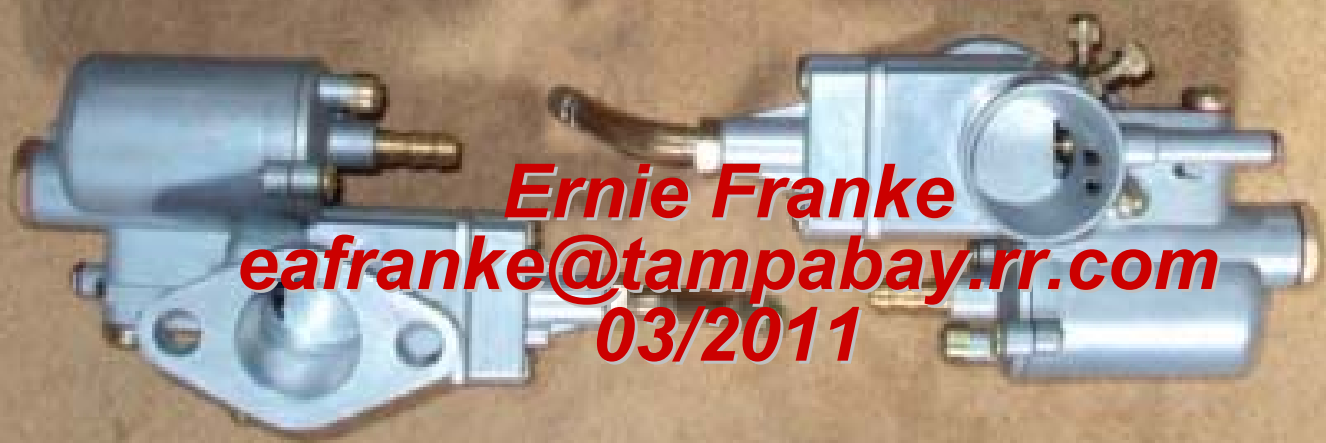
Ural (Урал) - Dnepr (Днепр) Russian Motorcycle Carburetors

Part 1: Introduction- Carburetor (Карбюраторыъ) Evolution for Russian Sidecars



Ernie Franke
eafranke@tampabay.rr.com
03/2011

Russian Carburetor Contents

- *Collection of History, Ideas, Experiences & Current Offerings, Gleaned Off Internet Websites*
- *Collected from Forums, Websites (Mostly Russian) and Part Suppliers*
- *Review of Carburetor Trouble-Shooting*
- *Review of Carburetor Terms*
- *Organized by Carburetor Evolution*
- *Displays Progression (improvements) and Compatibility (mounting and control cable)*
- *Multiple Assembly Views for Easy Understanding*
- *With Advent of the Internet, and eBay On-line Marketing; Replacement Parts and Re-Build Kits Are Readily Available*

Although the basis of carburetor designs use the same principles,carburetors of different models have their own characteristic features that define methods of disassembly and assembly, troubleshooting, adjustment.

Carburetor Evolution

- *First We Trace the Evolution of the Ural & Dnepr Motorcycle Sidecar History*
- *We Then Establish a Time-Line for Carb Development*
- *Next We Display Enough Photos of Carburetors that the Operator Can Clearly Identify Their Carburetor*
- *We Compare the Performance of Russian Carburetors*
- *We Look at the Many Sources for Re-Building or Repairing Russian Carburetors*
- *We Also Look at the Price of Replacing or Repairing Russian Carburetors*

We have included ample photos, assembly drawings and line drawings to help identify the correct carburetor on each Ural / Dnepr. Identification of the carburetor, along with the electrical system and engine displacement, helps the operator pin-point the year of manufacture (assuming the motorcycle has not been modified).

Index: Ural / Dnepr Russian Motorcycle Carburetors

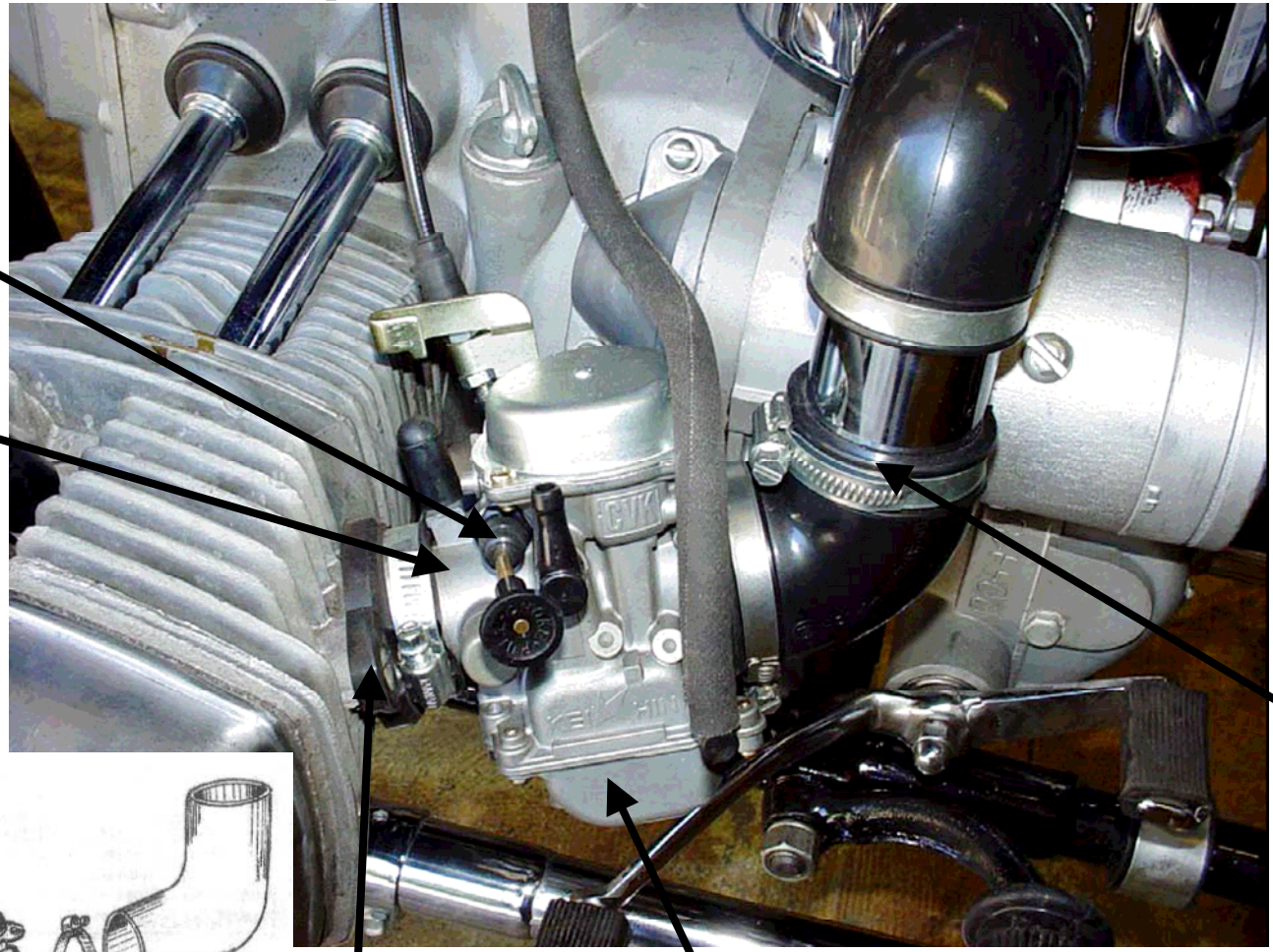
Carburetors for Russian Sidecars are presented as a function of time as they evolve to provide better service and meet stringent EPA regulations.

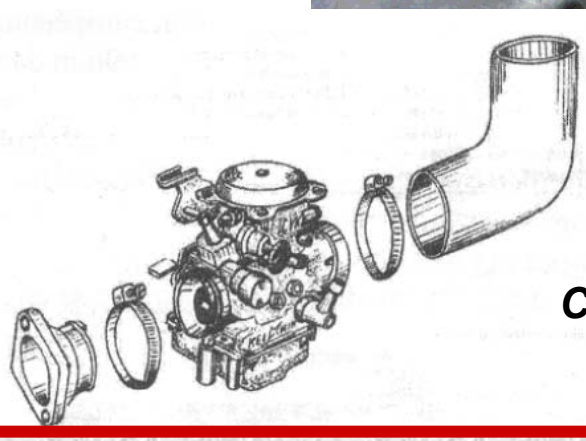
Carburetor Functionality and Trouble-Shooting

- Carburetor Function
  - Breaks Fuel into Tiny Particles (vapor)
  - Mixes Fuel with Air in Proper Ratio to Burn without Leaving Excess Fuel or Air
  - Delivers Combustible Air-Fuel Mixture to Engine
- Troubleshooting
  - When Air-Fuel Mixture Is Too Rich (excess fuel)
    - Engine Sounds Dull and Idles Roughly
    - Engine Stalls When Enricheners (a.k.a. Chokes) Applied
    - Engine Performance Grows Worse as It Warms Up
    - Removal of Air Cleaner Improves Engine Performance
    - Exhaust Gases Are Sooty
    - Spark Plug is Fouled (black wet deposit around electrode)
  - When Air-Fuel Mixture Is Too Lean
    - Poor Acceleration, Noticeable Lack of Power at Full Throttle
    - Improved Performance when Enricheners (a.k.a. Chokes) Closed
    - Engine RPM Fluctuates
    - Engine Overheats
    - Spark Plug Burns (blistered white insulator)

Proper functioning of the carburetor yields the right proportion of fuel and air to the engine.

Distinctive Components of Russian Carburetors

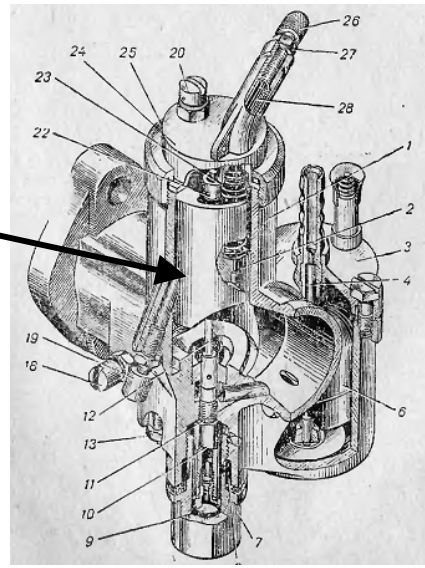


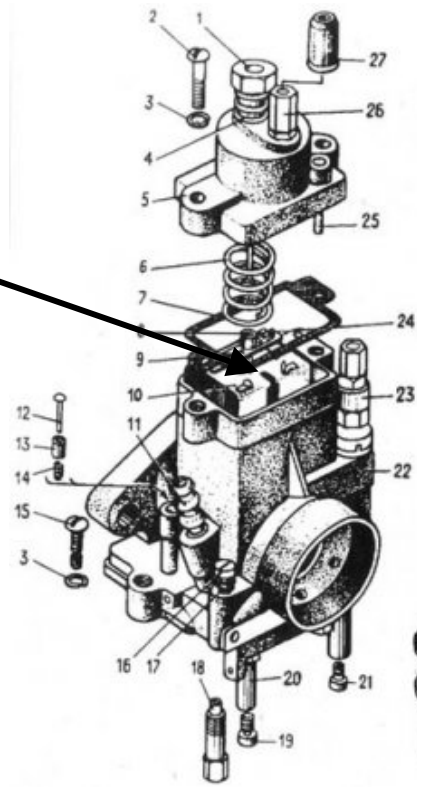


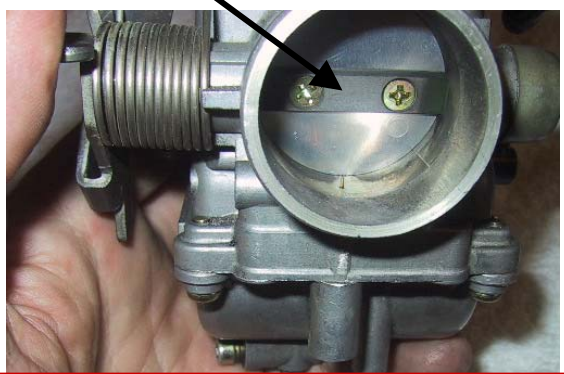
An example of identifying distinctive parts of a carburetor is shown on a modern (Keihin CVK32) with a spigot mount and butterfly valve throttle.

Round-Slide vs. Flat-Slide vs. Butterfly Throttle Valves

- **Round-Slide Throttle Valve**
  - K-37, PZ-28, K-38
  - Kaptex VDC-RAM
  - K-68
  - Mikuni VM-28
  - Jikov 2928
- **Flat-Slide Throttle Valve**
  - K-301 / K-302
  - K-62 / K-63 / K-65
- **Butterfly Throttle Valve**
  - Keihin CVK32



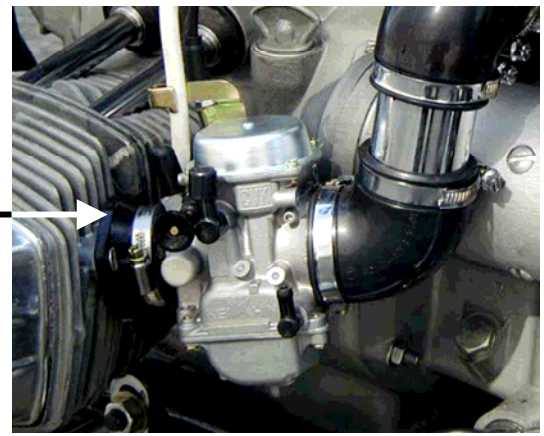




One term describing carburetors is round-slide, flat-slide or butterfly throttle valves.

Flange-Mount vs. Spigot-Mount

- *Flange-Mount*
  - *Bolts Directly on Cylinder Head or Adapter*
  - *K-37, PZ-28, K-38,*
  - *K-301 / K-302*
  - *K-62 / K-63 / K-65 / K-68*
  - *Kaptex VDC-RAM*



- *Spigot-Mount*
  - *Rubber Compliant Mount to Cylinder Head*
  - *Mikuni VM-28*
  - *Jikov 2928CE*
  - *Keihin CVK32*

Another term describing carburetors is flange-mount or spigot-mount.

Flange-Mount: Vertical vs. Horizontal

- *Vertical Mounting Holes (MT-9's, MT-10's)*
  - *K-37, PZ-28, K-38, K-301, K-302*

- *Horizontal Mounting Holes (MT-11's, MT-16's)*
  - *K-62, K-63, K-65, Kaptex VDC-RAM, K-68*

- *Transition from Vertical-to-Horizontal*
  - *Used to Transition from Older K-37/38 and K-301/302 Carbs to Modern K-62 / K-65 / K-68 Carbs*
  - *Adapter Plates Readily Available*

An adapter plate is needed to upgrade older motorcycles to the modern horizontal pattern for the K-63 / K-65 / K-68 type carbs.

Regular Carburetor Periodic Maintenance

- Carburetors Require the Sediment in the Float Bowls Be Drained Periodically
  - Ensures That Any Contaminants Accumulated Do Not Enter the Main or Idle Jets of the Carburetors
  - Fuel Can Be Drained by Opening the Drains Provided on Bottom of Float Bowls
- Fuel Filters Should Be Changed Every 10,000 km or When They Appear Dirty or Not Flowing Fuel Correctly
  - Changing the Filters Ensures That Clean Fuel Is Provided to the Carburetors and That There Is No Fuel Starvation
- Carburetor-to-Cylinder Head Adapters Should Be Checked for Leaks and Cracks Every Trip
  - Failure of Adapters Will Cause the Carburetor Fuel Mixture to Become Lean, which Could Cause Internal Damage to the Engine

Regular maintenance helps prevent the mysterious problems associated with the carburetor.

Russian Carburetor Time-Line (03/2011)

K-37 (M-72)

K-37 (M-72, M-72K, M-72M, M-72H, K-750)

K-38 (M-61, M-62, M-63)

K-301Б (M-63, M-66, K-650/MT-9)
K-301В (MT-10)
K-301Г (M-63, M-67, M-67.36)
K-301Д (MT-10, MT-10.36, MB-650M, K-650/MT-8/MT-9)

K-37 | K-37A | K-38 | K-301

1940 1945 1950 1955 1960 1965 1970 1975

K-302 (MT-11, MT-12, IMZ-8.103)

K-62 (MT-16, MT-12, MB-650)

K-63/K-65 (MT-11, MT-16)

28 mm Mikuni (8.103)

K-68 (MB-650)

CVK32 Keihin (8.103, 8.107)

K-302 | K-62 | K-63/K-65 | K-68

Urals

Last of the Dneprs

1975 1980 1985 1990 1995 2000 2005 2010

We have seen the gradual migration of the K-37 to the K-37A and then the K-38. The K-301 went through several iterations before the K-302 came along, followed by the K-Series carburetors.

K-301 to K-63 thru K-68 Carburetor Transition

(http://www.cossackmotorcycles.com/dnepr.html)

- Famously Awful K-301 Carburetor
- Standard on MT-9 and MT-10.36 Dneprs
- Standard on M-63 and M-66 Urals
- If They Work, You're One of the Few Lucky People
- Main Problem: Worn-Out in a Surprising Short Time
- One Solution: Replacement Pair of Re-conditioned K-301's
- Better Solution: Fit Just about Any Other Carb

K-301

K63/K65

- K-63 / K-65 Series
- Ok, If You Don't Mind Setting and Adjusting Carbs Every Other Week
- K-65 Will <u>Not</u> Fit Directly on a Bike Which Originally Had K-301's. Need Adapter Plate (vert.-to-horiz. mtg)

The common carburetors found on 650cc Russian motorbikes were the K-301's and K-302's. The K-301 went through several iterations before the K-302 came along. Then MT-11/MT-16's were fitted with K-63Ts.

K-68 to Keihin Carburetor Transition

(http://www.cossackmotorcycles.com/dnepr.html)

- K-68 Runs a Little Rich Most of the Time
- Requires Frequent Adjustment to Stay Perfectly in Tune

- Keihin Carb Was Fitted to Pass Stringent Emission Regulations (EPA) to Import to U.S.
- Generally a Good Carb, but Needs Re-Jetting to Avoid Overheating at High Engine Loads
- Must Be Kept Clean and Jets Need Regular Blowing Out, Especially the Ones That Can Be Seen in the Carb Throat If Air Filter Pipes Are Removed

Prompted by the need to meet the stringent EPA requirements, Ural chose the Mikuni, which was later replaced by the CVK32 Keihin in 2000 and has remained today.

Table I: IMZ (ИМЗ) - Ural (Урал) Sidecar Model/Year vs. Engine and Carburetor (03/2011)

Model	Use	Year	Engine Size (cm^3 / $inch^3$)	Compression Ratio	Horse Power BHP (hp / kW)	Max Power (rpm)	Voltage	Carburetor
M-72	Military	1941-56	746 / 45.3 SV	5.5:1	22 / 16.2	4,500-4,800	6-Volt	K-37, K-37A after 1950
M-72K	Military	1954-60	746 / 45.3 SV	5.5:1	22 / 16.2	4,500-4,800	6-Volt	K-37A (1950)
M-72M	Military	1956-60	746 / 45.3 SV	5.5:1	22 / 16.2	4,500-4,800	6-Volt	K-37A (1950)
M-61	Civilian	1958-60	649 / 39.4 OHV	6.2:1	28 / 20.6	4,800-5200	6-Volt	K-38
M-62	Civilian	1961-65	649 / 39.4 OHV	6.2:1	28 / 20.6	4,800-5,200	6-Volt	K-38
M-63 (Ural-2)	Civilian	1965-68	649 / 39.4 OHV	7.0:1	32 / 23.5	5,200-5,800	6-Volt	K-38, K-301, K-301Б, K-301В, K-301Г, K-301Д
M-66 (Ural-3)	Civilian	1968-72	649 / 39.4 OHV	7.0:1	32 / 23.5	5,600-5,900	6-Volt	K-301, K-301Б, K-301Г
M-67	Civilian	1973-75	649 / 39.4 OHV	7.0:1	32 / 23.5	5,000-5,200	12-Volt	K-301Г
M-67.36	Civilian	1976-95	649 / 39.4 OHV	7.0:1	36 / 26.5	4,600-4,900	12-Volt	K-301Г
8.103, 8.107 Series “650”	Civilian	1994-2002	649 / 39.4 OHV	7.0:1	36 / 26.5	5,000-5,200	12-Volt	K-302, K-63Y, 28mm Mikuni (1994), Keihin CVK32 (2000)
8.103 “750”Series	Civilian	2003-present	745 / 45.2 OHV	8.6:1	45 / 29	5,600	12-Volt	Keihin CVK32 (2000)

Prompted by the need to meet the stringent EPA requirements, Ural ended with the CVK32 Keihin in 2000 and has remained today.

Table II: KMZ (КМЗ) - Dnepr (Днепр) Sidecar Model/Year vs. Engine and Carb (03/2011)

Model	Use	Year	Engine Size (cm^3 / $inch^3$)	Compression Ratio	Horse Power BHP (hp / kW)	Max Power (rpm)	Voltage	Carburetor
M-72	Military	1952-56	746 / 45.3 SV	5.5:1	22 / 16.2	4,500-4,800	6-Volt	K-37A (1950)
M-72H	Military	1956-59	746 / 45.3 SV	5.5:1	22 / 16.2	4,500-4,800	6-Volt	K-37A (1950)
K-750	Military	1959-63	746 / 45.3 SV	6.0:1	26 / 19.1	4,600-4,800	6-Volt	K-37A (1950), K-38, K-63Ф
K-750M	Military	1963-77	746 / 45.3 SV	6.0:1	26 / 19.1	4,500-4,800	6-Volt	K-302
MB-750	Military 2WD	1964-73	746 / 45.3 SV	6.0:1	26 / 19.1	4,600-4,900	6-Volt	K-302
K-650/MT-8	Civilian	1967-70	649 / 39.4 OHV	7.0:1	32 / 23.5	5,000-5,200	6-Volt	K-301Б, K-301Д
MB-650	Civilian 2WD	1968-91	649 / 39.4 OHV	7.0:1	32 / 23.5	5,000-5,200	12-Volt	K-301, K-62, K-63, K-65T, K-68
K-650/MT-9	Civilian	1971-74	649 / 39.4 OHV	7.0:1	32 / 23.5	4,800-5,200	6-Volt	K-301, K-301Б, K-301Д, K-302
MB-750M	Military 2WD	1973-77	746 / 45.9 SV	6.0:1	26 / 19.1	4,500-4,900	6-Volt	K-302, K-63Ф
MT-10	Civilian	1973-76	649 / 39.4 OHV	7.5:1 (7.0:1)	36 / 26.5 (32 / 23.5)	5,600-5,800	12-Volt	K-301В, K-301Д, K-63T
MB-650M	Military 2WD	1974	649 / 39.4 OHV	7.5:1	36 / 26.5	5,000-5,200	12-Volt	K-301Д
MT-10.36	Civilian	1976-87	649 / 39.4 OHV	7.5:1 (7.0:1)	36 / 26.5 (32 / 23.5)	5,600-5,800	12-Volt	K-301Д
MT-12	Civilian 2WD	1977-85	746 / 45.3 SV	6.0:1	26 / 19.1	5,000-5,800	6-Volt	K-302, K-63Ф
MB-650-M1	Military (MT-16)	1985-2007	649 / 39.4 OHV	7.0:1	32 / 23.5	5,000-5,200	12-Volt	K-301Б
MT-16 (Dnepr-16)	Civilian & Military 2WD	1985-2005	649 / 39.4 OHV	7.5:1 (7.0:1)	36 / 26.5 (32 / 23.5)	5,600-5,900	12-Volt	K-301Д, K-62, K-63T, K-65T
MT-11 (Dnepr-11)	Civilian	1987-2005	649 / 39.4 OHV	7.5:1 (7.0:1)	36 / 26.5 (32 / 23.5)	4,800-5,200	12-Volt	K-301Д, K-302, K-62, K-63T, K-65T

To reduce heat-stress on the MT-10.36 engine at low speeds on difficult roads and to use lower octane fuel, the compression ratio was reduced from 7.5:1 to 7.0:1. This was achieved by an increase of 0.9 mm cylinder height.

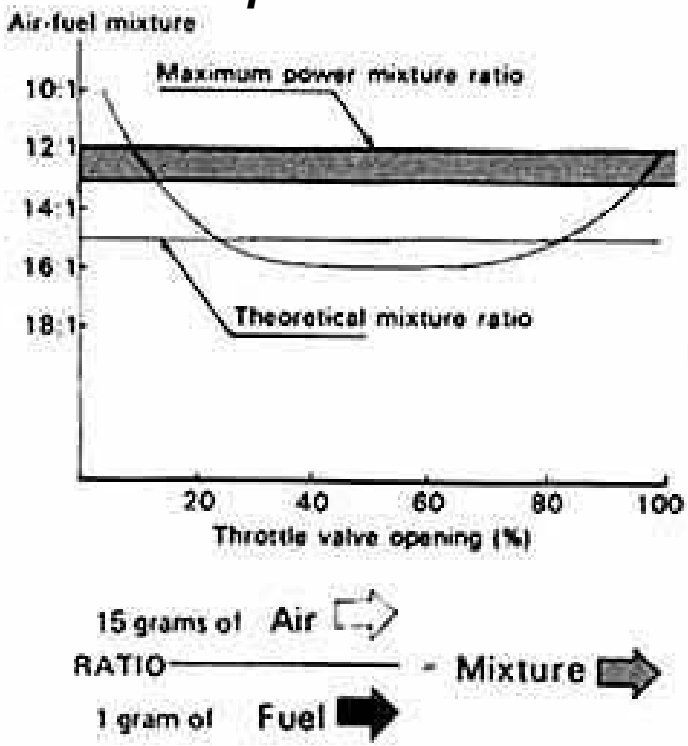
Carburetor Advice - 101

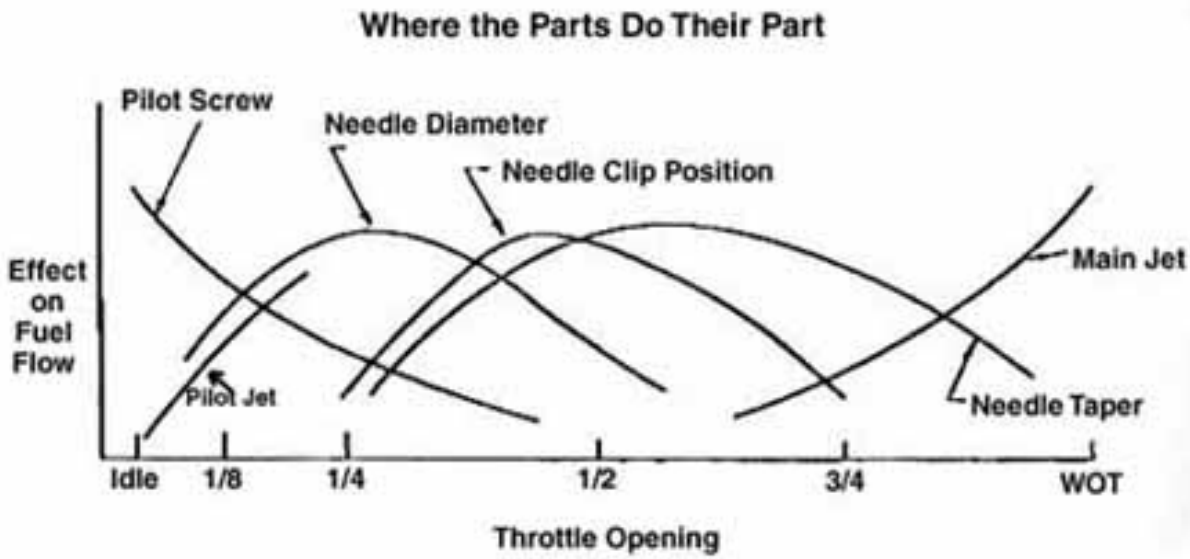
- When Troubleshooting Your Carb
  - Remember Its Job Is to Mix Fuel and Air to a Specific Ratio
  - There Are many Things That Can Cause an Imbalance in Your Mixture Besides the Carb Itself;
    - Leaking or Pinched Hose, Valve Clearance, Dirty Air Cleaner, Removing the Air-Box Cover and Even Running Out of Fuel
    - Anything That Affects Your Engine as It Sucks and Blows, Affects Your Mixture
- Before Blaming the Carb, Eliminate as Many Other Variables as Possible
- Different Jets Only Affect Certain Operations
  - Need to Correlate Performance Symptoms with the Proper Jet
    - Pilot or Idle Jet System
      - Comprised of Pilot Air Jet, Pilot Fuel Jet and Pilot Fuel Screw
      - Controls Idle Up to 25% Open Throttle
    - Needle Jet
      - Doesn't Even Look Like a Jet
      - Controls Fuel Mixture from 15% to 60% Open Throttle
    - Main Jet
      - Controls Fuel mixture from 60% to 100% Throttle

Most Folks Give the Same Advice Concerning Carburetors:
"Don't Touch It If It Isn't Broken"

Fuel/Air Mixture Ratio

- *Any Carb Problem Boils Down to Either It's Too Rich, (too much fuel or too little air) or It's Too Lean (too much air or too little fuel)*
  - *Mixture of Fuel and Air Is Ideal at around 15 Parts of Air to One Part of Gasoline by Weight (not by volume)*
  - *Maximum/Minimum Limits are 18:1 and 12:1*
  - *Too Rich and You're Wasting Fuel, Spewing More Pollutants, Diluting Your Oil, Fouling Engine Parts and Suffering Performance*
  - *Too Lean and You Run the Risk of Detonation, Engine Operating at Higher Temperatures and Suffering Performance*





Air-cooled engines need to run richer (more fuel), to aid in engine cooling.

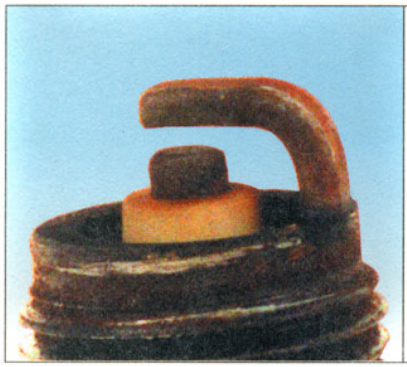
Carburetor Jetting Trouble-Shooting Steps

(www.iwt.com.au/mikunicarb.htm)

- Clean the Air Filter and Warm-Up the Motorcycle
- Accelerate thru the Gears until Throttle Is at Full Throttle
  - Slight Uphill is the best place for this
- After Few Seconds of Full Throttle Running, Quickly Pull in the Clutch and Stop the Engine (Do not allow the engine to idle or coast to a stop)
- Remove Spark Plug and Look at Its Color
  - It Should Be Light Tan Color
  - If It's White, Air/Fuel Mixture Is Too Lean and Bigger Main Jet Is Needed
  - If It's Black or Dark Brown, Air/Fuel Mixture Is Too Rich and Smaller Main Jet Is Needed
  - While Changing Jets, Change One Size at a Time, Test Run after Each Change and Look at Plug Color after Each Run
- After the main jet has been set, run the bike at half throttle and check plug color
  - If It's White, Lower the Clip on the Jet Needle to Richen Air/Fuel Mixture
  - If It's Dark Brown or Black, Raise the Clip to Lean Air/Fuel Mixture
- Pilot Circuit Can Be Adjusted while Bike Is Idling and Then Test Run
  - If Engine Is Running Poorly Just Off Idle, the Pilot Jet Screw Can Be Turned In or Out to Change Air-Fuel Mixture
  - If Screw Is In Back of the Carburetor, Screwing It Out Leans the Mixture, while Screwing It In Will Richen It
  - If Adjustment Screw Is in Front of the Carburetor, It Will Be the Opposite
  - If Turning the Screw between One and Two and a half Doesn't Have Any Effect, the Pilot Jet Will Have to be Replaced with Either a Larger or Smaller One
  - While Adjusting Pilot Screw, Turn 1/4 Turn at a Time and Test Run Bike between Adjustments
  - Adjust Pilot Circuit until Motorcycle Runs Cleanly Off Idle with No Hesitation

Common spark plug conditions

The Spark Plug is the Barometer of Your Carburetor!



NORMAL

Symptoms: Brown to grayish-tan colo electrode wear. Correct heat range for operating conditions.

Recommendation: When new spark installed, replace with plugs of the same

WORN

Symptoms: Rounded electrodes with a small amount of deposits on the firing end. Normal color. Causes hard starting in damp or cold weather and poor fuel economy.

Recommendation: Plugs have been left in the engine too long. Replace with new plugs of the same heat range. Follow the recommended maintenance schedule.

CARBON DEPOSITS

Symptoms: Dry sooty deposits indicate a rich mixture or weak ignition. Causes misfiring, hard starting and hesitation.

Recommendation: Make sure the plug has the correct heat range. Check for a clogged air filter or problem in the fuel system or engine management system. Also check for ignition system problems.

ASH DEPOSITS

Symptoms: Light brown deposits encrusted on the side or center electrodes or both. Derived from oil and/or fuel additives. Excessive amounts may mask the spark, causing misfiring and hesitation during acceleration.

Recommendation: If excessive deposits accumulate over a short time or low mileage, install new valve guide seals to prevent seepage of oil into the combustion chambers. Also try changing gasoline brands.

OIL DEPOSITS

Symptoms: Oily coating caused by poor oil control. Oil is leaking past worn valve guides or piston rings into the combustion chamber. Causes hard starting, misfiring and hesitation.

Recommendation: Correct the mechanical condition with necessary repairs and install new plugs.

GAP BRIDGING

Symptoms: Combustion deposits lodge between the electrodes. Heavy deposits accumulate and bridge the electrode gap. The plug ceases to fire, resulting in a dead cylinder.

Recommendation: Locate the faulty plug and remove the deposits from between the electrodes.

TOO HOT

Symptoms: Blistered, white insulator, eroded electrode and absence of deposits. Results in shortened plug life.

Recommendation: Check for the correct plug heat range, over-advanced ignition timing, lean fuel mixture, intake manifold vacuum leaks, sticking valves and insufficient engine cooling.

PREIGNITION

Symptoms: Melted electrodes. Insulators are white, but may be dirty due to misfiring or flying debris in the combustion chamber. Can lead to engine damage.

Recommendation: Check for the correct plug heat range, over-advanced ignition timing, lean fuel mixture, insufficient engine cooling and lack of lubrication.

HIGH SPEED GLAZING

Symptoms: Insulator has yellowish, glazed appearance. Indicates that combustion chamber temperatures have risen suddenly during hard acceleration. Normal deposits melt to form a conductive coating. Causes misfiring at high speeds.

Recommendation: Install new plugs. Consider using a colder plug if driving habits warrant.

DETONATION

Symptoms: Insulators may be cracked or chipped. Improper gap setting techniques can also result in a fractured insulator tip. Can lead to piston damage.

Recommendation: Make sure the fuel anti-knock values meet engine requirements. Use care when setting the gaps on new plugs. Avoid lugging the engine.

MECHANICAL DAMAGE

Symptoms: May be caused by a foreign object in the combustion chamber or the piston striking an incorrect reach (too long) plug. Causes a dead cylinder and could result in piston damage.

Recommendation: Repair the mechanical damage. Remove the foreign object from the engine and/or install the correct reach plug.

Obtained from Chiltons Manual

Normal

Combustion deposits are slight and not heavy enough to cause any detrimental effect on engine performance. Note the brown to greyish tan color, and minimal amount of electrode erosion which clearly indicates the plug is in the correct heat range and has been operating in a "healthy" engine.

Mechanical Damage

May be caused by a foreign object that has accidentally entered the combustion chamber. When this condition is discovered, check the other cylinders to prevent a recurrence, since it is possible for a small object to "travel" from one cylinder to another where a large degree of valve overlap exists. This condition may also be due to improper reach spark plugs that permit the piston to touch or collide with the firing end.

Oil Fouled

Too much oil is entering the combustion chamber. This is often caused by piston rings or cylinder walls that are badly worn. Oil may also be pulled into the chamber because of excessive clearance in the valve stem guides. If the PCV valve is plugged or inoperative it can cause a build-up of crankcase pressure which can force oil and oil vapors past the rings and valve guides into the combustion chamber.

Overheated

A clean, white insulator firing tip and/or excessive electrode erosion indicates this spark plug condition. k This is often caused by over advanced ignition, timing, poor engine cooling system efficiency (scale, stoppages, low level), a very lean air/fuel mixture, or a leaking intake manifold. When these conditions prevail, even a plug of the correct heat range will overheat.

Insulator Glazing

Glazing appears as a yellowish, varnish-like color. This condition indicates that spark plug temperatures have risen suddenly during a hard, fast acceleration period. As a result, normal combustion deposits do not have an opportunity to "fluff-off" as they normally do. Instead, they melt to form a conductive coating and misfire will occur.

Pre-Ignition

Usually one or a combination of several engine operating conditions are the prime causes of pre-ignition. It may originate from glowing combustion chamber deposits, hot spots in the combustion chamber due to poor control of engine heat, cross-firing (electrical induction between spark plug wires), or the plug heat range is too high for the engine or its operating conditions.

Gap Bridging

Rarely occurs in automotive engines, however, this condition is caused by similar conditions that produce splash fouling. Combustion deposits thrown loose may lodge between the electrodes, causing a dead short and misfire. Fluffy materials that accumulate on the side electrode may melt to bridge the gap when the engine is suddenly put under a heavy load.

Splash Fouled

Appears as "spotted" deposits on the firing tip of the insulator and often occurs after a long delayed tune-up. By-products of combustion may loosen suddenly when normal combustion temperatures are restored. During hard acceleration these materials shed from the piston crown or valve heads, and are thrown against the hot insulator surface.

Detonation

This form of abnormal combustion has fractured the insulator core nose of the plug. The explosion that occurs in this situation apples extreme pressures on internal engine components. Prime causes include ignition time advanced too far, lean air/fuel mixtures, and insufficient octane rating of the gasoline.

Ash Fouled

A build-up of combustion deposits stemming primarily from the burning of oil and/or fuel additives during normal combustion ... normally non-conductive. When heavier deposits are allowed to accumulate over a longer mileage period, they can "mask" the spark, resulting in a plug misfire condition.

Carbon Fouled

Soft, black, sooty deposits easily identify this plug condition. This is most often caused by an over-rich, air/fuel mixture.
Check for a sticking choke, clogged air cleaner, or a carburetor problem - float level high, defective needle or seat, etc.
This may also be attributed to weak ignition voltage, an inoperative preheating system (carburetor intake air), or extremely low cylinder compression.

Worn

This plug has served its useful life and should be replaced. The voltage required to fire the plug has approximately doubled and will continue to increase with additional miles of travel. Even higher voltage requirements, as much as 100% above normal, may occur when the engine is quickly accelerated. Poor engine performance and a loss in fuel economy are traits of a worn spark

SOURCE: Champion Spark Plugs

Normal condition – A brown, tan or grey firing end indicates that the engine is in good condition and that the plug type is correct

Ash deposits – Light brown deposits encrusted on the electrodes and insulator, leading to misfire and hesitation. Caused by excessive amounts of oil in the combustion chamber or poor quality fuel/oil

Carbon fouling – Dry, black sooty deposits leading to misfire and weak spark. Caused by an over-rich fuel/air mixture, faulty choke operation or blocked air filter

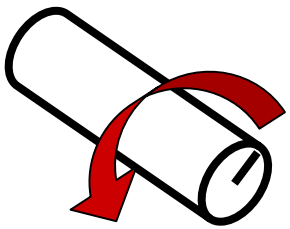
Oil fouling – Wet oily deposits leading to misfire and weak spark. Caused by oil leakage past piston rings or valve guides (4-stroke engine), or excess lubricant (2-stroke engine)

Overheating – A blistered white insulator and glazed electrodes. Caused by ignition system fault, incorrect fuel, or cooling system fault

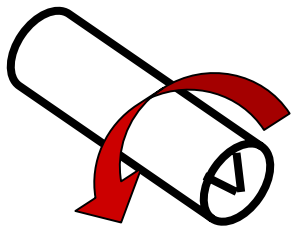
Worn plug – Worn electrodes will cause poor starting in damp or cold weather and will also waste fuel

Fuel Jet vs. Throttle Position

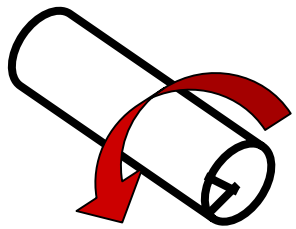
- Idle Range
  - Set Idle Speed to Proper r.p.m, by Adjusting the IDLE SPEED SCREW
  - Turn IDLE MIXTURE SCREW or AIR SCREW, Achieving highest speed and best response
  - IDLE MIXTURE SCREW controls fuel delivery to Idle Port
- Off Idle To 1/4 Throttle Range
  - The JET NEEDLE is the most effective component in this range
    - If Mixture Is Rich at 1/4 Throttle and Lean at 3/4 Throttle, a JET NEEDLE with Larger Taper Is Needed
    - If Mixture Is Lean at 1/4 Throttle and Rich at 3/4 Throttle, Change to Smaller Taper
    - If Calibration Is Lean from 1/4 to 3/4 Throttle, Raise the JET NEEDLE by Lowering Clip Position, or Use JET NEEDLE with Shorter Length
    - If Calibration Is Rich, Lower the JET NEEDLE with a Longer Length
  - Changing the STRAIGHT DIAMETER Changes the Calibration in Transition Range from the SLOW Circuit to the MAIN Circuit (1/8 to 1/4) Throttle
    - Smaller Diameter Makes This Range Richer and Larger Diameter Leans This Range
- Wide Open Throttle (W.O.T.) Range
  - Changing the MAIN JET Affects This Range
  - Select Size of MAIN JET Which Offers Best WOT Performance, Then Install One Size Larger for Ideal Engine Durability



Pilot or Idle Jet System (comprised of pilot air jet, pilot fuel jet and pilot fuel screw): Controls Idle Up to 25% Open Throttle



Needle Jet: Doesn't Even Look Like a Jet. Controls Fuel Mixture from 15% to 60% Open Throttle.

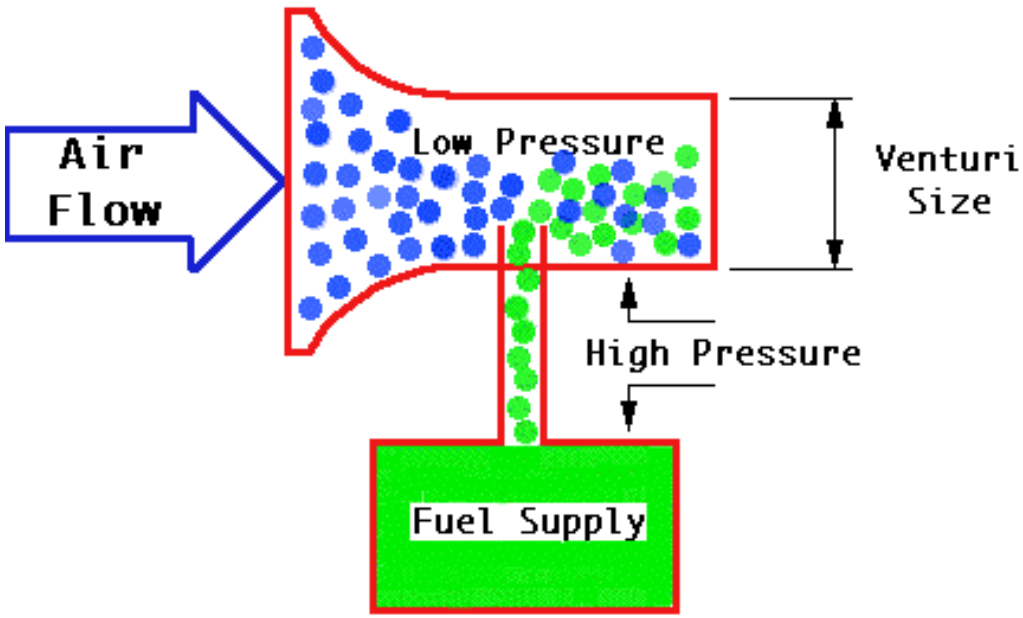


Main Jet: Controls Fuel mixture from 60% to 100% Wide Open Throttle (WOT)

Mikuni Motorcycle Carburetor Theory -101

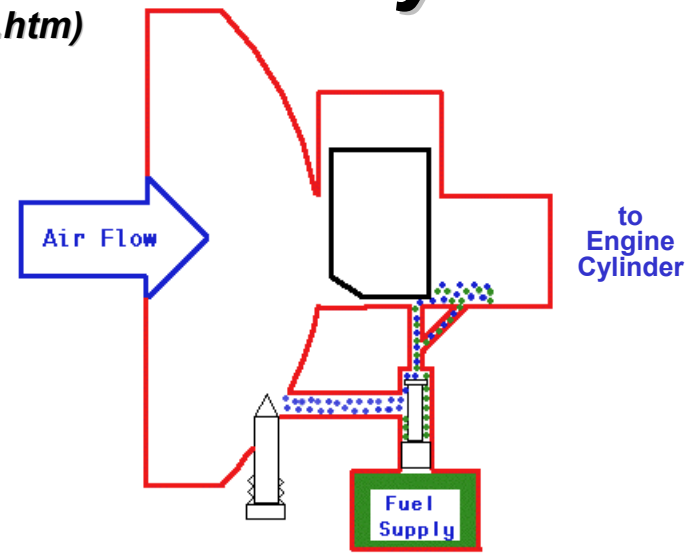
(www.iwt.com.au/mikunicarb.htm)

- All Carburetors Work Under Basic Principle of Atmospheric Pressure
  - Atmospheric Pressure Is Considered to be 15 pounds per square inch (PSI)
  - By Changing the Atmospheric Pressure inside the Engine and Carburetor, we can make Fuel and Air Flow
- Russian Motorcycles Use Four-Stroke, Air-Cooled Engines
  - Atmospheric Pressure Forces High Pressure to Low Pressure
  - As the Piston Goes Down, a Low Pressure Is Formed Within the Piston
  - This Low Pressure Causes a Low Pressure, or Suction, Inside the Carburetor
  - Since Pressure Is Higher Outside the Engine, Air Is Drawn into the Carburetor
  - The Moving Air thru the Carburetor Will Pick-Up Fuel and Mix with the Air
- Inside a Carburetor is a Venturi (restriction that forces air to speed-up)
  - Speeding Air Causes the Atmospheric Pressure to Drop inside the Carburetor
  - The Faster the Air Moves, the Lower the Pressure inside the Carburetor



Mikuni Motorcycle Carburetor Theory -101

(www.iwt.com.au/mikunicarb.htm)



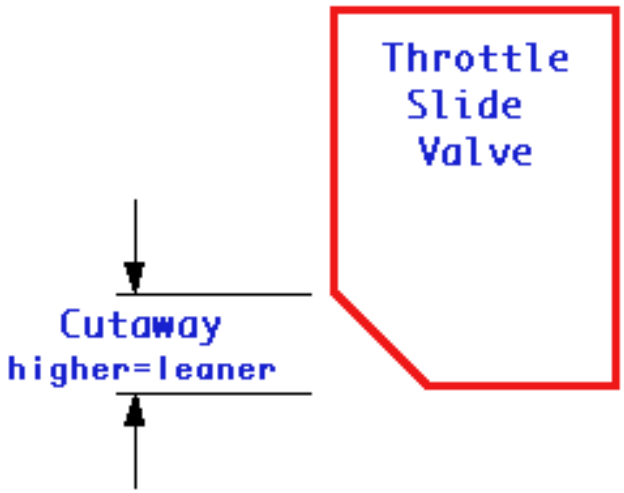
- Five Metering Circuits Overlap Each Other:
  - Pilot or Idle Circuit
  - Throttle Valve
  - Needle Jet and Jet Needle
  - Main Jet
  - Choke or Enrichener Circuit
- Pilot Circuit Has Two Adjustable Parts
  - Pilot Air Screw
    - Air Screw Can Be Located Either Near the Back-Side or Front-Side of Carb
    - If Screw Located Near Back, It Regulates How Much Air Enters
    - If Screw Turned In, It Reduces Amount of Air and Richens the Mixture
      - If Screw Turned Out, it opens the passage more and allows more air into the circuit which results in a lean mixture.
    - If Screw Located Near Front, It Regulates Fuel
      - Mixture Will Be Leaner If Screwed In and Richer If Screwed Out
    - If Air Screw Has To Be Turned More than 2 Turns Out for Best Idling, Next Smaller Size Pilot Jet Needed
  - Pilot Jet
    - Supplies Most of the Fuel at Low Throttle Openings
    - Has Small Hole which Restricts Fuel Flow thru It

Both the pilot air screw and pilot jet affects carburetion from idle to around 1/4 throttle.

Mikuni Motorcycle Carburetor Theory -101

(www.iwt.com.au/mikunicarb.htm)

- Throttle Slide Valve
  - –Affects Carburetion between 1/8-thru-1/2 Throttle, with Lesser Effect Up to ½ Throttle
  - –Comes in Various Sizes
    - Size Is Determined by How Much Is Cutaway from Backside
    - Larger the Cutaway, Leaner the Mixture (more air is allowed thru it)
    - Smaller the Cutaway, Richer the Mixture (less air is allowed thru it)
  - –Throttle Valves Have Numbers On Them That Explain How Much Is Cutaway
    - If There Is a 3 Stamped into the Slide, It Has a 3.0 mm Cutaway
    - A Number 1 Stamp Has a 1.0 mm Cutaway (which will be richer than a 3)
  - –Notch Needed for Smooth Transition from Low-Speed to Higher-Speed Operation

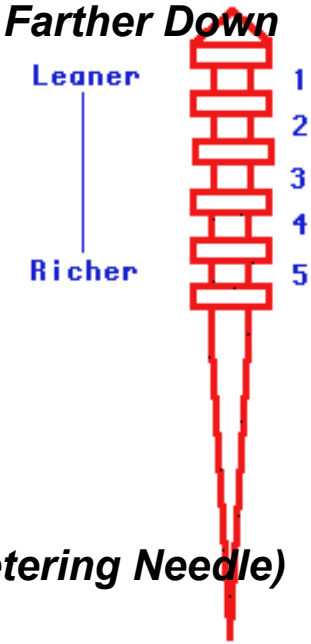


The throttle valve especially affects between 1/8 and ¼ throttle.

Mikuni Motorcycle Carburetor Theory -101

(www.iwt.com.au/mikunicarb.htm)

- Jet Needle and Needle Jet Affect Carburetion from ¼-thru-3/4 Throttle
- Jet Needle (Tapered Metering Needle)
  - –Long Tapered Rod that Controls Quantity of Fuel Drawn into Carburetor Venturi
  - –Thinner the Taper, Richer the Mixture
  - –Thicker the Taper, Leaner the Mixture
  - –Thicker Taper Will Not Allow as Much Fuel into Venturi as a Thinner One
  - –Tapers Precisely Designed to Give Different Mixtures at Different Throttle Openings
  - –Jet Needles Have Grooves Cut into Top-Part
  - –Clip Goes into One of These Grooves to Hold It from Falling or Moving from the Slide
  - –Clip position Can Be Changed to Make Engine Run Richer or Leaner
  - –If Engine Needs to Run Leaner, Clip Moved Higher, Dropping the Needle Farther Down into Needle Jet and Causing Less Fuel to Flow Past It
  - –If Clip is Lowered, Jet Needle is Raised and Mixture Will Be Richer
- Needle Jet
  - –Needle Jet Is the Hole that the Jet Needle Slides Into
  - –Depending on Inside Diameter of Needle Jet, It Will Affect the Jet Needle
  - –Most Tuning for This Range Is Done to Jet Needle, Not the Needle Jet



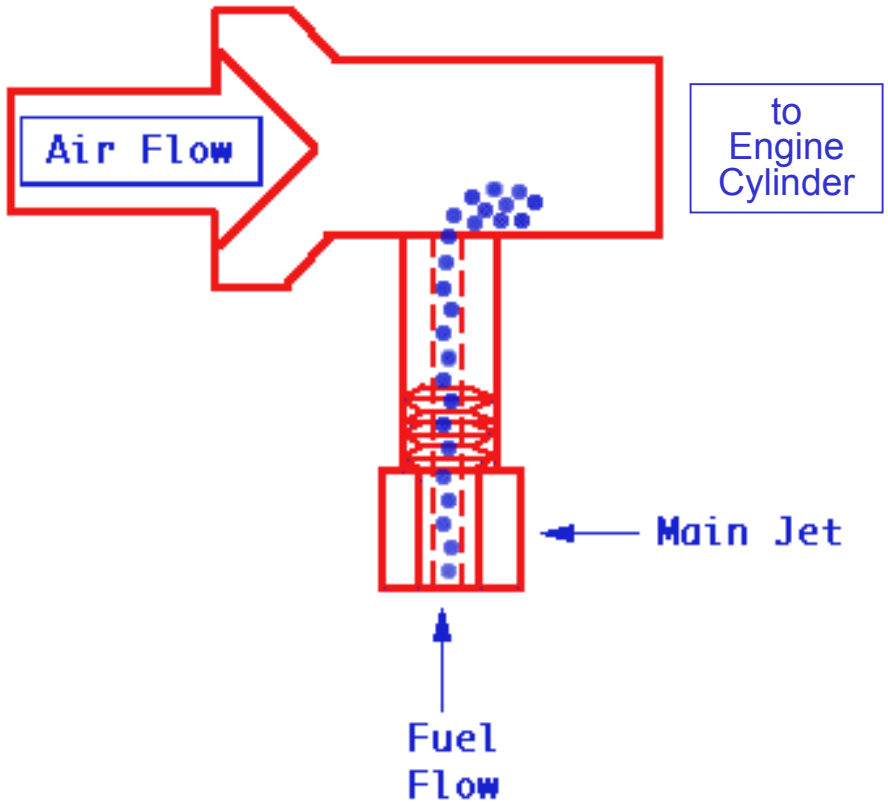
Jet Needle (Tapered Metering Needle)

The needle jet and jet needle work together to control the fuel flow between the 1/8 thru 3/4 throttle range.

Mikuni Motorcycle Carburetor Theory -101

(www.iwt.com.au/mikunicarb.htm)

- Once Throttle is Opened Far Enough;
  - Jet Needle is Pulled High Enough Out of the Needle Jet
  - Size of the Hole in Main Jet Begins to Regulate Fuel Flow
- Main Jets Have Different Size Holes
  - Bigger the Hole, the More Fuel Will Flow (and the richer the mixture)
  - Higher the Number on Main Jet, More Fuel Flows Thru It and Richer the Mixture

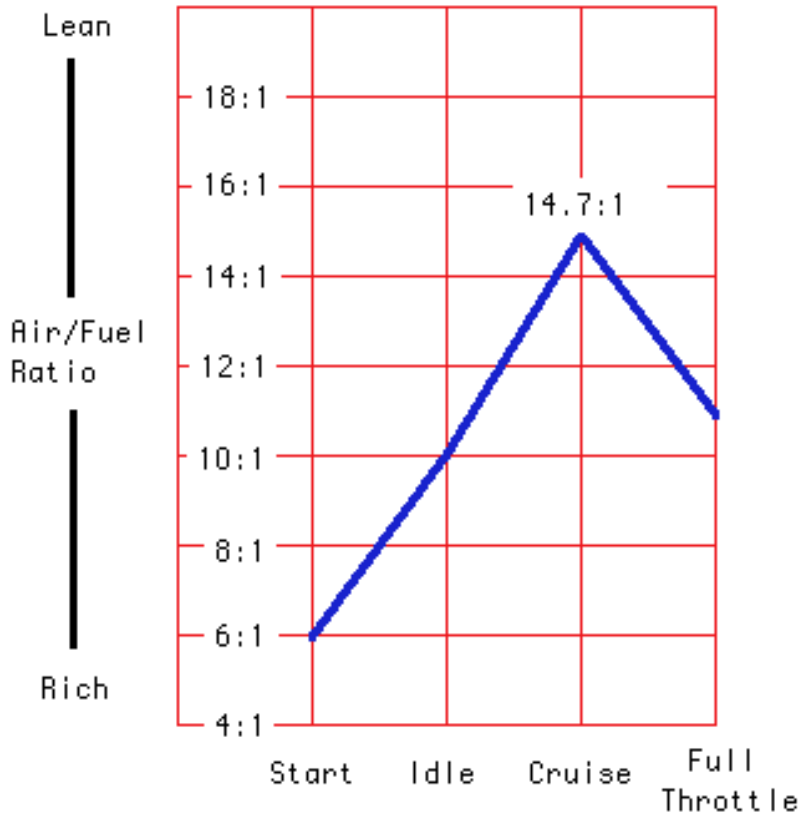


Main Jet Controls Fuel Flow from ¾-thru-full throttle.

Mikuni Motorcycle Carburetor Theory -101

(www.iwt.com.au/mikunicarb.htm)

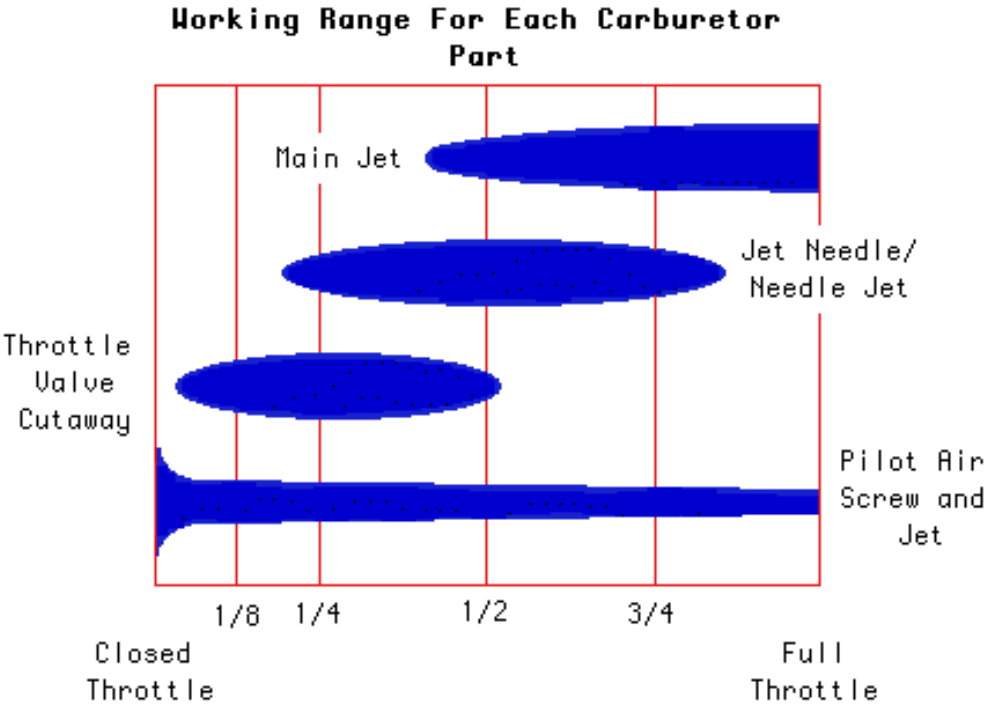
- Choke System Used to Start Cold Engines
  - Since Fuel in a Cold Engine is sticking to the cylinder walls due to condensation, the mixture is too lean for the engine to start
  - Choke System Adds Fuel to Engine to Compensate for Fuel that Is Stuck to Cylinder Walls
  - Once Engine Is Warmed-Up, Condensation Is Not a Problem, and Choke Is Not Needed
- Air/Fuel Mixture Must Be Changed to Meet the Demands of the Engine
  - Ideal Air/Fuel Ratio Is 14.7 grams of Air to 1 gram of Fuel
  - Ideal Ratio Is Only Achieved for a Very Short Period While the Engine Is Running
  - Due to Incomplete Vaporization of Fuel at Slow Speeds or Additional Fuel Required at High Speeds, Actual Operational Air/Fuel Ratio Is Usually Richer
  - Actual Air/Fuel Ratio for Any Given Throttle Opening Shown Here

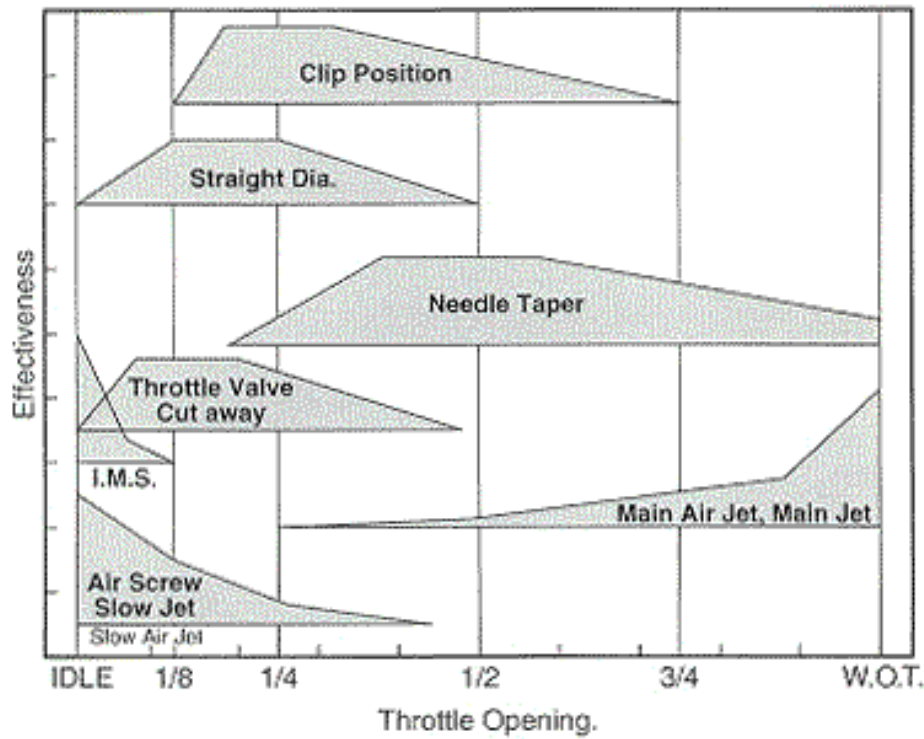


Carburetor Jetting Troubleshooting

(www.iwt.com.au/mikunicarb.htm)

- First Step In Trouble-Shooting Is Finding the Region Where the Engine Is Running Poorly;
  - –If Engine Having Troubles at Low rpm (idle to 1/4 throttle), the Pilot System or Slide-Valve Is Likely Problem
  - –If Engine Has Problems between 1/4 and 3/4 Throttle, the Jet Needle and Needle Jet (most likely the jet needle) is Likely Problem
  - –If Engine Is Running Poorly at 3/4 to Full Throttle, the Main Jet is Likely Problem





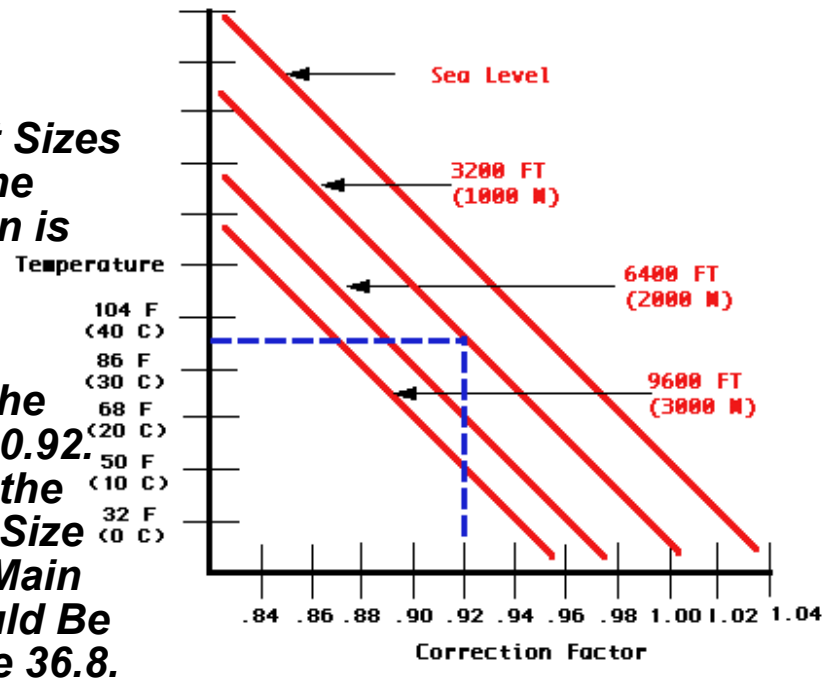
W.O.T. = Wide Open Throttle

Carburetor jetting is determined by throttle position, not engine speed.

Altitude, Humidity and Air Temperature Correction Factors

(www.iwt.com.au/mikunicarb.htm)

- Once Jetting Is Set and Bike Running Good, Many Factors Can Change the Performance
- Altitude, Air Temperature and Humidity Are Big Factors Affecting How an Engine Runs
- Air Density Increases as Air Gets Colder
  - There Are More Oxygen Molecules in the Same Space When the Air is Cold
  - When Temperature Drops, Engine Runs Leaner and More Fuel Is Needed to Compensate
  - When Air temperature Gets Warmer, the Engine Runs Richer and Less Fuel Is Needed
  - An Engine Jetted at 32°F May Run Poorly When Air Temperature Reaches 90°F
- Altitude Affects Jetting Since There Are Less Air Molecules as Altitude Increases
  - A Bike that Runs Well at Sea Level Will Run Rich at 10,000 ft Due to Thinner Air
- Humidity Is the Amount of Moisture in the Air
  - As Humidity Increases, Jetting Will Be Richer
  - Bike That Runs Well in Dry Morning Air May Run Rich as Humidity Increases
- Correction Factors Are Used to Find Correct Carburetor Settings for Different Temperatures and Altitudes
- This Chart Shows Typical Correction Factors
- To Use This chart;
  - Jet the Carburetor and Record Pilot and Main Jet Sizes
  - Determine Correct Air Temperature and Follow the Chart Over to the Right until the Correct Elevation is Found
  - Move Straight Down until the Correct Correction Factor is Found
  - Using an Example: Air Temperature is 95°F and the Altitude is 3,200 ft. The Correction Factor will be 0.92. To Find the Correct Main and Pilot Jets, Multiple the Correction Factor with Each Jet Size. A Main Jet Size of 350 Would Be Multiplied by 0.92 and the New Main Jet Size Would Be 322. A Pilot Jet Size of 40 Would Be Multiplied by 0.92 and the Pilot Jet Size Would Be 36.8.



Needle Jet/Jet Needle/Air Screw Correction Chart for Altitude, Humidity and Air Temperature

(www.iwt.com.au/mikunicarb.htm)

- *Correction Factors Can Also Be Used to Find the Correct Settings for the Needle Jet, Jet Needle, and Air Screw*
  - *Use the Previous Chart and Determine the Correction Factor*
  - *Then Use This Table to Determine What To Do with the Needle Jet, Jet Needle and Air Screw*

Correction Factor	1.04 or above	1.04-1.00	1.00-0.96	0.96-0.92	0.92 or below
Needle jet	Two sizes larger	One size larger	Same size	One size smaller	Two sizes smaller
Jet needle setting	Lower clip position	Same	Same	Same	Raise clip one position
Air screw opening	One turn in	1/2 turn in	Same	1/2 turn out	One turn out

Russian Iron Board Forum

(Antoni Font, http://picasaweb.google.es)

In the following parts of a long series, we shall review some of the great carburetors of Russian motorcycle history.