秋元 RACING SPORTS
AKIMOTO

PH. (909) 985-2383
FAX 0062

FBC Fuzzy Boost Control

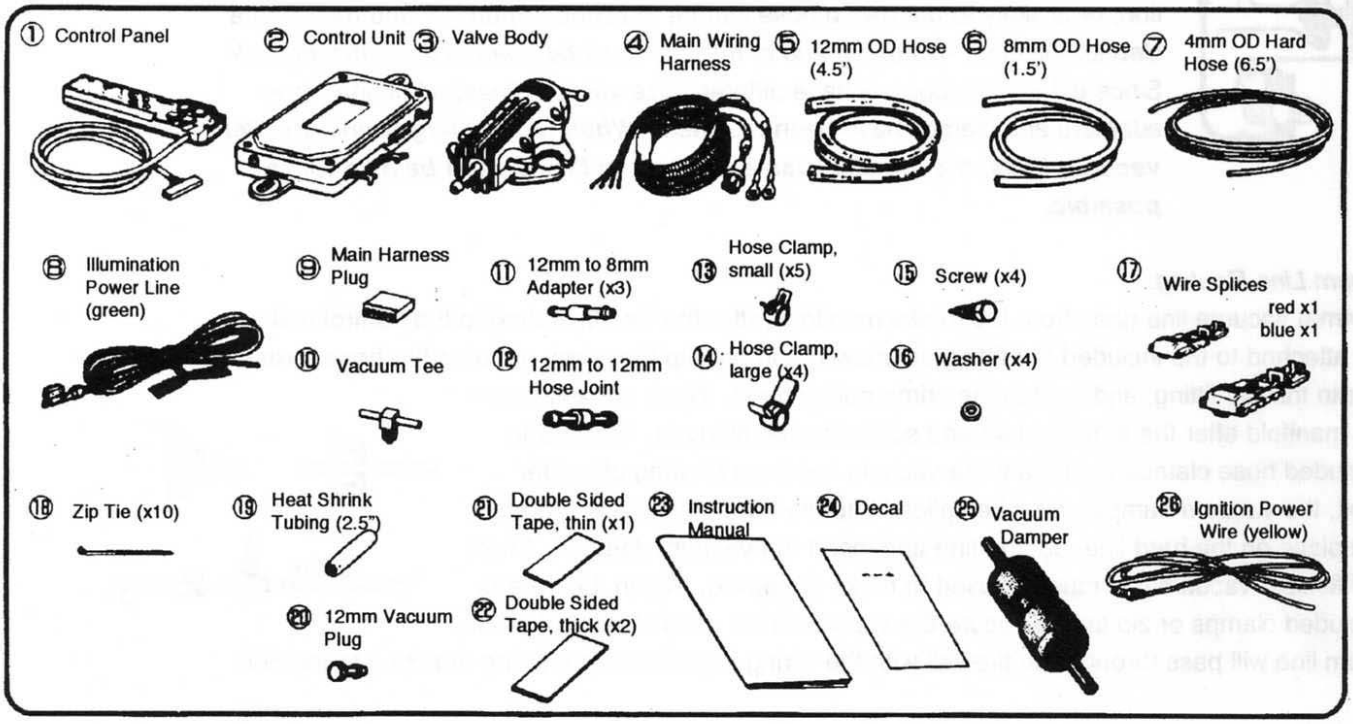
Introduction

The Fuzzy Boost Controller uses a computer controlled valve to control the pressure sent to the wastegate in order to give you precise control over boost levels from the cockpit. The control unit decides how and when to operate the valve body based on the boost setting selected on the control panel and on the response of the engine to previous inputs. Because the Fuzzy Boost Controller learns how to control boost levels in your particular car based on its experience, it takes 14 full throttle acceleration runs to learn how best to reach your boost setting without overshoot or spiking. Using this learning feature, the FBC custom tailors itself to whatever car it is installed in. Because this is a very complex and sophisticated piece of equipment, please follow these directions closely when installing and operating your Fuzzy Boost Controller.

CAUTION: The Fuzzy Boost Controller controls boost levels, but does not adjust fuel and ignition. It is possible to use this boost controller to raise boost above levels that the fuel and ignition systems are capable of compensating for. Engine damage can result from too much boost! Exercise caution when running high boost pressures. Neither the manufacturer nor the distributors assume any liability for damage caused if the operator uses too much boost pressure.

Contents

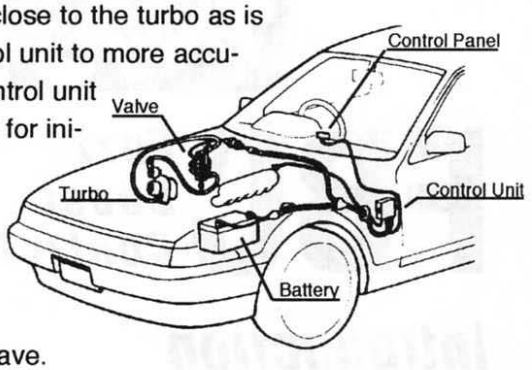
This package should contain the following items:



Installation

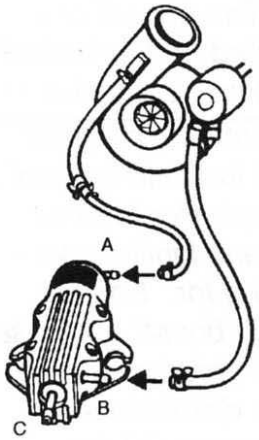
1. Location of Components

The valve body should be mounted as close to the turbo as is practically possible. This will allow the control unit to more accurately interpret and control signals received and sent by the valve body. The control unit must be mounted inside the car where it is safe from heat and moisture. Except for initial tuning, the control unit does not have to be easily accessible. The control panel should be mounted within easy reach of the driver. Double sided tape is provided to mount the control panel to the dash without drilling any holes.



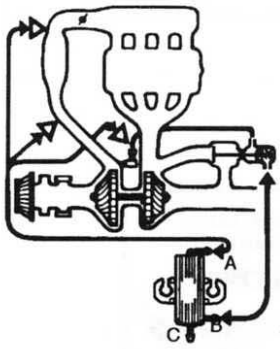
2. Routing of Vacuum Lines

Vacuum line routing varies depending on which type of wastegate you have.



Swing Valve Wastegates:

If you have a swing type wastegate you must insert the valve body in series with the compressor to wastegate actuator line as shown. The line from the compressor must go to port "A" on the valve body. If necessary, port "A" can be connected anywhere on the pressurized side of the intake system before the throttle valve and the compressor line can be plugged. The line from the wastegate actuator must go to port "B" on the valve body. Port "C" is left open to the air. If the valve body is mounted in an especially dirty location, or is likely to get wet, a hose can be attached to port "C" and routed to a cleaner location. *-Note: the end of this line must be open to the atmosphere!-* Since different turbos will have different size vacuum lines, additional hose adapters and clamps have been provided. ***When joining larger and smaller vacuum lines, the smaller diameter vacuum line should be as short as possible.***

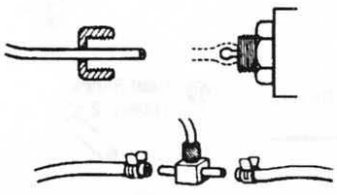


Poppet Valve Wastegates

Poppet type wastegates are connected as shown. Port "A" is connected to the Pressurized side of the intake system before the throttle valve. Port "B" is connected to the un-pressurized side of the wastegate actuator. Port "C" is left open to the air. If the valve body is mounted in an especially dirty location, or is likely to get wet, a hose can be attached to port "C" and routed to a cleaner location. *-Note: the end of this line must be open to the atmosphere!-* Since different turbos will have different size vacuum lines, additional hose adapters and clamps have been provided. ***When joining larger and smaller vacuum lines, the smaller diameter vacuum line should be as short as possible.***

Hard Vacuum Line Routing:

The hard, 4mm vacuum line goes from the intake manifold (after the throttle valve) to the control unit. The line is attached to the included tee fitting as shown. Simply slip the crimp nut over the hose, press the hose onto the tee fitting, and tighten the crimp nut by hand. Next, cut a vacuum line on the manifold after the throttle plate and splice the tee fitting in. Be sure to use the included hose clamps to prevent the vacuum line from blowing off under boost. Next, the vacuum damper must be spliced into the hard plastic line. At any convenient place on the hard line, cut the line and insert the vacuum damper. Short sections of flexible vacuum line must be used to make the splice. Again, be sure to use the included clamps or zip ties to secure the vacuum lines. The other end of the hard vacuum line will pass through the firewall with the wiring harness before being attached to the control unit.



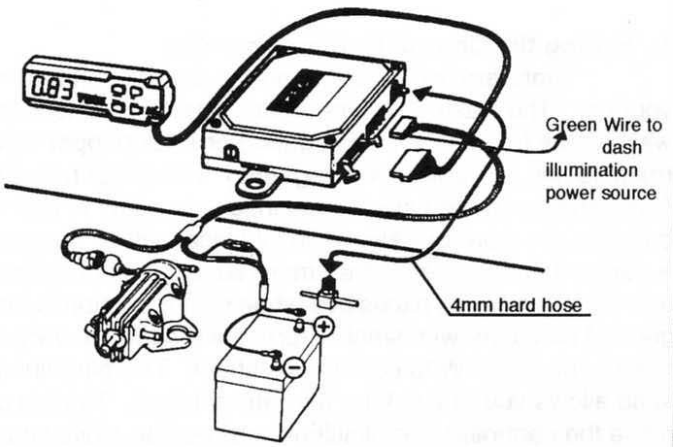
3. Wiring

1. Before any wiring, *disconnect the negative terminal of the battery to prevent accidental shorts.* Electrical surges can be very damaging to portions of the FBC.

2. Lay out the wiring harness to make sure that it will reach the control unit, the valve body, and the battery.

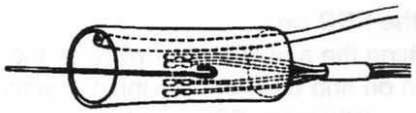
3. When passing the wiring harness through the firewall, it is essential to draw it through an opening that will remain sealed so water, fumes, and noise can not pass into the passenger compartment. Provided with the FBC are some tools to help with passing the harness through the firewall.

Overall Wiring Layout

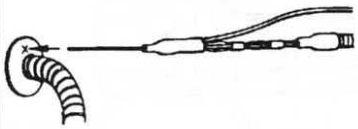


Passing Through the Firewall

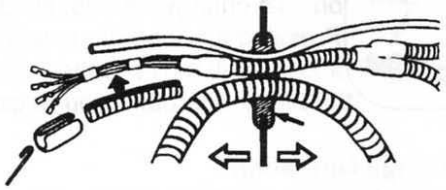
A. Once locations for all the components have been decided upon, find a grommet in the firewall that has enough room for the FBC harness.



B. Insert the black, pink, white, and red wires along with the hard plastic line and the included hook into the included heat shrink tubing as shown.

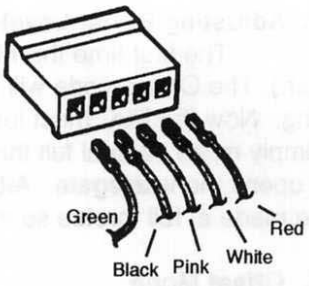


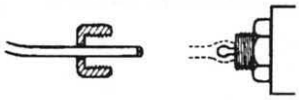
C. Heat the tubing to shrink it and pull through the grommet with the hook as shown.



D. Cut the heat shrink tubing from the harness and reinstall the plastic wire loom over the harness.

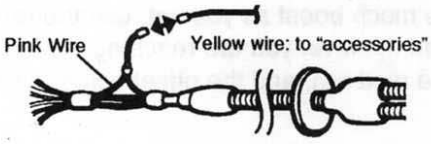
4. Once the harness is inside the car and the Control Unit is secured, the harness can be plugged into the Control Unit. First, insert the wires into the plug as shown. The green wire is for illumination, it should be connected to any dash lighting power source. This will make the FBC illumination turn on with the dash lights. Once the wires are secure in the connector, simply plug the connector into the Control Unit.





5. Next connect the hard plastic Vacuum line to the control unit. To do this, simply remove the crimp nut, slip the line on to the nipple on the Control Unit, and tighten the crimp nut as shown.

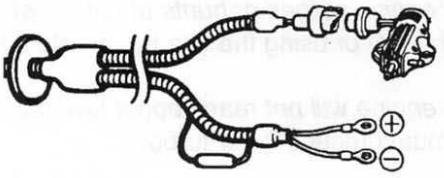
6. If you want the FBC to switch on and off with the ignition you must use the yellow wire included in the kit. (Note: the FBC will still be able to be turned off by simply pressing the "off" button. However, if the yellow wire is hooked up as shown here, the FBC may be left on all the time, and it will turn off automatically when the ignition is turned off.) In the wiring harness there should be a yellow wire spliced into the pink wire. Simply plug the yellow wire into this connector and attach the other end to the accessories side of the ignition switch.



7. Next plug the Control Panel connector into the Control Unit.

8. Next plug the Valve Body into the wiring harness.

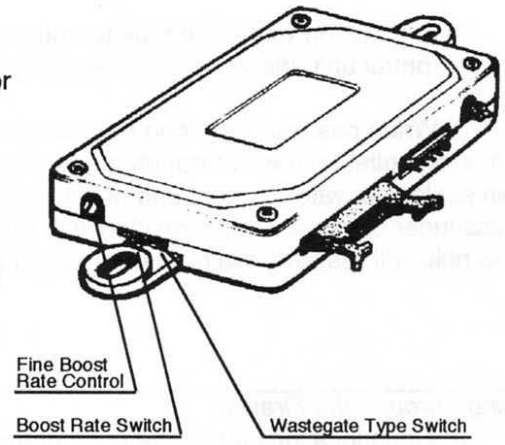
9. Finally, double check that all electrical connections are tight and correct, and connect the red and black wires to the + and - terminals of the battery, respectively. Reconnect the battery.



Operation and Adjustment

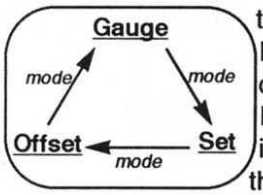
1. Setting the Control Unit for Your Car

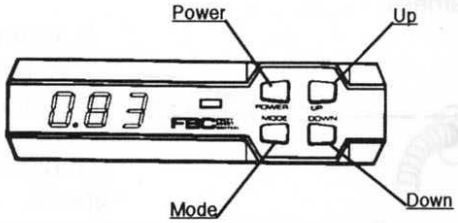
There are two switches on the control unit that must be set for your car. The wastegate type switch must be set to S for swing valve wastegates (most stock wastegates) or P for poppet valve wastegates (most racing or Porsche wastegates.) The boost rate switch is set to W or N depending on the type of response you want. N (narrow) will allow boost to rise more quickly, while W (wide) will let boost rise more slowly. A narrow boost curve is often more susceptible to spikes and overshoot and will often cause excessive wheelspin if traction is insufficient. As a general rule, cars with smaller turbos will spool up very quickly and will need to be set to W to control overshoot. The blue fine boost rate control knob allows you to fine tune the rate of boost. Turning clockwise will make the controller start limiting boost earlier, while counterclockwise will delay boost limitation. Initially the knob should be in the 12:00 position.



2. Turning the FBC on

Pushing the power button will turn the FBC on. The FBC can also be set to turn on and off with the ignition switch (see installation section). When the FBC is off, boost will remain at stock levels and the digital readout will serve as a boost gauge. The FBC will begin in gauge mode every time it is turned on. To change modes, simply press the mode button. Pressing it once will move to the "set" mode, pressing it again will move to the "offset" mode, and pressing a third time will return you to gauge mode.





3. Boost Gauge Operation

Most of the time, the FBC display will serve as a digital boost gauge. Even when the unit is off and boost control is stock, the display will still serve as a boost guage.

4. Adjusting Boost Levels

The first time the FBC is turned on, set mode will read 8.6psi (or 0.6 bar, if you ordered your FBC calibrated in bar.) The Offset mode will read 0.0. To set the boost pressure, use the up and down buttons to reach the desired setting. Now the FBC must learn how to operate the wastegate in order to achieve this boost level. To teach the FBC, simply make several full throttle acceleration runs. The FBC will adjust it's boost strategy during the first 14 times that it opens the wastegate. After this the boost strategy will be set. For this reason it is essential that these first 14 runs be made at full throttle so that the FBC designs its boost strategy to work at full throttle.

5. Offset Mode

When adjusting its output to control boost, the FBC may reduce final boost pressure in an effort to reduce spiking. The offset mode will allow you to bump the maximum boost level back up to the set level. If you are not getting as much boost as you set, use the up and down buttons to set the offset level to the difference between the set boost and the level you are reaching. NOTE: the offset value that you enter will be incorporated into the boost strategy on the next run, and the offset screen will be cleared. Every time you enter the offset mode, the offset value will read 0.0

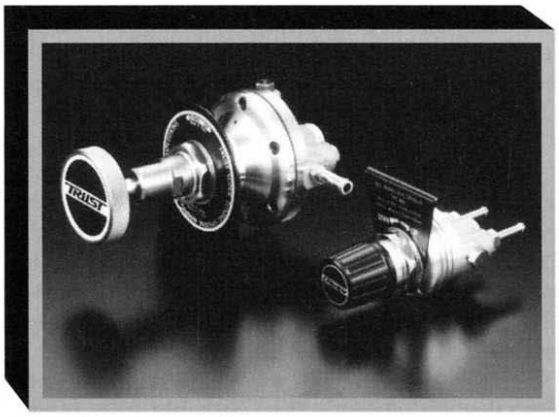
Troubleshooting:

If boost levels go way over set level, try re-setting boost level and make 14 full throttle runs so the FBC can adjust the boost level. The boost level should drop after each run until the set level is reached.

If the engine surges or hunts at full boost. If hunting does not go away after a few runs, try switching the boost rate switch to W or using the fine boost rate adjustment.

If the engine will not reach boost level set, try using the offset mode. If this does not work, you may be reaching the maximum output of your turbo.

If boost level rises very slowly, try switching the boost rate switch to N, or adjusting the fine boost rate control.



Manual boost controllers are an inexpensive way to turn up the boost. High-quality units like these from GReddy can be mounted in the engine bay or in the passenger compartment for ease of adjustment.

Under Pressure —Part II

The Magic Of Boost Controllers

By Michael Ferrara

If anyone watches as much late-night television as I do, then you would probably remember the Freedom Rock commercial. A Hippie reading the Wall Street Journal turns to his friend playing the radio and says, "Is that Freedom Rock?—Then turn it up Dude!" When it comes to boost controllers, "turning it up" is the name of the

Volume 8, Number 6

Turbo CLUB NEWS

THE OFFICIAL NEWSLETTER OF THE TURBO CLUB OF AMERICA

In this issue...

The Turbo Conversion Dilemma

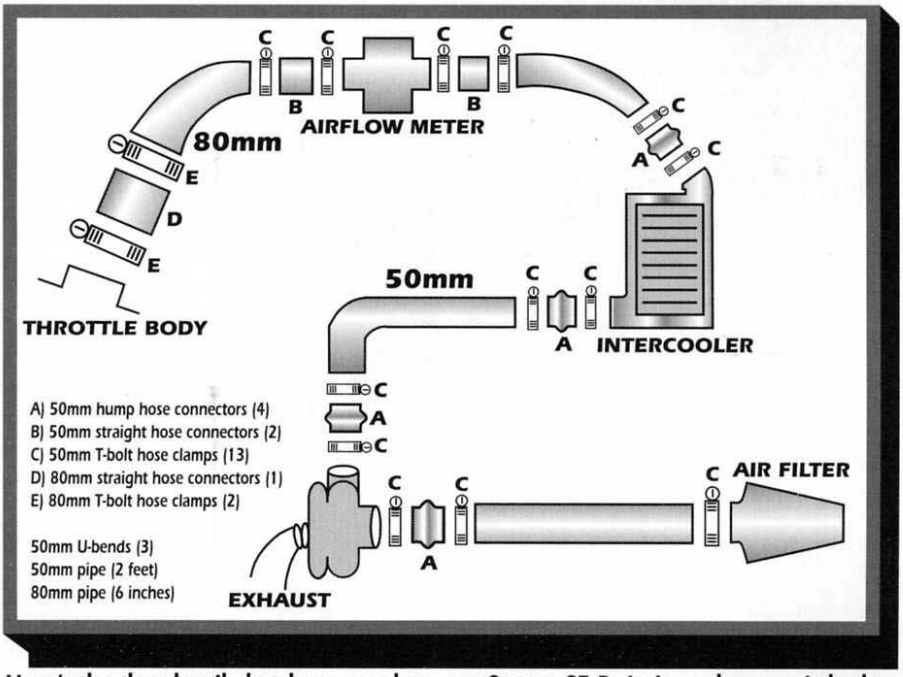
By E. K. Cozzene

Converting a naturally-aspirated engine to turbocharged fighting trim can be a nightmare. This transition, like that from human to werewolf, can be a catastrophically painful and arduous experience. Just as the cursed human must endure pain as his fingernails are torn away by protruding claws, an unsuspecting enthusiast contemplating a turbo conversion must survive a tortuous struggle to find the proper combination of parts.

Exhaust Manifold

Perhaps the most important piece of the turbo conversion puzzle is the exhaust manifold, as it determines the placement of the turbo. The position of the turbo will dictate the plumbing of oil and water lines (if the turbo has a water-cooled center section) and whether or not accessory items (air

See CONVERSION on page 5



Here's the thumbnail sketch we used on our Sentra SE-R. In it we have switched to a blow-through style mass air set-up. We later installed a bypass valve just before the intercooler. This diagram gives you a clear-cut goal and helps in devising a one-shot shopping list.

turbo CLUB NEWS

PUBLISHER
KIPP E. KINGTON

EDITOR
CARL CALVERT

TECHNICAL EDITORS
MICHAEL FERRARA
EVERETT K. STEELE
E. K. COZZENE

ART DIRECTOR
BRAD STODDARD

GRAPHIC ARTIST
KEVIN CONVERTITO

PRODUCTION MANAGER
CHRIS PETERSON

ADVERTISING DIRECTOR
STEPHEN BELANGER

OFFICE MANAGER
SUZIETTE CAMPBELL

THE TURBO CLUB NEWS is published bi-monthly by the Turbo Club of America, a division of Mag-Tec Productions, Inc., P.O. Box 2712, Huntington Beach, CA 92647. Membership fees: $35.00 per year; $47.00 per year (U.S. funds) surface mail foreign, $71.00 per year (U.S. funds) air mail foreign.

POSTMASTER: Address corrections should be sent to Turbo Club of America, P.O. Box 2712, Huntington Beach, CA 92647.

CONTRIBUTIONS: All manuscripts and other materials are submitted at the contributor's risk and cannot be returned unless sufficient return postage is included with submission. We welcome contributions but suggest writing or phoning for a set of editorial guidelines prior to submissions.

MANUFACTURER/DEALER MEMBERS: We welcome new members who are actively engaged in the turbo/hi-tech performance business. New member applicants in the dealer category may be required to provide references. New member applicants in the manufacturer category may be required to provide a sample product (returnable) with their application. For more information request a Turbo Club dealer application.

WARNING: Some of the products and/or modifications shown in this publication are designed for racing and off road use only and may be in violation of local or federal regulations for highway use. We recommend you check with each manufacturer prior to ordering these products to see if they are legal for highway use in your area. In addition many of the modifications shown or depicted in this publication could void the factory warranty on new vehicles. We recommend checking with your dealer/manufacturer before making any modifications which could void your factory warranty. It is intended that products shown and depicted in this publication that increase performance be used in a safe and legal manner.

PRINTED IN U.S.A.

game. But before we talk about boost controllers, you need to be aware of the repercussions of turning up the boost.

Turning It Up

The good news—slight to moderate increases of the boost pressure can result in serious power gains. The bad news—excessive increases in boost pressure can be the quickest path to a thin wallet (today's turbocharged engines are expensive to replace). When higher boost levels force additional air into the engine, additional fuel must also be added. To provide a safety cushion, factory injectors are often slightly oversized for stock boost levels. Many times, slight increases in boost pressure can be made without the need for larger injectors. Of course, there are exceptions to the rule. To find out the maximum amount of boost pressure for your particular combination, it's a good idea to contact the aftermarket parts manufacturers that specialize in your vehicle. When boost levels traverse the safety line, fuel-lean conditions, which encourage detonation, can quickly turn your boulevard bruiser into a junkyard loser.

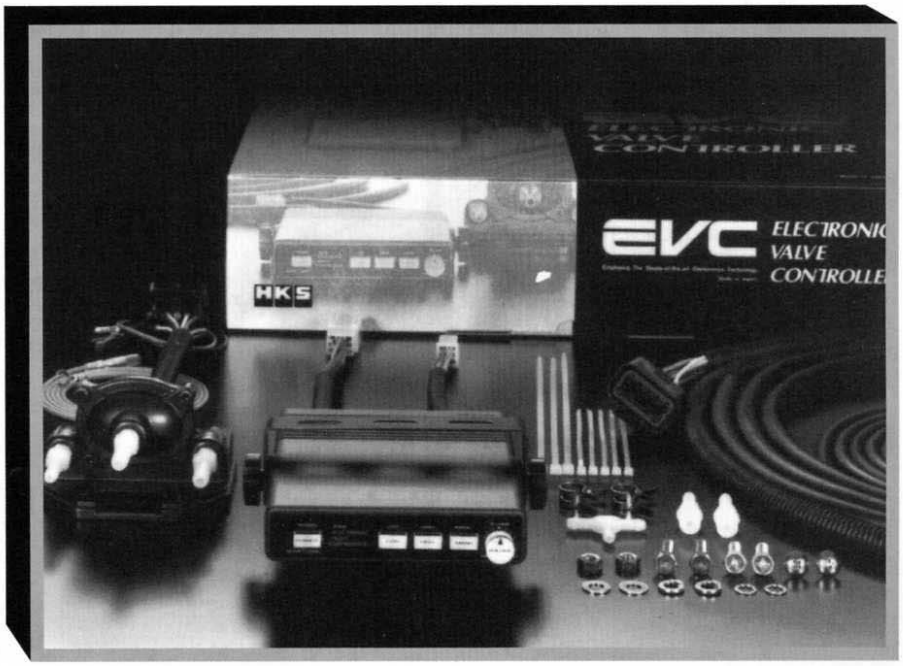
Boost Controllers

Manual

The most basic type of boost controller is known as a manual boost controller. Available from many manufacturers, these boost controllers are nothing more than an adjustable valve. In fact, they function in a very similar way to aquarium valves (which make excellent manual boost controllers for those on a budget). On single-port, integral-wastegated turbos, the manual boost controller is spliced into the vacuum line to the wastegate. The valve can then be partially closed to send a reduced signal to the wastegate. This reduced signal tricks the wastegate into believing that the boost level is lower than it actually is. As a result, the actual boost level will exceed the stock setting before the wastegate fully opens. When dialing in a manual boost controller, start with the valve fully open and then gradually close the valve until you reach the desired higher-than-stock boost level. Never rely on factory boost gauges, this is as bad as a surgeon using kitchen utensils to perform open-heart surgery. Quality boost gauges are available from many sources (GReddy, HKS, AutoMeter and others) and there is just no excuse for any turbocharged vehicle not to have one.

Electronic

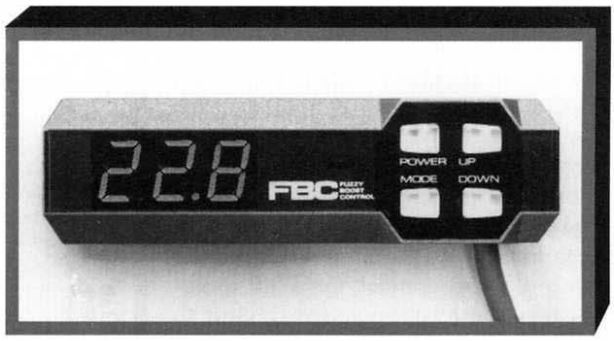
The first electronic boost controller to become popular for turbo car enthusiasts was the Electronic Valve Controller (EVC) manufactured by HKS and this original unit is still available. This system allows turbo owners the ability to dial-in three levels of increased boost. With the touch of a button, the driver can select from his boost settings at LOW, HIGH, or



The HKS Electronic Valve Controller (EVC) was the first electronic boost controller to become popular with turbo enthusiasts. Today, the original style unit is still in production and a new fuzzy-logic version is now available.

the best way to control the wastegate actuator and then compare (using feedback circuitry) this initial strategy to the results. The unit then alters the strategy for the next run, using portions of the first techniques which worked the best. After about five to 10 full-throttle runs, a fuzzy logic controller knows the ideal strategy for optimum boost control on your vehicle. As a result, a fuzzy logic controller will provide the steepest boost slope possible without excessive boost level spikes. This translates into better throttle response, reduced turbo lag, and quicker acceleration. Believe it or not, this "guess and check" method is the same technique used by computers to solve extremely complex mathematical equations.

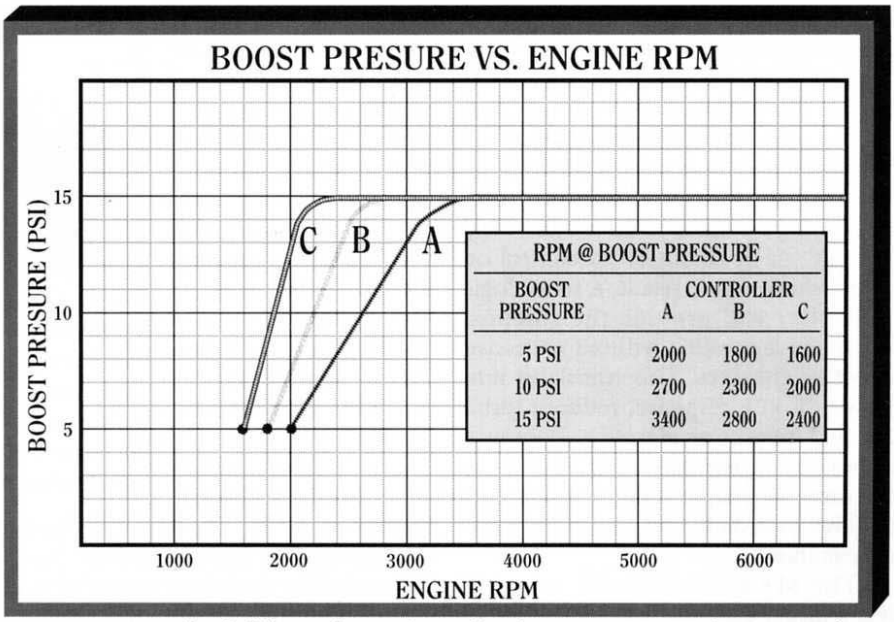
The M's Fuzzy Boost Controller has a large, easy-to-read LED display which makes boost monitoring an easy task. We have had first-hand experience with the M's FBC on our twin-turbo Mustang. After installation, we took the Mustang for a few performance runs so that the FBC could get to know the response characteristics of the ponycar's DDMI turbos. On the first run, the FBC attempted a very radical boost curve. As a result, boost levels quickly spiked past the preset 10 psi level and the engine bucked and backfired. On the second run, the FBC was able to start pulling in the reins on the galloping 'Stang and the bucking had vanished. By the forth run, it was smooth sailing as the M's FBC now had carnal knowledge of the heavy-breathing 5.0-liter .



The M's Fuzzy Boost Controller (FBC) was the first fuzzy-logic boost controller to invade America. Fuzzy logic controllers use a feedback (closed-loop) control method to provide a more radical boost slope and more accurate boost control.

Recently, HKS introduced its newest-generation EVC. Thanks to high-tech electronics, the new fuzzy-logic EVC unit is smaller and more powerful than the original unit. A special illuminated-LCD display (switches between green and amber, depending on mode) lets the driver set LOW, HIGH, and MANUAL boost levels where he desires. After setting the level, the display can then be used to monitor boost pressures. The new EVC also incorporates a built-in Scramble Boost Controller (SBC). The SBC feature allows the user to increase boost level for a preset length of time. This allows traction-deficient turbo cars the ability to launch at a low boost level without wheelspin, then increase boost level with the touch of a button. Currently, the fuzzy logic EVC is only available with a display that reads in the units of bar. At this year's Tokyo Auto Salon, HKS introduced the fuzzy-logic EVC ATM. This version incorporates absolute pressure sensors to ensure that boost pressure remains constant regardless of temperature or altitude. HKS USA is still unsure if the ATM version of the EVC will be made available for the United States market.

MANUAL. If desired, the control unit can even be turned off to return the vehicle to its stock boost level. The EVC package, which is available for both integral and external wastegated turbos, consists of an electronically-controlled pneumatic valve, installation hardware and the control unit. Besides offering the advantages of four levels of boost control, the EVC incorporates a microprocessor-design to improve boost response. Thus, the EVC not only raises the maximum boost level, it also increases the slope of the boost curve. The increased slope of the boost curve means that higher boost levels are realized at lower rpms. At the dragstrip, HKS claims that the original EVC will consistently produce quicker e.t.s than any type of manual boost controller when run at the same boost level.

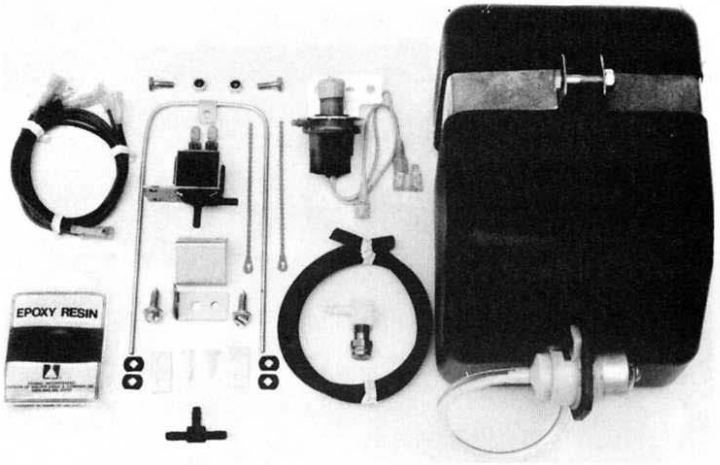


Here's an example of different boost slopes for the same amount of maximum boost. Boost curve A is the most gradual curve and this type of curve is typical for a manual boost controlled vehicle. Boost curves B and C are more radical as they reach maximum boost pressure at an earlier engine rpm. The addition of an electronic boost controller will change the slope of the boost curve to be more like curves B or C, instead of curve A.

Fuzzy Logic

In an effort to further improve the performance of electronic boost controllers, some manufacturers have incorporated "fuzzy logic" circuitry into their units. The M's Fuzzy Boost Controller (FBC) was the first fuzzy logic controller to invade America. This unit also utilizes an electronically-controlled pneumatic actuator, but unlike the original HKS EVC, the control head is separate from the brain. Fuzzy logic controllers use a feedback (closed-loop) control method to provide a more radical boost slope and more accurate boost control. Fuzzy logic controllers actually "guess"

INTERCOOLER OPTIMIZER — Spray Cooling System for Intercoolers



SPEARCO'S proven, 16 year technology in water injection has now been focused on an evaporation cooling spray system to greatly improve the cooling performance of any intercooler system. Injecting a controlled quantity of water into the air entering an engine results in charge air cooling as the water is evaporated and flashes to vapor. The same is true as water is sprayed over the ambient air side of an intercooler. Technically, the cooling takes place by evaporation and convection. The cooling effect can be very pronounced on a hot, dry day and basic physics shows us that for every pound of water evaporated, approximately 1,050 BTU of heat is absorbed. Since our reservoir holds .95 gallon or approximately 8.2 pounds, this equals 8,610 BTU!!

For comparison, lets look at a typical 2.5L turbo, intercooled engine. At maximum rpm and load the intercooler will be rejecting approximately 900 to 1,100 BTU/Minute. It is then easy to see that, even if we get less than ideal spray and coverage of the intercooler, we can anticipate increased intercooler performance during these periods of maximum power by 25% to 35%. Depending on charge temperature and other factors, this can reduce the charge temperature another 45° to 65° F. A large reduction with a resulting power increase!!!

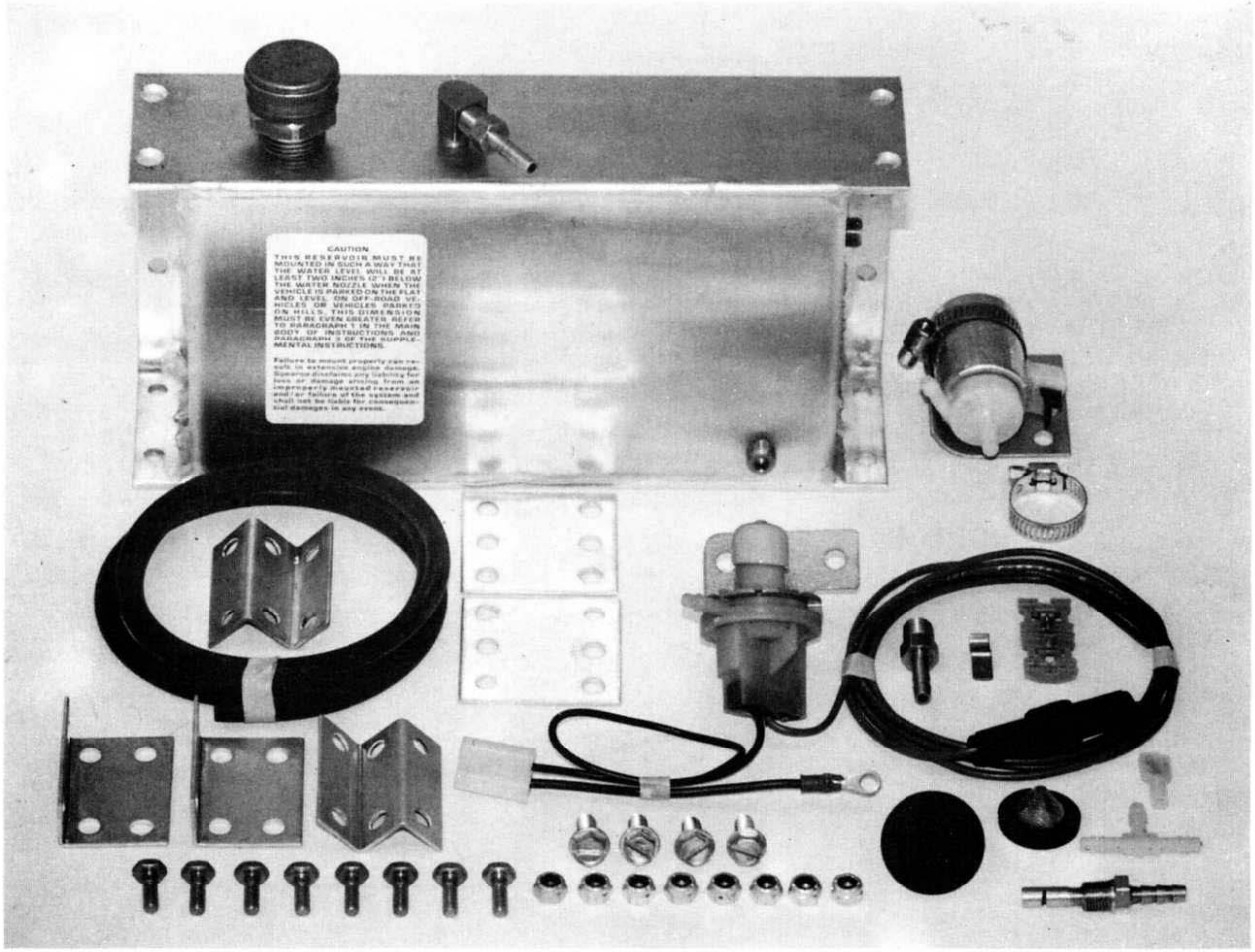
This system features a small, 12V pump and motor which supplies water at 19PSI to a special, wide-angle spray nozzle for maximum intercooler coverage. This pump and a solenoid valve are triggered by a boost pressure switch and the solenoid valve prevents drip or loss of water if the reservoir is mounted above the level of the nozzle.

Part Number 2-2200
Complete system includes detailed instructions applicable to all intercooled vehicles with the choice of four different spray nozzle mounting methods.

Part Number 2–2200 Intercooler Optimizer **$120.00**

SPEARCO PERFORMANCE PRODUCTS, INC.
14664 Titus Street, Panorama City, CA 91402 • (818) 901-7851 • FAX (818) 7854362

TURBO
water injection system



Now, from Spearco, the water injection experts, a water injection system designed specifically for factory turbo cars.

This system reduces air charge temperature on turbocharged engines, with or without intercoolers, and increases air density resulting in additional horsepower and torque. On engines equipped with detonation sensor controlled ignition systems, it will maintain maximum spark advance even on low octane fuels.

Features include:

- Compact .4 gallon aluminum reservoir with three mounting positions for universal placement in the engine compartment.
- Injects water upstream or downstream of the turbo
- Pump is controlled by an adjustable, O.E. quality pressure switch
- Kit includes 3 different size, specially designed injection nozzles.

Part Number 980 Turbo Water Injection System **$146.00**

SPEARCO PERFORMANCE PRODUCTS, INC.
14664 Titus Street, Panorama City, CA 91402 • (818) 901-7851 • FAX (818) 7854362