

# Powder-Actuated Tools

Available as single-shot, semiautomatic or full automatic, these low-velocity tools are the ones carpenters choose when driving fasteners into concrete or steel

BY BRUCE GREENLAW

**T**he crackling of small-arms fire and the smell of gunpowder are something that many people might expect at the local firing range, not on the job site. But if you're a carpenter, you know that shooting fasteners into concrete goes much faster than just hammering them in by brute force.

Powder-actuated tools, also known as PATs, were first developed in the early 1920s by British marine engineer Robert Temple. Resembling a firearm, the gunpowder-driven Temple Driver tacked temporary steel patches to leaky ships. But it wasn't until the late 1940s that PATs (often called "stud guns") were unveiled to the construction industry. Turns out few building trades could resist a tool that pops a fastener into concrete or steel at the squeeze of a trigger.

Carpenters have found PATs indispensable for installing drywall track and suspended-ceiling grids; nailing sill plates, plywood subflooring and commercial door jambs to concrete slabs; anchoring braces for concrete forms and tilt-up walls; hanging the rigid-foam insulation that forms the core of exterior insulation and finish systems (EIFS); and plenty of other tasks.

Electrical contractors also use PATs to mount boxes and conduit. Mechanical contractors use them to hang ductwork and fire-protection sprinkler systems. Roofers use them for securing rubber roof membranes, and steel erectors depend on them for installing decking, grating and more.

Here's a look at PATs, fasteners and powder loads, plus a thumbnail review of the most popular PATs used by carpenters. The sidebar (p. 114) tells where to find more information on the safe, efficient use of PATs.

## PAT anatomy

Powder-actuated tools are trigger- or impact-activated and detonate gunpowder-packed loads to



**Working with steel and concrete is easier with powder-actuated tools.** Modern PATs are quieter and faster, with semiautomatic and fully automatic functions that allow nearly nonstop firing.

drive fasteners into concrete or steel. To help prevent accidental discharge, the tools fire only when their spring-loaded muzzles are fully compressed against a hard surface.

Early PATs were direct-acting, high-velocity tools, which meant that the gunpowder's explosive force acted directly on fasteners to propel them at high average test velocities of more than 492 ft. per sec. High-speed fasteners that happened to pass

entirely through a substrate or that ricocheted could be hazardous or even lethal to operators or bystanders.

On the other hand, almost all modern PATs are indirect-acting low-velocity tools. They add a piston between the load and the fastener (drawing facing page). The piston delivers a powerful blow to the fastener head while reducing the ultimate fastener speed to a much safer average test velocity of less than 328 ft. per sec.—sufficient for fastening into most concrete and structural steel.

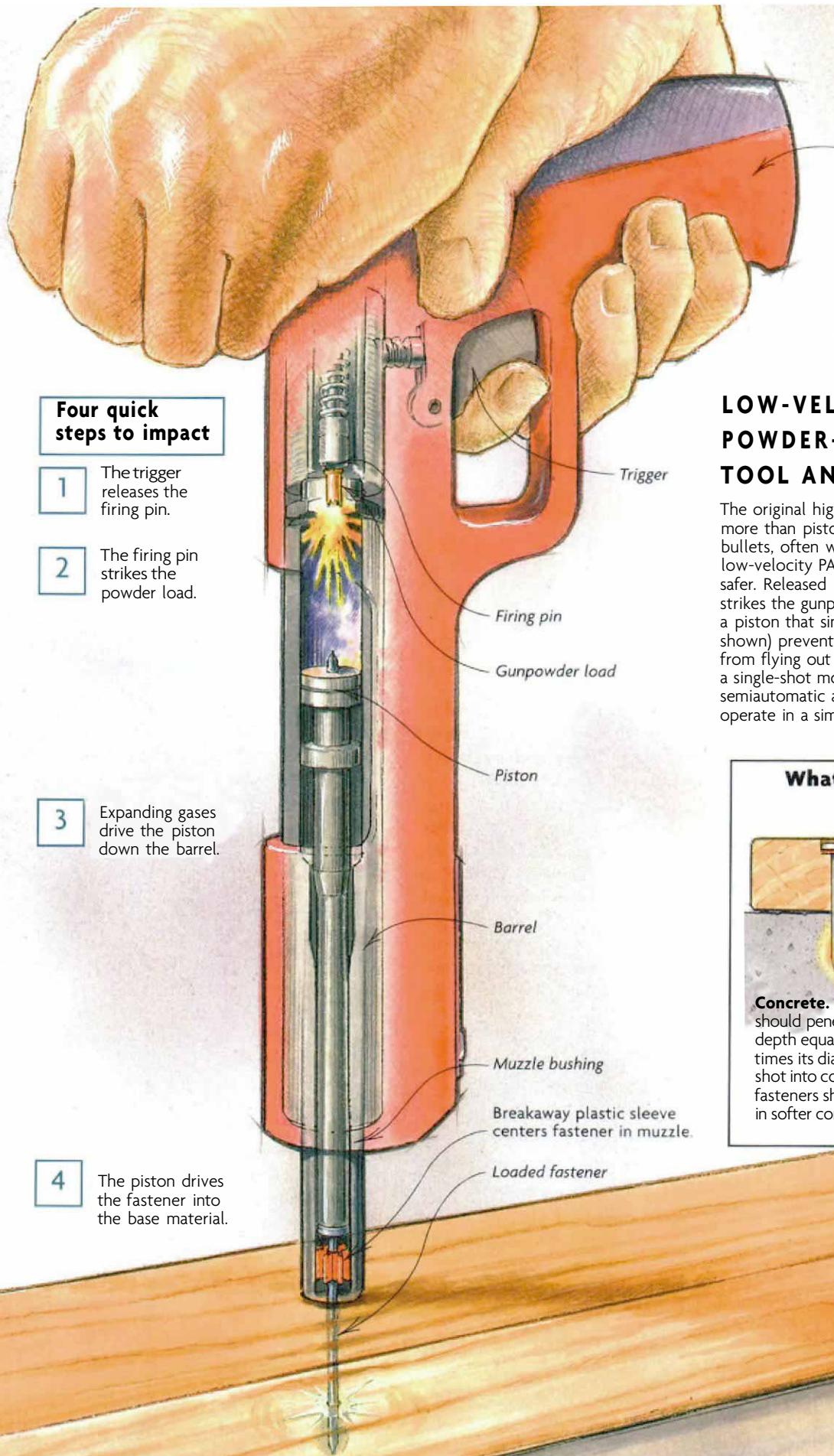
Contemporary PATs come in three basic types. Single-shot models hold one fastener and one powder load (with the load inserted last to minimize the chance of accidental discharge). Semiautomatics typically hold one fastener and ten loads assembled in a plastic strip or disk and must be cocked manually after each shot. Automatics also typically hold one fastener and a ten-shot strip or disk, but they cock automatically.

Some Hilti semiautomatics and all Hilti automatics accept an optional magazine that holds ten collated fasteners to eliminate the need to handle single fasteners (more on specific models later).

## Powder loads are gauged for power

Powder loads traditionally came in 12 color-coded power levels for driving fasteners into various substrates, but nowadays, they typically come in just six colors: Power-level #1 loads have gray-colored tips, while #2 loads are brown, #3 are green, #4 yellow, #5 red and #6 purple. The higher the number, the greater the driving power.

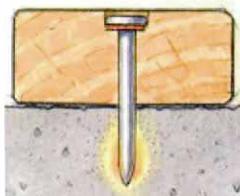
The textbook method for choosing the best power level for a job is to make a test-fastening



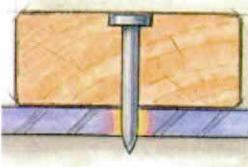
## LOW-VELOCITY POWDER-ACTUATED TOOL ANATOMY

The original high-velocity tools were nothing more than pistols that shot nails instead of bullets, often with disastrous results. Modern low-velocity PATs make the entire process much safer. Released by the trigger, the firing pin strikes the gunpowder load, which in turn drives a piston that sinks the fastener. Spall guards (not shown) prevent fragments of concrete or metal from flying out during operation. Shown here as a single-shot model, PATs are also available in semiautomatic and fully automatic models that operate in a similar fashion with collated loads.

### What length fastener to use?



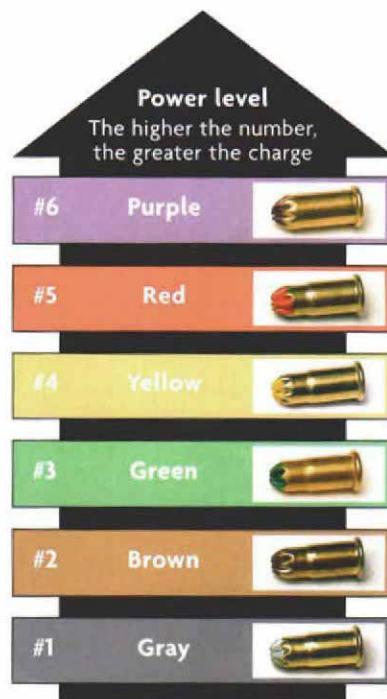
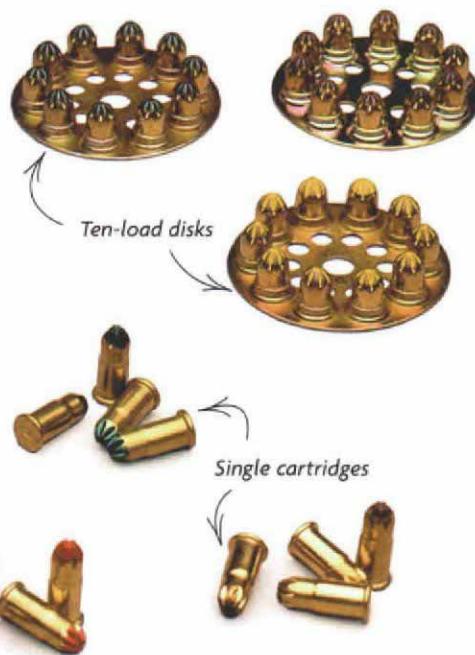
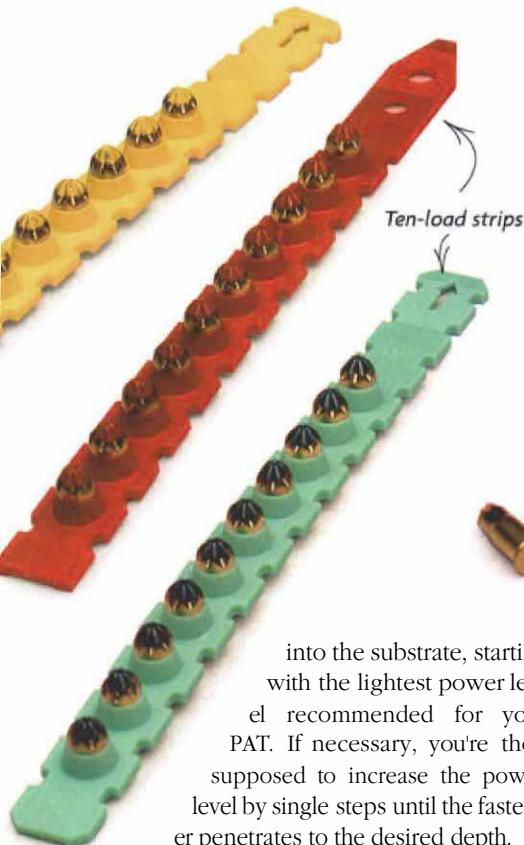
**Concrete.** The fastener should penetrate to a depth equal to 7 to 8 times its diameter when shot into concrete. Long fasteners should be used in softer concrete.



**Steel.** It's important that the fastener point penetrate the steel. For effective adhesion, the fastener diameter should not exceed the thickness of the steel.

## DIFFERENT-COLORED POWDER LOADS IN STRIPS, DISKS OR SINGLES

Powder loads are available as single cartridges, in collated strips or as ten-load disks, and are numbered and color-coded to indicate their power levels.



into the substrate, starting with the lightest power level recommended for your PAT. If necessary, you're then supposed to increase the power level by single steps until the fastener penetrates to the desired depth.

In the real world, most contractors supply the power level commonly used for the application. Depending on the PAT used and the hardness of the substrate, browns, greens, yellows or reds are normally used for concrete, while yellows, reds or purples are normally used for steel.

Loads are also classified by caliber, which indicates the casing's diameter in inches (a 0.22-caliber load has a diameter of 0.22 in.). The range of calibers reflects the manufacturers' desire to make loads that will fit only their PATs; within the readily available sizes (0.22, 0.25, 0.27) of a similar power level, the caliber itself has little effect on power.

### Choosing fasteners

Although there are a wide variety of PAT fasteners available (photo pp. 114-115), there are two basic types: drive pins and threaded studs. Both are hardened to withstand high-speed driving into construction materials. Drive pins resemble nails and are used for permanent fastening. Threaded studs are used for securing removable hardware and consist of pointed shanks driven into substrates, and threaded tops to which

objects can be attached with a nut. Both types of fasteners have breakaway plastic sleeves that center the fasteners in the tool muzzle and steer them into the work.

Drywallers normally use  $\frac{3}{4}$ -in. or  $\frac{7}{8}$ -in. pins for anchoring drywall track to concrete, and  $\frac{1}{2}$ -in. or  $\frac{7}{16}$ -in. pins for anchoring it to steel. Acoustical pros shoot special clips into overhead concrete and steel for tying off ceiling grids with hanger wire (Hilti offers pre-installed hanger wires). Stick-framers use  $2\frac{7}{8}$ -in. or 3-in. pins with factory-mounted washers for fastening sill plates to concrete.

### PAT pricing

**In many instances, if you're looking to buy a PAT, a distributor will include it for no additional cost as part of a larger package of fasteners and loads. Like most bulk building supplies, PAT loads and fasteners are sold by the box or by the crate. Distributors will often give substantial discounts for orders in excess of 1,000 units; the more you buy, the larger the discount becomes. However, there are no set rules, so call local distributors to find out what they will offer. Prices mentioned in the article are manufacturers' suggested retail.**

—B. G.

For bracing concrete forms in multiple pours, Hilti makes form nails that can be broken off flush with the surface of concrete after the forms are removed. And you also can buy special pins with big premounted plastic washers for installing EIFS insulation board onto concrete, a job that occasionally falls to lathers and drywallers.

### The center-punch test

When PAT fasteners are driven into concrete, the resulting heat and pressure cause the shanks to bond with the concrete. Spalling (surface flaking of concrete) can form a small crater around the fastener head, but it rarely affects the bond. When fastening to steel, the steel fuses to and clamps the fastener to achieve terrific holding power.

PATs also work well for fastening to hollow-concrete-block or brick structures, provided you fasten only to horizontal mortar joints. Fastening to hollow block isn't recommended because it can blow out a crater, leaving little material to grip the fastener.

If you doubt the feasibility of fastening to a particular substrate, try the center-punch test recommended by the Powder Actuated Tool Manufacturers' Institute (636-947-6610). Simply rest the point of an appropriate fastener on the base material or on a sample of the material, and strike the fastener head with a suitable hammer.

If the fastener point makes a clear impression in the material without blunting, then

## FROM THE SIMPLE TO THE COMPLEX



**Single-shot models are inexpensive and reliable.** Popular with carpenters who don't need a production tool, single-shot PATs are mechanically simple and easy to clean.



**Popular semiautomatics improve production.** Unlike single-shot models, semiautomatics use collated loads and advance a fresh load for each shot.



**Automatic PATs don't require a reset.** Unlike other models that must be cocked after every shot, automatics can be fired at a much faster rate.

### Sources of PATs

Desa (Remington)  
(800) 626-2237\*  
[www.de5aint.com/  
remington.html](http://www.de5aint.com/remington.html)

Hilti  
(800) 879-8000  
[www.hilti.com](http://www.hilti.com)

ITW Ramset  
(800) 348-3231\*  
[www.ramset-redhead.com](http://www.ramset-redhead.com)

MKT (Uniset)  
(800) 336-1640\*

Masterset  
(317) 591-5900\*  
[www.masterset.com](http://www.masterset.com)

Powers Rawl  
(800) 659-1069\*  
[www.rawlplug.com](http://www.rawlplug.com)

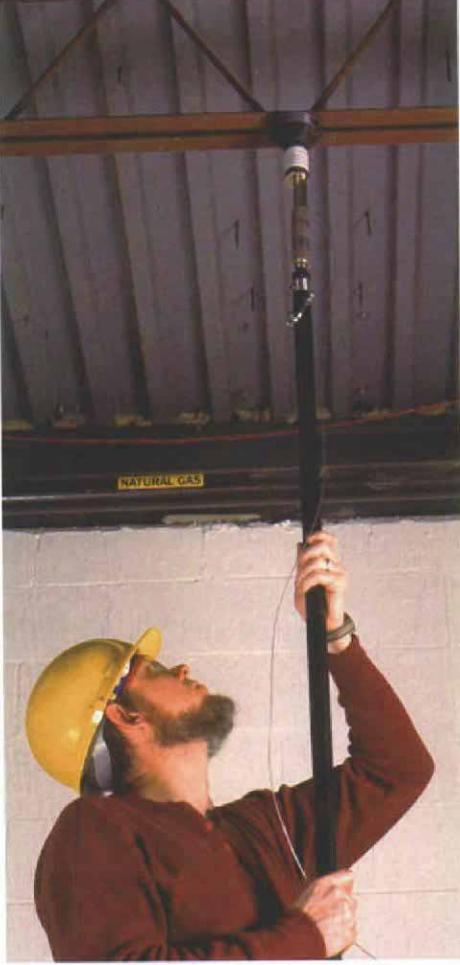
\*Sold through distributors only,



**Adjustment can vary the amount of power.** Hilti's semiautomatic DX 36M features a dial that adjusts the driving power of a particular load for maximum versatility.



**Load a clip.** Hilti makes a magazine for its automatic tools that fits onto the tools' muzzle and eliminates the need to load a fastener for every shot.



**No more climbing on ladders.** ITW Ramset's single-shot L1600 LADD tool shoots preassembled pin-and-clip assemblies into concrete or steel for tying off suspended-ceiling grids.

the material is probably okay (provided it's thick enough to withstand impact and grip the fastener), and you can proceed with a test-fastening. If the point blunts, the material is too hard; if the material cracks or shatters, it's too brittle; if the fastener sinks into it, it's too soft. Use the same test to determine if an object is too hard or brittle to fasten to a substrate. Always wear safety glasses when performing these tests.

### Shopping for PATs

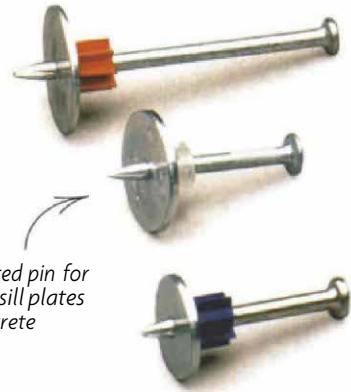
Several companies make high-quality PATs (sidebar p. 113), but Hilti and ITW Ramset seem to carry the most weight in the market.

For installing drywall track, Hilti's DX 35, DX 350 and DX 36M, as well as ITW Ramset's D45 (photo center left, p. 113), are the current favorites. The DX 35 (\$480, see sidebar p. 112) is a 0.25-caliber semiautomatic that holds ten-load strips and drives pins up to 1½ in. long. The 0.27-caliber semiautomatic DX 350 (\$730) also holds ten-load strips but drives fasteners up to 2⅓ in. long for greater versatility. Instructor Jim Vodicka of the United Brotherhood of Carpenters (UBC) Chicago and Northeast Illinois District Council of Carpenters tells me that Hilti once discontinued the DX 350 but brought it back by popular demand.

Hilti's DX 36M (\$735) resembles the DX 350 but adds a dial (photo top right, p. 113) that permits you to decrease the driving power of a load by venting some of the com-

### FASTENER TYPES

**PAT fasteners come in as many variations as there are jobs but can be classified in two basic groups: pins and threaded studs. Collated fasteners are used in automatic magazines.**



Washered pin for nailing sill plates to concrete

bustion gases. Roger Landrum, a hardwood-flooring instructor at the UBC Floor Layers' Training Center in St. Louis, tells me that one flooring company he once worked for uses the DX 36M for shooting subflooring or flooring sleepers to concrete slabs.

The 0.25-caliber semiautomatic ITW Ramset D45 (\$480) installs pins up to 2½ in.

## Safety is a must

**Remember Murphy's Law, which states "If anything can go wrong, it will?" It's dangerous enough to work with saws, knives, routers and hammers without adding guns to the mix, but PATs are, for all intents and purposes, handguns that shoot nails instead of bullets. Flying concrete shrapnel, ricochetting fasteners and accidental firings are all good reasons why OSHA requires all operators of PATs to be trained and licensed by the manufacturer or by an authorized instructor. In fact, separate training and licensing are required for**



each model you operate. Fortunately, all

**PAT distributors have authorized instructors; it's in their best interest to make sure no one gets hurt. Given at the store, training sessions last a couple of hours, and all candidates are required to pass a written test to receive their license. To train a large number of operators, the instructors will travel to the job site.**

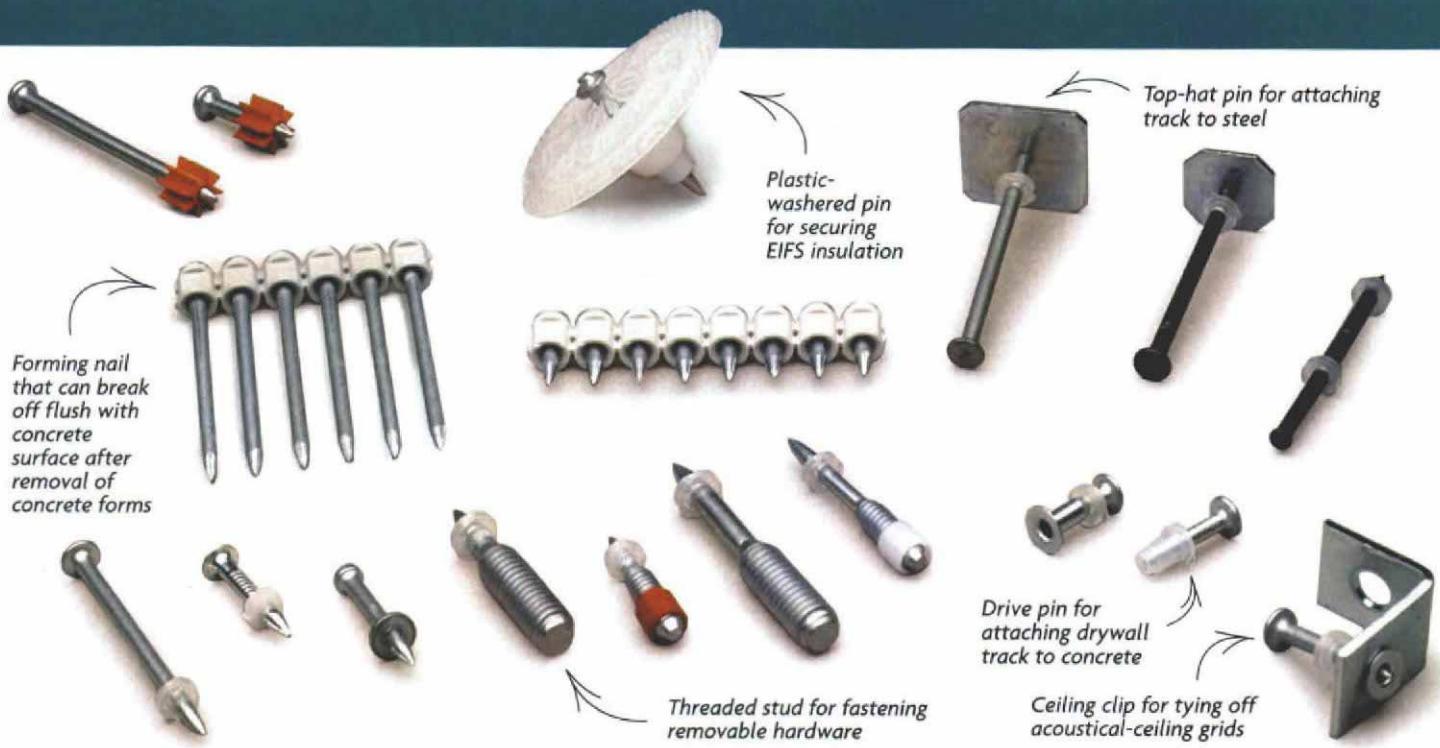
**More information on the safe, efficient use of PATs is close at hand. The Powder Actuated Tool Manufacturers' Institute (PATMI) publishes "Powder Actuated Fastening Systems Basic Training Manual," along with a video called "Understanding Powder Actuated Fastening Systems." The booklet is somewhat dated, but it gives excellent fastening pointers complete with charts and drawings and costs \$2.50 plus shipping. The video gives an informative overview of PAT operation, and costs \$10 plus shipping. Call PATMI at (636) 947-6610, or check out their**

**Web site at [www.tek-efx.com/patmi](http://www.tek-efx.com/patmi).**

**PAT manufacturers also supply training materials on request and include a handy operator's manual, fastener chart and load chart with each tool. And don't overlook product catalogs. I especially like ITW Ramset's full-line catalog, which makes it easy to match the models to the applications and also includes guidelines for effective fastening.**

**By the way, you should always wear safety glasses and use hearing protection when operating PATs.**

—B.G.



long and holds the company's patented ten-shot disks. Unlike strip-load models, which advance to the next load when they're cocked, disk-load models advance only when you pull the trigger. ITW Ramset product manager Nolan Day estimates that unnecessary cocking of semiautomatic strip-load tools wastes 15% to 20% of the loads.

Like many single-shot models (photo top left, p. 113), ITW Ramset's economical 0.22-caliber 721 (\$394) has been around for about 30 years, and it's still popular with drywallers. It's an easy-to-clean workhorse that drives pins up to 1½ in. long.

A number of PATs mount to extension poles for fastening suspended-ceiling clips without the need to climb a ladder or scaffold. But Chicago's Jim Vodicka and assistant to the coordinator Paul Sonner of the UBC's Southern Nevada Regional Training Center tell me that many carpenters prefer ITW Ramset's pole-mounted 0.22-caliber single-shot L1600 LADD (\$313) overhead fastening system (photo facing page).

The LADD is the only remaining direct-acting construction PAT on the market that I know of. You simply load a cartridge and a clip into the cupped end of the tool and then fire by bumping it against the ceiling. The speedy tool requires minimal maintenance.

Installing 2x4 sill plates? Many carpenters use Hilti's semiautomatic DX 350, but the company's automatic DX A41 (\$775) (photo bottom left, p. 113) holds ten-shot strips, installs fasteners up to 2⅞ in. long and fea-

tures a power-regulating dial for maximum flexibility. The tool also accepts an optional magazine (photo bottom right, p. 113) that holds ten collated pins for speedier delivery, but the magazine doesn't accept the washed pins required for installing sill plates.

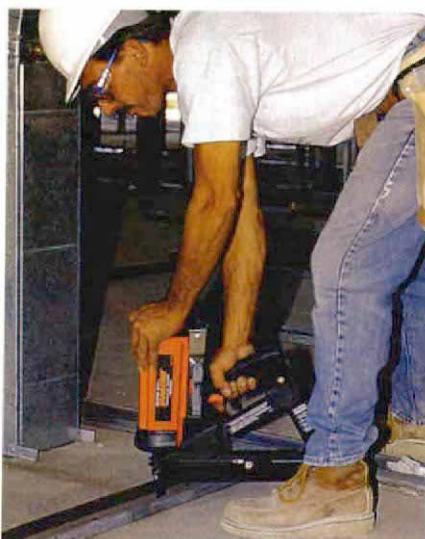
ITW Ramset's exciting new automatic AutoFast (\$529), which drives fasteners up

to 3 in. long, is designed to compete with the DX A41. The disk-load AutoFast weighs about 1½ lb. less than the DX A41 and, according to ITW Ramset, generates up to 37% less recoil shock to help fight operator fatigue. It's also supposed to clean easily and be quiet enough to fire in occupied buildings during business hours without sending people diving under their desks. Both tools also can be used to install drywall track, subflooring and other materials.

I also can't resist mentioning ITW Ramset's TrakFast tool (photo left). It's not a PAT, but many drywallers now use it instead of PATs for installing drywall track. The tool also can fasten metal lath to concrete or even to hollow concrete block.

Patterned after ITW Paslode's cordless nailers, the TrakFast (\$999) is powered by a rechargeable battery that can drive about 3,000 rounds per charge, plus a disposable gas cylinder that fires about 1,200 rounds. The clean-burning tool holds up to 42 pins ranging up to 1½ in. long and installs track up to five times faster than PATs while eliminating recoil. No operator's license is required. The downside? The tool is bulkier than equivalent PATs and, at 9¼ lb., can weigh nearly twice as much.

### GAS-POWERED TOOL DRIVES PINS FASTER THAN PATS



**Powered by a rechargeable battery and a disposable gas cylinder, ITW Ramset's TrakFast tool is becoming a popular alternative to PATs because of its speed and reduced recoil.**

Bruce Greenlaw is a free-lance writer in Taylorsville, CA. This article originally appeared in the January/February 2000 issue of *Carpenter*, the magazine of the United Brotherhood of Carpenters. Photos by Charles Bickford, except where noted.