SECTION 3-5 : FUEL SYSTEM MAINTENANCE

BING Carburetors

SAFETY CHECKPOINT

Fuel leaks or spills can cause fire or explosion. All fuel-carrying components MUST be checked frequently for any conditions that could lead to fuel leakage. Restricted air induction or fuel flow, incorrect carburetor adjustments, or other fuel system malfunctions can result in POWER LOSS and/or SUDDEN ENGINE STOPPAGE.

Pre-flight and Hour-Maintenance Inspections (see Section 3-1) include:

FUEL TANK(S)
Check for integrity of mounting, leaks, proper operation of filler cap(s), shutoff valve(s), vent(s), switching devices, gauge(s) and gauge wiring.

FUEL LINES, FITTINGS and IN-LINE COMPONENTS
Check for tightness of fittings, rubbing or chaffing, cracks, bends, restrictions and deterioration.

FUEL FILTERS
Check for integrity of mounting, tightness of connections, and leaks. EVERY 25 HOURS: remove fuel filter, empty fuel out through the inlet side of the filter into a suitable container. Inspect fuel and filter for particles or other contamination. Attach a short section of clean fuel line to the inlet side of the filter. Blow air into the line to check for restriction. REPLACE FILTER if any contamination or restriction is found. If heavy contamination is evident, drain and clean the ENTIRE fuel supply system.

AIR CLEANERS AND FILTER ELEMENTS
DURING EVERY PRE-FLIGHT INSPECTION, check for cleanliness and integrity of mounting. Replace any filter element that contains rips, or other signs of deterioration. Replace paper filter elements if visible debris is present, or if light cannot be seen through any part of element. Foam filter elements in good condition can be cleaned by washing in mild soap and water solution. After allowing foam filter to thoroughly air dry, work a SMALL AMOUNT of engine oil into the filter by hand. Wipe all oil from inside the rubber mounting snout before reinstalling the foam filter. Dry, dusty or sandy conditions will require more frequent air filter inspection, service and/or replacement.

AUXILIARY FUEL PUMP (if equipped)
Check for integrity of wiring, tightness of fittings, absence of leaks, proper switch operation. Pump should be audible when on.

THROTTLE AND CHOKE CONTROLS
With engine off, operate controls through entire range. Controls MUST move freely, without binding or sticking at any point. Lubricate, adjust or replace cables and control mechanisms as needed. Check stop settings for proper operation, adjust as needed.

CARBURETORS: Two types of carburetors are used, depending on engine configuration: Bing Type 54 or Mikuni VM Type. The section that follows is provided by the manufacturer of the carburetor type that applies to the engine as originally equipped. Refer to this information for carburetor maintenance, adjustments, troubleshooting, repairs and overhaul.

NOTE: Inspection of the jet needle and E-clip is REQUIRED as a CRITICAL maintenance item at least every 10 hours. 2 Stroke International RECOMMENDS that this procedure be incorporated into each Pre-flight Inspection that falls on a ten-hour increment. See the appropriate section in the carburetor manual for this procedure.

INDUCTION SETUP TAG: Every new engine is shipped with an Induction Setup Tag attached. This tag records the jetting used and conditions under which the engine was tested. This tag MUST be removed prior to placing the engine into service. For future reference purposes, the tag should be inserted in this section of the Owner's Manual by removing the wire and hooking the eyelet through a ring in the manual binder. See page 3-5.25 in this section for explanation and interpretation of Setup Tag, and for initial stock jetting specifications.

INTRODUCTION There are hundreds of possible jetting/air-valve/atomizer combinations that could be installed in your carburettor. Add to these, an infinite amount of variable mixture adjustments, and the possibilities become astronomical. Fortunately, the designers of your machine determined the proper combination that best fits your overall requirements in terms of power, economy, and reliability. They even left room for the individual pilot to make certain changes to suit his particular requirements. *When* these changes are required, *what* changes we make, and *results* we achieve is what this manual is all about.

Paramount in the designer's mind is *RELIABILITY*. We never change anything in the carburettor that reduces reliability, and changing anything else is always a compromise between *POWER* and *ECONOMY* unless of course, both have been reduced in the first place – only then will we see an improvement in performance and economy.

To make logical changes of our carburation, we first have to have at least a passing knowledge of the underlying principles that govern our engine's carburation requirements; – the following discussions hopefully will fulfill this need. By itself, the carburettor does nothing – but attach it to a reciprocating engine – and it comes to life, providing the very lifeblood that all engines exist on; *air* and *fuel!*

AIR Air that our engine uses in the combustion process contains 21% Oxygen, 78% Nitrogen, and 1% other gases.

FUEL The gasoline that we use in our engine contains liquid hydrocarbons (Hydrogen and Carbon).

COMBUSTION When *each* Carbon atom in our fuel is combined with *two* Oxygen atoms from our air supply, Carbon-Dioxide (CO_2) is formed during the "burning" process. The Carbon-Dioxide thus formed, and the 78% Nitrogen from our air source absorb the heat from the combustion process and turn it into mechanical energy by expansion.

AIR/FUEL MIXTURE A chemist will tell you that a perfect mixture – one that will be totally consumed in the combustion process contained 1 pound of fuel for each 14.8 pounds of air. He is right BUT we can't use this "perfect" mixture because it produces way too much heat that does nothing for efficient power or economy. Richer mixtures lower combustion temperatures and produce an increase of power until we reach a 13.8 air/fuel ratio. (Figure 1) From 13.8 to 12.5 we realize no increase in power, but we do see lower temperatures that greatly enhance the combustion process by allowing more time to convert heat to mechanical energy. Beyond 12.5 we will experience a pronounced drop in power as excessive cooling by the enrichened mixture robs us of combustion efficiency. Leaner mixtures can only be tolerated at cruising speeds. Below ¼ throttle, an excessively lean engine won't rev up smoothly – above ¾ throttle, you might see a hole where the top of your piston used to be (after an expensive tear-down). For cruising speed only, we can vary the mixture on the lean side between 16.4 and 18.2 to achieve desired economy levels.

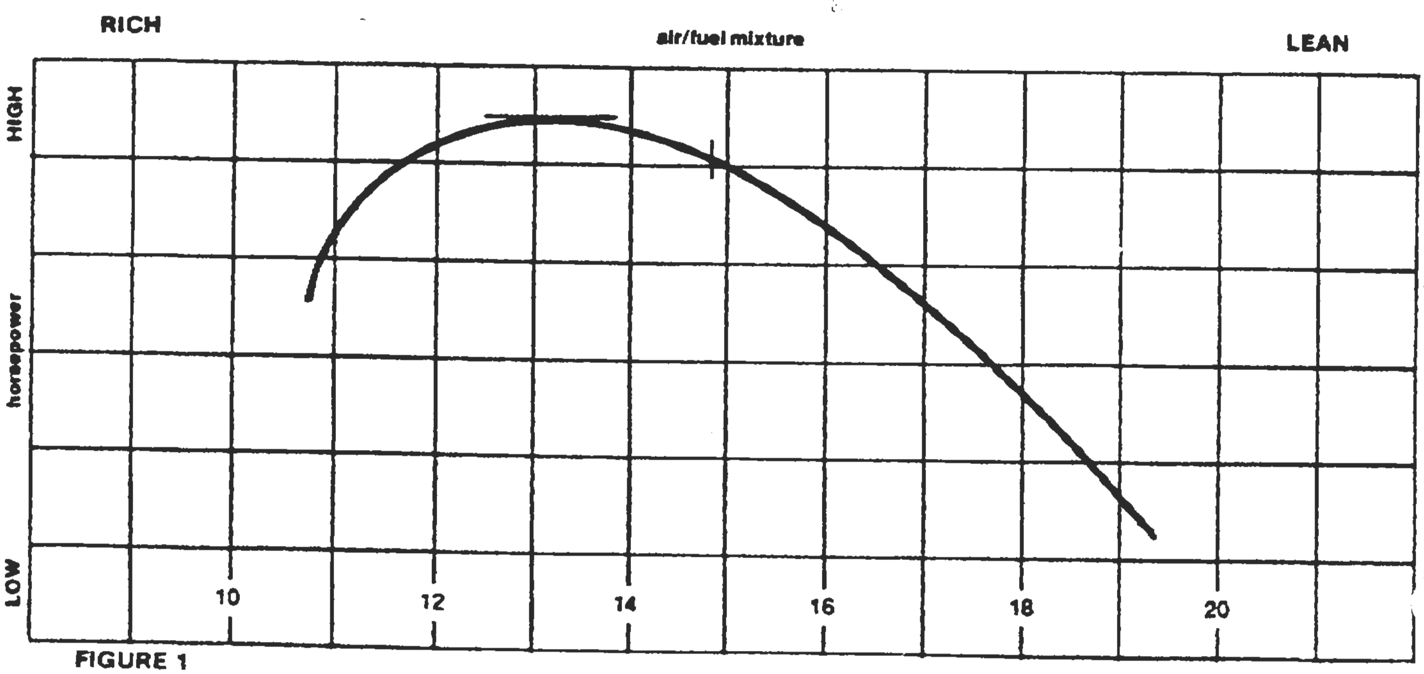


FIGURE 1

AIR PRESSURE is 14.69 pounds per square inch (psi) at sea-level and 59 degrees Farenheit. With the engine at rest, air pressure throughout the engine, carburettor, and exhaust is 14.69 psi. As the piston begins downward travel (with intake valve open) a low pressure (partial vacuum) area is created in the cylinder. Outside air at the higher 14.69 psi rushes through the carburettor to refill the low pressure area behind the retreating piston. The amount of air that enters the cylinder during the intake stroke is dependent upon the throttle valve opening.

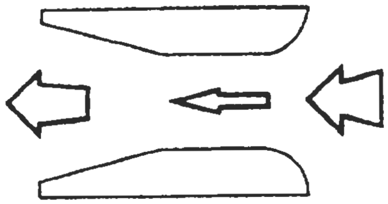


FIGURE 2a

THE VENTURI (Figure 2a.) A basic law of physics states: "as the velocity of air increases, the pressure of air decreases". In a given period of time, the amount of air exiting the carburettor must be equal to the amount of entering the carburettor. On its way through the venturi, the air flow encounters a restriction and has to "speed up" to get past the restruction and exit at the same rate that it enters. How does it "speed up"? The only available source of energy to boost its speed through the restriction is PRESSURE. We don't get something for nothing and therefore, we have a loss of pressure that is proportional to the increase of velocity through the restriction. At a point in the venturi where the lowest pressure exists, we place our fuel outlet. With a low pressure at the fuel outlet, the higher pressure (atmospheric) in the fuel chamber will force fuel up through our metering tube in an amount proportional to the air flowing through the venturi. In this manner, we now have the means with which to meter the correct amount of fuel for any given amount of air passing through the venturi. We will refer to the loss of pressure as LOW PRESSURE. (You may call it *vacuum* if you wish).

FULL POWER MIXTURE At the bottom of our metering tube, submerged deep in the fuel chamber, we place the MAIN JET, having a fixed bore diameter that restricts the amount of fuel that flows up through the tube at ¾ to full throttle (Figure 2b). Fuel flowing through the main jet at full power settings is totally dependent on the amount of air passing through the venturi.

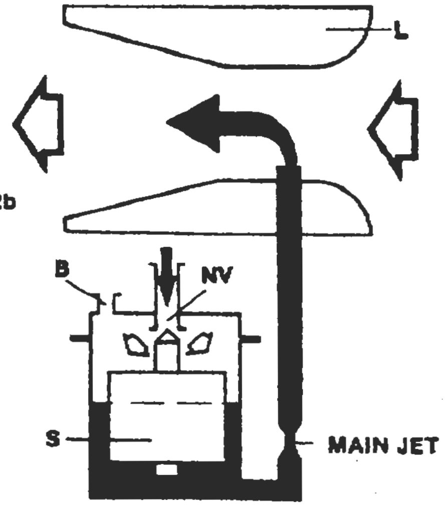


FIGURE 2b

PART THROTTLE MIXTURE We place in the metering tube a needle jet, and inside this jet, a tapered needle that when retracted increases the area through which the fuel must flow. (Figure 3) the needle is retracted at the same rate that our throttle (air) valve is opened, therefore we have a corresponding fuel flow for an increase of air flow. In this manner, our air/fuel mixture is precisely controlled from about ¼ to ¾ throttle.

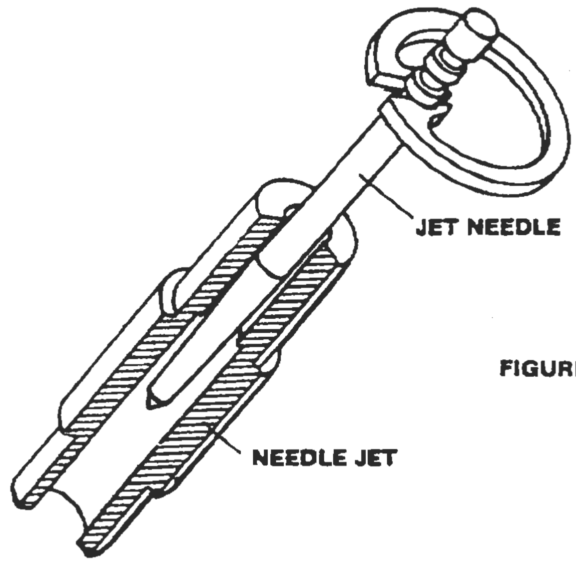


FIGURE 3

IDLE SPEED FUEL MIXTURE At throttle settings in the idling speed range there is insufficient air flow through the venturi. The resulting higher pressure (less vacuum) will not allow fuel to flow from the main fuel outlet. The fuel outlet for idle metering therefore is placed between the throttle valve and the intake manifold where low pressure exists when the throttle valve is nearly closed. (Figure 4) The amount of fuel allowed to enter the airstream is controlled by (1) the bore diameter of the ideal jet, and (2) the setting of our idle air screw. When the throttle valve starts to open, fuel begins to enter the air stream from the main fuel outlet while at the same time, it begins to cease flowing from the ideal circuit. In this manner, we achieve a smooth, unhesitating transition from idle to part throttle range. How smoothly this transition occurs is dependent upon (1) size of idle jet, (2) idle air adjusting screw setting, (3) the underside profile of our slide, (4) the combination of needle jet and jet needle, and (5) mixture correction components.

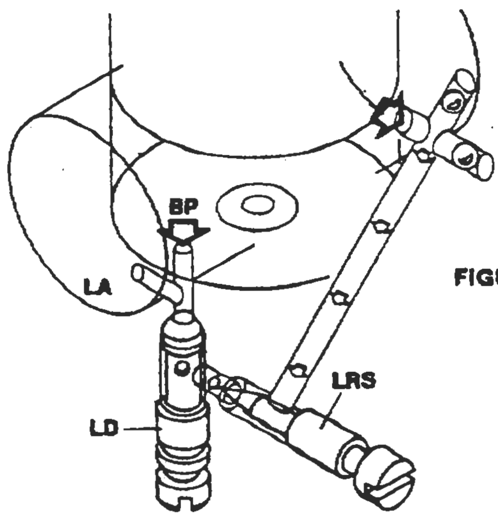


FIGURE 4

MIXTURE CORRECTION At the lower end of our part-throttle range, atmospheric pressure in our fuel chamber is not great enough to force fuel out of the main discharge nozzle and into the air stream. We give the fuel flow a "boost" at this point by directing an air stream into the metering tube. (Figure 5). In this manner, we not only help the fuel up and out of the nozzle, we also "break up" the fuel into smaller droplets that are more easily vaporized in the air stream. The component responsible for this pre-vaporization is our ATOMIZER.

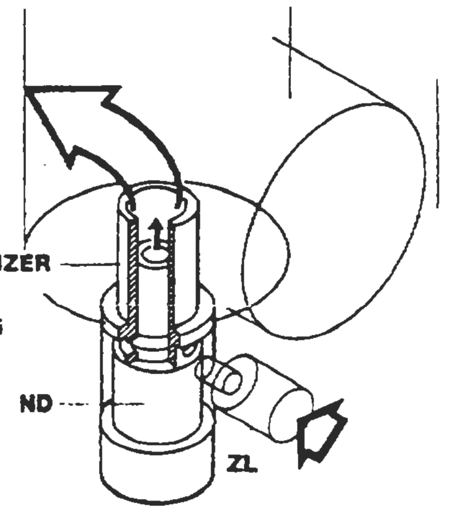


FIGURE 5

FUEL LEVEL CONTROL Much more important than maintaining a constant level in the fuel (or float) chamber, our floats determine the height that the fuel attains in our main fuel metering tube. (Figure 6) At the proper height, the pre-vaporized fuel is easily "picked off" by the (suction) that exists in our venturi. A "too high" level in the tube will allow more fuel into the air stream than is desired, with a resulting overly enriched air/fuel mixture. A "too low" level produces "lean" mixtures.

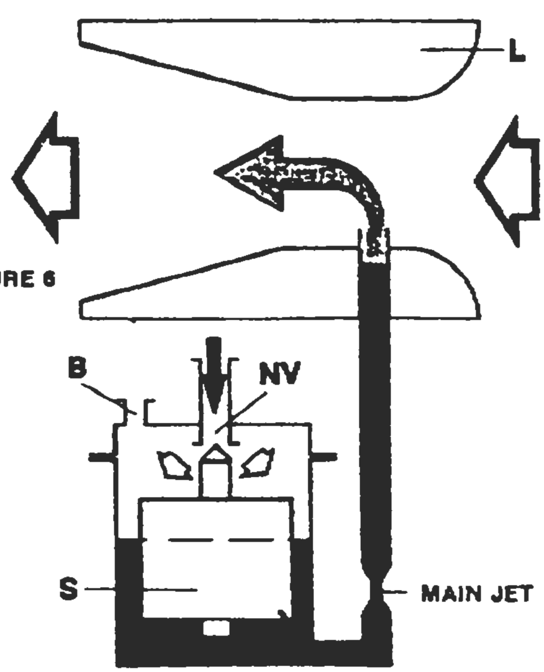


FIGURE 6

STARTING MIXTURE Bing carburettors may be equipped with starting carburettor, choke, or tickler. If you have a slide type carburettor and it is equipped with an independent "starting carburettor", it functions in the following manner: pulling on the starting carburettor lever raises a plunger assembly that allows a pre-determined amount of fuel to enter the carburettor throat when suction is initiated by engine cranking speed. An amount of air (as determined by the level setting) is mixed with the fuel to achieve a combustible mixture. Bing Constant Depression carburettors function similarly except: – a rotary valve replaces the plunger design, and fuel is varied as well as air (by lever position). Initial overly rich mixture is provided to the cold engine and reduced after engine is running. This reduction is accomplished automatically by nature of the starting jet design. The throttle MUST remain closed during starting carburettor operation.

TEAMWORK The best tuned carburettor in the world will not contribute anything to power or economy unless all influencing system components are in harmony! The following paragraphs are presented as an aid to understanding how the carburettor fits into the overall scheme of engine operation. Our fuel system, or rather our *total fuel system* is not limited to the gas tank, gas line, and carburettor. It begins with the outside surface of our air filter and ends at the tip of our exhaust system. Our carburettor has to compensate for an infinite amount of subtle, as well as pronounced changes that can and do occur anywhere in between. Your engine was designed to provide an optimum performance, economy, and reliability level under an extreme range of operating conditions, and all components must function as a team to ensure that these levels are properly maintained. Gasoline is vaporized, mixed with air, forced into the cylinder, compressed by the piston, then ignited by a spark with resulting heat being converted to mechanical energy. Since it is heat that produces the energy needed for our engine to work, we need to know about Thermal Efficiency.

THERMAL EFFICIENCY Of the total heat produced by combustion in the cylinder – only 25-30% is available for conversion to working energy; 15-20% is dissipated through our cooling fins, 5-10% is absorbed by our lubricating oil to reduce friction, and a whopping 40-45% disappears out the tail pipe. With only 25-30% available to do the work we must therefore exercise extremely close control over our air/fuel mixture to produce maximum allowable output with each power stroke. We say "allowable" because if we exceed the limits imposed by engine design, we overheat or overstress our engine, eventually losing what we thought we had gained.

VOLUMETRIC EFFICIENCY RATIO Simply stated is the amount, or VOLUME of air/fuel mixture (corrected for temperature and pressure) that is drawn into a given cylinder displacement-as compared to the volume that could be drawn in. At Sea-Level elevation with a standard temperature of 59°F, air pressure is 14.69 pounds-per-square-inch (psi), commonly referred to as "one atmosphere". The above parameters describe standard atmospheric conditions in fair weather, and they in turn, determine a standard AIR DENSITY. If our engine drawn in a volume of air/fuel mixture at the above density, and it is exactly equal to our engine's displacement, we can say that we are running at 100% volumetric efficiency. Many factors determine a lessor or greater than 100% volumetric efficiency. Turbocharging naturally would increase it – a decrease could be caused by, (1) operation at less than full throttle, (2) poorly designed exhaust systems, and (3) air intake obstructions.

EXHAUST SYSTEM Our exhaust system performs many functions that are useful to us and our engine. In addition to reducing exhaust noise to a comfortable level, its primary purpose is to remove the host spent gases from the cylinder after combustion has taken place. The momentum of the spent gases exiting the exhaust port creates a low pressure that starts the next air/fuel charge moving into the cylinder even though the piston is still moving upwards. In this manner, the incoming charge aids in removal (scavenging) of all spent gases thereby eliminating fresh-charge dilution. Scavenging only occurs if we have an exhaust system that properly shapes and directs pressure waves that leave and return to the exhaust port precisely on time.

PRESSURE WAVES The outrush of spent gas into the exhaust header creates a pressure wave that begins at the exhaust valve port and travels to the end of the pipe. At the open end of the pipe it is reflected back to the exhaust port, again turns and heads back to the open end of the pipe. This process is repeated endlessly – back and forth, back and forth. When it reaches the exhaust port and turns around it literally draws spent gas from the cylinder and simultaneously aids in drawing into the cylinder a fresh air/fuel charge – that in turn acts to push more spent gases out through the exhaust port. It is the task of the exhaust system to ensure the TIMING of the above PRESSURE WAVES to arrive at the exhaust port precisely on time, and at an exact and predetermined pressure that enhances the scavenging process.

INTAKE TRACT Your engine's total tract consists of: (1) the air box that contains the air filter, (2) air duct from air box to carburettor, (3) the carburettor, (4) intake manifold from carburettor to cylinder head, (5) intake port, (6) the cylinder, (7) exhaust port, (8) total exhaust system.

ALL TOGETHER NOW Let us follow all events that occur during the four complete cycles of engine operation. The air that's present throughout our engine, carburettor, and exhaust system is at rest. Without any piston movement, the pressure is equal throughout at one atmosphere (14.69) psi.

INTAKE STROKE The piston moves downward in the cylinder creating an ever-increasing empty space and low pressure behind it.

COMPRESSION STROKE The inrushing air/fuel mixture momentum is sufficient to overcome the rising piston pressure for a predetermined amount of piston travel. The piston continues upward to compress the mixture. At a predetermined point BEFORE the piston reaches TDC (top dead center), the mixture is ignited by the spark. WHY before? Because complete combustion of the mixture required TIME to BURN, and the maximum pressure created by the combustion process cannot be exerted on the piston until after it passes TDC and begins its downward . . .

POWER STROKE As the piston passes through TDC, it is forced downward by the rapid expansion of the burning mixture. At yet another predetermined point before the piston reaches BDC (bottom dead center), the EXHAUST port is opened while there still is pressure in the cylinder.

SCAVENGING Also aiding in this process is a pressure wave that was timed to arrive at the open exhaust port, turn around and head back out the exhaust pipe, carrying with it the spent gas.

CARBURETTOR TUNING The following information is presented on the assumption that all is well with your machine – spark plug of the specified heat range and correctly gapped, specified air filter installed (and clean), ignition settings as specified, factory installed exhaust system, and no air leaks in the intake or exhaust tracts. One last word of advice before we embark on this venture into the unknown – don't expect the carburettor to pry loose any more power than your engine is capable of producing. The Bing Carburettor is a precision-designed instrument, and is quite capable of maximizing to-the-limit, all available energy lurking within your machine.

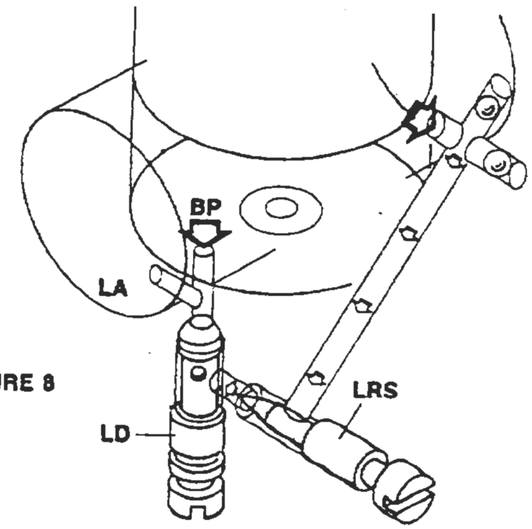
PRE-TUNING CHECKLIST We cannot overemphasize the need to verify that all carburetor components are "as specified". This information can be found on page 1 of this manual. If you find a component is not "as specified" check your owners manual, as the factory may have made late changes to the carburettor after it was supplied to them by Bing. In addition to all components being "as specified" (prior to tuning) have: (1) Needles at the proper height (clip position). (2) Idle Air Adjusting Screws turned LIGHTLY in against their seat – then backed out (CCW) the specified amount of rotation. Inspect the tips for concentricity with respect to wear. A tip with noticeable indentation will prevent fine regulation of your idle air/fuel mixture, and make carburettor "balancing", next to impossible. (3) Idle Speed Adjusting Screws backed completely off the throttle – CAREFULLY counting the required number of turns. If the number differs between carburettors, you can be sure that your idling system was improperly set. It is quite possible to have one carburettor throttle valve open further than the other carburettors', yet have normally appearing idle from both cylinders. This is because of the overlapping influence of idle air and idle speed settings. Misadjusted cables have a similar over-lapping effect. (4) New Rubber O'rings on Idle Air Screw, Idle Jet, Main Jet Stock, and in the case of "older" carburettors, the O'ring that seals off the throttle valve shaft-to-carburettor body.

MIXTURE TRANSITION SYSTEM We will explain this system first, as it is the easiest of all to tune – reason being that you cannot tune it. It has no tuneable components, yet it is the one that determines how our carburettor reacts as it makes many transitions through its various stages: Starting-to-Idle-Part Load (or Needle Control) and Part-Load-to-Full Power and then all the way back in reverse sequence. All of these transition stages are totally dependent upon how close we have tuned the areas just below and above where transition occurs. In other words, we cannot tune "just the idle" and "just the part-load" – we have to make certain that we select components that overlap one another – but not too much! Anyone can make an engine idle, accelerate, and pull G's at full step – it's the "artist" who can bring about smooth unhesitating performance zero-to-flat-out.

FUEL LEVEL In figure 6, you can see that the fuel stands higher in the metering tube than in the float chamber. The higher level in the metering tube is the result of pressure differential between the higher atmospheric pressure in the float chamber pushing against lower pressure in the metering tube when the engine is running and partial vacuum exists in the venturi. For a given constant RPM, metering tube fuel level is totally dependent upon float chamber fuel level – as determined by our float adjustment setting. If the level in the metering tube is too high, fuel will exit into the venturi at a much lower air velocity, resulting in the air/fuel mixture becoming enriched before it is supposed to – as in the low middle-to-higher RPM range. A too-low fuel level results in just the opposite. As fuel metering jets and jet needles also affect the above discharge rates, it is imperative that an exact pre-determined fuel level is maintained. If you find that a different fuel level improves performance or economy, rest assured that your jetting is wrongly set. Correct float adjustment is achieved by following the instructions found in the Tuning & Troubleshooting section on page 21 of this manual.

IDLE SYSTEM (Slide Carburettor) With the air slide nearly closed, vacuum, at the main fuel outlet is insufficient to draw fuel up from the main metering tube. Fuel and air to supplement the small volume of air getting under the slide for idling is then supplied through the auxiliary idle system (Figure 8) which consists of IDLE JET (LD), IDLE AIR SCREW (LRS), OUTLET BORE (LA) and BY PASS (BP).

FIGURE 8



The fuel passes through the idle jet whose bore will determine the amount of fuel allowed through. Behind the jet bore the fuel mixes with air which is supplied via cross ducts, the amount of air admitted being determined by the setting of the idle air screw. This initial mixture then flows through the idling outlet bore (LA) and the bypass or transition passages (BP) into the venturi where it is mixed further with pure air.

Idling should always be adjusted with the engine at operating temperature. First the mixture control screw is turned in fully clock-wise and then backed off by the number of turns specified for the particular engine (See Page 1). Turning in clockwise direction results in a richer mixture and turning in anti-clockwise direction produces a leaner mixture. The idle setting quoted serves as a guide only. The optimum will generally differ slightly. First select the desired idle speed by using the air slide adjusting screw. The idle air screw is then opened (turned anti-clockwise) until the speed rises. Then turn the screw back by a quarter of a turn.

If your idle jet is partially blocked by dirt or evaporated fuel residue, the air screw will have to be excessively rotated in a clockwise (CW) direction to obtain proper idle mixture. A "too lean" selected jet will also require the same excessive screw setting. If a "too rich" jet is selected, or if the carburettor air passages are partially blocked, these conditions will be indicated by the requirement of excessive screw setting in the opposite (CCW) direction.

If the air slide is closed down to the idle position while the engine is running, then only the idle outlet bore (LA) is available between slide and engine intake and it is thus exposed to the suction effect. When the slide is in this position, air will enter through the bypass bore (BP) which will make the pre-mixture leaner until idle speed is reached. If the slide is then opened, the bypass bore will also be subject to the vacuum and supply additional fuel to enrich the mixture in the transition range. Idling may be adjusted only by turning the idle speed and the idle air screw or by using idle jets of various size. Idle outlet bore (LA) and bypass bore (BP) are matched to the fuel requirements of any given engine and must not be changed.

To facilitate the idle setting on two cylinder engines having two carburettors where it is important that they are evenly adjust, it is possible to connect a vacuum gauge. To select the speed, the idle stop screws are in this case adjusted until the same vacuum is indicated for both carburettors. By slightly opening the throttle valve it is also possible to adjust cables or linkages evenly by making this vacuum comparison.

IDLE SYSTEM (Constant Depression Carburettor) During idle and low-load running the throttle valve is closed to such an extent that the air flow underneath the plunger no longer forms a sufficient vacuum. The fuel is then supplied via an auxiliary system (the idle system See Figure 9) which consists of IDLE JET (LD, MIXTURE SCREW GRS), OUTLET BORE (LA), BYPASS (BP), and in the case of later model carburettors, TRANSITION PASSAGES (TPS). The fuel passes through the idle jet whose bore will determine the amount of fuel. Behind the jet bore the fuel mixes with air which is supplied via cross ducts in the jet throat from the idling air channel, the amount of air admitted being determined by the size of the idling air jet at the inlet of this duct. This initial mixture then flows through the idle outlet bore (LA), the cross-sectional area of which can be adjusted by the mixture control screw. It then reaches the venturi via bypass or transition passages where it is mixed further with pure air. Idling should always be adjusted with the engine at operating temperature. First the mixture control screw is turned fully clockwise and then backed off by the number of turns specified for the particular engine. Turning in a clockwise direction results in a leaner mixture and turning in anti-clockwise direction in a richer mixture. (Note: this is just the opposite of the direction required in Bing slide carburettor mixture settings). The idling setting quoted serves as a guide only. The optimum will generally differ slightly. First select the desired idling speed by using the idling stop screw. When subsequently adjusting the mixture control screw—starting from the basic setting—a speed drop will be noticed in both directions. The optimum setting will generally be found half-way between the two settings at which this speed drop was noticed.

If your idle jet is partially blocked by dirt or evaporated fuel residue the air screw will have to be excessively rotated in a counter clockwise (CCW) direction to obtain proper idling mixture. A "too lean" selected jet will also require excessive screw setting. If a "too rich" jet is selected, or if carburettor air passages are partially blocked, these conditions will be indicated by the requirement of excessive screw setting in the opposite (CW) direction.

To facilitate the idle setting on two cylinder engines having two carburettors where it is important that they are evenly adjusted, it is possible to connect a vacuum gauge (Page 21) to a nipple which is normally closed off by a screw. To select the speed, the idle stop screws are in this case adjusted until the same vacuum is indicated for both carburettors. By slightly opening the throttle valve via a turning handle or the accelerator it is also possible to adjust cables or linkages evenly by making this vacuum comparison.

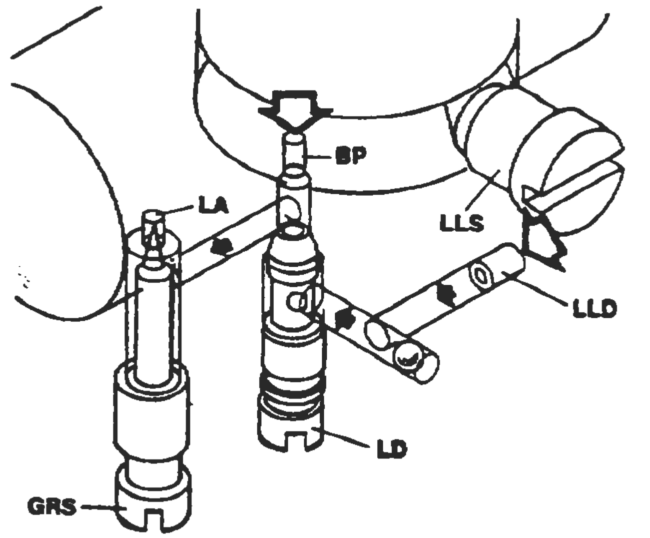


FIGURE 9

FIGURE 10

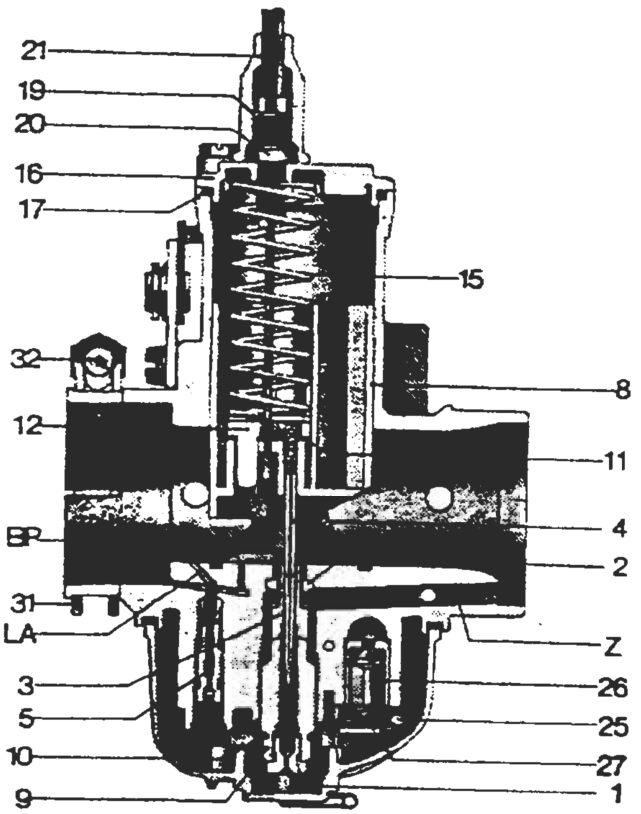
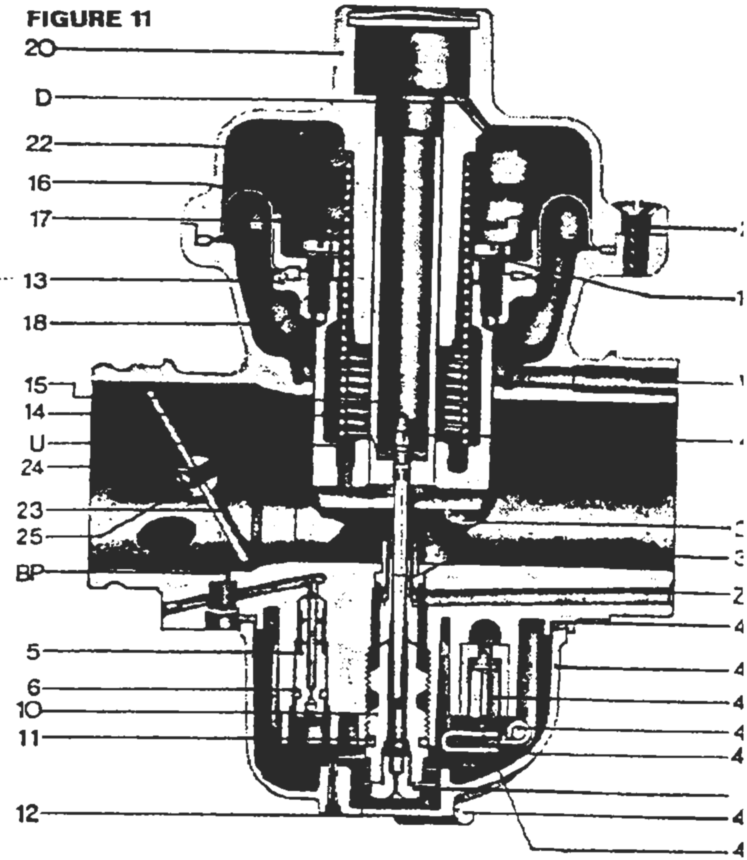


FIGURE 11



MAIN REGULATING SYSTEM (Slide Carburettor) The amount of mixture drawn in by the engine and thus its performance is determined by the cross-sectional area in the venturi which is opened up by the AIR SLIDE. The air flow produces a low pressure or (vacuum) which draws fuel from the float chamber through the jet system (Figure 10). On its way from the float chamber the fuel passes through the MAIN JET, the JET STOCK, and the NEEDLE JET; as it leaves the needle jet it is pre-mixed with air which is brought in from the filter connection via an AIR DUCT (Z) and the ATOMIZER in an annular flow around the needle jet. This air flow assists the atomizing process to form minute fuel droplets and thus favorably affects the fuel distribution in the intake manifold and combustion in the engine.

In the part-load range, in other words when the air slide is between one and three-quarters of its full stoke, less fuel is required than at full throttle. The fuel supply to the venturi is therefore reduced by the JET NEEDLE which is connected to the air slide and engages the needle jet. Depending on dimension of the flat cone of jet needle, the annular gap between jet needle and needle jet is enlarged or decreased. For fine adjustment the jet needle may be located in the air slide in various positions (needle positions) which, similarly to the jet needle cone, affect the amount of fuel drawn in. For example, a higher-needle position results in a larger annular cross-section in the needle jet which allows more fuel to pass through and vice versa. When the throttle slide opening is reduced, the amount of fuel supplied is affected also by the shape of the throttle slide at the lower end. With increasing height the cylindrical recess called air cushion results in the mixture becoming leaner. The recess on the filter side called cut-away has a similar effect but this extends up to a greater slide stroke. The air/fuel mixture is adjusted using main jets and needle jets of various sizes and also atomizers, air slides and jet needles of various types. The main jet may be surrounded by a strainer; in particularly severe operating conditions this ensures that the fuel is not spun away from the main jet. The strainer does not act as a filter!

MAIN REGULATING SYSTEM (Constant Depression Carburettor) the amount of mixture drawn in by the engine and thus its performance is determined by the cross-sectional area in the venturi which is opened up by the THROTTLE VALVE (Figure 11). If the throttle valve is opened while the engine is running, the increased air flow results in a vacuum building up at the outlet of the needle jet, drawing fuel from the float chamber through the jet system. At low speeds this vacuum is not sufficient for an adequate fuel supply; it must therefore be increased artificially by using a pressure regulater. For this purpose Bing Constant Depression Carburettors are provided with a DIAPHRAM regulated PLUNGER that reduces the cross-sectional area of the venturi by virtue of its own weight or, in some applications with the additional pressure from a spring and thus incrases air velocity and vacuum.

The vacuum in the venturi acts on the top of the diaphram and the plunger via a bore (U) in the plunger and attempts to lift the plunger against its own weight and spring. The considerably lower vacuum between air filter and carburettor is applied to the underside of the diaphram via duct (V) as reference pressure.

If the throttle valve is opened when the plunger is closed, then a vacuum will build up in the small cross-section at the bottom of the plunger which is sufficient to provide a supply of fuel. The weight of the plunger and the force of the spring are matched in such a way that this vacuum will be maintained with increasing speed until the plunger has fully opened the venturi cross-section. From this point onwards the carburettor acts as a throttle valve carburettor with fixed venturi. The vacuum increases with increasing speed.

On its way from the float chamber, the fuel passes through the MAIN JET, the JET STOCK, and the NEEDLE JET; as it leaves the needle jet it is pre-mixed with air which is brought in from the air filter via an air duct (Z) and the ATOMIZER in an annular flow around the needle jet. This air flow assists the atomizing process to form minute droplets of fuel, thereby favorably affecting fuel distribution in the intake manifold and combustion chamber.

Depending on the dimension of the flat cone of the jet needle, the annular gap between the needle and needle jet is enlarged or decreased and thus the fuel supply is throttled to a lesser or greater extent. The jet needle can be located in the plunger in four different positions which, similarly to the jet needle cone, affect the amount of fuel drawn in. For example "needle position 3" means that the jet needle has been suspended from the retaining spring with the third notch from the top. To achieve the height adjustment the jet needle is turned through 90 degrees and pushed up or down, the retaining spring engaging the next notch in the jet needle. If the needle is suspended higher up, this will result in a richer mixture and vice versa.

In short the main regulating system is set using main jets and needle jets of various diameters and also jet needles and plungers of various types. Between the main jet and jet stock, a washer is provided which, together with the float chamber, forms an annular gap. In particularly severe operating conditions this ensures the that the fuel is not spun away from the main jet. A rubber ring seals the jet stock off from the carburettor housing to avoid any fuel being drawn in via the thread the thus by-passing the main jet.

DUAL PLUG IGNITION Dual plug ignition systems greatly reduce detonation at high load and high power operation—so does a slightly rich air/fuel mixture. Use of dual plug ignitions therefore will allow you to "slightly" lean your mixture to achieve better economy at reasonable cruising speeds.

AIR/FUEL MIXTURE AT ALTITUDE From sea-level to about 3,000 feet elevation, atmospheric pressure decreases about one-inch-per-thousand feet of altitude—therefore our 29.92 barometer reading at sea-level now becomes about 27. at 5,000 feet—about 25, and 20.6 at 10,000 feet. Our engine (and carburettor) only react to air velocity—not weight of air. Not knowing this, the carburettor continues flowing the same amount (by weight) of fuel, and all of the sudden our "ideal mixture" at sea-level becomes extremely rich at higher elevations. The Bing carburettor is less susceptible to changes in elevation than other carburettors in use, and in general does not require jetting changes for the idle and lower part-throttle settings. These settings can be compensated for by mixture screw adjustment. However, the upper part-throttle range will require the lowering of the jet

needle to lean out mixture and continuous operation at higher elevation certainly necessitates the changing of the main jet. Table 1, provides all information necesssary to determine jetting changes in relation to altitude changes.

TEMP(F) \ ALTITUDE(ft)	0,000	1,600	3,300	5,000	6,500	8,200	10,000	11,500	13,000
-22	104	103	101	100	98	97	95	94	93
- 4	103	102	100	99	97	96	95	93	92
+14	102	101	99	98	96	95	94	92	91
+32	101	100	98	97	95	94	93	91	90
+50	100	99	97	96	95	93	92	91	89
+59	100	99	97	96	94	93	92	90	89
+68	100	98	97	95	94	93	91	90	88
+86	99	97	96	94	93	92	90	89	88
+104	98	96	95	94	92	91	90	88	87
+123	97	96	94	93	92	90	89	88	86

EXAMPLE: You're going to do a lot of flying in Colorado (Elevation about 5,000 feet). Your machine is performing just fine in Galveston, Texas (Elevation 7 feet). Your main jet is size 150. Temperature in Galveston (86°F) – Denver (50°F). The new jet required to obtain the same mixture ratio as was provided by the size 150 is determined from the equation:

$$J_2 = \frac{A_2}{A_1} \times J_1$$

Where

A_2 = the second altitude (Colorado)
A_1 = the first altitude (Galveston)
J_1 = original main jet (150)

* A_2 = 96 (alt 5,000—temp. 50 deg.)
A_1 - 99 (alt "0"—temp 86 deg.)
J_1 - 150 (original main jet)

$$J_2 = \frac{96}{99} \times 150 \text{ or, } .97 \times 150 = 145$$

Therefore, the same mixture at sea-level with a 150 main jet will be achieved at 5,000 feet with a 145 main jet (AT ABOVE TEMPERATURES ONLY)—If temperature in Colorado was 86 degrees, we would have:

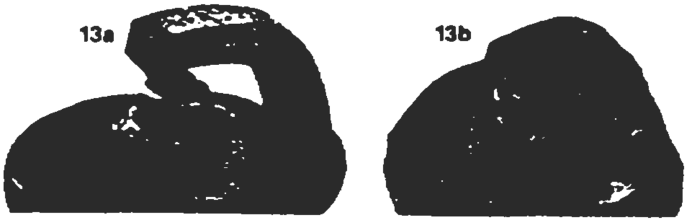
$$J_2 = \frac{94}{99} \times 150 = .95 \times 150 = 142$$

When changing jets for *altitude*, always make correction for temperature *as well*.

CARBURETTOR TROUBLESHOOTING Only two types of trouble occur with any carburettor (1) those that creep up gradually and (2) those that show up instantly. The ones that occur instantly are easy to locate through a logical process of elimination. Even the troubles that come upon us gradually can be pinpointed if we pay close attention to what the symptoms are telling us. Locating the exact area of malfunction becomes a relatively easy task if we always think in terms of AIR and FUEL. All possible carburettor faults have to be one or the other, or both. One last work of advice before we tear into the carburettor. Take a little time to make sure the problem does not lie elsewhere—(1) do we have good spark and at the correct time? (2) do we have proper compression that tells us our rings are in order? The condition of your spark plug tells all!

*Numerical values for A1 and A2 are found in Table 1 by reading across lines for temperature and down columns for altitude.

READING YOUR SPARK PLUG The spark plug from a normally functioning cylinder (with ideal air/fuel mixture) will appear as shown in Figure 13A). The ceramic insulator tip will exhibit an extremely light deposit in various shades of white/gray. The bottom edge of the threaded shell will be lightly coated with dry black soot. If the ceramic appears normal, but light reddish/brown soot appears on the shell, a



13a 13b

slightly lean condition is indicated. A TOO LEAN plug under the scrutiny of the magnifying glass will have tell-tale signs warning of the degree of leaness. Slightly lean-to-excessively lean signs would include (in order of leanness) (1) almost-white ceramic with sand-blasted surface, (2) shiny-white ceramic with tiny black specks, (3) tiny beads of copper deposited between center electrode and surrounding ceramic insulator, (4) engine in shop for new pistons and valves. (Figure 13B) illustrates the appearance of the spark plug from a rich running cylinder. The entire plug area exposed to combustion has a velvet-black carbon appearance. The above descriptions only relate to air/fuel mixture problems. Other plug conditions, such as burned, pitted, and erroded electrodes and oil, sludge, or rust deposits indicate engine or operational faults other than carburation.

ENGINE FAILS TO START (WET SPARK PLUG) A wet plug indicates excessive mixture—excessive to the point of plug fouling by gasoline. One source of this much gasoline would be from a too high fuel level but would usually be accompanied by fuel overflowing onto the ground (unless the overflow tube was plugged). Unless the floats have been mishandled, the chance of them being out of adjustment is slim indeed. A more likely cause of "too high fuel level" is a worn out float needle. If wet fouling occurs after machine has been sitting overnight with tank valve left open, a small amount of dirt may have prevented the float needled from holding back tank fuel (also accompanied by overflowing onto the ground). Repeated cranking with mixture control screw set "too rich" or too rich idle jet can also cause wet fouling. Especially with throttle valve completely blocking air flow through carburettor.

ENGINE FAILS TO START (DRY PLUG) A dry spark plug indicates a blocked fuel line, starting jet (CD Carburettor) or idle jet (Slide Carburettor) or in the case of normal jets, an excess of air being inducted into the cylinder. If your carburettor is equipped with a "starting carburettor", the starting jet is located in the float bowl starting chamber where it is vulnerable to any foreign matter contaminating the gasoline. Excessive throttle opening during cranking will prevent the proper amount of fuel from being drawn through the starting system.

ENGINE STARTS BUT DOES NOT IDLE If the idle speed adjusting screws are backed out too far, the throttle valve (CD Carburettor) and air slide (Slide Carburettor) will close off all air flow through the carburettor venturi. An ideally idling engine needs more air than is supplied by just the idle system. Excessive valve or slide opening allows too much air into the cylinder; therefore necessitating an extremely rich setting of the idle mixture screw. If this situation exists, the slightest idle jet blockage will result in an extremely lean idle condition.

ENGINE SPEED VARIES AT IDLE The "hunting" of RPM, trying to stabilize itself, accompanied by fast idle (or rather a slow return to idle) pretty much indicates an air leak between the carburettor and cylinder. Most leaks appear at the carburettor connection to the cylinder head intake manifold. Some air leaks have been traced to a worn out, or hardened rubber O'ring on the throttle valve shaft, but these are usually found on very high usage machines. If your CD Carburettor has a vacuum take-off port just to the front of the idle mixture screw, make sure the screw is snug (a little silicone seal is a lot of insurance here—and it's easily removed for carb balancing.)

ENGINE MISFIRE (0-to-⅛ throttle) The mixture in this throttle range is controlled by the IDLE JET and MIXTURE CONTROL adjusting screw. Misfiring in this range is a result of a "too lean" air/fuel mixture that is corrected by resetting the mixture screw or changing the idle jet to the next larger size, and matching the screw setting to the larger jet.

ENGINE MISFIRE (⅛-to-½ throttle) A lean mixture in this range is made richer by changing the needle jet to the next larger size—the mixture control screw has some influence over this area.

ENGINE MISFIRE (½-to-¾ throttle) Mixture strength in this range is mainly controlled by the taper of the jet needle—Increasing the size of the needle jet would certainly enrichen this range however, the ⅛-to-½ throttle range will also be enrichened.

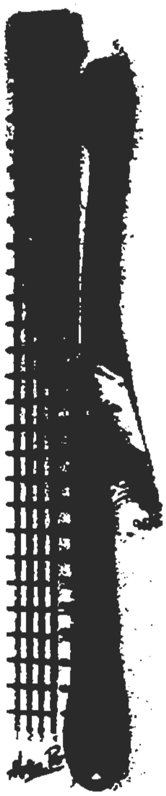
ENGINE MISFIRE (¾-to-full throttle) As the jet needle is almost totally retracted in this throttle range—mixture is controlled by the MAIN JET.

LOW POWER UPON ACCELERATION This condition, if a fault of the carburettor, would be an excessively rich air/fuel mixture. The various stages of throttle opening are similar to those above (for misfire) except the components would be selected to obtain a leaner mixture.

ENGINE BACKFIRES THROUGH CARBURETTOR An extremely lean mixture burns so slow that it may still contain flame when the intake valve opens to allow the next charge into the cylinder. The incoming charge will ignite in the intake tract.

ENGINE AFTERFIRES THROUGH EXHAUST An extremely rich mixture burns slow and incomplete. The unburned mixture enters the exhaust system, where it is ignited by the hot exhaust gases.

Mercury Carb Synchronizer

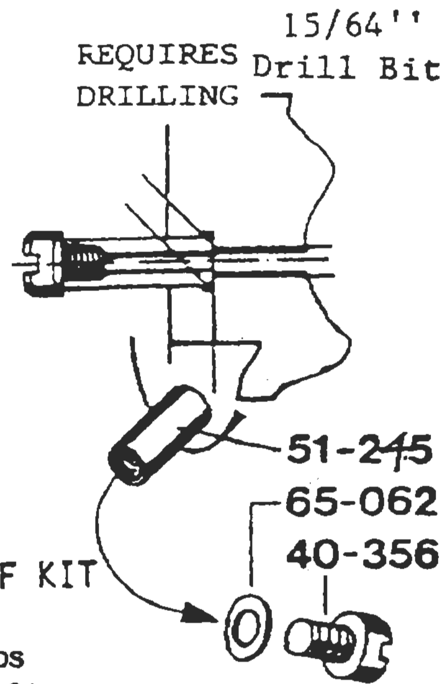


MADE IN USA

IMPORT

MOTION PRO
is the most accurate and convenient to use carburetor synchronizer available regardless of price.

- Large Clear Columns. You KNOW when the carbs are right. Gives you a resolution of 7 to 1 over the average gauge.
- Two CM Indicia spacing. So you know when you're within factory specs or better.
- Laboratory grade mercury (99.99% pure) (.004% non-volatile residue)
- Tough injection-molded, unbreakable nylon reservoir.

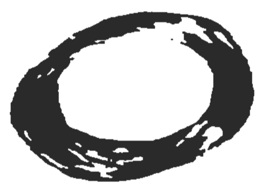


VACUUM TAKE-OFF KIT

For All Dual Carbs
Part No. 51-245-101

By Using The Color Tune With The Carb Synch You Can Professionally Tune Your Engine

See Page 22



B.A.I. LIFETIME Fuel Line - unconditional guaranty against hardening, cracking or leaking. Alcohol resistant.

ULTRA LIGHT CARBURETORS

TUNING & TROUBLE SHOOTING

First and foremost you must remember that Murphy is alive and well so take nothing for granted and leave nothing to chance. You can't park your Ultra Light on the nearest cloud and fix it if it quits.

Before getting into the care and feed of carburetors, please be absolutely sure of the following:

1. Your engine is timed exactly as the manufacturer recommends - not just close, but **EXACTLY**. Two stroke engine timing is probably the biggest cause of catastrophic engine failure as well as causing rough running, loss of power and overheating.
2. The exhaust system is the one recommended by the manufacturer and is in perfect working order.
3. There are no air leaks in the crank case or the intake manifold.
4. Your fuel is fresh, properly mixed and clean.
5. The air filter is the one recommended by the manufacturer and is clean.
6. Sparkplug is new, it's gap is set properly and it is the one recommended by the manufacturer.

One last thing - do not change more than one thing at a time when trying to track down a problem. If you do, you won't know which thing that you changed cured your problem, OR, you could inadvertently cause another problem.

OK, let's start with one of the most common problems encountered - fuel running out of the overflow tubes. This is usually caused by the float needle valve failing to shut off the fuel flow. There are several things that can cause this:

I. Floats
- A. Independent floats stuck down.
- B. One piece type floats stuck or ruined by alcohol or additives.
- C. Float hinge pin bent or grooves worn in it causing the float arms to bind.
- D. Float level incorrectly set.
  - 1. Set one piece floats per drawing A.
  - 2. Set independent float arms per drawing B.

II. Float Needle
- A. Worn or pitted.
- B. Stuck
- C. Dirt keeping it from seating.
- D. Needle seat damaged. Do not try to lap or modify the seat. If it is bad, and this is pretty rare, we can replace it for you in our shop.

CHECK AND ADJUST FLOAT-ARM in the following manner:

1. If carburetor is off the engine, turn it upside-down resting on its own weight, the float arm must be perfectly parallel with the carburetor base. If carburetor is mounted on the engine, the same parallelism must be maintained, but this must be ascertained WHILE NOT DEPRESSING THE FLOAT NEEDLE'S SPRING-LOADED PLUNGER INTO THE NEEDLE BODY.

2. Adjust for parallelism by bending the float-arm pointer with a small, flat-tipped screwdriver. Exercise care during adjustment - NOT TO BEND THE PARALLEL FLOAT ARM LEVERS. Not only must the arm be parallel with the carburetor, the arm levers must be parallel with each other, in order not to cause binding with the float elements.

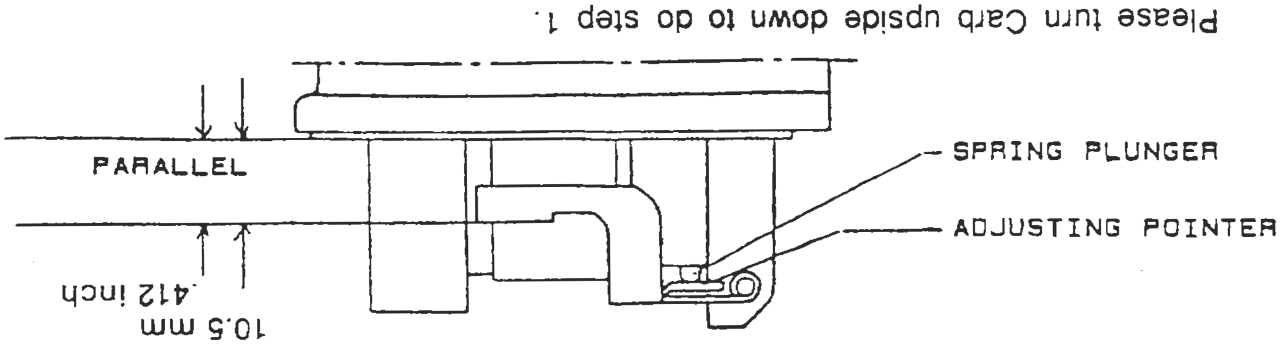


FIGURE B

HOW TO REPAIR THE PROBLEM:

First check the float level setting. If it is incorrect, reset the float level per the drawing by carefully bending the tab that contacts the needle with a small screwdriver. You do not need to remove the float arms to do this. The float level is checked with the needle closed and the float arm tab just touching the spring loaded plunger in the needle, not depressing the plunger. To check your work, push the float arms up until the spring loaded plunger has started to depress. Then have someone turn on the fuel and see if it still leaks. If it does, read on . . .

If you still have fuel leaking by the needle, you'll have to remove the carb from the engine and then remove the float arms and needle. Be sure you drive the float arms hinge pin out so the knurled end is not driven through the hinge pin bosses. Drift the pin out just a little one way or the other if you're not sure which end of the pin is knurled. You can readily see if the exposed end is knurled or not.

Once the pin has been driven out, remove the float arms and the float needle. Be sure you note the little hair clip on the float needle plunger and how it fits over the float arm tab. This is **IMPORTANT**. Be sure when replacing the float needle and float arms that this clip is properly in place!

Now that you have the float arms, float hinge pin and float needle removed check the hinge pin to be sure it is straight and has no grooves worn in it. If either problem exits, replace it. If it has grooves worn in it by the float arms, replace the float arms also. Now examine the tip of the needle using a magnifying glass. If there is a ring worn in the tip or any little craters or gouges, replace it. Check for debris around the needle and up inside the needle seat. Also, flush the needle seat from the needle side to remove any dirt which may be in the fuel passage above the needle seat. Flush this out on a clean white cloth so you can see if you had any junk in there. It just takes a whisker to keep the needle from seating!! If you have dirt there you must flush your fuel tank, petcock and lines. **CLEAN FUEL IS AN ABSOLUTE MUST!!**

Examine the hole in the needle seat very closely. It should be perfectly round and sharp edged. If you think it might be damaged, try a new float needle before you panic.

If you didn't find any dirt or any other problems replace the float needle first. Check the fuel shut off as I suggested before. If you have replaced the float needle and the fuel still won't shut off the seat must be replaced. This will only happen about 1 in 100 cases. Never attempt to fly with a carb that overflows fuel. It might run OK at take off power setting, but will probably flood and die at below half throttle. I recommend that you replace the hinge pin and float needle every 100 hours of operation.

Now let's talk about problems with the engine not wanting to run smoothly at all power settings or failing to develop full power. Before you come to the conclusion that the carb is the problem, there is a very simple test you must perform. With the aircraft tied down for a static engine test, bring the engine into the RPM range in which the problem is being encountered. While the engine is running in the problem area, apply the choke (actually it is a fuel enriching circuit). If the engine speeds up and makes more power, it is running lean at that throttle setting. If the engine loses more power, it is probably running rich at that throttle setting. If nothing happens when the enriching circuit is engaged, the problem is somewhere other than the carb. Check ignition and timing first - Remember ?!?! Most carb problems don't happen suddenly, they just sort of creep up on you. If you don't have cylinder head and exhaust gas temperature gauges on your aircraft you are asking for trouble sooner or later. These two instruments can save you an engine and hours of searching for a problem, not to mention saving your buns if you catch the problem before your engine decides to quit over The Black Forest.

If your engine suddenly decides to run rich at all throttle settings, check your float setting first then look for something plugging the air passage that runs to the atomizer and idle mix circuit. It's the small air hole located at the bottom of the air intake of the carb.

Don't forget that if you change your operating field to a higher or lower elevation of say more than 1000 feet from your old field, you will need to rejet per the chart. A change in air density due to temperature and humidity because of the change in seasons may require rejetting to bring the fuel air mixture into line.

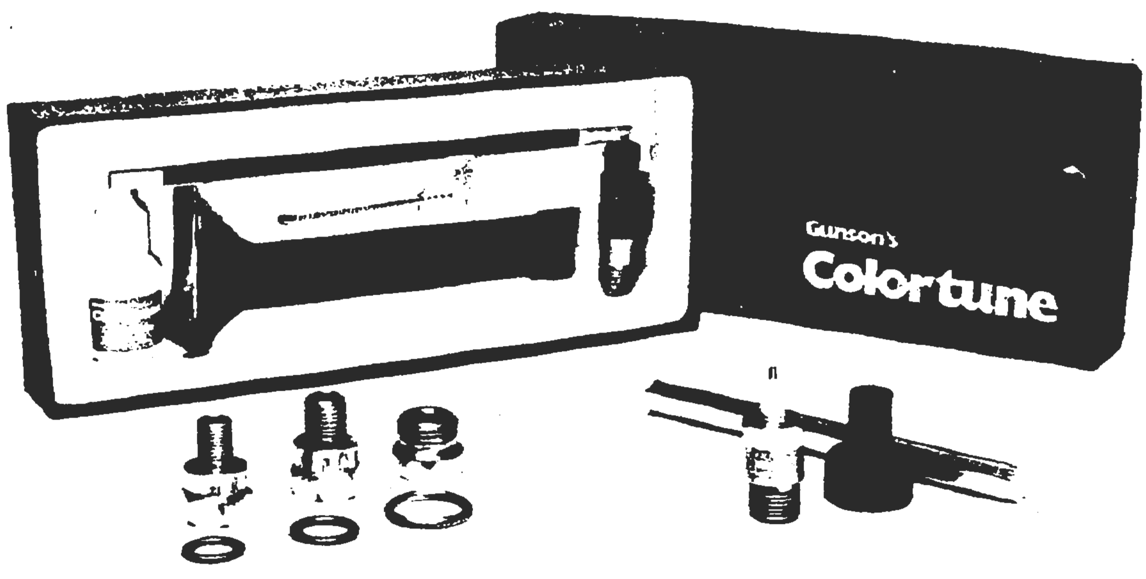
I'd like to mention the Color Tune sparkplug that we sell. This simple device will allow you to see the color of the flame in your combustion chamber. If it is cobalt blue the mixture is correct. If it is yellow the mixture is rich. If it is blue-white the mixture is lean. These tests are conducted during static run ups of the engine. This plug is never used under the load of flight. This is the most accurate method of checking mixture that I know of short of an exhaust gas analyzer.

You must set your idle mixture first by adjusting your idle mix screw. If the correct mix cannot be achieved by adjusting the mixture screw the pilot or idle jet must be changed. Once the idle mixture has been properly set you can proceed to check the mixture throughout the operational power settings. The needle and needle jet controls the mixture from off idle through 3/4 throttle. The main jet will control the mixture for the last 1/4 of throttle. The control of the needle, needle jet and main jet do overlap, but for adjustment purposes treat them as I have stated.

There are many combinations of needles, needle jets and main jets. However, the combination furnished by the manufacturer is usually quite close to optimum, so don't get too radical in your changes. As I stated before, you should have the cylinder head and exhaust gas temperature gauges to allow you to closely monitor your engine and it's fuel mixture.

For your safety and flying pleasure, I would recommend that you completely clean and rebuild your carb every 100 hours of operation and/or each spring after winter storage. When ordering a rebuild kit or parts, please use the number stamped on your carb. This number tells us what jets and parts are in your carb.

The Color Tune Spark Plug will allow you to set your idle mixture precisely by the color of the combustion flame. By running your engine up to cruise RPM briefly you can also observe the fuel mixture in that area. By using the Color Tune in conjunction with the Carb Stix you can professionally tune your engine. NEVER ATTEMPT to fly your aircraft with the Color Tune Spark Plug in place as it is not designed to run under load.



IDLE MIX SETTING

This adjustment is made by adjusting the idle mix air screw. What you are accomplishing by making this adjustment is setting the fuel/air mixture of the idle circuit.

The idle air mix screw changes the idle fuel/air mix by regulating the air flow to the idle jet circuit. When you open the screw you lean the circuit by letting more air in and when you close the screw you enrich the circuit by letting less air in.

In your owner's manual you should have received a suggested basic setting of the idle mix screw. It was probably 1/2 to 1 turn out from completely closed. Whatever is suggested is the recommended starting point. Once you have the engine warmed up and idling you can make the final setting. Make all adjustments slowly. First, open the screw very slowly. The engine should begin to increase in RPM while you are opening the mix screw. Open it until you reach maximum RPM. Here is where a tachometer is a handy tool to have, but you should be able to readily hear an engine increase or decrease in RPM. If you have opened the mix screw one turn more and noted no change in speed, the air bleed circuit for the idle mix and main jet atomizer is probably plugged. The opening for this circuit is located in the air intake opening of the carburetor. It is the small hole located at the bottom edge of the carburetor air intake. To correct this problem, see the "Carburetor Overhaul" section of these instructions. Just before the engine begins to run rough is the optimum mix setting. Once you have found the optimum setting by getting the engine to run at the highest RPM without running rough, you have reached the leanest idle mixture. Once you find the leanest idle mixture, I recommend that you close the idle mix screw 1/8 turn which will enrich the mixture just enough to provide optimum performance. If the idle speed has increased too much you can then slow the engine speed by adjusting the idle speed screw. DO NOT CONFUSE THESE TWO ADJUSTMENT SCREWS.

The idle air mix screw is the small one located nearest the air intake opening of the carb. The idle speed adjustment screw is very large and is located in the side of the slide bore and adjusts the idle speed by changing the opening of the throttle slide. If you change the idle speed adjustment, reset the idle mix. Remember - if you set your idle mix in the spring when the air is cool and dry you may have to reset it during midsummer when the air is hot and humid. The idle circuit is never shut off so it can have an effect on overall mixture. If you believe your idle jet is too big or too small causing a rich or lean mixture which you can't properly regulate with the mix screw, you will have to change the idle jet to the next size smaller or larger and readjust. However, the original jet as furnished is usually OK. If you are trying to adjust your idle mix screw and cannot get any results at any setting, you probably have a plugged air passage and have unknowingly adjusted the big idle speed screw to open the throttle slide far enough to get the engine to run and you are actually running on the needle jet circuit. If you can't get any change in idle speed by adjusting the idle mix screw, you probably need to overhaul your carb because in all likelihood your air bleed circuit is plugged. I'll cover more of this in another section called carb overhaul.

If you have adjusted your idle mix and now find that when you try to open the throttle the engine coughs through the carb and stumbles or just hesitates when you try to apply the throttle, you have a lean transition from idle circuit to the needle jet circuit. To solve this you must check and see if your idle jet is too lean or raise your slide needle one notch. Normally you will find that your idle jet is too lean (small) or you are setting your idle mix screw too lean (screwed out too far). If you raise your slide needle you will enrich the entire mid range so be sure that's what you want before you do it. If you want a quick check for a lean idle circuit just open the cold start enrichment circuit a little and see if the hesitation goes away. If it does, you are too lean.

MID RANGE ADJUSTMENTS

Your mid range is from 1/4 to 3/4 throttle. The mid range is regulated by the needle jet and jet needle (sometimes called the slide needle). The needle jet comes in a large variety of sizes, but the most commonly used are 2.66, 2.68, 2.70, 2.72, 2.74, 2.76, 2.78 and 2.80. The larger the number, the larger the hole and the richer the mix will be. The jet needle is a tapered needle that is moved up and down by the slide. The needle gets smaller towards the bottom so as the slide opens the more fuel can be drawn by the needle through the needle jet. The needle has four step rings on the top (three on the old needles) for adjustment as to height for basic settings. The top set ring is #1 and the bottom is #4. The #1 setting is the leanest and #4 is the richest. The setting is regulated by removing the needle from the slide and changing the position of the regulation clip from slot to slot.

How do you determine if your engine needs a mixture adjustment in the mid range? If you have a EGT gauge you can readily determine this by the operating exhaust gas temp of your engine. Otherwise, you have to go on felt power of the engine, read your sparkplug color or if your engine seizes you then know that you were too lean. If you really want to fly safe and prolong the life of your engine, not to mention prolong your own life, get an EGT gauge and properly install it.

For the rest of this instruction I'm going to assume that you have an EGT gauge and know exactly where you are as to rich or lean mixture in the 1/4 to 3/4 throttle range.

If you are lean or rich throughout the mid range you can try to lower or raise your jet needle first to see what happens. If it helps but doesn't completely solve the problem, you need to change your needle jet in the appropriate direction. Only change one thing at a time so you know exactly what caused any change, good or bad! To regulate a change of mix over the entire mid range is just a matter of hitting the right combination of needle jet and jet needle setting.

What if you are experiencing a lean or rich spot only at a certain area of throttle setting? This will most often mean that you need to change your jet needle. There are many different needles available. However, only several will be of value to you for your particular engine. The needles are sized by a number - letter - number system, i.e. 8G2, 15K2, etc. The higher the first number code the richer the mixture above 1/2 throttle. The higher the letter code the richer the mix below 1/2 throttle. By following this coding information you can selectively re-regulate mixtures above or below 1/2 throttle. If you just need to increase or decrease overall you can change to a needle with higher overall value or lower overall value or change needle jet. To more accurately determine where you are as to needle jet and jet needle flow areas you should consult the jet needle diameter graph and use the clearance area formula to see what change is made by changing the needle jet or jet needle. Don't be terrorized by how complicated the charts look. This is just giving you a mathematical way to figure things. You certainly don't have to mathematically figure everything out. Just applying the basic directions for needle jet and jet needle changes and following your EGT will let you get your engine running right.

At this point I'd like to mention the atomizer. This is the brass fitting that sticks up into the floor of the carb and your needle jet fits up into it also. This part is lightly pressed into the carb so it usually doesn't just fall out when you drop your needle jet out. However, it will come out with a gentle tap on its top. This part has a high and low side to the end that sticks up into the carb bore. Look down into the carb through the top with the slide removed. Note that the lower side or lower step faces the engine and the higher side or upper step faces the air intake of the carb. This atomizer must be oriented exactly in this manner to make the carb work right!! When overhauling the carb you must remove the atomizer. Be sure you understand the placement of this part!

REGULATION OF THE MAIN JET

The main jet regulates the air fuel mix above 3/4 throttle, or, when the area opened by the needle jet/jet needle combination equals or exceeds the area of the main jet. You can figure this relationship by once again consulting the jet needle chart and the clearance area formula and comparing it to the area of your main jet given in the main jet area chart. If your EGT is not in the normal heat range for full power operations, either high (lean) or low (rich), you will be able to change your main jet accordingly. The main jet does have some effect on the flow of fuel at less than 3/4 throttle due to flow dynamics, but you may usually disregard this. Main jet regulation is about the easiest part of carb tuning.

There is one simple test that you can perform at any throttle setting to give you a good idea if you are running lean, rich, or even if you have ignition problems. You can lightly apply the cold start enriching circuit. Many call this the choke, but it actually is an enriching circuit that simply gives more fuel to the air stream entering the engine. If you lightly apply the "choke" and the engine picks up power and your EGT drops to normal from too high, your engine is running lean at that throttle setting. If the engine loses power and the EGT starts dropping farther below normal operating temperature than it already is, you are running rich at that throttle setting. If nothing seems to change at all with the light application of "choke" you could very well have an ignition problem.

CARBURETOR OVERHAUL

This operation is recommended every 100 hours of operation as a preventative maintenance item. Most people don't even think about carburetion until a lack of performance is noticed. Sudden lack of power is usually not a carb problem. Carb problems usually are slowly developing problems which you don't notice until they have a major effect on engine performance. Once again, your EGT, CHT gauges and a tachometer are your best tools to monitor the health of your engine.

Before starting to overhaul your carb, be sure you have the exploded view of your carb for reference, a complete set of parts for a proper rebuild of your carb, a gallon of new carb cleaner, a source of clean high pressure air to blow out passages, water to rinse the parts in, and a clean, well lighted, well ventilated work area. I also recommend that you have a clean white cloth to lay the cleaned parts out on before you start reassembly. If you are not sure that you understand the exploded drawing, lay your parts on the clean cloth exactly in the order that they come out of the carb. You can soak the carb body by itself and clean the parts individually if this will help you keep things straight as to what goes where.

After soaking the carb body and parts, rinse with water and blow them dry with the air. **BE CAREFUL! CARB CLEANER IS A VERY POWERFUL CLEANER. WEAR FULL COVERAGE SAFETY GLASSES. KEEP SKIN CONTACT TO A MINIMUM.** Wash hands and arms immediately after handling the cleaned parts. Don't breathe the fumes any more than you absolutely have to. Keep the can covered before, during and after use! If you get this stuff in your eyes you will actually suffer a chemical burn to your eyes. **DON'T TAKE ANY CHANCES!** Observe all safety precautions. Now that I've scared hell out of you we'll continue!

Before starting reassembly examine all parts for wear. Note any defects in all parts, even the ones you are going to replace. This could give you a clue to any problems you might have been having. Be sure you have checked all internal passage ways for air flow by blowing them out first with the high pressure air and then by blowing on them with your mouth. Before reassembling the needle jet check the small end where the jet needle enters. If this is worn thin on one side, the hole will look oval instead of round - replace it. Also check the jet needle to see if it has a worn side on it. If you can see or feel any wear to the needle taper, replace it. Once you have decided that everything is ok, replace the "o" rings and reassemble your carb. Be sure you set the jet needle to the same setting it was on and re-check and reset the float level per my earlier instructions. Reset the idle air mix screw to the recommended base setting. Screw the idle speed screw in until it starts to lift the slide and then screw it in two more turns. This should allow you to start the engine and then you can set the idle speed and reset the idle air mix per my instructions given earlier.

FOR JET NEEDLE CLIP SERVICE, SEE PAGE 18.

BING VERGASER

ATTENTION!

Check your 3066 Needle Clip! Place your Jet Needle in the proper setting. If the needle spins freely, **ACTION <u>MUST</u> BE TAKEN!** Remove the clip, hold the needle up to the light. If the needle is reduced at clip position **REPLACE**. If not, offset sides of clip and use 240 emery paper or a fine file on each side til light shows between. Carefully squeeze clip together with pliers. Insert needle in clip and try to spin needle again. Repeat til needle does not spin freely. Needle must show a resistance to spinning.

CHECK EVERY 10 HOURS!

MAIN JET AREAS

MAIN JET	AREA
1.25	1.23
1.30	1.33
1.35	1.43
1.40	1.54
1.45	1.65
1.50	1.77
1.55	1.89
1.60	2.01
1.65	2.14
1.70	2.27
1.75	2.40
1.80	2.54
1.85	2.69
1.90	2.83
1.95	2.98

INITIAL STOCK JETTING AND SETUP FOR 2 s i AIRCRAFT ENGINES

Initial stock jetting is determined under laboratory conditions, ambient temperature 82° F (27.8 ° C), atmospheric pressure 30.14 in. Hg., relative humidity 53%. Jetting is affected by numerous factors including engine/airframe combinations, altitude, temperature, humidity and various other climatic and operating conditions. New engines are test run to determine individual jetting, which is recorded on the Induction Setup Tag attached to the engine. Actual initial jetting may vary slightly from stock jetting listed below. **INITIAL STOCK JETTING IS A STARTING POINT. DIFFERENT OPERATING CONDITIONS REQUIRE CHANGES IN JETTING AND SETUP.** Refer to specific information under carburetor service in Section 3-5 of this manual for diagnostic and adjustment calculations and procedures. For any remaining questions or concerns, contact Technical Assistance as instructed in Manual Section 4-4.

ENGINE MODEL NO.	CARB	IGN	MAIN JET NO.	IDLE (PILOT) JET NO.	NEEDLE JET NO.	JET NEEDLE NO.*
230A-20	M28	P1	180	PJ35	169 O-4	5F21 @ #2
230F-20	M28	K	190	PJ35	169 O-4	5F21 @ #2
230F-22	M32**	P1	230	PJ30	159 P-6	6DH2 @ #3
230F-22	B36	P1	175	55	2.70	11G2 @ #2
460F-35	B36	P1	195	30	2.80	15K2 @ #2
460F-40	B36	K	195	30	2.80	15K2 @ #2
460F-40	B36	P1**	190	45	2.78	19K2 @ #2
460F-45	M32	K	260	PJ25	159 Q-4	6DH2 @ #3
460L-50	B36	P2	190	55	2.76	11G2 @ #3
540L-70	B36	P1 or E**	175	55	2.80	11G2 @ #2
690L-70	B36	P2	170	45	2.78	4K2 @ #2
808L-95	B36	P1 or E**	168	55	2.76	11G2 @ #2

*Designation "@ # ___", indicates initial E-Clip Position on Jet Needle grooves. "@ #2" indicates E-clip positioned in second groove from top of Jet Needle.
**Optional Carburetor or Ignition System.

CARBURETORS
B36 = Bing 36mm
M28 = Mikuni 28 mm
M32 = Mikuni 32 mm

IGNITION SYSTEMS
E = Electromotive Direct Electronic
K = Kokusan CDI
P1 = Phelon Type 1 Inductive Module
P2 = Phelon Type 2 CDI

Step #1 *- Assume Nothing!!! Disassemble and check your carburetor(s) to verify the recommended jetting listed above is installed in your carb(s). This is the most up to date information available at the time of this publication.*

Step #2 *- Because air density varies with temperature and altitude changes, a main jet correction may be necessary. This chart was calculated at sea level with an air temperature of 60 F or 15C.*

Step #3 *- Apply the multiplication factor shown to the main jet size recommended in the chart at the top of the page.*

Step #4 *- Your operating conditions will vary by the change of seasons. If your EGT temps vary and your engine experiences performance difficulties, a review of your jetting may be necessary. Return to step #2.*

Step #5 *- Humidity is also a variable in determining air density. a high humidity means a lower air density of air to be consumed by combustion. Because we are generally not equipped with a way of easily reading the % of humidity present, this can be read in to this chart by adding altitude on high humidity days and subtracting altitude on in very dry climates. An EGT gauge should illustrate changes in these conditions under full throttle readings.*

How to Use the Bing Main Jet Correction Chart

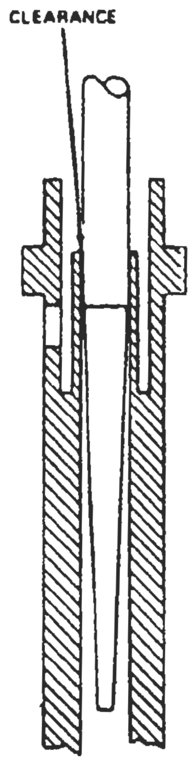
Main Jet Correction Chart — Example: 160 x 0.89= 142 Main Jet

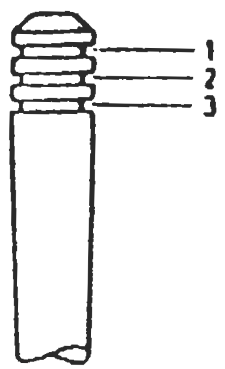
Altitude - Meters		0m	500m	1000	1500	2000	2500	3000	3500	4000
- Feet		0'	1500'	3000'	4500'	6000'	7500'	9000'	10500'	12000'
Temperature										
-22F	-30C	1.04	1.03	1.01	1.00	0.98	0.97	0.95	0.94	0.93
-4F	-20C	1.03	1.02	1.00	0.99	0.97	0.96	0.95	0.93	0.92
14F	-10C	1.02	1.01	0.99	0.98	0.96	0.95	0.94	0.92	0.91
32F	0C	1.01	1.00	0.98	0.97	0.95	0.94	0.93	0.91	0.90
50F	10C	1.00	0.99	0.97	0.96	0.95	0.93	0.91	0.90	0.88
59F	15C	1.00	0.99	0.97	0.96	0.94	0.93	0.92	0.90	0.88
68F	20C	1.00	0.98	0.97	0.95	0.94	0.93	0.91	0.90	0.88
86F	30C	0.99	0.97	0.96	0.94	0.93	0.92	0.90	0.89	0.88
104F	40C	0.98	0.96	0.95	0.94	0.92	0.91	0.90	0.88	0.87
123F	50C	0.97	0.96	0.94	0.93	0.92	0.90	0.89	0.88	0.86

Note: Before operating the engine again at lower atitudes, reinstallation of the original jetting is necessay. Engine damage may otherwise occur!

Type 54, Type 84, Type 55 Carburetor Jet Needle Clearance Area Information

Changing the holding plate or "E" clip to position #1 (top of pin) will draw the pin out later, causing a leaner condition. Moving the holding plate to the #3 position (bottom of pin) will draw the pin out earlier, producing a richer condition. If you feel your mid-range needs a change, try this first. It only takes a quick minute and doesn't cost anything. If this doesn't cure the problem, consider a change of components in this circuit.





Changing the holding plate position will change your mid-range fuel mixture.

***Figure #2:** Illustrates the relationship of these two components forming the ¼ to ¾ fuel supply.*

According to the chart, an 8G2 at 1/2 throttle opening measures around 2.3mm. If you are using a 2.72mm needle jet (the number stamped on this part is the inside diameter), you can figure the clearance area by applying a simple-to-use formula:

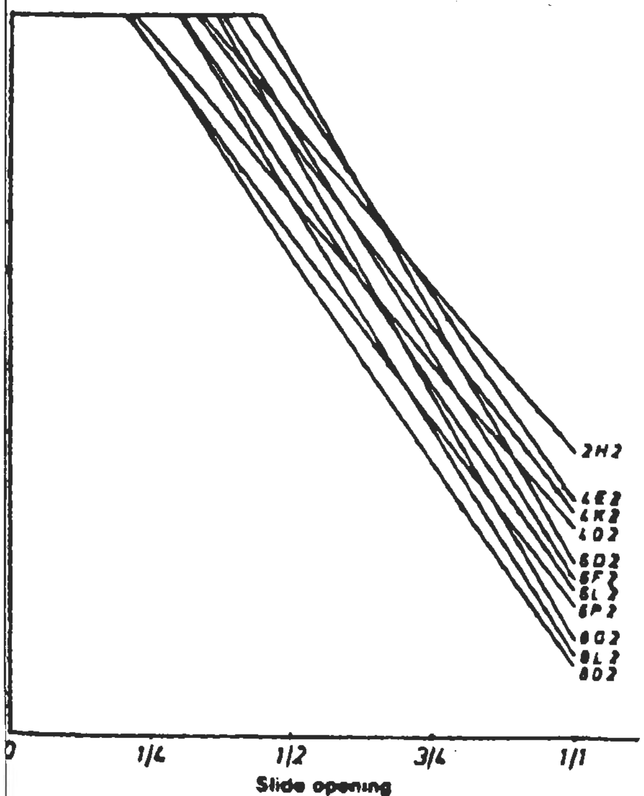
Clearance Area = (.25 × 3.14 × D1squared)−(.25 × 3.14 x D2 squared)
where:
D1 = Diameter of the needle jet (the number stamped on it).
D2 = Diameter of jet needle at a certain throttle opening (from chart).

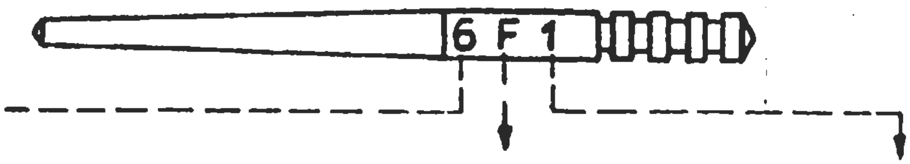
For example:
(8G2 Jet Needle used with 2.72 Needle Jet)
1/2 throttle opening:
Clearance = (3.14 × .25 × (2.72 squared)) − (3.14 × .25 × (2.30 squared)) = 1.66 mm sq
3/4 throttle opening:
Clearance = (3.14 x .25 x (2.72 squared)) −(3.14 x .25 x (1.19 squared)) = 4.71mm sq
(8L2 Jet Needle used with 2.74 Needle Jet)
1/2 throttle opening:

Clearance = (3.14 x .25 x (2.74 squared))−(3.14 x .25 x (2.2 squared)) = 2.09mm sq
3/4 throttle opening:
Clearance = (3.14 x .25 x (2.74 squared))−(3.14 x .25 x (1.88 squared)) = 3.12mm sq

You can apply the clearance formula to figure out at which point these parts are no longer smaller than the main jet passage. The diameter of the main jet passage is also the number stamped on it. (150 Main Jet = 1.50mm diameter; 180 Main Jet = 1.80mm diameter.)

Thus the area of the main jet is:
Area = 3.14 x .25 x (diameter of Main Jet (squared)).





Code for the final cone diameter

Code letter for the cone length

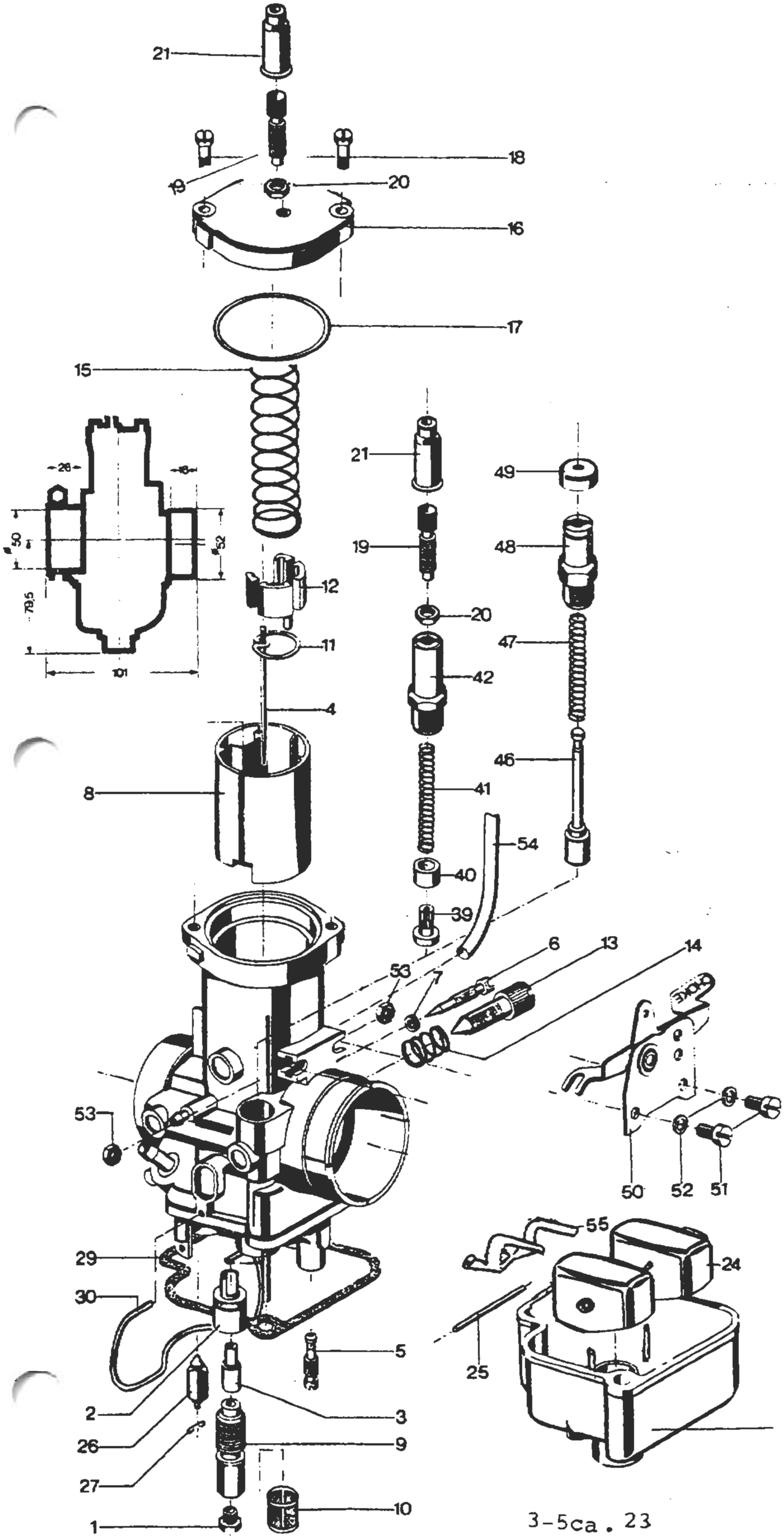
Code for other features

The Jet Needle is selected as follows:

o Needles with a "High Number Code" produce RICHER mixtures above HALF-THROTTLE...example- 8L2 instead of 6L2

o Needles with a "High Letter Code" produce RICHER mixtures below HALF-THROTTLE...example- 6P2 instead of 6D2

o The adjacent regions are also affected to a lesser extent



SLIDE CARBURETOR - TYPE 54
2 s i PART NUMBERS

1. 3056 MAIN JET
3. 3057 NEEDLE JET
4. 3058 JET NEEDLE
5. 3059 IDLER JET
6. 3060 AIR SCREW
7. 3061 O RING
8. 3063 PISTON
9. 3064 MIXING TUBE
10. 3065 SIEVE SLEEVE
11. 3066 CLIP
12. 3067 SPRING CUP
13. 3068 ADJUSTMENT SCREW
14. 3069 SPRING
15. 3070 SLIDE SPRING
16. 3071 COVER PLATE
17. 3072 O RING
18. 3073 SCREW
19. 3074 ADJUSTER
20. 3097 NUT
21. 3075 GROMMET
24. 3076 INDEPENDENT FLOAT
25. 3077 PIVOT PIN
26. 3078 FLOAT NEEDLE
27. 3079 CLIP
28. 3080 BOWL KIT
29. 3081 GASKET
30. 3082 BOWL CLIP
39. 3083 PISTON
40. 3084 SLEEVE
41. 3085 SPRING
42. 3086 HOUSING
46. 3087 PISTON
47. 3088 SPRING
48. 3089 HOUSING
49. 3090 RUBBER CAP
50. 3091 CHOKE LEVER
51. 3092 SCREW
52. 3093 WASHER
53. 3094 NUT
54. 3095 VENT TUBE
55. 3096 FLOAT ARM

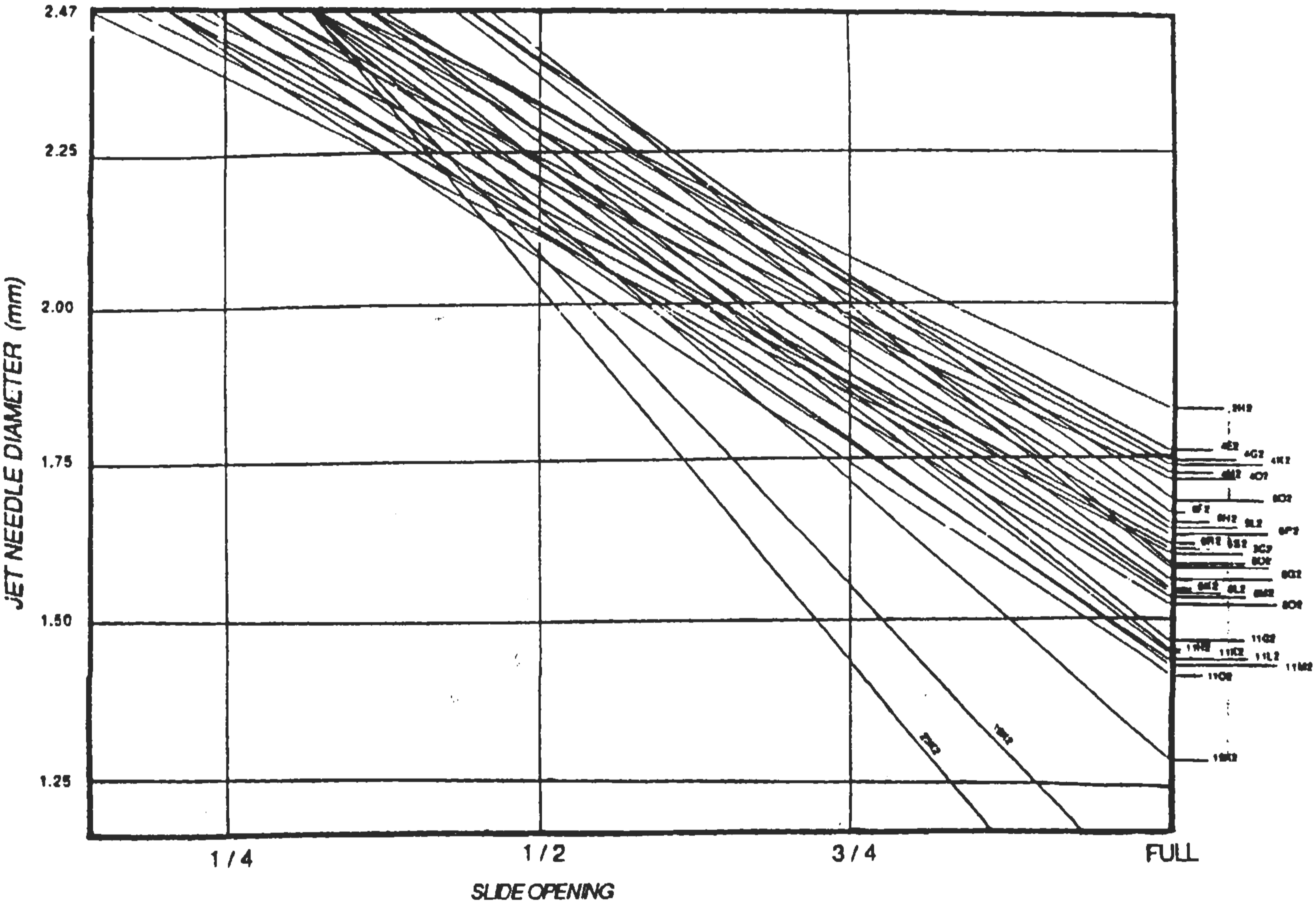
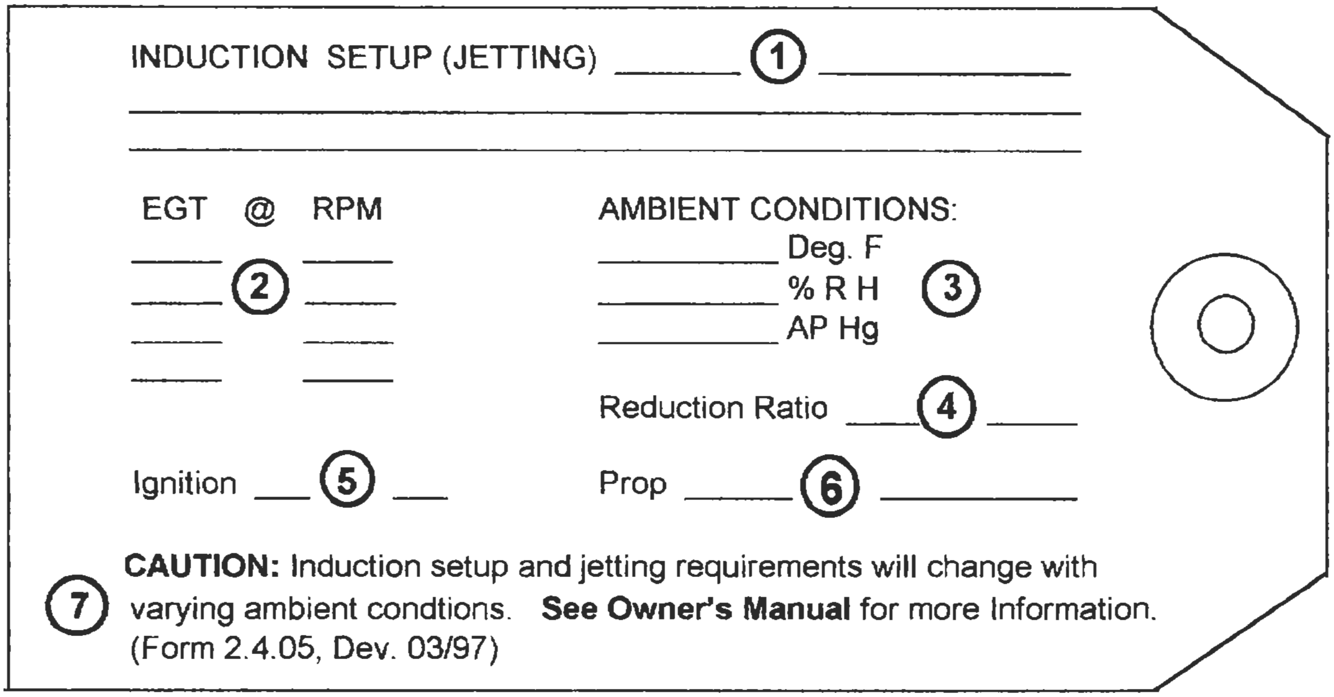


Figure #4: The configuration of the various jet needles is shown at any throttle opening with the holding plate in postition #2. (Middle)

INDUCTION SETUP TAG:



Each engine is subjected to a **Post-Assembly Running Test**, in which the specifics of fuel system setup and jetting are precisely determined. Explanation of each seciton of the tag is as follows:

1. The final jetting combination found to work best under the conditions specified, including Main Jet, Pilot (or Idle Jet), Needle Jet, Jet Needle, and possibly other variables on some carburetor models.
2. Exhaust Gas Temperatures (EGT) that were measured at various RPM's during the test.
3. Ambient conditions that affect engine performance are air temperature in Degrees Fahrenheit (Deg. F), percent of Relative Humidity (% RH), and atmospheric pressure in inches of mercury (AP Hg).
4. Reduction Ratio of Prop Speed Reduction Unit (PSRU) if used in testing.
5. Ignition System Type used on the engine.
6. Pitch, Diameter and other specifications for propeller, if used in testing.
7. Caution concerning changes in ambient conditions. If actual operating conditions will be substantially different than those listed, changes in setup will be required. Refer to Section 3-5 of the Owner's Manual for specifications and procedures.