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Perforator

- *4", 6", and 10" for various Casing sizes*
- *PVC and Steel Cutting Wheels*
- *Roller and Slide Adapters for up to 24" Casing*
- *Custom Adapters for odd and large sizes*
- *Push or Pull Operation*
- *Operates underwater*

MADE IN USA

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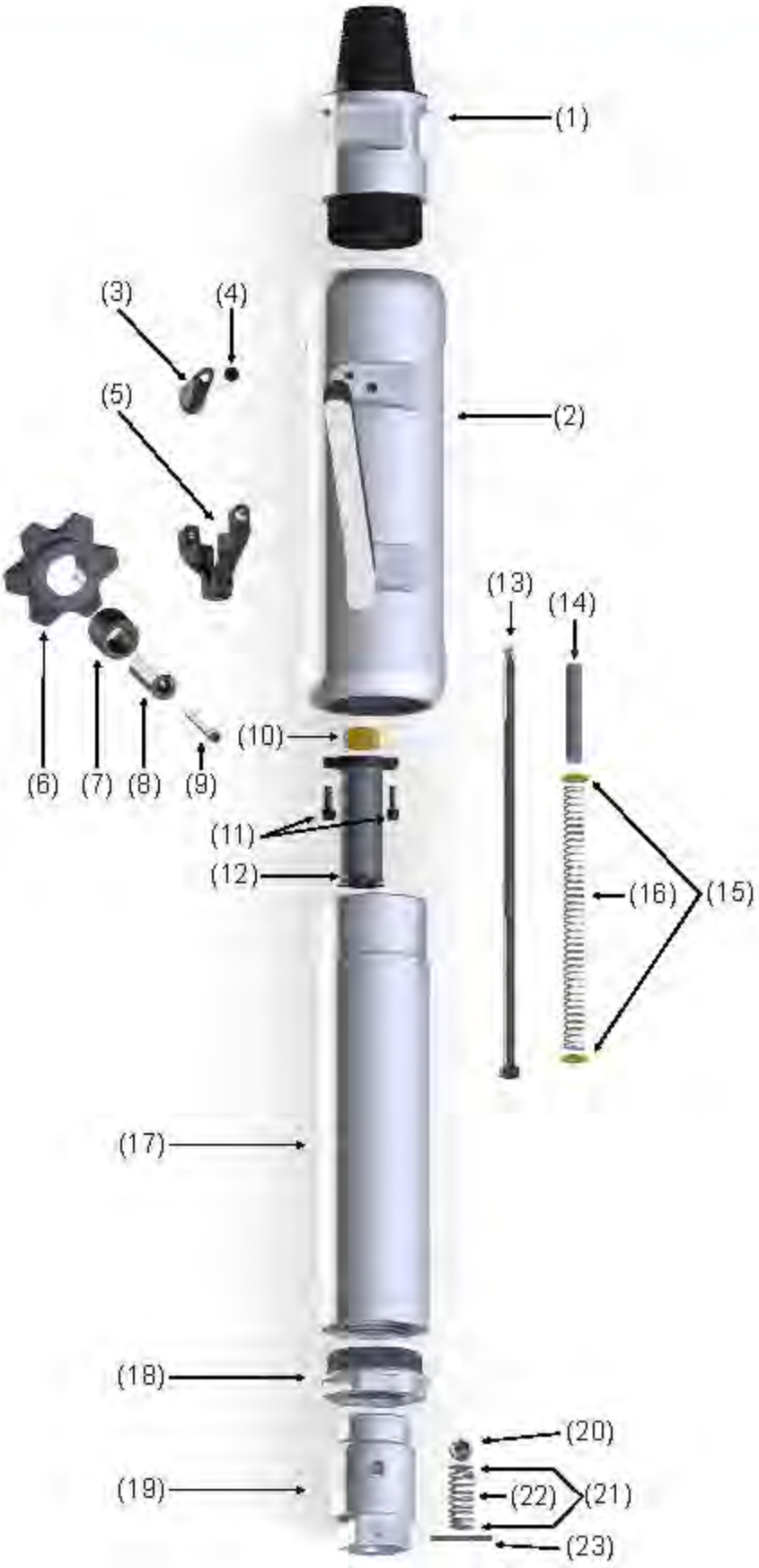
MADE IN USA

PERFORATOR MODEL



#	Description (qty)	Qty
1	Top Sub Adapter	1
2	Perforator Body	1
3	Travel Stop Right	*
NA	Travel Stop Left	*
4	Perforator Stop Bolts	*
5	Cutter Wheel Yoke	1
6	Steel Cutter Wheel	1
7	Cutter Wheel Bushing	†
8	Axle Pin	1
9	Axle Pin Bolt	1
10	Piston - Brass	1
11	Piston Cylinder Retaining Bolt	2
12	Piston Cylinder	1
13	Yoke Return Rod	1
14	Stop Tube	1
15	Washer	2
16	Return Rod Spring	1
17	Lower Housing	1
18	Pop-Off Valve Bushing	1
19	Pop-Off Valve Body	1
20	Ball Bearing	1
21	Washer	2
22	Pop-Off Valve Spring	1
23	Roll Pin	1

*Only the 6" Perforator has Travel Stops (1 Right, 1 Left, 2 bolts). †The 4" Perforator Cutter Wheel does not have a Bushing.

PERFORATOR PARTS LISTS

6" Perforator Parts

#	Description (qty)	Qty	PN	Spares
1	6" Perforator - Top Sub Adapter	1	260006-100690	
2	6" Perforator - Perforator Body	1	260006-100691	
3	6" Perforator - Travel Stop Right	*	260006-100705	
NA	6" Perforator - Travel Stop Left	*	260006-100706	
4	6" Perforator Stop Bolts	*	9000516-0001	
5	6" Perforator - Cutter Wheel Yoke (Includes Axle Pin Bolt)	1	260006-100692	
6	6" perforator Steel Cutter Wheel w/Bushing	1	260006-100693	1
8	6" Perforator - Axle Pin	1	260006-100695	1
9	6" Perforator - Axle Pin Bolt	1	260006-100696	1
10	4, 6" Perforator - Piston - Brass	1	260006-100698	
11	Piston Cylinder Retaining Bolt	2	900038-0001	
12	6" Perforator - Piston Cylinder	1	260006-100699	
13	4", 6" Perforator - Yoke Return Rod Only	1	260006-100701	
14	6" Perforator - Stop Tube	1	260006-100697	
15	Washer	2	260006-101266	
16	4" & 6" Perforator - Yoke Return Rod Spring Only	1	260006-100702	
17	6" Perforator - Lower Housing	1	260006-100703	
18	6" Perforator Pop-Off Valve Bushing	1	260006-100731	
19	4"/6"/10" Perforator - Pop-Off Valve (Assembly) Aluminum	1	260006-100730	

*Bushing without Wheel also available: PN 26006-100707

Replacement Cutting Wheels (with Bushing)

Perforator in. (mm)	Standard Wheel	Thin Wheel	PVC Wheel
4" (102)*	260004-100674	N/A	260004-100675
6" (152)	260006-100693	260006-0001	260006-100694
Large-10" (254)	2600010-100719	N/A	2600010-720

*4" Perforator Cutter Wheel does not use/come with a Bushing

4"/6"/10" Perforator - Pop-Off Valve Rebuild Kit
260006-0011
Includes Bearing, Washers, Spring, and Roll Pin

PERFORATOR PARTS & TOOLS LISTS

Replacement parts and needed quantities are listed below. Keep spares of these parts on hand or order them in advance of your expected need. All parts are available from Holte. Cutting Wheels, Wheel Bushings, Axles, and Axle Pins are expected to wear with use and need regular replacement.

4" Perforator Parts

#	Description (qty)	Qty	PN	Spares
1	4" Perforator - Top Sub Adapter	1	260004-100671	
2	4" Perforator - Perforator Body	1	260004-100672	
5	4" Perforator - Cutter Wheel Yoke	1	260004-100673	
6	4" Perforator - Steel Cutter Wheel	1	260004-100674	1
8	4" Perforator - Axle Pin	1	260004-100676	1
9	4" Perforator - Axle Pin Bolt	1	260004-100677	1
10	4", 6" Perforator - Piston - Brass	1	260006-100698	
11	Piston Cylinder Retaining Bolt	2	900038-0001	
12	4" Perforator - Piston Cylinder	1	260004-100680	
13	4", 6" Perforator - Yoke Return Rod Only	1	260006-100701	
14	4" Perforator - Stop Tube	1	260004-100678	
15	Washer	2	260006-101266	
16	4" & 6" Perforator - Yoke Return Rod Spring Only	1	260006-100702	
17	4" Perforator - Lower Housing	1	260004-100684	
19	4"/6"/10" Perforator - Pop-Off Valve (Assembly) Aluminum	1	260006-100730	

**Bushing without Wheel also available for Large Perforator: PN 26006-100733*

10" Perforator Parts

#	Description (qty)	Qty	PN	Spares
1	Large Perforator - Top Sub Adapter	1	260010-100716	
2	Large Perforator - Perforator Body	1	260010-100717	
5	Large Perforator - Cutter Wheel Yoke	1	260010-100718	
6	Large Perforator - Steel Cutter Wheel w/Bushing	1	260010-100719	1
8	Large Perforator - Axle Pin	1	260010-100721	1
9	Large Perforator - Axle Pin Bolt	1	260010-100722	1
10	Large Perforator - Piston - Brass	1	260010-100724	
11	Piston Cylinder Retaining Bolt	2	900038-0001	
12	Large Perforator - Piston Cylinder	1	260010-100725	
13	Large Perforator - Yoke Return Rod Only	1	260010-100727	
14	Large Perforator - Stop Tube	1	260010-100723	
15	Washer	2	260006-101266	
16	Large Perforator - Yoke Return Rod Springs Only	1	260010-100728	
17	Large Perforator - Lower Housing	1	260010-100729	
18	Large Perforator - Pop-Off Valve Bushing	1	260006-100731	
19	4"/6"/10" Perforator - Pop-Off Valve (Assembly) Aluminum	1	260006-100730	

Tools Recommended for Perforator Maintenance

Part Used On	Tool	Metric (mm)
Lower Housing, Bushing, and Pop-Off Valve	Strap or Chain Wrench (two or sub a pry bar)	Same
Axle Pin Bolt	1/4" Hex	6
Axle Pin Bolt Large	5/16" Hex	8
6" Perforator Travel Stops	3/16" Hex	4.5
Yoke Return Rods	3/4" Open-end Wrench	19
Piston Cylinder Bolts	5/16" Hex	8
Pop-Off Valve Roll Pin	3/16" Pin Punch	4.75
Pop-Off Valve Rebuild Fixturing	C-Clamp and Vise	Same
Pop-Off Valve Spring Compression	1.1" Dia x ~0.75" Deep Slotted Insert (pg 16)	28x19

A mixture of metric and standard sized parts are used. While conversions have been made between the two systems, the needed dimension is not always available in typical sizes and thus tool sizes listed may not represent a perfect fit.

SPECIFICATIONS: CUTTING WHEELS

Cutting Wheels are heat-treated to improve durability. Cutting Wheels wear with use and are expected to need regular replacement. Because Cutting Wheel life is dependent on the hardness and thickness of the Casing material perforated, they are not warrantied. Holte stands by the tools we make, so call us if you are having trouble. Perforators are intended to perforate Standard Well Casing (mild steel 0.375" thick). Perforators can perforate 0.250" thick Casing, but may overperforate (especially if stops are not used). Certain materials, such as N80 RJ55 used as Casing can be too hard to perforate properly.

Thickness of Cutter Wheel for Steel

A larger perforation requires more force to punch through the Casing. The Perforator acquires this force from the push and pull of the Rig on the Drill String. A larger hole is produced by a thicker Cutter, but this requires more force. A thinner Wheel can punch a perforation with less force, but the hole will be smaller. The force needed will depend on the Casing material and similarly named steel from different locations can vary greatly in quality. If significantly less force is available, some Users have ground the Cutting Wheel teeth to ~1/2 the length, but this reduces the Wheel durability and increases the spacing between holes. The best way to ensure proper perforation is to do an above ground test with a piece of the casing to be perforated.

Length of Cutting tooth~1"

Thin Steel Wheel ~1.5X Thinner

Standard Thickness

PVC Cutting Wheels

Special cutting wheels are used for perforation of PVC pipe. PVC requires sharper wheels with a finer point to minimize cracking of the pipe. Only use PVC cutting wheels with PVC and do not use Steel cutting wheels with PVC. PVC cutting wheels can be installed on any Perforator. PVC perforation works best at slower perforation rates than steel, to minimize cracking of the pipe. Perforate PVC at 20'/min (6.1m/min).

PVC Cutter Wheel

Steel Cutter Wheel

Perforation Column Recommendations

Diameter in (mm)	6" (152)	8" (203)	10" (254)
Perforation Columns	4	6	7

Diameter in (mm)	12" (305)	14" (356)	16" (406)
Perforation Columns	8	10	11

Diameter in (mm)	18" (457)	20" (508)	22" (559)	24" (610)
Perforation Columns	12	13	14	15

Info: *An unperforated 6" Well has an area of 28in² at the bottom to let water in. Perforating a 6" Well over a 20' section with four perforation columns adds ~105in² of area. The Perforations can be made where the water is, and are spread through the aquifer permitting faster recharge.*

Approximate Perforation Sizes

Wheel	4"	4" PVC	6" Thick	6" Thin
Length, width, spacing	0.75"x0.2"x1.6"	0.36"x0.2"x1.25"	1"x0.25"x1.5"	1"x0.188"x1.5"
Wheel	**6" PVC**	**Large Thick**	**Large Thin**	**Large PVC**
Hole Dimen.	0.45"x0.19"x1.75"	1.25"x0.38"x1.75"	1.25"x0.188"x1.75"	1"x0.26"x2.2"

Hole size may vary will material, cutter wear, ground conditions, and throughout the column. A 0.1" thick 6" wheel can also be made

SPECIFICATIONS: ADAPTERS AND RECOMMENDATIONS

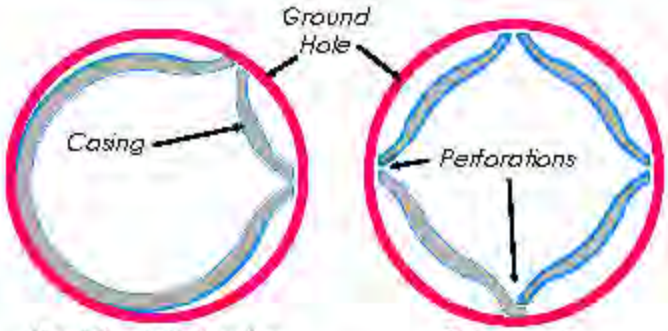
Roller and Slide Adapters

Perforators are sold with Adapters specific to the casing size. Adapters can be Slide or Roller style, Roller Adapters are unavailable for 4" Perforators. Roller Adapters are used for Casing sizes significantly larger than the Perforator For a 6" Perforator we recommend switching to a 10" roller if your rig has <35,000 lbs downforce.

Roller Adapter *Slide Adapter*

Perforation Recommendations

Perforate at the depths and for the length of Casing segment water is present. Hole size and number will vary with Cutting Wheel wear, if the standard or thin Cutting Wheel is used, Perforator size, Casing material & thickness, and perforation speed. Holes are approximately 1" long x 0.25" thick and spaced ~1.5" (25x6.35mm spaced 38mm). Perforation stretches the Casing slightly which can result in smaller holes in large diameter casings. Mild steel can be perforated at ~20ft/15 seconds (~105 holes; 6.1m/15secs). In overburden or dirt conditions, perforate columns around the entire Casing diameter. In hard rock, perforate only 1/3-1/2 of the Casing diameter. The Casing may dent outward and push the entire Casing to one side. When this occurs, the opposite side of the Casing will not perforate properly. Larger diameter pipe should have more columns of perforations (see previous page).



Hard Rock Perforation (No give for more perforations)

Dirt, Gravel, Overburden Perforation

Perforator in (mm)	Adapter in (mm)
4" (102)	No Adapter
	5" Slide (127)
	Custom Slides
6" (152)	No Adapter
	8" Slide (203)
	10" Slide (254)
	10" Roller (254)
	12" Roller (305)
	14" Roller (356)
	16" Roller (406)
	Custom Adapters
Large - 10" (254)	No Adapter
	10" Slide (254)
	12" Slide (305)
	12" Roller (305)
	14" Roller (356)
	16" Roller (406)
	18" Roller (457)
	20" Roller (508)
	22" Roller (559)
	24" Roller (610)
	Custom Adapter

Cutting Wheel	Casing Material & Thickness	Speed for 20' Section (6.1m)	Approximate Hole Size and Spacing (6" Perforator)
Steel*	Mild Steel 0.25-0.375" (6.35-9.5mm)	15 seconds; ~105 perforations	1X0.25"; spaced 1.5" (25x6.35; 35mm)
PVC	PVC Schedule 40 & 80	60 seconds; ~140 perforation	0.5X0.20"; spaced 1.6" (13x5.1; 41mm)

**The 4" Perforator makes holes ~20% thinner. The 10" Perforator makes holes ~50% thicker. The thin steel Wheel makes holes ~0.18" thick (5mm).*

OPERATION

Rig Connection

Connect the Perforator to the Drill String via the Perforator Top Sub threaded connection (regular API). The Perforator is activated by air delivered via the Top Head Drive (does not require oil).

Perforator in (mm)	Top Sub
4" (102)	2-7/8 API Regular
6" (152)	3-1/2 API Regular
Large-10" (254)	4-1/2 API Regular

Operation

Turn on Rig air, a minimum of 90 PSI (6.2bar) is required to extend the cutting wheel. Perform an above ground test to ensure the Perforator is functioning. The Cutter Wheel will extend when air is turned on. If possible, test perforation of Casing with an above ground segement. Turn off Air.

Lower the Perforator to the desired depth and turn on air (it will run on water too).

Once the cutting wheel is extended, the default setup is for perforation to occur as the drill string is pushed/lowered (see section on reversing Perforator direction for pullback operation).

As the Perforator is pushed down, the cutting wheel is further engaged by the casing and extends fully to the perforation stop to prevent over-perforation of standard thickness casing (0.375", 10mm).

Only the 6" Perforator uses stops; with no stop installed the wheel will extend the full travel of the perforation ramp. Full extension requires ~6" of travel down the casing (152mm). Partial perforations will occur until full extension, after which, full sized perforations will be created. Continue to lower the drill string until the desired length of casing has been perforated. Turn off air.

Return the string to the starting depth of the desired perforations. Rotate the drill string to where the next column of Perforations is needed (ensure air off!). Turn on air to extend the cutting wheel and lower the drill string to make another column of perforations (see table for Perforation recommendations).

Cutter Wheel Extension with Air

Full Cutter Wheel Extension

WARNING

Do not rotate the Drill String with the air on. The Cutting Wheel will be engaged to the Casing and rotation can damage the Wheel, Axle, Axle Pin, Bushing, and

OPERATION

Using Perforator Stops

Stops are installed by default on the 6" Perforator; the 4" and 10" Perforator do not use Stops. Stops must be removed for thin casing walls (< 1/4" thickness; 6.25mm). Stops limit the cutter wheel travel to minimize over-perforation. Stops are not adjustable.

Reversing Perforation Direction

The default Perforator setup when shipped is to perforate when pushing (downward). The Perforator may be setup to perforate when pulling the Perforator in the upward direction. This is essentially done by inverting the Perforator setup. Remove the Top Sub, remove the Pop-Off Valve and the Pop-Off Valve Bushing. Reassemble with the Top Sub where the Bushing was installed on the Lower Housing and the Pop-Off Valve and Bushing where the Top Sub was installed on the Perforator Body. Reinstall on the Rig with the Top Sub upward and the Perforator is now inverted and will perforate when pulling upward.

Crane/Hoist Operation

While not as easy to use as on a rig, some users have lowered Perforators with a winch (e.g., Pump Hoist Rig) and Perforated in pull-back mode.

Operation Under Water

Determine at what depth the water level is. Increase the air pressure to compensate for the water pressure due to depth. For every 1 ft increase the air pressure by 0.5 PSI. For each meter increase pressure by 0.11 Bar. For example, if perforating a section that will end at 20' under water (~6m), increase air pressure by 10 PSI (0.7bar), to a total of 100 PSI (7bar) before starting. Increase by 50 PSI (3.5bar), to a total of 140 PSI (9.7bar), before starting if perforating a 10' section (3m) that will end at 100' depth underwater (30m).

WARNING

Higher pressure is needed to perforate under water, ~0.5 PSI per foot or 0.11 Bar per meter.

WARNING

Over-perforation can result in too closely spaced holes that effectively slot the casing vertically, permitting intrusion of formations into the well.

Perforator setup for pull up operation

OPERATION: ADAPTERS

Installing Adapters

The Perforator Body has two slots that the Adapter slides into. The lower slot on each side has a bolt hole to mount the Adapter. The Large Perforator (10") uses four bolts.

While the Adapter can be mounted with the Perforator upright, it is easiest to lay the Perforator down lengthwise, with the Cutting Wheel fully retracted and facing down—such that the Adapter slots face upward.

Align the bolt holes on the Adapter and the Perforator Body. Slide the Adapter into the slots. Hand tighten the bolts with a wrench or ratchet.

The Adapter will be loose on the Perforator body. Once inside the Casing, pressure from the Casing wall will snug the Adapter to the Perforator Body.

Using the Adapter

Adapters are intended so the Perforator can be used with Casing sizes different than the Perforator diameter. While there is size overlap between Perforator sizes, it is still best to match the Perforator as closely as possible to the Casing (use the Large Perforator for big Casing)—see the chart on page 6 for options.

The force from the Rig is needed to insert the Adapter or Perforator into the Casing, to move it down the Casing, and to Perforate. Larger Casing diameters have a higher surface area, resulting in more friction, and needing more force. Roller Adapters require less force than Slide Adapters. Slide adapters work well with smaller diameter Casing because there is less surface area and less friction. If there is not enough force a Roller Adapter or more powerful Rig may be needed (approximately less than 35,000 lbs).

There are two sizes of Roller Wheels for Roller Adapters: 2.75" and 2.475" (70 and 63mm; outfitted at Holte depending on if Casing is sized by OD or ID). Smaller diameter Rollers can be tried if there is difficulty pushing the Perforator and Adapter down the Casing (User can unbolt and change Rollers). Ensure the Perforator is still snug. Smaller rollers may cause the Perforator to not be tight enough in the Casing, resulting in under-perforation.

Bolt holes for Large Perforator (two also on opposite side)

Adapter mounting bolt for 4" and 6" Perforator (second on opposite side)

Tip: *Add water to make the Adapter or Perforator slide more easily and to keep it cool. Add about a bucket per revolution.*

Perforator in (mm)	Bolt	qty	Wrench	Metric (mm)
4" (102)	1/2-13 Button	2	5/16" Hex	8
6" (152)	1/2-13	2	3/4" Open	19
Large- 10" (254)	5/8-11	4	15/16" Open	24

MAINTENANCE: CLEANING

The Perforator should be cleaned after each use and before storage to prevent damage and corrosion.

Rinse entire Perforator

Using fresh water, rinse the Perforator off. Remove the Cutting Wheel (see section on Replacing the Cutting Wheel page 13). Inspect the Cutting Wheel for wear and damage; replace if needed. With the Wheel removed, thoroughly rinse out the Yoke and where the Yoke connects to the Return Rod.

Thoroughly rinse Yoke with Wheel Removed

Dry the Yoke and Cutter Wheel Assembly parts. Regrease and reassemble the Bushing, Axle Pin, and Bolt (see section about replacing the Cutting Wheel on page 13).

Remove, inspect and regrease Cutting Wheel Assembly

Grease OD of Bushing

Use a bar and strap wrench, or two strap or chain wrenches, remove the Lower Housing with Pop-Off Valve and Bushing, then the Pop-Off Valve from the Lower Housing. Note that, depending on which part is more loose, the Valve may come off the Perforator before the Housing. The Bushing can be left attached to whichever part it comes off with.

MAINTENANCE: CLEANING

Rinse out the inside of the Lower Housing. Rinse out the inside of the Pop-Off Valve or replace it if needed. There are three holes in the Pop-Off Valve with a ball-bearing seated in the middle. Rinse each hole and around the bearing thoroughly.

Thoroughly rinse, dry, and WD-40

Rinse the Yoke Return Rod, Spring and inside the Piston Cylinder.

Dry the parts and spray all surfaces with a rust preventative like WD-40. Clean and spray inside the Lower Housing, the Yoke Return Rod and Spring, the Piston Cylinder and inside the Piston Cylinder, the Pop-Off Valve holes and bearing.

Put Anti-Seize on the threads of the Pop-Off Valve, Bushing, and Lower Housing. Reassemble the parts. Thread the Lower Housing into the Perforator by hand, ensure the Bushing is threaded between the Valve and Housing. Thread the Pop-Off Valve in by hand.

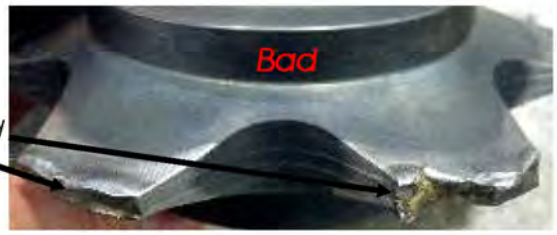
Tighten the Valve, Bushing, and Lower Housing into the Perforator using a bar and strap wrench, or two strap or chain wrenches.

Storage

Ensure the Perforator has been cleaned, is dry, and has been relubricated. Store in a relatively clean and dry environment.

MAINTENANCE: REPLACING CUTTING WHEEL

Clean the Perforator before replacing the Cutting Wheel (see section on Cleaning).



After use, inspect the Cutting Wheel for wear. When the edges of the Wheel become dull or pitted, the Wheel should be replaced.

Loosen the Axle Pin Bolt and remove it.

Slide the Cutter Wheel Assembly out of the Yoke. Pull out the Axle Pin. Remove the Wheel and Bushing (4" Perforator does not have a Bushing).

MAINTENANCE: REPLACING CUTTING WHEEL

Clean the Axle Pin and Bolt.

Clean and regrease the Cutting Wheel Bushing and insert in the Cutting Wheel. Insert the Cutting Wheel (with Bushing) into the Perforator Body Slot.

Grease OD of Bushing

Move the Wheel out of the Yoke if needed. Grease 1/4 of the Axle Pin body.

Insert greased end of the Axle Pin into the Perforator Body Slot and through the Cutting Wheel Bushing.

Move the Wheel into the Yoke.

MAINTENANCE: REPLACING CUTTING WHEEL

Put anti-seize on the threads of the Axle Pin Bolt and grease ½ of the bolt body.

Insert the Axle Pin Bolt through the non-threaded bolt hole on the Yoke, and through the center of the Axle Pin.

Thread the Axle Pin Bolt into the threaded bolt hole on the otherside of the Yoke.

Hand tighten; the head of the bolt will be recessed into the Yoke when tightened.

MAINTENANCE: REBUILDING THE POP-OFF VALVE

The Pop-Off Valve may need replacement if it becomes corroded, damaged, or full of debris that will not rinse out. This will be apparent if air pressure to the Perforator does not build, if the Cutting Wheel does not extend in an above ground test, or by visual inspection.

The entire Pop-Off Valve can be replaced. This should be done if the threads or the holes in the Pop-Off Valve are damaged. In other cases, the Valve can be rebuilt. Holte can rebuild the valve or it can be done by the User.

Special fixturing and tooling may need to be devised by the User to rebuild the valve. Remove the Pop-Off Valve from the Perforator. Support the Valve body (shown using a vise and C-clamp). Using a pin-punch, tap out the pin at the hex end of the Valve. This may be easier if an insert with a slot in the center (1.1" Diameter by ~0.75" long; 28 x 19 mm) or an equivalent tool is used that will retain the spring force while allowing the pin to be removed.

Using the parts in the Pop-Off Valve rebuild kit (PN 26006-0011), drop the ball bearing in the hole on the hex end into the center of the Valve. Follow with a washer, the spring, and another washer.

Fixture the Valve to support the body and to permit pushing the washer-spring assembly down below the point of pin insertion.

Tap the pin into place. One side will be flush with the hex flat while the other will be slightly recessed.

Compress Spring

Punch out Roll Pin

MAINTENANCE: REBUILDING THE YOKE RETURN ROD

With use or infrequent cleaning, the Yoke Return Rod Spring and Rod may become corroded and the Spring will lose force. If the Cutting Wheel does not fully retract when air is removed in an above ground test, or if there is severe visual corrosion of the parts, the spring, washers, and potentially the Return Rod should be replaced.

Assemble the new Yoke Return Rod Assembly by sliding a washer, the spring (single spring for 4" and 6" Perforator, long then short spring for Large Perforator), then another washer onto the Return Rod.

Coat the Rod threads with anti-seize.

Insert the threaded end of the Rod through the center of the Piston Cylinder and Piston and into the Perforator Body.

Insert the Stop Tube through the Perforator Body Slot and over the Return Rod.

MAINTENANCE: REBUILDING THE YOKE RETURN ROD

Bring the Yoke with the Cutting Wheel close to the Piston Cylinder end of the Perforator Body and thread the Return Rod into the threaded hole on the bottom center of the Yoke.

Threaded Hole

The spring will require some compression for the threads to reach the Yoke. Tighten the Return Rod using a wrench till hand tight.

Reassembled Yoke Return Rod with Spring slightly compressed.

Closeup of fully threaded Yoke Return Rod into Yoke, with Cutting Wheel in fully retracted position.

NON-ROUTINE MAINTENANCE

Many Perforators have been in use for several decades. Over such a long life, non-routine replacements may be needed such as the Piston, Piston Cylinder, Lower Housing, and Perforator Body.

Changing/Replacing the Top Sub

Over long use the Top Sub threads may wear, requiring replacement of the Sub. In other cases, a different thread may be needed to use the Perforator with another Rig. The Top Sub has four flats to allow removal with either an adjustable wrench, strap, or chain wrench and a pry-bar inserted in the body slot.

Ensure the threads inside the Body are clean. Anti-seize the threads of the new Sub. Hand thread the new sub in then tighten with wrenches.

Replacing the Lower Housing or Body

It is rare for the Body or Lower Housing to need replacement. Refer to previous sections of the manual to remove and clean all parts. Reassemble parts onto the new Body or Lower Housing, using strap or chain wrenches.

Replacing the Piston and Cylinder

Ensure Perforator parts have been cleaned.

Insert the Piston in the Cylinder.

Anti-seize coat the threads of the two Piston Retaining Bolts. Screw one bolt in a couple of threads deep.

Seat the Cylinder by angling the bolt retention slot under the bolt head then pressing it flush against the Perforator body.

Install the second bolt. Hand tighten, then use a rachet to tighten an additional 1/4 turn.