



**EAGLE
STAINLESS**



Visualize Tomorrow

ISO 9001:2000

AS 9100 Rev. B

6σ

SIX SIGMA IS PRACTICED HERE



SIX SIGMA – is not a quality measurement program, nor is it an alternative to ISO 9000. It is a culture that seeks to eliminate defects (aiming at 3.4 errors per million opportunities for error) which in turn passes the savings along to the customer. It is delivering a product to the right spot, at the right time, in the correct volume, and at the lowest possible cost.

Mission Statement

Eagle Stainless Tube & Fabrication, Inc., is committed to each and every customer to provide the ultimate in quality, service and performance. Every item furnished by Eagle Stainless that comes in contact with another human being, will reflect the care and meticulousness of the Eagle Stainless employees, who have the highest regard for human life.

Quality Policy

"Eagle Stainless Tube & Fabrication Inc. will provide to its customers products and services that demonstrate quality, reliability of product, dependability of service, and on-time delivery. To fulfill our mission and policy, we will utilize a systematic approach to quality assurance and management. The processes used to support customer satisfaction and business performance will continuously be monitored and improved to achieve Performance Excellence".

The key to our success is the development of relationships with our suppliers and customers that emphasize continuous improvement, customer satisfaction and performance excellence.

*"Never doubt that a small group of thoughtful,
committed people can change the world.
Indeed, it is the only thing that ever has."*

Margaret Mead, Anthropologist

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Meeting Industry's Need for Stainless Steel Products in 5 Ways

1) Stainless Steel Shipped from Extensive Inventory:

- Tubing
- Hollow Bar
- Flanges
- Bar Stock
- Pipe
- Fittings

Come to Eagle Stainless Tube & Fabrication, Inc., for standard mill lengths of the stainless product your application demands. If mill lengths are too long for your purposes, we will be glad to cut your order to more suitable lengths.

Eagle stocks round, square and rectangular tubing in both welded and seamless. Tubing is available in a size range of .008" O.D. to 8" O.D. and a wall thickness of .015" to 1". Cold worked annealed tubing is available in a size range of 1/16" O.D. to 4" O.D. and wall thickness of .010" to .125".

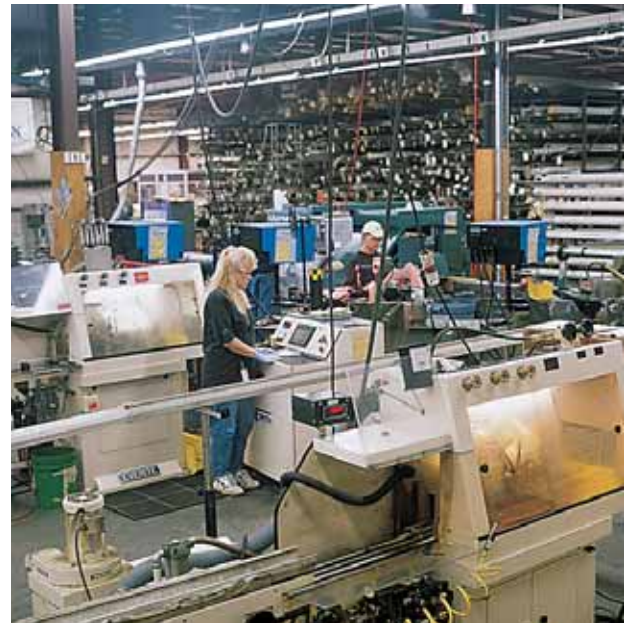
The convenient selection guides on pages 8 through 19 show the broad range of stainless product that Eagle has ready to meet your requirements.



2) Precision, Cut-to-Length Stainless Steel Tubing

Eagle Stainless is a leading supplier of ultra high precision, cut-to-length, stainless steel tubing and bar for medical, electronic, semi-conductor, industrial and aerospace applications. Our manufacturing facilities enable us to cut and deburr any diameter tubing in quantities from a single piece to 100,000 pieces or more. . . and from lengths of .040" and longer with standard tolerances of $\pm .005$.

If you need even closer tolerances, talk to us. We have the desire and the capability to do what other suppliers can't!



Controlling the manufacturing processes every step of the way to insure that you get what you expect when you order from us. . . That's what ISO 9001: 2000 has helped us achieve!



3) CNC Machining of Stainless Steel Components

Specializing in CNC machining of parts having diameters ranging from .032" to 2", Eagle Stainless operates a state-of-the-art manufacturing facility. The company is capable of providing close tolerance components made from Inconel®, titanium, nickel and nickel based alloys, as well as stainless. Small parts can be manufactured to tolerances within .0001", concentricity to $\pm .0005$, and better than a class I fit on threaded parts depending on their size and application.



4) Precision Bending and Coiling of Stainless Steel and Other Materials

Eagle is providing precision bent components for use in surgical devices, heat exchangers, instrumentation and handling equipment. Sizes range from .032" to 1-1/2" diameters in a variety of wall thicknesses, with minimal radius and wall thinning requirements.



5) Redrawing of Stainless Tubing, Rod & Bar Stock

For over twenty-five years Eagle Stainless has been delivering some of the most intricately formed stainless steel parts imaginable. Now Eagle has added custom drawn tubing, rod and bar stock to the products we offer. Eagle can draw stainless, titanium, aluminum and most any other malleable metals on the market. Sizes range from .032" to 1-1/2" in diameter in lengths up to 24 feet.

An in-depth look at our fabrication capabilities and services is provided on pages 20 through 23.





We Expect You to Expect a lot from the Eagle Staff

When You Call Eagle

...Expect to talk with a friendly professional who speaks your language and is prepared to respond to your needs. There is NO VOICEMAIL ! You will always talk to a qualified individual who will be able to help you. Whether you need specifics on our capabilities or details on our inventories and pricing, you will get answers immediately! If you require engineering input on a project, our representative will consult with the appropriate in-house specialists and get back to you promptly with all of the technical details.



ISO 9001-2000 Certification and Six Sigma Initiative

With Eagle as an ISO 9001:2000 and Six Sigma Initiative driven manufacturing plant, you can be assured that every member of our staff is concerned with the quality of every product at every step of its journey through our plant: from order entry to raw material purchasing...through fabrication and QA... to final test and shipping.



Order Processing Track

Once your order goes into our shop, production management lays out your specification and delivery requirements. They develop the production plan for your job, including coordinating the appropriate resources... raw materials, equipment and personnel. These are then carefully orchestrated to achieve on-time delivery.

Every order is tracked throughout the production cycle; so if questions arise, they can be answered quickly.



"Our ISO 9001: 2000 and AS9100 experience has assured our customers of our commitment to quality every step of the way. Our Six Sigma initiative and lean manufacturing techniques have insured our delivery of product on schedule, defect free, in the correct quantity and at the lowest cost of anyone in the industry."

- Robert J. Bubencik, Sr., President and CEO



Meeting the Demand

It takes a sophisticated inventory management system to guarantee that materials are available for off-the-shelf delivery... And it requires availability of machines and craftsmen to deliver fabricated products on time, every time.

Eagle assesses its equipment constantly and invests in the latest state of the art production equipment and maintains an aggressive hiring and training program... all to ensure that production will meet today's demand and tomorrow's growth.

When you Need Answers

When you purchase from Eagle you are getting superior products, the result of years of metals industry experience... all delivered to specification, on time and at the right price.

We welcome the opportunity to share our expertise in developing product concepts and helping you solve your engineering problems. Count on us as a resource for designing and fabricating solutions to all your stainless steel problems.

Customer Satisfaction

Today's customers should expect a total commitment to quality, product consistency and comprehensive technical services. The "Eagle Eye" quality assurance process insures the correct product to your exact specifications. Eagle's success is proof positive that we fulfill that expectation every day.

We guarantee your complete satisfaction! Even when we are asked to do things that other suppliers can't or won't. If ever you are not totally satisfied with any aspect of our business relationship, you can reach our top executives directly by phone, fax, e-mail and web site. We will make it right!



Cut to Length Tubing

All Cut-to-length Materials are Certified to Applicable Specifications.



Ordering Your Tubing

Tubing is generally ordered to **outside diameter and wall thickness**, and is inventoried as Eagle Service Center Stock. Although tubing has three dimensions (O.D., I.D. and wall thickness) only two may be specified with tolerances; the third is theoretical. If inside diameter is the more important dimension for you, tubing can be specially produced by our mill to **I.D. and wall**, or to **O.D. and I.D. dimensions**. Tolerances in any tube are applicable only to two cross-sectional dimensions. Thus, if outside diameter and wall thickness are specified, the inside diameter may not necessarily conform to published tolerances.

Get Tubing Cut to Exact Lengths

Our facilities enable us to cut and deburr any diameter tubing in quantities from 1 piece to 100,000 pieces or more. . . from lengths of 0.040" and longer. . . with a tolerance of $\pm .005$ as standard on diameters of less than one inch. Closer tolerances are certainly possible. Talk to us!

Grades of Stainless Steel

Grades are important depending on your application. One grade may be better than others for certain environments and uses (see pages 24 - 26).

Finish of Tubing

Most stainless tubes are produced with a bright silvery finish, although in some cases a "pickled" or dull pewter finish is produced. Most of Eagle Stainless finishes are of the "Bright" variety, it is always suggested to specify the expected finish.

Cut Length Tolerance Chart

Eagle Stainless Standard Cutting Tolerances				
with Diameters of	.040"	1"	6"	12"
but less than	1"	6"	12"	24"
Tolerance is \pm	.005"	.015"	.030"	.060"

Standard Tubing Tolerances for ASTM-A 269 / A249 / A213 (Fractional or Metric)

Outside Diameter, Inches	O.D. Inches	Wall
Less than 3/32	$\pm .005$	$\pm 15\%$
3/32 3/16	$\pm .005$	$\pm 15\%$
2/32 1/2	$\pm .005$	$\pm 15\%$
1/2 1-1/2	$\pm .005$	$\pm 10\%$
1-1/2 3-1/2	$\pm .010$	$\pm 10\%$
3-1/2 5-1/2	$\pm .015$	$\pm 10\%$
5-1/2 8	$\pm .030$	$\pm 10\%$

Standard Tolerances for ASTM-A 312 Stainless Steel Pipe

Nominal Pipe Size	Outside Diameter Tolerance		Wall
	Over	Under	
1/8 to 1-1/2 incl.	1/64 (0.015)	1/32 (0.031)	+ 0.0%/-12.5%
Over 1-1/2 to 4 incl.	1/32 (0.031)	1/32 (0.031)	+ 0.0%/-12.5%
Over 4 to 8 incl.	1/16 (0.062)	1/32 (0.031)	+ 0.0%/-12.5%
Over 8 to 18 incl.	3/32 (0.093)	1/32 (0.031)	+ 0.0%/-12.5%
Over 18 to 24 incl.	1/8 (0.125)	1/32 (0.031)	+ 0.0%/-12.5%

TEMPER – 300 Series Stainless Steel

Condition	Ultimate Tensile psi		Yield Strength	Elongation % in 2" Min
Fully annealed	100,000	Max	35,000-55,000	40%
1/4 Hard	100,000-125,000		55,000-75,000	35%
1/2 Hard	125,000-150,000		75,000-125,000	15%
3/4 Hard	150,000-175,000		125,000-135,000	10%
Full Hard	175,000-200,000		135,000-160,000	6%

Stainless Steel Tubing Shipped from Inventory

Eagle stocks both seamless and welded stainless steel tubing for a variety of applications requiring strength, corrosion resistance and/or heat resistance. Typical end uses include mechanical applications, architectural, heat exchangers, condensers, medical and instrumentation.



Seamless Stainless Steel Tubing

Eagle seamless stainless steel tubing is ordered to specifications that make the product versatile for general usage and capable of ready certification for more stringent requirements. These specifications ensure that mechanical property tests have been made, such as tensile, yield and elongation, as well as flaring, flanging, hardness, flattening, and hydrostatic or nondestructive electrical tests, etc.

Machining allowances are shown in Table 1-1 below.

Welded Stainless Steel Tubing

Eagle welded stainless steel tubing is also ordered to meet high quality standards for a multitude of end uses. Welded sizes up to and including 5" O.D. are certified to ASTM A-249/A-269 (average wall). This specification ensures that tensile, yield and elongation tests have been performed, in addition to flaring, flattening, flanging, hardness and hydrostatic or non-destructive electrical tests.

**Table 1-1
Clean up or Machining Allowances
for Round Tubing***

For Machined Parts Size, Outside Diameter, Inches	Machining Allowances on Diameter, Inches	
	Outside Diameter	Inside Diameter
Less than 3/32	0.008	0.008
3/32 3/16	0.012	0.012
2/32 1/2	0.015	0.015
1/2 1-1/2	0.020	0.020
1-1/2 3	0.040	0.040
3 5-1/2	0.060	0.060
5-1/2 8	0.080	0.080

* Note: The allowances in this table are nominal allowances which have been satisfactorily used for many applications but are not necessarily adequate for all tubular products and methods of machining. For example, when magnetic particle inspection or aircraft quality requirements are involved, greater allowances than those shown in the foregoing table should be used.

Welded and Drawn Tubing – available in a size range of .202" O.D. to 8" O.D. and wall thickness of .015" to 1".

Cold-rolled strip in long coils is rolled to tube form, then passed under the welding head, which melts the edges of the open seam to form a fusion weld. No filler metal or flux is used, and the weld bead is of the same analysis as the parent metal. All tubing is carefully inspected for weld porosity or other damaging faults before being approved for redrawing.

The welded tubing is then cold drawn in exactly the same way as seamless. As it undergoes repeated cold drawing and annealing it takes on the appearance and qualities of seamless tubing. The weld can be detected only by etching or by microscopic examination. Cold work and annealing cause the weld area to recrystallize with ductility and mechanical properties that are equivalent to the parent metal.

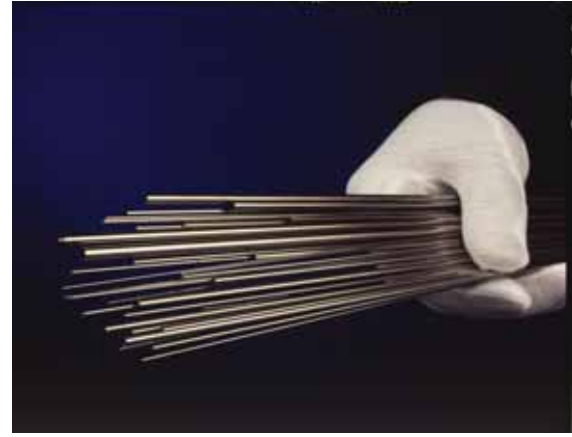
Cold Worked Annealed Tubing – available in a size range of 5/8" O.D. to 4" O.D. and wall thickness of .035" to .120".

This latest manufacturing method starts in the same manner as welded and drawn tubing. Cold-rolled strip is rolled into tube form and fusion welded without the addition of filler metal. It is then selectively cold worked in the weld area and given a full solution anneal, causing this area to recrystallize. With this controlled processing, the strength, ductility and corrosion resistance of the weld area is equal or superior to the parent metal. This similarity between parent and weld zone structures gives cold worked, annealed tubing uniformity and makes it ideally suited for condenser tube and other heat exchanger applications.

Cold worked annealed tubing meets the requirements of ASTM A-249 and tolerances of ASTM A-450. Required minimum mechanical properties – 75,000 psi Tensile Strength, 30,000 psi Yield Strength, and 35% elongation – are met in both the base metal and the weld area.

Tubing Selection Guide

The tubing in the tables below is available in standard 10 foot lengths. Eagle Stainless will be pleased to cut your order to shorter lengths as required.



Inconel 600™ and Monel 400™ are Trademarks of International Nickel Company

Stainless Steel Hypodermic Tubing • Full hard #3 temper • T304 • T316

Gauge Size	O.D. Range (Inches)	Nominal Wall (In.)	I.D. Range (Inches)	Gauge Size	O.D. Range (Inches)	Nominal Wall (In.)	I.D. Range (Inches)	Gauge Size	O.D. Range (Inches)	Nominal Wall (In.)	I.D. Range (Inches)
3 STD	.258/.260	.015	.226/.232	13 STD	.094/.096	.012	.069/.073	20XTW	.0355/.036	.004	.026/.0285
4 STD	.236/.240	.020	.195/.201	13TW	.094/.096	.009	.075/.079	20V	.034/.0345	.004	.0255/.0275
5 STD	.218/.220	.015	.187/.191	13XTW	.094/.096	.005	.083/.087	20STD	.032/.0325	.006	.0195/.021
5 TW	.218/.220	.010	.196/.200	14 STD	.082/.084	.010	.061/.065	21 TW	.032/.0325	.005	.022/.024
6 STD	.202/.204	.015	.170/.1765	14 SP	.082/.084	.008	.065/.069	21XTW	.032/.0325	.002	.0280/.0295
6TW	.202/.204	.010	.180/.186	14 TW	.082/.084	.0055	.071/.073	21 V	.030/.0305	.0035	.023/.0245
6V	.187/.189	.010	.165/.171	14XTW	.082/.084	.003	.075/.079	22 STD	.028/.0285	.006	.0155/.017
7 STD	.179/.181	.015	.147/.153	14 V	.077/.079	.007	.062/.066	22 TW	.028/.0285	.004	.019/.0205
7TW	.179/.181	.010	.158/.162	15 STD	.0715/.0725	.009	.0525/.0555	22XTW	.028/.0285	.0025	.0225/.024
7V	.171/.173	.011	.147/.153	15 TW	.0715/.0725	.006	.0595/.0615	22 V	.026/.027	.003	.0195/.021
8 STD	.164/.166	.015	.132/.138	15XTW	.0715/.0725	.004	.062/.066	23 STD	.025/.0255	.006	.0125/.014
8TW	.164/.166	.010	.143/.147	15 V	.0675/.0685	.007	.0525/.0555	23 TW	.025/.0255	.004	.0165/.018
8XTW	.164/.166	.009	.145/.149	16 STD	.0645/.0655	.009	.0455/.0485	23XTW	.025/.0255	.002	.0185/.020
8V	.155/.157	.010	.133/.139	16 TW	.0645/.0655	.006	.0525/.0545	23V	.023/.0235	.003	.0165/.018
9 STD	.147/.149	.015	.115/.121	16XTW	.0645/.0655	.004	.055/.058	24 STD	.022/.0225	.005	.0115/.013
9TW	.147/.149	.010	.126/.130	16 V	.0615/.0625	.005	.0505/.0535	24XTW	.022/.0225	.003	.0155/.017
9XTW	.147/.149	.006	.134/.138	17 STD	.0575/.0585	.008	.0405/.0435	24V	.021/.0215	.002	.0155/.017
9V	.140/.142	.011	.117/.121	17 TW	.0575/.0585	.005	.0465/.0485	25 STD	.020/.0205	.005	.0095/.011
10 STD	.133/.135	.014	.104/.108	17XTW	.0575/.0585	.003	.051/.053	25 TW	.020/.0205	.004	.0115/.013
10 TW	.133/.135	.010	.112/.116	17 V	.0555/.0565	.005	.045/.047	25XTW	.020/.0205	.002	.0155/.017
10XTW	.133/.135	.008	.1165/.120	18 STD	.0495/.0505	.0085	.0315/.0345	25V	.019/.0195	.002	.0135/.015
10 V	.125/.127	.010	.104/.108	18 SP	.0495/.0505	.006	.0375/.0395	26 STD	.018/.0185	.004	.0095/.011
11 STD	.119/.121	.013	.092/.096	18 TW	.0495/.0505	.004	.041/.043	27 STD	.016/.0165	.004	.0075/.009
11 TW	.119/.121	.010	.098/.102	18 V	.0455/.0465	.0065	.0315/.0345	27 TW	.016/.0165	.003	.0095/.011
11XTW	.119/.121	.007	.104/.108	19 STD	.0415/.0425	.0075	.0255/.0285	27 SP	.016/.0165	.002	.0115/.0125
11 V	.114/.116	.010	.092/.096	19 TW	.0415/.0425	.005	.0315/.0335	28 STD	.014/.0145	.0035	.0065/.008
12 STD	.108/.110	.012	.083/.087	19XTW	.0415/.0425	.0035	.034/.036	29 STD	.013/.0135	.003	.0065/.008
12 TW	.108/.110	.009	.089/.093	19 V	.0385/.0395	.006	.0255/.0285	30 STD	.012/.0125	.003	.0055/.007
12XTW	.108/.110	.0045	.098/.102	20 STD	.0355/.036	.006	.023/.0245	30TW	.012/.0125	.002	.0065/.008
12 V	.099/.101	.008	.080/.083	20 TW	.0355/.036	.005	.025/.027	31 STD	.010/.0105	.0025	.0045/.006
Note: Special sizes available on request!											
32 STD .009/.0095 .0025 .0035/.005											
33 STD .008/.0085 .002 .0035/.005											

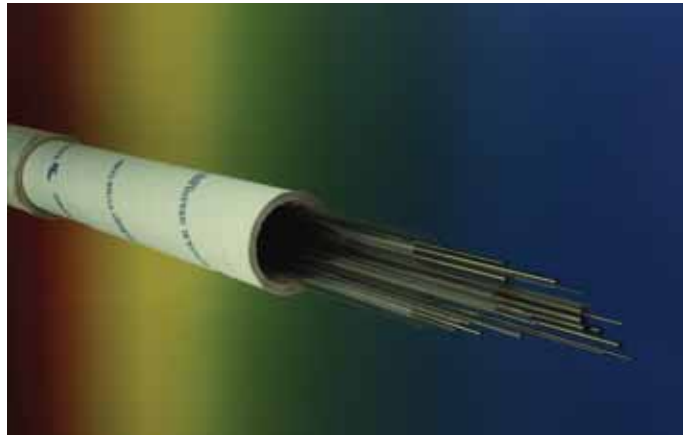
Metric Stainless Steel Tubing • T304 • Inconel 600™ • T316 • T321 • Monel 400™ • T347

O.D.	Wall	Theor I.D.	Weight Per Ft	O.D.	Wall	Theor I.D.	Weight Per Ft	O.D.	Wall	Theor I.D.	Weight Per Ft	O.D.	Wall	Theor I.D.	Weight Per Ft
1 mm (.040")	.25 mm (.010")	.5 mm (.020")	.002	7 mm (.276")	1 mm (.040")	5 mm (.196")	.140	13 mm (.512")	1 mm (.040")	11 mm (.432")	.202	20 mm (.787")	1 mm (.040")	18 mm (.707")	.319
2 mm (.080")	.25 mm (.010")	1.5 mm (.060")	.005	8 mm (.315")	.1 mm (.040")	6 mm (.235")	.118	14 mm (.551")	1 mm (.040")	11.7 mm (.463")	.238	21 mm (.827")	1 mm (.040")	19 mm (.747")	.336
3 mm (.118")	.64 mm (.025")	1.7 mm (.068")	.015	9 mm (.354")	1 mm (.040")	7 mm (.274")	.134	15 mm (.591")	1.2 mm (.049")	12.5 mm (.493")	.284	22 mm (.866")	1.2 mm (.045")	19.6 mm (.777")	.395
4 mm (.158")	.5 mm (.020")	.3 mm (.118")	.034	10 mm (.394")	.5 mm (.020")	9 mm (.354")	.140	16 mm (.630")	1.2 mm (.049")	13.4 mm (.527")	.304	23 mm (.906")	1 mm (.036")	21 mm (.834")	.335
5 mm (.197")	.5 mm (.020")	4 mm (.157")	.038	10 mm (.394")	1 mm (.040")	8 mm (.314")	.151	17 mm (.669")	1.2 mm (.046")	14.7 mm (.577")	.306	24 mm (.945")	1 mm (.038")	22 mm (.870")	.368
6 mm (.236")	.5 mm (.020")	5 mm (.236")	.045	11 mm (.433")	.8 mm (.032")	9.3 mm (.368")	.045	18 mm (.709")	1.2 mm (.045")	15.8 mm (.620")	.319	25 mm (.984")	1 mm (.041")	23 mm (.902")	.413
6 mm (.236")	1 mm (.040")	4 mm (.156")	.063	12 mm (.472")	.9 mm (.035")	10.1 mm (.402")	.163	19 mm (.749")	1.2 mm (.049")	16.5 mm (.651")	.366	26 mm (1.024")	1.3 mm (.052")	23.4 mm (.920")	.540

Lab Sample Kit

Here is a helpful new kit featuring a large assortment of 300 series stainless steel hypodermic tubing well suited for test, evaluation and prototyping by designers and laboratory personnel. Filling the need for customers who want to experiment with a variety of sizes before placing production orders, the kit features 81 pieces of 40" long hypodermic tubing in a full range of sizes from 6 Gauge to 33 Gauge – all with a variety of wall thicknesses. A handy reorder form is included for ordering production quantities of required sizes with 24 hour delivery.

Price \$249.95



Square / Rectangular Tubing Selection Guide

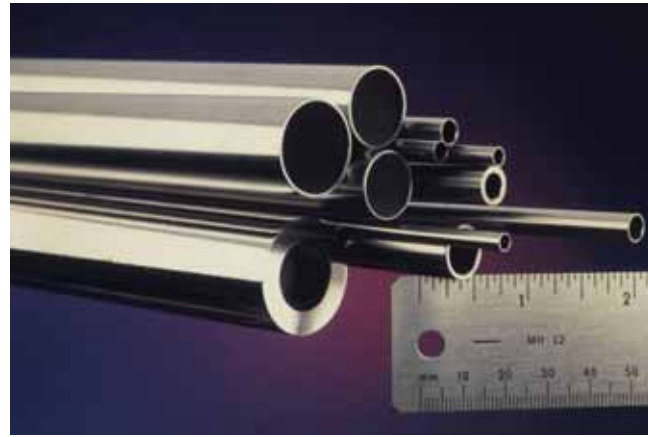
Eagle can re-draw standard tubing to provide you with the exact shape to meet your application requirements. Standard lengths are 10 to 12 feet.



Standard Tubing Square / Rectangular Sizing Chart												
Available with Wall Thicknesses of .010" .020" .028" .035"												
	.125	.187	.250	.313	.375	.437	.500	.625	.750	1.000	1.250	1.500
.125	✓	✓	✓	✓	✓	✓	✓	✓				
.187	✓	✓	✓	✓	✓	✓	✓	✓	✓			
.250	✓	✓	✓	✓	✓	✓	✓	✓	✓			
.313	✓	✓	✓	✓	✓	✓	✓	✓	✓			
.375	✓	✓	✓	✓	✓	✓	✓	✓	✓			
.437	✓	✓	✓	✓	✓	✓	✓	✓	✓			
.500	✓	✓	✓	✓	✓	✓	✓	✓	✓			
.625	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
.750								✓	✓	✓	✓	✓
1.000									✓	✓	✓	✓
1.250									✓	✓	✓	✓
1.500									✓	✓	✓	✓

Tubing Selection Guide

The tubing in the tables below is available in 20 foot random lengths. Eagle Stainless will be pleased to cut your order to shorter lengths as required.



Fractional Stainless Steel Tubing • T304 • Inconel 600™ • T316 • T321 • Monel 400™ • T347

O.D.	Wall	Theor I.D.	Weight Per Ft	O.D.	Wall	Theor I.D.	Weight Per Ft	O.D.	Wall	Theor I.D.	Weight Per Ft	O.D.	Wall	Theor I.D.	Weight Per Ft
1/16	.010	.042	.005	9/32	.028	.225	.076	5/8	.020	.585	.129	1-1/8	.028	1.069	.328
(.062)	.016	.030	.008	(.281)	.035	.211	.092	(.625)	.028	.569	.178	(1.125)	.035	1.055	.407
	.020	.022	.009						.035	.555	.221		.049	1.027	.563
	.028	.006	.012	5/16	.016	.281	.050		.049	.527	.301		.065	.995	.736
				(.313)	.020	.273	.062		.065	.495	.388		.095	.935	1.045
3/32	.010	.074	.009		.028	.257	.085		.083	.459	.480		.120	.885	1.288
(.094)	.016	.062	.015		.035	.243	.103		.095	.435	.537		.188	.750	1.881
	.020	.054	.016		.049	.215	.138		.120	.385	.647		.250	.625	2.336
	.028	.038	.020		.065	.183	.172		.188	.249	.877				
					.083	.147	.203					1-1/4	.028	1.194	.365
1/8	.010	.105	.015		.095	.123	.221	3/4	.020	.710	.155	(1.250)	.035	1.180	.454
(.125)	.016	.093	.019	3/8	.010	.355	.038	(.750)	.028	.694	.215		.049	1.152	.628
	.020	.085	.022	(.375)	.016	.343	.061		.035	.680	.267		.065	1.120	.822
	.025	.075	.025		.020	.335	.075		.049	.652	.366		.083	1.084	1.034
	.028	.069	.029		.028	.319	.103		.065	.620	.475		.095	1.060	1.172
	.035	.055	.033		.035	.305	.127		.083	.584	.591		.109	1.032	1.328
	.049	.027	.040		.049	.277	.170		.095	.560	.664		.120	1.010	1.448
					.065	.245	.215		.120	.510	.807		.188	.875	2.132
5/32	.010	.136	.019		.083	.209	.258		.156	.438	.990		.250	.750	2.670
(.156)	.016	.124	.034		.095	.185	.284								
	.020	.116	.040		.120	.135	.326	13/16	.028	.756	.235	1-3/8	.035	1.305	.500
	.028	.100	.060					(.812)	.035	.742	.290	(1.375)	.049	1.277	.693
	.035	.086	.082	7/16	.020	.398	.089		.049	.714	.399		.065	1.245	.909
	.049	.058	.096	(.438)	.028	.382	.123		.065	.682	.519		.120	1.135	1.608
					.035	.368	.150						.134	1.107	1.776
3/16	.010	.168	.019		.049	.340	.203	7/8	.028	.819	.253		.188	1.000	2.383
(.188)	.016	.156	.029		.065	.308	.258	(.875)	.035	.805	.314		.250	.875	3.004
	.020	.148	.035		.083	.272	.315		.049	.777	.432				
	.028	.132	.047						.065	.745	.562	1-1/2	.028	1.444	.440
	.035	.118	.057	1/2	.010	.480	.052		.083	.709	.702	(1.500)	.035	1.430	.547
	.049	.090	.073	(.500)	.016	.468	.082		.095	.685	.791		.049	1.402	.759
	.065	.058	.085		.020	.460	.102		.120	.635	.968		.065	1.370	.996
					.028	.444	.141		.156	.563	1.198		.083	1.334	1.256
7/32	.016	.186	.035		.035	.430	.173		.188	.499	1.379		.120	1.260	1.769
(.218)	.028	.162	.056		.049	.402	.236						.134	1.232	1.955
	.035	.148	.069		.065	.370	.302	1	.020	.960	.209		.156	1.188	2.239
					.083	.310	.418	(1.000)	.028	.944	.290		.188	1.125	2.634
1/4	.010	.230	.026		.095	.310	.418		.035	.930	.360		.250	1.000	3.338
(.250)	.016	.218	.040		.120	.260	.487		.049	.902	.497		.375	.750	4.506
	.020	.210	.049						.065	.870	.649	1-5/8	.049	1.527	.8248
	.028	.194	.066	9/16	.028	.506	.160		.083	.834	.812	(1.625)	.065	1.495	1.083
	.035	.180	.080	(.562)	.035	.492	.197		.095	.810	.918		.083	1.459	1.367
	.049	.152	.105		.049	.464	.257		.120	.760	1.128		.095	1.435	1.552
	.065	.120	.128		.065	.432	.346		.188	.624	1.630		.120	1.385	1.929
	.083	.084	.148		.095	.372	.474		.250	.500	2.003		.188	1.249	2.885
	.095	.060	.157		.125	.312	.584						.250	1.125	3.671
													.375	.875	5.006

Tubing Selection Guide

Fractional Stainless Steel Tubing • T304 • Inconel 600™ • T316 • T321 • Monel 400™ • T347															
O.D.	Wall	Theor I.D.	Weight Per Ft	O.D.	Wall	Theor I.D.	Weight Per Ft	O.D.	Wall	Theor I.D.	Weight Per Ft	O.D.	Wall	Theor I.D.	Weight Per Ft
1-3/4	.049	1.652	.8902	2-1/2	.049	2.402	1.283	3-3/4	.120	3.510	4.652	5-1/2	.065	5.370	3.773
(1.750)	.065	1.620	1.170	(2.500)	.065	2.370	1.690	(3.750)	.250	3.250	9.345	(5.500)	.120	5.260	6.895
	.120	1.510	2.089		.083	2.334	2.143		.375	3.000	13.520		.250	5.000	14.020
	.156	1.438	2.656		.095	2.310	2.440		.500	2.750	17.360		.375	4.750	20.530
	.188	1.374	3.316		.109	2.282	2.783		.625	2.500	24.030		.500	4.500	26.700
	.250	1.250	4.005		.120	2.260	3.050						.750	4.000	38.050
	.375	1.000	5.507		.134	2.232	3.386	4	.065	3.870	2.732		.875	3.750	43.220
	.500	.750	6.675		.156	2.188	3.905	(4.000)	.083P	3.834	3.472		1.000	3.500	48.060
					.188	2.125	4.642		.120P	3.760	4.973				
1-7/8	.065	1.745	1.257		.250	2.000	6.008		.188	3.624	7.654	6	.065	5.870	4.120
(1.875)	.095	1.685	1.806		.375	1.750	8.511		.226P	3.548	9.109	(6.000)	.083	5.834	5.245
	.120	1.635	2.249		.500	1.500	10.680		.250	3.500	10.010		.109	5.782	6.857
	.188	1.500	3.387		.625	1.250	12.515		.318P	3.364	13.180		.120	5.760	7.536
	.250	1.375	4.339						.375	3.250	14.520		.188	5.624	11.670
				2-3/4	.065	2.620	1.864		.500	3.000	18.690		.250	5.500	15.350
2	.035	1.930	.7345	(2.750)	.083	2.584	2.364		.625	2.750	22.530		.375	5.250	22.530
(2.000)	.049	1.902	1.021		.095	2.560	2.694		.636P	2.728	22.850		.500	5.000	29.370
	.065	1.870	1.343		.120	2.510	3.371		.750	2.500	26.030		.625	4.750	35.880
	.083	1.834	1.699		.188	2.375	5.144						.750	4.500	42.050
	.095	1.810	1.933		.250	2.250	6.675	4-1/4	.065	4.120	2.905		1.000	4.000	53.400
	.109	1.782	2.201		.375	2.000	9.512	(4.250)	.095	4.060	4.216				
	.120	1.760	2.409		.500	1.750	12.015		.120	3.880	5.293	6-1/4	.250	5.750	16.020
	.134	1.732	2.671		.750	1.250	16.020		.156	3.938	8.156	(6.250)	.375	5.500	23.530
	.156	1.688	3.072						.250	3.750	10.680		.500	5.250	30.710
	.188	1.625	3.638	3	.049	2.902	1.544		.313	3.624	13.160		.750	4.750	44.060
	.250	1.500	4.673	(3.000)	.065	2.870	2.038		.375	3.500	15.520		1.000	4.250	56.070
	.375	1.250	6.508		.083	2.834	2.586		.500	3.250	20.030				
	.500	1.000	8.010		.095	2.810	2.947		.688	2.874	26.170	6-1/2	.250	6.000	16.690
					.109	2.782	3.366		.750	2.750	28.040	(6.500)	.375	5.750	24.530
2-1/8	.049	2.027	1.086		.120	2.760	3.691						.500	5.500	32.040
(2.125)	.065	1.995	1.430		.134	2.732	4.102	4-1/2	.065	4.370	5.840		.625	5.250	39.220
	.095	1.935	2.060		.156	2.688	4.738	(4.500)	.120	4.260	5.613		.750	5.000	46.060
	.120	1.885	2.570		.188	2.624	5.646		.188	4.124	8.658		1.000	4.500	58.740
	.188	1.750	3.889		.250	2.500	7.343		.250	4.000	11.350				
	.250	1.625	5.006		.313	2.374	8.982		.375	3.750	16.520	7	.250	6.500	18.020
	.375	1.375	7.008		.375	2.250	10.510		.500	3.500	21.360	(7.000)	.375	6.000	26.530
	.500	1.125	8.678		.500	2.000	13.350		.625	3.250	25.870		.500	6.000	34.710
					.625	1.750	15.850		.750	3.000	30.040		.750	5.500	50.060
2-1/4	.049	2.152	1.152		.750	1.500	18.020		.875	2.750	33.880		1.000	5.000	64.080
(2.250)	.065	2.120	1.517					4-3/4	.120	4.510	5.934				
	.083	2.084	1.921	3-1/4	.065	3.120	2.211	(4.750)	.188	4.374	9.160	7-1/2	.250	7.000	19.360
	.095	2.060	2.252	(3.250)	.083	3.084	2.807		.250	4.250	12.020	(7.500)	.500	6.500	37.380
	.120	2.010	2.730		.095	3.060	3.201		.375	4.000	17.520				
	.188	1.874	4.140		.120	3.010	4.011		.500	3.750	22.700	8	.120	7.760	10.100
	.250	1.750	5.340		.188	2.874	6.148		.625	3.500	27.530	(8.000)	.250	7.500	20.690
	.375	1.500	7.509		.250	2.750	8.010		.750	3.250	32.040		.375	7.250	30.540
	.500	1.250	9.345		.375	2.500	11.514		.875	3.000	36.210		.500	7.000	40.050
					.500	2.250	14.685						.625	6.750	49.230
2-3/8	.065P	2.245	1.604		.750	1.750	20.025	5	.065	4.870	3.426		.750	6.500	58.070
(2.375)	.083	2.209	2.032					(5.000)	.083	4.834	4.359		1.000	6.000	74.760
	.095	2.185	2.313	3-1/2	.065	3.370	2.385		.120	4.760	6.254				
	.109P	2.157	2.638	(3.500)	.083P	3.334	3.029		.188	4.624	9.662				
	.154P	2.067	3.653		.120P	3.260	4.332		.250	4.500	12.680				
	.188	1.990	4.391		.188	3.124	6.650		.375	4.250	18.520				
	.218P	1.939	5.022		.216P	3.068	7.756		.500	4.000	24.030				
	.250	1.875	5.674		.250	3.000	8.678		.625	3.750	29.200				
	.343P	1.689	7.444		.300P	2.900	10.250		.750	3.500	34.040				
	.375	1.625	8.010		.375	2.750	12.520		.875	3.250	38.550				
	.436P	1.503	9.029		.500	2.500	16.020								
	.500	1.375	10.010		.625	2.250	19.190								
					.750	2.000	22.030								

Note: Larger sizes are available on request. Please consult factory.

"P" Designates pipe size

Inconel 600™ and Monel 400™ are Trademarks of International Nickel Company

Stainless Steel Piping Products Cold Drawn or Hot Finished

Eagle furnishes a full line of stainless steel pipe, fittings and flanges to handle any problem involving corrosion, temperature or pressure. We serve all major industries including chemical, petrochemical, nuclear, cryogenics, food, paper and pollution control.

In addition to stainless steel, Eagle can provide corrosion resistant piping products in such materials as aluminum, nickel alloys and special alloys.



Ordering Your Piping

Pipe is ordinarily ordered by its nominal diameter (pipe size) and wall thickness which is specified by a schedule number. The convenient Pipe Selection Guide at the right shows schedules with corresponding wall thicknesses as well as weights in pounds per foot of pipe length.

Stainless Steel Pipe

Eagle seamless and welded austenitic stainless steel pipe is **stocked in the annealed and pickled condition**, making it suitable for welding, bending, and fabrication of all kinds.

Permissible size variations are shown in Table 1-2 below.

All Eagle seamless and welded stainless steel pipe can be furnished with complete mill test reports including all chemical and mechanical data. Additional testing, including 100% X-Ray Test, Charpy Test, Dye Penetrant Test, etc., is available at an additional cost.

Seamless Stainless Steel Pipe

Cold drawn and hot finished seamless pipe can be certified to ASTM A-312, ASME SA-312. Selected sizes of cold drawn pipe also meet MIL-P-1144D, which is similar to ASTM A-312, but with the important addition of an acidified copper sulfate test. Hot finished pipe will not meet MIL-P-1144D because of surface finish requirements. When surface finish is not a critical consideration, hot finished pipe is a more economical product.

Cold Drawn Pipe – is available from 1/8" I.P.S. to 8" I.P.S. in all wall thicknesses.

Hot Finished Pipe – is available in selected sizes to meet competitive market conditions.

Welded Stainless Steel Pipe

Eagle welded stainless steel pipe is supplied in the full finished condition. It has been annealed and pickled and meets all aspects of ASTM A-312, ASME SA-312 and MIL-P-1144D. The weld bead has been cold worked to recrystallize the cast structure providing a flush condition on both the O.D. and the I.D. surfaces.

**Table 1-2
Austenitic Stainless Steel Pipe*
Seamless and Welded - Permissible Variations**

Nominal Pipe Size, Inches	Outside Diameter, Inches		
	Over	Under	Wall
1/8 to 1-1/2, incl.	1/64 (0.015)	1/32 (0.031)	
Over 1-1/2 to 4, incl.	1/32 (0.031)	1/32 (0.031)	
Over 4 to 8, incl.	1/16 (0.062)	1/32 (0.031)	-12.5%
Over 8 to 18, incl.	3/32 (0.092)	1/32 (0.031)	
Over 18 to 24, incl.	1/8 (0.125)	1/32 (0.031)	

* Note: For dimensions and weights see opposite page.

Pipe Selection Guide

• **GREEN Figures** - indicate wall thickness in inches • **BLACK Figures** - indicate weight in pounds/foot (Aluminum pipe weighs roughly one third as much as steel pipe)

Seamless & Welded Stainless Steel Pipe • A.S.A. Pipe Schedules

Pipe Size	O.D. (Inches)	5S	5	10S	10	20	30	40S & Standard	40	60	80S & Extra Heavy	80	100	120	140	160	Double Extra Heavy
1/8	.405		.035	.049	.049			.068	.068		.095	.095					
			.1383	.1863	.1863			.2447	.2447		.3145	.3145					
1/4	.540		.049	.065	.065			.088	.088		.119	.119					
			.2570	.3297	.3297			.4248	.4248		.5351	.5351					
3/8	.675		.049	.065	.065			.091	.091		.126	.126					
			.3276	.4235	.4235			.5676	.5676		.7388	.7388					
1/2	.840	.065	.065	.083	.083			.109	.109		.147	.147				.187	.294
		.5383	.5383	.6710	.6710			.8510	.8510		1.088	1.088				1.304	1.714
3/4	1.050	.065	.065	.083	.083			.113	.113		.154	.154				.218	.308
		.6838	.6838	.8527	.8527			1.131	1.131		1.474	1.474				1.937	2.441
1	1.315	.065	.065	.109	.109			.133	.133		.179	.179				.250	.358
		.8678	.8678	1.404	1.404			1.679	1.679		2.172	2.172				2.844	3.659
1-1/4	1.660	.065	.065	.109	.109			.140	.140		.191	.191				.250	.382
		1.107	1.107	1.806	1.806			2.273	2.273		2.997	2.997				3.765	5.214
1-1/2	1.900	.065	.065	.109	.109			.145	.145		.200	.200				.281	.400
		1.274	1.274	2.085	2.085			2.718	2.718		3.631	3.631				4.859	6.408
2	2.375	.065	.065	.109	.109			.154	.154		.218	.218				.343	.436
		1.604	1.604	2.638	2.638			3.653	3.653		5.022	5.022				7.444	9.029
2-1/2	2.875	.083	.083	.120	.120			.203	.203		.276	.276				.375	.552
		2.475	2.475	3.531	3.531			5.793	5.793		7.661	7.661				10.01	13.70
3	3.500	.083	.083	.120	.120			.216	.216		.300	.300				.437	.600
		3.029	3.029	4.332	4.332			7.576	7.576		10.25	10.25				14.32	18.58
3-1/2	4.000	.083	.083	.120	.120			.226	.226		.300	.300				.437	.600
		3.472	3.472	4.973	4.973			9.109	9.109		12.51	12.51					22.85
4	4.500	.083	.083	.120	.120			.237	.237	.281	.337	.337	.437			.531	.674
		3.915	3.915	5.613	5.613			10.79	10.79	12.66	14.98	14.98	19.01			22.51	27.54
4-1/2	5.000							.247			.355						.710
								12.53			17.61						32.53
5	5.563	.109	.109	.134	.134			.258	.258		.375	.375	.500			.625	.750
		6.349	6.349	7.770	7.770			14.62	14.62		20.78	20.78	27.04			32.96	38.55
6	6.625	.109	.109	.134	.134			.280	.280		.432	.432	.562			.718	.864
		7.585	7.585	9.289	9.289			18.97	18.97		28.57	28.57	36.39			45.30	53.16
7	7.625							.301			.500						.875
								25.57			38.05						63.08
8	8.625	.109	.109	.148	.148	.250	.277	.322	.322	.406	.500	.500	.593	.718	.812	.906	.875
		9.914	9.914	13.40	13.40	22.36	24.70	28.55	28.55	35.64	43.39	43.39	50.87	60.93	67.76	74.69	72.42
9	9.625							.342			.500						
								33.90			48.72						
10	10.750	.134	.134	.165	.165	.250	.307	.365	.365	.500	.500	.593	.718	.843	1.000	1.125	
		15.19	15.19	18.70	18.70	28.04	34.24	40.48	40.48	54.74	54.74	64.33	76.93	89.20	104.1	115.7	
11	11.750							.375			.500						
								45.55			60.07						
12	12.750	.156	.165	.180	.180	.250	.330	.375	.406	.562	.500	.687	.843	1.000	1.125	1.312	
		21.07	22.18	24.20	24.20	33.38	43.77	49.56	53.53	73.16	65.42	88.51	107.2	125.5	139.7	160.3	
14	14.000	.156		.188	.250	.312	.375	.375	.437	.593	.500	.750	.937	1.093	1.250	1.406	
		23.07		27.73	36.71	45.68	54.57	54.57	63.37	84.91	72.09	106.1	130.7	150.7	170.2	189.1	
16	16.000	.165		.188	.250	.312	.375	.375	.500	.656	.500	.843	1.031	1.218	1.437	1.593	
		27.90		31.75	42.05	52.36	62.58	62.58	82.77	107.5	82.77	136.5	164.8	192.3	223.5	245.1	
18	18.000	.165		.188	.250	.312	.437	.375	.562	.750	.500	.937	1.156	1.375	1.562	1.781	
		31.43		35.76	47.39	59.03	82.06	70.59	104.8	138.2	93.45	170.8	208.0	244.1	274.2	308.5	
20	20.000	.188		.218	.250	.375	.500	.375	.593	.812	.500	1.031	1.280	1.500	1.750	1.968	
		39.78		46.05	52.73	78.60	104.1	78.60	122.9	166.4	104.1	208.9	256.1	296.4	341.1	379.0	
24	24.000	.218		.250	.250	.375	.562	.375	.687	.968	.500	1.218	1.531	1.812	2.062	2.343	
		55.37		63.41	63.41	94.62	140.8	94.62	171.2	238.1	125.5	296.4	367.4	429.4	483.1	541.9	

Stainless Steel Bar Stock Shipped from Inventory

Eagle furnishes a full line of stainless steel bar stock in rounds, squares and flats.



Ordering Your Bar Stock

Bar is ordinarily ordered by its nominal diameter. The convenient Bar Stock Selection Guide at the right (pages 16–19) shows nominal sizes and provides convenient weight data.

However, for centerless grinding purposes when tolerances are tight, bar stock is generally ordered “oversize” to allow for sufficient material removal.

For example, if grinding 1/4" and 1/2" stock were required, 1/4" oversize and 1/2" oversize would be specified.

Stainless Steel Hollow Bar

Hollow bar is a significant breakthrough in materials availability. The production of parts where a starting tubular shape is more economical than bar stock

can now be effected. The reason for this is that Hollow Bar is available to the bar specifications called for on blueprints. Availability includes AMS, QQ-S and MIL-S grades, as well as ASTM A-511 (for mechanical tubing).

In general, whenever 30% or more material by weight is to be removed from the center of a solid bar, the use of Hollow Bar provides a saving. See table 1-4 below.

Ordering Hollow Bar Stock

Hollow bar stock ordering data can be found in the “Fractional Stainless Steel Tubing Selection Guides” on pages 12 and 13. Keep in mind that hollow bar is manufactured to O.D and wall specifications only – and that the I.D. is theoretical.

Table 1-3 Hollow Bar Tolerances	
Rounds	O.D., Inches
All Sizes 1-1/8 through 3" O.D.	±.005
Standard Sizes 3" O.D. through 3-1/2 O.D.	±.010
Standard Sizes over 3-1/2 O.D.	±.015
Non-standard Sizes over 3" O.D.	±.031
Hexagons	O.D., Inches
1-1/8 O.D. to 2" O.D. exclusive	+.000 / -.006
2" O.D. to 3" O.D. inclusive	+.000 / -.008
Over 3" O.D.	Refer to Eagle
Wall Thickness	
.125" to .250" exclusive	±12/5% of nominal wall
.250" and over	±10% of nominal wall

Table 1-4 Comparison of Hollow Bar and Solid Bar Costs by Size	
Nominal Bar Size, Inches	Maximum Tube Wall Competitive with Solid Bar, Inches
1	.125
1-1/4	.188
1-1/2	.313
1-3/4	.375
2	.437
2-1/4	.500
2-1/2	.563
2-3/4	.625
3	.688
3-1/4	.750
3-1/2	.813
3-3/4	.875
4-1/4	.937
4-1/2	1.000
5	1.125

Bar Stock Selection Guide

Round Bar Stock – Stainless Steel • 300 Series • 400 Series											
Size Inches	Estimated Weight, Lbs.		Size Inches	Estimated Weight, Lbs.		Size Inches	Estimated Weight, Lbs.		Size Inches	Estimated Weight, Lbs.	
	Per Foot	12 Ft. Bar		Per Foot	12 Ft. Bar		Per Foot	12 Ft. Bar		Per Foot	12 Ft. Bar
1/16	.010	.120	19/32	.941	11.29	1/2	6.008	72.1	4	42.73	512.8
5/64	.016	.19	5/8	1.043	12.52	1.510	6.21	74.5	4.020	43.15	517.8
3-32	.023	.28	.630	1.060	12.72	1-17/32	6.261	75.1	4.030	43.37	520.4
7/64	.032	.38	.635	1.076	12.91	9/16	6.520	78.2	1/8	45.40	544.8
1/8	.042	.50	.640	1.093	13.12	5/8	7.051	84.6	1/4	48.23	578.7
.130	.045	.54	41/64	1.096	13.15	11/16	7.604	91.3	3/8	21.11	613.3
9/64	.053	.64	21/32	1.150	13.80	3/4	8.178	98.1	7/16	52.58	631.0
5/32	.065	.78	11/16	1.262	15.14	1.770	8.365	100.4	1/2	54.08	648.9
11/64	.079	.95	.6925	1.280	15.37	16/16	8.773	105.3	4.530	54.80	657.5
3/16	.094	1.13	23/32	1.379	16.55	7/8	9.388	112.7	5/8	57.12	685.4
.1925	.099	1.19	3/4	1.502	18.02	15/16	10.02	120.2	3/4	60.25	723.0
.1975	.104	1.25	.755	1.522	18.26	2 –	10.68	128.2	7/8	63.48	761.8
13/64	.110	1.32	.760	1.540	18.48	2.020	10.896	130.7	15/16	65.10	781.2
7/32	.128	1.54	49/64	1.565	18.78	1/16	11.36	136.3	5 –	66.76	801.1
15/64	.147	1.76	25/32	1.630	19.56	1/8	12.06	144.7	1/8	70.10	841.2
1/4	.167	2.00	13/16	1.763	21.16	3/16	12.78	153.4	1/4	73.60	883.2
.255	.174	2.08	.8175	1.784	21.42	1/4	13.52	162.2	3/8	77.15	925.8
.260	.181	2.17	27/32	1.901	22.81	2.270	13.76	165.1	7/16	78.95	947.4
17/64	.188	2.26	7/8	2.044	24.5	5/16	14.28	171.4	1/2	80.78	969.4
9/32	.211	2.53	.880	2.067	24.8	3/8	15.06	180.7	5/8	84.48	1013.8
19/64	.235	2.82	.885	2.091	25.1	7/16	15.87	190.4	3/4	88.29	1059.0
5/16	.261	3.13	57/64	2.115	25.4	1/2	16.69	200.3	15/16	94.14	1130.0
.3175	.269	3.29	29/32	2.193	26.3	2.520	16.957	203.5	6 –	96.13	1153.5
.3225	.277	3.32	15/16	2.347	28.2	9/16	17.53	210.4	1/8	100.2	1202.4
21/64	.287	3.44	.9425	2.372	28.5	5/8	18.40	220.8	1/4	104.3	1252.0
11/32	.316	3.79	31/32	2.506	30.1	11/16	19.29	231.5	1/2	112.8	1353.8
23/64	.345	4.14	1 –	2.670	32.0	3/4	20.20	242.4	3/4	121.7	1460.0
3/8	.376	4.51	1.005	2.696	32.4	2.770	20.49	245.9	7	130.9	1570.8
.380	.386	4.62	1.010	2.723	32.7	13/16	21.12	253.4	1/4	140.4	1684.8
.385	.395	4.74	1/64	2.750	33.0	7/8	22.07	264.8	1/2	150.2	1802.0
25/64	.407	4.88	1.020	2.778	33.3	15/16	23.04	276.5	3/4	160.4	1924.8
13/32	.441	5.29	1/16	3.014	36.2	3 –	24.03	288.4	8	170.9	2051.0
27-64	.475	5.70	3/32	3.194	38.3	3.020	24.354	292.3	1/4	182.7	2180.0
7/16	.511	6.13	1/8	3.379	40.6	1/16	25.05	300.6	1/2	192.9	2315.0
.4425	.523	6.42	1.135	3.440	41.3	1/8	26.08	312.9	3/4	204.5	2454.0
.4475	.535	6.42	9/64	3.470	41.6	3/16	27.13	325.6	9	216.3	2596.0
29/64	.548	6.57	1.145	3.50	42.0	1/4	28.21	338.5	1/4	228.5	2741.8
15/32	.587	7.04	5/32	3.570	42.8	3.270	28.55	342.6	1/2	241.0	2892.0
31/64	.626	7.51	3/16	3.766	45.2	5/16	29.30	351.6	3/4	253.8	3045.6
1/2	.668	8.02	1/4	4.173	50.1	3/8	30.42	365.0	10	267.0	3204.0
.505	.680	8.33	1.260	4.240	50.9	7/16	31.55	378.6	1/2	295.2	3542.4
.510	.694	8.33	17/64	4.276	51.3	1/2	32.71	392.5	11	324.0	3888.0
33/64	.710	8.52	1.275	4.34	52.1	3.520	33.09	397.0	1/2	354.0	4248.0
17/32	.754	9.05	9/32	4.384	52.6	3.530	33.27	399.3	12	385.6	4626.7
9/16	.845	10.14	5/16	4.600	55.2	5/8	35.09	421.1	1/2	420.0	5025.0
.5675	.860	10.32	3/8	5.049	60.6	11/16	36.31	435.7	13	451.3	5415.5
.5725	.875	10.50	1.385	5.218	62.6	3/4	37.55	405.6	14	523.3	7512.0
.5775	.891	10.69	13/32	5.279	63.4	3.770	37.95	455.4	15	601.0	7212.0
37/64	.892	10.69	7/16	5.518	66.2	7/8	40.10	481.2	16	684.0	8208.0
						15/16	41.40	496.8			

Bar Stock Selection Guide (continued)

Flat Bar Stock – Stainless Steel • 300 Series • 400 Series											
Size Inches	Estimated Weight, Lbs.		Size Inches	Estimated Weight, Lbs.		Size Inches	Estimated Weight, Lbs.		Size Inches	Estimated Weight, Lbs.	
	Per Foot	12 Ft. Bar		Per Foot	12 Ft. Bar		Per Foot	12 Ft. Bar		Per Foot	12 Ft. Bar
1/8 x 3/16	.072	.86	3/16 x 6	3.825	45.90	5/16 x 2-3/4	2.930	35.16	7/16 x 3	4.460	53.5
	.106	1.27		8	5.100		61.20	3		3.188	38.26
5/16	.133	1.60	10	6.380	76.56	3-1/2	3.719	44.63	1/2 x 9/16	.960	11.5
	.159	1.91		12	7.660		91.92	4		4.250	51.00
7/16	.186	2.23	1/4 x 5/16	.266	3.19	4-1/2	4.776	57.31	3/4	1.275	15.3
	.213	2.56		3/8	.319		3.83	5		6.375	76.50
5/8	.266	3.19	7/16	.372	4.46	6	6.375	76.50	1	1.700	20.4
	.319	3.83		1/2	.425		5.10	8		8.500	102.00
7/8	.372	4.46	9/16	.480	5.76	10	10.630	127.50	1-1/4	2.125	25.5
	.425	5.10		5/8	.531		6.37	12		12.750	153.00
1-1/8	.480	5.76	3/4	.628	7.66	3/8 x 7/16	.576	6.91	1-1/2	2.550	30.6
	.531	6.37		7/8	.744		8.93	1/2		.638	7.07
1-3/8	.588	7.06	1	.850	10.20	9/16	.720	8.64	1-3/4	2.975	35.7
	.638	7.66		1-1/8	.956		11.47	5/8		.797	9.56
1-5/8	.696	8.35	1-1/4	1.063	12.76	3/4	.956	11.47	2-1/4	3.825	45.9
	.744	8.93		1-3/8	1.160		13.90	7/8		1.116	13.39
2	.850	10.20	1-1/2	1.275	15.30	1	1.275	15.30	2-3/4	4.675	56.1
	.956	11.47		1-5/8	1.380		16.56	1-1/8		1.430	17.16
2-1/2	1.063	12.76	1-3/4	1.488	17.86	1-1/4	1.594	19.13	3-1/4	5.524	66.2
	1.160	13.90		2	1.700		20.40	1-3/8		1.750	21.00
3	1.275	15.30	2-1/4	1.913	22.96	1-1/2	1.913	22.96	4	6.800	81.6
	1.380	16.56		2-1/2	2.125		25.50	1-5/8		2.080	24.96
3-1/2	1.488	17.86	2-3/4	2.340	28.08	1-3/4	2.231	26.77	5	8.500	102.0
	1.700	20.40		3	2.550		30.60	2		2.550	30.60
4-1/2	1.913	22.96	3-1/4	2.760	33.12	2-1/4	2.869	34.43	6	10.200	122.4
	2.125	25.50		3-1/2	2.975		35.70	2-1/2		3.188	38.26
6	2.550	30.60	4	3.400	40.80	2-3/4	3.500	42.00	7	11.904	142.8
	.160	1.92		4-1/2	3.825		45.90	3		3.825	45.90
5/16	.199	2.39	5	4.250	51.00	3-1/4	4.140	49.68	9	15.360	184.3
	.239	2.87		5-1/2	4.680		56.20	3-1/2		4.463	53.56
7/16	2.79	3.35	6	5.100	61.20	4	5.100	61.20	12	20.400	244.8
	.319	3.83		7	5.950		71.40	4-1/2		5.738	68.86
5/8	.398	4.78	8	6.800	81.60	5	6.375	76.50	3/4	1.440	17.3
	.478	5.74		10	8.500		102.00	5-1/2		7.010	84.10
7/8	.558	6.70	12	10.200	122.40	6	7.650	91.80	1-1/4	2.390	28.7
	.638	7.66		14	11.900		142.80	7		8.928	107.10
1-1/8	.717	8.60	5/16 x 3/8	.398	4.78	8	10.200	122.40	2	3.830	46.0
	.797	9.56		7/16	.460		5.52	10		12.750	153.00
1-3/8	.877	10.52	1/2	.531	6.37	12	15.300	183.60	7/8	1.859	22.3
	.956	11.47		5/8	.664		7.97	14		17.856	214.30
1-3/4	1.116	13.39	3/4	.797	9.56	7/16 x 1/2	.744	8.93	1-1/8	2.390	28.6
	1.275	15.30		7/8	.930		11.16	5/8		.929	11.15
2-1/4	1.440	17.28	1	1.063	12.76	3/4	1.116	13.39	1-3/8	2.930	35.2
	1.594	19.13		1-1/8	1.200		14.40	7/8		1.344	16.13
2-3/4	1.750	21.00	1-1/4	1.328	15.94	1	1.488	17.86	1-5/8	3.454	41.5
	1.913	22.96		1-1/2	1.594		19.13	1-1/4		1.859	22.31
3-1/2	2.231	26.77	1-3/4	1.859	22.31	1-1/2	2.231	26.77	2	4.250	51.0
	2.550	30.60		2	2.125		25.50	1-3/4		2.600	31.20
4-1/2	2.870	34.40	2-1/4	2.390	28.65	2	2.975	35.70	2-1/2	5.313	63.8
	3.188	38.26		2-1/2	2.656		31.86	2-1/2		3.720	44.60

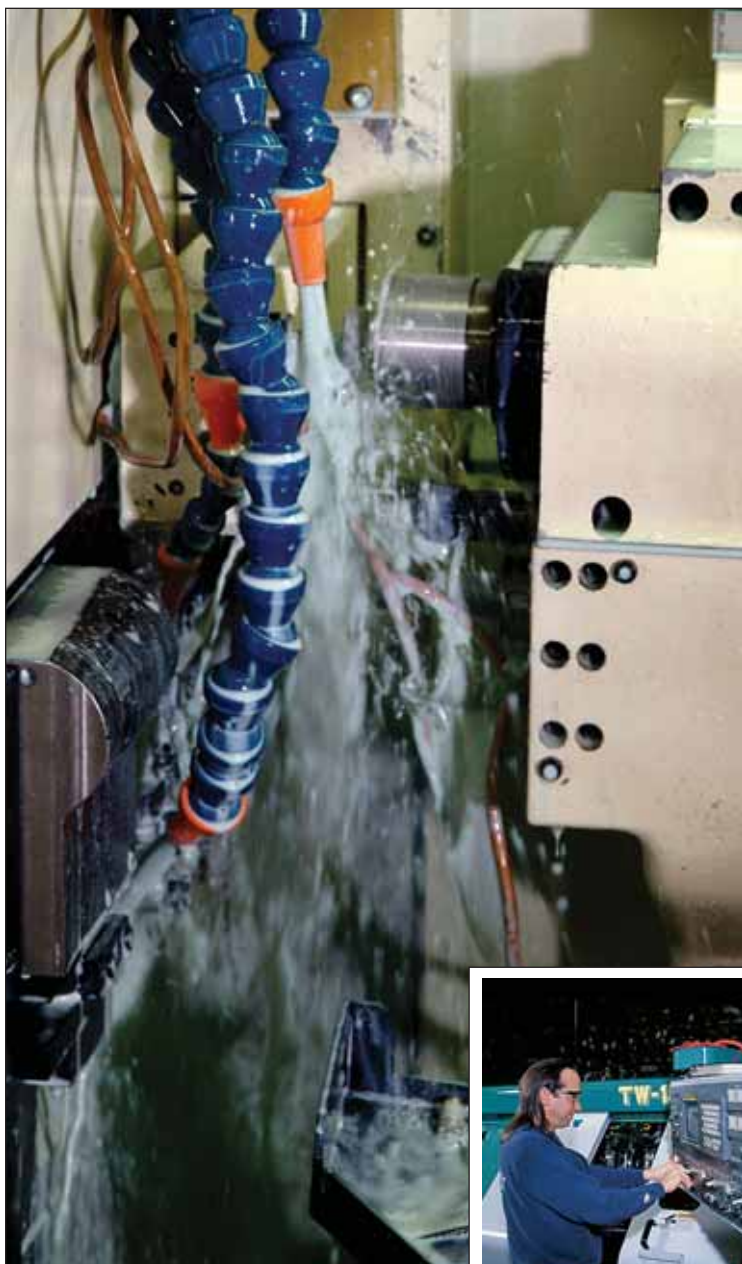
Bar Stock Selection Guide (continued)

Flat Bar Stock – Stainless Steel • 300 Series • 400 Series											
Size Inches	Estimated Weight, Lbs.		Size Inches	Estimated Weight, Lbs.		Size Inches	Estimated Weight, Lbs.		Size Inches	Estimated Weight, Lbs.	
	Per Foot	12 Ft. Bar		Per Foot	12 Ft. Bar		Per Foot	12 Ft. Bar		Per Foot	12 Ft. Bar
5/8 x 3	6.375	76.5	6-1/2	16.560	198.7	1-5/8	5.235	66.3	6	40.80	489.6
3-1/2	7.438	89.3	7	17.880	214.6	1-3/4	5.950	71.4	7	47.60	571.2
4	8.500	102.0	8	20.400	244.8	2	6.800	81.2	8	54.40	652.8
4-1/2	9.560	114.7	9	22.920	275.0	2-1/4	7.650	92.3	9	61.20	734.4
5	10.630	127.6	10	25.500	306.0	2-1/2	8.500	102.0	2 x 10	68.00	816.0
5-1/2	11.690	140.3	12	30.600	367.2	5-1/2	28.08	337.0	12	81.60	979.2
6	12.750	153.0	14	35.760	429.1	6	30.60	367.2	2-1/4 x 2-1/2	19.07	228.8
7	14.880	178.6	7/8 x 1	2.975	35.7	7	35.70	428.4	3	22.90	274.8
8	17.000	204.0	1-1/8	3.350	40.2	8	40.80	489.6	4	30.60	367.2
9	19.080	229.0	1-1/4	3.719	44.6	10	51.00	612.0	4-1/2	34.42	413.0
10	21.250	255.0	1-3/8	4.090	49.0	12	61.20	734.4	5	38.28	459.4
12	25.500	306.0	1-1/2	4.463	53.6	1-3/4 x 2	11.90	142.8	6	45.80	549.6
3/4 x 7/8	2.230	26.8	1-3/4	5.206	62.5	2-1/4	13.44	161.3	2-1/2 x 3	25.50	306.0
1	2.550	30.6	2	5.950	71.4	2-1/2	14.88	178.6	3-1/2	29.75	357.0
1-1/8	2.880	34.6	2-1/4	6.696	80.4	2-3/4	16.32	195.8	4	34.00	408.0
1-1/4	3.188	38.3	2-1/2	7.438	89.3	3	17.85	214.2	4-1/2	38.25	459.0
1-3/8	3.500	42.0	2-3/4	8.180	98.2	3-1/2	20.88	250.6	5	42.50	510.0
1-1/2	3.825	45.9	3	8.925	107.0	4	29.76	357.2	6	51.00	612.0
1-5/8	4.140	49.7	7/8 x 3-1/2	10.410	124.9	5	29.76	357.2	8	68.00	816.0
1-3/4	4.463	53.6	4	11.900	142.8	6	35.70	428.4	12	102.00	1224.0
2	5.100	61.2	4-1/2	13.440	161.3	8	47.60	571.0	3 x 3-1/2	35.76	429.1
2-1/4	5.738	68.9	5	14.880	178.6	10	59.52	714.2	4	40.80	489.6
2-1/2	6.375	76.6	6	17.850	214.2	12	71.40	856.8	4-1/2	45.90	551.0
2-3/4	7.000	84.0	7	20.880	250.6	2 x 2-1/4	15.36	184.3	5	51.00	612.0
3	7.650	91.8	8	23.800	285.6	2-1/2	17.00	204.0	6	61.20	734.4
3-1/4	8.290	99.5	10	29.750	357.0	2-3/4	18.72	224.6	8	81.60	979.2
3-1/2	8.925	107.0	12	35.700	428.4	3	20.40	244.8	3-1/2 x 4	47.60	571.0
4	10.200	122.4	14	41.760	501.1	3-1/2	23.80	285.6	5	59.50	714.0
4-1/2	11.470	137.6	1 x 1-1/8	3.828	46.0	4	27.20	326.0	6	71.40	857.0
5	12.750	153.0	1-1/4	4.250	51.0	4-1/2	30.60	367.0	4 x 5	68.04	816.5
5-1/2	14.040	168.5	1-3/8	4.680	56.2	5	34.00	408.0	6	81.60	979.2
6	15.300	186.3	1-1/2	5.100	61.2	5-1/2	37.44	449.3	8	108.84	1306.1

Square Bar Stock – Stainless Steel • 300 Series • 400 Series											
Size Inches	Estimated Weight, Lbs.		Size Inches	Estimated Weight, Lbs.		Size Inches	Estimated Weight, Lbs.		Size Inches	Estimated Weight, Lbs.	
	Per Foot	12 Ft. Bar		Per Foot	12 Ft. Bar		Per Foot	12 Ft. Bar		Per Foot	12 Ft. Bar
1/8	.053	.640	11/16	1.607	19.280	1 5/16	5.857	70.28	2 1/2	21.25	255.0
5/32	.083	.996	3/4	1.913	22.960	1 3/8	6.428	77.14	2 3/4	25.71	308.5
3/16	.120	1.440	13/16	2.245	26.940	1 1/2	7.650	91.80	3	30.60	367.2
1/4	.213	2.560	7/8	2.603	31.240	1 5/8	8.980	107.70	3 1/2	41.65	500.0
5/16	.332	3.980	15/16	2.988	35.856	1 3/4	10.410	124.90	4	54.40	652.8
3/8	.478	5.740	1	3.400	40.80	1 7/8	11.950	143.40	4 1/2	68.85	826.2
7/16	.651	7.810	1/16	3.840	46.08	2	13.600	163.20	5	85.00	1020.0
1/2	.850	10.200	1 1/8	4.303	51.64	2 1/8	15.350	184.20	5 1/2	102.90	1234.0
9/16	1.076	12.910	1 3/16	4.795	57.54	2 1/4	17.21	206.60	6	122.40	1469.0
5/8	1.328	15.940	1 1/4	5.313	63.76	2 3/8	19.18	230.20			

Manufacturing the Highest Quality Custom-Fabricated Components

• Bending/Coiling • Flaring/flanging • EDM (ram type) • CNC screw machine • Sand/Grit blasting • Bulging • Notching/slotting • Assembly • Re-drawing
• End forming • Swaging • Centerless grinding • Welding/brazing • Laser welding • Laser cutting • Laser notching • Laser etching • Electropolishing
• Passivation • Corsetting • Annealing • Radius end closures • Spherical, pointed or flat end closures • General machining • Drilling/reaming
• Deburring • Honing • Bevel cutting • Chamfering • Knurling • Threading



CNC machining centers assure repeatable precision in all Eagle Stainless products

CNC Machining

Specializing in CNC machining for more than two decades, Eagle Stainless has been delivering some of the most intricately formed stainless steel parts imaginable. Working on diameters ranging from .030" to 2" we're ready to meet the needs of your most demanding application.

Closed End Tubes

Closed end tubes are spun closed and welded shut in various end configurations: round, flat or pointed. All tubes are tested to insure there is no porosity or leakage.

Flaring & Reductions

Flaring and end reduction of tubing is an everyday precision process at Eagle. Special tools and procedures have been developed to insure repeatability for proper mating of flared and end-reduced tubes.

Welding & Brazing

Welding, brazing or soldering of standards or custom-made components to customer drawings or specifications are performed on state-of-the-art equipment including computer-controlled, laser machining centers as shown.

Assembly

Assembly of multiple parts to achieve a single component can be accomplished by various methods such as welding, threading, epoxy, etc. Eagle works to exact customer specifications, as well as the recommendations of our engineering experts, to achieve the lowest costs and the highest quality.

Precision-machined parts produced in the Eagle CNC machining centers.



Computer controls laser welding equipment enabling extremely close-tolerance cutting, notching, etching and welding operations.



Sample Laser Machined parts (top); Swaged parts (below).

Standard and Custom Shaped Tubing



Extrusion dies, designed and built in-house at Eagle, enable a variety of tubing materials to be drawn to precise, unique, custom shapes.

Custom Shaped tubing in virtually any shape

- Round • Oval • Square • Triangular
- Rectangular • Hexagonal • and more!

With a complete in-house tool and die facility, experienced toolmakers will develop a custom extrusion die to yield tubing that will meet or exceed your expectations. Eagle maintains an inventory of standard shaped dies to facilitate a rapid response to customer inquiries and deliveries.

Eagle manufactures both seamless and welded tubing in a range of diameter from .040" through 1.00" in lengths up to 17 feet. Your choice of alloys includes:

- Stainless Steel Alloys • Aluminum Alloys
- Nickel Alloys 200, 400, 600, 625, 800
- X750 • and Copper



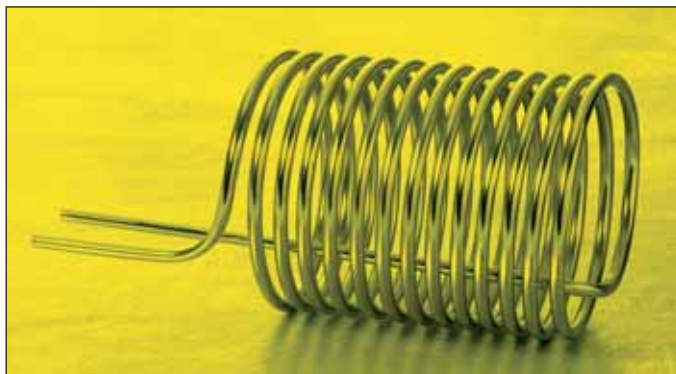
Precision bending / coiling of stainless steel and other alloys is one of Eagle's unique capabilities. Parts can be shaped to virtually any requirement.



Bending / Coiling Unique Configurations

Bending

The ability to bend tubes without excessive distortion, wrinkling or fracturing is an art born of experience. Eagle's skilled craftsmen working with state-of-the-art machinery supply uniformly smooth bends – meeting the tightest customer specifications and assuring satisfactory performance.



All tooling is engineered and manufactured in-house. Sample parts show the wide range in size capability.

Coiling

For over two decades Eagle Stainless has been delivering some of the most intricately coiled stainless steel tubes imaginable. Working on diameters ranging from .040" to 1.00" we're ready to meet the needs of your most demanding custom tubing application.



Shown above is one of the new, high precision, bending machines currently in operation at Eagle.

Why Stainless Steel?

What is Stainless Steel?

The many unique values provided by stainless steel make it a powerful candidate in materials selection. Engineers, specifiers and designers often underestimate or overlook these values because of what is viewed as the higher initial cost of stainless steel. However, over the total life of a project, stainless is often the best value option.



Samples of machined stainless steel components

Stainless steel is essentially a low carbon steel which contains chromium at 10% or more by weight. It is the addition of chromium that gives the steel its unique stainless, corrosion resisting properties.

The chromium content of the steel allows the formation of a tough, adherent, invisible, corrosion-resisting chromium oxide film on the steel surface. If damaged mechanically or chemically, this film is self-healing, provided that oxygen, even in very small amounts, is present. The corrosion resistance and other useful properties of the steel are enhanced by increased chromium content and the addition of other elements such as molybdenum, nickel and nitrogen. There are more than 60 grades of stainless steel. However, the entire group can be divided into four classes. Each is identified by the alloying elements which affect their microstructure and for which each is named.

Grades / Applications of Stainless Steel

400 Series Martensitic – Typical grade: 410
Straight chromium (12 - 18%); magnetic and can be hardened by heat treatment. Typical use: Fasteners, pump shafts.

400 Series Ferritic – Typical grade: 430
Straight chromium (12 - 18%); low carbon, magnetic, but not heat treatable. Typical use: Appliance trim, cooking utensils.

300 Series Austenitic – Typical grade: 304
Chromium (17 - 25%), Nickel (8 - 25%); nonmagnetic, not heat treatable. Can develop high strength by cold working. Additions of molybdenum (up to 7%) can increase the corrosion resistance. Typical use: Food equipment, chemical equipment, architectural applications.

Precipitation Hardening – Typical grade: 17-4
Chromium (12 - 28%), Nickel (4 - 7%); martensitic or austenitic. Develop strength by precipitation harden reaction during heat treatment. Typical use: valves, gears, petrochemical equipment.



Benefits of Stainless Steel

Corrosion resistance – Lower alloyed grades resist corrosion in atmospheric and pure water environments; high-alloyed grades can resist corrosion in most acids, alkaline solutions, and chlorine bearing environments making their properties useful in process plants.

Fire and Heat Resistance – Special high chromium and nickel-alloyed grades resist scaling and retain high strength at high temperatures.

Hygiene – The easy cleaning ability of stainless makes it the first choice for strict hygiene conditions, such as hospitals, kitchens and food processing plants.

Aesthetic appearance – The bright, easily maintained surface of stainless steel provides a modern and attractive appearance.

Strength-to-weight advantage – The work hardening property of austenitic grades, that results in a significant strengthening of the material from cold working alone, and the high strength duplex grades, allow reduced material thickness over conventional grades yielding considerable cost savings.

Ease of fabrication – Modern steel making techniques mean that stainless can be cut, welded, formed, machined, and fabricated as readily as traditional steels.

Impact resistance – The austenitic microstructure of the 300 series provides high toughness at elevated temperatures ranging to far below freezing, making these steels particularly suited to cryogenic applications.

Long term value – When the total life cycle costs are considered, stainless is often the least expensive material option.

Eagle Reference Guide

Technical Data on the Stainless Steels

Stainless and heat resisting steels possess unusual resistance to attack by corrosive media at atmospheric and elevated temperatures. They are produced with a wide range of mechanical and physical properties to meet specific requirements of various applications.

The commonly recognized standard types of stainless and heat resisting steels and several popular special grades listed in Table 1-5 have widely differing characteristics and in many cases have special qualifications which particularly recommend them for special uses.

It is a characteristic of products made of stainless and heat resisting steels, in general, that they require more than ordinary care throughout their fabrication. They are more sensitive to thermal and mechanical operations, the control of which is complicated by the varying degree of different chemical combinations. To secure the most satis-

factory results purchasers normally consult with Eagle regarding the working, machining, heat treating or other operations to be employed in fabrication; the mechanical properties to be obtained, and the condition of service for which the finished articles are intended. Particular attention should be given to informing Eagle of the end use, if such information is available, and the details of operations to which the steel will be subjected are known and can be transmitted for consultation.

The data which follows may be regarded as the basis for a majority of selection and working applications. In addition, the services of qualified Eagle representatives are available not only to assist the user in finalizing a proper materials selection, but to ensure his proper working of the material in production so as to avoid end-use problems.

Stainless Steel Compositions

Continuing studies on the part of the American Iron and Steel Institute have led to a simplified list of steel compositions. The compilation is known as Standard Types. These were selected on the basis of metallurgical judgement after consideration of many factors, including the advice and counsel of engineering and specification writing bodies and the needs of the armed services.

This method of standardization has led

to identification by types according to several groups, using a system of numbers as follows.

System of Identification

In a 3-digit number, the first digit indicates the series or group and the last two digits indicate type. Modifications of types are indicated by suffix letters.

The series designations identify the following groups.

2XX	Chromium-Nickel-Manganese; nonhardenable, austenitic and nonmagnetic
3XX	Chromium-Nickel Steels; nonhardenable, austenitic and nonmagnetic
4XX	Chromium Steels; hardenable, martensitic and magnetic
5XX	Chromium Steels; low chromium heat resisting

Special Types

There are continuing specialized needs particularly in the field of high temperature service where high strength and resistance to oxidation are also required. These needs continue to result in the development of special steels, or types. Many of these have been incorporated into Table 1-5 (pages 26 and 27). The ranges and limits of chemical composition are based on ladle

analysis which is subject to the check analyses in Table 1-8 (page 29). Table 1-5 is somewhat different from usual, as the repetitious tabulation of manganese, phosphorous and sulfur has been omitted (except where these elements are deliberate additives), to provide space for other more important attributes.

Eagle Reference Guide

Table 1-5a
Chemical Compositions and Major Characteristics

Type	Cr	Ni	C Max	Other Significant Elements	Major Characteristics
303	17.00-19.00	8.00-10.00	0.15	S 0.15 min	†Free-machining modification of Type 302.
303 Se	17.00-19.00	8.00-10.00	0.15	Se 0.15 min	†Free-machining version of Type 302. Produces better surface finish than Type 303.
304	18.00-20.00	8.00-10.00	0.08	-	†Low carbon variation of Type 302, minimizes carbide precipitation during welding.
304 L	18.00-20.00	8.00-10.00	0.03	-	†Extra-low carbon content eliminates harmful carbide precipitation due to welding.
309	22.00-24.00	12.00-15.00	0.20	-	†High strength and resistance to scaling at high temperatures.
310	24.00-26.00	19.00-22.00	0.20	-	†Higher alloy content improves basic characteristics of Type 309.
316	16.00-18.00	10.00-14.00	0.08	Mo 2.00-3.00	†Mo improves general corrosion and pitting resistance and high temperature strength over that of Type 302.
316 L	16.00-18.00	10.00-14.00	0.03	Mo 2.00-3.00	†Extra-low carbon version of Type 316. Eliminates harmful carbide precipitation due to welding.
317	18.00-20.00	11.00-15.00	0.08	Mo 3.00-4.00	†Higher alloy content improves basic advantages of Type 316.
321	17.00-19.00	9.00-12.00	0.08	Ti 5 x C, min	†Stabilized to permit use in 800-1500° F temperature range without harmful carbide precipitation.
347	17.00-19.00	9.00-13.00	.008	Cb + Ta 10 x C, min	†Characteristics similar to Type 321. Stabilized by Cb and Ta.
348	17.00-19.00	9.00-13.00	0.08	Ta 0.10 max Cb 0.20 max Cb + Ta 10 x C, min	†Similar to Type 347 but Ta reduced for atomic energy applications.
410	11.50-13.50	-	0.15	-	¥ Lowest cost general purpose stainless steel. Wide use where corrosion is not severe.
416	12.00-14.00	-	0.15	S 0.15 min	¥ Free-machining version of Type 410.
420	12.00-14.00	-	0.15 min	-	¥ Similar variation of Type 410 but higher carbon produces higher strength and hardness.
430	14.00-18.00	-	0.12	-	*Most popular of the chromium types. Combines good corrosion and heat resistance and mechanical properties.
430 F	14.00-18.00	-	0.12	S 0.15 min	*Free-machining version of Type 430.
440 A	16.00-18.00	-	0.60-0.75	-	¥ Series of high carbon types. Same basic composition with varying carbon content. Higher carbon produces higher strength and hardness but lower toughness. All Type 440 versions are corrosion resistant only in the hardened condition.
440 B	16.00-18.00	-	0.75-0.95	-	
440 C	16.00-18.00	-	0.95-1.20	-	
446	23.00-27.00	-	0.20	-	*Similar to Type 442 but Cr increased to provide maximum resistance to scaling.
15-5 PH	14.00-15.50	3.50-5.50	0.07	Cu 2.50-4.50	• Similar in properties and characteristics to 17-4 PH but has superior transverse ductility and toughness.
PH 15-7 Mo	14.00-16.00	6.50-7.75	0.09	Mo 2.00-3.00 Al 0.75-1.50	• • Special type similar to 17-7 PH but with higher strength.
17-4 PH	15.50-17.50	3.00-5.00	0.07	Cu 3.00-5.00	• Special type that combines excellent corrosion resistance, high strength and hardness, low temperature hardening and good fabrication characteristics.
17-7 PH	16.00-18.00	6.50-7.75	0.09	AL 0.75-1.25	• • Special ultra-high strength type with good formability, excellent fabricating characteristics.
* Ferritic, non-hardenable		†† Martensitic, essentially non-hardenable		° Austenitic, precipitation hardened	
** Ferritic, hardened by aging		• Martensitic, precipitation hardened		°° Austenitic, hardened by aging	
† Austenitic, non-hardenable by heat treatment		• • Semi-Austenitic, precipitation hardened		¥ Martensitic, hardenable	

Table 1-5b Typical Physical and Mechanical Properties

Item	Physical Properties	302	303	304	316	321	410	430	440C	17-4 PH	19-9DL	
		304L	303MA	316L	347	416	418	430F	440F	Condition H900		
Density												
pounds/cubic inch		0.29	.029	0.29	.028	0.284	.028	0.284	.028	0.287		
low carbon steel = 1.00		1.02	1.02	1.02	0.97	0.97	0.97	-	0.97	0.97		
Specific Elec. Resistance at 68°F												
microhms/cm ³		72	74	72	57	61.7	60	60	77	78		
microhms/in ³		28.4	29.2	28.5	22.4	24.3	23.6	-	30.3	-		
low carbon steel = 1.00		6.6	6.8	6.5	5.2	-	5.5	-	7.06	-		
Melting range Degrees F		2550-2650	2500-2550	2550-2600	2700-2790	2650-2750	2600-2750	2620 prox	2500-2550	2600-2610		
Structure		Austenitic	Austenitic	Austenitic	Martensitic	Martensitic	Ferritic	Pearlite-Carbide	Martensitic	Austenitic		
Magnetic Permeability as annealed		μ=1.003***	μ=1.003***	μ=1.003***	Magnetic	Magnetic	Magnetic	Magnetic	Magnetic	1.005-1.09		
Specific Heat												
cal./deg C./gm. (0 to 100°C)		0.12	0.12	0.12	0.11	-	0.11	-	0.11	-		
BTU/°F/lb. (32 to 212°F)		0.12	0.12	0.12	0.11	0.11	0.11	0.11	0.11	-		
low carbon steel = 1.00 (0 to 100°C)		1.1	1.1	1.1	1.0	1.0	1.0	-	1.0	-		
Thermal Conductivity												
cal./cm. ² /sec./°C/cm. at 100° C		0.0390	0.0373	0.0385	0.0595	-	0.0625	-	0.0427	0.0348		
BTU/sq. ft./hr./°F/in. at 212°F		113	113	112	173	140	181	203	124	101		
low carbon steel = 1.00 at 100°C		0.34	0.34	0.33	0.52	-	0.54	-	0.38	-		
ca./cm. ² /sec./°C/cm. at 500°C		0.0512	0.0512	0.0532	0.0686	-	0.0627	-	0.0540	-		
BTU/sq. ft./hr./°F/in. at 932°F		149	149	154	199	-	182	-	157	-		
Coefficient of Thermal Expansion												
per °F x 10 ⁻⁶ (32 to 212°F)		9.6	8.9	9.3	5.5	5.3	5.0	5.9**	6.0	8.5		
low carbon steel = 1.00 (32 to 212°F)		1.45	1.35	1.41	0.83	-	0.76	-	0.91	-		
per °F x 10 ⁻⁶ (32 to 912°F)		10.2	9.7	10.3	6.4	6.2	6.2	-	6.6	9.7		
Mechanical Properties at Room Temperature												
		Annealed	Annealed	Annealed	Annealed	Quenched & Tempered	Quenched & Tempered 975°F	Annealed	Annealed	Quenched & Tempered	Condition H900	Hot Rolled & Str. Rel. @ 1200°F
Tensile Strength, 10 ³ lb/sq.in.		75-95	80-95	80-100	75-100	90-200	190	70-90	approx 100	96-250	200	118.3
Yield Strength, 10 ³ lb/sq.in.		30-45	30-45	35-50	35-45	60-145	150	35-55	approx 60	55-220	185	69
Modulus of Elasticity, 10 ⁶ psi		28	28	28	29	29	29	29	29.0-30.0	29.0-30.0	28.5	29.5
Elongation in 2 inches, %		60-50	60-40	50-40	35-20	28-15	15	35-20	max. 20	4 to 1	14	56
Reduction of Area, %		75-60	70-55	70-50	75-60	75-60	62	60-40	35.0	13	50	55
Izod Impact Strength, ft.-lbs		110-80	110-80	110-80	100-60	100-30	26	-	21	7	20	46 ^c
Endurance Limit, psi		30-55	30-55	35-60	30-50	40-100	95 see note	35-50	55	45-140	90	81 see note
Brinell Hardness Number		135-185	135-185	135-185	max. 241	180-375	360	145-185	max. 240	200-600	420	241
Rockwell Hardness Number		B75-90	B75-90	B75-90	max. B100	C10-41	C39	B75-90	C-24••	C59-B93	C44	B100
Olsen Value, Inches		0.5-0.4	0.4-0.5	0.365-0.465	0.4-0.3	-	-	0.4-0.3	-	-	-	-
*Stress causing 1% elongation in 10,000 hours (Creep)												
at 1000°F, lbs/sq. ft.		17000	25000	19000	12000¥	25000	8500	-	-	-	41000	
at 1200°F, lbs/sq. ft.		7000	11000	9500	2000¥	5900	2200	-	-	-	19000	
at 1350°F, lbs/sq. ft.		3000	5200	4000	1400¥	2000¥¥	1200	-	-	-	10000	
at 1500°F, lbs/sq. ft.		850	2000	850	-	-	-	-	-	-	6000	
Scaling Temperature, °F (approx.)		1650	1650	1650	1300	1400	1550	1500	1500	1500	1600	
Initial Forging Temperature		2100-2300	2100-2300	2100-2300	2000-2200	2000-2100	1900-2050	2100	2150†	2150		
Finishing Temperature °F min.		1700	1700	1700	1500	1600-1700	1500	1600	1850	-		
Annealing Treatment		1900-2000 deg. F & quench	1900-2050 deg. F & quench	Heat to 1750-2050 deg. F Cooling	Furnace Cool to 1100 from 1500-1650°F or Air cool. 1400-1200°F	1500-1600 Slow cool to 1100	Air cool.	1600-1650°F Furnace cool	1900††† (O.A.)†††	1800		
		(A) (B)	(A) (B)	(A)	(D)	(E)	(D)					

(A) Preheat heavy sections slowly to 1600°F, then heat rapidly to the forging or annealing temperature.
 (B) Cooling rate should be rapid enough to prevent harmful carbide precipitation which impairs corrosion resistance. Retarded cooling through, or heating in the temperature range of 1800 to 1500°F should be avoided in service or in heat treating. Anneal after welding for maximum corrosion resistance.
 (D) Preheat slowly to 1450°F, then heat rapidly to initial temperature for forging. Full corrosion resistance is developed only in the heat treated condition.
 (E) In forging, preheat slowly to 1450°F. Excessive grain growth takes place above 2000°F. Expert welding is required to avoid excessive grain growth. Prolonged exposure at 850 to 950°F produces cold brittleness. Re-anneal to restore ductility.

• Some sizes of round hexagon bar may be slightly magnetic because of cold drawing operations to improve machinability.
 * Undetermined for type 303
 ** 68 to 212 °F
 *** This value is a function of chemical composition and increases with cold work.
 ¥ Applies only to Type 410.
 ¥¥ At 1300°F
 c Charpy
 Note: (12-2W) at 1000°F = 49; (19-9DL) at 1000°F = 62

Hardening treatment: Cool rapidly from 1700-1850°F
 Tempering treatment: After hardening reheat to a selected temperature with the range 400-1400°F depending upon the properties desired.
 † Furnace charge at 1200-2000°F, depending on size.
 †† Furnace charge at 1200-1900°F, depending on size.
 ††† Oil or Air depending on size. (Water not recommended)
 Properties of 15-5PH are available on request.
 •• Use only in the hardened and tempered condition. Do not use above 750°F

Eagle Reference Guide – Technical Data on the Stainless Steels

Passivation (Chemical Cleaning)

Treatment of stainless steels after fabrication with oxidizing chemicals is known as chemical cleaning, or passivation. If iron particles or other substances have become embedded in the surface during fabrication or polishing operations, they must be removed. Otherwise, these minute particles may promote discoloration, rusting, or even pitting. Besides dissolving such particles, the oxidizing action of the bath also tends to enhance the corrosion resistance of stainless steels by fortifying the natural passive surface film.

This processing should be the final operation on a stainless steel part. It is generally done by immersing in a nitric acid solution and then rinsing in clear running water and drying. If immersion of the stainless steel piece is impractical due to size, the acid solution may be applied with a suitable swab and removed by rinsing with water.

Nitric acid is recommended because it will dissolve any iron particles and leave the stainless steel unaffected. It is necessary that the surface of the steel be free of scale, heavy grease and oil if the chemical cleaning treatment is to be effective.

17-4PH Removing Heat Tint

The light heat tint produced at low hardening temperatures does not affect dimensions. There is no need to remove it from parts where appearance is not important. In many environments, the heat tint will have no effect on corrosion resistance; however, in some it will result in superficial rusting.

When desired, surface discoloration can be removed by immersing parts in a 10% nitric – 2% hydrofluoric acid (by volume) solution at 110 to 140° F for 2 to 3 minutes. Other methods such as polishing, vapor blasting, and barrel tumbling can also be used to remove heat tint.

**Table 1-6
Chromium-Nickel Non-Hardenable
Grades***

Type	Hardening	Annealing
301	For cold-worked material, to increase plastic properties	Type 301 } 1900°-2050°F
302		Type 302 } 10 - 30 Mins
303		Type 303 } 1850°-2050°F
304		Type 304 } 15 - 20 Mins
304L		Type 308 } 1850°-2050°F
308		Type 309 } 15 - 20 Mins
309		Type 316 } 1850°-2050°F
310		Type 310-1900°-1950°F
316		Type 321-1750°-1950°F
316L	Type 347-1800°-1950°F	
321		10-30 Mins.
347		Quench in Water Hardness R/B 77-90

STABILIZING– Types 321 & 347 only. 1600°-1650°F.. 2-4 Hours. Cool in Air of Water.
PRECAUTIONS–
Cool these grades rapidly through 800°-1500°F.
* Preheating is not necessary

**Table 1-7
Precipitation-Hardening
Grades**

Type	Condition	How Attained	Typical Mechanical Properties		
			Tensile psi	Yield 0.2% psi	Hardness
*17-4ph	A (Solution Annealed)	1875°-1625°F 1/2 Hr. Air Cooled or Oil Quenched	-	-	-
	H900	900°F. 1 Hr. Air cooled	200,000	185,000	R/C 44
	H1025	1025°F. 4 Hrs. Air cooled	170,000	165,000	R/C 38
	H1075	1075°F. 4 Hrs. Air cooled	165,000	150,000	R/C 36
	H1150	1150°F. 4 Hrs. Air cooled	145,000	125,000	R/C 33
17-7PH	A (Annealed)	1950°F. 1/2 Hr. Air cooled	130,000	40,000	R/B 85
	T	1400°F. 90 Mins. Air cooled to 60°F within 1 Hour	-	-	-
	TH 1050	1050°F. 90 Mins Air cooled	200,000	185,000	R/C 43

When it is hardened, 17-4PH undergoes a slight dimensional contraction. It amounts to about .0004 to .0006 inches per inch for Condition H 900, and increases to approximately .0008 to .001 for Condition H 1150. This contraction must be taken into consideration in both machining and heat treatment. However, because the contraction is uniform from bar to bar and lot to lot, it can be compensated for in design.
* 17-4PH should never be used in condition A because of its susceptibility to stress corrosion.

Table 1-8
Check Analysis Tolerances • Stainless & Heat Resisting Steels

Elements	Limit, or maximum of Specified range, percent	Tolerances over the max. limit or under the min. limit	Elements	Limit, or maximum of Specified range, percent	Tolerances over the max. limit or under the min. limit
Carbon	To 0.30 inclusive	0.005	Nickel	To 1.00 incl.	0.03
	Over 0.030 to 0.20 incl.	0.01		Over 1.00 to 5.00 incl.	0.07
	Over 0.20 to 0.60 incl.	0.02		Over 5.00 to 10.00 incl.	0.10
	Over 0.60 to 1.20 incl.	0.03		Over 10.00 to 20.00 incl.	0.15
Manganese	To 1.00 incl.	0.03		Over 20.00 to 30.00 incl.	0.20
	Over 1.00 to 3.00 incl.	0.04		Over 30.00 to 40.00 incl.	0.25
	Over 3.00 to 6.00 incl.	0.05	Molybdenum	Over 0.20 to 0.60 incl.	0.03
	Over 6.00 to 10.00 incl.	0.06		Over 0.60 to 1.75 incl.	0.05
	Over 10.00 to 15.00 incl.	0.10		Over 1.75 to 4.00 incl.	0.10
Over 15.00 to 20.00 incl.	0.15	Titanium	All ranges	0.05	
Phosphorous	To 0.040 incl.	0.005	Columbium-		
	Over 0.040 to 0.20 incl.	0.010	Titanium	All ranges	0.05
Sulphur	To 0.040 incl.	0.005	Tantalum	To 0.10 incl.	0.02
	Over 0.40 to 0.20 incl.	0.010	Cobalt	0.05 to 0.20 incl.	0.01
	Over 0.20 to 0.50 incl.	0.020	Aluminum	0.10 to 0.30 incl.	0.05
Silicon	To 1.00 incl.	0.05	Selenium	All ranges	0.03
	Over 1.00 to 3.00 incl.	0.020	Nitrogen	To 0.19 incl.	0.01
Chromium	Over 4.00 to 10.00 incl.	0.10	Over 0.19 to 0.25 incl.	0.02	
	Over 10.00 to 15.00 incl.	0.15			
	Over 15.00 to 20.00 incl.	0.20			
	Over 20.00 to 27.00 incl.	0.25			

Table 1-9
Theoretical Bursting & Bulging Pressures for Tubing

Outside Diameter (Inches)	Wall Thickness – Decimal Inch																	
	BWG Equivalent							Fraction Equivalent										
	.020 25	.028 22	.035 20	.049 18	.065 16	.095 13	.120 11	.156 5/32	.187 3/16	.210 7/32	.250 1/4	.313 5/16	.375 3/8	.500 1/2	.625 5/8	.750 3/4	.875 7/8	1.000 1
1/8	3200	5200	5600	7840														
3/16	2133	2987	3933	5227														
1/4	1600	2240	2800	3920	5200	7600												
5/16	1280	1792	2240	3136	4160	6100												
3/8	1067	1493	1867	2613	3467	5067	6400											
1/2	800	1120	1400	1960	2600	3800	4800	6240	7480									
5/8	640	896	1120	1568	2080	3040	3840	4992	5984	7008								
3/4	533	747	933	1307	1733	2533	3200	4160	4987	5840	6667							
7/8	457	640	800	1120	1486	2171	2743	3566	4274	5006	5714	7154						
1	400	560	700	980	1300	1900	2400	3120	3740	4380	5000	6260	7500					
1-1/8	355	498	622	871	1156	1689	2133	2773	3324	3893	4444	5564	66673					
1-1/4	320	448	560	784	1040	1520	1920	2496	2992	3504	4000	5008	6000	8000				
1-3/8	290	407	509	713	945	1382	1745	2269	2720	3185	3636	4553	5455	7273				
1-1/2	267	393	467	653	867	1267	1600	2080	2493	2920	3333	4173	5000	6667	8333			
1-3/4	229	318	400	560	743	1086	1371	1783	2137	2503	2857	3577	4286	5714	7143			
2	200	280	350	490	650	950	1200	1560	1870	2190	2500	3130	3750	5000	6250	7500		
2-1/4	178	250	311	436	578	844	1067	1387	1662	1947	2222	2782	3333	4444	5556	6667		
2-1/2			280	392	520	760	960	1248	1496	1752	2000	2504	3000	4000	5000	6000	7000	
2-3/4			255	356	473	691	873	1135	1360	1593	1818	2276	2727	3636	4545	5455	6364	7273
3				327	433	633	800	1040	1247	1460	1667	2087	2500	3333	4167	5000	5833	6667
3-1/4				302	400	585	738	960	1151	1348	1538	1926	2308	3077	3846	4615	5385	6154
3-1/2				280	371	543	686	891	1069	1251	1429	1789	2143	2857	3571	4286	5000	5714
3-3/4				261	347	507	640	832	997	1168	1333	1669	2000	2667	3333	4000	4667	5333
4				245	325	475	600	780	935	1095	1250	1565	1875	2500	3125	3750	4375	5000
4-1/4					306	447	565	734	880	1031	1176	1473	1765	2353	2941	3529	4118	4706
4-1/2					289	412	533	693	831	973	1111	1391	1667	2222	2778	3333	3889	4444
4-3/4					274	400	505	657	787	922	1053	1318	1579	2105	2632	3158	3684	4211
5					260	380	480	624	748	876	1000	1252	1500	2000	2500	3000	3500	4000
5-1/2						345	436	567	680	796	909	1138	1364	1818	2273	2727	3182	3636
6						317	400	520	623	730	833	1043	1250	1667	2083	2500	2917	3333
6-1/2							369	480	575	674	769	993	1154	1538	1923	2308	2692	3077
7								446	534	626	714	894	1071	1429	1786	2143	2500	2857
7-1/2								416	499	584	667	835	1000	1333	1667	2000	2333	2667
8									468	548	625	783	938	1250	1563	1875	2188	2500
8-1/2										515	588	736	882	1176	1471	1765	2059	2353
9											556	696	833	1111	1389	1667	1944	2222
9-1/2											526	659	789	1053	1316	1579	1842	2105
10											500	626	750	1000	1250	1500	1750	2000
10-1/2											476	596	714	952	1190	1429	1667	1905

The above table is based on the best known and most widely used formula for calculating the bursting pressure of tubes, namely, Barlow's:

$$P = \frac{2St}{D}$$

- P = Internal pressure in psi
- S = Fiber stress of tube in psi
- t = Wall thickness in inches
- D = Outside diameter in inches

Material	Tensile (Multiplier)	Yield (Multiplier)
6061-T6 Aluminum	42,000 psi (x 4.2)	35,000 psi (x 3.5)
Annealed low carbon steel	55,000 psi (x 5.5)	25,000 psi (x 2.5)
Annealed 18-8 Stainless	75,000 psi (x 7.5)	30,000 psi (x3.0)
1/8 Hard 18-8 Stainless	105,000 psi (x 10.5)	75,000 psi (x 7.5)
Cold Dr. 21-6-9 Stainless	142,000 psi (x 14.2)	120,000 psi (x 12.0)

The table (S = 1000) affords easy calculations with appropriate multipliers shown right. For theoretical bursting pressures, use tensile values. For theoretical bulging pressures, use yield values. Working pressures will vary depending upon safety factors required for environmental conditions involved as determined by your design engineer and appropriate codes.



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