Lord Kryo Puts His Hands on 17 Coolers

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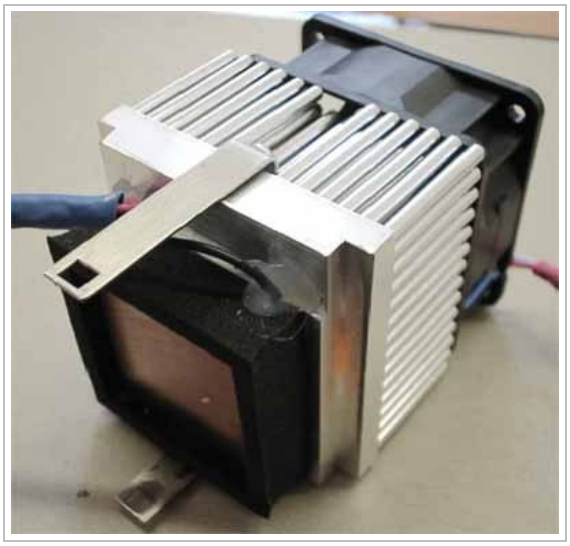
Often Ignored - Perfect Cooling Of The CPU

Hundreds of emails from readers are proof enough. Successful overclocking will fail if you have an unsuitable CPU cooler. This small but important part is often overseen when you want to tune up and overclock your PC system. Especially the new AMD Athlon processors are very delicate when it comes to heat. They do not have an integrated thermal protection such as Intel Pentium III CPUs.
Another problem that many PCs off the peg represent is a low budget cooler. Often these coolers are optimized for low cost instead of giving a good thermal solution. We took this fact as reason to test 17 coolers designed for socket-based processors. All coolers tested are suitable for socket462 (AMD Athlon and Duron) and Socket370 (Intel Pentium III and Celeron) as well as for the older but nonetheless still popular Socket7 (AMD K6-2 and K6-III).

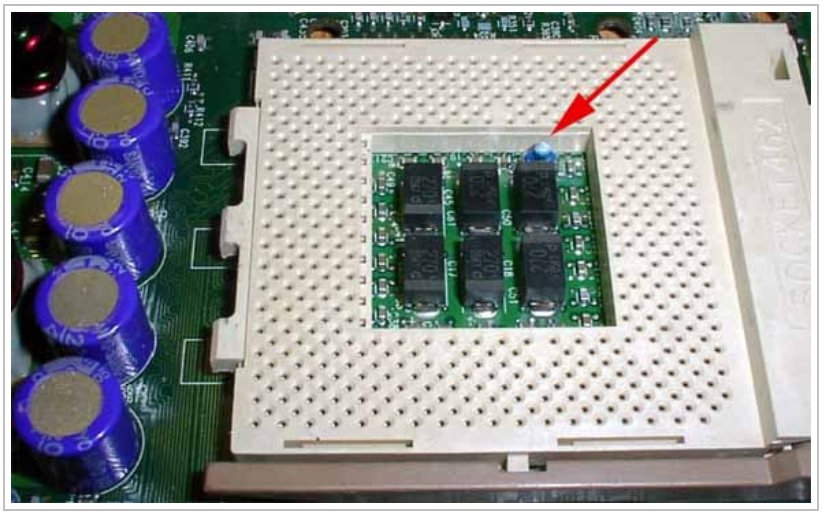


Indecisive! Swiftech withdrew their cooler based on a Peltier element from the roundup.

The minimum requirement for the performance of a processor cooler is everything else but trivial: The cooler shall provide the best cooling effect possible. That means it has to conduct the heat off the CPU core. This has to happen very quickly. Otherwise excessive heat is building up, leading to the destruction of the processor. In addition to that, there is another requirement. The noise of the cooler should not disturb you in any case. Therefore, it is not surprising that cheap coolers, which can be found everywhere in the shops, turn out to be of rather poor design. These cheap products can easily be identified. The heat sink of the cooler is made of cast iron instead of aluminum or copper and the fan comes without a acceptable bearing. Already after very short time the cooler quits its job and ends where it should - in the rubbish possibly taking the CPU with it.

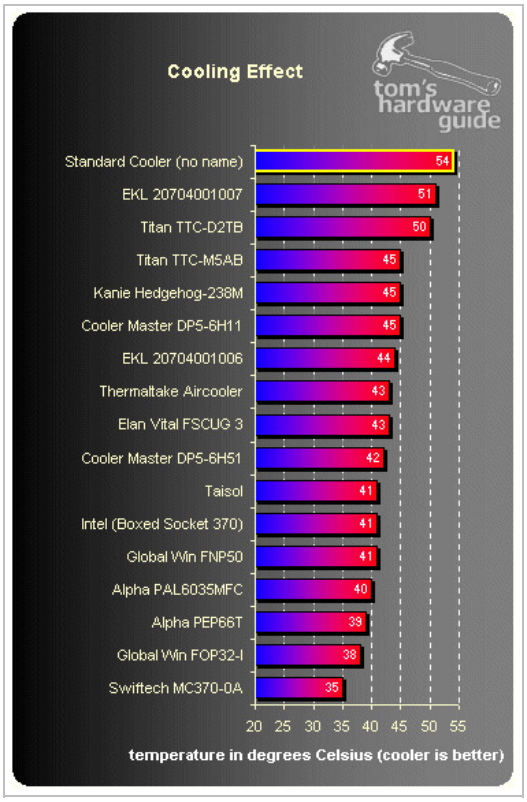
Evaluation Of The Cooling Effect - The CPU Temperature

First job of a cooler is to keep the temperature of the CPU die as low as possible. In order to determine this temperature we chose the AMD760 reference board as our testing platform. With the temperature sensor shown in the picture we determined the temperature near the CPU core.



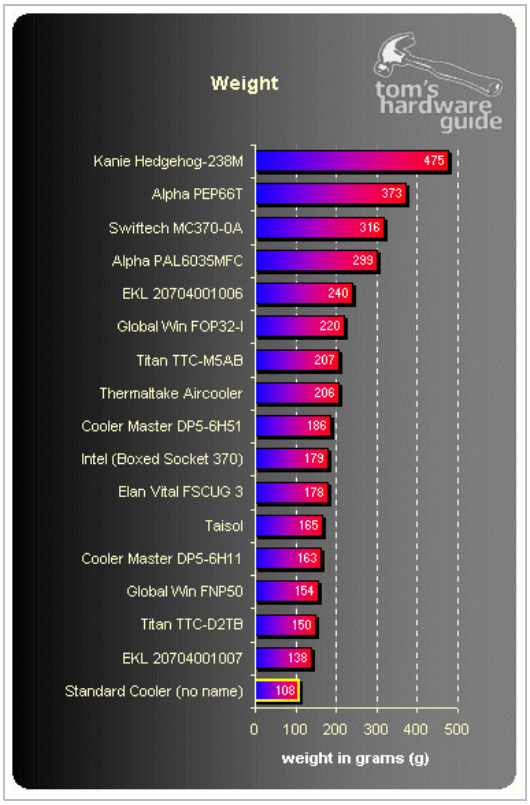
The AMD760 reference board gave us the chance to determine the CPU temperature very precisely using a sensor inside the socket462.

Every candidate was tested on an Athlon 1.00 GHz under ambient temperature conditions of 23 degrees Celsius. The CPU temperature was checked after 10 minutes of a defined test run. We originally planned to take the temperature with a laser-measuring device without any contact to the CPU. But a couple of tests proved that the determination of the temperature with the sensor of the AMD board was much more precise than the laser method. The average error of the measuring was less than 1 degree.



Weighing It Up - The Maximum Is 300 Grams!

AMD specified a maximum weight for coolers on socket462. This is 300 grams. The weight of a cooler is important for PC manufacturers that ship PC systems. Often enough there can be centrifugal forces or shocks that pull a heavy-weighted cooler off the socket.
Especially a powerful cooler with a massive heat sink can cause severe damage to a PC system and destroy all the parts built in. Because of this, heavy models such as the Kanie Hedgehog or the Swiftech have to be packed separately before transportation. You can find the weights of the coolers in the following table.



Thermal Conductivity - Discussing The Heatsink Material

The heatsink material is the most important as far as the performance of cooling is concerned. In principle, the heat sink can be made of different materials. The thermal conductivity is one important issue. The following comparative table shows the thermal conductivity of different materials.

Material	Thermal Conductivity
silver	422 W/mK
copper	402 W/mK
gold	298 W/mK
aluminium	226 W/mK
steel	73.3 W/mK
lead	34.8 W/mK

At first glance it is obvious that silver and copper have the best conductivity. As silver is too expensive for a massive heat sink, the manufacturers at best use copper. Using aluminum is cheaper but the conductivity is by far not as good as copper. That means silver and copper spread the heat very quickly. These two materials offer the best quality for a high cooling effect in a heat sink/fan system.

Well designed: Elan Vital's cooler is equipped with a copper heat spreader. In addition to that, it has cooling foils made of aluminum.

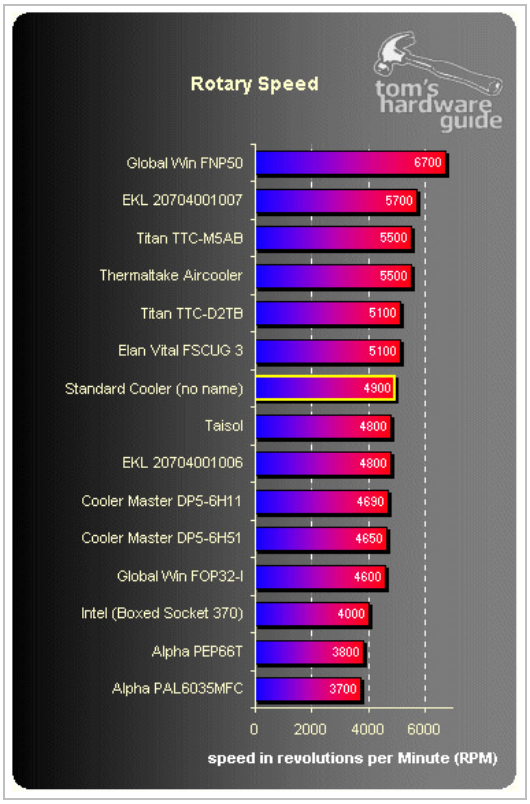
Engineering Art - The Design Of A Fan

The design of the fan, which is situated on top of the heatsink, always bears a conflict. On the one hand the user wants a high air flow, on the other the cooler should not make too much noise due to friction or whirling. Unfortunately, the air flow depends on the RPM rate and the size of the fins.
The perfect solution would be a clean path for the air with little whirls at the entry area and outflow area. An example for a badly designed solution regarding airflow are the radial coolers made by Thermaltake and Titan. At first glance they look pretty "cool", but in reality they both have a mediocre cooling effect.

Bad example -the Thermaltake Aircooler looks interesting but does not reach any high cooling effect. There is too much distance between the fins and the processor.

Do Revolutions Matter?

We checked the RPM rate of each test candidate. We found out that high RPM rates do not always mean much noise.

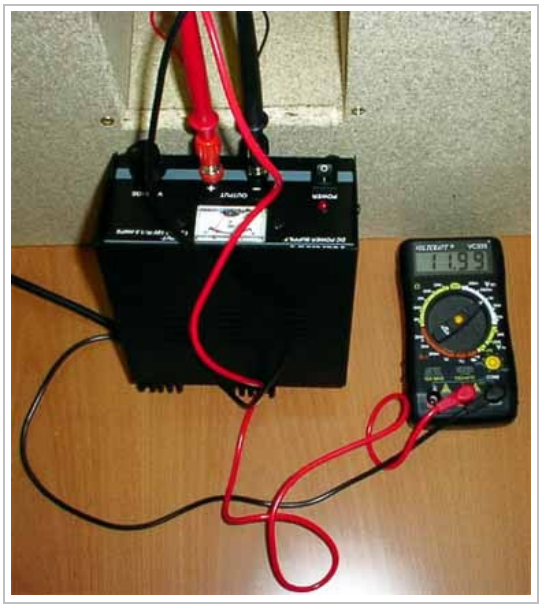


The "small" Global Win is the fastest cooler with 6700 rpm. The others lie between 4000 and 5000 rpms.

Sound Level - Whistler Or Noise?

The noise of a cooler during operation is an important aspect. This is depending on the friction and the air flow. The unit for "noise" is decibel dBA. Note that the scale is logarithmic. A difference of 10 dBA means that it is two times louder!
We ran our noise tests in our sound chamber using a sound level meter. The following two pictures show the test methodology.

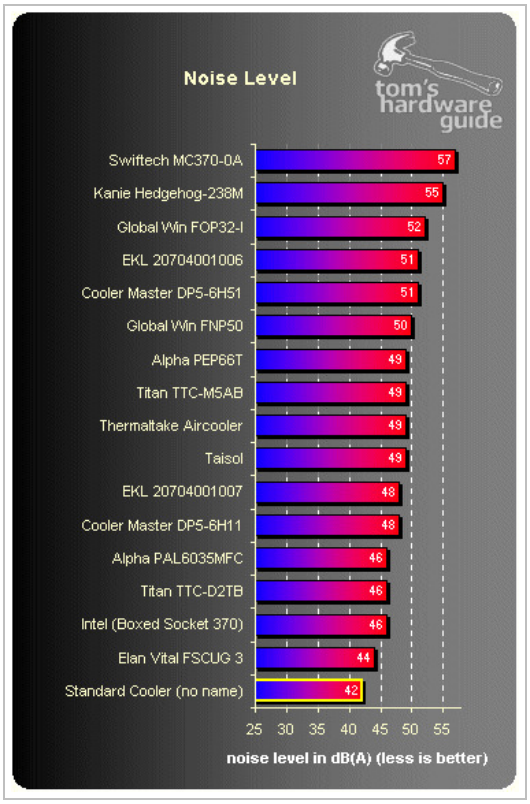
Our miniature sound chamber has enough space for a motherboard, hard disk or even a CPU cooler. The noise level is determined in the middle above the CPU cooler at a constant distance.



The power supply is located outside the box and is steadily monitored.

Sound Level - Whistler Or Noise? Continued

With this measuring device we determined the noise level (dBA) of all coolers.
The results show it clearly: The cooler with the best cooling, the Swiftech MC370-0A, is also the loudest one with 57 dBA. The cheap standard cooler is a real whistler producing only 42 dBA. A good compromise would be the one from Elan Vital. This cooler offers the lowest noise level among all test candidates with 44 dBA but it provides good cooling at the same time. Another good cooler comes from Intel with 46 dBA, which is excellent, too. The following table shows the results of all coolers.



Standard PCs Are Only Equipped With Cheap Coolers

The standard coolers, which you can find in most PCs, are not suitable at all for overclocking. Who plans to tune up his system by overclocking has also to consider that the CPU gets a powerful cooler. Otherwise the CPU will heat up too much by overclocking and a cheap cooler cannot handle these amounts of heat.

You can easily see the difference between quality models and no-name products as you can find them in discount PCs. The heatsink of every cheap cooler is usually made of cast steel. It works with a fan of simple design which has to work without any special bearing mechanism. The parts are made of plastic often show burrs and a good contact between cooler and CPU cannot always be guaranteed.

Battle Against Thermal Death: The Optimal CPU Cooler

How can you characterize the optimal CPU cooler? For this you have to know that there are two thermal interfaces. One is the junction between the die of your CPU and heat spreader, the other is the thermal resistance between surface of the cooler and the ambient air.

Let's have a look at the heat spreader that touches the die of your processor. You have to make sure that this junction has a good thermal conductivity. Any gaps impair the cooling effect, no matter how good the cooler is designed.

The major role is played by the spring bracket that you attach to the socket in order to press the heat sink onto the die. Sometimes, micro-gaps can't be avoided. Perfect smoothness can never be achieved because any material has certain ruggedness on the surface. Furthermore, the pressure of the bracket is unequally distributed.

You have to apply cooling paste to seal off any micro gaps. An alternative is also a thermal pad, which is basically a piece of adhesive tape with high thermal conductivity stuck to the heat spreader.

Now the distributed heat has to get absorbed by the ambient air. Two criteria are important - the surface area and the air flow. If you believe it or not, the material only plays an inferior role here. For example a copper heatsink can be worse than an aluminum one if the surface area of the copper cooler is smaller. Our tests prove it as you can see in the results.

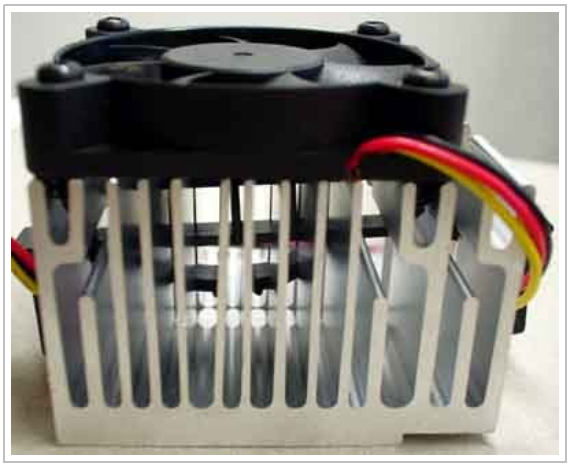
Single Results: 17 Coolers To Be Tested

Cooler Master DP5-6H11 And DP5-6H51

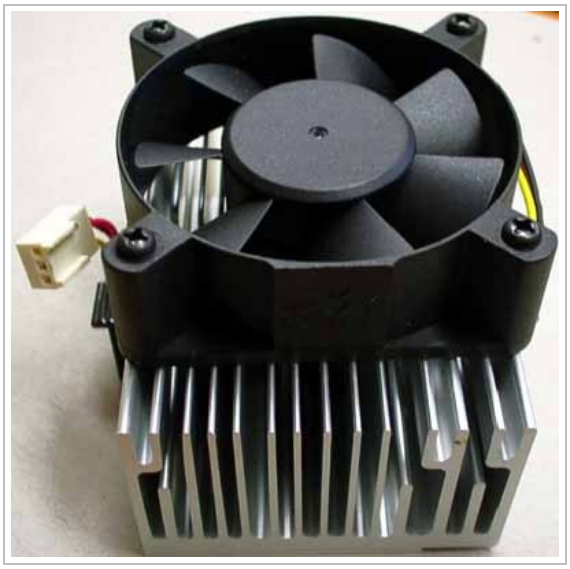
Cooler Master 6H51.
Both coolers have the same heatsink. The only difference is the size of the fan. The bigger fan achieves better cooling results so that DP5-6H51 turned out to be the victor between the two. Cooler Master already has a good reputation among PC manufacturers owed to the well-priced products.

Cooler Master 6H11.

EKL 20704001006 And 20704001007

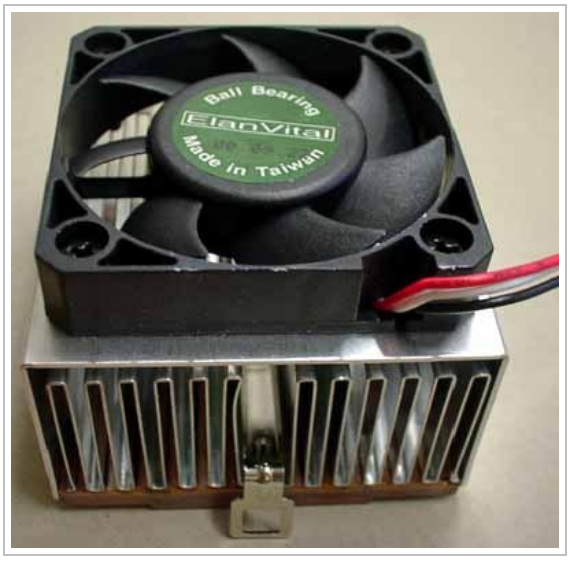


EKL 20704001006.
The names of these coolers are very cryptic. We still haven't figured out what they actually mean - only EKL seem to know the answer. Remarkable issues are the mountings, which are made of plastic and can break very easily under frequent use.
The small EKL differs from the big model by the size of the heatsink and fan. Due to its poor cooling results the small model is not suitable for Athlon CPUs. Please note that EKL seems to be some kind of cooler-OEM. The actual heat sinks and fans are both made in Taiwan and it seems likely that the design of the EKL-coolers is of Taiwanese origin as well.



EKL 20704001007.

Elan Vital FSCUG 3



Elan Vital FSCUG 3.
Among all candidates in the test the model from Elan Vital has a very compact design and belongs to the featherweights in this test. This cooler is technically very well designed. The cooling fins are arranged like lamellas, offeriong a large surface area. A big plus is the practical mounting which ensures uncomplicated installation. Due to its relatively small size it does not offer perfect cooling and a better test result at the same time.

Global Win FNP50 And FOP32-I

Global Win FNP50.

A striking feature of both models are the big and efficient heat sinks made of aluminum. With their cooling power both contestants can find themselves on upper places within the test range. FOP32-I is second. Even the small FNP50 performs well due to the high RPM rate of its fan. Both coolers represent a good compromise between heat sink and fan.

Global Win FOP32-I.

Intel (Boxed Socket 370)

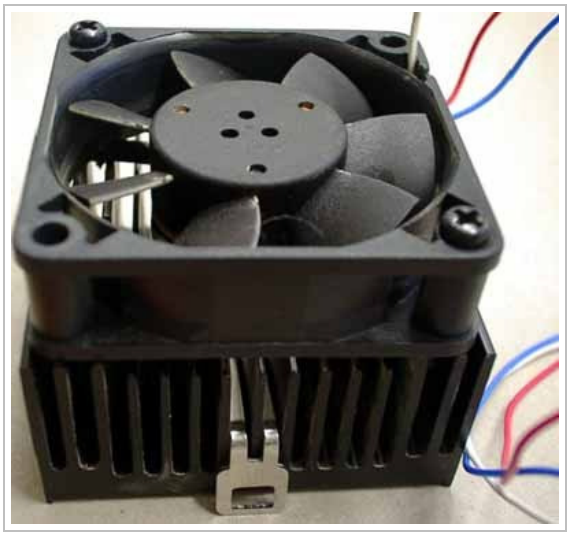
Intel (Boxed Socket 370).
This cooler is part of every Pentium III "in a Box" from 800 MHz upwards. The mounting clip is difficult to install. The cooling itself is very good so that this cooler would even be suitable for an Athlon CPU! This product is a good example that Intel took the time for good ideas in terms of cooling.

Kanie Hedgehog-238M

Kanie Hedgehog-238M.

The biggest disappointment is the Hedgehog-238M: Although it has a massive body made of copper, the Kanie cannot put this advantage of high conductivity into practice. The weight of 475 grams violates AMD's specifications, who only allow 300 grams, by far. Manufacturers of PC systems should not take this cooler because it is absolutely not suitable for transportation. Otherwise a loose Hedgehog would turn your PC interior into an expanse of ruins.

NoName Standard Cooler



NoName Standard Cooler.

The judgment about a usual cooler, which you can find in a discount PC, is easy: This featherweight made of steel is not suitable for Athlon CPUs. In our test this model delivered the worst results: The temperature of the CPU kernel went up to 54 degrees!

Swiftech MC370-0A

Swiftech MC370-0A.

The costly produced Swiftech turned out to be the candidate with the best cooling performance. It gave us a low CPU temperature of 35 degrees. The class A fan from Pabst brings enough air flow which unfortunately leads to a lot of noise. The body made of single aluminum parts is unique. Therefore, the weight goes up to 316 grams and this model also infringes the AMD specs. No question: This cooler is first choice for overclockers!

Thermaltake Aircooler And Titan TTC-M5AB

Thermaltake Aircooler.

Titan TTC-M5AB.

Both make a difference with their special design: The radial body promises a good cooling. Reality shows that it is not the case. Performance is below average. Both models have a good reputation among overclockers but the design is not optimal.

Both models turn out to be optical show makers. Furthermore, there might be the case that these coolers cannot be installed on some motherboards due to their size.

Taisol

Taisol.

This cooler reached us together with an AMD reference system. The cooling performance is identical with the Intel cooler. The low size of this model is striking, the fan comes with strong curved vanes. The Taisol is one of the lightweights with only 165 grams. Altogether a product of pretty average qualities.

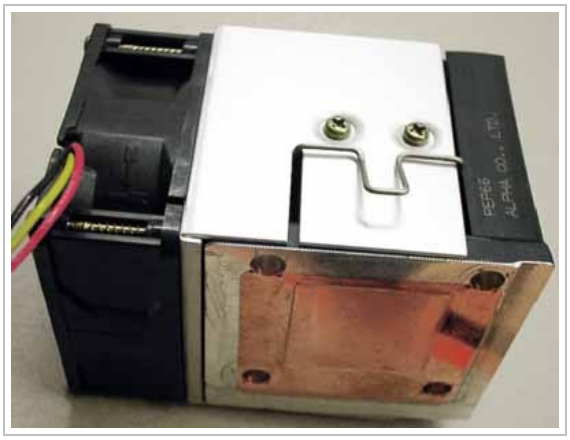
Titan TTC-D2 TB

Titan TTC-D2 TB.
This is one of the few coolers made of steel. Therefore, the cooling is not too good.

Alpha PAL6035MFC

Alpha PAL6035MFC.
The huge size of the Alpha results from a big, slow moving fan. Like the Swiftech model it has a body put together of single aluminum pins. Therefore, it has a big surface that absorbs the heat effectively. Due to its cooling performance of 40 degrees Celsius in our test, this cooler is number 4. The installation is a bit difficult as the mounting brackets sit very firmly.

Alpha PEP66T



Alpha PEP66T.

The powerful Alpha PEP66T needs a lot of space on the motherboard.

Conclusion: Optimal Cooling Is Always A Compromise

After our extensive tests we can say: Right now you cannot find the perfect CPU cooler in the market. The model with the best cooling result, the Swiftech MC370-0A, has two flaws. One is the noise, the other the weight. But it really convinced us when we measured a temperature of only 35 degrees Celsius near the die. Swiftech does not meet the AMD specifications regarding weight so that it cannot be shipped in a PC system.
The no-name standard cooler taken from a discount PC does not prevent the heat from going up to 54 degrees! We do not have to mention that such a cooler cannot guarantee a lifelong operation of your CPU. Nonetheless, all coolers tested present better features than any other cooler bundled with a discount PC system.
Among the candidates we found several "traps". Those two seem to be very promising by their looks but the performance was just poor. Practically they do not meet our expectations regarding cooling. These models are Titan and Thermaltake. Also the big Kanie Hedgehog-238M with its massive body made of copper is nothing special compared to others.
In order to make the choice easier for you we would like to recommend two models: **Swiftech MC370-0A** presents the best cooling performance and should bring a lot of fun to overclocking freaks. The **Global Win FOP32-I** could convince us as well. This model meets the AMD specs with 220 grams and it shines with a good cooling performance.
Users who are looking for an easy installable cooler with well-balanced feature set should consider **Elan Vital's FSCUG 3** . The only reason why this well-designed model with lamella-fins can't compete with the other models is its compact layout compared to the big size models of the top league.

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