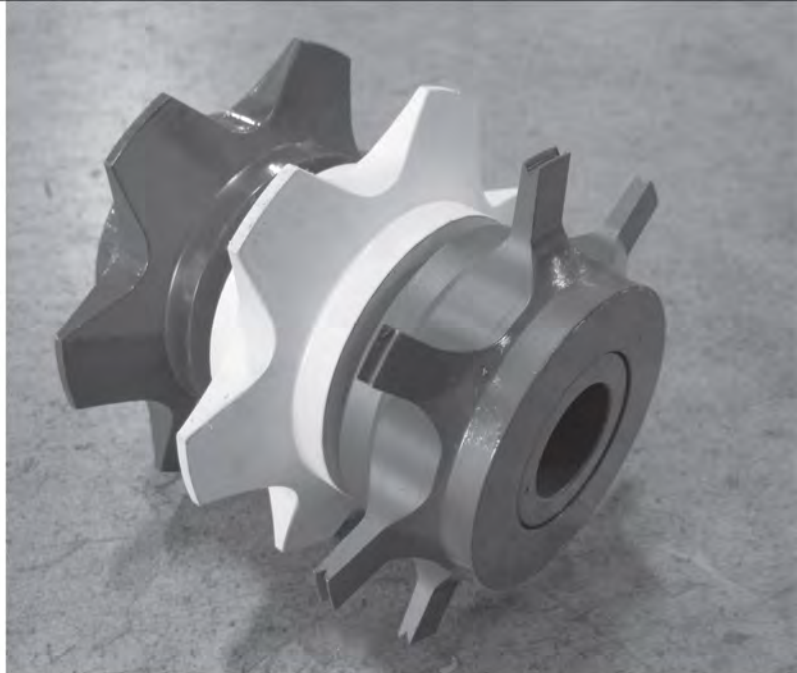


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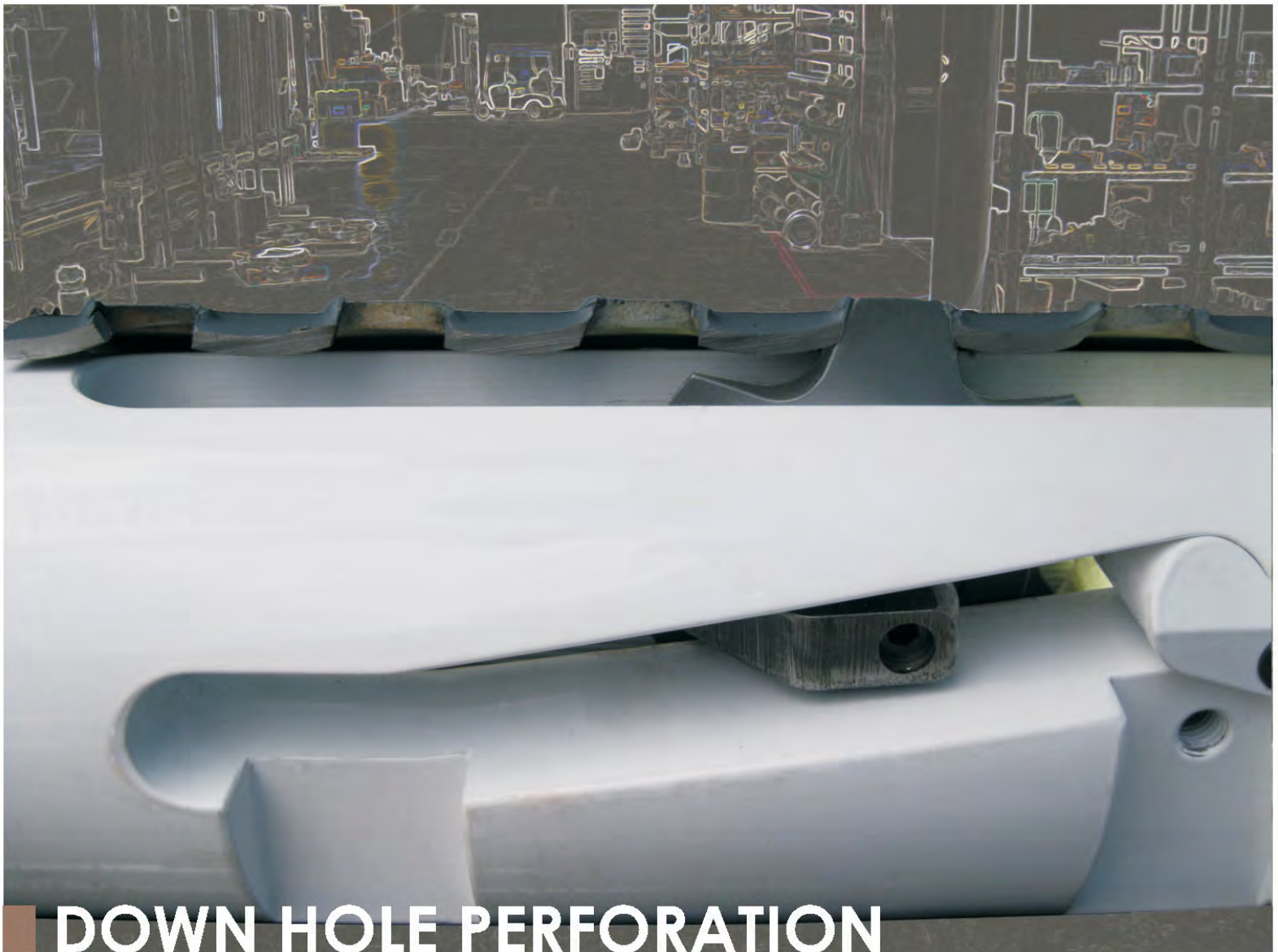


▪ PERFORATORS



Down Hole Perforation Features and Options

- Perforator Cutting Wheels
- Perforator Slide and Roller Adapters



DOWN HOLE PERFORATION

Save time with rapid underground perforation

- ▶ Ideal for perforating wells for abandonment
- ▶ Get more water out of old Wells
- ▶ The easiest way to get perforations where the water is
- ▶ Pre-slotted Casing costs more, loses air/efficiency during drilling, and can clog while drilling
- ▶ Saves time compared to torch/cutter perforation by hand
- ▶ Rapid perforation—105 holes in a 20 foot section made in 15 seconds
- ▶ Perforate going up or down the Casing and control the angle of the perforation column
- ▶ One tool can take adapters for many Casing sizes
- ▶ Durable tooling, which lasts for years, more than pays for itself (many 25-40 yr old tools in the field)



FEATURES AND OPTIONS

Exploded Perforator Model



Designed for use with Rotary Drills, the Perforator threads onto a standard Drill String. Either through knowledge of water depth, or watching the cuttings for tell-tale signs like water, gravel, or sand, the Perforator can be lowered to the exact depth of the aquifer.

Applying a small amount of air pressure (90 PSI, any CFM) the Perforator Cutting Wheel extends and bites into the Casing wall. As the Rig pushes the Perforator down the Casing pulls the Cutter out fully (after ~6" of travel) and the Perforator starts punching holes in the casing that are about 1" long, 0.25" wide, and spaced about 1.5" apart.

After quickly perforating a column, the Drill String is returned to the starting location, air is turned off to retract the Cutter, then the String is rotated to start the next column of perforations. Good practice is to put a column in about every 4-5 inches around the Casing diameter—about 4 or 5 columns for 6" Casing.

- ▶ 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 easily under water

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



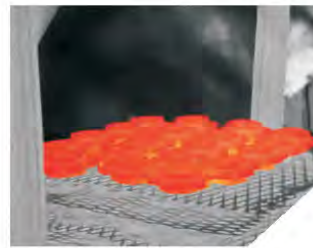
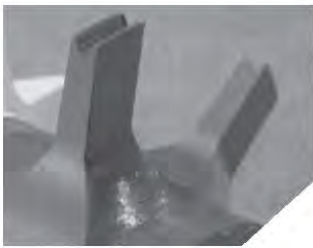
PERFORATOR CUTTING WHEELS

The Cutting Wheel is what makes Perforators so convenient. As it rotates down the Casing each tooth punches a hole about 1" X 0.25", resulting in a straight column of perforations. Cutting Wheels are heat-treated and carburized to ensure durability.

The Rig applies the force required for the Wheel to puncture the Casing and a thinner blade Wheel is available for Rigs with less pull down or if easier and smaller perforations are desired.

Perforators also work on PVC with a special Cutting Wheel designed to puncture PVC using a fine tooth and a slower perforation rate.

An old, unperforated, well was putting out about 9 GPM and the owners wanted more water. Perforating a 10' section at the bottom of the well brought the well up to 40 GPM! Perforation increased the collection area of the 6" casing from 28in² to 80in². Because perforation spreads out the well's collection area, it also can help speed up recharge. Putting in the 4 columns of holes took the Driller about 5 min.

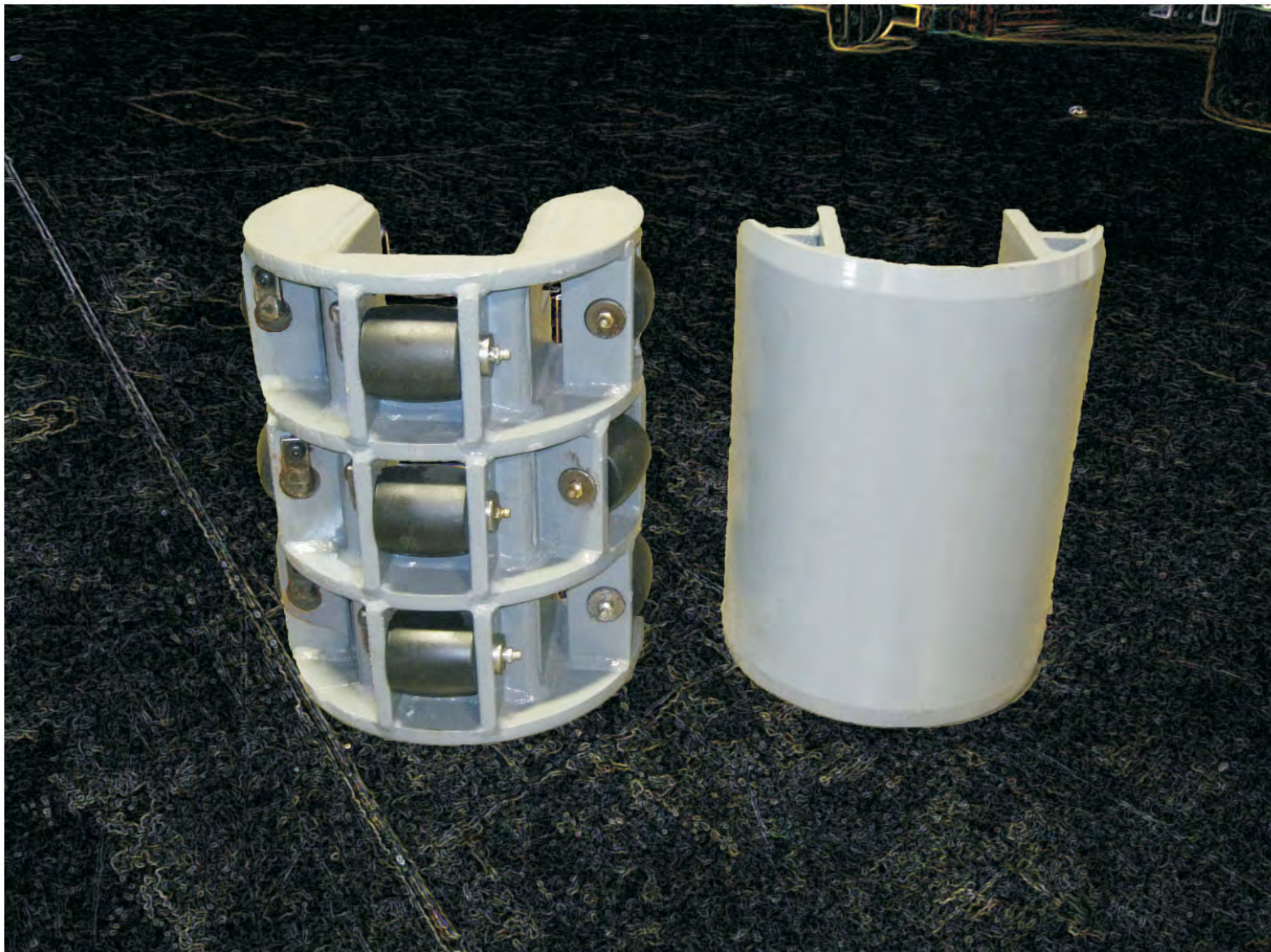


CUTTING WHEEL RECOMMENDATIONS*

Cutting Wheel	Casing Material & Thickness	Speed for 20' Section [6.1m]	Approximate Hole Size & Spacing
Steel (Std.)	Mild Steel 0.25"-0.375" [6.35-9.5mm]	15 seconds; ~105 holes	1" X 0.25"; Spaced 1.5" [25X6.35; 38mm]
PVC	PVC Schedule 40 & 80	60 seconds; ~140 holes	0.5" X 0.20"; Spaced 1.6" [13X5.1; 41mm]
Steel (Thin)	Mild Steel 0.25"-0.375" [6.35-9.5mm]	15 seconds; ~105 holes	1" X 0.18"; Spaced 1.5" [25X5.0; 38mm]

*Speed is recommended, faster or slower is possible. Some user's have perforated 0.5" thick casing but it is not guaranteed; very hard material, such as drill pipe (esp. N80 Rj55) generally will not perforate. Hole size, number, and spacing will vary with cutter wear, material of casing, thickness of casing, speed, and size of perforator (4", 6", 10"; 4" ~20% thinner; 10" ~50% thicker). Uniformity of holes may vary down the column due to formation and material inconsistencies. The thin steel cutting wheel is only available for the 6" perforator; it is used for thinner holes, requires less force to punch holes, and can be used on smaller Rigs (<50,000lbs pulldown). Cutter wheels wear with use and need replacement.

A Driller putting in a Well at a State Park was told he'd hit a gravel layer. After drilling 200' there was no gravel and no water. He decided to use a Perforator and put 4 perforation columns in a 10' section at 80' deep where he'd seen black sand in the cuttings. After blowing the perforated well for a bit his well started putting out 40 GPM!



PERFORATOR SLIDE AND ROLLER ADAPTERS

Adapters for most Casing diameters

Perforators can work with Casings from 4" to 24". Custom Adapters can be provided for odd sizes, special jobs, and for sizes even bigger than 24".

Smaller diameter pipe provides less friction for perforating with Slide Adapters. Roller Adapters reduce the force needed by about 25% so perforation can be done with smaller Rigs and Rollers work best for larger diameter pipes.

Roller Adapters can come with two different sizes of Rollers (for Casing diameters specified as OD or ID). Rollers for most Adapters can also be changed if there is not enough force to push the Perforator down the Casing.

The Large (10") Perforator comes standard with a 10" Slide Adapter while the 4" and 6" Perforators can be used on matched Casing without any Adapter.

Adapters attach quickly with two bolts—once inside the Well the Casing snugs the Adapter to the Perforator.



ADAPTER SOLUTION COMBINATIONS



4" [102mm]	6" [152mm]	10" [254mm]
No Adapter	No Adapter	10" Slide [254]
5" Slide [127]	10" Slide [254]	12" Slide [305]
Custom Slides	10" Roller [254]	12" Roller [305]
	12" Roller [305]	12" Roller [305]
	14" Roller [356]	14" Roller [356]
	16" Roller [406]	16" Roller [406]
	Custom Adapters	18" Roller [457]
		20" Roller [508]
		22" Roller [559]
		24" Roller [610]
		Custom Adapters

A Driller perforating wells for abandonment hit some casing that made the setup push his Rig off the ground when he was perforating. He called and decided to try setting the Perforator up for pull-back operation. He was able to keep his Rig on the ground and get the job done .