

PTECH+ DRILLING TUBULARS LLC



PERFORMANCE TECHNOLOGY PLUS C O N N E C T I O N

MAXIMUM TORQUE, IMPROVED FATIGUE RESISTANCE
AND ENHANCED STREAMLINE DESIGN



Performance Technology Plus Connection Comparison

PIPE BODY DATA

TOOL JOINT DATA

Nominal OD	Nominal Weight	Upset	Grade	Wall Thickness	Nominal ID	Torsional Yield Strength	Tensile Strength	Collapse Pressure	Internal Pressure	Connection Type	Connection OD	Connection ID	Torsional Yield Strength	Tensile Yield Strength	Make-up Torque	TJ/Pipe Torsional Ratio	Pin Tong Space	Box Tong Space
in.	lbs/ft			in.	in.	ft-lbs	lbs	psi	psi		in.	in.	ft-lbs	lbf	ft-lbs		in.	in.
4.000	14.00	IU	S135	0.330	3.340	41,918	513,646	20,141	19,491	PTECH39+	4 7/8	2 11/16	38,800	732,800	23,300	0.93	11	13.5
	14.00	IU	S135	0.330	3.340	41,918	513,646	20,141	19,491	NC38	4 7/8	2 9/16	20,186	648,916	12,112	0.48	9	12
	14.00	IU	S135	0.330	3.340	41,918	513,646	20,141	19,491	NC40	5 1/4	2 11/16	25,531	776,406	15,404	0.61	9	12
4.500	16.60	IEU	S135	0.337	3.826	55,453	595,004	16,773	17,693	PTECH48+	6 1/8	3 1/4	78,700	1,254,500	47,200	1.29	10	13
	16.60	IEU	S135	0.337	3.826	55,453	595,004	16,773	17,693	NC46	6 1/4	2 3/4	44,359	1,183,908	26,923	0.80	9	12
5.000	19.50	IEU	S135	0.362	4.276	74,100	712,070	15,672	17,105	PTECH51+	6 1/2	3 3/4	82,500	1,222,800	49,500	1.11	10	13
	19.50	IEU	S135	0.362	4.276	74,100	712,070	15,672	17,105	NC50	6 5/8	2 3/4	63,393	1,551,706	38,044	0.86	9	12
5.500	21.90	IEU	S135	0.361	4.778	91,278	786,809	12,679	15,507	PTECH55+	6 5/8	4 1/4	82,100	1,147,500	49,300	0.90	11	13
	21.90	IEU	S135	0.361	4.778	91,278	786,809	12,679	15,507	5-1/2 FH	7 1/4	3 1/2	72,213	1,619,231	43,490	0.79	10	12
5.500	24.70	IEU	S135	0.415	4.670	101,833	894,999	17,023	17,826	PTECH59+	7 1/4	4 1/4	112,700	1,528,900	67,600	1.11	11	13
	24.70	IEU	S135	0.415	4.670	101,833	894,999	17,023	17,826	5-1/2 FH	7 1/4	3 1/2	72,213	1,619,231	43,490	0.71	10	13
6.625	27.70	IEU	S135	0.362	5.901	137,330	961,556	7,813	12,909	PTECH68+	8 1/4	5 1/2	143,500	1,633,800	86,100	1.04	11	14
	27.70	IEU	S135	0.362	5.901	137,330	961,556	7,813	12,909	6-5/8 FH	8 1/2	4 1/4	108,353	2,102,260	65,535	0.79	10	13

* Tool Joint Tongs are 3" LTS as a standard for the PTECH+ product line.

Performance Technology Plus Connection Drill Pipe Tables

TUBE BODY

TOOL JOINT

Size OD	Nominal Weight	Upset Type	Grade	Wall Thickness	Nominal ID	Torsional Yield Strength	Tensile Yield Strength	Connection Type	Outside Diameter	Inside Diameter	Torsional Yield Strength	Tensile Yield Strength	Make-up Torque	Torsional Ratio Tool Joint to Pipe	Pin Tong Space	Box Tong Space
in.	lbs/ft			in.	in.	ft-lbs	lbf		in.	in.	ft-lbs	lbf	ft-lbs		in.*	in.*
2 3/8	4.85	EU	S	0.190	1.995	8,574	176,071	PTECH27+	3 3/8	1 3/4	12,200	311,200	7,300	1.42	10	11
	6.65	EU	S	0.280	1.815	11,251	248,786	PTECH27+	3 3/8	1 3/4	12,200	311,200	7,300	1.08	10	11
2 7/8	6.85	EU	S	0.217	2.441	14,549	244,624	PTECH32+	3 7/8	2 1/8	18,500	434,400	11,100	1.27	10	11
	10.40	EU	S	0.362	2.151	20,798	385,820	PTECH32+	3 7/8	2 1/8	18,500	434,400	11,100	0.89	10	11
3 1/2	13.30	EU	S	0.368	2.764	33,392	488,825	PTECH37+	4 3/4	2 11/16	33,300	634,800	20,000	1.00	11	13.5
	15.50	EU	S	0.449	2.602	37,954	580,995	PTECH37+	4 3/4	2 9/16	37,100	703,500	22,200	0.98	11	13.5
4	14.00	IU	S	0.330	3.340	41,918	513,646	PTECH39+	4 7/8	2 11/16	38,800	732,800	23,300	0.93	11	13.5
	15.70	IU	S	0.380	3.240	46,458	583,413	PTECH41+	5 1/4	2 13/16	49,900	872,400	29,900	1.07	10	13
4 1/2	16.60	IEU	S	0.337	3.826	55,453	595,004	PTECH48+	6 1/8	3 1/4	78,700	1,254,500	47,200	1.42	10	13
	20.00	IEU	S	0.430	3.640	66,421	742,244	PTECH48+	6 1/8	3 1/4	78,700	1,254,500	47,200	1.18	10	13
5	19.50	IEU	S	0.362	4.276	74,100	712,070	PTECH51+	6 1/2	3 3/4	82,500	1,222,800	49,500	1.11	10	13
	25.60	IEU	S	0.500	4.000	94,062	954,259	PTECH51+	6 1/2	3 3/4	82,500	1,222,800	49,500	0.88	10	13
5 1/2	21.90	IEU	S	0.361	4.778	91,278	786,809	PTECH55+	6 5/8	4 1/4	82,100	1,147,500	49,300	0.90	11	13
	24.70	IEU	S	0.415	4.670	101,833	894,999	PTECH59+	7 1/4	4 1/4	112,700	1,528,900	67,600	1.11	11	13
6 5/8	25.20	IEU	S	0.330	5.965	127,044	881,035	PTECH68+	8 1/4	5 1/2	143,500	1,633,800	86,100	1.13	11	13
	27.70	IEU	S	0.362	5.901	137,330	961,556	PTECH68+	8 1/4	5 1/2	143,500	1,633,800	86,100	1.04	11	13
	34.02	IEU	S	0.522	5.581	183,962	1,351,130	PTECH68+	8 1/4	5 1/8	168,400	2,056,300	101,000	0.92	11	13
	40.00	IEU	S	0.625	5.375	210,031	1,590,430	PTECH68+	8 1/4	5 1/8	168,400	2,056,300	101,000	0.80	11	13

* Tool Joint Tongs are 3" LTS as a standard for the PTECH+ product line.

PERFORMANCE TECHNOLOGY PLUS C O N N E C T I O N

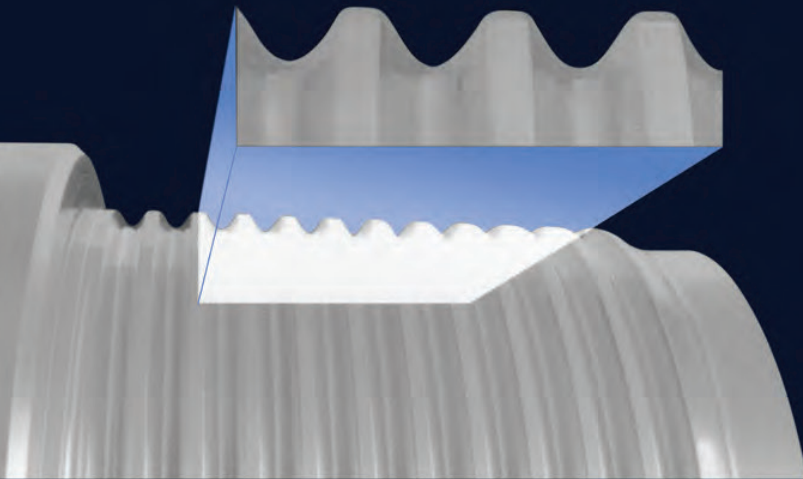
The Performance Technology Plus Connection is a new increased torque connection with exceptional torsion and fatigue properties designed to outperform and outlast the competition.

The Performance Technology Plus Connection is engineered and manufactured for maximum performance, giving you the strength and power you need without the premium cost.

The Performance Technology Plus Connection's increased critical cross-sectional areas and shoulder contact areas create a unique design that increases the mechanical properties of the connection over the competition.

The Performance Technology Plus Connection also takes advantage of 135ksi specified material yield strength (SMYS) to further increase the performance of the connection design.

The Performance Technology Plus Connection thread forms large single root radius reduces peak stresses in the connection, reduces connection stiffness and increases fatigue resistance.



Design Validation

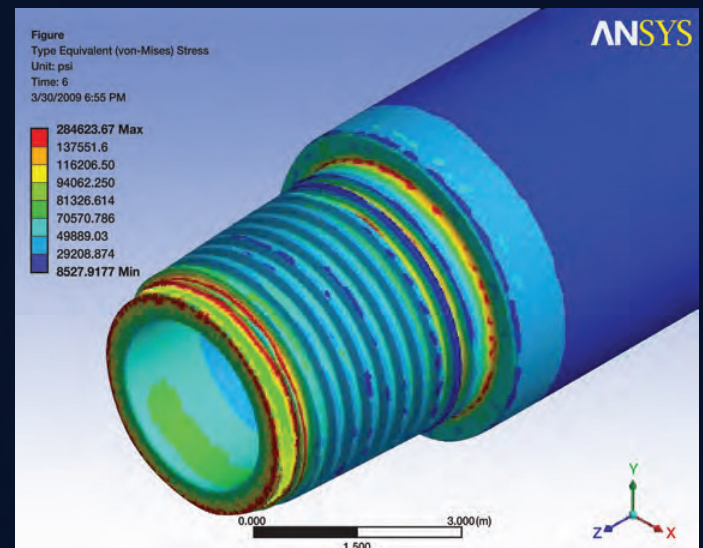
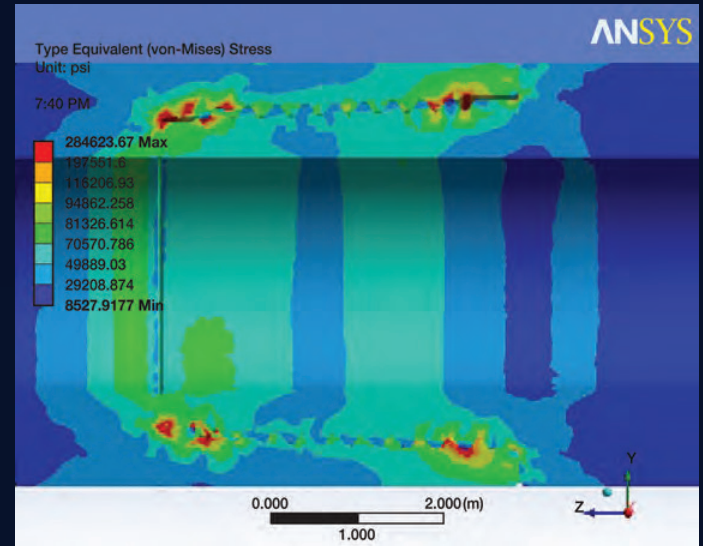
The Performance Technology Plus Connection Design has gone through the following testing and design validation.

- FEA analysis of Von Mises stress distribution
- Torque to failure
- Multiple make and breaks
- Comparative fatigue testing



FEA Analysis of Performance Technology Plus Connection VME Stress Distribution

The Performance Technology Plus Connection Design Models were numerically analyzed using ANSYS® X64ed. v12.1 to show the stress in the connection at both minimum and maximum internal gap tolerances due to make-up torque.



The FEA analysis confirms the reduced peak stresses and SCF (stress concentration factor) in the thread roots. The benefit is a more robust connection and superior fatigue resistance.

Comparative Fatigue Performance

Performance Technology Plus Connection Thread Form shows a considerable enhancement over API Thread Form.

Performance Technology Plus Connection 39

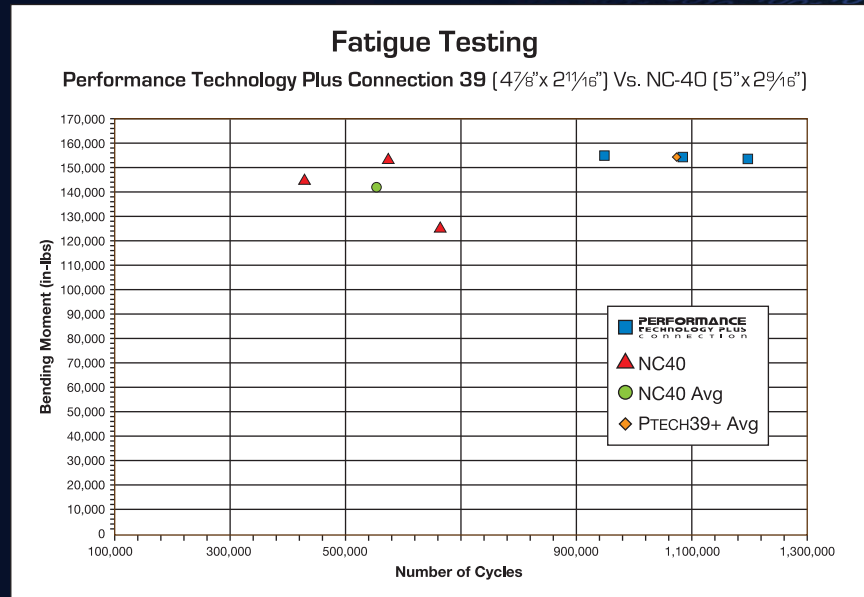
Average Cycles: 1,076,947

Average Bending Moment: 154,723 in-lbs

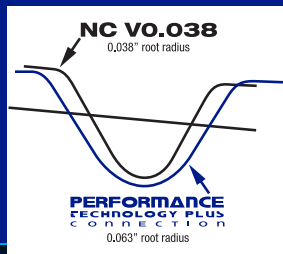
NC-40

Average Cycles: 556,631

Average Bending Moment: 141,648 in-lbs

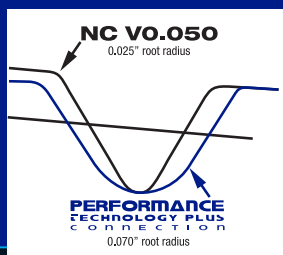


EXTENDED FATIGUE PERFORMANCE



- The Performance Technology Plus Connection 39 shows an increase in fatigue resistance of approximately 2.7 times that of NC-38 and 1.9 times greater than NC-40.
- A reduction in Tool Joint Stiffness.

Connection Type	Connection OD	Connection ID	Connection Stiffness About the CCS	Tool Joint Stiffness	Difference in Connection Stiffness	Difference in TJ Stiffness
	IN.	IN.	IN ⁴	IN ⁴	%	%
PTech39+	4.875	2.688	25.1	25.2		
NC-38	5.000	2.125	29.1	29.7	13.9%	15.2%



- Larger Performance Technology Plus Connections have even greater reduced Tool Joint Stiffness – from 20% to 39%.

Connection Type	Connection OD	Connection ID	Connection Stiffness About the CCS	Tool Joint Stiffness	Difference in Connection Stiffness	Difference in TJ Stiffness
	IN.	IN.	IN ⁴	IN ⁴	%	%
PTech55+	6.625	4.250	77.1	78.5		
5-1/2 FH	7.250	3.500	124.4	128.2	38.0%	38.8%
PTech59+	7.250	4.250	117.4	119.6		
5-1/2 FH	7.500	3.250	146.0	149.8	19.6%	20.2%