

Fiat 500L becomes a 500 Lusso Abarth - Part 1

Vehicle History and First Parts

Vehicle History

The original car was a personal import into Canada from Italy. It arrived here as a 1970 Fiat 500L. Fiat in Canada never sold them, so this was very first Fiat 500 brought to Canada! The L stands for "Lusso" or luxury version.

I bought this car on the 24th July 2004. From then on it was tucked away during our Ontario winters, and used only on good days. Considering its age, it had a very limited road mileage, and after much research, I determined what modifications I wanted to make during the build.

During the 60s, Abarth managed to homologate his small, agile, winning racing cars, with a propped-open rear engine cover, using the pretence that he required this for extra cooling, when in fact he had realised that he would gain 10 mph on the straights, due to the improved aerodynamics. And this was over a decade before Porsche arrived with the 911 and its rear spoilers. These Abarths competed with much larger and more powerful cars including American V8s, yet still were successful in winning races.



My love for the 500s in open-engine-cover style, with European group 5 arch flares, made this an easy option, as a basis for styling. I henceforth set about acquiring the parts to get started. The parts came in from Italy, U.K., and Poland. After ordering the first set of parts, work began in 2005, when the car had completed 63,000km.

Please note : I will go through all done in sequence, but will delve into each item in more detail, later, in other forum areas. For example, I say here about installing suspension, but the technicalities, such as spring rates, etc., will be expanded upon elsewhere.

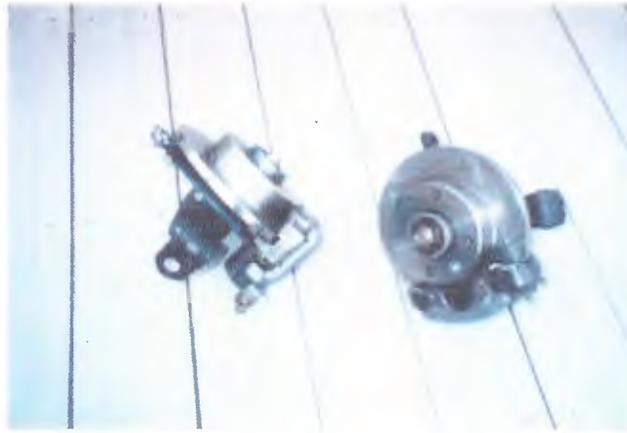
The First Set of Parts

Parts' choices need to be made and acquired before beginning modifications. For instance which wheels and tyres (and arch extensions) to have. If you intend to go to water cooling (for a bigger engine), means getting the right engine cover stays/struts. It's vital to have those parts present during the build.

Parts - Mechanical



It is important to match the modified reverse-eye front spring height with lowered rear coil springs (note on the transverse leaf spring, that the lateral spring eyes are substantial and located above the spring line to increase lowering of front). Below, Koni dampers and coil springs.



Nice big front disc brake conversion kit (from european Ford Fiesta MkIII).

It's important to keep the front and rear brakes in balance, as the tendency is to assume that bigger front brakes are sufficient, but the 500 being rear-engined and rear wheel drive, larger rear hubs and brakes should be installed. With that in mind, I have purchased larger rear drum brakes from a Polish 126P, and refurbished with new bearings, shoes and cylinders (in bottom-left of image above). Keeping shoes and drums on the rear still work well, and provides a better handbrake, but there are rear disc brake kits available.





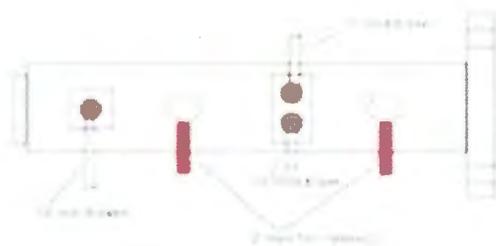
Nice big Abarth drive shafts. As I was installing the larger 650cc engine and transmission, I required the different and beefier driveshafts from the 500R.



Old single circuit master cylinder with unused brake light switch
(Have a four switch as brake light switch on brake pedal)



New Tandem (Dual Circuit) Master Cylinder minus brake light switch
(Have a four switch as brake light switch on brake pedal)



Notes

1. Solenoid fluid line needs to be added for tandem fixed front reservoir
2. Brake light switch can be ignored as now on brake pedal
3. Master cylinder mounting holes need to be slightly elongated to fit

Parts - Body

The famous Abarth engine cover struts.



A big choice for the look of the car is the wheel tyre and arch flares. These are european groupe 5 arch flares, but the amount of work to prepare the wing and arch area is considerable, as it intrudes into the car a lot on such small car. It's also important to size the wheels and tyres precisely to the car.



Parts - Wheels & Tyres

A new set of 7" x 13" Minilite wheels, from UK, were selected, after much searching and determination of fit and correct ET/offset for the 500. These were required to clear larger front and rear brakes, along with the change of wheel stud PCD of 4 x 98mm.... (the standard PCD for modern Fiat Group cars). New low-profile Radials (175/50HR13) were also installed.



Interior Parts



At this stage, I had decided to retain a standard interior, except for alloy pedals, gear knob and gated shifter. The carpet is new and rear seats are removed (weight reduction), and the rear area to be soundproofed and upholstered (possibly an area for battery stowage if later carrying out an EV (electric vehicle) conversion).

End of Part 1



Fiat 500L becomes a 500 Lusso Abarth - Part 2

Suspension and Brakes

Jacking Points

Front

If jacking up the front with a trolley jack, use the middle of the leaf spring where it mounts to the car.

Rear

At the rear, use the front of the rear trailing arm, again where that mounts to the car's body.

Note : *The 500/126 jacking points are notorious rot spots, and if any rust, will collapse and damage floor.*

Suspension

The 500's suspension is very simple; there's a transverse leaf spring up front and a set of coils at the rear. In standard tune, the cars have a tendency to feel a bit tippy-toe, as the suspension was designed to cope with a full Italian family and their luggage. Its not appropriate for today's roads, traffic speeds, and most importantly a doubling of the car's standard power output.

There are a set of choices available from the Italian 500 tuners like Abarth, and you must choose the level of ride height as well as stiffness. Do not fit polyurethane bushes, as 500s are pretty hectic, coarse cars anyway, and fitting these would make it too harsh.

Front

First thing done was to replace the front leaf spring with a reverse-eye leaf spring which is slightly de-cambered and stiffened. Using a leaf spring with the location bushes above the spring lowers the front by relocating the upright and stub-axle to a higher position, at the same time retaining all the suspension travel.

Front leaf spring effectively lowered car by 1.5".

Front camber was left as standard specification, with front tracking adjusted to a toe-in of 0 to 1/16 inch (0 to 2.0mm or 0 to 0.787 in).

Rear

At the rear, a set of uprated and lowered coil springs were fitted. These also changed the rear's positive camber setting to between neutral and slightly negative.

Rear coil springs effectively lowered car by 1.5".

Dampers

A set of Koni (red) uprated gas dampers were fitted all round.

Bushings

Polyurethane bushes were not installed, as 500s are pretty hectic, coarse cars anyway, and fitting these would be too harsh. New standard bushes are working very well. Even at that, I find the suspension a bit stiff for Ontario's badly repaired roads, but is wonderful on a smooth twisty road/track.

Rear Suspension Dismantling

Assuming that the car is on stands and that the brakes, hubs and drive blocks have been removed;

- Undo the brake lines at the car end of the flexible hoses.
- Undo the handbrake cables.
- Place jack under arms & raise to take up load.
- Undo the bottom shock-absorber nuts. (be careful as they are limiting the suspension travel and are under tension)
- Let down jack slowly.
- Note the number and location of spacers in the swing arm mounts (a rear wheel alignment will be required after this swap, even if the spacers referred to are correctly repositioned).
- Remove the 4 x 17 / 19mm bolts from the swing arm mounts.
- Remove swing arms.
- Fit the "F" swing arms by reversing the above process.

Rear Suspension Dismantling and Reassembly

- Jack up front of vehicles and place stands underneath.
- Remove front wheels from both vehicles.
- Remove 4 x 17mm nuts holding spring retaining brackets on both cars.
- Remove 2 x 17mm nuts from tie rod ends and undo tie rods from both cars.
- Undo both brake hoses on both cars.
- Remove 2 x 17mm bolts and nuts from top suspension arms on both cars.
- Place jack under lower suspension joint, (eye of spring) and take up strain.
- Undo lower shock-absorber 13mm nut. (be careful as they are limiting the suspension travel and are under tension)
- Slowly lower jack.
- Repeat on other side of the car.
- Reassembly is reverse of the dismantling process (see above). Don't forget to bleed the brakes.

Brakes

Front Brakes

Hydraulic disc brakes were installed from a Ford Fiesta Mk 3 (1989-97) with corresponding front pads (FT1011E 90 R-01179/090). It's easy to access the items in this kit individually. The Ford Fiesta disc brakes are selected for appropriate size, and a calliper with similar fluid requirement to the rear 126P drum brakes, so the tandem master cylinder will operate without excessive wheel lock up. A local engineering company with a size range of bearings will be able to supply an appropriate hub bearing, as I believe the standard 500 front uprights can be retained.

Rear Brakes

Hydraulic drum brakes, with automatic adjustment of the play between the jaws and the drums. Parking brake by cable. Installed larger rear drum brakes from the 126P, using all new bearings, linings and wheel cylinders.

Master Cylinder

Larger tandem master cylinder installed from a 126P including Jaguar hydraulic pipes from reservoir to master cylinder. Carrying this out, the brake system has been brought up to the later larger 126P standard.

Brake Fluid

I have used regular DOT3 brake fluid (*not synthetic*).

Brake Bleeding Procedure

- Make sure all brake bleeding screws are clean.
- Check fluid level in Master Cylinder (continue to do this frequently during the bleeding procedure).
- Either attach clear tubing on outside of bleed screw or insert correct size tapered adapter inside the centre cavity of the bleed screw, using a pushing, twisting motion.
- Operate the vacuum handle about 8 to 12 times to create a vacuum in the line.
- Open the bleed screw slightly (1/4 to 1/2 turn) to allow fluid to enter the jar.
- Air that is bled from the system will appear as large, uneven bubbles in the clear tubing. Continue until no more bubbles are visible.

End of Part 2



Fiat 500L becomes a 500 Lusso Abarth - Part 3

Bodywork

Bodywork Begins

Having finally received all parts to get started on my Fiat 500 (Abarth Lusso) project, it is time to begin. My friends (father and son team) Ennio and Ubi Campagiorni, have been actively involved on this project, and their assistance has been greatly appreciated. They are both trained professionals, and skilled craftsmen, of the "old school", one having been a Fiat mechanic in Italy, before emigrating to Canada. They have a mechanical flair with Italian cars and bikes, and are excellent on bodywork and painting, and both know exactly how things should fit, and what parts are interchangeable. I feel most fortunate have made their acquaintance and to have them nearby. Here George is using Italian trained professionals who understand this. It all begins with the donor :



Arches - Measure, Flare, Weld

Adding wheel arch extensions affects body rigidity and has to be done well. Installing arch extensions on a Fiat 500 is a big deal :

- Firstly, because so much of the body's area is involved, with rigidity being affected. The body around the old wheel arch needs to be flared, and seam welded to retain strength before the new arches are bonded in place.
- Secondly the arches have to be carefully matched to the wheels to make such a small car look good. This means that the lower and stiffer suspension and wheels/ tyres must be available and installed before beginning the bodywork.



Key shot showing extent of flaring, and trimming of the arch shape for correct suspension travel.



Wheels, tyres and suspension have to be prior installed, to get the arches well matched up. The black felt tip marks, on the arch extension, is where they needed taking back, and the extension edge has a return/guard for authenticity.

Painting

After the floor and underside was painted and rust proofed, the external bodywork was painted :

- Upper body colour - Chrysler Flame Red (Jeep,Dodge) Paint Code PPG# 4679
- Lower body colour - 1994 GMC Medium Grey Metallic (WA 8798)



Paintwork done. New carbon fibre door mirrors obvious here.



Bumpers are back on



End of Part 3



Fiat 500L becomes a 500 Lusso Abarth - Part 4

Bigger Engine and 126 Transmission

A Bigger Engine and 126 Transmission

Old 500 Engine and Transmission Removed



New 126 Transmission

The original transmission was updated with a 126 version imported with the engine from Italy. This is required, as the 650cc engine from the 126, has different mounting face from the 500. I have also installed new Abarth racing spec drive shafts (on advice and supplied from Middle Barton), and shown in parts area (Part 1).



The later 126 transmission designs are based on the original 500 layout, but with several improvements on the weaknesses inherent in the 500 designs. The 126 gearbox provides a good next step and will take double the torque of the 500 with these mods.

The original Fiat 500 had a non-synchromesh (crash) gearbox, so installing the 126 4-speed, synchromesh, manual transmission was going to be a big improvement. The 126 gearbox, has synchromesh on second, third and fourth gears, is an easier gearbox to use, and has a higher final drive ratio (ideal for running 13" diameter wheels and tyres), so it's more relaxed.

Both the 126 and later 850s still suffer from a fragile differential.... though stronger than the 500. Its something you need to check for fatigue cracks and wear regularly. Luckily, the differential is showing no fretting and less than 10 degrees of backlash (measured at tyre). The diff is noisy in operation, even when in good shape. And its well worth experimenting with oils for a longer quieter differential life. I have gone with Hypoid Gear Oil - SAE 90 or 85 W 90.

The Ratios are 3.25/2.07/1.30/0.57 with a final drive ratio of 4.88.

(N.B. To calculate the gear ratio of an 18/34 gear set, divide the 34 by 18 i.e $34/18 = 1.88:1$).

Clutch

An uprated clutch that bolts straight in was installed. It is more reliable at higher power outputs, its pressure plate will take up to about 60bhp and equivalent torque, while the diaphragm will help provide a smoother change with a better thrust bearing.

Engine

Initially I have installed a lightly modified single port Fiat 126 engine, delivered used from Italy, but was overhauled and rebuilt from bottom end up, with new gaskets, rings, etc.. A new single-port cylinder head was imported from U.K. and installed after free-flowing and porting. At the time of engine installation, new engine and transmission mountings and bushings were installed, along with a tuned, free-flow muffler being constructed. This was done to first satisfy me that the car was sorted out, with the correct braking and handling setup. Afterwards, I will then choose which way to improve the motive power.

A big advantage of this engine was the electric, push-button starter (previously a cable pull), and the upgrade to an alternator instead of an antiquated dynamo, for electrical charging.



Rebuilt 126 Engine below :



Ready for engine/transmission installation (note the new coil springs and dampers already installed).



Later options could be

- modify the 650cc engine into a big-valve, dual-port, Dell'orto carburettor, screamer
- modify it into a lower-rpm, single-port turbocharged brute
- or, convert to an EV (electric vehicle); a good idea in these ecology-minded days.

It's running really well, and the 650cc engine makes a surprising difference over the original 500cc (but certainly no speed demon).

End of Part 4



Fiat 500L becomes a 500 Lusso Abarth - Part 5

Misc. Items, Project Currently and Full Specs.

Following initial work

- Further relieving and welding of front wheel inner arches to clear wider wheels and tyres
- Rear window seal renewed
- Rear side windows seals renewed
- Spark plugs leads replaced with Taylor 8 mm HT wires
- Petronix Flame-thrower high output coil installed
- K&N air filter installed

Chassis Work Still To Do

- Replace flexible brake hoses (old ones are getting soft), but need to be sourced.
- Still not totally satisfied with suspension heights (back to front). Still some fine adjustments to be made.

My wife embracing 500 (note optional closed engine cover)



And optional open engine cover



Current Specifications *Specifications*

Dimensions

Wheelbase 72.4 in
 Length 117 in
 Width 56 in (Std. was 52 in)
 Height 50.0 in (Std. was 52 in)
 Front Track 44 in
 Rear Track 44.5 in
 Coefficient of Drag 0.39

Corner Weights and Total Kerb Weight

Weighed in June 2006 :

Front (Driver's Side) = 248 lbs Front Total = 508 lbs (47%)
 Front (Pass. Side) = 260 lbs
 Rear (Driver's) = 295 lbs Rear Total = 589 lbs (53%)
 Rear (Pass. Side) = 294 lbs
 Total = 1,097 lbs

Vehicle Height

Each corner measured, from level ground, up to to bottom, outer, flat, edge of sill. Point of measurement, about 2" from where sill meets wheel arch, and forward or rearward towards vehicle centre.

Date	Notes	Front LHS	Front RHS	Rear LHS	Rear RHS
5th. May 2009	tyres properly inflated and with rear seats	169 mm	165 mm	166 mm	159 mm
5th. May 2009	tyres properly inflated and minus rear seats	169 mm	167 mm	167 mm	169 mm

Performance

Max. Speed 65 mph (105 mph) (Std. was 61 mph (102 kph))
 0 - 30 mph 4.2 sec
 0 - 60 mph 35.9 sec
 0 - 80 mph
 30 - 60 mph 31.7 sec
 30 - 80 mph

Engine

Type In-line 2 cylinder 652 cc 2 valves per cylinder (Std. was 500 cc)
 Bore x Stroke 77 mm x 70 mm (Std. was 67.4 mm x 70 mm)
 New 650 cc engine type and Engine #s Type # : 126 A1 000 Eng. # : 9649458
 Crank/Oil Filter Pulley Rotation Clockwise (when looking from rear)
 Cylinder Head Single-port 650
 Inlet Valves 33 mm (500 was 32 mm)
 Exhaust Valves 28 mm (500 was 28 mm)
 Power 25 bhp @ 4,500 rpm
 Torque 31 lb/ft @ 3,000 rpm
 Maximum RPM 5,200 rpm
 Compression Ratio 7.5 : 1
 Carburettor Weber 28 IMB 5/250
 Air Filter Element K&N clamp-on
 Oil Filter Centrifugal
 Oil (Summer Hot) Mobil 1 15W50 Fully Synthetic (2.6 litres)
 Oil Pressure - Normal 36 - 43 psi
 Oil Pressure - Warning Light Activates 8.5 - 14 psi
 Spark Plugs (std.) NGK BPR6HS Denso W20FPR-U
 Spark Plugs (optional) NGK Iridium BPR6HIX Denso Iridium 1WF20
 E3 (not yet available in correct 1/2" reach)
 Spark Plug Gap 0.024 to 0.028 in / 0.6 to 0.7 mm

Spark Plug (Thread Pitch x Dia.)
Spark Plug Tightening Torque

M14 x 1.25 (1/2" reach)
15 – 22 lb/ft (20 – 30 Nm)

Ignition Timing

Static Advance
Maximum Centrifugal Advance
Points Gap
Poly-V-Belts
Length mm

10 degrees BTDC (equal to 13 mm round pulley)
18 degrees BTDC
0.018 to 0.021 in (0.47 to 0.53 mm)

Camshaft

Camshaft Label
9.325 mm)
Inlet Opens
Inlet Closes
Exhaust Opens
Exhaust Closes
Camshaft Lift
Replacement Sport Camshaft

26/57 (inlet dur. 263/exhaust duration 263/lift 0.367" or
26 degrees BTDC
57 degrees ABDC
72 degrees BBDC
17 degrees ATDC
0.367 in (9.325 mm)
Labelled : 40/85 (inlet dur. 305/exhaust dur. 310/lift 0.42" or
11.145 mm)

Cylinder Compressions

Fresh Engine
Good Used Engine
Getting Worn Engine

165 psi
145 psi
130 psi

Cooling System

Type

Air Cooled by Engine Driven Fan

Transmission

Gearbox
Gear Ratios (1; 2; 3; 4)
Final Drive Ratio
Gear Oil

Fiat 126 4-speed manual (synchromesh)
3.25; 2.07; 1.30; 0.57
4.88:1
Mobil 1 10W40 Fully Synthetic (eng/gear oil for V-Twin
Bikes) 1.1 litres

Clutch

Middle Barton have an off-the-shelf diaphragm clutch which has an up-rated diaphragm and centre plate.
(This takes care of anything you're likely to throw at it, and it's easy to install)

Suspension

Front Spring
Front Dampers
Rear Springs
Rear Dampers
Aforementioned Lowering Kit
Front Wheel Bearing Kit
Rear Wheel Bearing Kit

Stiffer, reverse eye single transverse leaf spring
Telescopic Red Konis
Stiffer coil springs (Green)
Telescopic Red Konis
(500Mania #AS001) Lowers by 1.5" in
Fiat 126P - QH # QWB241

Steering

Type

Worm (screw) and sector
(This later "L" steering column has better switches for lights
wipers, a steering column lock with the ignition switch and a
collapsible steering column for safety)

and

Ratio
Turn Lock to Lock
Fluid
Front Tracking

Toe-in : 0 to 1/16 in or : 0 to 2.0 mm

Brakes

Front Type
Front Disc Pads
R-00179/090)
Pad Adjustment

(500Mania Kit # MV006) 1989-1997 MkIII Ford Fiesta
Ford Fiesta Mk III (1989 to 1997) #FT1011E (90
Automatic

Rear Type
Brake Shoes
Shoe Adjustment
Rear Wheel Cylinders
Parking Brake
Master Cylinder

Hydraulic, Fiat 126P drum brakes
Fiat 126P - QH # BS544
Automatic
Fiat 126P - QH # BWC3089
Cable Operated
Larger tandem master cylinder from Fiat 126P
AKRON MALO # 89010
Other # on box - 791452
Hydraulic pipes from reservoir to master-cylinder are

Jaguar parts.
Fluid

Regular DOT 3 (not synthetic)

Wheel Bearings

Front
Rear

Ford or Fiat 126P ?
Fiat 126P - QH # QHB241

Wheels

Type
Size
Bolt Circle Diameter (PCD)
Backspacing
Wheel Bolts
bolt - 12
length

Minilite Alloy
13 in x 7 in
4 x 98 mm
4 in
(Similar to used on VW, Audi, BMW, Mini, MB, etc. Tapered
mm dia.....,..... / 1.5 mm pitch / 24 mm thread

Tyres

Make
Size
Pressures
Rear - 23 psi

Sumitomo HTR200
175/50HR13
Recommended for Std. Wheels/Tyres : Front - 17 psi

My low profile radials : Front - 13 psi Rear - 20 psi

Electrical

Alternator
Starter Motor
Battery
Headlight Bulb
Front Side/Signal Bulb
Rear Signal Bulb
Tail/Stop Light Bulb
Signal/Flasher Relay

Marelli or Polmot 33 Amp / 14.0 to 14.5 Volt
12 V / kW Type B 76-05/12S pre-engaged
12 V / 34 Ah (L235 mm;W133 mm;H198 mm)
Wurth Firstec 12v 45/40 Watt (art.-Nr. 720 120 1)
GE #7528 12v P21w/5W/BP2
GE #7506 12v P21w/BP2
GE #7528 12v P21w/5w/BP2
Tridon Standard 12V (550) #20-1036-2 (3 terminal +/P/L)
+ to battery
P to signal/indicator light
L to switch on steering column

Exterior

Paint Codes

Upper - Chrysler Flame Red (PPG # 4679)
Lower - 1994 GMC Medium Grey Metallic (WA 8798)

Alternative Paint 1

- Ferrari Rosso Corsa Glasurit FER 300/9

Alternative Paint 2

- Ecurie Ecosse Blue
- Scottish Flag Metallic Blue
- Lynx Flag Blue Metallic
Dupont (Lynx Flag Blue Metallic) :
Code # B72
Ref. # F9915
Microfiche # M1657
Value Shade # 7

Ignition Key
In-Line Fuel Filter

Fiat #A3095

End of Part 5



Fiat 500L becomes a 500 Lusso Abarth - Part 6

First Abarth Engine Upgrades and New Brake Hoses

Motive power is one item which can be considerably varied. I have spent over three years attempting to decide on which form of motive power I will employ. My choices were :

- Keep original 500 engine
- Modify original 500 engine
- Install larger 650cc to 700cc standard 2 cylinder engine
- Install and modify larger 650cc to 700cc engine
- Install larger Fiat 4 cylinder (FIRE) engine
- Install motorcycle engine
- Install Citroen or VW engine
- Install Mazda rotary engine
- Convert to EV

By far the most popular option, is to install the larger 650cc engine and then modify at a later date. This is the route I have chosen. In this, Part 6, I have installed all the external Abarth alloy components, along with an original (rare and very expensive) Dellorto FZD 32/28 carburettor, and intake manifold. At same time, I have made further adjustments to the suspension, etc., to obtain the larger wheel/tyre clearance and balance the ride height. New front and rear brakes hoses have now been sourced and installed.

A Sage Word About 500 Abarth Replicas/Clones

Abarth versions are the ones that we all hanker for, but in fact they're few and far between. Factory-built Abarths are as good as non-existent in Canada and extremely rare, even in Italy. Note that most 'Abarths' were fitted with Abarth tuning kits by Fiat dealers, and have Fiat, not Abarth, chassis numbers. Replicas are often better-built anyway.

Market View

Fiat 500 prices are firmer than they've ever been. A halfway decent 500 will cost you around c\$10,000. A nicely restored car could be as much as c\$24,000, or c\$32,000 for an Abarth 595 and up to c\$48,000 for a 695SS. Abarth replicas/clones are often better than the real thing in terms of ease of use, with a really good one costing around c\$32,000.

If you want to build a replica/clone, all the parts are there. With a Fiat 126 engine and gearbox, ZFD carb, free-flow exhaust, sport camshaft, and Abarth Alloy parts, you can get a great little motor. Then spend for lowered suspension, front disc brakes, wider fender flares, open engine cover and smaller steering wheel.

Conclusion

It's recommended not being too fixed about finding a genuine Abarth, unless you're a collector. You'll have more fun in a decent replica/clone, but make sure it has uprated suspension and a high-quality disc brake conversion, rather than just a hot engine.

Let's Talk About The Original 126 Engine Design

In 1957 Fiat launched the successor to its previous model the Topolino. The designer was Dante Giacosa who was to become a legend in the automobile design world. It drew heavily on the slightly larger 600 but differed dramatically in the engine department by having an all new 479cc overhead valve, air-cooled vertical twin mated to a four speed crash gearbox. With 13 bhp on tap it's neck breaking acceleration did not exactly conjure up images of a would-be Ascari at the wheel. So came the likes of Carlo Abarth, Giannini, Nardi, who had a field-day offering after-market accessories and bolt-on tuning parts.

Aurelio Lampredi, designer of Ferrari racing engines and larger V12 road engines, also created the air-cooled, in-line, vertical twin that powered 3,687,000 Fiat 500s and a following onslaught of 126s.

This is an engine design on the cusp of motorcycle and car. Each cylinder has its own separate cast-iron barrel which sits in a recess in the aluminium crankcase and is sandwiched there by a one-piece aluminium cylinder head which bridges both barrels. Eight long studs, four per barrel, clamp the assembly together. The overhead, slightly-inclined valves open into a wedge-shaped combustion chamber and are actuated by conventional pushrods and rockers from a camshaft mounted down in the crankcase. As is typical in air-

cooled engines, the pushrod tubes double as the return path for oil draining from the head. The original pistons, usually had four rings, all of them above the gudgeon pin.

Moving down to the crankcase again, we find a crankshaft whose design seems to savage all known notions of engineering symmetry. Half way along its length is a giant counterweight designed to compensate, up to a point, for the fact that both crank throws are opposite to it. This being a four-stroke parallel twin, both pistons must move up and down together if firing intervals are to be even. That's why this will never be a smooth, inherently-balanced design, whereas a two-stroke parallel twin can have its crank throws 180 degrees apart and still have even firing intervals, resulting in a much smoother engine.

Clearly there is no centre crankshaft bearing. Nor are there any thrust washers; the crankshaft is located longitudinally by the two flanged plain bearings, one at each end, and end-float is set on assembly by positioning the timing-chain-end bearing correctly then drilling its outer casing to take a dowel between it and the crankcase.

Now comes an extremely neat piece of design, a brainwave of simplicity. The crankshaft is hollow, and acts as the oil supply conduit for the engine's bottom end. Oil arrives in it from a centrifugal oil filter in unit with the bottom fan pulley. There's no filter element; instead the dirt particles are flung to the edge of the filter where they accumulate harmlessly until the cover is removed and dirt cleaned out.

And so to the head. This has just one shared inlet port, feeding down from the head's top face, but separate exhaust ports emerging from opposite ends of the head. Then there is the need to keep it all cool. A large, 14-bladed fan on the end of the dynamo (or alternator), to the left of the engine, draws air through hefty trunking from the louvres below the rear window. The carburettor's air filter draws its supply from within the fans shroud. Most of the cooling air is then forced past the cylinders' cooling fins, with a smaller portion blowing along channels between the base of the sump and a corrugated plate welded beneath it. A thermostatic shutter controls the rate of hot air departure from around the cylinders, and there's an alternative escape route along ducting into the 500s cabin which is controlled by the occupants via another shutter. They run quite hot (oil temperature can reach 130 degrees centigrade).

Air-Cooled 126 Engine Key Features

Although the 500 and the 126 engines are basically the same (even the crankshaft), it is best to start with a 126 engine (supplied from car above), because :

- the crankcase and rods are stronger.
- you can rebore 126 (650cc barrels) and fit larger pistons to get 700cc (while with the 500, you have to replace barrels also, to get larger capacity).
- you can change barrels and pistons on either engine to go up as far as 850cc

Note : the 650cc engine has "126 A1 000" stamped on engine casting adjacent to the fuel pump mounting flange (earlier 600cc has "126 A 000" only). The 650cc engines are remarkably tough, and although, a parallel twin has never been a good engine design, they have a number of good features :

- Strong twin valve springs, that prevent valve bounce.
- Alloy push rods, with less mass than steel.
- Light block alloy and head.
- Strong valves.

Operations Possible With Engine in Car

- Removal and installation of cylinder head
- Removal and installation of timing cover and gear
- Removal and installation of oil pump and centrifugal oil filter
- Removal and installation of sump
- Removal and installation of big-end bearings
- Removal and installation of connecting rods and pistons
- Removal and installation of cylinder barrels

Operations Not Possible With Engine in Car

- Removal and installation of camshaft
- Removal and installation of crankshaft
- Removal and installation of main bearings
- Removal and installation of crankshaft front oil seal

Efficiency - Where the Energy Goes

- A well designed engine converts 20 to 25 % of its fuel energy into useful work at the crankshaft, the rest being wasted heat.
- The largest part of the waste heat is in the exhaust gas, which has a pressure too low for further energy to be extracted, without a turbocharger.
- The next big slice of waste heat appears in the coolant, which is used to carry away heat from hot parts to prevent their melting or seizing, and includes waste heat, generated as friction. Engines typically have mechanical efficiencies of about 85%, meaning that, of the total power developed by expanding combustion gas against piston tops, only 85% makes it to the output shaft as net power.
- The rest does the job of overcoming friction. Piston and piston ring friction are the largest losses, followed by crank and rod bearings, valve mechanisms, and all the internal thrashing of oil and air by the moving parts. The higher an engine revs, the greater its internal loads, and the greater the frictional losses.

What Determines an Engine's Power Potential

- How much air per minute can be processed through the engine (increased rpm, forced induction, nitrous oxide)
- Flow capability of the cylinder head
- Total valve area
- Engine larger size increases torque, but doesn't have a great effect on engine power, although the larger bore size, allows larger valves and/or 4 valves, to be fitted.

A Fast and Reliable Method to Quickly Determine Engine Condition

Take off the rocker/cam cover oil filler cap and look through the hole :

- | | |
|-----------------------------------|-------------------------------------|
| • Silver alloy surfaces | - a fairly new engine |
| • Brown tarnished | - low mileage |
| • Dark brown | - higher mileage but well cared for |
| • Black | - getting poor |
| • Black coated and becoming dense | - very poor |
| • Black and very sludgy | - dead on its feet. |

Further New Items Imported

Abarth 4-litre Alloy Oil Sump

As I am planning over 35 bhp, I have chosen to fit a deeper sump (also makes engine more rigid). Engine oil runs up to 130 degrees Celsius, which is incredibly hot and is something which needs to be managed, because it is relative to the amount of power produced. I have chosen to install the 4 litre Abarth cast alloy sump (requires extended pick-up and surge plate), to provide increased oil and more cooling.



NOTE : It is stated, that the 3.5 litre Abarth sump doesn't require an extended oil pick-up nor surge tray, but that the 4 litre one requires both. However, the 4 litre sump comes only with the surge tray, and not the oil pick-up extension. After much research, I have found that it is perfectly alright to run the engine with the standard length oil pick-up pipe, in normal road use, as long as the oil level is maintained close to the max. level on the dipstick (however, if racing and under extreme cornering, it would be necessary to have the extension). With testing, using a laser thermometer, it has been found that, on a hot engine, there is no

discernible difference in temperature between the bottom of the sump and half way up, so having a pickup extended by that extra inch or so, makes no difference to the temperature of oil it's sucking back up. The question is, why if the extension is so crucial, does no one supply an extended dipstick to go with it? As long as you have your oil to the max on your dipstick you will have no problems.

Installation is relatively straightforward. You will require a new sump gasket, and 16 longer bolts (original 6 mm diameter, 17 mm long, 1.0 thread pitch), of same dimension except for being 30 mm long. The new alloy sump has much thicker (17mm) mounting flange. You will require to use smaller diameter washers as very tight access around the alloy sump mounting flanges. All fittings I chose were stainless steel. Remember to tighten up the alloy sump diagonally (don't just go around the rim) in stages, so as not to warp anything.

My only issue was with the two rear-most bolts (above the "ABARTH" logo). I could not get any access for a socket, and ended up laboriously tightening those two with a ring spanner in many little steps.

On refilling with oil, the new deeper sump does indeed take 4 litres to fill to correct dipstick level. I have refilled with the excellent Royal Purple 15w40 fully synthetic oil (used this same oil on my previous Ferrari).

Abarth Alloy Rocker Cover and Cap

To also increase cooling and provide a more rigid upper engine platform with stronger sealing.

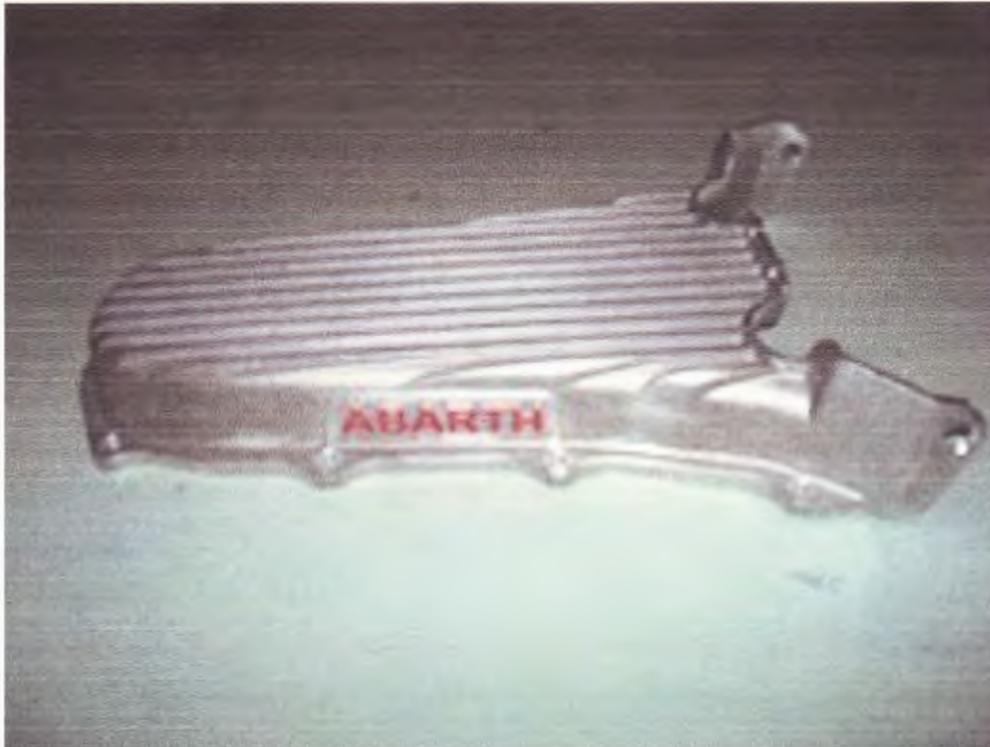
Note : there appear to be two types. I opted for the performance carburettor version, and found that it would now slide in with standard carburettor, as its mixture adjustment flange proved to be restrictive. This didn't matter here, as I just removed the old Weber carburettor as I was going to be installing the Dellorto FZD.

Installation is very simple, but before doing so, I fitted a K&N crankcase breather filter attached to the brass breather connector with a short length of clear plastic tubing. It is rotated away from the rear exhaust pipe flange.

You will require a new valve/rocker cover gasket.



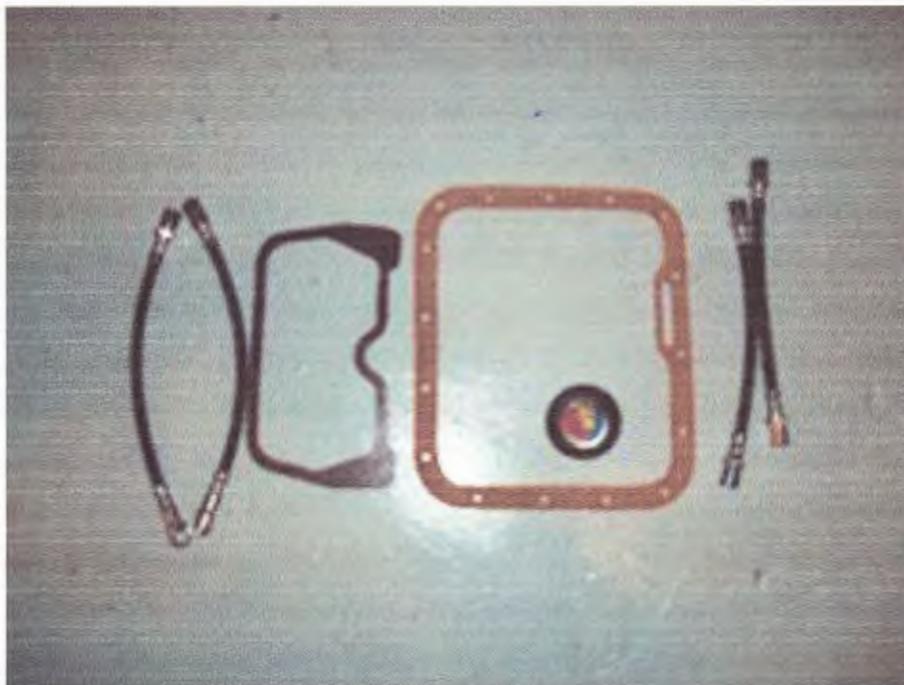
Abarth Alloy Cooling Fan Cover



To also increase cooling by making cooling fan more efficient with better sealing and removes the upper air outlet to the old carburettor intake. With new FZD carburettor setup, I will not require the pressurised engine cooling air to prevent carb. "blow-back". Anyway, with standard carb. this is unnecessary as long as you keep RPM below 6,000 rpm.

Again, in similar fashion to the sump, this alloy part is also much thicker, so requires longer 20 mm bolts (still 6 mm diameter, 1.0 thread pitch).

Front & Rear Brake Hoses Along With New Gaskets and Replacement Abarth Horn Button



Front and Rear Brake Flexible Hoses/Lines Installation

Old brake hoses had seen better days and were showing signs of rubber weakness. They were having a tendency to "balloon" when the brakes were applied, resulting in soft and inefficient braking.

Having now installed the new, upgraded front and rear flexible brake hoses/lines, has significantly improved the brakes. They are superb (remember discs are already installed on front along with larger rear drums plus a dual tandem master cylinder, with separate lines to front and rear). A much better system than the original solo master cylinder, having to feed front and rear, at the same time.

Note :

- Front and rear hoses are different styles
- Brake fluid flushed at same time and replaced with DOT 3 (non synthetic) brake fluid.

Dellorto FZD 32/28 Carburettor and Intake Manifold Installation



There is no carburettor accelerator pump on the standard 500/126 engine carburettor, so put a carburettor on with a pump jet, and it dramatically reduces the acceleration time. A favourite pump jet carburettor is the Dellorto FZD 32/28 single choke, semi-downdraught carburettor. The FZD has a 32/28mm or 1.25" venturi choke, is a good carburettor for up to 45 bhp, has not been made for some time now, is hard to find secondhand, and if found, is very expensive.

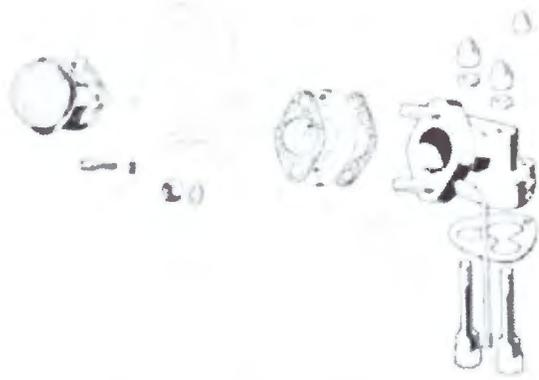
The FZD gives the same peak power (as a Weber DCOE), once set up, with no flat spots, an improved mid range, smoother torque curve, and an improvement in economy, without a loss of performance.

N.B. - If carburettor is well set up, you don't have to bother with connecting the choke. Just push the accelerator to the floor once, then lift foot off and start.

Dellorto Carburettor Tools

You can perform a minor rebuild on a Dellorto, without removing it from the intake manifold or disrupting the linkage. All you need is a flat-bladed screwdriver, pair of pliers, 10 mm and 12 mm sockets/wrenches, and a pin to poke through the progression holes. Major rebuilds require special tools, and are not for the faint-hearted.

Exploded View and Images of Intake Parts



How to Check Flanges for True Mating Surfaces and Repair

- Place some plate glass down on a flat surface and smear the glass with lipstick about twice the area of the flange.
- Draw the carburettor flange over the glass (the high spots on the flange will now show).
- Grip the carb in the vice and with a file, remove the high points.
- Smear the lipstick on again, and draw the carb back over, checking for high spots.
- Repeat this procedure until the flange is flat.

Installation Instructions

- Once the old original Weber is removed, remove the bakelite baseplate
- Then remove the two centre head nuts and the outer carburettor mount stud
- The new posts (supplied with the new manifold) are screwed on where the head nuts were removed and torqued down
- Fit new base gasket smeared with grease
- The manifold slips over the top and is secured front and back (tighten down evenly a 1/4 turn at a time)
- Finally, the Dellorto carburettor is fitted directly on to the manifold using new gasket smeared with grease.

Note : The FZD carburettors are not heavy and do not need to be supported like the twin barrel DCOE's or DHLA's. The larger twin barrel carburettors also require a soft mount to get around the problem of fuel agitation in their rather shallow fuel bowls. *The little FZD seems immune to this problem.*

Setting Up the Dellorto FZD 32/28 Carburettor

A Good Place To Start.

The Dellorto FZD 32/28 on a Fiat 650cc engine usually will have the following jetting, etc. :

- Main 132
- Air Corrector 190
- Pump 50
- Idle 48
- Emulsion 6747-8

This is as good a place as any to start. As you further tune the engine (larger valves, better camshaft, etc, then you may alter these to suit).

A Note About FZD Fuel Pressure and Fuel Filtering

- The standard Fiat 500/126 fuel delivery system uses a mechanical pump that constantly circulates fuel through the carburettor and back to the tank. This may flood the FZD carburettor as there is no adjustment on the output pressure.
- Fitting an electric pump along with a fuel pressure regulator, having constant low-pressure output providing a high volume of fuel at a low pressure (but no higher than 3 psi), and which stops pumping, when the float chamber is full, so no re-circulation pipe required, is best solution. The fuel pressure should be regulated to between 1.5 and 2.5 pounds per square inch at high RPM, and no higher than

3 PSI at low RPM. Too high a fuel pressure will force fuel past the float valve causing rich erratic running.

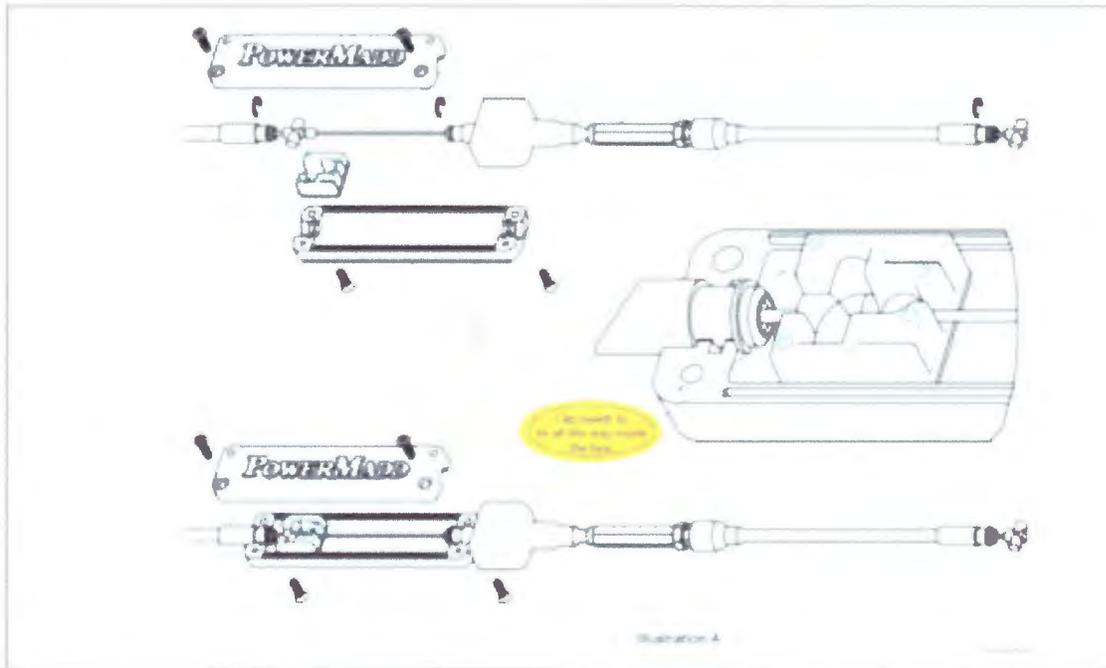
- These carburetors normally have a wire screen filter in the fuel inlet. This filter does not have a good reputation for working well over time, and considering the size of some of the jet openings, the built-in screen, is not really fine enough to prevent clogging. Install a high-volume fuel filter, between the fuel pump and the fuel regulator.

In-Line Fuel Filter

As the carburettor is not an easy thing to remove off the car and dismantle for cleaning clogged internal jets, you should fit an inline fuel filter.

Throttle Linkage Modification

As the old throttle cable pivot was eliminated with the installation of the new Abarth alloy air cover, a way of extending the throttle cable was required. This was completed by the installation of a "PowerMadd" throttle cable extension kit, which gave the required small extra length. This also permits throttle adjustment.



PM12042 - PowerMadd Throttle Cable Extension Junction Box Detail

Note - 2" clips are all the way inside the junction box, not in the groove





End of Part 6



Fiat 500L becomes a 500 Lusso Abarth - Part 7

Further Engine Tuning - Above Basic Abarth Specs

Overview in Modifying the 126 Engine Above Abarth Specs.

- The practical limit of the 126 engine is probably around 40 bhp (at the wheels).
- Beyond 40 bhp, you need to consider forged steel crank and rods (very expensive).
- The full race engines will give up to 70 bhp, but they are totally unsuitable for the road.

Air-Cooled 126 Basic Tuning Steps

- Stronger Head Gasket
- Raised compression ratio to 9.5:1 (not if turbocharging)
- Free-flow exhaust
- Ported, big-valve head (should only increase intake valve size - see info about raised CR with valve dia. ratios)
- Bigger carburettor/s
- Electronic contactless ignition
- Bigger cylinders with forged pistons
- Forged crankshaft and steel con rods (Blitz Tuning state standard parts good to 6,500 rpm, but Middle Barton state only good to 6,000 rpm)

See individual engine modification sections for more information (i.e. Bottom End, Cylinder Heads, etc.)

Electronic Contact-less Ignition

Install a contact-less electronic ignition module from Pertronix, for the Fiat 126 (distributor S152A) Pertronix Ignitor Part # MR-123. (Note that distributor rotates clockwise).

See Ignition section for more information

Remote Oil Filter

Has take-off for later oil cooler to be added (use VFR oil cooler).



End of Part 7

