

STAR® Downhole Casing (Aliphatic Amine Cured Epoxy - Product Data)

Product Description

- Pressure - Up to 4000 psi (27,6 MPa)
- Resin System - Aliphatic Amine Cured Epoxy
- Reinforcement - Premium Fiberglass
- Joining Systems - API 5B 8rd, Threaded and Coupled or Integral Joint
- Joint Length - 30 Feet (9,1 mts) Nominal, API Range 2, 28 to 32 feet (8,5 to 9,8 meters)
- Temperature - Up to 200° F (93.3° C) Maximum
- Sizes - 1½ through 9 5/8 inches
- Fittings - A variety of filament wound API 5B threaded Nipples and Couplings

Casing Design

- Non API Design
- Design Temperature - 200° F (93.3° C)
- Wall Thickness - Nominal
- Design - Based on the Proportional Elastic Limit in both the Hoop and Axial direction
- 100% Factory Hydrotest - All sizes to 1.25 x Pressure Rating
- Tensile Test - Since the hydrotest is across the joint and unsupported, tensile loads of a proportional amount are generated

Flow Factors

- Hazen Williams C=150
- Absolute Roughness = 0.00021 in. (0.00533 mm)

Nominal Moduli

- Modulus of Elasticity
 - Hoop - 5.0×10^6 psi (34.5 GPa)
 - Axial - 3.0×10^6 psi (20.7 GPa)
- Poisson's Ratio (Minor) = 0.25

Physical Properties

- Density = 122 lbs/cu ft (1.96 kgs/lt)
- Specific Gravity = 1.96

Thermal Properties

- Coefficient of Thermal Conductivity
0.23 BTU/(ft•hr•°F) (0.4 W/(m•°C))
- Coefficient of Thermal Expansion
 8.7×10^{-6} in/in/°F ($15,7 \times 10^{-6}$ mm/mm/°C)

Benefits

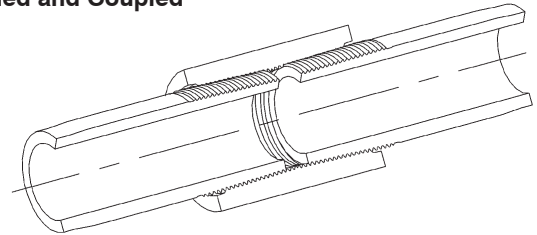
- Corrosion Control caused by CO₂, H₂S & Salt Water
- Improved Flow Efficiency
- Easily Drilled Up
- Excellent Logging Characteristics

Applications

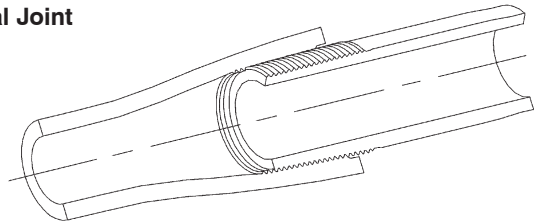
- Disposal or Injection Tubing to depths of 10,000 feet
- Production Tubing - ESP, Gas Lift or Rod Pump
- Casing Liners - Cemented and perforated, Zone or to Surface
- Chemical Waste Disposal
- Geothermal
- Slotted Production Liners and Prepacked Screens
- Observation Well Casing
- Open Hole Casing, Zone or to Surface

Joining System

Threaded and Coupled



Integral Joint



API THREADS (EUE 10rd, EUE 8rd, OD 8rd)

- Advanced Composite Thread (Patent No's 4,999,389 & 5,179,140)
- Precision molded with Epoxy, Graphite and Ceramic
- Tighter tolerances than steel.
- Improved make and break properties.
- Minimizes thread and wrench damage.
- Provides higher thread shear than cut or ground threads.
- Chemically resistant threads.
- Compatible with steel API 5B Threads

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 **Fiber Glass Systems**

SIZE (in)		Product Code	PIPE DIMENSIONS (NOMINAL)							IJ		T&C	
Pipe	Thread		Inside Diameter In (mm)	Drift Diameter In (mm)	Outside Diameter In (mm)	Wall Thickness In (mm)	Pipe Weight* Lbs/ft (kg/m)	Connection Diameter In (mm)	Connection Diameter In (mm)				

Series 1000 - ACT												
5	5 1/2	C1047	4.74 (120,4)	4.62 (117,2)	5.16 (131,1)	0.21 (5,3)	3.30 (4,9)	---	---	6.25 (158,8)		
6	6 5/8	C1059	5.93 (150,6)	5.81 (147,4)	6.50 (165,1)	0.28 (7,1)	4.80 (7,1)	7.30 (185,4)	7.55 (191,8)			
8	8 5/8	C1077	7.74 (196,6)	7.62 (193,4)	8.46 (214,9)	0.36 (9,1)	8.20 (12,2)	9.50 (241,3)	9.50 (241,3)			

Series 1250 - ACT												
4	4 1/2	C1238	3.85 (97,8)	3.73 (94,6)	4.30 (109,2)	0.22 (5,6)	2.60 (3,9)	5.40 (137,2)	5.80 (147,3)			
5	5 1/2	C1247	4.74 (120,4)	4.62 (117,2)	5.31 (134,9)	0.29 (7,4)	4.30 (6,4)	---	---	6.45 (163,8)		
6	6 5/8	C1255	5.50 (139,7)	5.38 (136,5)	6.07 (154,2)	0.29 (7,4)	4.80 (7,1)	7.56 (192,0)	7.70 (195,6)			
8	8 5/8	C1277	7.74 (196,6)	7.62 (193,4)	8.61 (218,7)	0.44 (11,2)	10.00 (14,9)	9.86 (250,4)	10.00 (254,0)			

Series 1500 - ACT												
3	3 1/2	C1529	2.94 (74,7)	2.82 (71,5)	3.39 (86,1)	0.22 (5,6)	2.10 (3,1)	4.53 (115,1)	4.60 (116,8)			
5	5 1/2	C1547	4.74 (120,4)	4.62 (117,2)	5.47 (138,9)	0.37 (9,4)	5.30 (7,9)	---	---	6.60 (167,6)		
6	6 5/8	C1555	5.50 (139,7)	5.38 (136,5)	6.22 (158,0)	0.36 (9,1)	6.00 (8,9)	7.77 (197,4)	7.90 (200,7)			
6	7	C1559	5.93 (150,6)	5.81 (147,4)	6.65 (168,9)	0.36 (9,1)	6.40 (9,5)	8.24 (209,3)	8.40 (213,4)			
8	9 5/8	C1577	7.74 (196,6)	7.58 (192,6)	8.76 (222,5)	0.51 (13,0)	12.80 (19,0)	11.12 (282,4)	11.50 (292,1)			

Series 1750 - ACT												
4	4 1/2	C1738	3.85 (97,8)	3.73 (94,6)	4.46 (113,3)	0.31 (7,9)	3.60 (5,4)	5.72 (145,3)	6.10 (154,9)			
5	5 1/2	C1747	4.74 (120,4)	4.62 (117,2)	5.47 (138,9)	0.37 (9,4)	5.40 (8,0)	---	---	6.75 (171,5)		
6	6 5/8	C1755	5.50 (139,7)	5.38 (136,5)	6.37 (161,8)	0.43 (10,9)	7.20 (10,7)	7.79 (197,9)	8.25 (209,6)			
6	7	C1759	5.93 (150,6)	5.81 (147,4)	6.79 (172,5)	0.43 (10,9)	7.60 (11,3)	8.32 (211,3)	8.75 (222,3)			
8	9 5/8	C1777	7.74 (196,6)	7.58 (192,6)	8.91 (226,3)	0.58 (14,7)	14.60 (21,7)	11.38 (289,1)	11.90 (302,3)			

Series 2000 - ACT												
1 1/2	1.9	C2014	1.44 (36,6)	1.32 (33,4)	1.87 (47,5)	0.22 (5,6)	1.00 (1,5)	2.70 (68,6)	2.80 (71,1)			
2 1/2	2 7/8	C2023	2.37 (60,2)	2.25 (57,0)	2.82 (71,6)	0.23 (5,8)	1.70 (2,5)	4.00 (101,6)	4.00 (101,6)			
4	4 1/2	C2038	3.85 (97,8)	3.73 (94,6)	4.62 (117,3)	0.38 (9,7)	4.50 (6,7)	5.88 (149,4)	6.10 (154,9)			
6	6 5/8	C2055	5.50 (139,7)	5.38 (136,5)	6.51 (165,4)	0.51 (13,0)	8.40 (12,5)	7.95 (201,9)	8.25 (209,6)			
6	7	C2059	5.93 (150,6)	5.77 (146,7)	6.94 (176,3)	0.50 (12,7)	8.90 (13,2)	8.53 (216,7)	8.75 (222,3)			
8	9 5/8	C2077	7.74 (196,6)	7.58 (192,6)	9.05 (229,9)	0.66 (16,8)	16.40 (24,4)	11.67 (296,4)	11.90 (302,3)			

Series 2250 - ACT												
2	2 3/8	C2219	1.94 (49,3)	1.82 (46,1)	2.39 (60,7)	0.22 (5,6)	1.40 (2,1)	3.46 (87,9)	3.60 (91,4)			
3	3 1/2	C2229	2.94 (74,7)	2.82 (71,5)	3.55 (90,2)	0.30 (7,6)	2.90 (4,3)	4.92 (125,0)	5.10 (129,5)			

Series 2750 - ACT												
2 1/2	2 7/8	C2723	2.37 (60,2)	2.25 (57,0)	2.98 (75,7)	0.31 (7,9)	2.30 (3,4)	4.24 (107,7)	4.30 (109,2)			
3	3 1/2	C2729	2.94 (74,7)	2.82 (71,5)	3.70 (94,0)	0.38 (9,7)	3.60 (5,4)	5.06 (128,5)	5.25 (133,4)			

Series 3000 - ACT												
1 1/2	1.90	C3014	1.44 (36,6)	1.32 (33,4)	1.87 (47,5)	0.22 (5,6)	1.10 (1,6)	2.96 (75,2)	3.05 (77,5)			

Series 3250 - ACT												
2	2 3/8	C3219	1.94 (49,3)	1.82 (46,1)	2.54 (64,5)	0.30 (7,6)	2.00 (3,0)	3.78 (96,0)	3.90 (99,1)			

(Metric Conversions are in Parentheses)

*NOTE: Pipe weight is base on Threaded and Coupled (T&C) Joining System

SIZE (in)		PRESSURE		TENSILE				COLLAPSE			
Pipe	Thread	Rating ⁽¹⁾ PSI (MPa)	Ultimate ⁽²⁾ ASTM D-1599 PSI (MPa)	Rating ⁽¹⁾ Lbs (kgs)	STAR ⁽²⁾ Ultimate Lbs (kgs)	Rating ⁽¹⁾ PSI (MPa)	Ultimate ⁽²⁾ ASTM D-2924 PSI (MPa)	Rating ⁽¹⁾ PSI (MPa)	Ultimate ⁽²⁾ ASTM D-2924 PSI (MPa)	Rating ⁽¹⁾ PSI (MPa)	Ultimate ⁽²⁾ ASTM D-2924 PSI (MPa)

Series 1000 - ACT													
5	5 1/2	1000	(6,9)	2600	(17,9)	27000	(12247)	130000	(58968)	400	(2,8)	2400	(16,5)
6	6 5/8	1000	(6,9)	2700	(18,6)	43000	(19505)	140000	(63504)	400	(2,8)	2500	(17,2)
8	8 5/8	1000	(6,9)	2700	(18,6)	73000	(33113)	215000	(97524)	400	(2,8)	2500	(17,2)

Series 1250 - ACT													
4	4 1/2	1250	(8,6)	3300	(22,8)	23000	(10433)	90000	(40824)	800	(5,5)	3000	(20,7)
5	5 1/2	1250	(8,6)	3400	(23,4)	37000	(16783)	130000	(58968)	1000	(6,9)	3200	(22,1)
6	6 5/8	1250	(8,6)	2900	(20,0)	41000	(18598)	140000	(63504)	600	(4,1)	2700	(18,6)
8	8 5/8	1250	(8,6)	3200	(22,1)	90000	(40824)	215000	(97524)	700	(4,8)	2900	(20,0)

Series 1500 - ACT													
3	3 1/2	1500	(10,3)	4200	(29,0)	17000	(7711)	60000	(27216)	1800	(12,4)	3900	(26,9)
5	5 1/2	1500	(10,3)	4300	(29,6)	47000	(21319)	130000	(58968)	1900	(13,1)	3900	(26,9)
6	6 5/8	1500	(10,3)	3700	(25,5)	53000	(24041)	140000	(63504)	1100	(7,6)	3400	(23,4)
6	7	1500	(10,3)	3400	(23,4)	56000	(25402)	175000	(79380)	900	(6,2)	3100	(21,4)
8	9 5/8	1500	(10,3)	3700	(25,5)	105000	(47628)	250000	(113400)	1200	(8,3)	3400	(23,4)

Series 1750 - ACT													
4	4 1/2	1750	(12,1)	4400	(30,3)	32000	(14515)	90000	(40824)	2100	(14,5)	4000	(27,6)
5	5 1/2	1750	(12,1)	4300	(29,6)	47000	(21319)	130000	(58968)	1900	(13,1)	3900	(26,9)
6	6 5/8	1750	(12,1)	4400	(30,3)	64000	(29030)	140000	(63504)	1900	(13,1)	4000	(27,6)
6	7	1750	(12,1)	4000	(27,6)	68000	(30845)	175000	(79380)	1600	(11,0)	3700	(25,5)
8	9 5/8	1750	(12,1)	4200	(29,0)	122000	(55339)	250000	(113400)	1700	(11,7)	3900	(26,9)

Series 2000 - ACT													
1 1/2	1.90	2000	(13,8)	7700	(53,1)	8000	(3629)	20000	(9072)	3500	(24,1)	7200	(49,6)
2 1/2	2 7/8	2000	(13,8)	5200	(35,9)	14000	(6350)	45000	(20412)	2500	(17,2)	4800	(33,1)
4	4 1/2	2000	(13,8)	5400	(37,2)	42000	(19051)	90000	(40824)	2500	(17,2)	5000	(34,5)
6	6 5/8	2000	(13,8)	5000	(34,5)	70000	(31752)	140000	(63504)	2500	(17,2)	4600	(31,7)
6	7	2000	(13,8)	4600	(31,7)	81000	(36742)	175000	(79380)	1600	(11,0)	4300	(29,6)
8	9 5/8	2000	(13,8)	4700	(32,4)	125000	(56700)	250000	(113400)	2400	(16,5)	4300	(29,6)

Series 2250 - ACT													
2	2 3/8	2250	(15,5)	6100	(42,1)	12000	(5443)	35000	(15876)	2750	(19,0)	5700	(39,3)
3	3 1/2	2250	(15,5)	5600	(38,6)	25000	(11340)	60000	(27216)	2750	(19,0)	5100	(35,2)

Series 2750 - ACT													
2 1/2	2 7/8	2500	(17,2)	6800	(46,9)	20000	(9072)	45000	(20412)	3250	(22,4)	6300	(43,4)
3	3 1/2	2500	(17,2)	6800	(46,9)	30000	(13608)	60000	(27216)	3250	(22,4)	6300	(43,4)

Series 2750 - ACT													
1 1/2	1.90	3000	(20,7)	7700	(53,1)	8000	(3629)	20000	(9072)	3500	(24,1)	7200	(49,6)

Series 3250 - ACT													
2	2 3/8	3500	(24,1)	7900	(54,5)	17000	(7711)	35000	(15876)	3750	(25,9)	7400	(51,0)

(Metric Conversions are in Parentheses)

Joining System Information

API THREADED SIZE - Inches	1 1/2		2 3/8		2 7/8		3 1/2		4 1/2		
Thread Type⁽⁴⁾	EUE 10rd		EUE 8rd		EUE 8rd		EUE 8rd		EUE 8rd		
Thread Length - In (mm)	2.36	(59,9)	2.94	(74,7)	3.25	(82,6)	3.50	(88,9)	3.88	(98,6)	
Make-Up Length Loss - In/Jt (mm/Jt)	2.06	(52,4)	2.56	(65,1)	2.88	(73,0)	3.13	(79,4)	3.50	(88,9)	
Make-Up Torque - Ft. Lbs. (mm)	• Optimum		125		(170)		150		(204)		
	• Minimum		100		(136)		125		(170)		
	• Maximum		175		(238)		225		(306)		
Recommended Make-Up Tool	No. 5 Strap								No. 11 Strap		
Pin Upset O.D. - In (mm)	2.15	(54,6)	260	(66,0)	3.10	(78,7)	3.75	(95,3)	4.75	(120,7)	
Handling Tools											
Elevators T&C (Shoulder Type) - In. ⁽⁶⁾	2 3/8		2 7/8		3 1/2		4 1/2		5 1/2		
Elevators IJ (Slip Type) ⁽⁶⁾	MYT		MYT		MYT		YT		YC		
Floor Slips (Standard Type) - In. ⁽⁷⁾	1 1/2		2 3/8		2 7/8		3 1/2		4 1/2		
Thread Compatibility											
FRP Long vs. Steel Short Form ⁽⁴⁾ (Extra Threads, Front of FRP Pin)	6		5		6		6		7		
Lubricant Usage (Joints/Gallon)	100		100		100		68		50		
Stretch Factor (in/lb. ft)	Series	in	(mm)	in	(mm)	in	(mm)	in	(mm)	in	(mm)
	1000	---	---	---	---	---	---	---	---	---	---
	1250	---	---	---	---	---	---	---	---	1.39	(35,3)
	1500	---	---	---	---	---	---	1.79	(45,4)	---	---
	1750	---	---	---	---	---	---	---	---	1.00	(25,5)
	2000	3.58	(90,9)	---	---	2.18	(55,4)	---	---	0.78	(19,8)
	2250	---	---	2.61	(66,4)	---	---	1.01	(25,6)	---	---
	2500	---	(86,3)	---	---	1.56	(39,6)	---	---	---	---
	3000	3.58	(90,9)	---	---	---	---	---	---	---	---
	3500	2.49	(63,2)	1.89	(48,1)	---	---	---	---	---	---

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

Corresponding Numbered Notes:

- Ratings** - All ratings are maximum operating limits. Exceeding these limits will void the warranty on all NOV Fiber Glass Systems pipe.
- Ultimates** - The typical mode of failure for pressure is weep and for tensile it is an across the joint pipe body shear.
- Collars** - Smaller O.D. collars are available upon request, subject to application approval. Any order for integral joint products may include up to 15% threaded and coupled pipe.
- Threads** - All 1 1/2" EUE 10rd and 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).
- Elevators T&C** - The 1000 & 1500 PSI products have smaller OD's which may work with the same size elevators as the thread size.
- Elevators IJ** - The setting plate must be removed so that the slips will properly set on the fiberglass pipe. NOV Fiber Glass Systems IJ tubing does not have an upset on the female end. 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.
- 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

API THREADED SIZE - Inches	5 1/2		6 5/8		7		8 5/8		9 5/8		
Thread Type⁽⁴⁾	OD 8rd		OD 8rd		OD 8rd		OD 8rd		OD 8rd		
Thread Length - In (mm)	4.74	(120,7)	4.25	(108,0)	4.85	(123,2)	4.85	(123,2)	5.13	(130,3)	
Make-Up Length Loss - In/Jt (mm/Jt)	4.38	(98,4)	3.88	(98,4)	4.50	(114,3)	4.50	(114,3)	4.75	(120,7)	
Make-Up Torque - Ft. Lbs. (mm)	• Optimum	400	(544)	500	(680)	525	(714)	700	(952)	630	(857)
	• Minimum	320	(436)	400	(544)	420	(572)	475	(646)	500	(680)
	• Maximum	560	(762)	650	(884)	735	(1000)	825	(1122)	880	(1200)
Recommended Make-Up Tool	Approved Power Tongs										
Pin Upset O.D. - In (mm)	5.55	(141,0)	6.65	(168,9)	7.05	(179,1)	8.65	(219,9)	9.65	(245,1)	
Handling Tools	6 7/8		7		7 5/8		9 5/8		10 3/4		
Elevators T&C (Shoulder Type) - In. ⁽⁶⁾	YC		MYT		YT		YT		Slip Type		
Elevators IJ (Slip Type) ⁽⁶⁾	5 1/2		6 5/8		7		8 5/8		9 5/8		
Floor Slips (Standard Type) - In. ⁽⁷⁾											
Thread Compatibility	5		6		7		9		11		
FRP Long vs. Steel Short Form ⁽⁴⁾ (Extra Threads, Front of FRP Pin)											
Lubricant Usage (Joints/Gallon)	34		34		26		26		26		
Stretch Factor (in/lb. ft)	Series	in	(mm)	in	(mm)	in	(mm)	in	(mm)	in	(mm)
	1000	1.22	(31,1)	0.72	(18,3)	---	---	0.44	(11,1)	---	---
	1250	0.89	(22,6)	0.77	(19,6)	---	---	0.36	(9,1)	---	---
	1500	0.68	(17,4)	0.60	(15,3)	0.56	(14,3)	---	---	0.30	(7,7)
	1750	0.68	(17,4)	0.49	(12,5)	0.47	(11,8)	---	---	0.26	(6,6)
	2000	---	---	0.42	(10,7)	0.39	(10,0)	---	---	0.23	(5,9)
	2250	---	---	---	---	---	---	---	---	---	---
	2500	---	---	---	---	---	---	---	---	---	---
	3000	---	---	---	---	---	---	---	---	---	---
	3500	---	---	---	---	---	---	---	---	---	---

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

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 (1,067 m) deep.
- 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.
- Anchoring is good practice.

Fishing

- Normal Procedures, Spear or Overshot.

Cutting

- Mechanical Jet Cutter.

Pipe Capacity					
Size (in)		Inside Diameter		Capacity	
Pipe	Thread	in	(mm)	Bbls/1,000 ft. (m ³ /km)	
1 1/2	1.90	1.50	(38,1)	2.20	(1,1)
2	2 3/8	1.94	(49,3)	3.70	(1,9)
2 1/2	2 7/8	2.37	(60,2)	5.40	(2,8)
3	3 1/2	2.94	(74,7)	8.40	(4,4)
3 1/2	4	3.33	(84,6)	10.80	(5,6)
4	4 1/2	3.85	(97,8)	14.40	(7,5)
4	4 1/2	3.91	(99,3)	14.80	(7,7)
5	5 1/2	4.74	(120,4)	21.80	(11,4)
6	6 5/8	5.50	(139,7)	29.40	(15,3)
6	7	5.93	(150,6)	34.20	(17,8)
8	8 5/8	7.74	(196,6)	58.10	(30,3)

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