Episode Book

EPISODE #5610

Magnetizing Screwdrivers: Do the Cycles Wear Out?

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SYNOPSIS

If you magnetize a screwdriver over and over for years, does the tool eventually wear out? Daniel wrote in with that exact question, plus a practical problem: his magnetizing block won't fit a flexible drill shaft. This episode covers the three categories of magnetizing tools on the market — the block, the telescopic wand, and the powered electronic unit — how to tell a good block from a lousy one, what the demagnetization pass is actually for, and why soft magnetic steel can be cycled indefinitely without degrading. Along the way: why the same neodymium magnets that make these tools work are also the most dangerous class of object a toddler can swallow, and how a schoolteacher built one out of a cardboard tube.

TRANSCRIPT



Corn

Here's a question that sounds simple until you actually try to answer it. If you run a screwdriver through a magnetizer over and over again, for years, does it eventually wear out? Not the steel. The magnetism. Does a tool have a finite number of magnetizations in it?



Herman

And it doesn't, which is the fun part.



Corn

It doesn't. But Daniel didn't know that when he wrote in, and neither did I, and that's where this whole thing starts. He's been doing the workbench series with us, and this one's on magnetizing tools. His framing is that these are defensible purchases if you've got a toddler in the house and you're doing electronics work at home, because it is so easy to lose a small washer or a nut, and nobody wants to find out later that it ended up somewhere it shouldn't. He also described the other thing that happens constantly, which is knocking a part off the bench and spending half an hour fishing it out from behind a cabinet.



Herman

Which is where the flexible drill shaft comes in.



Corn

Right. He was in exactly that situation, and instead of reaching for a telescopic magnetic wand, it occurred to him he could just magnetize one of his flexible drill shafts and use that as the fishing line. Except it didn't fit in the magnetizing block he owns. And he knows there are electronic versions of these things that give you more room to work with, but he couldn't remember what they're called. So he wants the market. He wants to know how you tell a good block from a lousy one. He wants to know what the demagnetization pass is actually for. And then the big one, whether repeated magnetization cycles degrade the tool or whether you can just keep doing it forever.



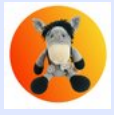
Herman

That's a good list.



Corn

So let's start with what's actually on the market.



Herman

Three categories, and they do different things. First is the magnetizing and demagnetizing block, which is what Daniel's calling the sweep. Second is the telescopic pickup wand, the extendable thing with a magnet on the end. Third is the powered electronic unit, which is the one he was trying to remember the name of.



Corn

And the block is the one he already owns.



Herman

The block is the one he already owns, and it's the most interesting of the three, because it's the only one that lets you magnetize something that isn't already a magnet. A wand only retrieves. It picks up the washer. It does not turn your flexible shaft into a retrieval tool. The block does. You pass a tool through the channel, the tool becomes magnetic, and now you've got a fishing line shaped however you need it.



Corn

Which is his whole instinct, and he's right about it. He said he likes the blocks a lot more than the telescopic versions because they open up options for oddly shaped things. That's exactly the tradeoff.



Herman

It is. The wand is a better tool for one specific job, which is reaching into a gap you can't get your hand into. The block is a better tool for the general problem, because it converts your existing tools into magnetic ones.



Corn

And then there's the safety frame he opened with, which I want to flag early because it runs underneath the whole episode. The same strong neodymium magnets that make a magnetizing block work are themselves the single most dangerous class of object a toddler can swallow.



Herman

That's the irony of the whole category. The tool you buy to protect against ingestion is made of the thing that causes the worst ingestion injuries.



Corn

So we've got the categories. Let's go deep on the block, because that's what he actually owns and that's what he's trying to evaluate.



Herman

Start with how simple it is. It's a block. One face has a strong permanent magnet in it. The other face has a channel designed to strip magnetism back out. There's no power, no battery, nothing to fail. You buy it once for somewhere between five and fifteen dollars and it sits on your bench for the rest of your life.



Corn

Which is why it's the thing working repair techs actually reach for. There was a thread on Hacker News years ago about iFixit's tooling, and a repair tech chimed in recommending Wiha's magnetizer alongside their precision screwdrivers. Not the powered units. The block.



Herman

Because it's always there and it always works. The powered units are for people doing volume work or working with tools that won't fit a block. For the person at a bench once a week, the block is correct.



Corn

So how do you tell a good one from a lousy one? Because Daniel's specific complaint is that his wouldn't fit the flexible shaft.



Herman

Four things, and the first one is magnet grade. Good blocks use neodymium, NdFeB. Cheap blocks use ferrite, and a ferrite block barely registers. The test is simple. Take a screwdriver, pass it through the magnetizing channel, and see if the tip will pick up a screw. A good block will visibly grab and hold. A weak one will give you a screwdriver that can just barely lift a paperclip.



Corn

And the second thing is the one that bit him.



Herman

Channel geometry. A deeper, wider magnetizing channel fits larger-diameter tools. Cheap blocks have a narrow slot that only takes small bits, which is exactly the flexible-shaft problem. If the shaft won't physically sit in the channel, the magnet can't do anything to it.



Corn

So it's not that his block failed. It's that his block was sized for bits and he was asking it to take a shaft.



Herman

Correct. And that's a real limitation of the format. A block has a fixed aperture. Whatever doesn't fit, doesn't get magnetized.



Corn

Which is the argument for the electronic units.



Herman

Third thing on the block checklist is the demagnetizing channel, and this is where the cheap ones really fall down. A proper demagnetizer uses a tapered or stepped channel, or an offset magnet arrangement, so that the field decays gradually as you withdraw the tool. A lousy one just has a second magnet that partially cancels the field, and you get inconsistent results. Sometimes it strips, sometimes it half-strips, sometimes it does nothing.



Corn

And fourth?



Herman

Build. Does it slide around the bench when you push a tool through it? Is it labeled clearly enough that you know which side does which? Those sound trivial until you're holding a screwdriver in one hand and guessing.



Corn

So that's the block. Now the electronic ones, because he specifically wanted the name.



Herman

They're sold as electronic magnetizer/demagnetizer units, or sometimes electromagnetic magnetizers. The mechanism is a coil. You drive the coil with a strong DC pulse to magnetize, and with a decaying AC field to demagnetize. That's the whole trick.



Corn

And the advantage is aperture.



Herman

The advantage is aperture. There's no fixed slot. You've got a coil with a hole through it, and if the tool fits through the hole, it gets magnetized. That's why these exist. They solve exactly the problem Daniel hit.



Corn

There's a wonderful detail in one of those Hacker News threads, which is a schoolteacher who built a homemade magnetizer by winding wire around a cardboard cylinder.



Herman

Which tells you everything about how complicated the electronic version actually is. It's a coil. A cardboard tube and some magnet wire and a power supply and you've built one.



Corn

So the "electronic" category is less mysterious than the name suggests.



Herman

Much less. The commercial ones are nicer, they're enclosed, they have a proper switch and a proper aperture, but the physics is a coil and a current.



Corn

And the telescopic wand, which he's skeptical of.



Herman

His skepticism is fair but I'd defend the wand for one job. When the part is already behind the cabinet and you need it out now, the wand is the correct tool. You are not going to magnetize a flexible shaft and thread it behind a cabinet in less time than it takes to extend a wand and pull the washer out.



Corn

So the wand is the retrieval tool and the block is the conversion tool.



Herman

That's the cleanest way to put it. He's not wrong that the block opens up more options. He's just wrong if he concludes the wand is redundant. They're for different halves of the problem.



Corn

So that's the market. Now the part of Daniel's question I actually find most interesting, which is the demagnetization pass. He said he's never quite understood what it's for.



Herman

And the honest answer is that it removes residual magnetism, which sounds like it's just undoing the previous step. It isn't. It's a deliberate feature for the times you don't want the tool magnetic.



Corn

Give me the times.



Herman

A magnetized screwdriver attracts steel chips, screws, and swarf. If you're working inside a device and you don't want debris clinging to your driver, you demagnetize. Magnetized tools can interfere with sensitive components. Magnetic media, some sensors, delicate electronics. And some fasteners or assemblies shouldn't be magnetically biased at all.



Corn

So it's not "undo." It's "off."



Herman

It's "off." The magnetizer is "on." You use whichever state the job calls for.



Corn

And that leads directly into the question he actually cares about, which is whether you can do this forever.



Herman

You can, and the reason is in what a screwdriver is made of. A screwdriver is a soft magnetic material. Typically a low-carbon or alloy steel chosen for toughness, not for magnetic hardness. Soft magnetic materials have low coercivity, which means their domains realign easily under an applied field and relax easily when the field is removed.



Corn

Domains being the little magnetic regions inside the steel.



Herman

Regions where the atomic moments are already aligned with each other. In an unmagnetized screwdriver, the domains point in random directions and cancel out. Apply a field, and the domains that happen to align with it grow, and the ones that don't shrink or rotate. Remove the field, and a soft material lets them relax back.



Corn

So magnetizing is not creating magnetism. It's organizing magnetism that was already there.



Herman

You're not adding anything. You're reorienting what's present.



Corn

Which is why the cycles don't accumulate.



Herman

There's no wear mechanism. You're flipping domains back and forth within the same crystal structure. There's no equivalent of a cutting edge dulling. The material doesn't remember how many times you've done it.



Corn

So a screwdriver that's been magnetized a thousand times magnetizes to roughly the same strength on the thousand-and-first.



Herman

Roughly the same, yes. The hysteresis loop for a soft magnetic material is narrow, which is the technical way of saying the material is designed to flip domains back and forth with minimal energy loss. That narrowness is governed by the material's magnetocrystalline anisotropy and its microstructure. For a screwdriver, it's narrow by design.



Corn

And the caveat?



Herman

The caveat is mechanical, not magnetic. If you bend the tool, or heat it above the Curie temperature, or work-harden the steel through heavy use, you change the microstructure and therefore the magnetic behavior. A bent, beaten-up driver may hold magnetism slightly differently than a fresh one. But that's from the mechanical history, not from the magnetization cycles.



Corn

So the cycles are innocent.



Herman

The cycles are innocent. The analogy I'd use is a light switch. Flipping a switch doesn't wear out the switch. The mechanism is designed to be flipped. Magnetizing and demagnetizing a soft steel tool is the same thing.



Corn

I want to be honest about one thing here, which is that the "indefinite cycling" claim is a general principle from materials science rather than something I can point you at a single study for. The hysteresis literature supports the framework. The specific claim that you can do it forever is the standard reading of how soft magnetic materials behave, not a result from one paper.



Herman

Which is the right way to say it. The framework is well established. The specific number of cycles is not something anyone has a reason to study, because there's no mechanism by which it would matter.



Corn

Now the safety beat, because Daniel opened with it and it deserves more than a nod.



Herman

It does. Magnet ingestion in children is its own category of foreign body ingestion, and it's a bad one. The reason is that a single magnet usually passes. Multiple magnets don't, because they attract each other across the walls of the bowel. They pinch tissue between them, and that tissue necroses, perforates, forms a fistula.



Corn

And a magnet plus a button battery is worse.



Herman

A magnet plus a button battery is worse, because you get ischemic injury and electrical injury at the same time. There's a case in the pediatric emergency literature of exactly that co-ingestion, and it required surgical repair of the bowel.



Corn

The position paper from the European pediatric gastroenterology society in 2023 is the one to look at here. It treats magnet ingestion as a distinct high-morbidity category and specifically flags high-powered earth magnets as carrying worse outcomes because of their greater field strength.



Herman

Which is directly relevant, because the magnets in a magnetizing block are exactly that class. Neodymium. Strong. Small.



Corn

And the incidence has gone up.



Herman

It's risen over two decades, tracking with smaller and more powerful magnets showing up in toys and in the home. Bolton and colleagues wrote about that in Current Opinion in Pediatrics in 2018. The magnets got better and the kids didn't change.



Corn

So Daniel's instinct that a magnetizing sweep is a defensible purchase for a household with a toddler is correct, and it's correct in a way that's supported by the clinical literature. But the tool itself is made of the hazard.



Herman

Which is the thing to actually say out loud. The sweep helps you clear the floor of small steel parts before a toddler finds them. The sweep is also a strong magnet in a plastic case sitting on a bench at toddler height. Both of those are true.



Corn

And I'd add the obvious thing, which is that the magnets inside a cheap block are sometimes just glued in, and glue fails.



Herman

Glue fails. A block that's been dropped, or sat in a hot garage, or just aged, can shed its magnet. And then you've got a loose neodymium disc in the house, which is the exact object the whole literature is about.



Corn

The safety advice is not "don't buy the block." It's "buy the block, and treat the block itself as the thing you're keeping away from the kid."



Herman

Which is the same advice as for any strong magnet in the house. The tool is not the exception to the rule. The tool is the rule.



Corn

I want to go back to something you said about the demagnetizer, because I think the cheap-block failure mode there is worth its own minute.



Herman

Go ahead.



Corn

You said a proper demagnetizer uses a tapered or stepped channel so the field decays gradually as you withdraw the tool. Walk me through why the withdrawal matters.



Herman

The demagnetization works by exposing the tool to a field that alternates and shrinks. As you pull the tool out of the channel, the field it sees gets weaker and weaker, and each pass through the alternating region flips the domains a little less, until they're left pointing in random directions again.



Corn

The speed of withdrawal is part of the mechanism.



Herman

It is. If you yank the tool out, you don't give the field enough cycles to decay the magnetization. You end up with a partially magnetized tool, which is arguably the worst outcome, because it's magnetic enough to attract chips but not magnetic enough to hold a screw.



Corn

It's worse than either end state.



Herman

It's worse than either end state. Fully magnetized is useful. Fully demagnetized is useful. Half-magnetized is a screwdriver that picks up swarf and drops screws.



Corn

That's the thing a cheap block gets wrong, because a cheap block's demagnetizer is just a second magnet that partially cancels the field.



Herman

A second magnet gives you one static field. There's no decay, no alternation, no gradient to withdraw through. You get whatever partial cancellation happens to occur at that position, and it's inconsistent.



Corn

The cheap block's demagnetizer isn't a demagnetizer. It's a weaker magnetizer.



Herman

That's a fair way to put it. It moves the tool toward a lower magnetization state, but it doesn't zero it, and it doesn't do so reliably.



Corn

Which is a good reason to spend the extra ten dollars. The whole category is cheap enough that there's no reason to buy the version that doesn't work.



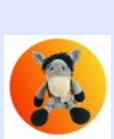
Herman

Agreed. The price difference between a block that works and a block that doesn't is a couple of coffees.



Corn

Okay. I want to bring in one more thing before we get to the physics payoff, which is the "magnetized tool is contaminated" idea. Daniel didn't say it, but I think it's in the air around this whole topic.



Herman

It is, and it's folklore. A magnetized tool is not ruined. It's not contaminated. It's in a different magnetic state, and it can be cycled back and forth indefinitely. There's a craft tradition of keeping precision tools demagnetized, and some of it is legitimate, because a magnetized tool does attract debris and can affect sensitive work. But some of it is superstition, treating magnetism as a kind of dirt that gets into the tool.



Corn

The physics says it's not dirt. It's a state.



Herman

You can leave the state whenever you want.



Corn

Which brings us to the part of Daniel's question that I think is the real payoff, which is whether the magnetization cycles affect the tool's quality or make subsequent magnetization less reliable.



Herman

The answer is no, for the reasons we've been through. Soft magnetic material, low coercivity, narrow hysteresis loop, domains that flip back and forth without accumulating damage.



Corn

Let me put the counterargument, just to make sure we've actually covered it. Someone could say, well, every time you flip a domain, you're doing a tiny bit of work on the crystal structure, and over millions of cycles that has to add up.



Herman

It does add up, in the sense that there's a real phenomenon there. Magnetic cycling can, in some materials, cause changes at the microstructure level. But for a soft magnetic steel in a screwdriver, at the field strengths a bench magnetizer produces, the effect is negligible. You'd need a much more aggressive regime and a much more magnetically hard material to see anything.



Corn

The failure pattern isn't magnetic. It's mechanical. The screwdriver wears out because you use it as a screwdriver.



Herman

Right. The tip rounds over. The shaft bends. The handle cracks. None of that is the magnet's fault.



Corn

I'd add the practical version of this, which is that if your magnetized screwdriver stops holding screws, the most likely explanation is not that you've magnetized it too many times. It's that the tip is worn and the screw is falling off because there's no purchase.



Herman

Which is a completely different problem with a completely different fix.



Corn

Hilbert.



Hilbert

I agree with you.



Corn

Okay.



Hilbert

The block is the right tool. But the demagnetizer isn't a second magnet. It's a channel. The field decays as you withdraw the tool. If you pull it out too fast, you get a half-magnetized tool, and a half-magnetized tool is worse than either end. I spent a week at a shop convinced the demagnetizer was broken because it wasn't stripping my driver, and the owner finally came over and pointed out I was pushing it through tip-first instead of handle-first. The tapered channel only works one direction.



Corn

That would do it.



Hilbert

The owner kept the block chained to the bench. Literally chained. Because technicians kept walking off with it. And there was a rule about never bringing it near the bench where the customer hard drives sat, because a magnetized screwdriver had once wiped a customer's backup drive and the shop had to pay for the data recovery.



Herman

That's the part I want to sit with. A magnetized screwdriver close enough to a spinning drive is a real data-loss event.



Hilbert

It was a real one. The customer had a backup drive on the bench because they'd asked us to pull files off it. Someone set a magnetized driver down next to it. That was the end of the drive.



Corn

The same tool that saves you from a toddler's stomach can cost you a customer's data.



Hilbert

It can. The magnets in those blocks are stronger than people assume. They're not fridge magnets. They're the class the pediatric literature is about.



Corn

Which is the thing I keep coming back to. The whole category has this strange property where the tool and the hazard are the same object.



Herman

They're the same object. There's no version of this where you get the useful magnetism without the dangerous magnetism. It's one phenomenon.



Corn

Hilbert's story makes that concrete in a way the abstract version doesn't. The magnet doesn't care whether it's holding a screw or erasing a drive. It's the same field.



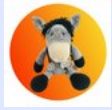
Herman

The same field. The application is what differs.



Corn

Where does that leave the design question? If the block is a strong magnet sitting on a bench, and the hazard is the block itself, is there a fix?



Herman

Shielding is possible but awkward, because you'd be shielding the magnet you need. A child-resistant latch on the block is more practical. Some blocks come with a cover. Most don't.



Corn

As neodymium gets cheaper and stronger, the ingestion problem probably gets worse, not better.



Herman

It probably does. The trend line in the pediatric literature is upward, and it's driven by exactly that. Stronger magnets in smaller packages in more homes.



Corn

Which is an argument for buying a block with a case, and keeping it in the case, and keeping the case somewhere a toddler can't reach. Not because the block is dangerous in normal use. Because the block is the exact object the safety literature is about.



Herman

That's the whole safety beat in one sentence.



Corn

Here's the misconception I want to end on. The most common wrong belief about this topic is that a magnetized screwdriver is somehow damaged or contaminated, and that running it through magnetization cycles wears it out.



Herman

It doesn't. A screwdriver is soft magnetic steel. Low coercivity. You're reorienting domains that were already there. The cycles don't accumulate. You can do it forever.



Corn

The tool doesn't wear out from being magnetized. It wears out from being used.



Herman

Which is the same as everything else on the bench.



Corn

One thing I'd flag before we close, which is that we couldn't verify current product specifics in this run. Brands, prices, exact model names for the electronic units. The category names are right, the mechanism is right, but if you're going shopping, check what's actually on the market right now.



Herman

Which is worth saying. The physics doesn't change. The catalog does.



Corn

Here's what I'm left with. If you can magnetize and demagnetize indefinitely, and there's no wear mechanism, then why is there such a strong craft tradition of keeping tools demagnetized? Some of it is practical, the chips and the swarf and the sensitive components. But some of it feels older than that, like magnetism was understood as a kind of contamination before anyone knew what a domain was.



Herman

The case for demagnetization probably gets stronger as electronics get smaller and more sensitive. A magnetized driver near a modern phone is a different risk than a magnetized driver near a 1990s desktop.



Corn

The other direction, as neodymium gets cheaper, the toddler problem gets worse, and somebody's going to design a block with a proper child-resistant latch and make a fortune.



Herman

Somebody should.



Corn

If you've got a magnetizer block on your bench, or a story about a magnetized tool causing a problem, send it in. We'd like to hear it. Thanks as always to Hilbert Flumingtop, who produces the show and who has strong opinions about chained tools.



Herman

This has been My Weird Prompts.



Corn

The human-AI collaboration podcast. If you've got a minute, a review helps other people find the show. Email us at show at my weird prompts dot com. We'll be back soon.