



CUSTOM COOLING STARTER'S GUIDE



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So you've just finished upgrading your PC or built a new one. Most people would be content to stop there, but you want the absolute best cooling setup to handle high-powered gaming, content creation, and more. We're with you there – for die-hard PC enthusiasts, it doesn't get more exciting than a custom cooling loop!

Of course, custom cooling can come with some anxiety as well. Will you be able to build your first loop? Could it leak? How do you even know where to start planning this project and what parts to buy?

This guide is meant to help you better understand cooling a PC, the decision behind custom cooling, and how you can plan out your loop and assemble it with absolute confidence. First-time builders who follow the provided instructions are almost guaranteed to avoid any issues, and as long as you do your research and stick to the plan, you'll be well on your way to success.

Anyone can do this!

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FIRST THINGS FIRST

This guide is intended to provide a complete overview of custom water cooling, answer questions about why and how to cool your PC, and teach you about all the parts of a custom cooling loop. If you're just looking to pick the parts for your loop and assemble it, you're only going to need this first section and then continue the process using our Custom Cooling Configurator.

■ PICKING THE PARTS

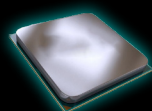
Before you can draw up a list of all custom loop components, you need to choose the following parts, as they define how a custom cooling loop will be set up:



Case



GPU



Processor

These three parts define the cooling water blocks needed, how much heat must be removed from your system, and how much space the case has for the loop.

Once you have this key information, visit the CORSAIR [Custom Cooling Configurator](#), and we'll generate a compatible set of components for water cooling, including a build schematic and a complete part list. Compatibility is of vital importance, so we suggest sticking to the provided list unless you know what you are changing and why.

■ BUILDING A CUSTOM COOLED PC

Your PC and your custom cooling components are ready – it's time to build your loop!

There are dozens of build videos and guides online to help you put a system together, so you can start anywhere you want. We also recorded and published a playlist of videos that show the installation of each Hydro X component, including instructions on where to connect the power and RGB cables, how to fill and maintain a loop, and other useful tips.

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This handful of short videos is all that's needed to confidently build a custom cooling loop, but don't forget to also watch fitting and system maintenance guides, and be sure to check the playlist for future updates.

Video collection at Corsair Lab YouTube channel:

<https://www.youtube.com/playlist?list=PL8YayGMfPGnUsyMakR50MeaArTKJCAz6E>

This is all that's needed to choose, buy, and securely build a custom cooled PC. If you'd like to know more about custom cooling, the following pages are full of information, interesting facts, insights, and lessons from the custom cooling enthusiast community.

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ALL ABOUT BEING COOL

Electronics heat up when they operate, and they heat up even more under heavy loads.

Once electronic components reach a critical temperature, they burn out. In PCs, temperature burnouts used to be quite common and expensive to fix, so component manufacturers started including temperature sensors that respond to critical temperatures. In the early days, your computer would just shut off when its processor temperature reached a critical level. Today, it reduces performance so that it can maintain temperatures and stay on. This performance reduction is called throttling.

To better understand how ALL computer cooling systems work, let's briefly look at what cooling is.

Sidenote

We've all burned ourselves on hot coffee before. There's one thing people around the world know – if you want your coffee to cool faster, you blow on it.

Cooling, by definition, is simply the equalization of temperatures. A cup of coffee over time will dissipate its excess heat into the environment and settle at the same temperature as the room. This heat equalization happens on the surface (yes, we're ignoring the cup for simplicity). If the difference between the liquid and the air temperature is high, heat will equalize faster. This is very easy to prove – if you stick your finger into hot coffee, you will immediately feel that heat is transferring to your finger a little too fast for comfort.

So why do we blow into our cups every morning? As the coffee releases heat into the room, the air near the surface of the cup is hotter than the room temperature. The temperature difference between the coffee and the immediately air over it is lower, and heat dissipates slower. That's why we blow on the cup, displacing the hot air, and increasing the temperature difference between the liquid and the air.

That, effectively, is what computer cooling does as well. It moves the heat to a place with a larger surface area where heat is dissipated into the cooler air surrounding it, and "blows" air across the cooling surface to blow away warm air and maintain a difference between the warm surface and ambient air.

When thinking about the physics of cooling, these are several main factors to consider. Where is heat generated and where is it dissipating into the environment? How is the heat being transported to the dissipation unit? How can the surface area of the dissipation element be increased? How can the temperature difference between the dissipation element and the air surrounding it be increased?

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COMPUTER COOLING TYPES AND THEIR DIFFERENCES

■ PASSIVE COOLING

If a component can benefit from some cooling beyond what it can receive simply from being exposed, it's usually fitted with a heatsink. This is a passive cooling component, which conducts heat and increases the surface area, but doesn't actively manage airflow over the surfaces.



■ AIR COOLING

When a component needs more than passive cooling, the first step up from a heatsink is an air cooler. An air cooler usually consists of heat pipes that move heat from the component to an array of thin, dense fins. These maximize the surface area to which heat is distributed. Effectively, an air cooler is a scaled-up passive cooler, fitted with fans that move air over the cooling fins, to further increase how fast heat dissipates into the environment.



Air cooling is the cheapest approach with the fewest moving parts for a computer, but when used in gaming PCs, it has limitations.

The main limitation of air coolers is heat pipe performance when cooling very hot components. A heat pipe evaporates liquid at the bottom end and the gases rise up the heat pipe, then condense at the other end, and eject the heat they carried. The cooler vapor condenses into fluid and makes its way to the bottom of the pipe again, where it's reheated. This circulation starts to fail when the whole assembly is so warm that fluid doesn't really get a chance to condense and fall to the bottom. At that moment, the air cooler becomes suddenly unable to effectively cool, and processor temperatures spike quickly. This is known as heat pipe dryout.

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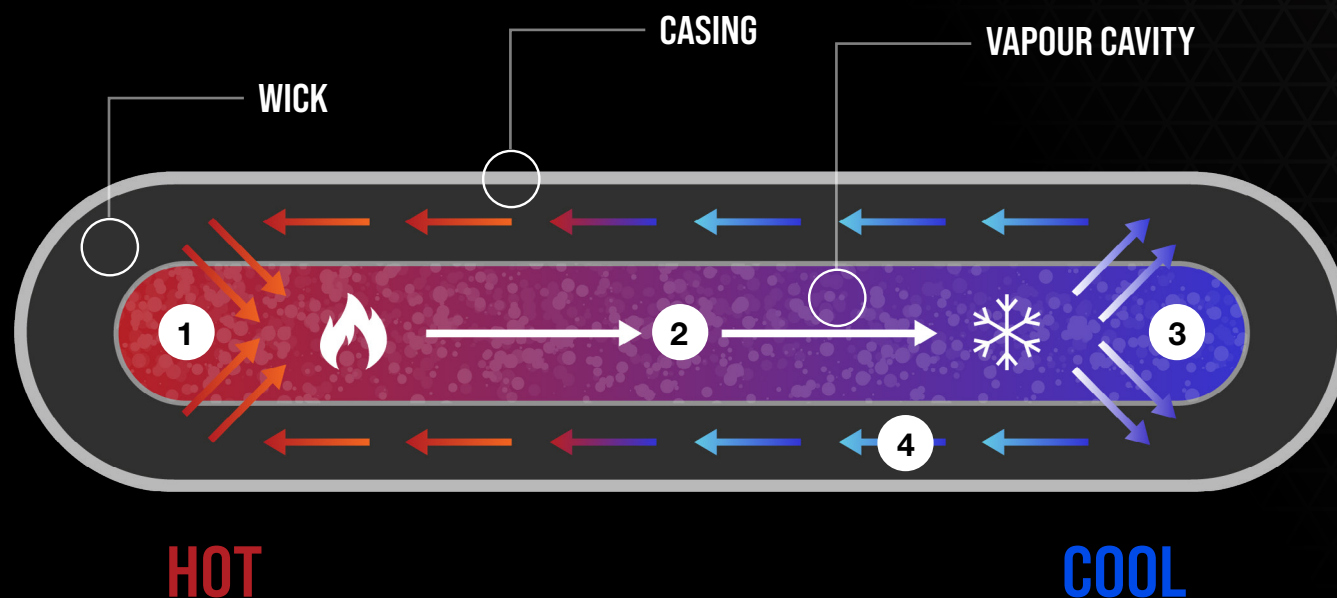
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An air cooler also blows warm air around the inside of your PC case, raising air temperatures inside the case. As the air inside the case warms up, the temperature difference between cooler fins and ambient air is lower, reducing the cooler's ability to dissipate heat and increasing the temperature for all passively cooled components.

- 1 Working fluid evaporates to vapour absorbing thermal energy.
- 2 Vapour migrates along cavity to lower temperature end.
- 3 Vapour condenses back to fluid and is absorbed by the wick, releasing thermal energy.
- 4 Working fluid flows back to the higher temperature end.

■ AIO

AIO stands for all-in-one liquid cooling and describes closed liquid cooling systems. The system includes a cooling block and pump assembly, a radiator, and fans.

Liquid cooling addresses cooling needs when air cooling can't manage the load. Water is highly efficient



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at transporting heat by moving the heat from the processor through the tubes to a place where it's easier to release into the environment.

The “cold plate” on top of the processor is cooled by water, which circulates down pipes through the radiator. The radiator takes the place of air cooler fins, and the fans attached to it blow warm air out of the case.

Water cooling offers some key improvements over air cooling. Instead of blowing hot air around the insides of the case, water efficiently carries heat to the radiator attached to the edge of the case and blows it directly out of the case.

An AIO liquid cooling system is prefilled with cooling liquid in an easy-to-install self-contained unit. A water block / pump assembly is attached to the processor, the radiator with fans is screwed to the edge of the case, and then the power connectors for the pump and fans are connected to your motherboard.

■ CUSTOM LOOP LIQUID COOLING

A custom loop liquid cooling system is a step above AIO cooling. It trades the simplicity of AIOs for expanded performance and modularity. A custom cooling loop is scalable as much as needed to keep a system running cool.

And, of course, it looks awesome while doing it.



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A custom cooling loop cools not only the CPU, but also the graphics card, SSD drives, and any other heat-generating component for which there's an available water block. The system can also be scaled to a desired level of performance. Want to reduce your operating temperature? Add one more radiator, and it will increase the temperature dissipation potential of your cooling setup.

We will cover all the custom loop components below.

Click on “learn more” to advance to the specific section in this document.



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CUSTOM COOLING SETUPS AND COMPONENTS

You can create any setup you can think of with custom cooling, but the main decisions will revolve around component choice and positioning, and the flow of circulating coolant.



Here, a single pump drives a loop in which the coolant reaches the GPU first, then enters the CPU block, and is then routed through two radiators – first the top radiator, and then the radiator on the right side of the case. After dissipating heat through the radiators, the coolant returns to the tank, where it's drawn up the tubes again by the pump.

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Sidenote

When deciding on a custom loop, consider how hard you're going to push the PC. Working on intensive operations or high-resolution gaming will generate more heat, and will likely need two radiators to effectively cool the liquid.

With two radiators in a cooling loop, the components can either be looped consecutively (Pump-GPU-CPU-Radiator-Radiator) or intermittently (Pump-GPU-Radiator-CPU-Radiator).

TUBING

Tubing is one of the decisions that most define how to plan a build and what the completed PC will ultimately look like.

We recommend that first-timers check YouTube for some insight into bending hardline tubing. If you're comfortable with this advanced part of the build, you will have a rewarding challenge routing your tubing. But if it seems a bit intimidating, you can go with soft tubing on your first attempt. Softline tubing is quite a bit easier to assemble, and if you change your mind about how tubes are going to route during the build, it's much easier to adapt halfway through.



Soft tubing

Using soft tubes is the easiest way to build a cooling loop. Tubes must be measured and cut to the correct lengths and fitted with compression fittings. This can be a good place to start for a beginner because every tube and bend of the system doesn't need to be visualized in advance. If you change your mind about how to route the tubes, you can cut new tubes and replace them in minutes.

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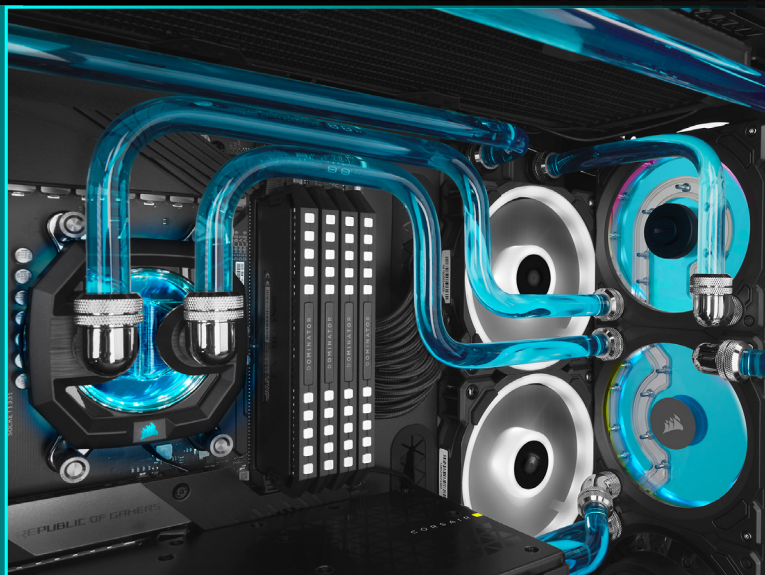
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Hard tubing

Most showcase builds take this approach. The added handicraft with tube bending and its perfect 90° turns are a point of pride for most custom cooling builders. The process takes a bit more time than a soft tubing build, but once completed, the satisfaction gained from a hard tubing build makes all the effort more than worth it.



Hard tubing with fitting bends

There's a pleasing aesthetic to the straight lines and angles of hard tubing, and there's also a way to assemble a hard tubing setup without tube bending by using angled fittings. While this will require more advance planning than other approaches (and cost a bit more due to the number of fittings), it's a distinct aesthetic to pursue. The amount of planning involved and the lack of flexibility to change your mind mid-build make this the most difficult setup to execute.

Sidenote

When looking at tube diameter, the decision comes down mostly to aesthetics. Thicker tubes do not deliver more cooling, as that is defined by the number and size of radiators. They are usually chosen by builders with larger cases so that the tubes are more visually balanced against the environment they are in.

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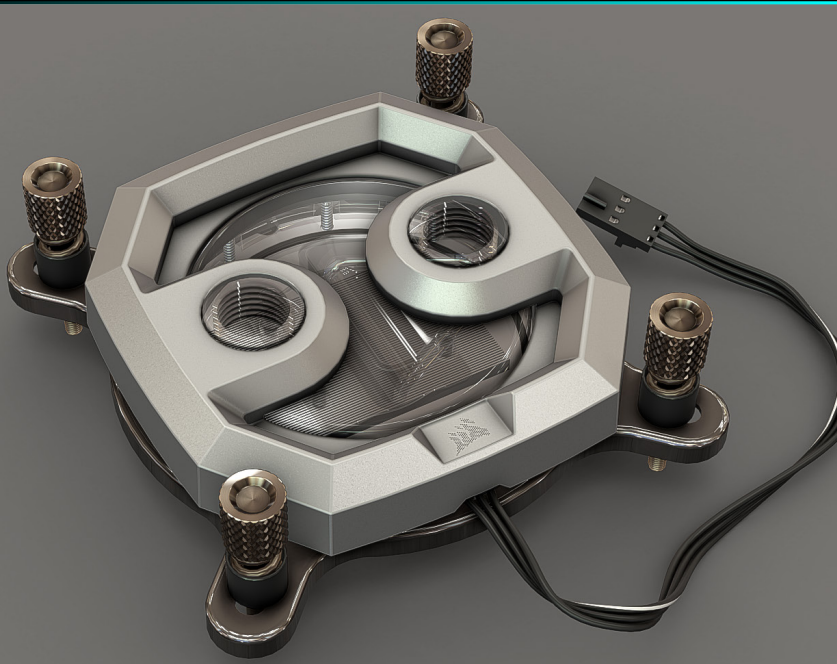
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■ CPU BLOCK

The CPU block sits atop the processor and absorbs heat from it. Its cold plate (the plate that sits directly on the processor unit) is usually made of copper or nickel-plated copper, both great conductors of heat. The bottom side of the block is incredibly flat, to ensure as much contact with the processor as possible, while the top side is covered in micro fins. These fins are in contact with water, and the machined pattern ensures a very large surface area over which the water passes.



The CPU block is installed in the same way as an air cooler. Additional thermal paste isn't needed on the processor, as Hydro X CPU blocks already include an optimal amount of factory pre-applied thermal paste on the cold plate.

Watch [this video](#) to see how to easily mount the water block.

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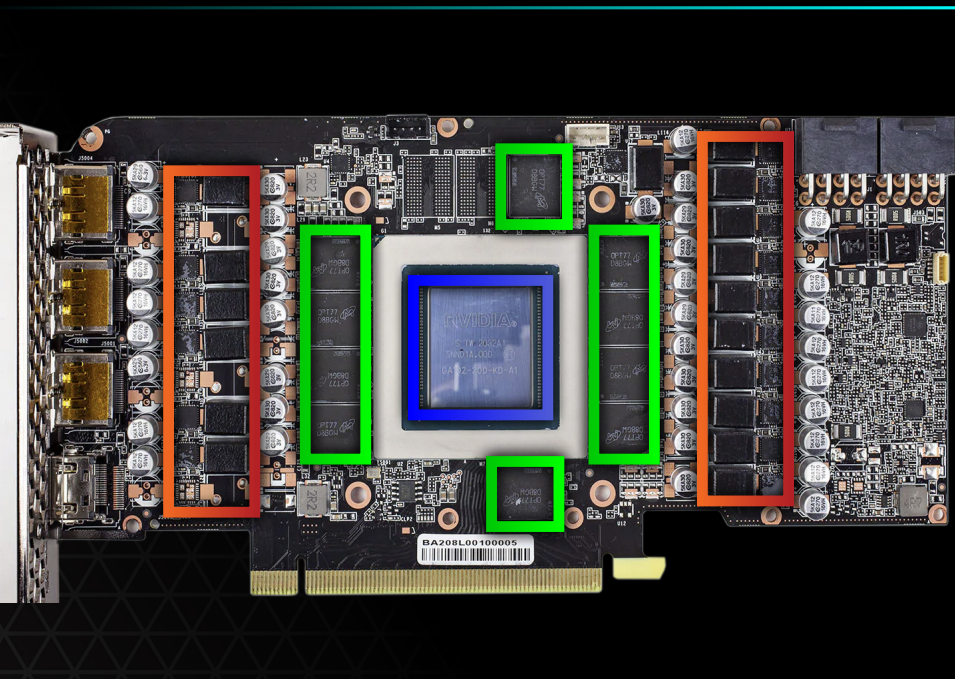
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■ GPU BLOCK

The GPU block is built to cool a graphics card, including the card's processor, VRMs, and GPU memory. Although the processor generates the most heat, all these components need to be effectively cooled to ensure peak performance under heavy loads. As graphics cards get bigger with every generation, performance cards take up a lot of space in a PC case. Manufacturer air coolers are getting longer and thicker to cope with the generated heat. Water cooling can get around this expansion, since water cooling performance scales mostly with radiator size, and radiators are attached to the side of the case, rather than the card.

To install a GPU block, you first need to **disassemble the GPU and take off the air cooler** [↗](#), exposing the PCB. There are many YouTube videos showing disassembly for any specific card. Once the air cooler is off, it looks something like this:



In this example, there are three key components that need to be cooled if they're expected to perform. The blue is the processor, the green is the memory, and the red is the power delivery system. On a high-end GPU, all of these will get hot, so the cooler needs good contact between the block and these parts.

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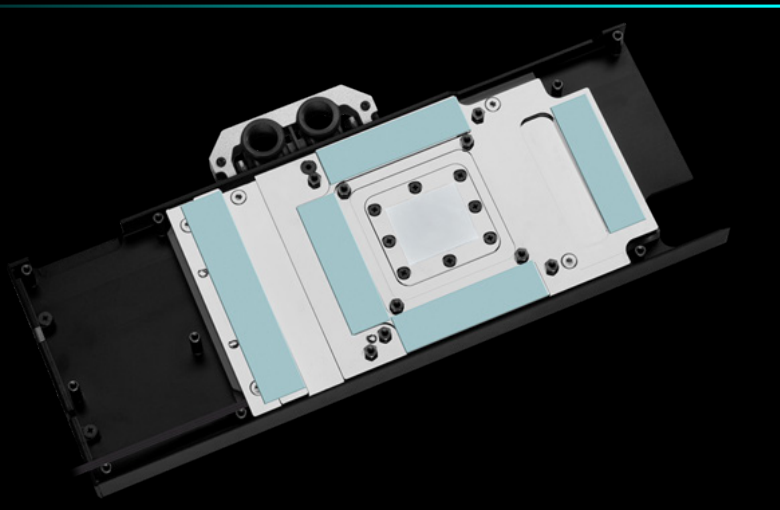
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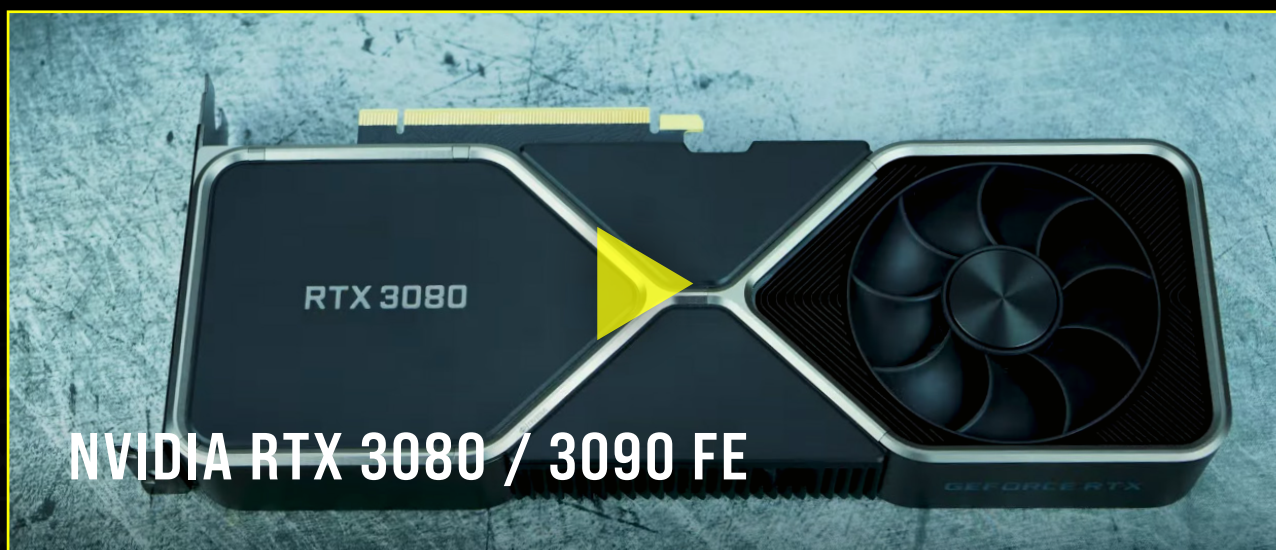
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This is why CORSAIR Hydro X Series GPU Water Blocks come with pre-fitted thermal pads for specific graphic card models to ensure that no hot spots on the board are left without adequate cooling.

To learn more about how to install CORSAIR Hydro X Series water blocks on graphics cards, see the following video:



NVIDIA RTX 3080 / 3090 FE



NVIDIA RTX 20-SERIES



NVIDIA RTX 3080 /
3090 VENTUS

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■ PUMPS

Custom cooling pumps are commonly integrated into the reservoir assembly. They circulate the coolant around the loop, and the volume of coolant they move depends on the cooling currently required by the PC. It's perfectly normal to see a pump doing almost no work when the computer is idle and CPU and GPU temperatures are cool. The pump is driven automatically with the help of iCue smart pump control, but you can, of course, tinker with the settings and define how the pump responds to temperatures and how much coolant it moves to cope with the load.

The primary difference between the available CORSAIR Hydro X Series pumps is size. They both include reservoirs, and the XD5 RGB is likely the most recognizable from iconic builds (including the one above in this document). While the XD5 RGB looks great, not everyone uses a case large enough to fit it. When space is a concern, the smaller XD3 RGB Pump / Reservoir Combo is the perfect choice.



Choose your pump and reservoir based on your preferred look, and, of course, what fits in the chosen case. The pumps include mounting brackets, which easily attach to the radiator fan or other case fan locations.

Sidenote

Pump performance isn't a concern unless you plan to run an industrial-sized cooling setup. Both Hydro X Series pumps are capable of moving volumes of water many times greater than you likely have in your case.

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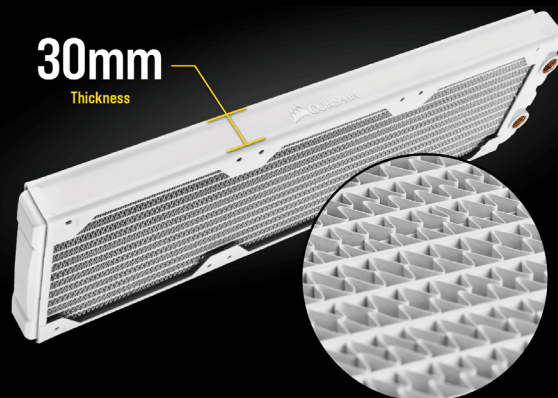
See the following video on how to install a pump and reservoir:



■ RADIATORS

Radiators in a water cooling system take the place of air cooler fins. The coolant that's heated in the CPU and GPU blocks is routed through the radiator, where the fins ensure a large surface area through which heat can dissipate. CORSAIR Hydro X Series radiators are built with a copper core, which further increases the thermal conductivity of the radiator.

You can choose the number and dimensions of radiators in your case. Radiator dimensions are defined by two factors – the length and the thickness of the radiator. Lengths are usually expressed in millimeters, but as a rule, the dimensions are a multiple of the number of fans attached to them.



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Sidenote

The most common fan size in performance PCs is 120mm (4.7in), expressed as the diameter. That means a 120mm radiator fits one fan, a 240mm radiator will fit two fans, and a 360mm radiator will fit 3 standard fans. There are also larger fans, with a diameter of 140mm, which then leads to radiator sizes of 140mm, 280mm, and 420mm, respectively.

The second dimension to consider is thickness. Radiators come in 30mm or 54mm sizes, with 30mm being more common. More thickness means more surface area, but there can be drawbacks to using a thicker radiator too. Not all cases and fans can manage the larger flow obstruction very well, so unless there's a specific reason to install a 54mm radiator, the basic 30mm should suffice.

You can also choose the number of radiators you want to use. Most mid-tower cases can fit one or two radiators, while some of the bigger ones can manage even more. Check our **CUSTOM COOLING CONFIGURATOR** [↗](#) and see how many radiators your chosen case (and components) can manage.

■ FANS

In a basic air-cooled computer, fans are used to exchange the air in the case with the air in the room outside it. They usually do so through openings with minimal obstruction, such as grills and air filters. In a custom loop, the fans serve a double purpose. They still move air out of your case, but they do this by pushing air through radiators (which cools the radiator and the coolant liquid inside it). This means that fans need to be able to produce enough static pressure to move air efficiently.

Airflow vs noise

Fans should move as much air as possible while keeping noise low. It's a basic tradeoff – a fan that spins faster becomes louder. That's why manufacturers of high-quality fans go to great lengths to develop new bearings and blade shapes to deliver more and more airflow while keeping noise under control. CORSAIR's highest performing fans, the CORSAIR ML Series, are built with magnetic levitation bearings, which generate far less noise than ball bearings while offering better long-term reliability than sleeved bearing fans.

Airflow vs static pressure fans

Generally, fans move air in one of two ways. One is high airflow, and the other is the creation of static pressure. Think of it as blowing out a candle vs. blowing up a balloon. You can blow out a candle simply by moving air, but blowing up a balloon requires air pressure.

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Airflow fans are generally meant to move large volumes of air in an environment with no resistance. For example, this would be an exhaust fan blowing air out of the case without the need for a dust filter. The static pressure fan is designed to create enough air pressure to force air through filters and radiators.



Figure 1: Airflow fan design



Figure 2: Static pressure fan design

These days, most fans are rated well for both airflow and static pressure.
Just make sure not to put a fan that looks like the one on the left in front of a radiator and dust filter.

Stator vane fans

Traditional fans generally exhaust airflow in a wide cone and direct most of the air to the outer rim of the cone. Water cooling relies on fans moving air across as many radiator fins as possible, so this presents a challenge. Stator vanes are directional guides that combat this phenomenon. They redirect airflow into a narrower and more equally distributed cone. In simple terms, fans with stator vanes make sure that a greater number of radiator fins receive the airflow they need to operate at their highest efficiency. There is a common misconception that static pressure is all that matters for radiator fans, but the results below speak for themselves.

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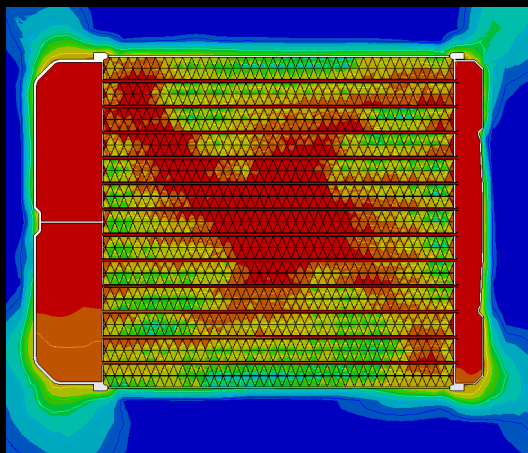


Figure 1: Static pressure fan

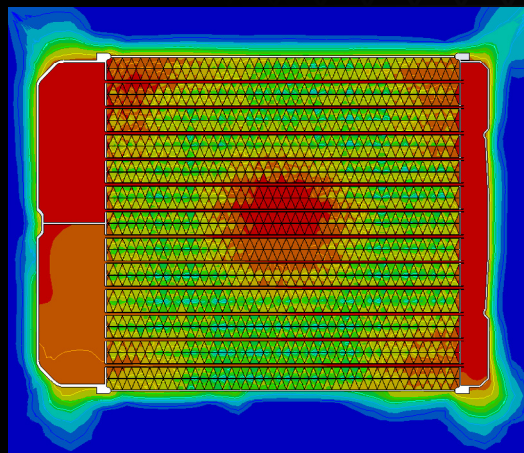


Figure 2: Stator vane fan

Push or pull?

This is the eternal discussion in gaming forums and subreddits. Fans on one side of the radiator can push air through, or on the other side, pull air through the radiator, or fans on both sides can do both (just make sure to have them turned in the same direction).

■ COOLANT

Coolant in a system needs to meet three requirements. It needs to efficiently transport heat from water blocks to the radiators, it shouldn't chemically react with other components in the loop, and of course, it should match the aesthetic of your finished system. It's very important to choose a coolant that has been tested for compatibility or, at the very least, is specialized for PC cooling, rather than tap water or distilled water.

Coolant needs to circulate in the system, resist algae contamination, and be non-reactive with all the copper, nickel, and plastic elements present. A list of tested, compatible coolants with all CORSAIR water blocks and pumps can be found [here](#) . Of course, we recommend CORSAIR Hydro X Series performance coolant – we've tested it more than any other coolant, and it works great in every machine in our office.

When selecting coolant from a compatible product line, consider the build's desired look.

First, there is a choice of transparent or colored coolant. If you don't like the look of the one you chose, you can easily drain your system and replace it with a different one. On the other hand, if you're undecided about the look you want to achieve, you can't go wrong with transparent coolant (again, don't use distilled or tap water). The color of the case can be changed by tweaking the RGB profile, and transparent coolant won't clash with any RGB lighting or mood.

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Sidenote

We don't recommend pastel coolants, as they tend to be somewhat unpredictable over time. The pastel color particles can separate and settle in a system, clogging up water block fins. This reduces coolant flow over the heat dissipation surface and would require a fairly arduous draining and manual cleaning process to get back to optimal cooling performance.

We understand how cool these pastel coolants can look, so we made sure that look is achievable with special satin hard tubes.

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■ FITTINGS

Fittings connect components to tubing, and they also help angle connections, set up drain valves, or split one flow line into two. The type of fittings depends on the choice of soft or hard tubing. Fittings ensure watertight seals differently with these types of tubes, which means that you should choose specific compression (for soft tubing) or hardline fittings.

Follow the guidance of the **CUSTOM COOLING CONFIGURATOR** [↗](#), where you can select the tubing type in the final overview of the system's specifications, and the configurator will adapt the part list to reflect the type of tubing you chose.



At this point, you've probably thought about the tubing type you're comfortable with, and coolant color. You can choose fittings in a color that matches your desired look, from white and black to match your case to silver and gold to realize a specific vision.

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CHOOSING YOUR COMPONENTS

When setting up your custom cooling system, component choice can be difficult. Choosing all the custom loop parts and making sure everything is compatible with your other PC components is hard enough, but how does it fit in your case?

That's why we've built a **custom cooling configurator** [✦](#) that can help determine the exact cooling loop pieces you need, as well as make sure that they're all compatible with other components. The system also makes sure they all fit in your case and calculates the heat output of your machine, adapting the cooling to support it.

Best of all, anyone can do it in a few minutes. Simply choose a case, motherboard, CPU, and graphics card from our extensive list of parts, and our cooling configurator will offer up to three setups. Each setup is calculated to ensure the system can extract enough heat to support components and fit in the chosen case.

Configurations can be saved to access later, and you can also download a complete parts list and price quote for your custom cooling loop.

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HYDRO X SERIES

CPU WATER BLOCK

CPU WATER BLOCK

COOLING PERFORMANCE

FAN STYLE

PUMP STYLE

CUSTOMIZATION

RGB

AIO-DIG

CONFIGURATION OVERVIEW

Total €973.99

GO TO MY ORDER

GO TO CONFIGURATION LINK

SELECT YOUR LANGUAGE

ENGLISH

SELECT YOUR LOCATION

EUROPE

ADD TO CART

CONFIGURATION OVERVIEW

CPU WATER BLOCK

1 x XCF RGB (200/140) - Black

€84.99

€104.99

GPU WATER BLOCK

1 x XCF RGB PE (200/140)

€169.99

€189.99

COOLING PERFORMANCE

2 x XR5 360mm Water Cooling Radiator

€157.80

€157.80

FAN STYLE

€167.40

Total €973.99

COMPARE

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CORSAIR 5000 SERIES

HYDRO X CUSTOM COOLING REFERENCE BUILD

ice build, using a reference design graphics card and the maximum radiator configuration set. This build does not sacrifice DRAM module or motherboard compatibility, giving you the widest choice of components. Visit [corsair.com/custom-cooling-configurator](#) to create your own custom cooling system.

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First-time custom cooling loop builders should probably [check out our custom cooling kits](#). The components in the kit are guaranteed to be compatible with each other, and they include the CPU water block, pump, tubing, fittings, fans, coolant, and radiator, as well as the basic tools needed to bend and cut tubes. The only things missing for a complete setup is a GPU block (you can find the specific one made for your graphics card in our store) and a heat gun, if you're planning to bend hardline tubing.



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ASSEMBLING THE LOOP

Before assembling a cooling loop, you need to assemble a PC.

We won't get into too much detail here, but check out our [video build guide](#) to get started.



When you're ready to assemble the loop, please refer to the [instructional video library](#), which will offer some general tips, build instructions, and even specific how-to videos on installing a water block, filling a system with coolant, maintaining the system, and many more.

There are many videos by pretty much all the major YouTube channels with detailed builds and guides, but first-timers might save some time on tube cutting, measuring, and experimenting by following this tip: once the motherboard, processor, and GPU are installed in the case, first position the components without screwing them in too tightly. Line up components, assemble the tubes and fittings, and if one of the tubes is a little bit off, you can usually shift the pump a bit higher or lower or slide a radiator an inch forward. Once you're comfortable with the tube lengths and routing, screw the components in their final places, tighten all the fittings, and fill the loop.

When filling the loop for the first time, you should put down some paper towels around the fittings and on the PSU shroud. If a fitting isn't tightened enough, it might leak tiny droplets – if so, shut down the system, retighten the fitting, and retry. Drips are rare if you follow instructions and guides, and anything more than that is even rarer.

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MAINTAINING THE LOOP

Whenever following custom cooling forums and subreddits, you will come across pictures and stories about coolant degradation or contamination. Whether it's from unapproved coolants or algae growth, these systems start getting cloudy brown contamination, and need to be flushed and cleaned.

Of all these issues, algae growth is the hardest to clear up since you need to completely clean every part to remove all traces of biocontamination before refilling the loop. This issue can be prevented by following some basic instructions.

There are many little crevices and gaps in a system where algae can settle, and as with any biological culture, if one is left behind, it will soon find a way to multiply into a thriving community. Put in simple terms, algae is an unlikely problem, but one that keeps coming back.

Some best practices to prevent and remove biocontamination are listed below. The best way to deal with custom loop biocontamination is to avoid it in the first place. It's worth taking some simple precautions in advance to prevent a headache later on. Avoid two factors of biocontamination: introducing the culture (algae) into the loop and providing the "food" that it needs to grow.

Keep it clean

Surgeons carefully wash their hands, wear masks and gloves, and use disinfected equipment for one (main) reason: to prevent a small infection from entering the patient and growing into a dangerous problem long after the surgery is over.

Custom cooling loops are similar – take every precaution possible to prevent the introduction of bio-contaminants into the loop as you build:

- > Always use clean components. If needed, especially after a coolant replacement or if the components were sitting in storage for a while, wash them with soapy water and rinse them with distilled water before installation.
- > Tap water is not your friend. It includes algae and bacteria which might be safe to drink but will make a custom loop their new home. After washing components with tap water, always rinse the complete loop with plenty of distilled water.
- > Wash hands thoroughly before handling custom loop parts and plug any holes in components not currently in use.

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