



Hydraulic Spear

B & W Spear
GS Spear

MAN-TTT-210 (R02)

Thru-Tubing Technology

A Division of Owen Oil Tools LP

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Hydraulic Spear

Description

The Hydraulic Spear is used to retrieve a string that is stuck or left in the hole having a internal fishing neck on top. The spear is designed to withstand high side and tensional loads during a jarring operation.

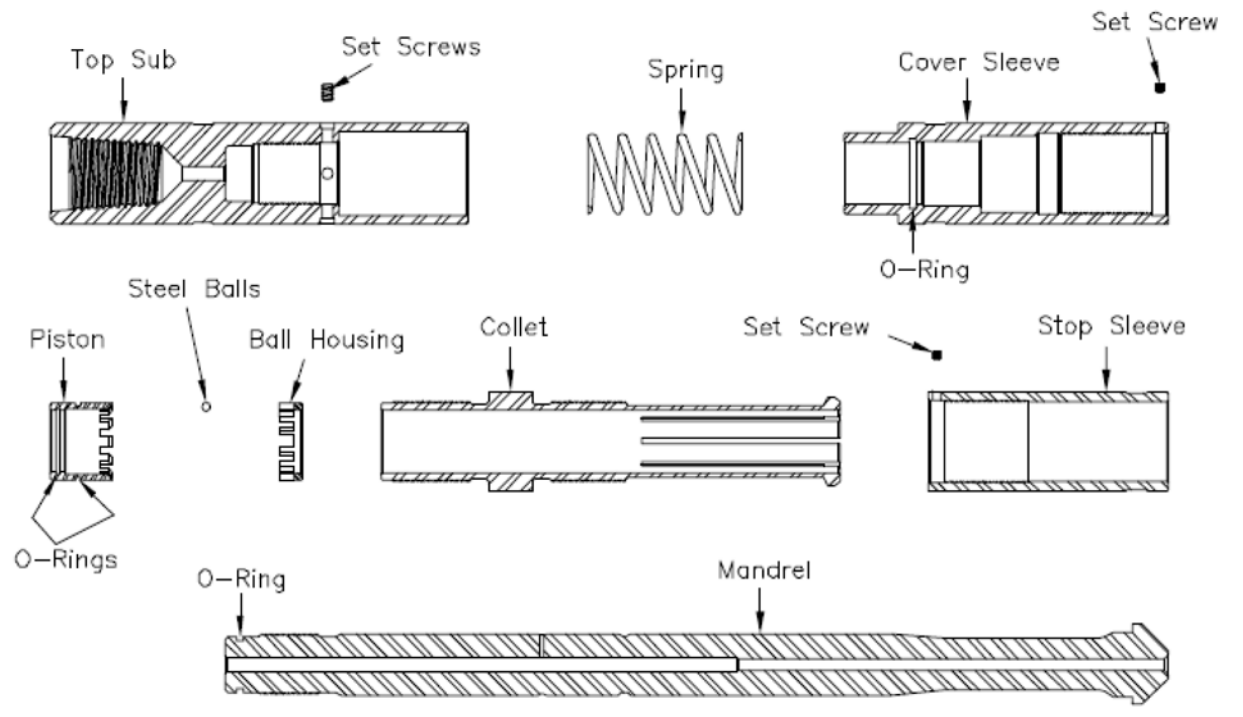
Operation

Tag the fish and apply set down weight. The collets will retract and then latch when entering the internal fish neck profile. Begin pulling and/or jarring to retrieve the fish. If retrieval is not possible, set down again on the fish. Pumping through the tool will lock it in release position, allowing disengagement of the fish. The fishing string can now be retrieved from the hole.

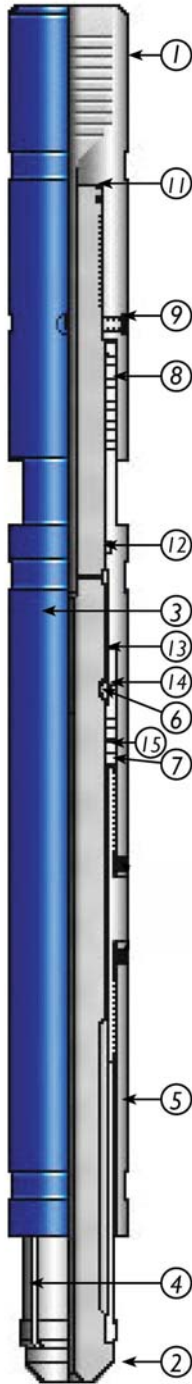
Product Code	Tool OD (in.)	Pressure to Hold in Release Position (psi)	Pump Rate (gpm)	Internal Profile Retrieved
TT0210-169E	1.688	350	19	2" B & W
TT0210-181E	1.813	350	19	2" GS
TT0210-213E	2.125	200	25	2 1/2" GS
TT0210-225E	2.25	200	25	2 1/2" GS
TT0210-270E	2.7	300	30	3" GS
TT0210-288E	2.875	300	30	3" GS

Hydraulic Spear

Parts Identification Chart



TT0210-169E BOM, Schematic and Specs



ITEM	QTY	TOOL PARTS DESCRIPTION	PART NUMBER
1	1	Top Sub	TT0210-169E-001
2	1	2" B & W Mandrel	TT0210-169E-002
3	1	Cover Sleeve	TT0210-169E-003
4	1	2" B & W Collet	TT0210-169E-004
5	1	2" B & W Stop Sleeve	TT0210-169E-005
6	1	Piston	TT0210-181E-006
7	1	Ball Housing	TT0210-181E-007
8	1	Wave Spring	PUR-TWS1096-128
9	4	Steel Allen Set Screws 1/4-20 x 5/16"	PUR-TSAS160-020
11	1	O-Ring 7/8" x 1" x 1/16" 2-020	PUR-TORV000-020
12	1	O-Ring 1 1/8" x 1 5/16" x 3/32" 2-122	PUR-TORV000-122
13	1	O-Ring 1 1/8" x 1 1/4" x 1/16" 2-024	PUR-TORV000-024
14	1	O-Ring 1 5/16" x 1 7/16" x 1/16" 2-027	PUR-TORV000-027
15	8	Steel Ball Bearings 3/16"	PUR-TSBC000-012

Tool Name: 1.688 in. OD Series E Hydraulic 2 in. B & W Spear
Product Code: TT0210-169E **Tool OD:** 1.688 in. **Tool ID:** 0.188 in.
Material: AISI 4140 HT **Tool Length:** 21.13 in. w/ 1" MT
Minimum Yield: 100,000 psi

Strength Properties of Tool:

Minimum Yield Point & Load to Yield: The taper of the recess OD of the Mandrel, 30,400 lbs; the Collet stop on the Mandrel, 32,300 lbs; the thread recess of the Mandrel Stub Acme pin connection, 36,300 lbs.

Burst Point and Burst Pressure: The O-ring groove on the OD of the Piston, 11,000 psi.

Torsional Weak Point and Ft-Lbs to Yield: 390 ft-lbs as a function of O-ring groove collapse of the Mandrel, **without** the four 1/4-20 Steel Allen set screws tightened to 77.9 in-lbs; 500 ft-lbs as a function of torsional yield of the pin end of the Mandrel, **without** the four 1/4-20 Steel Allen set screws tightened to 77.9 in-lbs; 555 ft-lbs as a function of O-ring groove collapse of the Mandrel, **with** the four 1/4-20 Steel Allen set screws tightened to 77.9 in-lbs; 665 ft-lbs as a function of torsional yield of the pin end of the Mandrel, **with** the four 1/4-20 Steel Allen set screws tightened to 77.9 in-lbs; 1,000 ft-lbs as a function of torsional yield of the Mandrel at the thread recess of the pin connection.

Recommended Make Up Torque:

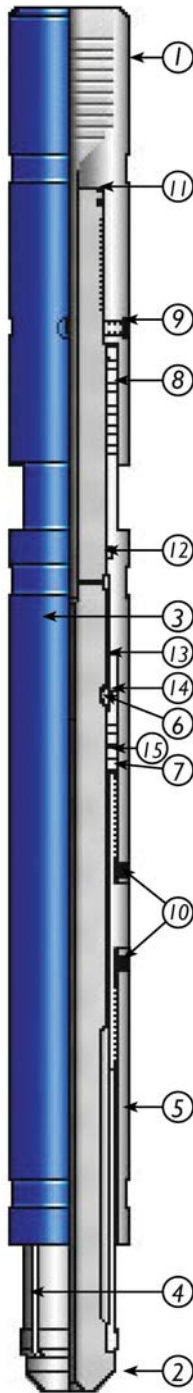
- 1st Connection:** The Top Sub - Mandrel Stub Acme connection - 95 ft-lbs.
- 2nd Connection:** The Cover Sleeve - Collet Stub Acme connection - 60 ft-lbs.
- 3rd Connection:** The Collet - Stop Sleeve Stub Acme connection - 110 ft-lbs.
- 4th Connection:** The 1/4-20 Steel Allen set screws - 77.9 in-lbs.

Fishing Profile Information:

The tool catches a 2 in. B&W (1.313 in. ID) internal fishing neck.

Hydraulic Spear

TT0210-181E BOM, Schematic and Specs



ITEM	QTY	TOOL PARTS DESCRIPTION	PART NUMBER
1	1	Top Sub	TT0210-181E-001
2	1	Mandrel	TT0210-181E-002
3	1	Cover Sleeve	TT0210-181E-003
4	1	2" Collet	TT0210-181E-004
5	1	Stop Sleeve	TT0210-181E-005
6	1	Piston	TT0210-181E-006
7	1	Ball Housing	TT0210-181E-007
8	1	Wave Spring	PUR-TWS1096-128
9	4	Steel Allen Set Screws 1/4-20 x 3/8"	PUR-TSAS160-024
10	2	Steel Allen Set Screws 10-32 x 3/16"	PUR-TSAS121-012
11	1	O-Ring 7/8" x 1" x 1/16" 2-020	PUR-TORV000-020
12	1	O-Ring 1 1/8" x 1 5/16" x 3/32" 2-122	PUR-TORV000-122
13	1	O-Ring 1 1/8" x 1 1/4" x 1/16" 2-024	PUR-TORV000-024
14	1	O-Ring 1 5/16" x 1 7/16" x 1/16" 2-027	PUR-TORV000-027
15	8	Steel Ball Bearings 3/16"	PUR-TSBC000-012

Tool Name: 1.813 in. OD Series E Hydraulic 2 in. GS Spear

Product Code: TT0210-181E **Tool OD:** 1.813 in. **Tool ID:** 0.188 in.

Material: AISI 4140 HT **Tool Length:** 21.13 in. w/ 1 in. MT

Minimum Yield: 100,000 psi

Strength Properties of Tool:

Minimum Yield Point and Load to Yield: The Collet stop on the Mandrel, 31,200 lbs; the taper of the recess OD of the Mandrel, 34,400 lbs; the thread recess of the Mandrel Stub Acme pin connection, 36,300 lbs.

Burst Point and Burst Pressure: The O-ring groove on the OD of the Piston, 11,000 psi.

Torsional Weak Point and Ft-Lbs to Yield: 390 ft-lbs as a function of O-ring groove collapse of the Mandrel, **without** the four 1/4-20 Steel Allen set screws tightened to 77.9 in-lbs; 500 ft-lbs as a function of torsional yield of the pin end of the Mandrel, **without** the four 1/4-20 Steel Allen set screws tightened to 77.9 in-lbs; 555 ft-lbs as a function of O-ring groove collapse of the Mandrel, **with** the four 1/4-20 Steel Allen set screws tightened to 77.9 in-lbs; 665 ft-lbs as a function of torsional yield of the pin end of the Mandrel, **with** the four 1/4-20 Steel Allen set screws tightened to 77.9 in-lbs; 1,000 ft-lbs as a function of torsional yield of the Mandrel at the thread recess of the pin connection.

Recommended Make Up Torque:

1st Connection: The Top Sub - Mandrel Stub Acme connection - 95 ft-lbs.

2nd Connection: The Cover Sleeve - Collet Stub Acme connection - 165 ft-lbs.

3rd Connection: The Collet - Stop Sleeve Stub Acme connection - 130 ft-lbs.

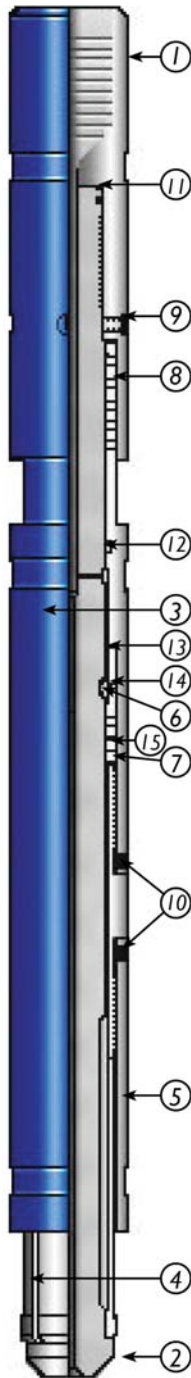
4th Connection: The 1/4-20 Steel Allen set screws - 77.9 in-lbs.

5th Connection: The 10-32 Steel Allen set screws - 33.5 in-lbs.

Fishing Profile Information:

The tool catches a 2 in. nominal (1.375 in. ID) internal fishing neck.

TT0210-213E BOM, Schematic and Specs



ITEM	QTY	TOOL PARTS DESCRIPTION	PART NUMBER
1	1	Top Sub	TT0210-213E-001
2	1	Mandrel	TT0210-225E-002
3	1	Cover Sleeve	TT0210-213E-003
4	1	2.500" Collet	TT0210-213E-004
5	1	Stop Sleeve	TT0210-213E-005
6	1	Piston	TT0210-225E-006
7	1	Ball Housing	TT0210-225E-007
8	1	Spring DWC-1870P-15	PUR-TCS0120-224
9	4	Steel Allen Set Screws 1/4-20 x 3/8"	PUR-TSAS160-024
10	2	Steel Allen Set Screws 10-32 x 3/16"	PUR-TSAS121-012
11	1	O-Ring 1 1/16" x 1 1/4" x 3/32" 2-121	PUR-TORV000-121
12	1	O-Ring 1 3/8" x 1 9/16" x 3/32" 2-126	PUR-TORV000-126
13	1	O-Ring 1 3/8" x 1 1/2" x 1/16" 2-028	PUR-TORV000-028
14	1	O-Ring 1 1/2" x 1 5/8" x 1/16" 2-029	PUR-TORV000-029
15	12	Steel Ball Bearings 3/16"	PUR-TSBC000-012

Tool Name: 2.125 in. OD Series E Hydraulic 2-1/2 in. GS Spear

Product Code: TT0210-213E **Tool OD:** 2.125 in. **Tool ID:** 0.250 in.

Material: AISI 4140 HT **Tool Length:** 25.5 in. w/ 1 1/2 in. MT Conn.

Minimum Yield: 100,000 psi

Strength Properties of Tool:

Minimum Yield Point and Load to Yield: The Collet stop on the Mandrel, 45,400 lbs; the thread recess of the Mandrel Stub Acme pin connection, 65,700 lbs.

Burst Point and Burst Pressure: The O-ring groove on the OD of the Piston, 10,000 psi.

Torsional Weak Point and Ft-Lbs to Yield: 690 ft-lbs as a function of O-ring groove collapse of the Mandrel, **without** the four 1/4-20 Steel Allen set screws tightened to 77.9 in-lbs; 900 ft-lbs as a function of O-ring groove collapse of the Mandrel, **with** the four 1/4-20 Steel Allen set screws tightened to 77.9 in-lbs; 940 ft-lbs as a function of torsional yield of the pin end of the Mandrel, **without** the four 1/4-20 Steel Allen set screws tightened to 77.9 in-lbs; 1150 ft-lbs as a function of torsional yield of the pin end of the Mandrel, **with** the four 1/4-20 Steel Allen set screws tightened to 77.9 in-lbs; 2,200 ft-lbs as a function of torsional yield of the Mandrel at the thread recess of the pin connection.

Recommended Make Up Torque:

1st Connection: The Top Sub - Mandrel Stub Acme connection - 170 ft-lbs.

2nd Connection: The Cover Sleeve - Collet Stub Acme connection - 190 ft-lbs.

3rd Connection: The Collet - Stop Sleeve Stub Acme connection - 190 ft-lbs.

4th Connection: The 1/4-20 Steel Allen set screws - 77.9 in-lbs.

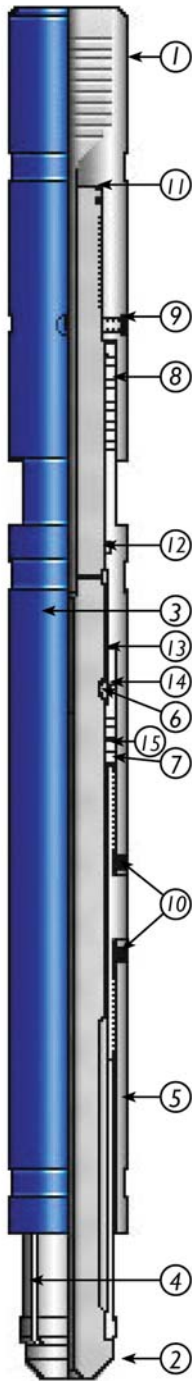
5th Connection: The 10-32 Steel Allen set screws - 33.5 in-lbs.

Fishing Profile Information:

The tool catches a 2-1/2 in. nominal (1.813 in. ID) internal fishing neck.

Hydraulic Spear

TT0210-225E BOM, Schematic and Specs



ITEM	QTY	TOOL PARTS DESCRIPTION	PART NUMBER
1	1	Top Sub	TT0210-225E-001
2	1	Mandrel	TT0210-225E-002
3	1	Cover Sleeve	TT0210-225E-003
4	1	2.500" Collet	TT0210-225E-004
5	1	Stop Sleeve	TT0210-225E-005
6	1	Piston	TT0210-225E-006
7	1	Ball Housing	TT0210-225E-007
8	1	Spring DWC-1870P-15	PUR-TCS0120-224
9	4	Steel Allen Set Screws 1/4-20 x 3/8"	PUR-TSAS160-024
10	2	Steel Allen Set Screws 10-32 x 3/16"	PUR-TSAS121-012
11	1	O-Ring 1 1/16" x 1 1/4" x 3/32" 2-121	PUR-TORV000-121
12	1	O-Ring 1 3/8" x 1 9/16" x 3/32" 2-126	PUR-TORV000-126
13	1	O-Ring 1 3/8" x 1 1/2" x 1/16" 2-028	PUR-TORV000-028
14	1	O-Ring 1 1/2" x 1 5/8" x 1/16" 2-029	PUR-TORV000-029
15	12	Steel Ball Bearings 3/16"	PUR-TSBC000-012

Tool Name: 2.250 in. OD Series E Hydraulic 2-1/2 in. GS Spear

Product Code: TT0210-225E **Tool OD:** 2.250 in. **Tool ID:** 0.250 in.

Material: AISI 4140 HT **Tool Length:** 25.5 in. w/ 1 1/2 in. MT Conn.

Minimum Yield: 100,000 psi

Strength Properties of Tool:

Minimum Yield Point and Load to Yield: The Collet stop on the Mandrel, 45400 lbs; the thread recess of the Mandrel Stub Acme pin connection, 65,700 lbs.

Burst Point and Burst Pressure: The O-ring groove on the OD of the Piston, 10,000 psi.

Torsional Weak Point and Ft-Lbs to Yield: 690 ft-lbs as a function of O-ring groove collapse of the Mandrel, **without** the four 1/4-20 Steel Allen set screws tightened to 77.9 in-lbs; 900 ft-lbs as a function of o-ring groove collapse of the Mandrel, **with** the four 1/4-20 Steel Allen set screws tightened to 77.9 in-lbs; 940 ft-lbs as a function of torsional yield of the pin end of the Mandrel, **without** the four 1/4-20 Steel Allen set screws tightened to 77.9 in-lbs; 1150 ft-lbs as a function of torsional yield of the pin end of the Mandrel, **with** the four 1/4-20 Steel Allen set screws tightened to 77.9 in-lbs; 2,200 ft-lbs as a function of torsional yield of the Mandrel at the thread recess of the pin connection.

Recommended Make Up Torque:

1st Connection: The Top Sub - Mandrel Stub Acme connection - 170 ft-lbs.

2nd Connection: The Cover Sleeve - Collet Stub Acme connection - 190 ft-lbs.

3rd Connection: The Collet - Stop Sleeve Stub Acme connection - 190 ft-lbs.

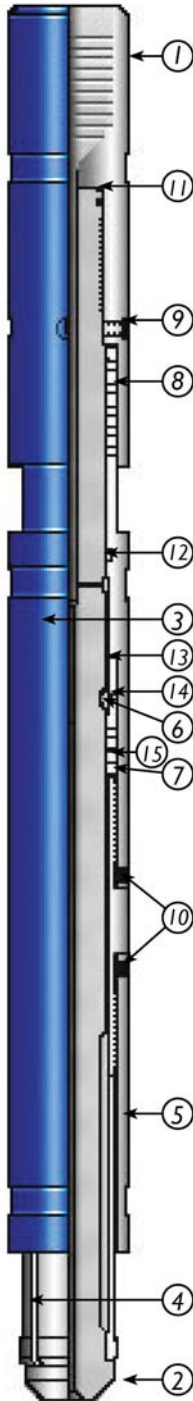
4th Connection: The 1/4-20 Steel Allen set screws - 77.9 in-lbs.

5th Connection: The 10-32 Steel Allen set screws - 33.5 in-lbs.

Fishing Profile Information:

The tool catches a 2-1/2 in. nominal (1.813 in. ID) internal fishing neck.

TT0210-270E BOM, Schematic and Specs



ITEM	QTY	TOOL PARTS DESCRIPTION	PART NUMBER
1	1	Top Sub	TT0210-270E-001
2	1	Mandrel	TT0210-288E-002
3	1	Cover Sleeve	TT0210-270E-003
4	1	3" Collet	TT0210-270E-004
5	1	Stop Sleeve	TT0210-270E-005
6	1	Piston	TT0210-288E-006
7	1	Ball Housing	TT0210-288E-007
8	1	Spring DWC-207PQ-18	PUR-TCS0144-320
9	4	Steel Allen Set Screws 5/16-18 x 1/2"	PUR-TSAS200-032
10	2	Steel Allen Set Screws 14-20 x 1/4"	PUR-TSAS160-016
11	1	O-Ring 1 3/8" x 1 9/16" x 3/32" 2-126	PUR-TORV000-126
12	1	O-Ring 1 3/4" x 2" x 1/8" 2-224	PUR-TORV000-224
13	1	O-Ring 1 11/16" x 1 7/8" x 3/32" 2-131	PUR-TORV000-131
14	1	O-Ring 1 15/16" x 2 1/8" x 3/32" 2-135	PUR-TORV000-135
15	12	Steel Ball Bearings 1/4"	PUR-TSBC000-016

Tool Name: 2.700 in. OD Series E Hydraulic 3 in. GS Spear

Product Code: TT0210-270E **Tool OD:** 2.700 in. **Tool ID:** 0.250 in.

Material: AISI 4140 HT **Tool Length:** 33.2 in. w/ 2 3/8 in. PAC DSI

Minimum Yield: 100,000 psi

Strength Properties of Tool:

Minimum Yield Point and Load to Yield: The Collet stop on the Mandrel, 68,000 lbs; the thread recess of the Mandrel Stub Acme pin connection, 93,900 lbs.

Burst Point and Burst Pressure: The O-ring groove on the OD of the Piston, 11,500 psi.

Torsional Weak Point and Ft-Lbs to Yield: 1,390 ft-lbs as a function of O-ring groove collapse of the Mandrel, **without** the four 5/16-18 Steel Allen set screws tightened to 156 in-lbs; 1,790 ft-lbs as a function of torsional yield of the pin end of the Mandrel, **without** the four 5/16-18 Steel Allen set screws tightened to 156 in-lbs; 1,810 ft-lbs as a function of O-ring groove collapse of the Mandrel, **with** the four 5/16-18 Steel Allen set screws tightened to 156 in-lbs; 2,210 ft-lbs as a function of torsional yield of the pin end of the Mandrel, **with** the four 5/16-18 Steel Allen set screws tightened to 156 in-lbs; 4,300 ft-lbs as a function of torsional yield of the Mandrel at the thread recess of the pin connection.

Recommended Make Up Torque:

1st Connection: The Top Sub - Mandrel Stub Acme connection - 340 ft-lbs.

2nd Connection: The Cover Sleeve - Collet Stub Acme connection - 550 ft-lbs.

3rd Connection: The Collet - Stop Sleeve Stub Acme connection - 550 ft-lbs.

4th Connection: The 5/16-18 Steel Allen set screws - 156 in-lbs.

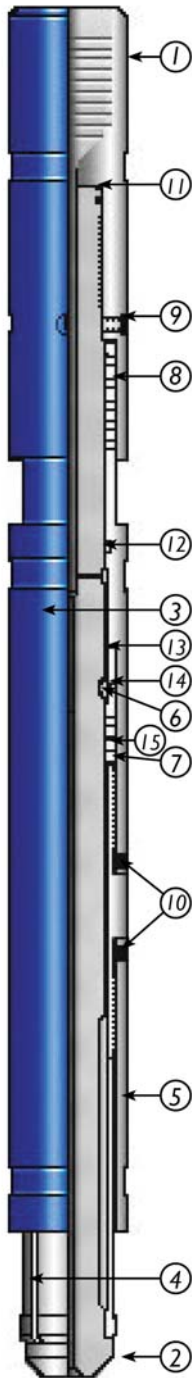
5th Connection: The 1/4-20 Steel Allen set screws - 77.9 in-lbs.

Fishing Profile Information:

The tool catches a 3 in. nominal (2.312 in. ID) internal fishing neck.

Hydraulic Spear

TT0210-288E BOM, Schematic and Specs



ITEM	QTY	TOOL PARTS DESCRIPTION	PART NUMBER
1	1	Top Sub	TT0210-288E-001
2	1	Mandrel	TT0210-288E-002
3	1	Cover Sleeve	TT0210-288E-003
4	1	3" Collet	TT0210-288E-004
5	1	Stop Sleeve	TT0210-288E-005
6	1	Piston	TT0210-288E-006
7	1	Ball Housing	TT0210-288E-007
8	1	Spring DWC-207PQ-18	PUR-TCS0144-320
9	4	Steel Allen Set Screws 5/16-18 x 1/2"	PUR-TSAS200-032
10	2	Steel Allen Set Screws 14-20 x 1/4"	PUR-TSAS160-016
11	1	O-Ring 1 3/8" x 1 9/16" x 3/32" 2-126	PUR-TORV000-126
12	1	O-Ring 1 3/4" x 2" x 1/8" 2-224	PUR-TORV000-224
13	1	O-Ring 1 11/16" x 1 7/8" x 3/32" 2-131	PUR-TORV000-131
14	1	O-Ring 1 15/16" x 2 1/8" x 3/32" 2-135	PUR-TORV000-135
15	12	Steel Ball Bearings 1/4"	PUR-TSBC000-016

Tool Name: 2.875 in. OD Series E Hydraulic 3 GS Spear

Product Code: TT0210-288E **Tool OD:** 2.875 in. **Tool ID:** 0.250 in.

Material: AISI 4140 HT **Tool Length:** 33.2 in. w/ 2 3/8 in. PAC DSI

Minimum Yield: 100,000 psi

Strength Properties of Tool:

Minimum Yield Point and Load to Yield: The Collet stop on the Mandrel, 68,000 lbs; the thread recess of the Mandrel Stub Acme pin connection, 93,900 lbs.

Burst Point and Burst Pressure: The O-ring groove on the OD of the Piston, 11,500 psi.

Torsional Weak Point and Ft-Lbs to Yield: 1,390 ft-lbs as a function of O-ring groove collapse of the Mandrel, **without** the four 5/16-18 Steel Allen set screws tightened to 156 in-lbs; 1,790 ft-lbs as a function of torsional yield of the pin end of the Mandrel, **without** the four 5/16-18 Steel Allen set screws tightened to 156 in-lbs; 1,810 ft-lbs as a function of O-ring groove collapse of the Mandrel, **with** the four 5/16-18 Steel Allen set screws tightened to 156 in-lbs; 2,210 ft-lbs as a function of torsional yield of the pin end of the Mandrel, **with** the four 5/16-18 Steel Allen set screws tightened to 156 in-lbs; 4,300 ft-lbs as a function of torsional yield of the Mandrel at the thread recess of the pin connection.

Recommended Make Up Torque:

1st Connection: The Top Sub - Mandrel Stub Acme connection - 340 ft-lbs.

2nd Connection: The Cover Sleeve - Collet Stub Acme connection - 550 ft-lbs.

3rd Connection: The Collet - Stop Sleeve Stub Acme connection - 550 ft-lbs.

4th Connection: The 5/16-18 Steel Allen set screws - 156 in-lbs.

5th Connection: The 1/4-20 Steel Allen set screws - 77.9 in-lbs.

Fishing Profile Information:

The tool catches a 3 in. nominal (2.312 in. ID) internal fishing neck.

1.0 Pre-Assembly



Warning: *Make sure all tool parts and components have been thoroughly cleaned or serious damage and/or injury could occur!*



Note: *Verify that the correct O-ring redress kit and quantities are used as specified on the Bill Of Materials (for example, 5 each etc....). Lay out all redress kit components on a clean surface.*



Note: *Make sure to lubricate all O-rings and threaded surfaces.*



Note: *Visually inspect all parts for damage or wear. Thread parts together without the O-rings to check fit. Repair or replace damaged parts.*



Caution: *Always file wrench marks or burrs and clean off debris!*



Caution: *This tool should always be disassembled, cleaned thoroughly, inspected and reassembled after job!*

2.0 Assembly

2.1 Grease the entire ID of the Stop Sleeve (item #5) and insert it, threads down, over the Collet (item #4) fingers. Thread on wrench tight.

2.2 Insert a Set Screw (item #10) into the Stop Sleeve and tighten.



Note: *The 1.688 B & W Spear (TT0210-169E) does not use a Set Screw.*

2.3 Put an O-ring (item #11) on the OD of the Mandrel (item #2). Push the Mandrel, threads first, into the Collet fingers until the fingers engage the end of the Mandrel.

2.4 Grease the OD of the Mandrel, then slip the Ball Housing (item #7), teeth up, over it.

Hydraulic Spear

2.5 Grease the teeth of the Ball Housing. Now place 8 Ball Bearings (item #15) into the spaces between the teeth.



Note: *The grease should hold the balls in place.*

2.6 Place an O-ring on the OD (item #14) and in the ID (item #13) of the Piston (item #6). Grease the Piston inside and out, then slide, teeth down, onto the threaded end of the Mandrel. Align the teeth of the Piston with those of the Ball Housing.



Note: *The Piston teeth should sit on the Ball Bearings.*

2.7 Put an O-ring (item #12) into the ID of the Cover Sleeve (item #3), then slide onto the end of the Mandrel and make hand tight. You might have to bump it down with a rubber mallet to clear the O-ring.

2.8 Put the assembly into a vise on the Stop Sleeve. Place a wrench on the Cover Sleeve and make wrench tight.

2.9 Insert a Set Screw (item #10) into the Cover Sleeve and tighten.



Note: *The 1.688 B & W Spear (TT0210-169E) does not use a Set Screw.*

2.10 Slide the Spring (item # 8) onto the end of the Mandrel.

2.11 Install the Top Sub (item #1), screw holes down, onto the end of the Mandrel and hand tighten as much possible. Now put the assembly into the vise on the Top Sub. Complete threading on the Top Sub, by placing a wrench on the head-end of the Mandrel. Make sure to file off any burrs on the Mandrel end.

2.12 Finally, insert 4 Set Screws (item #9) into the Top Sub and then tighten.

2.13 Install a plug into the tool bottom and function test prior to running in the well bore.

3.0 Disassembly

3.1 Remove and discard the 4 Set Screws (item #9) from the Top Sub (item #1), then remove the Top Sub.

3.2 Remove the spring.

3.3 If the Cover Sleeve (item #3) has a Set Screw (item 10), remove it then remove the Cover Sleeve.

3.4 Remove the Piston (item #6), then remove the 8 Ball Bearings (item #15).

3.5 Remove the Ball Housing (item #7).

3.6 Push the Mandrel (item #2) out of the Collet (item #4).

3.7 Finally, if the Stop Sleeve (item #5) has a Set Screw (item #10), remove it then remove the Stop Sleeve.



Note: Remove and discard all O-rings. Replace O-rings after each use. Thoroughly clean tool parts in a cleaner approved by state and/or local laws.



Note: Visually inspect tool for swelling after each use. Damaged or swelled components must be replaced.



Note: It is recommended that a Magnetic Particle Inspection (MPI) be completed on all components after each job.

Hydraulic Spear
