

CASING AND JOINT SPECIFICATIONS FOR SM2535-110 AND ULTRA-SF JOINTS

<http://www.tubular.nssmc.com/product-services/octg/materials/data-sheet/sm2535-110> is the link to Sumitomo's tech page with data for SM2535 & other CRA grades.

OCT 28 2014

Alberto A.Gutierrez, RG (Geolex)

From: Bob Pedrick <BPedrick@cralloys.com>
Sent: Wednesday, May 28, 2014 12:11 PM
To: 'aag@geolex.com'
Cc: Matt Etter; Brad Huber
Subject: Technical data

Good afternoon Alberto. It was a pleasure to talk with you earlier.

I have listed the Burst and Collapse values of interest below for both Alloys 2535 and 28 Cr. They have identical values within any single strength level.

	Min	YS	Burst	Collapse
7" x 23# (0.317" wall)	80		6,340 psi	3,830 psi
	110		8,720	4,440
	125		9,910	4,650
7" x 26# (0.362" wall)	80		6,600	5,410
	110		9,100	6,230
	125		10,300	6,450
7" x 29# (0.408" wall)	80		8,160	7,030
	110		11,220	8,530
	125		12,750	9,110

Please talk with Brad Huber about the specifications you require as this can have commercial implications.

Regards,

Bob Pedrick | Technical Quality



Corrosion Resistant Alloys | Houston, Texas

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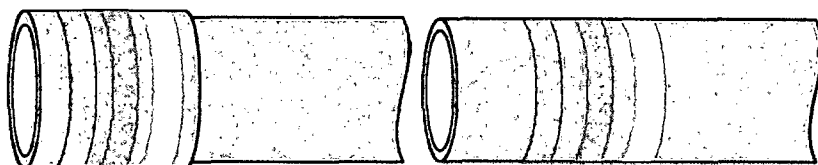
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Please select a material application among SM series and proprietary grades.

Selection Tool

Nickel Alloy ▼ SM2535-110 ▼

Nickel Alloy - SM2535-110



Coupling: Green, Orange, White Pipe Body: Green, Orange, White
[pdf document](#)

[open all](#)

General description

SM2535 is an Austenitic Fe (Iron) base material required for critical well conditions combining high concentrations of CO₂, H₂S and Chlorides. Launched in the mid-80's as an innovative development, SM2535 has become the reference product for Tubing & Liner applications in severe environments. It benefits from NSSMC's unrivaled know-how in manufacturing CRA (Corrosion Resistance Alloys) materials and best-in-class quality control.

SM2535-110 is manufactured based on API 5CT / ISO 11960 and API 5CRA / ISO 13680.

Diameters: 2 3/8" to 7 5/8" (larger sizes can be available upon request)

Weights: as per API 5CT/ISO 13680. Please note that while the API 5CT/ISO 11960 linear weight will define the pipe wall thickness the actual linear weight of the material will be slightly greater due to the heavier density of the elements it contains versus carbon steel.

Special application: Please contact NSSMC engineer, should you require specific size, weight, drift, or any other characterization.

Reference document

- Proprietary SM2535 series. TGP-2020 (latest revision)
- API 5CT / ISO 11960
- NACE MR0175 / ISO 15156
- API RP 5C1 / ISO 10405
- API 5CRA / ISO 13680
- VAM Book
- NSSMC Storage and handling procedure for CRA materials

Applicable environment

Corrosive environments featuring the combined presence of CO₂ + H₂S + Chloride, in temperatures up to 149 °C, in absence of elemental Sulfur

Its primary function is Tubing and Liner, sections permanently exposed to production fluids

Final material application will depend upon CO₂, H₂S, Temperature, pH and expected Chlorides content. For a more detailed assessment please contact NSSMC engineers Manufacturing

Process	Description
Steel making	Steel shall be made by electric furnace process followed by Vacuum Oxygen Decarburization (VOD) process &/or Argon Oxygen Decarburization (AOD) Process
Pipe making	Manufactured through Cold working the hot formed tubular product and shall be furnished in a cold worked conditions
Heat treatment	Solution Annealing Process before final cold drawing

Chemical Composition

(mass %)

C	Si	Mn	Cu	Ni	Cr	Mo
≤ 0.03	≤ 0.50	≤ 1.00	≤ 1.50	29.5 ~ 36.5	24.0 ~ 27.0	2.5 ~ 4.0

UNS Number: N08535

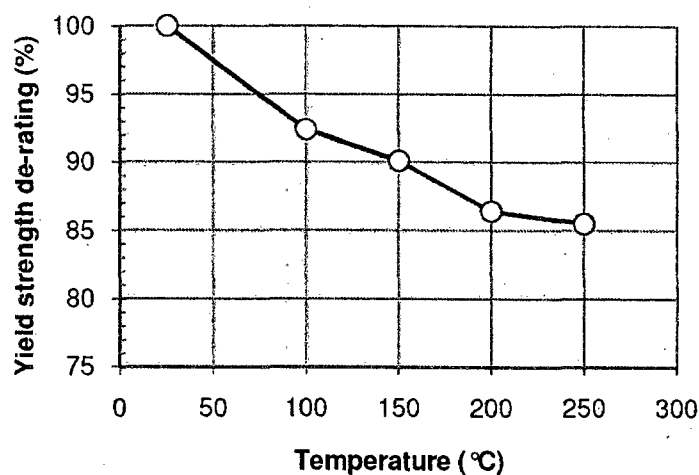
Specified mechanical properties

Yield strength ksi		Tensile strength ksi	Elongation %	Hardness HRC	Technical Note
Min	Max	Min	Min	Max	
110	140	115	12	32.0	-

Physical and thermal properties

	unit	25°C	100°C	150°C	200°C	250°C
Density	Kg/m ³	8000	7980	7960	7940	7930
Young's modulus	GPa	193	190	188	186	184
Poisson's Ratio	-	0.29	0.29	0.29	0.30	0.30
Tensile strength de-rating	%	100.0	93.5	90.1	86.4	85.5
Yield strength de-rating	%	100.0	92.4	90.1	86.3	85.5
Thermal Diffusivity	x10 ⁻⁶ m ² /s	3.02	3.44	3.58	3.67	3.88
Heat Capacity	x10 ⁶ J/m ³ deg.C	3.26	3.21	3.26	3.33	3.43
Thermal Conductivity	W/m deg.C	9.8	11.0	11.7	12.2	13.3
Specific Heat	J/Kg deg.C	407	402	409	420	432
Thermal expansion	x10 ⁻⁶ / deg.C	-	12.5	12.9	13.3	13.6

* Data will be shortly available.



Technical information

In wet combined CO₂ & H₂S environments, usage of SM2535 is recommendable starting from H₂S partial pressure exceeding 0.1 bar:

- for lower H₂S partial pressure ranging between 0.1 to 1.0 bar, these materials should be considered depending upon the combination of critical variables such as pH, Chloride content, S⁰ and temperature.
- for H₂S partial pressures exceeding 1.0 bar the only metallurgical solution to counter corrosion is to consider Austenitic Fe base or Nickel base materials.

Since H₂S is a potent pitting agent, a passivation film composed of Ni-S, Cr-O & Mo-S is required to maintain stability and protect the bulk material from corrosion attack up to a defined temperature threshold in wet combined CO₂ & H₂S environment. This is achieved through alloying of Cr-Ni & Mo.

SM2535 is a nominal 3% Molybdenum material recognized by ISO-13680 as Group 3 Category 25-32-3. This material is referenced as 4c material in NACE MR0175 /ISO 15156-3 (please refer to Fig. 1)

Material types	Cr mass fraction min. %	Ni + Co mass fraction min. %	Mo mass fraction min. %	Mo + W mass fraction min. %	Metallurgical condition
Type 4a	19	29.5	2.5		Solution-annealed or annealed
Type 4b	14.5	52	12		Solution-annealed or annealed
Type 4c	19.5	29.5	2.5		Solution-annealed or annealed or cold-worked
Type 4d	19	45		6	Solution-annealed or annealed or cold-worked
Type 4e	14.5	52	12		Solution-annealed or annealed or cold-worked

Fig 1: NACE MR0175 / ISO 15156-3 2003 Table A12

For this type of material, NACE MR0175 /ISO 15156-3 indicate the following application limits as general guidelines :

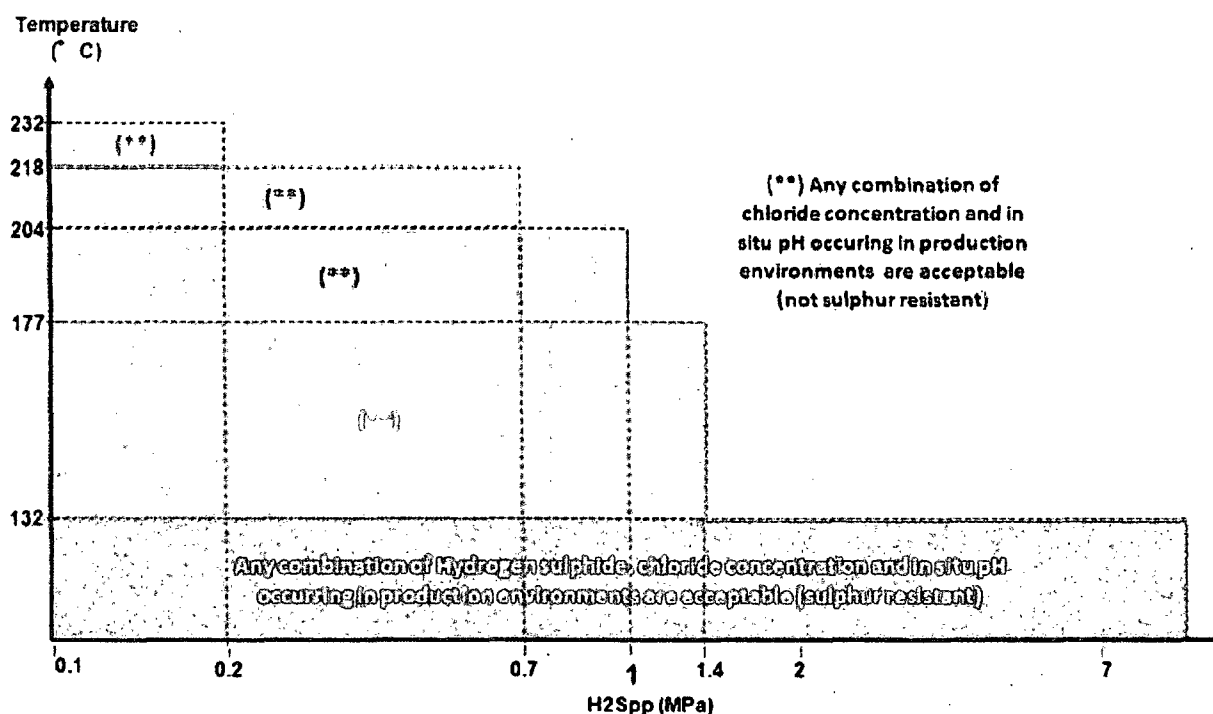


Fig 2: Material 4c application boundaries per NACE MR0175 / ISO 15156-3 2003 (Ref. Table A-14)

According to NACE MR0175 / ISO 15156-3 2003, final material selection for the intended service will be equipment user's responsibility and detailed information exchange with manufacturer is highly recommendable.

NSSMC, in absence of elemental sulfur, recommends usage of SM2535 materials for temperature up to 149°C (300°F) higher than 132°C (270°F) limit specified by ISO 15156-3.

This difference is based on NSSMC's unrivaled know-how in manufacturing austenitic stainless steel since the mid 80's and best-in-class quality control.

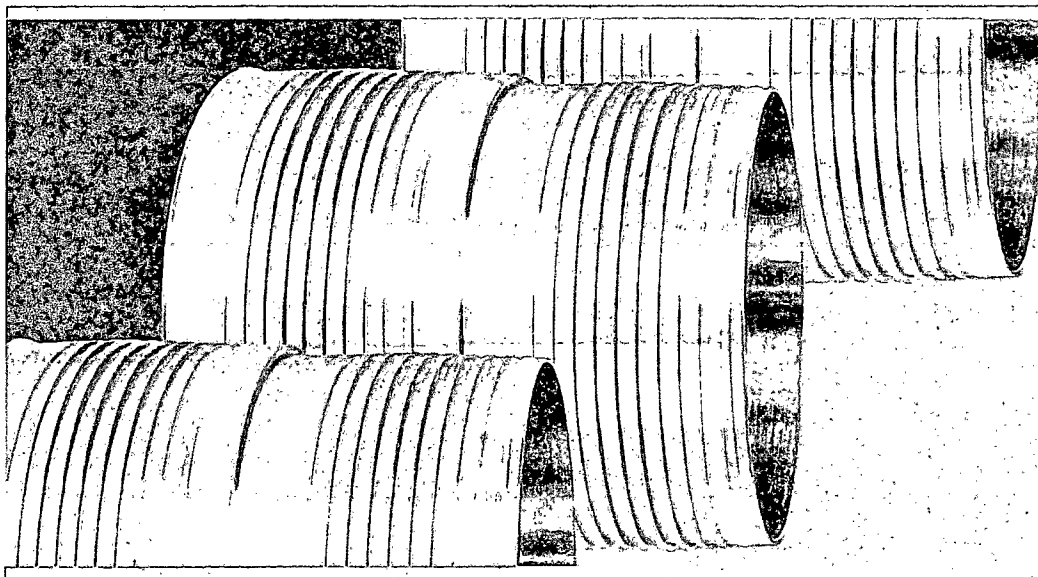
For fit for purpose conditions (** in Fig 2), NSSMC proposes verification test under the actual field condition.

Fig 3 below represents NSSMC SSC limits on various Austenitic materials.

Case history from the field
Storage and handling procedure

- [NSSMC CORPORATE WEBSITE](#)
- [Legal Notice](#)
- [Beware of counterfeit](#)

ULTRA-SF™
Semi-Flush Connection
3 1/2" - 13 5/8"



ULTRA-SF™
Semi-Flush Connection

Performance and Flexibility

The slim-line ULTRA-SF Premium Connection is the strongest semi-flush connection with the highest tensile efficiency of any semi-flush casing connection on the market and equal—or greater—compression efficiency to match. The ULTRA-SF Premium Connection is flexible enough to navigate sharp curves with ease while its locked metal center-shoulder seal maintains gas tightness. As our most popular premium connection, the ULTRA-SF Premium Connection is an integral piece of string designs for both major and independent operators alike.

Innovative Solutions

TMK IPSCO realizes that as drilling evolves, the stresses on tubulars are constantly increasing. Our team of technical experts is dedicated to engineering innovative connections to enable operators to tackle their most challenging targets. While traditional connections only offer strength in tension, every ULTRA™ Premium Connection is designed with our patented FullContact™ thread form which provides excellent tensile, compression and bending capacity translating into the flexibility necessary to navigate the curves of modern wells. The portfolio of ULTRA Premium Connections includes formidable threaded and coupled connections as well as slim-profile integral joint connections offering a range of options suited for every drilling application.

Global Strength

TMK IPSCO is one of the largest North American producers of welded and seamless pipe and premium connections dedicated to serving the oil and gas industry and many industrial markets. Our legacy of quality, industry-renowned customer service and focus on innovative products and services allow us to drive unparalleled value for our customers. TMK IPSCO is committed to be North America's energy tubular supplier of choice, with facilities strategically located in the key energy producing areas of North America. We operate eleven downstream pipe, processing and premium connection facilities complete with accessories.

As a part of OAO TMK, one of the world's largest pipe producers, we now offer an expanded range of products to meet all your energy tubular needs.



• 13 World Head Centers
• 102 Production Plants
• 14 Manufacturing and Sales Offices
• Research & Development

ULTRA-SF Product Summary: Pipe and Connection Data

For the ULTRA-SF Semi-Flush Connection: *compression* mechanical efficiency ≥ *tensile* mechanical efficiency.

Nominal OD in	Nominal Weight lb/ft	PE Weight lb/ft	PIPE BODY			Average PRA in ²	CONNECTION					Yield Load lbs	L-80		T-65		P-110		O-125				
			Wall Thickness in	Nominal ID in	Drift Dia in		Box OD in	Pin ID in	Termin Efficiency	% Compression Efficiency	Makeup Loss in		Reference Depth ft	Parting Load lbs	Yield Load lbs	Reference Depth ft	Parting Load lbs	Yield Load lbs	Reference Depth ft	Parting Load lbs	Yield Load lbs	Reference Depth ft	Parting Load lbs
3 1/2	12.70	12.52	0.375	2.750	2.625	3.682	3.638	2.719	90.0	91.4	5.593	265,000	14,100	308,000	316,000	16,800	343,000	365,000	19,400	407,000	416,000	22,100	443,000
3 1/2	15.50	15.37	0.476	2.548	2.423	4.522	3.669	2.517	90.6	92.0	5.823	329,000	14,200	381,000	391,000	16,900	425,000	452,000	19,600	504,000	514,000	22,200	548,000
3 1/2	17.00	16.83	0.530	2.440	2.315	4.945	3.657	2.409	90.2	91.5	6.392	358,000	14,100	415,000	425,000	16,800	462,000	492,000	19,400	548,000	559,000	22,100	596,000
4	11.60	11.34	0.286	3.428	3.303	3.337	4.154	3.384	90.1	91.7	5.464	242,000	14,200	278,000	287,000	16,800	311,000	332,000	19,500	368,000	377,000	22,100	401,000
4	13.20	12.93	0.330	3.340	3.215	3.805	4.152	3.309	89.7	91.2	5.004	274,000	14,100	316,000	325,000	16,700	352,000	377,000	19,400	418,000	428,000	22,000	455,000
4	14.68	14.68	0.380	3.240	3.115	4.322	4.148	3.209	90.5	92.0	5.809	314,000	14,200	362,000	373,000	16,900	404,000	432,000	19,600	479,000	490,000	22,200	521,000
4 1/2	13.50	13.04	0.290	3.920	3.795	3.836	4.655	3.876	90.0	91.5	5.456	277,000	14,100	318,000	328,000	16,700	355,000	380,000	19,400	421,000	433,000	22,100	458,000
4 1/2	15.10	14.98	0.337	3.826	3.701	4.407	4.645	3.782	91.0	92.5	5.299	322,000	14,300	369,000	382,000	17,000	413,000	442,000	19,600	489,000	503,000	22,300	533,000
4 1/2	16.60	16.52	0.375	3.750	3.625	4.860	4.650	3.719	90.5	91.9	5.782	353,000	14,200	405,000	419,000	16,900	452,000	485,000	19,500	536,000	551,000	22,200	584,000
4 1/2	17.00	16.72	0.380	3.740	3.615	4.918	4.656	3.709	91.4	92.9	5.290	361,000	14,300	414,000	429,000	17,100	463,000	496,000	19,700	548,000	564,000	22,400	597,000
4 1/2	18.80	18.69	0.430	3.640	3.515	5.498	4.659	3.609	86.7	87.0	5.096	383,000	13,600	439,000	455,000	16,200	491,000	527,000	18,700	582,000	599,000	21,300	634,000
5	15.00	14.87	0.296	4.408	4.283	4.374	5.160	4.377	88.7	90.2	5.424	311,000	13,900	355,000	370,000	16,500	398,000	428,000	19,100	471,000	486,000	21,700	513,000
5	18.00	17.93	0.362	4.276	4.151	5.275	5.160	4.245	90.9	92.4	5.651	385,000	14,300	439,000	457,000	16,900	492,000	529,000	19,600	582,000	601,000	22,300	635,000
5	20.30	20.01	0.408	4.184	4.059	5.886	5.180	4.153	88.2	89.6	5.591	416,000	13,800	475,000	495,000	16,400	532,000	573,000	19,000	630,000	651,000	21,600	687,000
5	20.80	20.63	0.422	4.156	4.031	6.069	5.178	4.125	88.4	89.8	5.820	430,000	13,800	491,000	511,000	16,500	550,000	592,000	19,100	651,000	673,000	21,700	710,000
5	21.40	21.30	0.437	4.126	4.001	6.264	4.460	4.095	88.6	90.0	5.368	446,000	13,900	508,000	529,000	16,500	569,000	612,000	19,100	674,000	696,000	21,700	735,000
5	23.20	23.08	0.478	4.044	3.919	6.791	5.171	4.000	90.1	91.5	5.988	491,000	14,100	561,000	583,000	16,800	628,000	678,000	19,500	743,000	768,000	22,100	811,000
5	24.10	24.03	0.500	4.000	3.875	7.069	5.168	3.969	89.1	90.5	6.159	505,000	14,000	577,000	601,000	16,600	646,000	695,000	19,200	765,000	791,000	21,900	834,000
5 1/2	17.00	16.87	0.304	4.892	4.767	4.962	5.663	4.848	91.2	92.8	5.856	363,000	14,300	413,000	432,000	17,000	463,000	500,000	19,700	548,000	567,000	22,400	598,000
5 1/2	20.00	19.81	0.361	4.778	4.653	5.828	5.646	4.734	90.2	91.6	5.471	422,000	14,200	479,000	500,000	16,800	537,000	580,000	19,500	635,000	659,000	22,100	693,000
5 1/2	23.00	22.54	0.415	4.670	4.545	6.630	5.696	4.626	91.6	93.0	5.371	487,000	14,400	553,000	579,000	17,100	620,000	670,000	19,800	734,000	762,000	22,500	801,000
5 1/2	26.00	25.54	0.476	4.548	4.423	7.513	5.688	4.504	92.0	93.4	6.165	555,000	14,400	630,000	659,000	17,200	706,000	763,000	19,900	836,000	867,000	22,600	912,000
5 1/2	26.80	26.70	0.500	4.500	4.375	7.854	5.670	4.469	89.1	90.4	6.165	561,000	14,000	637,000	667,000	16,600	715,000	772,000	19,200	846,000	877,000	21,800	923,000
5 1/2	29.70	29.64	0.562	4.376	4.251	8.718	5.692	4.345	84.5	82.0	5.751	592,000	13,300	672,000	702,000	15,700	753,000	814,000	18,300	891,000	925,000	20,800	975,000
6 5/8	24.00	23.58	0.592	5.921	5.796	6.937	6.789	5.890	89.9	91.4	5.368	501,000	14,100	562,000	594,000	16,700	632,000	689,000	19,400	747,000	782,000	22,100	817,000
6 5/8	28.00	27.65	0.675	5.791	5.666	8.133	6.833	5.760	90.5	91.9	5.343	591,000	14,200	663,000	701,000	16,900	745,000	812,000	19,500	881,000	923,000	22,200	964,000
6 5/8	32.00	31.20	0.745	5.675	5.550	9.177	6.835	5.644	91.7	93.1	6.199	676,000	14,400	759,000	803,000	17,100	853,000	929,000	19,800	1,009,000	1,056,000	22,500	1,103,000
7	23.00	22.63	0.317	6.366	6.241	6.655	7.176	6.335	90.5	92.0	6.081	483,000	14,200	540,000	574,000	16,900	608,000	664,000	19,500	719,000	756,000	22,200	787,000
7	26.00	25.66	0.362	6.276	6.151	7.549	7.157	6.232	90.8	92.2	5.534	550,000	14,200	615,000	653,000	16,900	692,000	756,000	19,600	818,000	859,000	22,300	895,000
7	29.00	28.72	0.408	6.184	6.059	8.449	7.208	6.153	90.4	91.9	5.221	613,000	14,200	686,000	728,000	16,800	772,000	844,000	19,500	912,000	958,000	22,200	999,000
7	32.00	31.67	0.453	6.094	6.000	9.317	7.212	6.071	90.6	92.0	5.934	678,000	14,200	758,000	805,000	16,900	853,000	933,000	19,600	1,009,000	1,060,000	22,300	1,104,000
7	35.00	34.58	0.498	6.004	5.879	10.172	7.180	5.973	89.1	90.4	6.183	728,000	14,000	813,000	864,000	16,600	916,000	1,000,000	19,200	1,082,000	1,137,000	21,900	1,185,000
7	38.00	37.26	0.540	5.920	5.795	10.959	7.240	5.889	87.8	89.0	6.059	772,000	13,800	863,000	917,000	16,400	972,000	1,062,000	19,000	1,149,000	1,207,000	21,500	1,257,000
7	41.00	40.39	0.590	5.820	5.695	11.881	7.243	5.789	88.9	90.2	6.827	848,000	13,900	948,000	1,007,000	16,600	1,067,000	1,167,000	19,200	1,262,000	1,326,000	21,800	1,381,000
7	42.70	42.55	0.625	5.750	5.625	12.517	7.243	5.719	89.6	90.8	7.294	901,000	14,100	1,007,000	1,070,000	16,700	1,133,000	1,238,000	19,300	1,340,000	1,408,000	22,000	1,466,000
7 5/8	26.40	25.56	0.328	6.969	6.844	7.519	7.792	6.938	88.3	89.8	5.974	532,000	13,800	592,000	633,000	16,500	668,000	733,000	19,100	789,000	833,000	21,700	864,000
7 5/8	29.70	29.04	0.375	6.875	6.750	8.541	7.786	6.844	88.6	90.0	5.585	607,000	13,900	675,000	721,000	16,500	761,000	835,000	19,100	899,000	949,000	21,700	985,000
7 5/8	33.70	33.04	0.430	6.765	6.640	9.720	7.839	6.734	91.3	92.7	5.583	712,000	14,300	791,000	846,000	17,000	892,000	979,000	19,700</				

ULTRA-SF™

Semi-Flush Connection

3 1/2" - 13 5/8"

The Strongest Semi-Flush Connection

- Highest tensile efficiency of any semi-flush casing connection
- Compression efficiency equal to or greater than its tensile efficiency
- Pressure ratings exceed API minimum internal yield and collapse pressure

FullContact™ Threads

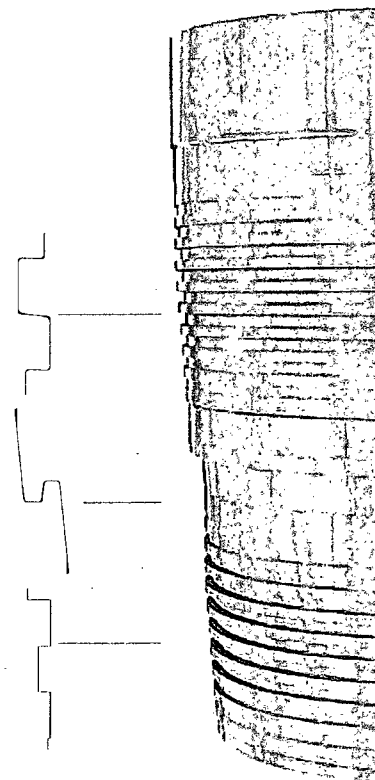
- Highest compression efficiency
- High tension and bending capacity
- Deep, easy stabbing and quick, easy make-up with no cross threading risk

Locked Metal Center-Shoulder Seal

- High torque resistance
- High fatigue resistance
- External factors (axial loads, temperature, dope, make-up torque) do not affect seal performance

Run In/Run-Out Threads

- Maximum critical section area
- Increases overall connection strength



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