms as blooms, billets, slabs, rods and tube rounds. The semifinished forms may be shaped mechanically into finished plate, sheet, strip, bar, structural shapes, round and flat wire and tubing. These finished materials are categorized as wrought materials. However, not all grades are available in all of the finished forms.

(2) The Unified Numbering System (UNS) is a recently instituted and greatly needed means of correlating many nationally used numbering systems. It provides the uniformity necessary for efficient indexing, record keeping, data storage and retrieval and cross-referencing. A given UNS number is not a specification. It is a unified identification number for the metal or alloy, for which controlling limits have been established in specifications published elsewhere.

TABLE 2 (continued)

AISI (specifications)	American Iron and Steel Institute, 1000 Sixteenth Street, N. W., Washington, D.C. 20036.
ASTM (Specifications)	American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.
SAE (Specifications)	Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, Pennsylvania 15096.
MIL (Military specifications)	U.S. Dept. of Defense, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.
FED (Federal specifications)	United States General Services Administration, Specification Sales, (3FRSBS), Bldg. 197, Washington, D.C. 20407.
AMS (Specifications)	Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, Pennsylvania 15096.

Table 3, "Stainless Steel Wrought Alloys," identifies each according to its UNS designation and also provides a cross reference to AISI, ASTM, SAE, MIL, FED and AMS specifications, where these specifications are available. Table 3 also provides the nominal analysis and classification of individual alloys. The alloys listed in Table 3 comprise the bulk of the wrought stainless steel tonnage presently in use.

Table 4 identifies frequently used stainless steel casting alloys. At present these alloys are not included in the Unified Numbering System. However, these alloys are often identified by numbers assigned by the Alloy Casting Institute (ACI) Division, Steel Founders Society of America, whose numbers may be considered to be key numbers for identification. Table 4 also gives nominal compositions and lists available ASTM, SAE, MIL and AMS specifications in cross reference.

Some characteristics and suitable applications of the wrought and casting alloys are also given in Tables 3 and 4, respectively.

5. SELECTION OF ALLOYS

The basic factors that enter into the choice of a stainless are (1) suitability to the intended service from a property standpoint, (2) economical fabricability into the desired component, and (3) commercial availability when and as needed.

The principal reason for the widespread use of stainless steel in meat and poultry processing equipment is that stainless steel can be cleaned with relative ease in the maintenance of sanitary conditions. Stainless steel alloys are available that can readily withstand the types of corrosive environments and service conditions encountered in meat and poultry processing and have a long service life. Furthermore the availability of stainless steels in compositions and forms suitable for the fabrication of a large variety of equipment components also contributes to its widespread use.

Fabricators are influenced by costs as well as design requirements in the selection of a stainless steel alloy for a given component. The alloy content of a stainless is frequently an important factor in its cost. Usually, the higher the alloy content, the higher the cost and a fabricator may sometimes wish to reduce costs through the use of alloys with lower alloy contents. Technical Services is especially concerned with design considerations which promote sanitary conditions; for example, flush grinding of weld beads to avoid recesses and avoidance of sharp corners where debris can accumulate. Design details such as this have been well documented (1).

Corrosion resistance, scaling (heat) resistance, acceptable mechanical properties, fabricability by cold operations, galling resistance, weldability and cutting edge retention are property requirements applicable to meat and poultry processing equipment components. It may be necessary to consider one or more of these requirements in making a selection or substitution of a stainless for a particular component.

Because of their availability in a large number of sizes of sheet, plate, bars, et cetera, their good corrosion resistance and general ease of fabrication; the iron-chromium-nickel alloys, Class III (AISI 300 series) have the most widespread application in meat and poultry processing equipment. However, the use of stainless steel need not be limited to the iron-chromium-nickel alloys. Frequently, other alloys may be just as suitable, or

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(1) Accepted Meat and Poultry Equipment (MP1-2), Scientific and Technical Services, Meat and Poultry Inspection Program, Animal and Plant Health Inspection Service, United States Department of Agriculture, May 1975; Equipment Standards, page 5.

better, for a given application and at lower cost.

Corrosion Resistance - The degree of corrosion resistance of iron alloys containing chromium is generally a function of chromium content. Stainless steels that have extra low carbon contents and relatively high chromium contents --- 10 percent or more chromium --- have very good corrosion resistance toward a wide variety of corrodents. Nickel stands next to chromium in importance as an alloying element in stainless steel. In addition to conferring valuable mechanical properties, nickel extends the resistance to corrosion by neutral chloride solutions and by acids of low oxidizing capacity when it is present in an alloy in amounts greater than 6 or 7 percent. Fully austenitic Class III iron-chromium-nickel alloys of the 18-8 variety (18% chromium - 8% nickel) are the finest of all stainless alloys from the combined standpoints of engineering properties and corrosion resistance. Nickel broadens the range of passivity (1) conferred by chromium. These alloys are in general better than the Class I, Class II and Class IV steels in all corrosive service. However, they have a mild susceptibility to pitting, a susceptibility to attack by sulphurous flue or smelter gases at high temperatures, and a characteristic liability to a type of intergranular deterioration known as sensitization (2).

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(1) Passivity, with regard to stainless steels, is a condition which impedes normal corrosion tendencies because of an impervious covering of oxide.

(2) Sensitization involves the harmful intergranular precipitation of chromium carbide in austenitic stainless steels when exposed to temperatures in the approximate range of 800 to 1500 F. Precipitation increases with increasing carbon content and exposure time. The principal effect is depletion of chromium content in a thin envelope surrounding each grain, thereby promoting susceptibility to corrosive attack. Sensitization is prevented by (a) reducing carbon content to values so low that carbide formation is inconsequential - less than 0.02 or 0.03% carbon, depending on exposure conditions; (b) using alloy additions of powerful carbide - formers such as titanium, columbium or tantalum to "stabilize" the alloy by pre-empting the carbon and thereby protecting the chromium." From Sensitization - Wrought Stainless Steels, Metals Handbook, Vol. 1, 8th Edition, p. 422.

Substances coming in contact with stainless used in meat and poultry processing equipment range considerably in corrosivity. Cereals are weakly corrosive. Ingredients of curing pickles such as acetic acid, ascorbic acid, tomato paste and sugars are weakly corrosive at the concentrations and temperatures of use. Blood (pH 7.2) and tissue (pH 7) are weakly corrosive, but become more corrosive through decomposition on heating. The fatty acids, stearic, palmitic, oleic and linoleic, individually, vary in corrosivity but as a group are mildly corrosive. Individual cleaners and sanitizers also vary in corrosivity. Most of them contain compounds in which the halogens, chlorine and bromine, are present. Stainless is susceptible to pitting and/or grain boundary attack by halogens. Minimization of exposure of stainless alloys to salt (sodium chloride) or brine solutions and other solutions containing halogens and thorough rinsing after exposure is necessary to prevent deterioration of these alloys. Because of cleaning practices employed to maintain sanitary conditions, stainless alloys currently used normally have a long service life in most meat and poultry processing equipment applications.

Alloy S31600 which contains molybdenum, and modifications of this alloy may be used where more corrosion resistance is required. Alloy S31700 which contains more molybdenum may be used in applications requiring more corrosion resistance and strength at higher temperatures.

Scaling (Heat) Resistance - Oxidation of steels resulting in the formation of scale occurs at elevated temperatures. Scaling results in metal loss. The nature of scaling is subject to the variables affecting oxidation such as fuel or flue gas composition, method of firing, temperature and pressure or velocity; and with a change in these variables different rates of scaling may be expected. Resistance to oxidation of stainless increases with increase in chromium content. Alloy S30400 will scale in continuous service at 1700 F and in intermittent service at 1550 F; whereas alloys S31000 and S44600 will scale in continuous service at 2050 F and 1900 F, respectively, and in intermittent service at 1900 F and 2050 F, respectively. The degree of elevated temperature and the nature of service, intermittent or continuous, are important criteria on which to base selection of an alloy for elevated temperature service.

Acceptable Mechanical Properties - Control of mechanical properties depends principally on composition, heat treatment and amount of cold work. Where medium to high strength is required the Class I - martensitic and Class IV - precipitation hardening alloys may be prescribed. The Class I steels are available in a variety of compositions and through heat treatment a considerable range in mechanical properties can be obtained. Alloys S40300, S41000 and S41600 and their modifications have good strength while higher strengths are obtainable from S44000 series alloys. S17700 and S35500 are examples of high strength precipitation hardening alloys.

Fabricability by Cold Operations - In fabricating stainless steel a useful division can be made between (a) cold operations involving tooling and (b) hot operations involving welding, brazing, soldering, etc. Drawing, spinning, cold upsetting and machining are important cold fabrication operations. Stainless alloys vary considerably in their fabricability in these operations. Cold operation procedures are in many cases quite different from that for the common carbon steels. They generally require more care but are not particularly difficult. Stainless steel producers can be consulted for specific information by fabricators when problem arise in fabricating.

Drawing - Types S30200 and S30400 are most widely used for deep drawing and S30100 for shallow drawing. The straight chromium grades S41000, S40300, S40500 and S43000 are acceptable for drawing.

Spinning - All chromium-nickel grades may be formed by spinning however, types S30500 and S30430 are best for this purpose. Types S40300, S41000, S40500, S43000 and S44600 of the straight chromium alloys are formable by spinning.

Cold upsetting - Type S40500 is probably the most suitable and types S30400 and S30200 are also used. Type S43000 is a suitable straight chromium grade. Where hardening is called for after upsetting, types S41000, S42000 and S43100 are frequently employed.

Machining - The machinability of Class I alloys depends to an important extent upon microstructural condition obtained in heat treatment. Dead-soft annealed Class I steel is tough and "draggy." Hardened and tempered Class I alloys machine more easily. Class II steels except for type S44600 machine quite readily. The Class III chromium nickel alloys are inclined to gall. Precipitation hardened alloys modified by sulfur or selenium additions have free-machining properties.

Galling and Spalling - Galling is the development of localized yielding and roughening on the contacting and rubbing surfaces of one or both of two metallic elements. It may be followed by spalling and further yielding and roughening. This condition may develop in some cold fabrication operation such as machining or drilling or on finished parts already in service. Spalling in food handling service is to be avoided. The Class III chromium-nickel alloys are the most prone to galling. The tendency of these alloys to gall is reduced through their modification by the addition of sulfur or selenium in their compositions. Class II alloys also have a tendency to gall. Here too, galling is reduced by sulfur or selenium modification. The Class I, heat treated alloys generally have the least tendency to gall.

Weldability - Weldability refers to the suitability of a metal for welding processes and the service performance of the resulting weld. Welding processes are limited for stainless because of possible chemical reaction of chromium with both carbon and oxygen at welding temperatures. Carbon arc processes and carboniferous electrode coatings are not suitable. Metal arc techniques are most suitable. All forms of pressure and resistance welding can be applied but precautions must be taken with regard to oxidation of the bonding surfaces.

Class I martensitic steels are susceptible to excessive hardening with consequent risk of cracking. S40300, S41000 and S41600 are weldable Class I alloys. However, they require pre-weld heating and post-weld heating to lessen cracking tendencies. The high carbon heat treatable Class I alloys are not suitable.

Class II ferritic steels tend toward excessive grain growth with consequent notch brittleness on welding. S40500, S43000 and S44600 are weldable Class II alloys. Pre-weld heating is recommended for these alloys.

The chromium-nickel, Class III alloys are the most weldable. However, they have a high coefficient of thermal expansion which may result in distortion and warping. In addition, sensitization may be a problem in welding all of these alloys. Welding produces a temperature band alongside the weld which is within the carbide precipitation range of approximately 800 to 1500 F. Because of this, unmodified types S30100, S30200, S30500, S30800, and so forth, require an anneal after welding at around 1850 F. Types S30900, S31000 and molybdenum bearing S31600 and S31700 are slightly less susceptible to sensitization. Types S30400, S30900 and S31000 with carbon contents reduced below 0.08 percent are usable without heat treatment where corrosion is not severe. With carbon below 0.03 percent in S30403 and S31603, heat treatment is not needed, though these alloys cannot be used for service in the range of sensitization temperatures. The stabilized grades such as S32100, S34700 and S34800 are used without heat treatment where service exposure temperatures are in the sensitization range. Precipitation hardening alloys such as S17400 and S17700 can be resistance or fusion welded by standard production methods.

Free machining modifications in all classes are subject to porosity and segregation during welding and are not suitable.

Cutting Edge Retention and Resistance to Abrasion - S42000, commonly known as the cutlery grade is the stainless steel most frequently used for knife blades, chopping tools and other applications have a cutting edge. This heat treatable alloy combines good corrosion resistance with high hardness, toughness and resistance to abrasion. For better abrasion resistance, with

some sacrifice of toughness and corrosion resistance a selection may be made from heat treatable alloys S44002, S44003 or S44004.

Types of stainless steel which find wide application in meat and poultry processing equipment are described briefly in a recent publication (1) of the American Iron and Steel Institute. The alloys are categorized on the basis of suitability for specific applications; and reference is made to alloy characteristics which render these alloys suitable for these applications:

> "Type S30200 - A general purpose alloy used extensively for cooking utensils and food handling equipment.
>
> Type S30400 - A low carbon (0.08 percent maximum) modification of Type S30200, particularly suited for use in assemblies that are to be welded. The restricted carbon content improves corrosion resistance at welded joints.
>
> Type S30500 - An increased nickel modification of Type S30200 specifically formulated to facilitate the forming of shapes by spinning. Many containers in the meat industry are spun from this stainless steel.
>
> Type S31600 - A modification of type S30200 which contains 2 or 3 percent molybdenum in addition to chromium and nickel. This type is frequently used in severe corrosive environments, such as in brine tanks, high-heat operations, or where contact with corrosive agents may be prolonged, such as in continuous processing equipment.
>
> Type S41000 - A general purpose alloy that is hardenable by heat treatment and is often found in meat plant valve and pump parts, nuts, bolts, screws and fasteners.
>
> Type S42000 - A high-carbon modification of type S41000 which has increased attainable hardness capability and is often used in top quality cutlery, knife blades and hand tools."

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(1) Stainless Steel - Problem Solver in Meat Packing and Processing, Committee of Stainless Steel Producers. Publisher, American Iron and Steel Institute, Washington, D.C. 20036, 1975.

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7. CREDIT

The cross reference specifications in Table 3 were adopted from data in ASTM DS-56 - SAE J1086. Characteristics and suitable applications given in Table 3 were derived largely from

data in the Metals Progress Data Book, 1974 edition, the AISI Steel Products Manual, Dec. 1974., and appropriate ASTM specifications. The cross reference specifications and characteristics and suitable applications in Table 4 were adopted from data in Alloy Casting Institute Data Sheets, 1973.

8. ACKNOWLEDGMENT

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Table 1

Wrought and Cast Equipment Material Requirements and Applicable Materials

Equipment	Component	Product Contact	Essential Material Requirements*	Stainless Steel Alloys		Materials Used Other Than Stainless Steel
				Currently Used Or Acceptable	Alternatives	
Blender-Mixer	Paddles/Ribbons	Yes	a-2,b-2,d-2,e-2,h-3	S30400	S30403, S30100	
	Paddle Shaft	Yes	a-2,b-2,d-3,h-3	S30400	S30403, S30100, S20100	
	Stuffing Box	Yes	a-2,b-3,c-3,d-3	S30400	S30403, S30215	Teflon,Delrin (alternative)
	Tank Assembly	Yes	a-2,b-2,e-2,h-3	S30200, S30400, S31600	S30400, S31600, S30200	
Conveyor, Belt	Drive Chain	No	a-2,b-2,e-2,f-1	S30200	S17400, S17700, S41000, S30400	
	Frame	No	a-2,f-2,n-2	S31600	S20200	
	Pulleys	No	a-2,b-2,e-2,f-2,h-2	S30200, S30400	S30403, S20200	
	Side rails and slider beds	Yes	a-2,b-2,e-2,h-3	S30200, S30300, S30400	S30403, S24000, S24100	
	Wire belt	Yes	a-2,b-2,d-2,g-3	S30400	S30430, S30200	
Conveyor, Screw	Hanger	Yes	a-2,b-1,g-1	S30400	S30300	UHMWP**
	Hanger bearing	Yes	a-2,b-3,d-3			
	Screw	Yes	a-2,b-3,d-3,f-2	S30400	S31600, S17400, S17700	
	Shaft	Yes	a-2,e-2,f-2,h-3	S30300	S30400, S30403	
	Trough	Yes	a-2,b-2,e-2,h-3	S30400	S30403	
Cutter, Dry Sausage	Carriage	Yes	a-2,b-2,e-2,f-2	S30200, S30400	S30403	
	Cutting blade	Yes	a-2,b-2,c-3,i-3	S44004, S42000	S44004, preferred	
	Frame	No	a-2,e-2,h-2	S30400, S31600	S20200	
	Trough	Yes	a-2,b-2,e-2,h-3	S30400	S30403	

*Code for Material Requirements **Ultra high molecular weight polyethylene

a. Corrosion resistance
b. Wear resistance
c. Scaling (heat resistance)
d. Resistance to galling
e. Strength
f. Machinability
g. Fabricability by Cold Operations
h. Weldability
i. Cutting Edge Retention

Requirements are indicated in ascending order.

1 Low, 2 Moderate, 3 High

Table 1 (continued)

Wrought and Cast Equipment Material Requirements and Applicable Materials

Equipment	Component	Product Contact	Essential Material Requirements*	Stainless Steel Alloys		Materials Used Other Than Stainless Steel
				Currently Used Or Acceptable	Alternatives	
Cutter, Silent	Bowl Support**	No	a-2,e-3,h-2	40 Cr Ni 27.4 (1.4340)***	CF20, CF8	
	Cutter Bowl**	Yes	a-2,b-2,e-2	40 Cr Ni 27.4 (1.4340)***	CF20, CF8	
	Cutting Knives	Yes	a-2,b-3,i-3	X90 Cr Co Mo V17 (1.4535)***	S44004	
	Knife Cover	Yes	a-2,g-2,h-2	X20 Cr 13 (1.4021)***	S30100	
	Knife Shaft	Yes	a-2,b-2,d-3,e-3,f-3	X12 Cr Mo 5 17 (1.4104)***	S30300	
	Scraper	Yes	a-2,b-3,d-3	X5 Cr Ni 8 9 (1.4301)***	S30400	
	Throw-out Disc	Yes	a-2,b-3,d-3,f-2			Nylon, PVC, UHMWP****
Deboner, Mechanical	Auger**	Yes	a-2,b-3,d-3,f-2,h-2,j-2	S44004	CA-40	
	Auger Housing**	Yes	a-2,b-3,d-3,f-2,g-2	S30400	CF-8	
	Cylinder**	Yes	a-2,b-3,d-3,e-3,f-3	S31600 (CF8-M)	S31603	
	Feed Screw	Yes	a-2,b-3,d-3,e-3,f-2,h-2	S30400	S30200, S17400	
	Head	Yes	a-2,b-3,e-3,f-2	S17400	S35000	
	Perforated Chamber	Yes	a-2,b-3,e-3,g-2	S44004, S30200	S17400, S30400	
	Plates	Yes	a-2,b-3,d-3,f-2,g-3,h-2	S30400	S30200	
	Pump**	Yes	a-2,b-3,d-3,f-2	S44004	CA-40	
	Rings	Yes	a-2,b-3,d-3,f-3	S17400	S35000	
	Tank	Yes	a-2,b-2,e-2,h-3	S30400	S30403, S30200	
Dicer/Cuber-Perforator	Chamber	Yes	a-2,b-3,d-3,e-3,f-2	S30400	S30200	
	Cut-Off Knife	Yes	a-2,b-3,i-3	S44004	S44004, S42004, S17400	
	Dicing Grid	Yes	a-2,b-3,e-2,i-2	S30100	S30200	
	Hopper	Yes	a-2,b-2,e-2,h-3	S30400	S30403	
	Piston	Yes	a-2,b-3,d-3,e-3,f-2	S30400	S17400	

*Code for Material Requirements **Casting ***German Alloy ****Ultra high molecular weight polyethylene

a. Corrosion resistance
b. Wear resistance
c. Scaling (heat resistance)
d. Resistance to galling
e. Strength
f. Machinability
g. Fabricability by Cold Operations
h. Weldability
i. Cutting Edge Retention

Requirements are indicated in ascending order.

1 Low, 2 Moderate, 3 High

Table 1 (continued)

Wrought and Cast Equipment Material Requirements and Applicable Materials

Equipment	Component	Product Contact	Essential Material Requirements*	Stainless Steel Alloys		Materials Used Other Than Stainless Steel
				Currently Used Or Acceptable	Alternatives	
Eviscerator, Poultry	Frame	No	a-2,e-2,h-2	S30400	S30403, S20200	
	Guide	No	a-2,b-3,d-2	S30400	S40300	
	Plate	Yes	a-2,f-2,g-2	S30200	S30100	
	Spoon	Yes	a-2,f-2,g-2	S30200, S30400	S30100, S30500	
	Upper Head Shaft	Yes	a-2,b-3,d-2,f-2	S30300		
Filler, Piston	Cylinder	Yes	a-3,b-3,d-2,e-2,f-3	S31600	S31620	
	Hopper	Yes	a-3,b-2,e-2,h-3	S30400, S31600	S31603	
	Nozzle Assembly	Yes	a-3,b-2,f-2,g-2	S17400, S30300	S35000	
	Nozzle Plunger	Yes	a-3,b-2,f-2,g-2	S30300	S17400, S30400	
	Piston	Yes	a-3,b-3,d-3,e-2,f-2		S17400 Teflon or chrome-plated	Delrin, Chrome Plated Steel, Waukesha, #23
	Piston Rod	No	a-2,e-2,f-2	S30400	S20100, S20200	
	Tube	Yes	a-3,b-2,e-2,g-3,h-3	S30400	S30403, S30409	
Flaker, Meat	Cutting Blades	Yes	a-2,b-3,e-3,h-3		S44004	Tool Steel
	Cutting Table	Yes	a-2,b-2,h-3	S30400	S30403	
	Discharge Chute	Yes	a-2,b-2,h-3	S30400	S30403	
	Drum**	Yes	a-2,b-2,e-3,f-2,h-2		CF-8, CA-15	Nickel plated cast iron
	Feed	Yes	a-2,b-2,e-2,f-2,h-3	S30400	S30403	
	Loading Table	Yes	a-2,b-2,h-3		S30400, S30403	Galvanized Steel
Freezer, Cryogenic	Door	No	a-2,e-3	S30400	S20200	
	Exhaust Duct	No	a-2,e-3,h-3	S30400	S30403, S31603	
	Freezing Tunnel	No	a-3,e-3,h-3	S30400	S30403, S31600, S31603	
	Wire Belt	Yes	a-2,b-2,d-2,e-3,g-3	S30400	S30430, S30500	

*Code for Material Requirements **Casting

a. Corrosion resistance
b. Wear resistance
c. Scaling (heat resistance)
d. Resistance to galling
e. Strength
f. Machinability
g. Fabricability by Cold Operations
h. Weldability
i. Cutting Edge Retention

Requirements are indicated in ascending order.

1 Low, 2 Moderate, 3 High

Table 1 (continued)

Wrought and Cast Equipment Material Requirements and Applicable Materials

Equipment	Component	Product Contact	Essential Material Requirements*	Stainless Steel Alloys		Materials Used Other Than Stainless Steel
				Currently Used Or Acceptable	Alternatives	
Grinder, Meat	Assembly Ring**	Yes	a-2,b-2,e-3		CF-8	Tin Plated Cast Iron
	Grinder Bowl**	Yes	a-2,b-2,e-3,f-2		CF-8	Tin Plated Cast Iron
	Grinder Plate**	Yes	a-2,b-3,e-3,f-2		CA-15	Tin Plated Cast Iron
	Grinder Screw**	Yes	a-2,b-3,d-3,e-3,h-2		CA-15	Tin Plated Cast Iron
	Knife	Yes	a-2,b-3,e-3,i-3		S44004	Tool Steel
	Tub	Yes	a-2,b-2,e-2,h-2	S30200	S30100	
	Tumbler**	Yes	a-2,b-2,d-2,h-2		CF-8	Tin Plated Cast Iron
Homogenizer	Cylinder Block**	Yes	a-3,b-3,d-3,e-3,f-3	S30400 (CF-8)	CF-8	
	Plunger Assembly	Yes	a-3,b-3,d-3,e-3,f-3	S30400	S17400	
	Value Assembly	Yes	a-3,b-3,d-3,f-3		None	Rexalloy
	Valve Seats	Yes	a-3,b-3,d-3,f-3		None	Waukesha 23
Injector, Pickle	Brine Tank	Yes	a-3,e-2,g-2,h-3	S31600	S31603, S20910	
	Conveyor Frame	No	a-3,e-2,h-2	S31600	S31603, S20910	
	Discharge Chute	Yes	a-3,b-2,g-2,h-3	S31600	S31603, S20910	
	Filter Screen	Yes	a-3,b-2,g-2,h-3	S31600	S31603, S20910	
	Meat Stripper	Yes	a-3,b-3,d-3,f-2,g-2			Delrin
	Needles	Yes	a-3,b-3,d-3,e-3,g-3,i-3	S31600		
	Needle Head	No	a-3,g-2,h-3			
	Pickle Pump**	Yes	a-3,b-3,d-3,e-2,f-3	S31600 (CF-8M)	CF-3M, CF-8M	Delrin
	Wire Belt	Yes	a-3,b-2,d-2,g-3	S31600	None	
Machine, Breading	Batter Conveyor	Yes	a-2,b-2,d-2,e-2,h-3	S30400	S30403, S30200	
	Batter Tank	Yes	a-2,e-2,h-3	S30400	S30403, S30200	
	Cross Feed Screw	Yes	a-2,b-2,d-2,e-2,h-3	S30400	S30403, S30200	
	Filter Screen	Yes	a-2,b-2,g-2,h-3	S30400	S30403, S30200	
	Pump**	Yes	a-2,b-2,d-2,e-2,f-2	S31600 (CF-8M)	CF-3M	
	Wire Belt	Yes	a-2,b-2,d-2,g-3	S30400	S30430, S30200	

*Code for Material Requirements **Casting

a. Corrosion resistance
b. Wear resistance
c. Scaling (heat resistance)
d. Resistance to galling
e. Strength
f. Machinability
g. Fabricability by Cold Operations
h. Weldability
i. Cutting Edge Retention

Requirements are indicated in ascending order.

1 Low, 2 Moderate, 3 High

Table 1 (continued)

Wrought and Cast Equipment Material Requirements and Applicable Materials

Equipment	Component	Product Contact	Essential Material Requirements*	Stainless Steel Alloys		Materials Used Other Than Stainless Steel
				Currently Used Or Acceptable	Alternatives	
Machine, Packaging	Frame	No	a-2,e-2,h-2		S20200, S20100, S30400	Painted Steel
	Heater Plate	No	a-1,b-2,c-3		S41000, S43000	Aluminum
	Infeed Conveyor	Yes	a-2,b-2,d-2,e-2,h-3	S30400	S30403	
	Knife Assembly	No	a-2,b-2,i-2	S44004	S44002	
	Package Forming Dies	No	a-2,b-2,e-2		S20200, S30400	Aluminum
	Vacuum Sealing Station	Yes	a-2,b-2,e-2,f-2	S30400	S30200	
Machine, Patty	Agitator	Yes	a-2,b-2,e-2,h-3		S30400, S30403	Tin Plated Steel
	Compression Chamber	Yes	a-2,b-3,d-3,e-3,f-3	S30400	S17400	
	Feed Screw	Yes	a-2,b-2,d-3,e-2,h-3	S30300	S30400, S30403, S17400	
	Fill Plate	Yes	a-2,b-2,d-3,e-2,f-3	S30400	S30300, S17400	
	Knock-Out Cups	Yes	a-2,b-2,d-3,g-2		S17700	Tin Plated Aluminum
	Mold Plates	Yes	a-2,b-3,d-3,e-3,f-3		S17400 teflon or chrome-plated	Cast Iron, Aluminum, Delrin
	Pressure Plate	Yes	a-2,b-2,d-3,e-2,f-3	S30400	S30300, S17400	
	Product Hopper	Yes	a-2,b-2,e-2,h-3	S30400	S30403	
	Ram	Yes	a-2,b-3,d-3,e-2,f-3		S17400 teflon or chrome-plated	Waukesha 118
	Wire Belt	Yes	a-2,b-2,d-2,g-3	S30400	S30430, S30200	
Oven	Baking Compartment	Yes	a-3,b-3,c-3,h-3	S43000	S31700, S31703	
	Door and Compartment Exterior	No	a-2,c-3,h-3	S43000	S42900, S20200	
	Heaters	No	c-3		Hasteloy, R235	Inconel, Incoloy
	Wire Belt	Yes	a-3,b-3,c-3,d-2,g-3	S30200	S30400, S30430	
Pump, Sanitary	Body**	Yes	a-3,b-3,e-3,f-3	S31600 (CF-8M)	CF-12M	
	Rotor**	Yes	a-3,b-3,d-3,f-3		S17400 teflon or chrome-plated	Waukesha 88
	Shaft	Yes	a-3,b-3,d-3	S31600	S31620	

*Code for Material Requirements **Casting

a. Corrosion resistance
b. Wear resistance
c. Scaling (heat resistance)
d. Resistance to galling
e. Strength
f. Machinability
g. Fabricability by Cold Operations
h. Weldability
i. Cutting Edge Retention

Requirements are indicated in ascending order.

1 Low, 2 Moderate, 3 High

Table 1 (continued)

Wrought and Cast Equipment Material Requirements and Applicable Materials

Equipment	Component	Product Contact	Essential Material Requirements*	Stainless Steel Alloys		Materials Used Other Than Stainless Steel
				Currently Used Or Acceptable	Alternatives	
Saw, Band	Blade Guides	Yes	a-2,b-3,d-3,f-2	S30400	S30300, S30200	
	Carriage Assembly	Yes	a-2,b-2,d-3,e-2,f-3	S30400	S30300	
	Guage Plate	Yes	a-2,b-2,f-3	S30400	S30300	
	Saw Blade	Yes	a-2,b-3,e-2,i-3		S44002 (13C27 modification)	G10950
	Table	Yes	a-3,b-1,e-2,f-2,h-2	S31600	S31603	
Scalder, Tripe	Baffles	Yes	a-2,b-2,e-2,f-2,h-2	S30400	S30200	
	Cylinder	Yes	a-2,b-2,d-2,e-2,f-2	S30400	S30200	
	Door	Yes	a-2,b-2,e-2,h-2	S30400	S30200	
Slicer	Blade	Yes	a-2,b-3,f-2,i-3	S44004	None	
	Frame	No	a-2,e-2,h-2	S30400	S20200	
	Product Guide	Yes	a-2,b-2,d-2,e-2,f-2	S30400	S30300	
	Tray Assembly	Yes	a-2,b-2,e-2,f-2	S30400	S30300	
	Wire Belt	Yes	a-2,b-2,d-2,g-3	S30400	S30430, S30100	
Smoke House	Exhaust Ducts	No	a-3,c-2,g-2,h-3	S30400	S31603	
	Door	No	a-3,c-2,g-2,h-3	S30400	S31603	
	Drip Pans	No	a-3,g-2,h-3	S30400	S31603, S30500	
	Wall Panels	No	a-3,c-2,g-2,h-3	S30400	S31603	
Stuffer	Cylinder**	Yes	a-2,b-3,d-3,e-3,f-3		CF-16F	Ni-Resist
	Horns**	Yes	a-2,b-2,e-2,f-2,h-2		CF-16F	Ni-Resist
	Lid**	Yes	a-2,b-2,e-3,f-3,h-2		CF-16F	Ni-Resist
	Piston**	Yes	a-2,b-3,d-3,e-3,f-3		CA-15	Nylon
	Safety Ring	Yes	a-2,b-2,d-2,e-2,f-2	S30400	S30300	

*Code for Material Requirements **Casting

a. Corrosion resistance
b. Wear resistance
c. Scaling (heat resistance)
d. Resistance to galling
e. Strength
f. Machinability
g. Fabricability by Cold Operations
h. Weldability
i. Cutting Edge Retention

Requirements are indicated in ascending order.

1 Low, 2 Moderate, 3 High

Table 1 (continued)

Wrought and Cast Equipment Material Requirements and Applicable Materials

Equipment	Component	Product Contact	Essential Material Requirements*	Stainless Steel Alloys		Materials Used Other Than Stainless Steel
				Currently Used Or Acceptable	Alternatives	
Tenderizer, Mechanical	Blades	Yes	a-2,b-2,d-3,e-2,g-2,i-3	S44004	S17700, S42000	Delrin
	Blade Guide	No	a-2,b-2,d-3,f-2			
	Blade Shank	No	a-2,e-2,h-2	S30100	S30200	
	Upright Shield	Yes	a-2,b-2,e-2,h-3	S30400	S30403	
	Wire Belt	Yes	a-2,b-2,d-2,g-3	S30400	S30430, S30200	
Tumbler-Massager	Stirrer	Yes	a-3,b-2,f-2,h-3	S30400, S31600	S30403, S31603	
	Tank	Yes	a-3,b-2,e-2,h-3	S30400, S31600	S30403, S31603	

*Code for Material Requirements

a. Corrosion resistance
b. Wear resistance
c. Scaling (heat resistance)
d. Resistance to galling
e. Strength
f. Machinability
g. Fabricability by Cold Operations
h. Weldability
i. Cutting Edge Retention

Requirements are indicated in ascending order.

1 Low, 2 Moderate, 3 High

TABLE 3 STAINLESS STEEL WROUGHT ALLOYS

UNIFIED NUMBER	CROSS REFERENCE SPECIFICATIONS AISI	ASTM	SAE	MIL	FED	AMS	NOMINAL ANALYSIS(1)	CLASS, CHARACTERISTICS AND SUITABLE APPLICATIONS
S13800	S13800	A564(XM-13)				5629A 5840	Al 0.90-1.35, C 0.05 max, Cr 12.25-13.25, Mn 0.20 max, Mo 2.00-2.50, Ni 7.50-8.50, N 0.01 max, P 0.01 max, Si 0.10 max, S 0.008 max. Other PH 13-8-Mo	Class IV Precipitation hardenable high strength with good corrosion and stress-corrosion resistance-for machine parts and other applications requiring good machining and hardening characteristics.
S14800		A564(XM-24)				5601 5603	Al 0.75-1.50, C 0.05 max, Cr 13.75-15.00, Mn 1.00 max, Mo 2.00-3.00, Ni 7.75-8.75, P 0.015 max, Si 1.00 max, S 0.010 max, Other PH 14-8-Mo	Class IV Precipitation hardenable high strength with good corrosion and stress-corrosion resistance-for machine parts and other applications requiring good machining and hardening characteristics.
S15500	S15500	A564(XM-12)				5658B 5659B	C 0.07 max, Cr 14.00-15.50, Cb 0.15-0.45, Cu 2.50-4.50, Mn 1.00 max, Ni 3.50-5.50, P 0.040 max, Si 1.00 max, S 0.030 max, Other 15-5PH	Class IV Precipitation hardenable. For machine parts and other applications requiring good machining and hardening characteristics. Has high transverse notch toughness and good forging characteristics.

(1) Other are proprietary alloy designations.

TABLE 3 STAINLESS STEEL WROUGHT ALLOYS (continued)

UNIFIED NUMBER	CROSS REFERENCE SPECIFICATIONS AISI	ASTM	SAE	MIL	FED	AMS	NOMINAL ANALYSIS	CLASS, CHARACTERISTICS AND SUITABLE APPLICATIONS
S15700	632	A564(632)	J467 (PH15-7-Mo)			5520 5657 5812 5813	Al 0.75-1.50, C 0.09 max, Cr 14.00-16.00, Mn 1.00 max, Mo 2.00-3.00, Ni 6.50-7.75, P 0.04 max, Si 1.00 max, S 0.03 max	Class IV Precipitation hardenable. For machine parts requiring good machining and hardening characteristics. Has much the same properties as S17700 but with better performance at elevated temperatures.
S17400	630 S17400	A564(630)	J467(17-4PH)	Mil-C-24111 Mil-S-22216 Mil-S-81506		5622 5604 5643 5825 5827	C 0.07 max, Cr 15.50-17.50, Cb 0.15-0.45, Cu 3.00-5.00, Mn 1.00 max, Ni 3.00-5.00 P 0.040 max, Si 1.00 max, S 0.030 max	Class IV Precipitation hardenable. For machine parts requiring good machining and hardening characteristics. Has good resistance to corrosion, galling and seizing.
S17700	631 S17700	A313(631) A564(631)	J467(17-7PH)	Mil-S-25043 Mil-W-46078		5528 5529 5568 5644 5673 5824	Al 0.75-1.50, C 0.09 max, Cr 16.00-18.00, Mn 1.00 max, Ni 6.50-7.75, P 0.040 max, Si 1.00 max, S 0.040 max	Class IV Precipitation hardenable. For machine parts requiring good machining and hardening characteristics. Has very good corrosion resistance, good cold forming capabilities and high strength after heat treatment.

TABLE 3 STAINLESS STEEL WROUGHT ALLOYS (continued)

UNIFIED NUMBER	CROSS REFERENCE SPECIFICATIONS AISI	ASTM	SAE	MIL	FED	AMS	NOMINAL ANALYSIS	CLASS, CHARACTERISTICS AND SUITABLE APPLICATIONS
S20100	201	A412(201) A429(201) A666(201)	J405(30201)		QQ-S-766(201)		C 0.15 max, Cr 16.00-18.00, Mn 5.50-7.50, Ni 3.50-5.50, N 0.25 max, P 0.060 max, Si 1.00 max, S 0.030 max	Class III Generally has better corrosion resistance than a 400 series steel. High strength material affording tough welds and good drawing. Low nickel equivalent of S30100.
S20200	202	A314(202) A412(202) A429(202) A473(202) A666(202)	J405(30202)		QQ-S-763(202) QQ-S-766(202)		C 0.15 max, Cr 17.00-19.00, Mn 7.50-10.00, Ni 4.00-6.00, N 0.25 max, P 0.060 max, Si 1.00 max, S 0.030 max	Class III Generally has better corrosion resistance than a 400 series steel. Has moderate weldability, formability and machinability. General purpose low-nickel equivalent of S30200.
S30100	301	A167(301) A177(301) A368(301) A666(301)	J405(30301)		QQ-S-766(301)	5517 5518 5519	C 0.15 max, Cr 16.00-18.00, Mn 2.00 max, Ni 6.00-8.00, P 0.045 max, Si 1.00 max, S 0.030 max	Class III A high strength material affording tough welds and good drawing.

TABLE 3 STAINLESS STEEL WROUGHT ALLOYS (continued)

UNIFIED NUMBER	CROSS REFERENCE SPECIFICATIONS AISI	ASTM	SAE	MIL	FED	AMS	NOMINAL ANALYSIS	CLASS, CHARACTERISTICS AND SUITABLE APPLICATIONS
S20910		A240(XM-19) A412(XM-19) A429(XM-19) A479(XM-19) A580(XM-19)				5764 5861	C .06 max, Cr 20.5-23.5, Cb 0.10-0.30, Mn 4.00-6.00, Mo 1.50-3.00, Ni 11.50-13.50, N 0.20-0.40, P 0.040 max, Si 1.00 max. S0.030 max, V 0.10-0.30, Other Nitronic 50	Class IV Material has a good combination of corrosion resistance and strength. More corrosion resistant than S30400 and S31600.
S21900		A276(XM-10) A580(XM-10)					C 0.08 max, Cr 18.00-21.00, Mn 8.00-10.00, Ni 5.00-7.00, N 0.15-0.40, P 0.060 max, Si 1.00 max, S 0.030 max, Other Nitronic 40	Class IV Material high yield strength and good corrosion resistance.

TABLE 3 STAINLESS STEEL WROUGHT ALLOYS (continued)

UNIFIED NUMBER	AISI	CROSS REFERENCE SPECIFICATIONS ASTM	SAE	MIL	FED	AMS	NOMINAL ANALYSIS	CLASS, CHARACTERISTICS AND SUITABLE APPLICATIONS
S30200	302	A167(302) A240(302) A276(302) A313(302) A314(302) A368(302) A473(302) A478(302) A479(302) A492(302) A493(302) A580(302) A666(302) A478(302) A479(302) A492(302) A493(302) A580(302) A167(302) A240(302)	J405(30302)		QQ-S-763(302) QQ-S-766(302)	5515 5516 5636 5637 5688	C 0.15 max, Cr 17.00-19.00, Mn 2.00 max, Ni 8.00-10.00, P 0.045 max, Si 1.00 max, S 0.030 max	Class III General purpose material having moderate weldability, formability and machinability
S30215	302B	A276(302B) A314(302B) A473(302B) A580(302B) A167(302B)	J405(30302B)				C 0.15 max, Cr 17.00-19.00, Mn 2.00 max, Ni 8.00-10.00, P 0.045 max, Si 2.00-3.00, S 0.030 max	Class III Material for general corrosion resistance and high temperature service.

TABLE 3 STAINLESS STEEL WROUGHT ALLOYS (continued)

UNIFIED NUMBER	AISI	ASTM	SAE	MIL	FED	AMS	NOMINAL ANALYSIS	CLASS, CHARACTERISTICS AND SUITABLE APPLICATIONS
S21900		A276(XM-10) A580(XM-10)					C 0.08 max, Cr 18.00-21.00, Mn 8.00-10.00, Ni 5.00-7.00, N 0.15-0.40, P 0.060 max, Si 1.00 max, S 0.030 max, Other Nitronic 40	Class IV Material combines high yield strength with good corrosion resistance.
S24000		A240(XM-29) A412(XM-29)					C .08 max, Cr 17.00-19.00, Mn 11.50-14.50, Ni 2.50-3.75, N 0.20-0.40, P 0.060 max, Si 1.00 max, S 0.030 max, Other Nitronic 33	Class IV Good wear and galling resistance comparable to S30400 for corrosion resistance.
S24100		A429(XM-28)					C 0.15 max, Cr 16.50-19.50, Mn 11.00-14.00, Ni 0.50-2.50, N 0.20-0.45, P 0.060 max, Si 1.00 max, S 0.030 max, Other Nitronic 32	Class IV Material has about twice the yield strength of S30400. Corrosion resistance approaches that of S30400.

TABLE 3 STAINLESS STEEL WROUGHT ALLOYS (continued)

UNIFIED NUMBER	AISI	CROSS REFERENCE SPECIFICATIONS ASTM	SAE	MIL	FED	AMS	NOMINAL ANALYSIS	CLASS, CHARACTERISTICS AND SUITABLE APPLICATIONS
S30300	303	A194(303) A314(303) A320(303) A473(303) A581(303) A582(303)	J405(30303)		QQ-S-764(303)	5640	C 0.15 max, Cr 17.00-19.00, Mn 2.00 max, Mo 0.60 max (opt), Ni 8.00-10.00, P 0.20 max, Si 1.00 max, S 0.15 min.	Class III Austenitic. Free machining. Used for bolts, bushings, nuts, screw machine products, shafts and valves.
S30310		A581(XM-5) A582(XM-5)	J405(303 plux X)		QQ-S-764(303 plus X)	5640 (Type 3)	C 0.15 max, Cr 17.00-19.00, Mn 2.50-4.50, Mo 0.75 max, Ni 7.00-10.00, P 0.20 max, Si 1.00 max, S 0.25 min	Class III Austenitic. Free machining. Designed especially for optimum machinability and for general corrosion and high temperature service.
S30323	303Se	A194(303Se) A314(303Se) A320(303Se) A473(303Se) A581(303Se) A582(303Se)	J405(30303Se)		QQ-S-764(303Se)	5641	C 0.15 max, Cr 17.00-19.00, Mn 2.00 max, Ni 8.00-10.00, P 0.20 max, Se 0.15 min, Si 1.00 max, S 0.060 max	Class III A free-machining modification of S30200, for lighter cuts and where hot working or cold heading may be involved.

TABLE 3 STAINLESS STEEL WROUGHT ALLOYS (continued)

UNIFIED NUMBER	AISI	CROSS REFERENCE SPECIFICATIONS ASTM	SAE	MIL	FED	AMS	NOMINAL ANALYSIS	CLASS, CHARACTERISTICS AND SUITABLE APPLICATIONS
S30400	304	A167(304) A240(304) A276(304) A313(304) A314(304) A473(304) A478(304) A479(304) A492(304) A493(304) A580(304) A666(304)	J405(30304)	23196	QQ-S-763(304) QQ-S-766(304)	5501 5513 5560 5565 5566 5567 5639 5697	C 0.08 max, Cr 18.00-20.00, Mn 2.00 max, Ni 8.00-10.50, P 0.045 max, Si 1.00 max, S 0.030 max	Class III A low carbon modification of S30200 more suitable than S30200 for welded applications. Used extensively for chemical and food processing equipment.
S30403	304L	A167(304L) A240(304L) A276(304L) A314(304L) A473(304L) A478(304L) A479(304L) A580(304L)	J405(30304L)		QQ-S-763(304L) QQ-S-766(304L)	5511 5647	C 0.030 max, Cr 18.00-20.00, Mn 2.00 max, Ni 8.00-12.00, P 0.045 max, Si 1.00 max, S 0.030 max	Class III An extra low carbon modification of S30200 for welded applications.
S30409		A213(304H) A249(304H) A271(304H) A312(304H) A376(304H) A430(304H) A479(304H)					C 0.04-0.10, Cr 18.00-20.00, Mn 2.00 max, Ni 8.00-11.00, P 0.040 max, Si 1.00 max, S 0.030 max	Class III High carbon stainless used in pipe and tubing applications

TABLE 3 STAINLESS STEEL WROUGHT ALLOYS (continued)

UNIFIED NUMBER	CROSS REFERENCE SPECIFICATIONS AISI	ASTM	SAE	MIL	FED	AMS	NOMINAL ANALYSIS	CLASS, CHARACTERISTICS AND SUITABLE APPLICATIONS
S30430	S30430	A493(XM-7)					C 0.10 max, Cr 17.00-19.00, Cu 3.00-4.00, Mn 2.00 max, Ni 8.00-10.00, P 0.045 max, Si 1.00 max, S 0.030 max, Other 18-9LW	Class III Cold-finished stainless used for cold heading or cold forging applications.
S30451	304N	A213(304N) A240(304N) A249(304N) A276(304N) A312(304N) A358(304N) A376(304N) A479(304N)					C 0.08 max, Cr 18.00-20.00, Mn 2.00 max, Ni 8.00-10.50, N 0.10-0.16, P 0.045 max, Si 1.00 max, S 0.030 max	Class III A modification of S30400 containing nitrogen and used in tube and pipe applications.
S30500	305	A167(305) A240(305) A276(305) A313(305) A314(305) A473(305) A478(305) A492(305) A493(305) A580(305)	J405(30305)		QQ-S-763(305) QQ-S-766(305)	5514 5685 5686	C 0.08 max, Cr 19.00-21.00, Mn 2.00 max, Ni 10.50-13.00, P 0.045 max, Si 1.00 max, S 0.030 max	Class III Low work hardening material. Used for expanded metal parts and in free spinning and cold heading.
S30800	308	A167(308) A276(308) A314(308) A473(308) A580(308)	J405(30308)				C 0.08 max, Cr 19.00-21.00, Mn 2.00 max, Ni 10.00-12.00, P 0.045 max, Si 1.00 max, S 0.030 max	Class III Composition used in industrial furnaces and other heat resisting applications. Also used in welding rod.

TABLE 3 STAINLESS STEEL WROUGHT ALLOYS (continued)

UNIFIED NUMBER	AISI	CROSS REFERENCE SPECIFICATIONS ASTM	SAE	MIL	FED	AMS	NOMINAL ANALYSIS	CLASS, CHARACTERISTICS AND SUITABLE APPLICATIONS
S30900	309	A167(309) A276(309) A314(309) A473(309) A580(309)	J405(30309)		QQ-S-763(309) QQ-S-766(309)		C 0.20 max, Cr 22.00-24.00, Mn 2.00 max, Ni 12.00-15.00, P 0.045 max, Si 1.00 max	Class III Used in heat resisting applications.
S30908	309S	A167(309S) A240(309S) A276(309S) A314(309S) A473(309S) A580(309S)	J405(30309S)			5523 5574 5650	C 0.08 max, Cr 22.00-24.00, Mn 2.00 max, Ni 12.00-15.00, P 0.045 max, Si 1.00 max, S 0.030 max	Class III A lower carbon modification of S30900. Used in welded construction.
S31000	310	A167(310) A276(310) A314(310) A473(310) A580(314)	J405(30310)		QQ-S-763(310) QQ-S-766(310)	5694 5695	C 0.25 max, Cr 24.00-26.00, Mn 2.00 max, Ni 19.00-22.00, P 0.045 max, Si 1.50 max, S 0.030 max	Class III Has higher elevated temperature strength and scale resistance than S30900 in heat resisting applications. Used in welding filler metals.
S31008	310S	A167(310S) A240(310S) A276(310S) A314(310S) A473(310S) A479(310S) A580(310S)	J405(30310S)			5521 5572 5577 5651	C 0.08 max, Cr 24.00-26.00, Mn 2.00 max, Ni 19.00-22.00, P 0.045 max, Si 1.50 max, S 0.030 max	Class III Low-carbon modification of S31000 for welded construction.

TABLE 3 STAINLESS STEEL WROUGHT ALLOYS (continued)

UNIFIED NUMBER	AISI	CROSS REFERENCE SPECIFICATIONS ASTM	SAE	MIL	FED	AMS	NOMINAL ANALYSIS	CLASS, CHARACTERISTICS AND SUITABLE APPLICATIONS
S31400	314	A276(314) A314(314) A473(314) A580(314)	J405(30314)			5522 5652	C 0.25 max, Cr 23.00-26.00, Mn 2.00 max, Ni 10.00-22.00, P 0.045 max, Si 1.50-3.00, S 0.030 max	Class III Has highest heat resistance properties of any of the chromium nickel steels.
S31600	316	A167(316) A240(316) A276(316) A313(316) A314(316) A473(316) A478(316) A479(316) A492(316) A493(316) A580(316)	J405(30316)		QQ-S-763(316) QQ-S-766(316)	5524 5573 5648 5690 5691	C 0.08 max, Cr 16.00-18.00, Mn 2.00 max, Mo 2.00-3.00, Ni 10.00-14.00, P 0.045 max, S 1.00 max, S 0.030 max	Class III Has higher corrosion resistance than S30200 and S30400 when exposed to many types of chemical corrodents.
S31603	316L	A167(316L) A240(316L) A276(316L) A314(316L) A473(316L) A478(316L) A479(316L) A580(316L)	J405(30316L)		QQ-S-763(316L) QQ-S-766(316L)	5507 5653	C 0.030 max, Cr 16.00-18.00, Mn 2.00 max, Mo 2.00-3.00, Ni 10.00-14.00, P 0.045 max, Si 1.00 max, S 0.030 max	Class III A very low carbon modification of S31600 recommended for parts which are fabricated by welding and which cannot be subsequently annealed.

TABLE 3 STAINLESS STEEL WROUGHT ALLOYS (continued)

UNIFIED NUMBER	CROSS REFERENCE SPECIFICATIONS AISI	ASTM	SAE	MIL	FED	AMS	NOMINAL ANALYSIS	CLASS, CHARACTERISTICS AND SUITABLE APPLICATIONS
S31609		A213(316H) A249(316H) A312(316H) A376(316H) A430(316H) A479(316H)					C 0.04-0.10, Cr 16.00-18.00, Mn 2.00 max, Mo 2.00-3.00, Ni 10.00-14.00, P 0.040 max, Si 1.00 max, S 0.030 max	Class III A modified composition of S31600 used in tube and pipe applications.
S31620	316F					5649	C 0.08 max, Cr 17.00-19.00, Mn 2.00 max, Mo 1.75-2.50, Ni 12.00-14.00, P 0.20 max, Si 1.00 max, S 0.10 min	Class III A free machining modification of S31600.
S31651	316N	A213(316N) A240(316N) A249(316N) A276(316N) A312(316N) A358(316N) A376(316N) A479(316N)					C 0.08 max, Cr 16.00-18.00, Mn 2.00 max, Mo 2.00-3.00, Ni 10.00-14.00, N 0.10-0.16, P 0.045 max, Si 1.00 max, S 0.030 max	Class III A modified composition of S31600 containing nitrogen to increase strength with a minimum effect on ductility and corrosion resistance.
S31700	317	A167(317) A240(317) A276(317) A314(317) A473(317) A478(317) A580(317)	J405(30317)		QQ-S-763(317)		C 0.08 max, Cr 18.00-20.00, Mn 2.00 max Mo 3.00-4.00, Ni 11.00-15.00, P 0.045 max, Si 1.00 max, S 0.030 max	Class III Has higher corrosion resistance than S31600 in special applications. Also used in elevated temperature applications.

TABLE 3 STAINLESS STEEL WROUGHT ALLOYS (continued)

UNIFIED NUMBER	CROSS REFERENCE SPECIFICATIONS AISI	ASTM	SAE	MIL	FED	AMS	NOMINAL ANALYSIS	CLASS, CHAPACTERISTICS AND SUITABLE APPLICATIONS
S31703	317L	A167(317L) A240(317L)					C 0.030 max, Cr 18.00-20.00, Mn 2.00 max, Mo 3.00-4.00, Ni 11.00-15.00, P 0.045 max, Si 1.00 max, S 0.030 max	Class III A very low carbon modification of S31700. Corrosion resistance is similar to type S31700 but has superior resistance to intergranular corrosion following welding or stress relieving. Recommended for parts fabricated by welding and which cannot be subsequently annealed.
S32100	321	A167(321) A240(321) A276(321) A314(321) A473(321) A479(321) A493(321) A580(321)	J405(30321)		QQ-S-763(321) QQ-S-766(321)	5510 5557 5559 5570 5576 5645 5689	C 0.08 max, Cr 17.00-19.00, Mn 2.00 max, Ni 9.00-12.00, P 0.045 max, Si 1.00 max, S 0.030 max, Ti 5XC min	Class III Stabilized with titanium this alloy is useful for weldments subject to severe corrosive conditions and for service from 800-1600F. For use in certain corrosives, particularly cylinders, where stress corrosion may occur. This alloy may be specified in the stress-relieved-annealed condition. Not recommended for use in decorative applications.

TABLE 3 STAINLESS STEEL WROUGHT ALLOYS (continued)

UNIFIED NUMBER	AISI	CROSS REFERENCE SPECIFICATIONS ASTM	SAE	MIL	FED	AMS	NOMINAL ANALYSIS	CLASS, CHARACTERISTICS AND SUITABLE APPLICATIONS
S32109		A213(321H) A249(321H) A271(321H) A312(321H) A376(321H) A430(320H) A479(321H)					C 0.04-0.10, Cr 17.00-20.00, Mn 2.00 max, Ni 9.00-12.00, P 0.040 max, Si 1.00 max, S 0.030 max, Ti, 4XC-0.60	Class III Composition quite similar to S32100. Used extensively in tubing and piping, particularly, in elevated temperature applications.
S34700	347	A167(347) A240(347) A276(347) A314(347) A473(347) A479(347) A493(347) A580(347)	J405(30347)		QQ-S-763(347) QQ-S-766(347)	5512 5556 5558 5571 5575 5646 5654 5674 5680 5681	C 0.08 max, Cr 17.00-19.00, Cb 10X C-min, Mn 2.00 max, Ni 9.00-13.00, P 0.045 max, Si 1.00 max, S 0.030 max	Class III Stabilized with columbium. Recommended for parts which cannot be subsequently annealed.
S34709		A213(347H) A249(347H) A271(347H) A312(347H) A376(347H) A430(347H) A479(347H)					C 0.04-0.10, Cr 17.00-20.00, Cb 8XC-1.00, Mn 2.00 max, Ni 9.00-13.00, P 0.040 max, Si 1.00 max, S 0.030 max	Class III Composition quite similar to S34700. Used extensively in piping, tubing and pressure vessel applications.
S34740						5642 (Type 1)	C 0.08 max, Cr 17.00-19.00, Cb 10XC-1.10, Mn 2.00 max, Ni 9.00-12.00, P 0.040 max, Si 1.00 max, S 0.18-0.35	Class III Composition quite similar to S34700. Contains sulfur. Free machining.

TABLE 3 STAINLESS STEEL WROUGHT ALLOYS (continued)

UNIFIED NUMBER	CROSS REFERENCE SPECIFICATIONS AISI	ASTM	SAE	MIL	FED	AMS	NOMINAL ANALYSIS	CLASS, CHARACTERISTICS AND SUITABLE APPLICATIONS
S34741						5642 (Type 2)	C 0.08 max, Cr 17.00-19.00, Cb 10XC-1.10, Mn 2.00 max, Ni 9.00-12.00, P 0.11-0.17, Se 0.15-0.35, Si 1.00 max, S 0.030 max	Class III Composition quite similar to S34700. Contains selenium. Free machining.
S34800	348	A167(348) A240(348) A276(348) A314(348) A473(348) A479(348) A580(348)	J405(30348)		QQ-S-766(348)		C 0.08 max, Cr 17.00-19.00, Co 0.20 max, Cb 10XC min, Mn 2.00 max, Ni 9.00-13.00, P 0.045 max, Si 1.00 max, S 0.030 max, Ta 0.10 max	Class III Composition quite similar to S34700. Used in certain applications requiring a restricted tantalum and cobalt content such as encountered in radio-active service.
S35000	633		J467(AM-350)			5546 5548 5554 5745 5774 5775	C 0.07-0.11, Cr 16.00-17.00, Mn 0.50-1.25, Mo 2.50-3.25, Ni 4.00-5.00, N 0.07-0.13, P 0.040 max, Si 0.50 max, S 0.030 max	Class IV Precipitation hardenable stainless for applications requiring high strength and good corrosion resistance.
S35500	634	A564(634)	J467(AM-355)			5547 5549 5594 5743 5744 5780 5781	C 0.10-0.15, Cr 15.00-16.00, Mn 0.50-1.25, Mo 2.50-3.25, Ni 4.00-5.00, N 0.07-0.13, P 0.040 max, Si 0.50 max, S 0.030 max	Class IV Precipitation hardenable stainless for applications requiring high strength and good corrosion resistance.

TABLE 3 STAINLESS STEEL WROUGHT ALLOYS (continued)

UNIFIED NUMBER	AISI	CROSS REFERENCE SPECIFICATIONS ASTM	SAE	MIL	FED	AMS	NOMINAL ANALYSIS	CLASS, CHARACTERISTICS AND SUITABLE APPLICATIONS
S36200		A564(XM-9)				5739 5740	Al 0.10 max, C 0.05 max, Cr 14.00-15.00, Mn 0.50 max, Ni 6.00-7.00, P 0.030 max, Si 0.30 max, S 0.030 max, Ti 0.55 - 0.90 Other Almar 362.	Class IV Precipitation hardenable stainless for applications requiring high strength and good corrosion resistance.
S38100		A167(XM-15) A213(XM-15) A240(XM-15) A249(XM-15) A269(XM-15) A312(XM-15)					C 0.08 max, Cr 17.00-19.00, Mn 2.00 max, Ni 17.50-18.50, P 0.030 max, Si 1.50-2.50, S 0.030 max Other 18-18-2	Class III For tube, pipe and pressure vessel applications subjected to elevated temperature.
S38400	384	A493(384)	J405(30384)				C 0.08 max, Cr 15.00-17.00, Mn 2.00 max, Ni 17.00-19.00, P 0.045 max, S .030 max, Si 1.00 max	Class III Low work hardening. Used for severe cold-heading or cold forming. Bolts, rivets and screws are applications.
S38500	385	A493(385)	J405(30385)				C 0.08 max, Cr 11.50-13.50, Mn 2.00 max, Ni 14.00-16.00, P 0.045 max, Si 1.00 max, S 0.030 max	Class III Low work hardening. Used for special drawing, cold-heading and spinning
S40300	403	A176(403) A276(403) A314(403) A473(403) A580(403)	J405(51403)		QQ-S-763(403)	5611 5612	C 0.15 max, Cr 11.50-13.00, Mn 1.00 max, P 0.040 max, Si 0.50 max, Ag 0.030 max	Class I Hardenable by heat treatment. Used in applications subject to corrosion, abrasive wear, wet erosion and high stresses.

TABLE 3 STAINLESS STEEL WROUGHT ALLOYS (continued)

UNIFIED NUMBER	AISI	CROSS REFERENCE SPECIFICATIONS ASTM	SAE	MIL	FED	AMS	NOMINAL ANALYSIS	CLASS, CHARACTERISTICS AND SUITABLE APPLICATIONS
S40500	405	A176(405) A240(405) A276(405) A314(405) A473(405) A580(405)	J405(51405)		QQ-S-763(405)		Al 0.10-0.30, C 0.08 max, Cr 11.50-14.50, Mn 1.00 max, P 0.040 max, Si 1.00 max, S 0.030 max	Class II Not hardenable by heat treatment. Used for components where the air-hardening types S40300 and S41000 are objectionable.
S40900	409	A176(409) A268(409) A651(409)	J405(51409)				C 0.08 max, Cr 10.50-11.75, Mn 1.00 max, Ni 0.50 max, P 0.045 max, Si 1.00 max, S 0.045 max, Ti 6XC-0.75	Class II General purpose construction chromium stainless steel. Used for applications where appearance is secondary to mechanical and corrosion resistance properties. Not recommended for meat or poultry processing applications.
S41000	410	A176(410) A240(410) A276(410) A314(410) A473(410) A493(410) A580(410)	J405(51410)		QQ-S-763(410) QQ-S-766(410)	5504 5505 5591 5613 5776 5777 5821	C 0.15 max, Cr 11.50-13.50, Mn 1.00 max, P 0.040 max, Si 1.00 max, S 0.030 max	Class I General purpose corrosion and heat resisting stainless. Has good corrosion resistance and fair machining properties.
S41400	414	A276(414) A314(414) A473(414) A580(414)	J405(51414)		QQ-S-763(414)	5615	C 0.15 max, Cr 11.5-13.5, Mn 1.00 max, Ni 1.25-2.50, P 0.040 max, S 0.030 max, Si 1.00 max	Class I Corrosion and heat resisting stainless with somewhat better corrosion resistance than S41000. It has higher mechanical properties when heat treated than S41000.

TABLE 3 STAINLESS STEEL WROUGHT ALLOYS (continued)

UNIFIED NUMBER	CROSS REFERENCE SPECIFICATIONS AISI	ASTM	SAE	MIL	FED	AMS	NOMINAL ANALYSIS	CLASS, CHARACTERISTICS AND SUITABLE APPLICATIONS
S41600	416	A314(416) A473(416) A581(416) A582(416)	J405(51416)		QQ-S-764(416)	5610E	C 0.15 max, Cr 12.00-14.00, Mn 1.25 max, Mo 0.60 max (opt), P 0.060 max, Si 1.00 max, S 0.15 min	Class I Corrosion resisting steel with sulfur added and other modifications to improve machining and nonseizing characteristics.
S41623	416Se	A314(416Se) A473(416Se) A581(416Se) A582(416Se)	J405(51416Se)		QQ-S-764(416Se)	5610	C 0.15 max, Cr 12.00-14.00, Mn 1.25 max, P 0.060 max, Se 0.15 min, Si 1.00 max, S 0.060 max	Class I Corrosion resisting steel with selenium added and other modifications to improve machining and nonseizing characteristics.
S42000	420	A276(420) A314(420) A473(420) A580(420)	J405(51420)		QQ-S-763(420) QQ-S-766(420)	5506 5621	C over 0.15, Cr 12.00-14.00, Mn 1.00 max, P 0.040 max, Si 1.00 max, S 0.030 max	Class I Hardenable stainless. Best corrosion resistance is in the hardened and tempered condition.
S42020	420F		J405(51420F)		QQ-S-764(420F)	5620	C over 0.15, Cr 12.00-14.00, Mn 1.25 max, Mo 0.60 max (opt), P 0.060 max, Si 1.00 max, S 0.15 min	Class I Hardenable stainless. Contains elements added to improve mechanical and nonseizing characteristics. Best corrosion resistance is in the hardened and tempered condition.

TABLE 3 STAINLESS STEEL WROUGHT ALLOYS (continued)

UNIFIED NUMBER	CROSS REFERENCE SPECIFICATIONS AISI	ASTM	SAE	MIL	FED	AMS	NOMINAL ANALYSIS	CLASS, CHARACTERISTICS AND SUITABLE APPLICATIONS
S42900	429	A176(429) A240(429) A276(429) A314(429) A473(429) A493(429)	J405(51429)		QQ-S-763(429) QQ-S-766(429)		C 0.12 max, Cr 14.00-16.00, Mn 1.00 max, P 0.040 max, Si 1.00 max, S 0.030 max	Class II A stainless and heat resisting steel with improved weldability as compared to S43000.
S43000	430	A176(430) A240(430) A276(430) A314(430) A473(430) A493(430) A580(430)	J405(51430)		QQ-S-763(430) QQ-S-766(430)	5503 5627	C 0.12 max, Cr 16.00-18.00, P 0.040 max, Si 1.00 max, S 0.030 max	Class II General purpose non-hardenable stainless. Has superior corrosion and heat resistance as compared with S41000.
S43020	430F	A314(430F) A473(430F) A581(430F) A582(430F)	J405(51430F)		QQ-S-764(430F)		C 0.12 max, Cr 16.00-18.00, Mn 1.25 max, Mo 0.60 max (opt), P 0.060 max, Si 1.00 max, S 0.15 min	Class II Free machining modifications of S43000. Contains molybdenum.
S43023	430F Se	A314(430F Se) A473(430F Se) A581(430F Se) A582(430F Se)	J405(51430F-Se)		QQ-S-764(430F Se)	5620	C 0.12 max, Cr 16.00-18.00, Mn 1.25 max, P 0.060 max, Se 0.15 min, Si 1.00 max, S 0.060 max	Class II Free machining modification of S43000. Contains selenium.

TABLE 3 STAINLESS STEEL WROUGHT ALLOYS (continued)

UNIFIED NUMBER	CROSS REFERENCE SPECIFICATIONS AISI	ASTM	SAE	MIL	FED	AMS	NOMINAL ANALYSIS	CLASS, CHARACTERISTICS AND SUITABLE APPLICATIONS
S43100	431	A276(431) A314(431) A473(431) A493(431) A580(431)	J405(51431)				C 0.20 max, Cr 15.00-17.00, Mn 1.00 max, Ni 1.25-2.50, P 0.040 max, Si 1.00 max, S 0.030 max	Class I Stainless alloy designed for heat treatment to high mechanical properties. Corrosion resistance is superior to types S41000, S42000, S43000 and S44000.
S44002	440A	A276(440A) A314(440A) A473(440A) A580(440A)	J405(51440A)		QQ-S-763(440A)	5631	C 0.60-0.75, Cr 16.00-18.00, Mn 1.00 max, Mo 0.75 max, P 0.040 max, Si 1.00 max, S 0.030 max	Class I Hardenable to higher hardness than S42000 with good corrosion resistance. Optimum corrosion resistance qualities is in the hardened and tempered condition.
S44003	440B	A276(440B) A314(440B) A473(440B) A580(440B)	J405(51440B)		QQ-S-763(440B)		C 0.75-0.95, Cr 16.00-18.00, Mn 1.00 max, Mo 0.75 max, P 0.040 max, Si 1.00 max, S 0.030 max	Class I Hardenable to higher hardness than S44002 and greater toughness than S44004. Optimum corrosion resistance qualities is in the hardened and tempered condition.

TABLE 3 STAINLESS STEEL WROUGHT ALLOYS (continued)

UNIFIED NUMBER	CROSS REFERENCE SPECIFICATIONS AISI	ASTM	SAE	MIL	FED	AMS	NOMINAL ANALYSIS	CLASS, CHARACTERISTICS AND SUITABLE APPLICATIONS
S44004	440C	A276(440C) A314(440C) A473(440C) A493(440C)	J405(51440C)		QQ-S-763(440C)	5618 5630	C 0.95-1.20, Cr 16.00-18.00, Mn 1.00 max, Mo 0.75 max, Si 1.00 max, S 0.030 max	Class I Hardenable to the highest hardness of any type of corrosion or heat resisting steel. Optimum corrosion resisting qualities is in the hardened and tempered condition.
S44200	442	A176(442)	J405(51442)				C 0.20 max, Cr 18.00-23.00, Mn 1.00 max, P 0.040 max, Si 1.00 max, S 0.030 max	Class II A high chromium corrosion and heat resisting steel used principally for parts which must resist scaling at high temperature.
S44600	446	A276(446) A314(446) A473(446) A580(446) A176(446)	J405(51446)		QQ-S-763(446) QQ-S-766(446)		C 0.20 max, Cr 23.00-27.00, Mn 1.50 max, N 0.25 max, P 0.040 max, Si 1.00 max, S 0.030 max	Class II A high chromium corrosion and heat resisting steel with the maximum amount of chromium in this series of steel. Used principally for parts which must resist scaling at high temperatures.

TABLE 4 STAINLESS STEEL CASTING ALLOYS

CROSS REFERENCE SPECIFICATIONS						
ACI	ASTM	SAE	MIL	AMS	NOMINAL ANALYSIS	CHARACTERISTICS AND SUITABLE APPLICATIONS
CA-15	A296(CA15) A351(CA15)	60410	S-16993A	5351B	C 0.15 max, Mn 1.00 max, Si 1.50 max, P 0.04 max, S 0.04 max, Cr 11.5-14.0, Ni 1.0 max, Mo 0.5 max, Fe bal.	Heat treatable to a wide range of hardness and other mechanical properties. Provides very good resistance to corrosion or staining by many organic media in relatively mild environment. Bushings, liners, trays, fittings, gears, impellers, pump casings, shafts and valve bodies are some examples of applications. Corresponding wrought alloy is S41000.
CA-40	A296(CA40)	60420			C 0.20-0.40, Mn 1.00 max, Si 1.50 max, P 0.04 max, S 0.04 max, Cr 11.5-14.0, Ni 1.0 max, Mo 0.5 max, Fe bal.	Similar in composition to CA-15 except for higher carbon content which permits hardening of this grade to a higher level. Has best corrosion resistance to tempering after hardening at 600F or below. Choppers, cutting blades, cylinder liners, molds, pump parts, casings, and impellers of applications. Corresponding wrought alloy is S42000.
CB-30	A296(CB30)	60442			C 0.30 max, Mn 1.00 max, Si 1.50 max, P 0.04 max, S 0.04 max, Cr 18-22, Ni 2.0 max, Fe bal.	This alloy is practically non-hardenable in the given composition. Castings of this alloy have fair ductility, but poor impact strength. Pump parts, hooks, tube supports and valve parts are some examples of applications. Corresponding wrought alloy is S44200.

TABLE 4 STAINLESS STEEL CASTING ALLOYS (continued)

CROSS REFERENCE SPECIFICATIONS						
ACI	ASTM	SAE	MIL	AMS	NOMINAL ANALYSIS	CHARACTERISTICS AND SUITABLE APPLICATIONS
CF-3	A296(CF-3) A351(CF-3) (CF-3A)				C 0.03 max, Mn 1.50 max, Si 2.00 max, P 0.04 max, S 0.04 max, Cr 17-21, Ni 8-12, Fe bal.	Has restricted carbon content. Weldable alloy that can be used where post-weld heat treatment is inconvenient or impossible. Bowls, pump casings, impellers, tubes and valve bodies are some examples of applications. Corresponding wrought alloy is S30403.
CF-8	A296(CF-8) A351(CF-8) (CF-8A)	60304	S-867 (Ships) Class 1		C 0.08 max, Mn 1.50 max, Si 2.00 max, P 0.04 max, S 0.04 max, Cr 18-21, Ni 8-11, Fe bal.	Not hardenable by heat treatment. Has good machining and welding characteristics. Castings "sensitized" as in welding must be solution heat treated again to restore full corrosion resistance. Autoclaves, fan parts, hardware, heating coils, mixing agitators and kettles, pump parts, rotary strainers, sanitary fittings, shaft sleeves, spray nozzles and valve bodies are some examples of applications. Corresponding wrought alloy is S30400.
CF-20	A296(CF-20)	60302			C 0.20 max, Mn 1.50 max, Si 2.00 max, P 0.04 max, S 0.04 max, Cr 18-21, Ni 8-11, Fe bal.	Not hardenable by heat treatment. Requires special care in machining. Weldable, except that oxyacetylene welding is not advisable. Welded castings should be solution heat treated to restore maximum corrosion resistance. Cylinder liners, pump and valve parts are some examples of applications. Corresponding wrought alloy is S30200.

TABLE 4 STAINLESS STEEL CASTING ALLOYS (continued)

ACI	CROSS REFERENCE SPECIFICATIONS ASTM	SAE	MIL	AMS	NOMINAL ANALYSIS	CHARACTERISTICS AND SUITABLE APPLICATIONS
CF-3M	A296(CF-3M) A351(CF-3M) (CF-3MA)				C 0.03, Mn 1.50, Si 1.50, P 0.04, S 0.04, Cr 17-21, Ni 9-13, Mo 2.0-3.0, Fe bal.	Has good machining and welding characteristics because of extra-low carbon and molybdenum contents. Castings should be solution treated for maximum corrosion resistance. Mixer parts, pump and valve parts are some examples of applications. Corresponding wrought alloy is S31603.
CF-8M	A296(CF-8M) A351(CF-8M)	60316	S-867 (Ships) Class III		C 0.08 max, Mn 1.50 max, Si 2.00, P 0.04 max, S 0.04 max, Cr 18-21, Ni 9-12, Mo 2.0-3.0, Fe bal.	CF8-M and CF12-M are iron-chromium-nickel-molybdenum alloys differing only in carbon content. Molybdenum is added to enhance general corrosion resistance and to provide greater strength at elevated temperatures. After welding castings should be solution heat treated to restore maximum corrosion resistance. Agitators, fittings, mixing propellers, pump parts, spray nozzles, and valve bodies and parts are some examples of applications. Corresponding wrought alloy is S31600.
CF-12M	A296(CF-8M) A351(CF-8M)	60316	S-867 (Ships) Class III		C 0.12 max, Mn 1.50 max, Si 2.00 max, P 0.04 max, S 0.04 max, Cr 18-21, Ni 9-12, Mo 2.0-3.0, Fe bal.	Same as above.

TABLE 4 STAINLESS STEEL CASTING ALLOYS (continued)

CROSS REFERENCE SPECIFICATIONS						
ACI	ASTM	SAE	MIL	AMS	NOMINAL ANALYSIS	CHARACTERISTICS AND SUITABLE APPLICATIONS
CF-16F	A296(CF-16F) (CF-16Fa)	60303 60303a			C 0.16 max, Mn 1.50 max, Si 2.00 max, P 0.17 max, S 0.04 max, Cr 18-21, Ni 9-12; Se 0.20-0.35, Mo 1.50 max, Fe bal.	Castings of this composition have good welding and machining characteristics. Welded castings should be solution heat treated to restore maximum corrosion resistance. Bearings, bushings, fittings, flanges, pump casings and valves are some examples of applications. Corresponding wrought alloy is S30300.
CN-7M	A296(CN-7M)				C 0.07 max, Mn 1.50 max, Si 1.50 max, P 0.04 max, S 0.04 max, Cr 19-22, Ni 27.5-30.5, Mo 2.0-3.0, Cu 3.0-4.0, Fe bal.	Not hardenable by heat treatment. Has good machining and fair welding characteristics. Welded castings should be solution heat treated to restore maximum corrosion resistance. Has good resistance to dilute acid and hot chloride salt solutions. Fittings, mixer components, hooks, racks, pump parts, tanks and valve parts are some examples of applications. There is no corresponding wrought alloy.

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16. ABSTRACT (*A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.*)

This manual presents selected data identifying wrought and cast stainless steel alloys commonly used for meat and poultry processing equipment. Essential material requirements for meat and poultry processing equipment are given. Alloy compositions and characteristics are described, and alternative materials are suggested.

17. KEY WORDS (*six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons*)

Alternative alloys; applications; characteristics; classification; equipment requirements; identification; meat processing; poultry processing; sanitary; stainless steel.

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