STAR™ Aliphatic Amine Downhole Tubing/Casing

Product Data

OIL & GAS MINING

Applications

- Disposal or Injection Tubing
- Production Tubing - ESP, Gas Lift, Rod Pump, PCP
- Casing Liners
- Chemical Waste Disposal
- Geothermal
- Slotted Production Liners and Prepacked Screens
- Observation Well Casing
- Open Hole Casing, Zone or to Surface
- Cement Tail Pipe
- Deviated Wells

Product Description

- **Sizes** - 2 ⅜ through 9 ⅝ inches
- **Pressure** - Up to 3,250 psi (22.4 MPa)
- **Temperature** - up to 200°F (93.3°C) Max.
- **Resin System** - Aliphatic Amine Cured Epoxy
- **Reinforcement** - Premium Fiberglass
- **Joining Systems** - API 5B 8rd, Integral Joint (IJ), Threaded and Coupled (T&C), and O-Ring (DH)
- **Joint Length** - 30 Feet (9.1 mts) Nominal Random Lengths of 28 to 32 Feet (8.5 to 9.8mts)
- **Fittings** - A variety of filament wound nipples and couplings

Tubing/Casing Design

- **Design Temperature** - 200°F (93.3°C)
- **Design** - Based on the Proportional Elastic Limit in both the Hoop and Axial direction.
- **Tensile Test** - The hydrotest is across the joint and unrestrained; therefore, tensile loads of a proportional amount are generated.
- **100% Factory Hydro Test** - All sizes 1.25 times the Series Pressure Rating.

Benefits

- Corrosion Control
- Improved Flow Efficiency
- Easily Drilled Up
- Excellent Logging Characteristics

Joining System

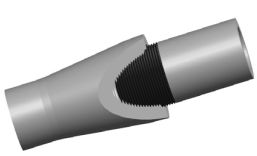
API 5B Threads - EUE 8rd, OD 8rd

- Integral Joint (IJ)
- Threaded and Coupled (T&C)
- **ACT** - Molded threads using a graphite, ceramic and epoxy composite for high performance applications.
- Tighter tolerances than steel
- Improved make and break properties
- Minimizes thread and wrench damage
- Compatible with steel API 5B threads

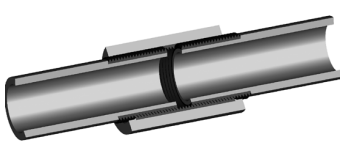
DH - Proprietary 4-round threaded connection

- Intrigra Joint (IJ)
- Mechanical O-Ring
- Coarse threads - no cross-threading
- Excellent make and break characteristics

View of Joint Illustrations



ACT - Integral Joint (IJ)



ACT - Threaded and Coupled (T&C)

DH - Integral Joint (IJ)

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Series 1000

1000 psi (6.9 MPa)

Thread Size	Product Code	Nominal Dimensions								Connection Diameter				Tensile Rating[3]		Collapse Rating[3]	
		Inside Diameter		Drift Diameter		Outside Diameter		Weight[1]		IJ[2]		T&C[2]					
in		in	mm	in	mm	in	mm	lbs/ft	kg/m	in	mm	in	mm	lbs	kgs	psi	MPa
5 ½	C1047	4.74	120.4	4.62	117.3	5.16	131.2	3.28	4.9	-	-	6.25	158.8	28,000	12,701	300	2.1
6 ⅝	C1059	5.94	150.7	5.81	147.6	6.52	165.6	5.17	7.7	7.31	185.7	7.54	191.7	46,000	20,865	400	2.8
8 ⅝	C1077	7.74	196.5	7.61	193.3	8.46	214.8	8.37	12.5	9.51	241.6	9.70	246.4	78,000	35,380	400	2.8

Series 1250

1250 psi (8.6 MPa)

Thread Size	Product Code	Nominal Dimensions								Connection Diameter				Tensile Rating[3]		Collapse Rating[3]	
		Inside Diameter		Drift Diameter		Outside Diameter		Weight[1]		IJ[2]		T&C[2]					
in		in	mm	in	mm	in	mm	lbs/ft	kg/m	in	mm	in	mm	lbs	kgs	psi	MPa
4 ½	C1238	3.85	97.7	3.72	94.5	4.30	109.1	2.83	4.2	5.39	136.9	5.80	147.3	24,000	10,886	800	5.5
5 ½	C1247	4.74	120.4	4.62	117.3	5.31	135.0	4.26	6.3	-	-	6.45	163.8	38,000	17,237	900	6.2
6 ⅝	C1255	5.50	139.7	5.38	136.7	6.07	154.2	5.29	7.9	7.55	191.8	7.80	200.6	44,000	19,958	500	3.4
8 ⅝	C1277	7.74	196.5	7.61	193.3	8.61	218.6	9.85	14.7	9.86	250.4	10.0	254	95,000	43,091	700	4.8

Series 1500

1500 psi (10.3 MPa)

Thread Size	Product Code	Nominal Dimensions								Connection Diameter				Tensile Rating[3]		Collapse Rating[3]	
		Inside Diameter		Drift Diameter		Outside Diameter		Weight[1]		IJ[2]		T&C[2]					
in		in	mm	in	mm	in	mm	lbs/ft	kg/m	in	mm	in	mm	lbs	kgs	psi	MPa
3 ½	C1529	2.94	74.7	2.82	71.6	3.39	86.0	2.12	3.2	4.51	114.6	4.5	116.7	18,000	8,165	1700	11.7
3 ½-DH	C1529LA	2.94	74.7	2.82	71.6	3.39	86.0	2.17	3.2	4.66	118.4	-	-	18,000	8,165	1700	11.7
5½	C1547	4.74	120.4	4.62	117.3	5.47	138.9	5.18	7.7	-	-	6.6	167.6	49,000	22,226	1800	12.4
6 ⅝	C1555	5.50	139.7	5.38	136.7	6.22	158.0	6.35	9.5	7.78	197.6	7.8	200.6	56,000	25,401	1100	7.6
7	C1559	5.94	150.7	5.81	147.6	6.65	168.8	6.79	10.1	8.25	209.6	8.4	213.4	59,000	26,762	900	6.2
9 ⅝	C1577	7.74	196.5	7.61	193.3	8.76	222.4	13.21	19.7	11.12	282.4	11.5	292.1	112,000	50,802	1100	7.6

Series 1750

1750 psi (12.1 MPa)

Thread Size	Product Code	Nominal Dimensions								Connection Diameter				Tensile Rating[3]		Collapse Rating[3]	
		Inside Diameter		Drift Diameter		Outside Diameter		Weight[1]		IJ[2]		T&C[2]					
in		in	mm	in	mm	in	mm	lbs/ft	kg/m	in	mm	in	mm	lbs	kgs	psi	MPa
4 ½	C1738	3.85	97.7	3.72	94.5	4.46	113.2	3.74	5.6	5.72	145.3	6.10	154.9	33,000	14,969	1900	13.1
5 ½	C1747	4.74	120.4	4.62	117.3	5.47	138.9	5.21	7.8	-	-	6.75	171.5	49,000	22,226	1800	12.4
6 ⅝	C1755	5.50	139.7	5.38	136.7	6.37	161.7	7.52	11.2	7.77	197.4	8.25	209.6	68,000	30,844	1900	13.1
7	C1759	5.94	150.7	5.81	147.6	6.79	172.5	7.61	11.3	8.32	211.3	8.75	222.3	72,000	32,659	1500	10.3
9 ⅝	C1777	7.74	196.5	7.61	193.3	8.90	226.1	14.89	22.2	11.38	289.1	11.9	302.3	127,000	57,606	1700	11.7

Series 2000

2000 psi (13.8 MPa)

Thread Size	Product Code	Nominal Dimensions								Connection Diameter				Tensile Rating[3]		Collapse Rating[3]	
		Inside Diameter		Drift Diameter		Outside Diameter		Weight[1]		IJ[2]		T&C[2]					
in		in	mm	in	mm	in	mm	lbs/ft	kg/m	in	mm	in	mm	lbs	kgs	psi	MPa
2 7/8	C2023	2.37	60.1	2.27	57.7	2.82	71.5	1.73	2.6	3.98	101.1	4.0	101.6	15,000	6,804	2500	17.2
2 7/8-DH	C2023LA	2.37	60.1	2.27	57.7	2.81	71.4	1.84	2.7	4.23	107.4	-	-	15,000	6,804	2500	17.2
4 1/2	C2038	3.85	97.7	3.72	94.5	4.62	117.2	4.55	6.8	5.87	149.1	6.1	154.9	43,000	19,504	2500	17.2
6 5/8	C2055	5.50	139.7	5.38	136.7	6.51	165.4	8.44	12.6	7.95	201.9	8.25	209.6	70,000	31,751	2500	17.2
7	C2059	5.94	150.7	5.81	147.6	6.94	176.2	9.04	13.5	8.54	216.9	8.75	222.3	86,000	39,009	2300	15.9
9 5/8	C2077	7.74	196.5	7.61	193.3	9.05	229.8	16.40	24.4	11.68	296.7	11.9	302.3	127,000	57,606	2300	15.9

Series 2250

2250 psi (15.5 MPa)

Thread Size	Product Code	Nominal Dimensions								Connection Diameter				Tensile Rating[3]		Collapse Rating[3]	
		Inside Diameter		Drift Diameter		Outside Diameter		Weight[1]		IJ[2]		T&C[2]					
in		in	mm	in	mm	in	mm	lbs/ft	kg/m	in	mm	in	mm	lbs	kgs	psi	MPa
2 3/8	C2219	1.94	49.3	1.85	47	2.39	60.6	1.41	2.1	3.47	88.1	3.6	91.4	12,000	5,443	2750	19
2 3/8-DH	C2219LA	1.94	49.3	1.85	47.0	2.39	60.6	1.45	2.2	3.48	88.4	-	-	12,000	5,443	2750	19.0
3 1/2	C2229	2.94	74.7	2.82	71.6	3.55	90.1	2.86	4.3	4.92	125	5.1	129.5	26,000	11,793	2750	19
3 1/2-DH	C2229LA	2.94	74.7	2.82	71.6	3.55	90.1	2.94	4.4	5.03	127.8	-	-	26,000	11,793	2750	19.0

Series 2750

2750 psi (19.0 MPa)

Thread Size	Product Code	Nominal Dimensions								Connection Diameter				Tensile Rating[3]		Collapse Rating[3]	
		Inside Diameter		Drift Diameter		Outside Diameter		Weight[1]		IJ[2]		T&C[2]					
in		in	mm	in	mm	in	mm	lbs/ft	kg/m	in	mm	in	mm	lbs	kgs	psi	MPa
2 7/8	C2723	2.37	60.1	2.27	57.7	2.98	75.6	2.27	3.4	4.22	107.2	4.3	109.2	21,000	9,525	3250	22.4
2 7/8-DH	C2723LA	2.37	60.1	2.27	57.7	2.97	75.4	2.40	3.6	4.38	111.3	-	-	21,000	9,525	3250	22.4
3 1/2	C2729	2.94	74.7	2.82	71.6	3.70	94.1	3.55	5.3	5.07	128.8	5.25	133.4	30,000	13,608	3250	22.4
3 1/2-DH	C2729LA	2.94	74.7	2.82	71.6	3.70	94.1	3.65	5.4	5.18	131.6	-	-	27,000	12,247	3250	22.4

Series 3250

3250 psi (22.4 MPa)

Thread Size	Product Code	Nominal Dimensions								Connection Diameter				Tensile Rating[3]		Collapse Rating[3]	
		Inside Diameter		Drift Diameter		Outside Diameter		Weight[1]		IJ[2]		T&C[2]					
in		in	mm	in	mm	in	mm	lbs/ft	kg/m	in	mm	in	mm	lbs	kgs	psi	MPa
2 3/8	C3219	1.94	49.3	1.85	47.0	2.54	64.5	1.88	2.8	3.78	96	3.9	99.1	17,000	7,711	3750	25.9
2 3/8-DH	C3219LA	1.94	49.3	1.85	47.0	2.54	64.5	1.95	2.9	3.71	94.2	-	-	17,000	7,711	3750	25.9

NOTE: Additional pressure classes are available on request.

[1] Tubing/Casing weight is based on Threaded and Coupled (T&C) Joining System.

[2] Threads - All 2 3/8" - 4 1/2" EUE 8rd API threads conform to API 5B Table 14, 14th Edition (L4 is minimum) and all 5 1/2" - 9 5/8" O.D. 8rd casing threads conform to API 5B, Table 7, 14th Edition (L4 is minimum).

[3] Ratings - All ratings are maximum operating limits. Exceeding these limits will void the warranty on all NOV Fiber Glass Systems pipe.

[4] Elevators T&C - The 1000 & 1500 psi products have smaller OD's which may work with the same size elevators as the thread size.

[5] Elevators IJ - The setting plate must be removed so that the slips will properly set on the fiberglass pipe. Sizing slip type elevators requires use of the tubing O.D. instead of the upset O.D. on the male end. Rubber setting plates are available to minimize marking and to improve the fit. Shorter bolts are required to hold in place.

[6] Floor Slips - When running lighter weight (1000-1500 psi) products, it is good practice to replace the slip dies to make sure they will latch on the pipe body.

Joining System Information (8rd)

API Thread Size			2 ⅜		2 ⅞		3 ½		4 ½	
Thread Type[2]			EUE 8rd		EUE 8rd		EUE 8rd		EUE 8rd	
Thread Length - in (mm)			2.94	74.7	3.25	82.6	3.50	88.9	3.88	98.6
Make-up Length Loss - in/jt (mm/jt)			2.56	65.0	2.86	72.6	3.13	79.5	3.50	88.9
Make-up Torque - ft•lb (N•m)		Optimum	150	204	185	251	225	306	300	407
		Minimum	125	170	150	204	175	238	250	339
		Maximum	225	306	250	339	300	407	450	611
Recommended Make-up Tools			No. 5 Strap						No. 11 Strap	
Pin Upset O.D. - in (mm)			2.60	66.0	3.10	78.7	3.75	95.3	4.75	120.7
Handling Tools										
Elevators T&C (Shoulder Type)[4] - in (mm)			2 ⅞		3 ½		4 ½		5 ½	
Elevators IJ (Slip Type)[5]			MYT		MYT		YT		YC	
Floor Slips (Standard Type)[6] - in (mm)			2 ⅜		2 ⅞		3 ½		4 ½	
Thread Compatibility FRP Long vs. Steel Short Form[2] (extra threads, front of FRP pin)			5		6		6		7	
Lubrication Usage - joint/gallon			100		100		100		50	
Stretch Factor in/100 ft (mm/30.5 m)	**Series**	1000	-	-	-	-	-	-	-	-
		1250	-	-	-	-	-	-	1.39	35.3
		1500	-	-	-	-	1.79	45.5	-	-
		1750	-	-	-	-	-	-	1.00	25.4
		2000	-	-	2.18	55.4	-	-	0.78	19.8
		2250	2.61	66.3	-	-	1.01	25.7	-	-
		2750	1.51	38.4	-	-	1.01	25.7	-	-
		3250	1.89	48.0	-	-	-	-	-	-

API Thread Size			5 ½		6 ⅝		7		8 ⅝		9 ⅝	
Thread Type[2]			OD 8rd		OD 8rd		OD 8rd		OD 8rd		OD 8rd	
Thread Length - in (mm)			4.75	120.7	4.25	108.0	4.88	124.0	4.85	123.2	5.13	130.3
Make-up Length Loss - in/jt (mm/jt)			4.38	111.3	3.88	98.6	4.50	114.3	4.50	114.3	4.75	120.7
Make-up Torque - ft•lb (N•m)		Optimum	400	543	500	678	525	712	700	950	630	855
		Minimum	320	434	400	543	420	570	475	645	500	678
		Maximum	560	760	650	882	735	997	825	1119	880	1194
Recommended Make-up Tools			Approved Power Tongs									
Pin Upset O.D. - in (mm)			5.55	141.0	6.65	168.9	7.05	179.1	8.65	219.7	9.65	245.1
Handling Tools												
Elevators T&C (Shoulder Type)[4] - in (mm)			6 ⅞		7		7 ⅝		9 ⅝		10 ¾	
Elevators IJ (Slip Type)[5]			YC		MYT		YT		YT		Slip Type	
Floor Slips (Standard Type)[6] - in (mm)			5 ½		6 ⅝		7		8 ⅝		9 ⅝	
Thread Compatibility FRP Long vs. Steel Short Form[2] (extra threads, front of FRP pin)			5		6		7		9		11	
Lubrication Usage - joint/gallon			34		34		26		26		26	
Stretch Factor in/100 ft (mm/30.5 m)	**Series**	1000	1.22	31.0	0.72	18.3	-	-	0.44	11.2	-	-
		1250	0.89	22.6	0.77	19.6	-	-	0.36	9.1	-	-
		1500	0.68	17.3	0.60	15.2	0.56	14.2	-	-	0.30	7.6
		1750	0.68	17.3	0.49	12.4	0.47	11.9	-	-	0.26	6.6
		2000	-	-	0.42	10.7	0.39	9.9	-	-	0.23	5.8
		2250	-	-	-	-	-	-	-	-	-	-
		2750	-	-	-	-	-	-	-	-	-	-
		3250	-	-	-	-	-	-	-	-	-	-

NOTES: These guidelines can vary depending on actual well conditions. A **STAR Well** will provide more accurate setting tension/stretch.

Joining System Information (O-Ring)

API Thread Size			**2 ⅜**		**2 ⅞**		**3 ½**	
Thread Type			DH		DH		DH	
Thread Length - in (mm)			4.50	114.3	4.50	114.3	4.50	114.3
Make-up Length Loss - in/jt (mm/jt)			4.50	114.3	4.50	114.3	4.50	114.3
Make-up Torque - ft. lbs (m kg)		Optimum	95	129	120	163	200	271
		Minimum	75	102	100	136	175	237
		Maximum	125	169	150	203	250	339
Recommended Make-up Tools			No. 5 Strap Wrench					
Pin Upset O.D. - in (mm)			2.78	70.6	3.50	88.9	4.09	103.9
Handling Tools								
Elevators (Sholder Type)[2]			2 ⅞		3 ½		4 ½	
Elevators IJ (Slip Type)[3]			MYT		MYT		YT	
Floor Slips (Standard Type)[4]			2 ⅜		2 ⅞		3 ½	
Stretch Factor in/100 ft (mm/30.5 m)	**Series**	1500	-	-	-	-	1.80	45.4
		2000	-	-	2.18	55.4	-	-
		2250	2.61	66.4	-	-	1.00	25.6
		2750	-	-	1.56	39.6	1.00	25.6
		3250	1.89	48.1	-	-	-	-

NOTES: These guidelines can vary depending on actual well conditions. A STAR Well will provide more accurate setting tension/stretch.

Typical Properties

Modulus of Elasticity		
Axial	**psi**	3.0×10^6
	GPa	20.7
Hoop	**psi**	5.0×10^6
	GPa	34.5
Poisson's Ratio (Minor)		0.25
Coefficient of Thermal Expansion	**in/in/°F**	8.7×10^{-6}
	mm/mm/°C	15.7×10^{-6}
Thermal Conductivity	**BTU/ft•hr•°F**	0.23
	W/m•°C	0.4
Density	**lbs/cu ft**	122
	kgs/lt	1.96
Specific Gravity		1.96
Absolute Roughness	**in**	0.00021
	mm	0.00533
Hazen-Williams Coefficient		150

Tubing/Casing Capacity

Pipe Size	**Inside Diameter**		**Capacity**	
	in	**mm**	**bbls/1,000 ft**	**(m3/km)**
2 ⅜	1.94	49.3	3.7	1.9
2 ⅞	2.37	60.2	5.4	2.8
3 ½	2.94	74.7	8.4	4.4
4 ½	3.85	97.8	14.4	7.5
5 ½	4.74	120.4	21.8	11.4
6 ⅝	5.50	139.7	29.4	15.3
7	5.94	150.9	34.2	17.8
8 ⅝	7.74	196.6	58.1	30.3
9 ⅝	7.74	196.6	58.1	30.3

Packer Selection
(More information listed in “Downhole Tubing and Casing Installation and Application Practices” manual)

- STAR Tubing is designed to be set in tension (see stretch chart).
- Double Grip Packers are preferred with an on/off tool seal assembly, 1/4 turn release.
- Direct Tension Set Packers should be avoided due to the movement of fiberglass.
- Direct Set Packers are set <3500 feet deep (1,067 m).
- When packer setting is >3500 feet (1,067 m) deep, use steel work string to set packer.
- Hydraulic Set Packers are not recommended due to uncontrollable forces.
- Polished Bore Receptacles are set with proper precautions to avoid compression. A complete STAR Well Evaluation must be performed to determine the proper set-ups.

Perforation

- Use a Jet Perforating Gun. Shoot a maximum of two shots at a time at 0° Phase or 180° Phase.
- Thread lock all steel to FRP connections.
- When installing mixed strings, have one joint of FRP casing supplied without a coupling (pin x pin) for cross-overs.

Cementing

- Cementing in two stages may help avoid exceeding collapse rating.
- Keep differential below external and internal ratings at all times.
- Care must be given to avoid shock collapse pressure when setting cement plug.
- Fiberglass centralizers are available, metal centralizers must be qualified to fit to FRP.
- Cement residue can be cleaned up with proper care using a rock bit.
- Landing joints are available, but must be sized for the well-head selected.
- Drilling-Up fiberglass tubing or casing is easy with a rock bit (not a mill).

Rod Pump Wells

- It is preferred that the tubing be anchored.
- Rod Guides must be used.

Electric Submersible Pumps

- Care must be given to direction and amount of start-up torque.

Fishing

- Normal Procedures, Spear or Overshot.

Cutting

- Mechanical Jet Cutter.

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