

# Flareless Tube Fittings Tubing Data Charts

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GYROLOK®



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## **For Your Safety**

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It is solely the responsibility of the system designer and user to select products suitable for their specific application requirements and to ensure proper installation, operation, and maintenance of these products. When selecting products, the total system design must be considered to ensure safe, trouble-free performance. Material compatibility, product ratings and application details should be considered in the selection. Improper selection or use of products described herein can cause personal injury or property damage.

Contact your authorized HOKE® sales and service representative for information about additional sizes and special alloys.

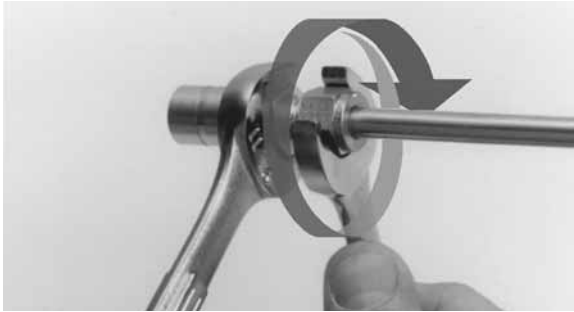
## **SAFETY WARNING:**

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HOKE® products are designed for installation only by professional suitably qualified licensed system installers experienced in the applications and environments for which the products are intended. These products are intended for integration into a system. Where these products are to be used with flammable or hazardous media, precautions must be taken by the system designer and installer to ensure the safety of persons and property. Flammable or hazardous media pose risks associated with fire or explosion, as well as burning, poisoning or other injury or death to persons and/or destruction of property. The system designer and installer must provide for the capture and control of such substances from any vents in the product(s). The system installer must not permit any leakage or uncontrolled escape of hazardous or flammable substances. The system operator must be trained to follow appropriate precautions and must inspect and maintain the system and its components including the product(s) and at regular intervals in accordance with timescales recommended by the supplier to prevent unacceptable wear or failure.



# Flareless Tube Fittings Tubing Data Charts



## Design

GYROLOK® Flareless Tube Fittings have been carefully designed and manufactured to provide a wide range of outstanding leak-tight application capabilities. GYROLOK® ratings and specifications are as follow:

### Pressure Ratings

GYROLOK® fittings are rated for working pressures higher than the tubing recommended for use with GYROLOK®. However, tubing should not be used above its maximum allowable working pressure.

Maximum allowable working pressures for tubing suitable for use with GYROLOK® are identified herein. If no pressure is identified for a given size and a wall thickness, then that tube size/wall combination is not suitable for use with GYROLOK® fittings. See caution below.

### Vacuum Rating

GYROLOK® offers excellent vacuum capability. With good quality tubing, GYROLOK® fittings will be leak-tight at vacuum levels of  $10^{-9}$  torr while tested with a leakage sensitivity of  $10^{-9}$  sccs.

### Materials

GYROLOK® & GYROLOK®-XP fittings are available in brass, 304 and 316 stainless steel, MONEL®, HASTELLOY®, INCONEL® & INCOLOY®, titanium, 2205 Duplex, 2507 Super Duplex and 254 SMO. Contact your local HOKE® distributor for further information.

### Tubing

Fully annealed tubing to the specifications identified herein are suitable for use with GYROLOK® fittings.

The tubing selected, whether metallic or nonmetallic should be compatible with the process fluid, temperature and applications. The wall thickness selections should be based on pressure and temperature conditions.

Tubing should always be fully annealed. While welded tubing may be used with GYROLOK®, inconsistencies in its manufacture and performance are sometimes encountered. As a result we recommend the use of seamless tubing.

For proper fitting performance, the tubing surface finish should be good, free from nicks or scratches. Do not use out of round tubing which does not easily go through fitting components.

Fitting performance is maximized when tube ends are squarely cut, using a tubing cutter, and deburred.

Proper fitting performance demands that the fitting be significantly harder than the tubing on which it is used. For example, stainless steel tubing should never exceed a maximum surface hardness of Rockwell B90, while MONEL® tubing should never exceed a maximum surface hardness of Rockwell B75.

### Gas Service

Gases (air, hydrogen, nitrogen, etc.) can escape through smaller leak paths than liquids. As such, the reduction of surface defects (scratches) on tubing becomes more important when the system media contains gases. As tubing wall thickness increases, the ability of the ferrules to coin out imperfections increases. The use of heavier wall tubing will help the ferrules to overcome minor surface defects that could contribute to gas leakage. HOKE recommends the following minimum wall thickness for tubing when system media contains gases.

TUBE OD (inches)	NOMINAL MINIMUM WALL THICKNESS (inches)	TUBE OD (inches)	NOMINAL MINIMUM WALL THICKNESS (inches)
1/8	0.028	3/4	0.065
3/16	0.028	7/8	0.083
1/4	0.028	1	0.083
5/16	0.035	1 1/4	0.109
3/8	0.035	1 1/2	0.134
1/2	0.049	2	0.180

### Suggested Allowable Pressure Tables

Figures and tables are for reference only. HOKE makes no implication that these valves can be used for design work. Applicable codes and practices in industry should be reviewed and considered. ASME Codes are the successor to and replacement of ASA Piping Codes. For combinations not shown, consult factory .

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# Calculating Yield, Burst, and Maximum Allowable Working Pressures

Maximum allowable stress values and calculation factors are used to determine yield, burst, and maximum allowable working pressures. HOKE® has made these calculations for a variety of materials and included the results in charts beginning on page 6. The following information is presented to provide an understanding of how the numbers are derived.

## Formulas

1. Maximum Allowable Working Pressure  
Fractional: Factor × Maximum Allowable Stress Value (psi)  
Metric: Factor × Maximum Allowable Stress Value (psi) × 0.06895  
Factor × Maximum Allowable Stress Value (ksi) × 68.95
2. Calculated Yield Pressure  
Fractional: Factor × Minimum Yield Strength (psi)  
Metric: Factor × Minimum Yield Strength (psi) × 0.06895
3. Calculated Burst Pressure  
Fractional: Factor × Minimum Tensile Strength (psi)  
Metric: Factor × Minimum Tensile Strength (psi) × 0.6895

See table of “Maximum Allowable Stress Values for Material at Various Temperatures” on pages 3 and 4, and the “Calculation Factor Tables” on page 5.

## Maximum Allowable Working Pressure Calculation Examples

The values listed on the “CALCULATION FACTOR TABLE” are for stainless steel and may be used to determine the maximum allowable pressure, yield pressure, burst pressure or any other pressure for which a stress value is available. The Calculation Factor Tables on page 5 are based on stainless steel tubing having maximum allowable outside diameter and minimum allowable wall thickness. Stress values may be obtained from “MAXIMUM ALLOWABLE STRESS VALUES FOR MATERIALS AT VARIOUS TEMPERATURES” table or other sources. All of the charts contained herein are based on use of tubing having the “worst” tolerance conditions allowed for that particular material.

### Example 1

Suppose that you want to know the maximum allowable working pressure of 304 S. ST. seamless, ASTM A-213, ¼” O.D. by .035 wall tubing at a temperature of 100° F. This information can be directly obtained from the table “MAXIMUM ALLOWABLE WORKING PRESSURE – 304 STAINLESS STEEL” or calculated as follows:

**First** Find the factor (K) corresponding to ¼” O.D. × 0.035 wall on the “CALCULATION FACTOR TABLE”.

$$K = 0.2753$$

**Second** Find the allowable stress (S<sub>A</sub>) for seamless 304 stainless steel tubing at 100° F on the “MAXIMUM ALLOWABLE STRESS VALUES FOR MATERIALS AT VARIOUS TEMPERATURES”.

$$S_A = 18,750 \text{ psi}$$

**Third** According to “CALCULATION FACTOR TABLE”, Maximum Allowable Working Pressure (P<sub>A</sub>) = Factor (K) × Maximum Allowable Stress (S<sub>A</sub>) Value in psi

$$\text{Therefore: } P_A = K \times S_A \\ P_A = 0.2753 \times 18,750 \text{ psi}$$

P<sub>A</sub> = 5161 psi (Max. Allowable Working Pressure at 100° F)

### Example 2

Suppose that you want to know the maximum allowable working pressure of 304 stainless steel seamless, ASTM A-213, 6mm O.D. by 1.2mm wall tubing at a temperature of 38° C. This information can be directly obtained from the table “MAXIMUM ALLOWABLE WORKING PRESSURE – 304 STAINLESS STEEL” or calculated as follows:

**First** Find the factor (K) corresponding to 6mm O.D. × 1.2mm wall on the “CALCULATION FACTOR TABLE”.

$$K = 0.4112$$

**Second** Find the allowable stress (S<sub>A</sub>) for seamless 304 stainless steel tubing at 38° C on the “MAXIMUM ALLOWABLE STRESS VALUES FOR MATERIALS AT VARIOUS TEMPERATURES”.

$$S_A = 18,750 \text{ psi}$$

**Third** According to “CALCULATION FACTOR TABLE”, Maximum Allowable Working Pressure (P<sub>A</sub>) = Factor (K) × Maximum Allowable Stress (S<sub>A</sub>) Value in psi × 0.06895

$$\text{Therefore: } P_A = K \times S_A \times 0.06895 \\ P_A = .4112 \times 18,750 \text{ psi} \times 0.06895$$

P<sub>A</sub> = 532 bar (Max. Allowable Working Pressure at 38° C)

**CAUTION:** Limited test data is available on certain materials, including HASTELLOY®, INCONEL®, 2205 Duplex, and 254 SMO. In such applications, further testing either by HOKE® or by the user is recommended to assure fitting suitability for the application.

# Maximum Allowable Stress Values for Materials at Various Temperatures

Values in ksi (psi=ksi × 1000)

TEMPERATURE		COPPER	TYPE 304			TYPE 316		MONEL® 400	INCONEL® 600
°F	°C	SEAMLESS ANNEALED TUBING SPEC ASTM B-75	SEAMLESS ANNEALED TUBING SPEC ASTM A-213	WELDED ANNEALED TUBING SPEC ASTM A-249	SEAMLESS ANNEALED TUBING SPEC ASTM A-213	WELDED ANNEALED TUBING SPEC ASTM A-249	SEAMLESS ANNEALED TUBING SPEC ASTM B-165	SEAMLESS ANNEALED TUBING SPEC ASTM B-167	
-20 to +100	-29 to +38	6.0	18.75	15.9	18.7	16	17.5	20.0	
150	66	5.1	18.27	15.5	18.7	16	16.95	20.0	
200	93	4.8	17.8	15.1	18.7	16	16.4	20.0	
250	121	4.8	17.2	14.6	18.	15.8	15.9	20.0	
300	149	4.7	16.6	14.1	18.4	15.6	15.4	20.0	
350	177	4.0	16.4	13.9	18.2	15.5	15.1	20.0	
400	204	3.0	16.2	13.8	18.0	15.3	14.8	20.0	
450	232		16.0	13.6	18.0	15.3	14.7	20.0	
500	260		15.9	13.5	18.0	15.3	14.7	20.0	
550	288		15.9	13.5	17.5	14.9	14.7	20.0	
600	316		15.9	13.5	17.0	14.5	14.7	20.0	
650	343		15.9	13.5	16.7	14.2	14.7	20.0	
700	371		15.9	13.5	16.3	13.9	14.7	20.0	
750	399		15.6	13.3	16.1	13.7	14.6	20.0	
800	427		15.2	12.9	15.8	13.4	14.2	20.0	
850	454		14.9	12.7	15.7	13.4	11.0	19.6	
900	482		14.7	12.5	15.6	13.3	8.0	16.0	
950	510		14.4	12.2	15.4	13.1		10.6	
1000	538		14.1	12.0	15.3	13.0		7.0	
1050	566		12.4	10.5	15.1	12.8		4.5	
1100	593		9.8	8.3	12.4	10.5		3.0	
1200	649		6.1	5.2	7.4	6.3		2.0	
1250	677		4.7	4.0	5.5	4.7			
1300	704		3.7	3.2	4.1	3.5			
1350	732		2.9	2.5	3.1	2.6			
1400	760		2.3	2.0	2.3	2.0			
1450	788		1.8	1.5	1.7	1.5			
1500	815		1.4	1.2	1.3	1.1			
Min. Tensile Strength (ksi) @ 100° F	Min Tensile Strength (ksi) @ 38° C	30	75	75	75	75	70	80	
Min. Yield Strength (ksi) @ 100° F	Min Yield Strength (ksi) @ 38° C	9	30	30	30	30	28	35	

# Maximum Allowable Stress Values for Materials at Various Temperatures

Values in ksi (psi=ksi × 1000)

TEMPERATURE		HASTELLOY® C-276		254 SMO	2205 DUPLEX	2507 SUPER DUPLEX	TITANIUM GRADE 2	
°F	°C	SEAMLESS SOLUTION ANNEALED TUBING SPEC ASTM B-622	WELDED SOLUTION ANNEALED TUBING SPEC ASTM B-626	SEAMLESS SOLUTION TREATED TUBING SPEC. ASTM A-269	SEAMLESS SOLUTION TREATED TUBING SPEC. ASTM A-789	SEAMLESS SOLUTION TREATED TUBING SPEC. ASTM A-789	SEAMLESS ANNEALED TUBING SPEC. ASTM B-338	WELDED ANNEALED TUBING SPEC. ASTM B-338
-20 to +100	-29 to +38	25	21.25	23.5	22.5	29.0	12.5	10.6
150	66	25	21.25	23.5	22.5	29.0	12.0	10.2
200	93	25	21.25	23.5	22.5	28.9	10.9	9.3
250	121	25	21.25	22.95	22.1	28.1	9.9	8.4
300	149	25	21.25	22.4	21.7	27.3	9.0	7.7
350	177	24.65	20.95	21.85	21.3	26.9	8.4	7.1
400	204	24.3	20.7	21.3	20.9	26.4	7.7	6.5
450	232	24.1	20.5	20.9	20.65	26.2	7.2	6.1
500	260	23.9	20.3	20.5	20.4	25.9	6.6	5.6
550	288	23.7	20.15	20.3	20.3	25.8	6.2	5.3
600	316	23.5	20	20.1	20.2	25.8	5.7	4.8
650	343	23.3	19.8	19.9				
700	371	23.1	19.6	19.9				
750	399	22.9	19.5	19.8				
800	427	22.8	19.4					
850	454	22.6	19.2					
900	482	22.3	18.9					
950	510	22.1	18.8					
1000	538	21.8	18.5					
1050	566	18.5	15.7					
1100	593	15	12.7					
1200	649	9.8	8.3					
1250	677	7.8	6.6					
1300	704							
1350	732							
1400	760							
1450	788							
1500	815							
Min. Tensile Strength (ksi) @ 100° F	Min. Tensile Strength (ksi) @ 38° C	100	100	94	90		50	50
Min. Yield Strength (ksi) @ 100° F	Min. Yield Strength (ksi) @ 38° C	41	41	44	65		40	40

Allowable stress values extracted from ASME Boiler and Pressure Vessels Code Section II Part D and ASME B31.3 Process Piping with permission of the publisher ASME.

# Tubing Data Charts

## Stainless Steel Calculation Factor Tables

For gas service, select a wall thickness that is **not** shaded (see Gas Service, page 1).

TUBING O.D. (inch)	WALL THICKNESS (inch)																
	0.010	0.012	0.016	0.020	0.028	0.035	0.049	0.065	0.083	0.095	0.109	0.120	0.134	0.148	0.156	0.180	0.188
1/16	0.3035	0.3733	0.5238	0.6910													
1/8					0.4585	0.5851											
3/16					0.2942	0.3791	0.5492										
1/4					0.2155	0.2753	0.4033	0.5493									
3/8					0.1405	0.1781	0.2566	0.3533	0.4631								
1/2						0.1316	0.1882	0.2559	0.3363	0.3922							
5/8							0.1486	0.2010	0.2625	0.3050	0.3574						
3/4							0.1227	0.1654	0.2152	0.2494	0.2904	0.3235					
7/8							0.1045	0.1406	0.1824	0.2110	0.2451	0.2725					
1								0.1220	0.1579	0.1824	0.2115	0.2349					
1 1/4									0.1249	0.1440	0.1666	0.1847	0.2080	0.2318	0.2455	0.2876	
1 1/2										0.1189	0.1374	0.1522	0.1711	0.1904	0.2015	0.2354	0.2469
2										0.0872	0.1006	0.1112	0.1248	0.1386	0.1465	0.1706	0.1787

For gas service, select a wall thickness that is **not** shaded (see Gas Service, page 1).

TUBING O.D. (mm)	WALL THICKNESS (mm)														
	0.5	0.6	0.7	0.8	1.0	1.2	1.5	1.6	1.8	2.0	2.2	2.5	3.0	4.0	
3	0.3285	0.4039	0.4790	0.5543	0.7009										
4	0.2406	0.2944	0.3504	0.4075	0.5213	0.6341									
6			0.2252	0.2607	0.3346	0.4112	0.5259	0.5642							
8			0.1659	0.1914	0.2439	0.2985	0.3846	0.4131							
10				0.1512	0.1919	0.2339	0.2993	0.3219	0.3686	0.4143					
12				0.1250	0.1582	0.1922	0.2450	0.2631	0.2999	0.3377					
14					0.1345	0.1632	0.2074	0.2224	0.2530	0.2844	0.3164	0.3665			
15					0.1252	0.1517	0.1926	0.2065	0.2347	0.2635	0.2930	0.3398			
16						0.1418	0.1798	0.1927	0.2189	0.2456	0.2728	0.3147	0.3873		
18						0.1253	0.1586	0.1699	0.1928	0.2161	0.2398	0.2761	0.3388		
20						0.1123	0.1420	0.1520	0.1723	0.1929	0.2139	0.2459	0.3010		
22						0.1017	0.1284	0.1375	0.1557	0.1742	0.1930	0.2217	0.2708		
25								0.1203	0.1361	0.1522	0.1684	0.1931	0.2354		
28										0.1348	0.1491	0.1708	0.2078	0.2849	
30										0.1254	0.1386	0.1587	0.1929	0.2640	
32										0.1172	0.1296	0.1483	0.1801	0.2460	
38											0.1238	0.1500	0.2041		

Factors to left of heavy black line were calculated using the "Boardman Formula", those to the right were calculated using the "Lamé Formula".

Chart Factors have been established per "ASME Boiler and Pressure Vessel Code, Section VIII, UG-27 and Appendix 1, and ASME B31.3, Process Piping, Par. 304.1.2

For factor tables of other materials, contact HOKE® or your local distributor.

# Tubing Data Charts

## Copper Annealed Seamless Tubing

ASTM B-75 or Equivalent, Maximum Recommended Hardness HR<sup>F</sup> 55

### Maximum Working Pressure (psi) for Fractional Sizes

Allowable Stress = 6,000 psi between -20° F and 100° F

#### For Welded Tubing

For welded tubing, a derating factor must be applied for weld integrity.

- 1) For double-welded tubing, multiply working pressure by 0.85.
- 2) For single-welded tubing, multiply working pressure by 0.80.

Allowable working pressures are calculated based on equations from ASME B31.1 and ASME B31.3 for a maximum allowable stress (S) of 6,000 psi (41.3 MPa).

For gas service, select a wall thickness that is not shaded (see Gas Service on page 1).

TUBING O.D. (inch)	WALL THICKNESS (inch)														
	0.014	0.020	0.028	0.032	0.035	0.049	0.065	0.083	0.095	0.109	0.120	0.134	0.148	0.156	0.180
1/16	2800	4000													
1/8			2800	3300	3700										
3/16			1800	2100	2300	3400									
1/4			1300	1500	1600	2400	3400								
3/8				900	1000	1500	2100	2800							
1/2					700	1100	1500	2000							
5/8					600	800	1200	1500	1800						
3/4					500	700	900	1200	1500	1700					
7/8					400	600	800	1000	1200	1400					
1					300	500	700	900	1100	1200	1400				
1 1/4							500	700	800	1000	1100	1200	1300	1400	1700
1 1/2							400	600	700	800	900	1000	1100	1200	1400
2							300	400	500	600	600	700	800	800	1000

### Maximum Working Pressure (bar) for Metric Sizes

Allowable Stress = 41.3 MPa between -29° C and 38° C

#### For Welded Tubing

For welded tubing, a derating factor must be applied for weld integrity.

- 1) For double-welded tubing, multiply working pressure by 0.85.
- 2) For single-welded tubing, multiply working pressure by 0.80.

Allowable working pressures are calculated based on equations from ASME B31.1 and ASME B31.3 for a maximum allowable stress (S) of 6,000 psi (41.3 MPa).

For gas service, select a wall thickness that is not shaded (see Gas Service on page 1).

TUBING O.D. (mm)	WALL THICKNESS (mm)						
	0.8	1	1.5	2	2.5	3	4.0
3	240						
4	170	220					
6	100	140	220				
8	80	100	160				
10	60	80	120	170			
12	50	60	100	140			
14		50	80	110	150		
15		50	80	100	140		
16		40	70	100	130	160	
18		40	60	80	110	140	
20		30	50	80	100	120	
22		30	50	70	90	110	
25		30	40	60	80	90	
28		20	40	50	70	80	110
30				50	60	80	100
32				40	60	70	100
38					50	60	80

### Ordering Information

High quality, fully annealed seamless tubing, ASTM B75 and EN 1057 or equivalent. Tubing to be free of scratches and suitable for bending. Secondary mechanical finishing is prohibited.



# Tubing Data Charts

## 304 & 316 Stainless Steel Annealed Seamless Tubing

ASTM A-269 UNS S31600 or Equivalent, Maximum Recommended Hardness HR<sup>B</sup> 90

### Maximum Working Pressure (psi) for Fractional Sizes

Allowable Stress = 20,000 psi between -20° F and 100° F

#### For Welded Tubing

For welded tubing, a derating factor must be applied for weld integrity.

- 1) For double-welded tubing, multiply working pressure by 0.85.
- 2) For single-welded tubing, multiply working pressure by 0.80.

Allowable working pressures are calculated based on equations from ASME B31.1 and ASME B31.3 for a maximum allowable stress (S) of 20,000 psi (137.9 MPa). GYROLOK®-XP fittings are suitable for use with medium pressure (1/8-hard) seamless tubing with an allowable stress (S) of 35,000 psi (241 MPa). Values shown below are for seamless annealed tubing only.

For gas service, select a wall thickness that is not shaded (see Gas Service on page 1).

GYROLOK®-XP fittings are intended for use where pressures are indicated with the “XP” subscript.

Tubing is suitable for use with either 316 stainless steel or 254 SMO GYROLOK® fittings.

TUBING O.D. (inch)	WALL THICKNESS (inch)															
	0.010	0.020	0.028	0.035	0.049	0.065	0.083	0.095	0.109	0.120	0.134	0.156	0.165	0.180	0.188	0.283
1/16	5800	12600														
1/8			8900	11400												
3/16			5600	7300	10700											
1/4			4300	5600	8100	11100 <sub>xp</sub>	14400 <sub>xp</sub>	16300 <sub>xp</sub>								
3/8				3600	5100	7100	9300 <sub>xp</sub>	10800 <sub>xp</sub>	12500 <sub>xp</sub>	13900 <sub>xp</sub>	15400 <sub>xp</sub>					
1/2				2600	3700	5100	6700	7900 <sub>xp</sub>	9200 <sub>xp</sub>	10200 <sub>xp</sub>	11500 <sub>xp</sub>	13500 <sub>xp</sub>	14300 <sub>xp</sub>	15500 <sub>xp</sub>	16200 <sub>xp</sub>	
9/16											10100 <sub>xp</sub>	11900 <sub>xp</sub>	12700 <sub>xp</sub>	13900 <sub>xp</sub>	14500 <sub>xp</sub>	
5/8					2900	4000	5200	6100								
3/4					2400	3300	4300	5000 <sub>xp</sub>	5800 <sub>xp</sub>	6500 <sub>xp</sub>	7300 <sub>xp</sub>	8700 <sub>xp</sub>	9300 <sub>xp</sub>			
7/8					2100	2800	3600	4200	4900							
1						2400	3100	3600	4200	4700	5300	6300				
1 1/4							2500	2800	3300 <sub>xp</sub>	3700 <sub>xp</sub>	4100 <sub>xp</sub>	4900 <sub>xp</sub>	5200 <sub>xp</sub>			
1 1/2								2300	2700	3000	3400 <sub>xp</sub>	4000 <sub>xp</sub>	4300 <sub>xp</sub>	4700 <sub>xp</sub>	4900 <sub>xp</sub>	
2									2000	2200	2500	2900	3100 <sub>xp</sub>	3400 <sub>xp</sub>	3600 <sub>xp</sub>	

### Maximum Working Pressure (bar) for Metric Sizes

Allowable Stress = 137.9 MPa between -29° C and 38° C

#### For Welded Tubing

For welded tubing, a derating factor must be applied for weld integrity.

- 1) For double-welded tubing, multiply working pressure by 0.85.
- 2) For single-welded tubing, multiply working pressure by 0.80.

Allowable working pressures are calculated based on equations from ASME B31.1 and ASME B31.3 for a maximum allowable stress (S) of 20,000 psi (137.9 MPa). GYROLOK®-XP fittings are suitable for use with medium pressure (1/8-hard) seamless tubing with an allowable stress (S) of 35,000 psi (241 MPa). Values shown below are for seamless annealed tubing only.

For gas service, select a wall thickness that is not shaded (see Gas Service on page 1).

GYROLOK®-XP fittings are intended for use where pressures are indicated with the “XP” subscript.

Tubing is suitable for use with either 316 stainless steel or 254 SMO GYROLOK® fittings.

TUBING O.D. (mm)	WALL THICKNESS (mm)						
	0.8	1	1.5	2	2.5	3	4.0
3	710						
4		760					
6	360	470	730	990 <sub>xp</sub>			
8		328	551				
10		260	410	570	730 <sub>xp</sub>		
12		220	340	470	600 <sub>xp</sub>		
14		169	283	400			
15		159	262	366			
16			240	340	430		
18			220	290	380	470 <sub>xp</sub>	
20			190	260	340	410 <sub>xp</sub>	
22			169	234	303		
25				210	260	320 <sub>xp</sub>	
28				180	230 <sub>xp</sub>	280 <sub>xp</sub>	
30				170	220	260 <sub>xp</sub>	
32				160	200	240 <sub>xp</sub>	340 <sub>xp</sub>
38					170	200	280 <sub>xp</sub>

### Ordering Information

High quality, fully annealed (Type 304, 304/304L, 316, 316/316L, 317, 317/317L) seamless tubing, ASTM A269 or equivalent. Tubing to be free of scratches and suitable for bending. Secondary mechanical finishing is prohibited.

# Tubing Data Charts

## 6MO ASTM A-269 UNS S31254 or Equivalent, Maximum Recommended Hardness HR<sup>B</sup> 90

### Maximum Working Pressure (psi) for Fractional Sizes

Allowable Stress = 27,100 psi between -20° F and 100° F

#### For Welded Tubing

For welded tubing, a derating factor must be applied for weld integrity.

- 1) For double-welded tubing, multiply working pressure by 0.85.
- 2) For single-welded tubing, multiply working pressure by 0.80.

Allowable working pressures are calculated based on equations from ASME B31.1 and ASME B31.3 for a maximum allowable stress (S) of 27,100 psi (186.9 MPa).

For gas service, select a wall thickness that is not shaded (see Gas Service on page 1).

GYROLOK®-XP fittings are intended for use where pressures are indicated with the "XP" subscript.

Tubing is suitable for use with either 316 stainless steel or 254 SMO GYROLOK® fittings.

TUBING O.D. (inch)	WALL THICKNESS (inch)							
	0.020	0.028	0.035	0.049	0.065	0.083	0.109	0.134
1/4	3200	4900	6300	9300	15100 <sub>xp</sub>			
3/8			4800	7000	9600 <sub>xp</sub>	12600 <sub>xp</sub>		
1/2			3500	5100	6900	9100 <sub>xp</sub>	12400 <sub>xp</sub>	
5/8				4000	5400	7100		
3/4				3300	4500	5800	7900 <sub>xp</sub>	
7/8				2800	3800	4900		
1					3300	4300	5700 <sub>xp</sub>	7200 <sub>xp</sub>
1 1/4							4500 <sub>xp</sub>	5600 <sub>xp</sub>
1 1/2							3700 <sub>xp</sub>	4600 <sub>xp</sub>

### Maximum Working Pressure (bar) for Metric Sizes

Allowable Stress = 186.9 MPa between -29° C and 38° C

#### For Welded Tubing

For welded tubing, a derating factor must be applied for weld integrity.

- 1) For double-welded tubing, multiply working pressure by 0.85.
- 2) For single-welded tubing, multiply working pressure by 0.80.

Allowable working pressures are calculated based on equations from ASME B31.1 and ASME B31.3 for a maximum allowable stress (S) of 186.9 MPa (27,100 psi).

For gas service, select a wall thickness that is not shaded (see Gas Service on page 1).

GYROLOK®-XP fittings are intended for use where pressures are indicated with the "XP" subscript.

Tubing is suitable for use with either 316 stainless steel or 254 SMO GYROLOK® fittings.

TUBING O.D. (mm)	WALL THICKNESS (mm)						
	0.8	1	1.5	2	2.5	3	4
3	1070	1350 <sub>xp</sub>					
6	490	630	1000 <sub>xp</sub>				
8		460	720 <sub>xp</sub>				
10		360	560	780 <sub>xp</sub>			
12		290	460	630 <sub>xp</sub>			
14			390	530			
15			360	490			
16			330	460 <sub>xp</sub>	590 <sub>xp</sub>		
18			290	400 <sub>xp</sub>	510 <sub>xp</sub>		
20			260	360	460 <sub>xp</sub>		
22			240	320	410 <sub>xp</sub>		
25				280	360	440 <sub>xp</sub>	
30				230 <sub>xp</sub>	290 <sub>xp</sub>	360 <sub>xp</sub>	
38				180 <sub>xp</sub>	230 <sub>xp</sub>	280 <sub>xp</sub>	380 <sub>xp</sub>

**Ordering Information:** High quality, fully annealed 6 MO tubing, ASTM A269 or equivalent. Tubing to be free of scratches, and suitable for bending. Secondary mechanical finishing is prohibited.

# Tubing Data Charts

## HASTELLOY® C-276 Solution Annealed Seamless Tubing

ASTM B622 UNS N10276 or Equivalent, Maximum Recommended Hardness HRB 98

### Maximum Working Pressure (psi) for Fractional Sizes

Allowable Stress = 27,300 psi between -20° F and 400° F

Allowable working pressures are calculated based on equations from ASME B31.1 and ASME B31.3 for a maximum allowable stress (S) of 27,300 psi (188.2 MPa).

GYROLOK®-XP fittings are intended for use where pressures are indicated with the “XP” subscript.

TUBING O.D. (inch)	WALL THICKNESS (inch)						
	0.010	0.028	0.035	0.049	0.065	0.083	0.095
1/16	8700						
1/8		13100	17200				
1/4		5900	7600	11200 <sub>xp</sub>	15700 <sub>xp</sub>		
3/8			4900	7000	9700 <sub>xp</sub>		
1/2			3600	5100	7000		
5/8				4000	5500 <sub>xp</sub>		
3/4					4500		
1					3300	4300 <sub>xp</sub>	5000 <sub>xp</sub>

### Maximum Working Pressure (bar) for Metric Sizes

Allowable Stress = 188.2 MPa between -29° C and 204° C

Allowable working pressures are calculated based on equations from ASME B31.1 and ASME B31.3 for a maximum allowable stress (S) of 188.2 MPa (27,300 psi).

GYROLOK®-XP fittings are intended for use where pressures are indicated with the “XP” subscript.

TUBING O.D. (mm)	WALL THICKNESS (mm)			
	1.0	1.5	2.0	2.5
3	890			
6	640 <sub>xp</sub>	1030 <sub>xp</sub>		
8	460	730 <sub>xp</sub>		
10	360	560		
12	300	460		
18			400	
25			220	350

### Ordering Information

High quality, fully seamless alloy C-276 tubing, ASTM B622 or equivalent. Tubing to be free of scratches and suitable for bending. Secondary mechanical finishing is prohibited.

# Tubing Data Charts

## MONEL® 400 (Nickel-Copper) Annealed Seamless Tubing

ASTM B-165 UNS N04400 or Equivalent, Maximum Recommended Hardness HRB 75

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### Maximum Working Pressure (psi) for Fractional Sizes

Allowable Stress = 18,700 psi between -20° F and 100° F

Allowable working pressures are calculated based on equations from ASME B31.1 and ASME B31.3 for a maximum allowable stress (S) of 18,700 psi (128.9 MPa).

TUBING O.D. (inch)	WALL THICKNESS (inch)			
	0.035	0.049	0.065	0.083
1/8	12100			
1/4		7300	9900	
3/8		4500	6300	
1/2		3300	4600	6100
5/8			2700	
3/4		2200	3000	
1			2200	

### Maximum Working Pressure (bar) for Metric Sizes

Allowable Stress = 128.9 MPa between -29° C and 38° C

Allowable working pressures are calculated based on equations from ASME B31.1 and ASME B31.3 for a maximum allowable stress (S) of 128.9 MPa (18,700 psi).

TUBING O.D. (mm)	WALL THICKNESS (mm)			
	1.0	1.5	2.0	2.5
3	890			
6	550			
8	401			
10		497		
12		365		
18			370	
25			220	350

### Ordering Information

High quality, fully annealed seamless alloy 400 hydraulic tubing, ASTM B165 or equivalent. Tubing to be free of scratches and suitable for bending. Secondary mechanical finishing is prohibited.

# Tubing Data Charts

## Grade 2 Titanium Annealed Seamless Tubing

ASTM B-338 UNS R50400 or Equivalent, Maximum Recommended Hardness HRB 90

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### Maximum Working Pressure (psi) for Fractional Sizes

Allowable Stress = 16,700 psi between -20° F and 100° F

Allowable working pressures are calculated based on equations from ASME B31.1 and ASME B31.3 for a maximum allowable stress (S) of 16,700 psi (115.1 MPa). For working pressure in accordance with ASME B31.1, multiply by 0.85.

TUBING O.D. (inch)	WALL THICKNESS (inch)			
	0.028	0.035	0.049	0.065
1/8		10500		
1/4	3600	4600	6800	9600
3/8		3000	4300	5900
1/2		2200	3100	4300
3/4				2700
1				2000

### Maximum Working Pressure (bar) for Metric Sizes

Allowable Stress = 115.1 MPa between -29° C and 38° C

Allowable working pressures are calculated based on equations from ASME B31.1 and ASME B31.3 for a maximum allowable stress (S) of 115.1 MPa (16,700 psi).

TUBING O.D. (mm)	WALL THICKNESS (mm)			
	1.0	1.5	2.0	2.5
6	390	610		
10	220	340	490	
12	180	280	390	
14			330	
16		210		
18		150	250	
20			220	280
25		130	170	220

### Ordering Information

High quality, fully annealed seamless grade 2 titanium, ASTM B338 or equivalent.

Tubing to be free of scratches and suitable for bending. Secondary mechanical finishing is prohibited.

# Tubing Data Charts

## 2507 Super Duplex Stainless Steel Solution Treated Seamless Tubing

ASTM A789 UNS S32750 or Equivalent, Maximum Recommended Hardness HRC 32

### Maximum Working Pressure (psi) for Fractional Sizes

Allowable Stress = 36,300 psi between -20° F and 200° F

Allowable working pressures are calculated based on equations from ASME B31.1 and ASME B31.3 for a maximum allowable stress (S) of 36,300 psi (250.3 MPa).

GYROLOK®-XP fittings are intended for use where pressures are indicated with the “XP” subscript.

TUBING O.D. (inch)	WALL THICKNESS (inch)				
	0.035	0.049	0.065	0.083	0.095
1/4	10000 <sub>xp</sub>	14800 <sub>xp</sub>			
3/8	6500 <sub>xp</sub>	9400 <sub>xp</sub>	12900 <sub>xp</sub>		
1/2	4800 <sub>xp</sub>	6800 <sub>xp</sub>	9300 <sub>xp</sub>	12300 <sub>xp</sub>	
5/8		5400 <sub>xp</sub>	7300 <sub>xp</sub>	9500 <sub>xp</sub>	
3/4		4400 <sub>xp</sub>	6000 <sub>xp</sub>	7800 <sub>xp</sub>	
1			4400 <sub>xp</sub>	5700 <sub>xp</sub>	6600 <sub>xp</sub>

### Maximum Working Pressure (bar) for Metric Sizes

Allowable Stress = 250.3 MPa psi between -29° C and 93° C

Allowable working pressures are calculated based on equations from ASME B31.1 and ASME B31.3 for a maximum allowable stress (S) of 250.3 MPa (36,300 psi).

GYROLOK®-XP fittings are intended for use where pressures are indicated with the “XP” subscript.

TUBING O.D. (mm)	WALL THICKNESS (mm)				
	1.0	1.5	2	2.5	3.0
6	850 <sub>xp</sub>				
10	480 <sub>xp</sub>	750 <sub>xp</sub>			
12	390 <sub>xp</sub>	610 <sub>xp</sub>	850 <sub>xp</sub>		
18		390 <sub>xp</sub>	540 <sub>xp</sub>		
20		350 <sub>xp</sub>	490 <sub>xp</sub>		
25		280 <sub>xp</sub>	380 <sub>xp</sub>	480 <sub>xp</sub>	590 <sub>xp</sub>

### Ordering Information

High quality, fully annealed seamless 2507 super duplex tubing, ASTM A789 or equivalent. Tubing to be free of scratches and suitable for bending. Secondary mechanical finishing is prohibited.

# Tubing Data Charts

## INCONEL® 625 Nickel Alloy Seamless Tubing

ASTM B-444 UNS N06625 or Equivalent

### Maximum Working Pressure (psi) for Fractional Sizes

Allowable Stress = 40,000 psi between -20° F and 200° F

Allowable working pressures are calculated based on equations from ASME B31.1 and ASME B31.3 for a maximum allowable stress (S) of 40,000 psi (275.8 MPa).

GYROLOK®-XP fittings are intended for use where pressures are indicated with the “XP” subscript.

TUBING O.D. (inch)	WALL THICKNESS (inch)			
	0.035	0.049	0.065	0.083
¼	11200 <sub>xp</sub>	16400 <sub>xp</sub>		
⅜	7200 <sub>xp</sub>	10300 <sub>xp</sub>	14200 <sub>xp</sub>	
½	5300 <sub>xp</sub>	7500 <sub>xp</sub>	10300 <sub>xp</sub>	13500 <sub>xp</sub>
¾			6600 <sub>xp</sub>	8600 <sub>xp</sub>
1			4900 <sub>xp</sub>	6300 <sub>xp</sub>

### Maximum Working Pressure (bar) for Metric Sizes

Allowable Stress = 275.8 MPa psi between -28° C and 93° C

Allowable working pressures are calculated based on equations from ASME B31.1 and ASME B31.3 for a maximum allowable stress (S) of 275.8 MPa (40,000 psi).

GYROLOK®-XP fittings are intended for use where pressures are indicated with the “XP” subscript.

TUBING O.D. (mm)	WALL THICKNESS (mm)			
	1.0	1.5	2.0	2.5
6	940 <sub>xp</sub>	1510 <sub>xp</sub>		
10	530 <sub>xp</sub>	830 <sub>xp</sub>		
12	440 <sub>xp</sub>	680 <sub>xp</sub>	940 <sub>xp</sub>	
18		440 <sub>xp</sub>	590 <sub>xp</sub>	
20		390 <sub>xp</sub>	530 <sub>xp</sub>	680 <sub>xp</sub>

### Ordering Information

High quality, fully annealed seamless alloy 625 tubing, ASTM B444 or equivalent.

Tubing to be free of scratches and suitable for bending. Secondary mechanical finishing is prohibited.

## INCOLOY® 825 Nickel Alloy Seamless Tubing

ASTM B-423 UNS N08825 or Equivalent

### Maximum Working Pressure (psi) for Fractional Sizes

Allowable Stress = 23,300 psi between -20° F and 100° F

Allowable working pressures are calculated based on equations from ASME B31.1 and ASME B31.3 for a maximum allowable stress (S) of 23,300 psi (160.6 MPa).

GYROLOK®-XP fittings are intended for use where pressures are indicated with the “XP” subscript.

TUBING O.D. (inch)	WALL THICKNESS (inch)				
	0.035	0.049	0.065	0.083	0.095
¼	6500	9500 <sub>xp</sub>	13400 <sub>xp</sub>		
⅜	4100	6000	8300 <sub>xp</sub>		
½	3000	4400	6000	7900 <sub>xp</sub>	
¾			3800	5000	5800 <sub>xp</sub>
1			2800	3700	4200 <sub>xp</sub>

### Maximum Working Pressure (bar) for Metric Sizes

Allowable Stress = 160.6 MPa psi between -29° C and 38° C

Allowable working pressures are calculated based on equations from ASME B31.1 and ASME B31.3 for a maximum allowable stress (S) of 160.6 MPa (23,300 psi).

GYROLOK®-XP fittings are intended for use where pressures are indicated with the “XP” subscript.

TUBING O.D. (mm)	WALL THICKNESS (mm)			
	1.0	1.5	2.0	2.5
6	540	880 <sub>xp</sub>		
10	310	480	670 <sub>xp</sub>	
12	250	390	540 <sub>xp</sub>	
18		250	340	440 <sub>xp</sub>
20		220	310	390 <sub>xp</sub>
25			240	310 <sub>xp</sub>

### Ordering Information

High quality, fully annealed seamless alloy 825 tubing, ASTM B423 or equivalent.

Tubing to be free of scratches and suitable for bending. Secondary mechanical finishing is prohibited.

# Tubing Data Charts

## 2205 Duplex Stainless Steel Solution Treated Seamless Tubing

ASTM A-789 UNS S31803 or Equivalent, Maximum Recommended Hardness HRc 30.5

### Maximum Working Pressure (psi) for Fractional Sizes

Allowable Stress = 30,000 psi between -20° F and 200° F

Allowable working pressures are calculated based on equations from ASME B31.1 and ASME B31.3 for a maximum allowable stress (S) of 30,000 psi (206.8 MPa). For working pressure in accordance with ASME B31.1 multiply by 0.85.

GYROLOK®-XP fittings are intended for use where pressures are indicated with the “XP” subscript.

TUBING O.D. (inch)	WALL THICKNESS (inch)					
	0.020	0.028	0.035	0.049	0.065	0.083
¼	4500	6500	8400 <sub>xp</sub>			
⅜		4200	5400	7700 <sub>xp</sub>	10700 <sub>xp</sub>	
½		3100	3900	5600	7700	10100 <sub>xp</sub>
¾			2600	3700	4900	6400 <sub>xp</sub>
1					3600	4700 <sub>xp</sub>

### Maximum Working Pressure (bar) for Metric Sizes

Allowable Stress = 206.8 MPa between -29° C and 93° C

Allowable working pressures are calculated based on equations from ASME B31.1 and ASME B31.3 for a maximum allowable stress (S) of 206.8 MPa (30,000 psi). For working pressure in accordance with ASME B31.1 multiply by 0.85.

GYROLOK®-XP fittings are intended for use where pressures are indicated with the “XP” subscript.

TUBING O.D. (mm)	WALL THICKNESS (mm)		
	1.0	1.5	2.0
10	400	620 <sub>xp</sub>	
12	330	510 <sub>xp</sub>	700 <sub>xp</sub>
14	280	430	590 <sub>xp</sub>
15	260	400	540 <sub>xp</sub>
16	240	370	510 <sub>xp</sub>
18	210	330	440 <sub>xp</sub>
25		240	310

### Ordering Information

High quality, fully annealed seamless 2205 duplex tubing, ASTM A789 or equivalent.  
Tubing to be free of scratches and suitable for bending. Secondary mechanical finishing is prohibited.



# Tubing Tolerances

## Copper ASTM B-75 (B-251 & B-251m)

O.D.	Tolerance
Up to 1/8" inclusive	±0.002"
Over 1/8"-5/8" inclusive	±0.002"
Over 5/8"-1" inclusive	±0.0025"
Over 1"-2" inclusive	±0.003"
Up to 3mm	±0.05mm
Over 3-16mm inclusive	±0.05mm
Over 16-25mm inclusive	±0.06mm
Over 25-51mm inclusive	±0.08mm

### Wall Thickness Tolerance (inch)

Wall Thickness	1/32-1/8" inclusive	Over 1/8-5/8" inclusive	Over 5/8-1" inclusive	Over 1-2" inclusive
Up to 0.017" inclusive	±0.002"	±0.001"	±0.0015"	±0.002"
Over 0.017-0.024" inclusive	±0.003"	±0.002"	±0.002"	±0.0025"
Over 0.024-0.034" inclusive	±0.003"	±0.0025"	±0.0025"	±0.003"
Over 0.034-0.057" inclusive	±0.003"	±0.003"	±0.0035"	±0.0035"
Over 0.057-0.082" inclusive	—	±0.0035"	±0.004"	±0.004"
Over 0.082-0.119" inclusive	—	±0.004"	±0.005"	±0.005"
Over 0.119-0.164" inclusive	—	±0.005"	±0.006"	±0.006"

### Wall Thickness Tolerance (mm)

Wall Thickness	0.80-3.0mm inclusive	Over 3.0-16mm inclusive	Over 16-25mm inclusive	Over 25-51mm inclusive
Over 0.40-0.60mm inclusive	±0.08mm	±0.05mm	±0.04mm	±0.06mm
Over 0.60-0.90mm inclusive	±0.08mm	±0.06mm	±0.06mm	±0.08mm
Over 0.90-1.5mm inclusive	±0.08mm	±0.08mm	±0.09mm	±0.09mm
Over 1.5-2.0mm inclusive	—	±0.09mm	±0.10mm	±0.10mm

## 304/304L and 316/316L Stainless Steel and 6MO Stainless Steel ASTM A-269

O.D.	O.D. Tolerance	Wall Thickness Tolerance
Up to 1/2" (12.7mm) exclusive	±0.005" (0.13mm)	±15%
1/2-1 1/2" (12.7-38.1mm) exclusive	±0.005" (0.13mm)	±10%
1 1/2-2" (38.1-50.8mm) inclusive	±0.010" (0.2mm)	±10%

## 2205 Duplex Stainless Steel ASTM A-789/A-789m & 2507 Super Duplex

O.D.	O.D. Tolerance	Wall Thickness Tolerance
Up to 1/2" (12.7mm) exclusive	±0.005" (0.13mm)	±15%
1/2-1 1/2" (12.7-38.1mm) exclusive	±0.005" (0.13mm)	±10%
1 1/2-2" (38.1-50.8mm) inclusive	±0.010" (0.2mm)	±10%

## MONEL® 400 ASTM B-165 & INCONEL® 600 ASTM B-167

O.D.	O.D. Tolerance	Wall Thickness Tolerance
Over 0.400-5/8" (10-16mm) exclusive	±0.005" (0.13mm)	±15%
5/8-1 1/2" (16-38.1mm) inclusive	±0.0075" (0.19mm)	±10%
Over 1 1/2-2" (38.1-50.8mm) inclusive	±0.010" (0.25mm)	±10%

# Tubing Tolerances

## HASTELLOY® C-276 ASTM B-622 (Seamless)

O.D.	O.D. Tolerance	Wall Thickness Tolerance
0.500– $\frac{5}{8}$ " (12.7–15.9mm) inclusive	±0.005" (0.13mm)	±12½%
Over $\frac{5}{8}$ –1½" (15.9–38.1mm) inclusive	±0.0075" (0.19mm)	±10%
Over 1½–2" (38.1–50.8mm) inclusive	±0.010" (0.25mm)	±10%

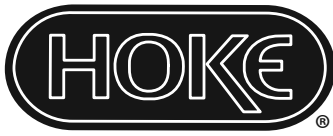
## HASTELLOY® C-276 ASTM B-622 (Welded)

O.D.	O.D. Tolerance	Wall Thickness Tolerance
Over $\frac{1}{8}$ – $\frac{5}{8}$ " (3.2–16mm) inclusive	±0.005" (0.13mm)	±15%
Over $\frac{5}{8}$ –1½" (16–38.1mm) inclusive	±0.0075" (0.19mm)	±12½%
Over 1½–2" (38.1–50.8mm) inclusive	±0.010" (0.25mm)	±12½%

## Titanium ASTM B-338

O.D.	O.D. Tolerance	Wall Thickness Tolerance
Up to 1" (25.4mm) exclusive	±0.004" (0.102mm)	±10%
1–1½" (25.4–38.1mm) exclusive	±0.005" (0.127mm)	±10%
1½–2" (38.1–50.8mm) exclusive	±0.006" (0.152mm)	±10%
2" (50.8mm) inclusive	±0.007" (0.178mm)	±10%

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