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Weber DCOE carburetors and the Triumph TR2 through TR4A engine

This web page covers Weber DCOE carburetor theory of operation and tuning as it applies to the Triumph TR3 and TR4 engine.

When I first installed a pair of Weber 45 DCOE carburetors in my TR3A, I knew very little about them so I started looking for information. I never found a single source that told me all I wanted to know about the Weber DCOE, nor one that went sufficiently into the use of DCOEs on the Triumph TR four cylinder engine. What follows is basically my collection of notes accumulated a bit here and a bit there from dozens of sources over several years.

Edoardo Weber developed his first carburetors in the 1920's. What made and still makes his carburetors so appealing (other than their overpowering charisma) is the adaptability of his designs. Carburetor functions that are cast into the bodies of other carburetors are separate tunable parts in Webers. You can even change the size of the venturi itself. This means Webers can be tuned specifically to individual engines to work best with the cam, exhaust system and compression ratio of your particular engine. They can be tuned for excellent fuel mileage, maximum power or anyplace in-between. Most people who buy DCOEs intend to tune for maximum power and not maximum fuel economy. If you are tuning for maximum fuel economy stick with the low jet and venturi numbers that I discuss below.

The problem with extreme adaptability is that it is a two edged sword . One edge allows you to closely tune the carburetor to your engine, the other edge leaves you wondering lost in a vast myriad of tuning component possibilities each affecting the function of the others. What I hope to do here is provide a tuning map of sorts, specifically for the TR2 through TR4A engine. Please take this as my best guess and current understanding and not as expert opinion or as the absolute truth.

Beware of looking to other brand same displacement engines for clues about carb size and jetting. The TR engine is low revving and high torque. The engines that came from the factory with DCOEs tend to be low torque high revving engines. Their jetting and venturi size will be wrong for the TR engine.

Some engine background

The engine used in the TR2 through 4A and most Morgans of the same years is a low revving torquey engine. There are major crank shaft harmonics around 5200, 5800 and 6200 RPM. The one at 5200 RPM tends to break the crank at the base of the flywheel mounting flange if you spend much time there. The one at 6200 is at the middle of the crank and tends to beat up the middle main bearing,

Triumph factory race cars were red lined at 5000 RPM (same as a stock engine) so they would not break the crank on a long race. The factory TR4 rally cars that had 42 DCOE 8s were jetted for power below 5000 RPM. Apparently some factory rally TR4s were fitted with 45 DCOE 9 carbs instead of the 42s.

There is a harmonic dampener kit currently available (Racetorations in the UK, British Frame & Engine in the US) that tames the 5200 RPM harmonic quite a bit and possibly the others as well. Nitriding the crank increases its hardness and is a must if you want to rev the engine. So are such things as balancing the engine, lightening the rocker assembly, going to an aluminium flywheel and going to stronger valve springs and retainers.

Also be aware that current stock non asbestos clutch disk linings seem to come apart if you spend much time at or above 6000 RPM.

Choosing a DCOE size

When the TR4 engine was fitted with DCOEs from the factory during the sixties (Morgan Super Sport and Triumph factory rally cars) or by individuals for racing, the carb most often used was a 42DCOE 8. These carbs have been unavailable for a long time. So our choice boils down to the smaller 40DCOE or larger 45DCOE. Which you pick will depend upon how the engine is built, how you intend to drive the car and what you wish the red line to be.

As an aside, the prefix number on the DCOE is the diameter of the throttle plate (the throttle bore) in mm; DC means "doppio corpo" (double throat); O means "orizzontale (horizontal); E means it is a die cast carburetor; and the number or number and letter suffix is the variation type. Except there seems to be several variations to most variation suffixes. You want to be very sure that the DCOEs you purchase are indeed matched pairs. You will never get two DCOEs to work properly together if they are different variations.

The Weber choke is a removable venturi. The larger the choke (venturi), the more air fuel mixture can flow through it and the less flexible the engine will be at lower RPMs. The smaller the choke the better the low & mid end is and the sooner it will start restricting flow at higher RPMs. The ideal choke size is the minimum size that provides good flow at your maximum usable RPM. Going larger than that costs you low end a mid RPM power without increasing high end power.

Here is an excerpt from an e-mail I received from Kas Kastner (12/9/03) on the subject of TR engine air flow through the intake.

> "Just for the books, in the ancient past I remember the so called "optimum gas speed" for best flow was 325 fps. Anyone remember differently? Interesting enough this might explain a little why lots of times increasing the size of the inlet valves does NOTHING for the power and may even be a deterant."

Just a reminder that bigger is not always better.

Here is what I have picked up as choke rules of thumb for the Triumph four cylinder engine.

36 mm choke - race engine or highly modified street engine with 87 or 89mm pistons redline 6000 RPM or higher. High speed power is the most important but mid range power is also important. You want the engine to pull strongly through 6500 RPM. This would be a good size for most prepared race engines expected to be used on high speed circuits. 36 chokes may be a overkill on a hot street engine. 38 chokes may be a possibility on all out track race engines that do not need mid range power.

34mm choke - modified street engine, autocross, 86, 87mm pistons, "fast street" cam (260-280 degrees) or longer duration. Wide power curve possible with correct cam. Very slightly better low end power than 36 chokes but starts running out of breath at around 6200 RPM or a little higher depending upon cam and flow characteristics from air horn to tail pipe. This would be a good size for auto crossing and fast driving where there are tight curves and you have the need to accelerate quickly as well as run at high speeds.

33 mm choke - same as above but with rev limit of around 5000 RPM, better low end power. Probably better suited for a fast street car with 86-87mm pistons.

32 mm choke - basically stock or mildly warmed up engine, 83 or 86mm pistons, stock or mild "street" cam, 5000 RPM red line (stock engine rev limit). Highway cruiser with lots of low speed flexibility. Can be tuned for good fuel economy. Smaller chokes down to 30 can be considered for stock engines being tuned for maximum economy and regular town and highway driving.

Here is where you choose your DCOE. The largest choke that will work properly in a 40DCOE is a 34 choke. The smallest choke that will work properly in a 45DCOE is a 34 choke. While larger chokes are available for 40DCOEs and smaller ones are available for 45DCOEs they will not work as well.

If you intend to keep the engine at or below 5000 RPM, the 40DCOE will provide you with your best all around power curve. This will handle fast street applications quite well and give you lots of low end flexibility. The 34s will give you fast street and you can choke down for additional low end grunt or better fuel economy. As a comparison, the 2L Alfa Romeo engine was equipped with 40DCOEs and 32mm chokes from the factory for both power and economy. So this combination should provide adequate power and economy for a 2L ex-tractor engine.

If you have a stock crank and no harmonic dampener keep the engine red line at 5000 RPM and stay with 40DCOE Webers. 45DOEs would be overkill and may not work quite as well in your application. If you want to rev higher, nitride the crank and get the harmonic dampener kit.

You only need 45 DCOEs if you are track racing. The 36 chokes can provide a little extra with the wild cam and 12:1 or higher compression. 45 DCOEs with 34 chokes will work fine for high RPM fast street or autocross but so should 40 DCOEs with 34 chokes. No wonder the factory chose the no longer available 42DCOEs.

The rule of thumb seems to be to fit the smallest choke that will give you full power at your maximum usable RPM. The smaller choke will provide better overall flexibility and power. Going to a larger choke will allow you maximum power at peak RPMs but will reduce low end power.

I'm currently running 34mm chokes in 45DCOEs on my TR3A engine. The engine pulls strongly past the point where the 6000 RPM tach is buried. The cam I'm using is designed to pull strongly between about 2500 RPM to 6000 RPM then have a wide flat top end.

I made the mistake of buying the carbs first then deciding what choke to use. As it turns out the smallest choke that works properly with 45DCOEs also works well on my engine. But who knows, a slightly smaller choke might work even better.

Make an honest evaluation of your engine and driving habits then choose the most likely correct choke size. THEN choose the DCOE carburetor size that fits the choke and purchase your carbs as a matched pair from a reliable source. Do your homework first and order matched carbs equipped with your best guess of venturis and jets from a dealer that will set them up to your specifications. Chokes and jets are expensive so you might as well start with a close ballpark set instead of paying for a bunch of parts you have no use for.

Beware that bargain used DCOE carburetors that someone decided not to use may end up costing as much or more than a new ball park jetted DCOE by the time you pay to replace wrong size venturis and jets. Weber jets do not come cheap.

Venturi (choke) shown on left. The size number is stamped on the front where visible looking down the barrel. This one is a 32mm choke for a 45 DCOE.

Auxiliary venturi shown on right side. The size is stamped along the outer side and is not readable unless the auxiliary venturi has been removed. The little centre venturi is where fuel from the main jet is drawn into the air flow.

Underside of 45DCOE

Both venturis are held in place by 10 mm fixing bolts on the underside. The fixing bolts are drilled for tie wiring and can either be kept secure by tie wire or by a lock tab as shown. *****

At the very top of the picture you can see part of the float bowl bottom access plate. This can be removed for thorough cleaning of the bowl under the jet stacks. This area is inaccessible from the top with the cover off.

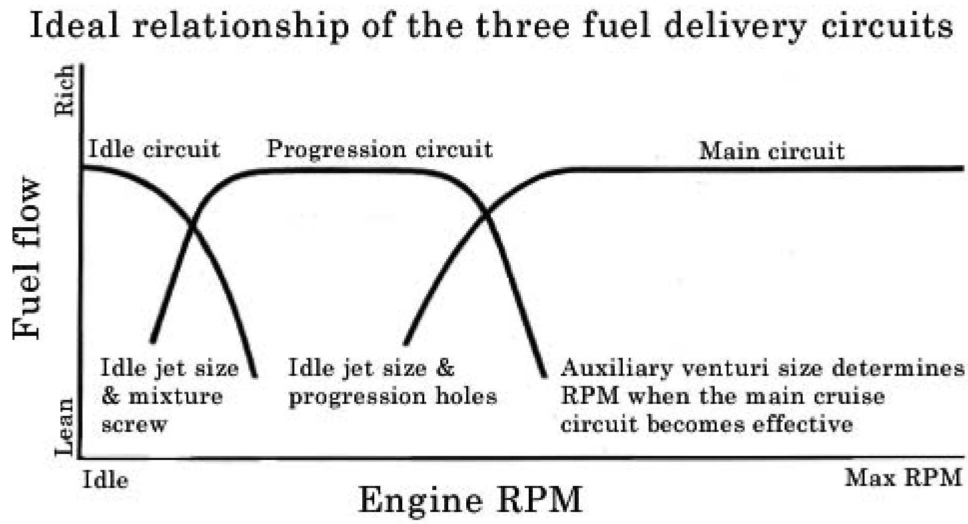
*** About the venturi fixing bolts -** Because of the thinness of the venturis they hold in place, there is very little torque on these bolts. The lock tabs provided by the factory have been known to loosen and allow a bolt to back out and fall off. The result is a lose venturi and a throat that doesn't operate correctly in the high 2000 RPM and higher range. The best thing you can do for reliability once you have decided upon the correct choke and auxiliary venturi combination is to toss the lock tabs and wire the bolts together.

Auxiliary chokes

The auxiliary chokes are small suspended venturis that sit inside the throats of the DCOE and atomises fuel from the main cruise circuit into the air stream.

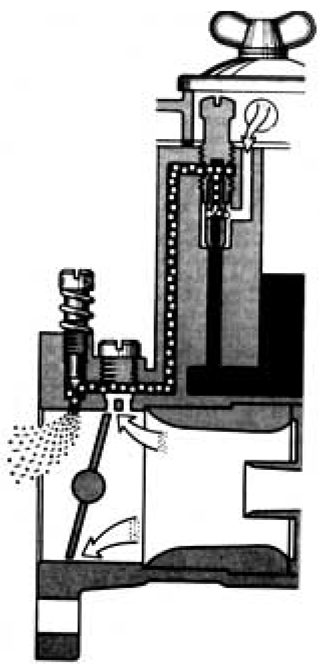
The number on the auxiliary choke refers to the diameter of the cross section area of the delivery port (venturi) and not the size of the fuel nozzle that delivers fuel into the port. The smaller the diameter, the higher the air velocity through this suspended venturi and the sooner the main or cruise circuit comes into play.

To understand the role of the auxiliary choke you need to understand how fuel is delivered to the engine at different RPMs. The DCOE has three different fuel delivery systems (not counting the cold start and accelerator pump circuits) that deliver fuel into the throats of the carburetor at different RPMs. Tuning a Weber is a matter of trying to obtain the relationship shown in the graph below.



Ideally you want the richness level of each circuit to be the same. The ideal intersection of the curves is where the fuel delivery of the circuit going out plus the fuel delivery of the circuit coming on added together equals the total amount of fuel delivered when either circuit is in the middle of its range.

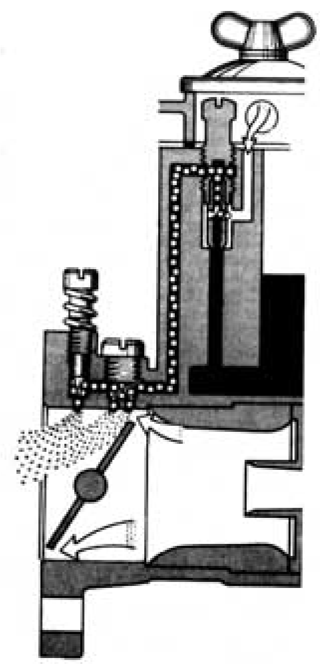
The idle and progression circuits are cast and drilled into the carburetor body making the peak location of their curves at fixed engine RPMs. The idle jet provides fuel to both the idle and progression circuits. This jet determines the richness of the progression circuit and the idle mixture adjustment screw sets the richness of the idle circuit curve. The main jet stack sets the richness of the main circuit and the size of the auxiliary venturi determines the RPM at which the main circuit curve intersects with the progression circuit curve. The main cruise circuit usually comes into play around 2800 to 3000 RPM. Below that, the engine is operating off the idle jets. This should help you trouble shooting any problem that occurs only above or below around 3000 RPM.



Here is how fuel is delivered to the cylinder. At idle the throttle plates (butterfly valves) are closed and fuel flows into the cylinder from an idle hole behind the throttle plates.

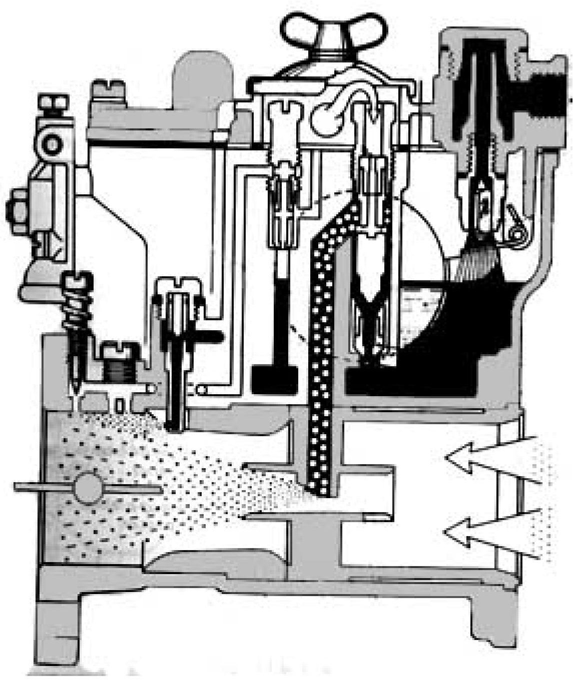
As the throttle plates start to open, the top edge of the plates move towards the mouth of the carb and encounters a number of progression circuit holes. These holes provide additional fuel into the increasing air flow. As the edge of the throttle plate passes a progression hole, the vacuum behind the plate draws fuel out of that progression hole. The additional fuel added by each progression hole keeps the cylinder from burning too lean in the RPMs above idle and before the cruise circuit kicks in.

If the initial adjustment of the throttle butterflies is open enough to uncover a progression hole, the engine will suck the fuel from the progression circuit during idle, resulting in a lean off-idle flat spot and poor fuel mileage.



At around 3000 RPM or a little below, the top edge of the throttle plate has passed all the progression holes and is opening wide enough to cause the vacuum to be too low to draw fuel out of the progression holes. This is when the main cruise circuit needs to be kicking in. The size of the auxiliary choke determines when this will happen.

If it kicks in too early (too small of a auxiliary choke) you get an



over rich condition and the engine bogs or stumbles in the progression (or just wastes fuel with no noticeable symptoms). If the auxiliary choke is too large there can be a lean area where the progression openings are not delivering enough fuel and the main cruise circuit has not yet kicked in.

This leanness is masked during acceleration by the accelerator pump. It would be seen as a leanness in a narrow RPM band while in a constant low RPM cruise (this is where an onboard CO monitor that can be read during driving would come in handy).

The goal here is to fit the smallest auxiliary choke that will not cause an over rich bog or stumbling during a slow opening of the throttle plates. This will assure the absence of a lean RPM band that might damage the engine over time.

Most DCOEs fitted to TR engines use 4.5 auxiliary venturis. They seem to work OK on the engines so no one seems to swap them out to see if 4.0's would also work. HP books "Weber Carburetors" suggests 40DCOE, 32mm chokes and a 3.5 auxiliary venturi for a stock TR engine. It is quite possible many TR engines run lean between the end of progression and the main cruise circuit.

A Note About Jets

Most DCOE jets have tapered ends. The tapered end of these jets sit snugly against seats in the carb body to create seals between different areas of the carburetor. If the seal is not made or is broken the carburetor will not function properly.

These jets are mounted onto holders with a friction fit. As the holder is threaded in, the taper at the end of the jet comes into contact with the passage seat and is pushed back into the holder maintaining a contact seal. If the jet is initially pushed in all the way onto the holder it may not reach all the way to the passage seat. The fit between the jet and holder should always be tight. A loose fit can allow a jet to back away from the seat over time.

The proper method of installing a jet is to fit it about one eighth inch extended on the holder then allow the passage seat to push the jet in the correct distance as you screw in the holder. Be careful not over tighten the jet assemblies. Once the jet is seated it doesn't take much torque to hold everything in place.

Most jet sizes are in numbers that give their actual diameter in hundredths of a millimetre. Idle jets can also have F numbers that indicate their ability to emulsify fuel. The number behind the F has nothing to do with the hole flow rate. Emulsion tube designation is by the numerical order in which they were designed and has nothing to do with their flow characteristics. There is NO flow relationship between different number designations of emulsion tubes.

1. Intake and discharge valve for accelerator circuit

2. Idle jet assembly

3. Main jet stack

4. Starter jet assembly

5. Accelerator pump jet

6. Idle jet

7. Air Correction jet

8. Emulsion tube

9. Main jet

10. Start jet (Cold start circuit)

Idle Jets 

Idle jets affect the idle and progression circuits of the DCOE. They are selected primarily for proper running of the progression circuit which extends from just above idle to where the main jet assembly takes over (from around 1200 RPM to around 3000 RPM). Proper selection is critical for smooth, economical low RPM cruising.

At idle, the fuel is mixed into the airflow behind the throttle plate (butterfly valve) and the flow is regulated by the idle flow screw. There are a series of progression holes, not affected by the idle screw, that get exposed behind the throttle plates as the throttle continues to open. As the throttle plate top edge moves past each hole, the vacuum behind the plate draws fuel from the idle jet out through that progression hole. This adds progressively more and more fuel to keep the engine running smoothly off idle until the airflow is high enough to draw fuel from the main jet. Since the progression holes are not adjustable, the idle jet is chosen primarily for the progression circuit.

Note: The idle position of the butterfly valves is adjustable by the linkage idle screw. If that screw is set wrong the butterfly valves may uncover a progression hole at idle. This will cause you to pick the wrong idle jet, or if you have the correct one there will be a lean flat spot right off idle that you will be unable to compensate for. Keep the throttle plate screw adjusted so the butterfly valve does not uncover a progression hole at idle.

Idle jets have a fuel hole drilled in the bottom of the jet and an air bleed hole drilled in the side.

The fuel hole regulates the amount of fuel for idle and gradual progression from the idle circuit to the main cruise circuit. The goal is the smallest hole that will provide a good smooth progression.

The air bleed hole affects the air fuel ratio of the fuel in the idle and progression circuits. A small air bleed hole means a richer mixture ratio and enlarging the hole leans out the air fuel mixture.

The idle jet code is the fuel hole diameter given in hundredths of a millimetre, followed by an 'F' followed by the size of the air correction hole. TR engines are often fitted with a 50F9 idle jet. I have seen 50F2 recommended from some sources. Once again a CO meter is your best friend for properly setting up the carbs.

Here is the complete list of idle jet air bleed holes in order from rich to lean

F6 (richest), F12, F9, F8, F11, F13, F2, F4, F5, F7, F1, F3 (leanest)

Most performance engines use F2 or richer air bleed hole sizes.

Here is the recommended fuel hole size recommended in one book:

50 idle jet for 1.65L to 2L (2L equals 83 mm pistons)

55 idle jet for 2L to 2.2L (2.2L equals 86mm pistons)

60 idle jet for 2.2L to 2.5L

The book suggests these jet sizes as starting points for testing. The goal is to end up with the leanest mixture that provides correct performance through the progression circuits.

Before testing idle verify that the idle position of the butterfly valves is not uncovering a progression hole. If it is, all your adjustments will be off and there will be a lean off-idle flat spot.

If the idle jet size is close to correct, the idle speed RPM should be correct when the idle flow screws are between 7/8 of a turn to 1-1/2 turns off closed. If only a half turn or so of the idle flow screw from closed obtains the correct idle RPM chances are the fuel opening in the idle jet is too large. If the screws need to be turned out 2-1/2 turns or more chances are the the fuel hole in the idle jet is too small.

If you are taking a CO reading, 2.5% CO at idle is ideal for a street engine. Higher than 3.5% is unusable and just provides poor fuel consumption without gains.

The final selection for idle jets should be based upon how the engine performs in the progression circuit over the progression band.

Before making the final testing for the idle jets make very sure the ignition is properly set up and functioning with the advance not starting until around 1200 RPM and properly advanced initial timing. With a modified engine the initial timing will probably be in the neighbourhood of 8 to 12 degrees BTDC with at total advance of 33 or 34 degrees. An ignition timing problem can be seen as a progression circuit leanness. Initial timing that is too retarded for the engine is a source of spitting out through the carburetor throats.

Slowly advance the throttle off idle and listen for any hesitation. If there is a hesitation the mixture is too weak. Adjust the idle flow screws out 1/2 turn and try again. If the hesitation is still there the jetting will need to be altered. Go to two steps richer on the air correction hole while leaving the fuel hole the same size.

Reset the idle then retest. If going to the richest level (F6) does not get rid of the hesitation, go to the next size larger fuel hole and rerun the tests with different air bleed holes.

When the no load tests are completed drive the car and retest under load conditions.

The ideal idle jet size provides an idle CO in the 2.5 to 3% range with the idle flow screws adjusted between 7/8ths of a turn and 1-1/2 turn and does not cause the engine to hesitate on the progression circuit. The next leaner air bleed size would cause a hesitation under load conditions. A richer jet will provide poorer fuel consumption. An over rich jet will not provide top performance.

Main jet/emulsion tube/air correction jet assembly

These three items form the main jet assembly that provides fuel to the engine once the throttle plates (butterfly valves) are open beyond the progression holes. The emulsion tube is a long brass tube with openings along the side. The main jet is a friction fit into the bottom of the emulsion tube. The air correction jet is a friction fit into the top of the emulsion tube.

There is a fuel passage that goes from the float chamber, through the main jet and into the emulsion tube. When the engine is not running the fuel level inside the emulsion tube is the height of the level in the float chamber.

There is an air passage from the small hole on the face of the DCOE into the float chamber, through the air correction jet and into the emulsion tube.

As the throttle plates move towards full open they cease to draw enough vacuum to pull fuel from the progression holes and start drawing fuel from the auxiliary chokes.

The vacuum at the auxiliary choke draws an emulsified air fuel mixture from the emulsion tube and out through the auxiliary venturis. As the emulsified air fuel mixture is drawn out of the emulsion tube, fuel flows from the float chamber through the main fuel jet into the emulsion tube to replace the emulsified air fuel mixture being drawn out of the emulsion tube.

Air is also drawn down through the air correction jet into the emulsion tube where the air and fuel are mixed.

Choosing the correct stack is essential for cruise and high RPM performance.

Main jets

The main jet controls the fuel mixture in the emulsion tube in the mid RPM range when the cruise circuit is activated. As the RPM range increases the air correction jet becomes more of a factor and becomes the dominant partner in controlling the mixture at high RPMs.

The main jets are numbered by the diameter of the jet opening and come in size steps of 5 hundredths of a mm. Too lean a jet can damage the engine through overheating. Too rich a jet washes the oil off the sides of the cylinder walls and causes rapid cylinder wall wear.

One reference book recommends a main jet size of 140 to 145 for modified Triumph sized engines. Other recommendations I have seen range from 130 for a pure stock engine running 32 or 33 chokes and having a red line 5000 RPM to 145 for a highly modified engine with a redline of around 6000 RPM. 140 looks like a good approximation for a high revving modified street engine and 135 for a modified street engine limited to 5000 RPM.

At high elevations our engines are getting less air, so they need less fuel to maintain the proper air/fuel ratio. Generally you would go down 1 main jet size for every 1750 to 2000 feet of elevation you go up. If you normally run a 140 main jet at sea level you would drop down to a 130 at 4000 feet. Something else goes down as you go up in elevation is horsepower. You can figure on losing about 3% or your power for every 1000 feet you go up. At 4000 feet your power will be down about 12%-even though you rejetted!

Air correction jets

The air correction jets only affect the top end performance of the engine. The larger the number on the jet the larger the air hole and the leaner the main jet runs at higher RPM.

If the air correction jet is too lean (too large a hole) the engine will miss near peak RPM. If the air correction jet is too rich (too small a hole), the engine will not produce optimum power. For testing purposes, find the largest diameter air correction jet that causes a high RPM misfire then fit a 10 to 20 smaller dia (richer) air correction jet.

The air correction jet number is their hole diameter in hundredths of a millimetre and range in size increments of 5. When testing, the minimum increment of changes should be 10 with 20 being the more common increment to notice changes.

Here is a guideline for approximate air correction jet selection for those of us without a large supply of air correction jets:

For stock to mild engines with a 5000 RPM redline where fuel economy is a strong factor, a good starting point for the air correction jet is figured by adding 60 to your main jet size.

As you progress towards a full race engine and higher RPMs the size of the air correction jets decreases (fuel mixture becomes richer), with a full race TR engine having an air correction jet size of about 10 or 20 hundredths of a millimetre larger than the main jet size.

For a modified street engine running 34mm chokes having a red line at or below 5000 RPM, adding 40 or 50 to the main jet size would probably be a good starting point for the air correction jet.

For a modified street engine running 34mm chokes and having a red line around 6000 RPM, adding 30 or 40 to the main jet size would probably be a good starting point for the air correction jet.

For a modified engine needing 36mm chokes to produce full power above 6000 RPM adding 10 or 20 to the main jet size will probably be a close starting point.

Emulsion tubes

As the name implies the emulsion tube is where air is mixed with fuel to form an air/fuel emulsion (fuel with lots of little air bubbles in suspension). The vacuum formed in the auxiliary choke draws this emulsion out of the emulsion tube and into the air streaming through the auxiliary choke where it is atomised into the air stream and delivered into the combustion chamber.

The emulsion tube affects the acceleration phase as the main jets are activated. If the emulsion tube size is incorrect the engine will not accelerate cleanly when the main cruise circuit is operating. The effect of changing emulsion tubes can be very subtle to detect. Emulsion tube operation is very sensitive to the fuel level in the float chamber. So you need the right size float valves and closely set floats for the emulsion tubes to work as intended.

Emulsion tubes differ by their internal diameters and the number, size and positions of the side holes. They are complex tubes where "just the right level of emulsification happens here". Their part number reflects the order in which they were developed and not any physical attribute.

The tube sizes are (in order of rich to lean):

F7 (rich), F8, F2, F11, F16, F15, F9 (lean). There are additional sizes.

F15 emulsion tubes seem to be the size universally recommended for Triumph engines and they seem to work OK. I do not understand them enough to experiment since so much of what happens is determined by the air and main jet sizes and the level of the fuel in the float chamber while the engine is running.

Accelerator Pump Jet

The accelerator circuit consists of:

- A fuel reservoir,
- A mechanically activated, spring loaded plunger (pump) that flushes the reservoir,
- A one way valve that lets fuel into the reservoir from the float chamber but not back out to the float chamber while the plunger is purging the reservoir (called an Accelerator pump intake/discharge valve),
- And an accelerator pump jet that both meters the amount of fuel pumped by the acceleration pump (plunger) and delivers that fuel directly into the rear of the carburetor throats.

The metering hole in the accelerator pump jet has to be large enough to remove any hesitation or stumble caused by the lean condition created by suddenly opening the throttle plates (butterfly valves) at low RPM. Too large a jet will cause a "bogging down" of the engine from too much raw fuel.

The jets are numbered for their hole size in hundredths of a millimetre and are in five hundredths of a millimetre steps (i.e. 35, 40, 45, 50).

Accelerator pump jets commonly recommended for the TR four cylinder engine are 40 and 45. Use the smallest jet size that will eliminate any hesitation or stalling when the throttle is suddenly opened.

The accelerator pump intake/discharge valve can have a discharge hole that finely tunes the flow of the accelerator pump jet in-between the step increments.

Accelerator pump intake/discharge valve 

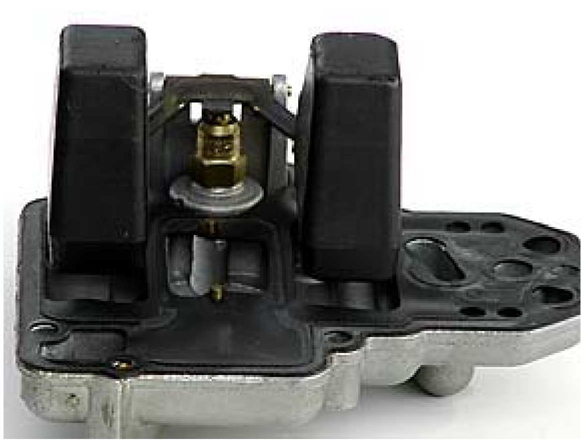
This is a one way valve that allows fuel to flow into the accelerator pump reservoir and keeps the fuel from going the wrong way when the accelerator pump is activated.

It can also be used to precisely tune the amount of fuel injected into the engine by the accelerator pump jet . This is accomplished by selecting a valve with a discharge hole on the side. If there is no discharge hole, the accelerator pump intake valve acts purely as a one way valve. If there is a hole, part of the fuel is discharged out the side hole back into the float chamber when the pump is activated, bleeding off the excess fuel not required to accelerate the car cleanly.

The number on a valve with a discharge hole is the size of the hole in hundredths of a millimetre, i.e. a valve marked 50 has a 0.5mm discharge hole in the side.

The most common accelerator pump intake/discharge valve size recommended for the TR engine is 50.

Needle valve



The needle or float valve assembly regulates the amount of fuel allowed into the carburetor's float chamber and maintains the fuel level within a very limited range. The top stop of the float regulates the level of the fuel while the lower open stop regulates how far open the valve can open. The diameter of the valve regulates the rate at which fuel that can enter the chamber as the valve opens.

There are a range of needle valve sizes available for the DCOE. The needle valve needs to be large enough to allow an adequate flow of fuel into the float chamber but should not be larger than necessary. Too large a valve will let too much fuel in quickly before it closes and cause a pulsing over rich condition.

A 2.00 needle and seat is usually recommended for TR engines. A 1.50 needle and seat might work better on a TR engine tuned for economy.

Some choke/jetting starting points based on the above:

Note these are ball park numbers based upon the recommendations of several people/companies/books/articles and should **not** be considered as absolute correct settings. But you need to begin somewhere. From here run CO testing for the main jet/emulsion tube/air correction jet stack. The whole purpose for all these jets and air correction tubes is to be able to dial in your carburetors to closely meet the needs of your engine and your driving conditions. If you settle for a loose approximation you might as well have stayed with your original SUs or Strombergs.

Engine Max RPM	Economy jetting, stock 5000 RPM	stock 5000 RPM	modified 5000 RPM	modified street/autocross 6000 RPM	modified track racing 6000+ RPM	Currently on my engine 6000 RPM	Factory fitted 42DCOE 8* 5000 RPM
choke	30-32	32-33	32-34	34-36	36-38	34	32
aux choke	3.5	4.0	4.0-4.5	4.5	4.5	4.5	4.5
idle jet	50F2	50F9	50F9	50F9-55F9	50F9-55F9	50F9	50F2
main jet	130	130-135	130-140	140-145	145	145	140

air correction jet	190	190 -180	180-160	170 - 150	170-150	170	150
emulsion tube	F15	F15	F15	F15	F15	F15	F15
accelerator pump jet	40	40	40-45	45	45	45	50
accelerator pump intake/ discharge valve	50	50	50	50	50	50	50
Needle valve	1.50	2.00	2.00	2.00	2.00	2.00	2.00

* 42DCOE 8 Webers were only used as the standard carburetor on the Maserati 3500 GT. They have been discontinued for some time. They were fitted to some Triumph factory rally cars and the Morgan Super Sport. They were the conversion of choice for Ford Pinto and Capri 2000 (when dual DCOEs were used), Volvo 122S, 144, P1800. So this might provide some ideas of where to look for used 42DCOEs.

Float setting

The floats open and close the float valve. The closed setting regulates the fuel level in the float chamber and in the emulsion tubes.

Traditionally DCOEs came with soldered brass floats. Lately most if not all are being provided with plastic floats. The float settings are different between metal and plastic floats.

The float setting is dependent upon the carburetor you use. Here is a chart for brass floats (My carbs have brass floats):

DCOE series	**float valve closed (mm)**	**float valve max open (mm)**
40DCOE, series 2, 4, 18, 22/23, 24, 27, 28, 31,32	8.5	15
40DCOE series 29/30	5.0	11.5
40DCOE series 44/45	7.0	14
40DCOE series 72/73, 76/77, 80/81	7.5	14
42 DCOE series 8	5.0	13.5
45DCOE series 14, 14/18, 17	8.5	15
45DCOE series series 9	5.0	13.5
45DCOE series 72/73, 76/77, 80/81	7.5	14
45DCOE series 38/39, 62/63, 68/69	5.0	14

Both floats need to have the identical setting. You may need to bend the arms between the two floats to get them exactly the same closed height.

The ideal tool to set the closed float position is a round rod with the precise diameter of the closed float setting. **The seam of the float should not be taken into account when measuring the float level** so there should be groves cut into the rod to clear the float seams. This will allow you to see both the accuracy of the setting and any variation between the two floats.

The open and closed measurements should be taken with the top gasket in place. The closed position should be measured just as the floats close the valve and not with the entire weight of the floats upon the valve. This is done with the top plate tilted a little over vertical.

Fuel pressure/ filtering

Webers need a pump that can provide a high volume of fuel at a low pressure. 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 RPMs.

Luckily for us the the stock AC fuel pump that comes on our engines pump in this range when healthy. A fuel pressure regulator is optional with the stock TR fuel pump. If you fit an electric fuel pump you will need to fit a fuel pressure regulator. If you use an after-market mechanical fuel pump be sure to test the output pressure over a range of RPMs to determine if you need to fit a pressure regulator.

It is important that your pump supply at least 1.5 pounds pressure at high RPMs. If it does not it will require rebuilding or replacing.

Webers have a wire screen filter in the inlet. This filter does not have a good reputation for working well over time. Considering the size of some of the jet openings I suspect the built in screen is not really fine enough to prevent clogging. You should consider installing a high volume fuel filter between the fuel pump and the fuel regulator.

A word about fuel lines - Do not use regular worm gear hose clamps with steel braided fuel lines. The steel braided fuel lines are designed not to crush. You will end up with an iffy seal.

Mounting

DCOEs prefer to be mounted with a 5 degree upward angle and should never be mounted at a greater angle that 7 degrees above horizontal. They will not perform properly at a greater angle.

A new intake manifold should be checked for proper alignment. Preferably before you pay for it. If the studs are out of alignment the carbs will be out of alignment causing differences in the way linkage opens each carb and sync problems at some part of the throttle travel.

One thing you can check in the store is that the studs are at right angles to the carb mounting surface. Also if you have a DCOE handy you can slide it over the studs and assure yourself that the cab base will sit flatly on the manifold with no gaps.

It is harder to check TR four cylinder intake manifolds for stud alignment because you need two manifolds per engine. You need to test fit the manifolds to a head for alignment testing. Once fitted, lay a straight edge over each row of studs and look for an out of alignment stud. The recommended maximum of allowable misalignment is 0.25 mm (0.010 inches). If it is more than that you need to weld the hole shut, resurface the top, and align drill a new stud hole. Like I said, it is best to make this measurement before money changes hands or when you can return the manifolds for replacement or credit.

The top studs should protrude 38 mm (1.5 inches) from the manifold. The bottoms ones can be between 38 and 40 mm (1.57 inches).

DCOEs are susceptible to fuel frothing and should be installed with anti vibration mounts. There are a couple of kinds and each comes with instructions for proper tightening. If you use the kind with 'O' rings that sit in a groove be sure the 'O' ring doesn't slip when you are mounting them. That would guarantee an air leak in a venturi.

TR linkage uses a solid cross bar with an arm and push rod for each carb plus one for the pedal linkage.

It is essential for the carb linkage push rods be of equal length, within 0.5 mm or 0.020 inches of each other. This will keep the carbs in sync as the arms move together.

The DCOE comes with a built in return spring. For safety, it is a good idea to add another return spring for each carb what will work if the linkage slips. This will be required if you go racing. MGB return springs work well for this application.

The DCOEs full of fuel are weights sitting at the end of the intake manifold. Manifolds have been known to stress crack over time and vibration. Some racers add a plate between the two carbs and a down diagonal brace from the plate arm to an anchor point connected to an oil pan mounting bolt. The brace rod is usually connected to it's anchor point at each end with rubber gaskets to reduce vibration. This relieves the weight off the manifold head studs and keeps stress cracks from appearing.

Air horns and air filters

Air is not good at making sharp right turns and turbulence is built up at the sharp edges of a DCOE throat that does not have an air horn. This decreases the amount of air fuel mixture that can be delivered to the engine and disrupts the air flow within the throats. The air horns provide a smooth flow of air into the throats of the DCOE. The rounded edges of the air horn allow air to enter with a minimum of turbulence.

Air horns of some length should always be fitted to a DCOE if the carburetor is to perform correctly and provide the most air fuel mixture to the engine.

The distance between the intake of a cylinder and the beginning edge of the air horn is called "the run". As a rule of thumb, the shorter the run, the more top end power. The longer the run the more low end torque and low end throttle response is available. The length of the run is tunable by the length of the air horn. This is why there are a number of lengths available.

Of course with our low rev engines, a long run is desirable for maximum power within our usable power band. Unfortunately for us the inner wheel well limits the space for a long run (long air horns). This is especially true in TR3s where the front DCOE throat sits close to the inner wing.

Some TR3 owners modify their inner wings to provide additional space for the air horns and air filter. I personally decided to sacrifice a little performance and maintain a stock inner wing. I went with the shortest of the air horns which is basically just a rounded lip to minimize turbulence and a very short itg air filter that allows air flow through the side facing the carb openings. Even then I needed to modify the front lower edge of the itg filter for clearance.

Which gets me around to air filters. While the air horns on a DCOE look very good and "racy" they should be covered up by an air filter. Your expensive engine will not last all that long without an air filter.

Sock type air filters should be avoided because they create turbulence that keeps the air horns from working properly and lowers the overall air flow into the throats of the carburetors. The worst you can do is a right angle air horn with a sock.

In general air filters seem to fit into two types. One has a short tubular type element with solid ends and the other has elements on all sides except the back plate.

The type with the short tubular element tend to be very good but take up a lot of space. For proper air flow into the air horns there should be minimum of two inches of space between the end blanking plate and the openings of the air horns.

The type that has filter elements everywhere except the back plate can be considerably closer to the air horn because air flows in from in front of the air horn.

These filters almost all have oiled foam elements. There are some very good ones and some very cheap not good ones. Stay away from the cheap filters that only have a single layer of one size foam.

Also, foam filters rely heavily upon their sticky oil coating to filter properly. Follow the care instructions that come with your filter religiously.

K&N and itg are two good names in the foam air filter business. I personally choose an itg filter for my TR3. It allowed me to use a single air filter that with a slight modification fits into the tight clearance between the TR3 inner wing and the front venturi. With the front foam surface and short horns I can get reasonable breathing on that front venturi.

itg has a formula (for their filters only) that calculates the minimum distance between the horn opening and the facing element for no negative affect in air flow. The minimum distance is calculated by dividing the inner diameter of the air horn by four. For instance the minimum non interference distance the filter face can be from a 58mm dia. air horn is 14.5mm (about 9/16s of an inch).

The shortest carb face to facing element filter itg offers for duel DCOEs is 55 mm. I used this height filter in conjunction with the shortest air horns available to achieve a fit adjacent to an unmodified TR3A inner wing

There is an air hole in the intake side of the carburetor above the throats that provides air to the float chamber and the various air bleed jets. It should not be blocked by the air filter backing plate and it should have the same pressure as the air horns get if you decide to build ram flow air box of some kind.

Timing considerations

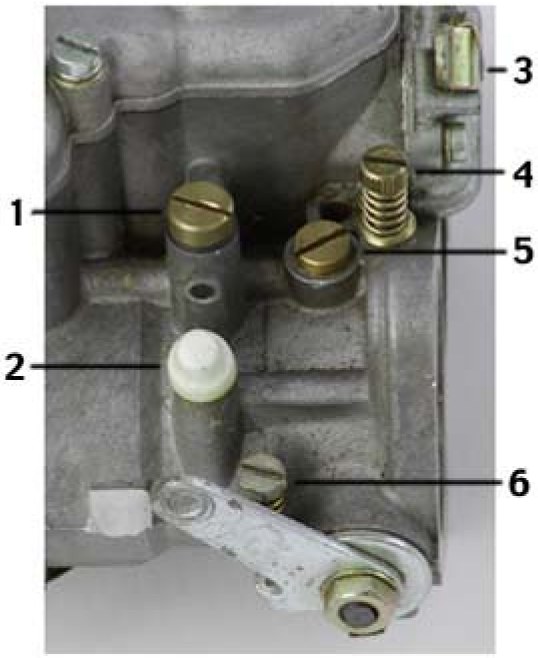
If you just add DCOEs to an engine and start it up chances are that it will idle poorly and occasionally spit out the front of the carbs. Modified engines and engines with DCOEs need more than stock advance. Stock advance is 4 degrees BTDC. You will probably **need at least 8 degrees BTDC initial timing** with a cam and DCOEs. With a cam a good idle speed should be 800-1200 RPM depending upon the duration of the cam. If the timing is too retarded the engine will not perform well below 3000-ish RPM unless you had very big idle jets. A way rich idle jet can mast a lack of spark advance and reduce cab spittings but will drastically decrease fuel mileage.

Maximum distributor advance on the TR engine should be 33 or 34 degrees. Too much advance causes the engine to run weaker at high RPMs and leads to early engine damage. I think max advance on a stock TR engine is 32 degrees.

The stock TR distributor would require experimenting with weaker springs to run on mechanical advance only and some kind of block to limit the max advance. A precision adjustment is almost impossible.

Best bet is to purchase a Mallory mechanical advance distributor and a curve adjustment kit. The off the shelf Mallory distributor comes with a 28 degree curve which is fine for a stock initial timing advance. Depending upon your cam you will probably want to adjust it to 22 to 26 degree advance to limit the total advance to 33 or 34 degrees.

A visual guide



1. Cap for accelerator pump jet

2. Venturi balance adjustment with plastic cap. Fitted to newer DCOEs

3. Cold start lever (choke)

4. Idle mixture adjustment screw

5. Progression hole cap. Allows access to progression holes for easy cleaning.

6. Idle lever adjustment screw

Top of a DCOE with centre cover and fuel filter cover removed

1. Main jet stack

2. Idle jet

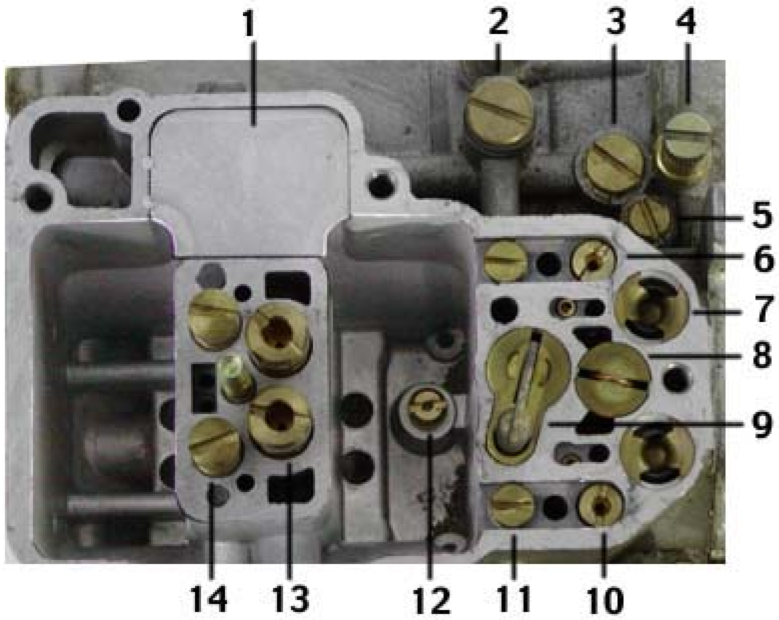
3. Fuel filter screen

4. Fuel chamber for filter

Notice how easy it is to get at the main and idle jets for cleaning or replacing. You can perform minor carb rebuilds without removing the carb from the manifold.

Top cover removed from a 45DCOE

1. Baffle plate (reduces chance of fuel



sloshing up into air correction jets)

2. Cover for accelerator pump jet

3. Cover for progression holes

4. Idle adjustment needle

5. Second progression hole cover. Only on some carbs.

6. & 10. Start jet (Cold start)

7. Cold start valve assembly

8. Anchor plate for internal throttle return spring

9. Accelerator pump

11. Threaded plug Underneath is a check valve ball and a stuffing ball.

12. Accelerator pump intake and discharge valve

13. Main jet stack

14. Idle jet stack

If you look into the bottom of the float chamber, on either side of the body casting that holds the main and idle jets you will see two largish holes going down. There is a baffled inner chamber area inside the casting that feeds the jets. This baffling arrangement minimizes sloshing and helps keep the fluid level constant under acceleration or cornering. There is an access plate under the carb that allows you access to the inner baffle chamber. for cleaning. Always use a new gasket.

Weber Tools

You can perform a minor rebuild on a DCOE without removing it from the intake manifold or disrupting the linkage. All you normally need is a flat blade screwdriver, pair of pliers, 10 and 12MM wrenches, a pin to poke through progression holes and a compressed air supply to blow out passages.

Major rebuilds can require special Weber tools. If you are going to remove the throttle shaft the official Weber tool would come in most handy. A major rebuild that requires special tools is not for the weak of heart and may best be done by a Weber rebuild professional (Besides most special Weber tools are expensive).

I broke down and purchased my first Official Weber tool. It is their 10mm and 12mm socket wrench. I found one for US$2.50 and could not resist. The 10 mm socket is for the venturi retaining bolts and the 12 mm socket fits the air horn retaining nuts. And of course it just looks like it would be part of a TR3 tool roll.

In conclusion

Gosh this is quite a lot of information. If you are trying to understand how DCOEs work from scratch I suggest rereading it at least one more time. It should make better sense the second time through.

Below are pictures of my TR3A's engine when I was first setting it up. I'm currently running regular fuel lines instead of the stainless braided ones that do not compress under a hose clamp. I also have added a fuel pressure regulator and pressure gauge to the bulkhead above the fuel pump and now route fuel to the carbs around the back side in front of the battery. Otherwise everything is pretty much as you see it. Well with the valve cover off anyway.

Links

Pierce Manifolds The largest source for DCOE parts in the United States. They carry the best sync meter I have found.

TWM Induction I like their intake manifolds, linkage, wide assortment of air horns and itg air filters. If you decide on fuel injection they manufacture throttle bodies & everything you need to fit their intake manifolds. If I ever got a TR250 or GT6+ I would think very seriously about TWM FI with the appropriate cam 8*)

6 cyl TR engine application Shane Ingate demystifies triple DCOE set ups for the TR6, GT6 & TR250.

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If you would like to discuss any of the contents, or just say hi, please feel free to e-mail me .

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