CORING RODS AND CASING CATALOG

BOART LONGYEAR™

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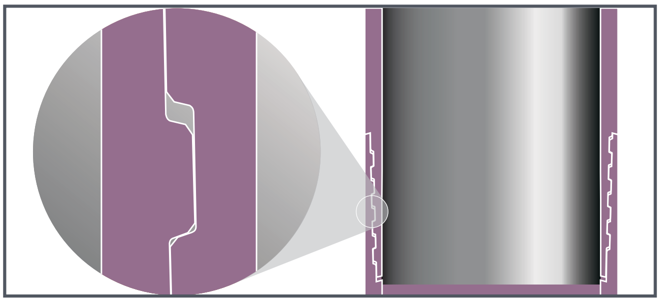
WIRELINE CORING RODS

Q™ THREAD

Q™ rods were first introduced in 1966 and the proprietary design continues to be the worldwide choice for wireline coring rods. Through innovative engineering and state-of-the-art manufacturing techniques, Q rods are known for quality, strength, and increased thread wear.

Q™ THREAD PROFILE



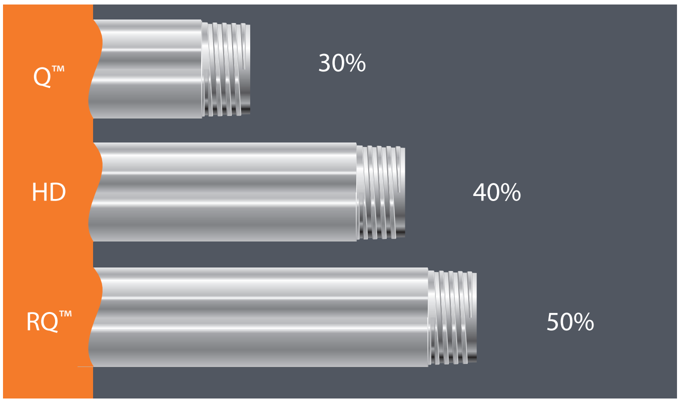
TUBING

- High quality alloy steel tubing.
- Consistent concentricity, straightness and heat treatment.

THREAD

- Tapered, coarse threads (3 threads per inch) provides easy make and break.
- Load efficiency of 30% provides sufficient strength for average applications.

JOINT LOAD EFFICENCY



WARNING Due to the significant safety risk, Boart Longyear drill rods should never be mixed with another manufacturers' rods. Doing so may cause catastrophic equipment failure, leading to bodily injury or death. In addition, mixing rods voids the Boart Longyear warranty.

This is a measure of how much load a joint can carry, as compared to the midbody (e.g. 30% provides a third of the strength). Inversely, this is a measure of how much more stress is created in the joint by a load, as compared to the midbody (e.g. 30% creates three times the stress under a load).

Q™ is a Boart Longyear proprietary product and as such retains all of the quality, features and fit associated with the Boart Longyear Q (registered) global manufacturing standards.

THRU-WALL HEAT TREATMENT

- Provides 140% material strength.
- Heat treated box threads significantly increase thread wear life.
- Q is a Boart Longyear™ proprietary product and as such contains all of the quality, features and fit associated with Boart Longyear manufacturing standards.

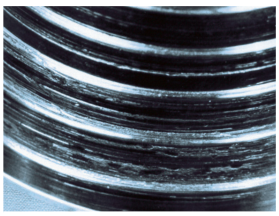
CASE HARDENING

- Boart Longyear is the only major manufacturer in the industry to case-harden threads.
- Significant research, development and field testing has resulted in a hardening process that is unmatched.
- Pin thread crest is hardened to nominal 55 HRC to eliminate damaging 'adhesion' wear.
- Eliminates the transfer of wear material back and forth as seen between threads of equal hardness, leading to large scale galling and joint seizing.

PIN THREAD (60HRc)

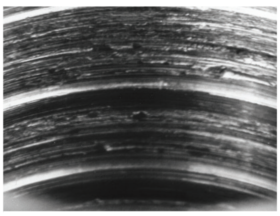
After 30 make/break cycles, Case-hardened pin resists wear.

BOX THREAD (30HRc)



After 30 make/break cycles, box thread shows minimal abrasion wear

COMPETING THREAD (30HRc on 30HRc)



After 30 make/break cycles, non-case-hardened pin thread show adhesion wear which leads to galling and seized threads.

After 30 make/break cycles, box thread shows adhesion wear which leads to galling and seized threads.

Q™ THREAD PART NUMBERS

BQ™

METRIC

PART #	DESCRIPTION
3548208	ROD, BQ 3.0 m ENHANCED
3548206	ROD, BQ 1.5 m ENHANCED

OD (mm)	ID (mm)	WEIGHT (kg/3 m)	THREAD PITCH (mm)	PIN LENGTH (mm)	CONTENT (l/100 m)
55.60	46.10	18.00	8.5	44.45	167.00

IMPERIAL

PART #	DESCRIPTION
3548209	ROD, BQ 10' ENHANCED
3548207	ROD, BQ 5' ENHANCED
51555	ROD, BQ 2'*
51554	ROD, BQ 1'*

OD (in)	ID (in)	WEIGHT (lb/10ft)	THREAD PITCH (tpi)	PIN LENGTH (in)	CONTENT (USgal/100ft)
2.19	1.81	42.00	3.0	1.75	13.00

WARNING

* Do not use rods shorter than 1.5m at top of hole, as a drive sub or Kelly rod because they do not have Q&T heat treatment; they only have pin thread case hardening for wear. Subs, which are made from Q&T material, should be used for these applications.

BQ™ BUNDLE SPECIFICATIONS

3.0 m/10 ft ROD BUNDLE (19 RODS)

Dimensions (L x W x H)........3150 x 292 x 254 mm (124 x 11.5 x 10 in)
Volume........0.23 m^3 (8 ft^3)
Gross Weight........355 kg (780 lb)

1.5 m/5 ft ROD BUNDLE (19 RODS)

Dimensions (L x W x H)........1600 x 292 x 254 mm (63 x 11.5 x 10 in)
Volume........0.11 m^3 (4 ft^3)
Gross Weight........180 kg (400 lb)

CONTAINER SHIPMENTS:

20 ft container load of 3.0 m/10 ft rods holds 53 bundles (1007 rods)
40 ft container load of 3.0 m/10 ft rods holds 68 bundles (1292 rods)

Q™ THREAD PART NUMBERS

RODS

NQ™

	PART #	DESCRIPTION
METRIC	3548212	ROD, NQ 3.0 m ENHANCED
	3548210	ROD, NQ 1.5 m ENHANCED

OD (mm)	ID (mm)	WEIGHT (kg/3 m)	THREAD PITCH (mm)	PIN LENGTH (mm)	CONTENT (l/100 m)
69.90	60.30	23.40	8.5	44.45	286.00

	PART #	DESCRIPTION
IMPERIAL	3548213	ROD, NQ 10' ENHANCED
	3548211	ROD, NQ 5' ENHANCED
	51563	ROD, NQ 2'*
	51562	ROD, NQ 1'*

OD (in)	ID (in)	WEIGHT (lb/10ft)	THREAD PITCH (tpi)	PIN LENGTH (in)	CONTENT (USgal/100ft)
2.75	2.38	52.40	3.0	1.75	23.00

WARNING

* Do not use rods shorter than 1.5m at top of hole, as a drive sub or Kelly rod because they do not have Q&T heat treatment; they only have pin thread case hardening for wear. Subs, which are made from Q&T material, should be used for these applications.

NQ™ BUNDLE SPECIFICATIONS

3.0 m/10 ft ROD BUNDLE (19 RODS)

Dimensions (L x W x H)........3124 x 368 x 330 mm (123 x 14.5 x 13 in)
Volume........0.3681 m^3 (13 ft^3)
Gross Weight........453 kg (1000 lb)

1.5 m/5 ft ROD BUNDLE (19 RODS)

Dimensions (L x W x H)........1600 x 368 x 330 mm (63 x 14.5 x 13 in)
Volume........0.1982 m^3 (7 ft^3)
Gross Weight........239 kg (526 lb)

CONTAINER SHIPMENTS:

20 ft container load of 3.0 m/10 ft rods holds 32 bundles (608 rods)
40 ft container load of 3.0 m/10 ft rods holds 45 bundles (855 rods)

Q™ THREAD PART NUMBERS

HQ™

	PART #	DESCRIPTION
METRIC	3548216	ROD, HQ 3.0 m ENHANCED
METRIC	3548214	ROD, HQ 1.5 m ENHANCED

OD (mm)	ID (mm)	WEIGHT (kg/3 m)	THREAD PITCH (mm)	PIN LENGTH (mm)	CONTENT (l/100 m)
88.90	77.80	34.50	8.5	44.45	475.00

	PART #	DESCRIPTION
IMPERIAL	3548217	ROD, HQ 10' ENHANCED
IMPERIAL	3548215	ROD, HQ 5' ENHANCED
IMPERIAL	51569	ROD, HQ 2'*
IMPERIAL	51568	ROD, HQ 1'*

OD (in)	ID (in)	WEIGHT (lb/10ft)	THREAD PITCH (tpi)	PIN LENGTH (in)	CONTENT (USgal/100ft)
3.50	3.06	77.00	3.0	1.75	38.00

WARNING

* Do not use rods shorter than 1.5m at top of hole, as a drive sub or Kelly rod because they do not have Q&T heat treatment; they only have pin thread case hardening for wear. Subs, which are made from Q&T material, should be used for these applications.

HQ™ BUNDLE SPECIFICATIONS

3.0 m/10 ft ROD BUNDLE (19 RODS)

Dimensions (L x W x H)........3048 x 470 x 406.4 mm (120 x 18.5 x 16 in)
Volume........0.60 m³ (21 ft³)
Gross Weight........682 kg (1,505 lb)

1.5 m/5 ft ROD BUNDLE (19 RODS)

Dimensions (L x W x H)........1588 x 470 x 406.4 mm (62.5 x 18.5 x 16 in)
Volume........0.31 m³ (11 ft³)
Gross Weight........346 kg (764 lb)

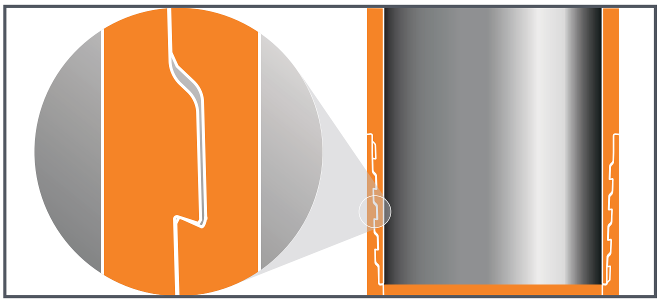
CONTAINER SHIPMENTS:

20 ft container load of 3.0 m/10 ft rods holds 20 bundles (380 rods)
40 ft container load of 3.0 m/10 ft rods holds 30 bundles (570 rods)

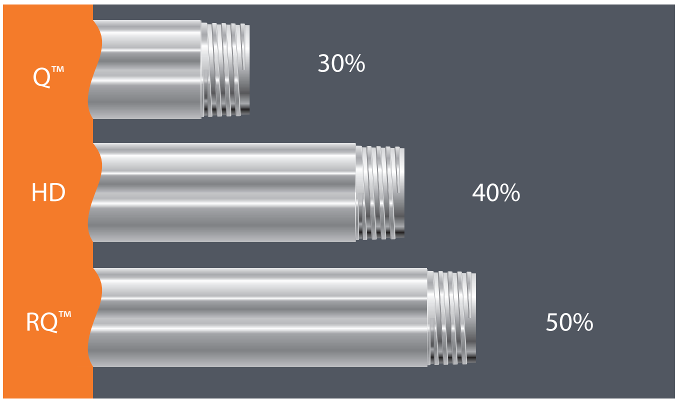
RQ™ THREAD

The patented RQ™ rods feature a combination of exclusive heat treatments and innovative engineering to provide the ultimate in performance and longevity. RQ drill rods expand your drilling capabilities and lower your total drill rod cost per meter/foot in deep, deviated and demanding wireline coring applications.

RQ™ THREAD PROFILE



JOINT LOAD EFFICENCY



WARNING

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This is a measure of how much load a joint can carry, as compared to the midbody (e.g. 30% provides a third of the strength). Inversely, this is a measure of how much more stress is created in the joint by a load, as compared to the midbody (e.g. 30% creates three times the stress under a load).

Q™ is a Boart Longyear proprietary product and as such retains all of the quality, features, and fit associated with the Boart Longyear Q (registered) global manufacturing standards.

FEATURES

TUBING

- High quality alloy steel tubing
- Consistent concentricity, straightness and heat treatment

THREAD

- Coarse RQ threads (3 threads per inch) with increased taper, provide easier make and break as well as anti jamming
- Finer RQ™TK threads provide high performance for Thin Kerf wireline systems
- Load efficiency of 50% provides ultimate strength for demanding applications
- RQ™ is a Boart Longyear™ proprietary product and as such contains all of the quality, features and fit associated with Boart Longyear manufacturing standards

THRU-WALL HEAT TREATMENT

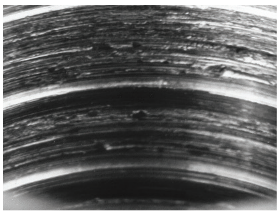
- Provides 175% material strength
- Heat treated box threads significantly increase thread wear life

CASE HARDENING

- Boart Longyear is the only major manufacturer in the industry to case-harden threads
- Significant research, development and field testing has resulted in a hardening process that is unmatched unique and in the marketplace
- Pin thread crest is hardened to eliminate damaging 'adhesion' wear
- Eliminates the transfer of wear material back and forth as seen between threads of equal hardness, leading to large scale galling and joint seizing

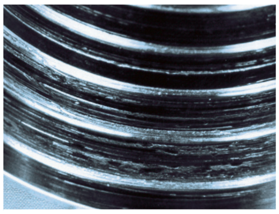
PIN THREAD WEAR

Boart Longyear™ Patented RQ™ Thread
After 60 make/break cycles, the case hardened pin thread resists wear.



Competing Thread
After only 30 make/ break cycles, the non-case-hardened pin thread allows adhesion wear.

BOX THREAD WEAR



Boart Longyear™ Patented RQ™ Thread
After 60 make/break cycles, the box thread shows minimal abrasion wear.

Competing Thread
After only 30 make/ break cycles, the box thread shows adhesion wear which leads to galling and seized threads.

RQ™ THREAD PART NUMBERS

RODS

The RQ™TK rods utilize a reduced wall thickness to allow for the larger size tools and core samples obtained with the corresponding Q™TK wireline systems. RQ TK rods are not compatible with our standard RQ coring rods.

ARQ™TK

METRIC

PART #	DESCRIPTION
3540968	ARQTK 3.0 m ROD
104977	ARQTK 1.5 m ROD

OD (mm)	ID (mm)	WEIGHT (kg/3 m)	THREAD PITCH (mm)	PIN LENGTH (mm)	CONTENT (l/100 m)
44.70	37.50	10.70	6.4	38.53	110.00

IMPERIAL

PART #	DESCRIPTION
3540970	ARQTK 10' ROD
3540971	ARQTK 5' ROD
3540972	ARQTK 2' ROD*
3541568	ARQTK 1' ROD*

OD (in)	ID (in)	WEIGHT (lb/10ft)	THREAD PITCH (tpi)	PIN LENGTH (in)	CONTENT (USgal/100ft)
1.76	1.48	24.00	4.0	1.52	9.0

WARNING

* Do not use rods shorter than 1.5m at top of hole, as a drive sub or Kelly rod because they do not have Q&T heat treatment; they only have pin thread case hardening for wear. Subs, which are made from Q&T material, should be used for these applications.

ARQ™TK BUNDLE SPECIFICATIONS

3.0 m/10 ft ROD BUNDLE (19 RODS)
Dimensions (L x W x H)........3.2 x 0.2 x 0.2 m (10.3 x 0.8 x 0.7 ft)
Volume........0.2 m³ (7.1 ft³)
Gross Weight........213 kg (470 lb)

1.5 m/5 ft ROD BUNDLE (19 RODS)
Dimensions (L x W x H)........1.6 x 0.2 x 0.2 m (5.3 x 0.8 x 0.7 ft)
Volume........0.1 m³ (3.5 ft³)
Gross Weight........111 kg (246 lb)

CONTAINER SHIPMENTS:
20 ft container load of 3.0 m/10 ft rods holds 70 bundles (1330 rods)
40 ft container load of 3.0 m/10 ft rods holds 90 bundles (1710 rods)

RQ™ THREAD PART NUMBERS

BRQ™TK

METRIC

PART #	DESCRIPTION
306227	BRQTK 3.0 m ROD
3540867	BRQTK 1.5 m ROD

OD (mm)	ID (mm)	WEIGHT (kg/3 m)	THREAD PITCH (mm)	PIN LENGTH (mm)	CONTENT (l/100 m)
55.80	48.40	14.30	7.30	40.64	184.00

IMPERIAL

PART #	DESCRIPTION
3541174	BRQTK 10' ROD
3541379	BRQTK 5' ROD
3541343	BRQTK 2' ROD'*
3545303	BRQTK 1' ROD*

OD (in)	ID (in)	WEIGHT (lb/10ft)	THREAD PITCH (tpi)	PIN LENGTH (in)	CONTENT (USgal/100ft)
2.20	1.91	32.00	3.50	1.60	15.00

WARNING

* Do not use rods shorter than 1.5m at top of hole, as a drive sub or Kelly rod because they do not have Q&T heat treatment; they only have pin thread case hardening for wear. Subs, which are made from Q&T material, should be used for these applications.

BRQ™TK BUNDLE SPECIFICATIONS

3.0 m/10 ft ROD BUNDLE (19 RODS)
Dimensions (L x W x H)........3.2 x 0.3 x 0.3 m (10.3 x 1.0 x 0.8 ft)
Volume........0.2 m^3 (8.1 ft^3)
Gross Weight........306 kg (675 lb)

1.5 m/5 ft ROD BUNDLE (19 RODS)
Dimensions (L x W x H)........1.6 x 0.3 x 0.3 m (5.3 x 1.0 x 0.8 ft)
Volume........0.1 m^3 (3.5 ft^3)
Gross Weight........160 kg (350 lb)

CONTAINER SHIPMENTS:
20 ft container load of 3.0 m/10 ft rods holds 53 bundles (1007 rods)
40 ft container load of 3.0 m/10 ft rods holds 68 bundles (1292 rods)

BRQ™

	PART #	DESCRIPTION
METRIC	306238	BRQ 3.0 m ROD
METRIC	3541308	BRQ 1.5 m ROD

OD (mm)	ID (mm)	WEIGHT (kg/3 m)	THREAD PITCH (mm)	PIN LENGTH (mm)	CONTENT (l/100 m)
55.60	46.10	18.00	8.50	41.91	167.00

	PART #	DESCRIPTION
IMPERIAL	3541555	BRQ 10' ROD
IMPERIAL	3541378	BRQ 5' ROD
IMPERIAL	3541340	BRQ 2' ROD*
IMPERIAL	3545301	BRQ 1' ROD*

OD (in)	ID (in)	WEIGHT (lb/10ft)	THREAD PITCH (tpi)	PIN LENGTH (in)	CONTENT (USgal/100ft)
2.19	1.81	42	3.00	1.65	13.00

WARNING

* Do not use rods shorter than 1.5m at top of hole, as a drive sub or Kelly rod because they do not have Q&T heat treatment; they only have pin thread case hardening for wear. Subs, which are made from Q&T material, should be used for these applications.

BRQ™ BUNDLE SPECIFICATIONS

3.0 m/10 ft ROD BUNDLE (19 RODS)
Dimensions (L x W x H)........3.2 x 0.3 x 0.3 m (10.3 x 1.0 x 0.8 ft)
Volume........0.2 m^3 (8.1 ft^3)
Gross Weight........355 kg (780 lb)

1.5 m/5 ft ROD BUNDLE (19 RODS)
Dimensions (L x W x H)........1.6 x 0.3 x 0.3 m (5.3 x 1.0 x 0.8 ft)
Volume........0.1 m^3 (3.5 ft^3)
Gross Weight........180 kg (400 lb)

CONTAINER SHIPMENTS:
20 ft container load of 3.0 m/10 ft rods holds 33 bundles (1007 rods)
40 ft container load of 3.0 m/10 ft rods holds 68 bundles (1292 rods)

RODS: RQ™ THREAD PART NUMBERS

NRQ™

METRIC

PART #	DESCRIPTION
104741	NRQ 3.0 m ROD
3541309	NRQ 1.5 m ROD

OD (mm)	ID (mm)	WEIGHT (kg/3 m)	THREAD PITCH (mm)	PIN LENGTH (mm)	CONTENT (l/100 m)
69.90	60.30	23.40	8.5	41.91	286.00

IMPERIAL

PART #	DESCRIPTION
3541556	NRQ 10' ROD
3541380	NRQ 5' ROD
3541341	NRQ 2' ROD*
3542459	NRQ 1' ROD*

OD (in)	ID (in)	WEIGHT (lb/10ft)	THREAD PITCH (tpi)	PIN LENGTH (in)	CONTENT (USgal/100ft)
2.75	2.38	52.40	3.0	1.65	23.00

WARNING

* Do not use rods shorter than 1.5m at top of hole, as a drive sub or Kelly rod because they do not have Q&T heat treatment; they only have pin thread case hardening for wear. Subs, which are made from Q&T material, should be used for these applications.

NRQ™ BUNDLE SPECIFICATIONS

3.0 m/10 ft ROD BUNDLE (19 RODS)
Dimensions (L x W x H)........3.2 x 0.4 x 0.3 m (10.3 x 1.2 x 1.1 ft)
Volume........0.4 m^3 (13.0 ft^3)
Gross Weight........453 kg (1000 lb)

1.5 m/5 ft ROD BUNDLE (19 RODS)
Dimensions (L x W x H)........1.6 x 0.4 x 0.3 m (5.3 x 1.2 x 1.1 ft)
Volume........0.2 m^3 (7.0 ft^3)
Gross Weight........239 kg (526 lb)

CONTAINER SHIPMENTS:
20 ft container load of 3.0 m/10 ft rods holds 32 bundles (608 rods)
40 ft container load of 3.0 m/10 ft rods holds 45 bundles (855 rods)

HRQ™

METRIC

PART #	DESCRIPTION
306243	HRQ 3.0 m ROD
3541310	HRQ 1.5 m RO

OD (mm)	ID (mm)	WEIGHT (kg/3 m)	THREAD PITCH (mm)	PIN LENGTH (mm)	CONTENT (l/100 m)
88.90	77.80	34.50	8.50	41.91	475.00

IMPERIAL

PART #	DESCRIPTION
3541558	HRQ 10' ROD
3541381	HRQ 5' ROD
3541342	HRQ 2' ROD*
3545071	HRQ 1' ROD*

OD (in)	ID (in)	WEIGHT (lb/10ft)	THREAD PITCH (tpi)	PIN LENGTH (in)	CONTENT (USgal/100ft)
3.50	3.06	77.00	3.0	1.65	38.00

WARNING

* Do not use rods shorter than 1.5m at top of hole, as a drive sub or Kelly rod because they do not have Q&T heat treatment; they only have pin thread case hardening for wear. Subs, which are made from Q&T material, should be used for these applications.

HRQ™ BUNDLE SPECIFICATIONS

3.0 m/10 ft ROD BUNDLE (19 RODS)
Dimensions (L x W x H)........3.2 x 0.5 x 0.4 m (10.3 x 1.5 x 1.3 ft)
Volume........0.6 m^3 (21.2 ft^3)
Gross Weight........682 kg (1,505 lb)

1.5 m/5 ft ROD BUNDLE (19 RODS)
Dimensions (L x W x H)........1.6 x 0.5 x 0.4 m (5.3 x 1.5 x 1.3 ft)
Volume........0.3 m^3 (10.9 ft^3)
Gross Weight........346 kg (764 lb)

CONTAINER SHIPMENTS:
20 ft container load of 3.0 m/10 ft rods holds 20 bundles (380 rods)
40 ft container load of 3.0 m/10 ft rods holds 30 bundles (570 rods)

V-WALL™

V-Wall™ is an internally-upset rod available with our high load-efficiency patented RQ™ thread or HD thread. V-Wall rods undergo our unique combination of heat treatment processes for performance in demanding applications.

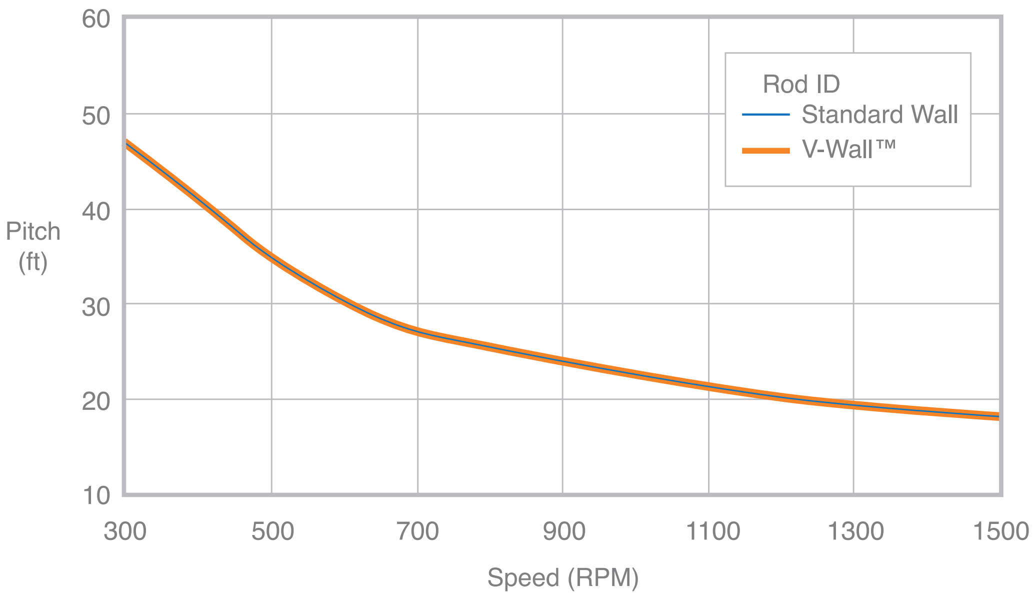
V-Wall™ for Increased Productivity and Reduced Costs

With up to 30% less weight in the drill string, productivity will increase while overall operation costs will be reduced.

V-Wall Rods:

- Decrease operator fatigue in rod handling – increasing safety and productivity.
- Decrease fuel costs in rod transportation, and increase the fuel efficiency of each rig on the site.
- Increase drill's rated depth capacity.
  - For example, a drill rated to 2500 m HRQ will be able to manage a 3000 m HRQ V-Wall drill string.
- Increase midbody flexibility, which is advantageous in wedging or steering applications, but does not reduce drill string stiffness during coring operations. *The figure below demonstrates that the helical whirling response to normal drilling loads (pitch of the twisted 'corkscrew' shape of the drill string) is identical for both standard and V-Wall rods.*

MIDBODY BENDING STRESS



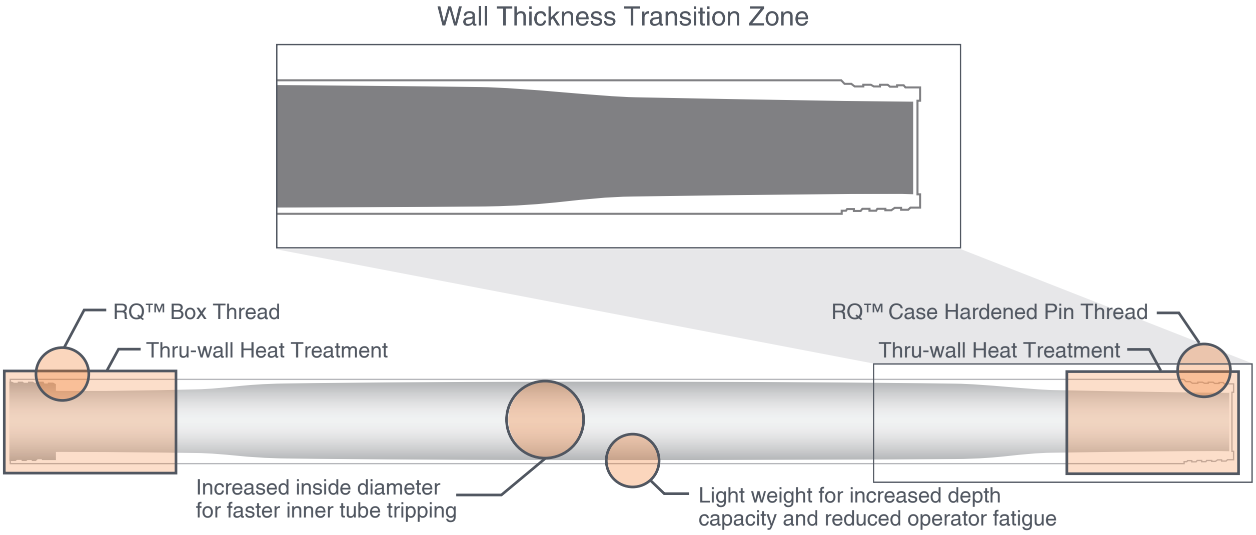
Usable under the following patents: AU2010339878; CA 2,784,532; CL 2012-01618; CN 201080057031.0; US 8,485,280; US 9,234,398; ZA 2012/05268; AU 2008222974; CA 2,679,933; CN 200880007004.5; US 9,359,847; ZA 2009/05921; Patents Pending.

V-WALL™

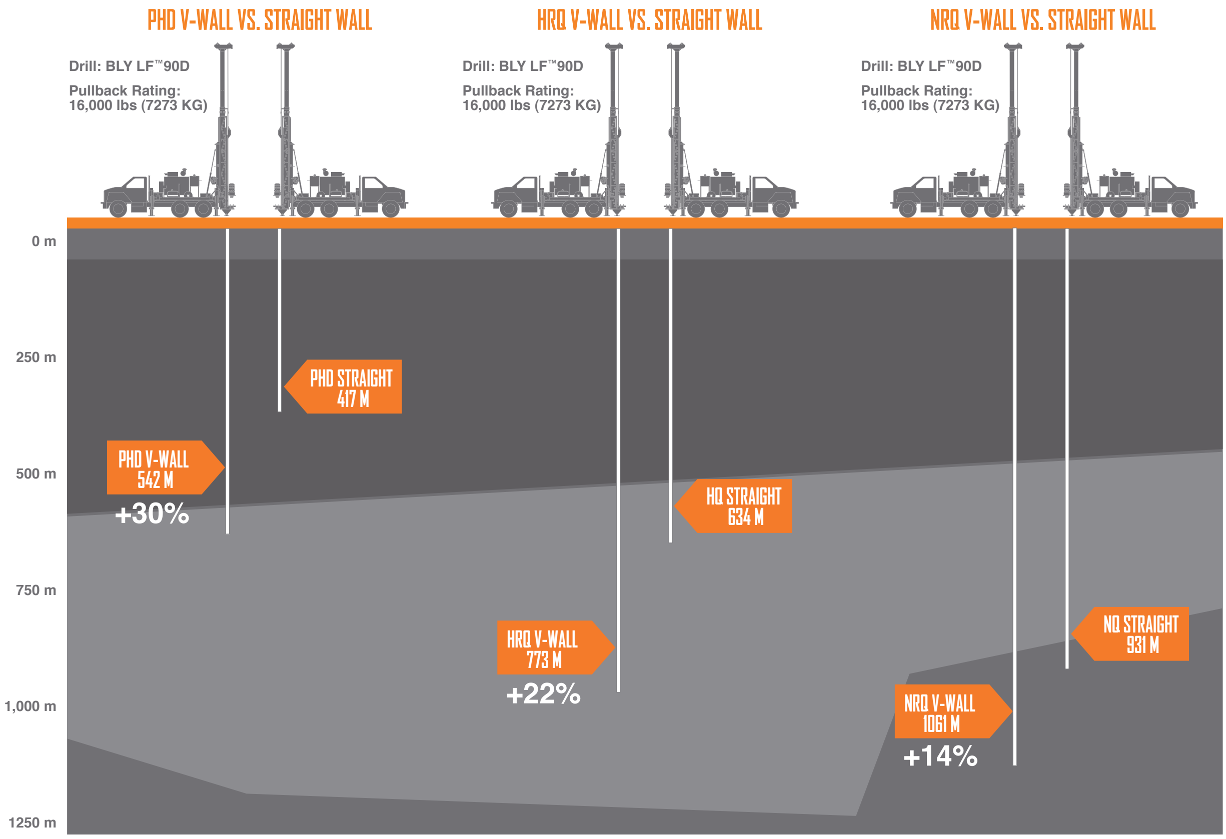
V-WALL™ FOR FASTER INNER TUBE TRIPPING

Annular clearance between the core barrel and the interior wall of the rod is larger which enables faster core barrel tripping speeds.

When combined with Quick Descent™ core barrel technology, tripping speed increases up to 50%.



V-WALL™ PULL-BACK ADVANTAGE



V-WALL™

METRIC

PART #	DESCRIPTION	OD (mm)	BODY ID (mm)	JOINT ID (mm)	WEIGHT (kg/3 m)	THREAD PITCH(mm)	PINLENGTH (mm)	CONTENT (l/100 m)
3544312	ROD, NRQ 3.0M V-WALL	69.90	62.00	60.30	21.00	8.5	41.91	297.00
3544311	ROD, HRQ 3.0M V-WALL	88.90	81.00	77.80	27.00	8.5	41.91	506.00

IMPERIAL

PART #	DESCRIPTION	OD (in)	BODYID(in)	JOINT ID (in)	WEIGHT (lb/10ft)	THREAD PITCH (tpi)	PINLENGTH (in)	CONTENT (USgal/100ft)
3544310	ROD, NRQ 10' V-WALL	2.20	1.91		32.00	3.50	1.60	15.00
3544309	ROD, HRQ 10' V-WALL	3.50	3.19	3.06	60.0	3.0	1.60	41.00

V-WALL™ ROD BUNDLE SPECIFICATIONS

NQ/NRQ 3.0 m/10 ft ROD BUNDLE (19 RODS)

Dimensions (L x W x H)............3.2 x 0.4 x 0.3 m (10.3 x 1.2 x 1.1 ft)
Volume............0.4 m^3 (13.0 ft^3)
Gross Weight............394 kg (869 lb)

CONTAINER SHIPMENTS:
20 ft container load of 3.0 m/10 ft rods holds 32 bundles (608 rods)
40 ft container load of 3.0 m/10 ft rods holds 50 bundles (950 rods)

HQ/HRQ 3.0 m/10 ft ROD BUNDLE (19 RODS)

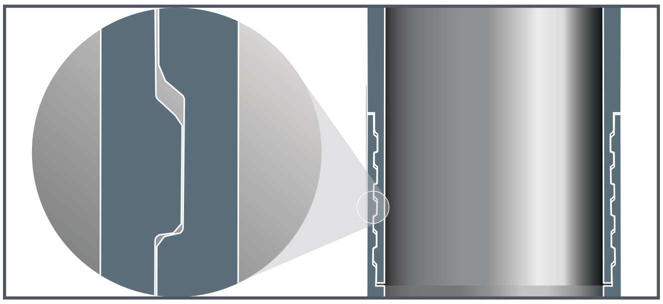
Dimensions (L x W x H)............3.2 x 0.5 x 0.4 m (10.3 x 1.5 x 1.3 ft)
Volume............0.6 m^3 (21.2 ft^3)
Gross Weight............540 kg (1,191 lb)

CONTAINER SHIPMENTS:
20 ft container load of 3.0 m/10 ft rods holds 20 bundles (380 rods)
40 ft container load of 3.0 m/10 ft rods holds 38 bundles (722 rods)

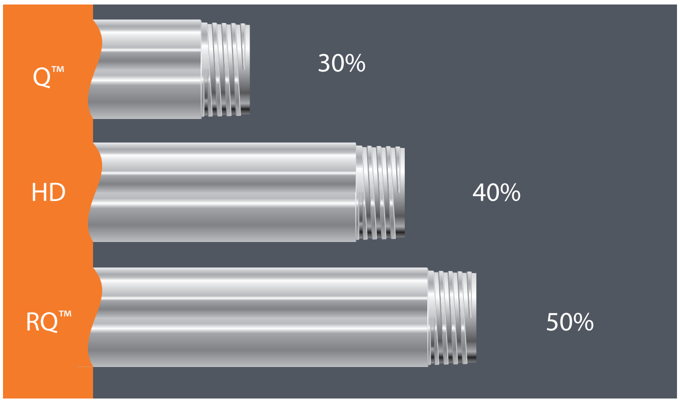
HD THREAD

HD threads are designed for reliability in large size core drilling, the HD drill rod offers a robust, coarse thread profile for heavy duty wireline applications.

HD THREAD PROFILE



JOINT LOAD EFFICENCY



WARNING

Due to the significant safety risk, Boart Longyear drill rods should never be mixed with another manufacturers' rods. Doing so may cause catastrophic equipment failure, leading to bodily injury or death. In addition, mixing rods voids the Boart Longyear warranty.

This is a measure of how much load a joint can carry, as compared to the midbody (e.g. 30% provides a third of the strength). Inversely, this is a measure of how much more stress is created in the joint by a load, as compared to the midbody (e.g. 30% creates three times the stress under a load).

FEATURES

TUBING

- High quality alloy steel tubing
- Consistent concentricity, straightness and heat treatment

THREAD

- Larger deeper threads (2.5 threads per inch) provide maximum durability
- Load efficiency of 40% provides sufficient strength for large hole sizes
- HD is a Boart Longyear proprietary product and as such contains all of the quality, features, and fit associated with Boart Longyear manufacturing standards

CASE HARDENING

- Boart Longyear is the only major manufacturer in the industry to case-harden threads
- Significant research, development and field testing has resulted in a hardening process that is unmatched unique and in the marketplace
- Pin thread crest is hardened to eliminate damaging 'adhesion' wear
- Eliminates the transfer of wear material back and forth as seen between threads of equal hardness, leading to large scale galling and joint seizing

HD THREAD PART NUMBERS

RODS

PHD

	PART #	DESCRIPTION
METRIC	3542314	PHD 3.0 m ROD
	3541743	PHD 1.5 m ROD

OD (mm)	ID (mm)	WEIGHT (kg/3 m)	THREAD PITCH (mm)	PIN LENGTH (mm)	CONTENT (l/100 m)
114.00	101.60	52.20	10.2	62.7	811.00

	PART #	DESCRIPTION
IMPERIAL	3540845	PHD 10' ROD
	3540844	PHD 5' ROD
	3542519	PHD 2' ROD*

OD (in)	ID (in)	WEIGHT (lb/10ft)	THREAD PITCH (tpi)	PIN LENGTH (in)	CONTENT (USgal/100ft)
4.50	4.00	117.00	2.5	2.47	65.00

WARNING

* Do not use rods shorter than 1.5m at top of hole, as a drive sub or Kelly rod because they do not have Q&T heat treatment; they only have pin thread case hardening for wear. Subs, which are made from Q&T material, should be used for these applications.

PHD BUNDLE SPECIFICATIONS

3.0 m/10 ft ROD BUNDLE (7 RODS)

Dimensions (L x W x H)........3.2 x 0.4 x 0.3 m (10.3 x 1.2 x 1.1 ft)

Volume........0.4 m^3 (14.1 ft^3)

Gross Weight........373 kg (823 lb)

1.5 m/5 ft ROD BUNDLE (7 RODS)

Dimensions (L x W x H)........1.6 x 0.4 x 0.3 m (5.3 x 1.2 x 1.1 ft)

Volume........0.20 m^3 (7.1 ft^3)

Gross Weight........194 kg (428 lb)

CONTAINER SHIPMENTS:

20 ft container load of 3.0 m/10 ft rods holds 24 bundles (168 rods)

40 ft container load of 3.0 m/10 ft rods holds 54 bundles (378 rods)

V-WALL™

RODS

The V-Wall™ Rod is an internally-upset rod available with our high load-efficiency patented RQ™ thread or HD thread. In addition, all V-Wall rods undergo our unique combination of heat treatment processes for performance in demanding applications.

	PART #	DESCRIPTION	OD (mm)	BODY ID (mm)	JOINT ID (mm)	WEIGHT (kg/3 m)	THREAD PITCH(mm)	PINLENGTH (mm)	CONTENT (l/100 m)
METRIC	3003743	ROD, PHD 3.0M V-WALL	114.00	106.00	102.00	37.21	10.2	63.00	869.30

	PART #	DESCRIPTION	OD (in)	BODYID(in)	JOINT ID (in)	WEIGHT (lb/10ft)	THREAD PITCH (tpi)	PINLENGTH (in)	CONTENT (USgal/100ft)
IMPERIAL	3546256	ROD, PHD 10' V-WALL	4.50	4.19	4.00	82.00	2.5	2.50	70.00

V-WALL™ ROD BUNDLE SPECIFICATIONS

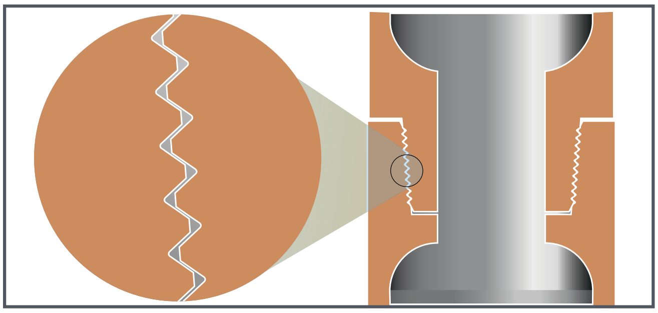
PHD 3.0 m/10 ft ROD BUNDLE (7 RODS)
Dimensions (L x W x H)........3.2 x 0.4 x 0.3 m (10.3 x 1.2 x 1.1 ft)
Volume........0.4 m^3 (14.1 ft^3)
Gross Weight........268 kg (591 lb)

CONTAINER SHIPMENTS:
20 ft container load of 3.0 m/10 ft rods holds 25 bundles (175 rods)
40 ft container load of 3.0 m/10 ft rods holds 56 bundles (392 rods)

WJ THREAD

The WJ rod is a conventional drill rod consisting of a tubular mid-body with friction welded pin and box ends. The tapered threads are similar to an API thread form and are manufactured using DCDMA gauges. WJ rods are used for conventional core drilling, geotechnical and environmental applications and rotary drilling applications.

WJ THREAD PROFILE



FEATURES

MIDBODY TUBING

- High quality alloy steel tubing
- Consistent concentricity, straightness and heat treatment
- Midbody tubing is standard Q™ weight for WJ or Q TK weight for WJLW

THREAD DESIGN

- API style of thread featuring a 'V' style thread with ample taper providing easier and faster making and breaking
- Excellent pulling load capacity

CONSTRUCTION

- Reliable friction welded construction ensure joints have mechanical properties equal to the parent material
- Avoids failures inherent to the brittle material created by conventional welding techniques

WJ THREAD PART NUMBERS

Light weight (LW) WJ rods utilize the RQ™TK rod tubing for midbodies to provide lighter weight thus providing greater drilling depths

AWJ AND AWJLW

	PART #	DESCRIPTION
METRIC	63467	AWJLW 3.0 m ROD
METRIC	63468	AWJLW 1.5 m ROD

OD (mm)	BODY ID (mm)	JOINT ID (mm)	WEIGHT (kg/3 m)	THREAD PITCH(mm)	PINLENGTH (mm)	CONTENT (l/100 m)
44.50	38.10	15.90	10.40	5.1	44.45	94.40

	PART #	DESCRIPTION
IMPERIAL	62785	AWJ 10' ROD
IMPERIAL	62786	AWJ 5' ROD
IMPERIAL	63094	AWJ 2' ROD

OD (in)	BODYID(in)	JOINT ID (in)	WEIGHT (lb/10ft)	THREAD PITCH (tpi)	PINLENGTH (in)	CONTENT (USgal/100ft)
1.75	1.50	0.63	32.00	5.0	1.75	7.40

AWJ and AWJLW BUNDLE SPECIFICATIONS

3.0 m/10 ft ROD BUNDLE (19 RODS)
Dimensions (L x W x H)........3.2 x 0.2 x 0.2 m (10.3 x 0.8 x 0.7 ft)
Volume........0.2 m³ (7.1 ft³)
Gross Weight........AWJ: 288.5 kg (636 lb); AWJLW: 209.0 kg (461 lb)

1.5 m/5 ft ROD BUNDLE (19 RODS)
Dimensions (L x W x H)........1.6 x 0.2 x 0.2 m (5.3 x 0.8 x 0.7 ft)
Volume........0.1 m³ (3.5 ft³)
Gross Weight........AWJ: 149.7 kg (330 lb); AWJLW: 109 kg (242 lb)

CONTAINER SHIPMENTS:
20 ft container load of 3.0 m/10 ft rods holds 75 bundles (1425 rods)
40 ft container load of 3.0 m/10 ft rods holds 97 bundles (1843 rods)

BWJ AND BWJLW

	PART #	DESCRIPTION
METRIC	3544303	BWJLW 3.0 m ROD
METRIC	3544361	BWJLW 1.5 m ROD
METRIC	3544732	BWJ 3.0 m ROD
METRIC	3544731	BWJ 1.5 m ROD

OD (mm)	BODY ID (mm)	JOINT ID (mm)	WEIGHT (kg/3 m)	THREAD PITCH(mm)	PINLENGTH (mm)	CONTENT (l/100 m)
55.80	BWJ: 44.50 BWJLW: 48.40	19.00	BWJ: 54.00 BWJLW" 49.20	51	50.80	176.60

BWJ and BWJLW BUNDLE SPECIFICATIONS

3.0 m/10 ft ROD BUNDLE (19 RODS)
Dimensions (L x W x H)........3.2 x 0.3 x 0.3 m (10.3 x 1.0 x 0.8 ft)
Volume........0.2 m³ (8.1 ft³)
Gross Weight........BWJ: 360 kg (796 lb); BWJLW 289 kg (639 lb)

1.5 m/5 ft ROD BUNDLE (19 RODS)
Dimensions (L x W x H)........1.6 x 0.3 x 0.3 m (5.3 x 1.0 x 0.8 ft)
Volume........0.1 m³ (3.9 ft³)
Gross Weight........BWJ: 193 kg (427 lb); BWJLW 164 kg (362 lb)

CONTAINER SHIPMENTS:
20 ft container load of 3.0 m/10 ft rods holds 36 bundles (684 rods)
40 ft container load of 3.0 m/10 ft rods holds 36 bundles (684 rods)

WJ THREAD PART NUMBERS

RODS

NWJ

METRIC

PART #	DESCRIPTION
63739	NWJ 3.0 m ROD
63738	NWJ 1.5 m ROD

OD (mm)	BODY ID (mm)	JOINT ID (mm)	WEIGHT (kg/3 m)	THREAD PITCH(mm)	PINLENGTH (mm)	CONTENT (l/100 m)
66.70	57.20	28.60	23.50	6.4	63.50	243.60

IMPERIAL

PART #	DESCRIPTION
3543046	NWJ 10' ROD
62999	NWJ 5' ROD
63098	NWJ 2' ROD

OD (in)	BODYID(in)	JOINT ID (in)	WEIGHT (lb/10ft)	THREAD PITCH (tpi)	PINLENGTH (in)	CONTENT (USgal/100ft)
2.63	2.25	1.13	52.00	4.0	2.50	20.00

NWJ BUNDLE SPECIFICATIONS

3.0 m/10 ft ROD BUNDLE (19 RODS)
Dimensions (L x W x H)........3.2 x 0.3 x 0.3 m (10.3 x 1.0 x 0.8 ft)
Volume........0.3 m^3 (10.2 ft^3)
Gross Weight........458 kg (1,012 lb)

1.5 m/5 ft ROD BUNDLE (19 RODS)
Dimensions (L x W x H)........1.6 x 0.3 x 0.3 m (5.3 x 1.0 x 0.8 ft)
Volume........0.1 m^3 (5.1 ft^3)
Gross Weight........248 kg (597 lb)

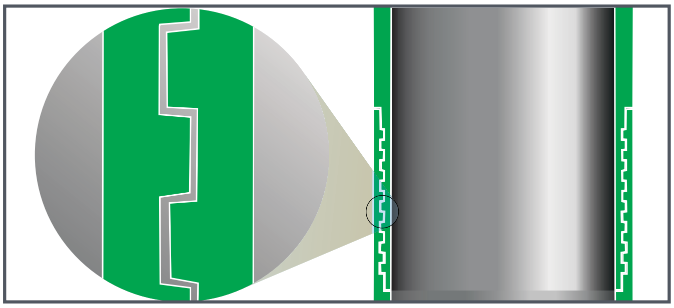
CONTAINER SHIPMENTS:
20 ft container load of 3.0 m/10 ft rods holds 34 bundles (646 rods)
40 ft container load of 3.0 m/10 ft rods holds 45 bundles (855 rods)

CASING

W THREAD

This casing is intended for single use or situations where the casing is left in the hole. The W casing is made from DCDMA C80 tubing and utilize the DCDMA W thread form. The W thread is a straight thread (4 threads per inch). This casing is universal in design and can be used in any drilling application where threaded casing is required to be left in the ground.

W THREAD PROFILE



FEATURES

TUBING

- Parallel wall tubing compatible with Q™ Wireline in-hole tools
- Standard DCDMA W sizes allow 'nesting' of other W casing
-

THREAD DESIGN

- Double-butt joint gives strength in driving and jarring

AW

METRIC

PART #	DESCRIPTION
66533	AW 3.0 m CASING
66531	AW 1.5 m CASING

OD (mm)	ID (mm)	WEIGHT (kg/3 m)	THREAD PITCH (mm)	PIN LENGTH (mm)	CONTENT (l/100 m)
57.10	48.40	17.00	6.4	57.15	184.40

IMPERIAL

PART #	DESCRIPTION
26355	AW 10' CASING
26356	AW 5' CASING
26358	AW 2' CASING
26359	AW 1' CASING

OD (in)	ID (in)	WEIGHT (lb/10 ft)	THREAD PITCH (tpi)	PIN LENGTH (in)	CONTENT (USgal/100ft)
2.25	1.91	38.00	4.0	2.25	14.80

AW BUNDLE SPECIFICATIONS

3.0 m/10 ft CASING BUNDLE (19 PIECES)
Dimensions (L x W x H) .... 3.2 x 0.3 x 0.3 m (10.3 x 1.0 x 1.0 ft)
Volume .... 0.3 m^3 (10.6 ft^3)
Gross Weight .... 343 kg (756 lb)

1.5 m/5 ft CASING BUNDLE (19 PIECES)
Dimensions (L x W x H) .... 1.6 x 0.3 x 0.3 m (5.3 x 1.0 x 1.0 ft)
Volume .... 0.1 m^3 (5.1 ft^3)
Gross Weight .... 179 kg (395 lb)

CONTAINER SHIPMENTS:
20 ft container load of 3.0 m/10 ft rods holds 44 bundles (836 rods)
40 ft container load of 3.0 m/10 ft rods holds 59 bundles (1121 rods)

W THREAD PART NUMBERS

BW

METRIC

PART #	DESCRIPTION
66539	BW 3.0 m CASING
66537	BW 1.5 m CASING

OD (mm)	ID (mm)	WEIGHT (kg/3 m)	THREAD PITCH (mm)	PIN LENGTH (mm)	CONTENT (l/100 m)
73.00	60.30	31.30	6.4	63.50	285.80

IMPERIAL

PART #	DESCRIPTION
26360	BW 10' CASING
26361	BW 5' CASING
3543007	BW 2' CASING
26364	BW 1' CASING

OD (in)	ID (in)	WEIGHT (lb/10 ft)	THREAD PITCH (tpi)	PIN LENGTH (in)	CONTENT (USgal/100ft)
2.88	2.38	70.00	4.0	2.50	23.00

BW BUNDLE SPECIFICATIONS

3.0 m/10 ft CASING BUNDLE (19 PIECES)
Dimensions (L x W x H)............3.2 x 0.3 x 0.3 m (10.3 x 1.0 x 1.0 ft)
Volume............0.3 m^3 (10.6 ft^3)
Gross Weight............343 kg (756 lb)

1.5 m/5 ft CASING BUNDLE (19 PIECES)
Dimensions (L x W x H)............1.6 x 0.3 x 0.3 m (5.3 x 1.0 x 1.0 ft)
Volume............0.1 m^3 (5.1 ft^3)
Gross Weight............179 kg (395 lb)

CONTAINER SHIPMENTS:
20 ft container load of 3.0 m/10 ft rods holds 24 bundles (456 rods)
40 ft container load of 3.0 m/10 ft rods holds 33 bundles (627 rods)

NW

METRIC

PART #	DESCRIPTION
66545	NW 3.0 m CASING
66543	NW 1.5 m CASING
66542	NW 1.0 m CASING

OD (mm)	ID (mm)	WEIGHT (kg/3 m)	THREAD PITCH (mm)	PIN LENGTH (mm)	CONTENT (l/100 m)
88.90	76.20	38.40	6.4	69.85	455.70

IMPERIAL

PART #	DESCRIPTION
26365	NW 10' CASING
26366	NW 5' CASING
26368	NW 2' CASING

OD (in)	ID (in)	WEIGHT (lb/10 ft)	THREAD PITCH (tpi)	PIN LENGTH (in)	CONTENT (USgal/100ft)
3.5	3.00	86.00	4.0	2.75	36.70

NW BUNDLE SPECIFICATIONS

3.0 m/10 ft CASING BUNDLE (19 PIECES)
Dimensions (L x W x H)............3.2 x 0.5 x 0.4 m (10.3 x 1.5 x 1.3 ft)
Volume............0.6 m^3 (21.0 ft^3)
Gross Weight............760 kg (1,676 lb)

1.5 m/5 ft CASING BUNDLE (19 PIECES)
Dimensions (L x W x H)............1.6 x 0.5 x 0.4 m (5.3 x 1.5 x 1.3 ft)
Volume............0.3 m^3 (11.0 ft^3)
Gross Weight............390 kg (860 lb)

CONTAINER SHIPMENTS:
20 ft container load of 3.0 m/10 ft rods holds 20 bundles (380 rods)
40 ft container load of 3.0 m/10 ft rods holds 26 bundles (494 rods)

W THREAD PART NUMBERS

HW

METRIC

PART #	DESCRIPTION
66551	HW 3.0 m CASING
66549	HW 1.5 m CASING
66548	HW 1.0 m CASING

OD (mm)	ID (mm)	WEIGHT (kg/3 m)	THREAD PITCH (mm)	PIN LENGTH (mm)	CONTENT (l/100 m)
114.30	101.60	52.20	6.4	76.20	810.80

IMPERIAL

PART #	DESCRIPTION
26370	HW 10' CASING
26371	HW 5' CASING
26373	HW 2' CASING
26374	HW 1' CASING

OD (in)	ID (in)	WEIGHT (lb/10 ft)	THREAD PITCH (tpi)	PIN LENGTH (in)	CONTENT (USgal/100ft)
4.50	4.00	117.00	4.0	3.00	65.30

HW BUNDLE SPECIFICATIONS

3.0 m/10 ft CASING BUNDLE (7 PIECES)
Dimensions (L x W x H)....3.2 x 0.4 x 0.3 m (10.3 x 1.2 x 1.1 ft)
Volume....0.4 m^3 (14.1 ft^3)
Gross Weight....373 kg (823 lb)

1.5 m/5 ft CASING BUNDLE (7 PIECES)
Dimensions (L x W x H)....1.6 x 0.4 x 0.3 m (5.3 x 1.2 x 1.1 ft)
Volume....0.2 m^3 (7.1 ft^3)
Gross Weight....194.1 kg (428 lb)

CONTAINER SHIPMENTS:
20 ft container load of 3.0 m/10 ft rods holds 24 bundles (168 rods)
40 ft container load of 3.0 m/10 ft rods holds 54 bundles (378 rods)

PW

METRIC

PART #	DESCRIPTION
66731	PW 3.0 m CASING
66730	PW 1.5 m CASING
66729	PW 1.0 m CASING

OD (mm)	ID (mm)	WEIGHT (kg/3 m)	THREAD PITCH (mm)	PIN LENGTH (mm)	CONTENT (l/100 m)
139.70	127.00	64.30	6.4	82.55	1266.60

IMPERIAL

PART #	DESCRIPTION
26629	PW 10' CASING
26630	PW 5' CASING
26631	PW 2' CASING
26632	PW 1' CASING

OD (in)	ID (in)	WEIGHT (lb/10 ft)	THREAD PITCH (tpi)	PIN LENGTH (in)	CONTENT (USgal/100ft)
5.50	5.0	144.00	4.0	3.25	102.00

PW BUNDLE SPECIFICATIONS

3.0 m/10 ft CASING BUNDLE (7 PIECES)
Dimensions (L x W x H)....3.2 x 0.5 x 0.4 m (10.3 x 1.5 x 1.3 ft)
Volume....0.6 m^3 (21.2 ft^3)
Gross Weight....463 kg (1022 lb)

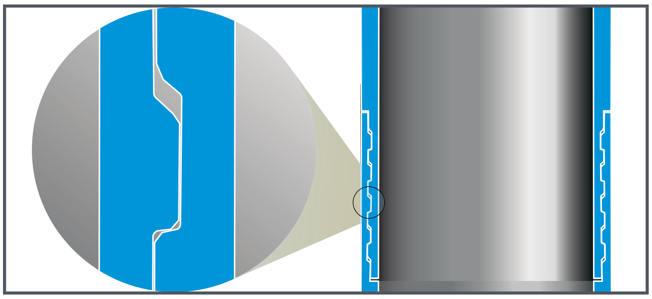
1.5 m/5 ft CASING BUNDLE (7 PIECES)
Dimensions (L x W x H)....1.6 x 0.5 x 0.4 m (5.3 x 1.5 x 1.3 ft)
Volume....0.3 m^3 (10.6 ft^3)
Gross Weight....254 kg (560 lb)

CONTAINER SHIPMENTS:
20 ft container load of 3.0 m/10 ft rods holds 20 bundles (140 rods)
40 ft container load of 3.0 m/10 ft rods holds 44 bundles (308 rods)

WT THREAD

This casing is engineered to surpass expectations for a casing and features quicker make-up and easier break-out characteristics than the standard W casing. This thread works well under difficult drilling conditions and is designed for repeated application. The WT casing is made with DCDMA C80 tubing and the tapered HD thread provides increased strength and easier make and break-out (2.5 threads per inch).

WT THREAD PROFILE



FEATURES

TUBING

- Parallel wall tubing compatible with Q™ wireline in-hole tools
- Standard DCDMA W sizes allow nesting of other W casing

THREAD DESIGN

- Tapered joint and fewer threads per inch result in easier and faster make and break for reduced wear and reduced labor costs
- Double-butt tapered joint and heavy duty buttress thread form provide greater torsion and pullback strength
- Tapered thread reduces stress and provides a rigid joint to reduce movement and lubricant loss
- Load efficiency of 40% provides greater pullback strength to allow retrieval from difficult ground conditions and repeated use
- Threads are easier to clean due to wider spacing of the threads for situations where casing is reused
- Compatible with HD rod threads

WT THREAD PART NUMBERS

NWT

METRIC

PART #	DESCRIPTION
5008513	NWT 3.0 m CASING
5008787	NWT 1.5 m CASING

OD (mm)	ID (mm)	WEIGHT (kg/3 m)	THREAD PITCH (mm)	PIN LENGTH (mm)	CONTENT (l/100 m)
88.90	76.20	38.40	10.2	62.7	455.70

IMPERIAL

PART #	DESCRIPTION
5008813	NWT 2' CASING

OD (in)	ID (in)	WEIGHT (lb/10 ft)	THREAD PITCH (tpi)	PIN LENGTH (in)	CONTENT (USgal/100ft)
3.5	3.00	86.00	2.5	2.47	36.70

NWT BUNDLE SPECIFICATIONS

3.0 m/10 ft CASING BUNDLE (19 PIECES)
Dimensions (L x W x H)........3.2 x 0.5 x 0.4 m (10.3 x 1.5 x 1.3 ft)
Volume........0.6 m^3 (21.0 ft^3)
Gross Weight........760 kg (1,676 lb)

1.5 m/5 ft CASING BUNDLE (19 PIECES)
Dimensions (L x W x H)........1.6 x 0.5 x 0.4 m (5.3 x 1.5 x 1.3 ft)
Volume........0.3 m^3 (11.0 ft^3)
Gross Weight........390 kg (860 lb)

CONTAINER SHIPMENTS:
20 ft container load of 3.0 m/10 ft rods holds 20 bundles (380 rods)
40 ft container load of 3.0 m/10 ft rods holds 26 bundles (494 rods)

HWT

METRIC

PART #	DESCRIPTION
101338	HWT 3.0 m CASING
101339	HWT 1.5 m CASING
3541683	HWT 1.0 m CASING
3541682	HWT 0.5M CASING

OD (mm)	ID (mm)	WEIGHT (kg/3 m)	THREAD PITCH (mm)	PIN LENGTH (mm)	CONTENT (l/100 m)
114.30	101.60	52.20	10.2	44.45	810.80

IMPERIAL

PART #	DESCRIPTION
54843	HWT 10' CASING
54826	HWT 5' CASING
102987	HWT 5' CASING L/H
55055	HWT 2' CASING

OD (in)	ID (in)	WEIGHT (lb/10 ft)	THREAD PITCH (tpi)	PIN LENGTH (in)	CONTENT (USgal/100ft)
4.50	4.00	117.00	2.5	2.47	65.30

HWT BUNDLE SPECIFICATIONS

3.0 m/10 ft CASING BUNDLE (7 PIECES)
Dimensions (L x W x H)........3.2 x 0.4 x 0.3 m (10.3 x 1.2 x 1.1 ft)
Volume........0.4 m^3 (14.1 ft^3)
Gross Weight........373 kg (823 lb)

1.5 m/5 ft CASING BUNDLE (7 PIECES)
Dimensions (L x W x H)........1.6 x 0.4 x 0.3 m (5.3 x 1.2 x 1.1 ft)
Volume........0.2 m^3 (7.1 ft^3)
Gross Weight........194.1 kg (428 lb)

CONTAINER SHIPMENTS:
20 ft container load of 3.0 m/10 ft rods holds 24 bundles (168 rods)
40 ft container load of 3.0 m/10 ft rods holds 54 bundles (378 rods)

WT THREAD PART NUMBERS

PWT

METRIC

PART #	DESCRIPTION
3543977	PWT 3.0 m CASING
3543976	PWT 1.5 m CASING
3547569	PWT 1.0 m CASING

OD (mm)	ID (mm)	WEIGHT (kg/3 m)	THREAD PITCH (mm)	PIN LENGTH (mm)	CONTENT (l/100 m)
139.70	127.00	64.30	10.2	44.45	1266.60

IMPERIAL

PART #	DESCRIPTION
3543975	PWT 10' CASING
3543974	PWT 5' CASING
3543973	PWT 2' CASING

OD (in)	ID (in)	WEIGHT (lb/10 ft)	THREAD PITCH (tpi)	PIN LENGTH (in)	CONTENT (USgal/100ft)
5.50	5.00	144.00	2.5	2.47	102.00

PWT BUNDLE SPECIFICATIONS

3.0 m/10 ft CASING BUNDLE (7 PIECES)
Dimensions (L x W x H)........3.2 x 0.5 x 0.4 m (10.3 x 1.5 x 1.3 ft)
Volume........0.6 m^3 (21.2 ft^3)
Gross Weight........463 kg (1022 lb)

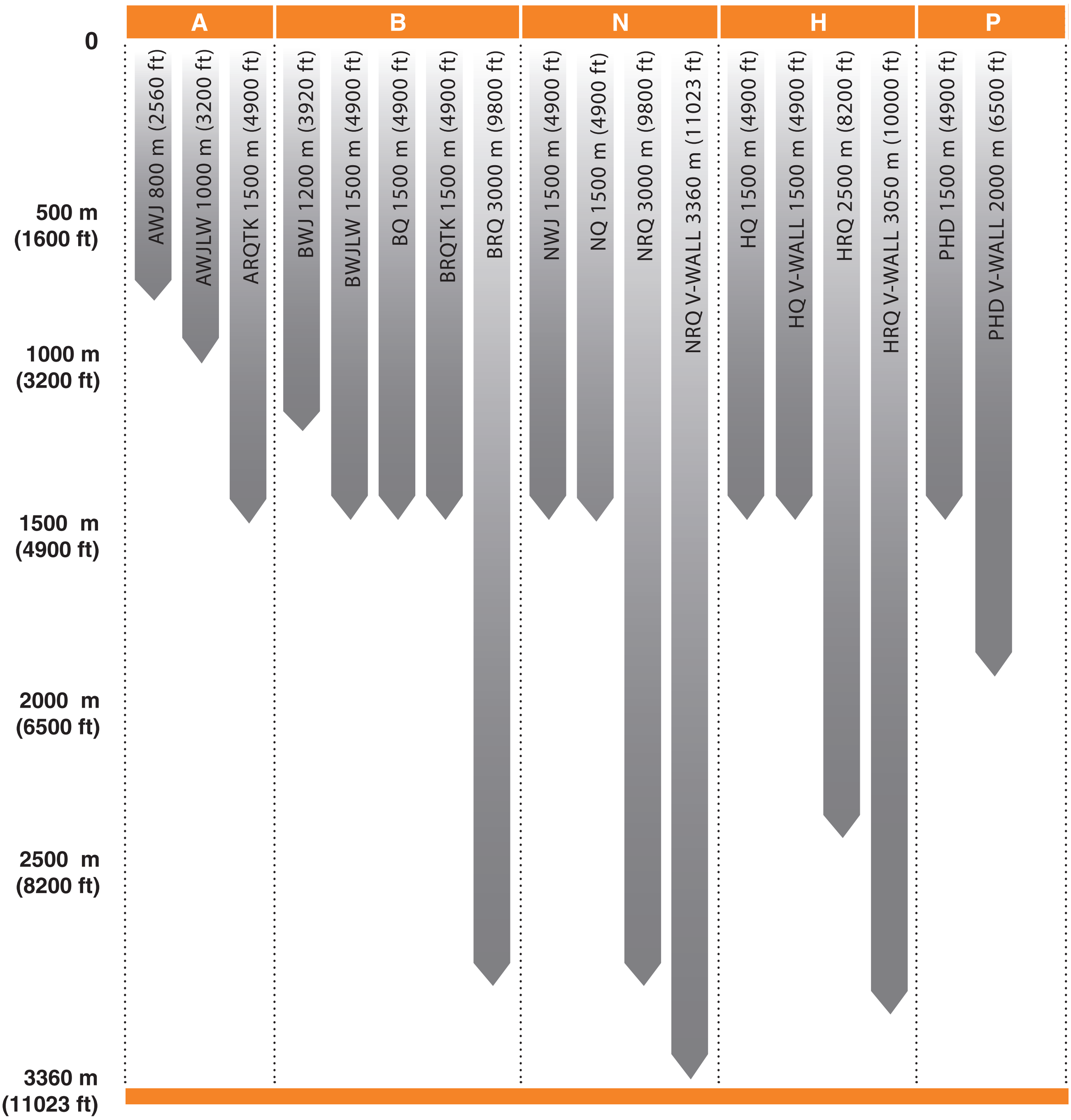
1.5 m/5 ft CASING BUNDLE (7 PIECES)
Dimensions (L x W x H)........1.6 x 0.5 x 0.4 m (5.3 x 1.5 x 1.3 ft)
Volume........0.3 m^3 (10.6 ft^3)
Gross Weight........254 kg (560 lb)

CONTAINER SHIPMENTS:
20 ft container load of 3.0 m/10 ft rods holds 20 bundles (140 rods)
40 ft container load of 3.0 m/10 ft rods holds 44 bundles (308 rods)

TECHNICAL SPECIFICATIONS

WIRELINE CORING RODS

DRILL ROD JOINT DEPTH CAPACITY - DRY HOLE

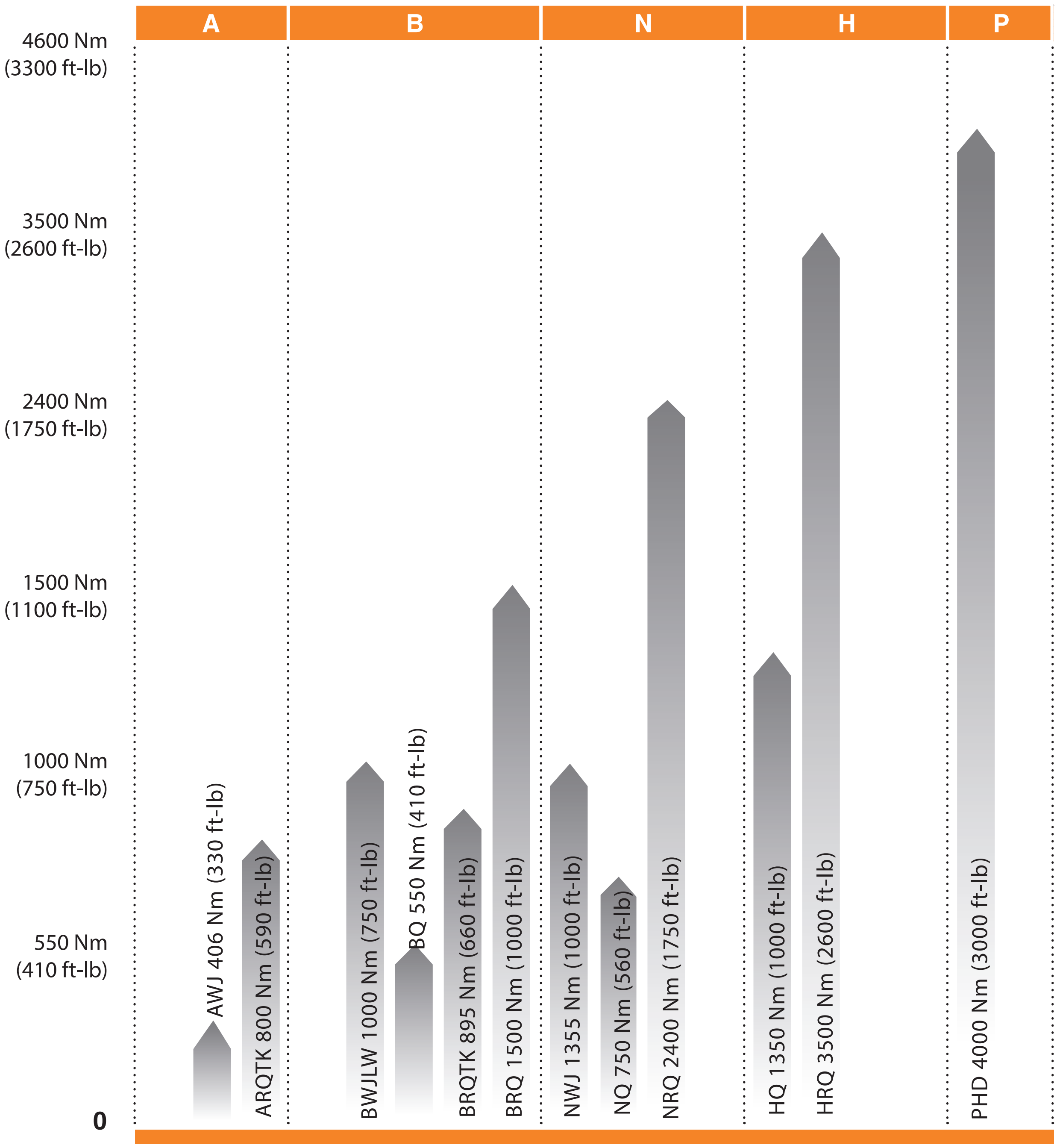


WARNING

- All ratings and recommendations are based on torque and tension load testing by an independent party.
- Depth and load capacities decrease with wear. For example, de-rate by at least 50% for box shoulder thickness worn to 50% of original.
- Actual performance may vary depending on operating conditions and drilling practices.
- Increase make-up torque to match operating torque as depth increases. Operating torque should not exceed make-up torque.

WIRELINE CORING RODS

DRILL ROD JOINT MAX TORQUE RATING

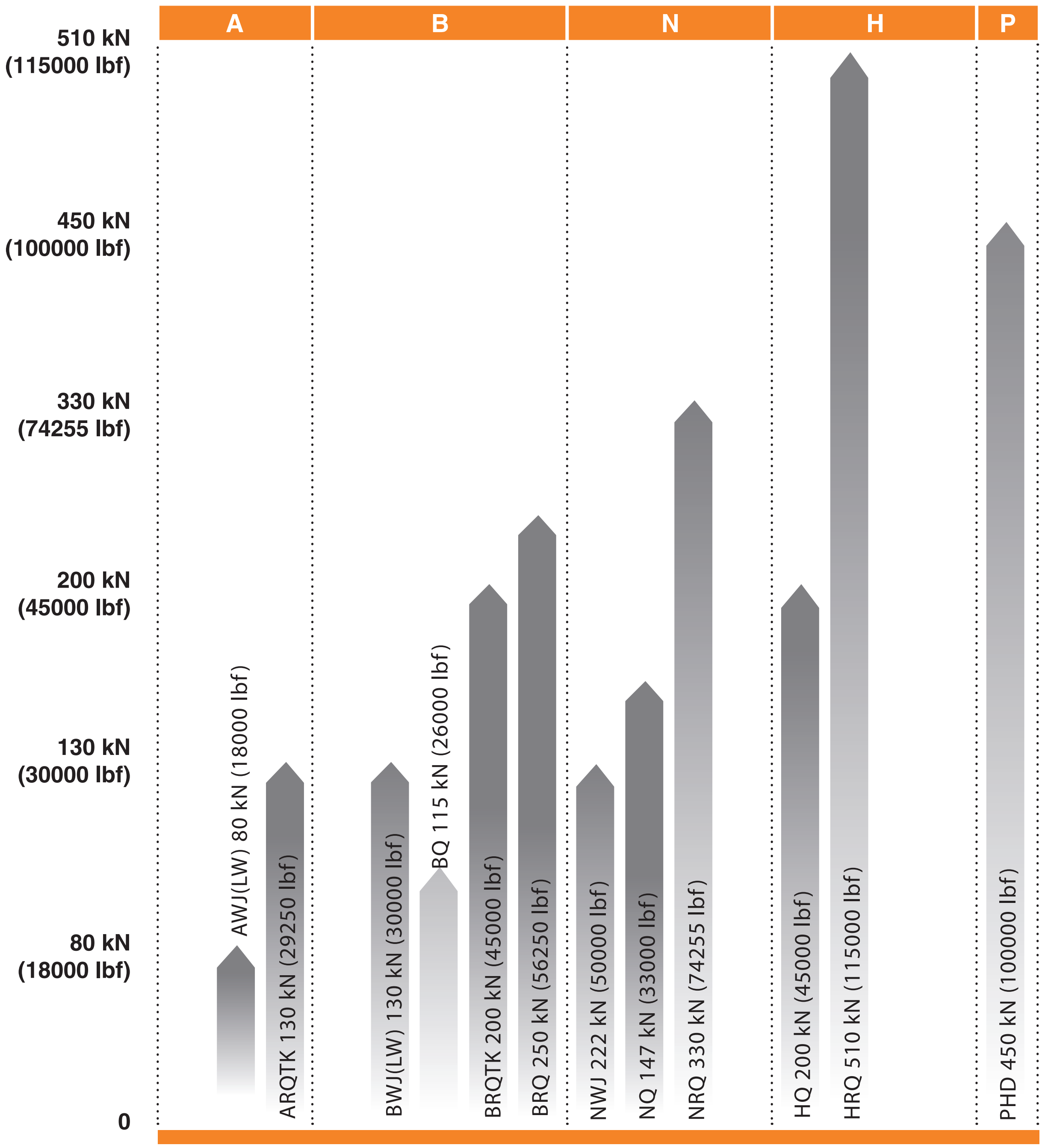


WARNING

- All ratings and recommendations are based on torque and tension load testing by an independent party.
- Depth and load capacities decrease with wear. For example, de-rate by at least 50% for box shoulder thickness worn to 50% of original.
- Actual performance may vary depending on operating conditions and drilling practices.
- Increase make-up torque to match operating torque as depth increases. Operating torque should not exceed make-up torque.

DRILL ROD OVERVIEW

DRILL ROD JOINT MAX PULLBACK RATING



TECHNICAL SPECIFICATIONS

WARNING

- All ratings and recommendations are based on torque and tension load testing by an independent party.
- Depth and load capacities decrease with wear. For example, de-rate by at least 50% for box shoulder thickness worn to 50% of original.
- Actual performance may vary depending on operating conditions and drilling practices.
- Increase make-up torque to match operating torque as depth increases. Operating torque should not exceed make-up torque.

CORING RODS

TECHNICAL SPECIFICATIONS

ARQ™TK TECHNICAL INFORMATION

PERFORMANCE RATING	METRIC SYSTEM	IMPERIAL
Rated Drilling Depth by Joint Strength	1500 m	4,900 ft
Rated Maximum Pullback	130 kN	29,250 lbf
Rated Maximum Torque (Operating or Make-Up)	800 Nm	590 ft lb
Recommended Minimum Make-Up Torque for Deep Holes over 2000m		
Recommended Minimum Make-Up Torque for Deep Holes over 1000m	381 N m	281 ft lb
Recommended Minimum Make-Up Torque	339 N m	250 ft lb
API Theoretical Burst Pressure at Box Shoulder (per API bulletin 5C3)	74 733 kPa	10,839 psi
API Theoretical Burst Pressure at Midbody (per API bulletin 5C3)	90 138 kPa	13,073 psi
API Theoretical Collapse Pressure at Midbody (per API bulletin 5C3)	94 464 kPa	13,700 psi

RATING CRITERIA	METRIC SYSTEM	IMPERIAL
Rod Midbody Outer Diameter	44.83 mm	1.76 in
Rod Midbody Inner Diameter	37.39 mm	1.47 in
Rod Joint Inner Diameter	37.39 mm	1.47 in
Rod Resistance to Deviation (Moment of Inertia)	2538 mm^4	3.9 in^4
Rod Weight per Unit Length	3.77 kg/m	2.53 lb/ft
Rod Content Weight (Water) per Unit Length	1.09 l/m	0.09 gal/ft
Rod Displacement (Water) per Unit Length	0.50 l/m	0.04 gal/ft

BQ™ TECHNICAL INFORMATION

PERFORMANCE RATING	METRIC SYSTEM	IMPERIAL
Rated Drilling Depth by Joint Strength	1500 m	4,900 ft
Rated Maximum Pullback	115 kN	26,000 lbf
Rated Maximum Torque (Operating or Make-Up)	800 Nm	590 ft-lb
Recommended Minimum Make-Up Torque for Deep Holes over 2000m		
Recommended Minimum Make-Up Torque for Deep Holes over 1000m	504 Nm	416 ft lb
Recommended Minimum Make-Up Torque	405 Nm	300 ft lb
API Theoretical Burst Pressure at Box Shoulder (per API bulletin 5C3)	39 500 kPa	5,729 psi
API Theoretical Burst Pressure at Midbody (per API bulletin 5C3)	93 200 kPa	13,511 psi
API Theoretical Collapse Pressure at Midbody (per API bulletin 5C3)	97 300 kPa	14,117 psi

RATING CRITERIA	METRIC SYSTEM	IMPERIAL
Rod Midbody Outer Diameter	55.9 mm	2.19 in
Rod Midbody Inner Diameter	46.1 mm	1.81 in
Rod Joint Inner Diameter	46.1 mm	1.81 in
Rod Weight per Unit Length	6.25 kg/m	4.20 lb/ft
Rod Content Weight (Water) per Unit Length	1.67 L/m	0.13 gal/ft
Rod Displacement (Water) per Unit Length	0.80 L/m	0.07 gal/ft

All ratings and recommendations are based on tension load testing by an independent party.
- These ratings apply to new, unused rods of Boart Longyear manufacture, in a straight vertical down hole, assuming compliance to Boart Longyear Care and Handling or Product Literature and standard core drilling practices.
- Actual performance may vary depending on operating conditions and drilling practices.
- Depth and load capacities decrease with wear. For example, de-rate by at least 50% for box shoulder thickness worn to 50% of original.
- Increase make-up torque to match operating torque as depth increases. Operating torque should not exceed make-up torque.

BRQ™ TECHNICAL INFORMATION

PERFORMANCE RATING	METRIC	IMPERIAL
Rated Drilling Depth by Joint Strength	3 000 m	9,843 ft
Rated Maximum Pullback	250 kN	56,250 ft lbf
Rated Maximum Torque (Operating or Make-Up)	1 500 Nm	1100 ft-lb
Recommended Minimum Make-Up Torque for Deep Holes over 2000m	950 Nm	750 ft lbf
Recommended Minimum Make-Up Torque for Deep Holes over 1000m	680 Nm	500 ft lbf
Recommended Minimum Make-Up Torque	405 Nm	300 ft lbf
API Theoretical Burst Pressure at Box Shoulder (per API bulletin 5C3)	61 300 MPa	8,891 psi
API Theoretical Burst Pressure at Midbody (per API bulletin 5C3)	93 200 MPa	13,511 psi
API Theoretical Collapse Pressure at Midbody (per API bulletin 5C3)	97 300 MPa	14,117 psi

RATING CRITERIA	METRIC	IMPERIAL
Rod Midbody Outer Diameter	55.9 mm	2.19 in
Rod Midbody Inner Diameter	46.1 mm	1.81 in
Rod Joint Inner Diameter	46.1 mm	1.81 in
Rod Weight per Unit Length	6.25 kg/m	4.20 lb/ft
Rod Content Weight (Water) per Unit Length	1.67 L/m	0.13 gal/ft
Rod Displacement (Water) per Unit Length	0.80 L/m	0.07 gal/ft

TECHNICAL SPECIFICATIONS

BRQ™TK TECHNICAL INFORMATION

PERFORMANCE RATING	METRIC	IMPERIAL
Rated Drilling Depth by Joint Strength	1500 m	4,900 ft
Rated Maximum Pullback	200 kN	45,000 lbf
Rated Maximum Torque (Operating or Make-Up)	895 Nm	660 ft-lb
Recommended Minimum Make-Up Torque for Deep Holes over 2000m		
Recommended Minimum Make-Up Torque for Deep Holes over 1000m	680 Nm	500 ft lb
Recommended Minimum Make-Up Torque	405 Nm	300 ft lb
API Theoretical Burst Pressure at Box Shoulder (per API bulletin 5C3)	56 418 kPa	8,182 psi
API Theoretical Burst Pressure at Midbody (per API bulletin 5C3)	74 703 kPa	10,834 psi
API Theoretical Collapse Pressure at Midbody (per API bulletin 5C3)	72 506 kPa	10,516 psi

RATING CRITERIA	METRIC	IMPERIAL
Rod Midbody Outer Diameter	56.03 mm	2.20 in
Rod Midbody Inner Diameter	48.32 mm	1.90 in
Rod Joint Inner Diameter	48.32 mm	1.90 in
Rod Resistance to Deviation (Moment of Inertia)	5362 mm^4	8.3 in^4
Rod Weight per Unit Length	4.95 kg/m	3.30 lb/ft
Rod Content Weight (Water) per Unit Length	1.83 l/m	0.15 gal/ft
Rod Displacement (Water) per Unit Length	0.76 l/m	0.06 gal/ft

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- These ratings apply to new, unused rods of Boart Longyear manufacture, in a straight vertical down hole, assuming compliance to Boart Longyear Care and Handling or Product Literature and standard core drilling practices.
- Actual performance may vary depending on operating conditions and drilling practices.
- Depth and load capacities decrease with wear. For example, de-rate by at least 50% for box shoulder thickness worn to 50% of original.
- Increase make-up torque to match operating torque as depth increases. Operating torque should not exceed make-up torque.

TECHNICAL INFORMATION

NQ™ TECHNICAL INFORMATION

PERFORMANCE RATING	METRIC SYSTEM	IMPERIAL
Rated Drilling Depth by Joint Strength	1 500 m	4,921 ft
Rated Maximum Pullback	147 kN	33,000 lbf
Rated Maximum Torque (Operating or Make-Up)	1200 Nm	900 ft lbf
Recommended Minimum Make-Up Torque for Deep Holes over 2000m		
Recommended Minimum Make-Up Torque for Deep Holes over 1000m		
Recommended Minimum Make-Up Torque	600 Nm	442 ft lbf
API Theoretical Burst Pressure at Box Shoulder (per API bulletin 5C3)	31 300 kPa	4,542 psi
API Theoretical Burst Pressure at Midbody (per API bulletin 5C3)	75 500 MPa	10,952 psi
API Theoretical Collapse Pressure at Midbody (per API bulletin 5C3)	73 900 kPa	10,724 psi

RATING CRITERIA	METRIC SYSTEM	IMPERIAL
Rod Midbody Outer Diameter	69.95 mm	2.754 in
Rod Midbody Inner Diameter	60.3 mm	2.38 in
Rod Joint Inner Diameter	60.3 mm	2.38 in
Rod Resistance to Deviation (Moment of Inertia)	13135 mm^4	20.4 in^4
Rod Weight per Unit Length	7.80 kg/m	5.20 lb/ft
Rod Content Weight (Water) per Unit Length	2.86 l/m	0.23 gal/ft
Rod Displacement (Water) per Unit Length	0.0.97 l/m	0.04 gal/ft

NRQ™ TECHNICAL INFORMATION

PERFORMANCE RATING	METRIC SYSTEM	IMPERIAL
Rated Drilling Depth by Joint Strength	3000 m	9,800 ft
Rated Maximum Pullback	330 kN	74,255 lbf
Rated Maximum Torque (Operating or Make-Up)	2400 Nm	1,750 ft lb
Recommended Minimum Make-Up Torque for Deep Holes over 2000m	1 400 Nm	1,048 ft lb
Recommended Minimum Make-Up Torque for Deep Holes over 1000m	1 043 Nm	769 ft lb
Recommended Minimum Make-Up Torque	600 Nm	490 ft lb
API Theoretical Burst Pressure at Box Shoulder (per API bulletin 5C3)	49 700 kPa	7,215 psi
API Theoretical Burst Pressure at Midbody (per API bulletin 5C3)	75 513 kPa	10,952 psi
API Theoretical Collapse Pressure at Midbody (per API bulletin 5C3)	73 943 kPa	10,724 psi

RATING CRITERIA	METRIC SYSTEM	IMPERIAL
Rod Midbody Outer Diameter	69.9 mm	2.75 in
Rod Midbody Inner Diameter	60.3 mm	2.38 in
Rod Joint Inner Diameter	60.3 mm	2.38 in
Rod Resistance to Deviation (Moment of Inertia)	13135 mm^4	20.4 in^4
Rod Weight per Unit Length	7.79 kg/m	5.23 lb/ft
Rod Content Weight (Water) per Unit Length	2.86 l/m	0.23 gal/ft
Rod Displacement (Water) per Unit Length	0.97 l/m	0.08 gal/ft

All ratings and recommendations are based on tension load testing by an independent party.

- These ratings apply to new, unused rods of Boart Longyear manufacture, in a straight vertical down hole, assuming compliance to Boart Longyear Care and Handling or Product Literature and standard core drilling practices.
- Actual performance may vary depending on operating conditions and drilling practices.
- Depth and load capacities decrease with wear. For example, de-rate by at least 50% for box shoulder thickness worn to 50% of original.
- Increase make-up torque to match operating torque as depth increases. Operating torque should not exceed make-up torque.

NRQ™ V-WALL™ TECHNICAL INFORMATION

PERFORMANCE RATING	METRIC SYSTEM	IMPERIAL
Rated Drilling Depth by Joint Strength	3360 m	11023 ft
Rated Maximum Pullback	330.0 kN	74255 lbf
Rated Maximum Torque (Operating or Make-Up)	2400 Nm	1750 ft lbf
Recommended Minimum Make-Up Torque for Deep Holes over 2000m	1400 Nm	1000 ft lbf
Recommended Minimum Make-Up Torque for Deep Holes over 1000m	1000 Nm	750 ft lbf
Recommended Minimum Make-Up Torque	600 Nm	452 ft lbf
API Theoretical Burst Pressure at Box Shoulder (per API bulletin 5C3)	49 700 kPa	7,215 psi
API Theoretical Burst Pressure at Midbody (per API bulletin 5C3)	63 387 kPa	9,193 psi
API Theoretical Collapse Pressure at Midbody (per API bulletin 5C3)	52 421 kPa	7,603 psi

RATING CRITERIA	METRIC SYSTEM	IMPERIAL
Rod Midbody Outer Diameter	69.90 mm	2.75 in
Rod Midbody Inner Diameter	62.00 mm	2.44 in
Rod Joint Inner Diameter	60.30 mm	2.38 in
Rod Resistance to Deviation (Moment of Inertia)	11408 mm^4	17.7 in^4
Rod Weight per Unit Length	20.42 kg/3 m	45.0 lb/10 ft
Rod Content Weight (Water) per Unit Length	2.97 kg/m	0.24 gal/ft
Rod Displacement (Water) per Unit Length	0.80 kg/m	0.07 gal/ft

HQ™ TECHNICAL INFORMATION

PERFORMANCE RATING	METRIC SYSTEM	IMPERIAL
Rated Drilling Depth by Joint Strength	1 500 m	4,900 ft
Rated Maximum Pullback	200 kN	45,000 lbf
Rated Maximum Torque (Operating or Make-Up)	1 356 Nm	1,000 ft lbf
Recommended Minimum Make-Up Torque for Deep Holes over 2000m		
Recommended Minimum Make-Up Torque for Deep Holes over 1000m	1 200 Nm	900 ft lbf
Recommended Minimum Make-Up Torque	1 010 Nm	750 ft lbf
API Theoretical Burst Pressure at Box Shoulder (per API bulletin 5C3)	30 000 kPa	4,365 psi
API Theoretical Burst Pressure at Midbody (per API bulletin 5C3)	64 000 kPa	9,850 psi
API Theoretical Collapse Pressure at Midbody (per API bulletin 5C3)	60 000 kPa	8,770 psi

RATING CRITERIA	METRIC SYSTEM	IMPERIAL
Rod Midbody Outer Diameter	89.0 mm	3.50 in
Rod Midbody Inner Diameter	77.8 mm	3.06 in
Rod Joint Inner Diameter	77.8 mm	3.06 in
Rod Resistance to Deviation (Moment of Inertia)	31668 mm^4	49.1 in^4
Rod Weight per Unit Length	11.44 kg/m	7.7 lb ft
Rod Content Weight (Water) per Unit Length	4.80 l/m	0.38 gal/ft
Rod Displacement (Water) per Unit Length	1.50 l/m	0.12 gal/ft

All ratings and recommendations are based on tension load testing by an independent party.
- These ratings apply to new, unused rods of Boart Longyear manufacture, in a straight vertical down hole, assuming compliance to Boart Longyear Care and Handling or Product Literature and standard core drilling practices.
- Actual performance may vary depending on operating conditions and drilling practices.
- Depth and load capacities decrease with wear. For example, de-rate by at least 50% for box shoulder thickness worn to 50% of original.
- Increase make-up torque to match operating torque as depth increases. Operating torque should not exceed make-up torque.

TECHNICAL INFORMATION

HRQ™ TECHNICAL INFORMATION

PERFORMANCE RATING	METRIC SYSTEM	IMPERIAL
Rated Drilling Depth by Joint Strength	2500 m	8,200 ft
Rated Maximum Pullback	510 kN	115,000 lbf
Rated Maximum Torque (Operating or Make-Up)	3 500 Nm	2,600 ft lb
Recommended Minimum Make-Up Torque for Deep Holes over 2000m	2 750 Nm	2,000 ft lb
Recommended Minimum Make-Up Torque for Deep Holes over 1000m	2 000 Nm	1,500 ft lb
Recommended Minimum Make-Up Torque	1 000 Nmm	750 ft lb
API Theoretical Burst Pressure at Box Shoulder (per API bulletin 5C3)	45 000 kPa	6,561 psi
API Theoretical Burst Pressure at Midbody (per API bulletin 5C3)	64 000 kPa	9,852 psi
API Theoretical Collapse Pressure at Midbody (per API bulletin 5C3)	60 000 kPa	8,772 psi

RATING CRITERIA	METRIC SYSTEM	IMPERIAL
Rod Midbody Outer Diameter	89.03 mm	3.505 in
Rod Midbody Inner Diameter	77.89 mm	3.067 in
Rod Joint Inner Diameter	77.89 mm	3.067 in
Rod Resistance to Deviation (Moment of Inertia)	31668 mm^4	49.1 in^4
Rod Weight per Unit Length	11.40 kg/m	7.70 lb/ft
Rod Content Weight (Water) per Unit Length	5.14 l/m	0.38 gal/ft
Rod Displacement (Water) per Unit Length	1.54 l/m	0.12 gal/ft

HRQ™ V-WALL™ TECHNICAL INFORMATION

PERFORMANCE RATING	METRIC SYSTEM	IMPERIAL
Rated Drilling Depth by Joint Strength	3050 m	10000 ft
Rated Maximum Pullback	510 Nm	115,000 ft lb
Rated Maximum Torque (Operating or Make-Up)	3 500 Nm	2,600 ft lb
Recommended Minimum Make-Up Torque for Deep Holes over 2000m	2 750 Nm	2,000 ft lb
Recommended Minimum Make-Up Torque for Deep Holes over 1000m	2 000 Nm	1,500 ft lb
Recommended Minimum Make-Up Torque	1 000 Nm	750 ft lb
API Theoretical Burst Pressure at Box Shoulder (per API bulletin 5C3)	44 500 kPa	6,458 psi
API Theoretical Burst Pressure at Midbody (per API bulletin 5C3)	50 200 kPa	7,280 psi
API Theoretical Collapse Pressure at Midbody (per API bulletin 5C3)	29 000 kPa	4,206 psi

RATING CRITERIA	METRIC SYSTEM	IMPERIAL
Rod Midbody Outer Diameter	88.90 mm	3.50 in
Rod Midbody Inner Diameter	81.00 mm	3.19 in
Rod Joint Inner Diameter	77.80 mm	3.06 in
Rod Resistance to Deviation (Moment of Inertia)	24592 mm^4	38.1 in^4
Rod Weight per Unit Length	27.23 kg/3 m	60.0 lb/10 ft
Rod Content Weight (Water) per Unit Length	5.14 l/m	0.40 gal/ft
Rod Displacement (Water) per Unit Length	1.1 l/m	0.09 gal/ft

All ratings and recommendations are based on tension load testing by an independent party.
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- Actual performance may vary depending on operating conditions and drilling practices.
- Depth and load capacities decrease with wear. For example, de-rate by at least 50% for box shoulder thickness worn to 50% of original.
- Increase make-up torque to match operating torque as depth increases. Operating torque should not exceed make-up torque.

PHD TECHNICAL INFORMATION

PERFORMANCE RATING	METRIC SYSTEM	IMPERIAL
Rated Drilling Depth by Joint Strength	1 500 m	4,900 ft
Rated Maximum Pullback	450 kN	100,000 lbf
Rated Maximum Torque (Operating or Make-Up)	4000 Nm	3,000 ft lb
Recommended Minimum Make-Up Torque for Deep Holes over 2000m	3 425 Nm	2,526 ft lb
Recommended Minimum Make-Up Torque for Deep Holes over 1000m	2 225 Nm	1,641 ft lb
Recommended Minimum Make-Up Torque	672 Nm	495 ft lb
API Theoretical Burst Pressure at Box Shoulder (per API bulletin 5C3)	21 614 kPa	3,135 psi
API Theoretical Burst Pressure at Midbody (per API bulletin 5C3)	62 038 kPa	8,998 psi
API Theoretical Collapse Pressure at Midbody (per API bulletin 5C3)	50 026 kPa	7,255 psii

RATING CRITERIA	METRIC SYSTEM	IMPERIAL
Rod Midbody Outer Diameter	114.40 mm	4.50 in
Rod Midbody Inner Diameter	101.40 mm	4.00 in
Rod Joint Inner Diameter	101.40 mm	4.00 in
Rod Resistance to Deviation (Moment of Inertia)	80423 mm^4	124.7 in^4
Rod Weight per Unit Length	17.40 kg/m	11.70 lb/ft
Rod Content Weight (Water) per Unit Length	8.14 l/m	0.65 gal/ft
Rod Displacement (Water) per Unit Length	2.24 l/m	0.17 gal/ft

PHD V-WALL™ TECHNICAL INFORMATION

PERFORMANCE RATING	METRIC SYSTEM	IMPERIAL
Rated Drilling Depth by Joint Strength	2000 m	6500 ft
Rated Maximum Pullback	450.0 kN	100,000 ft lbf
Rated Maximum Torque (Operating or Make-Up)	4 000 Nm	3,000 ft lbf
Recommended Minimum Make-Up Torque for Deep Holes over 2000m		
Recommended Minimum Make-Up Torque for Deep Holes over 1000m		
Recommended Minimum Make-Up Torque		
API Theoretical Burst Pressure at Box Shoulder (per API bulletin 5C3)	21 700 kPa	3,145 psi
API Theoretical Burst Pressure at Midbody (per API bulletin 5C3)	38 849 kPa	5,634 psi
API Theoretical Collapse Pressure at Midbody (per API bulletin 5C3)	15 852 kPa	2,299 psi

RATING CRITERIA	METRIC SYSTEM	IMPERIAL
Rod Midbody Outer Diameter	114.00 mm	4.50 in
Rod Midbody Inner Diameter	106.00 mm	4.19 in
Rod Joint Inner Diameter	102.00 mm	4.00 in
Rod Resistance to Deviation (Moment of Inertia)	53739 mm^4	83.3 in^4
Rod Weight per Unit Length	37.30 kg/3 m	82.16 lb/10 ft
Rod Content Weight (Water) per Unit Length	8.80 l/m	0.70 gal/ft
Rod Displacement (Water) per Unit Length	2.20 l/m	0.17 gal/ft

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- Actual performance may vary depending on operating conditions and drilling practices.
- Depth and load capacities decrease with wear. For example, de-rate by at least 50% for box shoulder thickness worn to 50% of original.
- Increase make-up torque to match operating torque as depth increases. Operating torque should not exceed make-up torque.

GUIDELINES FOR USE, CARE AND HANDLING

GUIDELINES FOR USE, CARE AND HANDLING

PACKING FEATURES:

- Drill rods and casing are packaged and sold in "bundles" which offer product protection during shipping and handling.
- Protective caps cover box and pin threads sealing in thread lubrication.
- Heavy duty galvanized hexagon bundle end caps protect the drill rod ends.
- Drill rods are coated with rust inhibitor to reduce surface oxidation during shipping. When storing rods for long periods of time, it is recommended you reapply a rust inhibitor to protect the rods from oxidation.

LUBRICATION AND CLEANING

Boart Longyear™ drill rod threads are coated with thread compound (lubricant) for shipment from the factory. For initial use, it is neither necessary nor desirable to remove this thread compound unless contamination has occurred. Thereafter, clean and re-lubricate the threads with a Boart Longyear recommended compound (BOL or Esso Z50) after each use. Use enough compound to cover both thread and shoulder surfaces. A 40 to 50 mm (1.5 to 2 inch) brush is excellent for applying lubrication compound.

WARNING

Note: Keep the compound and brush clean.

Note: While occasional mixing of the compound is recommended to avoid settling, dilution of any kind (e.g. diesel, gasoline or oil) will render the compound ineffective.

The thread compound is critical to the wear life of the joint. In order to prevent wear, metallic particulate in the compound forms an inner-layer that is able to withstand the contact pressure and prevent galling. A poor choice of compound or diluted compound will allow the mating surfaces to interact, resulting in adhesion or abrasion wear.

The thread compound is also critical to the strength of the joint. The interaction of the metallic particulate and the surface determines the frictional resistance to torque loads. This in turn determines the joint load efficiency: how much torque is transferred through the joint versus how much is absorbed by the joint. A poor choice of compound or diluted compound will provide insufficient friction, decreasing efficiency loading to overload failure.

Compounds containing 50% zinc particulate generally provide a higher friction factor (higher torque capacity) and get better resistance than those containing similar amounts of copper, lead or graphite particulate. Environmentally friendly compounds must contain non-toxic, bio-stable, solid particles of similar properties and performance characteristics to that of typical zinc particles in order to perform.

WARNING

Note: Use of grease without solid particulates will void the warranty. Metallic particulates will react in acidic water leading to hydrogen embrittlement and reduce fatigue life of the rods.

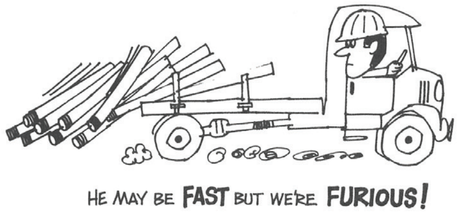
In addition, lubricating the rod body with grease is recommended to reduce hole friction, drilling torque and midbody wear.

NOTICE - PETROLEUM-BASED GREASE: Throughout this manual, the use of grease or thread compounds is mentioned. It is important to note that the use of petroleum-based or metal bearing lubricant products in some areas of the world is prohibited. Contact your Boart Longyear representative for recommended alternatives.

MAKING AND BREAKING THE DRILL STRING

PREPARATION FOR TRANSIT:

Load rods on at least three cross members and tie down with suitable chain or strap at end cross members. For long rods, an additional chain or strap should be provided in the middle.



WARNING Always provide proper protection for threaded ends.

STORAGE OF DRILL RODS

Always clean and grease the pin and box end threads of the rods before storing. Store rods horizontally on a minimum of three cross supports on less than 30 cm (12 in) from the ground to keep moisture and dirt away from the rods.

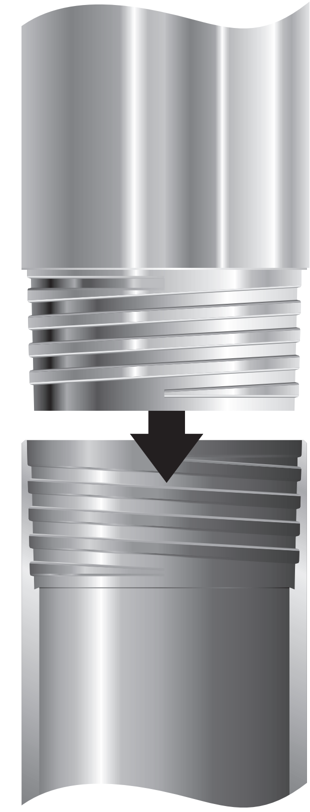
WARNING Always provide proper protection for threaded ends.

When rods are temporarily stacked in the mast or rod rack, always provide a wooden or rubber base to protect the pin ends. This is especially important when handling multiple length stands of 6 m (20 ft) or more.

Inspect used rods for bent midbodies regularly. Straighten or discard bent rods immediately as these cause vibration and can hamper drilling performance.

In addition to thread compound, a corrosion inhibitor on the body is recommended for long term storage (see packaging).

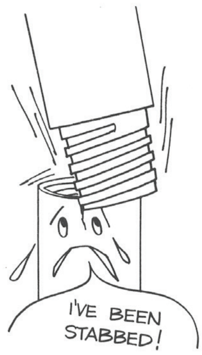
DANGER Due to the significant safety risk, Boart Longyear drill rods should never be mixed with another manufacturers' rods. Doing so may cause catastrophic equipment failure, leading to bodily injury or death. In addition, mixing rods voids the Boart Longyear warranty.



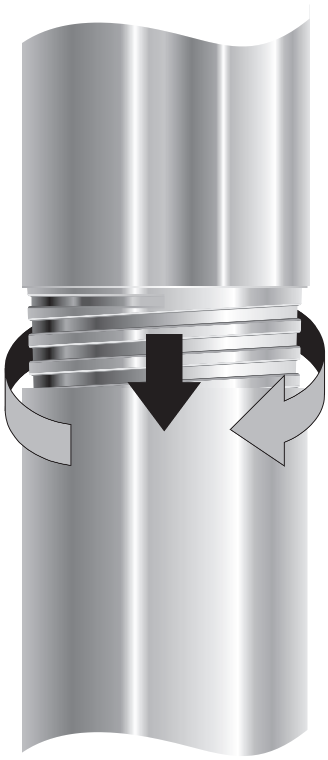
STABBING

Wireline drill rods and casing provide very little radial clearance when first inserting a pin end into a box end (stabbing). If the pin end is not aligned, it will stab into the box end shoulder causing permanent damage regardless of design or heat treatment. This damage will create leakage ranging from negligible to significant, depending on the degree of damage. Severe stabs can compromise the fit of the joint and potentially cause fatigue failures.

Once the face of the pin end shoulder is even with the face of the box end shoulder, the pin end should be lowered slowly into the box until the stab flank of the pin thread mates against the stab flank of the box thread. If the pin is not in true vertical alignment over the box or if the joint has insufficient taper to allow the first turn of pin thread to clear the first turn of box thread, the pin thread crest may wedge or 'jam' against the box thread crest or begin to cross-thread. Rotating the connection counter-clockwise will correct the misalignment.



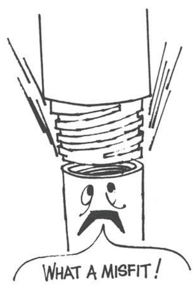
Once successfully lowered, rotate the stabbing rod by hand to ensure proper thread engagement. It is recommended that a stabbing guide be utilized (e.g. Boart Longyear™ hoist plug and water swivel adapter subs have a bull nose lead-in feature to prevent stabbing damage).



MAKE-UP

Wireline rods and casing make-up by slowly rotating the pin clockwise into the box (right hand threads). On most drills, this must be done at a very low rotation (e.g. 10 RPM or less) to avoid applying extraneous torque due to the inertia of the drill head. For example, a 45 kg (100 lb) drill head rotating at 100 RPM can apply an extra 1350 Nm (1000 ft-lb) or more of inertial torque when the joint is closed abruptly. Adjust the feed rate to match the rod thread (e.g. 3 threads per inch for Q™ rods) while maintaining light compression on the joint to minimize thread wear.

If the stand-off gap, 0.8-1.6mm (1/32"-1/16"), is outside specification or if the joint does not close after applying a small amount of make-up torque, break-out the joint and clean and inspect both threads. This is an indication of excessive wear, excessive foreign material, or thread deformation due to overloading during making or breaking. It may also indicate that the product is from a different manufacturer.

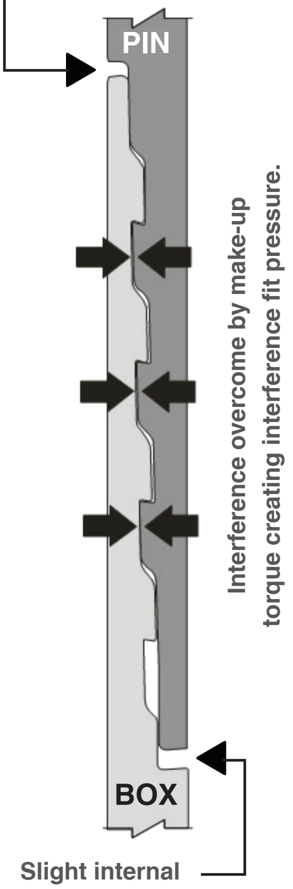


DANGER

Due to the significant safety risk, Boart Longyear drill rods should never be mixed with another manufacturers' rods. Doing so may cause catastrophic equipment failure, leading to bodily injury or death. In addition, mixing rods voids the Boart Longyear warranty.

MAKING AND BREAKING DRILL STRING

Fluid Seal: Shoulder compression and pin tension closes gap and stops leakage of drill fluids.



Slight internal stand-off gap under recommended make-up torque — will close as operating torque increase to provide maximum capacity.

MAKE-UP TORQUE (PRE-LOADING)

After the stand-off gap is closed, additional make-up is required to sufficiently pre-load the joint. While a large wrench may be sufficient on smaller sized rod strings or less demanding applications, make-up applied with the drill head or other power make-up devices is often required. This is to ensure the box shoulder does not become unloaded during drilling allowing leakage, fretting or premature fatigue failures. Joints will not self make-up sufficiently during drilling alone as the joint has additional frictional resistance to make-up under drilling loads.

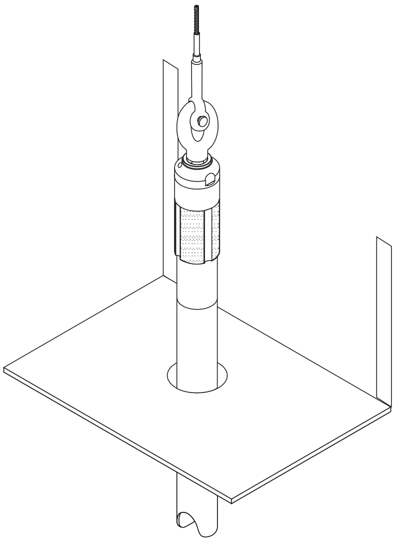
Joints with insufficient make-up will begin to leak as the pullback load increases and the box shoulder relaxes. Another visual sign of insufficient make-up is pitting-wear in the joints due to fretting and in extreme cases, fatigue failures.

As a rule of thumb, the make-up torque on each joint should be adjusted to match the drilling torque it is expected to see. Additional make-up is required to maintain box shoulder compression under excessive pullback or bending loads. However, note that excessive make-up reduces the available load capacity and fatigue strength.

ROD TYPE	MINIMUM MAKE-UP TORQUE	
	[NM]	[FT-LBS]
ARQTK	340	250
BQ	405	300
BRQ		
BRQTK		
NQ	600	442
NRQ		
NRQTK		
HQ	1010	750
HRQ		
PHD	672	495

WARNING Note: A common practice, in standard applications, is to apply 20% more make-up than drilling torque, however this takes away from the remaining load capacity and is not recommended for demanding applications.

The pin end is engineered to be slightly shorter than the box end to allow pre-loading of the box shoulder and elastic response to drilling loads. This is evident by a gap at the internal torque shoulder. Under extraordinary make-up or drilling torque, the pin and box will be sufficiently loaded to close this gap and engage the internal torque shoulder providing additional torque capacity.

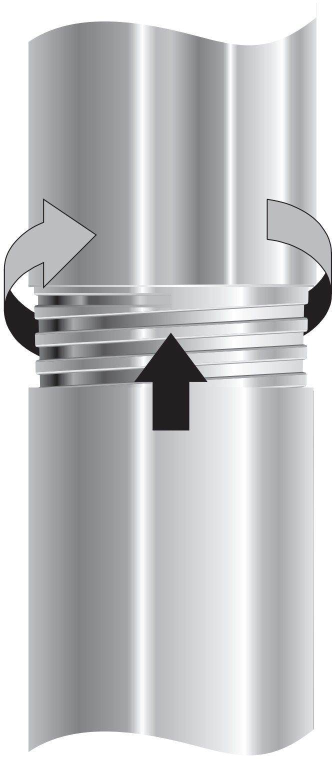


LOWERING/INSERTING

The drill drive and hoist sheave must be aligned with the center line of the hole to prevent undue bending and drag. The drill must also be well secured to the casing, ground or work face to ensure it does not load the rod string or become misaligned.

Adjust hollow spindle drive chucks or feed rollers to ensure that contact pressure is not permanently deforming or bending midbodies, especially in the case of light weight rod strings. In order to avoid fracture failures, do not use feed rollers with carbide teeth, do not chuck on rod joints, and do not feed rod joints through feed rollers.

In down-holes always lower the rod string with the inner tube assembly latched in position. The inner tube assembly will act as a check valve in case the rod string is accidentally dropped.

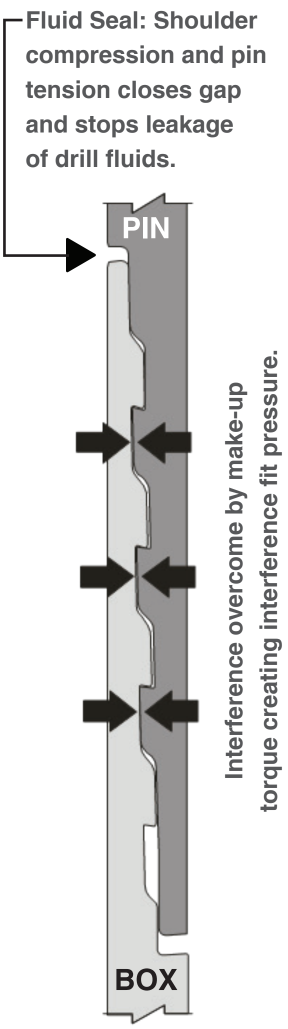


BREAK-OUT

Theory and laboratory tests show that break-out torque should be 70-80% of the greater of make-up or drilling torque applied to each joint. Despite this, breaking-out may be problematic as some drill rigs do not have the same load capacity in breaking as they do in making-up or drilling. Additionally, during drilling, the joints may be subject to vibration allowing incremental make-up. Note that a poor choice of compound will contribute to this effect as well. This may result in a break-out torque requirement that exceeds the original make-up applied. This can be overcome utilizing the same effect by applying a slight percussive blow to the side of the box with a rubber mallet or similar non-damaging tool. Do not use a metal hammer or similarly hard objects. They will affect material properties in the impacted area and potentially cause fatigue failures and may void the Boart Longyear warranty.

On down hole applications of significant depth, prior to breaking-out, ensure that the drill rig foot-clamp is holding the rod string weight and that any tension across the joint (between the drill head and foot clamp) has been relieved. This eliminates undue thread wear and a potential safety hazard on deep holes; the pin should not 'jump' out of the box on break-out.

Once the threads have disengaged, the pin can be slowly lifted. Cleaning and re-lubricating is recommended to maximize wear life.



FLUID SEAL

Conventional and wireline drill rods and casing utilize steel-on-steel interfaces as a fluid seal. Make-up torque is required to load the box end shoulder face against the pin external shoulder face to develop the necessary contact pressure at the interface. Given the high elastic modulus of steel, the performance of these seals is very limited despite seal face geometry or heat treatment. As a result, the fluid seal is very sensitive to damage on either seal face.

Note: Chucking on or applying wrenches to the external shoulder will cause leakage.

The sealing performance of a rod string in a down hole can be evaluated with a pressure test:

1. Drop an inner tube assembly adjusted to zero-bit-gap such that the weight of the column of fluid above the inner tube will create a seal between the core lifter case and the bit.
2. Run the fluid supply pump until maximum pressure is achieved and then close the valve between the rod string and pump.
3. Monitor the fluid pressure gauge and record any drop in pressure over a time interval. The amount of flow loss can be calculated using standard pressure vessel formula.

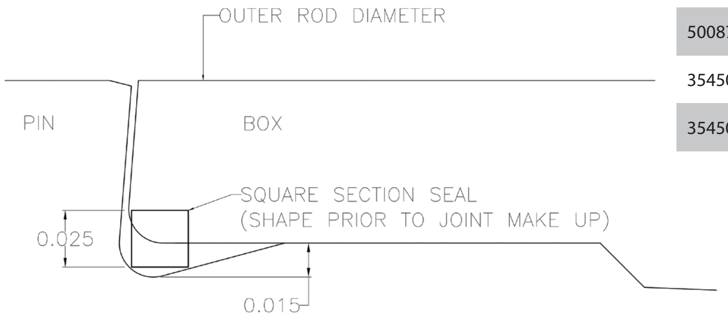
While no drop in pressure should occur on a new string, only a complete loss of pressure in less than one minute is significant.

EXAMPLE:
An 1800 m (5900 ft) string of NQ™ rod that loses 14 MPa (2000 psi) in one minute is only losing 7 lpm (1.6 gpm) where the minimum recommended flow for an NQ bit is 30 lmp (8 gpm).

If enhanced sealing performance is desired, optional seals can be added to the drill string joints. The seals must be installed on the pin as shown in the picture below. To ensure sealing, make certain there is no damage to the box end, otherwise the seal may be damaged during tightening.

CARE AND HANDLING

Rod Seal Installation



Rod Joint Seals

5008777	SEAL, BRQ R/P POLYURETHANE
3545025	SEAL, HRQ R/P POLYURETHANE
3545024	SEAL, NRQ R/P POLYURETHANE

WARNING

Note: Due to the care required in installation Boart Longyear does not guarantee sealing performance nor does it guarantee seal compatibility with fluids used.

Rod Lifter* **Part#: 5008890**

- Ergonomically keeps the wrist and hand in a neutral position and eliminates strain
- Removes fingers from pinch points and sharp surfaces
- Allows for proper lifting techniques and body positioning
- Prevents thread damage
- Prevents pipe slippage through the use of a specially designed carbide grip

CARE AND HANDLING

THREAD WEAR

The wear of sliding steel-on-steel surfaces, such as in a rod or casing joint, commonly referred to as galling, mainly consists of adhesion and abrasion wear as a result of making and breaking. While some wear can be tolerated without compromising performance, worn surfaces are prone to further wear. If unattended, the degree of wear can worsen to the point where it can cause premature failure or, in the case of mating surfaces of similar hardness, seize the joint. Additionally, a worn thread can damage a good thread.

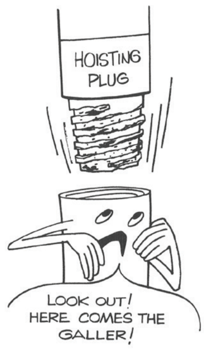
The rate of wear to be expected in a sliding metal-to-metal system can only be determined by considering all of the following variables:

- Lubrication or wear factor: published values are greater for poor lubrication; less for mating surfaces of dissimilar hardness (see lubrication and cleaning).
- The hardness of the softer surface.
- The distance of contact slide.
- The contact load or pressure.

Less wear resistance can be achieved by:

- Cleaning and lubricating joints regularly; preferably after every break. Dry lubrication coatings are available but these wear off and must also be cleaned and lubricated.
- Choosing joints with mating surfaces of dissimilar hardness. Published data shows that given equal contact pressures and equal hardness on the softer surfaces, a system with a harder mating surface (dissimilar hardness) can provide several times the wear life.
- Choosing joints with greater hardness on the softer thread.
- Reduce the sliding contact distance by choosing joints with greater taper.
- Reduce or eliminate the contact pressure by adjusting the feed rate and rotation speed during make and break to match the thread pitch and compensate for rod and drill head weight.

Another source of rod joint wear is worn accessories. All threaded accessory equipment, such as Kelly (drive) rods, drive head adapter subs, hoist plugs, water swivels and cross-over adapter subs should be inspected prior to use to ensure they are in good condition. Use only genuine Boart Longyear™ accessories to ensure proper fits and maximum wear life. Boart Longyear tooling and gauging adhere to a high global standard.



BOX WEAR

Similar to the steel-on-steel wear systems of the joint, the box and midbody are subject to relative sliding contact with the wall of the casing or hole. In the case of wear against the wall of the hole, the surface of the hole may be of significantly greater hardness and roughness (not to mention cuttings suspended in the drilling fluid) potentially resulting in rapid wear rates. However, in many applications the cause of retirement of a drill rod is due to localized wear resulting from the deformation of the box out of a 'flush' position or of the typical midbody out of straight.

In typical joints, it is inherent for the box and box end shoulder to elastically deform radially or 'bulge'. This is due to radial and hoop stresses imposed by conventional threads which add to drilling load stresses. This is evident by a thin section in the box shoulder and/or a small polished area on the side of the joint where thread engagement begins. As the wear progresses, the box becomes weaker and the deformation more pronounced, increasing the wear rate. RQ™ style joints however, mimic the load response of a solid tube in that radial and hoop stresses imposed by the thread subtract from drill load stresses, virtually eliminating "bulging".

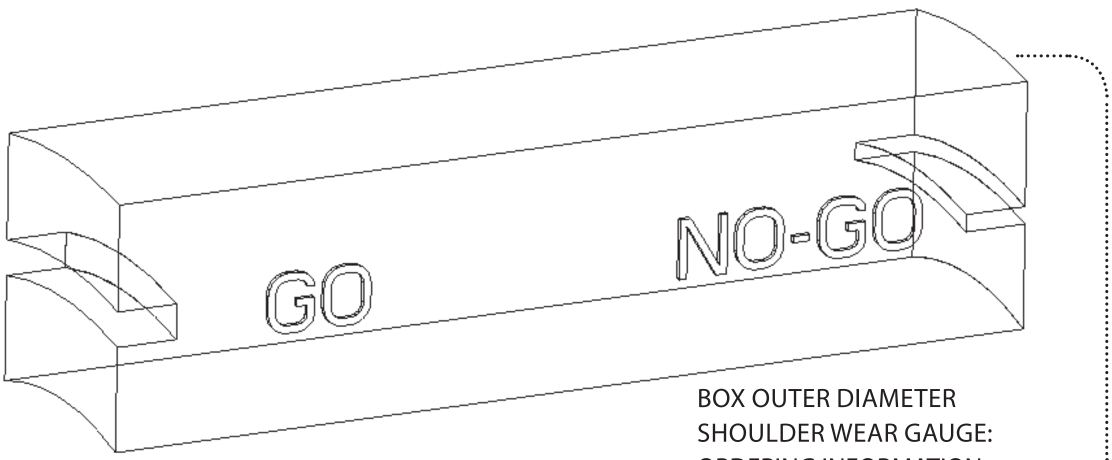
MIDBODY WEAR

It is inherent for a rod string to respond to significant drilling loads and rotation in a three dimensional corkscrew shape, a phenomenon first identified and defined by Boart Longyear as 'helical whirling'. As loads or rotation increase, the contact pressure between the string and the hole increases contributing to an increased midbody wear rate.

Given sufficient contact pressure and speed, the heat generated between the rod string and casing or hole can cause heat-check cracking which ultimately appears as an axial crack, typically on the box end.

The bending stresses associated with this helical whirling become significant under high load or rotation, especially in oversize holes or 'caves', and may cause permanent bending of the string. Boart Longyear™ drill rods incorporate enhanced tubing processing which doubles the bend strength of the midbody virtually eliminating permanent bending.

The use of 'rod grease' to reduce friction between the rod string and the casing or hole is common however the only effective solution to reduce midbody abrasion wear is to significantly increase the hardness through case hardening.



BOX OUTER DIAMETER
SHOULDER WEAR GAUGE:
ORDERING INFORMATION

3547010 GAUGE, BQ/BRQ R/B OD WEAR
3547011 GAUGE, HQ/HRQ R/B OD WEAR
3547027 GAUGE, NQ/NRQ R/B OD WEAR
5003593 GUAGE, PHD R/B OD WEAR

CARE AND HANDLING

CARE AND HANDLING

BOX OUTER DIAMETER SHOULDER WEAR GAUGE

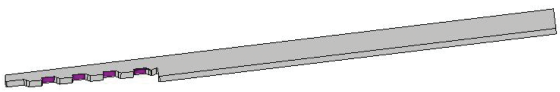
The 'box' or female end of the drill rod joint is subject to abrasive wear against the wall of the drill hole. As the shoulder decreases in thickness, the load capacity of the joint is reduced. This "go / no-go" gauge determines whether a particular portion of the shoulder has retained 60% of it's original thickness. The ends of the wear gauge are labelled "GO" or "NO-GO". A curved groove is cut into each end of the gauge with a radius that matches that of the drill rod joint.

1. Ascertain the portion of the box with the least thickness by visual inspection. A thin section will become pronounced as joints respond to large torque or pullback loads and wear against the hole.
2. Attempt to insert the thinnest portion of the box shoulder into the "NO-GO" end of the gauge.

   If the box will insert into the gauge, there is less than 60% of the original shoulder thickness remaining. This means that the joint's load capacity has been significantly compromised. The rod should be considered for retirement and the remainder of the rod string should be inspected. If the box will not insert into the gauge, there is more than 60% of the shoulder thickness remaining and the majority of the joint's load capacity is available.
3. Insert the thinnest portion of the box shoulder into the "GO" end of the gauge. The amount of radial movement or "play" will allow the operator to estimate the amount of wear that has taken place or the amount of wear life remaining. If the box shoulder will not insert into the gauge, the box is in a "new" condition and has greater than nominal thickness due to tubing mill tolerance.

RQ™ THREAD WEAR GAUGES
ORDERING INFORMATION

5008766	GAUGE, BRQ R/B THREAD WEAR
5008767	GAUGE, BRQ R/P THREAD WEAR
5008768	GAUGE, NRQ R/B THREAD WEAR
5008769	GAUGE, NRQ R/P THREAD WEAR
5008770	GAUGE, HRQ R/B THREAD WEAR
5008771	GAUGE, HRQ R/P THREAD WEAR



RQ™ THREAD WEAR GAUGES

Due to its lesser hardness, the box thread accepts virtually all of the wear when made and broken against the pin thread. During make and break, the box thread should only have contact on the 'root' or minor diameter and on the 'stab' or 'clearance' flank. If the 'load' flank has deformed or worn in error, it may lead to failures. This "go / no-go" gauge determines whether the load flank portion of the thread form has retained its original shape sufficient to provide its 'RQ' low-stress & anti-bulge features.

1. Mate the gauge with the box threads such that the outer diameter shoulders are not in contact.
2. Slide the gauge along the threads until the shoulders mate and apply hand pressure to ensure it stays in place.
3. Try to pry the gauge off of the threads.
   If the gauge cannot be removed (without 'unthreading'), the box thread form is intact. This means that the make and break set up on the rig is good and the joint has retained full load capacity.

   If the gauge is removable (without 'unthreading'), the box thread load flank has been deformed. This means that the make and break set up is incorrect, the joint's load capacity has been reduced, and RQ features are lost. Consider retirement and inspect the remainder of the rod string.

LOADS AND DEVIATED HOLES

Fatigue failures are brittle failures or cracks that occur under stress or load levels that are significantly below static load ratings; however, the loads are applied or cycled a large number of times. An example of this type of load is where a rod string is rotating in a deviated hole, the surface of the rod undergoes both tension and compression in each revolution. Where the rod is deviated at significant depth, this bending load is superimposed on a constant pullback load resulting in a fluctuating tension load on the rotating surface. Another example is in oversized holes or caved hole sections wherein the string can bend or buckle, significantly increasing bending stresses.

Due to the reduced cross-sections of material in the threaded ends, the joints between mated rods in the string are significantly weaker than the rod midbodies – regardless of heat treatment or thread design (despite the interlocking thread, RQ™ joints for example, are weaker and are not stiffer than their midbody). Also, joints are pre-loaded (make-up) and have interference fits which further reduce the deviation capacity of the joint.

A further limitation on the ability of a drill rod joint to perform through a bend is due to a peculiarity of the steel material itself. If there is a constant tension load applied in addition to a cyclical load, the fatigue strength is even further reduced. In the case of drill rod joints, if the joint is properly made up the pin end will always be under a greater tension load than the box end. As a result, the pin end is the weakest part of a drill rod and is the typical location of failure under an excessive cyclic load. Boart Longyear utilizes a full scale cyclic bend load test to evaluate joint designs and to ensure manufacturing quality.

A fatigue failure crack always occurs perpendicular to the cyclic load or stress. Therefore the most common failure is a circumferentially oriented crack which indicates that the cyclic load or stress was axially oriented which can only be caused by bending. If the crack is axially oriented it is either the result of heat-check cracking or indicates that the cyclic load was circumferentially oriented. This can only be caused by improper fit of a joint in terms of make-up, deformation, foreign debris, or wear.

Fatigue failures can be avoided by limiting the level of cyclic loads with consideration for the pullback load. Limit the build angle or rate of hole deviations checking that the deviation rating per rod length is not exceeded rather than the deviation per 30 m (100 ft), for example, which can be significantly less. Deviation should be further limited as pullback increases with increasing hole depth.

WARNING

Note: Standard weight wireline drill rods have limited deviation capacity. Lightweight or internally upset rods are recommended for greater deviation.

ROD MIDBODY BENDING

Midbody bending has occurred since the development of coring rod, and is not the result of a quality defect. Modelling, testing and experience has shown that all rod strings are unstable and buckle into a cork screw shape even under normal loading. Whether the rod returns to straight or bends permanently depends on a number of variables which are difficult to predict.

Work done in the early 2000's sought to improve rods resistance to bending. Benchmarking tests confirmed by neutron diffraction testing showed that the residual stress of rod straightening contributed to rod bending. As a result, new bend-strength test equipment and manufacturing processes were introduced by Boart Longyear to eliminate residual stresses. Once an optimal annealing process was developed, bending resistance improved greatly. Rod bending is the result of more complex dynamic loading. It is important to note that a driller will not directly observe the helical shape/bending, instead he would observe increased vibration (the helical shape can sometimes be seen in video recordings).

Both 3D modelling and field tests have been used to identify the influencing factors of rod bending. As part of these tests, special Boart Longyear™ super high strength rod was tested against normal rods and rods without annealing, to see if bending could be prevented. Under dynamic loading, all the tubes bent and tubes without optimal annealing bent marginally more. The dynamics of bending are severe enough that it will always be possible to bend rod. The important variables are as follows:

- RPM: Higher rotation speed (higher energy) makes it easier to bend rods, but rods can still bend at lower RPM. Changing RPM can have a huge influence by avoiding harmonic resonance of the rod string, which changes with hole depth. For example, adjusting rod rotation 50 rpm has been shown to reduce vibration values by a factor of 5x.
- Drilling Fluid: Drilling fluids dampen out vibration. Instances of lost circulation increase the vibration and the side wall friction both of which increase the chances of bending.
- Hole Angle: Increases in hole angle generate more side wall friction, increasing the chance of bending.
- Hole Clearance: Running oversize bits or using large diameter casing allows space for a larger corkscrew to form and increases the likelihood of rod bending.
- Trajectory: Changes in dip and azimuth greatly contribute to rod friction and stress. Ten degrees of azimuth change in 20m produces stress equivalent to 70% of the rods bend strength.

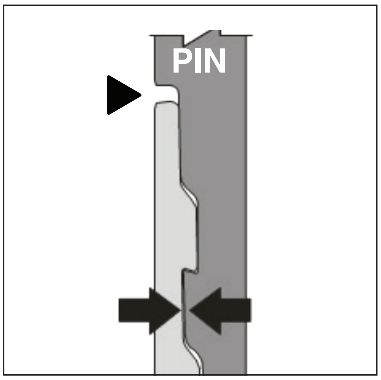
A few things can be done in the field to reduce likelihood of bending.

1. Minimize drill rod friction, (circulation, grease rods).
2. Minimize vibration by adjusting speed up or down (very important).
3. Monitor deviation, especially azimuth. While it is common to accurately control dip, as the primary way to stay on target, Azimuth change plays an important role in bending, so effort should be made to prevent turning. Directional control can be made by adopting use of full-hole outer tubes, free-cutting bit formulas, taller crown bits such as Stage™ bits, and dual length shells. Once a severe dogleg is cut, there may not be any prevention of bending without changing hole direction.

TROUBLESHOOTING

TROUBLESHOOTING

Proper use and handling or coring rods in the field lead to lower rod and operational costs in the long run. Rods are typically 3% of total drilling costs. Fishing a dropped string for one week would represent a 2% increase in costs. Re-drilling a hole for one month results in a 9% increase of costs.



STAND-OFF GAP EXCESSIVE OR DOES NOT CLOSE UPON MINIMAL MAKE-UP OR DIFFICULTY BREAKING OUT

Potential Causes and Corrective Actions

1. Clean and inspect threads for excessive foreign or wear debris. Accelerated wear may be due to damaged accessories; inspect accessories (e.g. adapter subs).
2. Rods are of different manufacture. Separate all rods by manufacturer and do not interchange. RQ™ style joints are proprietary to Boart Longyear. ⚠
3. Hand tools can only be used to close the stand-off gap. Use hydraulic tools, such as chuck or head to apply the minimum make-up torque required.
4. Threads are deformed from overload or excessive load during make and break. Inspect string for damage and discard rods with deformed threads. Overload or difficult breaking may be due to poor choice of thread compound (see lubrication and cleaning and break-out).
5. Deformation due to hammering damage (see break-out) or stabbing damage (see stabbing). Inspect string and discard damaged rods.

LEAKAGE

Potential Causes and Corrective Actions

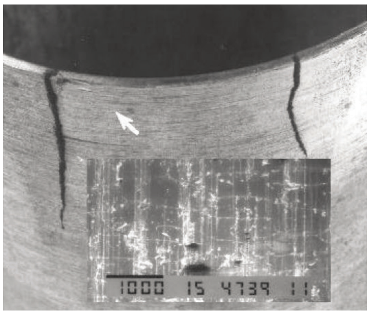
1. Rods run in loose (joints not closed) due to insufficient make-up or to excessive stand-off gap (see causes of excessive stand-off above).
2. The pin or box outer diameter shoulder face has stabbing or handling damage.
3. Outer shoulder contact pressure distribution is uneven due to poor fit. Threads are significantly worn or deformed from overload or excessive load during make and break or shoulders are deformed from overload. Accelerated wear may be due to damaged accessories; inspect accessories e.g. adapter subs. Inspect string for excessive wear. Overload may be due to poor choice of thread compound. If using Q™, consider upgrading to RQ™ rods.
4. Box wear life exceeded. Inspect string for excessive wear. Consider upgrading to RQ™ rods.
5. Rods are of different manufacture. Separate all rods by manufacturer and do not interchange. RQ™ style joints are proprietary to Boart Longyear. ⚠

TROUBLESHOOTING

FATIGUE FAILURES OR CRACKED PINS OR BOXES

Potential Causes and Corrective Actions

1. Bend stresses have exceeded the fatigue strength of the joint. Bend stresses are caused by excessive steering, excessive hole deviations or caves, or helical whirling. Do not exceed deviation ratings. This may have been compounded by high pullback loads at depth or excessive make-up. Plan deviations to occur at portions of the string that are under low pullback (e.g. avoid the upper portion of a deep hole string). Fatigue strength may have been exceeded in previous application and joint has now reached limit. Consider upgrading to RQ™ joints for higher load capacity or consider lightweight rods for reduced stiffness.
2. Rods run in loose (joints not closed) due to insufficient make-up or to excessive stand-off gap.
3. Extraneous hoop stresses caused by deformation due to hammering damage, stabbing damage, excessive foreign debris, or wear debris in the joint.
4. Box shoulder deformed due to overload leaving pin or box unsupported. Overload may be due to poor choice of thread compound. Consider upgrading to RQ™ rods.
5. Box wear life exceeded. Inspect string for excessive wear .
6. Rods string has suffered from hydrogen embrittlement). Replace rod string and use non-metallic thread compound.
7. Rods are of different manufacture. Separate all rods by manufacturer and do not interchange. RQ™ style joints are proprietary to Boart Longyear.



PREMATURE BOX END CRACKING / HEAT CHECK CRACKING

Potential Causes and Corrective Actions

1. Axial cracks at the box end due to a change in micro-structure of the tubing material. Change in microstructure is caused by the cyclic friction between the rotating string and the casing or hole wall and is independent of tubing type, steel grade and/or applied heat treatments. Often associated with a bright, polished area and thin cross-section on the box end. Reduce drilling loads and/or pullback, or improve lubrication of the string to compensate.

THREAD WEAR OR GALLING

CONVENTIONAL AND Q™ ROD

Potential Causes and Corrective Actions

1. Thread compound has failed to prevent mating thread surfaces from interacting. This is due to either a poor or diluted compound or poor lubrication practice. Upgrade thread compound or increase frequency of cleaning and re-lubing joints.
2. Thread contact pressure is excessive. For stab flank wear, reduce feed rate/pressure and/or increase rotation during make and break. For load flank wear, increase feed rate and/or reduce rotation during make and break. Rods with significant load flank wear should be discarded.
3. Thread sliding contact is excessive (e.g. too much drag during make/break turns) or frequent jamming or cross-threading. Consider upgrading to RQ™ style joints.
4. Accelerated wear may be due to damaged accessories; inspect accessories for damage or wear (e.g. adapter subs).
5. Thread wear life exceeded. Accelerated wear may be due to damaged accessories; inspect accessories (e.g. adapter subs). Inspect string for excessive wear.
6. Consider upgrading to RQ™ rods (e.g. harder threads last longer).

RQ™ AND RQ™TK ROD

Potential Causes and Corrective Actions

1. RQ™ style joints have the greatest joint taper (e.g. fewest make/break turns) available in the industry and have anti-jamming geometry.
2. RQ joints have the hardest threads available in the industry.

BOX WEAR OR BOX BULGING OR THREAD JUMPING

CONVENTIONAL AND Q™ ROD

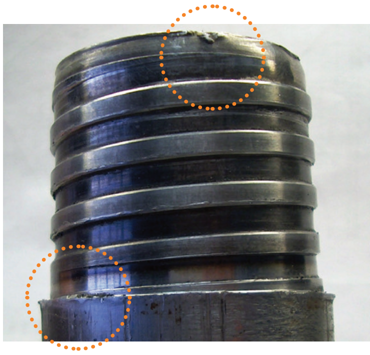
Potential Causes and Corrective Actions

1. Box bulging due to excessive hoop stresses imposed by thread, potentially from overload. Evident by polished areas on one side of box or thread jumping in the extreme case. Overload may be caused by poor choice of thread compound. Consider upgrading to RQ™ rods.
2. Box wear life exceeded leading to overload. Inspect string for excessive wear. Consider upgrading to RQ™ rods (e.g. harder material lasts longer).

RQ™ AND RQ™TK ROD

Potential Causes and Corrective Actions

1. RQ™ joints do not bulge nor jump, and have the highest yield strength material available in the industry.



EXTERNAL SHOULDER WEAR OR EXTERNAL SHOULDER FLARED/ROLLED OVER

CONVENTIONAL AND Q™ ROD

Potential Causes and Corrective Actions

1. Box shoulder flared and/or pin outer shoulder rolled over due to overload. Overload may be due to poor choice of thread compound. Consider upgrading to RQ™ joints. RQ joints have the highest load capacity available in the industry.
2. Box shoulder wear life exceeded. Inspect string for excessive wear. Consider upgrading to RQ rods.

RQ™ AND RQ™TK ROD

Potential Causes and Corrective Actions

1. RQ™ boxes are the hardest available in the industry.

MIDBODY WEAR

CONVENTIONAL AND Q™ ROD

Potential Causes and Corrective Actions

1. Hole deviations (e.g. rotary drilled holes, wedging, or down-hole monitoring) induce increased contact pressure and friction between string and hole or casing wall. Improve lubrication of string to compensate.
2. Hole has oversized or 'cave' sections allowing the string to elastically bend or buckle under load increasing contact pressure and friction. Reduce drilling loads or rotation speed to compensate or repair hole.
3. High pullback or thrust load combined with high rotation speed has caused the string to elastically or permanently bend, increasing contact pressure and friction against the hole or casing wall. Evident by polished or heavy wear on one side of string in a slow spiral pattern (e.g. spiral has a multiple length pitch). Reduce drilling loads and/or pullback. Consider upgrading to RQ™ rods.

RQ™ AND RQ™TK ROD

Potential Causes and Corrective Actions

1. High pullback or thrust load combined with high rotation speed causes the string to elastically bend, increasing contact pressure and friction against the hole or casing wall. Evident by polished or heavy wear on one side of string in a 'slow' spiral pattern (e.g. spiral has a multiple length pitch).

MIDBODY FATIGUE FAILURES

1. Accumulated surface damage combined with cyclic loading leads to fatigue cracking. Care should be taken when handling rods to prevent damage. Rods with damage deeper than 1/32" or .8 mm should be retired.

TROUBLESHOOTING

ROD BENDING OR HIGH TORQUE AND VIBRATION

The drill string has permanently bent, increasing contact pressure and friction against the hole or casing wall. Evident by increased vibration and torque in the hole. Rods show polishing or heavy wear on one side of string in a slow spiral pattern (e.g. spiral has a multiple length pitch).

Many of the following factors can contribute to rod bending:

1. Higher RPM speeds increase likelihood.
2. A lack of lubrication since fluid dampens vibration and reduces friction to prevent bending.
3. Increasing hole angle increases friction in the hole.
4. Larger Annulus, Larger size casing or oversize bits create more space for rods to bend
5. Dogleg severity or rapid change in direction. Even 10 degrees in 20 m approaches rod strength limit.
6. Rod bending is a resonance or dynamic event, so minimizing vibration by adjusting speed up or down by as little as 50 rpm can reduce the chance of rod bending.

GLOSSARY

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Adhesion Wear
This type of wear involves the adhesion (micro-bonding or micro-welding) of very small areas between the contacting surfaces of mating threads with similar hardness. The bonded areas can fracture off, generating wear particles, or transfer to the mating surface. Wear particulate can then bond together and grow in size, producing larger scale wear. In the extreme case, adhesion wear can seize a joint. The rate of adhesion wear decreases as the surface hardness increases. Adhesion wear will not occur if the thread compound prevents contact of the surfaces.

Abrasion Wear
This type of wear involves gouging and polishing of a surface by wear particles or foreign debris. Wear particles are either repelled or embedded into the subject surface but do not build or micro-weld avoiding joint seizure. The rate of abrasion wear is directly proportional to the contact pressure and the sliding distance between the mating surfaces. The rate of abrasion wear decreases as the surface hardness increases. Also, the rate of wear is less between mating thread surfaces of differing hardness. Abrasion wear will not occur if the thread compound prevents contact of the surfaces.

Fretting
Small relative cyclic movement between two surfaces in contact. Fretting produces pitting wear (a form of adhesion wear) which can lead to fatigue failures. The wear rate increases with amplitude but not with frequency.

Galling
Large scale (visual) damage to both mating thread surfaces in a joint caused by small areas of plastic deformation (adhesions or transfers, see adhesion wear) that interfere with sliding which can lead to seizure. Galling resistance is a function of the mating surfaces, not of a single surface, and is typically not seen on Boart Longyear™ drill rods.

Heat-Check Cracking
This is axial cracking (crack works from the outside surface in) resulting of the rapid expansion of a thin layer of brittle surface material that was hardened by the heat of friction (e.g. rods rubbing on casing or hole) and then rapidly quenched by drilling fluid and the cooler material underneath.

Hydrogen Embrittlement
Hydrogen has damaging effects on all metals, including reduction of fatigue strength, enhancement of crack propagation and corrosion cracking. Hydrogen may be encountered in the hole, or may be created by reactions with acidic fluids in the hole or generated by corrosion.
The absorption of hydrogen in metals is enhanced by sulphide-bearing waters (H_2S) and by thread compounds containing metal particulate.

Inertia
The force developed by the momentum of a moving or rotating mass (such as a rotating rod string or a drill head) which resists acceleration or deceleration.

Inertial Torque
Inertial torque is make-up induced when the joint of an added rod is fully made up and stops abruptly against the inertia of the rotating drill head.

Joint / Load Efficiency

This is a measure of how much load a joint can carry, as compared to the midbody. Inversely, this is a measure of how much more stress is created in the joint by a load, as compared to the midbody. Consider that about half of the rod tubing wall thickness or section is removed when cutting a threaded joint, which means a loss of half the strength. Also, all traditional threads create additional stress (less strength) due to poor choice of geometry. For example, the Q™ joints are 30% load efficient which means there is only a third the load capacity of the full section of tube, or three times the stress than that created in a full section of tube. The HD threads have a better choice of geometry improving load efficiency to 40%, producing only 2.5 times the stress under load. Ultimately, the engineered RQ™ joints actually mimic the load response of a solid tube and provide 50% load efficiency which is half the strength of a solid tube, or only twice the stress under load.

Joint Seizure

Mating thread surfaces are not able to move relative to each other as a result of increased friction due to galling or adhesion wear (local solid-state welding, "micro-welding") potentially preventing break-out of a joint.

Memory

Fatigue damage is cumulative. All steels have a limit to the number of applications or reversals of an excessive repeating load which is commonly referred to as memory. For example, a rod may successfully complete one demanding application and then fail in a future, less demanding application when the limit is finally exceeded with only a few more cycles of excessive load. The generally accepted limit for steels to an excessive repeating or alternating load is three million cycles. At 500 RPM, this is 100 hours of drilling which could easily traverse more than one job where the excessive loading is not continuous (larger sizes are more prone to memory failures as they run at lower RPM and have inherently higher bend stresses). Memory failures can be caused by any excessive load that fluctuates due to rotation (e.g. a bend load, a hoop stress due to large foreign debris particles, stabbing damage, etc).

Spin Outs

Sudden break-out of joints due to the inertia of a rotating rod string under deceleration.

Stress

Stress is the material response to a load. Stress causes steel to deform elastically (strain) up to the yield strength, beyond which deformation is permanent. In a drill rod, there are three components or directions of stress:

- Axial stress
- Hoop stress
- Radial stress

These components add together according to vector addition to a total stress value known as the principle or von-Mises stress. The axial stress is directed parallel to the rod longitudinal axis and is a direct result of drilling or bend loads. The hoop stress is directed circumferentially around the tube and perpendicular to the rod axis. In a rod joint, hoop stress is induced by the thread form and adds to the total stress – except in RQ™ style joints which reduce the total stress – mimicking the midbody. The radial stress is directed radially inwards or outwards from the rod longitudinal axis and is typically not significant, except under extraordinarily high fluid pressures.

WARRANTY

Limited Warranty.

(a) Consumables. Boart Longyear warrants for a period of one (1) year after the date of shipment of the consumable products manufactured by it, or the performance of related services, under the Contract, that such consumable products are free from defects in materials and workmanship and such services are performed in a professional and workmanlike manner; provided, however, with respect to consumable products purchased through an authorized Boart Longyear distributor, the warranty period shall commence on the date of purchase by the end-user.

(b) Capital Equipment. Boart Longyear warrants that the capital equipment manufactured by it is free from defects in materials and workmanship for a period equal to the lesser of (i) one (1) year after the date of shipment, or (ii) the initial 1,000 operating hours. Boart Longyear warrants for a period of six (6) months after the performance of related services that such services are performed in a professional and workmanlike manner.

(c) General Terms. Boart Longyear further warrants that, to the extent applicable, as of the date of shipment or performance, all goods manufactured by it and services performed shall conform to the written specifications agreed between the parties. THIS IS BOART LONGYEAR'S ONLY WARRANTY. BOART LONGYEAR MAKES NO OTHER WARRANTY, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. As a condition to Boart Longyear's warranty obligations, Purchaser must: (i) contact Boart Longyear and request authorization to return any goods claimed to be defective promptly upon Purchaser's discovery of the alleged defect, (ii) upon receipt of an approved authorization code from Boart Longyear, return any goods claimed to be defective under the foregoing warranty, at Purchaser's expense, to the facility designated by Boart Longyear, and (iii) with respect to consumable products purchased through an authorized Boart Longyear distributor, the party making the warranty claim must also deliver to Boart Longyear reasonable evidence of the date of purchase. Boart Longyear shall perform its examination of the goods so returned by Purchaser and shall report the results of its examination to Purchaser within thirty (30) days following its receipt of such goods from Purchaser, or, if longer time is required to complete such examination, within such time as would be required through the exercise of reasonable diligence. As a further condition to Boart Longyear's obligations hereunder for breach of warranty, Purchaser shall offer its reasonable cooperation and assist Boart Longyear in the course of Boart Longyear's review of any warranty claim. If requested by Purchaser, Boart Longyear will promptly repair or replace, at Boart Longyear's expense, goods that are confirmed to be non-conforming as a result of Boart Longyear's examination and according to Boart Longyear's warranty as set forth herein. All removal and installation of goods shall be at Purchaser's expense; provided, however, Boart Longyear will reimburse the Customer for an amount equal to the reasonable expenses incurred by the Customer and attributable to the removal and shipment of any defective goods. Boart Longyear reserves the right to reimburse Purchaser for an amount equal to the purchase price of any defective goods in lieu of providing repaired or replacement goods. Anything contained herein to the contrary notwithstanding, in no event shall Boart Longyear be liable for breach of warranty or otherwise in any manner whatsoever for: (i) normal wear and tear; (ii) corrosion, abrasion or erosion; (iii) any goods, components, parts, software or services which, following delivery or performance by Boart Longyear, has been subjected to accident, abuse, misapplication, modification, improper repair, alteration, improper installation or maintenance, neglect, or excessive operating conditions; (iv) defects resulting from Purchaser's specifications or designs or those of its contractors or subcontractors other than Boart Longyear; (v) defects associated with consumable parts or materials, the lifetime of which is shorter than the warranty period set forth in this Section; (vi) defects associated with

Purchaser's specifications or designs or those of its contractors or subcontractors other than Boart Longyear; (vii) defects resulting from the manufacture, distribution, promotion or sale of Purchaser's own products; or (viii) accessories of any kind used by the Purchaser which are not manufactured by or approved by Boart Longyear.

(d) Sourced Goods. If the defective parts or components are not manufactured by Boart Longyear, the guarantee of the manufacturer of those defective parts or components is accepted by the Purchaser and is the only guarantee given to the Purchaser in respect of the defective parts or components. Boart Longyear agrees to assign to the Purchaser on request made by the Purchaser the benefit of any warranty or entitlement to the defective parts or components that the manufacturer has granted to Boart Longyear under any contract or by implication or operation of law to the extent that the benefit of any warranty or entitlement is assignable.

(e) Limitation on Liability. Except as provided for herein, in no event will Boart Longyear be liable for any indirect, incidental, special, consequential, punitive or similar damages including, but not limited to, lost profits, loss of data or business interruption losses. In no event will the total, aggregate liability of Boart Longyear under the Contract exceed the value of the Contract under which liability is claimed. The liability limitations shall apply even if Boart Longyear has been notified of the possibility or likelihood of such damages occurring and regardless of the form of action, whether in contract, negligence, strict liability, tort, products liability or otherwise. The parties agree that these limits of liability shall survive and continue in full force and effect despite any termination or expiration of any Contract. Any action by Purchaser against Boart Longyear must be commenced within one year after the cause of action has accrued. No employee or agent of Boart Longyear is authorized to make any warranty other than that which is specifically set forth herein. The provisions in any specification, brochure or chart issued by Boart Longyear are descriptive only and are not warranties.

PRODUCT INDEX

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