Gunson®

COLORTUNE

Part No. G4074 | G4171 | G4172

Handbook

Index

Applications

The original and best tool for seeing what's happening inside the combustion chamber of the petrol engine. It allows you to see the combustion and to adjust the mixture by colour.
For use on Petrol/LPG 2/4 stroke engines with single, twin or multiple carburetors or fuel injection systems.

The Tune-up plug for Petrol/LPG 2 & 4 stroke engines with single, twin or multiple carburetors or fuel injection systems.

Fits most petrol engines in standard form with additional adaptors available for vehicles with alternative sized spark plugs

18mm - G4055E
14mm - Long Reach G4055D
14mm - Tapered Seat G4055C
12mm - G4055B
10mm - G4055A

The complete **COLORTUNE** kit is also available with the following adaptors:

G4171 with 12mm **COLORTUNE** Plug
G4170 with 10mm **COLORTUNE** Plug

Contents

The COLORTUNE G4074 - 14mm

1. **COLORTUNE** plug 14mm size short reach with 16mm (5/8”) hexagonal body size. A hexagon adaptor is provided to adapt to a 13/16” (20.6mm) plug spanner also suitable for long reach applications.
2. Solid cross section gas seal washer.
3. Extension H.T. lead incorporating an end suitable to connect either Champion or Continental Bosch type suppressor caps (clip or thread)
4. Cleaning Brush
5. Viewerscope (two parts)
6. Instructions

Other COLORTUNE kits available

G4171 - with 12mm **COLORTUNE** Plug
G4172 - with 10mm **COLORTUNE** Plug

Adaptors for COLORTUNE (Suitable for use with any kit)

10mm	Part No 4055A
12mm	Part No 4055B
14mm	Part No 4055C
14mm Long Reach	Part No 4055D
18mm	Part No 4055E

COLORTUNE will still ignite the mixture and because it is only fitted for a brief period there will be no combustion carbon deposited on the exposed threads in the cylinder head.

General Precautions

- Testing of vehicles is potentially hazardous. Take every precaution to avoid injury and ensure that you have sufficient understanding of the task being undertaken. Seek advice or follow the guidance of a comprehensive vehicle manual.

- Using this product involves working on a car while the engine is running. This is a potential hazard and the user should take every precaution to avoid any possibility of damage or injury. Never wear loose clothing that can catch in moving engine parts and always tie-up or cover long hair. Do as much of the work as possible with the engine idle.

- Do not inhale exhaust gases - they are very poisonous. Always operate the vehicle in a well ventilated area.

- Always make sure the vehicle is in park (Automatic transmission) or neutral (manual transmission) and that the parking brake is firmly set. Block the wheels as additional safeguard if the vehicle is on sloping ground.

- Never lay metal tools on a vehicle battery. Always keep yourself and test equipment away from moving or hot engine parts, remember that thermostatically controlled fans may suddenly start with no warning. Treat high tension ignition components with respect, remembering that electrical shocks can cause involuntary movement which may result in secondary injury.

- Never smoke or have open flames near the vehicle. Vapours from petrol or a charging battery are highly flammable / explosive. Keep a suitable fire extinguisher handy. Use approved safety equipment and eye protection where appropriate.

- Always turn ignition key OFF when connecting or disconnecting electrical components, unless otherwise instructed. Never leave vehicle unattended while running tests.

- Keep children and pets away from the vehicle while work is being carried out.

How Colortune works

Understanding the principle by which COLORTUNE works helps in getting the best out of it. That principle is commonly seen in action on paraffin heaters, gas cookers, or anywhere where a fuel is burnt in air to produce heat or energy. Combustion at its most efficient produces a clear blue flame, various other colours result from inefficient mixtures.

Inside an internal combustion engine those same coloured flames are present though not normally seen. With **COLORTUNE** fitted, in place of a sparking plug, the flame is visible through the glass insulator and the fuel is ignited by a spark in the **COLORTUNE**. This allows the user to obtain greatest engine efficiency by assessing the colour and appearance of the flame and correcting any faults thus revealed.

Using the product could hardly be easier, fit it into a warm engine, in place of a spark plug, and you are ready to begin.

COLORTUNE gives you a fascinating insight to the working of an engine without the usual complexities of most other diagnostic equipment. It can provide a unique view of the behaviour of the fuel system, in the individual cylinders, which no other equipment can do, saving in many cases time, expense and a great deal of effort in fault diagnosis. A gas analyser gives an average reading of all cylinders, and no diagnosis of faults or setting errors which affect mixture distribution.

While working with this product be aware that:

- This product may be used at a wide range of engine speeds but should not be used in an engine under load as overheating and product failure could occur. Take additional care when using the product on an air cooled engine which has no fan assisted cooling. On these engines limit the total test duration to 5 minutes and avoid extended running at high rpm.

- The viewerscope supplied with this product is made from a glass reinforced heat resistant material but will be damaged by excessive heat before the **COLORTUNE** plug. If this is damaged it serves as a clear warning of overheating. Obtain a replacement and take more care to avoid overheating. Discontinue use if the product plating is discoloured by heat or the glass / ceramic shows signs of damage.

A) Combustion flame appearance

The general appearance of the combustion flame when viewed through **COLORTUNE** is as follows:

Yellow	Indicates a fuel / air mixture which have excessive petrol content (rich). Like a candle flame - producing more light but less heat.
Bunsen Blue	Indicates a mixture which is correctly proportioned.
Whitish Blue	Indicates a mixture which has less petrol content (lean) Note: this colour is more easily seen at higher speeds. At idle, engine instability and misfiring may occur before this weak mixture and pale shade of blue is fully visible.

There are sometimes exceptions to the above as petrol engines are imperfect machines, these will be described later.

B) The Science

- The correctly proportioned mixture is - 14.7 parts of air by weight to 1 part of petrol (hydrocarbon fuel).
- If there is perfect combustion, all the fuel will be burnt to produce carbon dioxide and water with no carbon monoxide or unburnt fuel (hydrocarbons).
- The carbon in the fuel burns with oxygen in the air to produce carbon monoxide (CO), which then burns with more oxygen to produce carbon dioxide (CO_2)
- Hydrogen in the fuel burns with the oxygen in the air to produce water (H_2O)
- Nitrogen in the air passes through to the exhaust with little reaction.
- When there is less air in the mixture, there is not enough oxygen to complete the burning process so some carbon monoxide is not changed to carbon dioxide and hydrocarbons (unburnt fuel) may be present in the exhaust.
- Carbon particles glow yellow in the combustion of a rich mixture and in severe cases you may see black carbon smoke in the exhaust.
- When there is too much air in the mixture, it becomes more difficult to ignite, burns slower, and is therefore less efficient.
- The diluted mixture burns with a pale flame.
- Misfiring may occur and hydrocarbon levels in the exhaust gas will rise.
- Carbon monoxide levels stay low because there is plenty of oxygen available to convert it to carbon dioxide.

C) The practical details

- On an engine with one carburettor/single point injection, a single **COLORTUNE** plug will enable the mixture to be observed in any cylinder for a quick check, or one cylinder at a time for a more thorough evaluation of a multi-cylinder engine.
- Twin or multiple fuel systems can even be checked in this way (one cylinder at a time) but it is time consuming and a comparison between cylinders at any instant is not possible.
- Multi-cylinder engines, particularly those with twin or multiple fuel systems are best tested with a **COLORTUNE** in each cylinder.
- Variations in mixture between the cylinders are easier to see and faults can be more easily spotted and rectified.
- Nowhere is this better demonstrated than on high performance motorcycles - where accurate calibration of at least eight settings on four individual carburettors is a highly skilled task, done mainly by ear.
- A more accurate setting can be achieved with **COLORTUNE** in half the time normally taken.

NOTE: A multi-cylinder engine with a carburettor (or injector) to each cylinder and a single exhaust system can not be thoroughly tested with a gas analyser at the tailpipe. The analyser only gives an average fuel mixture indication for all cylinders and no warning of large mixture variations due to setting errors or indication of other faults.

- Modern engines with multipoint injection systems, and earlier high performance car engines with twin or multiple carburettors, have a lot in common with the example of the motorcycle given previously.
- **COLORTUNE** gives a marvellous insight to the inner workings of all these engines, so that errors and faults can be easily spotted. Despite its simplicity, **COLORTUNE** is an invaluable piece of equipment for the amateur or the experienced technician.

Fitting Colortune to the engine

1. Before fitting **COLORTUNE**, start the engine and warm up to normal operating temperatures, preferably by going for a short drive.

2. To assist with flame visibility, park your car in such a way that the engine is in the shade, (or you may use the viewerscope attachment).

3. Stop the engine, take care to avoid hot engine parts and brush away any grit from around the spark plug before removing it.

4. Fit the **COLORTUNE** in its place. Never over tighten **COLORTUNE** into the engine as an adequate gas seal will be achieved even on taper seat applications with little more than the equivalent of finger tightness. The rubber bush in a normal plug spanner will not retain the **COLORTUNE** as the ceramic is smaller. The HT adaptor lead may be attached and threaded through the plug socket or viewerscope base to start the thread. A hexagon adaptor is supplied to adapt larger plug sockets to the smaller **COLORTUNE** hexagon

5. If the plug recess is not easily accessible it is wise to apply high melting point grease to the **COLORTUNE** washer to help retain it.

6. Screw the plain end of **COLORTUNE** adaptor lead to the centre electrode of **COLORTUNE**. Care should be taken not to over tighten it or bend the centre electrode.

7. Fit the lower half of the Viewerscope over the lead (if required) pushing the end down over the hexagon. With the adaptor lead to one side, push the upper half of the Viewerscope into the lower half in such a manner that the adaptor lead emerges from the slot in the upper half.

8. Plug the other end of the adaptor lead into the plug cap of the car’s ignition system. The adaptor is designed to fit both types of plug cap (with bare thread or clip type fitting) and fits most ignition systems. Try to keep the leads away from engine parts, particularly the exhaust and rotating items.

9. Repeat the above steps if using more than one **COLORTUNE**.

10. Start the engine. All cylinders should now be firing regularly and the combustion flames should be clearly visible, either directly or in the viewerscope mirror.

Avoid touching ignition parts when the engine is running remember ignition sparks can jump, particularly if a connection is not secure.

Tightening torque nominal	10mm	0.20Nm -	1.2 ft-lb
	12mm	0.24Nm -	1.4 ft-lb
	14mm	0.28Nm -	1.6 ft-lb

Test Pressure Non Destructive	34 Bar	5000psi.
Destructive Test Pressure min.	95 Bar	12000psi.

See the following sections for adjustments and fault diagnosis

Simple engine tests with Colortune

Idle speed

With **COLORTUNE** installed in a warm engine and the engine running at idle speed, a regular flash of light, with a Bunsen blue flame, should be visible as the mixture is ignited in the cylinder. On systems which have a slow running mixture adjustment, turn the adjustment to explore the range of colour available. The position at which yellow disappears leaving only blue, is the richest setting which should be used e.g. when setting mixture on a simple motorcycle carburettor without an accelerator pump device. Engines before 1985 should be set halfway between the point where yellow flame disappears (say 4.5%CO) and the point where engine speed falls slightly (say 0.5%%CO). Engines produced since that date should idle at say 1%CO (almost at the point where idle speed falls). These leaner settings progressed with engine developments to give economy with low exhaust emissions.

Oxygen Sensor Mixture Control

On engines which have oxygen sensor mixture control, no yellow flame should be visible. The flame colour should be blue with a slight variation as the oxygen sensor continually trims the mixture every two seconds approximately (more rapid at higher rpm). A yellow flame appearing in some cylinders is an indication of an air leak into the other cylinder(s) or the exhaust manifold. The sensor tries to compensate for the excessive oxygen level by increasing fuel input. (The same can happen if one injector is faulty but symptoms may then be worse at higher engine speeds, whereas an air leak has less of an effect when the throttle is opened.)

Part throttle

If the throttle is opened very slowly until the engine is running at perhaps half of the maximum rated speed, the blue flame should become slightly lighter. The lighter blue is due to a slightly leaner mixture (less fuel) arranged to give improved economy at part throttle operation.
Note: At idle the same lean economical setting is difficult to achieve due to engine inefficiencies at slow speed with the throttle virtually closed.

Full throttle

When maximum power is demanded (at full throttle position) it is normal to again have a slightly richer mixture, at most engine speeds there will be a yellow flame. Engines with modern electronic engine management systems which have more precise control would not usually give a yellow flame at full throttle, except at times of rapid acceleration.

Rapid acceleration

When the engine is running slowly at idle and there is a sudden demand for power (throttle rapidly opened) this can cause an unstable condition and the engine may stall. A rich and easily ignitable mixture helps to avoid this, so it is common to see a yellow combustion flame with rapid engine acceleration. A special fitment may for example be provided on a carburettor to achieve this extra fuel delivery - this is commonly called an accelerator pump.

Engines with modern electronic engine management systems which have more precise control would give a very brief yellow flame which quickly reverts to blue. Less sophisticated systems may give a yellow flame throughout the period of acceleration. Very simple carburettors found on small motorcycles and garden machinery may have no acceleration device on the carburettor and will need a richer mixture setting at idle to avoid engine stalling or a “flat spot” during rapid acceleration.

Cold starting

A rich and easily ignitable mixture is also provided for starting a cold engine. If a manual cold start device (choke) is fitted, a yellow flame should be visible in **COLORTUNE** when this is operated. This applies with a hot or cold engine. If enrichment is by electronic control unit (ECU) or auto-choke, test for a yellow flame when the engine is cool / cold. Try to keep the test brief to avoid carbon deposits on the **COLORTUNE** glass.

Some exceptions to all the above conditions may be found, for example small engines used in lawn mowers or chain saws may have simple fuel systems which are less able to provide the ideal fuel / air mixture. Electric generators with speed governors do not experience rapid acceleration so should have a blue flame under all operating conditions.

Fuel System types

The following description of fuel systems is intended purely to identify the various types which may be encountered and to highlight the basic features. While this may be sufficient description for some simple adjustments to be performed, a comprehensive vehicle manual or the General Fuel System Manual should be referred to for further detailed information.

The information is in two main sections, one covering the various types of carburettor and the second dealing with fuel injection systems. In each case the least complex systems are described first for reasons of clarity.

NOTE: Many twin and multiple carburettors require flow balancing before mixture is set - see the end of this section

A basic Carburettor fuel system

1. There are four basic elements to a simple “fixed choke” carburettor which might be fitted to garden machinery or small power plant engines
2. A throttle to open or restrict the main passage of fuel / air mixture to the engine, this usually has an adjustable throttle stop to control idle speed.
3. A float and valve arrangement to maintain a steady fuel supply level (or a sensitive pressure regulating diaphragm)
4. A slow speed fuel discharge and adjustment (idle jet and idle mixture screw) this is found close to the engine mounting flange and the throttle plate. The throttle uncovers extra passages (progression holes) for feeding fuel as it begins to open.
5. A high speed fuel feed and adjustment (main jet and main mixture screw) normally located closer to the inlet air cleaner mounting flange. The main fuel discharge feeds into a venturi shape, whose restriction (a fixed size choke) gives a low pressure to pull the fuel in.
6. Note: a cold start device is also sometimes called a choke - it also gives a restriction to draw in extra fuel.

Carburettor fuel systems as fitted to motorcycles

1. Variable choke carburettor. This usually has the same parts as described in items 1-3 for the basic fixed choke carburettor but the main discharge has fine tapered needle in a jet to meter the fuel accurately. The variable choke size is formed by a rising piston arrangement attached to a flexible diaphragm. When the throttle is opened, the engine draws in more air and the diaphragm pulls the piston and the needle further open, maintaining a constant low pressure (constant depression) in the carburetter. This gives precision control of the air and fuel over a range of conditions. Enrichment for acceleration conditions may be provided with a separate pump device or by controlling the rate at which the piston rises. Needle / jet calibration size controls mixture except at low speed / light load which is governed by the adjustable idle mixture control.

2. Slide type carburettor. The slide carburettor has been used on motorcycles and other small engines for very many years. Fuel feed is from a chamber with float and needle valve and an idle fuel system

is provided with an adjustable mixture screw. There are no progression holes in the idle system as the throttle plate is replaced by the slide which gives this carburettor its name. The slide is attached to a needle running in a jet in a similar way to the variable choke carburettor but this does not give a constant depression as the slide position is governed by the throttle position selected at the time, not by a diaphragm.

Mixture is governed by the shaped bottom of the slide at lower speeds/light loads, the needle taper and position at mid speeds and the main jet size at all engine speeds when on full throttle.

Carburettor fuel systems fitted to car engines

Fixed choke carburettors

These are broadly similar to the basic carburettor fuel system described except no adjustment is normally provided for the fuel fed by the main jet system.
More sophisticated idle and main circuits are used, with additional fuel feed circuits. Also there are air jets and emulsion tubes which provide a graduated addition of air bubbles (emulsion) to give greater control of fuel flow characteristics.
Idle speed adjustment is normally by a throttle stop screw, but sometimes this is locked and an adjustable throttle by-pass passage is used.
This type may have two fixed choke carburettors combined in one casting to provide either -

A twin choke carburettor where both throttles open simultaneously -generally for improved power output (two twin choke carburettors may be fitted to a high performance four cylinder engine).
A twin choke (progressive) carburettor where one choke is used for most low speed driving and the other opens in addition for high speeds. This gives improved economy and smooth engine response

Variable choke carburettors

These have some similarity to motorcycle variable choke carburettors but a separate idle circuit is not usually provided. Two basic types are used with control of the air valve being either diaphragm (Stromberg/CD) or piston in cylinder type (SU).
A constant depression (low pressure) is maintained on a tapered needle and jet system which is attached to the air valve/carburettor piston. This air valve rises as the throttle is opened and then at full throttle it will continue to rise further as the engine speed also increases. This gives accurate mixture control over the whole range of operation. Enrichment for acceleration conditions is provided by controlling the rate, at which the air valve rises, with an oil damper, (the oil may require topping up regularly).
The fuel needle is machined with a very accurate taper, individually selected for each engine design.
Spring loaded types of needle are more accurate when new but they rub against the jet giving errors when worn (e.g. over 50,000 miles 80,000 Km). Appearance of the combustion flame will be rich at the operating conditions where the needle is worn (usually idle / part throttle). If the mixture has been adjusted to normal at idle, weak mixtures will then occur under acceleration.

Fuel injection systems

As the name suggests, fuel injection systems use pressure to force fuel into the engine (instead of drawing it in with air under low pressure). The amount of fuel should be in proportion generally with the amount of air going into the engine, but this is adjusted slightly for economy at part throttle, higher power at full throttle and other less significant reasons. A three dimensional map of the requirements, for a specific engine, is drawn and it is then the job of the injection control system to satisfy this requirement. Determination of the quantity of air going into the engine is itself a difficult task under conditions of varying temperature, varying pressure, and with extreme disruption to the flow caused by valves opening and closing at an incredible rate. Some systems attempt to measure flow directly with a moving vane in the air flow, or a hot wire system which senses the cooling effect of the air flow. Others use a prediction from the throttle position, engine rpm and the manifold pressure. All have various means of compensating for engine and air temperature, atmospheric pressure etc. Early systems use more mechanical parts, later systems still require a mechanical pump to maintain a steady high pressure but control is almost entirely electronic.

Fuel injection systems with adjustable idle mixture

Single point injection

This system has one injector and one throttle plate through which all air and fuel passes into the engine manifold. Despite this simplicity, the same control systems are required to achieve accurate fuel metering. Idle mixture and idle speed, are the two adjustments that may be provided on early systems.

Multipoint injection with one throttle plate

Separate injectors are placed close to the inlet valves rather than in the main throttle body. The manifold system is designed with a suitable inlet tract length to enhance engine performance. This feeds from a larger chamber and throttle body which does not have the same dimensional restrictions as the single point system because it feeds air only. Idle mixture and idle speed, are the two adjustments that may be provided on early systems.

Multipoint injection multiple throttle

Some early systems which were mainly mechanical in operation had this arrangement. Balancing the air flow through each throttle plate is crucial to effective operation. Injectors are set to deliver equal quantities of fuel and any error in air flow then has a dramatic effect on mixture. Testing and fine tuning of the balance between throttles requires patience even with a **COLORTUNE** in each cylinder. It is almost impossible without **COLORTUNE**. A Lucas system of this type was fitted to a few high specification vehicles in the early 70’s and a few other road vehicles and racing systems fit this description.

Fuel injection systems with oxygen sensor feedback

The development of sophisticated electronic control systems plus a robust exhaust oxygen sensor allowed the three way exhaust catalyst to be introduced. This had a dramatic effect on exhaust emissions and was introduced into most vehicle markets from the early 1990’s.

The oxygen sensor gives no output when there is oxygen present in the exhaust (both sides of the sensor are exposed to oxygen) and it gives an output (usually 1.0 volts) when there is no oxygen present in the exhaust (when there is a difference across the sensor). It is therefore an excellent detector of small percentages of oxygen and the electronic control unit (ECU) is able to continually adjust above and below the point at which the sensor has an output. The ability of the ECU to learn and adjust the programmed map of information stored in its memory, adds a further precision of control.

With this type of injection system there is little or no facility for adjustment, (except perhaps fuel pump pressure, selection of different settings for different octane fuels etc). When there are no faults present the performance is generally very good under all operating conditions, but even minor faults may have an exaggerated effect. **COLORTUNE** can provide a unique view of the behaviour of the fuel injection system, in the individual cylinders, which no other equipment can do, saving in many cases time, expense and a great deal of effort in fault diagnosis.

Fortunately, many systems also have the facility for a limited amount of self diagnosis, and give fault code information in the form of a blink code (a number indicated by a flashing led) or more complex forms of data transmission. This may pinpoint the problem or give some guide to the area that requires investigation. Often the information requires further analysis as the system does not recognize mechanical problems only the effect on electronic items and will show for example a lambda (oxygen) sensor or lambda control system fault in the case of inlet or exhaust manifold air leaks.

Multiple, twin and twin choke carburettors

Multiple throttle body injection.

On any system that has multiple throttles, it is important to synchronize the action of these before setting mixture controls. This ensures that the system is balanced, but more importantly it aids accurate mixture setting.

The procedure is usually a basic mechanical setup of the following procedure. Release the linkage; adjust throttle stops to achieve identical air flow, clamp linkage. Check that throttles begin to open simultaneously when operated by the actual accelerator cable or rod mechanism, (not some other part of the linkage).
A twin choke carburettor that has both throttle plates in one casting does not usually progressive opening.

Fixed choke carburetors

If two twin choke carburettors are used the linkage between these must be set to achieve a synchronized opening.

Engine fault finding with Colortune

As COLORTUNE allows you to view the burning of the fuel air mixture, most of the faults observed during its use will be mixture / fuel system related. However, there are other faults which affect efficient combustion and these will also be easier to diagnose. For example, an engine misfire which occurs despite the mixture being correct can be identified as an ignition or compression fault.

The following information gives a basic guide but operator experience and other published information will be invaluable in identifying the causes of observed combustion problems. These will vary with specific fuel systems and other engine equipment.

Always determine the extent of the problem, for example:
Is the fault affecting all cylinders, multiple cylinders or just one cylinder?
In the case of multiple cylinders what is common to these?
(Two together may have a head gasket leak between them or be fed by one of twin carburettors).
Is the fault mainly at idle speed, low throttle or wider throttle opening?

At idle speed

Symptoms	**Fault details for different fuel systems**
Blue combustion flame is not achievable when adjusting idle mixture	Fixed Choke - Blocked idle air jet / idle jet loose Variable Choke - Wear on needle / jet Injection System -Senses high air flow, air flow device faulty / vane sticking, throttle position sensor / switch. Cold start device or temp sensor
Yellow combustion flame is not available when adjusting idle mixture	All systems - Manifold air leak. Check other cylinders to help pinpoint position of leak. Fixed Choke -Blocked idle jet / idle air jet loose Variable Choke - Needle loose or shoulder set low, sticking air valve. Injection System - Air leak or idle air valve, MAP sensor fault (detects low air / manifold pressure).
Blue flame turns yellow after a prolonged idle	Fixed Choke and Variable Choke - Leaking float chamber needle valve. Variable choke - overheating causes rich idle. Check inlet manifold insulator block fitting.
Blue combustion flame is not constant, intermittent yellow at all or most settings	Fixed Choke -Blocked idle air jet gives erratic idle fuel discharge. Float level high gives main circuit “drip” feed Variable Choke - Float level high. Advanced ignition timing producing engine instability. Injection System - Oxygen sensor response slow
Blue combustion flame is not visible (non adjustable systems)	Injection System - Oxygen sensor / connection or control failure. Air leak to exhaust manifold or to inlet manifold if confined to most cylinders but not all cylinders.

Above idle speed

Symptoms	Fault details for different fuel systems
Yellow Flame at 1000-1700rpm	Fixed Choke or carburettor with separate idle circuit - restricted idle air bleed Variable choke - Worn metering needle/jet
Yellow Flame 1200 and above	Variable choke - Hole in diaphragm. Manifold air leak results in a rich setting to compensate for a weak idle (rich setting then affects whole operating range) All carburettors - Float chamber level high
Intermittent yellow Flame1200 - 1500rpm	Fixed Choke - Main circuit feeding early, Float chamber level too high. (Lower by 2mm approx) The fuel drips (not spray) if it feeds too early Variable Choke - Sticky air valve / carburettor piston.
Yellow appears at high rpm only	Fixed Choke - Main circuit feeding early, Float chamber level too high. (Lower by 2mm approx) The fuel drips (not spray) if it feeds too early Variable Choke - Sticky air valve / carburettor piston.
Light blue flame engine unstable 1000-2000 rpm	Blocked main jet or water in the fuel system.

Rapid throttle opening

No yellow flame visible at any speed or flat spot in acceleration followed by little yellow flame	Fixed choke - Accelerator pump not working. Observe for fuel discharge into choke when throttle is opened (engine stopped). Variable choke - Oil damper needs top up Fuel Injection - MAP sensor or Throttle Position Sensor fault. Faulty idle switch

WARRANTY

This warranty is in addition to the statutory rights of the purchaser.

The Tool Connection Limited has made every effort to ensure that this product is of the highest quality.

If this product should require service or repair at any time, it should be returned to The Tool Connection Limited, Kineton Road, Southam, Warwickshire CV47 0DR.

IF YOU HAVE DIFFICULTY USING THIS PRODUCT CONTACT THE TECHNICAL SERVICE DEPARTMENT. IF RETURNING GOODS FOR SERVICE OR ANY OTHER REASON INCLUDE FULL DETAILS AND A DESCRIPTION OF ANY FAULTS.

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The Complete Connection

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Guarantee

If this product fails through faulty materials or workmanship, contact our service department direct on: **+44 (0) 1926 818186**. Normal wear & tear are excluded as are consumable items & abuse.