



# MacBook Pro 16" 2019 Teardown

An iFixit teardown of the 2019 MacBook Pro 16" in which we investigate the new Magic Keyboard, the redesigned speakers and the new thermal design.

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## INTRODUCTION

A beloved old feature returns to the MacBook Pro, and it starts with *M-a-g*. If you guessed MagSafe, we have disappointing news, but if you said “Magic Keyboard,” we have the teardown for you. It’s the all-new, butterfly-less, 16-inch MacBook Pro, and we’re here to turn it inside-out—from the fancy new thermals to those thumping loud speakers. Be sure to read our [blog post](#) for our initial take, and then meet us back here for the full teardown.

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### TOOLS:

- [Spudger](#) (1)
  - [Suction Handle](#) (1)
  - [iFixit Opening Picks set of 6](#) (1)
  - [Tweezers](#) (1)
  - [T5 Torx Screwdriver](#) (1)
  - [T3 Torx Screwdriver](#) (1)
  - [T8 Torx Screwdriver](#) (1)
  - [P2 Pentalobe Screwdriver iPhone](#) (1)
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## Step 1 — MacBook Pro 16" 2019 Teardown



- The modern MacBook Pro ranks among Apple's most divisive devices, but that wasn't always the case. We'll keep our fingers crossed that this new model represents a return to form. Specs on our teardown ~~victim~~ unit include:
  - 16" LED-backlit IPS Retina display with True Tone, 3072 × 1920 resolution (226 ppi)
  - 2.6 GHz 6-core Intel Core i7 (Turbo Boost up to 4.5 GHz), paired with an AMD Radeon Pro 5300M
  - 16 GB of 2666 MHz DDR4 SDRAM
  - 512 GB SSD
  - 100 Wh battery
  - Six-speaker sound system and high-performance microphone array
- ① From the outside, Apple doesn't give much away—at the very least, they haven't facelifted this design just to attract impulse buyers. The only real clue comes from the new model number: **A2141** and EMC 3347.

## Step 2



- Stacked up like pancakes, you'll notice the new MacBook Pro is noticeably bigger (and just a hair thicker) than the latest 15" model. It actually compares well with the 2015 model—in size that is, not port selection.
- With the 16" Pro back-to-back against the 2015 Pro, you're almost seeing double ... until you look closer. The display hinge has changed, and the old Pro's keys peek out just a bit more.
- In a similar game of "spot the differences" between the two 2019 MacBook Pros, the 16" version gets:
  - A physical Esc key, separated from the Touch Bar
  - A matte finish on the Touch ID/power button, matching the rest of the keys
  - A Touch Bar shortened in length by about 19 mm
  - Inverted-T arrow keys, all half-sized
  - If you [zoom and enhance](#) the left grille, you can see the camouflaged holes for the improved triple-mic. And now, you can never un-see it.

## Step 3



- Time for us to do what we do best: jam tools into things and see what comes apart.
- Let's start with some keycaps. Remember the iMac's [Magic Keyboard](#)? It's a well-liked, reliable design that Apple calls the "[core technology](#)" for the redesigned keyboard in this new machine.
- That might be understating it slightly: side by side, we're hard pressed to spot *any* differences. Scissor switches, keycaps... There's slightly less *space* surrounding these new keys, and pundits will celebrate those reconfigured arrow keys—but everything else looks nigh identical.
- ❗ **News flash:** there's not even a [dust-proofing membrane](#) on these new switches. We're inclined to take this as a *very* good sign. (It means we can finally eat Doritos during teardowns again.)
- To round out the comparison, here's a third image showing the controversial (and notoriously temperamental) "butterfly" switch in the 15" MacBook Pro [released just a few months ago](#).
- But why stop there? [Here's a shot](#) of the scissor switch in the "unibody" 2012 MacBook Pro design...
- ...and the scissor in Apple's last laptop with a "good" keyboard, the [2015 MacBook Pro](#) with Retina display.

## Step 4



- What's underneath the scissor mechanism? Hey, we'll ask the questions here—you just finish taking this thing apart.
  - Wait, scratch that—reverse it.
- Here's a look at the "[Apple-designed rubber dome](#) that stores more potential energy for a responsive key press."
- Beneath that, a backlight assembly with an interesting pattern—more on that later.
- And bordering all that, a thin black gasket—presumably to stop the bright bits from bleeding out past the edge of the key.
- Compared once again with the desktop Magic Keyboard:
  - The two scissor mechanisms look nearly identical. The old Magic scissor is ever-so-slightly thicker (1.6 vs 1.38 mm).
- ❗ 0.22 mm may not seem like much, but no doubt a lot of engineering went into the re-creation of this slender new scissor switch.

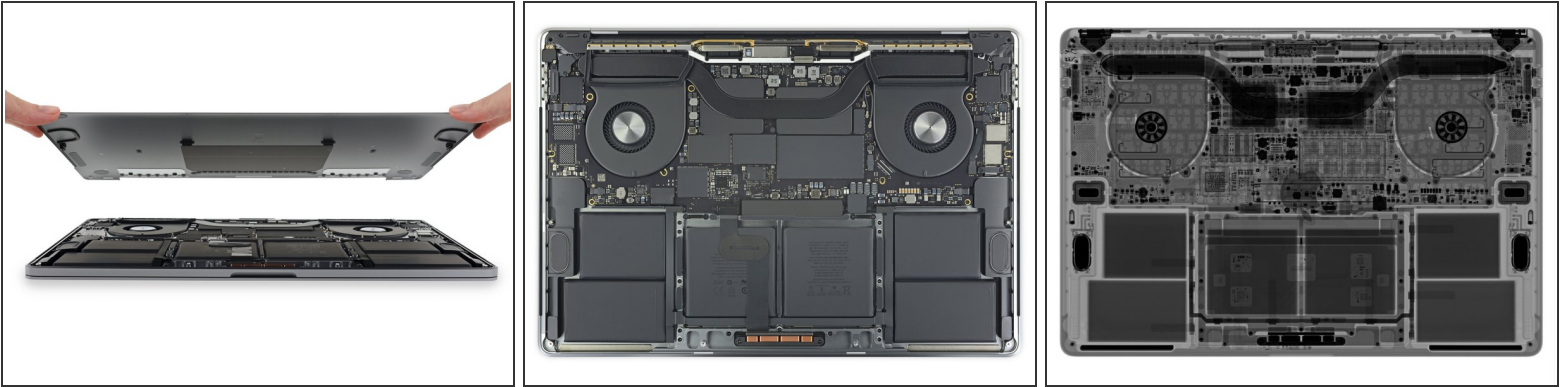


## Step 5



- Despite the differential in thickness, these keyboards look so similar that we're tempted to mix dark Magic with light and see what happens...
  - ⓘ \*Heavenly chorus\* [The Creation of Magic](#)
- Yes, what you're looking at is a 2015 white Magic Keyboard keycap on a 16" MacBook Pro keyboard and scissor. It works!
  - The old Magic command key is smaller (hence the larger gap around the key) and thicker than the new one.
  - Not every single key is interchangeable, and the old Magic keys don't have transparent lettering for the backlight. So don't get too excited yet, keyboard modders.

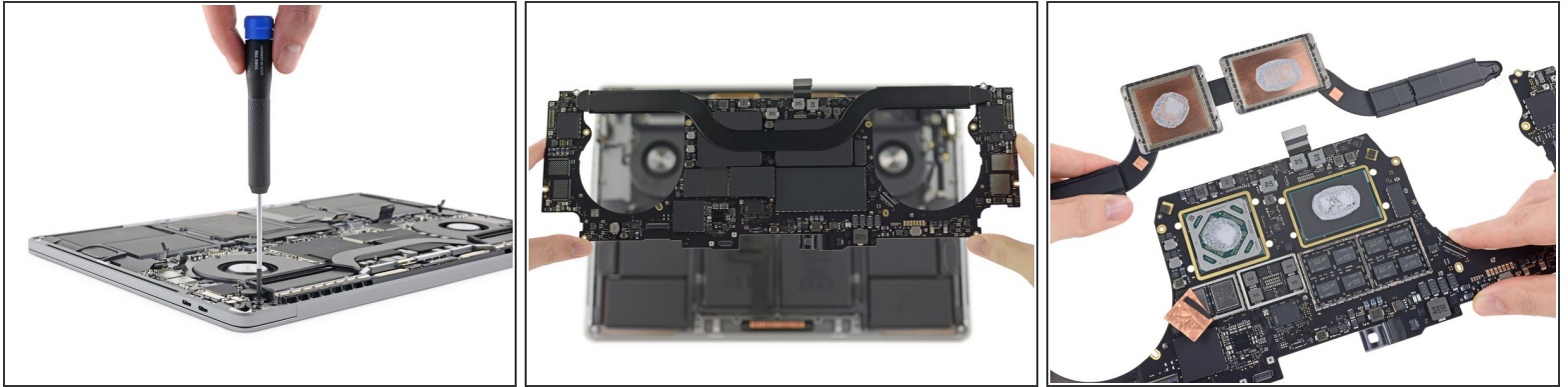
## Step 6



- Having finished poking at the keyboard (for now), let's de-lid the chassis and look inside.
- Apple already showed us this angry owl [in a GIF from their press release](#), but what we haven't seen yet are high-energy X-rays passing through the owl to show us what's *behind* its frustrated facade.
- The X-rays make it even angrier! Run away! Luckily our friends at [Creative Electron](#) are taking all the risk here—we'll resume disassembly after things calm down.

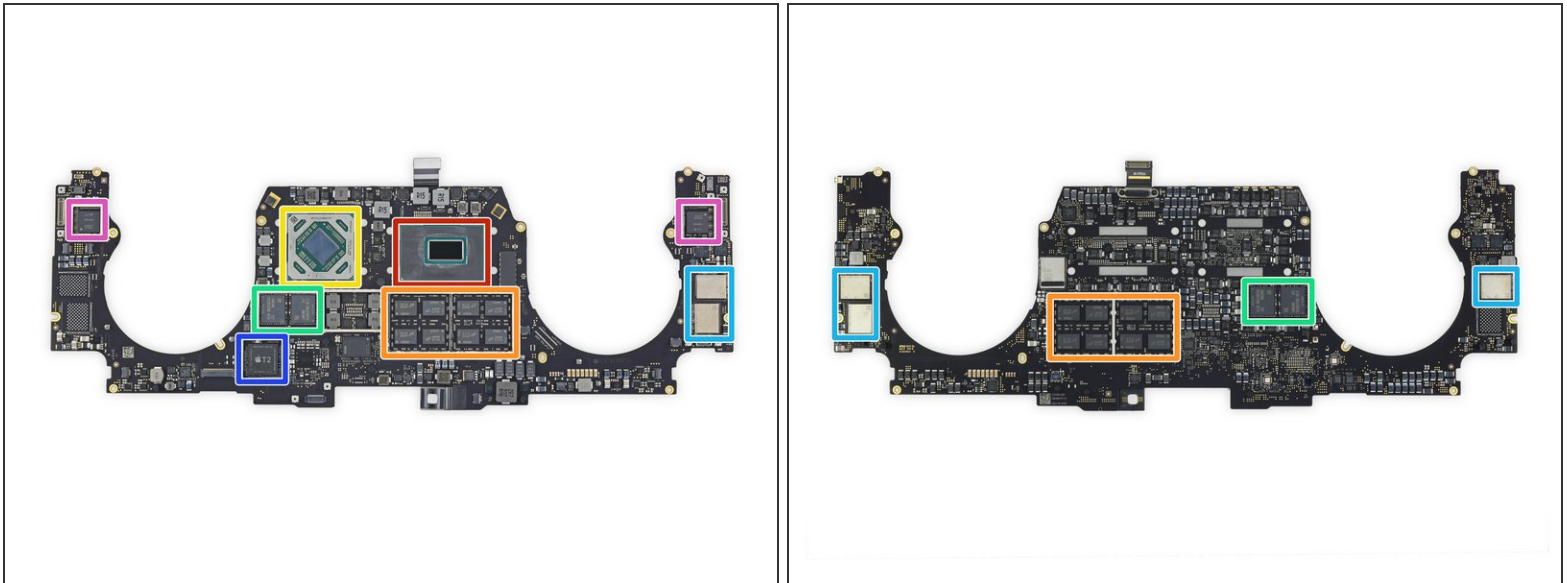


## Step 7



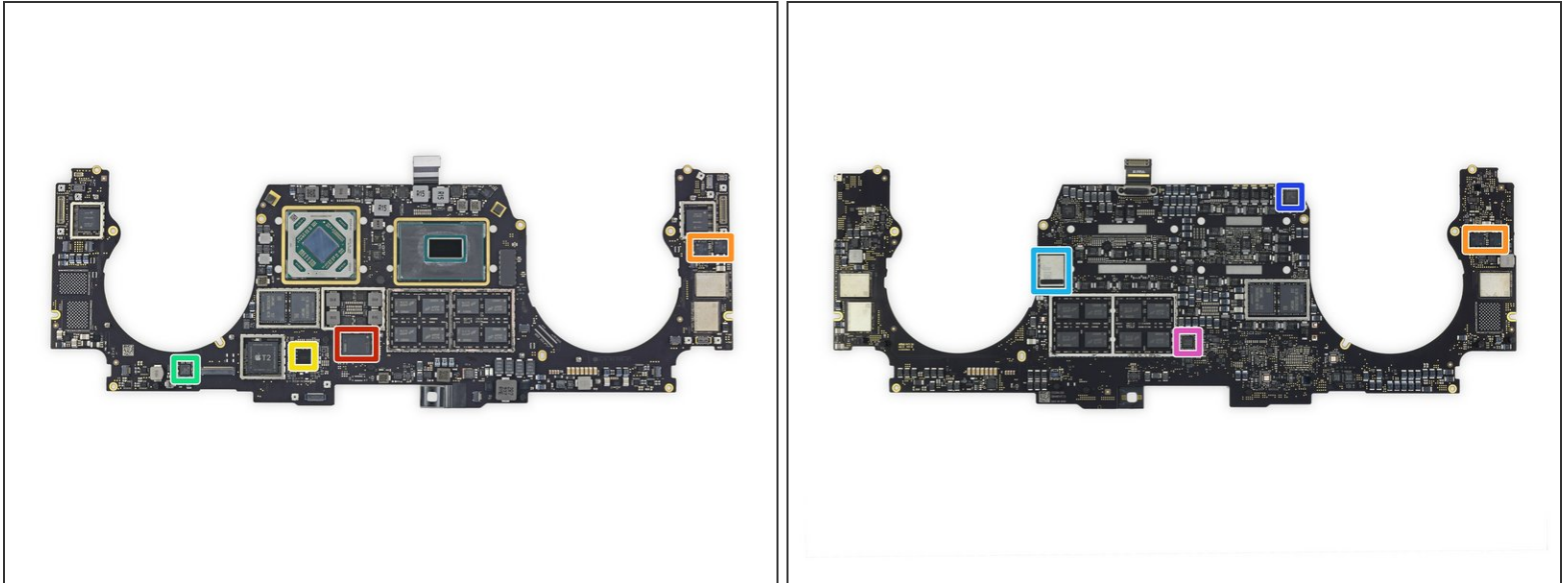
- *Torx screws, schmox screws*—our [Marlin](#) driver set does it all. (Although come to think of it, we've yet to find a use for the schmox bits.)
- Even with this computer open, we're faced with more mystery—a masked MacBook! Is it you, [Bruce](#)?
- Apple touts major advancements in this MacBook Pro's thermal design, and says this heat sink is [35 percent bigger](#). (We'd have guessed 34, but let's take their word for it.)
- We also found some upgraded hardware covering what we presume to be fast new GDDR6 chips—a copper shield and a couple [aluminum thermal pads](#).

## Step 8



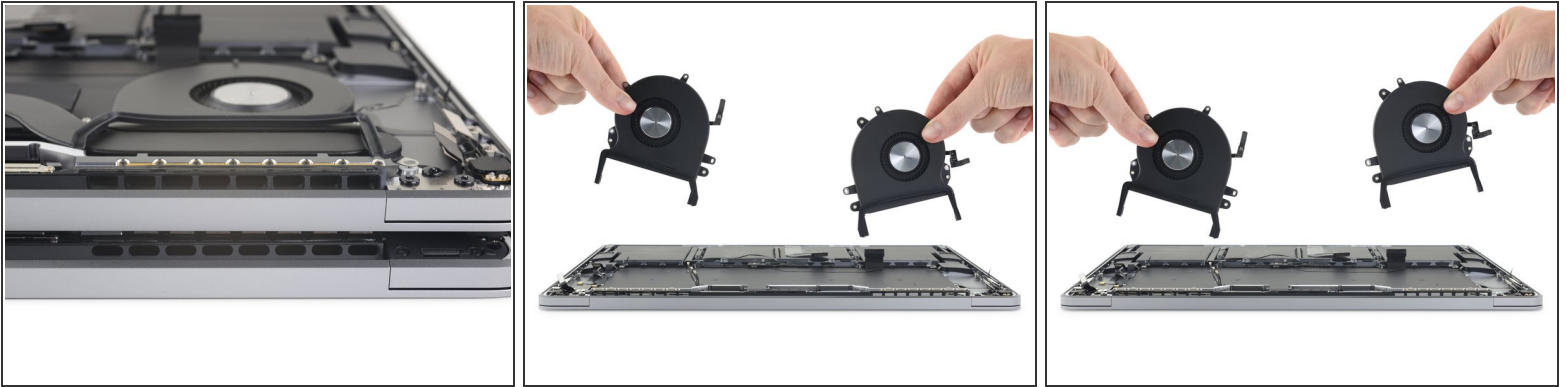
- We can't stop thinking of these logic boards as mustache-shaped, so let's take the anthropomorphic analogy way way too far and comb through the bristles. Here's what sticks to our comb:
  - 9th-generation Intel Core [i7-9750H](#) 6-core processor
  - 16x Micron [MT40A1G8SA-075](#) 8 Gb DDR4 SDRAM (16 GB total)
  - AMD [Radeon Pro 5300M](#) mobile GPU
  - 4x Samsung [K4Z80325BC-HC14](#) 8 Gb GDDR6 RAM (4 GB total)
  - Toshiba TSB4227VE8434CHNA11926 and TSB4227VE8437CHNA11926 flash storage (512 GB total)
  - Apple T2 APL1027 339S00536 coprocessor
  - Intel [JHL7540](#) Thunderbolt 3 controller

## Step 9



- We continue combing for silicon. Silicon comes from sand. [Have we been doing this all wrong?](#)
  - Intel [SR40E](#) platform controller hub
  - Texas Instruments CD3217B12 (likely power controllers)
  - 338S00267-A0 (likely Apple PMIC)
  - Texas Instruments TPS51980B power controller
  - 339S00610 (likely Apple Wi-Fi/Bluetooth module)
  - Intersil [6277](#) PWM modulator
  - Renesas 225101C

## Step 10



- With the motherboard out of the way, we can take a peek at the rest of the improved thermal design.
- Pardon us while we vent for a minute. Stacked atop its slightly-older sibling (the 15-inch 2019 model), the new MacBook Pro has some noticeably larger exhaust holes.
- ⓘ That combined with these new fans, which feature bigger impeller blades, pushes 28% more air through the new Pro.
- This may sound like a bunch of hot air, but all these cool improvements allegedly allow this 16" Pro to sustain up to 12 more watts during intensive workloads than the previous design.

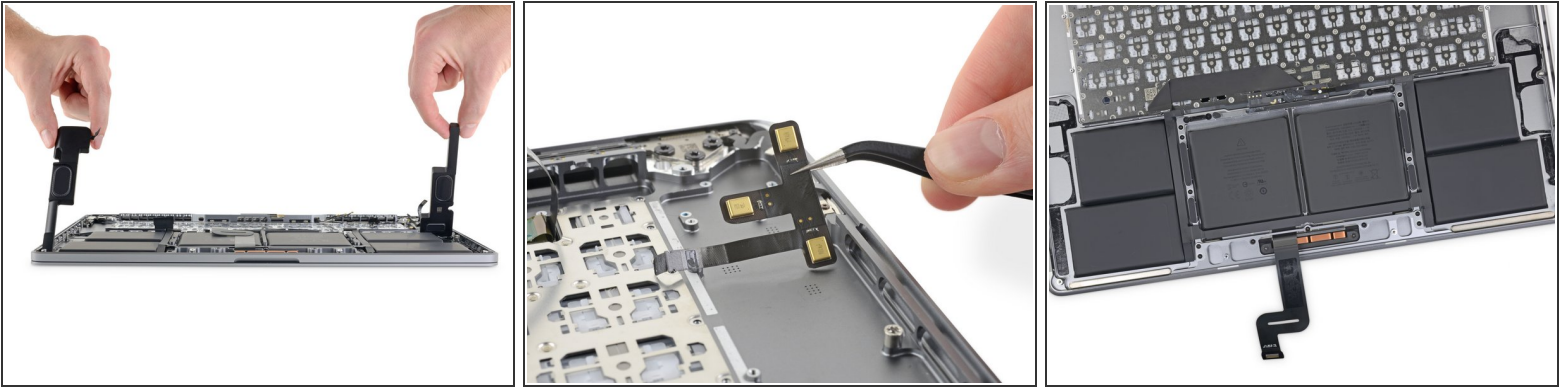
## Step 11



- We slowly peel away the keyboard backlight, hoping to find Magic underneath.
- The backlight assembly consists of a flexible diffuser, which carries light from LEDs along the edges. Flexible diffusers are common, but this one looks [specially etched](#), possibly to maximize brightness and evenness.
- Underneath the backlight, we spot some Pentalobe P2 screws along the edges of the metal keyboard frame. Could it be? Can we unscrew this thing to swap a busted key after a Dorito-fueled type-a-thon?
- **Nooooo!** [Once again](#), the keyboard assembly is riveted down. Though the switches are likely less vulnerable to crumbly assailants, the keyboard itself isn't any more repairable than the Butterfly boards.
- It's basically 2016 all over again: we've got a new keyboard married to a non-serviceable design, with only Apple's word that it "won't break." And this one isn't even a part of the [Keyboard Service Program](#), so ... : /
- The one glimmer of hope is that this new keyboard design is extremely similar to past Apple keyboards that have mostly withstood the test of time.
- Refusing to leave this keyboard interaction empty-handed, we pry up the keyboard as much as we can to get a glimpse at what makes it click. We are rewarded with a look at the flexible PCB layer sandwiched between the key and the metal backplate where the button presses happen ... but no magic.

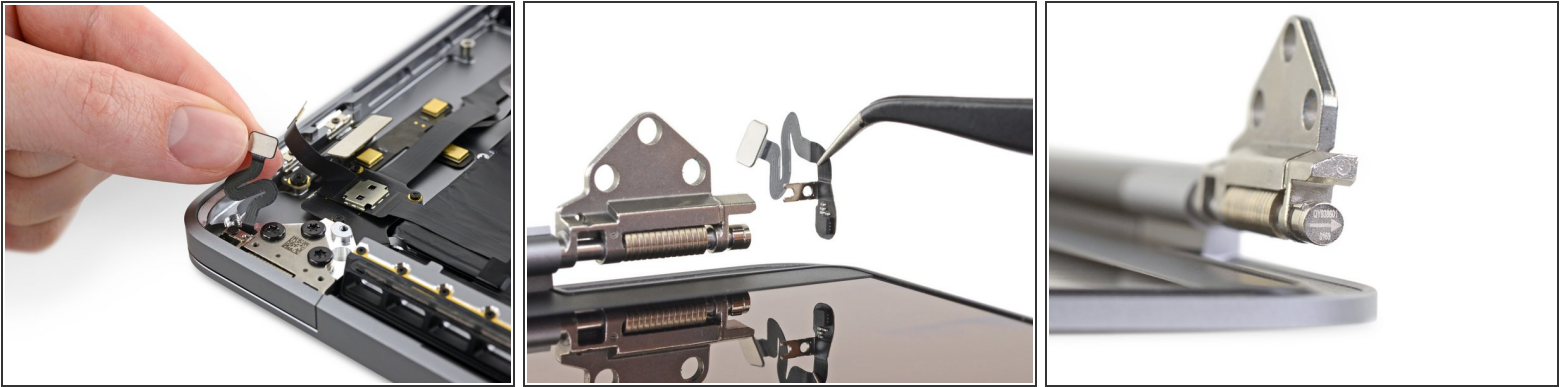


## Step 12



- Now that all our keyboard questions are laid to rest, we can move on to the rest of the bits still lying around.
- First up, these fancy new ~~XL-Earpods~~ speakers with an extended enclosure, and opposed woofers on the top and bottom.
  - ⓘ The opposed woofers are supposed to cancel each other's vibration out. Kinda like the anti-noise feature of the new [AirPods Pro](#), but ... with bass. Anti-bass?
- We aren't as sure about the elongated enclosure, but our best guess is that the new shape redirects sound to improve its quality. Maybe extra volume was needed to accommodate the second woofer?
- Next, another sound upgrade: a "high performance" three-mic array. It's laid out similarly to the [three-mic array in the 2018 MacBook Air](#), but looks a little beefier, which could mean these are higher-quality mics.
- Finally, the lithium powerhouse that's probably drawing a suspicious glare from [the FAA](#): Apple's 99.8 Wh battery (11.36 V, 8790 mAh).
  - That's the largest battery we've ever seen in a MacBook—a 4.8 Wh increase over the [17" MacBook Pro](#), and a huge 16.2 Wh increase over the latest [15" MacBook Pro](#).
  - Where did this extra capacity come from? Here, Apple pulled an [iPhone 11](#)—each battery cell looks identical to its predecessor, but measures 0.8 mm thicker on average.

## Step 13



**Teardown Update:** Hey, what's this little flex cable doing here? We don't remember seeing this before, and [MacRumors](#) was kind enough to ask us about it.

- We have to fully remove the display to investigate, but it turns out there's a new sensor facing the left-side hinge, and a magnet embedded in the hinge itself. The arrow on the magnet indicates alignment/polarity, which rotates in sync with the display.
  - Looks like Apple added a **lid angle sensor**. Why would they need that? Will this enable some cool new macOS feature?
  - Maybe. It could also be a clever way for Apple to trace the history of how the device was used if repairs are needed. For instance, [if the display cables fray](#), Apple might want to know how much the display was adjusted, and how often.
- ★ MacRumors did some additional gumshoeing, and found out that Apple wants this little sensor calibrated after repairs. Check out our post to [speculate with us](#)!

## Step 14



- Let's lay out our feelings for this new MacBook Pro:
  - Though the fancy new-old scissor mechanisms may be more durable than fragile butterflies, the whole keyboard assembly is still riveted in place.
  - The revamped thermal system is a welcome improvement to the notoriously hot-and-throttled Pro lineup.
  - The 99.8 Wh battery flies just under the FAA radar, pumping out 16.2 Wh more capacity than the most recent 15" model. With such a slight increase in case size, this capacity increase is surprising.
  - Despite the thumping new speakers, the podcast-quality mic array, and that giant screen, we can't help but feel that Apple can do better—especially after seeing Microsoft perform some [real engineering magic](#) to make its latest laptops more repairable. Here's hoping that the 2020 Pro lineup will really take our breath away.
- For now though, the only thing left to do is give this thing a score.

## Step 15 — Final Thoughts

### REPAIRABILITY SCORE:



- The MacBook Pro 16" 2019 earns a **1 out of 10** on our repairability scale (10 is easiest to repair):
  - The trackpad can still be removed and replaced with very little drama.
  - Minor components are modular, but the processor, RAM, and flash memory are soldered to the logic board.
  - Glue and/or rivets secure the keyboard, battery, speakers, and Touch Bar, making those components a tricky fix.
  - The Touch ID sensor is the power switch and is locked to the logic board, greatly complicating repairs.