Drilling Tools
General Catalog

ThyssenKrupp Materials Oil & Gas

ThyssenKrupp

Notes

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Steel making and forging

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Steel making

ThyssenKrupp Drilling Tools are made from AISI 4145 H modified alloy steel, forged and fully heat treated to API and other specifications.
ThyssenKrupp most modern steel plants use electric remelt furnaces, ladle refining and vacuum degassing.
Raw material consists of selected steel scrap and ferro-alloys. Special care is taken to produce a clean and uniform steel during this triple melting process.
The chemistry of the steel is verified continuously by 10 chemical analyses during the melting process.
Further cleaning of the steel is provided with the bottom pouring method for ingots of larger sizes.
Most of ThyssenKrupp Drilling Tools are made from bars poured by a custom designed continuous casting unit.
Using this slow process, continuous casting assures a uniform and homogeneous steel free of unwanted inclusions and gases.
Excess material is instantly removed by a built-in gas cutting process which assures clean and uniform material up to the very end of each bar.

Steel Grades

ThyssenKrupp have also developed a new steel grade for use in Sour Service.This proprietary steel grade, 4145H Mod. 45 has the same mechanical properties as AISI 4145 H, but offers vastly improved resistance to H2S embrittlement.
Drilling tools can also be made from non-magnetic steels for directional requirements and MWD/LWD Services.
Please refer to page 14 for details.

Forging

Most ThyssenKrupp Drilling Tools are forged on a unique radial forge designed to provide shaped forgings and bars for kelly's, drill collars, heavy weights and other ThyssenKrupp drilling equipment.
Forgings are tough, ductile, have uniform grain flow and metallurgical structures to assure material integrity, fatigue resistance and strength.
The forging cycle on a radial hammer forge is extremely short and excellent time-temperature control can be achieved.
The bar is turned by manipulators. A multitude of radially arranged hammers allows this forge to shape round forgings to desired dimensions. The forge is totally computer controlled.

Heat treating and quality

Heat treating

Following this unique forging process is a custom designed heat treating line. Each bar is moved and turned on skewed rollers through the heat treating furnace which gives uniform heating from all sides.

Each bar is then water quenched by ring jets in a barrel type quenching unit. This process provides the required strength of the forged material. In order to obtain the mechanical properties of the finished product, the bars are tempered in a tempering furnace to complete the heat treating process.

Quality

ThyssenKrupp Drilling Tools are made in most recent manufacturing plants and to highest standards.
All products are made to API specifications 7-1 & 7-2 standards.

In addition ThyssenKrupp Materials France guarantees that ThyssenKrupp Drilling Tools are meeting NS-1 standards.

Mill certificates and machining inspection certificates are provided with each product. The organization of the Drilling Tools Department rely on the ISO 9001 Qualification of ThyssenKrupp Materials France.

Drill collar manufacturing

Steel grades

ThyssenKrupp Drill Collars are made from AISI 4145H modified alloy steel, heat treated to API standards and other specifications.
Drill collars are also available from non-magnetic steel for directional services and 4145H Mod.

Forging

ThyssenKrupp Drill Collars are forged on a unique radial hammer forge based on the latest forging technology.

Heat treating

Heat treating, quenching and tempering of this material is the most critical process in the making of steel bars for drill collars.
Customs designed heat treating equipment assures the continued success of this critical manufacturing phase.

Boring

Following peeling, ultrasonic inspection and individual physical property analysis of each bar, the most important straightening operation takes place. Following this, the bars are bored by a battery of specially adapted boring machines. These precision borers provide extremely straight bores and a minimal step in the center.
Gaging to API specifications with a 10 FT drift mandrel is standard practice for all bored bars.

End connections

Machining of end connections is done on CNC machines with constant profile cutting tools. Thread profile, lead, depth, taper and stand-off are constantly inspected during and after machining. Following API gaging, thread roots are cold rolled to improve fatigue resistance of connections.

Slick drill collar

Mechanical properties per API 7-1

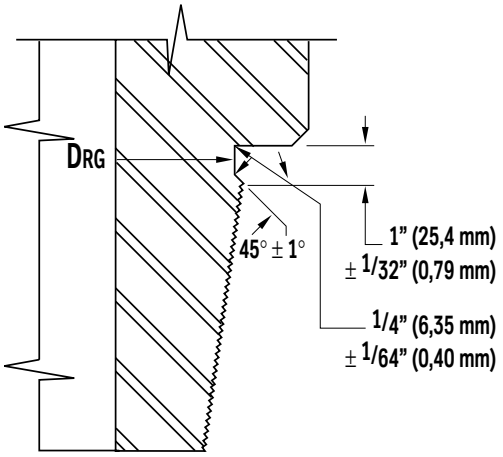
Ultimate tensile strength psi	Yield strength psi	Elongation[1] %	Reduction of Area %	Impact strength[2] J	Hardness[3] HB
135,000 to 140,000	100,000 to 110,000	15 min	45 min	50 min	285 to 341

(1) L = 4 D
(2) ASTM A 370 Charpy - V)
(3) one inch below surface

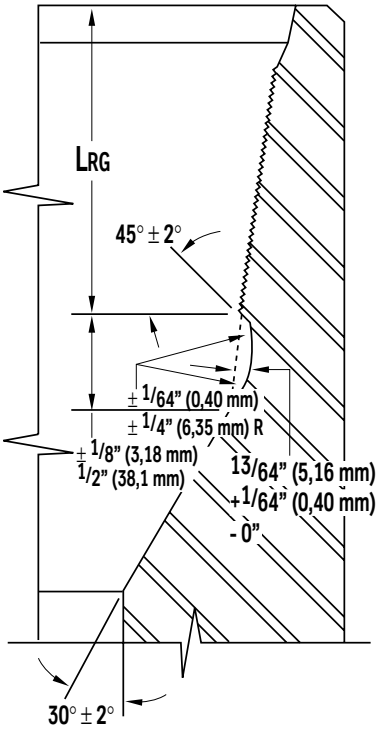
Drill collar manufacturing

Connections

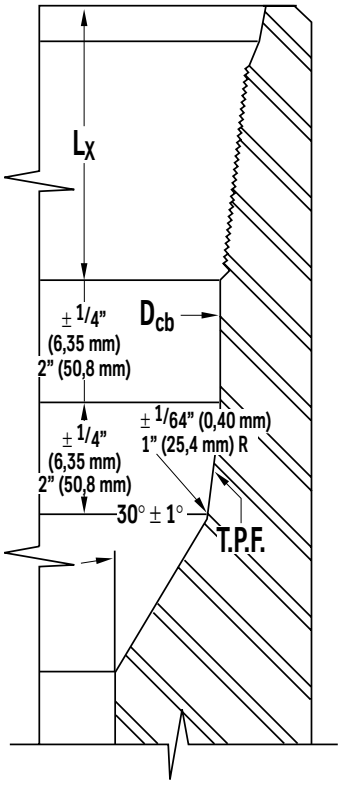
All connections are phosphated to help prevention of galling during initial make-up.
API or customer specified thread compounds are applied before fitting the connections with pressed steel thread protectors.



Pin stress-relief feature



Box stress-relief groove



Boreback box stress-relief feature

Stress-relief features for drill collar connections

Number[1] or Size and Style of Connection*	Length, Shoulder Face to Last Thread Scratch of Box Member, in. Tol. ± 1/16 in. L_X	Diameter of Cylinder Area of Box Member, in. Tol. + 1/64 – 0 in. D_{cb}	Taper of Area Behind Cylinder Area of Box Member, in. per ft. ± 1/4 in./ft. T.P.F.	Diameter of Pin Member at Groove, in. Tol. + 0 – 1/32 in. D_{rG}	Length, Shoulder Face to Groove of Box Member, in. Tol. + 0, – 1/8 in. L_{rG}
NC35	3 1/4	3 15/64	2	3 15/64	3 3/8
NC38 (3 1/2 IF)	3 1/2	3 15/32	2	3 33/64	3 5/8
NC40 (4 FH)	4	3 21/32	2	3 25/32	4 1/8
NC44	4	4	2	4 3/16	4 1/8
NC46 (4 IF)	4	4 13/64	2	4 21/64	4 1/8
NC50 (4 1/2 IF)	4	4 5/8	2	4 3/4	4 1/8
NC56	4 1/2	4 51/64	3	5 18/64	4 5/8
NC61	5	5 15/64	3	5 56/64	5 1/8
NC70	5 1/2	5 63/64	3	6 47/64	5 5/8
NC77	6	6 35/64	3	7 27/64	6 1/8
4 1/2 FH	3 1/2	3 51/64	3	4 13/64	3 5/8
5 1/2 REG	4 1/4	4 1/2	3	4 56/64	4 3/8
6 5/8 REG	4 1/2	5 8/32	2	5 27/64	4 5/8
7 5/8 REG	4 3/4	5 56/64	3	6 13/32	4 7/8
8 5/8 REG	4 7/8	6 25/32	3	7 18/64	5

(1) Connections NC23, NC26 (2 3/8 IF) and NC31 (2 7/8 IF) do not have sufficient metal to accommodate stress-relief features.

Drill collar manufacturing

Slick drill collars

ThyssenKrupp slick drill collars are available for all typical sizes and bores.
Surface finish of slick drill collars is achieved by a carefully controled peeling operation.
All features such as stress relief grooves on connections and slip and elevator recesses are available on most sizes.

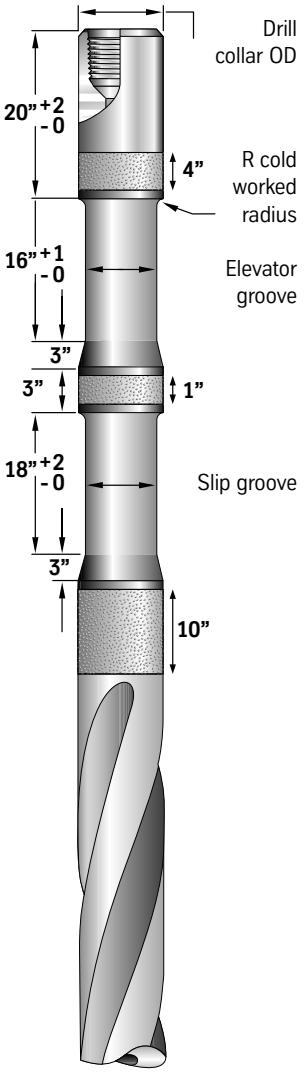
Spiralling

Spiralling of drill collars reduces the dangers of differential pressure sticking particularly in deviated or horizontal holes. Spiral grooving of ThyssenKrupp collars provides sufficient depth in order to be effective.
Spiralling of drill collars is available from sizes 4 3/4 in. to 11" 1/4 outside diameter.

Hardbanding

ThyssenKrupp offers several hardbanding options from fine particle hardbanding to our own smooth hardbanding design or special hardbanding options supplied by third parties.
The ThyssenKrupp recommended hardbanding design is as follows:

- DRILL COLLARS without slip and elevator grooves: 10" long wear band at 30" minimum from the pin end
- DRILL COLLARS with slip and elevator grooves: 4" long wear band above elevator grooves, 1" band between grooves, 10" long wear band under slip groove.
- Standard application is raised (proud). Flush on request.
- Other configurations are available on request.



Spiral drill collar

Slip and elevator grooves

Slip and elevator grooves are defined by API standard RP 7 G.

Grooves

Drill collar OD in.	Diameter of elevator groove in.	Diameter of slip groove in.	Cold worked radius in.
10	9 1/8	9 1/2	1/4
9 3/4	8 7/8	9 1/4	1/4
9 1/2	8 5/8	9	1/4
9 1/4	8 3/8	8 3/4	1/4
9	8 1/8	8 1/2	1/4
8 1/2	7 3/4	8	3/16
8	7 1/4	7 1/2	3/16
7 3/4	7	7 1/4	3/16
7 1/2	6 3/4	7	3/16
7 1/4	6 1/2	6 3/4	3/16
7	6 1/4	6 1/2	3/16
6 3/4	6	6 1/4	3/16
6 1/2	5 7/8	6	1/8
6 1/4	5 5/8	5 3/4	1/8
6	5 3/8	5 1/2	1/8
5 3/4	5 1/8	5 1/4	1/8
4 3/4	4 1/4	4 3/8	1/8
4 1/8	3 11/16	3 3/4	1/8

Drill collar typical sizes and connections

Typical sizes

ThyssenKrupp Drill Collars are available in lengths of 10, 15, 20, 30, 31, 32 and 42 feet and in nominal sizes ranging from 3" 1/8 to 14" outside diameter. Typical sizes are listed here. Other sizes are available on request.
Factors as hole size, type of well, torque and BSR have to be considered when selecting ThyssenKrupp Drill Collars.

Marking

ThyssenKrupp Drill Collars are marked with the API monogram, serial number, connections, OD and ID.

Connection interchange list

Connection name	Size					
Numbered connection NC	26	31	38	40	46	50
Internal flush IF	2 3/8	2 7/8	3 1/2		4	4 1/2
Slim hole SH	2 7/8	3 1/2	4 1/2			
Full hole FH				4		
Extra hole XH					4 1/2	5

On inquiries and orders please specify

- Outside and inside diameters (OD, ID).
- Slick or spiral.
- Length.
- Connection size and type.
- API Stress Relief Groove on pin and box ends.
- API Bore back on box.
- Slip and elevator recess.
- Type of thread protector (pressed steel or cast steel).
- Special features.

Typical sizes, bores and connections

OD in.	Bore		Connection style and size		Weight Standard bore kg		Weight reduction for ZIP kg
	Standard in.	Optional in.	Standard bore	Optional bore	Slick	Spiral	
3 1/8	1 1/4	1	NC 23	2 3/8" REG	333	n/a	n/a
3 1/2	1 1/2	1 1/4	NC 26 2 3/8" IF	NC 26 2 3/8" IF	428	n/a	n/a
4 1/8	2	1 3/4	NC 31 2 7/8" IF	NC 31 2 7/8" IF	490	457	-10
4 1/4	2	1 3/4	NC 31 2 7/8" IF	NC 31 2 7/8" IF	530	493	-11
4 1/2	2	1 3/4	NC 31 2 7/8" IF	NC 31 2 7/8" IF	614	572	-12
4 3/4	2 1/4	2	NC 35	NC 38 3 1/2" IF	703	654	-13
5	2 1/4	2	NC 38 3 1/2" IF	NC 38 3 1/2" IF	754	702	-14
5 1/4	2 1/4	2	NC 38 3 1/2" IF	NC 38 3 1/2" IF	852	793	-15
5 1/2	2 1/4	2	NC 38 3 1/2" IF	NC 38 3 1/2" IF	952	886	-16
5 3/4	2 1/4	2 13/16	NC 40 4" FH	4 1/2" FH	1 058	985	-21
6	2 1/4	2 13/16	NC 44	NC 40 4" FH	1 168	1 088	-22
6 1/4	2 1/4	2 13/16	NC 46 4" IF	NC 46 4" IF	1 280	1 192	-22
6 1/2	2 1/4	2 13/16	NC 46 4" IF	NC 50 4 1/2" IF	1 407	1 310	-25
6 3/4	2 1/4	2 13/16	NC 46 4" IF	NC 50 4 1/2" IF	1 535	1 429	-26
7	2 13/16	2 1/4	NC 50 4 1/2" IF	NC 50 4 1/2" IF	1 662	1 545	-27
7 1/4	2 13/16	3	NC 50 4 1/2" IF	5 1/2" FH	1 684	1 567	-30
7 1/2	2 13/16	3	NC 50 4 1/2" IF	5 1/2" REG	1 824	1 697	-31
7 3/4	2 13/16	3	NC 56 6 5/8" REG	NC 56 6 5/8" REG	1 967	1 830	-32
8	2 13/16	3	NC 56 6 5/8" REG	NC 56 6 5/8" REG	2 118	1 970	-34
8 1/4	2 13/16	3	6 5/8" REG	6 5/8" REG	2 268	2 110	-35
8 1/2	2 13/16	3	6 5/8" REG	6 5/8" REG	2 428	2 258	-36
8 3/4	2 13/16	3	6 5/8" REG	6 5/8" REG	2 591	2 421	-37
9	3	2 13/16	NC 61 7 5/8" REG	NC 61 7 5/8" REG	2 715	2 525	-38
9 1/4	3	2 13/16	NC 61 7 5/8" REG	NC 61 7 5/8" REG	2 888	2 699	-40
9 1/2	3	2 13/16	7 5/8" REG	7 5/8" REG	3 068	2 854	-40
9 3/4	3	2 13/16	NC 70 7 5/8" REG	NC 70 7 5/8" REG	3 252	3 026	-47
10	3	2 13/16	NC 70 7 5/8" REG	NC 70 7 5/8" REG	3 436	3 196	-48
11	3	2 13/16	NC 77 8 5/8" REG	NC 77 8 5/8" REG	4 227	3 933	-52
11 1/4	3	2 13/16	NC 77 8 5/8" REG	NC 77 8 5/8" REG	4 440	4 130	-54
12	3	2 13/16	NC 77 8 5/8" REG	NC 77 8 5/8" REG	5 078	4 745	-58
14	3	2 13/16	NC 77 8 5/8" REG	NC 77 8 5/8" REG	6 853	6 404	-58

Forged square and hexagonal kellys

Manufacturing

All ThyssenKrupp kellys are made from AISI 4145 modified alloy steel and machined from a unique shaped, integral forging.
Straightness is checked before, during and after each machining operation. Kellys are rough turned, straightened, bored with specially designed equipment, drifted, straightened, finish turned on specially designed full length kelly turning lathes, straightened, joints are threaded on NC equipment and phosphated.

Milling

The next process is the critical milling operation. All milling is performed on specially designed rigid kelly mills. Smooth radii are machined on both ends of each flat to assure the least possible stress concentration. The flats are precision milled to a tolerance stricter than API specifications. The kellys are straightened one more time prior to serializing, painting and inserting in ThyssenKrupp standard kelly scabbards for shipping and storage.

Heat treatment

The forged, heat treated alloy steel used in our kellys has a Brinell hardness range of 285-341 and can withstand virtually all drilling conditions. All ThyssenKrupp kellys are shipped in a protective steel scabbard.
Rat hole scabbards can be supplied on request.
Connections are cold rolled and supplied with pressed steel thread protectors. Other thread protectors can be supplied on request.

Square kelly specifications

Nominal Size in.	Overall Lengths[1] ft L	Top connection		Bottom connection		Bore A	Drive section		Approx. Wt. of 40 ft (kg) kelly
		API Box Thread LH	OD in.	Right Hand Connections	OD in.		Across Corners B	Across Flats C	
2 1/2	40	6 5/8 REG 4 1/2 REG	7 3/4 5 3/4	NC26 (2 3/8 IF)	3 3/8	1 7/16	3.250	2 1/2	412 363
3	40,46	6 5/8 REG 4 1/2 REG	7 3/4 5 3/4	NC31 (2 7/8 IF)	4 1/8	1 3/4	3.875	3	500 449
3 1/2	40,46	6 5/8 REG	7 3/4	NC38 (3 1/2 IF)	4 3/4	2 1/4	4.437	3 1/2	608
4 1/4	40,46,54	6 5/8 REG	7 3/4	NC46 (4 IF) NC50 (4 1/2 IF)	6 1/4 - 6 3/8	2 13/16	5.500	4 1/4	835
5 1/4	40,46,54	6 5/8 REG	7 3/4	NC50 (4 1/2 IF) 5 1/2 FH	6 1/4 - 7	3	6.750	5 1/4	1 270
6	40,46,54	6 5/8 REG	7 3/4	6 5/8 REG	7 3/4	3	7.875	6	1 688

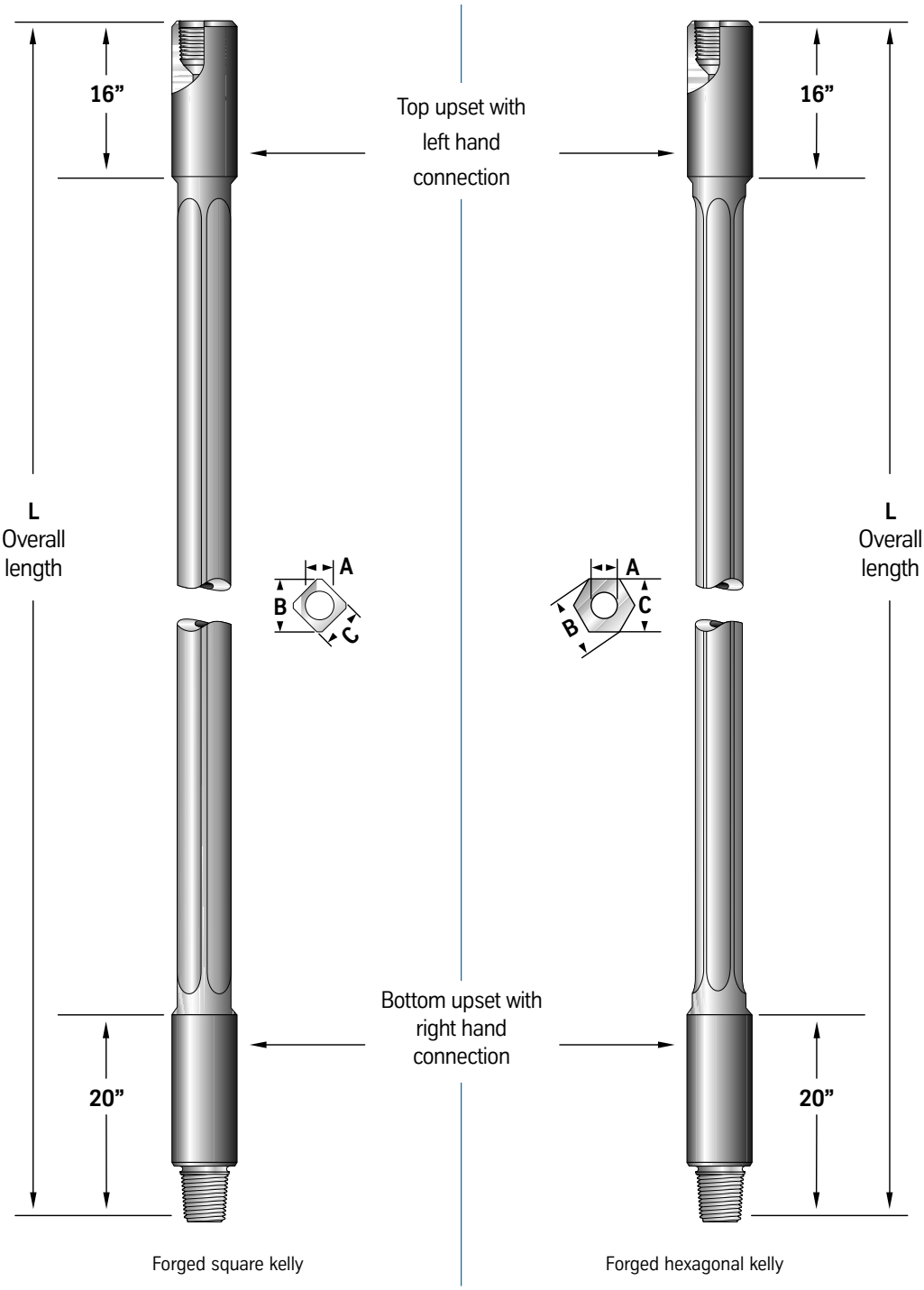
(1) ThyssenKrupp can manufacture special kellys to customer specifications.

Hexagon kelly specifications

Nominal Size in.	Overall Lengths[1] ft L	Top connection		Bottom connection		Bore A	Drive section		Approx. Wt. of 40 ft (kg) kelly
		API Box Thread LH	OD in.	Right Hand Connections	OD in.		Across Corners B	Across Flats C	
3	40	6 5/8 REG 4 1/2 REG	7 3/4 5 3/4	NC26 (2 3/8 IF)	3 3/8	1 7/16	3.375	3	449 400
3 1/2	40,46	6 5/8 REG 4 1/2 REG	7 3/4 5 3/4	NC31 (2 7/8 IF)	4 1/8	1 3/4	3.937	3 1/2	600 549
4 1/4	40,46	6 5/8 REG	7 3/4	NC38 (3 1/2 IF)	4 3/4	2 1/4	4.781	4 1/4	798
5 1/4	40,46,54	6 5/8 REG	7 3/4	NC46 (4 IF) NC 50 (4 1/2 IF)	6-6 1/4 6 1/4-6 3/8	2 13/16 3	5.900	5 1/4	1 166
6	40,46,54	6 5/8 REG	7 3/4	5 1/2 FH	7	3	6.812	6	1 388

(1) ThyssenKrupp can manufacture special kellys to customer specifications.

Forged square and hexagonal kellys



On inquiries and orders please specify

- Kelly type (hexagonal or square)
- Nominal size
- Overall length
- Bore-A
- Size and type of top connection
- Size and type of bottom connection
- Plain Shipping Scabbard or Rathole Drilling Scabbard

Forged heavy weight

Manufacture

ThyssenKrupp heavy weight drill pipe are made from one integral forging on a rotary hammer forge for uniform strength and reliability. No welds with questionable quality are of concern to the user.

Hardbanding

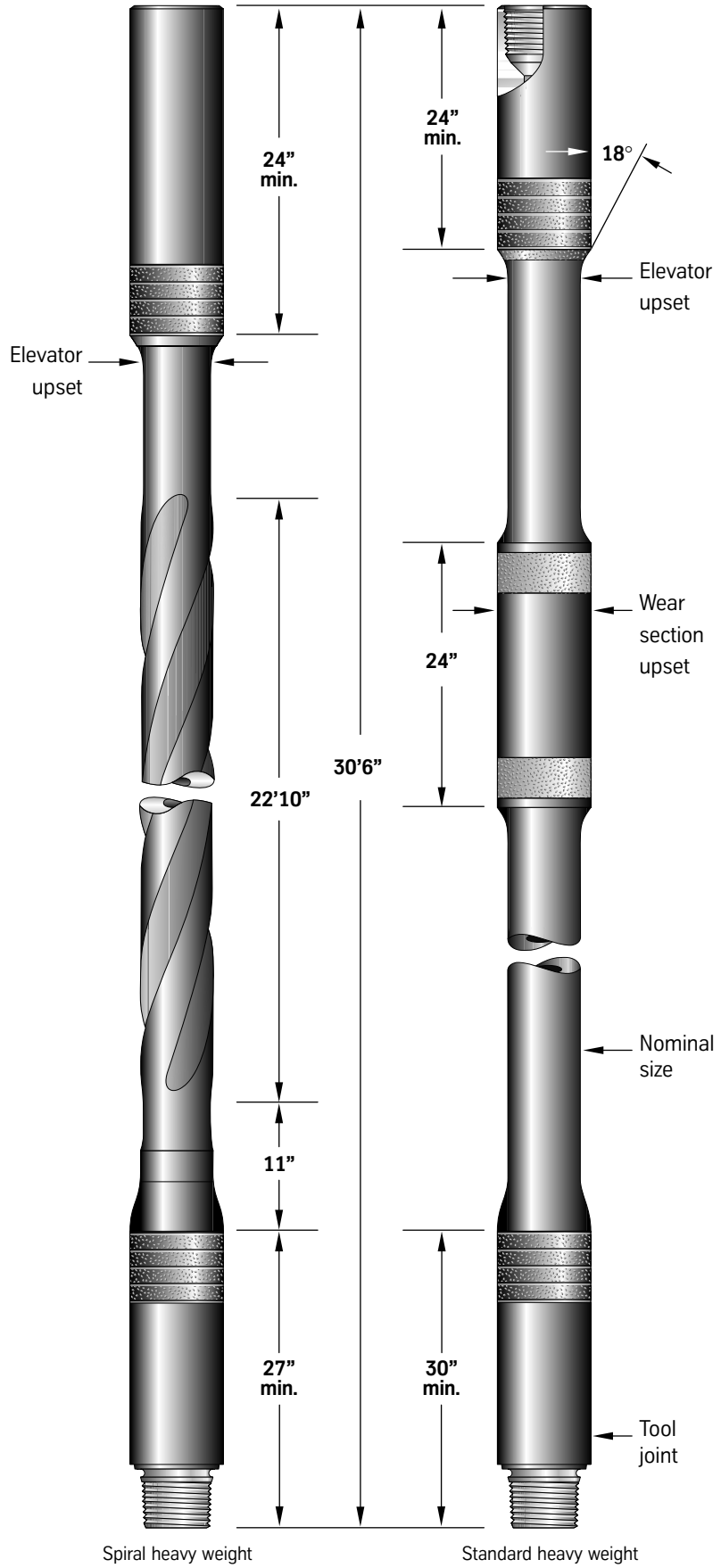
To optimize wear resistance, hardbanding is standard on tool joints and central upsets. Hardbanding is deposited after preheating and is followed by stress relieving.

Standard pads:

- One 3" wear pad on both pin and box end, plus one 1" pad on taper section of box.
- Two 3" wear pads on central upsets. The hardbanding is raised on both tool joints and 1/8" oversize on the central upset (flush on request).
- All standard types of hardbanding can be provided as well as proprietary types.

Stress Relief Groove and Connection Features

- API stress relief grooves on box ends and API stress relief grooves on pin ends are standard.
- Thread roots are cold worked on all sizes.
- All connections are phosphated, coated with lubricant and provided with pressed steel protectors.



Forged heavy weight

Heavy weight drill pipe data

Note:
- Special heavy weight drill pipe are available on request.
- Range 3 (44'3") heavy weight drill pipe with 2 central upsets is available on request.

Central section, Standard HW

Nominal Size in.	ID in.	Elevator Upset Diameter in.	Wear Section Diameter in.	Mechanical Properties	
				Tensile Yield lbs	Torsional Yield ft-lbs
2 7/8	1 3/4 - 2 1/8	3 3/16	3 5/16	449,518	21,290
3 1/2	2 1/16 - 2 1/4	3 5/8	4	690,800	39,160
4	2 9/16	4 1/8	4 1/2	815,000	55,270
4 1/2	2 13/16	4 5/8	5	1,066,086	80,196
5	3	5 1/8	5 1/2	1,382,301	112,992
5 1/2	3 1/2 - 3 7/8	5 5/8	6	1,555,088	144,450
6 5/8	4 - 5	6 3/4	7 1/4	2,409,000	261,200

Central section, Spiral HW

Nominal Size in.	ID in.	Elevator Upset Diameter in.	Wear Section Diameter in.	Mechanical Properties	
				Tensile Yield lbs	Torsional Yield ft-lbs
2 7/8	1 3/4 - 2 1/8	3 3/16	3 5/16	449,518	21,291
3 1/2	2 1/16 - 2 1/4	3 5/8	4	690,800	39,160
4	2 9/16	4 1/8	4 1/2	815,000	55,270
4 1/2	2 13/16	4 5/8	5	1,066,086	80,196
5	3	5 1/8	5 1/2	1,382,301	112,992
5 1/2	3 1/2 - 3 7/8	5 5/8	6	1,555,088	144,450
6 5/8	4 - 5	6 3/4	7 1/4	2,409,000	261,200

Tool joints

Nominal Size in.	Connection Size and Type *	OD in.	ID in.	Mechanical Properties		Approximate Weight Joint kg	Make-up Torque Value ft-lbs
				Tensile Yield lbs	Torsional Yield ft-lbs		
2 7/8	NC31 / 2 7/8 IF	3 3/4 - 4 1/4	1 3/4 - 2 1/8	572,200	14,200	245	8 500
3 1/2	NC38 / 3 1/2 IF	4 3/4	2 1/16 - 2 1/4	763,900	19,000	349	11 500
4	NC40 / 4 FH	5 1/4	2 9/16	758,500	25,000	426	17 200
4 1/2	NC46 / 4 IF	6 1/4	2 13/16	1,024,500	38,800	562	25 700
5	NC50 / 4 1/2 IF	6 1/2 - 6 5/8	3	1,265,600	56,900	680	34 200
5 1/2	5 1/2 FH	7 - 7 1/4	3 1/2 - 3 7/8	1,383,400	61,900	726	38 000
6 5/8	6 5/8 FH	8 - 8 1/4	4 - 5	2,080,000	108,000	953	60 000

* Other connections available on request

On inquiries and orders please specify

- Nominal size.
- Range.
- Internal coating if required.
- Extra-long tool joints if required.

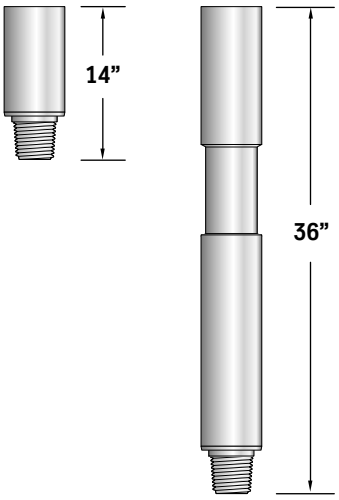
Lifting plugs and subs

Rotary subs

All subs, pup joints and basket subs are made of AISI 4145 H modified alloy steel, fully heat treated to 285-341 Brinell hardness and 50 Joules minimum impact strength. In addition, all bars are inspected on an ultra-sonic unit, over their full length and section. All connections are machined and finished according to API standards. Thread roots are cold rolled. Connections are phosphated, coated with lubricant and equipped with protectors.

On inquiries and orders please specify

- Type of sub.
- Length between shoulders.
- Largest outside diameter.
- Bore.
- Size and type of connection.
- Special features, if any.
- Nominal size for pup joints.
- Pin or Box top connection for basket subs.



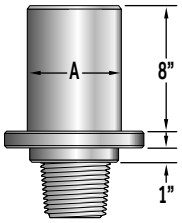
Kelly saver subs

Lifting plugs

– Standard type.
– Bail type.
– Pin to box type.
They are all made of AISI 4145 H steel fully heat treated, and feature API precision machined shoulders and threads.

On inquiries and orders please specify

- Plug type.
- Drill collar outside diameter (OD).
- Lifting face outside diameter (OD).
- Size and type of connection.



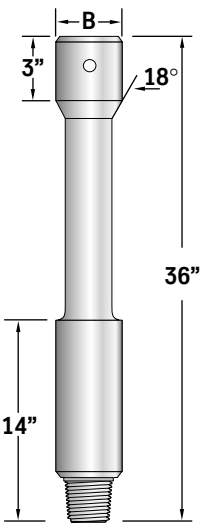
Lifting plugs

Lifting subs

The ThyssenKrupp heavy duty lifting subs are made of AISI 4145 H modified alloy steel, fully heat treated, as for drill collars.

On inquiries and orders please specify

- Type of sub (whether 18° taper or square shoulder elevator type).
- Outside diameter (OD).
- Inside diameter (ID).
- Overall length, reduced section length, etc.
- Size and type of connection.



Lift subs

Integral stabilizers

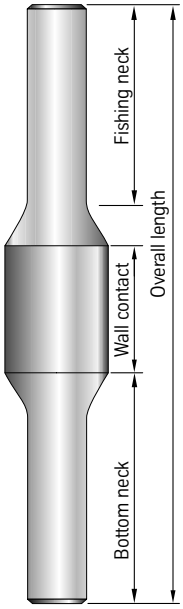
Integral stabilizers

The ThyssenKrupp integral stabilizer has a single piece body made of 4145 H modified alloy steel. ThyssenKrupp stabilizers are heat treated to 285-341 Brinell hardness and 50 Joules charpy impact strength.
ThyssenKrupp stabilizers can be supplied in near bit or string configuration.
They are gaged to API standards.
Finished stabilizers are available from ThyssenKrupp in all configurations and sizes.
Hardfacing samples are given below.

Design

- Long wall contact to increase wear resistance and provide directional stability.
- Upper body to blade angle: 30 degrees.
- Lower body to blade angle: 30 degrees.
- Long fishing neck and bottom neck.

ThyssenKrupp integral stabilizers can be supplied in forged body, semi finished or fully finished stages.

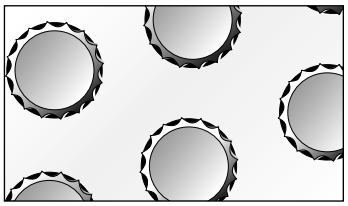


Standard sizes

Hole Size in.	Std DC Size in.	Wall Contact in.	Fishing Neck Length in.	Bottom Neck Length(1) in.	Overall Length in.	Approx. Wt kg
6-6 3/4	4 1/2-4 3/4	16	30	28	75	172
7 5/8-8 1/2	6 1/2	18	36	35	90	354
9 5/8-12 1/4	8	18	36	35	100	953
14 3/4-17 1/2	9 1/2	20	36	30	100	1 361
20-26	11	24	36	30	110	1 996

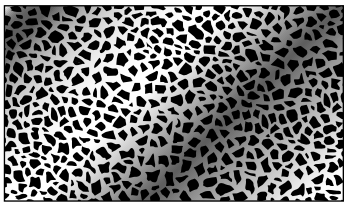
(1) For reference only

Tungsten Carbide Inserts (TCI)



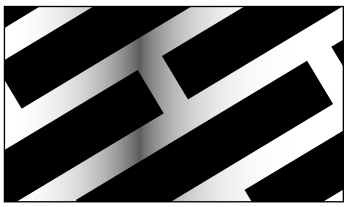
TCI-Tungsten carbide buttons with a serrated circumference to offer tighter placement in the blade material.

Crushed Tungsten Carbide (CTC)



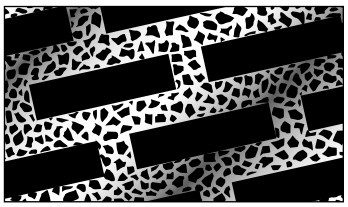
CTC-A composite of crushed tungsten carbide in a wear-resistant chrome nickel matrix.

Tungsten Carbide Plates (TCP)



TCP-Tungsten carbide plates are metallurgically fused to the blade.

Trapezoidal Tungsten Carbide (TTC)



Trapezoidal tungsten carbide inserts held in a sintered carbide nickel bronze matrix.

Other drilling tools such as reamers and hole openers are available from ThyssenKrupp.

Non-magnetic steels

Steel making

Stainless Steel Drill Collars require specific non-magnetic properties, physical properties, resistance to stress corrosion, pitting and galling. These requirements are taken into consideration when we select the chemical composition and heat treatment process of our steels.

The resultant stainless steel drilling tools form tough and reliable components of the drill string.

Forging

The correct forging is a key aspect in the manufacturing process of high quality stainless steel drilling tools. There is a requirement for tight control on time/temperature cycles and a need for adequate forging capacity to warm work these steels. This requirement is accomplished with purpose built hammer forging systems where the bars are turned and advanced by computer controlled manipulators.

General product specifications

Our non-magnetic stell meet the requirements of API Spec.7-1 and NS-1.
Dimentional tolerances follow API specification 7-1 and 7-2.
The bore eccentricity follows NS-1 specifications.
The mechanical properties are measured according to the requirements of ASTM A 370.
The relative magnetic permeability is guaranteed to be less than 1.010.

Field gradient measurements are taken on each bored non-magnetic bar and guaranteed to deviate no more than ± 0.05 microtesla from a uniform magnetic field.
Resistance to intergranular stress corrosion is measured by the ASTM A 262 practice E test.
Subjecting the exposed surfaces to compressive treatments reduces transgranular stress corrosion tendencies.
Material integrity is controlled by ultra-sonic inspection per API Spec.7-1 and NS-1.

Stainless steel grade AMAGNIT 501

Design for most drill string components such as drill collars, MWD and LWD housings, compressive service drill pipe (flex collars) subs, stabilisers, etc. this material meets the stringent requirements of today's drilling and directional drilling industry.

Typical chemical composition in %

C	Mn	Cr	Mo	Ni	N_2
0.05 max	18.5-22	13-15	1 max	2 max	0.25-0.50

Mechanical properties (room temperature, ASTM A 370)

OD range	Minimum yield strength	Minimum tensile strength	Minimum elongation	Minimum reduction of area
3 1/2 to 6 7/8	120 000 Psi	135 000 Psi	25 %	50 %
7 to 11	112 000 Psi	130 000 Psi	25 %	50 %
Over 11"	100 000 Psi	120 000 Psi	25 %	50 %

Surface hardness: 277-350 HB

Stainless steel grade AMAGNIT 601

Design specifically for the increased requirements of MWD Directional Tools and LWD formation evaluation tools.

Typical chemical composition in %

C	Mn	Cr	Mo	Ni	N_2
0.05 max	18-22	16.5-19.5	1 max	2 max	0.45-0.80

Mechanical properties (room temperature, ASTM A 370)

OD range	Minimum yield strength	Minimum tensile strength	Minimum elongation	Minimum reduction of area
Up to 9 1/4	140 000 Psi	150 000 Psi	20 %	50 %
Above 9 1/4	130 000 Psi	150 000 Psi	20 %	50 %

Surface hardness: minimum 300 HB

Steels for the oil industry

ThyssenKrupp offers a wide range of Oil Industry Steel for manufacturing finished products, in solid or bored bars.

4145 H
API 7

For Subs, pup joints and all different items requiring high quality API 7-1 steel.

Standard stock sizes range from 3 1/8" to 12" OD.

Standard bar lengths are 9.45m and they can be solid or bored.

Larger diameters and shorter or longer lengths can be manufactured on request.

4140 H-L 80
API6A/5CT/NACE MR 01.75

For all production tools.

Standard stock sizes range from 1" to 18 OD.

Standard bar lengths are 4.5-6m and they can be solid or bored.

4130
API 6A/NACE MR 01.75

For flanges, X mas trees, wellhead equipment.

Standard stock sizes range from 1" to 46 OD.

Square from 9" to 16 OD.

Standard bar lengths are 4.5-6m and they can be solid or bored.

All material is 100% ultrasonic inspected and fully traceable.

Chemical composition in %

	C	Mn	Cr	Mo	P	S	Si	Ni	Cu	Hardness
4145 H	0.42-0.49	0.70-1.20	0.80-1.30	0.15-0.35	≤ 0.025	≤ 0.025	0.15-0.40	≤ 0.50	≤ 0.35	285-340 HB
4140 H	0.38-0.43	0.75-1.00	0.80-1.10	0.15-0.25	≤ 0.025	≤ 0.025	0.15-0.35	≤ 0.25	≤ 0.35	197-234 HB
4130	0.28-0.33	0.40-0.60	0.80-1.10	0.15-0.25	0.025	0.025	0.15-0.35	0.25	0.35	197-234 HB

Mechanical properties

	Yield strength		Tensile strength		Elongation	Reduction area	Impact test
	Mpa min.	PSI min.	Mpa	PSI min.	% mini	% mini	KV Joules
4145 H 3 1/8 to 6 7/8 7 to 11	 758 689	 110000 100000	 965 931	 140000 135000	 13 13	 45 45	 +20°C ≥ 52 -20°C ≥ 30
4140 H	552-654	80000 to 95000	655	95000	18	35	-32°C ≥ 42
4130	517	75000	655	95000	18	35	-60°C ≥ 27

Conversion Table Inches to Millimeters

Inch	0	1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	Inch
0	0.00	1.59	3.18	4.76	6.35	7.94	9.53	11.11	12.70	14.29	15.88	17.46	19.05	20.64	22.23	23.81	0
1	25.40	26.99	28.58	30.16	31.75	33.34	34.93	36.51	38.10	39.69	41.28	42.86	44.45	46.04	47.63	49.21	1
2	50.80	52.39	53.98	55.56	57.15	58.74	60.33	61.91	63.50	65.09	66.68	68.26	69.85	71.44	73.03	74.61	2
3	76.20	77.79	79.38	80.96	82.55	84.14	85.73	87.31	88.90	90.49	92.08	93.66	95.25	96.84	98.43	100.01	3
4	101.60	103.19	104.78	106.36	107.95	109.54	111.13	112.71	114.30	115.89	117.48	119.06	120.65	122.24	123.83	125.41	4
5	127.00	128.59	130.18	131.76	133.35	134.94	136.53	138.11	139.70	141.29	142.88	144.46	146.05	147.64	149.23	150.81	5
6	152.40	153.99	155.58	157.16	158.75	160.34	161.93	163.51	165.10	166.69	168.28	169.86	171.45	173.04	174.63	176.21	6
7	177.80	179.39	180.98	182.56	184.15	185.74	187.33	188.91	190.50	192.09	193.68	195.26	196.85	198.44	200.03	201.61	7
8	203.20	204.79	206.38	207.96	209.55	211.14	212.73	214.31	215.90	217.49	219.08	220.66	222.25	223.84	225.43	227.01	8
9	228.60	230.19	231.78	233.36	234.95	236.54	238.13	239.71	241.30	242.89	244.48	246.06	247.65	249.24	250.83	252.41	9
10	254.00	255.59	257.18	258.76	260.35	261.94	263.53	265.11	266.70	268.29	269.88	271.46	273.05	274.64	276.23	277.81	10
11	279.40	280.99	282.58	284.16	285.75	287.34	288.93	290.51	292.10	293.69	295.28	296.86	298.45	300.04	301.63	303.21	11
12	304.80	306.39	307.98	309.56	311.15	312.74	314.33	315.91	317.50	319.09	320.68	322.26	323.85	325.44	327.03	328.61	12
13	330.20	331.79	333.38	334.96	336.55	338.14	339.73	341.31	342.90	344.49	346.08	347.66	349.25	350.84	352.43	354.01	13
14	355.60	357.19	358.78	360.36	361.95	363.54	365.13	366.71	368.30	369.89	371.48	373.06	374.65	376.24	377.83	379.41	14
15	381.00	382.59	384.18	385.76	387.35	388.94	390.53	392.11	393.70	395.29	396.88	398.46	400.05	401.64	403.23	404.81	15
16	406.40	407.99	409.58	411.16	412.75	414.34	415.93	417.51	419.10	420.69	422.28	423.86	425.45	427.04	428.63	430.21	16
17	431.80	433.39	434.98	436.56	438.15	439.74	441.33	442.91	444.50	446.09	447.68	449.26	450.85	452.44	454.03	455.61	17
18	457.20	458.79	460.38	461.96	463.55	465.14	466.73	468.31	469.90	471.49	473.08	474.66	476.25	477.84	479.43	481.01	18
19	482.60	484.19	485.78	487.36	488.95	490.54	492.13	493.71	495.30	496.89	498.48	500.06	501.65	503.24	504.83	506.41	19
20	508.00	509.59	511.18	512.76	514.35	515.94	517.53	519.11	520.70	522.29	523.88	525.46	527.05	528.64	530.23	531.81	20
21	533.40	534.99	536.58	538.16	539.75	541.34	542.93	544.51	546.10	547.69	549.28	550.86	552.45	554.04	555.63	557.21	21
22	558.80	560.39	561.96	563.56	565.15	566.74	568.33	569.91	571.50	573.09	574.68	576.26	577.85	579.44	581.03	582.61	22
23	584.20	585.79	587.38	588.96	590.55	592.14	593.73	595.31	596.90	598.49	600.08	601.66	603.25	604.84	606.43	608.01	23
24	609.60	611.19	612.78	614.36	615.95	617.54	619.13	620.71	622.30	623.89	625.48	627.06	628.65	630.24	631.83	633.41	24
25	635.00	636.59	638.18	639.76	641.35	642.94	644.53	646.11	647.70	649.29	650.88	652.46	654.05	655.64	657.23	658.81	25
26	660.40	661.99	663.58	665.16	666.75	668.34	669.93	671.51	673.10	674.69	676.28	677.86	679.45	681.04	682.63	684.21	26
27	685.80	687.39	688.98	690.56	692.15	693.74	695.33	696.91	698.50	700.09	701.68	703.26	704.85	706.44	708.03	709.61	27
28	711.20	712.79	714.38	715.96	717.55	719.14	720.73	722.31	723.90	725.49	727.08	728.66	730.25	731.84	733.43	735.01	28
29	736.60	738.19	739.78	741.36	742.95	744.54	746.13	747.71	749.30	750.89	752.48	754.06	755.65	757.24	758.83	760.41	29
30	762.00	763.59	765.18	766.76	768.35	769.94	771.53	773.11	774.70	776.29	777.88	779.46	781.05	782.64	784.23	785.81	30
31	787.40	788.99	790.58	792.16	793.75	795.34	796.93	798.51	800.10	801.69	803.28	804.86	806.45	808.04	809.63	811.21	31
32	812.80	814.39	815.98	817.56	819.15	820.74	822.33	823.91	825.50	827.09	828.68	830.26	831.85	833.44	835.03	836.61	32
33	838.20	839.79	841.38	842.96	844.55	846.14	847.73	849.31	850.90	852.49	854.08	855.66	857.25	858.84	860.43	862.01	33
34	863.60	865.19	866.78	868.36	869.95	871.54	873.13	874.71	876.30	877.89	879.48	881.06	882.65	884.24	885.83	887.41	34

Notes

Worldwide Stock Points

· North Sea: Aberdeen
· Gulf Coast: Houston
· Middle East: Dubai
· Far East: Singapore

New Website - www.thyssenkrupp-materials-oil-gas.com
A dedicated team by your side!



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