The New Generation of 12-Volt Cordless Drills

They offer better balance, more power and longer battery life

by Gary M. Katz

I'm not that old, but I have been around longer than cordless drills. Before nicad batteries, I had a Yankee push drill to simplify the tasks of drilling holes and driving screws, and I still have the scar on my left thumb from the time the push drill slipped off the screw head. I bought my first cordless drill in 1983, a 7.6v tool that could drive only 20 or 30 screws on a single charge. Nonetheless, it was a pleasure to install finish hardware so easily and so quickly.

When the 9.6v systems appeared, I upgraded reluctantly. The new tools seemed awkward and heavy, but I soon accepted those handicaps because battery technology had improved and because my spare had almost enough time to recharge before the battery in my drill got tired from too many hinge screws. Then my drill was stolen, and I bought a more powerful 12v drill. I should've shopped more carefully because I discovered that there are about a dozen companies making cordless drills up to 18v.

Pistol grip or midhandle grip?—Until recently, the familiar pistol grip was the only handle style available for cordless drills, and it's still offered by most manufacturers. However, lots of companies have shifted their production toward midhandle, or T-handle, drills (photo above). Because the new higher-voltage cordless drills weigh more than their lower-voltage cousins, handle style is critical to your comfort, especially if you use your drill a lot every day.

According to the folks at Milwaukee, three out of five drill users prefer pistol-handle drills. But all of the workers I talked to while preparing this article prefer the midhandle tools over the pistol grip. The consensus is that a 12v pistol-grip drill requires a lot more effort to operate than a 12v midhandle drill. The nose-heavy weight of a pistol-grip drill steadily pulls your wrist forward and down, sort of like losing an arm-wrestling contest. With a midhandle drill, the weight is bal-

anced over your hand and wrist, keeping both in natural positions.

Some companies argue that pistol-grip drills are superior to midhandle drills because they can be operated with one hand behind the barrel of the drill, putting your force in a direct line with the screw tip or drill bit. Freud and Metabo molded their pistol handles to put the hand behind the drill barrel, and the other pistol-grip models also can be gripped from behind.

When I drove long screws with a pistol-grip drill held with one hand from behind, I seemed to have slightly more control than I did with a midhandle drill, but my wrist and forearm had to absorb all of the torque. I had to add my other hand to keep the drill body from twisting as the resistance of the screw or drill bit increased.

When I spoke with a Freud representative, he adamantly defended the pistol-grip design, saying that operating a midhandle drill always requires two hands. But I disagree. In addition to driving long screws, most of the work I do involves hanging doors and installing hardware, and midhandle drills were always easier to use with one hand or two (top photo). Milwaukee, Metabo and Porter-Cable all currently make only pistol-handle models, but all plan to introduce midhandle 12v drills within the year. (Editor's note: In Freud's case the discussion is moot. Just as this issue was going to press, we learned that Freud is discontinuing its line of cordless drills.)

The motors and batteries in midhandle models are identical to those in the pistol-grip models made by the same company, so if a company offered both, I chose a midhandle model to evaluate for this article. To limit the number of drills I had to deal with and to keep things fair, the models I looked at were all 12v or higher variable-speed driver/drills with ⅜-in. keyless chucks and two-speed torque settings.

Evaluating power and duration—I field-tested all of the tools under similar circumstances, primarily hanging doors and driving 1¼-in. #12 hinge screws. I also used the cordless drills for installing finish hardware such as locks, door closers and towel bars. During testing I built a deck and a fence at my home and gave each drill a workout both screwing framing together and fastening decking with 3-in. screws.

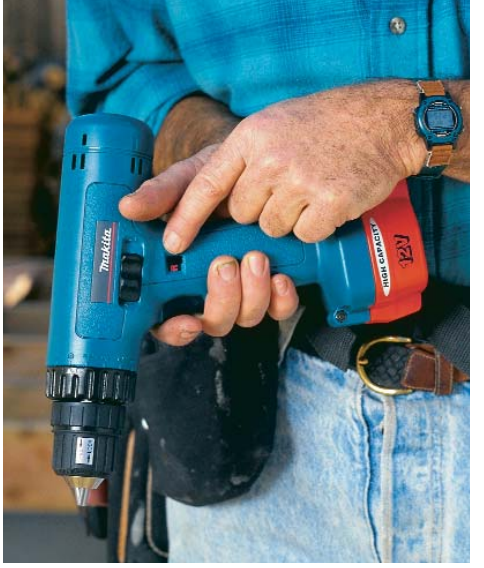
I decided not to evaluate each tool in the shop by driving countless screws, drilling a multitude of spade-bit holes or pulling back triggers to time no-load battery duration. The tools I reviewed are so improved over the 9.6v systems that it's no longer important how many screws they can drive: They all can drive handfuls.

Because motor and transmission design varies so much among the drills, measuring the no-load running time of each tool doesn't really tell you very much. Some drills, such as the Pana-

Natural hand position means comfortable work. The weight of the midhandle drill is distributed evenly over the hand so that the hand and wrist stay in natural positions. Pistol-grip drills are nose-heavy and pull the hand and wrist forward.

Motor size affects performance. The Ryobi (bottom left) and the Makita (top) have smaller motors that operate less efficiently. The larger motors of the DeWalt and the Bosch (bottom middle and right) are more efficient but weigh a lot more.

Different battery styles mean different handles. The tower, the part of the battery inserted into the handle, can dictate how thick the handle is. DeWalt's single-cell tower (left) gives the drill a slimmer grip than Hitachi's dual-cell tower (right).

Forward/reverse switches should be convenient. Bosch's forward/reverse switch (left) slides back and forth above the trigger and is well within reach of both finger and thumb. Hitachi's switch pivots above the trigger (center) and can easily be pushed one way with the trigger finger but not the other. Makita's switch, mounted on the handle (right), always requires the other hand to change positions.

sonic and the Hitachi, are designed specifically for increased run time, and others, such as the Makita, the DeWalt, the Porter-Cable, the Freud and the Bosch, are designed for higher-torque situations. The only fair way to judge these tools was in the field.

For hanging doors, most of the tools worked well for between three and four hours without having batteries changed. The Makita, the Metabo and the Ryobi tools seemed to run out of power more quickly than the others.

Each drill is equipped with high and low gears, and even though I always drilled pilot holes for hinge screws, only the Bosch, the Freud, the Porter-Cable, the Milwaukee and the DeWalt drills were able to drive screws in high gear until the battery died. The Makita, the Panasonic and the Hitachi couldn't drive more than 10 screws in high gear before the drill had to be switched to low gear. The Ryobi drill couldn't drive any hinge screws in high gear.

Overall design determines battery duration—Driving 1,500 or so deck screws, I got a good idea of each tool's battery duration. Most of the tools drove screws for more than an hour on a single battery charge, so there was time to charge the spare. Only the Ryobi, the Metabo, the Makita and the Hitachi ran out of power before their spare batteries could be charged in standard one-hour chargers.

The great difference in discharge duration between these tools caused me to assume that some companies make better batteries than others. But that's not true (sidebar p. 59). If your cordless tool runs out of power fast, don't be too quick to blame it on the battery.

What does affect discharge duration is the overall design of motor and transmission. Product managers and representatives from DeWalt, Bosch, Porter-Cable and Makita informed me that most of the tools on the market are assembled with electrical motors supplied by the same two manufacturers, Johnson and Mabuchi, and that these motors come in various sizes.

A peek inside the drills is revealing (center photo, p. 55). The Makita that I tried uses a Johnson 700 motor, and the Ryobi uses the smaller Johnson 400, giving the Ryobi its seductively light weight. However, the smaller motor in the Ryobi heats up during use, so Ryobi installed an aluminum heat sink at the rear of the motor to draw off excess heat. I felt that heat building in the Ryobi drill while I was using it, and I noticed similar problems with Panasonic's drill. I couldn't get the Panasonic open, but one of the company's representatives told me the drill has an aluminum heat shield shrouding the motor.

On the other hand, Bosch, Freud, Porter-Cable and DeWalt had the largest motors, but the DeWalt drill was also the heaviest of all the cordless drills I reviewed. DeWalt, which makes its own motors, says that its motors have more windings than the motors on other drills, a fact I couldn't verify. More windings supposedly mean more power but also more weight. However, in my experience, the Bosch and the DeWalt mid-handle tools consistently outperformed all the others both in duration and in power.

I should point out that the DeWalt has the only cordless-drill motors with replaceable brushes. With the life expectancy of these motors increasing as their design evolves, brushes can be replaced easily when they wear out so that tool owners won't have to discard the entire motor.

With battery chargers, sometimes lighter is better—Cordless drills come with two basic types of charging systems. The most common system relies on a transformer and works by monitoring the temperature of the charging battery. The charging cycle stops when the system senses the proper temperature. Every company except Freud, Panasonic and DeWalt has transformer-type one-hour chargers.

Those three companies use a charging system that relies on a computer chip to judge the charging condition of a battery. The chip-enhanced charger measures the battery's voltage as charging progresses and stops charging when the battery reaches a specific voltage. This type of charger recharges a battery in one hour.

It's easy to spot a charger with a transformer because it is much heavier than the computer-chip variety. But the weight of the charger is a minor consideration. A transformer type of charger creates a lot more heat during the charging process, which reduces the overall life of a battery. According to Bosch, the life expectancy of a battery charged by the heat-sensing method is between 600 and 700 recharges. DeWalt says that a battery charged by its computer-chip charger will last 1,200 recharges.

Fifteen-minute chargers, the coffee-break special—I wish I had a dollar for every time I put a dead battery into the charger and walked off without plugging it in. An hour or so later, I'm standing there with an uncharged battery and a dumb look on my face. A 15-minute charger would have saved me a lot of embarrassment, not to mention time and money.

DeWalt and Panasonic offer 15-minute chargers and Metabo has an optional 10-minute charger that operate on computer chips. They claim that this fast charger is the best way to recharge a battery in terms of both time and battery life. Bosch's 15-minute Fuzzy Logic charger is a computer-chip system Bosch says analyzes the battery's charging conditions many different ways each second. Bosch says the Fuzzy Logic charger increases a battery's life expectancy two to three times beyond what you can expect with its

Twelve-volt cordless drills

Model	Volts	Grip style	Chuck size	Charger	Batteries	Tool weight	RPMs	List price**	Same-battery accessories	Forward/reverse switch
Bosch 3310 (800) 301-8255	12	Mid-handle	⅜ in.	One-hr. transformer; 15-min. two-stage computer chip	2	3.8 lb.	0-400 0-1,200	$312 $332	Hammer drill	Excellent; push button
Bosch 3300	12	Pistol	⅜ in.	One-hr. transformer	2	3.6 lb.	0-450 0-1,100	$259	Hammer drill	Poor; pivot lever
DeWalt 972 (800) 433-9258	12	Mid-handle	⅜ in.	One-hr., two-stage computer chip	2	4.2 lb.	0-450 0-1,400	$362	Flashlight, hammer drill, saw	Good; push button
DeWalt 991	14.4	Mid-handle	⅜ in.	One-hr., two-stage computer chip	1	4.9 lb.	0-450 0-1,400	$388	Flashlight, hammer drill, saw	Good; push button
DeWalt 994 KQ	14.4	Mid-handle	½ in.	15-min., two-stage computer chip	1	5.3 lb.	0-450 0-1,400	$458	Same as DeWalt 991	Good; push button
Freud EDS 120* (800) 472-7307	12	Pistol	⅜ in.	One-hr., two-stage computer chip	2	4.1 lb.	0-375 0-1,300	$380	None	Good; push button
Freud EDS 132*	13.2	Pistol	⅜ in.	One-hr., two-stage computer chip	2	4.2 lb.	0-400 0-1,400	$415	None	Good; push button
Hitachi DS 10 DVA (800) 706-7337	12	Mid-handle	⅜ in.	One-hr., one-stage transformer	1	4.0 lb.	0-400 0-1,600	$417	Hammer drill, impact wrench	Poor; pivot knob
Makita 6211 DWHE (800) 462-5482	12	Mid-handle	⅜ in.	One-hr., one-stage transformer	2	4.0 lb.	0-370 0-1,150	$368	None	Poor; flush sliding switch
Makita 6212 DWG	12	Mid-handle	⅜ in.	One-hr., one-stage transformer	1; power display	4.0 lb.	0-370 0-1,150	$412	None	Poor; flush sliding switch
Makita 6311 DWHE	12	Mid-handle	½ in.	One-hr., one-stage transformer	2	4.3 lb.	0-370 0-1,150	$399	None	Poor; flush sliding switch
Makita 6312 DWG	12	Mid-handle	½ in.	One-hr., one-stage transformer	1; power display	4.3 lb.	0-370 0-1,150	$432	None	Poor; flush sliding switch
Metabo BEAT 12/2 R&L (800) 638-2264	12	Pistol	⅜ in.	One-hr., two-stage transformer; 10-min. computer chip	2	3.9 lb.	0-300 0-900	$363 $415	Flashlight, hammer drill	Fair; pivot lever
Milwaukee 0408-6 (800) 414-6527	12	Pistol	⅜ in.	One-hr., one-stage transformer	2	3.75 lb.	0-350 0-1,000	$354	Hammer drill	Fair; pivot lever
Panasonic EY6100 EQKW (800) 338-0552	12	Mid-handle	⅜ in.	15-min., two-stage computer chip	2	3.8 lb.	50-350 180-1,300	$380	Lantern	Excellent; push button
Porter-Cable 9853S (800) 487-8665	12	Pistol	⅜ in.	One-hr., two stage transformer	2	4.45 lb.	0-350 0-1,000	$305	None	Fair; pivot lever
Ryobi1202 (800) 323-4615	12	Mid-handle	⅜ in.	One-hr., two-stage transformer	2	3.6 lb.	0-300 0-1,000	$169	None	Excellent; push button

*Freud has recently announced that it is discontinuing its line of cordless drills. **Retail and mail-order prices are often considerably less than manufacturers' list prices.

one-hour charger. Add that to the time saved on each charge, and the extra $10 to $50 for a 15-minute charger seems like a good deal.

Two-stage charging provides a deeper charge—When I bought my first cordless drill, I was told to remove the battery from the charger right after the charging cycle was done. But that's not necessary with some new chargers. Many new chargers, including the DeWalt, the Panasonic, the Porter-Cable, the Metabo, the Freud, the Ryobi, the Hitachi and the Bosch Fuzzy Logic, charge the battery in two stages.

The first stage, referred to as the fast charge, brings the battery to the maximum voltage that it can absorb in the shortest possible time, either one hour or 15 minutes, depending on the charger. When fast charge is complete, the battery is usually at only 80% to 90% of its capacity.

With two-stage chargers, a longer, slower charge called a trickle charge begins after the fast charge. Leaving your battery in the charger for a trickle charge gives it a deeper, longer-lasting charge.

To understand how deep charging works, you must first realize that the battery pack for a cordless drill contains many battery cells. The fast charge stops when any one cell in the pack reaches 97% of its total voltage capacity. However, because the cells in the battery pack don't all charge at the same rate, some of the cells may stop charging at only 80% or 90% of their capacity when the fast charge is complete. Unfortunately, the overall power of the battery is only as good as its weakest cell. The slower trickle-charge process brings each cell in the battery pack to 97% of its capacity.

Battery style can affect handle comfort—When you try holding the new high-power drills, you'll notice that some are more comfortable to grip than others, especially if you don't have hands as big as Magic Johnson's. For my small hands the thinner handles are easier than the thicker handles to hold for long periods. A lot of

Twelve-volt drills with ½-in. chucks can drive bigger drill bits. A large, self-feeding auger bit is no problem for most 12v drills in low gear, making them attractive to other tradesmen such as plumbers and electricians.

A belt clip keeps the drill handy. Makita's belt clip makes it convenient to hang the drill on your pocket or tool belt between tasks.

A battery with a fuel gauge. LED lights on Makita's optional power-display battery tell you how much power is left in the battery.

what determines the circumference of the drill handle is the number of cells in the tower, or the part of the battery pack that is inserted into the handle (bottom photo, p. 55). Generally, batteries with single-cell towers are narrower and require smaller handles than those with dual-cell towers. Ryobi, Panasonic and DeWalt have the only batteries with single-cell towers, and I found their handles the most comfortable to grip. The Makita was an exception. Despite the dual-cell tower on its batteries, the Makita handle was as comfortable as any of those with single-cell towers.

The location of the forward/reverse switch makes some drills easier to use than others (photos p. 56). I like to reverse the direction of the drill without disengaging the driver bit from the screw head, which is most convenient if I can operate the reverse switch with the hand that's wrapped around the drill handle. Thicker handles make this maneuver more difficult.

The switch on the Hitachi, located just above the trigger, has a longer throw than any of the other tools. I could get the drill into reverse easily enough, but my fingers were too short to switch back to forward. I found the switch on Freud's drill nearly impossible to operate. The Makita drill has a switch flush-mounted on the side of the handle, which requires your other hand to operate. The reverse switch on the Bosch midhandle drill was the easiest to operate in either direction without moving the drill.

Adjustable clutches: Do I need 21 settings?—Adjustable clutches are handy for a lot of jobs, but I never used more than four or five settings. Most of the tools I tested have more than that, and the Panasonic has 21 settings. I tried the clutches while driving deck screws and finish screws, and even installing drywall. Porter-Cable had the best clutch on a pistol-handle drill, and DeWalt had the best for a midhandle.

I found clutches most useful when I didn't have to pay close attention to the depth of the screws. However, the clutch reacts to the resistance of the screw, which changes as the density of the material changes, so I couldn't rely on the clutch to set deck screws to a consistent depth, nor could I countersink drywall screws without breaking the drywall paper occasionally.

Adjusted properly, however, a clutch can keep you from driving a screw too deep, which makes this feature indispensable for beginners. With this powerful new generation of cordless tools, an adjustable clutch can also reduce the possibility of stripping a screw head or of snapping a screw off altogether.

How variable is variable speed?—Although each tool I tried was variable speed, I noticed a significant difference in both start-up speeds and in switch sensitivity. Not all of the drills start at 0 rpm. The Panasonic starts at 50 rpm in low gear and 180 rpm in high gear, which is too fast for driving screws with any real control. The Makita and the Hitachi have 0 rpm start-up speeds, but in high gear I had a tough time getting them to spin slowly. The DeWalt and Bosch start at true 0 rpm in both high and low gears, a real advantage when you need to back a screw out just a hair or to give a screw an extra one-eighth of a turn, which can be crucial when installing door hardware.

As far as top speeds, all of the tools performed about the same for the work I was doing. The fastest was Hitachi at 1,600 rpm, and Metabo the slowest at 900 rpm. If you drill a lot of holes in metal with high-speed twist drills, high rpms are a must.

Accessories make some drills more attractive—It probably sounds like I'm being picky, but I like to keep all of my bits and screwdriving tips in the same place as my drill charger and extra battery. And with the rough nature of most job sites, I want a carrying case that will last. DeWalt, Porter-Cable, Metabo and Milwaukee all supply metal boxes with their drills, and Milwaukee's roomy box even has a lift-out tray. The rest of the tools have molded-plastic cases with plastic friction latches.

The Makita 12v drill comes with a number of interesting accessories; in fact, I'm tempted to buy the tool just for the belt clip (photo top right, facing page). If you've driven a lot of screws with cordless drills, you've probably had your keyless chuck loosen up when backing out a screw. Only Makita offers an optional locking chuck to prevent this from happening. But I always forgot to unlock the chuck when changing bits. The chuck then spun in my hand and took off a layer of skin in the process.

Makita also makes the only cordless-drill battery with a fuel gauge (photo bottom right, facing page). Batteries that come with Makita's DWG models have a series of LED lights that show how much power is left in the battery.

Total cordless systems: drills, flashlights and saws with the same battery—Another thing that I always liked about my old 9.6v Makita cordless drill was that my Makita trim saw, flashlight and right-angle drill all used the same battery and charger system. Now as I'm upgrading to the next level of cordless drills, I can't help but look at other compatible tools manufacturers plan to sell alongside their cordless drills.

As I write this article, only Panasonic and DeWalt offer 12v flashlights that use the same battery as their drills. DeWalt also offers 12v and 14v cordless saws and a 14v flashlight. Makita now makes a 12v cordless saw, but its flashlight is still 9.6v. Bosch has plans for a 14.4v drill, a hammer drill, a screw shooter, a cordless saw and a flashlight that use the same battery. By August Panasonic planned to have a cordless hammer drill available, and a company spokesman says it has a cordless saw due within a year. Virtually every other company making cordless tools is at least looking into making other tools that run on its drill batteries.

Most of the drills I looked at for this article had ⅜-in. chucks. However, many manufacturers, including Makita, Milwaukee, Porter-Cable, Freud and DeWalt, offer ½-in. models as well. Freud's ½-in. pistol-grip drill is also available in 13.2v, and DeWalt makes a ½-in. drill in a midhandle, 14.4v model.

The ½-in. drills will probably appeal more to plumbers and electricians, who use large bits on a regular basis. I found that Makita's ½-in. drill would run a 1-in. self-feeding auger bit with no problem in low gear (photo left, facing page). One day I even chucked my 2⅛-in. lockset bit into DeWalt's ½-in. 14.4v pistol-grip hammer drill and was able to install door hardware with no additional power tools. Keeping in mind that batteries should be interchangeable, I'm tempted by the 14v DeWalt hammer drill in combination with the 14v midhandle drill/driver, cordless saw and flashlight. Now if someone would only come out with a cordless router for latch and strike mortises.

Personally, I didn't find the ½-in. drills comfortable for my type of work, and although they are sold as driver/drills, I believe that they are much more useful as just drills. Driving screws all day with 5-lb. pistol-grip tools is much more taxing than using 4-lb. midhandle tools. By the way, DeWalt let me try out a prototype of an 18v drill that will also be out by the time this article is published. Nicad-powered trucks and vans can't be far off.

The envelope, please—So which cordless drill would I recommend? If you're a homeowner who rarely needs a cordless drill for tough jobs and won't be using it every day, the inexpensive, lightweight Ryobi will probably suit your needs. A do-it-yourselfer looking for a little more quality in a lightweight drill might prefer the Panasonic or the pistol-grip Milwaukee. If you plan to work your cordless driver/drill hard and demand a lot from it, such as drilling holes with spade bits and driving mountains of large screws, then it's a toss-up between the DeWalt and the Bosch. □

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Nicad batteries: myths and facts

I've seen workers put rubber bands or clamps on the triggers of their cordless drills to drain the batteries completely before recharging. If you don't drain the battery all the way, it will never take a full charge again. Right?

After speaking to manufacturers and reading a stack of instruction manuals, I found out that most nicad batteries in today's cordless tools (photo below) do not have "memories" and that discharging a rechargeable battery all the way can harm the nicad cells. These battery packs should be recharged when they're no longer able to accomplish the task at hand (when there is not enough power to drive more screws). Recharging the battery pack before this point will reduce its total work life, and discharging the pack beyond this point can damage the pack.

Once you've started charging a battery, the charge cycle should not be interrupted. If the pack is removed from the charger and reinserted, or if power to the charger is interrupted, the charger starts a new cycle, which again can reduce the life of the pack.

Nicad batteries come in many shapes. Regardless of their appearance, 12v batteries all contain ten individual cells, most of which are made by just three companies.

Most nicad cells that go into cordless-drill battery packs are made by one of three companies, Sanyo, Gates or Panasonic, and battery cells coming off the production line are not created equal. Cell capacity varies, and they are rated accordingly. Battery packs sold as "high capacity" contain only the highest-rated cells, and the better cells take a charge and hold it longer than lower-rated cells. Regular battery packs include cells with a mixture of ratings depending on the company's standards. Most manufacturers offer high-capacity or heavy-duty batteries for typically $10 to $50 more. Make sure that the kit you buy has the best batteries available.—*G. M. K.*