

## Overland Journal: Air Compressor Test

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# Air Compressor Test

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The pressure is on:

*Overland Journal* puts six 4WD and four motorcycle compressors to the test.

My first portable air compressor was a gift from a well-meaning but non-automotive-oriented friend. The yellow plastic contraption boasted not just a compressor ("250 psi!"), but a built-in gauge, a flashlight and a red hazard blinker, nozzles for inflating beach balls and pool toys, and a couple other attachments I've forgotten. I swear there was a bottle opener on it somewhere—which would have been its most useful accessory, given the Pleistocene-like interval the thing took to inflate a stock All-Terrain from, say, 16 psi to, say, 17 psi, while vibrating in circles like an enraged Chihuahua.

Alas, it went to Goodwill days after I got it, and so could not be included here for baseline data/comic relief.

A reliable, powerful air supply is the last component of the tire repair process I have explored in the last few issues of Overland Journal. Nearly as importantly, and far more frequently, an air supply allows you to properly reduce pressure in your tires on the trail to enhance traction and flotation while reducing erosion, and then quickly air them back up to safe levels for driving on pavement. If the supply produces enough volume, it can be used to reseal tire beads. With a nozzle you can clean small parts or blow impacted grass out of a radiator.

Essentially, air on the trail can come from one of two sources: a pressurized storage tank—usually liquefied CO<sub>2</sub>, since it stores a much higher volume than atmospheric air given the same size tank, at a lower (safer) pressure—or a compressor, which can be either electric (usually 12-volt DC) or engine-driven via an auxiliary belt. (A compressor can also be plumbed through a modest air tank to provide a regulated supply of air to run air tools, and some compressors have a small built-in reservoir to operate air-locking differentials.)

I decided to confine this test to 12-volt DC compressors, which I believe are generally the best choice for overland journeys, especially extended expeditions. They are compact, and available across a wide spectrum of power and output to suit different budgets and needs. Most 12-volt compressors can be installed either in a hard-mount configuration—bolted somewhere in the vehicle and wired directly—or purchased as a portable kit that includes clip-on battery leads, a hose, and a case, making it simple to move from vehicle to vehicle.

I excluded the engine-mounted, belt-driven units (such as the Kilby) that employ a modified AC compressor, which, while very powerful, require special brackets, increase complexity and reduce accessibility in the engine compartment, and cannot be quickly moved to different vehicles. (That doesn't mean they aren't worth considering, just that they didn't fit my current parameters.) I also excluded the excellent Oasis 12-volt DC compressors, which are extremely powerful, extremely heavy, and extremely expensive—probably overkill for most overlanding use unless you want one compressor to service a group of vehicles, or are driving something with very large tires such as a Unimog. Finally, I also excluded CO<sub>2</sub> tanks. They are excellent in many ways—I used one for several years, and was always impressed with the fast, quiet operation. There's no electrical draw, and no connections to worry about—just open the valve and go. They're easy to move from vehicle to vehicle, will run air tools and reseal beads easily, and on a cfm-per-dollar basis they can't be touched by any compressor on the market. The problem with CO<sub>2</sub> is, it runs out—and guessing when and where is the rub. Yes, you can weigh the tank and estimate, but it's imprecise, and you've still got a finite supply and are tied to outside sources—common in some areas, nonexistent in others. The cfm-per-dollar advantage doesn't count the cost of refills. A CO<sub>2</sub> tank is worth considering if your travels are restricted to North America, but if you plan journeys farther afield, or just want complete independence, a compressor is the way to go.

We received six 4WD compressors to review (see following story for the four motorcycle-specific models). Three of the 4WD units—the ARB, Warn, and Quick Air, arrived as bare units, and three—the Expeditionaire, the ExtremeAire Magnum, and the Viair, were furnished

as portable kits that included battery cables and air hoses. Every compressor employs essentially the same configuration: a 12-volt DC electric motor powering a piston-actuated compressor. The piston is not what you might be picturing; that is, the reciprocating, tuna-can-shaped internal-combustion piston that goes straight up and down. Most small air compressors employ what is known as a WOB-L piston: a flattened disk attached rigidly to a connecting rod with no wrist pin (it's also called a fixed piston). A WOB-L piston actually wobbles back and forth slightly since it's one piece with the rod, and the up-and-down movement (stroke) is relatively small. Thus friction is minimized, less heat is generated, and the piston does not require oil lubrication. (The exception here is the Quick Air, which does use standard pistons that are oil-free.) Inlet valves are normally simple flaps of metal or composite material; outlet valves can be a flap or a poppet valve.

While efficiency varies somewhat among different compressor designs, in the end you can't cheat the laws of physics. A faster, more powerful compressor will usually draw more amperage than a slower, less powerful unit. The trade-off is that the quicker unit will draw power for a shorter time, so the total drain on your electrical system might be more or less the same. Another inescapable result of physics is that the higher the pressure, the hotter the compressor will get. Tires that take 60 psi road pressure will put more stress on a pump than tires that take 40 psi.

Many compressors have a duty cycle—a ratio of work time to cool-down time. For example, a 50-percent duty cycle means that for every specified interval you run the compressor you must let it cool down for an equal interval. Duty cycles are rarely a factor when you are working on a single vehicle, but if you want to air up several you might overextend the rated run time. Most compressors also incorporate a thermal cutoff switch that will temporarily shut down the unit if it overheats.

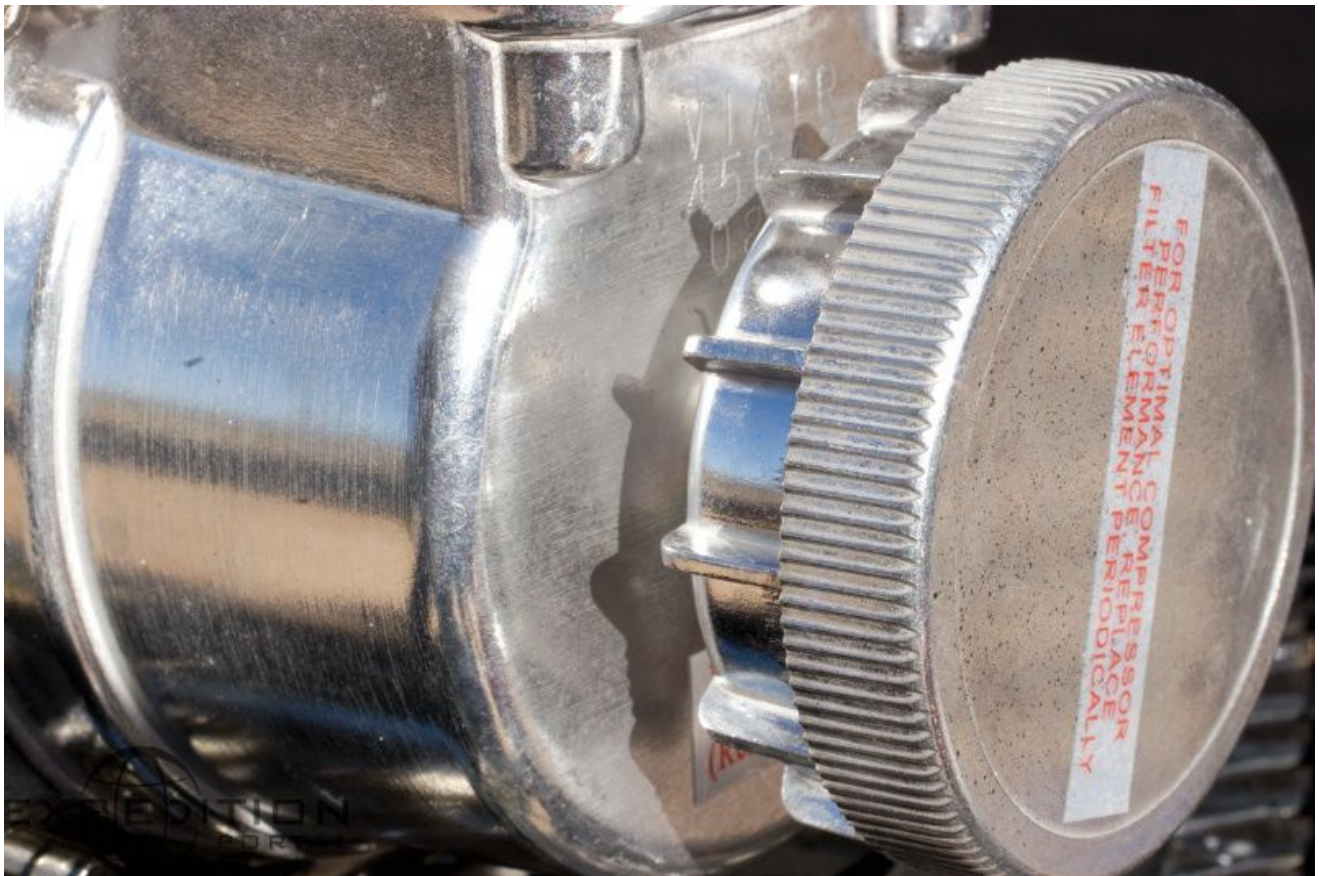
Don't pay much attention to advertised maximum psi (pounds per square inch) ratings. It's unlikely you'll need more than 100 psi for any overland application. Volume in cfm (cubic feet per minute) is more relevant, but again, cfm at 0 psi doesn't mean much. Look for a volume rating at 50 or 100 psi to get an idea of the compressor's true capability.

## Test Procedure





I put the compressors through several trials, starting with the 4WD units (see page 49 for motorcycle specific compressors; test procedures were similar). First, I timed how long each one took to fill a 255/85/R16 BFG Mud-Terrain from dead flat (valve core removed and replaced) to 35 psi, with the wheel and tire off the vehicle. Next, I timed how long it took to re-inflate four tires the same size, on the vehicle, from 15 psi to 35 psi, replicating a typical air-up procedure. Finally, I attempted to reseal the beads on the same 255/85/R16 tire, after unseating them with Tyrepliers. While I also timed this procedure, the results didn't weigh in my rankings—there are too many variables in how the tire is seated and how good the initial seal is to result in a consistent comparison. During each test, I monitored the power consumption with a Snap-on EEDM56CK digital multimeter and a 400-amp clamp-on probe, which recorded both average and maximum draw. I also monitored the temperature of the head of the compressor cylinder—usually the hottest spot on the unit—with a Snap-on RTEMP25B remote-reading infrared thermometer. Ambient air temperature during the test varied between 72°F and 78°F, so there was little exterior heat stress involved. I used an inline dial gauge supplied by Viair to obtain instantaneous pressure readings. If possible, it's always a good idea to run the vehicle's engine while using a compressor, even if you have a high-capacity auxiliary battery. A battery in a non-running vehicle will usually produce a bit over 12 volts—which can drop quickly when supplying a powerful compressor— while the alternator on a running engine will produce well over 13 volts through the same battery. When you supply higher voltage to the compressor, it runs a bit faster yet draws fewer amps.





Extreme Outback

ExtremeAire Magnum Portable

(Kit, \$675, compressor only, \$550)

*Editor's Choice*



The moment you open the steel tool box encasing the ExtremeAire Magnum Portable, it's obvious you're looking at a product with a lot of thought behind it. The hose connections are protected with spring coils, the leads to the stout, 4-gauge battery cables are sealed and shrink- wrapped, and a fat, washable, oiled UNI-filter protects the intake of the compressor, which is powered by a massive, fan-cooled, 1 1/2-horsepower motor. Magnets at each end of the box hold a tire gauge and LED penlight.

The "ordinary" ExtremeAire compressor is already very well-known among serious expeditioners as a fast and durable air source. The Magnum effectively doubles the power of that model in a package only two inches longer—albeit at something over twice the amp draw: 78 amps average, 80.1 maximum. The power was immediately apparent, as the Magnum edged out the Warn SPI for fastest time in the single tire 0-to-35 psi task, at just 2 minutes, 20 seconds, and the four- tire, 15-to-35 psi test, which the Magnum whizzed through in 6 minutes, 39 seconds—35 seconds ahead of the Warn and nearly three times faster than the slowest compressor here (it did get pretty hot during the latter test: 303°F). Reseating the tire beads took just 24 seconds. When I hooked up the Magnum to a five-gallon air tank with a 100 PSI regulator, it effortlessly ran a 1/2-inch Snap- on impact gun while I removed 24 lug nuts from a Land Cruiser.

If your electrical system can keep up, the 100-percent-duty-cycle Magnum will run for as long as you need it to. However, there is no automatic pressure cutoff; the portable kit comes with an open chuck that simply bleeds off excess pressure. If you attach the Magnum to a closed air line it will eventually stop from back pressure at about 180 PSI (if the line doesn't burst first), but that's not something to do regularly. (Extreme Outback does offer an optional cutoff switch in several ranges.) There is also no on/off switch, just a heavy-duty quick-disconnect on the battery cables, which, while foolproof, is not as convenient. But, those small annoyances aside, no compressor here will get you back on the road faster.

**Pros:**

- Extremely fast
- High-quality fittings
- 100-percent duty cycle • Fan-cooled motor

**Cons:**

- High amp draw
- Heavy
- No on/off switch
- No pressure cut-off
- Noisy

ARB CKMA12 High-volume

(\$273 with air locker wiring harness, \$330 portable inflation kit)



The original ARB compressor was designed solely to provide a supply of air for ARB's air-locking differentials, using a small storage plenum to ensure an instant shot of compressed air to activate the unit. However, so many people plumbed the compressors to inflate tires as well, that the company offered a kit for the purpose—even though airing up a single vehicle in hot weather often seriously overstressed the unit. ARB's new high-volume compressor boasts four times the airflow under load, to properly handle multiple tasks.

It's still a remarkably compact compressor, by a significant margin the smallest in the review unless you pulled a single AtomAire out of the ExpeditionAire. It is easily mounted in virtually any free space. But it proved a powerhouse for its size, turning in the fourth fastest time in both the single-tire (3 minutes, 55 seconds) and four-tire (10 minutes, 40 seconds) tests—although in the latter its head temperature peaked at a blistering 329°F, the highest I measured. It also drew a fair amount of power: 32 amps average with a maximum of 33.4—close to that used by the dual-piston Quick Air 3. ARB rates this compressor at 50-percent duty cycle—30 minutes on, 30 off. That should be enough to air up at least a couple of vehicles unless the thermal cutoff switch kicks in. It successfully seated the beads on the test tire in 28 seconds.

The ARB is available either in a kit that includes a plastic carrying case, battery cables, and a 20-foot air hose, or in a more diff-locker-oriented set that comes with a very thorough wiring harness and switches, but no air lines.

### Pros

- Compact
- Powerful for its size



- Available in a portable configuration, or with wiring loom and switches to run an air locker

## Cons

- Runs very hot

Viair 450P-A

(Kit only, \$299)

Value Award



The Viair astonished me with its quiet and extremely smooth operation. While it was the second-slowest unit in both the single-tire, 0-to-35 psi test (4 minutes, 17 seconds) and the four-tire, 15-to-35 psi test (14 minutes, 15 seconds), it went about its business so politely that I simply didn't mind. Several of the other compressors are so loud and frenetic you can hardly wait to turn them off; by contrast you and a friend can stand on either side of a running 450P-A and hold a normal conversation. Average amp draw was a very low 14.4, with a maximum of 15.5, so the drain on the vehicle's electrical system is modest indeed—most modern alternators can more than keep up with an extra 15-amp load.

The 450P-A boasts a 100-percent duty cycle at an impressive 100 psi—in addition to being polite it's a hard (if deliberate) worker. There's an automatic shutoff at 150 psi, so the 450P-A would be easy to hardmount and plumb into a small tank to run an ARB air locker (although ARBs prefer around 100 psi, so you'd need an inline regulator). The Viair uses an easily replace-able foam intake filter element; several spares are included with the kit I received, which also includes battery cables, a 25-foot air hose, and an excellent inline tire gauge with a pistol-grip chuck, in a generously sized nylon soft case. The compressor is attached with rubber isolators to a base that allows you to set it in the dirt, and the insulated handle means you can pick it up even when it's still hot.

I discovered a curious phenomenon while monitoring the Viair's head temperature: The infrared thermometer could not register off the polished fins on the unit; it consistently indicated a reflected atmospheric reading much lower than the obvious true temperature. I finally masked the compressor with tape and spray-painted the head black, which solved the problem. The highest reading was a moderate 220°F.

**Pros:**

- Very quiet, minimal vibration
- Good filtering
- Base helps keeps dirt out of the intake
- Insulated handle
- 100-percent duty cycle

**Cons:**

- Second-slowest inflation times.

Warn Air-Power SPI

(\$595, no kit)





The Warn is a big compressor—16 inches long, 9 wide, and 14 tall in its tubular exoskeleton, which incorporates both a comfortable carrying handle and a sturdy base. Without any accessories, it takes up considerably more room than even the ExtremeAire Magnum Portable in its tool box complete with jumper cables and hose. It's also the heaviest unit here at 34.4 pounds, including the frame but no air hose. Somewhat offsetting the volume and mass are additional features on the SPI, such as a finned, 1/3-gallon reservoir, which reduces the outflow temperature and provides a ready source for air lockers should you decide to hard-mount the SPI, plus an automatic pressure cutoff switch (100 psi), and a lighted on/off switch.

Even upstream of the reservoir the SPI runs cool. Despite turning in the second-fastest single-tire fill (2 minutes, 25 seconds) and four-tire air-up (7 minutes, 14 seconds), the head temperature on the 100-percent-duty-cycle compressor never exceeded 220°F, indicating that if you have the room and the electrical system capacity in your vehicle, the SPI should be a long-lived workhorse. I was surprised then, to note the miniscule air filter, about the size of a thimble. It's washable porous metal, and should be durable enough, but I expect it would clog more quickly in dusty conditions than the big oiled UNI-filter on the ExtremeAire. At least it's high off the ground on this compressor. The SPI easily resealed the tire beads in 22 seconds. Given the ease with which it had handled everything to that point, I gave it a sterner test and hooked it up directly to a Snap-on 1/2-inch impact driver. I let the compressor fill its reservoir and shut off at 100 psi (actually 96 psi on my remote gauge), then started zipping off lug nuts on the Land Cruiser. The compressor kicked in again, but I was able to undo all 24 nuts with pressure to spare. Very impressive.

There is a cost, of course, besides size. The SPI is a power hog, drawing an average of 83 amps and a maximum of 86.2, the highest I recorded. You'd want a big alternator if you planned to use the SPI for long sessions showing off its capabilities.



**Pros:**

- Very fast
- Reservoir reduces outlet temperature
- 100-percent duty cycle
- Automatic pressure shutoff at 100 PSI

**Cons:**

- Very bulky
- High amp draw
- Inadequate air filter
- Noisy

Sun Performance Quick Air 3

(Kit, \$491, compressor only, \$437)



The dual-piston Quick Air 3 is a compact compressor that puts out a lot of air. Barely larger than the single-piston Viair, it filled a single tire in 3 minutes, 19 seconds, and aired up four in 8 minutes, 50 seconds, placing it third overall in speed behind the monster ExtremeAire Magnum and Warn SPI. It also popped both beads back on the test tire in a scant 18 seconds, which, while it says more about how well I happened to have the tire seated just then, still indicates what's possible. Power draw was a reasonable 35.1 amp average, with a 39.1 maximum, and the head temperature while airing up four tires stayed low at 220°F.

The duty rating on the Quick Air seems odd for such an obviously sturdy unit: it's certified for a 15-percent duty cycle, with a maximum run time of 40 minutes at 40 psi. While 40 minutes is long enough for any reasonable work session on a single or even multiple vehicles, many tires run higher street pressures than that, so airing up several trucks with load range E tires could push the rating. Also, the maximum working pressure of 70 psi is insufficient should you wish to fill an air tank to run an air impact gun, which normally requires over 90 psi, or to operate an air locker. I suspect the duty rating might be a corollary of the conventional metal piston design in the Quick Air, which appears extremely durable but perhaps needs more cooling-off time.

Each piston of the Quick Air has its own small washable foam filter. To access them you must remove the four Allen bolts that secure each head. Use care not to lose the O-ring and associated parts of the outlet valve when you do so.

### **Pros**

- Fast
- Modest size offers multiple mounting options

### **Cons**

- Angled air outlet increases mounting clearance
- 15-percent duty cycle could limit multi-vehicle use

Extreme Outback ExpeditionAire

(Kit, \$299, single AtomAire compressor, \$80)





What's one way to ensure you have a working compressor for the duration of an extended third-world expedition? Take two compressors. Inside the ExpeditionAire's homely but bomb-proof .50-caliber ammunition-can case are twin AtomAire compressors plumbed into a single outlet hose. In the unlikely event one should fail, the other will almost certainly see you through.

The ExpeditionAire kit includes 10-foot, 10-gauge jumper cables with full-size terminal clamps, two inline 15-amp fuses with spares, and a 20-foot coil air hose with quick release. A tire gauge and an LED penlight ride on magnets in the corners of the box. All the air fittings are brass, and the electrical connections are protected by heat-shrink tubing. The Expedition- Aire has no on/off switch—you attach the jumper cables to your battery, then plug them into a pigtail on the unit to start it. This is done for simplicity and reliability, but I have to admit I would have preferred a switch. An open-cell foam gasket on the end of each motor housing filters intake air. Extreme Outback claims you can bury a running AtomAire in sand and it will still function.

Working in tandem, the tiny but sturdy AtomAires delivered enough volume to inflate the test tire from 0 to 35 psi in 5 minutes, 17 seconds. Extreme Outback recommends a 50-percent duty cycle for the AtomAires—15 minutes on; 15 off. Airing up four tires from 15 psi to 35 took a leisurely 18 minutes, 35 seconds, but the unit ran non-stop with no problem (both times were the slowest in the review). Average amp draw was a very modest 14, with a peak of 16.5. Maximum head temperature during the second test was a mild 182° F. The two units never varied by more than 10 degrees from each other.

I had some doubts that the ExpeditionAire would be able to reseal tire beads, but in fact it did so in 2 minutes, 19 seconds. I had to be careful with the tire alignment on the rim to minimize leakage, and I sprayed some extra detergent lube in one spot that was bubbling, but they finally popped on. This means the ExpeditionAire should be capable of any tire



repair you might need to accomplish in the bush, as long as you don't have bandits hot on your trail.

**Pros:**

- Extremely compact and lightweight
- Rugged, weatherproof case
- Redundant backup ensures reliability
- Completely self-contained

**Cons:**

- Slow
- No on/off switch
- 50-percent duty cycle and slow speed restrict multi-vehicle use
- Cables and hoses barely fit inside case

Conclusions



In many equipment reviews a clear winner emerges within the first few minutes of

evaluating the field. In others an obvious choice distinguishes itself, but not until all aspects of every contender have been evaluated. This one was different. In fact, I could make a case for several of these compressors as an ideal fit for a specific application.

The ARB high-volume compressor is a smart upgrade by ARB from their original low-volume unit, which was intended solely for activating locking differentials. It's now vastly more capable as a multi-purpose compressor, and a highly recommended upgrade if you currently use an original ARB compressor for both lockers and tire inflation. Given how hot it runs while inflating multiple tires, I'd mount it outside the engine compartment to keep it as cool as possible (a good idea with any compressor).

The ExpeditionAire is a brilliant choice if you like the idea of a compressor that literally halves the chances of complete failure in the field. Its ammo-box case and high-quality fittings inspire confidence; there's little doubt the thing would shrug off six months banging around in the back of a Land Rover between Tangier and Cape Town. It's capable of handling any job up to and including reseating beads on a large tire.

However, I think the ExpeditionAire is best employed in a reserve capacity. Used in a situation where it might be called upon to air up four tires several times a day—even once a day—its leisurely inflation times would take significant chunks out of your schedule. Kept accessible for repairs, and used in situations that require tire adjustments every few thousand miles, it would be a faithful tool—and, given its Little-Train-that-Could attitude, probably the one that would engender the most affection.

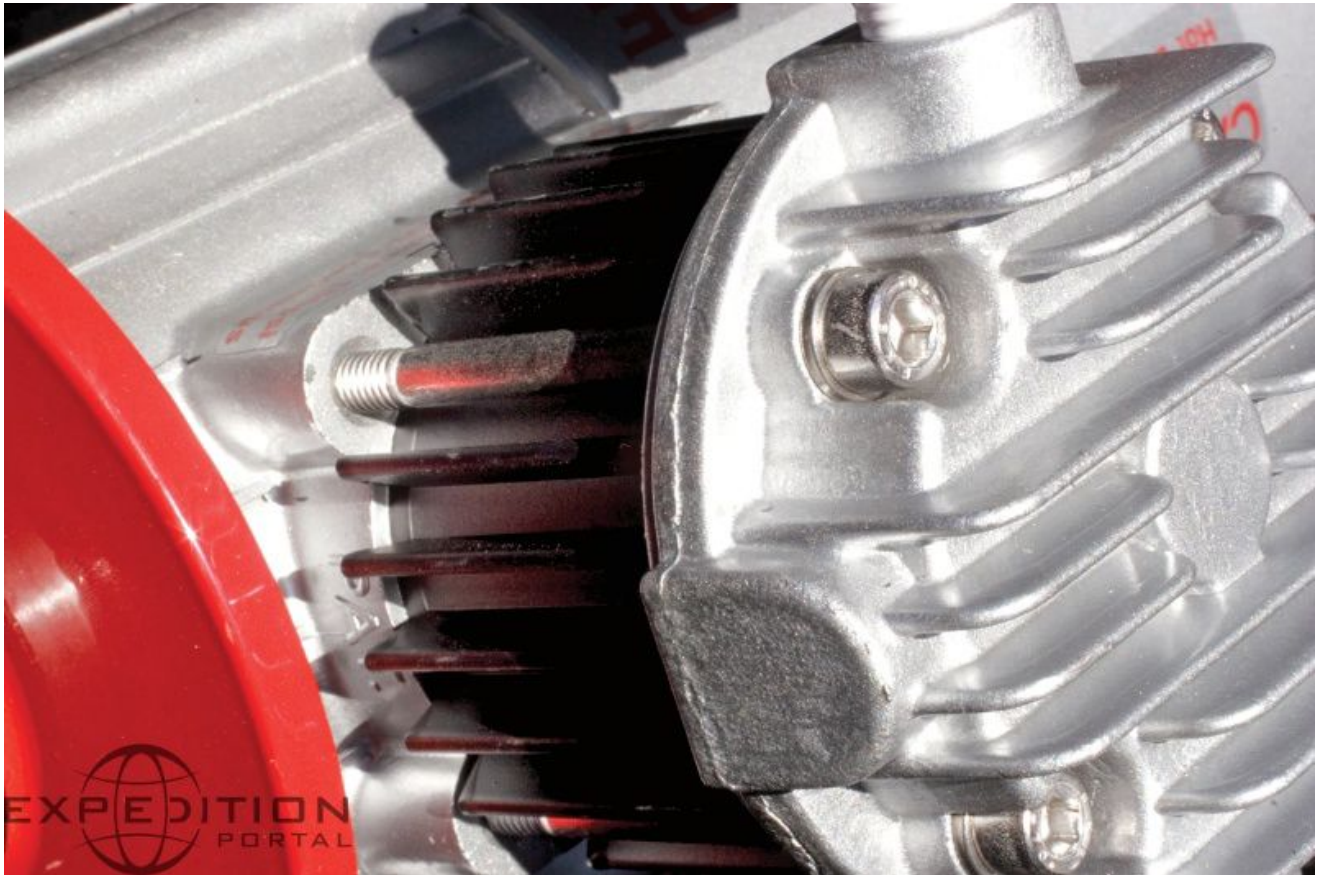
The Warn Air-Power SPI is a very powerful compressor with features that give it a near-industrial capacity for work: 100-percent duty cycle, 1/3-gallon reservoir with finned heat dissipation, and automatic pressure cutoff. It ran cool throughout the test, and turned in the second-fastest inflation times. It easily operated a 1/2-inch air impact gun. The reservoir and pressure switch mean it could be set up as a hard-mounted unit to run locking differentials (the 100 psi cutoff is perfect for air lockers) as well as doing inflation duty.

But the SPI takes up a near-industrial amount of space, too. Even with the exoskeleton handle/base removed it is a bulky compressor. You wouldn't want this thing mounted in the back of your Defender 90, and I don't know of an engine compartment that would suit it short of a Tatra's. I think the Warn is a good choice for a big SUV or a full-size pickup, and it would easily service multiple vehicles—you could air up three trucks with 33-inch-tall tires in 20 minutes.

The Quick Air 3 would make an excellent hard-mount or portable compressor for a solo full-sized expedition vehicle. It's small enough to fit handily in a 110, a four-door JK, or an 80-series Land Cruiser, and airs up four 33-inch tires in a jiffy. The construction seems very solid, and several major components are owner-serviceable. However, its 70 psi maximum working pressure and 15-percent duty cycle were surprising for the price, and could limit its usefulness for a group of vehicles.

I found myself using the Viair 450P-A a lot for inflation duties not related to the review, simply because it was so nice to use. It's light, quiet, and smooth, and the 100-percent duty cycle at 100 psi means it's willing to keep on working after other compressors need a break, even if at a slower pace. It's compact enough to install in a hard-mount configuration in even a small vehicle. The portable kit is well-equipped and easy to stow in its nylon case, and the supplied inline gauge is a nice touch. I liked the Viair better than several faster and more expensive compressors. It is a worthy recipient of our new Value Award.

## Editor's Choice



In the end the Editor's Choice had to go to the ExtremeAire Magnum—but not because it was the fastest unit. That performance was expectedly commensurate with its premium price. The Magnum rose to the top because no matter where I looked or which component I inspected, it was clear that Extreme Outback spared nothing to ensure that every last bit of the product is as good as it can be, from the oversize battery cables to the washable, oiled intake filter, from the powdercoated motor housing to the brass fittings and stainless fasteners. If you don't need (or cannot afford) the performance offered by the Magnum, you can be assured that the standard ExtremeAire and the ExtremeAire Junior (as well as the ExpeditionAire) share the same quality. And quality is what you can count on to see you through any expedition.